

TrimTrac Pro Locator

Technical Manual

**Including Enhanced Features and
Vehicle Adapter or Control Module**

**Part Number 70200-00-UG
Version 3.08
March 2008**

REVISION HISTORY

Version	Primary Author(s)	Description of Version	Date Completed
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- 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.

Changes and modifications not expressly approved by the manufacturer or registrant of this equipment can



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CE

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

EEC

The TrimTrac Pro products comply with Directive 72/245/EEC as amended by Directive 95/54/EC (el*72/245*95/54).

FCC The TrimTrac products comply with the FCC Part 15, FCC Part 24, and Industry Canada requirements. The TrimTrac products comply 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 Pro

FCC ID: JUPTRIMTRACC

IC ID: 1756A-TRMTRACC

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About this Manual

Welcome to the *TrimTrac™ Pro 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 Pro locator. Any end-user documentation is to be prepared and furnished by the Resellers.

This manual covers the TrimTrac Pro with v3.08.00.000 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 Pro 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: 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.



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:

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

Minimum Information Required for Technical Assistance

If you or a user reports difficulty with a TrimTrac Pro locator (i.e. no GPS fixes, not communicating, LED not working, etc.), it is helpful to retrieve directly from the unit all current configuration settings and the message log. In some cases, a more detailed debug log file is required to trouble shoot communications related issues.

Please provide the requested information and follow the procedures described below:

1. Unit IMEI number
2. Name of SIM Card Carrier

Using a Provisioning Module

1. Insert the Provisioning Module in the TrimTrac Pro and connect to it via HyperTerminal.
2. In HyperTerminal under the “Transfer” menu, select “Capture Text” and name a file to which the data from the TrimTrac Pro will be saved.
3. To retrieve the configuration and message log, do one of the following:
 - a. In the HyperTerminal window, type the following AT commands in order:

ATI
AT+CTKC?
AT+CTKF?
AT+CTKJ?
AT+CTKG?
AT+CTKK?
AT+CTKP?
AT+CTKX?
AT+CTKY?
AT+CTKZ?
AT+CTKO?
 - b. Rather than repeatedly typing these commands, they can be typed once and saved as a text file. Then use the “Send Text File” command under the HyperTerminal “Transfer” menu to send the text file to the TrimTrac Pro.
 - c. Before stopping the Capture Text, type AT+CTEL? to retrieve the device error message log.
3. Send the resulting file as an email attachment to your Trimble technical support representative.



Over-the-Air Retrieval

If the TrimTrac Pro or Provisioning Module are not available, but the TrimTrac Pro is otherwise communicating with the server application:

1. Send the appropriate QUERY_CONFIG messages to the TrimTrac Pro to retrieve the GPS, Application, Provisioning, Extended Application and VAM-only parameters. (Reminder: Multiple QUERY_CONFIGs can be included in a single SMS message.)
2. Provide a log of raw messages, including all position, status and query responses, as actually received from the TrimTrac Pro in either CSV or Text file format

Additional Debugging Capability

In most cases, providing the information as requested in the preceding sections will provide enough information to analyze the operation of the TrimTrac Pro; however, additional information may be required to troubleshoot communications related issues, particularly when GPRS is being used. As such, the TrimTrac Pro has additional data logging capabilities that can be used to debug specific communication problems. To utilize this enhanced debug logging capability, the TrimTrac Pro must be connected to a Provisioning Module and a PC to which the data will be logged.

1. Insert the Provisioning Module in the TrimTrac Pro and connect to it via HyperTerminal.
2. In HyperTerminal under the "Transfer" menu, select "Capture Text" and name a file to which the data from the TrimTrac Pro will be saved.
3. Configure the device to operate in the manner in which the device will be used.
4. Enable the debug logging capability in the in the HyperTerminal window, type the following AT commands in order

AT+CTDL=9,5,1

AT+CTDL=5,5,1

5. Issue following command to cause device to reboot in special debugging mode:

AT+CTDL

6. This will cause the device to operate in the debugging mode for as long as the GSM modem remains powered up. If the GSM modem powers off for any reason, the debugging mode will be disabled and will not be active when the next time the GSM modem is powered back on. As such, if it is desirable to leave the



debug logging mode active for more than one state machine cycle, then the Anytime Polling mode should be set “2=OnDemand”. In so doing, the GSM modem will remain powered up continuously and, as a consequence, the debug logging will remain active. (Note: if Anytime Polling is set “2=OnDemand”, then either change configuration of the device to power off the GSM modem or cycle power to de-active the debug logging mode.)

7. Please return the resulting data log file, along with the complete unit configuration and message log to your Trimble technical representative for analysis.

To test the connection between the TrimTrac and modem, please do the following:

1. In HyperTerminal, start a capture text file
2. Type AT+CTKM=1 and wait for the prompt “AT-Command Interpreter ready”
3. Then type AT+GSN (note each character will appear twice)
4. If the TrimTrac is able to communicate with the modem, it should return its IMEI number (i.e. 011074000001984)
5. If it returns an IMEI number, then type AT+CTKM=0

Firmware Release Notes

This manual covers the TrimTrac Pro with v3.08.00.000 firmware. Firmware changes since 1.00.00.000 firmware are summarized in Table 1 through Table 7.

CHANGE SUMMARY FROM 1.00.00.0000 TO 1.03.00.000
Schedule Hours Status flag added to Position Reports and Status Messages. If motion triggered message is logged during after hours, than TriggerType shall be set “2=Exception Report” and the Scheduled Hours Status flag shall be set “1=After Hours Motion”
Low voltage cutoff added to prevent over-draining AA alkaline batteries. If battery voltage drops below cutoff voltage, a new Status Message will be created and logged with the Battery Level indicated as 999% indicating that a low voltage cutout has occurred.
If a LPA-based geofence was re-centered while outside GSM coverage, the device would continuously attempt to transmit a re-centering notice until the device re-entered GSM coverage. In the meantime, no new position fixes would be computed.
If LPA mode was not set to “1=Disabled” and the LPA input was used for geofence enforcement, the device would skip the DELAY State.
All motion triggered messages will have a TriggerType set “2=Exception Report” if one or more enforced conditions are violated, including Scheduled Hours, Geofences, Speeding, or priority inputs (HPA, MPA, LPA).
1 Hz GPS enabled before entering FIX state if motion is detected and Motion Report Flag is set “1=Enabled”
Speed Reporting expanded to include Speeding Report Mode and Speeding Countdown Timer capabilities
RTKZ message and checksum error corrected. Start/Stop reporting corrected.

Table 1, Firmware Changes through v1.03.00.000

CHANGE SUMMARY FROM 1.03.00.0000 TO 1.05.00.000
Added Stop Report to Motion Report Flag
Eliminated redundant Scheduled Report transmissions
Improved GSM registration process while roaming on new networks

Table 2, Firmware Changes v1.03.00.000 through v1.05.00.000

CHANGE SUMMARY FROM 1.05.00.0000 TO 1.06.00.000
Added concurrent GPRS/SMS operation. TrimTrac can receive SMS messages even while GPRS connection is established and respond via SMS or GPRS depending upon availability of network services and Communication Mode settings
Added 30 second MPA activation delay to guard against nuisance alerts

CHANGE SUMMARY FROM 1.05.00.0000 TO 1.06.00.0000
Improved GSM performance and status code reporting
Improved acknowledgement of OTA Configuration messages
Improved LPA-based Runtime Meter threshold reporting
Improved filtering of speed violations based upon Report Delay Flag settings

Table 3, Firmware Changes v1.05.00.000 through v1.06.00.000

CHANGE SUMMARY FROM 1.06.00.0000 TO 1.08.00.0000
Improved GSM roaming and network registration
Improved consistency of GPS 3D fix reporting
Modified TrimTrac Session Protocol to send new NetEntry packet in response to unsolicited NetEntry Nack. This capability allows the server application to identify which TrimTrac is maintaining a GPRS session after a server-side failure even when no user-data is otherwise being transmitted

Table 4, Firmware Changes v1.06.00.000 through v1.08.00.000

CHANGE SUMMARY FROM 1.08.00.0000 TO 2.03.00.0000
Improved GSM registration while using SIM that require a SIM PIN
Improved Runtime Meter accuracies
Eliminated 160 character limit on GPRS data packets

Table 5, Firmware Changes v1.08.00.000 through v2.03.00.000

CHANGE SUMMARY FROM 2.03.00.0000 TO 2.04.00.0000
Resolved communication timer conflict

Table 6, Firmware Changes v2.03.00.000 through v2.04.00.000

CHANGE SUMMARY FROM 2.04.00.0000 TO 3.08.00.0000
Added Over-the-Air Firmware Reflash via TFTP
Added Input Change-of-State Reporting
Enhanced Speeding Reporting
Added Engine Idling Time Reporting
Increased number of Geofences from 2 to 10
Improved resolution of Stop Report by adding a Stop Report Countdown Timer
Use of GPS Velocity and/or ignition sense as “Move Qualifiers”
Added Virtual Odometer
Repeatable Logging and Reporting Intervals
Expanded Reporting and Log Dump Sequence Options

CHANGE SUMMARY FROM 2.04.00.0000 TO 3.08.00.000
Improved handling of APN UserNames and Passwords
Over-the-Air Configuration of UnitID and SecurityPassword
Expanded AT Commands and TrimTrac Application Protocol Messages
GPS Signal Mask default changed to 10 (1/10ths of AMU)
TCP Operational Improvements

Table 7, Firmware Changes v2.04.00.000 through v3.08.00.000

Safety First

Simple Guidelines

Please follow these guidelines when configuring, using or recycling the TrimTrac Pro. 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 Pro 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 Pro may encounter electrical interference that may affect its performance.

Avoid Body Contact with Device During Operation

Do not operate the TrimTrac Pro in direct contact with your body. Maintain at least 10 inches (25 cm) separation between the device and any parts of your body.

Qualified Service

Except for batteries and Subscriber Identification Module (SIM) card, the TrimTrac Pro 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 or fire if an incorrect type replaces batteries or if battery contacts are shorted. Do not stack battery modules with batteries inserted. Batteries should only be inserted into battery module when the battery module is properly inserted into the TrimTrac Pro and snapped in securely. Do not exceed the temperature ranges or other environmental conditions specified by the battery manufacturer. Dispose of used batteries according to the instructions provided with the batteries.

Water-Resistance

The TrimTrac Pro is not waterproof. It is water-resistant and tested to IP-55 standard except when used with an external GPS antenna or Control Module. 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 Pro 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 Pro is not designed to be worn on a person's body even though it has been tested and meets FCC and ACA/NZS RF exposure guidelines when used with an accessory that contains no metal and that positions the unit a minimum of 1.5 cm from the body. Use of other accessories may not ensure compliance with RF exposure guidelines.

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 Pro.

Pacemakers

The Health Industry Manufacturers Association recommends that a minimum separation of six (6") inches must be maintained between a handheld wireless phone and a pacemaker to avoid potential interference with the pacemaker. The TrimTrac Pro is not intended for handheld use or to be worn on the body. A minimum separation of ten (10") inches (25 cm) must be maintained between the TrimTrac Pro and any person's body.

Persons with pacemakers:

Should ALWAYS keep the TrimTrac Pro more than ten (10") inches (25 cm) from their pacemaker with the device is operational.

Should not carry the TrimTrac Pro on their person



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

Other Medical Devices

If any other personal medical devices are used in the vicinity of a TrimTrac Pro, 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 Pro 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 Pro 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 Pro 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 Pro 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 Pro 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 Pro, 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 PRO IS NOT DESIGNED TO BE WORN ON A PERSON'S BODY. AS SUCH, BODY WORN TEST POSITIONS FOR THE TRIMTRAC PRO 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 Pro is not intended for handheld use or to be worn on the body. A minimum separation of ten (10") inches (25 cm) must be maintained between the TrimTrac Pro and any person's 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. Make batteries sure only AA alkaline batteries are used and not replaced by some other 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 stack battery modules loaded with batteries. Stacking of battery modules may allow electrical shorts between contacts.
6. Do not heat the batteries to try to rejuvenate their charge.
7. Replace all four batteries at the same time.
8. Do not mix batteries with different charge levels.
9. Do not exceed the temperature ranges or other environmental conditions specified by the battery manufacturer.
10. Never use the TrimTrac Pro without the battery cover installed.

Overview

Introduction

This manual covers the TrimTrac Pro 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).

EEC

The TrimTrac product complies with Directive 72/245/EEC as amended by Directive 95/54/EC (e11*72/245*95/54).

FCC

The TrimTrac product complies with 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.

ACMA & NZMED

The TrimTrac Pro product complies as required by Notices under: Section 407 of Australian Telecommunications Act 1997, Section 182 of the Australian Radiocommunications Act 1992, Section 134 of the New Zealand Radiocommunications Act 1989

The TrimTrac Pro complies with the directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

What's New

Firmware v3.08 provides several major functional enhancements to the TrimTrac Pro that address requirements for the mobile resource management market. Motion-based power management and position reporting continues to be a hallmark of the TrimTrac Pro, but firmware v3.08 adds the following enhancements:

- Over-the-Air Firmware Reflash via TFTP
- Input Change-of-State Reporting*
- Enhanced Speeding Reporting
- Engine Idling Time Reporting*
- Expanded Geofence Support (10)
- Enhanced Stop Reporting
- Use of motion, GPS Velocity and/or ignition sense* as “Move Qualifiers”
- Virtual Odometer
- Fixed Interval Reporting/Logging
- Expanded Reporting Options
- Improved handling of APN UserNames and Passwords
- Over-the-Air Configuration of UnitID and SecurityPassword
- Expanded AT Commands and TrimTrac Application Protocol Messages

*=Requires use of Vehicle Adapter or Control Module and external wiring

For more detailed descriptions of these new features, please see Application Feature Details beginning on page 13

Reflashing Firmware:

Once a TrimTrac Pro locator has been reflashed from pre-v3.08 firmware to v3.08 or later firmware, the device must have its previous configuration parameters and default settings cleared by using the AT+CTKE=1 or AT+CTKE=3 command.

Use the FlashLoader v2.15 or later as described in “TrimTrac Pro Firmware Flash Upgrade Procedure, Document Number: 70200-10-DP, Revision: A”, to reflash pre-v3.08 firmware equipped TrimTrac Pros or TrimTrac 1.5s to v3.08 or later firmware using a Provisioning Module.

Key Features

The TrimTrac Pro 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.

- Portable, AA Batteries or Vehicle-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 (via SMS or GPRS) and the TrimTrac Pro 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 Pro operational states is helpful, configuring the TrimTrac Pro does not require a highly skilled software programmer or technician.

If your wireless carrier supports over-the-provisioning, simply insert an activated SIM card into the TrimTrac Pro and power it up using all factory-default settings. The first time the device connects to the GSM network, the device could then be

completely provisioned and re-configured over-the-air. This eliminates the need to provision the TrimTrac using a Provisioning Module.

Cost-effective, Universally Available Communications

The TrimTrac Pro 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 Pro 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 Pro to particular application requirements. These options include a miniature external GPS antenna that allows for more discrete, protected installation of the TrimTrac Pro.

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 Pro is desired. This is particularly useful when a battery- powered TrimTrac Pro is routinely moved from one asset to another.



Figure 1. TrimTrac Pro Shown with Optional External GPS Antenna and Quick Release Bracket.



Figure 2. TrimTrac with Metal Bracket.

Optional Plug-In Modules

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

Provisioning Module. Allows configuration of the TrimTrac Pro via a USB 2.0 connection to a PC.



Figure 3. Provisioning Module inserted into a TrimTrac Pro

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 standby battery that allows continued operation of the TrimTrac Pro for a limited period of time if external power is lost.



Figure 4. Vehicle Adapter Module inserted into a TrimTrac Pro

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



Figure 5. Control Module.

Application Feature Details

The TrimTrac Pro supports a number of important new application features that modify how the TrimTrac Pro 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 Pro state machine as detailed in State Machine Overview section or, preferably, the State Machine Design Details section.

Even though the TrimTrac Pro 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 Pro 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.

Beginning with firmware v3.08, new firmware can be downloaded to the TrimTrac Pro over GPRS from a TFTP server. Units with firmware earlier than v3.08 must first be re-flashed to at least v3.08 using a Provisioning Module and v2.15 or later FlashLoader before they can be subsequently reflashed over-the-air. See the complete OTA Firmware Update Process described on page 193.

The following sections 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 for some typical applications scenarios.

Input Change-of-State Reporting

Change-of-State Reporting causes the TrimTrac Pro to send a message each time a Vehicle Adapter or Control Module input switches back and forth between being “Activated” and “Normal”.

With the input mode set “4=Change-of-State Reporting”, when an input switches from its “Normal” condition to “Activated”, the TrimTrac Pro will transmit a new STATUS_MESSAGE in which the TriggerType is set “2=Exception Report” and the associate input status set “1=Activated”.

Subsequent messages, including both STATUS_MESSAGE and REPORT_POSITION messages, will have the associated input status set “3=Acknowledged” until the monitored input changes back to its “Normal” condition.

Upon returning to the “Normal” condition, the TrimTrac will generate and transmit a new STATUS_Message in which the TriggerType is set “2=Exception Report” and the associate input status set “4=Cleared”. For as long as the monitored input remains in the “Normal” condition, subsequent messages transmitted by the TrimTrac will have the associated input status field set “0=Normal”.

Engine Idling Reporting

Excessive engine idling increases maintenance and repair costs and needlessly wastes fuel. TrimTrac Pro detects engine idling and reports once a pre-determined time limit is reached, at the end of an idling session or both. The TrimTrac Pro can be configured either to accumulate total engine idling time or reset itself after it has reported at the end of an idling period.

An asset is considered idling whenever 1 Hz GPS velocity is less than the GPS Velocity Move Qualifier setting (default=3 MPH) and Ignition Sense is ON for longer than the Engine Idling Threshold, T32 setting (default = 0 seconds). Ignition Sense via a Vehicle Adapter or Control Module is required for Engine Idling Reporting.

An Engine Idling Report consists of a new STATUS_MSG or REPORT_POS message, depending upon whether GPS is available, with a TriggerType set “5=Runtime/Engine Idling Meter Report” plus a RESP_METERS2 message that includes engine idling time since last reset.

Move Qualifiers

In earlier firmware versions, the TrimTrac Pro relied exclusively on the motion sensor to determine whether the device was in motion or at rest. Beginning with firmware v3.08, GPS velocity and Ignition Sense can be used as additional move qualifiers. The TrimTrac Pro is considered to be in motion if any of the following apply:

1. Either the Static or Dynamic Motion Filter have been tripped;
2. Ignition Sense is ON (see next section); OR
3. 1Hz GPS is enabled (See Fix Rate on page 41), the GPS receiver is powered on and GPS Velocity is greater than the GPS Velocity Move Qualifier setting.

If the device is at rest in the IDLE State, the GPS receiver can be turned on by either the Static Motion Filter or Ignition Sense. GPS velocity cannot be used since the GPS receiver is powered off in the IDLE State. GPS velocity can only be used to keep the GPS receiver turned on once the device has been set in motion.

Ignition Sense

The TrimTrac Pro has always been able to monitor and report the status of other on-board systems and devices via inputs on the Vehicle Adapter and Control Module; however, firmware v3.08 and later provides additional capabilities dedicated to sensing whether the vehicle ignition is either on or off and to use this information to augment the TrimTrac motion sensor as described in the previous section. With this additional information, for instance, the TrimTrac Pro is able to detect and report excessive engine idling while a vehicle is stationary. This will help improve productivity and minimize fuel costs. Additionally, the ignition sense line can be used to turn on the GPS receiver and keep it powered up even if the motion detector indicates that the vehicle is not moving. Either the High or Low Priority inputs can be used to sense ignition; however, if the Low Priority input is used, then High and Medium Priority inputs that are not in their respective “normal” conditions will mask the Low Priority ignition sense line function.

Virtual Odometer

Beginning with firmware v3.08, the TrimTrac Pro has the ability to track distance traveled while 1 Hz GPS is enabled. The total distance traveled can be reported in each REP_POSITION in lieu of altitude (See Advanced Reporting Options). Additionally, the device can be queried for its current odometer reading even if the odometer reading is not included in the REP_POSITION message. The Virtual Odometer cannot be configured to automatically report at a pre-determine reading or interval. The Virtual Odometer is enabled/disabled by the Advanced Reporting Options settings as described on page 15.

Fixed Message Intervals

With previous versions of firmware the time between messages while in motion would remain reasonably constant only if the device had good GPS and GSM coverage; however, if GPS and/or GSM signals were weak or otherwise unavailable, the time between messages could vary substantially.

Beginning with firmware v3.08, the variability between messages due to the lack of GPS or GSM coverage can be greatly reduced by selecting the appropriate Advanced Reporting Options and Automatic Message Log Dump settings.

To minimize the variances resulting from poor GPS signal availability, set Bit -3 under Advanced Reporting Options.

It should be noted, however, that enabling Fixed Message Interval configurations could significantly increase the number of in-route STATUS_MESSAGES containing no GPS information or REP_POSITION messages in which the Position Age flag is set “1=Aged”.

Reporting frequency variability due to poor GSM coverage can be reduced by setting Automatic Message Log Dump to “2=All FIFO” as described in the Automatic Message Log Dump section.

Please see section on Fix, Log and Reporting Rates page 41 for a more detailed discussion on how each are affected by Advanced Reporting Options and Automatic Message Log Dump settings.

Advanced Reporting Options

The reporting options in firmware v3.08 have been greatly expanded to provide greater functionality and flexibility. The Advanced Reporting Options parameter is a 16-bit hex field ranging from 0x0 to 0xFF and, depending upon how each of the bits are set, the TrimTrac Pro can enable any or all of the following in any combination:

- Enable a virtual odometer and replace the Altitude Field in the REP_POSITION message with distance traveled. Requires 1 Hz GPS. (Bit-0)
- Include the most recent REP_POSITION message with every STATUS_MESSAGE (unless some other reports are otherwise associated the STATUS_MESSAGE) (Bit-1)
- Enable Geofence Change-of-State Reporting (Bit-2)



- Maintain a more constant interval between messages even if GPS is not available.
Requires 1 Hz GPS (Bit-3)

Possible configurations and Advanced Reporting Options values are shown in Table 8,
Advanced Reporting Options Settings

Advanced Reporting Option Setting	Fixed GPS Interval ¹	Report Geofence Change-of-State	Attach RTKP to RTKS	Odometer (in lieu of Altitude in RTKP) ¹
	Bit-3	Bit-2	Bit-1	Bit-0
0000 (Default)				
0001				Yes
0002			Yes	
0003			Yes	Yes
0004		Yes		
0005		Yes		Yes
0006		Yes	Yes	
0007		Yes	Yes	Yes
0008	Yes			
0009	Yes			Yes
000A	Yes		Yes	
000B	Yes		Yes	Yes
000C	Yes	Yes		
000D	Yes	Yes		Yes
000E	Yes	Yes	Yes	
000F	Yes	Yes	Yes	Yes

¹ Requires 1 Hz GPS

Table 8, Advanced Reporting Options Settings

Over-the-Air Configuration of UnitID and SecurityPassword

Beginning with firmware v3.08, the UnitID and SecurityPassword (not to be confused with the GPRS APN UserName and Security Password) can now be changed using over-the-air commands. The SIM PIN, however, still can not be changed using over-the-air commands. Afterall, if the SIM PIN was incorrectly programmed into the device, the device would not be able to communicate anyway.

This ability to re-configure the UnitID and SecurityPassword over-the-air is particularly useful if your wireless carrier supports over-the-air provisioning. To fully configure and provisioning the device, all you would need to do is insert an activated SIM card and power up the device. The first time the device is powered up and connects to the GSM network, the wireless carrier send completely reconfigure the device by sending it the appropriate SMS configuration messages per your instructions. SMS messages are used to configure the device even if it will ultimately operate in the GPRS-only mode. This eliminates the need to provision the TrimTrac using a Provisioning Module.

Enhanced Start and Stop Reporting

There are several ways in which Start and Stop reports can be configured depending upon specific application requirements.

A “Start” report can be created when a device first starts to move after being at rest for a period of time (i.e., in the IDLE State). Conversely, a “Stop” report can be created when a device has come to rest after a period of movement.

In earlier firmware versions, the timing of a Stop Report was largely determined by the DELAY Timeout, T4, and/or by the time it otherwise took the TrimTrac Pro to cycle through one complete State Machine cycle after coming to rest. This inherently induced variability in how quickly a Stop Report would be transmitted after the device had come to “rest”.

With firmware v3.08, there is a separate Stop Report Countdown Timer, T34, that starts counting down when:

- the Dynamic Motion Filter indicates that the device is no longer in motion; and
- When GPS velocity drops below the GPS Velocity Move Qualifier if GPS Fix Rate is set to 3
- 1 Hz GPS is enabled (i.e., GPS Fix Rate set to “1”, “2” or “3”)

Upon expiration of the Stop Report Countdown Timer, T34, the device immediately transmits a Stop Report, including its most recent position fix, regardless of which State the device happens to be in at the time.

For instance, if the Stop Report Countdown Timer, T34, is set to 120 seconds, then the device will attempt to transmit a Stop Report as soon as 2 minutes after the device has



stopped sensing motion and GPS velocity has dropped below the GPS Velocity Move Qualifier threshold.

Additionally, there are two related Start/Stop Reporting modes available under the Report Delay Flag that can be used to suppress in-route position report and status message transmissions depending upon application requirements.

If no in-route position reports are to be transmitted, the standard Start/Stop Reporting modes available under the Report Delay Flag are used. Both cause the TrimTrac Pro to transmit one report upon first motion and one position report after coming to rest. There are no other regular reports transmitted while the device is in motion even though the device may be logging, but not transmitting, positions in the background.

This in-motion logging 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 typically determined primarily by the DELAY Timeout, T4; however, other factors such as which state the device was in at the time motion stopped will also influence how long after coming to rest a stop report is actually sent.

On the other hand, if in-route position reports are required in addition to start motion reports, stop motion reports or both, then the Motion Report Flag is used enable the start and/or stop reports while the Report Delay Flag is used to set the in-route reporting frequency.

In all cases, the Stop Report Countdown Timer, T34, and GPS velocity (if enabled) will be used to determine when the vehicle has “stopped”; else the DELAY Timeout, T4, will be the primary determinant of how long the vehicle must be stopped before a Stop Report is generated and transmitted.

See Report Delay Flag and Motion Report Flag settings in AT+CTKC on page 137; SET_APP_CONFIG on page 156. The possible Report Delay Flag and Motion Report Flag setting combinations and the resulting operation are depicted in Table 9, Motion Report and Report Delay Flag Setting Options below. If the Stop Report Countdown Timer, T34, is enabled, 1 Hz GPS must also be enabled.

Motion Report Setting	Report Delay Flag Setting	TX Start Report	Tx In-Route Positions	Tx Stop Report	Tx Status while @ Rest
0	0		Yes ³		Yes
0	1				
0	2		Yes		
0	3				Yes
0	4	Yes		Yes	Yes
0	7	Yes		Yes	
1	0	Yes	Yes ³		Yes
1	1	Yes			
1	2	Yes	Yes		
1	3	Yes			Yes
2	0		Yes ³	Yes	Yes
2	1			Yes	
2	2		Yes	Yes	
2	3			Yes	Yes
3	0	Yes	Yes ³	Yes	Yes
3	2	Yes	Yes	Yes	

Notes:

- 1) Exception Reports and Responses will always be transmitted regardless of Motion Report and Report Delay Flag setting.
- 2) Use Stop Report Countdown Timer to determine how soon a Stop Report is transmitted.
- 3) Can use Report Delay Flag = 5 or 6 to transmit only every 6th or 11th in-route position, respectively.

Table 9, Motion Report and Report Delay Flag Setting Options

Automatic Message Log Dump

When GSM coverage becomes available after a period of no coverage, the TrimTrac Pro 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 Pro 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.

Beginning with firmware v3.08, the Automatic Message Log Dump feature now has the option of strictly enforcing FIFO (First-In, First-Out), meaning that any given message will only be transmitted after all logged messages with lower Report Sequence numbers have been transmitted first.

With previous versions of firmware, the device would transmit all reports in the sequence in which they were created only for as long as the device remained connected to authorized GSM/GPRS service. If the device traveled outside authorized wireless coverage or, in the case of GPRS, was not able to receive the appropriate acknowledgements from either the network or server application, the device would continue logging the messages. Then, whenever authorized wireless service and/or a connection was re-established to the server application, the device would first transmit the most recent single message first followed by the previously logged messages in the order they were created. This would result in messages being received by the server application out of sequence, which can prove problematic for some server applications.

Enforcing strict FIFO transmission of all messages also has the side benefit of reducing variability of message logging frequency while outside of GSM coverage since the TRANSMIT Timeout, T3, is not added between logged messages.

(See AT+CTKZ on page 146; SET_EXT2_APP_CONFIG on page 160)

Communication Mode

The TrimTrac Pro supports SMS and GPRS data communication via the GSM network and can be configured to use one or the other exclusively or automatically switch between the two.

For instance, if the Communication Mode is set 0=SMS-only, then the device will communicate exclusively via SMS. Alternately, if the Communication Mode is set 1=GPRS-only, the device is able to receive messages via GPRS or SMS, but the device will use only GPRS to respond. Finally, if the Communication Mode is set 2=Auto-select, the device is able to receive messages via GPRS or SMS and the device will respond via GPRS whenever possible; however, if a GSM network is present but GPRS service is not available, the device will revert to SMS until such time as GPRS service becomes available.

Note that if GPRS service is enabled by the carrier on a SIM card already in service, the GSM modem in the TrimTrac may need to be power cycled before the newly enabled GPRS service becomes active. (See AT+CTKC on page 137; SET_APP_CONFIG on page 156).



GPRS Connection and Setup

If GPRS is enabled via the appropriate Communication Mode setting, then the GPRS connection and setup parameters are used to establish and maintain GPRS sessions. The TrimTrac Pro supports UDP and TCP transport protocols. UDP is a connection-less protocol that generally requires less overhead than TCP, but TCP has a number of advantages that may make it the preferred choice of transport protocol for smaller deployments.

If UDP is selected as the transport protocol, then it is strongly recommended that the GPRS Session Protocol be set “1=TrimTrac Session Protocol”. The TrimTrac Session Protocol is more fully described in the separate document “TrimTrac Session Protocol ICD”. The TrimTrac Session Protocol when used over UDP provides the most important benefits of TCP without the added overhead of TCP. Those applications which are required to scale to several thousands of users per server would be well advised to consider using the TrimTrac Session and UDP Transport Protocols together in lieu of “naked” TCP. Trimble will not provide GPRS-related technical support if UDP is used without the TrimTrac Session Protocol..

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
GPRS Transport Protocol	0=UDP (TrimTrac Session Protocol mandatory); 1=TCP	>STKF (163) >QTKF (169) >RTKF (186)	AT+CTKF (139)
GPRS Session Protocol	0=None; 1=TrimTrac Session Protocol (See Separate ICD Document, v3.08)		
TrimTrac Session Keep-alive Timeout, T25	In Seconds (0=Never; 1–43200)		
GPRS Session Timeout, T26	In Seconds (0=Never; 1–43200)		
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		
GPRS APN	Access Point Name (APN) Web address up to 40 case sensitive alphanumeric characters as assigned by GPRS network operator. Example: “apn.trimble.com”.	>STKJ (164) >QTKJ (169) >RTKJ (187)	AT+CTKJ (139)
GPRS Username	Up to 40 case sensitive alphanumeric characters		
GPRS Password	Up to 20 case sensitive alphanumeric characters		

Table 10, GPRS Parameters, Settings, Messages and Commands

In all cases, the GPRS APN is provided by the carrier and determines how the mobile device connects to the GPRS network and is authenticated. It is the GPRS functional equivalent to the SMSC for SMS, if you will.

The GPRS Destination Address, on the other hand, includes both the IP Address and Port Number of the application server. The IP address can either be a public IP address or, if the ASP has a direct connection to the carrier, then it can be a private IP address. Either way, the ASP must assign the Port Number.



The TrimTrac does NOT use DNS in the GPRS Destination Address translation. The TrimTrac operates exclusively with IP Addresses and Port Numbers and this approach has proven to be the preferred choice of major ASPs. To achieve the desired level of redundancy, the most major ASPs maintain multiple Internet connections routed to separate firewalls located, in some cases, in different data centers. Messages from the mobile devices get routed to the different firewalls based upon the routing and load management tables updated by the ASP. If one or more firewall goes down, then messages are re-routed to the others based upon the routing rules defined by the ASP.

Mobile device messages are passed from these Internet connections to specific application servers and ports based upon the Network Address and Port Translation (NAPT) function of each firewall. If the firewalls have load management functionality, then these messages can be re-directed to other application servers in the data center if the original target server and/or port are unavailable.

At a much higher application level, use of the TrimTrac Session Protocol and Automatic Message Log Dump is also recommended. Especially in the case of UDP, the TrimTrac Session Protocol will help the device recover from short term outages. Whereas, Automatic Message Log Dump will help the device flywheel through periods of more extended outages.

Until relatively recently, many GPRS network operators ignored APN UserNames and Passwords. A series of recent network security enhancements, including CHAP encryption of APN UserNames and Passwords, required expanded capabilities on the TrimTrac Pro. These enhanced capabilities are included in firmware v3.08 and later.

Expanded GSM Status Codes

The GSM Status Codes listed in all REPORT_POS and STATUS_MESSAGES include:

- 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)
- 6=Modem Initialization Failure
- 7=GPRS Opening Failure
- 8=TCP Connection Failure
- 9=Session Protocol Failure

These GSM Status Codes are more fully explained Table 11, GSM Status Codes Explained, beginning on the following page.

GSM Status Code	Description
0=Network Available	All the criteria for the configured Communication Mode were satisfied. This is the normal code used when there are no problems in original message transmission. For GPRS, the UDP/TCP connection was established and, if the TrimTrac Session Protocol is enabled, the session sign-on message was sent and acknowledged.
1=Message Logged (i.e. Report Delay Flag set=1)	No attempt was made to transmit the message. The Report Delay Flag was set to “1=Exception Reports-only”.
2=Network Timeout	TrimTrac Pro was not able to acquire a usable network. This is typically inadequate GSM coverage. If TrimTrac Pro is configured for GPRS, then this code will also occur if there’s a SIM configuration mismatch (i.e., SIM is configured SMS-only). If TrimTrac Pro is configured for SMS, this code will occur if SMS transmit fails (happens occasionally) and the number of transmit attempts is exhausted. Note, if the server application receives a message from the TrimTrac Pro that has the GSM Status Code set to “2=Network Timeout”, then the message was transmitted after the fact due to the Automatic Message Log Dump feature being enabled.
3=SIM Error / No SIM	No SIM present or SIM not accessible. This is usually “no SIM present” or “SIM not properly seated in carrier”. This could also be a bad SIM or SIM locked due to more than 3 attempts to access with invalid PIN code (In this case a PUK code from the network provider is needed to unlock the SIM.)
4=SIM PIN Error	SIM requires a PIN and the correct PIN was not provided. TrimTrac Pro keeps track of the number of times a PIN is rejected to prevent the SIM from becoming locked (more than 3 attempts will lock the SIM).
5=Pre-TX log	The message was logged but a failure occurred that prevented transmission. This is the initial logged status prior to transmission attempt; it will be updated with Network Available or one of the error codes as communications progresses. This code should not occur unless TrimTrac Pro power is removed during the transmit process.
6=Modem Initialization Failure (Low battery)	Initialization of TrimTrac Pro’s GSM module did not complete correctly. This code is an indication of an internal error associated with the GSM module. It will occur when the batteries are too low to support proper GSM module functionality.
7=GPRS Opening Failure	Communication Mode is set “1=GPRS” or “2=AutoSelect” and the device is registered with a network on which GPRS service is available, but the device could not open a PPP session. This failure will occur, for instance, if the TrimTrac Pro’s GPRS communication parameters are not properly set for the GPRS network provider as defined by the SIM. The GPRS APN, GPRS Username, and GPRS Password must all match those required by the GPRS network provider. This status will

	be recorded in the message log if it's the last available status when the TRANSMIT Timeout, T3, expires.
8=TCP Connection Failure	Communication Mode is set "1=GPRS" or "2=AutoSelect" and the device is registered with a network on which GPRS service is available and a PPP session was successfully opened, but the TCP connection with the server application was not established. This will occur if the server application's GPRS Destination Address is not correctly set in the TrimTrac Pro's GPRS communication parameters or if the server application is offline.
9=Session Protocol Failure	Communication Mode is set "1=GPRS" or "2=AutoSelect" and the device is registered with a network on which GPRS service is available and a PPP session was successfully opened, but the TrimTrac Session Protocol or TCP was not satisfied. This will occur if the server application fails to send a properly formatted acknowledgement in response to the TrimTrac Session Protocol or TCP sign-on message. The TrimTrac Pro tries once for TCP or 3 times for UDP at 15 second intervals; if no acknowledgement is received, the session is dropped and re-established. For UDP, a session will be established even if an invalid / unreachable Port Number is configured and a session sign-on will be attempted; in this case, a TrimTrac Session Protocol failure could also indicate an invalid port number.

Table 11, GSM Status Codes Explained

Geofences

The TrimTrac Pro can self-monitor up to ten 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 Pro Vehicle Adapter or Control Module. These capabilities allow the device to be “locked down” where needed without creating nuisance reports during normal operation. (See AT+CTKK on page 140)

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 Pro 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 Pro. The TrimTrac Pro 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 “0=Transmit (‘Tx’) All Messages”, the device will transmit a both a new position report noting that a geofence violation has occurred and a message noting which geofence had been most recently 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 any geofence conditions. It will report the first position that is not in violation of a geofence, but then stop reporting until another geofence violation or some other appropriate TriggerType event occurs

Enforcement

You can decide whether to enforce any given geofence as follows:

- At all times (24/7);
- During normal working hours or after hours (both as defined by the Scheduled Hours Mode feature settings); or
- If the TrimTrac Pro 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 switch is in the closed position.

If the LPA input is configured to define and/or enforce a geofence, then the LPA input should not be used as either an ignition sense, alert or runtime meter input and vice versa.

To avoid nuisance geofence violations, a 30-meter diameter circle is established with the center point being the current position of the TrimTrac Pro. 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.

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 Pro during the provisioning process, by sending a TrimTrac Application command via the GSM network, or, if the TrimTrac Pro is using either a Vehicle Adapter or Control Module, by configuring the geofence to use 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 inclusive or exclusive geofence located entirely inside another should be avoided if all geofences are enforced during the same time of day. If one or more inclusive or exclusive geofences are located completely inside another, then each should be enforced during different times of the day (See Scheduled Hours Mode); else only the larger of the two will be enforced. It is acceptable to locate multiple Boundary Crossing geofences in others

Geofence Shape and Size

Once the centerpoint of the geofence has been determined (either by configuration, commands or LPA switch), 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 as distance from the center point increases. 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.

The geofence size should be selected based upon the rate at which GPS fixes are computed. Selecting 1 Hz GPS operation will provide the highest resolution of GPS fence enforcement and the size of the geofenced area can be reduced accordingly. On the other hand, if the device does not have 1 Hz GPS operation enabled, then setting the geofence area any smaller than the distance the device could be expected to travel in between position fixes would be of little benefit.

Geofence Types

All geofences in the TrimTrac Pro must be of the same type, of which there are three choices: Boundary Crossing, Inclusive and Exclusive.

If the Geofence Type is set as Boundary Crossing, then the TrimTrac Pro will set the Geofence Status flag to “1=Violation” each time the device detects it has crossed a 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 either direction.

In the case of an Inclusive Geofence Type, the TrimTrac Pro will set the Geofence Status flag to “1=Violation” whenever the device detects it is outside the geofence area, the device will commence transmitting position and status reports as if the Report Delay Flag is set “0=Transmit (‘Tx’) All Messages”. The device will continue transmitting in this mode until the device re-enters the inclusive an active geofence area.

Finally, the TrimTrac Pro will set the Geofence Status flag to “1=Violation” whenever the device detects it is inside an active geofence area if the Geofence Type is set as Exclusive.

Geofence Status

At any given time, Geofence Status is indicated in each REPORT_POS and STATUS_MESSAGE as follows:

- 0=Normal
- 1=Violation
- 5=Geofence Re-centered by LPA Input

Whenever a geofence boundary crossing is detected by the TrimTrac Pro, the Geofence Status flag will change as follows:

From “0=Normal” to “1=Violation” if:

- Geofence Type is set “0=Boundary Crossing; or
- Geofence Type is set “1=Inclusive” and the TrimTrac detects it has exited all active geofence areas; or
- Geofence Type is set “2=Exclusive” and the TrimTrac detects it has entered any active geofence areas.

From “1=Violation” to “0=Normal” if:

- Geofence Type is set “0=Boundary Crossing and no boundary crossing has been detected since the previous GPS position fix; or
- Geofence Type is set “1=Inclusive” and the TrimTrac detects it has entered any active geofence area; or
- Geofence Type is set “2=Exclusive” and the TrimTrac detects it has exited all active geofence areas.

Geofence Status flag will remain set as follows:

“0=Normal” if:

- Geofence Type is set “0=Boundary Crossing and no boundary crossing has been detected since the previous GPS position fix; or
- Geofence Type is set “1=Inclusive” and the last GPS position computed by the TrimTrac Pro is within any active geofence area; or
- Geofence Type is set “2=Exclusive” and the last GPS position computed by the TrimTrac Pro is outside all active geofence area.

“1=Violation” if:

- Geofence Type is set “1=Inclusive” and the last GPS position computed by the TrimTrac Pro is outside all active geofence area; or
- Geofence Type is set “2=Exclusive” and the last GPS position computed by the TrimTrac Pro is inside any active geofence area.

The Geofence Status flag will set “5=Geofence Re-centered by LPA Input” once each time the LPA input switch is activated and if the Geofence Enforcement is set “3=LPA Centered and Enforced”

Reporting Geofence Violations

Geofence violation triggered messages consist of a new REPORT_POS message (page 177), in which the TriggerType is set “2=Exception Report” and the Geofence Status is set “1=Violation”, plus a

RESP_GEOFENCE_CONFIG message (page 185) that indicates which particular active geofence was most recently violated.

Regardless of which Geofence Type is used, or how the Report Delay Flag or Advanced Reporting Options are set, the TrimTrac Pro will always attempt to transmit a geofence violation triggered message whenever the TrimTrac Pro has detected that it has crossed an active geofence boundary (i.e., Geofence Status flag changes state from “0=Normal” to “1=Violation” or, except for Boundary Crossing-type geofences, from “1=Violation” to “0=Normal”).

Whether or not other messages in which the Geofence Status flag is set “1=Violation” are transmitted is determined by the Advanced Reporting Options setting for geofences. Unless “Geofence Change-of-State Reporting” is selected under the Advanced Reporting Options, the TrimPro will attempt to transmit all messages in which the Geofence Status flag is set “1=Violation”. On the other hand, if “Geofence Change-of-State Reporting” is selected, the device will attempt to transmit geofence violations as described in the previous paragraph.

For instance, if the Geofence Type is set “1=Inclusive”, then TrimTrac Pro will attempt to transmit a geofence violation message when it first computes a position fix outside all inclusive geofence areas. Then, for as long as the device continues to compute position fixes outside all inclusive geofence areas, the Geofence Status flag will be set “1=Violation” in all subsequent messages; however, the TriggerType will not be promoted to “2=Exception Report” in those messages due solely to the geofence violation. The next message to be transmitted due to a

geofence violation would be when the device re-entered an active inclusive geofence area and the Geofence Status is changed from “1=Violation” to “0=Normal”

See Table 12 and Table 14 for geofence related configuration settings and reporting options.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
Geofence ID	Unique geofence identifier: 1 through 10	>STKK (162) >QTKK (171) >RTKK (185)	AT+CTKK (140)
Geofence Enforcement	0=Disabled; 1=Enforced; 2=LPA Input Enforced; 3=LPA Centered and Enforced.		
Geofence Schedule	0=24/7; 1=After Scheduled Hours; 2=During Scheduled Hours. (See Scheduled Hours Mode)		
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 (160) >QTKZ (169) >RTKZ (184)	AT+CTKZ (146)
Advanced Reporting Options	Set Bit-2 to transmit only beginning and ending of inclusive or exclusive geofence violations.		

Table 12. Geofence Parameters, Settings, Messages and Commands

Detecting 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 Pro. 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 Pro is outside BOTH geofence areas. Conversely, if the TrimTrac Pro is inside EITHER geofence area, then no violations will be reported.

Exclusive geofence violations will be reported if the TrimTrac Pro is inside EITHER geofence area. Conversely, if the TrimTrac Pro is outside BOTH geofence areas, then no violations will be reported.

Whenever a geofence violation (boundary crossing, inclusive or exclusive) has occurred, the TrimTrac Pro 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 (all with TriggerType set “2=Exception Report”) until the device re-enters an inclusive area or exits an exclusive geofence (i.e. no geofence violation persists).

Upon the initial violation of an inclusive or exclusive geofence, the TrimTrac will send a new POSITION_REP and a RESP_GEOFENCE_CONFIG message for the geofence that has been most recently violated. If SMS is being used, both messages will be included in a single SMS message. The POSITION_REP will have the TriggerType set “2=Exception Report Alert” and include 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 most recently 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 messages, along with the associated RESP_GEOFENCE_CONFIG message, so long as motion and the geofence violation persists; provided, however, that no such RESP_GEOFENCE_CONFIG message will be sent if some event other than just motion triggered the new POSITION_REP. For instance, if a Speed Violation or activation of an input alert occurs or is cleared, then the device will transmit either a REPORT_POS or STATUS_MSG without the RESP_GEOFENCE_CONFIG message even though a geofence violation may be in effect. Nonetheless, if a geofence violation is in effect, the Geofence Status will still be set to “1=Violation” even if a RESP_GEOFENCE_CONFIG message is not attached.

Each new POSITION_REP sent while a geofence violation is in effect will have the TriggerType set “2=Exception Report 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 will have the TriggerType set “2=Exception Report 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.

When the device enters or leaves a geofence area and a geofence violation no longer exists, the device will transmit the REPORT_POS message containing the location information on which this determination has been made. In this “All-Clear” REPORT_POS message, the Geofence Status flag will be set “0=No Violation” and the TriggerType will be set “2=Exception Report Alert” even if all other alerts are also in a normal status.



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=Exception Report 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.

Trimble Navigation Ltd
 TrimTrac 1.5 (tm)
 Revision: 1.00.00.0000
 AT+CTKC=43200,300,240,90,60,168,20,0,0,1,0
 AT+CTKF=1,0,300,0,"0.0.0.0"
 AT+CTKK=1,1,1,10,0,"+37.3842980","-122.0070000"
 AT+CTKK=2,1,1,10,0,"+37.6493278","-121.7861028"
 AT+CTKX=0,0,0,2,3600,60,0,0,1,1,10,20,10,0
 AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,1,1,0,1,0,0,0,0,0,0,0,0

AT+CTKO?

+CTKO:

Device located within Geofence 1 area. Normal position reporting.

>RTKP04391048T1390324765000000003000+373841818-1220070325+00000000000;ID=GEOFENCE;*45<

>RTKP043A1053F1390324950000000003000+373842069-1220069993+00016000000;ID=GEOFENCE;*28<

>RTKP043B1045F1390325359000000003000+373842095-1220070698+00000000000;ID=GEOFENCE;*26<

Device leaves Geofence 1 Area. Note TriggerType=2, Geofence Status=1 and attached RTKK message

>RTKP043C2038F1390325476000000013000+373882085-1220038456+00039018017;ID=GEOFENCE;*21<>RTKK01110001000000+373842980-1220070000;ID=GEOFENCE;*1C<

>RTKP043D2039F1390325543000000013000+373870043-1219981651+00039000000;ID=GEOFENCE;*2C<>RTKK01110001000000+373842980-1220070000;ID=GEOFENCE;*1C<

Device re-enters Geofence 1 Area. Note TriggerType=2, Geofence Status=0 and no attached RTKK message

>RTKP043E2042F1390325601000000003000+373838116-1220015783-00101033267;ID=GEOFENCE;*27<

Device located within Geofence 1 area. Normal position reporting.

>RTKP043F1036F1390325676000000003000+373841880-1220070050+00019000000;ID=GEOFENCE;*2B<

>RTKP04401042F1390325832000000003000+373841875-1220070443+00036000000;ID=GEOFENCE;*56<

Table 13, Sample Geofence Violation Messages

Geofence Type Change-of-State Only RTKP Parameter			Position versus Geofence Area												
			Outside Time -->		Inside Geofence Area							Outside			
			Sample RTKP Report Sequence Number												
			0064	0065	0066	0067	0068	0069	006A	006B	006C	006D	006E		
Exclusive	No	TriggerType	1	1	1	2	2	2	2	2	2	1	1		
		Geofence Violation	0	0	0	1	1	1	1	1	0	0	0		
	Yes	TriggerType	1	1	1	2	1	1	1	1	2	1	1		
		Geofence Violation	0	0	0	1	1	1	1	1	0	0	0		
Inclusive	No	TriggerType	2	2	2	2	1	1	1	1	2	2	2		
		Geofence Violation	1	1	1	0	0	0	0	0	1	1	1		
	Yes	TriggerType	1	1	1	2	1	1	1	1	2	1	1		
		Geofence Violation	1	1	1	0	0	0	0	0	1	1	1		
Boundary Crossing	Either	TriggerType	1	1	1	2	1	1	1	1	2	1	1		
		Geofence Violation	0	0	0	1	0	0	0	0	1	0	0		

Assumptions:

1. Continuous GPS coverage
2. No Exception Report conditions other than Geofence Violations present
3. Messages with TriggerType set "2=Exception Report" transmitted regardless of how the Report Delay Flag is set

Table 14, Sample Geofence Report Settings

Geofences and GPS Fix Rate

Depending upon how strictly geofences must be enforced, it may be advantageous to enable 1Hz GPS (See Fix Rate on page 41). Geofences are enforced based upon the most recently computed GPS position. If the TrimTrac Pro 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 Pro 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 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 Pro 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, in accordance with the Advanced Reporting Options setting, 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.

Geofences and Scheduled Hours Mode

Geofence enforcement can be linked to time of day enforcement by using the Scheduled Hours Mode feature described in the next section. A geofence can be configured to be enforced 24/7 or during normal working or after hours. This later capability is particularly useful when, for instance, a vehicle is allowed to roam over a greater area during normal working hours, but needs to be restricted to a smaller area after hours. Please note that the geofences can be linked to the Scheduled Hours time periods even if the Scheduled Hours Mode feature itself is not enabled.

Scheduled Hours Mode

This feature is particularly useful when monitoring commercial assets that are used during certain hours of the day, but then are supposed to remain at rest or within a relatively constrained area during after hours.



The Scheduled Hours Mode feature is used to establish how the device reports motion or during what time periods a geofence is enforced. 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 Pro to report this motion and its current position. Monitoring of equipment at a construction site is an application example that would use this Scheduled Hours feature, possibly in conjunction with a geofence. (See AT+CTKZ on page 146; SET_EXT2_APP_CONFIG on page 160)

The Scheduled Hours mode first establishes daily consecutive hours during which use of the monitored asset is considered either “authorized” or “unauthorized” or when geofences are to be enforced during different times of the day.

When Scheduled Hours Mode is enabled, any unauthorized motion detected after hours (i.e. outside normal working hours as defined by the schedule) will cause the Scheduled Hours Flag to be set “1=After Hours Motion” and any motion-triggered messages will have the TriggerType set “2=Exception Report”. Setting the TriggerType to “2=Exception Report” will cause these messages to be transmitted regardless of how the Report Delay Flag may be set.

Non-motion triggered messages created “after hours” will have the TriggerType set in accordance with the non-motion event (i.e. Query, Scheduled Report, expiration of IDLE Timeout, T1, etc.) and the Scheduled Hours Flag will be set “0=No After Hours Motion”.

Before the Scheduled Hours Mode feature can be enabled, or geofences linked to time-of-day enforcement, you must define a daily start time (relative to 12:00 AM 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 Mode	0=Disabled; 1=Enabled	>STKZ(160) >RTKZ (184) >QTKZ(169)	AT+CTKZ (146)
Scheduled Hours Daily Start Time, T27	In Seconds (0 – 86399) after 12:00AM UTC.		
Scheduled Hours Work Day Length, T28	In Seconds (0 – 86400)		
Scheduled Hours First Weekly Work Day	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC)		
Scheduled Hours 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 15. Scheduled Hours Parameters, Settings, Messages and Commands

Runtime Meters

Equipment maintenance schedules are often managed based upon accumulated run-time hours. There are two resettable equipment runtime meters available on the TrimTrac Pro. 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 otherwise configured as a standard input or is used for geofences). These meters can be individually activated or reset. The LPA-based runtime meter accumulates hours whenever the switch contacts are closed. If the LPA input is used as a runtime meter, then LPA Mode should be set “1=Disabled”.

Each meter also has a separately programmable countdown timer. Upon expiration of a countdown timer, the TrimTrac Pro will transmit a message indicating which countdown timer has expired. After each expiration and transmission or transmission attempt, the countdown timer will automatically reset itself and begin counting down again. This feature is useful in equipment maintenance applications where, for 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 Pro, which will respond with a RESP_METERS message containing the current runtime readings.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
Runtime Motion-based	0=Disabled; 1=Enabled	>STKZ(160) >RTKZ (184) >QTKZ(169)	AT+CTKZ (146)
Runtime Motion-based Countdown, T29	In Hours (0=No Countdown, 1-990)		
Runtime LPA-based	0=Disabled; 1=Enabled		
Runtime LPA-based Countdown, T30	In Hours (0=No Countdown, 1-990)		
Runtime LPA-based Query	0=Report Only (No Reset); 1=Report with Reset	>QTKM(172)	None
Runtime 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(188)	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 16. Runtime Meter Parameters, Settings, Messages and Commands



Trimble Navigation Ltd

TrimTrac 1.5 (tm)

Revision: 1.00.00.0000

AT+CTKC=43200,300,240,90,60,168,20,0,0,1,0

AT+CTKX=0,0,0,2,3600,60,0,0,1,1,10,20,10,0

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

AT+CTKO?

+CTKO:

Normal position reporting based upon motion:

```
>RTKP0ADE1042F1390330933000000001000+376184790-1218112530+00879046223;ID=RUNTIMEM;*3F<
```

```
>RTKP0ADF1039F1390331089000000001000+376027020-1218459433+00400056248;ID=RUNTIMEM,*3B<
```

```
>RTKP0AE01039F1390331248000000001000+375761165-1218807921+00252066244;ID=RUNTIMEM;*42<
```

Runtime triggered by expiration of Runtime Motion Motion-based Countdown Timer, T29:

```
>RTKS0AE15045F1390331404721000000000;ID=RUNTIMEM;*62<>RTKM0200000289380000000000;ID=RUNTIMEM
```

Normal position reporting based upon motion resumes:

```
>RTKP0AE21046F1390331488000000001000+375297730-1219435760+00131075229;ID=RUNTIMEM;*40<
```

```
>RTKP0AE31034F1390331657000000001000+374871053-1219161521+00150074150;ID=RUNTIMEM;*4D<
```

```
>RTKP0AE41037F1390331815000000001000+374442801-1218908568+00019075170;ID=RUNTIMEM;*46<
```

Figure 6. Sample Runtime Message Log

Fix, Log and Reporting Rates

The rates at which the TrimTrac Pro 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 Pro 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 Pro 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 Pro reports its last known GPS fix based on the 1 Hz rate.

Beginning with firmware v3.08, the TrimTrac Pro can be configured to provide 1 Hz GPS operation at all times (except while in the IDLE State) plus:

- Include current position in all messages whenever GPS is available; and
- Use GPS velocity as an indication of motion

For instance, if the GPS Fix Rate is set to “1=1Hz GPS”, then the GPS receiver will be powered up and computing a position fix once per second for as long as sufficient GPS signal is available and the device has not entered the IDLE State. While in the IDLE State, the GPS receiver will be powered off to conserve power.

If the GPS Fix Rate is set to “2”, then 1Hz GPS is enabled (as described above) but the TrimTrac Pro also will include current GPS position in all messages whenever sufficient GPS signal is available to compute a position fix. For instance, compared to earlier versions of firmware or if the GPS Fix Rate is set to “1=1Hz GPS”, certain reports, such as input alerts and Scheduled Reports, or Runtime Meter reports would include STATUS_MESSAGES with no position information. GPS Fix Rate is set to “2” in firmware v3.08 and a current position is available, the device will create a REPORT_POS message in lieu of a STATUS_MESSAGE.

Finally, if the GPS Fix Rate is set to “3”, then 1Hz GPS operation is enabled, GPS position is included in all messages as described in the previous paragraph plus GPS velocity can be used as an odometer, engine idling and motion move qualifier as described in section on Move Qualifiers on page 14.

The GPS Fix Rate is set by using either the AT+CTKZ command or by sending the TrimTrac Pro a SET_EXT2_APP_CONFIG message.

Log Rate

Every time the TrimTrac Pro cycles through the standard State Machine due to motion the TrimTrac Pro logs its current position (or position fix attempt). This logging rate is determined primarily by DELAY State Timeout, T4, but is also influenced by the availability of GPS and GSM signals. Enabling Fixed Interval GPS under the Advanced Reporting Options and setting Automatic Message Log Dump to “2=All FIFO” will reduce variability in the logging frequency that would otherwise result from GPS signal and GSM coverage variations, respectively.

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 Pro 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 Pro to log ten messages and then transmit the next.

This report rate is also influenced by the availability of GPS and GSM signals. Enabling Fixed Interval GPS under the Advanced Reporting Options will reduce variability in the logging frequency that would otherwise result from GPS signal; however, the reporting frequency will be directly determined by the availability of GSM coverage regardless of how the Automatic Message Log Dump is enabled.

Parameter	Settings	Msg. Header (See Page)	Commands (See Page)
DELAY Timeout, T4	In seconds (10 – 86400)	>STKA(156) >QTKA(169) >RTKA(180)	AT+CTKC (137)
Report Delay Flag	5=Tx every 6 th motion-triggered message & Exceptions 6= Tx every 11 th motion-triggered message & Exceptions		
GPS Fix Rate	0=GPS operation during FIX State only; 1=1Hz GPS, except GPS off in IDLE; 2=Same as 1 plus position in all messages, if available; 3=Same as 2 plus GPS Velocity Move Qualifier	>STKZ(160) >RTKZ (184) >QTKZ(169)	AT+CTKZ (146)

Table 17. 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. Each type of input has four mode options: Automatic, Ignore, Network-Acknowledgement, Monitor-only and, beginning with v3.08 firmware, Change-of-State. Figure 7, Input Mode Reporting Options on page 47 shows how the Input Status flags are set in all REP_POSITION and STATUS_MESSAGE reports in accordance with each Input Mode setting. See

AT+CTKY Module-only Application Configuration on page 144..

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 Pro 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 Pro 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 Pro that the message had indeed arrived safely. When set to “Automatic”, the TrimTrac Pro 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.

When set to “2=Network Acknowledgement”, the TrimTrac Pro 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 delivery 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 (i.e. Alert Status set “4=Monitor Activated”) will be indicated in 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 to “0=Normal” accordingly.

Change-of-State Reporting

With the input mode set “4=Change-of-State Reporting”, when an input switches from its “Normal” condition to being “Activated”, the TrimTrac Pro will transmit a new STATUS_MESSAGE in which the TriggerType is set “2=Exception Report” and the associate input status set “1=Activated”.

Subsequent messages, including both STATUS_MESSAGE and REPORT_POSITION messages, will have the associated input status set “3=Acknowledged” until the monitored input changes back to its “Normal” condition.

Upon returning to the “Normal” condition, the TrimTrac will generate and transmit a new STATUS_Message in which the TriggerType is set “2=Exception Report” and the associate input status set “3=Cleared”. For as long as the monitored input remains in the “Normal” condition, subsequent messages transmitted by the TrimTrac will have the associated input status field set “0=Normal”.

No SET_ALERT_STATE messages are required to either acknowledge or clear Change-of-State alerts.

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 Pro 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 Pro 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 146 and
SET_EXT2_APP_CONFIG on page 160.

ALERT STATUS MESSAGE CODING BASED UPON SWITCH POSITION AND MODE SETTING

Switch Position												
		Normal			Activated				Normal			
		Time-->										
Report Seq. No.->		0064	0065	0066	0067	0068	0069	006A	006B	006C	006D	006E
Input Mode ^D	0=Automatic	0	0	0	1	2 ^A	2	2	2	2	3 ^B	0 ^C
	1=Ignore	0	0	0	0	0	0	0	0	0	0	0
	2=Network Ack	0	0	0	1	3 ^A	3	3	3	3	3	0 ^C
	3=Monitor-only	0	0	0	4	4	4	4	4	0or4 ^E	0	0
	4=Change-of-State	0	0	0	1	3	3	3	3	5	0	0

Alert Status indication in RTKP and RTKS Messages

Notes:

^A Requires GSM Status Code being set "0=Transmitted" in previous Report

^B Requires "Acknowledgement" message (>STKL...) from Server

^C Requires "Clear" Message (>STKL...) from Server

^D See AT+CTKY and >STKY

^E Depending upon current state when input changed condition

Figure 7, Input Mode Reporting Options

Automatic Message Log Dump

In certain geographic areas, TrimTrac Pro 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 Pro 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 Pro 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 Pro message log with the GSM Status set “2=No Network”. Once the TrimTrac Pro 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 Pro 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 Pro has been at rest for a while, it is likely in the IDLE State. Once the device starts to move, default settings will cause the device to 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 has started to move (i.e. a “Start Report”), 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 while the device was in the IDLE State. 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. If the device was in some state other than the IDLE State when motion commenced, then the device will first compute a new position fix before sending a new message to the server application.

A “Stop Report” is also available under the Motion Report Flag settings. The TrimTrac Pro will also attempt a final “at-rest” position after coming to a stop; however, the Stop Report function will set the TriggerType to “6=Stop Report” denoting that the device has actually come to rest.

Unlike the Start/Stop reporting settings under Report Delay Flag, the transmission of in-route position reports and status messages will NOT be selectively suppressed based upon these Motion Report Flag settings alone.

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=Tx Exception Reports only” suppresses all normal position reports and status messages and only Exception Reports are transmitted.

An Exception Report is defined as any message that is transmitted as a result of:

- Alert Status (HPA, MPA or LPA) becoming set to either “1=Activated” or “2=Sent”;
- Scheduled Report becoming due;
- Violation of a Scheduled Hours Mode, Geofence Enforcement or Speed Enforcement parameter;
- Response to queries received from the server application.

Provided there are no conditions that would otherwise trigger an Exception Report, the device will operate in the background based on motion to compute and log, but not transmit, new position fixes whenever the Report Delay Flag is set to “1=Tx Exception Reports only”. These logged messages and positions can

be subsequently retrieved by the server application by sending the TrimTrac Pro 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 Report Mode messages are transmitted regardless of how the Report Delay Flag is set.

Additionally, the Report Delay Flag can selectively suppress motion-triggered transmissions by time of day, when used in conjunction with the Scheduled Hours Mode, or based upon the starting and stopping of motion.

When the Report Delay Flag is set to “4=Tx Start/Stop, IDLE Status & Exception Reports” or “7=Tx Start/Stop & Exception Reports (No IDLE Status)”, the device will send reports based upon the initiation of motion and when the device comes to rest as follows:

1. When the device exits the IDLE State due to motion (according to the Static Motion Filter), the device will:
 - a. Compute and transmit a new POSITION_REP, if GPS is available (or STATUS_MSG if GPS is not available) if the Motion Report Flag is set “0=Disabled”, or
 - b. Transmit a Motion Report if the Motion Report Flag is set “1=Enabled” and then it will compute and log a new POSITION_REP, if GPS is available (or STATUS_MSG if GPS is not available).
2. For as long as motion continues (according to the Dynamic Motion Filter), the device will continue operating in the background computing and logging position fixes, but these position reports will not normally be transmitted. Each time the device logs a new position fix, it will also attempt to find and register on a GSM network to receive any incoming messages from the server application.
3. When the device comes to rest (i.e. There has been no motion since the most recent FIX State according to the Dynamic Motion Filter), it will compute and transmit a new POSITION_REP, if GPS is available (or STATUS_MSG if GPS is not available).

Several factors determine how long the device must remain at rest before a stop report is transmitted. Typically, the DELAY Timeout, T4, is the primary determinant; however, what state the device happens to be in when motion ceases can also have a significant effect. Being “at rest” is defined as no motion since the device last exited the FIX State. If motion ceased just prior to the most recent position fix being computed, then the stop report will be transmitted just after the TRANSMIT Timeout, T3, QUERY Timeout, T5, and DELAY Timeout, T4, have all expired. If motion ceased just after a position fix has been computed, then the device must cycle through the entire state machine once more, compute one last position fix, and then wait for the other state timeouts to expire before transmitting the stop report.

In as much as coming to rest is a random event relative to whatever state the device happens to be in at the time and whether or not GPS and GSM coverage are available, the expected time before a stop report is transmitted will be the average of these two extremes.

The difference between “4=Tx Start/Stop, IDLE Status & Exception Reports” or “7=Tx Start/Stop & Exception Reports (No IDLE Status)” is that with “4=Tx Start/Stop, IDLE Status & Exception Reports” STATUS_MESSAGES triggered by expiration of the IDLE Timeout, T1, are transmitted; with “7=Tx Start/Stop & Exception Reports (No IDLE Status)” no such STATUS_MESSAGES are transmitted. Please note that if no STATUS_MESSAGES triggered by expiration of the IDLE Timeout, T1, are transmitted and the device remains at rest, the device will not report its health to the server application. As such, the server application will need to devise some other method to, for instance, monitor battery capacity.

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.

This intermittent transmitting of in-route position reports can be particularly useful when used in conjunction with the Motion Report Flag settings. For instance, some applications may not need frequent in-route position reports, but want to know very quickly when the TrimTrac Pro has come to a stop. Setting the Report Delay Flag to either 5 or 6 while setting the Motion Report Flag to 2 or 3 will reduce the number of in-route position reports but still provide a timely Stop Report shortly after the TrimTrac Pro has come to rest. This configuration has the added benefit of providing a high density historical track log that can be queried should the need arise.

Diagnostics Mode

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

Enhanced Speed Enforcement

This feature is used to report speed limit violations. If 1 Hz GPS is disabled, then the speed measured while the device is in the FIX state is used to determine whether a speed limit violation is in effect. If 1 Hz GPS is enabled, then the device will more continuously monitor speed while the device is in motion.

In earlier versions of firmware, a speed violation would be reported when the Speed Limit Threshold was exceeded for 10 or more continuous seconds. Firmware v3.08 includes a programmable Speeding Threshold Timer, T33 instead of using the fixed 10 second window. This new capability give you complete

control over how long the Speed Limit must be exceed before a Speeding Violation occurs and how Speeding Violations are reported

Speeding Status Flag

The Speeding Status flag will become set to “1=Violation” whenever:

1. The speed measured while in the FIX State is greater than the Speed Enforcement threshold if 1 Hz GPS is NOT enabled; or
2. If 1 Hz GPS is enabled, whenever measured speed exceeds the Speed Enforcement threshold longer than then Speeding Threshold Timer, T33.

The Speeding Status flag will remain set to “1=Violation” whenever:

1. The speed measured while in the FIX State is greater than the Speed Enforcement threshold if 1 Hz GPS is NOT enabled; or
2. 1 Hz GPS velocity is greater than ninety (90%) percent of the Speed Enforcement threshold.

The Speeding Status flag will be or become set “0=No Violation” whenever:

1. The speed measured while in the FIX State is equal to or less than the Speed Enforcement threshold if 1 Hz GPS is NOT enabled;
2. 1 Hz GPS is enabled and:
 - a. If the Speeding Status flag is set “1=Violation” AND the measured speed drops below ten (10%) less than the Speed Enforcement threshold; or
 - b. If the Speeding Status flag is already set “0=No Violation” AND the measured speed does not exceed the Speed Enforcement threshold for ten (10) or more consecutive seconds.

Speeding Report Mode

The Speeding Report Mode determines whether or not motion-based REPORT_POS and STATUS_MSG messages are transmitted on the basis of the Speeding Status flag setting regardless of how the Report Delay Flag is set.

If the Speeding Report Mode is set “0=Report All Violations” and

1. If the Speeding Countdown Timer, T31 has not been enabled:
 - a. When the Speeding Status flag is set or becomes set “1=Violation”, then all motion-based REPORT_POS and STATUS_MSG messages shall have the TriggerType set “2=Exception Report” and will be transmitted.
 - b. When the Speeding Status flag changes from “1=Violation” to “0=No Violation”, the device will transmit a REPORT_POS in which the TriggerType is set “2=Exception Report”.
 - c. For as long as the Speeding Status flag remains set “0=No Violation”, then the device will operate in conformance with its

other parameters, including by way of example the the Report Delay Flag.

2. If the Speeding Countdown Timer, T31 is enabled and running, but has NOT yet expired, then the Speeding Status flag setting will have no effect on whether or not the TriggerType is set to “2=Exception Report” in any REPORT_POS and STATUS_MSG messages created while the Speeding Countdown Timer, T31 is running .
3. If the Speeding Countdown Timer, T31 is enabled AND expires while the measured speed continues to set the Speeding Status flag to “1=Violation”, the device will transmit a single REPORT_POS in which the TriggerType is set “2=Exception Report”.

If the Speeding Report Mode is set “1=Report Initial Violation”, the device will operate as follows:

1. Changing the Speeding Status flag from “0=No Violation” to “1=Violation” will:
 - a. Cause the creation of a REPORT_POS in which the TriggerType will be set “2=Exception Report” if the Speeding Countdown Timer, T31 has expired or has not otherwise been enabled:
 - b. Have no effect on whether or not the TriggerType is set to “2=Exception Report” in any REPORT_POS and STATUS_MSG messages created while the Speeding Countdown Timer, T31 is running
2. If the Speeding Status flag had already been previously set to “1=Violation”, a continuing speed violation in and by itself will not cause the TriggerType to be set “2=Exception Report” in any REPORT_POS and STATUS_MSG messages created while the speed violation persists, but rather the device will operate and report in accordance with its other configuration parameters.
3. No new REPORT_POS and STATUS_MSG will be logged or transmitted as a result of the Speeding Status flag changing from “1=Violation” to “0=No Violation” or remaining set “0=No Violation”.

Speeding Countdown Timer

The Speeding Countdown Timer, T31 is intended to suppress nuisance speed violation reports caused by, for instance, stop and go traffic in which the measured speed toggles above and below the speeds required to set or clear the Speeding Status flag. In other words, the Speeding Countdown Timer, T31 specifies the minimum time between new speed violation triggered messages.

The Speeding Countdown Timer, T31 starts running immediately after the Speeding Status flag changes from “0=No Violation” to “1= Violation”. While the Speeding Countdown Timer, T31 is running, continued or new speeding violations will not cause the TriggerType to be set to “2=Exception Report” in any REPORT_POS and STATUS_MSG messages.

Note that if a geofence violation is in effect when the Speeding Status flag is either set or cleared, the geofence configuration information that would otherwise be included with messages sent by the TrimTrac Pro will not be included. See section on geofences.

Speeding Threshold Timer

The Speeding Threshold Timer, T33, is another way to filter out nuisance speeding alerts. Before a speeding alert is triggered, the GPS velocity must exceed the Speed Enforcement limit longer than Speeding Threshold Timer, T33, continuous seconds. Then and only then would a speeding alert be triggered. In pre-3.08 versions of firmware, T33 was set at 10 seconds; however, in v3.08 firmware, this value is configurable.

Scheduled Report 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 Report Mode is enabled, the TrimTrac Pro 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 message. The new STATUS_MESSAGE will have the Position Age set "1=Aged" if there has been motion since the most recent REPORT_POSITION message as logged.

Enabling this Scheduled Report 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 Pro being connected to the GSM network at the designated time. This is particularly useful if the TrimTrac Pro 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.

Note that this feature can not be used to force the TrimTrac Pro to report at fixed intervals other than daily or weekly.

Polling

Polling on the TrimTrac Pro has been implemented somewhat differently than earlier generations of the TrimTrac locator. Polling can be implemented on the TrimTrac Pro either based upon motion or regardless of motion. In order to enable polling, the TrimTrac Pro 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 continuously communicate with the device may outweigh these negative side effects.

When do you want to communicate with the TrimTrac?	Anytime Polling Setting	In Motion Polling Setting	Comments
At anytime 24/7	2=OnDemand	0=Disabled	Recommended for GPRS only. High continuous power consumption
While in motion only	0=Disabled	1=OnDemand	GSM off while in IDLE State
While in motion and sometimes while at rest	1=Duty-Cycled	1=OnDemand	GSM on continuously, excepted cycled on/off while in IDLE to save power. Recommended for SMS-only mode.
Only when it would wake up on its own	0=Disabled	0=Disabled	Lowest power consumption.

Table 18. GSM Polling Options

If communication with the device is required at all times, whether the device is moving or is at rest, then the Anytime Polling feature can be 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 continuously 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 the Duty-Cycled setting for Anytime Polling. When enabled, Duty-Cycled 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 enabled ONLY while motion is being 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 whenever Anytime Polling is set to OnDemand. If Anytime Polling is set to OnDemand, the GSM modem will remain powered in all States regardless of how the In-Motion Polling feature is set or whether or not motion is sensed.

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.

A popular combination when using SMS messaging is to have In-Motion Polling set to “1=OnDemand” and Anytime Polling set to “1=Duty Cycled while in IDLE State”. This will allow continuous communication with any device while it is motion, but then cycle the GSM modem on and off while in the IDLE State to minimize power consumption but still allowing more frequent polling of the device than would otherwise be afforded by the expiration of IDLE Timeout, T1, alone.

Duty cycling the GSM modem while in the IDLE State may result in excessive GPRS data charges since some carriers charge a minimum number of Bytes (i.e. 1k Bytes) each time a GPRS session is established regardless of how much user data is actually transmitted during the current GPRS session. Therefore, leaving the GSM modem on for as long as possible by setting this Anytime Polling to 2=OnDemand may be preferred when using GPRS communications, even if doing so results in much higher power consumption.

Final consideration on how polling is enabled is that network operators from time to time make changes on their networks that require power cycling of mobile devices. The power reset occurs automatically on the TrimTrac Pro each time the device cycles through the state machine in accordance with its default settings; however, if Anytime Polling is set “2=OnDemand” or if the device is in continuous motion and In-Motion Polling is set “1=Enabled”, the device may never power cycle off.

It is, therefore, recommended that Anytime Polling be set “2=OnDemand” only when the application absolutely requires uninterrupted communications and the device can be physically accessed to execute a power off reset whenever such a need arises.

For those applications that require polling capabilities and the ability to recover from network changes or outages that require power cycling, it is recommended that In-Motion Polling be set to “1=OnDemand” and Anytime Polling be set to “1=Duty Cycled while in IDLE State” with:

- i) Polling Duty-Cycle Frequency, T19, set to 60 Seconds (or longer; provided, however, $T19+T20 < T1-120$)
- ii) Polling Duty-Cycle On-Time, T20=3600 Seconds (or longer; provided, however, $T19+T20 < T1-120$)

Query Hold Flag

The Query Hold Flag is seldom changed from its default configuration. In its default 0=Disabled 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 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 value, 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; however, if the device is expected to be operating in areas where GSM networks may have marginal robustness, then Status Message Transmit Attempts, N2, and Position Report Transmit Attempts, N1, should be set to either “0=Until T3 Expires” or to “3 to 5 Attempts”. HPA Transmit Attempts, N5, MPA



Transmit Attempts, N6 and LPA Transmit Attempts, N7 should be left at the default setting of “0=Until Tx Expires”.

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 Pro 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 gets 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 Pro operates in accordance with its current parameter configurations; however, when a High or Medium Priority Alert is activated, the frequency at which the TrimTrac Pro cycles through the state machine can be varied. For instance, the TrimTrac Pro 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 Pro 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 Pro, 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 Pro 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 Pro is one position fix every 30 seconds. Achieving this level of fix density requires that Anytime Polling or In-Motion Polling be set to “OnDemand” and that 1Hz GPS is enabled (See Fix Rate on page 41) with good GPS signal strength and GSM coverage.

Reporting Frequency

The TrimTrac Pro can report at different rates depending upon whether the device is in motion or is at rest. The IDLE Timeout, T1, setting largely determines how frequently the device will report will at rest. Each time the IDLE Timeout, T1, expires, the device will transmit a STATUS_MESSAGE unless the Report Delay Flag is set to suppress such messages.

The TrimTrac Pro is designed to compute new position fixes while the device is in motion. The rate at which the TrimTrac Pro 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 Pro 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 (‘Tx’) 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 Pro or if the Scheduled Report 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 Pro only while the device is in the QUERY State, which may not allow frequent enough communications for some applications. As such, the TrimTrac Pro 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 Pro 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. Power consumption and battery life will both be negatively affected.

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 “1=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.

A final consideration on whether or not to enable polling is that network operators make changes on the GSM network from time to time that require mobile devices to be turned off and then powered back up before such changes take effect. If the modem is left on continuously due to polling being enabled, then this power cycling will not happen automatically.

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 1-2 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 Pros using a Vehicle Adapter or Control Module while connected to an external source of 12VDC power.

Example Applications

Baseline (Default) Application

TrimTrac Pro 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 and Clear the Message Log	See Page
AT+CTKE=3	138

Table 19, Provisioning Command for Default Configuration Settings and Log Clearing

Note: Clearing the Message Log does not reset the Report Sequence Number.

Mobile Resource Management Applications

Normal Reporting:

- Transmit a Start Report whenever the vehicle engine is started or if the vehicle starts to move faster than 3 MPH
- Transmit in-motion reports every 5 minutes regardless of GPS availability
- Transmit a Stop Report whenever the vehicle has stopped for 2 minutes
- Transmit a message whenever the ignition is switched from on to off
- Transmit a Status Report, along with the most recently logged position, once every day at 9AM GMT
- Transmit current status and position if stationary for 24 hours and then every 24 hours thereafter for as long as asset remains at rest.

Exception Reporting:

- Transmit an Engine Idling Report whenever the vehicle has remained stationary with the engine idling for 2 minutes. Then transmit another Engine Idling Report whenever either the engine is switched off or the vehicle has started to move again
- Transmit a geofence message indicating whether the vehicle has entered or exited an active exclusive geofence area.
- Transmit a Speed Violation whenever vehicle has exceeded 55 MPH for 2 or more continuous minutes.
- Transmit a runtime report after every 100 hours of accumulated engine run time (i.e., ignition ON).
- Transmit an alert whenever vehicle voltage drops below DC +5 V.

Other:

- Include a virtual odometer reading with each position report in lieu of altitude
- Transmit all messages, including those logged while out of GPRS coverage, in strict First-in, First-Out (FIFO) sequence
- Include GPS in all messages whenever GPS is available.
- Attach most recently logged REPORT_POS message with all STATUS_MESSAGES unless some other message (i.e., Geofence or Runtime Meter) is already attached.
- Power off GSM modem once vehicle has remained stationary for 1 hour with the engine turned off.
- Use GPS velocity as for engine idling detection, virtual odometer and move qualifier.

Installation Requirements:

- Vehicle powered
- LPA used as an “ignition sense” for engine idling and runtime purposes
- End-of-Line 100K Ohm resister across yellow leads on module

Sample Logistics and Telematic Application Configuration Settings	See Page
AT+CTKC=86400,300,300,290,4,168,20,3,0,1,1	137
AT+CTKX=1,32400,1,1,86400,3600,0,0,1,1,10,20,10,0	143
AT+CTKY=10,10,10,10,0,120,60,0,0,0,3,4,4	145
AT+CTKZ=10,0,0,43200,1,5,0,1,0,100,2,3,0,2,55,1,120,000F,2,0,3,120,3,120	146

Table 20, Sample Logistics and Telematic Application Settings

Query-to-Fix Applications

Some applications may not need regular position updates at all and only need regularly scheduled status updates to confirm device health and battery level. In such applications, the device would occasionally be queried for its current position on an “as-need” basis..

Setting	Point	Counterpoint
Report Delay Flag set to “1=Tx Exception Reports Only”.	Saves communication costs by not transmitting any normal REP_POSTION or STATUS_MESSAGE	Normal reporting is halted unless queried.
Scheduled Report 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”	Alternately, the Report Delay Flag could be set “3=Tx IDLE Timeout, T1, Status Messages & Exceptions” with IDLE Timeout, T1, set to 999,990 seconds.
Motion Sensor Override set to “2=Motion Never”	This will keep the device from computing a new position fix even though there may be actual motion.	Because the device is not actively computing position 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 “1=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 within one hour for 60 seconds of coming to rest in the IDLE State. During the 60 seconds, the device is able to receive messages. Then the off/on cycle repeats. If T19 is increased substantially, or in areas with GSM networks known to have poor coverage or performance, it may be beneficial to also 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 QUERY_POSITION message with Position Query Mode set "P=Compute New Position"	Upon receipt of the QUERY_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 QUERY_POSITION message until Polling Duty-Cycle Frequency, T19 expires (up to an one-hour in this example), the next Scheduled Report time, or upon expiration of the IDLE Timeout, T1, whichever is earliest.

Table 21, 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=43200,300,300,900,60,168,20,0,1,1,0	142
AT+CTKX=1,0,0,1,3600,60,0,0,1,1,10,20,10,2	143

Table 22, Sample Non-default Commands for Query-to-Fix Configuration

Stationary Assets

Whereas a personal automobile normally moves on a daily basis, other assets are expected to remain stationary. When a stationary asset does move, it truly 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 the locator is still alive and functioning.

Using the Scheduled Report 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 23, would be approximately 9-10 months even if the asset moved once a week for an hour or so.

Setting	Point	Counterpoint
Scheduled Report 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=Tx Motion-related & Exceptions”	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=Tx Exception Reports 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 in the IDLE State. Then goes and does a position fix.	May not be worth the extra data message in some applications.

Table 23, Stationary Asset Settings

Sample Stationary Configuration Settings Expected Battery Life: 9-10 Months	See Page
AT+CTKC=43200,300,300,900,60,168,20,1,2,1,0	137
AT+CTKX=2,0,0,0,3600,60,0,0,1,1,10,20,10,0	143

Table 24, Sample Non-default Commands for Stationary Configuration

Small Fleet Management 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 Pro can be an extremely cost-effective way to monitor dynamic assets.

If 1Hz GPS is enabled (See Fix Rate on page 41), 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 Pro 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
In-Motion Polling set “1=OnDemand”; Anytime Polling set “1=Duty-Cycled”; Polling Duty-Cycle Frequency, T19, set to 60 Seconds; Polling Duty-Cycle On-Time, T20.	Allows near constant communication with the TrimTrac Pro 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 Report Mode and Motion Report Flag Triggered messages transmitted, set Report Delay Flag to “1=Tx Exception Reports only”.
QUERY Timeout, T5, set to minimum 10 seconds	Minimizes the time between message transmissions	Should be set no lower than 60 seconds if either In-Motion Polling or Anytime Polling set “0=Disabled”

1Hz GPS is enabled (See Fix Rate on page 41)	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.
Automatic Message Log Dump set “1=Enabled”	Causes the transmission of messages logged while outside GSM coverage upon restoration of GSM Coverage	Messages may be received out of sequence at the server application.

Table 25, High Performance Settings

Sample High Performance Configuration Settings	See Page
Expected Battery Life: Less than One Day	
AT+CTKC=43200,300,300,10,10,168,20,1,0,1,0	137
AT+CTKX=0,0,1,1,60,3600,0,0,1,1,10,20,10,0	143
AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,1,1,0,1,0,0,0,0,0,0,0,0,0	146

Table 26, Sample High Performance Settings

Rapid Start and Stop Motion Reports with Periodic In-route Reporting

Some applications may require relatively infrequent in-route position reports but want timely Start and Stop Motion Reports. In such applications, the settings are largely the same as those for High Performance applications except the Report Delay Flag and Motion Report Flag settings are different.

Setting	Point	Counterpoint
Motion Report Flag set either to “2=Stop Motion Report” or “3=Start and Stop Motion Reports”	Provides a Stop Motion Report soon after the TrimTrac Pro has come to rest	
Report Delay Flag set either to “5=Tx every 6 th motion triggered message” or “6=Tx every 11 th motion triggered message”	Reduces the number of in-route position report transmissions while still allowing a timely Stop Motion Report.	
In-Motion Polling set “1=OnDemand”; Anytime Polling set	Allows near constant communication with the TrimTrac Pro even while	Drastically reduces battery life to as little as 4 days even if there is no new

“1=Duty-Cycled”; Polling Duty-Cycle Frequency, T19, set to 60 Seconds; Polling Duty-Cycle On- Time, T20.	actively computing a new position fix or transmitting a message.	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 Report Mode and Motion Report Flag Triggered messages transmitted, set Report Delay Flag to “1=Tx Exception Reports only”.
QUERY Timeout, T5, set to minimum 10 seconds	Minimizes the time between message transmissions	Should be set no lower than 60 seconds if either In- Motion Polling or Anytime Polling set “0=Disabled”
1Hz GPS is enabled (See Fix Rate on page 41)	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.
Automatic Message Log Dump set “1=Enabled”	Causes the transmission of messages logged while outside GSM coverage upon restoration of GSM Coverage	Messages may be received out of sequence at the server application.

Table 27, Start and Stop Motion Report and In-route Report Settings

Sample High Performance Configuration Settings Expected Battery Life: Less than One Day	See Page
AT+CTKC=43200,300,300,10,10,168,20,1,0,1,0	137
AT+CTKX=0,0,1,1,60,3600,0,0,1,1,10,20,10,0	143
AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,1,1,0,1,0,0,0,0000,0,0,0,0,3,0	146

Table 28, Sample High Performance Settings



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 PRO 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=10,10,10,10,0,300,60,0,0,0,1,1,1	145

Table 29, 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 Pro can be configured to address these scenarios.

The TrimTrac Pro 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 Pros. Use of runtime meters will help manage maintenance schedules and track equipment usage for deployment, billing and taxation purposes.

Setting	Point	Counterpoint
Runtime LPA-based set “1=Enabled”	Positive start/stop of runtime meter based upon the LPA input switch position (no regard to motion). 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 “2=LPA Input Enforced” or “3=LPA Centered and Enforced”
Runtime LPA-based Countdown, T30	Provides automatic reports based upon runtime. Good for maintenance, billing or taxation.	
Runtime Motion-based	Good for monitoring when equipment is being transported or used. Can be used on battery powered or Module equipped TrimTrac Pros	Can not distinguish between runtime caused by transportation or operation
Scheduled Hours Mode set “1=Enabled”	Prevents nuisance transmissions during normal working hours. Unit, however, still logs position information in the background	Start time same for each workday. Consecutive daily hours and workdays only.
Scheduled Report 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 LPA-based
1Hz GPS is enabled (See Fix Rate on page 41)	Provides for more continuous geofence enforcement	Substantially increased power consumption while in motion.

Table 30, Construction Equipment Monitoring Settings

Sample Construction Equipment Configuration Settings	See Page
AT+CTKC=43200,300,300,900,60,168,20,0,1,1,0	137
AT+CTKK=1,1,0,100,0,"+37.3842980","-122.0080760"	140
AT+CTKX=1,55785,1,1,60,3600,0,0,1,1,10,20,10,0	143
AT+CTKZ=10,1,55785,3600,1,5,1,0,100,0,1,1,0,1,50,0,0,0000,0,0,0,0,3,0	146

Table 31, Sample Construction Equipment Monitoring Settings

Under these sample configuration settings, the device will compute and log positions at a nominal rate of once every 17-18 minutes. These and other messages will be transmitted, if and only if:

- The device leaves the inclusive geofence area;
- Motion is sensed outside normal working hours;
- Motion-based Runtime Meter has accumulated 100 hours since last runtime report;
- Speed limit of 50 mph is violated;
- Query messages is received; or
- It is time to transmit a weekly status report.

Summary End-user and Installation Instructions

Battery Powered Units

1. Configure and provision the TrimTrac Pro 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 Pro 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 Pro base while aligning the arrow on Battery Module with the arrow on the TrimTrac Pro 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 Pro base cover and tighten the hold down screw.
8. Place the TrimTrac Pro horizontally with TrimTrac logo facing up and with as clear a view of the sky as possible.
9. To change batteries, remove the TrimTrac Pro base cover and properly dispose of old batteries, then follow steps 6 through 8 above.

Vehicle Adapter or Control Module Equipped Units

PLEASE CONNECT ALL WIRE LEADS **PRIOR** TO INSERTING THE VEHICLE ADAPTER MODULE INTO THE TRIMTRAC PRO BASE

REQUIRED CONNECTIONS:

1. Connect RED wire to a constant, non-switched 9-32 VDC source of power (+). An 1.0 Amp fuse rated for 1000 Amp interrupt capability is required (Examples include Littelfuse p/n 0257001 and Bussmann p/n BK/ATC-1).
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 Pro is programmed to Disable Medium Priority Alerts.
4. If a Control Module is being used, the internal standby battery needs to be plugged in prior to initial use.

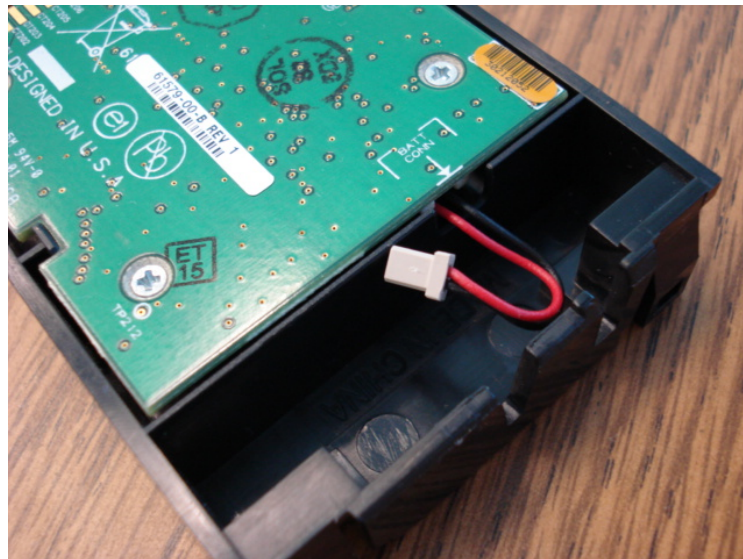


Figure 8. Control Module with Disconnected Stand-by Battery Leads

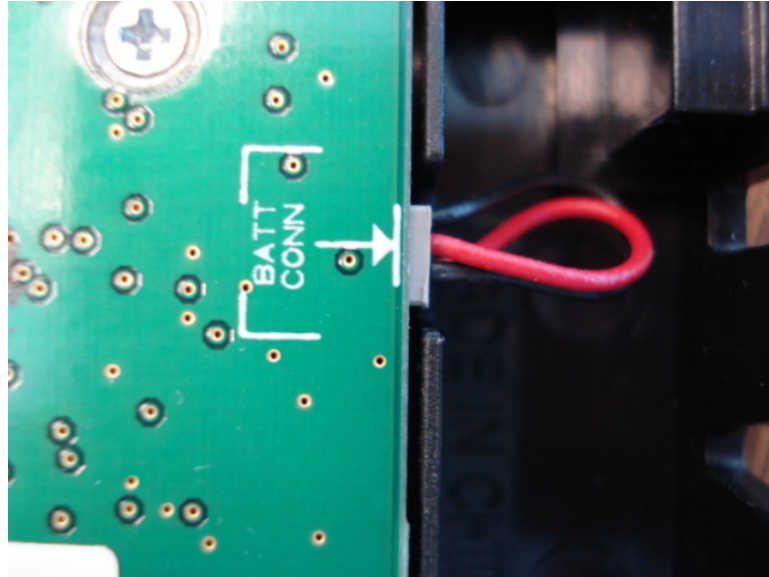


Figure 9. Control Module with Stand-by Battery Leads Connected

OPTIONAL INPUTS AND ALERTS:

1. Refer to the Vehicle Adapter and Control Module wiring diagrams provided in the Technical Manual, in Figure 36 or Figure 37 on pages 233 and 234, respectively.
2. Mount the monitored input 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 Pro). In so doing, maximum tampering protection is afforded.
3. Install a 100K-Ohm End-of-Line resistor as shown in the wiring diagram, if Medium Priority Alerts are to be used.

OPTIONAL OUTPUTS (Control Module Only):

1. Refer to the Control Module wiring diagram provided in the Technical Manual, in Figure 37 on page 234.
2. The ORANGE (Output 1) and BLUE (Output 2) wires can be connected directly to loads of less than 500 mA @ 12 VDC. , respectively. Larger loads should be controlled via an automotive grade relay.

FINAL ASSEMBLY AND INSTALLATION:

1. Configure and provision the TrimTrac Pro as described in “TrimTrac Pro Configuration” beginning on page 129. Generally, 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 Pro base cover and any previously installed module to access the SIM cardholder.
3. Insert the activated 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.

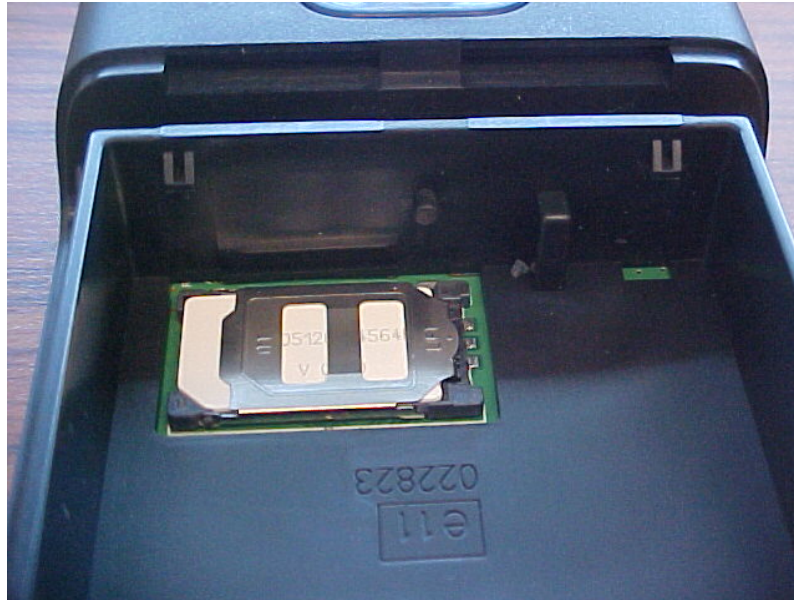


Figure 10. Properly inserted SIM Card and latched holder.

3. Place the AA Battery, Vehicle Adapter or Control Module in the TrimTrac Pro base while aligning the arrow on module with the arrow on the TrimTrac Pro base. If a Control Module is being used, be sure to connect the stand-by battery as shown in Figure 9 before inserting the module into the TrimTrac Pro base.



Figure 11. Align Arrows on base and module.

4. Press down on the module to snap in securely in place on all four corners making sure all corner tabs are all fully engaged.



Figure 12. Module with all four corners securely snapped into place.

5. If a Vehicle Adapter or Control Module is being used, remove rubber channel plug from the TrimTrac Pro base unit.



Figure 13. Rubber Channel Plug Removed

6. Route the wires from the Vehicle Adapter or Control Module through the wiring channel in the TrimTrac Pro base. If a Vehicle Adapter Module is being used, press the molded rubber piece into the channel.

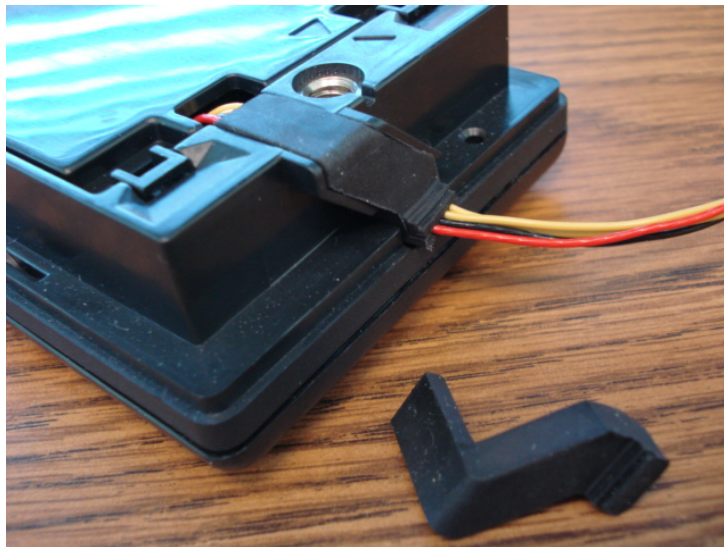


Figure 14. Vehicle Adapter Module Wires Properly Routed.

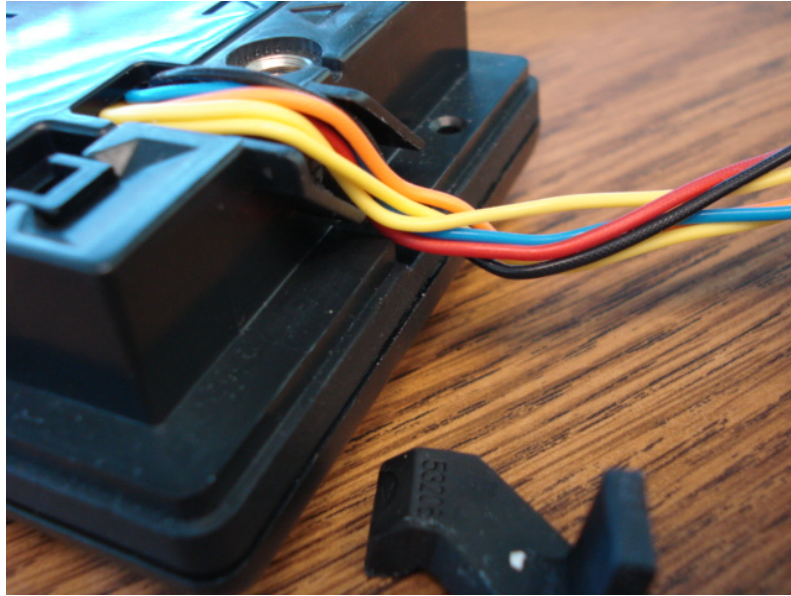


Figure 15. Control Module Wires Properly Routed

7. Install TrimTrac Pro base cover and tighten the hold down screw being careful not to pinch any wires if a Vehicle Adapter or Control Module are being used.



Figure 16. Cover in place with Wires Properly Routed

8. Place the TrimTrac Pro 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.

STANDBY BATTERY RECHARGE:

The internal standby battery should be recharged no less frequently than once every three months. Unless the battery has been subjected to a deep discharge, the internal standby battery will reach its maximum charge within 3 hours after external power has been applied to the Vehicle Adapter or Control Module. Fully discharging the standby battery will decrease the battery life in terms of the number of available recharge cycles and the maximum charge. Charging of a fully discharged standby battery may take up to 24 hours.

External GPS Antenna

The TrimTrac Pro can operate on its internal GPS antenna or with an optional external GPS antenna. To connect the external GPS antenna, remove the screw plug on the side of the TrimTrac Pro to expose the RF connector. Carefully insert the mating cable connector into the TrimTrac RF connector. No more than five pounds of force should be used to snap the connectors together. Also, take care that no excessive side force is applied to the cable connector. Excessive insertion or side force may cause damage to the TrimTrac Pro and such damage will not be covered by warranty. When used with an external GPS antenna, the TrimTrac Pro is no longer water or dust resistant and battery life may be slightly impacted.

Use of the external GPS antenna is recommended whenever:

1. The TrimTrac Pro can not be placed where it can receive adequate GPS signals without the device being subjected to environmental outside its specified ranges; or
2. The application requires a more discrete installation.



Figure 17. External GPS Antenna RF Connector Plug.



Figure 18. External GPS Antenna RF Connector.



Figure 19. External GPS Antenna Connected to TrimTrac Pro

Vehicle Placement Guidelines

1. Placing the TrimTrac Pro, 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 Pro be placed where it is subjected to extreme environmental conditions (temperature, vibration, water). For instance:
 - a. DO NOT leave the TrimTrac Pro on the dashboard exposed to direct sunlight or extreme temperatures (hot or cold).
 - b. DO NOT mount it where it will block the driver's view or otherwise impair safety.
 - c. DO NOT mount it inside the engine compartment
 - d. DO NOT subject it to direct water spray from the vehicle wheels.
2. Typical placement locations for the TrimTrac Pro 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 Pro be placed in the trunk or boot of the vehicle.

3. Unless used with the optional external GPS antenna, the TrimTrac Pro should be placed in a near horizontal position with the TrimTrac badge facing upward toward the sky. If used with the optional external GPS antenna is used, then the antenna element should be placed in a near horizontal position facing upward toward the sky
4. Depending upon how the TrimTrac Pro is configured to operate, placement within the vehicle can have a significant impact on battery life and, as shown in Figure 20, the number of position reports that are generated. Actual results will vary.

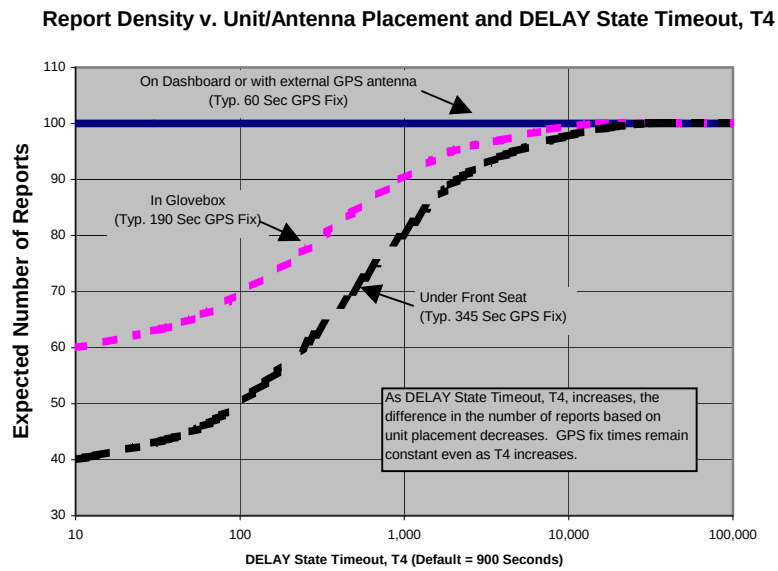


Figure 20. Vehicle Placement versus Expected Number of Reports

Technical Tips and Troubleshooting

Introduction

The TrimTrac Pro and accessories are designed to operate in the conditions outlined in the Specifications on page 193.

When used and maintained properly, the TrimTrac Pro provides years of trouble-free service. The TrimTrac Pro has no user-serviceable parts other than its replaceable batteries.

Should the TrimTrac Pro 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 Pro to the authorized Service and Repair Center for repair.

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

Dead Batteries

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

Poor GPS reception

Poor GSM coverage

Communication failure with base

TrimTrac Pro Application programming errors

Requesting Technical Assistance

The TrimTrac Pro and accessories are designed to operate in the conditions outlined in the Specifications on page 193.

If the TrimTrac Pro continues to operate poorly after you follow the troubleshooting guidelines described in this chapter, please contact your TrimTrac Pro supplier for assistance and be prepared to provide complete unit configuration and message log per the procedures described under "Minimum Information Required for Technical Assistance" on page xv of this manual.

Battery Problems

Make sure your batteries are generating sufficient current to power your TrimTrac Pro 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 and do not leave dead batteries in the TrimTrac Pro for extended periods of time. Alkaline batteries will leak and, in some cases, rupture, if exposed to temperatures in excess of the manufacturer specifications or if left installed in the TrimTrac Pro fully discharged for extended periods of time.

Battery Temperature Ranges

The TrimTrac Pro is specified to operate from –10 to +55 degrees C. This does not necessarily mean that the TrimTrac Pro stops working outside this range. In the case of the TrimTrac Pro, for instance, it means that its operation is type approved over this range. The device may continue to operate in terms of computing position fixes and transmitting or receiving messages outside the specified temperature range, however, such operation is not guaranteed by Trimble nor 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 and the batteries will leak when subjected to high temperatures. The TrimTrac Pro will survive when subjected to temperatures as high as +105 degrees C; however, alkaline batteries would likely be damaged, leak 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 standby 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 standby battery. A good battery will reach full charge in approximately 3 hours.

GPS Reception Problems

Even though the TrimTrac Pro 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 Pro or external GPS antenna is reasonably positioned to receive GPS signals.

GPS Antennas

The TrimTrac Pro has an internal GPS antenna or can be used with an optional external GPS antenna. When an external GPS antenna is first connected, the TrimTrac Pro will not recognize that an external GPS antenna is attached until the next time it enters the FIX State. On the other hand, if the external GPS antenna is disconnected for five or more seconds, then the device will begin using the internal GPS antenna immediately without first having to enter the FIX State. Whether the device is using the internal or external GPS antenna is indicated (and whether the device has a complete almanac) in each POSITION_REP and STATUS_MESSAGE for which a position fix was attempted. Battery life may be impacted when an external GPS antenna is used.

GPS Almanac Collection

When the TrimTrac Pro is used for the first time after being provisioned, the unit may not have a complete or current GPS almanac. If the TrimTrac Pro needs to collect or update the GPS almanac, it will do so by keeping the GPS receiver operating in the background after a position fix is computed. This GPS almanac collection will not interfere with the other operations of the TrimTrac Pro. Whether the device has a complete almanac (and whether the device is using the internal or external GPS antenna is indicated) in each POSITION_REP and STATUS_MESSAGE for which a position fix was attempted.

GPS Almanac Loading

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

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'](http://www.trimtrac.com/documents/partners/) page.

Orientation

When using the internal GPS antenna, the TrimTrac Pro should be in a near horizontal position 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 Pro frequently times out before completing a position fix, try moving the TrimTrac Pro to a new location where it, or the optional external GPS antenna, is not blocked as much.

GPS Jamming

The TrimTrac Pro 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 Pro, Trimble recommends a minimum clearance of 50cm (approximately 18 in.) from these transmitting devices.

Land-based transmitters, including microwave and television transmitters, can also interfere with GPS reception. If the TrimTrac Pro is operating near an antenna farm, the TrimTrac Pro may temporarily lose GPS reception while in the vicinity of the transmitters. Reception should return once the TrimTrac Pro 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 Pro. 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 Pro 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 Pro 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 Pro 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 Pro, 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 21. 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 Pro 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 Pro, or the optional external GPS antenna, should be installed as far away as possible from other transmitting antennas including other TrimTrac Pros, 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 Pro farther away from these antennas. Generally, the stronger the other transmitting device, the wider the distance required between antennas.

No Data Communication via Provisioning Module

If you were able to communicate with an original TrimTrac using the Provisioning Module and a PC running HyperTerminal, then you should also be able to communicate with a TrimTrac Pro. Please make sure that you have loaded the proper FTDI driver and configured HyperTerminal as described in section Provisioning Set-up beginning on page 129.

If you continue to experience problems, then do the following:

1. Inspect the spring loaded connectors on the TrimTrac Pro to confirm that none are damaged or misaligned.
2. It may be helpful to clean the contact pads on the Provisioning Module, especially if the Provisioning Module has been in service for an extended period of time. A pencil eraser has proven effective in removing any residue or oxidation that may have built up.
3. When inserting the Provisioning Module into the TrimTrac Pro, make sure all four corners of the Provisioning Module are completely and securely snapped into place. If not securely snapped into place, then there may not be good contact between the Provisioning Module and the TRIMTRAC PRO base.
4. Start Hyperterminal and open a new connection using the recommended settings. Type ATI and see if you a response. If no response, then squeeze the Provisioning Module and TRIMTRAC PRO together near the end where the connectors mate. You may get a RDY response or string of characters if there is an intermittent connection.
5. Inspect the bottom of the Provisioning Module PCB. There are several through-hole leads near the corner with the bar code label. If any leads are protruding up through the solder, then perhaps they need to be trimmed if you received an early version of the provisioning module built before the lead trimming process had been fine tuned..

No Data Communication with Base

If the TrimTrac Pro 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. The TrimTrac Pro is specified to work with 3.0 Volt SIMs only. If a 5.0 Volt SIM is used, the device may work with SMS, but it will NOT work with GPRS.
3. Confirm proper provisioning, including Unit ID, SMS Destination Address, Security Password, and, if needed, SIM PIN. Make sure the correct APN, Username and Password are used for GPRS;
4. 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.

5. Set the Diagnostics Mode to “1=Enabled” and observe the LED to confirm that the unit properly enters the TRANSMIT and QUERY states.
6. Use the AT+CTKO? command with a provisioning module to review logged messages while paying particular attention to the GSM Status field.

Working with GPRS

If a GPRS session has been established by the mobile device and data is being actively exchanged between the mobile device and server application, then it is known conclusively that:

1. The GSM modem in the device is powered up;
2. GPRS service is available¹; and
3. The device is using GPRS to communicate with the server application.

At any given time, there may be several reasons why there is no active GPRS session established, including by way of example:

1. Outside GSM coverage;
2. Within GSM coverage but no GPRS service is available;
3. GPRS service is available while roaming, but the SIM card does not have the appropriate authorization to connect;
4. The GSM modem is turned off;
5. Device is configured to used SMS only; or
6. Device has been configured with incorrect GPRS parameters.

The difficulty, of course, is differentiating between the reasons for the lack of an active GPRS session when the device has already been deployed in the field. Other than waiting for the mobile device to establish a new GPRS sessions, the only other way to communicate with a mobile device for which there is no current GPRS session is to send it a SMS message. Even so, the device will respond to appropriately formatted SMS messages sent from the server application if and only if the device is:

1. Within GSM coverage;
2. In a state that has the GSM modem powered up; AND
3. Configured to communicate via:

¹ Except when using UDP without the TrimTrac Session Protocol, in which case the device can leave a GPRS service area but neither the device and server application will know that a GPRS session is no longer active.

4. SMS-only, or
5. Either SMS or GPRS and there is no GPRS service available.

It is also important to note that all GPRS communications are, by definition, real time, meaning that messages can be sent or received if and only if a active GPRS session is in effect. Unlike SMS, GPRS has no SMSC-based store-and-forward capabilities. Therefore, server applications utilizing GPRS communications may benefit from having a message queuing capability such that messages can be generated and readied for delivery whenever the next GPRS session is established by the mobile device. This, of course, requires that GPRS-based server application be on-line continuously (otherwise no GPRS session can be established between the mobile device and server application). With SMS, the network SMSC will holdover SMS messages sent in either direction for a certain period of time until the receiving device or server is connected to the network. Both the mobile device and server application need not be online at the same time with SMS.

Enabling GPRS on a SIM already in Service

Some carriers support over-the-air activation of services. For instance, is a SIM currently in use supports only SMS, some carriers are able to activate GPRS service over-the-air; however, before this service change takes effect, the GSM modem in the TrimTrac Pro may need to be power cycled. Such power cycling happens each time the TrimTrac Pro cycles through the state machine assuming that the GSM modem is not left powered up due to polling being enabled. To force the GSM modem to power cycle, either remove the battery pack or Vehicle Adapter or Control Module from the TrimTrac Pro base unit, or disable polling until the device has cycled through the State machine at least once.

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 Pro

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

1. Try a known-good TrimTrac Pro.
2. Move into an area with strong GSM coverage.
3. Send the TrimTrac Pro a data message requesting a response.

Note – Before returning the TrimTrac Pro, be sure to save the TrimTrac Pro's configuration settings, and remove your SIM unless otherwise requested by Trimble.

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 Pro is configured and operating correctly. Do the following:

1. Check to see if the Destination Address or GPRS Set-up parameters are programmed correctly.
2. Verify the Server Application software is sending messages to the correct SIM MSISDN and using the correct Unit ID, Security Password and, if required by the SIM card, the SIM PIN, or if using GPRS, that the correct parameters are being used.

TrimTrac Pro Not Reporting

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

1. **Configuration.** Always confirm whether the TrimTrac Pro 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 Pro 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 Pro message log and Report Sequence Numbers compared to those received by the server application. If there are missing or inconsistent Report Sequence Numbers at the server application vis-à-vis the messages logged within the TrimTrac Pro, then a problem associated with the GSM network is the likely culprit;

3. **Unsent Reports.** If the TrimTrac Pro 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 ('Tx') All Messages". (Note the Report Delay Flag has no effect on the sending of Alert messages);
4. **No Reports Generated.** The TrimTrac Pro 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 Motion 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 Pro 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 enabling 1Hz GPS (See Fix Rate on page 41). In so doing, the GPS receiver will continuously compute new position fixes until the GPS signal is lost. Then, if the TrimTrac Pro comes to rest after losing the GPS signal due to blockage, the TrimTrac Pro 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 Pro 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 Motion 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 Motion 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 Pro 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 36. 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 Pro when the Vehicle Adapter or Control Module is first inserted into the TrimTrac Pro.

Once the Medium Priority Alert is activated, the TrimTrac Pro 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 Pro 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 PRO TO IMMEDIATELY ACTIVATE A MEDIUM PRIORITY ALERT AND BEGIN TRANSMITTING NOMINALLY EVERY 2-3 MINUTES UNTIL AN ACKNOWLEDGEMENT IS RECEIVED.

Low and Medium Priority Alerts not being Reported

Lower level alerts will not be recognized if any higher priority switches are not in their normal physical positions. For instance, if a High Priority Alert switch is closed (which is not its “normal” condition), then subsequent changes in Medium and Low Priority Alert switches will not be reported or acted upon. Once all

higher priority alert switches are returned to their normal physical positions, then lower priority events will be reported in accordance with how the device and alerts are otherwise configured.

Verify Checksums when Analyzing Data

An easy way to analyze data received from The TrimTrac Pro 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 Pro. 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 Pro.

Updating Firmware in the Field

You can upload new firmware from a PC or laptop connected to the Provisioning Module or by using the OTA Firmware Update Process described beginning page 193. 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 149. If you detect a problem, then have the TrimTrac Pro inspected by qualified service personnel.

Responding to Query or Set Data Messages

The TrimTrac Pro 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 Pro, 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.

The configuration of the TrimTrac Pro can be changed using over-the-air SET messages; however, if these messages are not formatted correctly (i.e. out of range parameter values are used), then the TrimTrac Pro will send a response but the response will contain the existing configuration parameter values.

Different network operators may also handle queued up SMS messages differently. For instance, if the TrimTrac Pro 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 Pro 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 21. Expected Reporting Frequencies on page 98, the frequency at which the TrimTrac Pro 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 Pro to compute a new position fix is inversely proportional to available GPS signal level. When the TrimTrac Pro 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 22. Warm Start TTFFs on page 99. 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.

TrimTrac Placement vs. Reporting Frequency

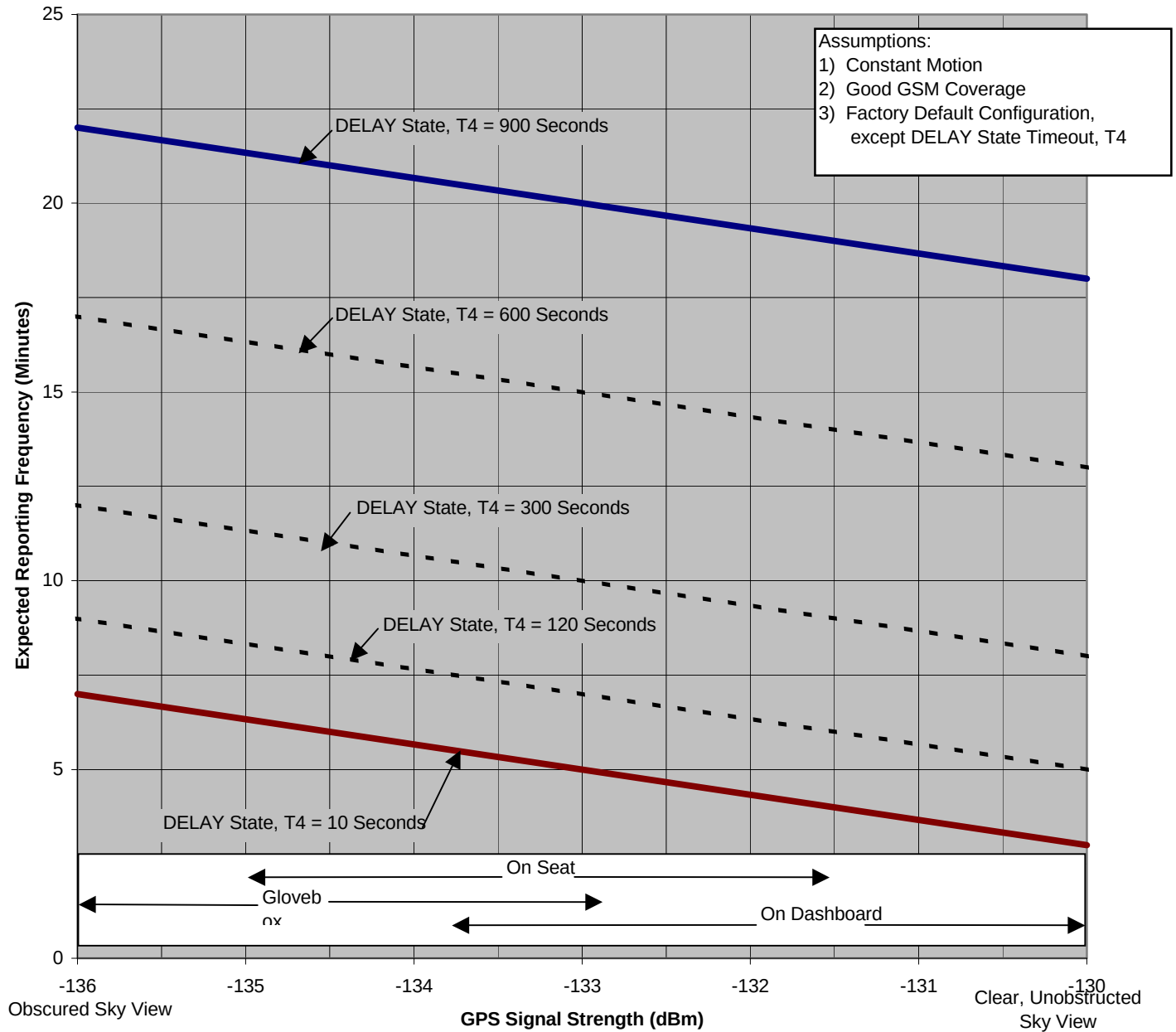


Figure 21. Expected Reporting Frequencies

Typical GPS Fix Times (Warm Start, 50%)

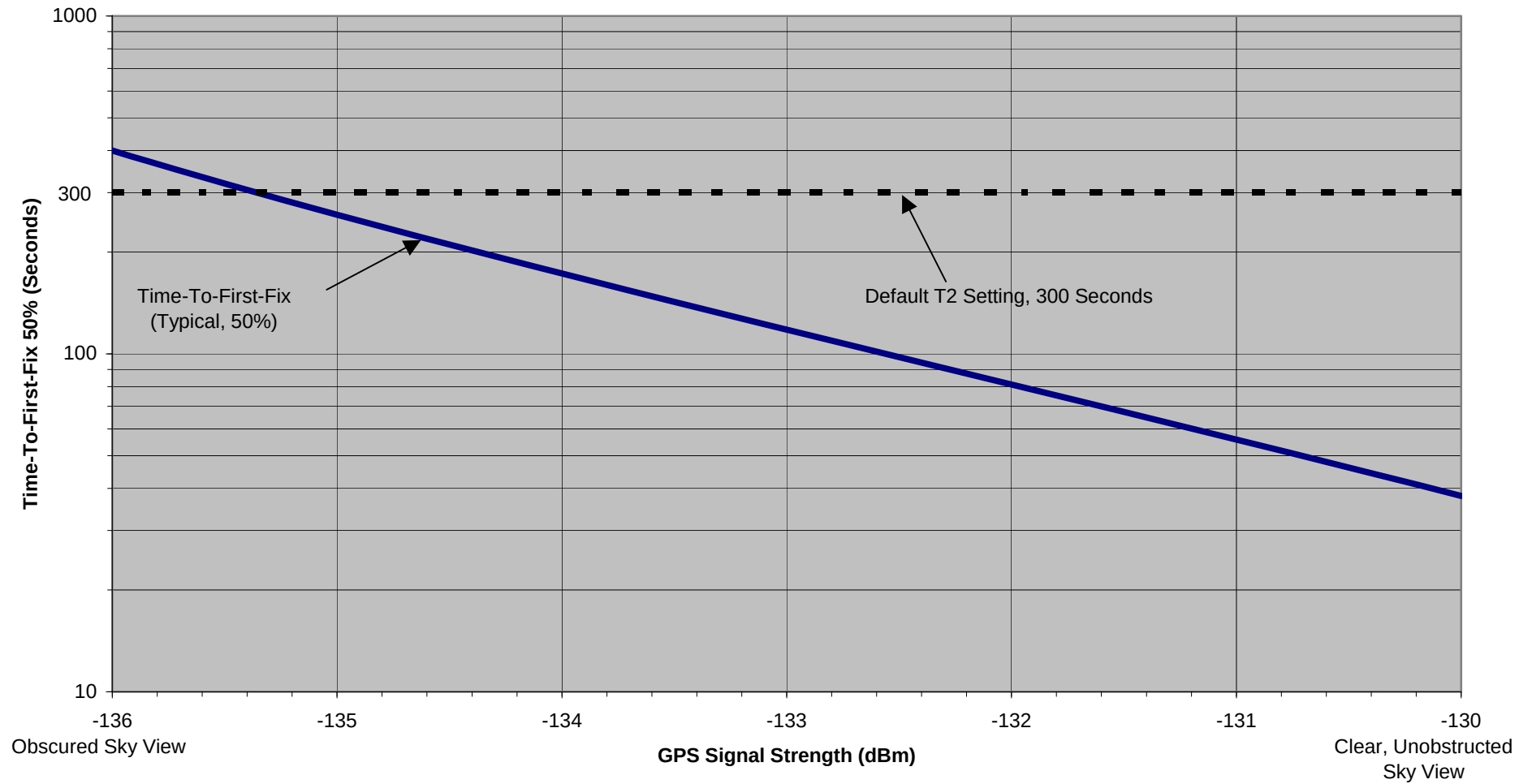


Figure 22. Warm Start TTFs

TrimTrac Basic State Machine

Introduction

In most applications, motion-based reporting is the fundamental operating premise of the TrimTrac Pro as shown in Figure 23. 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 Pro 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 Pro 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.

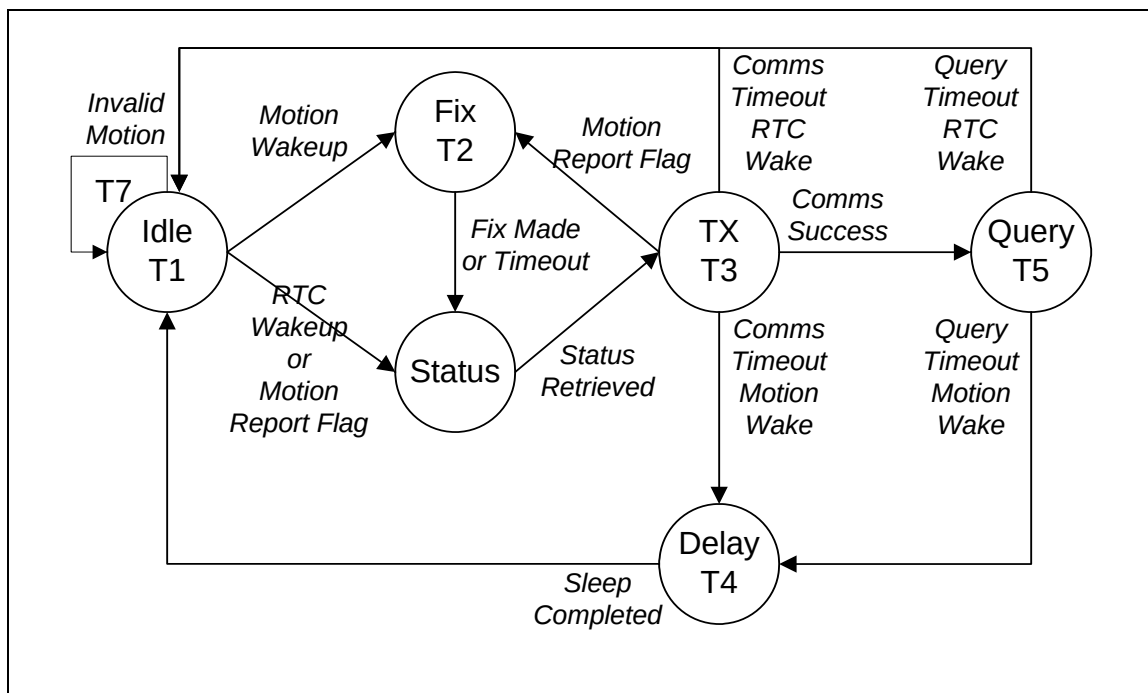


Figure 23. Summary TrimTrac Operational State Diagram

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 23 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 Pro 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 Pro transitions to the STATUS state. If no position fix is achieved prior to expiration of the FIX Timeout, T2, the TrimTrac Pro 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 Pro 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 Pro 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 Pro transitions to the QUERY state. If the transmission fails, the TrimTrac Pro 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 Pro can only receive and process Data messages sent from the server application while in the QUERY state; however, it can receive messages during 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 “1=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 Pro. The TrimTrac Pro 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. At its default setting, the Motion Counter Threshold must sense at least 10 instances of motion per second before motion in that second is recognized.

Next, the TrimTrac keeps track of how many seconds have exceeded the Motion Counter Threshold within a configurable sampling period. The length of the sample period is determined by Static Motion Filter Timeout, T7 and Dynamic Motion Filter Timeout, T21 depending upon whether the device is stationary or is in motion, respectively. Both the static and dynamic motion filters use a rolling time window during which it counts the number of seconds that motion occurred (Static Motion Filter Counter, N3, and Dynamic Motion Filter Counter, N4, respectively).

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, during any period determined by Dynamic Motion Filter Timeout, T21, then the device continues cycling through the State Machine.

State Machine Design Details

As seen in Figure 23 on page 100 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 Pro:

TriggerType; and
ReportType

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

0=IDLE Timeout
1=Motion Detected
2=Exception Report Alert
3=Query
4=Scheduled Report
5=Runtime/Engine Idling Meter Report
6=Start/Stop Report
7=Firmware Updated
8=Attempted LPA-based Geofence Center while no GPS

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 177 for complete details.

Please note that the TrimTrac Pro 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 or are messages attached to STATUS_MSG and REPORT_POS messages that identify, for instance which geofence has been most recently violated or runtime meter or engine idling reports.

A Position Age flag is set depending upon whether motion has been detected or if the ignition has been on 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 Pro, the device is able to monitor and report on High, Medium and Low priority inputs as shown in Figure 36. Vehicle Adapter Module Alert Wiring Diagram, on page 233. 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
5=Change-of-State to Normal

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 alert conditions have been returned to normal and the associated alerts have been either cleared to “0=Normal” or set “3=Acknowledged”; in which case, the status of lower priority 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 lower priority alerts will not in and by themselves result in new message transmissions.

When a VAM or Control Module equipped TrimTrac Pro 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 Pro 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 Pro has also received a SET_ALERT_STATE message (See page 155) or if the particular alert mode has been set “3=Monitor-only” or “4=Change-of-State”.

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 Pro has received the appropriate SET_ALERT_STATE message or if the particular alert mode has been set “3=Monitor-only” or “4=Change-of-State”. This will help guard against an unauthorized person disabling the TrimTrac Pro or the Vehicle Adapter or Control Module inputs. Alerts whose modes are set to “3=Monitor-only” or “4=Change-of-State” 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 and, in the case of alerts configured for change-of-state reporting, the device has logged a message with an alert status set “5=Change-of-State to Normal”.

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 Pro 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” or “4=Change-of-State”, 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”. If the alert mode has been configured as “4=Change-of-State”, then correcting whatever condition that triggered the original alert will cause the alert status to be set to “5=Change-of-State back to Normal” before being set back to “0=Normal”.

Examples of how the Alert Status flags are set based upon the different Input Modes is shown in Table 32. Sample Alert Status Message Coding on page 107.

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 associated alert messages. The underlying alert monitoring software can only be



reset or cleared by sending the device the appropriate SET_ALERT_STATE message.

ALERT STATUS MESSAGE CODING BASED UPON SWITCH POSITION AND MODE SETTING

Switch Position		Activated										
		Normal								Normal		
Time-->												
Report Seq. No.->		0064	0065	0066	0067	0068	0069	006A	006B	006C	006D	006E
Input Mode ^D	0=Automatic	0	0	0	1	2 ^A	2	2	2	2	3 ^B	0 ^C
	1=Ignore	0	0	0	0	0	0	0	0	0	0	0
	2=Network Ack	0	0	0	1	3 ^A	3	3	3	3	3	0 ^C
	3=Monitor-only	0	0	0	4	4	4	4	4	0	0	0
	4=Change-of-State	0	0	0	1	3 ^A	3	3	3	5	0	0

Alert Status indication in RTKP and RTKS Messages

Notes:

^A Requires GSM Status Code being set "0=Transmitted" in previous Report

^B Requires "Acknowledgement" message (>STKL...) from Server

^C Requires "Clear" Message (>STKL...) from Server

^D See AT+CTKY and >STKY

Table 32. Sample Alert Status Message Coding

IDLE State

The IDLE State is where 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 always checks if motion has been detected since the device last exited the FIX State plus, depending upon its current configuration, whether:

- Ignition is ON (requires Ignition Sense); or
- GPS velocity greater than GPS Velocity Move Qualifier threshold.

If any of the foregoing are true, 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 none of the conditions set forth above are true, the TrimTrac Pro 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 Pro will transition to the STATUS state (bypassing the FIX state).
 - If motion is detected while in the IDLE state, the TrimTrac Pro 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 ignition sense is turned on, 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 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=Exception Report 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 Pro 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 Report 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.
- If either of the Runtime meters have a threshold set to some value other than “0 hours” and the accumulated runtime hours reach 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=Tx Start/Stop, IDLE Status & Exception Reports” 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=Exception Report 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=Exception Report 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=Exception Report 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 settings in effect. In TrimTrac Pro, 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 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 Pro 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 1Hz GPS is enabled (See Fix Rate on page 41); in which case, the GPS receiver will remain powered and operational.

4. If Bit-3 of Advanced Reporting Options is set to “Fixed GPS Interval” and 1Hz GPS is enabled (See Fix Rate on page 41), FIX Timeout, T2, is limited to 3 Seconds if the GPS receiver was powered up prior to entering the current FIX State.

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 Pro 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 Pro 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 Pro 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 Pro will:

1. Power up the GSM hardware (if not already operational due to Polling being enabled);
2. Start the TRANSMIT Timeout, T3 (LED Blink: Short ON, Long OFF);
3. Attempt to 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, per the Automatic Message Log Dump sequence.

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

1. The GSM protocol stack confirms successful transmission of queued TrimTrac Pro messages; OR
2. The TrimTrac Pro 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 Pro messages; OR
3. Expiration of TRANSMIT Timeout, T3.

Upon occurrence of any of the foregoing, the TrimTrac Pro 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 Pro has made Status Message Transmit Attempts, N2, before the GSM protocol stack has confirmed successful transmission of queued TrimTrac Pro 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 Pro messages, other than a Motion Report, succeeded.
4. To the DELAY state if the TriggerType is set “1=Motion Detected”, ignition sense is on, or GPS velocity being greater than the GPS Velocity Move Qualifier threshold and:
 - a. The TrimTrac Pro 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 Pro 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 Pro messages.

Alert Processing in TRANSMIT State

Should HPA Status become set “1=Activated” during the current TRANSMIT state, the TrimTrac Pro 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 24 through Figure 27.

HPA Processing in TRANSMIT

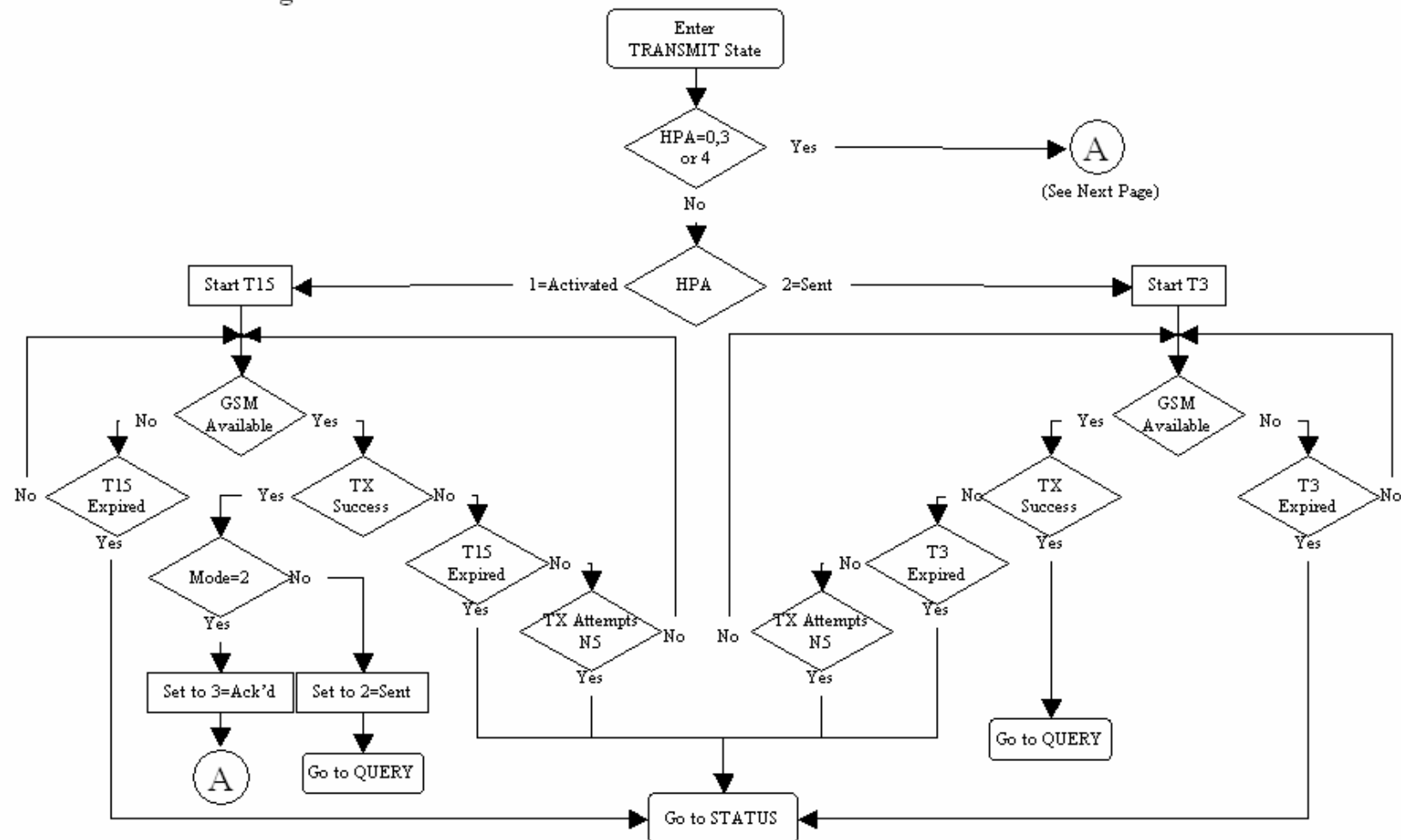


Figure 24. HPA Processing in TRANSMIT

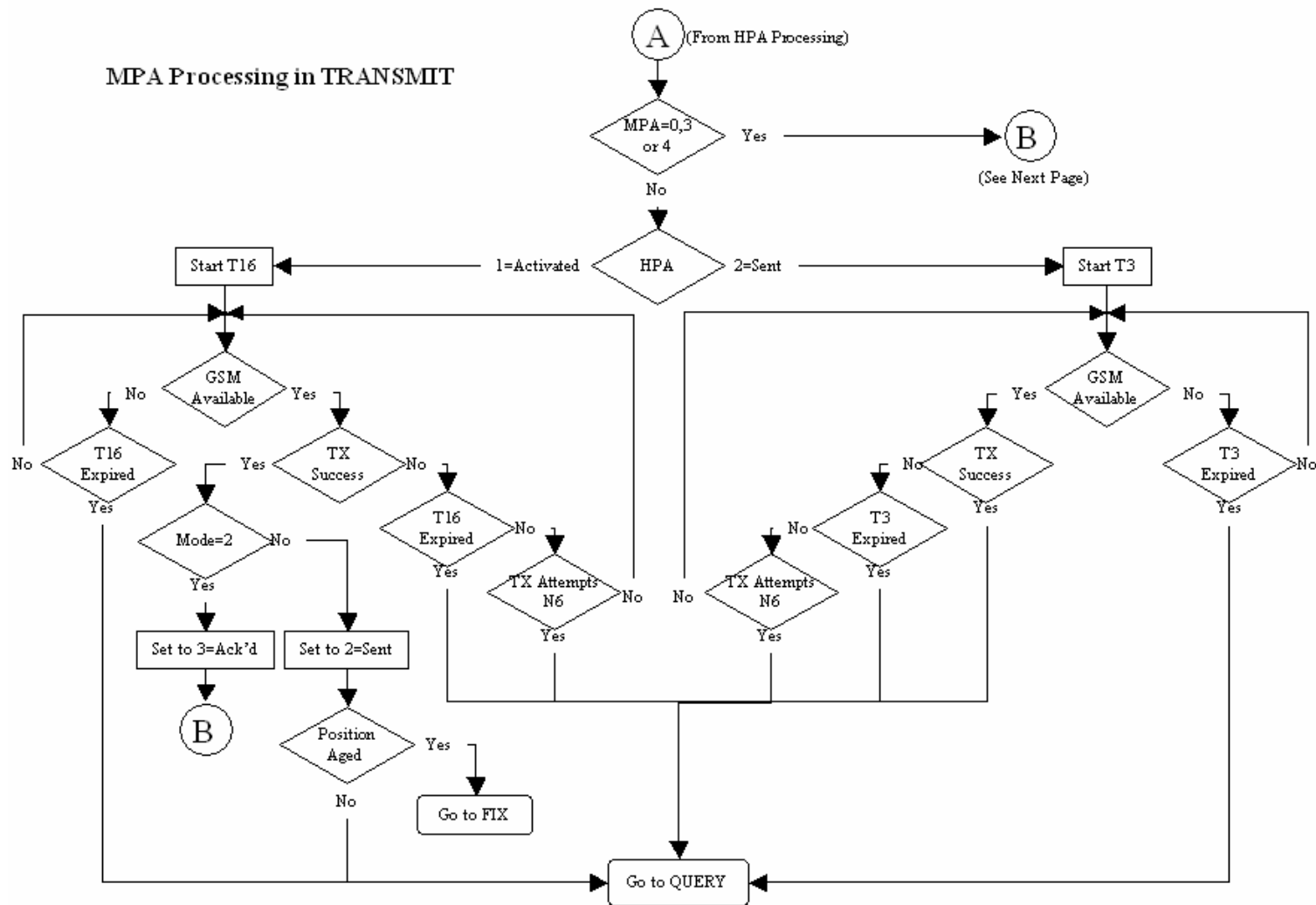


Figure 25. MPA Processing in TRANSMIT (Assuming HPA Switch in Normal Position)

Message Processing with no “Activated” or “Sent” Alerts

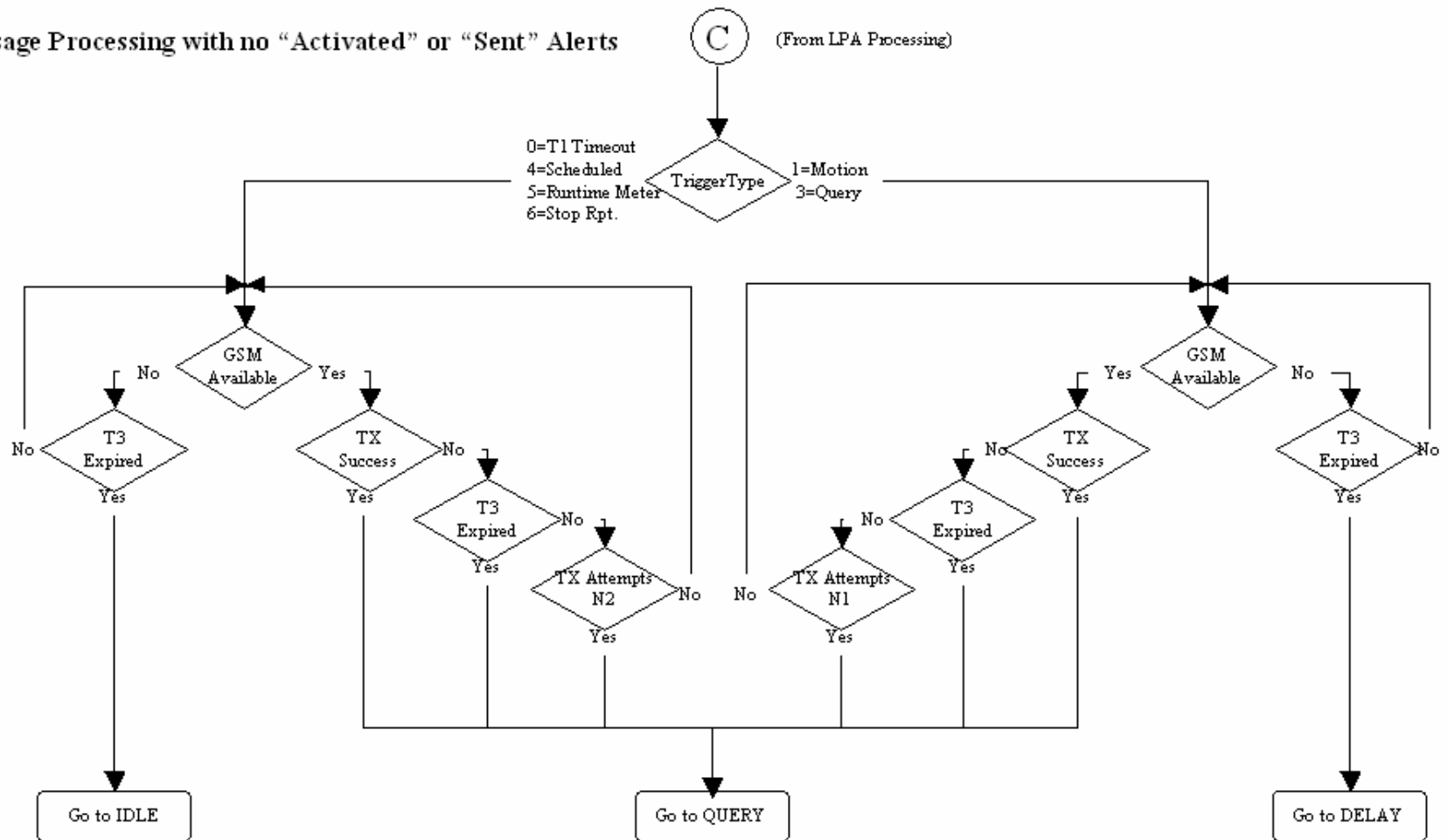


Figure 27. Other Message Processing in TRANSMIT

QUERY State

The QUERY State is where the TrimTrac Pro 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 Pro 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 Pro 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 Pro will continue to send the responses and accept new queries. (Note: If a SET_ALERT message clearing activated alerts to normal is received, but the monitored devices or conditions have not yet been returned 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 Pro 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 Pro transitions to the IDLE state.
7. If Query Hold Flag is set “1=Enabled”, the TrimTrac Pro 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.

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 Pro 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 Pro 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 Report Mode is set “1=Enabled”.
 - b. To the QUERY state upon receipt of a data message if In-Motion Polling is set “1=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 Motion 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.

Whenever an Alert Mode is set “0=Automatic”, an alert is processed as follows:

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 Pro
9. TrimTrac Pro changes the cleared alerts back to “normal” and resumes its normal operation.

NOTE: IF A CLEAR MESSAGE IS SENT TO THE TRIMTRAC PRO 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 PRO

Priority and Status-Levels

The TrimTrac Pro 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 six status-levels at any given time:

- 0=Normal
- 1=Activated
- 2=Sent
- 3=Acknowledged
- 4=Monitor Activated
- 5=Change-of-State back to Normal

Operation of the TrimTrac Pro 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 36. Vehicle Adapter Module Alert Wiring Diagram on page 100 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 Pro is in any of its operational states (See Figure 23. Summary TrimTrac Operational State Diagram). How the TrimTrac Pro 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 Priority switch or device changes from its normal condition for 200 mSeconds or more, or in the case of a Medium Priority alert, upon loss of external power or the switch being open for 30 or more seconds, the associated alert is set to “1=Activated”. 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 Pro has successfully transmitted the associated message to the GSM network. Depending on the priority of the alert, the TrimTrac Pro 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 Pro 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 Pro will continue transmitting the alert messages until it receives back from the server application an appropriately configured SET_ALERT_STATE message (See 155), at which time, the alert status can be set “3=Acknowledged”.

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.

Finally, all changes-of-state of lower priority alerts will be masked whenever higher priority switches are not in their “normal” positions.

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 Pro 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 Pro.

Please see Table 33, High Priority Alert Processing on page 126. Also, Figure 24. HPA Processing in TRANSMIT, on page 114 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 Pro 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. annunciators operating).

If a High Priority Alert switch is closed, then operation of the Medium Priority Alert switch will be ignored until all High Priority Alert switches are returned to their normal positions..

Please see Table 34, Medium Priority Alert Processing (Assuming HPA switches in normal position) on page 127. Also, Figure 25. MPA Processing in TRANSMIT, on page 115 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 36. 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 Pro would sense this motion and commence transmitting an alert message until acknowledged or cleared by the server application.

If a High Priority Alert switch is closed or a Medium Priority Alert switch is open, then operation of the Low Priority Alert switch will be ignored until all higher priority switches are returned to their normal positions. This is particularly important to note whenever the LPA input is used for either runtime meter or engine idling reporting. While either the High or Medium Priority Alert switches are in their non-normal position, the runtime and engine idling meters will continue accumulating or non accumulating time depending upon their status at the time either the High or Medium Priority Alert switches last changed from their normal positions.

Please see Table 35, Low Priority Alert Processing. (Assuming HPA and MPA conditions normal) on page 128. Also, Figure 26. LPA Processing in TRANSMIT, on page 116 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 Pro 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 Pro 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 Pro 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 device generates a new STATUS_MESSAGE in which the TriggerType is set "2=Exception Report 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 33, High Priority Alert Processing

Medium Priority Alert (MPA) Flag	Position Age	
	"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 device generates a new STATUS_MESSAGE in which the TriggerType is set "2=Exception Report 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: - 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 - 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 - 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: - The GSM protocol stack confirms a MPA Report containing a new position fix is successfully sent; OR - 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 34, Medium Priority Alert Processing (Assuming HPA switches in normal position)

Low Priority Alert (LPA) Flag	Position Age	
	"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 device generates a new STATUS_MESSAGE in which the TriggerType is set "2=Exception Report 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 35, Low Priority Alert Processing. (Assuming HPA and MPA conditions normal)

TrimTrac Pro Configuration

Introduction

Configuration is the process of setting the operational and communication parameters of the TrimTrac Pro. Except for the SIM PIN, 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. The SIM PIN, can only be entered or changed when the TrimTrac Pro is connected to a PC via a Provisioning Module.

Personnel without prior configuration or provisioning experience should familiarize themselves with the TrimTrac Pro operation and application characteristics as more fully described in the TrimTrac Basic State Machine chapter beginning on page 100.

Provisioning Mode and Equipment

Before a new TrimTrac Pro 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 Pro, it is best to have the laptop connected to AC power. Alternately, if you must use a battery-powered laptop to configure the TrimTrac Pro, it is best to first insert the Provisioning Module into the TrimTrac Pro 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 Pro 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 Pro, 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 Pro 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 Pro.



Figure 28. TrimTrac Pro with Modules Removed.

2. If an active SIM card is available, insert it into the base unit SIM cardholder. Note: The TrimTrac Pro can still be configured and provisioned even if a SIM is not available. It can be inserted at a later time if so desired.



Figure 29. Open SIM Card Holder.



Figure 30. Properly Latched SIM Card Holder.

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



Figure 31. Properly Inserted Provisioning Module.



Figure 32. Provisioning Module Improperly Inserted. Upper Tab not Latched Properly.

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.)



Figure 33. TrimTrac Pro Connected to PC via Provisioning Module and USB A-to-A Cable.

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 Pro 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=43200,300,300,900,60,168,20,0,0,1,0

OK

8. You are now ready to begin provisioning the TrimTrac Pro(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 PRO 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 Pros need to be configured, then you can send the units text files with the desired settings rather than typing individual AT commands. To configure HyperTerminal to send text files to the TrimTrac Pro, 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 Pro via HyperTerminal when connected to the Provisioning Module.

Command	Description	See Page
AT+CTKC	Assigns Application parameters	137
AT+CTKC?	Queries Application parameters	
AT+CTKE	Restores Factory Defaults and/or Erases Message Log	138
AT+CTEL?	Queries Error Message Log	138
AT+CTKF	Assigns GPRS Connection parameters	139
AT+CTKF?	Queries GPRS Connection parameters	
AT+GSN	Queries IMEI Number (via Service Mode)	139
AT+CTKJ	Assigns GPRS Setup parameters	139
AT+CTKJ?	Queries GPRS Setup parameters	
AT+CTKG	Assigns GPS parameters	140
AT+CTKG?	Queries GPS parameters	
AT+CTKK	Assigns Geofence parameters	140
AT+CTKK?	Queries Geofence parameters	
AT+CTKP	Assigns SMS Communication parameters	142
AT+CTKM	See AT+GSN	139
AT+CTKP	Assigns SMS Communication parameters	142
AT+CTKP?	Queries SMS Communication parameters	
AT+CTKX	Assigns Extended Application parameters	143
AT+CTKX?	Queries Extended Application parameters	
AT+CTKY	Assign Vehicle Adapter and Control Module parameters	145
AT+CTKY?	Queries Vehicle Adapter and Control Module parameters	
AT+CTKZ	Assigns Extended 2 Application parameters	146
AT+CTKZ?	Queries Extended 2 Application parameters	
AT+CTK0?	Retrieves Logged Messages	142
ATI	Queries Firmware Version	147

Table 36, Summary of AT Commands

AT+CTKC Application Configuration

The AT+CTKC command is used to configure the Basic Read/Write parameters of the TrimTrac Pro. Use AT+CTKC? to query the device for current settings.

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 (300 – 3600). Default 300
<DELAY Timeout, T4>	In seconds (10 – 86400). Default 900
<QUERY Timeout, T5>	In seconds (4 – 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 Motion 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=Start Motion Report 2=Stop Motion Report 3= Start & Stop Motion Reports. Default 0
<Report Delay Flag>	0=Transmit (“Tx”) All Messages 1=Tx Exception Reports & Query/Set Responses only 2=Tx Motion-related, Exceptions & Responses 3=Tx IDLE Timeout, T1, Status Msgs, Exceptions & Responses 4=Tx Start/Stop, IDLE Status, Exceptions & Responses 5=Tx every 6th motion-triggered message, Exceptions & Responses 6=Tx every 11th motion-triggered message, Exceptions & Responses 7=Tx Start/Stop, Exception & Responses (No IDLE Status). Default 0
<Diagnostics Mode>	0= None; 1= LED. Default 1
<Communication Mode>	0= SMS; 1= GPRS; 2=AutoSelect. Default 0

Table 37, AT+CTKC Assignment

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

AT+CTEL? Query Error Log Command

The AT+CTEL? command retrieves the error message log from the TrimTrac Pro device.

at+ctel?
APP Error Logs:
0 Records read from error logs
GPS Error Logs:
0 Records read from GPS error logs
OK

Table 38, AT+CTEL? Query Error Log Command

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 Pro device. After a slight pause (5-10 seconds), the RDY response will appear. Wait for RDY to appear before executing additional commands. It is important to execute the AT+CTKE=1 or 3 after upgrading from pre-v3.08 firmware to v3.08 or later firmware.

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

Table 39, 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. Use AT+CTKF? to query the device for current settings.

AT+CTKF=<GPRS Transport Protocol>,<GPRS Session Protocol>,<TrimTrac Session Keep-alive Timeout, T25>,<GPRS Session Timeout, T26>,<GPRS Destination Address> OK	
<GPRS Transport Protocol>	0=UDP (TrimTrac Session Protocol mandatory); 1=TCP. Default: 1
<GPRS Session Protocol>	0=None; 1=TrimTrac Session Protocol (See Separate ICD Document, v3.08). Default: 0
<TrimTrac Session Keep-alive Timeout, T25>	In Seconds (0=Never; 1–43200). Default: 300
<GPRS Session Timeout, T26>	In Seconds (0=Never; 1–43200). 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 40, AT+CTKF Assignment

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

AT+GSN Query IMEI Number

The AT+GSN command returns the device IMEI number; however, the device must first be put into a special service mode using the AT+CTKM=1 command. After a slight pause, the “AT-Command Interpreter ready” response will appear. Then type AT+GSN to obtain the IMEI number (note double characters will appear). The device needs to be put back into normal operational mode using the AT+CTKM=0 command after the IMEI number is obtained.

at+ctkm=1 OK AT-Command Interpreter ready aatt++ggssnn 011074000001992 OK aatt+c+cttkkmm==00	
<Service Mode>	0=Operational Mode; 1=Service Mode

Table 41, AT+GSN Query IMEI Number Command

AT+CTKJ GPRS Setup Provisioning

The AT+CTKJ command configures the GPRS setup provisioning parameters. All fields must be enclosed with quotations . All GPRS setup provisioning parameters are provided by the GPRS service provider. Use AT+CTKJ? to query the device for current settings.

AT+CTKJ=<GPRS APN>,<GPRS Username>,<GPRS Password> OK	
<GPRS APN>	Access Point Name (APN) Web address up to 40 case sensitive alphanumeric characters as assigned by GPRS network operator. 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 42, AT+CTKJ Assignment

Default: AT+CTKJ=”,”,”

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. Unless you are very familiar with the types of parameters listed below and how changes will effect overall GPS performance in any given application environment, it is recommended that you leave these parameters at their factory default settings. Use AT+CTKG? to query the device for current settings.

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 (1 – 80). Default 10
<GPS Dynamics Mode>	(Do Not Change); Default 5

Table 43, AT+CTKG Assignment

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

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. Use AT+CTKK? to query the device for current settings.

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 through 10. Default: 1
<Geofence Enforcement >	0=Disabled; 1=Enforced; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default: 0
<Geofence Schedule>	0=24/7; 1=After Scheduled Hours; 2= During Scheduled Hours. (See Scheduled Hours Mode). 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 44, AT+CTKK Assignment

Default: AT+CTKK=1x,0,0,1,1,”+0.0000000”,”+0.0000000”

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 45, AT+CTKO? 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 Pro. 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

The AT+CTKP command configures the SMS Communication, identification and security parameters, such as the SMS Destination Address, SIM PIN, Unit ID and Security Password. This command is the only method to change the SIM PIN. Use AT+CTKP? to query the device for current settings. 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 46, AT+CTKP Assignment

Default: AT+CTKP=“00000000”,”,”, “00000000”

SIM PIN and Security Password fields are masked out when queried.

AT+CTKX Extended Application Configuration

The AT+CTKX command is used to configure the enhanced Basic Read/Write parameters of the TrimTrac Pro. Use AT+CTKX? to query the device for current settings.

AT+CTKX=<Scheduled Report 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 Motion Filter Timeout, T21>,<Dynamic Motion Filter Counter, N4>,<Motion Sensor Override> OK	
<Scheduled Report 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 Report 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. See “Polling” section on page 54. 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, 10-999990). 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 Pro. 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. Set to 1 if Communication Mode set “1=GPRS-only”. 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 Motion 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 Motion 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 Motion Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Motion 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 47, AT+CTKX Assignment

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

AT+CTKY Module-only Application Configuration

The AT+CTKY command configures the application parameters specific to the Vehicle Adapter or Control Module. Use AT+CTKY? to query the device for current settings.

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) If not set 0-Infinity, should be set no lower than 300 Seconds. Default 300
<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; 4=Change-of-State. Default 0
<MPA Mode>	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only; 4=Change-of-State. 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); 4=Change-of-State. Default 0

Table 48, AT+CTKY Assignment

Default: AT+CTKY=10,10,10,10,0,300,60,0,0,0,0,1,0

AT+CTKZ Daily Hours, Runtime & Other Extended Settings

The AT+CTKZ command configures the Scheduled Hours Mode, Runtime Meter and other operation parameters as defined below. Use AT+CTKZ? to query the device for current settings.

AT+CTKZ=<Motion Counter Threshold>,<Scheduled Hours Mode>,<Scheduled Hours Daily Start Time, T27>,<Scheduled Hours Work Day Length, T28>,<Scheduled Hours First Weekly Work Day>,<Scheduled Hours Work Days per Week>,<Runtime Motion-based>,<Runtime LPA-based>,<Runtime Motion-based Countdown, T29>,<Runtime LPA-based Countdown, T30>,<Automatic Message Log Dump>,<GPS Fix Rate>,<LPA Input Arming Delay, T31>,<Geofence Type>,<Speed Enforcement>,<Speeding Report Mode>,<Speeding Countdown Timer, T31>,<Advanced Reporting Options>,<Ignition Sense Override>,<Engine Idling Threshold, T32>,<Engine Idling Reporting>,<Speeding Threshold Timer, T33>,<GPS Velocity Move Qualifier>,<Stop Report Countdown Timer, T34> OK	
<Motion Counter Threshold >	Counter (1-2000). Default: 10
<Scheduled Hours Mode>	0=Disabled; 1=Enabled. Default: 0
<Scheduled Hours Daily Start Time, T27>	In Seconds (0 – 86399) after 12:00AM UTC.. Default: 0
<Scheduled Hours Work Day Length, T28>	In Seconds (0 – 86400). Default: 43200
<Scheduled Hours First Weekly Work Day >	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC). Default: 1
<Scheduled Hours 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 Motion-based >	0=Disabled; 1=Enabled. Default: 0
<Runtime LPA-based>	0=Disabled; 1=Enabled. Default: 0
<Runtime Motion-based Countdown, T29>	In Hours (0=No Countdown, 1-990). Default: 0
<Runtime LPA-based Countdown, T30>	In Hours (0=No Countdown, 1-990). Default: 0
<Automatic Message Log Dump>	0=Disabled; 1=Tx Current, then Logged FIFO; 2= All FIFO. Default: 0
<GPS Fix Rate>	0=GPS operation during FIX State only; 1=1Hz GPS, except GPS off in IDLE; 2=Same as 1 plus position in all messages, if available; 3=Same as 2 plus GPS Velocity Move Qualifier. Default: 0
<LPA Input Arming Delay, T31>	In Seconds (0-990). Default: 0
<Geofence Type>	0=Boundary Crossing; 1=Inclusive; 2=Exclusive. Default 1
<Speed Enforcement>	0=No Enforcement; 1-990 = Limit in MPH. Default: 0.
<Speeding Report Mode >	0=Report All Violations; 1=Report Initial Violations Only. Default: 0
<Speeding Countdown Timer, T31>	In Seconds (0-99990). Default: 0

T31>	
<Advanced Reporting Options>	16-bit Field ranging from 0x0 to 0xFFF: Bit-0 = Replace Altitude with Odometer in RTKP Bit-1 = Include most recent RTKP with RTKS Bit-2 = Report Geofence Change-of-State Bit-3 = Fixed GPS Interval Default: 0000
<Ignition Sense Override>	0=No Ignition Sense; 1=HPA Closed; 2=LPA Closed; 3= LPA Open. Requires VAM or Control Module. Default 0
<Engine Idling Threshold, T32>	In Seconds (0=Disabled, 1-9990). Requires Ignition Sense Override. Default 0
<Speeding Threshold Timer, T33>	In Seconds (0=10 Second Default, 10-9990). Default 0
<GPS Velocity Move Qualifier>	In Miles per Hour (0-90 MPH). Note: Threshold speed used for Engine Idling, Odometer and Move Qualification. Default 3
<Stop Report Countdown Timer, T34>	In Seconds (0-9990). Requires 1 Hz GPS. Default 0

Table 49, AT+CTKZ Assignment

Default: AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,0,0,1,0,0,0,0000,0,0,0,3,0

ATI Retrieve Firmware Version Command

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

<pre> ati Trimble Navigation Ltd TrimTrac (tm) Revision: {message} OK </pre>
--

Table 50, ATI Query

TrimTrac Pro Defaults

Introduction

Factory default settings of the TrimTrac Pro are listed in Table 98 through Table 102, beginning on page 201. 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.

With the exception of the SIM PIN, all 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. The SIM PIN can only be entered or changed using the Provisioning Module. Please refer to the TrimTrac Basic State Machine chapter beginning on page 100 for detailed descriptions of each TrimTrac state.

The TrimTrac Pro 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 Pro and send that almanac to other TrimTrac Pro units; or
2. The TrimTrac Pro 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 to be collected from the GPS satellites, it is important that when the TrimTrac Pro 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 Pro 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 Pro. 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 Pro do not match the incoming message, then those messages are ignored with no response forthcoming from the TrimTrac Pro.

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 Pro 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 108, Read-only Parameters on page 218 includes operational parameters that are changed as a part of the normal operation of the TrimTrac Pro. Sending a TrimTrac Application message to the TrimTrac Pro via the GSM network can change all these values. Using these messages the server application can change the functionality of the TrimTrac Pro. 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 Pro will blink at different rates depending on the TrimTrac Pro's operational state. If the TrimTrac Pro is powered off the LED is off. Once the battery charge drops to 10% or below, the LED turns red remains on in all states except the DELAY State when the LED is turned off. Please see Table 51 for a full description of LED blink rates.

TrimTrac State	Blink Rate (Green except as noted)	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, RED	Low Battery (either AA alkaline batteries or Vehicle Adapter or Control Module standby battery).

Table 51, Diagnostic LED Blink Rates

TrimTrac Application Protocol

Introduction

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

The TrimTrac Pro 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 Pro are used. It is used to communicate with and control TrimTrac Pros that have already been provisioned and deployed to the field.

For security reasons, the SIM PIN cannot be changed over-the-air using TrimTrac Application Protocol messages.

To minimize the number of data messages sent to the TrimTrac Pro, 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 Pro may similarly include more than one response in a single SMS. See QUERY_POSITION on page 173 and Aggregate Log Reporting Flag in QUERY_LOG on page 171 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 Pro 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)
C	Data string.
PPPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLYDefault 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 52, 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 Pro)
S	Set or configure parameters (sent to TrimTrac Pro)
R	Response to a query or a scheduled or autonomous report (from the TrimTrac Pro)

Table 53, 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 Pro. The default Security Password is set to “00000000”; however, the TrimTrac Pro may be assigned any UPPERCASE alphanumeric password of up to eight characters while the TrimTrac Pro is connected to a Provisioning Module.

The TrimTrac Pro 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 Pro does not match the Security Password configured in the TrimTrac Pro, then the message is ignored.

Unit ID

The Unit ID must be used in all communications with the TrimTrac Pro. The TrimTrac Pro may be assigned an UPPERCASE alphanumeric Unit ID of eight characters using the appropriate over-the-air command or while the TrimTrac Pro is connected to a Provisioning Module (available separately). The default Unit ID is set to 00000000.

The TrimTrac Pro 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 Pro does not match the Unit ID configured in the TrimTrac Pro, 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 54, 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 54, Sample XOR Checksum Source Code

Configuration Messages

The following messages are sent to the TrimTrac Pro 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 Pro to acknowledge or clear alert states; provided, however, that the TrimTrac Pro is connected to a Vehicle Adapter or Control Module. When received the TrimTrac Pro will send a RESP_ALERT_STATE (page 180) 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=PPPPPPP;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
PPPPPPP	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_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 Pro. When received the TrimTrac Pro will send a RESP_APP_CONFIG (page 180) message in response.

>STKABBBBBBCCCCCDDDDDEEEEEEEEEFFFFFGGGTTHIJK;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 (300 – 3600). Default 300
EEEEEE	DELAY Timeout, T4. In seconds (10 – 86400). Default 900
FFFFFF	QUERY Timeout, T5. In seconds (4 – 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 Motion 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=Start Motion Report 2=Stop Motion Report 3= Start & Stop Motion Reports. Default 0
I	Report Delay Flag. 0=Transmit (“Tx”) All Messages 1=Tx Exception Reports & Query/Set Responses only 2=Tx Motion-related, Exceptions & Responses 3=Tx IDLE Timeout, T1, Status Msgs, Exceptions & Responses 4=Tx Start/Stop, IDLE Status, Exceptions & Responses 5=Tx every 6th motion-triggered message, Exceptions & Responses 6=Tx every 11th motion-triggered message, Exceptions & Responses 7=Tx Start/Stop, Exception & Responses (No IDLE Status). Default 0
J	Diagnostics Mode. 0= None; 1= LED. Default 1
K	Communication Mode. 0= SMS; 1= GPRS; 2=AutoSelect. Default 0
PPPPPPP	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_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 (page 181) message.

>STKABCDXXXXXXXXXXXXXXX;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 ONLYDefault 00000000
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 57, SET_CONTROL_OUTPUT Message

SET_EXT_APP_CONFIG

This message is used to set the Extended Application parameters in the TrimTrac Pro. When received the TrimTrac Pro will send a RESP_EXT_APP_CONFIG (page 182) message in response.

>STKABCCCCCDEFFFFFFFGGGGGGHIJJJKKLLMMNNO;PW=PPPPPPPP;ID=YYYYYYYY; *ZZ<	
A	TrimTrac Configuration Set: ‘X’ = Extended Application Parameters
B	Scheduled Report Mode. 0=None; 1=Daily; 2=Weekly. Default 0
CCCCC	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 Report 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. See “Polling” section on page 54. 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.
GGGGG	Polling Duty-Cycle On-Time, T20. In Seconds (0, 10-999990). 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 Pro. 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. Set to 1 if Communication Mode set "1=GPRS-only". 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 Motion 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 Motion 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 Motion Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Motion Filter Timeout, T21; else the unit may not exit QUERY state.. Default 10.
0	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.
PPPPPPP	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_EXT_APP_CONFIG Message

SET_EXT2_APP_CONFIG

This message is used to set the Extended 2 Application parameters in the TrimTrac Pro. When received the TrimTrac Pro will send a RESP_EXT2_APP_CONFIG (page 184) message in response.

>STKABBBBCDDDDDEEEEEEFGHIJJJJKKKLMNNNOQQRRSSSSSTTTTUVVVVWXXXXYYZZZZ;PW=PPPPPPP;ID=YYYYYYY;*ZZ<	
A	TrimTrac Pro Configuration Set: 'Z' = Extended 2 Application Parameters
BBBB	Motion Counter Threshold: Counter (1-2000). Default 10
C	Scheduled Hours Mode: 0=Disabled; 1=Enabled. Default 0
DDDD	Scheduled Hours Daily Start Time, T27: In Seconds (0 – 86399) after 12:00AM UTC.. Default 0
EEEE	Scheduled Hours Work Day Length, T28: In Seconds (0 – 86400). Default 43200
F	Scheduled Hours First Weekly Work Day: 0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC). Default 1
G	Scheduled Hours 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 Motion-based: 0=Disabled; 1=Enabled. Default 0.
I	Runtime LPA-based: 0=Disabled; 1=Enabled. Default 0
JJJ	Runtime Motion-based Countdown, T29: In Hours (0=No Countdown, 1-990). Default 0
KKK	Runtime LPA-based Countdown, T30: In Hours (0=No Countdown, 1-990). Default 0
L	Automatic Message Log Dump: 0=Disabled; 1=Tx Current, then Logged FIFO; 2= All FIFO. Default 0
M	GPS Fix Rate: 0=GPS operation during FIX State only; 1=1Hz GPS, except GPS off in IDLE; 2=Same as 1 plus position in all messages, if available; 3=Same as 2 plus GPS Velocity Move Qualifier. Default 0
NNN	LPA Input Arming Delay, T31: In Seconds (0-990). Default 0
0	Geofence Type: 0=Boundary Crossing; 1=Inclusive; 2=Exclusive
QQQ	Speed Enforcement: 0=No Enforcement; 1-990 = Limit in MPH. Default 0.
R	Speeding Report Mode: 0=Report All Violations; 1=Report Initial Violations Only. Default 0.
SSSS	Speeding Countdown Timer, T31: In Seconds (0-99990). Default 0.
TTTT	Advanced Reporting Options. 16-bit Field ranging from 0x0 to 0xFFF: Bit-0 = Replace Altitude with Odometer in RTKP Bit-1 = Include most recent RTKP with RTKS

	Bit-2 = Report Geofence Change-of-State Bit-3 = Fixed GPS Interval. Default: 0000
U	Ignition Sense Override. 0=No Ignition Sense; 1=HPA Closed; 2=LPA Closed; 3= LPA Open. Requires VAM or Control Module. Default 0.
VVVV	Engine Idling Threshold, T32. In Seconds (0=Disabled, 1-9990). Requires Ignition Sense Override. Default 0.
W	Engine Idling Reporting. 0=Disabled; 1=End of Idling, No Reset; 2=End of Idling and Reset; 3=Threshold and End of Idling, No Reset; 4=Threshold and End of Idling with Reset. Default 0.
XXXX	Speeding Threshold Timer, T33. In Seconds (0=10 Second Default, 10-9990) Default 0.
YY	GPS Velocity Move Qualifier. In Miles per Hour (0-90 MPH). Note: Threshold speed used for Engine Idling, Odometer and Move Qualification. Default 3.
ZZZZ	Stop Report Countdown Timer, T34. In Seconds (0-9990). Requires 1 Hz GPS. 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 59, SET_EXT2_APP_CONFIG Message

SET_GEOFENCE_CONFIG

This message is used to set up a Geofence in the TrimTrac Pro device. When received the TrimTrac Pro device will send a RESP_GEOFENCE_CONFIG (page 185) 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 (page 160) or AT+CTKZ (page 146).

>STKABBCDEEEEEFFFFFFGGGHHHHHHIIIIJJJJJJJ;PW=PPPPPPP;ID=YYYYYYYY; *ZZ<	
A	TrimTrac Pro Configuration Set: 'K' = Geofence Parameters
BB	Geofence ID: Unique geofence identifier: 1 through 10.
C	Geofence Enforcement: 0=Disabled; 1=Enforced; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default 0
D	Geofence Schedule: 0=24/7; 1=After Scheduled Hours; 2=During Scheduled Hours. (See Scheduled Hours Mode). Default: 0
EEEE	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.
FFFF	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 JJJ	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
PPPPPPP	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, SET_GEOFENCE_CONFIG Message

SET GPRS CONNECT CONFIG

This message is used to set the GPRS Connection Configuration Values in the TrimTrac Pro device. When received the TrimTrac Pro device will send a RESP_GPRS_CONNECT_CONFIG (page 187) message in response.

>STKABCDDEEEFFFFFFF";PW=PPPPPPP;ID=YYYYYYY; *ZZ<	
A	TrimTrac Pro Configuration Set: 'F' = GPRS Communication Configuration Parameters.
B	GPRS Transport Protocol: 0=UDP (TrimTrac Session Protocol mandatory); 1=TCP. Default 1
C	GPRS Session Protocol: 0=None; 1=TrimTrac Session Protocol (See Separate ICD Document, v3.08). Default 0
DDDD	TrimTrac Session Keep-alive Timeout, T25: In Seconds (0=Never; 1–43200). Default: 300
EEEE	GPRS Session Timeout, T26: In Seconds (0=Never; 1–43200). Default 0
FFFFFFF FFFFFFF 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
PPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
YYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 61, SET_GPRS_CONNECT_CONFIG Message

SET_GPRS_SETUP_CONFIG

This message is used to set the GPRS Setup Configuration Values in the TrimTrac Pro device. All GPRS setup provisioning parameters are provided by the GPRS service provider. When received the TrimTrac Pro device will send a RESP_GPRS_SETUP_CONFIG (page 187) message in response.

>STKABBB"CCCCCCCC CC"DDDDDDDDDDDDDDDDDDDDDD" ;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Pro 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 as assigned by GPRS network operator. 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 62, 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 Pro. When received the TrimTrac Pro will send a RESP_GPS_CONFIG (page 165) 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.

>STKABBBCCCDDDEEEF;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 (1 – 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 63, SET_GPS_CONFIG Message

SET_IDENTITY

This message is sent by the server to change the TrimTrac Pro Unit ID and Security Password. Requires v3.08 or later firmware.

>STKABBBBBBBBBCCCCCCC;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always 'I': Indicates a set Unit ID and Security Password message.
BBBB BBBB	NEW Unit ID: Always 8 alphanumeric characters, UPPER CASE ONLY
CCCC CCCC	NEW Security Password: Always 8 alphanumeric characters, UPPER CASE ONLY
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, SET_IDENTITY 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 Pro will send a RESP_MODULE_APP_CONFIG (page 189) message in response.

>STKABBBBBBCCCCCDDDDDEEEEEFFFFFFFGGGGGGHHHHHHIIJJJKKKLMN;PW=PPPPPPP;ID=YYYYYYY;*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) If not set 0-Infinity, should be set no lower than 300 Seconds. Default 300
HHHHHH	HPA Query Timeout, T17. In Seconds (10-3600). Default 60
IIII	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; 4=Change-of-State. Default 0
M	MPA Mode. 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only; 4=Change-of-State. 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); 4=Change-of-State. 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 65, SET_MODULE_CONFIG Message

SET_OTA_FIRMWARE

This message is used by the server to start or stop the OTA firmware per the OTA Firmware Update Process described on page 193. Once the OTA firmware upgrade is completed or otherwise terminated, the TrimTrac Pro will send a RESP_OTA_FIRMWARE, page 191, message in response. Note, the OTA firmware process can only be started and completed while communicating via GPRS.

>STKABFFFFFFFCCCCCCCCDDDDDDDDDDDDDDDD"EE";PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always "T": Indicates a set OTA Firmware command
B	OTA Firmware Upgrade Command: 0=Stop; 1=Start
FFFFFFF	OTA File Size: Always 8 Digits: 00000000=Not Used; Else as Provided by Trimble
CCCCCCCC	OTA File Checksum: Always 8 Characters: FFFFFFFF=Not Used; Else as Provided by Trimble
D...D (up to 15 Char.)	OTA TFTP IP Address: IP address of TFTP server in the following format: 111.222.333.444. The quote (") must be used to terminate this numeric field regardless of number of digits used. TFTP server must be on Port 69.
E...E (up to 40 Char.)	OTA TFTP Filename: Provided by Trimble. The quote (") must be used to terminate this text field regardless of number of characters used.
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 66, SET_OTA_FIRMWARE Message

SET_PROV_CONFIG

The SET_PROV_CONFIG message is used by the server application to set the SMS Communication values in the TrimTrac Pro. When received by the TrimTrac Pro, the unit will send a RESP_PROV_CONFIG (page 189) message in response.

>STKABBBBBBBBBBBBBBBBBBBBBBBB;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Configuration Set: 'V' = Provisioning Parameters
BBBBBB BBBBBB	SMS Destination Address. 24 characters including optional international dialing "+" sign and country code for SMS messages.

BBBBBB BBBBBB	Field padding in SPACES (not 0's) before the international dialing “+” sign. Default <Empty>.
PPPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLYDefault 00000000
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 67, SET_PROV_CONFIG Message

Query Messages

QUERY_CONFIG

This QUERY_CONFIG message is used by the server application to request the TrimTrac Pro send its TrimTrac Application, GPS or Communication parameters in the appropriate response message as indicated below.

>QTKA;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Configuration Set: (Response Message) ‘A’ = Application Parameters (RTKA page 180) ‘F’ = GPRS Connection Parameters (RTKF page 186) ‘G’ = GPS Parameters (RTKG page 187) ‘J’ = GPRS Setup Parameters (RTKJ page 187) ‘V’ = Provisioning Parameters (RTKP page 189) ‘X’ = Extended Application Para. (RTKX page 180) ‘Y’ = Module Application Para. (RTKY page 189) ‘Z’ = Extended 2 Application Para. (RTKZ page 184)
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 68, QUERY_CONFIG Message

QUERY_CONTROL_OUTPUT

This message is sent by the server to request the current state of the Control Module Outputs. TrimTrac Pro responds by sending RESP_CONTROL_OUTPUT (page **Error! Bookmark not defined.**) message.

>QTKA;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 69, QUERY_CONTROL_OUTPUT Message

QUERY_GEOFENCE_CONFIG

This QUERY_GEOFENCE_CONFIG message is used by the server application to request the TrimTrac Pro send its geofence parameters in the appropriate RESP_GEOFENCE_CONFIG (page 185) message.

>QTKABB;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Configuration Set: 'K' = Geofence Parameters
BB	Geofence ID: Unique geofence identifier: 1 through 10. 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 70, QUERY_CONFIG Message

QUERY_CONTROL_OUTPUT

This message is sent by the server to request the current state of the Control Module Outputs. TrimTrac Pro responds by sending RESP_CONTROL_OUTPUT (page 181) message.

>QTKA;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 71, QUERY_CONTROL_OUTPUT Message

QUERY_GEOFENCE_CONFIG

This QUERY_GEOFENCE_CONFIG message is used by the server application to request the TrimTrac Pro send its geofence parameters in the appropriate RESP_GEOFENCE_CONFIG (page 185) message.

>QTKABB;PW=PPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Configuration Set: 'K' = Geofence Parameters
BB	Geofence ID: Unique geofence identifier: 1 through 10. Use lead 0.
PPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLY Default 00000000
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 72, QUERY_GEOFENCE_CONFIG Message

QUERY_IDENTITY

This message is sent by the server to query the current TrimTrac Pro Unit ID and Security Password. Requires v3.08 or later firmware.

>QTKA;PW=PPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always 'I': Indicates a query Unit ID and Security Password message.
PPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 73, QUERY_IDENTITY 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 Pro 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 Pro 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, may result in the transmission of all 1,024 logged messages.

>QTKABBBBCCCC[DE[FGHIJJJK[LLLLMMMMMM[NNNN000000]]];PW=PPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always 'R': Indicates a query for old REPORT messages
BBBB	Beginning Report Sequence Number. 16-bit Hex (0000-FFFF) incrementing by 1 for each logged report.

CCCC	Ending Report 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.
000000	GPS seconds into week of ending date. 'Most recent' if not present.

Table 74, 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. TrimTrac Pro responds by sending a RESP_METERS (page 188) message.

>QTKABC;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always 'M': Indicates a query runtime meters message.
B	Runtime Motion-based Query: 0=Report Only (No Reset); 1=Report with Reset
C	Runtime 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.
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Table 75, QUERY_METERS Message

QUERY_METERS2

This message is sent by the server to request the current state of the Odometer and Engine Idling Meter (See SET_EXT2_APP_CONFIG for Odometer and Engine Idling meter setup instructions). The Odometer and Engine Idling Meter can also be individually reset via this message. TrimTrac Pro responds by sending a RESP_METERS2 message (page 189).

>QTKABC;PW=PPPPPPPP;ID=YYYYYYYY; *ZZ<	
A	Always ‘N’: Indicates a query Odometer and Engine Idling Meter message.
B	Odometer Query 0=Report Only (No Reset); 1=Report with Reset
C	Engine Idling 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 76, QUERY_METERS2 Message

QUERY_OTA_FIRMWARE

This message is sent by the server to request the current state of the OTA Firmware Update Process described on page 193. Upon receipt of this QUERY_OTA_FIRMWARE message, the TrimTrac Pro will send a RESP_OTA_FIRMWARE , page 191, message in response..

>QTKA;PW=PPPPPPPP;ID=YYYYYYYY; *ZZ<	
A	Always ‘T’: Indicates a query OTA Firmware 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 77, QUERY_OTA_FIRMWARE Message

QUERY_POSITION

This message is used to command the TrimTrac Pro to report either its current or its most recently logged position depending upon how the Position Query Mode is set in the QUERY_POSITION message as shown in Figure 34 on page175.



More specifically, the unit will compute and report a NEW position fix when queried if and only if the Position Query Mode is set:

1. “P=Compute New Position Fix”, **OR**
2. “S=Compute if Position Aged” **AND** there has been motion since the device last exited the FIX State (i.e. Position Age has become set “1=Aged”).

If either of the foregoing settings and conditions are true and the device was able to compute a new position fix as requested, then the unit will respond to the QUERY_POSITION message by computing a new position fix and sending it in a new REPORT_POS message (with TriggerType set to “3=Query”).

If the TrimTrac Pro was unable to compute a new position fix prior to expiration of the GPS Fix Timeout specified in the QUERY_POSITION message, then a new STATUS_MSG and the most recently logged REPORT_POS messages will be sent in response. This new STATUS_MSG will have the TriggerType set “3=Query”, GPS Status Code set to some value other than "0=3D Fix, 1=2D Fix or 7=No Fix Attempted" and the Position Age flag will be set “1=Aged”. No other position information will be provided with the response.

If either of the foregoing settings and conditions are true, or if Position Query Mode is set “L=Status Report with Last Logged Position”, the unit will send a

Response to QUERY_POSITION

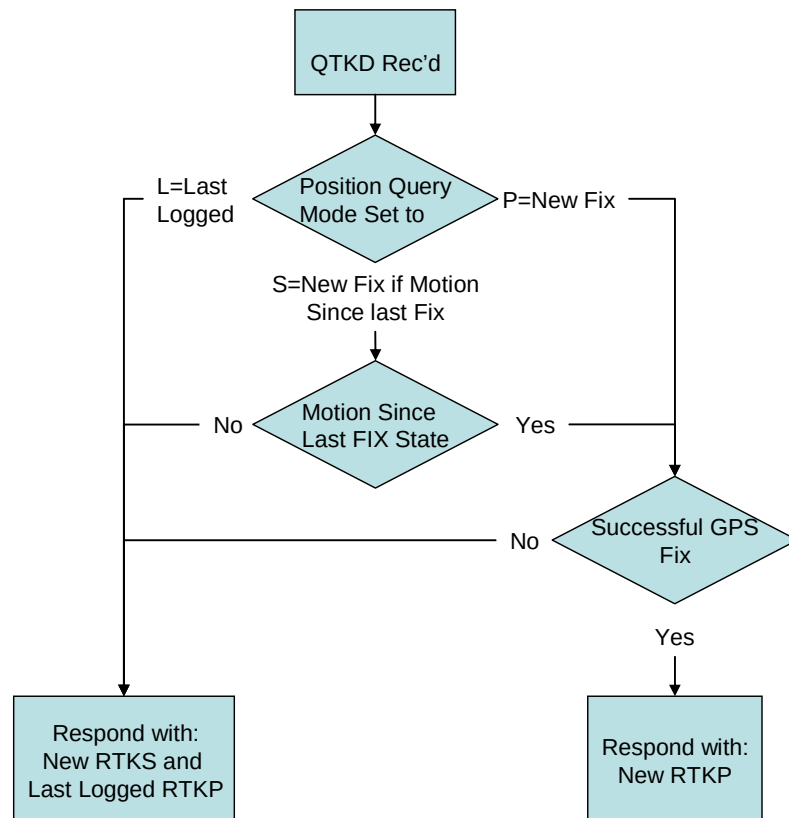


Figure 34. QUERY_POSITION Response Flowchart

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 Position Query Mode set “L=Status Report with Last Logged Position”; OR
2. QUERY_POSITION has the Position Query 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 Position Query 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 Position Query 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=PPPPPPP;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.
PPPPPPP	Security Password. Always 8 alphanumeric characters, UPPER CASE ONLY. Default 00000000
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 78, QUERY_POSITION Message

Position and Status 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.

>RTKABBBBCDDDEFFFFGGGGGGSTVOPQRWXabU[HHHHIIIIIIJJJJKKKKKKKKLLLLLLMMMNNN];ID=YYYYYYYY;*ZZ<	
A	TrimTrac Report Type: 'P' = Position Report 'S' = Status Report
BBBB	Report Sequence Number. 16-bit Hex (0000-FFFF) incrementing by 1 for each logged report.
C	TriggerType 0=IDLE Timeout 1=Motion Detected 2=Exception Report Alert 3=Query 4=Scheduled Report 5=Runtime/Engine Idling Meter Report 6=Start/Stop Report 7=Firmware Updated 8=Attempted LPA-based Geofence Center while no GPS
DDD	Battery Level. 0-100%, 999%=Low Voltage Cut-out.
E	Battery Changed Flag. T=True; F=False
FFFF	GPS Time Week. Always 4 Digits
GGGGGG	GPS Time Seconds. 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) 6=Modem Initialization Failure 7=GPRS Opening Failure 8=TCP Connection Failure

	9=Session Protocol Failure
V	Position Age: 0=Current (no motion since last position) 1=Aged (motion since last position)
O	HPA Status: 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal
P	MPA Status: 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal
Q	LPA Status: 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal
R	External Power: 0=Bad (Below 5 VDC); 1=Good (5 VDC or higher)
W	Geofence Status: 0=Normal; 1=Violation; 5= Geofence Re-centered by LPA Input
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
a	Speeding Status: 0=Normal; 1=Violation
b	Scheduled Hours Flag: 0=Normal; 1=Violation
U	Reserved for future use
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.
	Optional (Provided only if Position Report)
HHH.IIIIII I	Latitude. WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = North and '-' = South. (-90.0000000 to +90.0000000)
JJJJ.KKKKK KK	Longitude. WGS-84 Coordinates. Units of Degrees to 7 decimal places plus '+' sign = East and '-' = West. (-180.0000000 to +180.0000000)
LLLLLL	Altitude [Odometer]. Altitude in Feet with sign (-99999 to +99999) [Odometer in tenths of Miles without sign (000000 to 999999 in >RTKP, 0000000000 to 9999999999 in >RTKN)]
MMM	Speed. Miles Per Hour. Always 3 Digits.
NNN	Heading. Relative to True North, increasing Easterly. Units of Degrees. Always 3 Digits. (000-359).

Table 79, 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.

Response Messages

The following messages are sent in response to Set or Query messages received by the TrimTrac Pro.

RESP_ALERT_STATE

The TrimTrac Pro sends this message after a SET_ALERT_STATE (page 155) request is received and processed; provided, however, that the TrimTrac Pro 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; 5=Change-of-State to Normal
C	MPA Status. 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal
D	LPA Status. 0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 80, RESP_ALERT_STATE Message

RESP_APP_CONFIG

This is the response message to the SET_APP_CONFIG (page 156) and QUERY_CONFIG (page 169) messages containing the Application Parameter values.

>RTKABBBBBBCCCCCDDDDDEEEEEFFFFFFFGGGTTHIJKLLLLMMMMMNP P; 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 (300 – 3600)
EEEEEE	DELAY Timeout, T4. In seconds (10 – 86400)
FFFFFF	QUERY Timeout, T5. In seconds (4 – 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 Motion 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=Start Motion Report 2=Stop Motion Report 3= Start & Stop Motion Reports
I	Report Delay Flag. 0=Transmit (“Tx”) All Messages 1=Tx Exception Reports & Query/Set Responses only 2=Tx Motion-related, Exceptions & Responses 3=Tx IDLE Timeout, T1, Status Msgs, Exceptions & Responses 4=Tx Start/Stop, IDLE Status, Exceptions & Responses 5=Tx every 6th motion-triggered message, Exceptions & Responses 6=Tx every 11th motion-triggered message, Exceptions & Responses 7=Tx Start/Stop, Exception & Responses (No IDLE Status)
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 81, RESP_APP_CONFIG Message

RESP_CONTROL_OUTPUT

This is the by the TrimTrac Pro in response to the SET_CONTROL_OUTPUT (page 157)or QUERY_CONTROL_OUTPUT (page 170) messages.

>RTKABCDXXXXXXXXXXXXXXXXXX; ID=YYYYYYYY; *ZZ<	
A	Always ‘U’: Indicates a set Control Module output message.
B	Output 1 Status: 0=Output Low; 1=Output High; 2=No Change (STKU-only); 3=No Module Attached
C	Output 2 Status: 0=Output Low; 1=Output High; 2=No Change (STKU-only); 3=No Module Attached
XXXXXXXXXX XXXXXXXXXX	Reserved for future use. Must be sent as ‘0000000000000000’.
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 82, RESP_CONTROL_OUTPUT Message

RESP_EXT_APP_CONFIG

This is the response message to the SET_EXT_APP_CONFIG (page 158) and QUERY_CONFIG (page 169) message containing the Extended Application Parameter values.

>RTKABCCCCCDEFFFFFFFGGGGGGHIJJJKKKLLMMNNO;ID=YYYYYYYYY; *ZZ<	
A	TrimTrac Configuration Set: 'X' = Extended Application Parameters
B	Scheduled Report Mode. 0=None; 1=Daily; 2=Weekly
CCCCC	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 Report 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. See "Polling" section on page 54. 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".
GGGGG	Polling Duty-Cycle On-Time, T20. In Seconds (0, 10-999990). 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 Pro.
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. Set to 1 if Communication Mode set "1=GPRS-only".
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 Motion 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 Motion 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 Motion Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Motion Filter Timeout, T21; else the unit may not exit QUERY state.. Default 10.
0	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 83, RESP_EXT_APP_CONFIG Message

RESP_EXT2_APP_CONFIG

This is the response message to the SET_EXT2_APP_CONFIG (page 160) and QUERY_CONFIG (page 169) message containing the Extended 2 Application Parameter values.

>STKABBBBCDDDDDEEEEFHGIJJJJKKKLMNNNOQQRRSSSSSTTTTUVVVVWXXXXYYZZZZaaaa;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Pro Configuration Set: 'Z' = Extended 2 Application Parameters
BBBB	Motion Counter Threshold: Counter (1-2000). Default 10
C	Scheduled Hours Mode: 0=Disabled; 1=Enabled. Default 0
DDDD	Scheduled Hours Daily Start Time, T27: In Seconds (0 – 86399) after 12:00AM UTC.. Default 0
EEEE	Scheduled Hours Work Day Length, T28: In Seconds (0 – 86400). Default 43200
F	Scheduled Hours First Weekly Work Day: 0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC). Default 1
G	Scheduled Hours 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 Motion-based: 0=Disabled; 1=Enabled. Default 0.
I	Runtime LPA-based: 0=Disabled; 1=Enabled. Default 0
JJJ	Runtime Motion-based Countdown, T29: In Hours (0=No Countdown, 1-990). Default 0
KKK	Runtime LPA-based Countdown, T30: In Hours (0=No Countdown, 1-990). Default 0
L	Automatic Message Log Dump: 0=Disabled; 1=Tx Current, then Logged FIFO; 2= All FIFO. Default 0
M	GPS Fix Rate: 0=GPS operation during FIX State only; 1=1Hz GPS, except GPS off in IDLE; 2=Same as 1 plus position in all messages, if available; 3=Same as 2 plus GPS Velocity Move Qualifier. Default 0
NNN	LPA Input Arming Delay, T31: In Seconds (0-990). Default 0
0	Geofence Type: 0=Boundary Crossing; 1=Inclusive; 2=Exclusive
QQQ	Speed Enforcement: 0=No Enforcement; 1-990 = Limit in MPH. Default 0.
R	Speeding Report Mode: 0=Report All Violations; 1=Report Initial Violations Only. Default 0.
SSSS	Speeding Countdown Timer, T31: In Seconds (0-99990). Default 0.
TTTT	Advanced Reporting Options. 16-bit Field ranging from 0x0 to 0xFFF: Bit-0 = Replace Altitude with Odometer in RTKP Bit-1 = Include most recent RTKP with RTKS

	Bit-2 = Report Geofence Change-of-State Bit-3 = Fixed GPS Interval. Default: 0000
U	Ignition Sense Override. 0=No Ignition Sense; 1=HPA Closed; 2=LPA Closed; 3= LPA Open. Requires VAM or Control Module. Default 0.
VVVV	Engine Idling Threshold, T32. In Seconds (0=Disabled, 1-9990). Requires Ignition Sense Override. Default 0.
W	Engine Idling Reporting. 0=Disabled; 1=End of Idling, No Reset; 2=End of Idling and Reset; 3=Threshold and End of Idling, No Reset; 4=Threshold and End of Idling with Reset. Default 0.
XXXX	Speeding Threshold Timer, T33. In Seconds (0=10 Second Default, 10-9990) Default 0.
YY	GPS Velocity Move Qualifier. In Miles per Hour (0-90 MPH). Note: Threshold speed used for Engine Idling, Odometer and Move Qualification. Default 3.
ZZZZ	Stop Report Countdown Timer, T34. In Seconds (0-9990). Requires 1 Hz GPS. 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 84, RESP_EXT2_APP_CONFIG Message

RESP_GEOFENCE_CONFIG

This is the response message to the SET_GEOFENCE_CONFIG (page 162) and QUERY_GEOFENCE_CONFIG (page 171) message containing the Geofence Parameter values. It is also sent with any REPORT_POS and STATUS_MSG having TriggerType set “2=Exception Report Alert” and Geofence Status set “1=Violation” or “5=New LPA-based Geofence”, except when some other new event, such as a Speed Violation, has triggered the REPORT_POS OR STATUS_MSG. The RESP_GEOFENCE_CONFIG message sent with either a REPORT_POS OR STATUS_MSG will be for the geofence most recently violated or boundary most recently crossed.

>RTKABBCDEEEEEFFFFGGGHHHHHHIIIIJJJJJJJ;ID=YYYYYYYY; *ZZ<	
A	TrimTrac Pro Configuration Set: ‘K’ = Geofence Parameters
BB	Geofence ID: Unique geofence identifier: 1 through 10.
C	Geofence Enforcement: 0=Disabled; 1=Enforced; 2=LPA Input Enforced; 3=LPA Centered and Enforced.. Default 0
D	Geofence Schedule: 0=24/7; 1=After Scheduled Hours; 2=During Scheduled Hours. (See Scheduled Hours Mode). Default: 0

EEEE	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.
FFFF	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 JJJ	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 85, RESP_GEOFENCE_CONFIG Message

RESP_GPRS_CONNECT_CONFIG

This is the response message to the SET_GPRS_CONNECT_CONFIG (page 163) and QUERY_CONFIG (page 186) message containing the GPRS Connection Parameter values.

>RTKABCDDEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEEE";ID=YYYYYYYY;*ZZ<	
A	TrimTrac Pro Configuration Set: ‘F’ = GPRS Communication Configuration Parameters.
B	GPRS Transport Protocol: 0=UDP (TrimTrac Session Protocol mandatory); 1=TCP. Default 1
C	GPRS Session Protocol: 0=None; 1=TrimTrac Session Protocol (See Separate ICD Document, v3.08). Default 0
DDDD	TrimTrac Session Keep-alive Timeout, T25: In Seconds (0=Never; 1 – 43200). Default: 300
EEEE	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
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 86, RESP_GPRS_CONNECT_CONFIG Message

RESP GPRS SETUP CONFIG

This is the response message to the SET_GPRS_SETUP_CONFIG (page 164) and QUERY_CONFIG (page 187) message containing the GPRS Setup Parameter values.

>RTKABBB"CC"DDDDDDDDDDDDDDDDDDDDDDDD";PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	TrimTrac Pro 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 as assigned by GPRS network operator. 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>
YYYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 87, RESP_GPRS_SETUP_CONFIG Message

RESP GPS CONFIG

This is the response message to the SET_GPS_CONFIG (page 165) and QUERY_CONFIG (page 187) message containing the GPS Configuration.

>RTKABCCDDDEEFF; 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 (1 – 80)
F	GPS Dynamics Mode. (Do Not Change)
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 88, RESP_GPS_CONFIG Message

RESP_IDENTITY

This message is sent by the device in response to a SET_IDENTITY message. Requires v3.08 or later firmware.

>RTKABBBBBBBBBCCCCCCCC;PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always 'I': Indicates a set Unit ID and Security Password message.
BBBB BBBB	NEW Unit ID: Always 8 alphanumeric characters, UPPER CASE ONLY
CCCC CCCC	NEW Security Password: Always 8 alphanumeric characters, UPPER CASE ONLY
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 89, RESP_IDENTITY Message

RESP_METERS

This is the response message to the QUERY_METERS (page 172) message. This message is also sent whenever either Runtime meter reaches its automatic report threshold, if so enabled. (See SET_EXT2_APP_CONFIG page 160 for runtime meter setup instructions).

>RTKABCD D D D D D D D D D D E E E E E E E E E E ; ID=YYYYYYYY;*ZZ<	
A	Always 'M': Indicates a response to a QUERY_METERS message.
B	Runtime Motion-based Reset Confirmation: 0=Report without Reset; 1=Report with Reset; 2=Disabled
C	Runtime LPA-based Reset Confirmation: 0=Report without Reset; 1=Report with Reset; 2=Disabled
DDDD DDDD	Runtime Motion-based Reading: Accumulated seconds since last reset, always 10 digits
EEEE EEEE	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 90, RESP_METERS Message

RESP METERS2

This is the response message to the QUERY_METERS2 (page 167). This message is also sent whenever either engine idling timer reaches its automatic report threshold or at the end of an idling period, if either are so enabled. (See SET_EXT2_APP_CONFIG page 160 for engine idling setup instructions).

>RTKABCDHDDDDDDDDDEEEEEEEEEEE; ID=YYYYYYYY; *ZZ<	
A	Always ‘N’: Indicates response to a QUERY_METERS2 message.
B	Error! Reference source not found. 24 characters including optional international dialing “+” sign and country code for SMS messages.
C	Error! Reference source not found. Always 8 alphanumeric characters, UPPER CASE ONLY
DDDDD DDDDD	Odometer Reading Accumulated 1/10ths of Miles since last reset
EEEE EEEE	Engine Idling Reading: Accumulated seconds since last reset, always 10 digits
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 91, RESP_METERS2 Message

RESP MODULE APP

This is the by the TrimTrac Pro in response to the SET_MODULE_APP_CONFIG (page 166) and QUERY_CONFIG (page 169) message.

>RTKABBBBCCCCDDDDDEEEEEFFFFFGGGGGHHHHHHIIJJJKKKLMN;ID=YY YYYYYY;*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) If not set 0-Infinity, should be set no lower than 300 Seconds
HHHHHH	HPA Query Timeout, T17. In Seconds (10-3600)
IIII	HPA Transmit Attempts, N5. 0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires
JJJJ	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; 4=Change-of-State
M	MPA Mode. 0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only; 4=Change-of-State. 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); 4=Change-of-State
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 92, RESP_MODULE_APP Message

RESP_OTA_FIRMWARE

This is the response message to either a SET_OTA_FIRMWARE or QUERY_OTA_FIRMWARE Message as part of the OTA Firmware Update Process described on page 193.

>RTKABFFFFFFFFCCCCCCCCDDDDDDDDDDDDDDDD"EE";PW=PPPPPPPP;ID=YYYYYYYY;*ZZ<	
A	Always "T": Indicates a response to either a SET_OTA_FIRMWARE or QUERY_OTA_FIRMWARE Message
B	OTA Firmware Upgrade Status: 0=Idle 1=Starting OTA Download 5=Download Error (TFTP Transfer) 6=Flash Storage Error 7=Image Checksum Error 8=Image Integrity Error 9=Image Decompression Error A=Successful OTA Reflash B=Incompatible Flash Device C=Reflash Error
FFFFFFF	OTA File Size: Always 8 Digits: 00000000=Not Used; Else as Provided by Trimble
CCCCCCCC	OTA File Checksum: Always 8 Characters: FFFFFFFF=Not Used; Else as Provided by Trimble
D...D (up to 15 Char.)	OTA TFTP IP Address: IP address of TFTP server in the following format: 111.222.333.444. The quote (") must be used to terminate this numeric field regardless of number of digits used. TFTP server must be on Port 69.
E...E (up to 40 Char.)	OTA TFTP Filename: Provided by Trimble. The quote (") must be used to terminate this text field regardless of number of characters used.
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 93, RESP_OTA_FIRMWARE Message

RESP_PROV_CONFIG

This is the response message to the SET_PROV_CONFIG (page 167) and QUERY_CONFIG (page 169) message containing the provisioning information.

>RTKABBBBBBBBBBBBBBBBBBBBBB; 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 94, RESP_PROV_CONFIG Message

RESP_QUERY_AGGR

The TrimTrac Pro sends this message after a QUERY_LOG (page 171) 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 95, RESP_QUERY_AGGR Message

RESP_QUERY_LOG

This message is sent after a QUERY_LOG (page 171) 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. If -001, then one or more QUERY_LOG parameters were set outside of allowed ranges.
YYYYYYYY	Unit ID. Always 8 alphanumeric characters, UPPER CASE ONLY
ZZ	Checksum.

Table 96, RESP_QUERY_LOG Message

OTA Firmware Update Process

Beginning with v3.08 firmware, the TrimTrac Pro can have its firmware updated over-the-air (OTA) via GPRS per the following procedure:

1. Obtain a new firmware image from Trimble, including file size and checksum information.
2. Load the new firmware image on a TFTP server (Not a “FTP” server).
3. Appropriately configure an SET_OTA_FIRMWARE message, including the IP address of the TFTP server on which the new firmware image was loaded and the filename (limited to 40 characters)
4. Send the SET_OTA_FIRMWARE message to the target TrimTrac Pro device via GPRS.
5. Upon receipt of the SET_OTA_FIRMWARE, the device will respond with an RTKT message indicating that it is starting the OTA firmware update process.
6. The TrimTrac Pro will then connect to the TFTP server and commence the downloading the new firmware image.
7. Once the new firmware image has been successfully downloaded to the TrimTrac Pro (RTKT B=?), the on-board boot manager will load the new firmware image into flash memory and, once completed successfully, the device will reset itself.
8. At the conclusion of the OTA process, the device will transmit the following messages:
 - a. If the OTA update process was successful, the device will transmit a RESP_OTA_FIRMWARE message with the OTA Firmware Upgrade Status set “A=OTA Reflash Successful” followed by a STATUS_MESSAGE message with a TriggerType set “7=Firmware Updated”
 - b. If the OTA update process was not successful, the device will transmit a RESP_OTA_FIRMWARE message in which the OTA Firmware Upgrade Status would be set to some value other than “A=OTA Reflash Successful” depending upon the type of error that had been encountered.

Depending upon the quality of the GPRS connection and actual data throughput, this OTA update process typically takes between 15 and 20 minutes.

Note that OTA firmware updates will not change current configuration settings of the device. If configuration settings changes are desired, then use the appropriate TrimTrac Protocol commands after updating the firmware.

You should avoid updating a large number of devices all at once, especially if all of the devices are reasonably expected to be connected to the same GSM base

station (i.e., in a confined geographic area). Even though the new firmware image is compressed, the image still represents a reasonably large amount of data. Downloading to many devices all at once could overload the local GSM base station or the connection to TFTP server itself.

The OTA firmware upgrade process cannot be used under any of the following conditions:

1. If the target TrimTrac Pro has pre-v3.08 firmware. (All units such units must first be reflashed using a Provisioning Module to v3.08 or later firmware before they can be subsequently reflashed OTA);
2. If the Communications Mode is set “0=SMS-only”;
3. If the device is outside of GPRS service coverage;
4. If the quality of the GPRS connection does not provide adequate data throughput; OR
5. If the device is not authorized to access available GPRS networks.

The TrimTrac Pro will stop the OTA firmware upgrade process during downloading upon receipt of a SET_OTA_FIRMWARE message in which the OTA Firmware Upgrade Command is set “0=Stop”.

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 <80 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 @ +40°C

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 x 38 mm
5.78" x 2.99" x 1.44"

Weight

205 grams (7.2 oz) not
including batteries

TrimTrac Part Numbers

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

Part Number	Description	
48274	TRIMTRAC CABLE USB 1M A TO A MALES RoHS	RoHS
53226	TRIMTRAC BRACKET METAL RoHS	RoHS
53227	TRIMTRAC BRACKET PLASTIC Non-RoHS	Non-RoHS
53227-05	TRIMTRAC BRACKET PLASTIC RoHS	RoHS
54206-00	TRIMTRAC COVER ASSY Non-RoHS	Non-RoHS
54206-05	TRIMTRAC COVER ASSY RoHS	RoHS
54207-00	TRIMTRAC AA HOLDER Non-RoHS	Non-RoHS
54207-05	TRIMTRAC AA HOLDER RoHS	RoHS
54208-00	TRIMTRAC VEHICLE ADAPTER Non-RoHS	Non-RoHS
54208-05	TRIMTRAC VEHICLE ADAPTER RoHS	RoHS
54209-00	TRIMTRAC PROVISIONING MODULE Non-RoHS	Non-RoHS
54209-05	TRIMTRAC PROVISIONING MODULE RoHS	RoHS
70200-00	TRIMTRAC PRO BASE WITH TRIMTRAC BADGE RoHS	RoHS
60210-00	TRIMTRAC PRO-1.5 CONTROL MODULE RoHS	RoHS
66237-50	TRIMTRAC PRO-1.5 EXTERNAL GPS ANTENNA RoHS	RoHS

Table 97, TrimTrac and TrimTrac Pro 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.	00000000	>STK(all) >QTK(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.	00000000	>STK(all) >QTK(all)	AT+CTKP

Table 98, 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	>STKG >QTKG >RTKG	AT+CTKG
GPS Signal Mask	In tenths of AMUs (1 – 80)	10		
GPS PDOP Mask	In tenths of PDOP (60 – 200)	120		
GPS PDOP Switch	In tenths of PDOP (40 – 120)	60		
GPS Dynamics Mode	(Do Not Change)	5		

Table 99, 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 (300 – 3600)	300		
DELAY Timeout, T4	In seconds (10 – 86400)	900		
QUERY Timeout, T5	In seconds (4 – 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 Motion 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=Start Motion Report 2=Stop Motion Report 3= Start & Stop Motion Reports	0		
Report Delay Flag	0=Transmit (“Tx”) All Messages 1=Tx Exception Reports & Query/Set Responses only 2=Tx Motion-related, Exceptions & Responses 3=Tx IDLE Timeout, T1, Status Msgs, Exceptions & Responses 4=Tx Start/Stop, IDLE Status, Exceptions & Responses 5=Tx every 6th motion-triggered message, Exceptions & Responses 6=Tx every 11th motion-triggered message, Exceptions & Responses 7=Tx Start/Stop, Exception & Responses (No IDLE Status)	0		
Diagnostics Mode	0= None; 1= LED	1		
Communication Mode	0= SMS; 1= GPRS; 2=AutoSelect	0		

Table 100, Basic State Machine Parameters, Messages and Command

Enhanced Feature Parameter Ranges and Default Settings

Parameter	Unit/Notes	Default	Messages	Commands
Scheduled Report 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 Report 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. See “Polling” section on page 54. 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, 10-999990). 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	>STKX >QTKX >RTKX	AT+CKTX
Reserved	0=Formerly “Extended Motion Detection” in TrimTrac 1.0 Not used in TrimTrac Pro.	0		
Position Report Transmit Attempts, N1	0=Until T3 Expires; 1-255=Number of Tx Attempts. Set to 1 if Communication Mode set “1=GPRS-only”	1		
Status Message Transmit Attempts, N2	0=Until T3 Expires; 1-255=Number of Tx Attempts. Set to 1 if Communication Mode set “1=GPRS-only”	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 Motion 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 Motion 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 Motion Filter Timeout, T21, is active. WARNING: Dynamic Motion Filter Counter, N4, must always be set equal to or less than the setting for Dynamic Motion 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 101, 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	>STKY >QKTY >RTKY	AT+CTKY
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) If not set 0-Infinity, should be set no lower than 300 Seconds.	300		
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		
HPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only; 4=Change-of-State	0		
MPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only; 4=Change-of-State. 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); 4=Change-of-State	0		



Table 102, 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 as assigned by GPRS network operator. 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>		
TrimTrac Session Keep-alive Timeout, T25	In Seconds (0=Never; 1 –43200) Note: Idle time before sending “Keep-alive” packet. Only TrimTrac Session Protocol is enabled.	300	>STKF >QTKF >RTKF	AT+CTKF
GPRS Session Protocol	0=None; 1=TrimTrac Session Protocol (See Separate ICD Document, v3.08)	0		
GPRS Transport Protocol	0=UDP (TrimTrac Session Protocol mandatory); 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 103, GPRS Communication Provisioning Read/Write Parameters.

Extended TrimTrac Pro 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 Mode	0=Disabled; 1=Enabled	0		
Scheduled Hours Daily Start Time, T27	In Seconds (0 – 86399) after 12:00AM UTC.	0		
Scheduled Hours Work Day Length, T28	In Seconds (0 – 86400) Note: Number of seconds worked each workday.	43200		
Scheduled Hours First Weekly Work Day	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC)	1		
Scheduled Hours 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	5		
Runtime Motion-based	0=Disabled; 1=Enabled	0		
Runtime LPA-based	0=Disabled; 1=Enabled	0		
Runtime Motion-based Countdown, T29	In Hours (0=No Countdown, 1-990)	0		
Runtime 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		
Speed Enforcement	0=No Enforcement; 1-990 = Limit in MPH	0		
Speeding Report Mode	0=Report All Violations; 1=Report Initial Violations Only	0		
Speeding Countdown Timer	In Seconds (0-99990)	0		

Table 104, Extended TrimTrac Pro Read/Write Parameters.

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 Mode	0=Disabled; 1=Enabled	0		
Scheduled Hours Daily Start Time, T27	In Seconds (0 – 86399) after 12:00AM UTC.	0		
Scheduled Hours Work Day Length, T28	In Seconds (0 – 86400) Note: Number of seconds worked each workday.	43200		
Scheduled Hours First Weekly Work Day	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC)	1		
Scheduled Hours 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	5		
Runtime Motion-based	0=Disabled; 1=Enabled	0		
Runtime LPA-based	0=Disabled; 1=Enabled	0		
Runtime Motion-based Countdown, T29	In Hours (0=No Countdown, 1-990)	0		
Runtime LPA-based Countdown, T30	In Hours (0=No Countdown, 1-990)	0		
Automatic Message Log Dump	0=Disabled; 1=Tx Current, then Logged FIFO; 2= All FIFO. Note: Causes previously unsent messages to be transmitted in the stated order upon re-entering GSM network coverage.	0		
GPS Fix Rate	0=GPS operation during FIX State only; 1=1Hz GPS, except GPS off in IDLE; 2=Same as 1 plus position in all messages, if available; 3=Same as 2 plus GPS Velocity Move Qualifier.	0		
LPA Input Arming Delay, T31	In Seconds (0-990). Number of seconds after initial contact closure before LPA becomes “Armed”.	0		
Speed Enforcement	0=No Enforcement; 1-990 = Limit in MPH	0		
Speeding Report Mode	0=Report All Violations; 1=Report Initial Violations Only	0		
Speeding Countdown Timer, T31	In Seconds (0-99990)	0		

Advanced Reporting Options	16-bit Field ranging from 0x0 to 0xFFF: Bit-0 = Replace Altitude with Odometer in RTKP Bit-1 = Include most recent RTKP with RTKS Bit-2 = Report Geofence Change-of-State Bit-3 = Fixed GPS Interval	0000	>STKZ >QTKZ >RTKZ	AT+CTKZ
Ignition Sense Override	0=No Ignition Sense; 1=HPA Closed; 2=LPA Closed; 3=LPA Open. Requires VAM or Control Module	0		
Engine Idling Threshold, T32	In Seconds (0=Disabled, 1-9990). Requires Ignition Sense Override	0		
Engine Idling Reporting	0=Disabled; 1=End of Idling, No Reset; 2=End of Idling and Reset; 3=Threshold and End of Idling, No Reset; 4=Threshold and End of Idling with Reset.	0		
Speeding Threshold Timer, T33	In Seconds (0=10 Second Default, 10-9990)	0		
GPS Velocity Move Qualifier	In Miles per Hour (0-90 MPH). Note: Threshold speed used for Engine Idling, Odometer and Move Qualification	3		
Stop Report Countdown Timer, T34	In Seconds (0-9990). Requires 1 Hz GPS.	0		

Table 105, Extended TrimTrac Pro Read/Write Parameters.

Geofence Settings:

Parameter	Unit/Notes	Default	Messages	Commands
Geofence ID	Unique geofence identifier: 1 through 10	1	>STKK >QTKK >RTKK	AT+CTKK
Geofence Enforcement	0=Disabled; 1=Enforced; 2=LPA Input Enforced; 3=LPA Centered and Enforced.	0		
Geofence Schedule	0=24/7; 1=After Scheduled Hours; 2= During Scheduled Hours. (See Scheduled Hours Mode)	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 106, 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	
Odometer Query	0=Report Only (No Reset); 1=Report with Reset	>QTKN
Engine Idling Query	0=Report Only (No Reset); 1=Report with Reset	
Runtime Motion-based Query	0=Report Only (No Reset); 1=Report with Reset	>QTKM
Runtime 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
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
Service Mode	0=Operational Mode; 1=Service Mode	AT+CTKM

Table 107, Stateless Operations

Read-Only Parameters, Formats and Ranges

Parameter	Value	Messages
Report Sequence Number	16-bit Hex (0000-FFFF) incrementing by 1 for each logged report	>RTKP >RTKS
TriggerType	0=IDLE Timeout 1=Motion Detected 2=Exception Report Alert 3=Query 4=Scheduled Report 5=Runtime Meter Report 6=Start/Stop Report 7=Reserved 8=Attempted LPA-based Geofence Center while no GPS	
Battery Level	0-100%, 999%=Low Voltage Cut-out	
Battery Changed Flag	T=True; F=False	
GPS Time Week	Always 4 Digits	
GPS Time Seconds	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	
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) 6=Modem Initialization Failure 7=GPRS Opening Failure 8=TCP Connection Failure 9=Session Protocol Failure	>RTKP >RTKS
Position Age	0=Current (no motion since last position) 1=Aged (motion 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= Geofence Re-centered by LPA Input	
External Power	0=Bad (Below 5 VDC); 1=Good (5 VDC or higher)	
Scheduled Hours Flag	0=Normal; 1=Violation	
Speeding Status	0=Normal; 1=Violation	
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)	
Speed	Miles Per Hour. Always 3 Digits	
Heading	Relative to True North, increasing Easterly. Units of Degrees. Always 3 Digits. (000-359)	

Parameter	Value	Messages
Protocol Sequence Number	16-bit Hex (0000-FFFF) incrementing by 1 for each logged report	>RTKP >RTKS
TriggerType	0=IDLE Timeout 1=Motion Detected 2=Exception Report Alert 3=Query 4=Scheduled Report 5=Runtime/Engine Idling Meter Report 6=Start/Stop Report 7=Firmware Updated 8=Attempted LPA-based Geofence Center while no GPS	
Battery Level	0-100%, 999%=Low Voltage Cut-out	
Battery Changed Flag	T=True; F=False	
GPS Time Week	Always 4 Digits	
GPS Time Seconds	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	
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) 6=Modem Initialization Failure 7=GPRS Opening Failure 8=TCP Connection Failure 9=Session Protocol Failure	>RTKP >RTKS
Position Age	0=Current (no motion since last position) 1=Aged (motion since last position)	
HPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal	
MPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal	
LPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal	
Geofence Status	0=Normal; 1=Violation; 5= Geofence Re-centered by LPA Input	
External Power	0=Bad (Below 5 VDC); 1=Good (5 VDC or higher)	
Scheduled Hours Flag	0=Normal; 1=Violation	
Speeding Status	0=Normal; 1=Violation	
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 [Odometer]	Altitude in Feet with sign (-99999 to +99999) [Odometer in tenths of Miles without sign (000000 to 999999 in >RTKP, 0000000000 to 9999999999 in >RTKN)]	
Speed	Miles Per Hour. Always 3 Digits	

Parameter	Value	Messages
Heading	Relative to True North, increasing Easterly. Units of Degrees. Always 3 Digits. (000-359)	
Odometer Reading	Accumulated 1/10ths of Miles since last reset	>RTKN
Engine Idling Reading	Accumulated seconds since last reset, always 10 digits	
Odometer Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled	
Engine Idling Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled	
Runtime Motion-based Reading	Accumulated seconds since last reset, always 10 digits	>RTKM
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	
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 Status	0=Output Low; 1=Output High; 2=No Change (STKU-only); 3=No Module Attached	>RTKU
Output 2 Status	0=Output Low; 1=Output High; 2=No Change (STKU-only); 3=No Module Attached	

Table 108, Read-only Parameters

Over-the-Air (OTA) Firmware Parameters, Formats and Ranges

Parameter	Value	Messages
OTA Firmware Upgrade Command	0=Stop; 1=Start	>STKT
OTA Firmware Upgrade Status	0=Idle 1=Starting OTA Download 5=Download Error (TFTP Transfer) 6=Flash Storage Error 7=Image Checksum Error 8=Image Integrity Error 9=Image Decompression Error A=Successful OTA Reflash B=Incompatible Flash Device C=Reflash Error	>STKT >RTKT
OTA File Size	Always 8 Digits: 00000000=Not Used; Else as Provided by Trimble	
OTA File Checksum	Always 8 Characters: FFFFFFFF=Not Used; Else as Provided by Trimble	
OTA TFTP IP Address	IP address of TFTP server in the following format: 111.222.333.444. The quote (") must be used to terminate this numeric field regardless of number of digits used. TFTP server must be on Port 69.	
OTA TFTP Filename	Provided by Trimble. The quote (") must be used to terminate this text field regardless of number of characters used.	

Table 109, Over-the-Air (OTA) Firmware Parameters

Parameter List (All)

Parameter	Unit/Notes	Default	Messages	Command
Almanac Timeout, T6	In hours (10 – 990)	168	>STKA, >RTKA	AT+CTKC
Altitude [Odometer]	Feet (-9999 to 99999)		>RTKP	AT+CTKP
Anytime Polling	0=Disabled; 1=Duty-Cycled; 2=OnDemand	0=Disabled	>STKX, >RTKX	AT+CTKX
Automatic Message Log Dump	0=Disabled; 1=Tx Current, then Logged FIFO; 2= All FIFO	0=Disabled	>STKZ, >RTKZ	AT+CTKZ
Battery Change Time	GPS Time Seconds		>RTKP, >RTKS	
Battery Change Week	GPS Time Week		>RTKP, >RTKS	
Battery Changed Flag	T=True; F=False		>RTKP, >RTKS	
Battery Level	0-100%, 999%=Low Voltage Cut-out		>RTKP, >RTKS	
Communication Mode	0= SMS; 1= GPRS; 2=AutoSelect	0	>STKA, >RTKA	AT+CTKC
DELAY Timeout, T4	In seconds (10 – 86400)	900	>STKA, >RTKA	AT+CTKC
Diagnostics Mode	0= None; 1= LED	1	>STKA, >RTKA	AT+CTKC
Dynamic Motion Filter Timeout, T21	In Seconds (1-90)	20	>STKX, >RTKX	AT+CTKX
Dynamic Motion Filter Counter, N4	In Seconds (1-90)	10	>STKX, >RTKX	AT+CTKX
Erase/Restore Mode	1= Restore Defaults; 2=Erase Message Log; 3=Erase Log & Restore Defaults		None	AT+CTKE
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		>RTKP, >RTKS	
External Power	0=Bad (Below 5 VDC); 1=Good (5 VDC or higher)		>RTKP, >RTKS	
Firmware Version	Numeric String		>RTKA	ATI
FIX Timeout, T2	In seconds (10 – 3600)	300	>STKA, >RTKA	AT+CTKC
Geofence Center Latitude	-90.0000000 to +90.0000000 Degrees	+0.0000000	>STKK, >RTKK	AT+CTKK
Geofence Center Longitude	-180.0000000 to +180.0000000 Degrees	+0.0000000	>STKK, >RTKK	AT+CTKK
Geofence Delta X	100s of meters	1	>STKK, >RTKK	AT+CTKK

Parameter	Unit/Notes	Default	Messages	Command
Geofence Delta Y	100s of meters	1	>STKK, >RTKK	AT+CTKK
Geofence Enforcement	0=Disabled; 1=Enforced; 2=LPA Input Enforced; 3=LPA Centered and Enforced.	0	>STKK, >RTKK	AT+CTKK
Geofence ID	Unique geofence identifier: 1 through 10		>STKK, >RTKK	AT+CTKK
Geofence Schedule	0=24/7; 1=After Scheduled Hours; 2= During Scheduled Hours. (See Scheduled Hours Mode)	0	>STKK, >RTKK	AT+CTKK
Geofence Status	0=Normal; 1=Violation; 5= Geofence Re-centered by LPA Input		>RTKP, >RTKS	
Geofence Type	0=Boundary Crossing; 1=Inclusive; 2=Exclusive	1	>STKZ, >RTKZ	AT+CTKZ
GPRS APN	Access Point Name (APN) Web address up to 40 case sensitive alphanumeric characters as assigned by GPRS network operator. Example: "apn.trimble.com".	<Empty>	>STKJ, >RTKJ	AT+CTKJ
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	0.0.0.0:0	>STKF, >RTKF	AT+CTKF
GPRS Password	Up to 20 case sensitive alphanumeric characters	<Empty>	>STKJ, >RTKJ	AT+CTKJ
TrimTrac Session Keep-alive Timeout, T25	TrimTrac Session Keep-alive Timeout, T25	300	>STKF, >RTKF	AT+CTKF
GPRS Session Protocol	0=None; 1=TrimTrac Session Protocol (See Separate ICD Document, v3.08)	0	>STKF, >RTKF	AT+CTKF
GPRS Session Timeout, T26	In Seconds (0=Never; 1–43200)	0	>STKF, >RTKF	AT+CTKF
GPRS Transport Protocol	0=UDP (TrimTrac Session Protocol mandatory); 1=TCP	1	>STKF, >RTKF	AT+CTKF
GPRS Username	Up to 40 case sensitive alphanumeric characters	<Empty>	>STKJ, >RTKJ	AT+CTKJ
GPS Dynamics Mode	(Do Not Change)	5	>STKG, >RTKG	AT+CTKG
GPS Elevation Mask	In degrees (0-30)	5	>STKG, >RTKG	AT+CTKG
GPS Fix Rate	0=GPS operation during FIX State only; 1=1Hz GPS, except GPS off in IDLE; 2=Same as 1 plus position in all messages, if available; 3=Same as 2 plus GPS Velocity Move Qualifier	0	>STKZ, >STKZ	AT+CTKZ
GPS PDOP Mask	In tenths of PDOP (60 – 200)	120	>STKG, >RTKG	AT+CTKG
GPS PDOP Switch	In tenths of PDOP (40 – 120)	60	>STKG, >RTKG	AT+CTKG

Parameter	Unit/Notes	Default	Messages	Command
GPS Signal Mask	In tenths of AMUs (1 – 80)	10	>STKG, >RTKG	AT+CTKG
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	
GPS Time Seconds	Always 6 Digits		>RTKP, >RTKS	
GPS Time Week	Always 4 Digits		>RTKP, >RTKS	
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) 6=Modem Initialization Failure 7=GPRS Opening Failure 8=TCP Connection Failure 9=Session Protocol Failure		>RTKP, >RTKS	
Heading	Relative to True North, increasing Easterly. Units of Degrees. Always 3 Digits. (000-359)		>RTKP	
HPA Delay Timeout, T13	In Seconds (10-86400)	10	>STKY, >RTKY	AT+CTKY
HPA Idle Timeout, T11	In Seconds (10-999990)	10	>STKY, >RTKY	AT+CTKY
HPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only; 4=Change-of-State	0	>STKY, >RTKY	AT+CTKY
HPA Query Timeout, T17	In Seconds (10-3600)	60	>STKY, >RTKY	AT+CTKY
HPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal		>RTKP, >RTKS	
HPA Transmit Attempts, N5	0=Until T15 Expires; 1-255=Number of Tx Attempts before T15 expires	0	>STKY, >RTKY	AT+CTKY
HPA Transmit Timeout,	0=Infinity; Else in Seconds (10-999990)	0	>STKY, >RTKY	AT+CTKY

Parameter	Unit/Notes	Default	Messages	Command
T15				
IDLE Timeout, T1	In seconds (10 – 999990)	43200	>STKA, >RTKA	AT+CTKC
In-Motion Polling	0=Disabled; 1=OnDemand	0	>STKX, >RTKX	AT+CTKX
Latitude	-90.0000000 to +90.0000000 Degrees		>RTKP	
Longitude	-180.0000000 to +180.0000000 Degrees		>RTKP	
LPA Input Arming Delay, T31	In Seconds (0-990)	0	>STKZ, >RTKZ	AT+CTKZ
LPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3= Monitor-only (regardless of motion); 4=Change-of-State	0	>STKY, >RTKY	AT+CTKY
LPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal		>RTKP, >RTKS	
LPA Transmit Attempts, N7	0=Until T3 Expires; 1-255=Number of Tx Attempts before T3 expires	0	>STKY, >RTKY	AT+CTKY
Motion Counter Threshold	Counter (1-2000)	10	>STKZ, >RTKZ	AT+CTKZ
Motion Report Flag	0=None 1=Start Motion Report 2=Stop Motion Report 3= Start & Stop Motion Reports	0	>STKA, >RTKA	AT+CTKC
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	>STKX, >RTKX	AT+CTKX
MPA Delay Timeout, T14	In Seconds (10-86400)	10	>STKY, >RTKY	AT+CTKY
MPA Idle Timeout, T12	In Seconds (10-999990)	10	>STKY, >RTKY	AT+CTKY
MPA Mode	0=Automatic; 1=Disabled; 2=Network Acknowledgement; 3=Monitor-only; 4=Change-of-State.	1	>STKY, >RTKY	AT+CTKY
MPA Status	0=Normal; 1=Activated; 2=Sent; 3=Acknowledged; 4=Monitor Activated; 5=Change-of-State to Normal		>RTKP, >RTKS	
MPA Transmit Attempts, N6	0=Until T16 Expires; 1-255=Number of Tx Attempts before T16 expires	0	>STKY, >RTKY	AT+CTKY
MPA Transmit Timeout, T16	0=Infinity; Else in Seconds (10-999990) If not set 0-Infinity, should be set no lower than 300 Seconds	300	>STKY, >RTKY	AT+CTKY
Odometer	Tenths of Miles 6 digits in >RTKP, 10 digits in >RTKN,		>RTKP, >RTKN	

Parameter	Unit/Notes	Default	Messages	Command
	no sign			
OTA Firmware Upgrade Command	0=Stop; 1=Start		>STKT	
OTA File Checksum	Always 8 Characters: FFFFFFFF=Not Used; Else as Provided by Trimble		>STKT,>RTKT	
OTA TFTP Filename	Provided by Trimble. The quote (") must be used to terminate this text field regardless of number of characters used.			
OTA File Size	Always 8 Digits: 00000000=Not Used; Else as Provided by Trimble			
OTA Firmware Upgrade Status	0=Idle 1=Starting OTA Download 5=Download Error (TFTP Transfer) 6=Flash Storage Error 7=Image Checksum Error 8=Image Integrity Error 9=Image Decompression Error A=Successful OTA Reflash B=Incompatible Flash Device C=Reflash Error			
OTA TFTP IP Address	IP address of TFTP server in the following format: 111.222.333.444. The quote (") must be used to terminate this numeric field regardless of number of digits used. TFTP server must be on Port 69.			
Output 1	0=Output Low; 1=Output High; 2=No Change		>STKU	
Output 1 Status	0=Output Low; 1=Output High; 2=No Change (STKU-only); 3=No Module Attached		>RTKU	
Output 2	0=Output Low; 1=Output High; 2=No Change		>STKU	
Output 2 Status	0=Output Low; 1=Output High; 2=No Change (STKU-only); 3=No Module Attached		>RTKU	
Polling Duty-Cycle Frequency, T19	In Seconds (10-999990)	3600	>STKX, >RTKX	AT+CTKX
Polling Duty-Cycle On-	In Seconds (0, 10-3600)	60	>STKX, >RTKX	AT+CTKX

Parameter	Unit/Notes	Default	Messages	Command
Time, T20				
Position Age	0=Current (no motion since last position) 1=Aged (motion since last position)		>RTKP, >RTKS	
Position Query Fix Timeout	In Seconds (10-3600)		>QTKD	
Position Query Mode	S=Compute if Position Aged; P=Compute New Position Fix; L=Status Report with Last logged position		>QTKD	
Position Report Transmit Attempts, N1	0=Until T3 Expires; 1-255=Number of Tx Attempts	1	>STKX, >RTKX	AT+CTKX
Report Sequence Number	16-bit Hex (0000-FFFF) incrementing by 1 for each logged report		>RTKP, >RTKS	
Query Hold Flag	0=Disabled; 1=Enabled	0	>STKX, >RTKX	AT+CTKX
QUERY Timeout, T5	In seconds (4 – 3600)	60	>STKA, >RTKA	AT+CTKC
Report Delay Flag	0=Transmit (“Tx”) All Messages 1=Tx Exception Reports & Query/Set Responses only 2=Tx Motion-related, Exceptions & Responses 3=Tx IDLE Timeout, T1, Status Msgs, Exceptions & Responses 4=Tx Start/Stop, IDLE Status, Exceptions & Responses 5=Tx every 6th motion-triggered message, Exceptions & Responses 6=Tx every 11th motion-triggered message, Exceptions & Responses 7=Tx Start/Stop, Exception & Responses (No IDLE Status)	0	>STKA, >RTKA	AT+CTKC
Reserved		0	>STKX, >RTKX	AT+CTKX
Runtime LPA-based	0=Disabled; 1=Enabled	0	>STKZ, >RTKZ	AT+CTKZ
Runtime LPA-based Countdown, T30	In Hours (0=No Countdown, 1-990)	0	>STKZ, >RTKZ	AT+CTKZ
Runtime LPA-based Query	0=Report Only (No Reset); 1=Report with Reset		>QTKM	
Runtime LPA-based Reading	Accumulated seconds since last reset, always 10 digits		>RTKM	

Parameter	Unit/Notes	Default	Messages	Command
Runtime LPA-based Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled		>RTKM	
Runtime Motion-based	0=Disabled; 1=Enabled	0	>STKZ, >RTKZ	AT+CTKZ
Runtime Motion-based Countdown, T29	In Hours (0=No Countdown, 1-990)	0	>STKZ, >RTKZ	AT+CTKZ
Runtime Motion-based Query	0=Report Only (No Reset); 1=Report with Reset		>QTKM	
Runtime Motion-based Reading	Accumulated seconds since last reset, always 10 digits		>RTKM	
Runtime Motion-based Reset Confirmation	0=Report without Reset; 1=Report with Reset; 2=Disabled		>RTKM	
Scheduled Hours Daily Start Time, T27	In Seconds (0 – 86399) after 12:00AM UTC.	0	>STKZ, >RTKZ	AT+CTKZ
Scheduled Hours First Weekly Work Day	0=Sunday; 1=Monday; 2=Tuesday; 3=Wednesday; 4=Thursday; 5=Friday; 6=Saturday (All relative to UTC)	1	>STKZ, >RTKZ	AT+CTKZ
Scheduled Hours Flag	0=Normal; 1=Violation		>RTKP, >RTKS	
Scheduled Hours Mode	0=Disabled; 1=Enabled	0	>STKZ, >RTKZ	AT+CTKZ
Scheduled Hours Work Day Length, T28	In Seconds (0 – 86400)	43200	>STKZ, >RTKZ	AT+CTKZ
Scheduled Hours 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	5	>STKZ, >RTKZ	AT+CTKZ
Scheduled Report Mode	0=None; 1=Daily; 2=Weekly	0	>STKX, >RTKX	AT+CTKX
Scheduled Report Time, T18	In Seconds (0-604799)	0	>STKX, >RTKX	AT+CTKX
Security Password	Always 8 alphanumeric characters, UPPER CASE ONLY	00000000	>STK(all), >QTK(all)	AT+CTKP
SIM PIN	If used, must be between 4 and 8 digits.	<Empty>	>STKP	AT+CTKP
SMS Destination Address	24 characters including optional international dialing “+” sign and country code for SMS messages.	<Empty>	>STKP, >RTKP	AT+CTKP
Speed	Miles Per Hour. Always 3 Digits		>RTKP, >RTKS	
Speeding Countdown Timer, T31	In Seconds (0-99990)	0	>STKZ, >RTKZ	AT+CTKZ
Speed Enforcement	0=No Enforcement; 1-990 = Limit in MPH	0	>STKZ, >RTKZ	AT+CTKZ

Parameter	Unit/Notes	Default	Messages	Command
Speeding Report Mode	0=Report All Violations; 1=Report Initial Violations Only	0	>STKZ, >RTKZ	AT+CTKZ
Speeding Status	0=Normal; 1=Violation		>RTKP, >RTKS	
Static Motion Filter Counter, N3	In Seconds (1-90)	10	>STKX, >RTKX	AT+CTKX
Static Motion Filter Timeout, T7	In Seconds (1-90)	20	>STKA, >RTKA	AT+CTKC
Status Message Transmit Attempts, N2	0=Until T3 Expires; 1-255=Number of Tx Attempts. Set to 1 if Communication Mode set "1=GPRS-only"	1	>STKX, >RTKX	AT+CTKX
TRANSMIT Timeout, T3	In seconds (300 – 3600)	300	>STKA, >RTKA	AT+CTKC
TriggerType	0=IDLE Timeout 1=Motion Detected 2=Exception Report Alert 3=Query 4=Scheduled Report 5=Runtime/Engine Idling Meter Report 6=Start/Stop Report 7=Firmware Updated 8=Attempted LPA-based Geofence Center while no GPS		>RTKP, >RTKS	
Unit ID	Always 8 alphanumeric characters, UPPER CASE ONLY	00000000	>RTK(all)	AT+CTKP

Figure 35, Parameter Index (All)

AT Command and Default Summary

Command	Description	Default Settings	See Page
AT+CTKC	Assigns Application parameters	AT+CTKC=43200,300,300,900,60,168,20,0,0,1,0	137
AT+CTKC?	Queries Application parameters		
AT+CTKF	Assigns GPRS Connection parameters	AT+CTKF=1,0,300, 0,"0.0.0.0:0"	138
AT+CTKF?	Queries GPRS Connection parameters		
AT+CTKJ	Assigns GPRS Setup parameters	AT+CTKJ="","",""	139
AT+CTKJ?	Queries GPRS Setup parameters		
AT+CTKG	Assigns GPS parameters	AT+CTKG=5,120,60,10,5	140
AT+CTKG?	Queries GPS parameters		
AT+CTKK	Assigns Geofence parameters	AT+CTKK=1,0,0,1,1,"+0.0000000",""+0.0000000" AT+CTKK=2,0,0,1,1,"+0.0000000",""+0.0000000"	140
AT+CTKK?	Queries Geofence parameters		
AT+CTKP	Assigns SMS Communication parameters	AT+CTKP="00000000","","","00000000"	142
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	143
AT+CTKX?	Queries Extended Application parameters		
AT+CTKY	Assign Vehicle Adapter and Control Module parameters	AT+CTKY=10,10,10,10,0,300,60,0,0,0,0,1,0	144
AT+CTKY?	Queries Vehicle Adapter and Control Module parameters		
AT+CTKZ	Assigns Extended 2 Application parameters	AT+CTKZ=10,0,0,43200,1,5,0,0,0,0,0,0,1,0,0,0,0000,0,0,0,0,3,0	146
AT+CTKZ?	Queries Extended 2 Application parameters		
AT+CTDL	Captures Diagnostic Data Log	Not Applicable	xv
AT+CTEL?	Queries Error Message Log	Not Applicable	138
AT+GSN	Queries IMEI Number (via Service Mode)	Not Applicable	139
AT+CTKE	Restores Defaults and/or Erases Log	Not Applicable	138
AT+CTK0?	Retrieves Logged Messages	Not Applicable	146
ATI	Queries Firmware Version	Not Applicable	147

Table 110, 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	169
>QTKR	QUERY_LOG	Requests logged messages (REPORT_POS and STATUS_MSG)	170
>QTKM	QUERY_METERS	Requests/Clears current state of Runtime Meters	172
>QTKD	QUERY_POSITION	Requests current or logged position information	173
>QTKU	QUERY_CONTROL_OUTPUTS	Requests current status of Control Module outputs	176
>RTKP	REPORT_POS	Basic position message	177
>RTKL	RESP_ALERT_STATE	Reports acknowledgment or, if conditions all normal, clearing of alerts	180
>RTKA	RESP_APP_CONFIG	Reports current Basic Application parameters	180
>RTKX	RESP_EXT_APP_CONFIG	Reports current Extended Application parameters	182
>RTKZ	RESP_EXT2_APP_CONFIG	Reports Scheduled Hours, Runtime Meters and other parameters	184
>RTKK	RESP_GEOFENCE_CONFIG	Reports Geofence parameters	185
>RTKF	RESP_GPRS_CONNECT_CONFIG	Reports GPRS Configuration	186
>RTKJ	RESP_GPRS_SETUP_CONFIG	Reports GPRS Setup	187
>RTKG	RESP_GPS_CONFIG	Reports GPS parameters	185
>RTKM	RESP_METERS	Reports Runtime meter readings	188
>RTKV	RESP_PROV_CONFIG	Reports current SMS Communication parameters	188
>RTK{1-4}	RESP_QUERY_AGGR	Reports summary of two logged messages	192
>RTKR	RESP_QUERY_LOG	Reports requested logged messages	192
>RTKY	RESP_MODULE_APP_CONFIG	Reports current module application parameters	189
>RTKU	RESP_CONTROL_OUTPUT	Reports current Control Module Output condition	Error! Bookmark not defined.
>STKL	SET_ALERT_STATE	Acknowledges or clears Module alerts	155
>STKA	SET_APP_CONFIG	Changes Basic Application parameters	156
>STKX	SET_EXT_APP_CONFIG	Changes Extended Application parameters	157
>STKZ	SET_EXT2_APP_CONFIG	Changes Scheduled Hours, Runtime Meters and other parameters	160
>STKK	SET_GEOFENCE_CONFIG	Changes Geofence parameters	162
>STKF	SET_GPRS_CONNECT_CONFIG	Changes GPRS Configuration	163
>STKJ	SET_GPRS_SETUP_CONFIG	Changes GPRS Setup	164
>STKG	SET_GPS_CONFIG	Changes GPS parameters	164
>STKV	SET_PROV_CONFIG	Changes SMS Communication parameters	165
>STKY	SET_MODULE_APP_CONFIG	Changes Module application parameters	166
>STKU	SET_CONTROL_OUTPUT	Controls Control Module Outputs	157
>RTKS	STATUS_MSG	Same as REPORT_POS except no location/altitude/velocity data	177

Table 111, 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	169
>QTKD	QUERY_POSITION	Requests current or logged position information	173
>QTKM	QUERY_METERS	Requests/Clears current state of Runtime Meters	172
>QTKR	QUERY_LOG	Requests logged messages (REPORT_POS and STATUS_MSG)	170
>QTKU	QUERY_CONTROL_OUTPUTS	Requests current status of Control Module outputs	176
>RTK{1-4}	RESP_QUERY_AGGR	Reports summary of two logged messages	192
>RTKA	RESP_APP_CONFIG	Reports current Basic Application parameters	180
>RTKF	RESP_GPRS_CONNECT_CONFIG	Reports GPRS Configuration	186
>RTKG	RESP_GPS_CONFIG	Reports GPS parameters	185
>RTKJ	RESP_GPRS_SETUP_CONFIG	Reports GPRS Setup	187
>RTKK	RESP_GEOFENCE_CONFIG	Reports Geofence parameters	185
>RTKL	RESP_ALERT_STATE	Reports acknowledgment or, if conditions all normal, clearing of alerts	180
>RTKM	RESP_METERS	Reports Runtime meter readings	188
>RTKP	REPORT_POS	Basic position message	177
>RTKR	RESP_QUERY_LOG	Reports requested logged messages	192
>RTKS	STATUS_MSG	Same as REPORT_POS except no location/altitude/velocity data	177
>RTKU	RESP_CONTROL_OUTPUT	Reports current Control Module Output condition	Error! Bookmark not defined.
>RTKV	RESP_PROV_CONFIG	Reports current SMS Communication parameters	188
>RTKX	RESP_EXT_APP_CONFIG	Reports current Extended Application parameters	182
>RTKY	RESP_MODULE_APP_CONFIG	Reports current Module application parameters	189
>RTKZ	RESP_EXT2_APP_CONFIG	Reports Scheduled Hours, Runtime Meters and other parameters	184
>STKA	SET_APP_CONFIG	Changes Basic Application parameters	156
>STKF	SET_GPRS_CONNECT_CONFIG	Changes GPRS Configuration	163
>STKG	SET_GPS_CONFIG	Changes GPS parameters	164
>STKJ	SET_GPRS_SETUP_CONFIG	Changes GPRS Setup	164
>STKK	SET_GEOFENCE_CONFIG	Changes Geofence parameters	162
>STKL	SET_ALERT_STATE	Acknowledges or clears Module alerts	155
>STKU	SET_CONTROL_OUTPUT	Controls Control Module Outputs	157
>STKV	SET_PROV_CONFIG	Changes SMS Communication parameters	165
>STKX	SET_EXT_APP_CONFIG	Changes Extended Application parameters	157
>STKY	SET_MODULE_APP_CONFIG	Changes module application parameters	166
>STKZ	SET_EXT2_APP_CONFIG	Changes Scheduled Hours, Runtime Meters and other parameters	160

Table 112, TrimTrac Application Protocol Messages (Sorted by Header)

TrimTrac Command and Response Summary

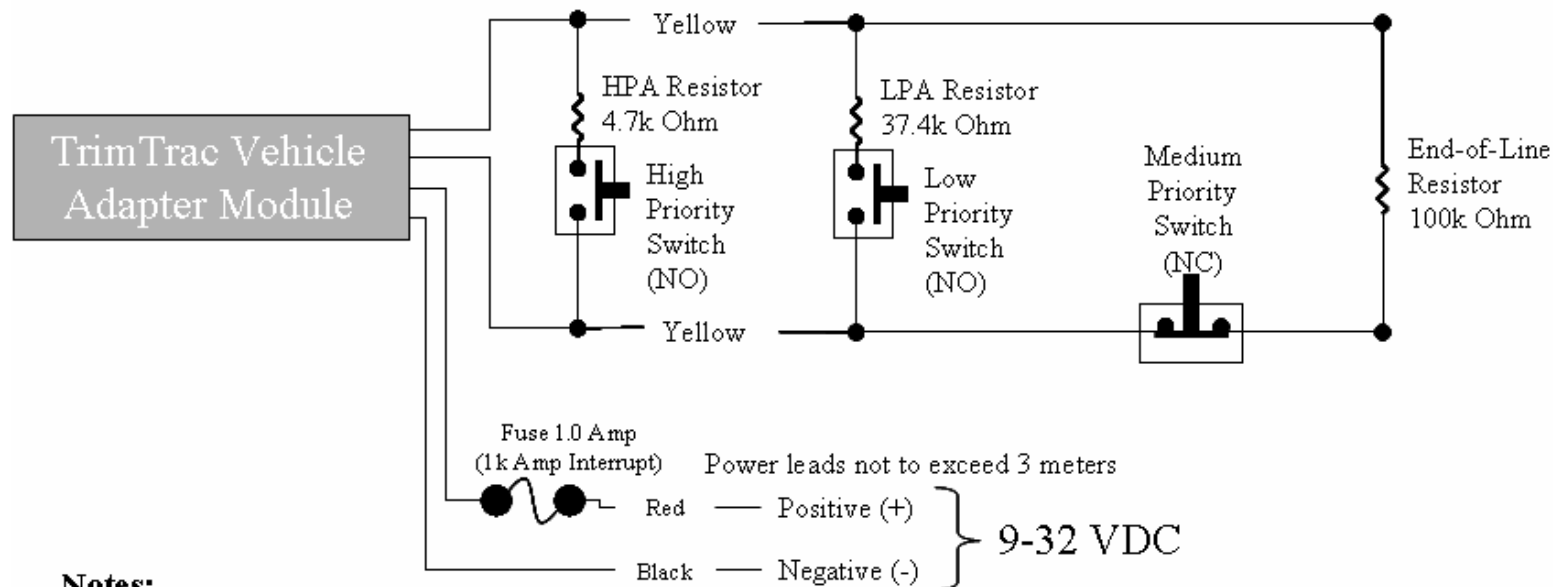
COMMANDS SENT TO TRIMTRAC			RESPONSES SENT FROM TRIMTRAC		
See Page	Command Message Name	Command Header	Response Header	Response Message Name	See Page
170	QUERY_LOG	>QTKR	>RTKR or >RTK{1-4}	RESP_QUERY_LOG or RESP_QUERY_AGGR	192
172	QUERY_METERS	>QTKM	>RTKM	RESP_METERS	188
173	QUERY_POSITION	>QTKD	>RTKS +/or >RTKP	STATUS_MSG +/-or REPORT_POS	177
169	QUERY_CONFIG	>QTKA	>RTKA	RESP_APP_CONFIG	180
169	QUERY_CONFIG	>QTKX	>RTKX	RESP_EXT_APP_CONFIG	182
169	QUERY_CONFIG	>QTKZ	>RTKZ	RESP_EXT2_APP_CONFIG	184
171	QUERY_GEOFENCE_CONFIG	>QTKK	>RTKK	RESP_GEOFENCE_CONFIG	185
169	QUERY_CONFIG	>QTKF	>RTKF	RESP_GPRS_CONNECT_CONFIG	186
169	QUERY_CONFIG	>QTKJ	>RTKJ	RESP_GPRS_SETUP_CONFIG	187
169	QUERY_CONFIG	>QTKG	>RTKG	RESP_GPS_CONFIG	185
169	QUERY_CONFIG	>QTKV	>RTKV	RESP_PROV_CONFIG	188
169	QUERY_CONFIG	>QTKX	>RTKX	RESP_EXT_APP_CONFIG	182
169	QUERY_CONFIG	>QTKY	>RTKY	RESP_MODULE_APP_CONFIG	189
155	SET_ALERT_STATE	>STKL	>RTKL	RESP_ALERT_STATE	180
156	SET_APP_CONFIG	>STKA	>RTKA	RESP_APP_CONFIG	180
157	SET_EXT_APP_CONFIG	>STKX	>RTKX	RESP_EXT_APP_CONFIG	182
160	SET_EXT2_APP_CONFIG	>STKZ	>RTKZ	RESP_EXT2_APP_CONFIG	184
162	SET_GEOFENCE_CONFIG	>STKK	>RTKK	RESP_GEOFENCE_CONFIG	185
163	SET_GPRS_CONNECT_CONFIG	>STKF	>RTKF	RESP_GPRS_CONNECT_CONFIG	186
164	SET_GPRS_SETUP_CONFIG	>STKJ	>RTKJ	RESP_GPRS_SETUP_CONFIG	187
164	SET_GPS_CONFIG	>STKG	>RTKG	RESP_GPS_CONFIG	185
165	SET_PROV_CONFIG	>STKV	>RTKV	RESP_PROV_CONFIG	188
165	SET_MODULE_APP_CONFIG	>STKY	>RTKY	RESP_MODULE_APP_CONFIG	189
157	SET_CONTROL_OUTPUT	>STKU	>RTKU	RESP_CONTROL_OUTPUT	Error! Bookmark not defined.
			>RTKP	REPORT_POS	177
			>RTKS	STATUS_MSG	177

Table 113, TrimTrac Command and Response Summary

Parameter Cross Reference TrimTrac Pro Versus Earlier TrimTrac Versions

TrimTrac Pro	Previous TrimTrac Versions	Reason/Comment
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
300 Seconds	60 Seconds	Minimum setting for TRANSMIT Timeout, T3
All other existing parameter names/values unchanged		

Table 114, Parameter Name Field Cross-Reference



Notes:

- 1) High and Low Priority switches must be Normally Open; Medium Priority switch must be Normally Closed
- 2) HPA and MPA Switches can be either Momentary or Latching, LPA switch must be latching-type
- 3) High, Low and Medium Switches are optional and can be used in any combination
- 4) Multiple switches can be used in parallel in each branch circuit; provided, however that branch resistance values are maintained as shown.
- 5) End-of-Line Resistor is required unless Ignore MPA is set "1=Ignore"
- 6) If Alert Switches are not used, then set Ignore HPA, MPA and LPA all to "1=Ignore"
- 7) Set MPA to "1=Ignore" if you do not want a MPA message if no external VDC is available.
- 8) All resistors (+/- 5%, .250 Watt min.) and switches provided by installer.
- 9) Opens, shorts and ground faults on main circuit and loss of external VDC handled as "Medium Priority Alerts"
- 10) New High and Low Priority alerts may not be recognized if a Medium Priority alert caused by an open, short or ground fault is already in effect.
- 11) An 1.0 Amp fuse rated for 1000 Amp interrupt capability is required (Examples include Littelfuse p/n 0257001 and Bussmann p/n BK/ATC-1). Power leads not to exceed 3 meters

Figure 36. Vehicle Adapter Module Alert Wiring Diagram

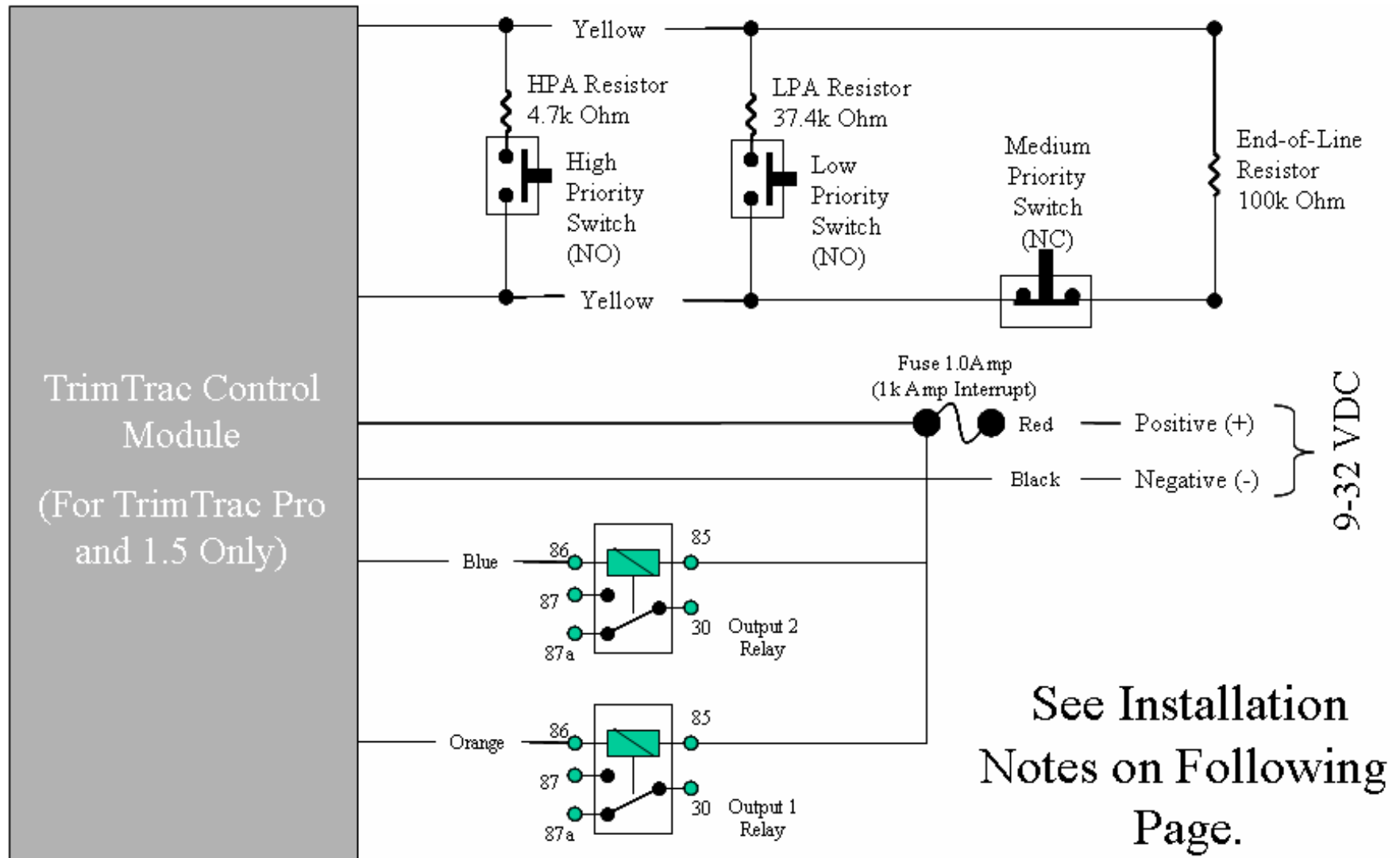


Figure 37. Control Module Wiring Diagram

CONTROL MODULE INSTALLATION NOTES

(See Control Module Wiring Diagram On Previous Page)

1. Control Module is compatible only with TrimTrac Pro and TrimTrac 1.5.
2. High and Low Priority switches must be Normally Open; Medium Priority switch must be Normally Closed
3. HPA and MPA Switches can be either Momentary or Latching, LPA switch must latching-type
4. High, Low and Medium Switches are optional and can be used in any combination
5. Multiple switches can be used in parallel in each branch circuit; provided, however that branch resistance values are maintained as shown.
6. End-of-Line Resistor is required unless Ignore MPA is set "1=Ignore"
7. If Alert Switches are not used, then set Ignore HPA, MPA and LPA all to "1=Ignore"
8. Set MPA to "1=Ignore" if you do not want a MPA message when no external VDC is available.
9. All resistors (+/- 5%, .250 Watt min.), relays and switches provided by installer.
10. Opens, shorts and ground faults on main circuit and loss of external VDC handled as "Medium Priority Alerts"
11. 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.
12. Outputs 1 and 2 are limited to 500 mA each at 12 VDC.
13. Use only automotive grade relays requiring less than 500 mA at 12 VDC to energize.
14. The TrimTrac Pro/1.5 is NOT water resistant when used with Control Module. IP55 of TrimTrac Pro/1.5 rating maintained only when used with Battery Pack or Vehicle Adapter Module.
15. An 1.0 Amp fuse rated for 1000 Amp interrupt capability is required (Examples include Littelfuse p/n 0257001 and Bussmann p/n BK/ATC-1). Power leads not to exceed 3 meters.

Table 115. Control Module Installation Notes