MP Rugged Wireless Modem

TAIP Reference

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SIERRA WIRELESS
HEART OF THE WIRELESS MACHINE®

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1: Introduction

- Document Structure
- Currency
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- Conventions

Note: The MP GPRS 750 and MP CDMA 555 have embedded Trimble SQ modules. The modules used in the first releases of these products do not support differential GPS. Support for differential GPS is planned for a future release.

This guide is intended to provide an understanding of the Trimble ASCII Interface Protocol (TAIP) used to communicate with the GPS modules in the Sierra Wireless MP GPRS 750 and MP CDMA 555. Most applications of the GPS module involve a custom computer application using the data from the GPS unit. To develop that application the communication interface to the GPS must be clearly understood.

In addition to details of the sentence syntax for each message type, this document provides information on the configuration of the module to set elements of the TAIP sentence structure and methodology of automated reporting.

For general information on GPS and how it works, please consult the *Primer on GPS Operation* available from the Sierra Wireless Internet site, www.sierrawireless.com.

Document Structure

This document is divided into three primary sections:

Section 1 - Introduction - provides introductory information on the subject including the module models and firmware it is current with and typographic conventions used in the document.

Section 2 - TAIP Overview - Introduces the format of the TAIP sentence. It also includes details on configuration options and automated reporting methodology.

Section 3 - Message Reference - Provides an alphabetical listing of the message identifiers; describing their sentence syntax and interpretation. It begins with a sample layout of the reference entries that follow.

Currency

This document is current with version 1.x of the MP GPRS 750 and MP CDMA 555 modems. Both modems have an embedded Trimble SQ module. The module has a single communication port and does not support differential GPS.

Later releases of each product will have an embedded SQ module that does have an auxilary port, providing support for differential GPS.

References

You may want to consult the other documents available on our Internet site at www.sierrawireless.com. In particular, the *Primer on GPS Operation* is helpful in understanding the nature of the data in TAIP messages.

Terminology and Acronyms

This document makes wide use of acronyms that are in common use in data communications. Our Internet site provides a Glossary that may be helpful in understanding some acronyms and terminology used in this guide.

Some terms specific to GPS operation are defined below:

DGPS Differential GPS

DOP Dilution of Precision - an effect that reduces the accuracy of a position fix caused by the satellites being clustered together in the same part of the sky.

DR Dead Reckoning - the position is a calculation based on heading and velocity applied to a previously known position.

IODE Issue of Data Ephemeris - Particularly important for differential GPS use, this identifies the ephemeris edition (usually updated every hour) in use at the satellite. It is important that both the receiver and the differential reference station are using the same IODE.

NMEA National Marine Electronics Association - NMEA 1083 is a protocol used to communicate between marine navigation and control devices.

RTCM Radio Technical Commission for Maritime Services - RTCM SC-104 is a protocol for communicating differential corrections to the module.

SV Space Vehicle - A code unique to each satellite.

TAIP Trimble ASCII Interface Protocol - A protocol common for vehicle monitoring which uses printable ASCII data exclusively.

TSIP Trimble Standard Interface Protocol - A binary protocol providing the most robust command and control of the module.

WGS-84 World Geodetic System - 1984

Conventions

Command and sentence syntax is noted using an alternate font:

```
>DPV0010000002000060<
```

Braces { and } enclose items which can be repeated in the sentence.

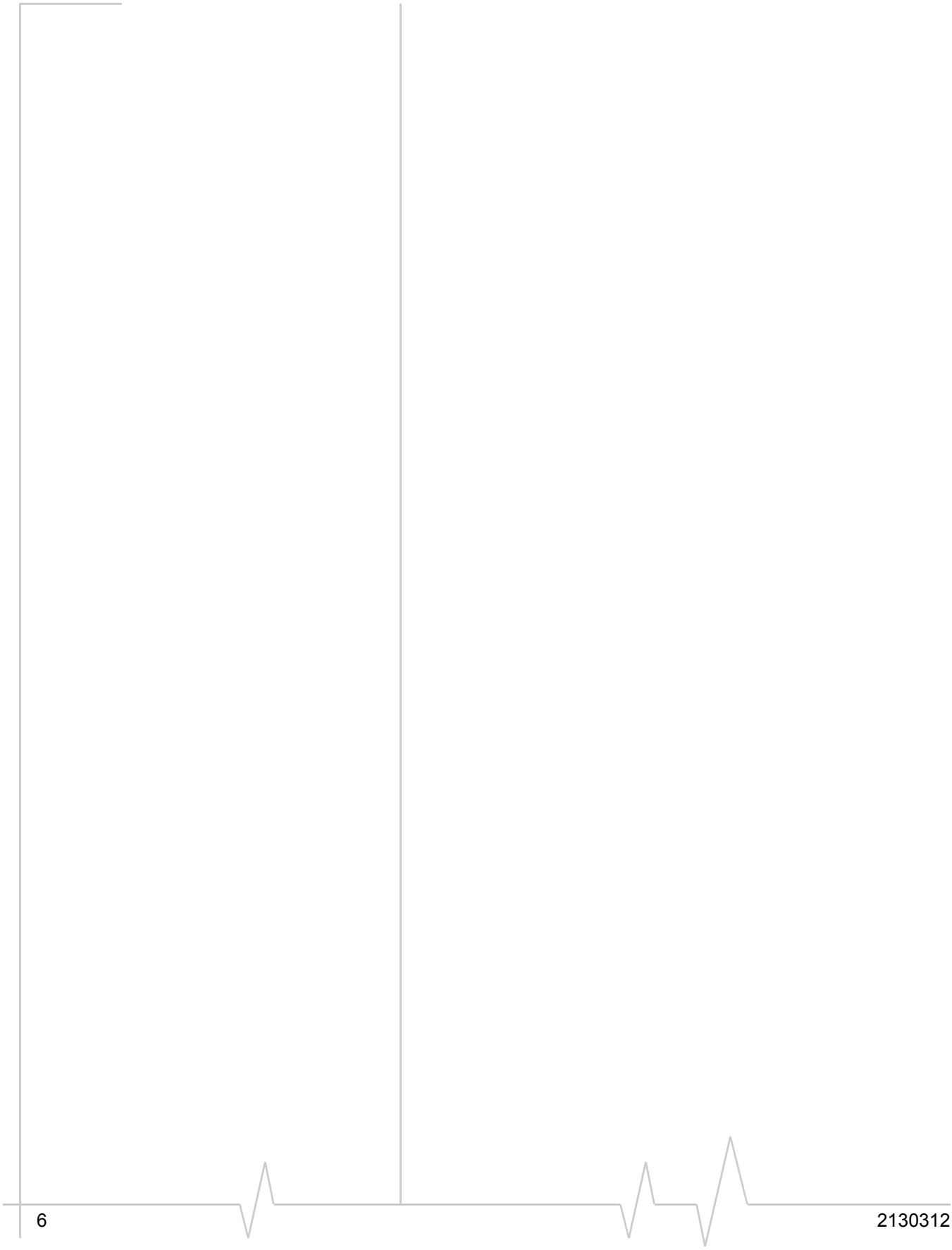
If lowercase letters appear inside braces such as "{f}" then the item is of variable length.

Square brackets [and] enclose items that may or may not be included in the sentence based on the module's configuration.

The vertical bar | is used to indicate OR in a list of options from which only one is to be used in a given instance of the message.

Shading and character changes are used to mark field boundaries within a data string and where decimal places are to be inferred.

Numeric values are generally presented in decimal but may also be expressed in hexadecimal or binary. Hexadecimal values are shown with a prefix of 0x, i.e. in the form 0x3D. Binary values are shown with a prefix of 0b, i.e. in the form 0b00111101. Otherwise, values are presumed decimal.



2: TAIP Overview

2

- Issuing TAIP commands to the modem
- TAIP sentence structure
- Configuring the GPS module
- Automated reporting
- Modem power considerations

The MP has an embedded Trimble SQ GPS module. The module supports the TAIP (Trimble ASCII Interface Protocol) and NMEA (National Marine Electronics Association) protocols. As shipped, the GPS module is configured to report GPS data using the TAIP protocol.

Note: An AT command can be used to switch between the NMEA and TAIP protocols. See the AT Command Reference for your product for more details.

This chapter provides a general description of the Trimble ASCII Interface Protocol (TAIP). Individual sections deal with the generic sentence structure, the presentation format used in this reference, configuration options to control elements of the protocol, and a description of the frequency and distance based automated reporting.

TAIP uses a printable ASCII format for communication over a serial data link. TAIP is ideal for use with mobile data terminals, seven bit modems, portable computers, and especially in vehicle tracking applications. In a network or fleet environment, the protocol supports scheduled and polled responses, checksums on all messages, scheduled output at user-specified time intervals, as well as the tagging of all messages with the unit's user-specified identification number (ID).

Issuing TAIP commands to the modem

TAIP commands can be issued to the MP in three ways: through Watcher (the application that comes with the modem); through AT commands; or by using a proprietary protocol called MT.

Watcher

Watcher installs from the installation CD that ships with the MP modem. Once installed, you can issue TAIP commands from a window that is accessed by selecting **Tools > Configuration > GPS**. (You type the commands in the **Command** field and issue them by selecting the **Send** button.)

AT commands

TAIP commands can be issued through the AT command, **AT!MPGPSCMD**. See the *AT Command Reference* for your product for more details. (The reference is available from the Sierra Wireless web site, www.sierrawireless.com.)

MT protocol

The MT ("Monitoring and Tracking") protocol provides the only means of issuing TAIP commands to the modem remotely. The protocol defines the contents and format of data reported by the modem and is required by system integrators developing applications to be used with the modem. To obtain documentation on MT, you must request it from Sierra Wireless.

TAIP sentence structure

All TAIP communication uses printable, uppercase ASCII characters. The user tells the GPS unit via the interface to output sentences on a scheduled basis or when queried. TAIP message characters must be in uppercase.

The following is the generic sentence format:

>ABB{C}[;ID=DDDD][;*EE]<

Where:

Table 2-1: TAIP sentence structure

>	Sentence start delimiter (ASCII 62 or 0x3E).
A	Message Qualifier (described below)
BB	A distinct two-letter Message Identifier e.g. PV, CP, LN used to indicate the subject of the message. These are described in detail in the reference section.

Table 2-1: TAIP sentence structure

C	A data string composed of one or more fixed length fields. The data string is comprised of any printable ASCII characters with the exception of the '>', '<', and ';' characters which are used as delimiters. Field separators, including commas and spaces, are not part of the messages unless otherwise specified. Strings generally use fixed-length fields although some sentences use comma or semicolon delimiters. The message qualifier and the message identifier determine the format and length of the data string.
;	Data string delimiter to separate data types (fixed length field data and various optional protocol elements).
ID=	Tag to identify the vehicle ID protocol element.
DDDD	The user defined vehicle ID (described below).
;*	Delimiter and tag to identify the checksum protocol element.
EE	Checksum expressed in ASCII representation of an eight-bit hexadecimal value (described below).
<	Sentence end delimiter (ASCII 60 or 0x3C).

Note that the data string, **{C}**, may or may not be present. This is determined by the requirements of the message identifier and the qualifier used. Both the vehicle ID and the checksum are optional elements.

Message qualifier

A one-character message qualifier is used to indicate the action to be taken on the message. The following describes the valid TAIP qualifiers:

Q – Query

Q is used to query the module for a report. The format is:

>QAA[;ID=BBBB][;*CC]<

AA is the message identifier being queried. The module will reply with the same message identifier but using the Report (**R**) qualifier.

Note that sentences using this qualifier require only the message identifier and none of the data string.

R – Report

R indicates the module's automatic report or response to a query. The format is:

>RAA{B}[;ID=CCCC][;*DD]<

AA is the two-character message identifier and {B} represents the data string containing the requested information. The content of the data strings for each message identifier are described in the reference section of this guide.

S – Set

S is used to configure the GPS module. The format is:

>SAA{B}[;ID=CCCC][;*DD]<

AA is the two-character message identifier and {B} represents the value of the setting. This qualifier is used to send data to the module for several purposes, primarily: port and protocol configuration, initial position, and differential corrections.

The content of the data string is described for each of the messages in the reference section of this guide.

F – Frequency

F is used to define when, and how often, the receiver must issue a scheduled report. Note that messages with this qualifier use the same data string format regardless of the message identifier.

The format is:

>FAABBBBCCCC[;ID=DDDD][;*FF]<

Sending this sentence tells the unit to report the message specified by the two-character identifier AA at the time interval of BBBB seconds with time epoch at CCCC seconds from top of the hour. Specifying the time interval of 0000 stops the scheduled reporting of the message.

The factory default includes having the PV message response issued at five-second intervals. This is equivalent to the command:

>FPV00050000<

For more detail on this automated interval reporting see "Set time interval (frequency) reporting" on page 17.

D – Distance

D is used to configure automatic reports based on distance travelled and minimum/maximum time intervals. Note that messages with this qualifier use the same data string format regardless of the message identifier.

The format is similar to the F qualifier but adds additional controls:

>DAABBBBCCCCEEEEFFFF[;ID=GGGG][;*HH]<

Where:

AA Message to report (i.e. **PV** means Position Velocity message)

BBBB Minimum time interval (in seconds) between reports

CCCC Report epoch (number of seconds from top of the hour)

EEEE Delta distance (in metres) from last reported position

FFFF Maximum time interval (in seconds) between reports

If the minimum time parameter is zero (BBBB=0000), then the message output is disabled.

If the maximum time parameter is zero (**FFFF**=0000) then the maximum time feature is disabled. In this case, the unit will report only if the current position is at least the delta distance (specified in EEEE) away from the position when the previous report was issued.

For more detail on this form of automated message see "Set position change (distance) reporting" on page 18.

Vehicle ID

A vehicle identification (ID), consisting of a four-character alphanumeric code, may be optionally tagged to all output messages sent from the sensor. This allows one application to receive messages from several vehicles in a fleet and still distinguish which unit is reporting.

If the Vehicle ID is included, it is delimited with a semicolon.

;ID=AAAA

The default setting is: ID set to "0000" and the ID Flag set to "F" (false).

The sensor will accept all messages with a matching ID or with the ID element omitted. Messages sent to the module with an ID that are different from the one set in the module will be disregarded. This is true even if the ID Flag is turned off (set to false). See "Reporting format" on page 14 for a discussion on setting the control flag.

Checksum

Checksums are useful in detecting data transmission errors when the communication channel is noisy. If provided, they are delimited from the rest of the sentence by a semicolon and are always the last element of the sentence before the end delimiter.

;*AA<

The default mode of operation is to include checksums in sentences from the module. The checksum itself is a two-byte ASCII representation of an eight-bit hexadecimal value. The checksum is computed as the exclusive or (XOR) of all characters from the beginning of the sentence (including the start delimiter) up to and including the asterisk (*) character in the checksum protocol element.

The sensor will accept all messages with a correct checksum or with the checksum element omitted. Messages sent to the module with an incorrect checksum will be disregarded. This is true even if the CS Flag is turned off (set to false). See “Reporting format” on page 14 for a discussion on setting the control flag.

Sample PV message

The following is an analysis of a typical PV message to further illustrate the TAIP message protocol. Starting with the report sentence from the module:

>RPV15714+3739438-1220384601512612;ID=1234;*7F<

Apply the data field mapping from the reference section:

>qPV AAAAA ±BBCCCCC ±DDDEEEEE FFF GGG H I <
>RPV 15714 +3739438 -12203846 015 126 1 2 ;ID=1234 ;*7F <

Table 2-2: Interpreting the sample sentence

Field	Meaning	Size	Sample value	Comments
A	GPS Time of Day	5	15714	Seconds into the day converts to: 04:21:54 GPS time (time of last fix)
±BC	Latitude	8	+37.39438	+37.39438 degrees converts to: N37°23’39.768”
±DE	Longitude	9	-122.03846	-122.03846 degrees converts to: W122°2’18.456”
F	Speed	3	015	15 MPH
G	Heading	3	126	126° (approx. SE)
H	Source of Data	1	1	1 = 3D GPS

Table 2-2: Interpreting the sample sentence

Field	Meaning	Size	Sample value	Comments
!**	Age of Data	1	2	2 = fresh (<10s)
;ID=	Vehicle ID		1234	User defined unit identifier.
;*	Checksum		7F	For communication integrity check.

Latitude and longitude conversion

The TAIP protocol reports latitude and longitude with a leading plus (+) or minus (-) sign to indicate direction from the equator and the prime meridian. Latitude is reported as positive north decimal degrees and longitude as positive east decimal degrees, using the WGS-84 datum.

It may be necessary to convert these figures to degrees, minutes, and seconds. The following example illustrates this conversion process.

Example: The latitude and longitude for Sierra Wireless, Inc. in decimal degrees is:

Latitude: +49.175011 degrees

Longitude -123.072693 degrees

Convert by successively removing the integer portion and multiplying the remainder by 60:

+49.175011

+	49.175011		
	49	.175011 x 60	
		= 10.50066	
		10	.50066 x 60
			= 30.0396
N	49°	10′	30.0396″

Since the sign of the latitude in this example is positive the result is:

Latitude: N 49° 10′ 30.04″

Longitude is converted in the same fashion with +ve meaning East and –ve meaning West:

Longitude: -123.072693 = W 123° 04′ 21.69″

At the earth's equator, one degree of latitude and longitude represents 68.7 miles. This means that 0.00001 degrees represents approximately 3.6 feet or 1.1 metres. Each second represents approximately 100.76 ft (30.7m).

This continues to be fairly accurate for latitude but longitude compresses as you approach the poles.

GPS time versus UTC

Most messages report a time in seconds only, representing GPS time. The GPS system operates on its own time base, reported in seconds from the start of the day (midnight). GPS time is offset from UTC by a value reported in the TM (Time/Date) message.

Only the TM (Time/Date) message reports the accurate UTC time. Here the GPS time value is adjusted within the module by the offset (also reported in the message). The hours, minutes, and seconds reported are the computed result giving the UTC time and date.

Configuring the GPS module

Note: An AT command, **AT!MPGPSINIT**, *allows you to include up to five TAIP commands in the initialization string for the modem. (The commands are executed each time the modem is powered.) See the AT Command reference for your product for more details.*

There are several elements of the GPS module that can be configured to better suit your requirements:

- Reporting Format
- Vehicle ID
- Communication Port Parameters

This section discusses the commands and gives some samples. Consult the related TAIP message reference for complete option details.

Reporting format

The data responses from the GPS module can be configured to optionally include or exclude the following elements:

- **Vehicle ID [ID]** – This is a user-configured identification code (four characters). Every response from the GPS module can include this identifier to aid in associating the source unit with received data in cases where a single monitoring system is receiving traffic from multiple units.
- **Checksum [CS]**– In cases where there could be doubt about the integrity of the data received, a checksum can be included in each response. See “Checksum” on page 12 for details on the algorithm used.
- **Echo Set Commands [EC]** – This controls whether or not the module will issue a reply (Report sentence) to commands which make settings. By enabling this feature,

the user can verify that the GPS unit received the correct command settings.

- **Frequency Reporting [FR]** – This is a convenient method to disable or enable auto-response messages from the module. This command will affect both Frequency based reports and Distance based reports.
- **Carriage Return and Line Feed [CR]** – If the receiving system (particularly where direct display of replies are used) requires each reply to appear on a new line, this feature will have the module precede each message with <CR><LF> characters.

The default settings are:

Table 2-3: Default settings for the reporting format

Flag	Default
ID_FLAG	False
CS_FLAG	True
EC_FLAG	True
FR_FLAG	True
CR_FLAG	False

To change a setting, use the RM (Reporting Mode) command with the option flag and desired value. You may set as many options as necessary in a single command line. A semicolon separates each option flag in the line.

Sample: To include the Vehicle ID and exclude the Checksum issue the command:

```
>SRM;ID_FLAG=T;CS_FLAG=F<
```

These settings are retained across warm starts and resets but are restored to defaults on cold starts and resets with the COLD parameter applied. (From a cold start, it may take five minutes for the module to obtain its first satellite fix. From a warm start, it takes less than a minute. For more information, see the *Primer on GPS Operations* available from the Sierra Wireless web site, www.sierrawireless.com.)

Vehicle ID

Each GPS unit can include a Vehicle ID code in each reply, or simply report the value through a direct query. The user sets the value of the four-character ID code. The code can contain any combination of letters and numerals.

See “Reporting format” on page 14 above for information on including the ID in each reply.

Sample: To set the Vehicle ID to 1A12 issue the command:

```
>SID1A12<
```

If the reporting mode is set to include the Vehicle ID (**ID_FLAG=T**) then each reply from this GPS unit will be appended with “**;ID=1A12**”.

These settings are retained across warm starts and resets but are restored to defaults on cold starts and resets with the COLD parameter applied. The setting can be made the default (stored in nonvolatile memory) by using the Reset – Save Configuration setting:

```
>SRTSAVE_CONFIG<
```

Port parameters

Note: Do not change the GPS primary port characteristics on the MP. The GPS module communicates with the software within the modem. Changing the GPS primary port characteristics would break this communication link.

The primary port is used for communication with a host application that issues settings and queries, and receives reports from the module. This port is configured at the factory to use TAIP for both input and output. Only if your application is capable of supporting one of the other protocols available should this be changed.

Automated reporting

Auto-response settings

The GPS module can be configured to issue responses based on either time interval or changes in position (auto-responses). By default the module will issue the PV (Position and Velocity) response at five-second intervals. Most message identifiers support this feature. See the TAIP message reference for details.

In order for the module to issue auto-responses it must have:

- Frequency Reporting enabled (**FR_FLAG=T**), and
- A running real-time clock. The clock will not start until the first satellite is acquired. Once started the clock will continue to run as long as there is, at the least, stand-by power.

Disabling auto-response

Depending on your purpose, you can disable auto-responses in one of two ways.

Suspend all auto-responses temporarily

Set the Frequency Reporting flag to False with the command:

```
>SRM;FR_FLAG=F<
```

This suspends all auto-responses but leaves the configuration of them intact. This method will simultaneously stop all auto-responses for all message identifiers; no matter how many messages were set for auto-responding at the time. All auto-responding commands will retain the time (Frequency) or position change (Distance) settings; ready to resume when Frequency Reporting is restored.

This can be used to temporarily stop the messages while you carry on some specific queries or other activities. When the Frequency Reporting flag is set to True, all suspended reporting will resume, unless they have been explicitly re-configured while suspended.

Disable a specific message's auto-response

Issue the specific command with a frequency setting of 0. (See "Set time interval (frequency) reporting" on page 17 and "Set position change (distance) reporting" on page 18.) This selectively turns off the auto-responding of the named message. If other commands were set to auto-respond, they will continue to do so. To restore the command's auto-responding you will have to reconfigure it.

Set time interval (frequency) reporting

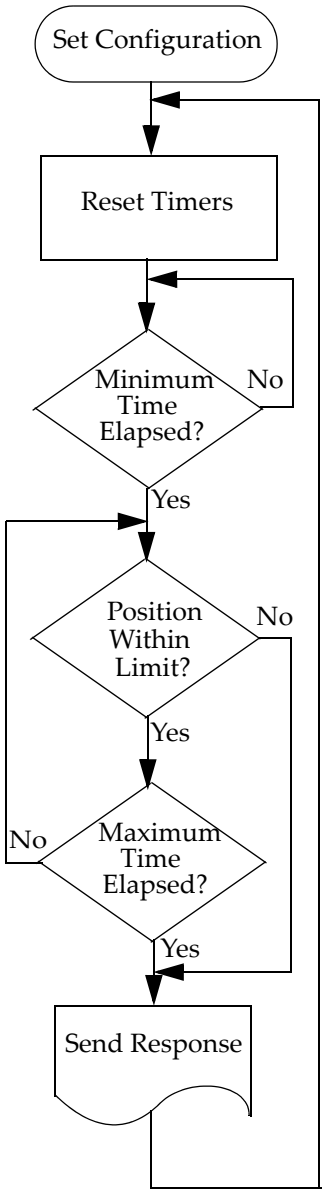
Auto-responses can be configured to be issued at regular time intervals. Any message supporting the Frequency (**F**) prefix allows this setting.

The user selects both the frequency of the response and the epoch – the point from the top of the hour when the frequency count begins. If the epoch is omitted, the modem will use the time at the moment the command is received.

The sentence syntax is the same for all frequency setting messages. The message consists of the qualifier (**F**), the message identifier to be reported, the time interval in seconds, and the epoch. The epoch can be omitted.

If the sentence is sent with the time interval set to 0000 (or omitted entirely), the auto-response for the specified message identifier is disabled until re-configured.

Note: Unless the modem is tracking two or more satellites, the Long Navigation message (see page 27) cannot be generated (automatically or otherwise).



Sample: To have the GPS report the Long Navigation message at 30 second intervals on the quarter minute you would issue this command:

>FLN0030 0015<

This sets the frequency to 0030 seconds and the epoch to 0015 seconds (from the beginning of the hour). Responses will automatically be issued by the GPS twice each minute at 15 seconds and 45 seconds into the minute.

In cases where a fleet of vehicles are reporting to a single host application, it is recommended that frequency reporting on each unit use differing epochs to prevent the communication network from being overwhelmed with messages at the same moment.

Set position change (distance) reporting

In addition to frequency reports based on time change, the module can be configured to issue automatic responses whenever the receiver's position changes by at least the specified amount. This type of configuration also sets time restrictions on responses. The feature is available for any command that allows the Distance (**D**) prefix.

The command includes a minimum time between reports: the reports must not be any more frequent than this regardless of the amount of change in position. An epoch (number of seconds from the beginning of the hour) is used to offset the time-base. If the minimum time is set to 0000 (or all parameters are omitted from the sentence) then the distance auto-response is disabled for the specified message.

There is also a setting for the maximum time allowed between reports. If the receiver does not move the specified distance within this time, a new report will be issued anyway. If the maximum time setting is 0 (or is omitted), this test is bypassed and the unit will have to move in order to issue a report.

The flowchart on the left illustrates the method the module uses to determine when to issue this type of auto-response.

Sample: To have the GPS report the Position and Velocity no more often than every 10 seconds but at least every minute (offset by 8 seconds from the top of the clock) and indicate changes of more than 200 meters, the following command would be used:

>DPV0010 0008 0200 0060<

0010 is the minimum time, **0008** is the epoch, **0200** is the 200-meter limit, and **0060** is the maximum time between reports.

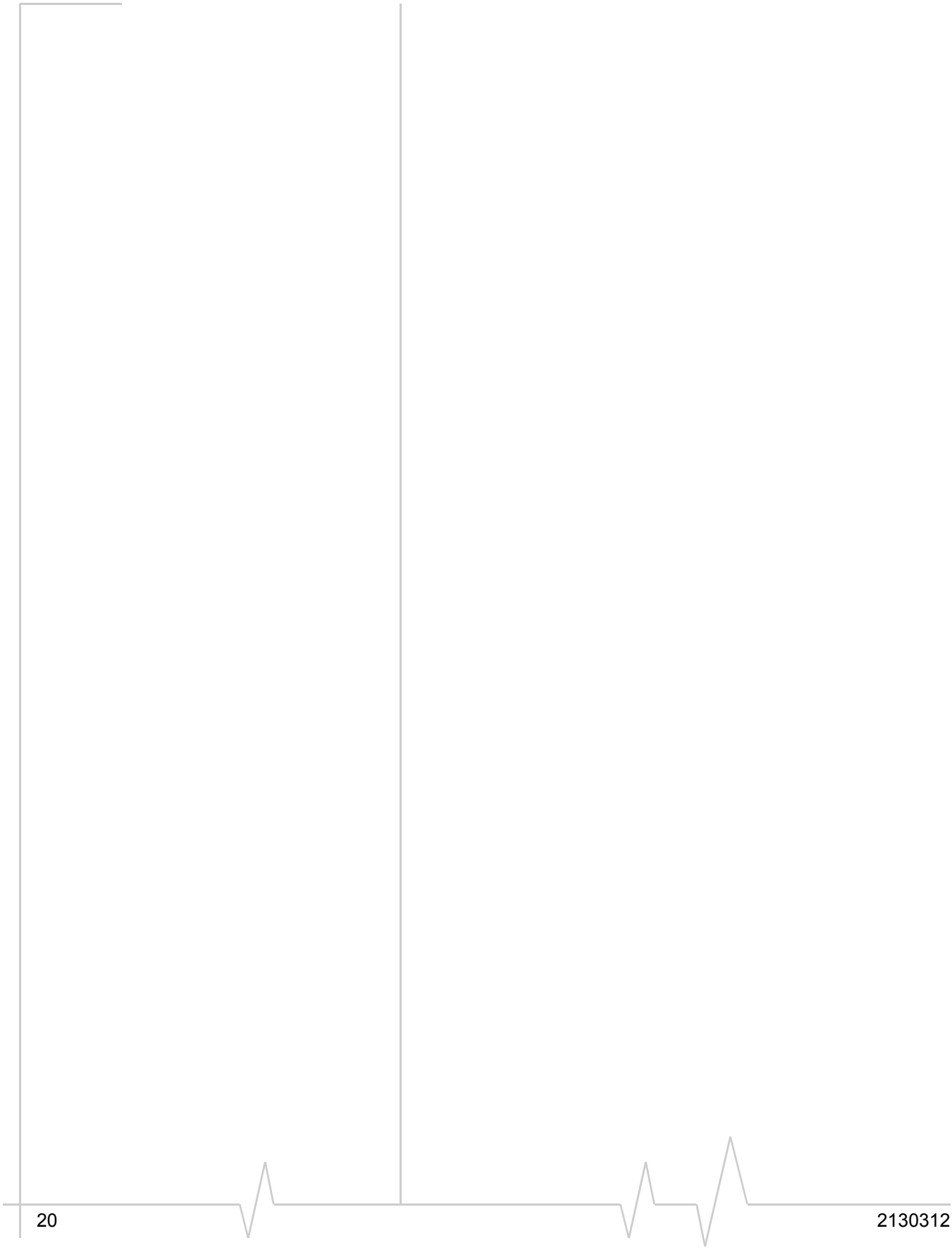
Modem power considerations

The GPS module maintains settings and position data in RAM. This RAM depends on power from the host power supply, usually a vehicle battery. Depending on how the modem is installed, it will be powered on by the vehicle's ignition or by a separate on/off switch. In either case, if the modem is properly connected, the GPS module will receive stand-by power when the modem is powered off, so that the contents of RAM is maintained across power cycles.

In addition, there is a capacitor in the unit that can sustain the RAM and real-time clock for a minimum of 15 minutes when the unit is completely disconnected from its power source. This allows the unit to be moved between vehicles, or servicing of the vehicle battery.

If all sources of power are removed or drained, the contents of RAM will be lost. On the next power-up the GPS module will do a cold start, requiring up to five minutes to acquire its first fix. (See the *Primer on GPS Operations* on the Sierra Wireless web site, www.sierrawireless.com for more details.)

On the next power-up, the GPS module will also load the configuration stored in non-volatile memory, and execute and TAIP commands specified by the AT command **AT!MPGPSINIT**.



3: Message Reference

Syntax conventions

For each message type, the description appears with this sample layout:

MI Message Identifier

MI

Q	✔
S	✘
F	✔
D	✔
R	✔

A description of the message purpose, content and particular features appears here. This particular instance is only a sample. There is no actual **MI** message identifier.

At the left is a box indicating which message qualifiers apply to this message type.

Note that the Query qualifier (**Q**) requires only the message identifier and none of the data string. Also note that the Frequency (**F**) and Distance (**D**) qualifiers use a fixed syntax described above in the previous chapter. The full syntax below applies to Set (**S**) and Report (**R**) qualifiers.

The syntax of the message appears below. The lowercase q is a placeholder for the message qualifier. Any of the valid letters indicated in the box on the left can be used in this position. Shading is used to indicate the field breaks in the data string. Where the letters change but the shade does not, there is an inferred decimal place. This is reinforced in the comments in the table. Optional elements such as Vehicle ID and Checksum are not shown.

If lowercase letters appear inside braces such as "**{f}**" then the item is of variable length.

>qMIAAAAA±BBCCC±DDDEEEEFG<

Item	Format	Bytes	Units	Value	Comments
GPS Time of Day	AAAAA	5	Sec	0 – 86399	
Latitude	**±BBCCC**	7	Deg	North positive, WGS-84	Value is inferred to three decimal places
Longitude	±DDDEEEE	8	Deg	East positive, WGS-84	Value is inferred to four decimal places

Item	Format	Bytes	Units	Value	Comments
Source	**F**	1	N/A	0 = 2D GPS 1 = 3D GPS 6 = DR 9 = Unknown	
Age of data indicator	G	1	N/A	0 = No Fix Yet 1 = Old, 10≥ Sec 2 = Fresh, <10 Sec	

Note: Pay particular attention to units of measure. Some values are metric and some are US!

The table includes value ranges and units where applicable and known. In some cases a list of values is provided with their interpretations.

Altitude/Vertical Velocity

This message, requiring the reception of at least four satellites, reports the altitude relative to mean sea level (in metres) and the vertical velocity (in miles per hour).

>qALAAAAA±BBBBB±CCCDE<

AL

Q	✔
S	✔
F	✔
D	✔
R	✔

Item	Format	Bytes	Units	Value	Comments
GPS Time of Day	AAAAA	5	Sec	N/A	
Altitude	**±BBBBB**	6	Metres		Relative to mean sea level in WGS-84
Vertical Velocity	±CCC	4	MPH	N/A	Value is inferred to four decimal places
Source	**D**	1	N/A	0 = 2D GPS 1 = 3D GPS 2 = 2D DGPS 3 = 3D DGPS 6 = DR 8 = Degraded DR 9 = Unknown	
Age of data indicator	E	1	N/A	2 = Fresh, <10 sec 1 = Old, ≥10 Sec 0 = No Fix Yet	

The Source character (**D**) should be verified to ensure a three-dimensional reading. However, this message contains data obtained from the last successful three-dimensional fix and may not be current.

If the Age of Data Indicator (**E**) is equal to 0, the current data is not available. In this case the data in this message is invalid and should not be used.

Compact Position solution

This message reports time, latitude, and longitude only. The GPS time of day is the time of the fix rounded to the nearest second.

CP

Q	✔
S	✔
F	✔
D	✔
R	✔

>qCPAAAAA**±BBCCCC±**DDDEEEE**F**G**<**

Item	Format	Bytes	Units	Value	Comments
GPS Time of Day	AAAAA	5	Sec	0 – 86399	
Latitude	**±BBCCCC**	7	Deg	North positive, WGS-84	Value is inferred to four decimal places
Longitude	±DDDEEEE	8	Deg	East positive, WGS-84	Value is inferred to four decimal places
Source	**F**	1	N/A	0 = 2D GPS 1 = 3D GPS 2 = 2D DGPS 3 = 3D DGPS 6 = DR 8 = Degraded DR 9 = Unknown	
Age of data indicator	G	1	N/A	0 = No Fix Yet 1 = Old, ≥10 Sec 2 = Fresh, <10 Sec	

If the Age of Data Indicator (**G**) is equal to 0, then the data is not available. In this case, the data in this message is invalid and should not be used.

DC

Q	✘
S	✔
F	✘
D	✘
R	✘

Differential Corrections

Note: Differential GPS is not supported in early releases of the MP GPRS 750 and MP CDMA 555.

This message provides the sensor with differential corrections from RTCM-104 record types 1 and 9. The numerical values are presented in hex format, thus producing two ASCII characters for each byte of data.

The **DC** TAIP message is provided to enclose differential corrections within the TAIP format. This sentence is for input only. There is no acknowledgement or query/report available.

>qDCAAAABBCC{DDEEEEFFGG}<

Item	Format	Bytes	Units	Value	Comments
Modified Z-count	AAAA	4	0.6 sec	WORD	
Station health	BB	2	N/A	BYTE	
Number of SV's	CC	2	N/A	BYTE	

The next 5 bytes (10 characters) are repeated for each SV.

Item	Format	Bytes	Units	Value	Comments
SV PRN and scale factor	DD	2	N/A	BYTE	See note [a] below.
Range Correction	EEEE	4	RTCM-104	WORD	
Range-rate Correction	FF	2	RTCM-104	BYTE	
IODE	GG	2	N/A	BYTE	

a. The "SV PRN and scale factor" contains the SV PRN in the low order five bits and the scale factor in the high order three bits. The scale factor has only three acceptable values: 0 (0b000) for "use with low scale factor," 4 (0b100) for "use with high scale factor," and 7 (0b111) for "don't use." Range corrections are scaled by: 0.02 metres for the low scale factor, and 0.32 metres for the high scale factor.

The units and scale factors are as defined by RTCM-104 version 2.1.

DD

Q	✘
S	✔
F	✘
D	✘
R	✘

Delta Differential corrections

Note: Differential GPS is not supported in early releases of the MP GPRS 750 and MP CDMA 555.

This message provides the sensor with delta differential corrections from RTCM-104 record type 2. The numerical values are written out in hex format, thus producing a hex number represented by two ASCII characters for each byte of data.

The **DD** TAIP message is provided to enclose differential corrections within the TAIP format. This sentence is for input only. There is no acknowledgement or query/report available.

>qDDAAAA**BB{**CC**DDDD}<**

Item	Format	Bytes	Units	Value	Comments
Modified Z-count	AAAA	4	0.6 sec	WORD	
Number of SV's	**BB**	2	N/A	BYTE	

The next 3 bytes (6 characters) are repeated for each SV.

Item	Format	Bytes	Units	Value	Comments
SV PRN and scale factor	CC	2	N/A	BYTE	See note [a] below.
Delta Range Correction	**DDDD**	4	RTCM-104	WORD	

a. The "SV PRN and scale factor" contains the SV PRN in the low order five bits and the scale factor in the high order three bits. The scale factor has only three acceptable values: 0 (0b000) for "use with low scale factor", 4 (0b100) for "use with high scale factor", and 7 (0b111) for "don't use". Delta Range corrections are scaled by: 0.02 metres for the low scale factor, and 0.32 metres for the high scale factor.

The units and scale factors are as defined by RTCM-104 version 2.1.

Identification number

ID

Q	✔
S	✔
F	✔
D	✔
R	✔

This message is used to report the unit's user-assigned identification number, which consists of a unique combination of four alpha-numeric characters, excluding the semicolon character.

If the ID string is shorter than four characters, the module will prefix the string with zeroes (0).

>qIDAAAA<

Item	Format	Bytes	Units	Value	Comments
Vehicle ID	AAAA	4	N/A	The default at cold start is '0000'	The semicolon is not permitted in the string.

The sensor will accept all messages with a matching ID or no specified ID. Messages with an ID different from the one set will be disregarded, even if the Reporting Mode ID Flag is set to false.

If stand-by power fails the vehicle ID will revert to the default. To preserve the setting, use the Reset – Save Configuration command:

>SRTSAVE_CONFIG<

Initial Position

IP

Q	✔
S	✔
F	✔
D	✔
R	✔

This message helps to provide a reference position and altitude; thereby decreasing the amount of time needed to locate the first fix.

Note: This command will only improve the time to first fix if the MP has moved 1000 miles since its previous fix.

The default at cold start and any reset is Latitude 0, Longitude 0, and Altitude 0.

>qIP±AA±BBB±CCCC<

Item	Format	Bytes	Units	Value	Comments
Initial Latitude	±AA	3	Deg	-90 – +90	
Initial Longitude	**±BBB**	4	Deg	-180 – +180	
Initial Altitude	±CCCC	5	10 metres		Relative to mean sea level.

Report forms of this sentence will provide the values of the last setting. The module does *not* update it when accurate fixes are available.

Long Navigation message

LN

Q	✔
S	✔
F	✔
D	✔
R	✔

This message reports the latitude/longitude/altitude, the horizontal and vertical speed, and heading. Unlike the Position/Velocity (**PV**) message, **LN** provides three-dimensional information. The **LN** message also reports the ID's and IODE's of up to eight satellites currently being tracked.

The total length of the sentence will vary based on the number of satellites (SV's) being used.

Note: Unless the modem is tracking two or more satellites, this message cannot be generated (automatically or by command).

>qLNAAAAABBB**±**CCDDDDDDD**±**EEEFFFFFFF**±**GGGGGGGHH**I**IIJ**±**
KKKL**MMMN**OO{**PP**QQ}**RRRRRRRRRR**ST**<**

Item	Format	Bytes	Units	Value	Comments
GPS Time of Day	AAAAABBB	8	Sec	0 – 86399.999	Value is inferred to three decimal places
Latitude	±CCDDDDDDD	10	Deg	North positive, WGS-84	Value is inferred to seven decimal places
Longitude	±EEEFFFFFFF	11	Deg	East positive, WGS-84	Value is inferred to seven decimal places
Altitude relative to mean sea level	±GGGGGGHH	9	Feet	N/A	Value is inferred to two decimal places
Horizontal Speed	IIIJ	4	MPH	N/A	Value is inferred to one decimal place
Vertical Speed	±KKKL	5	MPH	N/A	Value is inferred to one decimal place
Heading	MMMN	4	Deg	Degrees from True North (0) increasing clockwise	Value is inferred to one decimal place
Number of SV's used	OO	2	N/A	0 – 8	
SV ID	PP	2	N/A	N/A	These two entries (four characters) are repeated for each SV used
IODE (2 digit hex)	QQ	2	N/A	N/A	
Reserved	RRRRRRRRRR	10	N/A	N/A	
Source	S	1	N/A	0 = 2D GPS 1 = 3D GPS 2 = 2D DGPS 3 = 3D DGPS 6 = DR 8 = Degraded DR 9 = Unknown	
Age of Data Indicator	T	1	N/A	0 = No Fix Yet 1 = Old, ≥10s 2 = Fresh, <10s	

If the Age of Data Indicator (**T**) is equal to 0, the data is not available. In that case, the information in this message is invalid and should not be used.

Position/Velocity solution

PV

Q	✔
S	✔
F	✘
D	✘
R	✔

This message queries and reports the latitude/longitude, speed, and heading. Unlike Long Navigation (**LN**), the **PV** message provides 2-dimensional information only.

The Set qualifier is provided to allow more accurate initial position setting when doing a cold or warm start. This capability is rarely used.

>qPVAAAAA**±BBCCCCC**±DDDEEEEE**FFF**GGG**H**I**<**

Item	Format	Bytes	Units	Value	Comments
GPS Time of Day	AAAAA	5	Sec	0 – 86399	
Latitude	**±BBCCCCC**	8	Deg	North positive, WGS-84	Value is inferred to five decimal places
Longitude	±DDDEEEEE	9	Deg	East positive, WGS-84	Value is inferred to five decimal places
Speed	**FFF**	3	MPH	N/A	
Heading	GGG	3	Deg	N/A	
Source	**H**	1	N/A	0 = 2D GPS 1 = 3D GPS 2 = 2D DGPS 3 = 3D DGPS 6 = DR 9 = Unknown	
Age of data indicator	I	1	N/A	0 = No Fix Yet 1 = Old ≥ 10 Sec 2 = Fresh < 10 Sec	

If the Age of Data Indicator (**I**) is equal to 0, it is indicating that data is not available and therefore, the data in this message is invalid and should not be used. Under normal operating conditions the module will recalculate this solution once per second.

Reporting Mode

RM

Q	✔
S	✔
F	✘
D	✘
R	✔

This message sets report control flags for configuring the protocol.

Note that each element is optional so only those flags to be changed need to be included in the command. Each element is delimited with a semicolon.

Query and reporting qualifiers will return a message indicating all current settings.

>qRM[;ID_FLAG=A][;CS_FLAG=B][;EC_FLAG=C][;FR_FLAG=D][;CR_FLAG=E]<

Item	Format	Bytes	Units	Value	Comments
ID Flag	A	1	N/A	T=True, F=False	
CS Flag	B	1	N/A	T=True, F=False	
EC Flag	C	1	N/A	T=True, F=False	
FR Flag	D	1	N/A	T=True, F=False	
CR Flag	E	1	N/A	T=True, F=False	

The default settings are:

ID_FLAG = F

CS_FLAG = T

EC_FLAG = T

FR_FLAG = T

CR_FLAG = F

See Section 2.2.1 above for a description of the various flags.

The reporting mode settings are not included in the configuration saved with the Reset – Save Configuration (**RT**) message, although they are preserved across warm resets.

RT

Q	✘
S	✔
F	✘
D	✘
R	✘

Reset

This message only supports the Set qualifier. It performs a soft reset of the GPS module approximately equivalent to a power cycle. There are two optional parameters, any one of which can be used. Uppercase characters are required.

>qRT[COLD|SAVE_CONFIG]<

Item	Bytes	Comments
[ ]	0	(No parameter) Warm start
[COLD]	4	Cold start
[SAVE_CONFIG]	11	Save serial EEPROM user values and do warm reset.

ST

Q	✔
S	✘
F	✔
D	✔
R	✔

Status

The message queries and reports on the operational status of the GPS sensor. This message includes both numeric codes and bitmapped values.

ASCII character pairs are used as hexadecimal representations of bitmapped values. Status Byte 1 has a valid range from 0x00-0x3F while Status Byte 2 ranges from 0x00-0x0F. The data format and meanings of the bits are represented in the following tables.

>qSTAABBCCDDEE<

Item	Format	Bytes	Units	Value	Comments
Tracking Status Code	AA	2	N/A	See Table Below	
Status Byte 1	BB	2	N/A	See Table Below	
Machine ID	CC	2	N/A		A fixed value used to identify the GPS module type. This value may be ignored by the user.
Status Byte 2	DD	2	N/A	See Table Below	
Reserved	EE	2	N/A	Not currently used	

Tracking Status Code

Value of AA	AA Meaning	Comments
00	Doing position fixes	Normal operation of the module.
01	Do not have GPS time yet	Cold start
03	DOP is too high	Dilution of Precision. See note 1 below.
08	No usable satellites	
09	Only 1 usable satellite	
0A	Only 2 usable satellites	
0B	Only 3 usable satellites	
0C	Chosen satellite is unusable	SVeeSix units only

1Dilution of Precision occurs when the available satellites are clustered too closely together in the sky to provide an accurate position fix.

Status Bytes

In the tables below, the items in grey are not supported in the most current modules (ACE II firmware Version 7.80 and above). In some earlier versions of the modules, some of the other bits can be set, though they may not be officially supported.

More detailed descriptions of these items are provided below the tables.

Error Codes – Status Byte 1 Error Codes – Status Byte 2

Bit	Meaning
0	**Battery Backup Fail**
1	Signal Processor Error
2	Alignment Error Channel/Chip 1

Bit	Meaning
0	Synthesizer Fault
1	**Real Time Clock not available at power up**
2	A/D Converter Fault

Bit	Meaning
3	Alignment Error Channel/Chip 2
4	**Antenna Feedline Fault**
5	Excessive Reference Frequency Error
6	N/A
7	N/A

Bit	Meaning
3	**Almanac Incomplete or Unavailable**
4	N/A
5	N/A
6	N/A
7	N/A

Battery Backup Fail – The unit has been disconnected from the vehicle battery for too long; therefore, stand-by power has been removed from the RAM and real-time clock. The module can retain RAM and the real-time clock for a limited period while disconnected from the vehicle battery. If this disconnection lasts too long, this status bit will be set upon restart of the module. This message does not indicate a hardware fault.

When detected, the bit will remain set until the module receives the Reset message (RT) or the unit is power-cycled without losing stand-by power.

Antenna Feedline Fault – The module has detected a short or open on the antenna connector. The status bit will clear immediately upon correction (without needing a reset or power cycle).

Real Time Clock not available at power up – This will occur in conjunction with battery backup failure. The clock will restart as soon as you get a position fix. The error code bit will clear when the clock begins operation.

Almanac Incomplete or Unavailable – There may have been a battery back-up failure in which case the RAM could not be retained. Another possibility is that the last time the module was used, it was not on for a sufficient period of time to assemble a complete almanac.

The status bit will clear as soon as the module has assembled a complete almanac.

Time/date

TM

Q	✔
S	✘
F	✔
D	✔
R	✔

TM reports the time of day and date as computed by the GPS sensor. The time will be in UTC if the GPS UTC offset is available, or in GPS in the GPS UTC offset is not available.

The Set qualifier is not available on units with real-time clocks. Since all modules used by the MP have real-time clocks, this qualifier is considered to be unsupported.

>qTMAABBCCDDDEEFFGGGGHHIJJKLLLLL<

Item	Format	Bytes	Units	Value	Comments
Hours	AA	2	Hours	0-23	
Minutes	BB	2	Min	0-59	
Seconds	CCDDD	5	Sec	0-59.999	Value is inferred to three decimal places
Date; Day	EE	2	Day	1-12	
Date; Month	FF	2	Month	0 = 2D GPS 1 = 3D GPS 2 = 2D DGPS 3 = 3D DGPS 6 = DR 9 = Unknown	
Date; Year	GGGG	4	Year	1997-2016	
GPS/UTC Time Offset	HH	2	Sec	N/A	The difference (in seconds) between the GPS and UTC time standards. (The GPS/UTC Offset Flag indicates whether this is valid.)
Current Fix Source	I	1	N/A	0 = 2D GPS 1 = 3D GPS 2 = 2D DGPS 3 = 3D DGPS 6 = DR 8 = Degraded DR 9 = Unknown	
No. of usable SV's	JJ	2	N/A	0-8	

Item	Format	Bytes	Units	Value	Comments
GPS/UTC Offset Flag	**K**	1	N/A	1 = Valid 0 = Invalid	If this is valid, the UTC time of day is also valid
Reserved	LLLLL	5	N/A	N/A	

The time is most accurate when the unit is doing fixes, as determined by the Status message (**ST**). It is less accurate but still usable when the unit is not doing fixes but the Number of Usable SV's (**JJ**) is one or more.

If all satellite reception is lost this message provides the time from the real-time clock. This will continue to operate as long as the unit has power (including stand-by power from internal capacitors).

Version number

VR

Q	✔
S	✘
F	✔
D	✔
R	✔

This message queries or reports the module's hardware and firmware information.

The items Core Version Number, Core Release Date, and Copyright Text are not supported on ACE II GPS modules. They may appear on some earlier SVeeSix units.

Note: The response to the VR is semicolon delimited and the length is variable.

>qVR{a}; VERSION B.BB(CC/CC/CC); CORE VERSION D.DD(EE/EE/EE);{f}<

Item	Format	Bytes	Units	Value	Comments
Product Name	**a**	N/A	N/A	See Table Below	; delimiter must be used to parse data elements
Major Version No.	B.BB	4	N/A	N/A	
Major Release Date	CC/CC/CC	8	N/A	Month/Day/ Year	
Core Version No.	D.DD	4	N/A	N/A	firmware version
Core Release Date	EE/EE/EE	8	N/A	Month/Day/ Year	
Copyright text	f	Variable	N/A	N/A