TSIP Reference

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Preface

Welcome to the *TSIP Reference*. This publication provides reference information about TSIP (Trimble Standard Interface Protocol). Included is technical information about TSIP packet structures, data formats, and detailed information about TSIP command and report packets. TSIP is a communications protocol for sending configuration commands to Trimble receivers and receiving reports output by Trimble receivers. TSIP commands and reports can be interchanged between a Trimble receiver and an external device using a direct cable connection or wireless communications link.

Scope and Audience

The TSIP information in this publication is of a highly technical nature and is intended for software developers and GPS system integrators.

The typical Trimble receiver user might find this reference information useful for gaining a better understanding of the operation of the TSIP software included with the receiver.

To understand the information included in this manual, you need to have a good understanding of GPS theory of operation, NMEA message types, RTCM SC-104 message types, and a strong understanding of the application for which you plan to develop software or integrate GPS systems. Some information also may require a good understanding of beacon and satellite differential theory of operation and/or the sensors used in GPS/Dead Reckoning systems.

Organization

This manual contains the following chapters:

- Chapter 1, Trimble Standard Interface Protocol provides detailed information about the Trimble Standard Interface Protocol (TSIP) packet structures.
- Chapter 2, Command Packets includes detailed descriptions of TSIP command packets.
- Chapter 3, Report Packets includes detailed descriptions of TSIP report packets.
- Appendix A, Packet Usage Summary summarizes the TSIP command and report packets and identifies the products supported by each packet.
- Appendix E, Machine Control Products provides TSIP implementation clarifications, identifies the supported TSIP packets, and gives the default parameters settings for Machine Control products.

- Appendix B, Mapping Products provides TSIP implementation clarifications, identifies the supported TSIP packets, and gives the default parameters settings for Mapping products.
- Appendix C, Marine Products provides TSIP implementation clarifications, identifies the supported TSIP packets, and gives the default parameters settings for Marine products.
- Appendix E, Machine Control Products provides TSIP implementation clarifications, identifies the supported TSIP packets, and gives the default parameters settings for Machine Control products.
- Appendix D, Mobile Positioning and Communication Products provides TSIP implementation clarifications, identifies the supported TSIP packets, and gives the default parameters settings for Mobile Positioning and Communications products.
- Appendix F, NMEA-0183 Messages, describes the NMEA-0183 sentences supported by the TSIP implementation.
- The Bibliography lists additional reading material.
- The Alphabetical Packet Index lets you lookup packet information alphabetically by packet name.
- The Numerical Packet Index lets you lookup packet information numerically by packet ID.
- The Index lets you lookup words and terms and other topics.

Related Information

This manual contains TSIP reference information for Trimble receivers. The following sections discuss other sources of information.

Document Updates

The *TSIP Reference* is continuously updated as new TSIP improvements are implemented in firmware releases. Printed versions of the *TSIP Reference* are typically released semi-annually. Interim releases of the *TSIP Reference* may be available for download from the Trimble World Wide Web site or ftp (File Transfer Protocol) site. Contact your local Trimble Dealer for more information.

World Wide Web (WWW) Site

For an interactive look at Trimble, visit our site on the World Wide Web (http://www.trimble.com).

File Transfer Protocol (FTP) Site

Use the Trimble FTP site to send files or to receive files such as software patches, utilities, and FAQs. The address is ftp://ftp.trimble.com.

You can also access the FTP site from the Trimble World Wide Web site (http://www.trimble.com/support/support.htm).

Technical Assistance

If you have a problem and cannot find the information you need in the product documentation, ***contact your local dealer***.

Reader Comment Form

Thank you for purchasing this product. We would appreciate feedback about the documentation. Use the reader comment form at the back of this manual or, if this is not available, send comments and suggestions to the address in the front. All comments and suggestions become the property of Trimble Navigation Limited.

Document Conventions

Italics are used for emphasis.

Bold is used to emphasize important topics.

Notes, Tips, Cautions, and Warnings

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

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

Tip – Indicates a shortcut or other time or labor-saving hint that can help you make better use of TSIP.

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

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

1 Trimble Standard Interface Protocol

Trimble receivers can be configured and controlled using the Trimble Standard Interface Protocol (TSIP). This chapter provides an overview of TSIP and gives general guidelines for using TSIP to configure and control Trimble receivers.

Note – The TSIP information in this publication is of a highly technical nature and is intended for software developers and GPS system integrators. The typical Trimble receiver user might find this reference information useful for gaining a better understanding of the operation of the TSIP software included with a Trimble receiver.

The Trimble Standard Interface Protocol (TSIP) allows you to control the GPS receiver and set GPS configuration parameters. For receivers with appropriate capabilities, TSIP can be used to control beacon and satellite DGPS parameters and external sensor configurations. Along with this flexibility, comes the responsibility of making intelligent parameter selections consistent with each other and the overall system application.

Detailed descriptions of TSIP command packets and reports packets are included in Chapter 2, Command Packets and Chapter 3, Report Packets.

The GPS receiver is set to factory default parameter settings for working with a great number of applications. When a customized application is needed, some modification to the standard settings must be applied. Application hints for several packets are described in this chapter to help you use the powerful features of TSIP.

1.1 TSIP Interface Scope

The Trimble Standard Interface Protocol is used in a large number of Trimble electronics and navigation sensor designs. The protocol was originally defined for the Trimble Advanced Navigation Sensor (TANS) and is may be referred to as the TANS protocol even though it is applied to many other devices.

Typically one serial port on the receiver electronics is used to input and output TSIP commands and reports, control the GPS and other electronics, and output data for instrumentation such as:

- Integration with control systems
- Mobile vehicle tracking and management systems
- Navigation processors
- Navigation displays

TSIP is based on the transmission of information packets between your equipment and a Trimble receiver.

1.2 TSIP Implementation Clarifications

The TSIP reference information in this publication is presented in a generic manner. Information for clarifying the TSIP implementation for individual receivers is provided separately in the appendices.

1.2.1 Machine Codes and Product ID Codes

In TSIP, most products are uniquely identified by a product ID and a machine ID, much like people are named with a first and last name. The machine ID, like a last name, associates the GPS receiver with a particular family of Trimble receivers. The product ID, like a first name, uniquely specifies the product within its family. While all Trimble TSIP receivers are assigned a machine ID, not all of them may have a product ID as well. The machine ID is used in Report Packet 0x45, Report Packet 0x4B, and Report Packet 0x8F 0x8F. The product ID is used in Report Packet 0x45, Report Packet 0x8F 0x64, Report Packet 0x8F 0x7B, and Report Packet 0x8F 0x8F. To identify the machine ID and product ID used by a Trimble receiver, see the product specific appendices.

1.2.2 Serial Port Naming Conventions

This publication uses the terms Port A and Port B to refer to the first and second serial ports of a Trimble receiver. These are internal names assigned to Trimble receiver electronics. Many Trimble receivers use the same naming convention to label serial port connectors on the back panel. Some receivers use alternate naming schemes to identify serial ports. Serial port naming conventions for all receivers are described in the appendices.

1.2.3 TSIP Packets Supported by Individual Receivers

Separate descriptions of each TSIP packet are described in Chapter 2, Command Packets and Chapter 3, Report Packets. The product-specific appendices contain lists of the packets supported by individual receivers.

Appendix A, Packet Usage Summary, contains a complete list of TSIP packets and identifies the subset of packets supported by each receivers. You can use this information to quickly identify the packets supported by a specific receiver. Software developers and system integrators might find this information useful when developing applications for multiple Trimble receiver products.

1.3 TSIP Signal Characteristics

The user interface signals are EIA RS-232 or RS-422 using a standard serial format, sent least-significant-bit first, at 9600 baud, with 8 data bits, odd parity, and one stop-bit.

1.4 TSIP Packet Structure

The basic structure of a TSIP packet is the same for both command and report packets. (see Figure 1-1).

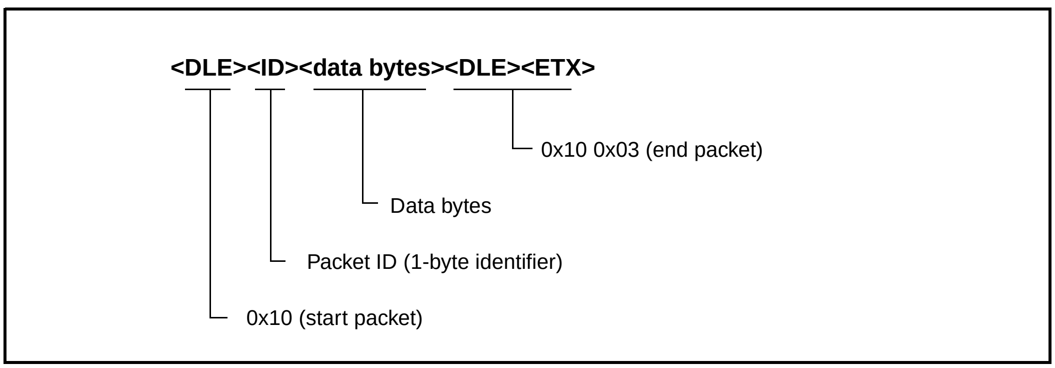


Figure 1-1 TSIP Packet Structure

1.4.1 Packets

<DLE> is the byte 0x10, <ETX> is the byte 0x03, and <ID> is a packet ID byte, which can have any value with the exception of <ETX> and <DLE>. The values of the data bytes varies and are dependent on the function performed by the packet.

To prevent confusion with the starting and ending frame sequences, <DLE> <ID> and <DLE> <ETX> respectively, every <DLE> byte in the <data bytes> of a packet is preceded by an extra <DLE> stuffing byte. These extra <DLE> bytes must be added (stuffed) before sending a packet and removed (unstuffed) after receiving the packet. A simple <DLE> <ETX> sequence does not necessarily signify the end of the packet, as these can be bytes in the middle of a data string. The end of a packet is <ETX> preceded by an odd number of <DLE> bytes.

Note – The 1-byte hexadecimal Packet ID defines the meaning and format of the data in the packet.

1.4.2 Subpackets

Several packets support multiple functions which are processed using subpackets. Subpackets are treated as and behave like separate packets (see Figure 1-2).

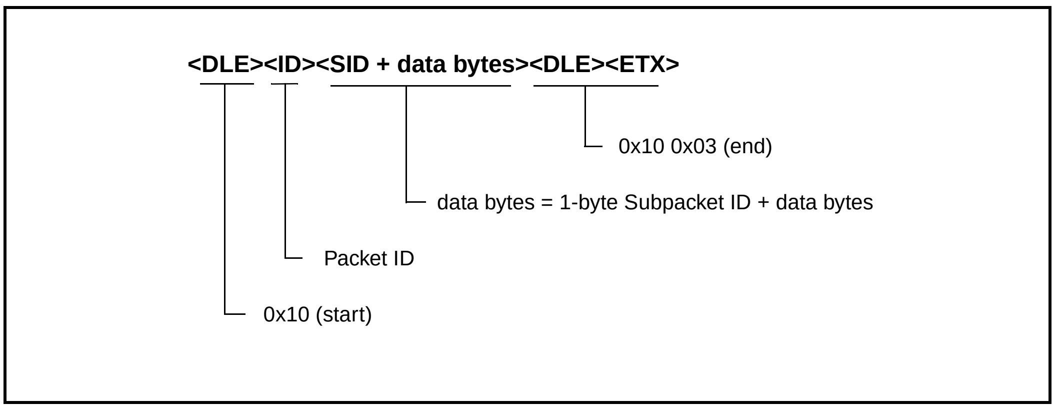


Figure 1-2 TSIP Subpacket Structure

To identify these subpackets, a 1-byte hexadecimal Subpacket ID (SID) is included as the first byte of data. Hexadecimal notation is used to identify the subpackets associated with a packet. For example, 0x8E 0x20 means Command Packet 0x8E Subpacket 0x20, and 0x8F 0x20 means Report Packet 0x8F Subpacket 0x20. The word Subpacket is dropped from and actual descriptions. For example, Command Packet 0x8E Subpacket 0x20 is referred to Command Packet 0x8E 0x20 or more simply as 0x8E 0x20.

1.4.3 Checksums

Some TSIP packets include a checksum at the end of the data bytes. Unless otherwise noted, the checksum is computed over all of the data bytes, excluding the checksum itself, and including a subpacket id, if applicable.

1.4.4 Data Types

Multiple-byte data types follow the ANSI / IEEE Standard and the 754 IEEE Standard for binary Floating-Point Arithmetic. These values are sent most-significant byte first and results in the switching the order of the bytes as they are normally stored. Only the fractional part of the mantissa for real numbers, Single and Double, is reported because the leading bit on the mantissa is always 1.

TSIP supports the following data types:

- **BYTE** – an 8-bit unsigned number
- **INTEGER** – a 16-bit number sent in two's complement format
- **LONG Integer** – A 32-bit number sent in two’s compliment form
- **SINGLE** – single-precision (4-byte) real numbers are sent as a series of four bytes (a, b, c, d). They have a precision of 24 significant bits, roughly 6.5 digits with the following value:

  exponent = 2 (0x7F & a) + (0x80 & b) / 128 - 127

  mantissa = 1 + ((0x7F & b) + (c + d / 256) / 256) / 128

  sign = + if (0x80 & a) is 0, - otherwise.

- **DOUBLE** – double-precision (eight-byte) real numbers are sent as a series of eight bytes (a, b, c, d, e, f, g, h). They have a precision of 52 significant bits, a little better than 15 digits with the following value:

  exponent = 16 (0x7F & a) + (0xF0 & b)/ 16 - 1023

  mantissa = 1 + ((0x0F & b) + (c+ (d+ (e+ (f+ (g+h/ 256) /256) /256) / 256) / 256) / 256) / 16

  sign = + if (0x80 & a) is 0, - otherwise.

1.5 Key GPS Setup Parameters

Correctly selecting the proper GPS operating parameters is important to get the best performance from the GPS electronics. The key GPS command packets follow:

- Command Packet 0x22 (Position Fix Mode Command)
- Command Packet 0x2C (Operating Parameters Command)
- Command Packet 0x35 (I/O Option Flags Command)
- Command Packet 0x62 (DGPS Position Fix Mode Command)
- Command Packet 0xBB (Receiver Configuration Parameters Commands)

The default settings for these GPS parameters allow the receiver to operate under a wide variety of demanding conditions. You can use command packets to change the default GPS parameters if the receiver's default settings are not adequate for a specific receiver application or operating environment.

Warning – When the receiver is operating under conditions different from those established by the default GPS parameter settings, performance can be degraded.

1.5.1 Key Mobile Receiver Setup Parameters

The default parameters produce good GPS performance in almost any environment. You can optimize the receiver to a particular application if the vehicle dynamics and expected signal blockage levels are known. If the receiver is removed from this environment, then a specifically tuned receiver may not operate as well as a receiver with the default options.

Note – Always consult the receiver's operation manual for the optimum parameter settings for specific applications. The operation manual included with a receiver usually specifies optimized GPS parameter settings for horizontal applications. For example, the parameter settings for a Marine reciever product might be optimized for a sea-going vessel, the settings for a Precision Agricultural receiver might be optimized for land-based farm machinery, and the settings for an Intelligent Mobile Tracking receiver might be optimized for use in vehicles operating in urban canyons. The default settings may also be found in the product-specific appendix

1.5.2 GPS Parameter Descriptions

Before configuring the GPS parameters, you must consider the environment in which the receiver is expected to operate. It is important to determine the priorities and make the appropriate selections based on the trade-offs between how frequently a position solution is available versus the absolute accuracy of the solution.

Note – This becomes increasingly important when frequent satellite blockages are expected for example, in downtown urban canyon environments and heavily foliated areas.

If you contrast the sensor performance required for an aircraft flying level, or a marine vessel in a calm sea, with that of a truck or bus being driven in an area of partial or complete blockage due to buildings and trees, then it is clear that different demands are made on the GPS sensor. Accuracy of the position solution is optimized when the *Minimum Projection* (Command Packet 0x35) option flag is ON causing the GPS to output a position solution only when it has a continuous lock on three or more satellites simultaneously. Four SVs are required when the receiver is set to 3D mode.

In a downtown urban canyon, it is difficult to maintain continuous lock on a specific satellite constellation for any length of time. The GPS sensor may find it almost impossible to pick up signals simultaneously from 3 or 4 satellites and is also subject to continuous constellation shifts, since the satellites are frequently blocked from view by tall buildings.

Switching the Minimum Projection Flag to OFF gives the receiver more freedom to select and propagate old measurements to yield a position solution. Where signal blockage occurs, new positions are computed for 2-3 seconds using the last satellite velocity vector before the signal blockage occurred. The drawback is that there is less accuracy than when a continuous lock is maintained.

You can check for the occurrence of this condition by setting the Additional Fix Status to ON (Command Packet 0x35) causing automatic output Report Packet 0x5E to identify the number of old measurements being used. This data is useful where the GPS sensor is used as part of a Dead Reckoning (DR) system to check the independence of measurements. This information can be used as a weighting parameter in computing the overall solution.

PDOP Masks set other limitations as do Elevation and SNR Masks. You must be satisfied with a lower accuracy provided that solution density or frequency is at an acceptable level.

Avoid setting the Elevation and SNR Masks too low. GPS Satellite geometry is sometimes improved considerably by selecting satellites positioned at a low elevation. Low elevation satellites are subject to significant signal degradation due to greater ionospheric and tropospheric attenuation and signal blockage by passing scenery when the GPS sensor is in a moving vehicle.

GPS codephase data from low-elevation satellites is more difficult to decode and has more noise. Set the Elevation Mask between 5° and 10° whenever possible.

The Dynamics Code should be set correctly to optimize the search algorithm for satellites if there has been a complete loss of lock due to short periods of signal blockage.

1.5.3 GPS Position Fix Mode

For the best accuracy, the preferable GPS position fix mode is Manual 3D (three dimensional) where the following calculations are included:

- Altitude
- Latitude
- Longitude
- Time

Four satellites are required to obtain a position with a PDOP below the PDOP Mask set in Command Packet 0x2C. This normally provides the most accurate solution. For example, if only 3D solutions are desired, you should set the 3D Manual mode. This may be restrictive depending on how the PDOP Mask is set; especially when the receiver is subjected to frequent signal blockage or when the geometry is poor due to an incomplete constellation.

Trimble does not recommended using manual 2D position solutions, however if a 2D (two dimensional) solution is needed, set the 2D Manual mode. The sensor uses the last altitude obtained in a 3D solution or the altitude you supplied. Any error in the altitude and altitude error degrades the accuracy of the latitude and longitude solution.

When high accuracy is required for 2D solutions, you must supply an accurate altitude. The limitation is that solutions are only as accurate as the altitude supplied. For example, if a marine user enters sea-level as the altitude, small errors in the horizontal solution occur when the sea state is rough or there are high tidal variations. These errors however, may be smaller than the altitude errors induced by Selective Availability (SA). 2D may be preferable for a marine user who does not want to observe unusual altitudes.

The default mode is Auto 2D/3D. The receiver first attempts to obtain a 3D solution with a PDOP below both the PDOP Mask and PDOP Switch. If this is not possible, the receiver attempts to obtain a 2D solution with a PDOP less than the PDOP Mask. This mode supplies fairly continuous position solutions even when there is frequent signal blockage. This mode is preferable for most land or air applications, where altitude changes are occurring and there is occasional signal blockage.

1.5.4 GPS Operating Parameters

Operating parameters are used to define the:

- Maximum dynamics you expect to experience
- Set of usable satellites based on the GPS satellite geometry at your position

Dynamics Code

For many applications it is reasonable to set the dynamics mode to LAND mode—the receiver assumes a medium dynamic environment, and the satellite search and reacquisition routines are optimized for vehicle type environments. Table 1-1 describes the Dynamic Codes.

Table 1-1 Dynamic Codes

Code	Description
LAND	Satellite search and reacquisition routines are optimized for vehicle type environments.
SEA	Satellite search and reacquisition routines assume a low acceleration environment.
AIR	Satellite search and reacquisition routines are optimized for high acceleration conditions
STATIC	Satellite search and reacquisition routines are optimized for stationary receivers such as reference stations

For additional information, see Command Packet 0x2C on page 2-14 and Report Packet 0x4C on page 3-27.

Elevation Mask

The Elevation Mask establishes the minimum elevation angle for satellites to be used in a solution output by the receiver. Satellites located near the horizon are more difficult to track due to signal attenuation and are also less accurate due to the higher variability in the ionospheric and tropospheric corruption of the signal.

When there are no obstructions, the receiver can track a satellite down to near the horizon. If the Elevation Mask is set too low, the receiver can experience frequent constellation switching due to low elevation satellites being obscured.

Frequent constellation switching is undesirable because position jumps may occur. The size of these jumps is much more noticeable when S/A is present and DGPS is not available. The benefit of a low Elevation Mask is that more satellites are available for use in a solution and a better PDOP may result. An Elevation Mask of 10° provides a reasonable trade-off of the benefits and drawbacks. High accuracy users may prefer a higher mask angle—for example, and Elevation Mask of 15°—where the ionosphere and troposphere begin to be more predictable. The default Elevation Mask value varies depending on the receiver application. For application-specific information, see the appendices. For additional information, see Command Packet 0x2C on page 2-14 and Report Packet 0x4C on page 3-27.

SNR Mask

The SNR Mask defines the minimum signal strength for a satellite to be used in a solution. There is an internal hysteresis on this threshold that allows excursions below the threshold if lock is maintained and the signal was previously above the mask.

The SNR Mask should only be lowered cautiously since this mask is also used to minimize the effects of jammers on the receiver. High accuracy users should use a mask set to 5.0 or 6.0 since weaker measurements can contain slightly more noise. The default value varies depending on the application and are specified in the appendices. For additional information, see Command Packet 0x2C on page 2-14 and Report Packet 0x4C on page 3-27.

PDOP Mask and Switch

The PDOP Mask sets the maximum Position Dilution of Precision (PDOP) for which any 2D or 3D solution is made. The PDOP Switch sets the level at which the receiver stops attempting a 3D solution and attempts to generate a 2D solution in the automatic 2D/3D mode.

The PDOP Switch level does not affect either manual mode. Raising the PDOP Mask increases the position solution density during signal blockage, but position solutions with the higher PDOP are less accurate, especially with S/A present. Lowering the mask improves the average accuracy at the risk of lowering the position solution density.

The default PDOP Mask and PDOP Switch varies depending of the receiver application. For application-specific information, see the appendices.

For additional information, see Command Packet 0x2C on page 2-14 and Report Packet 0x4C on page 3-27.

1.5.5 I/O Options

The I/O Option parameters include options for enabling and disabling the output of automatic reports and options for setting time of fix parameters. The following sections give guidelines for setting Time of Fix parameters to optimize the operation of the receiver.

Fix Computation Time

Several options are available to specify the time of the GPS solution. Table 1-2 describes the Time of Fix parameters.

Table 1-2 Fix Computation Time Parameter Options

Parameter	Description
At Integer Second	Receivers with older architectures use this parameter to ensure that the fix is always calculated at the integer second, instead of at 250 msecs and 750 msecs, etc.The most recent measurements are obtained at each integer second and a solution is then computed for that integer second. The benefit of this mode is the standard fix time. The drawback is that some measurement projection may be performed. Most modern receivers synchronize fixes to the integer second and therefore ignore this setting.
ASAP	In receivers with older architectures, measurements are not taken all at the same time, and positions are calculated as soon as enough measurements are available. Most modern receivers take all the measurements at once and compute fixes at regular intervals (i.e. 1 Hz, 5 Hz, 10 Hz) and therefore ignore this setting.

Minimum Projection Flag

If the receiver loses the signal for one of the GPS satellites in a constellation, a position solution is not computed until a new satellite is added to the constellation. For example, if a four-satellite constellation is required for the current GPS position fix mode and lock on one of the four satellites is lost, the receiver must lock on another satellite to complete the constellation. Such constellation switching can also cause position jumps.

Normally when the Minimum Projection Flag is not set, slightly older measurements on the order of 2-3 seconds are tolerated to provide solutions when obstructions make it impossible to acquire the same constellation.

In applications that require high accuracy instead of high availability, the Minimum Projection Flag should be set ON.

Simultaneous Measurements Flag

All measurements must be tagged with the same time when the Simultaneous Measurements Flag (Command Packet 0x35) parameter is are set. In older receiver architectures, measurements were not guaranteed to be taken simultaneously unless the Simultaneous Measurements Flag was set. The measurements were then all propagated to a common time to calculate a position fix. Most modern receivers automatically take simultaneous measurements, and therefore they ignore this setting.

1.5.6 DGPS Position Fix Mode

The receiver can be configured to operate in Manual GPS mode, Manual DGPS, or Automatic mode using Command Packet 0x62. Command Packet 0x62 is acknowledged with Report Packet 0x82. Table 1-3 describes the differential position fix modes.

Table 1-3 Differential GPS Position Fix Solution Modes

Mode	Description
Manual GPS	Differential correction processing is disabled and position fix solutions are determined without DGPS corrections.
Manual DGPS	The receiver only computes solutions if corrections are available for the selected satellites. Manual DGPS is the most accurate mode but, it is also the most selective since the fix density is dependent on the availability of corrections. Use the Manual DGPS mode if accuracy is critical.
Auto DGPS	The receiver automatically switches between GPS and DGPS mode, depending on the availability of differential correction data. Auto DGPS mode avoids the fix density problem but opens the possibility of moving in and out of DGPS mode resulting in position and velocity jumps. Use the Auto DGPS mode if fix density is critical.

1.5.7 Overdetermined Mode

The receiver can be configured to compute overdetermined solutions and weighted overdetermined solutions.

Overdetermined Mode (non-weighted) directs the receiver to use all currently tracked satellites satisfying the masks for computation of the position fix.

Weighted Overdetermined Mode is similar to overdetermined mode except that different measurements are given different *weights*. The *weights* are determined based on the estimated measurement errors for the satellites used in the position fix.

2 Command Packets

Command packets are sent to the receiver when requesting data, making inquiries about parameter settings or operating modes, or executing commands. Command packets are usually acknowledged by the receiver by returning a response in the form of a report packet to a computer program designed to read or display TSIP packets.

Some command packets contain no data bytes, as in the case where a request for data is sent. Other command packets include data bytes to select options which command the receiver to change a parameter setting or to perform an action.

In some cases, the receiver might acknowledge a command packet by sending one of several report packets based on the data bytes contained in the command packet.

2.1 Command Packet Summary

Table 2-1 lists the command packet ID numbers, provides a short description of each command packet, and identifies all packets returned by the receiver in response to a particular command packet.

Table 2-1 Command Packets

Command Packet ID	Packet Description	Report Packet ID
0x1A	TSIP RTCM Wrapper Command	0x1A
0x1A 0x00	Raw RTCM Data Packet Request	0x1A 0x00
0x1D	Oscillator Offset Command	–
0x1E	Clear Battery-Backed Memory Command	–
0x1F	Receiver Firmware Information Request	0x45
0x20	Almanac Request	0x40
0x21	Current Time Request	0x41
0x22	Position Fix Mode Command	0x44 or 0x6D
0x23	Initial Position (XYZ Cartesian ECEF) Command	–
0x24	GPS Position Fix Mode Request	0x44 or 0x6D
0x25	Soft Reset / Self Test Command	0x45, 0x46, 0x4B, 0x42 or 0x83, 0x4A or 0x84
0x26	Health Request	0x46, 0x4B
0x27	Signal Levels Request	0x47
0x28	GPS System Message Request	0x48
0x29	Almanac Health Page Request	0x49
0x2A	Altitude for 2D Mode Command	–
0x2B	Initial Position (Latitude, Longitude, Altitude) Command	–
0x2C	Operating Parameters Command	0x4C
0x2D	Oscillator Offset Request	0x4D
0x2E	GPS Time Command	0x4E
0x2F	UTC Parameters Request	0x4F
0x31	Accurate Initial Position (XYZ Cartesian ECEF) Command	–
0x32	Accurate Initial Position (Latitude, Longitude, Altitude) Command	
0x33	Analog-to-Digital Readings Command	0x53
0x34	Satellite Number For One-Satellite Mode Command	–
0x35	I/O Option Flags Command	0x55
0x36	Velocity Aiding of Acquisition Command	0x55

Table 2-1 Command Packets (Continued)

Command Packet ID	Packet Description	Report Packet ID
0x37	Last Position and Velocity Request	0x57, 0x42 or 0x83, or 0x4A or 0x84, 0x43 or 0x56
0x38	Download and Upload Satellite System Data	0x57
0x39	Satellite Attribute Database Command	0x59
0x3A	Last Raw Measurement Request	0x5A
0x3B	Satellite Ephemeris Status Request	0x5B
0x3C	Satellite Tracking Status Request	0x5C
0x3D	Serial Port A Communication Parameters Command	0x3D
0x3E	Additional Fix Parameters Request	0x5E
0x60	DGPS Pseudorange Corrections Command	–
0x61	DGPS Delta Pseudorange Corrections Command	–
0x62	DGPS Position Fix Mode Command	0x82
0x65	Differential Correction Status Request	0x85
0x67	Reference Station Parameters Command	0x87
0x67 0x00	Reference Station Control Command	0x87 0x00
0x67 0x01	Reference Station Options Command	0x87 0x01
0x67 0x02	Reference Station Output Version Command	0x87 0x02
0x67 0x03	Reference Station Position Command	0x87 0x03
0x67 0x04	Reference Station ID Command	0x87 0x04
0x67 0x05	RTCM Type 16 Text Command	0x87 0x05
0x67 0x06	RTCM Type Specific Output Intervals Command	0x87 0x06
0x67 0x09	Average Position Reference Station Position Request	0x87 0x09
0x67 0x0A	Time Schedule Message Interval and Offset Request	0x87 0x0A
0x68	Mobile Differential Parameters Command	0x88
0x68 0x00	Mobile Differential Mode Command	0x88 0x00
0x68 0x01	Mobile Differential Options Command	0x88 0x01
0x68 0x02	Mobile Differential Input Version Command	0x88 0x02
0x68 0x03	Masking Reference Station Position Command	0x88 0x03
0x68 0x04	Input Reference Station ID Command	0x88 0x04
0x68 0x05	Last Received RTCM Type 16 Request	0x88 0x05
0x6A	Differential Corrections Used in the Fix Commands	0x6A
0x6A 0x01	Fix Differential Corrections Output Control Command	0x6A 0x01
0x6B	QA/QC Commands	0x8B
0x6B 0x00	Position Sigma Information Parameters Command	0x8B 0x00

Table 2-1 Command Packets (Continued)

Command Packet ID	Packet Description	Report Packet ID
0x6B 0x01	Position VCV Parameters Command	0x8B 0x01
0x6B 0x02	Position Sigma Information Request	0x8B 0x02
0x6B 0x03	Position VCV Information Request	0x8B 0x03
0x6D	Average Position Commands	0x8D
0x6D 0x00	Average Position Start/Stop Control Command	0x8D 0x00
0x6D 0x01	Average Position Options Command	0x8D 0x01
0x6D 0x02	Auto Stop Parameter Options Command	0x8D 0x02
0x6D 0x03	Current Average Position Request	0x8D 0x03
0x6D 0x04	Average Position Delta from Last Position	0x8D 0x04
0x6E	Synchronized Measurement Parameters Commands	0x6F
0x6E 0x01	Synchronized Measurement Parameters Command	0x6F 0x01
0x70	Position/Velocity Filter Command	0x70
0x75	Overdetermined Mode Command	0x76
0x77	Maximum PRC Age Command	0x78
0x7A	NMEA Output Configuration Commands	0x7B
0x7A 0x00	NMEA Interval and Message Mask Command	0x7B 0x00
0x7A 0x01	NMEA Messages to Output By Name List Command	–
0x7A 0x02	NMEA Messages Now By Mask Request	–
0x7A 0x03	NMEA Messages Now By Name List Request	–
0x7A 0x04	Current NMEA Output Messages Mask and/or Name List Request	0x7B 0x04
0x7A 0x05	NMEA Local Time Offset Command	0x7B 0x05
0x7A 0x06	NMEA Message Options Command	0x7B 0x06
0x7A 0x80	NMEA Interval and Message Mask Command	0x7B 0x80
0x7A 0x81	NMEA Messages to Output By Name List Command	–
0x7A 0x82	NMEA Messages Now By Mask Request	–
0x7A 0x83	NMEA Messages Now By Name List Request	–
0x7A 0x84	Current NMEA Output Messages Mask and/or Name List Request	0x7B 0x84
0x7A 0x85	NMEA Local Time Offset Command	0x7B 0x85
0x7A 0x86	NMEA Message Options Command	0x7B 0x86
0x7C	Position Fix or PRC Rate Configuration Commands	0x7D
0x7C 0x00	ASAP Fix Rate Command	0x7D 0x00
0x7C 0x01	Fast Rate I/O Options Command	0x7D 0x01
0x7C 0x02	Position Fix Output Interval and Offset Command	0x7D 0x02
0x7C 0x03	Maximum Measurement Age Command	0x7D 0x03
0x7C 0x05	CTS to Transmit Delay Command	0x7D 0x05
0x7C 0x06	RTS Trailing Edge Delay Command	0x7D 0x06

Table 2-1 Command Packets (Continued)

Command Packet ID	Packet Description	Report Packet ID
0x7C 0x09	Time-Based Message Interval Command	0x7D 0x09
0x8E	Application Commands	0x8F
0x8E 0x20	Super Packet Output Request	0x8F 0x20
0x8E 0x60	DR Calibration Command	0x8F 0x60
0x8E 0x62	GPS/DR Position/Velocity Request	0x8F 0x62
0x8E 0x64	Firmware Name Request	0x8F 0x64
0x8E 0x6B	Gyroscope Calibration Values Command	0x8F 0x6B
0x8E 0x6D	Odometer Calibration Values Command	0x8F 0x6D
0x8E 0x6F	Firmware Version Name and Configuration Block Request	0x8F 0x6F
0x8E 0x70	Beacon Channel Status Request (Obsolete)	0x8F 0x70
0x8E 0x71	Beacon DGPS Station Database Report Request	0x8F 0x71
0x8E 0x73	Beacon Channel Control Command (Obsolete)	0x8F 0x73
0x8E 0x74	Clear Beacon Database Command	0x8F 0x74
0x8E 0x75	FFT Start Command	0x8F 0x75
0x8E 0x76	FFT Stop Command	0x8F 0x76
0x8E 0x78	Beacon Station Attributes Report Request	0x8F 0x78
0x8E 0x79	Beacon Station Attributes Command	0x8F 0x79
0x8E 0x7B	Receiver Configuration Block and Software Version Request	0x8F 0x7B
0x8E 0x7C	Receiver Configuration Block Command	0x8F 0x7C
0x8E 0x7E	Satellite Line-of-Sight (LOS) Request	0x8F 0x7E
0x8E 0x7F	Receiver ROM Configuration Block and Software Version Request	0x8F 0x7F
0x8E 0x80	DGPS Service Provider System Information Request	0x8F 0x80
0x8E 0x81	Decoder Station Information Command	0x8F 0x81
0x8E 0x82	Decoder Diagnostic Information Request	0x8F 0x82
0x8E 0x84	Satellite FFT Control Command	0x8F 0x84
0x8E 0x85	DGPS Source Tracking Status Request	0x8F 0x85
0x8E 0x86	Satellite Database Control	0x8F 0x86
0x8E 0x87	Network Statistics Request	0x8F 0x87
0x8E 0x88	Diagnostic Output Options Command	0x8F 0x88
0x8E 0x89	DGPS Source Control Command	0x8F 0x89
0x8E 0x8A	Service Provider Information Request	0x8F 0x8A
0x8E 0x8B	Service Provider Activation Information Command	0x8F 0x8B
0x8E 0x8E	Service Provider Data Load Command	0x8F 0x8E
0x8E 0x8F	Receiver Identity Request	0x8F 0x8F
0x8E 0x90	Guidance Status Request	0x8F 0x90
0x8E 0x91	Guidance Configuration Command	0x8F 0x91

Table 2-1 Command Packets (Continued)

Command Packet ID	Packet Description	Report Packet ID
0x8E 0x92	Lightbar Configuration Command	0x8F 0x92
0x8E 0x94	Guidance Operation Command	0x8F 0x94
0x8E 0x95	Button Box Configuration Type Command	0x8F 0x95
0x8E 0x96	Point Manipulation Command	0x8F 0x96
0x8E 0x97	Utility Information Request	0x8F 0x97
0x8E 0x98	Individual Button Configuration Command	0x8F 0x98
0x8E 0x9A	Differential Correction Information Request	0x8F 0x9A
0xB0	PPS Signal and Event Commands	0x8F 0x8E
0xB0 0x00	PPS Signal Configuration Command	0xB0 0x80, 0xB0 0x82
0xB0 0x01	PPS Signal Enable/Disable Command	0xB0 0x81
0xB0 0x40	Event Timestamp Selection Command	0xB0 0xC0
0xB0 0x41	Event Packet Options Command	0xB0 0xC1
0xB0 0x42	Event Plus Position Request	0xB0 0xC2
0xB0 0x43	Event Only Request	0xB0 0xC3
0xB0 0x44	Event Marker Miscellaneous Command	0xB0 0xC4
0xBB	Receiver Configuration Parameters Commands	0xBB
0xBB 0x00	Primary Receiver Configuration Parameters Request	0xBB 0x00
0xBC	Serial Port Configuration Parameters Command	0xBC
0xC2	Port A Data Transmission Command	–

2.2 Command Packet Descriptions

0x1A Command Packet 0x1A
TSIP RTCM Wrapper Command

Packet 0x1A allows the GPS receiver to accept RTCM data into the *Control* port.

0x1A 0x00 Command Packet 0x1A 0x00
Raw RTCM Data Packet Request

The raw RTCM data must be wrapped inside a TSIP header and trailer with the appropriate 0x1A packet identifier with a subpacket ID of 0x00 (zero). The raw RTCM data enclosed in Packet 0x1A begins with the header {<DLE>0x1A 0x00}and ends with the trailer {<DLE><ETX>}. For detailed information about the structure of TSIP packets, see section 1.4 on page 1-3. Table 2-2 shows the data format.

Table 2-2 Request Raw RTCM Data Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Raw RTCM Data Packet
1-end	Data	BYTE	*data*	Raw RTCM data

This packet can be generated in base station mode (see Command Packet 0x67 0x01).

If Command Packet 0x7C 0x01 is sent with the “echo RTCM Port A input in Command Packet 0x1A 0x00” turned on, the data is sent out the opposite port.

0x1D Command Packet 0x1D
Oscillator Offset Command

Command Packet 0x1D sets or clears the GPS oscillator offset in battery-backed memory.

The GPS oscillator offset requires clearing only when servicing the receiver or performing field diagnostics. To clear the oscillator offset in the receiver, the receiver is sent one data byte, the ASCII letter C (C = 0x43) as shown in Table 2-3. Clear the oscillator only when specifically told to do so by an authorized Trimble service center.

Table 2-3 Clear Oscillator Offset

Byte #	Item	Type	Value/Units	Meaning
0	Oscillator Offset Clear Flag	BYTE	0x43	Clear the GPS Oscillator offset

To set the oscillator offset, the receiver is sent four data bytes in Command Packet 0x1D as shown in Table 2-4.

Table 2-4 Set Oscillator Offset

Byte #	Item	Type	Value/Units	Meaning
0-3	Oscillator Offset	SINGLE	*Hz*	GPS Oscillator Offset value, in Hz

0x1E

Command Packet 0x1E
Clear Battery-Backed Memory Command

Command Packet 0x1E clears all battery-backed data and performs a software reset to initiate a cold start in the receiver. This packet contains one data byte equal to the ASCII letter K = 0x4B as shown in Table 2-5.

Table 2-5 Clear Battery-Backed Memory

Byte #	Item	Type	Value/Units	Meaning
0	Battery Clear Flag	BYTE	0x4B	Clear all battery-backed data and reset receiver

Caution – When using this packet, the receiver loses all almanac, ephemeris, current position, and mode information. In normal use this packet should not be sent.

0x1F

Command Packet 0x1F
Receiver Firmware Information Request

Command Packet 0x1F can be sent with no data bytes to request the firmware version numbers of a receiver or with two data bytes to request a specific type of firmware information.

When information is requested about the firmware version numbers (Navigation and Signal Processors), there are no data bytes contained in the command packet. In response, the receiver sends Report Packet 0x45. For the second form, Command Packet 0x1F contains data bytes as indicated in Table 2-6, and the receiver sends an extended form of Report Packet 0x45.

Table 2-6 Request Extended Receiver Firmware Information

Byte #	Item	Type	Value/Units	Meaning
0	Machine ID	BYTE	*ID*	Receiver Machine ID. See product-specific appendix for machine IDs.
1	Firmware Information Request	BYTE	*flag*	Requests the receiver configuration or sets the Reset Acknowledgment bit in Report Packet 0x4B: 0 Request Receiver configuration 1 Set Reset Acknowledge bit in Report Packet 0x4B

0x20

Command Packet 0x20
Almanac Request

Command Packet 0x20 requests almanac data for one satellite from the receiver by including one data byte specifying the satellite PRN number. The receiver acknowledges by sending the PRN number in Report Packet 0x40.

0x21 Command Packet 0x21
Current Time Request

Command Packet 0x21 requests current GPS time, and the receiver responds by sending the data in Report Packet 0x41. Command Packet 0x21 contains no data bytes.

0x22 Command Packet 0x22
Position Fix Mode Command

Command Packet 0x22 configures the receiver to operate in a specific position fix mode and stores the new mode setting in battery-backed memory. One data byte is included in the packet to select the position fix mode. Table 2-7 identifies the position fix modes selectable with their corresponding data byte values.

Table 2-7 Set Position Fix Mode

Byte #	Item	Type	Value/Units	Meaning
1	Position Fix Mode	BYTE	*flag*	Position fix mode: 0 Automatic (2D/3D) (*default*) 1 Time only (0D) 3 Horizontal (2D) 4 Full position (3D) 10 Overdetermined clock mode†

† Not all receivers support this mode.

Time only (0D) mode uses a single satellite to determine receiver clock error (time) and error rate (frequency) when the position is precisely known. In this mode, the receiver does not compute positions or velocities and responds by sending the clock bias and bias rate in Report Packet 0x54. Similarly, overdetermined clock mode uses more than one satellite to determine receiver clock error and error rate when the position is precisely known. Time only and overdetermined clock modes are useful for timing applications, allowing the receiver to maintain 1 PPS (Pulse Per Second) accuracy even when a full-position fix is not possible.

0x23

Command Packet 0x23
Initial Position (XYZ Cartesian ECEF) Command

Command Packet 0x23 sends an approximate initial position, in Cartesian ECEF (Earth Centered, Earth Fixed) WGS-84 coordinates, to the receiver. Packet 0x23 is useful when a receiver is moved more than 1,000 miles (approximately) after calculating its last position fix. When Packet 0x23 is received, the receiver immediately searches for visible SVs starting at the approximate initial position and widens the search to all SVs if insufficient SVs are available for calculating a position fix.

Note – The receiver can automatically initialize without requesting additional information from the user, but the initialization process takes longer.

Command Packet 0x23 reduces the time required for initialization. A software reset is not performed by issuing this command, and this command packet is ignored if the receiver is already generating positions. Table 2-8 shows the format of the data bytes for setting initial position in XYZ Cartesian ECEF.

Table 2-8 Set Initial Position (XYZ Cartesian ECEF)

Byte #	Item	Type	Value/Units	Meaning
0-3	X	SINGLE	*meters*	X coordinate position along X-axis of Earth-Centered, Earth-Fixed (ECEF) coordinate system
4-7	Y	SINGLE	*meters*	Y coordinate position along Y-axis of ECEF coordinate system
8-11	Z	SINGLE	*meters*	Z coordinate position along Z-axis of ECEF coordinate system

The X-axis points toward the intersection of the equator and the Greenwich meridian, the Y-axis points toward the intersection of the equator and the 90° meridian, and the Z-axis points toward the North Pole.

0x24

Command Packet 0x24
GPS Position Fix Mode Request

Command Packet 0x24 requests the current position fix mode, DOPs, and selected satellites of the receiver. The receiver responds to the request by sending the information in Report Packet 0x44 or Report Packet 0x6D. Command Packet 0x24 contains no data bytes.

0x25

Command Packet 0x25
Soft Reset / Self Test Command

Command Packet 0x25 initiates a software reset for the receiver, causing the receiver to perform the equivalent of powering off and then on. The receiver performs a self-test during the reset routine. Command Packet 0x25 contains no data bytes. The receiver acknowledges the request by returning Report Packets 0x41, 0x45, 0x46, 0x4B, (0x42 and 0x4A) or (0x83 and 0x84).

Tip – The receiver sends Report Packet 0x45 only when powering up and resetting (or on request). When Report Packet 0x45 is sent by the receiver without request, the receiver has either powered up or has been reset.

0x26

Command Packet 0x26
Health Request

Command Packet 0x26 requests health and status information from the receiver, and the receiver responds by returning Report Packet 0x46 and Report Packet 0x4B. Command Packet 0x26 contains no data bytes.

0x27

Command Packet 0x27
Signal Levels Request

Command Packet 0x27 requests signal levels for all satellites currently being tracked by the receiver, and the receiver responds by sending the information in Report Packet 0x47. Command Packet 0x27 contains no data bytes.

0x28

Command Packet 0x28
GPS System Message Request

Command Packet 0x28 requests the GPS system ASCII message sent with the navigation data by each satellite, and the receiver responds by sending the data in Report Packet 0x48. Command Packet 0x28 contains no data bytes.

0x29

Command Packet 0x29
Almanac Health Page Request

Command Packet 0x29 requests the health page from the almanac stored in the receiver, and the receiver responds by sending the health page in Report Packet 0x49. Command Packet 0x29 contains no data bytes.

0x2A Command Packet 0x2A

Altitude for 2D Mode Command

Command Packet 0x2A sets or requests the altitude parameters used when the receiver is operating in Manual 2D mode. The receiver responds to Packet 0x2A by setting the altitude parameters defined by the data bytes in the packet. When Packet 0x2A contains no data bytes, the receiver sends all current altitude values in Report Packet 0x4A. Table 2-9 through Table 2-11 show the data byte values for setting the 2D altitude parameters.

Table 2-9 Set Altitude Only

Byte #	Item	Type	Value/Units	Meaning
0-3†	Reference Altitude	SINGLE	*altitude*	Reference altitude for 2D

† Sets the Altitude Flag and sets the Inverse Variance to default.

Table 2-10 Set Altitude and Inverse Variance

Byte #	Item	Type	Value/Units	Meaning
0-3	Reference Altitude	SINGLE	*altitude*	Reference Altitude is used for manual 2D positions when the Altitude Flag is set. The altitude value is in units of HAE WGS-84 or MSL depending on the selected I/O options for the position
4-7	Inverse Variance	SINGLE	10-100	Inverse Altitude Variance is the scale factor for estimating reference altitude accuracy. This value ranges from 10.0 (indicating an accuracy of 10 cm) to 100.0 (indicating an accuracy of 1 cm, the default)

Table 2-11 Set Altitude Flag

Byte #	Item	Type	Value/Units	Meaning
0	Altitude Flag	BYTE	*flag*	Determines whether or not the Reference Altitude and Inverse Altitude Variance parameters are used when the receiver operates in 2D mode. The parameters are used when the Altitude Flag is set, and when the Altitude Flag is cleared, the last 3D altitude (altitude hold) is used. 0 Not used 1 Used

0x2B Command Packet 0x2B
Initial Position
(Latitude, Longitude, Altitude) Command

Command Packet 0x2B is used to set an approximate initial WGS-84 position (latitude, longitude, and altitude coordinates) for the receiver. Command Packet 0x2B is useful when a receiver is moved more than 1,000 miles from the location of the last position fix.

Command Packet 0x2B causes an immediate search for the visible SVs starting at the approximate initial position and widens the search to all SVs if the receiver cannot acquire enough SVs to generate a position. The receiver can initialize without any data from you, but it takes more time to generate a position.

Command Packet 0x2B does not perform a software reset and is ignored when the receiver is already generating positions. Table 2-12 shows the data format.

Table 2-12 Set Initial Position (LLA)

Byte #	Item	Type	Value/Units	Meaning
0-3	Latitude	SINGLE	*radians, north*	Latitude coordinate of approximate initial position.
4-7	Longitude	SINGLE	*radians, east*	Longitude coordinate of approximate initial position.
8-11	Altitude	SINGLE	*meters*	Altitude at approximate initial position.

0x2C Command Packet 0x2C
Operating Parameters Command

Command Packet 0x2C sets the operating parameter values of a receiver or requests the current parameter values, and the receiver responds by sending the parameter values in Report Packet 0x4C. The receiver stores the operating parameters in battery-backed memory. Table 2-13 and Table 2-14 show the data formats.

Table 2-13 Request or Set Operating Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Dynamics Code	BYTE	Table 2-14	Sets expected vehicle dynamics (velocity) used when computing the initial solution
1-4	Elevation Mask	SINGLE†	*radians*	Sets lowest acceptable elevation angle for satellites included in position solutions
5-8	Signal Level Mask	SINGLE†	*AMUs*	Sets minimum signal level for satellites included in position solutions. For a description of AMUs, see Report Packet 0x5A on page 3-41.
9-12	PDOP Mask	SINGLE†	*PDOP*	Sets maximum PDOP for satellites included in position solutions
13-16	PDOP Switch	SINGLE†	*PDOP*	Sets transition between 2D and 3D mode when the receiver is operating in Auto 2D/3D position fix mode. A 3D position fix is computed when 4 or more satellites are available and the resulting PDOP is less than the PDOP Switch value

† A negative value in a Single field leaves the current setting unchanged.

Table 2-14 Byte 0, Dynamics Codes

Dec	Hex	Dynamics Code Meaning	Approximate Acceleration
0	0x00	Current value left unchanged	
1	0x01	Land mode	< 2 g
2	0x02	Sea mode	< 1 g
3	0x03	Air mode	< 4 g
4	0x04	Static mode	Stationary

When the *Dynamics Code* is set to static and the fix mode is automatic (set by Command Packet 0x22), the receiver enters automatic 1-satellite mode when a position fix cannot be performed but there is at least one usable satellite. In this mode, no positions or velocities are computed. Instead, the receiver sends Report Packet 0x54 with the clock bias and bias rate. As long as the receiver remains stationary, this mode can be used for time transfer applications and to enable the receiver to maintain the accuracy of the 1 PPS (Pulse Per Second) output even if a full position fix is not possible.

0x2D

Command Packet 0x2D
Oscillator Offset Request

Command Packet 0x2D requests the calculated offset of the receiver GPS oscillator, and the receiver responds by returning Report Packet 0x4D. The permissible oscillator offset varies with the particular receiver. This packet is used mainly for service. Command Packet 0x2D contains no data bytes.

0x2E

Command Packet 0x2E
GPS Time Command

Command Packet 0x2E sets the approximate GPS time of week and the week number in receiver memory, and the receiver responds by sending Report Packet 0x4E. The GPS week number reference is Week # 0 starting January 6, 1980. The seconds count begins at midnight each Sunday morning. Table 2-15 shows the data format.

Table 2-15 Set GPS Time

Byte #	Item	Type	Value/Units	Meaning
0-3	GPS time	SINGLE	*seconds*	GPS time of week
4-5	GPS week	INTEGER	*weeks*	GPS week number

0x2F

Command Packet 0x2F
UTC Parameters Request

Command Packet 0x2F requests the current UTC-to-GPS time offset (leap seconds), and the receiver responds by sending Report Packet 0x4F. Command Packet 0x2F contains no data bytes.

0x31

Command Packet 0x31
Accurate Initial Position (XYZ Cartesian ECEF) Command

Command Packet 0x31 provides an accurate initial position to the receiver in XYZ coordinates and is similar to the content in Command Packet 0x23. Command Packet 0x31 is used for satellite acquisition aiding in systems where another source of position is available and/or in time-transfer (1-satellite mode) applications. For acquisition aiding, the position provided to the receiver in this packet should be accurate to a few kilometers. To achieve high-accuracy time transfer, the position should be accurate to within a few meters.

0x32 Command Packet 0x32
Accurate Initial Position
(Latitude, Longitude, Altitude) Command

Command Packet 0x32 provides the receiver with an accurate initial position in latitude, longitude, and altitude coordinates, and is similar in content to Command Packet 0x2B. Command Packet 0x32 is used for satellite acquisition aiding in systems where another source of position is available and/or in time-transfer (1-satellite mode) applications.

For acquisition aiding, the position provided to the receiver in this packet should be accurate to within a few kilometers. To achieve high-accuracy time transfer, the position should be accurate to within a few meters.

0x33 Command Packet 0x33
Analog-to-Digital Readings Command

Command Packet 0x33 requests reports from the analog-to-digital channels. The command packet contains no data bytes. The receiver returns the analog to-digital reports in Report Packet 0x53.

Command Packet 0x33 and Report Packet 0x53 are primarily intended for Trimble production testing and field diagnostics.

0x34 Command Packet 0x34
Satellite Number For One-Satellite Mode Command

Command Packet 0x34 lets the user assign the satellite used for the 1-satellite mode. The receiver does not retain the satellite assignment in battery-backed memory. Packet 0x34 contains one data byte as shown in Table 2-16.

Table 2-16 Set Satellite Number for One-Satellite Mode

Byte #	Item	Type	Value/Units	Meaning
0	SV PRN	BYTE	*ID*	Pseudorandom number of the satellite to track: 0 Use valid satellite with highest elevation above horizon. This is the setting for the receiver if it does not receive Command Packet 0x34. 1-32 PRN of satellite to use

0x35 Command Packet 0x35
I/O Option Flags Command

Command Packet 0x35 requests or sets the current I/O option flags, and the receiver responds by sending Report Packet 0x55. Packet 0x35 is sent with no data bytes when requesting the I/O option flags, or with 4 data bytes when setting the option flags. The receiver records the I/O option flag settings in battery-backed memory. Table 2-17 describes the I/O option flag settings and the byte values for changing these I/O option flags. For factory default values, consult product-specific appendix.

Table 2-17 Request or Set I/O Option Flags

Byte #	Item	Type	Value/Units	Meaning
0	Position Flags	BYTE	*flags*	Sets options for position and altitude-related data
1	Velocity Flags	BYTE	*flags*	Sets options for velocity-related data
2	Timing Flags	BYTE	*flags*	Sets options for time-related data
3	Auxiliary Flags	BYTE	*flags*	Sets other miscellaneous options

Table 2-18 Byte 0, Position Flags

Bit	Meaning
0	Automatic output of XYZ ECEF position data in Report Packet 0x42 or Report Packet 0x83:† 0: Off 1: On
1	Automatic output of LLA position data in Report Packet 0x4A or Report Packet 0x84:† 0: Off 1: On
2	Format of LLA altitude data output in Report Packet 0x4A or Report Packet 0x84:† 0: HAE WGS-84 1: MSL
3	Format of altitude data input in Command Packet 0x2A: 0: HAE WGS-84 1: MSL
4	Numeric precision of position data in automatic reports: 0: Send single-precision data in Report Packet 0x42 and/or Report Packet 0x4A 1: Send double-precision data in Report Packet 0x83 and/or Report Packet 0x84
5	Automatic output of Super Packet data in Report Packet 0x8F 0x20: 0: Off 1: On
6-7	Reserved (set to zero)

† Selection of single-precision or double-precision report packet is determined by bit setting of Byte 4.

Table 2-19 Byte 1, Velocity Flags

Bit	Meaning
0	Automatic output of XYZ ECEF data in Report Packet 0x43: 0: Off 1: On
1	Automatic output of ENU data in Report Packet 0x56: 0: Off 1: On
2-7	Reserved (set to zero)

Table 2-20 Byte 2, Timing Flags

Bit	Meaning
0	Type of Time data: 0: GPS time 1: UTC
1	Fix computation time: 0: ASAP 1: At Integer Second
2	Time of position fix output in Command Packet 0x37: 0: When Computed 1: On request
3	Simultaneous Measurements Status: 0: Off 1: On
4	Minimum Projection: 0: Off 1: On
5-7	Reserved (set to zero)

Table 2-21 Byte 3, Auxiliary Flags

Bit	Meaning
0	Automatic output of raw measurement data in Report Packet 0x5A: 0: Off 1: On
1	Raw or filtered codephase measurements: 0: Raw 1: Filtered
2	Automatic output of Additional Fix Status information in Report Packet 0x5E: 0: Off 1: On
3-7	Reserved (set to zero)

0x36 Command Packet 0x36
Velocity Aiding of Acquisition Command

Command Packet 0x36 sends velocity information to the GPS receiver from an external source to aid in satellite acquisition and reacquisition. Table 2-22 shows the data format.

Table 2-22 Set Velocity Aiding of Acquisition

Byte #	Item	Type	Value/Units	Meaning
0	Coordinate Selection	BYTE	*flag*	Select ECEF or ENU coordinates: 0 ECEF 1 ENU (East, North, Up)
1	Velocity Aiding Flag	BYTE	*flag*	Velocity Aiding flag status: 0 Disable 1 Enable (see note below) When the velocity aiding enable flag is set to 1, the GPS receiver assumes that velocity data is accurate to 25 meters per second or better and can be used for aiding. The GPS receiver uses the velocity data until another Packet 36 is sent with the aiding enable flag set to 0. Once aiding begins, Packet 36 must be sent again whenever velocity changes greater than 25 meters per second occur or until velocity aiding is disabled. A flag value of 0 disables velocity aiding. The velocity aiding data is ignored once acquisition occurs, but the aiding data is used again if acquisition is lost.
2-5	X or E	SINGLE	*meters/second*	X or East velocity
6-9	Y or N	SINGLE	*meters/second*	Y or North velocity
10-13	Z or U	SINGLE	*meters/second*	Z or Up velocity

0x37 Command Packet 0x37
Last Position and Velocity Request

Command Packet 0x37 requests information about source codes, time of last fix, GPS week, and UTC offset. The receiver returns Report Packet 0x57 and the appropriate position packet (Report Packet 0x42 or 0x4A, or Report Packet 0x83 or 0x84) and the appropriate velocity packet (Report Packet 0x43 or 0x56), based on the I/O options in effect. Packet 0x37 contains no data bytes.

0x38 Command Packet 0x38
Download and Upload Satellite System Data

Command Packet 0x38 downloads satellite data from one receiver, and uploads the data to another receiver. The receiver acknowledges a download operation by sending the requested data in Report Packet 0x58.

The process of downloading satellite data from one receiver and uploading it to another decreases the amount of time required for the receiver to initialize from a cold start (battery-backed memory cleared). Note that the receiver can initialize itself without uploading data - it merely takes longer.

To download data from one receiver, use only bytes 0-2. To upload the data to another receiver, use all bytes. Table 2-24 shows the data format.

Note – Data can be downloaded from most receivers, but all receivers do not accept uploaded data.

Table 2-23 Request or Load Satellite System Data

Byte #	Item	Type	Value/Units	Meaning
0	Operation	BYTE	*flag*	Determines whether data is uploaded to the receiver or downloaded from the receiver: 1 Download satellite data from receiver 2 Uploads satellite data into receiver if the receiver supports satellite data uploads
1	Type of Data	BYTE	*flag*	Requested data type: 1 Not used 2 Almanac 3 Health page, T_oa, WN_oa 4 Ionosphere 5 UTC 6 Ephemeris
2	SV PRN	BYTE	*flag*	Selects an individual satellite or all satellites (if applicable): 0 Data is not satellite specific 1-32 Data is requested for a specific satellite PRN (pseudorandom number)
3	Length	BYTE	*n*	Number of data bytes to load
4 to *n*+3	Data	*n* BYTEs		Data to be loaded

Caution – Use extreme caution when using this command packet. The structure of satellite data is critical to receiver operation. The action of downloading of data from a receiver to a PC cannot harm the reciever or PC. However, receiver damage could result if the structure of the satellite data is not compatible with the receiver. It is safe to download and upload data between receivers with the same Trimble model number. Contact Trimble before attempting download and upload data between two different Trimble receiver models.

0x39 Command Packet 0x39
Satellite Attribute Database Command

The receiver maintains a satellite attribute database containing 32 records. One record exists for each one of the 32 GPS satellites. Normally, all of the satellites are enabled for use in the computation of solutions, and the health data for the satellite is heeded when computing solutions. This also assumes that the satellites meet the requirements set for the mask parameters for elevation angle, signal level, and PDOP.

Command Packet 0x39 is used to reset the satellite attribute flag for individual satellite records or all satellite records, allowing you to unconditionally disable the corresponding satellite(s) or to ignore the health of the corresponding satellite(s), regardless of whether the satellite(s) meet all other requirements.

This packet is also used to view the current Enable/Disable status and Heed/Ignore status of satellites. The receiver returns Report Packet 0x59 for operation values of 3 and 6 only. When viewing the list of disabled satellite records included in Report Packet 0x59, the satellite records are not numbered, even though they are listed numerically.

Byte 1 is set to a value ranging from 1-32 to select a particular satellite record, or it is set to 0 to select all 32 satellite records. The bit value of Byte 0 determines whether or not the satellite record is enabled or disabled and whether or not the health of the satellite is heeded. Byte 0 performs a variety of operations on the satellites depending on the value of the operation byte. The receiver does not hold this information in battery-backed memory. When powering on and after resetting the receiver, the database records are reset to their default values (all satellites are available for selection when computing a solution, and the health of all satellites is heeded when determining whether or not the satellites are suitable for selection). Table 2-24 shows the data format.

Table 2-24 Request or Set Satellite Disable or Ignore Health

Byte #	Item	Type	Value/Units	Meaning
0	Operation	BYTE	*flag*	Requested operation: 1 Enable satellite(s) for selection 2 Disable satellite(s) for selection 3 Request Enable/Disable attribute status of all satellites 4 Heed health of satellite(s) 5 Ignore health of satellite(s) 6 Request Heed/Ignore attribute status on all satellites
1	SV PRN #	BYTE	*PRN #*	Include data for one satellite or all satellites (where applicable) in request: 0 All 32 satellites 1-32 Any one satellite PRN number

Caution – Use extreme caution when ignoring satellite health. Ignoring health can cause the receiver software to lock up, since an unhealthy satellite could contain defective data. Also, disabling all satellites constrains the receiver, making it impossible to compute positions.

0x3A

Command Packet 0x3A
Last Raw Measurement Request

Command Packet 0x3A requests the most recent raw measurement data for a specified satellite or for all satellites in the current tracking set. The receiver returns Report Packet 0x5A when data is available. Table 2-25 shows the data format.

Tip – The I/O auxiliary option byte (byte 3 of Command Packet 0x35) bit 1 determines whether the received codephase measurement is raw or carrier filtered.

Table 2-25 Request Last Raw Measurement

Byte #	Item	Type	Value/Units	Meaning
0	Satellite #	BYTE	0x00	Satellite(s) data included in report: 0 All satellites in the current tracking set 1-32 Specific satellite PRN number

0x3B

Command Packet 0x3B
Satellite Ephemeris Status Request

Command Packet 0x3B requests the current status of satellite ephemeris data. The receiver acknowledges with Report Packet 0x5B when data is available. Table 2-26 shows the data format.

Table 2-26 Request Satellite Ephemeris Status

Byte #	Item	Type	Value/Units	Meaning
0	Satellite #	BYTE	0x00	Satellite(s) data included in report: 0 All satellites for which ephemeris data is available 1-32 Specific satellite PRN number

0x3C Command Packet 0x3C

Satellite Tracking Status Request

Command Packet 0x3C requests the current satellite tracking status. The receiver acknowledges with Report Packet 0x5C when data is available. Table 2-27 shows the data format.

Table 2-27 Request Satellite Tracking Status

Byte #	Item	Type	Value/Units	Meaning
0	Satellite #	BYTE	0x00	Satellite(s) data included in report: 0 All satellites in the current tracking set 1-32 Specific satellite PRN number

0x3D Command Packet 0x3D

Serial Port A Communication Parameters Command

Command Packet 0x3D sets or requests the communication parameter settings for serial Port A, including the input and output baud rates, the number of data bits, parity, the number of stop bits, the input and output protocols, and the flow control state. The communication parameter settings for Port A are used to control the throughput and format of data processed internally by the receiver.

When Command Packet 0x3D is used to request serial communication parameter settings, the packet is sent with no data bytes. When Command Packet 0x3D is used to set serial communication parameter settings, the packet includes the data bytes described in Table 2-28. The receiver retains these values in battery-backed memory.

Note – The terms Port A and Port B refer to the first and second serial ports on the receiver electronics. Some receivers use alternate naming conventions to identify both the serial port numbers and the serial port connector labels on the back panel of the receiver. Refer to the applicable product-specific appendix for additional information.

Note – Some receivers allow either serial port to be configured independently. These receivers may use this packet to configure the "other" serial port (i.e. if sending packet to Port A which is running TSIP, the configuration changes apply to Port B, and vice versa). Some receivers may use this packet to always configure the serial port explicitly labeled Port A. Refer to the applicable product-specific appendix for additional information.

When the language mode for the input port is set to RTCM, raw RTCM data is processed on Port A. These corrections are used only if the DGPS mode parameter is enabled with Command Packet 0x62.

The following parameter settings are hardware flow control options:

- **Heed CTS** is used to send data when CTS input is asserted and stop sending data when CTS is not asserted (negated). For additional information about the CTS to transmit delay, see Report Packet 0x7D 0x05.
- **Ignore CTS** is used to send data regardless of the CTS input state.
- **RTS Rx mode** is an output signal used to notify an external data source that the receiver input buffer is nearly full and data input must stop.
- **RTS Tx mode** is an output signal used to indicate that the receiver has data ready for output. For additional information about the RTS trailing edge delay, see Report Packet 0x7D 0x06.
- **RTS always high** is an output signal that is always asserted.
- **RTS always low** is an output signal that is always not asserted (negated).

Flow control parameter settings are ignored for receivers that do not support flow control negotiation.

When Command Packet 0x3D is received with no data bytes, the receiver responds by sending the current settings in Report Packet 0x3D.

Table 2-28 Port A Configuration Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Output Baud Rate	BYTE	*flag*	Baud rate of output data: 0 50 bps 1 110 bps 4 300 bps 5 600 bps 6 1200 bps 8 2400 bps 9 4800 bps 11 9600 bps 12 38400 bps 28 19200 bps
1	Input Baud Rate	BYTE	*flag*	Baud rate of input data (see above)
2	Data Bits and Parity	BYTE	*flag*	Data Bits and Parity: 2 7 bits, Even parity 3 8 bits, Even parity 6 7 bits, Odd parity 7 8 bits, Odd parity 18 7 bits, No parity 19 8 bits, No parity

Table 2-28 Port A Configuration Parameters (Continued)

Byte #	Item	Type	Value/Units	Meaning
3	Stop Bits and Flow Control	BYTE	*flag*	Stop Bits and Hardware Flow Control: 7 1 stop bit, heed CTS, normal RTS 15 2 stop bits, heed CTS, normal RTS 23 1 stop bit, ignore CTS, normal RTS 31 2 stop bits, ignore CTS, normal RTS 39 1 stop bit, heed CTS, RTS always 47 2 stop bits, heed CTS, RTS always 55 1 stop bit, ignore CTS, RTS always 63 2 stop bits, ignore CTS, RTS always All receivers do not support flow control negotiation. The stop bit setting is heeded, and the flow control settings are ignored when a receiver does not support flow control.
4	Language Mode for Transmission	BYTE	*flag*	Language Mode for Transmission: 0 TSIP Packets 1 Off 5 NMEA 6 RTCM SC-104 7 Report Packet 0x60 and 0x61 output
5	Language Mode for Reception	BYTE	*flag*	Language Mode for Reception: 0 TSIP Packets 1 RTCM SC-104 6 Off (do not decode Port A input)

Note – The default port parameters vary depending on the receiver. Refer to the applicable product-specific appendix for additional information.

0x3E

Command Packet 0x3E
Additional Fix Parameters Request

Command Packet 0x3E requests the attributes of a position fix, i.e. the number of old measurements used in the fix and whether the fix converged. The GPS receiver acknowledges the request with Report Packet 0x5E. The I/O options can be set by the fourth byte of Command Packet 0x35 to output Report Packet 0x5E continuously.

0x60

Command Packet 0x60
DGPS Pseudorange Corrections Command

Command Packet 0x60 provides the receiver with differential corrections from RTCM SC-104 message types 1 and 9, in TSIP format. Normally, there is no response to this packet, although the RTCM notify packet (Report Packet 0x88 0x08) can be enabled to respond, by setting bit 5 of byte 1 in Command Packet 0x68 0x01. Note that the Station ID will be 6060 in the notify packet if the corrections are from Command Packet 0x60.

The units of measure and scale factors are determined by RTCM SC-104, Version 2 format.

Note – RTCM SC-104 Version 1 formatted messages in TSIP format are not supported by most receivers.

Table 2-29 Set Differential GPS Pseudorange Corrections

Byte #	Item	Type	Value/Units	Meaning
0-1	Z count	INTEGER	*seconds*	Modified Z count in units of 0.6 seconds
2	Station Health Flags	BYTE		Health of reference station
3	Version/Type/# SVs	BYTE	Table 2-30	Sets RTCM message type, version, and number of differential corrections
4,9,...†	Scale/UDRE/ SV Flags	BYTE	Table 2-31	Sets RTCM Version 2 scale factor and UDRE, and pseudorandom numbers for number of satellites used to compute differential corrections
5-6 10-11,...†	PRC	INTEGER	*meters*	Pseudorange corrections for satellites identified in RTCM packet
7,12,...†	RRC	BYTE	*meters/sec*	Range rate correction (value is signed) for satellites
8,13,...†	IODE	BYTE	*IODE #*	Issue of Data Ephemeris used by reference station

† Repeated for up to 12 SVs.

Table 2-30 Byte 3, Station Health Flags

Bit	Meaning
0-5	Number of differential corrections from satellites in this packet
6	RTCM SC-104 Message Type: 0: Type 1 1: Type 9
7	RTCM SC-104 Version:[†] 0: Version 1 1: Version 2

[†] Only RTCM SC-104 Version 2 format is supported.

Table 2-31 Byte 4,9,... Scale/UDRE/SV Flags

Bit	Meaning
0-4	Pseudorandom numbers for satellite
5-6	RTCM SC-104 Version 2 UDRE
7 (MSB)	RTCM SC-104 Version 2 scale factor

0x61 Command Packet 0x61
DGPS Delta Pseudorange Corrections Command

Command Packet 0x61 provides the receiver with delta differential corrections from RTCM SC-104 message type 2, in TSIP format. There is no response to this packet.

The units of measure and scale factors are determined by RTCM SC-104, Version 2 format.

Note – RTCM SC-104 Version 1 formatted messages wrapped in TSIP packets are not supported by the receiver.

Note – Many modern receivers do not need the delta pseudorange corrections and will ignore this packet.

Table 2-32 DGPS Delta Pseudorange Corrections

Byte #	Item	Type	Value/Units	Meaning
0-1	Z count	INTEGER	*seconds*	Modified Z count in 0.6 seconds units
2	Health Flags	BYTE	Table 2-33	Sets RTCM version number and number of delta differential corrections in this packet
3,6,...†	Scale/ UDRE/SV Flags	BYTE	Table 2-34	Sets RTCM Version 2.0 scale factor and UDRE, and pseudorandom numbers of satellite
4-5 7-8,...†	DPRC	INTEGER	*data*	Delta pseudorange corrections for satellite

† Repeated for up to 12 SVs.

Table 2-33 Byte 2, Station Health Flag

Bit	Meaning
0-5	Number of delta differential corrections in packet
6	Reserved (set to zero)
7 (MSB)	RTCM SC-104 Version:† 0: Version 1 1: Version 2 (*default*)

† Only RTCM SC-104 Version 2 format is supported.

Table 2-34 Byte 3,6,... Scale/UDRE/SV Flags

Bit	Meaning
0-4	Pseudorandom numbers of satellite
5-6	RTCM Version 2 UDRE†
7 (MSB)	RTCM Version 2 scale factor

† Not used in Command Packet 0x61 by all TSIP receivers. The UDRE value is taken from the most recent Report Packet 0x60. The UDRE of the Version 2 message is encoded here to provide extra information.

0x62 Command Packet 0x62
DGPS Position Fix Mode Command

Command Packet 0x62 sets or requests the differential GPS position fix mode and other RTCM parameters, and the receiver retains this information in battery-backed memory. When DGPS parameters are requested, Command Packet 0x62 is sent with no data bytes. The position fix modes include: Manual GPS, Manual DGPS, and Automatic.

The receiver acknowledges Command Packet 0x62 by sending the current mode setting in Report Packet 0x82. Table 2-35 and Table 2-36 show two other versions of this packet.

Table 2-35 Request or Set DGPS Position Fix Mode

Byte #	Item	Type	Value/Units	Meaning
0	Mode	BYTE	*flag*	GPS Position Fix Mode: 0 Manual GPS (Mode 0) differential off, directs the receiver to perform position solutions without differential corrections, even if the differential corrections are available 1 Manual DGPS (Mode 1) directs the receiver to perform position solutions only if valid differential correction data is available 2 or 3 Automatic (Mode 2 or 3) directs the receiver to automatically switch between Mode 2 and 3. The receiver automatically operates in mode 2 (differential currently off) when not receiving differential correction data for all satellites in a constellation that meets all other mask requirements. The receiver automatically operates in mode 3 (differential currently on) when receiving differential correction data for all satellites in a constellation that meets all other mask requirements

Table 2-36 Request or Set DGPS Position Fix Mode and Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Mode	BYTE	*flag*	GPS Position Fix Mode: 0 Manual GPS (Mode 0) differential off, directs the receiver to perform position solutions without differential corrections, even if the differential corrections are available 1 Manual DGPS (Mode 1) directs the receiver to perform position solutions only if valid differential correction data is available 2 or 3 Automatic (Mode 2 or 3) directs the receiver to automatically switch between Mode 2 and 3. The receiver automatically operates in mode 2 (differential currently off) when not receiving differential correction data for all satellites in a constellation that meets all other mask requirements. The receiver automatically operates in mode 3 (differential currently on) when receiving differential correction data for all satellites in a constellation that meets all other mask requirements
1	Version	BYTE	*flag*	RTCM Version: 0 Automatic (RTCM Version 1, 2, or PRC Type 9) 1 Version 1 only 2 RTCM Version 2 or PRC Type 9
2-3	Reference Station ID	INTEGER	*flag*	Identification code assigned to the reference station which sends RTCM corrections to the radiobeacon: 0xFFFFID is -1, allows any reference station to be selected *other*: Accept only given reference station ID for use

0x65 Command Packet 0x65
Differential Correction Status Request

Command Packet 0x65 requests the status of differential corrections for a specific satellite or for all satellites for which data is available. The receiver responds by sending Report Packet 0x85 for each satellite if data is available. The contents of Command Packet 0x65 are shown in Table 2-37.

Table 2-37 Request Differential Correction Status

Byte #	Item	Type	Value/Units	Meaning
0	Satellite #	BYTE	0x00	Satellite(s) data included in report: 0 All satellites for which correction status data is available 1-32 Specific satellite PRN number

0x67 Command Packet 0x67
Reference Station Parameters Command

Command Packet 0x67 has several forms differentiated by the Subpacket ID as the first data byte. Each (0x67 subpackets) packet can be thought of as a different command packet. The GPS receiver responds by sending the data in Report Packet 0x87. Table 2-38 through Table 2-60 shows the data format. All reference station parameters including the position must be set before turning on the reference station output by setting the control. The *Port A Language Mode for Transmission* (Command Packet 0x3D, byte 4) must be set to 6 to enable RTCM output. For the best performance from a reference station, the GPS receiver's *Dynamic Code* (Command Packet 0x2C, byte 0) should be set to *static*. The Pseudorange Correction (PRC, Type 1 or 9) message can be output slower than the position fix rate using the *Interval* and *Offset* parameters (see Command Packet 0x7C 0x02).

0x67 0x00 Command Packet 0x67 0x00 Reference Station Control Command

Command Packet 0x67 0x00 turns the reference station on or off, resets the reference station, or requests the current status of the reference station. To request reference station control information, use the packet shown in Table 2-38. To set reference station control, use the packet shown in Table 2-39. The receiver responds by sending the data in Report Packet 0x87 0x01.

Table 2-38 Request Reference Station Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Request Reference Station Control

Table 2-39 Set or Reset Reference Station Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Set Reference Station Control
1	Control	BYTE	*flag*	Reference Station Control: 0 Turn off Reference Station 1 Turn on Reference Station 2 Reset Reference Station

0x67 0x01 Command Packet 0x67 0x01 Reference Station Options Command

Command Packet 0x67 0x01 requests or sets the reference station option flags. Send byte 0 only to request the options, and the receiver responds by sending the data in Report Packet 0x87 0x01. Table 2-40 through Table 2-43 show the data format to set the reference station options.

Table 2-40 Set Reference Station Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Set Reference Station Options
1	Option 1 Flags	BYTE	Table 2-41	First bank of Reference Station option flags
2	Option 2 Flags	BYTE	Table 2-42	Second bank of Reference Station option flags

Table 2-41 Byte 1, Option 1 Flags

Bit #	Option
0 (LSB)	Output RTCM Type 16: 0: No (*default*) 1: Yes
1	Output ASCII Carriage Return after RTCM messages: 0: No 1: Yes (*default*)
2	Output ASCII Line Feed after RTCM messages: 0: No (*default*) 1: Yes
3	Output TSIP wrapper around RTCM messages using Report Packet 0x1A: 0: No (*default*) 1: Yes
4	Output Type 2 messages in RTCM PRC Type 9 mode: 0: No (*default*) 1: Yes
5	Output TSIP RTCM Output Notification using Report Packet 0x87 0x08: 0: No 1: Yes (*default*)
6	Output RTCM PRC (Type 1 or 9): 0: No 1: Yes (*default*)
7	Output Report Packet 0x60 and 0x61 on Port B: 0: No (*default*) 1: Yes

Table 2-42 Byte 2, Option 2 Flags

Bit #	Option	Associated Packet
0 (LSB)	Automatically transfers the average position to the reference position and starts the reference station when the minimum number and/or duration is satisfied:† 0: Off (*default*) 1: On	0x67 0x03, 0x67 0x00
1	Outputs a warning if the reference station is enabled and generating corrections, but the Port A language for transmissions is not set to RTCM or Report Packet 0x60 and 0x61: 0: Output (*default*) 1: Do not output	0x87 0x7E, 0x3D
2	Auxiliary Message Scheduling: 0: PRC Based – interval PRC messages per auxiliary message (Command Packet 0x67 0x06) (default) 1: Time Based – interval and offset within the hour (Command Packet 0x67 0x0A)	
3-7	Reserved (set to zero)	

† When the time duration and/or the number of positions requirement is satisfied and this bit is set to On, the equivalent of the following two commands are performed:

Command Packet 0x67 0x03, Type Value of 5: Copies current average position to reference position.

Command Packet 0x67 0x00, Control Value of 1: Turns the reference station on.

0x67 0x02 Command Packet 0x67 0x02
Reference Station Output Version Command

Command Packet 0x67 0x02 sets or requests the RTCM version output from the reference station. Send the packet with byte 0 only to request the RTCM version. Send the entire packet shown in Table 2-44 when setting the RTCM version. The receiver responds with Report Packet 0x87 0x02.

Table 2-43 Request Reference Station Output Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Requests the RTCM version output by the reference station

Table 2-44 Set Reference Station Output Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Sets the RTCM version output by the reference station
1	Version	BYTE	*flag*	Sets the RTCM version to use when outputting RTCM messages from reference station: 2 Output RTCM Version 2 0xFF Output RTCM PRC Type 9

0x67 0x03 Command Packet 0x67 0x03
Reference Station Position Command

Command Packet 0x67 0x03 requests or sets the Reference Station Position parameter settings. The packet is also used to clear the current reference station position and set the position to the current average position. The reference station position can be set or output in one of several format depending on the byte settings included in the packet. Table 2-45 through Table 2-50 show the format of the data bytes.

Table 2-45 Request Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Request Reference Station Position
1	Type	BYTE	*flag*	Request position in specified units or execute following command: 0 Request position in XYZ ECEF 1 Request position in LLA, Alt in WGS-84 4 Request position in LLA, Alt in MSL

Table 2-46 Set Reference Station Position, XYZ ECEF

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Set Reference Station Position
1	Type	BYTE	0x00	Set XYZ ECEF
2-9	X	DOUBLE	*meters*	X value in meters
10-17	Y	DOUBLE	*meters*	Y value in meters
18-25	Z	DOUBLE	*meters*	Z value in meters

Table 2-47 Set Reference Station Position, LLA, WGS-84, HAE

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Set Reference Station Position
1	Type	BYTE	0x01	Set LLA, WGS-84
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*meters*	Altitude in meters, WGS-84 HAE

Table 2-48 Set Reference Station Position, LLA, WGS-84, MSL

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Set Reference Station Position
1	Type	BYTE	0x04	LLA, MSL
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*meters*	Altitude in meters, WGS-84, MSL

Table 2-49 Set Reference Station Position to the Current Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Set Reference Station Position
1	Type	BYTE	0x02	Set to the current position

Table 2-50 Set Reference Station Position to the Average Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Set Reference Station position
1	Type	BYTE	0x05	Set to current average position

Table 2-51 Clear the Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Set Reference Station Position
1	Type	BYTE	0x03	Clear the position

0x67 0x04 Command Packet 0x67 0x04 Reference Station ID Command

Command Packet 0x67 0x04 requests or sets the Reference Station ID parameter. Report Packet 0x87 0x04 is sent in response.

Table 2-52 Request Reference Station ID

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Request Reference Station ID. The receiver responds by returning the data in Report Packet 0x87 0x04

Table 2-53 Set Reference Station ID

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Set Reference Station ID
1-2	ID	INTEGER	0-1023	Reference Station ID

0x67 0x05 Command Packet 0x67 0x05 RTCM Type 16 Text Command

Command Packet 0x67 0x05 requests or sets the text in RTCM Type 16 records. Report Packet 0x87 0x05 is sent in response to a request for a report.

Table 2-54 Request RTCM Type 16 Text

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Request RTCM Type 16 Text

Table 2-55 Set RTCM Type 16 Text

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Set RTCM Type 16 Text
1-end	Text	BYTE	*ASCII*	Up to 90 characters of ASCII text

0x67 0x06 Command Packet 0x67 0x06
RTCM Type Specific Output Intervals Command

Command Packet 0x67 0x06 requests or sets the RTCM Type Record-Specific Output Intervals.

Send the packet using the structure shown in Table 2-56 to request the data in Report Packet 0x87 0x06:

Table 2-56 Request RTCM Type Specific Output Intervals

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	RTCM Type Specific Output Intervals
1	Type	BYTE	*flag*	Output interval type: 2 Type 2 interval (default 15) 3 Type 3 interval (default 30) 6 Type 6 interval (default 0) 16 Type 16 interval (default 30)

Send the packet using the structure shown in Table 2-57 to set the RTCM Type Specific Output Interval:

Table 2-57 Set RTCM Type Specific Output Interval

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	RTCM Type Specific Output Intervals
1	Type	BYTE	*flag*	Output interval type: 2 Type 2 interval (default 15) 3 Type 3 interval (default 30) 6 Type 6 interval (default 0) 16 Type 16 interval (default 30)
2	Interval	BYTE	*flag*	RTCM message output interval and RTCM record type: 0 Disables message output 1-250 Outputs one message for every Interval PRC (Type 1 or 9) messages 254 Outputs message now (Type 16 only) 255 Sets interval to default value

0x67 0x09 Command Packet 0x67 0x09
Average Position Reference Station Position Request

Command Packet 0x67 0x09 average position reference station position. The receiver sends the data in Report Packet 0x87 0x09.

Table 2-58 Request Average Position – Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x09	Average Position Reference Station Position
1	Type	BYTE	*flag*	Average position in XYZ delta or ENU delta: 0 XYZ delta units 1 ENU delta units

0x67 0x0A Command Packet 0x67 0x0A
Time Schedule Message Interval and Offset Request

Command Packet 0x67 0x0A requests or sets the time schedule message interval and offset.

Table 2-59 Request Time Schedule Message Interval and Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x0A	Time Schedule Interval and Offset
1	Type	BYTE	*flag*	Requests Time Schedule Type: 2 Type 2 time interval and offset 3 Type 3 time interval and offset 6 Type 6 time interval and offset 16 Type 16 time interval and offset

Table 2-60 Set Time Schedule Message Interval and Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x0A	Time Schedule Interval and Offset
1	Type	BYTE	*flag*	Time Schedule type: 2 Type 2 time interval and offset 3 Type 3 time interval and offset 6 Type 6 time interval and offset 16 Type 16 time interval and offset
2-3	Interval	INTEGER	*flag*	Time, in seconds, between message outputs: 0 Message output is off 1-3600 Time between message outputs in seconds (1-3600 seconds) 0xFFFF Sets interval to the default value
4-5	Offset	INTEGER	*flag*	Offsets (delays) the second of message output: 0-3600 Offsets (delays) the second of message output 0xFFFF Sets offset to the default value

0x68 Command Packet 0x68
Mobile Differential Parameters Command

Command Packet 0x68 has several forms differentiated by the subpacket ID as the first data byte. Each 0x68 subpacket can be thought of as a different command packet. The GPS receiver responds by returning the corresponding 0x88 report packet. Table 2-61 through Table 2-76 show the data format.

0x68 0x00 Command Packet 0x68 0x00
Mobile Differential Mode Command

Send the packet using the structure shown in Table 2-61 to request the mobile differential mode in Report Packet 0x88 0x00.

Table 2-61 Request Differential Mode

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Mobile Differential Mode

Send the command packet using the format shown in Table 2-62 when setting the mobile differential mode.

Table 2-62 Set Differential Mode (duplicates Packet 62)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Mobile Differential Mode
1	Mode	BYTE	*flag*	Sets the mobile differential mode: 0 Differential Off (Manual GPS) 1 Differential On Manual (Manual DGPS) 2 or 3 Differential Auto (DGPS if available, otherwise, GPS)

0x68 0x01 Command Packet 0x68 0x01
Mobile Differential Options Command

Send the command packet using the format shown in Table 2-63 when requesting the mobile differential options. Report Packet 0x88 0x01 is sent in response.

Table 2-63 Request Mobile Differential Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Mobile Differential Options

Send the command packet using the format shown in Table 2-64 when settings the mobile differential options

Table 2-64 Set Mobile Differential Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Mobile Differential Options
1	Options 1	BYTE	Table 2-65	Various Mobile Differential Options
2	Options 2	BYTE	0x00	Reserved (set to zero)

Table 2-65 Byte 1 Bit Position Encoding

Bit #	Option
0 (LSB)	Output RTCM Type 16 in Report Packet 0x88 0x05: 0: No (*default*) 1: Yes
1-4	Reserved (set to zero)
5	Output TSIP RTCM Reception Notification in Report Packet 0x88 0x08: 0: No (*default*) 1: Yes
6-7	Reserved (set to zero)

0x68 0x02 Command Packet 0x68 0x02

Mobile Differential Input Version Command

Send the command packet using the format shown in Table 2-66 when requesting the mobile differential RTCM input version.

Table 2-66 Request Mobile Differential Input Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Mobile Differential Input Version. The receiver sends the data in Report Packet 0x88 0x02

Send the command packet using the format shown in Table 2-67 when settings the mobile differential RTCM input version.

Table 2-67 Set Mobile Differential Input Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Mobile Differential Output Version
1	Version	BYTE	*flag*	RTCM Version: 0 Automatic (RTCM Version 1, 2, or PRC Type 9) 1 Accept RTCM Version 1 only 2 Accept RTCM Version 2 or PRC Type 9 only

0x68 0x03 Command Packet 0x68 0x03
Masking Reference Station Position Command

A masking reference station position allows you to use a location other than the current location to determine satellite elevations for satellite tracking determination, and for Elevation Mask comparison. This is useful for long baseline postprocessed applications to ensure that the mobile receiver sees the same set of satellites as the reference station. Table 2-68 through Table 2-71 shows the data format.

Send the command packet using the format shown in Table 2-68 when requesting the masking reference station position.

Table 2-68 Request Masking Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position. The receiver sends the data in Report Packet 0x88 0x03
1	Type	BYTE	*flag*	Select the coordinate system for reporting the position: 0 XYZ ECEF 1 LLA, Alt in WGS-84 HAE 4 LLA, Alt in WGS-84 MSL

Send the command packet using the format shown in Table 2-69 when setting the masking reference station position using XYZ ECEF coordinates.

Table 2-69 Set Masking Reference Station Position, XYZ ECEF

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x00	Set XYZ ECEF
2-9	X	DOUBLE	*meters*	X value in meters
10-17	Y	DOUBLE	*meters*	Y value in meters
18–25	Z	DOUBLE	*meters*	Z value in meters

Send the command packet using the format shown in Table 2-70 when setting the masking reference station position using LLA, WGS-84 HAE coordinates.

Table 2-70 Set Masking Reference Station Position, LLA, WGS-84, HAE

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x01	Set LLA, WGS-84
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*radians*	Altitude in meters WGS-84, HAE

Send the command packet using the format shown in Table 2-71 when setting the masking reference station position using LLA, WGS-84 MSL coordinates.

Table 2-71 Set Masking Reference Station Position, LLA, WGS-84, MSL

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x04	LLA, WGS-84, MSL
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*radians*	Altitude in meters, MSL

Send the command packet using the format shown in Table 2-72 when setting the masking reference station position to your current coordinates.

Table 2-72 Set Masking Reference Station Position to Current Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x02	Set to the current position

Send the command packet using the format shown in Table 2-73 when disabling the masking reference station position.

Table 2-73 Disable the Masking Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x03	Disable the position

0x68 0x04 Command Packet 0x68 0x04 Input Reference Station ID Command

Command Packet 0x68 0x04 requests or sets the input reference station ID. Send the packet using the structure shown in Table 2-74 to request the Input Reference Station ID in Report Packet 0x88 0x04:

Table 2-74 Request Input Reference Station ID

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Input Reference Station ID

Send the packet using the structure shown in Table 2-75 to set the Input Reference Station ID:

Table 2-75 Set Input Reference Station ID

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Input Reference Station ID
1-2	ID	INTEGER	*flag*	Selects Reference Station ID: 0xFFFFAccept any Reference Station ID *other* Accept only this Reference Station ID

0x68 0x05 Command Packet 0x68 0x05 Last Received RTCM Type 16 Request

Command Packet 0x68 0x05 requests the last received RTCM Type 16 record. Report Packet 0x88 0x05 is sent in response.

Table 2-76 Request Last Received RTCM Type 16

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Last Received RTCM Type 16 Request

0x6A Command Packet 0x6A
Differential Corrections Used in the Fix Commands

Command Packet 0x6A has several forms differentiated by the subpacket ID as the first data byte. Each 0x6A subpacket can be thought of as a different command packet. The GPS receiver responds by returning the corresponding 0x6A report packet.

0x6A 0x01 Command Packet 0x6A 0x01
Fix Differential Corrections Output Control Command

Command Packet 0x6A 0x01 controls whether or not the receiver will output the fix differential corrections in Report Packet 0x6A 0x00 when the receiver is calculating differential position fixes. To query for the fix differential corrections output settings, send Command Packet 0x6A 0x01 as data bytes.

Table 2-77 Fix Differential Corrections Output Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Fix Differential Corrections Output Control
1	Output Enabled	BYTE	*flag*	Fix differential corrections output: 0 Disable 1 Enable
2-3	Reserved	BYTE	0x00	Reserved (set to zero)

0x6B Command Packet 0x6B
QA/QC Commands

Command Packet 0x6B has several forms that are differentiated by the subpacket ID as the first data byte. Each (0x6B subpacket) packet can be thought of as a different command packet. Table 2-78 through Table 2-83 show the data formats. The GPS receiver responds by returning the corresponding 0x8B report packet.

0x6B 0x00 Command Packet 0x6B 0x00
Position Sigma Information Parameters Command

Send the command packet using the format shown in Table 2-78 when requesting the position sigma information parameters. Report Packet 0x8B 0x00 is sent in response.

Table 2-78 Request Position Sigma Information Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Request Position Sigma Information Parameters

Send the command packet using the format shown in Table 2-79 when setting the position sigma information parameters. Report Packet 0x8B 0x00 is sent in acknowledgment.

Table 2-79 Set Position Sigma Information Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Position Sigma Information Parameters
1	Enable	BYTE	*flag*	Automatic output of information: 0 Disable 1 Enable
2-5	Reserved	BYTE	0	Reserved (set to 0)
6-7	Checksum	INTEGER		Checksum

0x6B 0x01 Command Packet 0x6B 0x01
Position VCV Parameters Command

Send the command packet using the format shown in Table 2-80 when requesting the position VCV parameters. Report Packet 0x8B 0x01 is sent in response.

Table 2-80 Request Position Sigma VCV Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Request Position Sigma VCV Parameters

Send the command packet using the format shown in Table 2-81 when setting the position VCV parameters. Report Packet 0x8B 0x01 is sent in acknowledgment.

Table 2-81 Set Position VCV Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Position VCV Parameters
1	Enable	BYTE	*flag*	Automatic output of information: 0 Disable 1 Enable
2-5	Reserved	BYTE	0	Reserved (set to 0)
6-7	Checksum	INTEGER		Checksum

0x6B 0x02 Command Packet 0x6B 0x02

Position Sigma Information Request

Send the command packet using the format shown in Table 2-82 when requesting the a single position sigma information report. To enable automatic output of the position sigma information, use Command Packet 0x6B 0x00. Report Packet 0x8B 0x02 is sent in response.

Table 2-82 Request Position Sigma Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Request Position Sigma Information

0x6B 0x03 Command Packet 0x6B 0x03

Position VCV Information Request

Send the command packet using the format shown in Table 2-83 when requesting the a single position VCV information report. To enable automatic output of the position VCV information, use Command Packet 0x6B 0x01. Report Packet 0x8B 0x03 is sent in response.

Table 2-83 Request Position VCV Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Request Position VCV Information

0x6D Command Packet 0x6D
Average Position Commands

Command Packet 0x6D allows the user to average position fixes computed by the receiver. The averaging can be performed over a predetermined period of time, for a predetermined number of positions, or until the averaging process is stopped by the user.

If the receiver also has reference station capability, the receiver can be configured to automatically start the reference station using the average position, after the averaging process has progressed for a user-defined duration of time and/or achieved a user-defined number of positions in the average. For more information see Command Packet 0x67 0x01, Byte 2, Bit 0.

0x6D 0x00 Command Packet 0x6D 0x00
Average Position Start/Stop Control Command

Command Packet 0x6D 0x00 requests or sets the Average Position Stop/Stop Control as shown in Table 2-84 and Table 2-85. The receiver responds by sending the data in Report Packet 0x8D 0x00.

Table 2-84 Request Average Position Start/Stop Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Request Average Position Start/Stop Control

Table 2-85 Set Average Position Start/Stop Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Average Position Start/Stop Control
1	Control	BYTE	*flag*	Average position start/stop control: 0 Stop averaging positions 1 Restart averaging positions 2 Continue to average positions. Ignored if averaging is on

0x6D 0x01 Command Packet 0x6D 0x01
Average Position Options Command

Command Packet 0x6D 0x01 requests or sets the average position options as shown in Table 2-86 and Table 2-87. The receiver responds by sending the data in Report Packet 0x8D 0x01.

Table 2-86 Request Average Position Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Request Average Position Options

Table 2-87 Set Average Position Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Average position options
1	Option Flags 1	BYTE	Table 2-88	First bank of Option flags
2	Option Flags 2	BYTE	Table 2-89	Second bank of Option flags

Table 2-88 Byte 1, Option 1 Flags

Bit #	Option
0 (LSB)	Generate Report Packet 0x8D 0x03 with the Average Position in XYZ ECEF units: 0: No 1: Yes
1	Generate Report Packet 0x8D 0x03 with the Average Position in LLA, WGS-84, HAE units: 0: No 1: Yes
2	Generate Report Packet 0x8D 0x03 with the Average Position in LLA, WGS-84, MSL units: 0: No 1: Yes
3	Reserved (set to zero)
4	Generate Report Packet 0x8D 0x04 with the Delta Average Position in XYZ units: 0: No 1: Yes
5	Generate Report Packet 0x8D 0x04 with the Delta Average Position in ENU units: 0: No 1: Yes
6-7	Reserved (set to zero)

Note – When a particular output format is enabled, the packet for that data is output every time a new position is included in the average.

Table 2-89 Byte 2, Option 2 Flags

Bit #	Option
0 (LSB)	Average Position behavior upon Reset or power cycle: 0: Continue Average 1: Restart Average
1-7	Reserved (set to zero)

0x6D 0x02 Command Packet 0x6D 0x02 Auto Stop Parameter Options Command

Command Packet 0x6D 0x02 requests or sets the options and controls for the Auto Stop parameters. The structure of the packet varies depending on the selected parameter type (byte 1).

Send the packet using the structure shown in Table 2-90 to request the Auto Stop Parameter Options in Report Packet 0x8D 0x02:

Table 2-90 Request Auto Stop Parameters (Controls/Options)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto Stop Parameter Options.
1	Type	BYTE	0x00	Auto stop control/options

Send the packet using the structure shown in Table 2-91 to set the Auto Stop Parameter Options:

Table 2-91 Set Auto Stop Parameters (Controls/Options)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto Stop Parameter Options. Receiver sends data in Report Packet 0x8D 0x02
1	Type	BYTE	0x00	Auto stop control/options
2	Option Flags 1	BYTE	Table 2-92	Various auto stop options
3	Option Flags 2	BYTE	0x00	Reserved (set to zero)

Table 2-92 Type 0 Byte 2 Bit Encoding

Bit #	Option
0 (LSB)	Stop or restart (see next note) averaging when the maximum coordinate offset from the initial position is met: 0: Disable 1: Enable
1	Stop Averaging when the Minimum Number and/or Duration is met: 0: Disable 1: Enable
2-7	Reserved (set to zero)

Note – Stop or Restart is selected in byte 6 of Command Packet 0x6D 0x02 Type 1. Also, changing the maximum offset enable/disable state clears the maximum offset status (Bit 2) in the status byte.

Send the packet using the structure in Table 2-93 to request the maximum coordinate offset from initial position of the Auto Stop parameters in Report Packet 0x8D 0x02:

Table 2-93 Request Auto Stop Parameters (maximum coordinate offset from initial)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto Stop Parameters
1	Type	BYTE	0x01	Maximum coordinate offset from initial

Send the packet using the structure shown in Table 2-94 to set the maximum coordinate offset from initial position of the Auto Stop parameters:

Table 2-94 Set Auto Stop Parameters (maximum coordinate offset from initial)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto Stop Parameters
1	Type	BYTE	0x01	Maximum coordinate offset from initial
2-5	Max Offset	SINGLE		Maximum offset from initial (Negative values are ignored)
6	Options	BYTE	Table 2-95	Options for Maximum Offset

Note – Changing the maximum offset value or changing the options byte bit 0 value clears the maximum offset status (bit 2) in the status byte.

Table 2-95 Type 1, Byte 6 Bit Encoding

Bit #	Option
0 (LSB)	Behavior when Maximum Offset is met: 0: Restart Averaging. In this case, the position offset occurrence bit (bit 2) in the status byte is set and remains set until the process in manually restarted 1: Stop Averaging. In this case, the position offset occurrence bit (bit 2) in the status byte is set. This bit gets cleared if the process is restarted or continued
1-7	Reserved (set to zero)

Send the packet using the structure in Table 2-96 to request the number and/or duration Auto Stop parameters in Report Packet 0x8D 0x02

Table 2-96 Request Auto Stop Parameters (number and duration)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto stop parameters. The receiver sends the data in Report Packet 0x8D 0x02
1	Type	BYTE	0x02	Number and Duration

Send the packet using the structure shown in Table 2-97 to set the number and/or duration Auto Stop Parameters:

Table 2-97 Set Auto Stop Parameters (number and/or duration)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto stop parameters
1	Type	BYTE	0x02	Number and Duration
2-5	Number	LONG	>0	Auto stop after *Number* positions are included in average (*default*: 1)
6-9	Duration	LONG	≥0	Auto stop after the averaging has been on for *Duration* seconds (*default*: 0)
10	Options	BYTE	Table 2-98	Number and Duration auto stop options

Note – Negative numbers entered for either *Number* or *Duration* are ignored.

Table 2-98 Type 2 Byte 10 Bit Encoding

Bit #	Option
0 (LSB)	Number and/or Duration: 0: Auto stop averaging process if **both** *Number* **and** *Duration* conditions are satisfied (*default*) 1: Auto stop averaging process if **either** the *Number* **or** *Duration* conditions are satisfied, whichever comes first
1-7	Reserved (set to zero)

0x6D 0x03 Command Packet 0x6D 0x03
Current Average Position Request

Command Packet 0x6D 0x03 requests the current average position in one of three different formats. The receiver responds by sending the data in Report Packet 0x8D 0x03.

Table 2-99 Request Current Average Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Current Average Position Request
1	Type	BYTE	*flag*	Selects the format of the data included in Report Packet 0x8D 0x03: 0 XYZ ECEF 1 LLA WGS-84 HAE 4 LLA WGS-84 MSL

0x6D 0x04 Command Packet 0x6D 0x04
Average Position Delta from Last Position

Command Packet 0x6D 0x04 requests a report containing the delta position between the last average position and the current averaged position in XYZ or ENU units. The receiver responds by sending the data in Report Packet 0x8D 0x04.

Table 2-100 Request Average Position Delta from Last, XYZ or ENU

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Average Position Delta from Last Position
1	Type	BYTE	*flag*	Sets the units for reporting average position delta: 0 XYZ 1 ENU

0x6E Command Packet 0x6E

Synchronized Measurement Parameters Commands

Command Packet 0x6E sets or requests the Synchronized Measurement parameters. The receiver responds by sending the synchronized measurements in Report Packet 0x6F. There are two sychronized measurement parameters:

- Enable or Disable Synchronized Measurements
- Output Interval.

Note – After Command Packet 0x25 turns on or resets the receiver, a position fix must be made before outputting synchronized measurements to verify the validity of the information within the Synchronized Measurement Packet.

Note – Report Packet 0x6F 0x01 is not output at a rate greater than once per second.

0x6E 0x01 Command Packet 0x6E 0x01

Synchronized Measurement Parameters Command

Command Packet 0x6E 0x01 sets or requests the Synchronized Measurement Parameter settings using the data formats shown in Table 2-101 or Table 2-102.The receiver responds by sending Report Packet 0x6E 0x01.

Table 2-101 Request Synchronized Measurement Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Synchronized Measurement Parameters

Table 2-102 Set Synchronized Measurement Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Synchronized Measurement Parameters
1	Enable	BYTE	*flag*	Method used to output synchronized measurements at the output interval: 0 Disable outputs 1 Enable using filtered pseudorange values 3 Enable using raw pseudorange values
2	Output Interval	BYTE	0x01-0xFF	Sets time elapsing (1-255 seconds) while outputting synchronized measurements. The interval is synchronized to the time of the week†

† For example, with an output interval of 5 seconds, synchronized measurement outputs (Report Packet 0x6F) are sent at time of week seconds: 0, 5, 10, 15, and on.

0x70 Command Packet 0x70
Position/Velocity Filter Command

The PV filter smooths position data when the antenna is moving and attempts to reduce the effects of position disturbances which include reflected signals and small outages of DGPS corrections.Command Packet 0x70 enables or disables the P/V Filter, Static Filter, and/or Altitude Filter.The format is shown in Table 2-103.

To request the filter operation state, send Command Packet 0x70 with no data bytes.

Note – The dynamic filter must be turned *on* before the Static Filter can operate. If the Dynamic Filter is turned *off*, enabling the Static Filter with this packet **does not** turn the Static Filter *on* until the Dynamic Filter is *enabled*.

Table 2-103 Set Position/Velocity Filter Operation Packet

Byte #	Item	Type	Value/Units	Meaning
0	Dynamic Filter Switch	BYTE	*flag*	Dynamic Filter Switch: 0 Disable 1 Enable
1	Static Filter Switch	BYTE	*flag*	Static Filter Switch: 0 Disable 1 Enable
2	Altitude Filter Switch	BYTE	*flag*	Altitude Filter Switch: 0 Disable 1 Enable
3	Reserved	BYTE	0x00	Reserved (set to zero)

0x75 Command Packet 0x75
Overdetermined Mode Command

Command Packet 0x75 requests or sets the solution mode (assigns the type of constellation and weighting scheme) used when the receiver generates a position solution. The receiver responds with Report Packet 0x76. There are two position fix constellation modes.

- Overdetermined Mode (non-weighted)
- Weighted Overdetermined Mode

To request the Overdetermined Mode Report, Command Packet 0x75 is sent with no data bytes. Table 2-104 lists the data byte values for setting the solution mode.

Table 2-104 Set Overdetermined Mode

Byte #	Item	Type	Value/Units	Meaning
1	Fix Type	BYTE	flag	Solution Mode: 1 *Overdetermined solution.* Overdetermined (non-weighted) directs the receiver to use all currently tracked satellites satisfying the masks for computation of the position fix. Uses all available satellites 2 *Weighted overdetermined solution*. Weighted Overdetermined is similar to overdetermined mode except that different measurements are given different weights based on the estimated measurement errors for the satellites used in the position fix. Uses all available satellites

0x77 Command Packet 0x77
Maximum PRC Age Command

Command Packet 0x77 sets or requests the maximum time interval in seconds to propagate RTCM pseudorange corrections (PRC) if no new corrections are received while the receiver is operating in DGPS mode. The corrections are no longer used when the timer elapses. The receiver acknowledges with Report Packet 0x78. To request the maximum pseudorange correction age, the Command Packet 0x77 is sent with no data bytes. To set the maximum pseudorange correction age, follow the format shown in Table 2-105.

Table 2-105 Set Maximum PRC Age

Byte #	Item	Type	Meaning
0-1	Maximum PRC Age	INTEGER	Maximum pseudorange correction age in seconds

0x7A Command Packet 0x7A
NMEA Output Configuration Commands

Command Packet 0x7A has several forms differentiated by a Subpacket ID as the first data byte. Each 0x7A subpacket pair can be thought of as a separate command packet. These subpackets are divided into two groups: subcodes 0x00-0x7F correspond to NMEA output control for the opposite port to that from which the command is issued; subcodes 0x80-0xFF represent the same control offered in the 0x00-0x7F packets but the NMEA output control applies to the current port. For example, if the TSIP communication is occuring on Port A, subcodes 0x00-0x7F apply to the Port B NMEA configuration, but subcodes 0x80-0xFF apply to the Port A NMEA configuration.

Message Mask is the NMEA message mask, a 32-bit vector for determining whether or not a given NMEA message is output. If the bit for a message is set, the message is sent every *Interval* seconds with two exceptions: ALM and GSV messages.

- On rare occasions, the GSV output is missed because the time of output coincides with a receiver update computation, and becomes available again on the next *Interval* second output.
- The receiver automatically sends ALM messages when a new almanac is decoded. Upon decoding a new almanac, one almanac message is output each second starting from SV 1, until all existing SV almanacs are sent. The current almanac can be requested at any time, allowing the output of one almanac message per second until all SV almanacs are output.

Bit Mask is the hexadecimal numbers are *ORed* together to produce the combined output mask. Table 2-106 shows the hex bit mask values.

Table 2-106 Bit Mask Values (Hexadecimal)

Message	Bit Mask
GGA	0x00000001
GLL	0x00000002
VTG	0x00000004
GSV	0x00000008
GSA	0x00000010
ZDA	0x00000020
ALM	0x00000040
RMC	0x00000080
GRS	0x00000100
GBS	0x00000200
GST	0x00000400
MSS	0x00001000
PTNLAG001	N/A
PTNLID	0x00002000

Table 2-106 Bit Mask Values (Hexadecimal) (Continued)

Message	Bit Mask
PTNLDG	0x00004000
PTNLSM	0x00008000
PTNL,GGK	0x00010000

For example, GGA, VTG, GSA, and ZDA messages are enabled for output (the default mask) when the mask value is 0x00000035, and all of the above messages are enabled for output when the mask value is 0x0000007F.

The ZDA message is output only when an external input is received (see DataMerge protocol in Command Packet 0x8E 0x7C), so there is no bit mask value to enable it.

Message List (the NMEA message name list) is an alternative to dealing with the mask directly. A message name list is a sequence of ASCII characters representing the names of the messages, separated by commas, and terminated with a zero.

Example list: GGA,VTG (= G,G,A,,,V,T,G, 0) or, in hex, 0x47, 0x47, 0x42, 0x2C, 0x56, 0x54, 0x47, 0x00). This list corresponds to a mask of 0x00000005.

Note – Not all products support the same NMEA messages. Check the product-specific appendices for availability.

0x7A 0x00 Command Packet 0x7A 0x00 NMEA Interval and Message Mask Command

Command Packet 0x7A 0x00 requests or sets the NMEA message transmission interval or a combination of the NMEA message transmission interval and the message mask for the opposite port. The receiver responds by sending Report Packet 0x7B 0x00.

Table 2-107 Request NMEA Interval and Message Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Request NMEA Interval and Message Mask. The receiver responds with Report Packet 0x7B 0x00

Table 2-108 Set NMEA Interval

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	NMEA Interval
1	Interval	BYTE	*seconds*	NMEA message output interval: 0 Output messages at position fix rate others Time interval in seconds

Table 2-109 Set NMEA Interval and Message Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	NMEA Interval and Message Mask
1	Interval	BYTE	*seconds*	NMEA message output interval: 0 Output messages at position fix rate others Time interval in seconds
2-5	Output mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages

Note – The position fix interval and offset set by Command Packet 0x7C 0x02 does not influence NMEA scheduling.

0x7A 0x01 Command Packet 0x7A 0x01 NMEA Messages to Output By Name List Command

Command Packet 0x7A 0x01 sends a comma-delimited list of NMEA message names for the opposite port to the receiver. The receiver responds by sending Report Packet 0x7B 0x00.

Table 2-110 Set NMEA Messages to Output, By Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	NMEA Messages to Output By Name List
1-end	List	MESSAGE LIST	*list*	Comma-delimited NMEA name list of messages to automatically output

0x7A 0x02 Command Packet 0x7A 0x02 NMEA Messages Now By Mask Request

Command Packet 0x7A 0x02 requests that the selected NMEA messages indicated by the message mask included in the packet be immediately output on the opposite port.

Table 2-111 Request NMEA Messages Now By Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Request NMEA Messages Now By Mask
1	Reserved	BYTE	0x00	Reserved (set to zero)
2-5	Request Mask	MESSAGE MASK	*mask*	Message mask for desired messages

0x7A 0x03 Command Packet 0x7A 0x03
NMEA Messages Now By Name List Request

Command Packet 0x7A 0x03 requests that the NMEA messages identified in the comma-delimited message name list included in the packet be immediately output on the opposite port.

Table 2-112 Request NMEA Messages Now, By Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Request NMEA messages now, by name list
1-end	List	MESSAGE LIST	*list*	Comma-delimited NMEA name list to request

0x7A 0x04 Command Packet 0x7A 0x04
Current NMEA Output Messages Mask and/or Name List Request

Command Packet 0x7A 0x04 requests the NMEA comma-delimited message name list, the message mask or a combination of the two for the opposite port. The receiver sends the data in Report Packet 0x7B 0x04.

Table 2-113 Request Current NMEA Output Messages Mask and/or Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Request current NMEA mask and/or name list
1	Request	BYTE	*flag*	Selects the NMEA data included in Report Packet 0x7B 0x04: 1 Request message name list 2 Request message mask 3 Request both message name list and mask

0x7A 0x05 Command Packet 0x7A 0x05
NMEA Local Time Offset Command

Command Packet 0x7A 0x05 requests or sets the NMEA local time offsets for the opposite port.

Send the packet using the structure shown in Table 2-114 to request the data in Report Packet 0x7B 0x05.

Table 2-114 Request NMEA Local Time Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	NMEA Local Time Offset

Send the packet using the structure shown in Table 2-115 to set the Local Time Offsets:

Table 2-115 Set NMEA Local Time Offsets

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	NMEA Local Time Offsets
1	Hour Offset	BYTE	*hours*	GMT hours minus Local hours
2	Minute Offset	BYTE	*minutes*	GMT minutes minus Local minutes

Note**:** Offsets may be either positive or negative numbers.

0x7A 0x06 Command Packet 0x7A 0x06
NMEA Message Options Command

Command Packet 0x7A 0x06 requests or sets the data reporting options for the NMEA GGA, GLL, VTG, and RMC message sentences for the opposite port.

Send the packet using the structure shown in Table 2-116 to request the data in Report Packet 0x7B 0x06.

Table 2-116 Request NMEA Message Specific Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	NMEA Message Options
1	Message Request	BYTE	*flag*	Selects requested message options: 0 Request GGA Options and Precision 1 Request GLL Options and Precision 2 Request VTG Options 3 Request VTG Precision 4 Request RMC Options and Precision

Send the packet using the structure shown in Table 2-117 to set the GGA options and precision for the opposite port.

Table 2-117 Set NMEA GGA Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	NMEA Message Options
1	Message	BYTE	0x00	Set GGA Options and Precision
2	Options	BYTE	Table 2-118	GGA Options
3	Precision	BYTE	0x00-0x07	Set GGA Precision (0-7 decimal places)

Table 2-118 Byte 2 NMEA GGA Options

Bit	Option
0 (LSB)	Reserved (set to zero)
1	Validity of GGA for old positions. In an old position the time in the GGA message is not the current time: 0: Valid 1: Invalid
2	Validity of GGA for non-differential positions when in Auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GGA: 0: All null fields 1: ‘0’ in the status field
4	Precision of time in GGA (decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Send the packet using the structure shown in Table 2-119 to set the GLL options and precision for the opposite port.

Table 2-119 Set NMEA GLL Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	NMEA Message Options
1	Message	BYTE	0x01	Set GLL Options and Precision
2	Options	BYTE	Table 2-120	GLL Options
3	Precision	BYTE	0x00-0x07	Set GLL Precision (1-7 decimal places)

Table 2-120 Byte 2, NMEA GLL Options

Bit	Option
0 (LSB)	NMEA Version of GLL: 0: Version 2.01 1: Version 1.5
1	Validity of GLL for old positions. In an old position the time in the GLL message is not the current time: 0: Valid 1: Invalid
2	Validity of GLL for non-differential positions when in Auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GLL: 0: All null fields 1: 'V' in status field
4	Precision of time in GLL (decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Send the packet using the structure shown in Table 2-121 to set the VTG options for the opposite port.

Table 2-121 Set NMEA VTG Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	NMEA Message Options
1	Message	BYTE	0x02	Set VTG Options
2	Options	BYTE	Table 2-123	VTG Options

Table 2-122 Byte 2, NMEA VTG Options

Bit	Option
0 (LSB)	NMEA Version of VTG: 0: Version 2.01 1: Version 1.5
1-4	Reserved (set to zero)
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

Send the packet using the structure shown in Table 2-123 to set the VTG speed precision for the opposite port:

Table 2-123 NMEA VTG Speed Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	NMEA Message Options
1	Message	BYTE	0x03	Set VTG Speed Precision
2	Precision	BYTE	0x00-0x03	VTG Speed Precision (0-3 decimal places)

Send the packet using the structure shown in Table 2-124 to set the RMC options and precision for the opposite port:

Table 2-124 NMEA RMC Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	NMEA Message Options
1	Message	BYTE	0x04	Set RMC Options and Precision
2	Option Flags	BYTE	Table 2-125	Set RMC message options
3	Position Precision	BYTE	0x00-0x07	Set RMC position precision (0-7 decimal places)
4	Speed Precision	BYTE	0x00-0x03	Set RMC speed precision (0-3 decimal places)

Table 2-125 Byte 2, NMEA RMC Option Flags

Bit	Meaning
0 (LSB)	Reserved (set to zero)
1	Validity of RMC for old positions. For an old position, the time in the RMC message is not the current time. 0: Valid 1: Invalid
2	Validity of RMC for non-differential positions when in Auto DGPS mode: 0: Valid 1: Invalid
3	Reserved (set to zero)
4	Precision of time in RMC message (decimal places): 0: Two 1: None
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

0x7A 0x80 Command Packet 0x7A 0x80 NMEA Interval and Message Mask Command

Command Packet 0x7A 0x80 requests or sets the NMEA message transmission interval or a combination of the NMEA message transmission interval and the message mask for the current port. The receiver responds by sending Report Packet 0x7B 0x80.

Table 2-126 Request NMEA Interval and Message Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x80	Request NMEA Interval and Message Mask. The receiver responds with Report Packet 0x7B 0x80

Table 2-127 Set NMEA Interval

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x80	NMEA Interval
1	Interval	BYTE	*seconds*	NMEA message output interval: 0 Output messages at position fix rate others Time interval in seconds

Table 2-128 Set NMEA Interval and Message Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x80	NMEA Interval and Message Mask
1	Interval	BYTE	*seconds*	NMEA message output interval: 0 Output messages at position fix rate others Time interval in seconds
2-5	Output mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages

Note – The position fix interval and offset set by Command Packet 0x7C 0x02 does not influence NMEA scheduling.

0x7A 0x81 Command Packet 0x7A 0x81 NMEA Messages to Output By Name List Command

Command Packet 0x7A 0x81 sends a comma-delimited list of NMEA message names for the current port to the receiver. The receiver responds by sending Report Packet 0x7B 0x80.

Table 2-129 Set NMEA Messages to Output, By Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x81	NMEA Messages to Output By Name List
1-end	List	MESSAGE LIST	*list*	Comma-delimited NMEA name list of messages to automatically output

0x7A 0x82 Command Packet 0x7A 0x82 NMEA Messages Now By Mask Request

Command Packet 0x7A 0x82 requests that the selected NMEA messages indicated by the message mask included in the packet be immediately output on the current port.

Table 2-130 Request NMEA Messages Now By Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x82	Request NMEA Messages Now By Mask
1	Reserved	BYTE	0x00	Reserved (set to zero)
2-5	Request Mask	MESSAGE MASK	*mask*	Message mask for desired messages

0x7A 0x83 Command Packet 0x7A 0x83
NMEA Messages Now By Name List Request

Command Packet 0x7A 0x83 requests that the NMEA messages identified in the comma-delimited message name list included in the packet be immediately output on the current port.

Table 2-131 Request NMEA Messages Now, By Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x83	Request NMEA messages now, by name list
1-end	List	MESSAGE LIST	*list*	Comma-delimited NMEA name list to request

0x7A 0x84 Command Packet 0x7A 0x84
Current NMEA Output Messages Mask and/or Name List Request

Command Packet 0x7A 0x84 requests the NMEA comma-delimited message name list, the message mask or a combination of the two for the current port. The receiver sends the data in Report Packet 0x7B 0x84.

Table 2-132 Request Current NMEA Output Messages Mask and/or Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x84	Request current NMEA mask and/or name list
1	Request	BYTE	*flag*	Selects the NMEA data included in Report Packet 0x7B 0x84: 1 Request message name list 2 Request message mask 3 Request both message name list and mask

0x7A 0x85 Command Packet 0x7A 0x85
NMEA Local Time Offset Command

Command Packet 0x7A 0x85 requests or sets the NMEA local time offsets for the current port.

Send the packet using the structure shown in Table 2-133 to request the data in Report Packet 0x7B 0x85.

Table 2-133 Request NMEA Local Time Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x85	NMEA Local Time Offset

Send the packet using the structure shown in Table 2-134 to set the Local Time Offsets for the current port:

Table 2-134 Set NMEA Local Time Offsets

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x85	NMEA Local Time Offsets
1	Hour Offset	BYTE	*hours*	GMT hours minus Local hours
2	Minute Offset	BYTE	*minutes*	GMT minutes minus Local minutes

Note: Offsets may be either positive or negative numbers.

0x7A 0x86 Command Packet 0x7A 0x86 NMEA Message Options Command

Command Packet 0x7A 0x86 requests or sets the data reporting options for the NMEA GGA, GLL, VTG, and RMC message sentences for the current port.

Send the packet using the structure shown in Table 2-135 to request the data in Report Packet 0x7B 0x86.

Table 2-135 Request NMEA Message Specific Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	NMEA Message Options
1	Message Request	BYTE	*flag*	Selects requested message options: 0 Request GGA Options and Precision 1 Request GLL Options and Precision 2 Request VTG Options 3 Request VTG Precision 4 Request RMC Options and Precision

Send the packet using the structure shown in Table 2-136 to set the GGA options and precision for the current port.

Table 2-136 Set NMEA GGA Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	NMEA Message Options
1	Message	BYTE	0x00	Set GGA Options and Precision
2	Options	BYTE	Table 2-137	GGA Options
3	Precision	BYTE	0x00-0x07	Set GGA Precision (0-7 decimal places)

Table 2-137 Byte 2 NMEA GGA Options

Bit	Option
0 (LSB)	Reserved (set to zero)
1	Validity of GGA for old positions. In an old position the time in the GGA message is not the current time: 0: Valid 1: Invalid
2	Validity of GGA for non-differential positions when in Auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GGA: 0: All null fields 1: ‘0’ in the status field
4	Precision of time in GGA (decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Send the packet using the structure shown in Table 2-138 to set the GLL options and precision for the current port.

Table 2-138 Set NMEA GLL Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	NMEA Message Options
1	Message	BYTE	0x01	Set GLL Options and Precision
2	Options	BYTE	Table 2-139	GLL Options
3	Precision	BYTE	0x00-0x07	Set GLL Precision (1-7 decimal places)

Table 2-139 Byte 2, NMEA GLL Options

Bit	Option
0 (LSB)	NMEA Version of GLL: 0: Version 2.01 1: Version 1.5
1	Validity of GLL for old positions. In an old position the time in the GLL message is not the current time: 0: Valid 1: Invalid
2	Validity of GLL for non-differential positions when in Auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GLL: 0: All null fields 1: 'V' in status field
4	Precision of time in GLL (decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Send the packet using the structure shown in Table 2-140 to set the VTG options for the current port.

Table 2-140 Set NMEA VTG Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	NMEA Message Options
1	Message	BYTE	0x02	Set VTG Options
2	Options	BYTE	Table 2-141	VTG Options

Table 2-141 Byte 2, NMEA VTG Options

Bit	Option
0 (LSB)	NMEA Version of VTG: 0: Version 2.01 1: Version 1.5
1-4	Reserved (set to zero)
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

Send the packet using the structure shown in Table 2-142 to set the VTG speed precision for the current port:

Table 2-142 NMEA VTG Speed Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	NMEA Message Options
1	Message	BYTE	0x03	Set VTG Speed Precision
2	Precision	BYTE	0x00-0x03	VTG Speed Precision (0-3 decimal places)

Send the packet using the structure shown in Table 2-143 to set the RMC options and precision for the current port:

Table 2-143 NMEA RMC Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	NMEA Message Options
1	Message	BYTE	0x04	Set RMC Options and Precision
2	Option Flags	BYTE	Table 2-144	Set RMC message options
3	Position Precision	BYTE	0x00-0x07	Set RMC position precision (0-7 decimal places)
4	Speed Precision	BYTE	0x00-0x03	Set RMC speed precision (0-3 decimal places)

Table 2-144 Byte 2, NMEA RMC Option Flags

Bit	Meaning
0 (LSB)	Reserved (set to zero)
1	Validity of RMC for old positions. For an old position, the time in the RMC message is not the current time. 0: Valid 1: Invalid
2	Validity of RMC for non-differential positions when in Auto DGPS mode: 0: Valid 1: Invalid
3	Reserved (set to zero)
4	Precision of time in RMC message (decimal places): 0: Two 1: None
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

0x7C Command Packet 0x7C
Position Fix or PRC Rate Configuration Commands

Command Packet 0x7C has four forms that are differentiated by the subpacket ID as the first data byte. Each (0x7C subpacket) pair can be thought of as a separate command packet. The receiver acknowledges with corresponding Report Packet 0x7D subpacket.

0x7C 0x00 Command Packet 0x7C 0x00
ASAP Fix Rate Command

Command Packet 0x7C 0x00 sets or requests the rate for computing position fixes or for computing pseudorange corrections when the Reference Station mode is enabled. The selected rate takes effect on the next integer second. The ASAP Fix Rate applies only if the Fix Computation Time is set to ASAP mode in the I/O Options Timing byte (Command Packet 0x35, byte 2). If the Fix Computation Time is set to At Integer Second, position fixes are computed only at integer seconds irrespective of the specified ASAP Fix Rate. The receiver retains the GPS position fix rate in battery-backed memory. Table 2-145 and Table 2-146 show the data format. Send the packet using the structure shown in Table 2-145 to request the ASAP Fix Rate in Report Packet 0x7D 0x00:

Table 2-145 Request ASAP Fix Rate

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Request ASAP Fix Rate

Send the packet using the structure shown in Table 2-146 to set the ASAP Fix Rate:

Table 2-146 Set ASAP Fix Rate

Byte #	Item	Type	Value/Units	Meaning
0†	Subpacket ID	BYTE	0x00	ASAP Fix Rate
1†	ASAP Rate	BYTE	0x01-0x0A	Number of position fixes per second (fix rate in Hz) (*range*: 1-10)

† Report Packet 0x45, Byte 23 gives information on the receiver's fastest ASAP rate which varies by product. When selecting a position fix rate greater than 5 Hz in 12-channel receivers, the maximum number of satellites tracked simultaneously may be reduced to 8. Also, pseudorange corrections can be output at a maximum rate of 5 Hz.

0x7C 0x01 Command Packet 0x7C 0x01
Fast Rate I/O Options Command

Command Packet 0x7C 0x01 sets or requests the position fix rate I/O option bytes. Table 2-148 through Table 2-150 show the position fix rate I/O options and the byte values for all possible states. The receiver retains the option states in battery-backed memory.

Send the packet using the structure shown in Table 2-147 to request the data in Report Packet 0x7D 0x01.

Table 2-147 Request Position Fix Rate Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Request Position Fix Rate Options

Send the packet using the structure shown in Table 2-148 to set the Position Fix Rate options.

Table 2-148 Set Position Fix Rate Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Set Position Fix Rate Options.
1	Option Flags 1	BYTE	Table 2-149	Various options
2	Option Flags 2	BYTE	Table 2-150	Various options

Table 2-149 Byte 1, Option 1 Flags

Bit	Option
0 (LSB)	Set Precision of Time for report packets 0x42, 0x43, 0x4A, 0x54, 0x56, 0x57, 0x83, and 0x84: 0: Single (*default*) 1: Double
1	Timestamp of Velocity: 0: Same as position timestamp (*default*) 1: True time of velocity
2-7	Reserved (set to zero)

Supporting position fixes greater then 2 Hz

To support position fix rates greater than 2 Hz, a double precision time of fix output can be selected which affects the following position, velocity, and time report packets:

- Report Packet 0x42 – Single-Precision Position Fix (XYZ Cartesian ECEF) Report
- Report Packet 0x43 – Velocity Fix (XYZ Cartesian ECEF) Report
- Report Packet 0x4A – Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report
- Report Packet 0x54 – One Satellite Bias and Bias Rate Report
- Report Packet 0x56 – Velocity Fix East-North-Up (ENU) Report
- Report Packet 0x57 – Last Computed Fix Report
- Report Packet 0x83 – Double-Precision XYZ Position Fix & Clock Bias Report
- Report Packet 0x84 – Double-Precision LLA Position Fix & Clock Bias Report

When double precision is selected, the time of fix output is of type Double instead of Single in each of these packets. The packet lengths increase by 4 bytes and otherwise remain unchanged. Some receivers may automatically switch to double precision time representation in these packets if the position fix rate is faster than 2 Hz.

Table 2-150 Byte 2, Option 2 Flags

Bit	Option
0 (LSB)	Port A automatic message control for all automatic packets that cannot be controlled in another way: 0: Output (*default*) 1: No output
1	Port B automatic message control for all automatic packets that cannot be controlled in another way: 0: Output (*default*) 1: No output
2	Time only (0D) output in Report Packet 0x54: 0: On (*default*) 1: Off
3	Output full Satellite Data for ephemeris and UTC when received in Report Packet 0x58: 0: Off (*default*) 1: On
4	Echo RTCM Port A input in Report Packet 0x1A 0x00: 0: Off (*default*) 1: Off
5-7	Reserved (set to zero)

0x7C 0x02 Command Packet 0x7C 0x02
Position Fix Output Interval and Offset Command

The *Interval* and *Offset* parameters allow outputting positions at a slower rate than the current position fix rate setting. For example, if the *Integer Second* mode is in effect and the *Interval* is 5 and *Offset* is 0, then the position output occurs at the GPS time of the week seconds: 0, 5, 10, 15, and so on. If the *Offset* value is changed from 0 to 1 in this example, then the position output occurs at the GPS time of the week seconds: 1, 6, 11, 16, and so on.

In another example, with a 5 Hz position fix rate, if the *Interval* is 3 and *Offset* is 0, the position output occurs at the GPS time of the week seconds: 0, 0.6, 1.2, 1.8, 2.4, 3.0, and so on. The *Interval* and *Offset* parameters also affect the RTCM Pseudorange Corrections (PRC Type 1 or 9) messages. These parameters do not affect the NMEA output. Send the packet using the structure shown in Table 2-151 to request the data in Report Packet 0x7D 0x02.

Table 2-151 Request Position Fix Output Interval and Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Position Fix Output Interval and Offset

Send the packet using the structure shown in Table 2-152 to set the Position Fix Output Interval and Offset.

Table 2-152 Set Position Fix Output Interval and Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Position Fix Output Interval and Offset
1-2	Interval	INTEGER	*interval*	Output one every *interval* position fixes. A value of 0 restores the receiver defaults.
3-4	Offset	INTEGER	*offset*	Determines which position is output within an *interval*

0x7C 0x03 Command Packet 0x7C 0x03
Maximum Measurement Age Command

Command Packet 0x7C 0x03 requests or sets the maximum age before measurements are no longer considered when computing position fixes.

Send the packet using the structure shown in Table 2-153 to request the data in Report Packet 0x7D 0x03.

Table 2-153 Request Maximum Measurement Age

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Maximum Measurement Age

Send the packet using the structure shown in Table 2-154 to set Maximum Measurement Age.

Table 2-154 Set Maximum Measurement Age

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Maximum Measurement Age
1-2	Max Age	INTEGER	0x00-0x1388	Sets the maximum time, in milliseconds (0-5000), after which the measurement is no longer used to compute a position fix.

0x7C 0x05 Command Packet 0x7C 0x05
CTS to Transmit Delay Command

The CTS to Transmit Delay Time parameter allows the user to set up a delay before the transmission of data. This is typically used with radio transmitter setups to allow the transmitter to power up completely before any data is sent.

Send the packet using the structure shown in Table 2-155 to request the data in Report Packet 0x7D 0x05.

Table 2-155 Request CTS to Transmit Delay

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Requests the CTS to Tx Delay Time

Send the packet using the structure shown in Table 2-156 to set the CTS to Transmit Delay.

Table 2-156 Set CTS to Transmit Delay

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Set CTS to Tx Delay
1-2	CTS to Tx Delay	INTEGER	0x00-0x7D00	Delay time in milliseconds (0-32000)

If the Heed CTS mode is selected in Command Packet 0x3D, the delay time begins when a signal is received on the CTS input.

If the Ignore CTS mode is selected in Command Packet 0x3D, the programmed delay is still used. The delay time begins when the receiver has data ready to send.

0x7C 0x06 Command Packet 0x7C 0x06
RTS Trailing Edge Delay Command

The RTS Trailing Edge Delay Time parameter allows the user to set a delay time for the deactivation of the RTS signal after the last bit of data is sent. This feature could be used in radio data transmission systems where RTS is used for the Push-to-Talk signal.

Send the packet using the structure shown in Table 2-157 to request the data in Report Packet 0x7D 0x06.

Table 2-157 Request RTS Trailing Edge Delay

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	RTS Trailing Edge Delay Time

Send the packet using the structure shown in Table 2-158 to set the RTS Trailing Edge Delay.

Table 2-158 Set RTS Trailing Edge Delay

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	RTS Trailing Edge Delay
1-2	RTS Delay	INTEGER	0x00-0x7D00	Delay time in milliseconds (0-32000)

0x7C 0x09 Command Packet 0x7C 0x09

Time-Based Message Interval Command

In order to set the message output rate for a protocol that is tied to a fixed time interval and not relative to the position rate (as in packet 0x7C 0x02), the Time-Based Message Interval Command may be used.

Selecting a specific output interval does not affect the current fix rate of the receiver or the protocol currently in use on the specified port. For example, if a TSIP interval of 100 milliseconds is selected for Port 0, but Port 0 is currently outputting TSIP data and the receiver is currently calculating fixes at a 5 Hz rate (every 200 msecs), the TSIP data will not be output any faster than the fix rate so the receiver will report data every 200 msecs. If the fix rate is subsequently increased to 10 Hz (every 100 msecs), the the TSIP data will be output at the originally configured rate of 100 msecs. Similarly, if the port is currently configured for NMEA output, sending a command to configure the TSIP output interval on that port will not change the output protocol, so NMEA data will continue to be output at whatever interval it was previously configured. If the output protocol is later changed to TSIP, the configuration sent previously will be in effect.

Command Packet 0x7C 0x09 can be sent in an abbreviated form to request output of Report Packet 0x7D 0x09 as shown in Table 2-159.

Table 2-159 Time-Based Message Interval Request

Byte #	Item	Type	Value/ Units	Meaning
0	Subpacket ID	BYTE	0x09	Time-based message interval request
1	Port	BYTE		Interval data is requested for settings on a specific port: 0 Port 0 1 Port 1 0xFF All ports (multiple report packets will be generated)
2	Message Protocol	BYTE		Protocol to which the interval applies 0 TSIP 1 NMEA
3-6	Reserved	BYTE	0	Reserved
7-8	Checksum	INTEGER	*checksum*	Checksum

To configure the message interval on a given port, use the packet form shown in Table 2-160.

Table 2-160 Time-Based Message Interval Command

Byte #	Item	Type	Value/ Units	Meaning
0	Subpacket ID	BYTE	0x09	Time-based message interval command
1	Port	BYTE		Interval data command applies to a specific port: 0 Port 0 1 Port 1 0xFF All ports
2	Message Protocol	BYTE		Protocol to which the interval applies 0 TSIP 1 NMEA
3	Message Interval	BYTE		Output interval for messages of protocol specified in byte 2 1 5 seconds 2 1 second 3 200 milliseconds[1] 4 100 milliseconds[1] 5 50 milliseconds[1]
4-11	Reserved	BYTE	0	Reserved
12-13	Checksum	INTEGER	*checksum*	Checksum

[1]If Fast rate option is purchased and fix update rate is supported by receiver.

0x8E Command Packet 0x8E Application Commands

Several packets have been added to the core TSIP protocol to provide additional application-specific output. In the 0x8E packets, the first data byte is a Subpacket ID which indicates the subpacket type. Therefore, the ID code for these packets is 2 bytes long followed by the data. Each (0x8E subpacket) pair can be thought of as a separate command packet. The receiver acknowledges with corresponding Report Packet 0x8F subpackets.

0x8E 0x20 Command Packet 0x8E 0x20 Super Packet Output Request

Command Packet 0x8E 0x20 can be sent to request Report Packet 0x8F 0x20. The command packet requests the transmission of detailed information about the last position and velocity solutions, including the information required to perform inverted differential GPS post processing. Automatic output of Super Packet data can be enabled with Command Packet 0x35. See also Report Packet 0x8F 0x20.

Note – The GPS receiver may not support Super Packet Output unless the Super Packet Option is installed. Check the product-specific appendices for more information.

Table 2-161 Super Packet Output Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x20	Super Packet Output Request

0x8E 0x60 Command Packet 0x8E 0x60 DR Calibration Command

Command Packet 0x8E 0x60 requests or sets the DR (dead reckoning) sensor calibration values which include the results of the odometer and gyroscope calibrations. The receiver responds by sending Report Packet 0x8F 0x60.

Table 2-162 Request DR Calibration

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x60	Request DR Sensor Calibration Values
1-2	Checksum	INTEGER	*checksum*	Checksum of byte 0

Table 2-163 Set DR Calibration

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x60	Set DR Sensor Calibration Values
1	Reserved	BYTE	0x00	Reserved (set to zero)
2	Digital/Analog Odometer Switch	BYTE	*flag*	Type of vehicle odometer: 1 Digital 2 Analog
3	Odometer Status	BYTE	*flag*	Health status of odometer: 0 Good health (no errors) *other* Bad health (errors)
4-11	Odometer Scale Factor	DOUBLE	*pulses/mile*	Number of pulses output by odometer after traveling one mile, measured during the odometer calibration
12	Reserved	BYTE	0x00	Reserved (set to zero)
13	Gyro Status	BYTE	*flag*	Health status of gyroscope: 0 Good health (no errors) *other* Bad health (errors)
14-21	Gyro Rate Bias	DOUBLE	*degrees/ second*	Bias rate of gyroscope recorded during calibration. Bias rate is not used in the actual calibration but should be within -10 to +10 degrees per second if the gyroscope is operating correctly.
22-29	Gyro Scale Factor 1	DOUBLE	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
30-37	Gyro Scale Factor 2	DOUBLE	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
38-39	Checksum	INTEGER	*checksum*	Checksum of bytes 0-37

0x8E 0x62 Command Packet 0x8E 0x62 GPS/DR Position/Velocity Request

Command Packet 0x8E 0x62 requests Report Packet 0x8F 0x62, the GPS/DR Position/Velocity Report. Table 2-164 shows the data structure.

Table 2-164 Request GPS/DR Position/Velocity

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x62	GPS/DR Position/Velocity Request
1-2	Checksum	INTEGER	*checksum*	Checksum of byte 0

0x8E 0x64 Command Packet 0x8E 0x64
Firmware Version Name and Configuration Block Request

Command Packet 0x8E 0x64 requests two types of information from the receiver. Report Packet 0x8F 0x64 is sent in response in one of two forms, depending on the setting of Byte 1. The data structure is shown in Table 2-165.

Table 2-165 Firmware Version Name and Configuration Block Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x64	Firmware Version Name Request
1	Report Type	BYTE	*flag*	Determines the type of port requested: 0 Reports the board configuration and intermediate frequency 1 Reports the firmware version name, version number, and configuration
2-3	Checksum	INTEGER	*checksum*	Checksum of byte 0-1

0x8E 0x6B Command Packet 0x8E 0x6B
Gyroscope Calibration Values Command

Command Packet 0x8E 0x6B requests or sets the gyroscope calibration values. The receiver responds to by sending Report Packet 0x8E 0x6B.

Table 2-166 Request Gyroscope Calibration Values

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x6B	Request Gyroscope Calibration Values
1-2	Checksum	INTEGER	*checksum*	Checksum of byte 0

Table 2-167 Set Gyroscope Calibration Values

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x6B	Set Gyroscope Calibration Values
1-4	Gyro Scale Factor 1	FLOAT	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
5-8	Gyro Scale Factor 2	FLOAT	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
9-10	Checksum	INTEGER	*checksum*	Checksum of bytes 0-8

0x8E 0x6D Command Packet 0x8E 0x6D
Odometer Calibration Values Command

Command Packet 0x8E 0x6D requests or sets the vehicle's odometer calibration values and the receiver responds with Report Packet 0x8E 0x6D.

Table 2-168 Request Odometer Calibration Values

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x6D	Request Odometer Values
1-2	Checksum	INTEGER	*checksum*	Checksum of byte 0

Table 2-169 Set Odometer Calibration Values

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x6D	Set Odometer Values
1-4	Odometer Scale Factor	FLOAT	*pulses/mile*	Number of pulses output by odometer after traveling one mile, measured during the odometer calibration
5	Health	BYTE	*flag*	Sets the health status of odometer: 00 System healthy 01 No pulses since power is on 02 Odometer scale factor invalid 04 Backup light active 08 Invalid time 10 Odometer speed is invalid
6	Analog/Digital Switch	BYTE	*flag*	Sets the Analog or Digital Odometer potentiometer setting type: 0 Custom (load potentiometer values from packet) 1 Digital (set potentiometer values to their digital default levels, 0xB000 in version 2.30) 2 Analog (set potentiometer values to their digital default levels, 0x1000 in version 2.30)
7	Potentiometer Value	BYTE	0x1000 to 0xB000	Sets the sensitivity of the odometer input circuit. The valid range is 0x1000 for the most sensitive setting (Analog) to 0xB000 for the lease sensitive setting (Digital)
8-9	Checksum	INTEGER	*checksum*	Checksum of bytes 0-7

0x8E 0x6F Command Packet 0x8E 0x6F
Firmware Name Request

Command Packet 0x8F 0x6F is sent when requesting the receiver's firmware name. Report Packet 0x8F 0x6F is sent in response. Table 2-170 shows the data structure.

Table 2-170 Request Firmware Name Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x6F	Request Firmware Name
1-2	Checksum	INTEGER	*checksum*	Checksum of bytes 0

0x8E 0x70 Command Packet 0x8E 0x70 (Obsolete)
Beacon Channel Status Request (Obsolete)

Note – Command Packet 0x8E 0x70 and Report Packet 0x8F 0x70 continue to be supported in firmware releases after version 1.04. However, the preferred packets to use are Command Packet 0x8E 0x85 and Report Packet 0x8F 0x85.

Command Packet 0x8E 0x70 requests a report containing the status of the two Beacon channels. The requested data is returned in Report Packet 0x8F 0x70 (Obsolete).

Table 2-171 Request Beacon Channel Status

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x70	Beacon Channel Status Request
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x71 Command Packet 0x8E 0x71
Beacon DGPS Station Database Report Request

Command Packet 0x8E 0x71 requests a report containing the data in the ten Beacon DGPS Station Database records. The requested data is returned in Report Packet 0x8F 0x71.

Table 2-172 Request Radiobeacon Database Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x71	Radiobeacon Database Report Request
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x73 Command Packet 0x8E 0x73 (Obsolete)
Beacon Channel Control Command (Obsolete)

Note – Command Packet 0x8E 0x73 and Report Packet 0x8F 0x73 continue to be supported in firmware releases after version 1.04. However, the preferred packets to use are Command Packet 0x8E 0x89 and Report Packet 0x8F 0x89.

Command Packet 0x8E 0x73 sets the configuration parameters for one of the two Beacon channels. To operate the Beacon channels in any automatic acquisition mode, the command packet must be sent twice to change both channels to the same automatic acquisition mode. For example, to operate the receiver in Auto Range acquisition mode, send Command Packet 0x8E 0x73 with Byte 2 set to 1 once to set Beacon Channel 0 and a second time to set Beacon Channel 1. Report Packet 0x8F 0x73 (Obsolete) is returned to acknowledge completion of the parameter configuration.

Table 2-173 Receiver Control Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x73	Beacon Channel Control Command
1	Channel Number	BYTE	*flag*	Beacon channel number: 0 Beacon Channel 0 1 Beacon Channel 1
2	Acquisition Mode	BYTE	Table 2-174	Beacon channel acquisition mode
3-4	Frequency	INTEGER	Table 2-175	Radiobeacon station frequency for Manual acquisition mode, ranging from 283.5-325 kHz, in 0.5 kHz increments.
5-6	Checksum	INTEGER	*checksum*	Checksum

Table 2-174 Byte 2, Acquisition Mode

Dec	Hex	Meaning
0	0x00	Manual acquisition mode. The receiver disregards the acquisition mode selected for the other Beacon channel when one channel is placed in Manual mode.
1	0x01	Auto Range Acquisition Mode. The channel uses one of the two closest radiobeacon stations. The command packet must be sent twice to place both channels in Auto Range acquisition mode.
2	0x02	Auto Power Acquisition Mode. The channel uses one of the two most powerful radiobeacon stations. The command packet must be sent twice to place both channels in Auto Power acquisition mode.
3	0x03	Reserved
4	0x04	Disables the Beacon channel. To completely disable the radiobeacon signal acquisition, the command packet must be sent twice, once for each channel, to disable both channels. Disabling beacon acquisition is useful when operating the unit as a GPS receiver or when accepting differential corrections through a port from another source of differential GPS corrections.

Table 2-175 Byte 3-4, Frequency

Dec	Hex	kHz	Dec	Hex	kHz	Dec	Hex	kHz
2835	0xB13	283.5	2975	0xB9F	297.5	3115	0xC2B	311.5
2840	0xB18	284.0	2980	0xBA4	298.0	3120	0xC30	312.0
2845	0xB1D	284.5	2985	0xBA9	298.5	3125	0xC35	312.5
2850	0xB22	285.0	2990	0xBAE	299.0	3130	0xC3A	313.0
2855	0xB27	285.5	2995	0xBB3	299.5	3135	0xC3F	313.5
2860	0xB2C	286.0	3000	0xBB8	300.0	3140	0xC44	314.0
2865	0xB31	286.5	3005	0xBBD	300.5	3145	0xC49	314.5
2870	0xB36	287.0	3010	0xBC2	301.0	3150	0xC4E	315.0
2875	0xB3B	287.5	3015	0xBC7	301.5	3155	0xC53	315.5
2880	0xB40	288.0	3020	0xBCC	302.0	3160	0xC58	316.0
2885	0xB45	288.5	3025	0xBD1	302.5	3165	0xC5D	316.5
2890	0xB4A	289.0	3030	0xBD6	303.0	3170	0xC62	317.0
2895	0xB4F	289.5	3035	0xBDB	303.5	3175	0xC67	317.5
2900	0xB54	290.0	3040	0xBE0	304.0	3180	0xC6C	318.0
2905	0xB59	290.5	3045	0xBE5	304.5	3185	0xC71	318.5
2910	0xB5E	291.0	3050	0xBEA	305.0	3190	0xC76	319.0
2915	0xB63	291.5	3055	0xBEF	305.5	3195	0xC7B	319.5
2920	0xB68	292.0	3060	0xBF4	306.0	3200	0xC80	320.0
2925	0xB6D	292.5	3065	0xBF9	306.5	3205	0xC85	320.5
2930	0xB72	293.0	3070	0xBFE	307.0	3210	0xC8A	321.0
2935	0xB77	293.5	3075	0xC03	307.5	3215	0xC8F	321.5
2940	0xB7C	294.0	3080	0xC08	308.0	3220	0xC94	322.0
2945	0xB81	294.5	3085	0xC0D	308.5	3225	0xC99	322.5
2950	0xB86	295.0	3090	0xC12	309.0	3230	0xC9E	323.0
2955	0xB8B	295.5	3095	0xC17	309.5	3235	0xCA3	323.5
2960	0xB90	296.0	3100	0xC1C	310.0	3240	0xCA8	324.0
2965	0xB95	296.5	3105	0xC21	310.5	3245	0xCAD	324.5
2970	0xB9A	297.0	3110	0xC26	311.0	3250	0xCB2	325.0

0x8E 0x74 Command Packet 0x8E 0x74
Clear Beacon Database Command

Command Packet 0x8E 0x74 clears the records in the radiobeacon database. Report Packet 0x8F 0x74 is sent in response.

Table 2-176 Clear Beacon Database Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x74	Clear Beacon Database Command
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x75 Command Packet 0x8E 0x75
FFT Start Command

Command Packet 0x8E 0x75 configures the receiver to perform Fast Fourier Transforms (FFT), allowing the receiver to generate either narrowband (with or without signal input squaring) or wideband FFT spectral plots. The packet is acknowledged with Report Packet 0x8F 0x75, and the actual reports containing the FFT data are returned with Report Packet 0x8F 0x77.

Table 2-177 FFT Start Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x75	FFT Start Command
1	Narrowband Flag	BYTE	*flag*	FFT spectral plot type: 0 Wideband FFT spectral plot 1 Narrowband FFT spectral plot
2	Input Squared Flag	BYTE	*flag*	Squares the input prior to generating narrowband FFT spectral plot. 0 Not squared 1 Squared
3-4	Center Frequency	INTEGER	Table 2-175	Center frequency, in 100 Hz units, ranging from 283.5 to 325.0 kHz[2]
5	Number of Integrations	BYTE	*flag*	Number of post FFT power sums: 5 Narrowband (recommended) 33 Wideband (recommended)
6	Channel Number	BYTE	*flag*	Beacon Channel Number:[1] 0 Channel 0 1 Channel 1
7-8	Checksum	INTEGER	*checksum*	Checksum

1 The wideband FFT program uses a single channel.

2 MF (medium frequency) ranges from 283.5-325.0 kHz, in 100 Hz units.

0x8E 0x76 Command Packet 0x8E 0x76
FFT Stop Command

Command Packet 0x8E 0x76 stops the generation of FFT spectral plots. Report Packet 0x8F 0x76 is sent is response.

Table 2-178 FFT Stop Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x76	FFT Stop Command
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x78 Command Packet 0x8E 0x78
RTCM Reports Request

Command Packet 0x8E 0x78 requests the generation and transmission of RTCM reports. The request is acknowledged with Report Packet 0x8F 0x78, followed by the actual report containing the RTCM data.

Table 2-179 Request RTCM Reports

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x78	RTCM Reports Request
1	RTCM Report Flag	BYTE	*flag*	Determines if RTCM reports are output by receiver: 0 Disabled 1 Enabled
2-3	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x79 Command Packet 0x8E 0x79
Beacon Station Attributes Command

Command Packet 0x8E 0x79 changes the attribute of one or more of the 84 radiobeacon stations, ranging from 283.5 KHz to 325.0 KHz, in 0.5 KHz increments. See also Report Packet 0x8F 0x79.

Table 2-180 Set Radiobeacon Station Attributes

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x79	Radiobeacon Station Attributes Command
1	1st station	BYTE	*flag*	Station attributes for first through eighty-fourth station (from 283.5 KHz to 325.0 KHz) in 0.5 KHz increments: 0 Station Enabled/Health heeded 1 Station Enabled/Health Ignored 2 Disabled - Station disabled 3 Unmonitored When station health is unmonitored, it is treated as a healthy station in the Auto Range mode selection process
. . .	. . .			
84	84th station			
85-86	Checksum	INTEGER	*checksum*	Checksum

The station attributes are used only in the Auto Power and Auto Range signal acquisition modes. When a station is disabled (Byte = 2), it is not included in the search list. If the station attribute is set to ignore health (Byte = 1), the station is included in the search list regardless of its health status. When the station is not monitored and is defined as unmonitored (Byte = 3), the station is treated as a healthy station in the selection process for Auto Range acquisition mode only.

0x8E 0x7A Command Packet 0x8E 0x7A
Beacon Station Attributes Report Request

Command Packet 0x8E,0x7A requests a report containing the attribute assigned to the 84 radiobeacon station definitions. The request is acknowledged with Report Packet 0x8F 0x7A.

Table 2-181 Request Radiobeacon Station Attributes Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7A	Radiobeacon Station Attributes Request
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x7B Command Packet 0x8E 0x7B
Receiver Configuration Block and Software Version Request

Command Packet 0x8E 0x7B requests a report containing the current receiver configuration parameter settings and software version number. Report Packet 0x8F 0x7B is sent in response.

Table 2-182 Request Receiver Configuration Block and Software Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7B	Output Receiver Configuration Block and Software Version Request
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x7C Command Packet 0x8E 0x7C
Receiver Configuration Block Command

Command Packet 0x8E 0x7C is used to set the receiver configuration parameters stored in battery-backed RAM (Random Access Memory). Report Packet 0x8F 0x7C is sent in response.

Table 2-183 Set Receiver Configuration Block

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7C	Receiver Configuration Block
1	Head	BYTE	0x55h	Beginning of Configuration Block
2	Version	BYTE	0x00-0x01	Version Number of Configuration Block (1-2)
3-34	Serial Number	STRING	*ASCII*	Serial Number of Receiver
35	Day	BYTE	0x01-0x1F	Day of Manufacture (1-31)
36	Month	BYTE	0x01-0x0C	Month of Manufacture (1-12)
37-38	Year	INTEGER	*year*	Year of Manufacture
39-40	Superpacket Option Flag	INTEGER	*flag*	DGPS postprocessing option with Report Packet 0x8F 0x20: 0 Off 1 On
41	Input Protocol	BYTE	*flag*	Port B Input Protocol: 0 None 1 TSIP 4 RTCM 11 ASCII IN then OUTPUT PORT A (DataMerge) 12 ASCII IN then OUTPUT PORT B (DataMerge) 14 LBAR (from Lightbar)

Table 2-183 Set Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
42	Output Protocol	BYTE	*flag*	Port B Output Protocol: 0 None 2 TSIP 3 NMEA 5 Internally-generated RTCM (i.e. base station) 10 Externally-generated RTCM (i.e. flow-thru RTCM) 15 LBAR (to Lightbar)
43	Input Baud Rate	BYTE	*flag*	Port B Input Baud Rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps
44	Output Baud Rate	BYTE	*flag*	Port B Output Baud Rate (see above)
45	Parity	BYTE	*flag*	Port B Parity: 0 None 1 Odd 2 Even
46	Data Bits	BYTE	*flag*	Port B Data Bits: 0 5 data bits 1 6 data bits 2 7 data bits 3 8 data bits
47	Stop Bits	BYTE	*flag*	Port B Stop Bits: 0 1 stop bit 1 2 stop bits
48	Reserved	BYTE	0x00	Reserved (set to zero)

Table 2-183 Set Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
49	Input Protocol	BYTE	*flag*	Port A Input Protocol: 0 None 1 TSIP 4 RTCM 11 ASCII IN then OUTPUT PORT A (DataMerge) 12 ASCII IN then OUTPUT PORT B (DataMerge) 14 LBAR (from Lightbar)
50	Output Protocol	BYTE	*flag*	Port A Output Protocol: 0 None 2 TSIP 3 NMEA 5 Internally-generated RTCM (i.e. base station) 10 Externally-generated RTCM (i.e. flow-thru RTCM) 15 LBAR (to Light bar)
51	Input Baud Rate	BYTE	*flag*	Port A Input Baud Rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps
52	Output Baud Rate	BYTE	*flag*	Port A Output Baud Rate (see above)
53	Parity	BYTE	*flag*	Port A Parity: 0 None 1 Odd 2 Even
54	Data Bits	BYTE	*flag*	Port A Data Bits: 0 5 data bits 1 6 data bits 2 7 data bits 3 8 data bits

Table 2-183 Set Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
55	Stop Bits	BYTE	*flag*	Port A Stop Bits: 0 1 stop bit 1 2 stop bits
56	Reserved	BYTE	0x00	Reserved (set to zero)
57	Product ID	BYTE		Product Identification Code. See product-specific appendix for values.
58	P/V Filter Flag	BYTE	*flag*	Position/Velocity Filter: 0 Disabled 1 Static/dynamic filters on 2 Dynamic filter only on 3 Static/dynamic/altitude filters on 4 Dynamic/altitude filters on 5 Altitude filter only on The PV filter smooths position data when the antenna is moving and attempts to reduce the effects of position disturbances which include reflected signals and small outages of DGPS corrections.
59	Carrier Phase Flag	BYTE	*flag*	Carrier Phase Processing: 0 Disable 1 Enable
60	1 PPS Flag	BYTE	*flag*	1 PPS Output: 0 Disable 1 Enable
61-64	Antenna Gain	REAL	*dB value*	Antenna gain, in decibels
65	Event Flag	BYTE	*flag*	Event Marker Input: 0 Disable 1 Enable The flag setting is ignored if the receiver does not support Event Marker input.
66	Beacon Enabled/ Disabled Flag	BYTE	*flag*	Beacon receiver: 0 Disable 1 Enable
67	Maximum Position Rate	BYTE	*flag*	Maximum allowable position rate: 0 1 Hz 1 5 Hz 2 10 Hz

Table 2-183 Set Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
68	Beacon Attribute	BYTE	*flag*	Default beacon attribute used by receiver: 0 Heed health 1 Ignore health 2 Disable beacon 3 Beacon is not monitored
69	RTCM Time-out	BYTE	*seconds*	Time-out period on external RTCM input, in seconds
70	Scorpio Decoding	BYTE	*flag*	Availability of Scorpio decoding: 0 Off 1 On
71	Base Station	BYTE	*flag*	Reference station option: 0 Not available 1 RTCM Type 1 corrections available 2 RTCM Type 1 and 9 corrections available
72	Everest	BYTE	*flag*	Everest Multipath Reduction option: 0 Not available 1 Available
73	Modem Control	BYTE	*flag*	Availability of modem control: 0 Not available 1 Available
74	Reserved	BYTE	0x00	Reserved (set to zero)
75-76	D&E Subscription	INTEGER	*week*	D&E subscription week number
77	Guidance	BYTE	*flag*	Guidance option availability: 0 Not installed 1 Installed and currently disabled 2 Installed and currently enabled
78	Satellite Differential Service Provider	BYTE	*flag*	Satellite differential service provider used to acquire differential GPS corrections: 0 All 1 Racal only 2 Omnistar only
79	Language	BYTE	*flag*	Language used on display: 0 English 1 Spanish 2 French 3 German 4 Portugese

Table 2-183 Set Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
80	Hardware name	BYTE		Hardware type: 0 Unknown 1 Beast 2 Spot 3 Bascom 4 Taz 5 EuroBeast
81-82	TNL Subscription	INTEGER	*week*	TNL subscription week number
83	Display units	BYTE		Display units: 0 Metric 1 U.S.
84	Disabled streams	BYTE	0x00	Set to zero
85-124	Reserved	BYTEs	0x00	Reserved (set to zero)
125-126	End	INTEGER	0xAA55h	Tail of Configuration Block
127-128	Checksum	INTEGER	*checksum*	Checksum of configuration block computed as (0 - sum of bytes 1 through 126)
129-130	Checksum	INTEGER	*checksum*	Checksum of Bytes 0-128 (normal TSIP checksum)

0x8E 0x7E Command Packet 0x8E 0x7E Satellite Line-of-Sight (LOS) Request

Command Packet 0x8E 0x7E enables or disables the automatic output of Report Packet 0x8F 0x7E.

Table 2-184 Request Satellite Line-of-Sight (LOS) Output

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7E	Satellite Line-of-Sight (LOS)
1	LOS Enable Flag	BYTE	*flag*	0 Disable Report Packet 0x8F 0x7E 1 Enable Report Packet 0x8F 0x7E
2-3	Reserved	BYTE	0x00	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x7F Command Packet 0x8E 0x7F
Receiver ROM Configuration Block and Software Version Request

Command Packet 0x8E 0x7F requests a report containing the ROM receiver configuration parameter settings and software version number. Report Packet 0x8F 0x7F is sent in response.

Table 2-185 Request Receiver ROM Configuration Block and Software Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7F	Output Receiver ROM Configuration Block and Software Version
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x80 Command Packet 0x8E 0x80
DGPS Service Provider System Information Request

Command Packet 0x8E 0x80 requests system information about the status of the satellite DGPS service specified. Report Packet 0x8F 0x80 is sent in response.

Table 2-186 Request DGPS Service Provider System Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x80	DGPS Service Provider System Information
1	Provider	BYTE	*flag*	Selects the DGPS service provider: 3 Racal 4 Omnistar 0xFF Current provider in use
2-3	Reserved	BYTE	0x00	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x81 Command Packet 0x8E 0x81
Decoder Station Information Command

The Racal satellite DGPS service provides RTCM from multiple stations on the same link. To query for information about these stations, send the packet shown in Table 2-187.

Table 2-187 Request Decoder Station Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x81	Decoder Station Information
1-2	Checksum	INTEGER	*checksum*	Checksum

To change the decoder station information, use the packet shown in Table 2-188. Report Packet 0x8F 0x81 (a null packet) is sent in response. By default, the receiver enables output from all of the stations in the downlink list and then picks the best station to use. The user can change how the receiver chooses the "best" station by modifying the station selection preference setting in byte 7. In most areas, the network solution should provide better DGPS performance. In some areas near the edge of the network coverage, you may receive better DGPS coverage by setting the selection preference to prefer the closest station instead of the network station.

Note – Do not attempt to configure the station information before a valid station list exists.

Table 2-188 Set Decoder Station Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x81	Decoder station information
1	Selection Flag	BYTE	*flag*	Selects the decoder station: 0 Select station provided 1 Select all available stations
2-3	Station ID	INTEGER	*identifier*	Station identifier
4	RTCM Enable Flag	BYTE	*flag*	Enables RTCM output from the selected station: 0 Disable RTCM output from this station 1 Enable RTCM output from this station
5-6	Reserved	INTEGER	0x00	Reserved (set to zero)
7	Selection preference	BYTE	*preference*	Station selection preference: 0 Prefer network station 1 Prefer closest station
8-10	Reserved	BYTE	0x00	Reserved (set to zero)
11-12	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x82 Command Packet 0x8E 0x82 Decoder Diagnostic Information Request

Command Packet 0x8E 0x82 requests data decoder diagnostic information for the satellite DGPS service specified. Report Packet 0x8F 0x82 is sent in response.

Table 2-190 Request Decoder Diagnostic Info Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x82	Decoder Diagnostic Information
1	Provider	BYTE	*flag*	Selects the service provider: 3 Racal 4 Omnistar 0xFF Current provider in use
2-3	Reserved	BYTE	0x00	Reserved
4-5	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x84 Command Packet 0x8E 0x84 Satellite FFT Control Command

Command Packet 0x8E 0x84 starts or stops the satellite FFT (Fast Fourier Transform) diagnostics and sets the FFT diagnostic options. The packet is acknowledged with Report Packet 0x8F 0x84 (a null packet).

Table 2-191 Set Satellite FFT Control Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x84	Satellite FFT Control Command
1	Mode	BYTE	*flag*	Starts or stops FFT diagnostics: 0 Stop FFT (all other data fields ignored) 1 Start FFT
2	Oscillator Offset	BYTE	*flag*	Include or exclude oscillator offset in narrowband FFT: 0 Exclude oscillator offset 1 Include oscillator offset
3	FFT Plot Type Flag	BYTE	*flag*	Selects narrowband or wideband FFT plot: 0 Wideband FFT spectral plot 1 Narrowband FFT spectral plot
4	Input Squared Flag	BYTE	*flag*	Determines if a narrowband FFT plot is squared: 0 Input is not squared 1 Input is squared before generating narrowband FFT plot
5-12	Center Frequency	DOUBLE	*hertz*	FFT center frequency (Hz)

Table 2-191 Set Satellite FFT Control Packet (Continued)

Byte #	Item	Type	Value/Units	Meaning
13	Number of Integrations	BYTE	*sums*	Number of post-FFT power sums 5 Narrowband (recommended) 33 Wideband (recommended)
14-16	Reserved	BYTE	0x00	Reserved (set to zero)
17-18	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x85 Command Packet 0x8E 0x85 DGPS Source Tracking Status Request

Command Packet 0x8E 0x85 requests the tracking status for the source of DGPS corrections (either beacon or satellite). Report Packet 0x8F 0x85 is sent in response.

Note – With the release of Firmware Release 1.04, this is the preferred packet to use in lieu of Command Packet 0x8E 0x70 (Obsolete) which was previously used to query for beacon status.

Table 2-192 Request DGPS Source Status Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x85	DGPS Tracking Status
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x86 Command Packet 0x8E 0x86 Satellite Database Control

Command Packet 0x8E 0x86 requests the contents of the satellite DGPS station database or clears the database. Report Packet 0x8F 0x71 is sent when requesting the database contents, and Report Packet 0x8F 0x86 (a null packet) is sent when clearing the database.

Table 2-193 Satellite Database Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	Satellite Database Control
1	Operation	BYTE	*flag*	Database operation: 0 Request database of Racal stations 1 Clear database of Racal stations
2-3	Reserved	BYTE	0	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Packet checksum

Note – The Record Index (byte 1) of Report Packet 0x8F 0x71 is modified and contains additional flags in the uppermost bits: If this is a satellite database, bit 4 indicates whether the database contains Racal LandStar station information or Omnistar station information. Bit 5 indicates if the station is the RTCM source, Bit 6 indicates if the station is a network station, and Bit 7 indicates if this is a Beacon or Satellite database (bit set = Satellite).

0x8E 0x87 Command Packet 0x8E 0x87 Network Statistics Request

Command Packet 0x8E 0x87 requests a report containing the network statistics for the VRS solution. Report Packet 0x8F 0x87 is sent in response.

Table 2-194 Request Network Statistics Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x87	Network Statistics Request
1	Channel	BYTE	*flag*	Satellite DGPS or External RTCM: 0 Satellite DGPS (Racal only) 1 External RTCM
2	Satellite ID	BYTE	0x00-0x20	SV ID (1-32) or 0 to receive network statistics for all SVs
3	Reserved	BYTE	0x00	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x88 Command Packet 0x8E 0x88 Diagnostic Output Options Command

Command Packet 0x8E 0x88 requests or sets the Diagnostic Output options.

To request the current output options, send the packet shown in Table 2-195. Report Packet 0x8F 0x88 is sent in response.

Table 2-195 Request Diagnostic Options Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x88	Diagnostic Output options
1	Port Number	BYTE	0x00-0x01	Serial port number
2-3	Checksum	INTEGER	*checksum*	Packet checksum

To change the output options, send the packet shown in Table 2-196. Report Packet 0x8F 0x88 is sent in response.

Table 2-196 Set Satellite Output Options Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x88	Satellite Output options
1	Port Number	BYTE	0x00-0x01	Serial port 0 Port B 1 Port A
2	I/O Options	BYTE	Table 2-197	Racal or Omnistar decoder diagnostics
3-6	Reserved	BYTE	0x00	Reserved (set to zero)
7-8	Checksum	INTEGER	*checksum*	Checksum

Table 2-197 Byte 2, I/O Option Flags

Bit #	Meaning
0 (LSB)	Racal decoder diagnostics: 0: Disable 1: Enable
1	Omnistar decoder diagnostics: 0: Disable 1: Enable
2	Reserved (set to zero)
3-7	Reserved (set to zero)

0x8E 0x89 Command Packet 0x8E 0x89
DGPS Source Control Command

The Satellite DGPS source control packet is used to control whether the desired source of differential corrections is a Beacon or a Satellite Station and to set the appropriate parameters depending on the source chosen.

The packet is used in three different ways for Beacon and Satellite receivers:

- To configure the beacon modes and frequencies when operating in *Beacon Differential Only* source mode. For Beacon receivers, this is the only mode available.
- To configure the satellite differential bit rate and frequency when operating in *Satellite Differential Only* source mode.
- To configure the satellite and beacon frequencies and RTCM time-outs when operating in *Auto Differential* source mode.

Important Note About Auto-Differential Source Mode

Due to the complexity of automatic source switching, Trimble does not recommend using Auto-Differential Source mode. Users will be more satisfied with performance and operation using either Beacon Only or Satellite Only source mode.

In order to successfully enter Auto-Differential mode, the following requirements must be met:

- Valid Beacon frequencies for both beacon channels must be specified. If only one beacon is available in a region, both channels must be set to the same beacon frequency.
- The Beacon acquisition mode must be set to Manual mode.
- A valid satellite frequency must be specified.
- A valid satellite bit rate must be specified.

This packet replaces Command Packet 0x8E 0x73 (Obsolete) which was formerly used to control the beacon channels. A single acquisition mode is used for both beacon channels.

To request the current DGPS source parameters, send the packet shown in Table 2-198. Report Packet 0x8F 0x89 is sent in response.

Table 2-198 Request Satellite DGPS Source Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x89	Satellite DGPS Source Control
1-2	Checksum	INTEGER	*checksum*	Checksum

To change the DGPS source parameters, send the packet shown in Table 2-199. Response packet is null Report Packet 0x8F 0x89.

Table 2-199 Set DGPS Source Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x89	Satellite DGPS Source Control
1	DGPS Source Mode	BYTE	*flag*	DGPS Source mode: 0 Beacon differential only 1 Satellite differential only 2 Automatic switching between beacon and satellite DGPS sources (see note above)
2	Beacon Acquisition Mode	BYTE	*flag*	Beacon mode used to acquire DGPS signals: 0 Manual mode 1 Auto Distance mode 2 Auto Power mode 3 Reserved 4 Channel disabled
3-4	Beacon Frequency 0	INTEGER	2835-3250	Channel 0 manual beacon frequency for manual beacon mode and DGPS source auto-switching mode (units of 0.1 kHz). Value 0 = unchanged
5-6	Beacon Frequency 1	INTEGER	2835-3250	Channel 1 manual beacon frequency for manual beacon mode and DGPS source auto-switching mode (units of 0.1 kHz). Value 0 = unchanged
7-8	Beacon RTCM Time-out	INTEGER	*seconds*	Time to wait for RTCM corrections before switching to Satellite in DGPS source auto-switching mode (seconds). (*default*: 30 sec.) Value 0 = unchanged
9-16	Satellite Frequency	DOUBLE	*Hz*	Satellite frequency for manual Satellite mode and DGPS source auto-switching mode. Value 0 = unchanged
17-20	Satellite Bit Rate	SINGLE	*baud*	Satellite bit rate (600, 1200, 2400)
21-22	Satellite RTCM Time-out	INTEGER	*seconds*	Time to wait for RTCM corrections before switching to Beacon in DGPS source auto-switching mode (seconds). (*default*: 60 sec.) Value 0 = unchanged
23-26	Reserved	BYTE	0x00	Reserved (set to zero)
27-28	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x8A Command Packet 0x8E 0x8A
Service Provider Information Request

Information about the service providers supported by the receiver is available through this packet. To query for service provider information, send the packet shown in Table 2-200. All of the database entries or just the first *n* entries can be requested.

Table 2-200 Request Service Provider Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8A	Service provider information
1	Number of Entries	BYTE		Number of requested provider entries (0 requests all entries)
2-3	Reserved	BYTE	0x00	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Packet checksum

If Racal or Omnistar add another service with a separate service identifier and scrambling information, this service may need to be added to the receiver's default database in order to be able to access this service. To add a service provider to the existing database, use the packet shown in Table 2-201. To delete a service provider, send in the service identifier of the entry to be deleted and set the service provider to 'Unknown'. Otherwise this information persists in receiver memory until battery-backed RAM is cleared.

Table 2-201 Add Service Provider Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8A	Service provider information
1	Service Provider	BYTE	*flag*	Service provider: 3 Racal only 4 Omnistar only 0xFF Unknown service provider
2-3	Service Identifier	INTEGER		Service identifier for particular link 0x8E20Racal LandStar service 0xC685OmniStar service 0x2873OmniStar service 0xFFFFUnknown service
4-5	Scrambler 1 Generator	INTEGER		Generator polynomial for first scrambler
6-7	Scrambler 1 Initial State	INTEGER		Initial state of first scrambler
8-9	Scrambler 2 Generator	INTEGER		Generator polynomial for second scrambler
10-11	Scrambler 2 Initial State	INTEGER		Initial state of second scrambler
12-13	Reserved	BYTE	0x00	Reserved (set to zero)
14-15	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x8B Command Packet 0x8E 0x8B
Service Provider Activation Information Command

Information about the user activation for service providers requiring external activation is available through this packet. Send the packet using the structure shown in Table 2-202 to query for service provider activation informatio. Two different activation information packets are available. See Report Packet 0x8F 0x8B for more information.

Table 2-202 Request Service Provider Activation Information Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8B	Service Provider Activation Information
1	Service Provider	BYTE		Service provider: 4 OmniStar
2	Information Type	BYTE		Type of activation information: 0 Brief description 1 Extended description
3	Reserved	BYTE	0x00	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Checksum

Send the packet using the structure shown in Table 2-203 to set the activation information:

Table 2-203 Enter Service Provider Activation Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8B	Service Provider Activation Information
1	Service Provider	BYTE		Service provider: 4 OmniStar activation
2-25	ASCII Activation Code	BYTE	*code*	ASCII numeric user activation code provided by OmniStar upon subscription
26-33	Reserved	BYTE	0x00	Reserved (set to zero)
34-35	Checksum	INTEGER	*checksum*	Packet checksum

The subscription information persists in receiver memory even if battery-backed RAM is cleared, however if battery-backed RAM is cleared, the activation code entered for this subscription will be cleared.

0x8E 0x8E Command Packet 0x8E 0x8E
Service Provider Data Load Command

Command Packet 0x8E 0x8E requests the service provider to download data (almanac, reference station lists, etc.) or to request the service provider to accept data uploaded to the receiver. Since the amount of downloaded or uploaded data exceeds 114 bytes the data is divided among several packets called pages. Even when all of the data bytes are DLEs (which transmits 2 TSIP bytes for each data bytes), the packet structure does not overflow the 255 byte TSIP buffer length.

The data structure of the packets is described in Table 2-204 and Table 2-205. Each page contains a maximum of 114 bytes, so multiple pages are generated until all of the data bytes are transmitted. All of the pages (packets) must be merged together to form one data block.

Table 2-204 Upload Service Provider Data

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8E	Service Provider Data Load Command
1	Data Type	BYTE	0x01	Upload data
2	Service Provider Type	BYTE	0x04	Service provider: 4 Omnistar
3-6	Version	SINGLE		Service provider version
7	Page Number	BYTE	*number*	Page number (number of 114 byte packet)
8	Transfer Complete	BYTE	*flag*	Flag setting determines if this is last page (packet) of data, signifying the end of transmission: 0 More pages left to transmit 1 Last page transmitted
9	Byte Count	BYTE	1-114	Number of data bytes in packet, *n*
10-(10 + *n*)	Data	BYTE	0-255	Service provider upload data
(11 + *n*)-(12 + *n*)	Checksum	INTEGER	*checksum*	Checksum of bytes 0-10+n

Table 2-205 Request Service Provider Data

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8E	Service Provider Data Load Command
1	Data Type	BYTE	0x00	Data request
2	Service Provider Type	BYTE	0x04	Service provider: 4 Omnistar
3-4	Reserved	INTEGER	0x00	Reserved
5-6	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x8F Command Packet 0x8E 0x8F
Receiver Identity Request

Command Packet 0x8E 0x8F queries the receiver for the Machine ID and Product ID used to uniquely identify the receiver architecture. Report Packet 0x8F 0x8F is sent in response. Table 2-206 shows the packet data structure.

Table 2-206 Request Receiver Identity

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8F	Receiver Identity Request
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x90 Command Packet 0x8E 0x90
Guidance Status Request

Command Packet 0x8E 0x90 can be sent with no data bytes to request output of Report Packet 0x8F 0x90. Automatic output of the guidance status packet is configured using Command Packet 0x8E 0x91.

0x8E 0x91 Command Packet 0x8E 0x91
Guidance Configuration Command

The items inside the guidance configuration packet are configurable items that most users will only change once, if they change them at all. Each of these items controls some aspect of the guidance functionality provided by the PSO. Some additional definitions of packet entries are described below.

Display Mode

The display mode determines in which direction the lightbar LEDs light and arrow indicators point to indicate error. If *Show Correction* is selected, the LEDs will indicate the direction to steer. If *Show Error* is selected, the LEDs will reflect the error with respect to the current swath. Select *Show Correction* to follow the LEDs, and *Show Error* to "pull" the LEDs.

Boundary Mode

Boundary mode determines what kind of boundary will be specified by the headland points. Headland points are used to describe the field boundary so that the receiver can provide an indicator of where the vehicle is relative to the field boundary.

Table 2-207 Boundary Mode/Headland Type Settings

Setting	Value	Description
None	0	No headland wanted.
A-B End zones	1	Establishes a headland area at opposite ends of the field where the field ends are defined by the A and B baseline points.
Closed Circuit	2	Field perimeter defined by user-supplied (via ADD headland) points.
Curved Headland	3	Last automatically logged curved pass before 'End Headland' retained as field boundary.

Swath Direction

The swath direction setting establishes the direction for swath increment, left or right of the A-B line. *Auto Turn Detect* changes swath number when the equipment turns around approximately 110° with respect to the current swath. *Snap to Swath* is a second automatic swath changing option which is not heading dependent. In *Snap to Swath*, the swathing system determines which swath is nearest the current position and sets the swath number accordingly and provides guidance relative to that swath as shown in Figure 2-1.

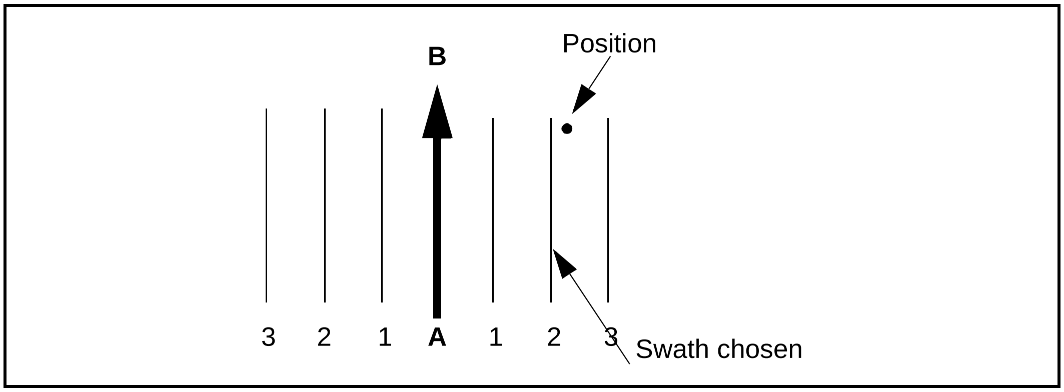


Figure 2-1 Snap to Swath

Both *Auto Turn Detect* and *Snap to Swath* are temporarily disabled when a user manually changes the swath either by incrementing or decrementing or setting to a specific swath number. The automatic options reactivate when the operator brings the equipment onto the selected swath. The reactivation thresholds are ±3 meters and ±5 degrees with respect to the manually selected swath number. For example, if the user is on swath #5 in *Auto Turn Detect* mode and increments 5 times to make the current swath #10, the *Auto Turn Detect* mode will not reactivate until the user drives within ±3meters and ±5 degrees of swath #10. The user may drive either direction on swath #10.

Swath Width

The swath width parameter is set according to the width of the applicator or spray boom, where the total width is measured from one end of the boom to the other.

When calculating coverage area, half the swath width is added. The resulting adjusted field area represents the enclosed area plus a strip of land 1/2 swath width wide around the edge (see *AgGPS Parallel Swathing Option Manual* for more information).

Output Rate

The output rate controls how often the guidance status packet is sent. The output rate is selectable in 200 msec increments including integer seconds (1000 msecs). A value of 0 turns automatic output off.

Command Packet 0x8E 0x91 can be sent with no data bytes to request output of Report Packet 0x8F 0x91 as shown in Table 2-208.

Table 2-208 Guidance Configuration Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x91	Guidance configuration command
1-2	Checksum	INTEGER	*checksum*	Checksum

To change the guidance configuration, send the packet using the structure shown in Table 2-209.

Table 2-209 Guidance Configuration Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x91	Guidance configuration command
1	Units	BYTE	*flag*	Specifies what units will be used for the lightbar text display and lightbar LEDs 0 Metric 1 English
2	Display Mode	BYTE	*flag*	Determines in which direction the lightbar LEDs illuminate and arrow indicators point to indicate error 0 Show Correction 1 Show Error
3	Boundary Mode	BYTE	Table 2-207	Specifies desired field boundary/headlands type (see notes above)
4	Pattern Mode	BYTE	Table 2-210	Guidance pattern to use
5-6	Look Ahead	INTEGER	*seconds*	Allows the system to predict future error. This accounts for system delays, including operator response time. The recommended setting is 2 seconds.
7	Swath Direction	BYTE	*flag*	Direction to generate swaths relative to A-B line (see notes above) 0 Left 1 Right 2 Automatic turn detection 3 Snap to closest swath
8-11	Swath Width	SINGLE	*meters*	Width of applicator or spray boom (see notes above)
12-15	Antenna Offset	SINGLE	*meters*	Antenna position offset fore or aft of the applicator boom > 0 The antenna is ahead of the boom < 0 The antenna is behind the boom
16-19	Guidance Output Rate	LONG	*msecs*	Rate of guidance status packet transmission in increments of 200 msecs: 0 No automatic output 200,1000 Output every 200 or 1000 msecs, etc.
20-21	Number of swaths to skip	INTEGER	*number*	Number of swaths to skip when using Skip 'N' pattern. Unused when pattern is not Skip N. 0 to 999 is valid range.
22-34	Reserved	BYTE	0	Reserved
35-36	Checksum	INTEGER	*checksum*	Checksum

Table 2-210 Pattern Mode Settings

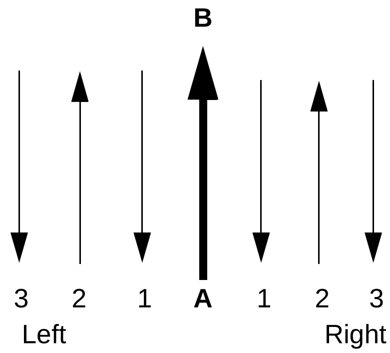
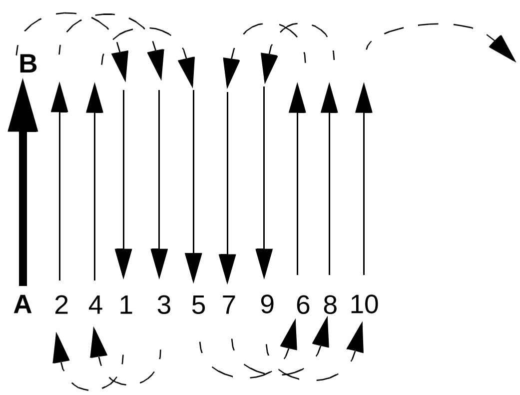
Setting	Value	Description
None	0	No pattern wanted. Basic A-B guidance  Increment action bumps swath by 1 to the right or left, depending on the side of the current swath.
Skip ’N’	1	Swath increment involves skipping over ’N’ swaths at a time. Skip 2 is  shown here. Set the number to skip in guidance configuration packet.

Table 2-210 Pattern Mode Settings (Continued)

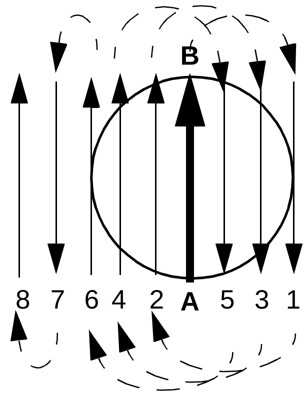
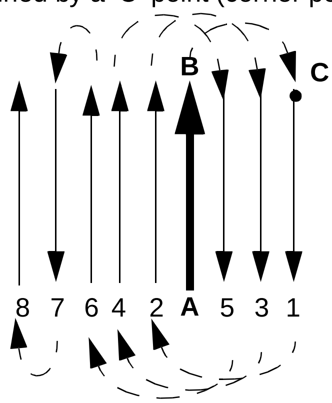
Setting	Value	Description
Circle Racetrack	2	A-B distance defines circle diameter. A detected or user-specified turn direction sets the first increment to the swath nearest one radius left or right. Subsequent swath increments index swath as shown.  When the incrementing is high enough to take you back to the A-B line (i.e. after swath 6 below), the incrementing switches to move up the field (to swaths 7 and 8, etc.). This pattern is only available in the *Ag*GPS FlightBar product.
Half-field Racetrack	3	Similar to circle racetrack, except distance between subsequent swaths is determined by a ’C’ point (corner point).  This pattern is only available in the *Ag*GPS FlightBar product.

Table 2-210 Pattern Mode Settings (Continued)

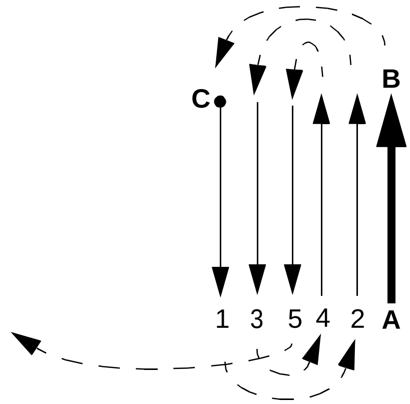
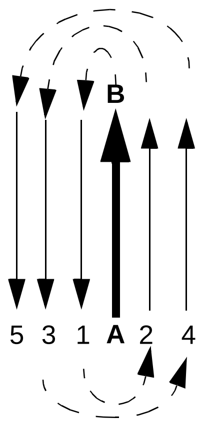
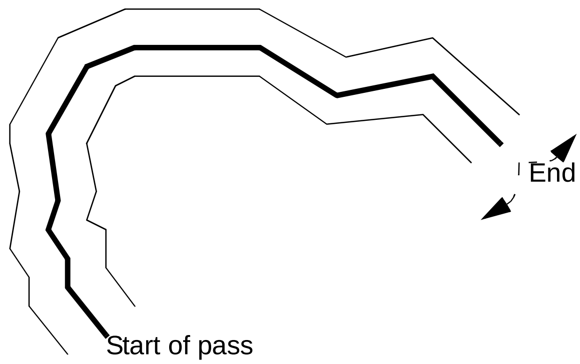
Setting	Value	Description
Squeeze	4	Spiral in, using point ’C’ point to define outer spiral.  This pattern is only available in the *Ag*GPS FlightBar product.
Inverse Squeeze	5	Spiral out  This pattern is only available in the *Ag*GPS FlightBar product.

Table 2-210 Pattern Mode Settings (Continued)

Setting	Value	Description
Follow Last Curve	6	Guidance is parallel to last path. System logs points along arbitrary path and computes parallel offset of the 'curved' path. Path logged is shown as wide line below. Parallel offset is right or left at end of this pass, depending on vehicle turn at end (curved arrows). Offset occurs when vehicle exceeds snap-to-swath threshold while executing the turn. 
Follow Last Curve Spiral	7	Curve following, but offset is immediate to the right or to the left when a user ends a swath with 'Increment' or 'Decrement' respectively. System need not wait for vehicle to exceed snap-to-swath threshold before computing the offset. External switch (Trimble Keypad) Increment and Decrment switches provide interface to this feature.

0x8E 0x92 Command Packet 0x8E 0x92
Lightbar Configuration Command

The lightbar configuration packet contains configurable items that most users will only change once, if they change them at all. Each of these items controls some aspect of the lightbar operation.

Indicator LED Sensitivity

The indicator LED sensitivity defines the sensitivity of the lightbar's large center LED when approaching the pause/resume point while guidance is paused. The indicator LED will glow red, Orange, then green as a vehicle passes over the resume point. Sensitivity is the radius of the GREEN zone, and the width of the ORANGE zone.

The indicator LED is also used to indicate field boundaries when particular headland modes are selected. However, the LED is toggled between GREEN and RED at field boundaries, so the indicator LED sensitivity does not apply.

Note – The faster the ground speed, the larger the LED sensitivity should be. As a frame of reference, a speed of 8 m.p.h. (13 k.p.h.) must have a sensitivity of 36 ft. (11 m) to yield a 3-second warning.

Send the packet described in Table 2-211 to request the current lightbar configuration.

Table 2-211 Lightbar Configuration Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x92	Lightbar configuration request
1-2	Checksum	INTEGER	*checksum*	Checksum

To change the lightbar configuration, send the packet described in Table 2-212.

Table 2-212 Lightbar Configuration Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x92	Lightbar configuration command
1	Lightbar Mounting	BYTE	*flag*	Specifies how lightbar is mounted 0 Dash mounted (upright mounting) 1 Ceiling mounted (inverts lightbar text)
2	Lightbar Intensity	BYTE	1-5	Determines the LED brightness and text base on a scale of 1 to 5.

Table 2-212 Lightbar Configuration Command (Continued)

Byte #	Item	Type	Value/Units	Meaning
3	Lightbar Text Type	BYTE	*flag*	Specifies what kind of information will be provided on the small text display below the LEDs on the lightbar 0 No text 1 Swath # and predicted cross-track error 2 GPS status information 3 Current swath number 4 Distance from start of current swath 5 Distance to end of current swath 6 GPS-derived true heading 7 Predicted cross-track error 8 Directional error between current heading and direction of A-B line, or the desired heading of a curved swath. 9 Ground speed 10 Current swath number and ground speed 11 Lightbar demo text 12 Curve Arrows: turn signal indicator active under curved guidance. 13 Number of points logged on a curved swath. **Note –** Setting the text type to Demo Text will put the lightbar into a demo mode where the lightbar continually cycles through its initialization lightshow. This is primarily intended as an eye-catcher for trade shows.
4	LED Spacing Mode	BYTE	*flag*	This setting configures the lightbar for linear or scaled display 0 Linear display - allows an LED interval to be specified, and spaces each of the 17 LEDs to either side of center by this distance. 1 Scaled display - allows specification of an LED interval and a distance which the end LED represents.
5-8	Lightbar LED Interval	SINGLE	*meters*	If linear spacing is selected, the interval is used as the interval represented by each LED. If scaled spacing is selected, the interval represents the LED spacing at the center of the lightbar.
9-12	Lightbar LED End Interval	SINGLE	*meters*	If scaled spacing is selected, the end interval represents the LED spacing at the far ends of the lightbar.

Table 2-212 Lightbar Configuration Command (Continued)

Byte #	Item	Type	Value/Units	Meaning
13-16	Proximity Indicator Sensitivity	SINGLE	*meters*	The indicator LED sensitivity defines the sensitivity of the lightbar's large, center LED. This setting determines how near a PAUSE point a vehicle must be before turning ORANGE and GREEN.
17	Event Option	BYTE	Table 2-213	Lightbar event output designed to sound alarm.
18-21	Cross-track-error alarm tolerance	SINGLE	*meters*	Applies when event option 0x08 is active. Lightbar event outpu continuously active when cross-track-error exceeds this value.
22-29	Reserved	BYTE	0	Reserved
30-31	Checksum	INTEGER	*checksum*	Checksum

Table 2-213 Lightbar Event Options

Bit #	Meaning
0 (LSB)	When swath number changes: 0: No event 1: Short beep
1	When crossing field boundary (boundaries defined by RED zone for indicator LED. See Figure 3-1, Figure 3-2, Figure 3-3): 0: No event 1: Long beep
2	When inside field (GREEN and ORANGE zones): 0: No event 1: Continuous output
3	When cross-track error exceeds cross-track-error alarm tolerance: 0: No event 1: Continuous output
4	When switch pressed: 0: No event 1: Beep
5-7	Reserved (set to zero)

Note – The center LED spacing and the end LED distance are used to describe the distance represented by the first LED from the center and the distance represented by all of the LEDs on one side of the lightbar, respectively. For example, if the center LED spacing is set to 0.5 meters, the LED slides one unit to the left or right for every 0.5 meters off-line. A smaller sensitivity setting provides more precise guidance. A larger setting increases the distance off-line before the LEDs indicate error. If the LED display is *Scaled*, the first 10 LEDs left and right of center are spaced equally by the spacing value. The outside LEDs become less sensitive to represent the end value settings. The seven outside LEDs are scaled to the configured LED end distance.

Note – You cannot set an end distance in *Linear* mode since the total distance represented by the lightbar LEDs is controlled completely by the linear spacing value.

0x8E 0x94 Command Packet 0x8E 0x94 Guidance Operation Command

This command is used to set up the receiver for guidance operation in a particular field. The command format is described in Table 2-214. The receiver acknowledges the actions by sending Report Packet 0x8F 0x94.

Table 2-214 Guidance Operation Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x94	Guidance operation command
1	Operation	BYTE	*flag*	Type of operation 0 Set Point A 1 Set Point B 2 Set Point C 3 Increment swath number 4 Decrement swath number 5 Pause guidance 6 Resume guidance 7 Jump to a specific swath number (see note) 8 Reset guidance For types 0-2, the user may set the point from the current position (default) or from a provided position by setting the lat/lon/alt values below and the user-provided position flag.
2-3	Set swath number	SIGNED INTEGER	*flag*	Swath number to jump to if ’Jump to specific swath number’ is chosen 0 A-B Line < 0 Swaths right of A-B line > 0 Swaths left of A-B line
	OR... Move Curved swath when in curved guidance mode.			Position of path being guided to, with respect to vehicle position at end of the previous swath. 0 Offset Curved path to the LEFT. 1 Offset Curved path to the RIGHT. 2 No offset. Guidance will be back down the previous curved swath.
4	User provided position	BYTE	*flag*	Source of point position 0 Use current receiver position 1 Use provided position
5-12	Latitude	DOUBLE	*radians*	Latitude of provided position
13-20	Longitude	DOUBLE	*radians*	Longitude of provided position

Table 2-214 Guidance Operation Command (Continued)

Byte #	Item	Type	Value/Units	Meaning
21-28	Altitude	DOUBLE	*meters*	WGS-84 altitude of provided position
29-36	Reserved	BYTE	0	Reserved
37-38	Checksum	INTEGER	*checksum*	Checksum

Note – The "jump to a specific swath" setting is only necessary when you want to change swath rows to the opposite side of the A-B line or fix an accidental increment while maintaining the existing A-B line. See additional notes about changing swath number while in *Auto Turn Detect* or *Snap to Swath* modes in Command Packet 0x8E 0x91 documentation.

Note – Curved guidance operation does not permit jumps to any swath in a field because the system stores data only from the previous path driven. 'Change Swath' when curve following involves moving the path being guided to by the lightbar between three possible positions: Left, Right, and Center with respect to the path driven on the previous swath (during which time the system was logging points for guiding on the next swath).

0x8E 0x95 Command Packet 0x8E 0x95 Button Box Configuration Type Command

The button box configuration type packet is used to select a set of factory-defined actions for the buttons on the button box. The user may clear all of the factory-defined actions by selecting *Clear All Buttons*. The user may also define a custom configuration by selecting *Custom Button Configuration* below and then using Command Packet 0x8E 0x98 to define each button separately. To request the current button box configuration, use packet format described in Table 2-215.

Table 2-215 Button Box Configuration Type Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x95	Button box configuration type request
1-2	Checksum	INTEGER	*checksum*	Checksum

To assign a type of button boxconfiguration, use the packet described in Table 2-216. If a custom configuration is desired, use Command Packet 0x8E 0x98 to configure individual buttons. If you have previously defined a custom configuration but then switched to a default configuration, you may return to the custom button definitions by selecting *Custom Button Configuration*.

Table 2-216 Button Box Configuration Type Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x95	Button box configuration type command
1	Button Configuration Type	BYTE	*flag*	Configure buttons according to 0 Default button box definitions 1 Default external switch definitions 2 Custom button configuration (individual buttons are defined using Command Packet 0x8E 0x98) 3 Clear all button definitions
2-6	Reserved	BYTE	0	Reserved
7-8	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x96 Command Packet 0x8E 0x96 Point Manipulation Command

This packet is used to capture, delete last, and clear all headland points and area points. Report Packet 0x8F 0x96 is sent in response. The format of Command Packet 0x8E 0x96 is shown in Table 2-217.

Table 2-217 Point Manipulation Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x96	Point capture command
1	Operation	BYTE	*flag*	Point operation: 0 Capture current position 1 Delete last point captured of type specified 2 Delete all points of type specified 3 Capture using provided position (bytes 7-30) 4 Request number of points of type "Type of Point"
2	Type of point	BYTE	*flag*	Type of point to capture 0 Headlands point 1 Area point
3-6	Reserved	BYTE	0	Reserved
7-14	Latitude	DOUBLE	*radians*	Latitude of provided position
15-22	Longitude	DOUBLE	*radians*	Longitude of provided position
23-30	Altitude	DOUBLE	*meters*	WGS84 Altitude of provided position
31-34	Reserved	BYTE	0	Reserved
35-36	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x97 Command Packet 0x8E 0x97
Utility Information Request

This packet requests various utility information including the current area and the coverage area determined from the area points. The packet is described in Table 2-218.

Table 2-218 Utility Information Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x97	Utility information request
1	Request type	BYTE	*flag*	Information requested 0 Area within points 1 Adjusted area (includes area flaps for boom width). 2 Sum of length of line segments connecting successive area points. 3 Same as 2 above, with addition of segment between last and first area point to provide a perimeter measure. 4 Length of last segment: distance between last two points in area-point vector
2-5	Reserved	BYTE	0	Reserved
6-7	Checksum	INTEGER	*checksum*	Checksum

0x8E 0x98 Command Packet 0x8E 0x98
Individual Button Configuration Command

The individual button configuration packet is used to configure an action for each button on the button box if the user wants to customize them. Several default configurations can be easily set using Command Packet 0x8E 0x95. Report Packet 0x8F 0x98 is sent in response.

To request the current button configurations, use packet format described in Table 2-219.

Table 2-219 Individual Button Box Configuration Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x98	Individual button configuration request
1-2	Checksum	INTEGER	*checksum*	Checksum

To assign new operations to a button or buttons, use the packet described in Table 2-220. This is a variable length packet depending on how many buttons are configured.

Table 2-220 Individual Button Box Configuration Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x98	Individual button configuration command
1	Number of buttons	BYTE	*buttons*	Number of buttons configured in this packet
2-6	Reserved	BYTE	0	Reserved
For each button, n, specified in byte 1				
7, 10, 13, etc.	Button	SIGNED BYTE	-6 thru 6, excluding 0	Button number according to Trimble cable pin out. Negative numbers indicate the shift key is pressed before this button, i.e -5 indicates the button combination Shift 5.
8, 11, 14, etc.	Operation	BYTE	Table 2-221	When button is pressed, this operation occurs.
9, 12, 15, etc.	Reserved	BYTE	0	Reserved
(7 + 3*n) - (8+ 3*n)	Checksum	INTEGER	*checksum*	Checksum

Table 2-221 Button Box Operations

Value	Meaning	Intended Use
0	Clear button definition	*Ag*132 PSO and *Ag*GPS FlightBar
1	Set Point A	*Ag*132 PSO
2	Set Point B/C	*Ag*132 PSO
3	Pause/Resume	*Ag*132 PSO
4	Set A → Set B → Pause → Resume → Pause ...	*Ag*GPS FlightBar
5	Increment swath	*Ag*132 PSO and *Ag*GPS FlightBar
6	Decrement swath	*Ag*132 PSO and *Ag*GPS FlightBar
7	Reset guidance	*Ag*132 PSO and *Ag*GPS FlightBar
8	Add headland point†	*Ag*132 PSO
9	Delete last headland point†	*Ag*132 PSO
10	Clear all headland points†	*Ag*132 PSO
11	Add area point†	*Ag*132 PSO
12	Delete last area point†	*Ag*132 PSO

† If a boundary point operation is selected for a button, any buttons configured for headland or area operations will be cleared. Likewise, if a headland or area operation is selected for a button, any buttons configured for boundary operations will be cleared.

Table 2-221 Button Box Operations (Continued)

Value	Meaning	Intended Use
13	Clear all area points[†]	*Ag*132 PSO
14	Add boundary point (headland and area point)[†]	*Ag*GPS FlightBar
15	Delete last boundary point[†]	*Ag*GPS FlightBar
16	Clear all boundary points[†]	*Ag*132 PSO and *Ag*GPS FlightBar
17	Shift button	*Ag*132 PSO and *Ag*GPS FlightBar
18	Toggle pattern mode	*Ag*132 PSO and *Ag*GPS FlightBar

† If a boundary point operation is selected for a button, any buttons configured for headland or area operations will be cleared. Likewise, if a headland or area operation is selected for a button, any buttons configured for boundary operations will be cleared.

Note – Duplicate operation assignments are not permitted. If an operation is selected for a button and was previously assigned to another button, the previous assignment will be cleared.

Note – The button defined as a Shift key cannot have a Shift-n assignment.

0x8E 0x9A Command Packet 0x8E 0x9A Differential Correction Information Request

Command Packet 0x8E 0x9A can be sent with no data bytes to request output of Report Packet 0x8F 0x9A as shown in Table 2-222.

Table 2-222 Differential Correction Information Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x9A	Differential correction information request
1-2	Checksum	INTEGER	*checksum*	Checksum

0xB0 Command Packet 0xB0
PPS Signal and Event Commands

The Command Packet 0xB0 subpackets are used to request and configure the PPS signal and event input settings. In the 0xB0 packets, the first data byte is a Subpacket ID which indicates the subpacket type. Therefore, the ID code for these packets is 2 bytes long followed by the data. Each (0xB0 subpacket) pair can be thought of as a separate command packet.

0xB0 0x00 Command Packet 0xB0 0x00
PPS Signal Configuration Command

Command Packet 0xB0 0x00 can be used to configure PPS output options or request a report containing the current configuration options.

Table 2-223 shows the structure of Command Packet 0xB0 0x00 when requesting a report of PPS configuration settings. The receiver responds by sending the data in Report Packet 0xB0 0x80.

Table 2-223 Request PPS Configuration Settings Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	PPS Configuration Settings Report Request
1	PPS Number	BYTE	0x01	Currently supports the output of one PPS signal.
2-3	Checksum	INTEGER	—	Checksum of bytes 0-1

Table 2-224 shows the structure of Command Packet 0xB0 0x00 when commands are sent to configure PPS settings. The receiver resets the configuration settings and acknowledges the command by sending Report Packet 0xB0 0x80.

Table 2-224 Set PPS Configuration Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	PPS Configuration Settings Command
1	PPS Number	BYTE	0x01	Currently supports the output of one PPS signal (PPS Number = 1).
2	Enable Flag	BYTE	*flag*	Enables or disables the specified PPS signal (PPS Number): 0 Disabled 1 Enabled
3	PPS Timebase	BYTE	*flag*	Sets the PPS timebase to use the GPS or UTC time of the week, or the receiver's internal clock (user-defined): 0 GPS time 1 UTC (Universal Time Coordinated) 2 Receiver's internal clock (user-defined)

Table 2-224 Set PPS Configuration Command (Continued)

Byte #	Item	Type	Value/Units	Meaning
4	PPS Polarity	BYTE	*flag*	Sets the polarity of the specified PPS signal (PPS Number): 0 Negative polarity 1 Positive polarity
5	Auto Generated Reports	BYTE	*flag*	Enables or disables the automatic output of Report Packet 0xB0 0x82 for the specified PPS Number: 0 Disable 1 Enable
6-9	Reserved	BYTE	0x00	Reserved (set to zero)
10-17	Period	DOUBLE	1.0 Hz	Currently supports a 1 Hz PPS (pulse per second) output signal rate.
18-25	Offset	DOUBLE	*seconds*	PPS output signal offset in seconds for the specified PPS Number. The Polarity of the PPS signal is offset by the specified number of seconds. Negative polarity causes the signal to output sooner, and positive polarity causes the PPS signal to output later
26-29	Max UNC Threshold	SINGLE	*seconds*	Maximum allowable clock uncertainty threshold, in seconds, for the specified PPS Number. If the Maximum UNC Threshold is set to a large value (e.g. 1 second), the GPS receiver continues to produce a PPS signal even when a position fix is not available (satellites are not tracked). If the Maximum UNC Threshold is set to a small value (e.g. 1 msec), the PPS signal is disabled a few seconds after a position is no longer available (satellites are no longer tracked). The PPS signal drifts when a position fix is not available and snaps back to the correct position once a position fix becomes available again
30-31	Checksum	INTEGER	*checksum*	Checksum

0xB0 0x01 Command Packet 0xB0 0x01
PPS Signal Enable/Disable Command

Command Packet 0xB0 0x01 enables or disables a specified PPS signal (PPS Number). The receiver enables or disables the specified PPS signal and acknowledges the operation with Report Packet 0xB0 0x81.

Table 2-225 PPS Signal Enable/Disable Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	PPS Signal Enable/Disable Command
1	PPS Number	BYTE	0x01	Currently supports the output of one PPS signal (PPS Number = 1).
2	Enable Flag	BYTE	*flag*	Enables or disables the specified PPS signal (PPS Number): 0 Disable 1 Enable
3-4	Checksum	INTEGER	*checksum*	Checksum

0xB0 0x40 Command Packet 0xB0 0x40
Event Timestamp Selection Command

Command Packet 0xB0 0x40 can be used to configure event timestamp selection options or request a report containing the current configuration options.

Table 2-226 shows the structure of Command Packet 0xB0 0x40 when requesting a report of event timestamp selection settings. The receiver responds by sending the data in Report Packet 0xB0 0xC0.

Table 2-226 Request Event Timestamp Selection

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x40	Request Event Timestamp Selection
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.

Table 2-227 shows the structure of Command Packet 0xB0 0x40 when commands are sent to configure event timestamp settings. The receiver resets the configuration settings and acknowledges the command by sending Report Packet 0xB0 0xC0.

Table 2-227 Set Event Timestamp Selection

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x40	Event Timestamp Selection
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Slope	BYTE		Event input configuration: 0 Disable 1 Enable and timestamp positive edge 2 Enable and timestamp negative edge

0xB0 0x41 Command Packet 0xB0 0x41 Event Packet Options Command

Command Packet 0xB0 0x41 can be used to configure event timestamp options or request a report containing the current options.

Table 2-228 shows the structure of Command Packet 0xB0 0x41 when requesting a report of event timestamp options settings. The receiver responds by sending the data in Report Packet 0xB0 0xC1.

Table 2-228 Request Event Packet Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x41	Request Event Timestamp Options
1	Event Selected	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.

Table 2-229 shows the structure of Command Packet 0xB0 0x41 when commands are sent to configure event timestamp options. The receiver resets the configuration settings and acknowledges the command by sending Report Packet 0xB0 0xC1.

Table 2-229 Set Event Packet Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x41	Set Event Timestamp Options
1	Event Selected	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Options 1	BYTE	Table 2-230	Output options 1
3	Options 2	BYTE	Table 2-231	Output options 2
4	Options 3	BYTE	Table 2-232	Output options 3

Table 2-230 Byte 2 Output options 1

Bit #	Meaning
0 (LSB)	Automatic output of event plus position Report Packet 0xB0 0xC2 upon event reception: 0: Disable 1: Enable
1	Automatic output of event only Report Packet 0xB0 0xC3 upon event reception: 0: Disable 1: Enable
2-7	Reserved (set to zero)

Table 2-231 Byte 3 Output options 2

Bit #	Meaning
0-7	Reserved (set to zero)

Table 2-232 Byte 4 Output options 3

Bit #	Meaning
0-7	Reserved (set to zero)

0xB0 0x42 Command Packet 0xB0 0x42 Event Plus Position Request

Command Packet 0xB0 0x42 is used to request a single output of the event plus position packet, Report Packet 0xB0 0xC2. To enable automatic output of Report Packet 0xB0 0xC2, use Command Packet 0xB0 0x40.

Table 2-233 shows the structure of Command Packet 0xB0 0x42 when requesting a report of event plus position. The receiver responds by sending the data in Report Packet 0xB0 0xC2.

Table 2-233 Request Event Plus Position Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x42	Event Plus Position Report
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.

0xB0 0x43 Command Packet 0xB0 0x43
Event Only Request

Command Packet 0xB0 0x43 is used to request a single output of the event only packet, Report Packet 0xB0 0xC3. To enable automatic output of Report Packet 0xB0 0xC3, use Command Packet 0xB0 0x41.

Table 2-234 shows the structure of Command Packet 0xB0 0x43 when requesting a report of the event only packet. The receiver responds by sending the data in Report Packet 0xB0 0xC3.

Table 2-234 Request Event Only Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x43	Request Event Only Report
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.

0xB0 0x44 Command Packet 0xB0 0x44
Event Marker Miscellaneous Command

Command Packet 0xB0 0x44 is used to either force an event or reset the event counter.Table 2-235 shows the structure of Command Packet 0xB0 0x44. The receiver responds by sending the data in Report Packet 0xB0 0xC4.

Table 2-235 Event Marker Miscellaneous Command

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x44	Event Marker Action Command
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Command	BYTE	*flag*	Action to be taken: 0: Force event now 1: Reset event count to zero

0xBB Command Packet 0xBB
Receiver Configuration Parameters Commands

Command Packet 0xBB sets or displays the receiver configuration parameters.

0xBB 0x00 Command Packet 0xBB 0x00
Primary Receiver Configuration Parameters Request

Command Packet 0xBB 0x00 contains the primary receiver configuration parameters that a user usually needs to modify. To leave any parameter unchanged, enter *0xFF or -1 as the value. To query for the primary receiver configuration, send packet BB with subcode 0 as the only data byte as shown in Table 2-236.

Table 2-236 Request Primary Receiver Configuration Block

Byte #	Item	Type	Value/Units	Meaning
0	Subcode	BYTE	0x00	Request Primary Receiver Configuration Block

Table 2-237 Set Primary Receiver Configuration Block

Byte #	Item	Type	Value/Units	Meaning
0	Subcode	BYTE	0x00	Set Primary Receiver Configuration Block
1	Operating Dimension	BYTE	*flag*	Operating dimension: 0 Automatic 1 Time Only (1 SV) 3 Horizontal (2D) 4 Full Position (3D) 6 2D Clock Hold 7 Overdetermined Clock
2	DGPS Mode	BYTE	*flag*	Differential GPS mode: 0 DGPS off 1 DGPS only 3 DGPS auto
3	Dynamics Code	BYTE	*flag*	Vehicle dynamics code: 1 Land 2 Sea 3 Air 4 Stationary
4	Solution Mode	BYTE	*flag*	Overdetermined mode used to compute position solution: 1 Overdetermined fix 2 Weighted overdetermined fix
5-8	Elevation Mask	SINGLE	0-PI/2	Lowest satellite elevation for fixes (radians)
9-12	AMU Mask	SINGLE	*AMUs*	Minimum signal level for fixes
13-16	PDOP Mask	SINGLE	*PDOP*	Maximum PDOP for fixes
17-20	PDOP Switch	SINGLE	*PDOP*	Selects 2D/3D transition mode when the reciever is operating in auto 2D/3D mode

Table 2-237 Set Primary Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
21	DGPS Age Limit	BYTE	*seconds*	Maximum time to use a DGPS correction, in seconds
22	Foliage Mode	BYTE	*flag*	Foliage mode usage: 0 Never 1 Sometimes 2 Always
23	Low Power Mode	BYTE	*flag*	Low Power mode: 0 Disable *(recommended)* 1 Auto
24	Clock Hold Mode	BYTE	*flag*	Clock Hold mode: 0 Disable 1 Enable
25	Measurement Rate	BYTE	*flag*	Measurement rate: 0 1 Hz 1 5 Hz 2 10 Hz
26	Position Fix Rate	BYTE	*flag*	Position Fix Rate: 0 1 Hz 1 5 Hz 2 10 Hz 3 Position at measurement rate
27-39	Reserved	BYTEs	-1	Reserved for future use

0xBC Command Packet 0xBC
Serial Port Configuration Parameters Command

Command Packet 0xBC sets or displays the port configuration parameters. The data format for requesting Report Packet 0xBC is shown in Table 2-238. The data format for configuring serial port parameters is shown in Table 2-239.

The operation type is used to specify special protocol operation such as reference station output. For example, if the receiver protocol is set to reference station mode and TSIP is active on a port, then only DGPS corrections packets 0x60 and 0x61 will be output on that port.

Table 2-238 Request Serial Port Configuration Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Port #	BYTE	*port number*	Request Serial Port Configuration Parameters

Table 2-239 Set Serial Port Configuration Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Port #	BYTE	*flag*	Set Serial Port Configuration Parameters for specified reciever port: 0 Port 0 1 Port 1 2 Port 2 3 Port 3 0xFF Current port
1	Input Baud Rate	BYTE	*flag*	Input baud rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps
2	Output Baud Rate	BYTE	*flag*	Output baud rate (see above)
3	# Data Bits	BYTE	*flag*	Number of data bits: 0 5 data bits 1 6 data bits 2 7 data bits 3 8 data bits

Table 2-239 Set Serial Port Configuration Parameters (Continued)

Byte #	Item	Type	Value/Units	Meaning
4	Parity	BYTE	*flag*	Parity of transmitted data: 0 None 1 Odd 2 Even
5	# Stop Bits	BYTE	*flag*	Number of stop bits in transmitted data: 0 1 bit for 6-8 data bits or 1.5 bits for 5 data bits 1 2 bits
6	Flow Control	BYTE	Table 2-240	Method of flow control negotiation
7	Input Protocols	BYTE	Table 2-241	Input protocol used by serial port
8	Output Protocols	BYTE	Table 2-241	Output protocol used by serial port
9	Protocol Operation Mode	BYTE	Table 2-242	Special operation mode of protocols

Table 2-240 Byte 6 Flow Control

Bit #	Meaning
0 (LSB)	RTS CTS: 0: Disabled 1: Enabled
1	Transmit XON/XOFF: 0: Disabled 1: Enabled
2	Transmit XANY: 0: Disabled 1: Enabled
3	Receive XON/XOFF: 0: Disabled 1: Enabled
4-7	Reserved (set to zero)

Table 2-241 Protocols

Bit #	Meaning
0 (LSB)	TAIP: 0: Disabled 1: Enabled
1	TSIP: 0: Disabled 1: Enabled
2	NMEA: 0: Disabled 1: Enabled
3	RTCM: 0: Disabled 1: Enabled
4	DCOL: 0: Disabled 1: Enabled
5-7	Reserved (set to zero)

Table 2-242 Byte 9 Special Operation Modes

Bit #	Meaning
0 (LSB)	Reference station mode: 0: Disabled 1: Enabled
1-7	Reserved (set to zero)

0xC2 Command Packet 0xC2
Port A Data Transmission Command

Command Packet 0xC2 is used to send an arbitrary stream of data bytes out of Port A.

Table 2-243 Output Arbitrary Data Stream on Port A

Byte #	Item	Type	Value/Units	Meaning
0-end	Data	BYTEs	*data*	The data sent out of receiver Port A.

Note – Command Packet C2 must be sent to Port B, and the Port A Output Language (Command Packet 0x3D, Byte 4) must not be set to *TSIP* or *Off* to send the data out through Port A.

3 Report Packets

The Trimble GPS receiver sends report packets in response to command packets. Report packets are also sent when the receiver is powered up and automatically at periodic intervals or when information is available to report.

Some report packets contain no data and are used to acknowledge the performance of the action associated with a command packet.

Report packets are assigned a hexadecimal identification code to distinguish one report from another. For example, the report packet ID for the differential GPS receiver application reports is 0x8F.

Some report packets have several subpackets which are assigned hexadecimal subpacket ID codes. For example, the hexadecimal number 0x8F 0x7C is the hexadecimal code for Report Packet 0x8F, Subpacket 0x7C. The subpackets are treated as discrete report packets because they usually perform a function associated with the report packet ID code. For example, some of the 0x8F subpackets report on or acknowledge a variety of unique beacon or satellite differential functions.

Most report packets are contained within a single report packet. A few report packets exceed the 123 byte data limit for TSIP packets and are divided into multiple packets called pages. For more information, see TSIP Packet Structure on page 1-3.

3.1 Report Packet Summary

Table 3-1 lists the report packet ID numbers, provides a short description of each packet, and indicates when the packet is sent.

Table 3-1 Report Packet Summary

Report Packet ID	Packet Description	Power Up	Auto	Request	Command Packet ID
0x13	TSIP Parsing Error Notification				–
0x1A	TSIP RTCM Wrapper / Port A Echo Report			✔	–
0x1A 0x00	Raw RTCM Wrapper / Port A Echo Report				–
0x3D	Serial Port A Configuration Report			✔	0x3D
0x40	Almanac Data for Single Satellite Report		✔	✔	0x20
0x41	GPS Time Report	✔	✔	✔	0x21
0x42	Single-Precision Position Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	0x25, 0x37
0x43	Velocity Fix (XYZ Cartesian ECEF) Report		✔	✔	0x37
0x44	Non-Overdetermined Satellite Selection Report			✔	0x22, 0x24
0x45	Receiver Firmware Information Report	✔		✔	0x1F, 0x25
0x46	Health of Receiver Report	✔	✔	✔	0x25, 0x26
0x47	Signal Levels for All Satellites Report			✔	0x27
0x48	GPS System Message Report		✔	✔	0x28
0x49	Almanac Health Page Report		✔	✔	0x29
0x4A	Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report				
	Single-Precision LLA Position Fix Report	✔	✔	✔	0x25, 0x37
	Manual 2D Reference Altitude Parameters Report			✔	0x2A
0x4B	Machine / Code ID and Additional Status Report	✔	✔	✔	0x25, 0x26
0x4C	Operating Parameters Report			✔	0x2C
0x4D	Oscillator Offset Report			✔	0x2D
0x4E	GPS Time Command Verification			✔	0x2E
0x4F	UTC Parameters Report			✔	0x2F
0x53	Analog-to-Digital Readings Report			✔	0x33
0x54	One Satellite Bias and Bias Rate Report		✔	✔	0x34
0x55	I/O Options Report			✔	0x35

Table 3-1 Report Packet Summary (Continued)

Report Packet ID	Packet Description	Power Up	Auto	Request	Command Packet ID
0x56	Velocity Fix East-North-Up (ENU) Report		✔	✔	0x37
0x57	Last Computed Fix Report			✔	0x37
0x58	Satellite System Data Reports		✔	✔	0x38
0x59	Satellite Attribute Database Status Report			✔	0x39
0x5A	Raw Measurement Data Report			✔	0x3A
0x5B	Satellite Ephemeris Status Report		✔	✔	0x3B
0x5C	Satellite Tracking Status Report			✔	0x3C
0x60	Differential GPS Pseudorange Corrections Report		✔		0x3D
0x61	Differential GPS Delta Pseudorange Corrections Report		✔		0x3D
0x6A	Differential Corrections Used in the Fix Reports		✔		0x6A
0x6A 0x00	Differential Corrections Used in Fix Report			✔	0x6A 0x01
0x6A 0x01	Fix Differential Corrections Output Control Report			✔	0x6A 0x01
0x6D	All-In-View Satellite Selection Report		✔	✔	0x24
0x6E	Synchronized Measurement Parameters Reports			✔	0x6E
0x6E 0x01	Synchronized Measurement Output Parameters Report			✔	0x6E 0x01
0x6F	Synchronized Measurements Reports			✔	0x6E
0x6F 0x01	Synchronized Measurements Report		✔	✔	0x6E 0x01
0x70	Position/Velocity Filter Operation Report			✔	0x70
0x76	Overdetermined Mode Report			✔	0x75
0x78	Maximum PRC Age Report			✔	0x77
0x7B	NMEA Output Control Reports			✔	0x7A
0x7B 0x00	NMEA Interval and Message Mask Report			✔	0x7A 0x00
0x7B 0x04	NMEA Name List / Message Mask Report			✔	0x7A 0x04
0x7B 0x05	NMEA Local Time Offsets Report			✔	0x7A 0x05
0x7B 0x06	NMEA Message Options and Precision Report			✔	0x7A 0x06
0x7B 0x80	NMEA Interval and Message Mask Report			✔	0x7A 0x80
0x7B 0x84	NMEA Name List / Message Mask Report			✔	0x7A 0x84
0x7B 0x85	NMEA Local Time Offsets Report			✔	0x7A 0x85
0x7B 0x86	NMEA Message Options and Precision Report			✔	0x7A 0x86
0x7D	Position Fix Rate Configuration Reports			✔	0x7C
0x7D 0x00	ASAP Fix Rate Report			✔	0x7C 0x00
0x7D 0x01	Position Fix Rate Options Report			✔	0x7C 0x01
0x7D 0x02	Position Fix Output Interval and Offset Report			✔	0x7C 0x02
0x7D 0x03	Maximum Measurement Age Report			✔	0x7C 0x03

Table 3-1 Report Packet Summary (Continued)

Report Packet ID	Packet Description	Power Up	Auto	Request	Command Packet ID
0x7D 0x05	CTS to Transmit Delay Report			✔	0x7C 0x05
0x7D 0x06	RTS Trailing Edge Delay Report			✔	0x7C 0x06
0x7D 0x09	Time-Based Message Interval Report			✔	0x7C 0x09
0x7D 0x7F	Fast Rate Option Not Installed Notification	✔			–
0x82	Differential Position Fix Mode Report	✔	✔	✔	0x62
0x83	Double-Precision XYZ Position Fix & Clock Bias Report	✔	✔	✔	0x25, 0x37
0x84	Double-Precision LLA Position Fix & Clock Bias Report	✔	✔	✔	0x25, 0x37
0x85	Differential Correction Status Report			✔	0x65
0x87	Reference Station Parameters Report			✔	0x67
0x87 0x00	Reference Station Control Report			✔	0x67 0x00
0x87 0x01	Reference Station Options Report			✔	0x67 0x01
0x87 0x02	Reference Station Output Version Report			✔	0x67 0x02
0x87 0x03	Reference Station Position Report			✔	0x67 0x03
0x87 0x04	Reference Station ID Report			✔	0x67 0x04
0x87 0x05	RTCM Type 16 Text Report			✔	0x67 0x05
0x87 0x06	RTCM Type Specific Output Intervals Report			✔	0x67 0x06
0x87 0x08	TSIP Notification of Sent Version 2 RTCM Report		✔		–
0x87 0x09	Average Position – Reference Station Position Report			✔	0x67 0x09
0x87 0x0A	Time Schedule Message Interval and Offset Report			✔	0x67 0x0A
0x87 0x7D	Mobile Packet Ignored by Reference Station Notification			✔	–
0x87 0x7E	Reference Station Warnings Notification			✔	–
0x87 0x7F	Reference Station Option Not Installed Notification			✔	–
0x88	Mobile Differential Parameters Report			✔	0x68
0x88 0x00	Mobile Differential Mode Control Report			✔	0x68 0x00
0x88 0x01	Mobile Differential Options Report			✔	0x68 0x01
0x88 0x02	Mobile Differential Input Version Report			✔	0x68 0x02
0x88 0x03	Masking Reference Station Position			✔	0x68 0x03
0x88 0x04	Input Reference Station ID Report			✔	0x68 0x04
0x88 0x05	Last Received RTCM Type 16 Report			✔	0x68 0x05
0x88 0x08	TSIP Notification of Received Version 2 RTCM Report		✔		–
0x88 0x7F	Mobile Differential Option Not Installed Notification		✔		–
0x8B	QA/QC Reports			✔	0x6B

Table 3-1 Report Packet Summary (Continued)

Report Packet ID	Packet Description	Power Up	Auto	Request	Command Packet ID
0x8B 0x00	Position Sigma Information Parameters Report			✔	0x6B 0x00
0x8B 0x01	Position VCV Parameters Report			✔	0x6B 0x01
0x8B 0x02	Position Sigma Information Report		✔	✔	0x6B 0x02
0x8B 0x03	Position VCV Information Report		✔	✔	0x6B 0x03
0x8D	Average Position Reports			✔	0x6D
0x8D 0x00	Average Position Start/Stop Control Report			✔	0x6D 0x00
0x8D 0x01	Average Position Options Report			✔	0x6D 0x01
0x8D 0x02	Auto Stop Parameters (Control / Options) Report			✔	0x6D 0x02
0x8D 0x03	Current Average Position XYZ ECEF Report			✔	0x6D 0x03
0x8D 0x04	Average Position Delta from Last XYZ or ENU Report			✔	0x6D 0x04
0x8F	Application Reports			✔	0x8E
0x8F 0x20	Super Packet Output Report			✔	0x8E 0x20
0x8F 0x60	DR Calibration and Status Report			✔	0x8E 0x60
0x8F 0x62	GPS/DR Position/Velocity Report		✔	✔	0x8E 0x62 0x8E 0x6B
0x8F 0x64	Firmware Version Name Report			✔	0x8E 0x64
0x8F 0x6B	Last Gyroscope Readings Report		✔	✔	0x8E 0x6B 0x8E 0x6B
0x8F 0x6D	Last Odometer Readings Report		✔	✔	0x8E 0x6D 0x8E 0x6B
0x8F 0x6F	Firmware Version and Configuration Report			✔	0x8E 0x6F
0x8F 0x70	Beacon Channel Status Report (Obsolete)			✔	0x8E 0x70
0x8F 0x71	DGPS Station Database Reports			✔	0x8E 0x71
0x8F 0x73	Beacon Channel Control Acknowledgment (Obsolete)			✔	0x8E 0x73
0x8F 0x74	Clear Beacon Database Acknowledgment			✔	0x8E 0x74
0x8F 0x75	FFT Start Acknowledgment			✔	0x8E 0x75
0x8F 0x76	FFT Stop Acknowledgment			✔	0x8E 0x76
0x8F 0x77	FFT Reports		✔		0x8F 0x75
0x8F 0x78	RTCM Reports		✔		0x8E 0x78
0x8F 0x79	Beacon Station Attributes Acknowledgment			✔	0x8E 0x79
0x8F 0x7A	Beacon Station Attributes Report			✔	0x8E 0x78
0x8F 0x7B	DGPS Receiver RAM Configuration Block Report			✔	0x8E 0x7B
0x8F 0x7C	DGPS Receiver Configuration Block Acknowledgment			✔	0x8E 0x7C
0x8F 0x7E	Satellite Line-of-Sight (LOS) Message			✔	0x8E 0x7E
0x8F 0x7F	DGPS Receiver ROM Configuration Block Report			✔	0x8E 0x7F

Table 3-1 Report Packet Summary (Continued)

Report Packet ID	Packet Description	Power Up	Auto	Request	Command Packet ID
0x8F 0x80	DGPS Service Provider System Information Report			✔	0x8E 0x80
0x8F 0x81	Decoder Station Information Report and Selection Acknowledgment			✔	0x8E 0x81
0x8F 0x82	Decoder Diagnostic Information Report			✔	0x8E 0x82
0x8F 0x84	Satellite FFT Control Acknowledgment			✔	0x8E 0x84
0x8F 0x85	DGPS Source Tracking Status Report			✔	0x8E 0x85
0x8F 0x86	Clear Satellite Database Acknowledgment			✔	0x8E 0x86
0x8F 0x87	Network Statistics Report			✔	0x8E 0x87
0x8F 0x88	Diagnostic Output Options Report			✔	0x8E 0x88
0x8F 0x89	DGPS Source Control Report /Acknowledgment			✔	0x8E 0x89
0x8F 0x8A	Service Provider Information Report and Acknowledgment			✔	0x8E 0x8A
0x8F 0x8B	Service Provider Activation Information Report and Acknowledgment			✔	0x8E 0x8B
0x8F 0x8E	Service Provider Data Load Report			✔	0x8E 0x8E
0x8F 0x8F	Receiver Identity Report	✔		✔	0x8E 0x8F
0x8F 0x90	Guidance Status Report			✔	0x8E 0x90
0x8F 0x91	Guidance Configuration Report			✔	0x8E 0x91
0x8F 0x92	Lightbar Configuration Report			✔	0x8E 0x92
0x8F 0x94	Guidance Operation Acknowledgment			✔	0x8E 0x94
0x8F 0x95	Button Box Configuration Type Report			✔	0x8E 0x95
0x8F 0x96	Point Manipulation Report			✔	0x8E 0x96
0x8F 0x97	Utility Information Report			✔	0x8E 0x97
0x8F 0x98	Individual Button Configuration Report			✔	0x8E 0x98
0x8F 0x9A	Differential Correction Information Report			✔	0x8E 0x9A
0xB0	PPS and Event Report Packets			✔	0xB0
0xB0 0x80	PPS Signal Configuration Report			✔	0xB0 0x00
0xB0 0x81	PPS Signal Enable/Disable Acknowledgment			✔	0xB0 0x01
0xB0 0x82	PPS Signal Auto-Generated Report		✔		0xB0 0x01
0xB0 0xC0	Event Timestamp Selection Report			✔	0xB0 0x40
0xB0 0xC1	Event Packet Options Report			✔	0xB0 0x41
0xB0 0xC2	Event Plus Position Report		✔	✔	0xB0 0x42
0xB0 0xC3	Event Only Report		✔	✔	0xB0 0x43
0xB0 0xC4	Event Marker Miscellaneous Action Taken			✔	0xB0 0x44

Table 3-1 Report Packet Summary (Continued)

Report Packet ID	Packet Description	Power Up	Auto	Request	Command Packet ID
0xBB	Receiver Configuration Parameters Reports			✔	0xBB
0xBB 0x00	Primary Receiver Configuration Parameters Report			✔	0xB0 0x00
0xBC	Serial Port Configuration Parameters Report			✔	0xBC

3.2 Report Packet Descriptions

0x13 Report Packet 0x13
TSIP Parsing Error Notification

Packet 0x13 is sent to notify the calling software when the receiver cannot parse the data sent in a command packet. The contents of the problem packet are included in the report.

Table 3-2 TSIP Parsing Error Notification

Byte #	Item	Type	Value/Units	Meaning
0	Packet ID	BYTE	*packet ID*	Packet ID of non-parsable packet
1-*n*	Contents of Packet	BYTE	*data*	Data content of non-parsable packet with length *n*

0x1A Report Packet 0x1A
TSIP RTCM Wrapper / Port A Echo Report

Only one subpacket 0x00 is valid at this time.

0x1A 0x00 Report Packet 0x1A 0x00
Raw RTCM Wrapper / Port A Echo Report

Report Packet 0x1A 0x00 can be generated by one of the following two methods:

Method 1: Reference Station receivers can generate Report Packet 0x1A 0x00 on Port A when in RTCM Output mode by setting the TSIP RTCM wrapper bit (Command Packet 0x67 0x01), Bit 3, Options Byte 1). This places (DLE, 0x1A, 0x00) before and (DLE, ETX) after normal RTCM bytes. Note that RTCM Version 2 does not contain any internal DLE bytes, so DLE stuffing does not apply.

Method 2: Report Packet 0x1A 0x00 can be generated by setting the Port A RTCM Echo bit (Command Packet 0x7C 0x01), Bit 4, Options Byte 2). In this case, Report Packet 0x1A 0x00 is generated on Port B and contains all data received on Port A, provided that Port A is not in TSIP mode (see Command Packet 0x3D, Byte 5). Note that this allows RTCM data to be monitored on Port B at the same time it is being decoded by the receiver. A new Port A Reception Language (see Command Packet 0x3D, Byte 5) value of *Off* has been introduced to bypass the RTCM decoding of the RTCM (or other) data which is being received on Port A, but still allows the echo function. When the Echo mode is enabled, the data from Port A is accumulated into a 32-byte buffer and is sent whenever the buffer is full or every half second when data is in the buffer.

Table 3-3 TSIP RTCM Wrapper / Port A Echo

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	RTCM data
1-end	Data	BYTE	*data*	The raw data

0x3D

Report Packet 0x3D
Serial Port A Configuration Report

Report Packet 0x3D reports the logical communication parameter settings for the serial Port A on the receiver. The Port A communication parameters must match those of the external port being configured (typically the port which does not support TSIP input and output). The Port A communication parameters are used to digitally control the throughput and format of data processed internally within the receiver.

Warning – The terms Port A and Port B refer to the first and second serial ports on the receiver electronics. Some receivers use alternate naming conventions to identify both the serial port numbers and the serial port connector labels on the back panel of the receiver. Refer to the applicable product-specific appendix for additional information.

Some receivers allow either serial port to be configured independently. These receivers may use this packet to configure the "other" serial port (i.e. if sending packet to Port A which is running TSIP, the configuration changes apply to Port B, and vice versa). Some receivers may use this packet to always configure the serial port explicitly labeled Port A. Refer to the applicable product-specific appendix for additional information.

The configuration parameters support options for setting the baud rate of the input and output serial ports, number of bits, parity, and number of stop bits, hardware flow control, and the input and output protocols. The receiver sends this 6-byte packet in response to Command Packet 0x3D. Table 3-4 shows the data format.

Table 3-4 Port A Configuration Report

Byte #	Item	Type	Value/Units	Meaning
0	Output Baud Rate	BYTE	*flag*	Baud rate of data output through Port A: 0 50 bps 1 110 bps 4 300 bps 5 600 bps 6 1200 bps 8 2400 bps 9 4800 bps 11 9600 bps 12 38400 bps 28 19200 bps
1	Input Baud Rate	BYTE	*flag*	Baud rate of data input through Port A (see Byte 0)

Table 3-4 Port A Configuration Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
2	Parity and # bits/character code	BYTE	*flag*	Number of data bits and parity of data input and output through Port A: 2 7 bits, Even Parity 3 8 bits, Even Parity 6 7 bits, Odd Parity 7 8 bits, Odd Parity 18 7 bits, No Parity 19 8 bits, No Parity
3	Stop bits code and hardware flow control	BYTE	*flag*	Number of stop bits and flow control of data input and output through Port A: 7 1 stop bit, heed CTS, normal RTS 15 2 stop bits, heed CTS, normal RTS 23 1 stop bit, ignore CTS, normal RTS 31 2 stop bits, ignore CTS, normal RTS 39 1 stop bit, heed CTS, RTS always 47 2 stop bits, heed CTS, RTS always 55 1 stop bit, ignore CTS, RTS always Only the Stop Bits parameter is valid for receivers that do not support flow control negotiation. The flow control settings are ignored for receivers that do not support flow control negotiation.
4	Output Protocol	BYTE	*flag*	Type of data output through CHAN-A: 0 TSIP Packets 1 Off 5 NMEA 6 RTCM SC-104 7 Packets 0x60 and 0x61
5	Input Protocol	BYTE	*flag*	Type of data input through Port A: 0 TSIP Packets 1 RTCM SC-104 6 Off (do not decode Port A input)

For transmission, the language mode specifies whether packets, RTCM messages, or NMEA messages are output on Port A. For reception, the language mode specifies whether packets or RTCM data are received on Port A.

The baud rate and protocol of the logical Port A input and output serial ports can be set independently. However, the number of data bits, parity, and the stop bits are the same for both the transmitter and the receiver.

When the input serial port is configured to support RTCM SC-104, raw binary RTCM SC-104 data is input through Port A. These corrections are used only if the DGPS mode parameter is set to Manual On or Automatic using Command Packet 0x62.

The receiver holds this information in battery-backed memory. After loss of battery-backed memory, the receiver reverts to default values.

Note – The default port parameters vary depending on the receiver. Refer to the applicable product-specific appendix for additional information.

The following parameter settings are hardware flow control options:

- **Heed CTS** is used to send data when CTS input is asserted and stop sending data when CTS is not asserted (negated). For additional information about the CTS to transmit delay, see Report Packet 0x7D 0x05.
- **Ignore CTS** is used to send data regardless of the CTS input state.
- **RTS Rx mode** is an output signal used to notify an external data source that the receiver input buffer is nearly full and data input must stop.
- **RTS Tx mode** is an output signal used to indicate that the receiver has data ready for output. For additional information about the RTS trailing edge delay, see Report Packet 0x7D 0x06.
- **RTS always high** is an output signal that is always asserted.
- **RTS always low** is an output signal that is always not asserted (negated).

0x40 Report Packet 0x40
Almanac Data for Single Satellite Report

Report Packet 0x40 reports the almanac data for a single satellite. The receiver sends this packet on request (Command Packet 0x20) and when data is received from a satellite. Table 3-5 shows the data format.

Table 3-5 Almanac Data for Single Satellite

Byte #	Item	Type	Value/Units	Meaning
0	Satellite	BYTE	0x01-0x20	SV pseudorandom number (PRN), 1-32
1	T_zc	SINGLE	*seconds*	Refer to ICD-GPS-200 specification
5	Week number	INTEGER	*weeks*	Refer to ICD-GPS-200 specification
7	Eccentricity	SINGLE	*dimensionless*	Refer to ICD-GPS-200 specification
11	T_oa	SINGLE	*seconds*	Refer to ICD-GPS-200 specification
15	i_o	SINGLE	*radians*	Refer to ICD-GPS-200 specification
19	OMEGA_dot	SINGLE	*radians/sec*	Refer to ICD-GPS-200 specification
23	Square root A	SINGLE	$(meters)^{1/2}$	Refer to ICD-GPS-200 specification
27	OMEGA o	SINGLE	*radians*	Refer to ICD-GPS-200 specification
31	Omega	SINGLE	*radians*	Refer to ICD-GPS-200 specification
35	M o	SINGLE	*radians*	Refer to ICD-GPS-200 specification

The ICD-GPS-200 defines these symbols. T_zc is normally positive. If no almanac data is available for this satellite, then T_zc is negative. T_zc and the week number in this packet refer to the Z count time and week number at the time the almanac was received. The ICD-GPS-200 also describes the remaining items.

0x41 Report Packet 0x41
GPS Time Report

Report Packet 0x41 reports the current GPS time of week and the week number. The receiver sends this packet in response to Command Packet 0x21 and during an update cycle. Update cycles occur every 15 seconds when not performing fixes and occur every 150 seconds when performing fixes. Table 3-6 shows the data format.

Table 3-6 GPS Time

Byte #	Item	Type	Value/Units	Meaning
0-3	Time	SINGLE	*seconds*	GPS time of week
4-5	Week	INTEGER	*weeks*	GPS week number
6-9	Offset	SINGLE	*seconds*	UTC/GPS time offset

GPS time differs from UTC by a variable integral number of seconds. UTC = (GPS time) – (GPS/UTC offset). The GPS week number reference is Week # 0 beginning on January 6, 1980. The seconds count begins with 0 each Sunday morning at midnight GPS time. A negative value for time of week indicates that the time is not yet known. In this case, the receiver only sends the packet on request. Table 3-7 shows the relationship between the information in Report Packet 0x41, and the Report Packet 0x46 status code.

Table 3-7 Command Packet 0x41 and Packet 0x46 Relationship

Approximate Time Accuracy	Packet 0x46 Time Source	Sign (TOW)	Packet 0x46 Status Code
None	No time at all	-	0x01
Unknown	Approximate time from real-time clock or Packet 0x2E	+	0x01
20-50 msec + clock drift	Time from satellite	+	Not 0x01
Full accuracy	Time from GPS solution	+	0x00

Note – For the most accurate GPS time, before using the GPS time from Report Packet 0x41, verify that the Report Packet 0x46 status code is 00h (Doing position fixes).

0x42 Report Packet 0x42
Single-Precision Position Fix (XYZ Cartesian ECEF) Report

Report Packet 0x42 reports the current GPS position fix in XYZ ECEF (Earth-Centered, Earth-Fixed) coordinates. If the I/O position option (Command Packet 0x35) is set to XYZ ECEF and the I/O precision of position output is set to single-precision, then the receiver sends this packet each time a fix is computed if selected by the I/O timing option. Table 3-8 shows the data format.

Table 3-8 Single-Precision Position Fix (XYZ Cartesian ECEF)

Byte #	Item	Type	Units	Meaning
0-3	X	SINGLE	*meters*	Position along x-axis of XYZ Cartesian ECEF coordinate system
4-7	Y	SINGLE	*meters*	Position along y-axis of XYZ Cartesian ECEF coordinate system
8-11	Z	SINGLE	*meters*	Position along z-axis of XYZ Cartesian ECEF coordinate system
12-15†	Time of Fix	SINGLE†	*seconds*	Time of position solution in GPS seconds

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes 12-19. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

The time of fix is in GPS time or UTC as selected by the I/O timing option. At start-up, the receiver sends this packet and/or Report Packet 0x83 with a negative time of fix to report the last computed position. Report Packet 0x83 provides a double-precision version of this information.

0x43 Report Packet 0x43
Velocity Fix (XYZ Cartesian ECEF) Report

Report Packet 0x43 reports the current GPS velocity fix in XYZ ECEF coordinates. If the I/O position option (Command Packet 0x35) is set to XYZ ECEF, the receiver sends this packet each time a fix is computed if selected by the I/O timing option. Table 3-9 shows the data format.

Table 3-9 Velocity Fix (XYZ Cartesian ECEF)

Byte #	Item	Type	Units	Meaning
0-3	X Velocity	SINGLE	*meters/sec*	Velocity of vehicle along x-axis of XYZ Cartesian ECEF coordinate system
4-7	Y Velocity	SINGLE	*meters/sec*	Velocity of vehicle along y-axis of XYZ Cartesian ECEF coordinate system
8-11	Z Velocity	SINGLE	*meters/sec*	Velocity of vehicle along z-axis of XYZ Cartesian ECEF coordinate system
12-15	Bias Rate	SINGLE	*meters/sec*	Bias rate in meters per second
16-19†	Time of Fix	SINGLE	*seconds*	Time of position fix, in GPS seconds

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes 16-23. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

The time of fix is in GPS time or UTC as selected by the I/O timing option.

0x44

Report Packet 0x44
Non-Overdetermined Satellite Selection Report

Report Packet 0x44 provides a list of satellites used for position fixes by the GPS receiver. The packet also provides the PDOP, HDOP, VDOP, and TDOP of that set and provides the current mode (automatic or manual, 3D or 2D). The GPS receiver sends this packet in response to Command Packet 0x24 and whenever a new satellite selection is attempted. If more than four satellites are used to generate the position, the GPS receiver sends overdetermined-mode Report Packet 0x6D instead of this packet. Therefore, you must listen for both packets if in overdetermined mode. In non-overdetermined mode, the GPS receiver only generates Report Packet 0x44. The GPS receiver attempts a new selection every 15 seconds and whenever satellite availability and tracking status changes. Table 3-10 shows the data format.

A PDOP value of zero indicates that the GPS receiver is not doing fixes, usually because there are not enough healthy usable satellites for position fixes. In this case, the satellite number list contains up to four of the satellites that are usable.

Empty satellite number bytes contain zero. Negative PDOP values indicate that the PDOP is greater than the PDOP mask value and therefore the GPS receiver is not performing fixes.

Table 3-10 Non-Overdetermined Satellite Selection

Byte #	Item	Type	Value/Units	Meaning
0	Mode	BYTE	*flag*	Non-overdetermined mode: 1 Auto, 1-satellite, 0D 3 Auto, 3-satellite, 2D 4 Auto, 4-satellite, 3D 11 Manual, 1-satellite, 0D 13 Manual, 3-satellite, 2D 14 Manual, 4-satellite, 3D
1-4	4 SV #s	BYTE		4 satellite numbers
5-8	PDOP	SINGLE	*PDOP*	Precision Dilution of Precision
9-12	HDOP	SINGLE	*HDOP*	Horizontal Dilution of Precision
13-16	VDOP	SINGLE	*VDOP*	Vertical Dilution of Precision
17-20	TDOP	SINGLE	*TDOP*	Time Dilution of Precision

Note – Some receivers only output Report Packet 0x6D, regardless of solution mode setting. Refer to the applicable product-specific appendix for additional information.

0x45 Report Packet 0x45
Receiver Firmware Information Report

Report Packet 0x45 provides information about the version of firmware in the Navigation and Signal Processors, and can provide information about the receiver configuration. The receiver sends this packet containing the software versions only after a power-on or reset and in response to Command Packet 0x1F. Table 3-11 shows the data format.

Table 3-11 Receiver Firmware Information

Byte #	Item	Type	Value/Units	Meaning
0	NAV Proc Major Number	BYTE	*release number*	Major portion of NAV Processor firmware release number. Number to left of decimal point
1	NAV Proc Minor Number	BYTE	*release number*	Minor portion of NAV Processor firmware release number. Number to right of decimal point
2	NAV Proc Month	BYTE	0x01-0x0C	Month of year (1-12) when NAV Processor firmware released
3	NAV Proc Day	BYTE	0x01-0x1F	Day of month (1-31) when NAV Processor firmware released
4	NAV Proc Year	BYTE	*year minus 1900*	Year when NAV Processor firmware released, minus 1900
5	SIG Proc Major Number	BYTE	*release number*	Major portion of SIG Processor firmware release number. Number to left of decimal point
6	SIG Proc Minor Number	BYTE	*release number*	Minor portion of SIG Processor firmware release number. Number to right of decimal point
7	SIG Proc Month	BYTE	0x01-0x0C	Month of year (1-12) when SIG Processor firmware released
8	SIG Proc Day	BYTE	0x01-0x1F	Day of month (1-31) when SIG Processor firmware released
9	SIG Proc Year	BYTE	*year minus 1900*	Year when SIG Processor firmware released, minus 1900

If the receiver configuration is also requested in response to Packet 0x1F with Command 0, the packet continues with the information shown in Table 3-12.

Table 3-12 Receiver Firmware Configuration

Byte #	Item	Type	Value/Units	Meaning
10-14	BCD Serial Number	BYTE	*serial number*	Serial number of BCD
15	Checksum	BYTE	*checksum*	Checksum of serial number. Least significant byte of sum of bytes 10 to 15 = 0xFF
16-17	Revision	INTEGER	0x00	Configuration revision number.
18	Machine ID	BYTE		Receiver Machine ID. Values are listed in the product-specific appendices
19	Configuration Length	BYTE	74	Length of data in configuration block
20	Number of Channels	BYTE	8-12	Number of satellite tracking channels
21	RTCM Input	BYTE	*flag*	RTCM input status: 0 Not Installed 1 Installed (available) 2 Default at Clear RAM
22	RTCM Output	BYTE	*flag*	RTCM output status: 0 Not Installed 1 Version 2 Installed (available) 2 Version 2 and PRC Type 9 Installed (available)
23	Fix Rate	BYTE	*flag*	Maximum fix rate. 0 1 Hz 1 2 Hz 4 5 Hz 9 10 Hz
24	Synchronized Measurements	BYTE	*flag*	Synchronized measurements status: 0 Not installed 1 Installed (available) 3 Carrier Phase installed (available)
25	Miscellaneous	BYTE	3	Default value
26	NMEA Output	BYTE	*flag*	NMEA output status: 0 Not installed 1 Installed (available) 2 Default at clear RAM
27	1 PPS Output	BYTE	*flag*	1 PPS Output Status: 0 Not installed 1 Installed

Table 3-12 Receiver Firmware Configuration (Continued)

Byte #	Item	Type	Value/Units	Meaning
28	Product ID	BYTE		Receiver Product ID. Values are listed in the product-specific appendices.
29	Reserved	BYTE	0x01	Reserved (set to 1)
30-93	Reserved	BYTE	0x00	Reserved (set to zero)
94-95	Checksum	INTEGER	*checksum*	Checksum of bytes 20-93

Installed means that the hardware and firmware exist in this particular receiver and can be used to perform the specified function. In some cases, the functionality is installed in a particular unit, but it must be enabled prior to use.

For example, consider byte #26 values for NMEA output: receivers that have a value of 2 for byte #26, output NMEA messages as the default without requiring the receiver to be configured to perform this function. Receivers without firmware for enabling NMEA output have a 0 value for this byte. Finally, some receivers have a value of 1 for this byte, meaning NMEA output is available, but not the default. In this configuration a TSIP command must be used to enable the function before NMEA is output. This is why the byte #26 value 1 meaning in Table 3-12 is annotated as available.

0x46 Report Packet 0x46
Health of Receiver Report

Report Packet 0x46 provides information about the satellite tracking status and the operational health of the receiver. The receiver sends this packet after power-on or software-initiated resets, in response to Command Packet 0x26, during an update cycle, when a new satellite selection is attempted, and when the receiver detects a change in its health. Report Packet 0x4B is always sent with this packet.

Table 3-13 Health of Receiver

Byte #	Item	Type	Value/Units	Meaning
0	Status Code	BYTE	*flag*	Current status of receiver: 0 Doing position fixes 1 Do not have GPS time yet 2 Reserved (set to zero) 3 PDOP is too high 8 No usable satellites 9 Only 1 usable satellite 10 Only 2 usable satellites 11 Only 3 usable satellites 12 The chosen satellite is unusable. This message is included when the one-satellite mode is in effect and a specific satellite is chosen with Command Packet 0x34, the selected satellite is not usable
1	Error Code Flags	BYTE	Table 3-14	Bits of byte are flags for displaying error codes

Table 3-14 Byte 1 Bit Encoding, Error Code Flag Values

Bit #	Meaning if bit value = 1
0 (LSB)	Battery-backed Memory Battery Condition:[1] 0: Good condition 1: Battery failed.
1	Reserved (set to zero)
2	Reserved (set to zero)
3	Reserved (set to zero)
4	Antenna Feed Line Status[2] 0: No fault 1: Fault
5	Reference Frequency Error Condition:[3] 0: No errors or acceptable rate of errors 1: Excessive error rate
6	Reserved (set to zero)
7 (MSB)	Reserved (set to zero)

1 After error is detected, bit remains set until the receiver is reset. "Battery failed" indicator is also set if battery-backed memory was intentionally cleared.

2 This bit follows the current status of the antenna feed line fault-detection circuitry. If this bit is set, this may be an indication that there is a fault in the antenna or the antenna connection.

3 Bit is 1 if the last computed reference frequency error indicated that the reference oscillator is out of tolerance. Command Packet 0x2D requests the oscillator offset and Report Packet 0x4D returns the oscillator offset. Not all receivers report this condition.

0x47 Report Packet 0x47
Signal Levels for All Satellites Report

Report Packet 0x47 provides received signal levels for all satellites currently being tracked or on which tracking is being attempted. The receiver sends this packet only in response to Command Packet 0x27. Table 3-15 shows the data format.

Table 3-15 Signal Levels for all Satellites

Byte #	Item	Type	Meaning
0	Count	BYTE	Number of satellite records in packet
1	Satellite Number 1	BYTE	PRN number of first satellite
2-5	Signal Level 1	SINGLE	Signal level of first satellite
6	Satellite Number 2	BYTE	PRN number of second satellite
7-10	Signal Level 2	SINGLE	Signal level of second satellite
. . .	. . .	. . .	PRN numbers and signal levels of other satellites within view

Up to 12 satellite number/signal level pairs may be sent, indicated by the count field. The signal level is normally positive. If it is zero then that satellite is not acquired. If it is negative then that satellite had acquired lock in the past and is not currently in lock. The absolute value of the signal level field is the last known signal level of that satellite. The signal level provided in this packet is a linear measure of the signal strength after correlation or de-spreading.

0x48 Report Packet 0x48
GPS System Message Report

Report Packet 0x48 provides the 22-byte ASCII message carried in the GPS satellite navigation message. The receiver sends this packet in response to Command Packet 0x28 and when this data is received from a satellite. The message effectively is a bulletin board from the GPS Control Segment to users. The format is free-form ASCII. The message may be blank.

0x49 Report Packet 0x49

Almanac Health Page Report

Report Packet 0x49 provides health information on 32 satellites. Packet data consists of 32 bytes each containing the 6-bit health from almanac page 25. Byte #0 is for satellite #1, and so on, see Table 3-16. The receiver sends this packet in response to Command Packet 0x29 and when this data is received from a satellite.

Table 3-16 Almanac Health Page

Byte #	Item	Type	Value/Units	Meaning
0	Health of Satellite # 1	BYTE	*flag*	Health status of satellite 1: 0 Healthy satellite > 0 Unhealthy satellite
1	Health of Satellite # 2	BYTE	*flag*	Health status of satellite 2 (see Byte 0)
.	.	BYTE	*flag*	Health status of satellites 3-31 (see Byte 0)
.	.	BYTE	*flag*	
.	.	BYTE	*flag*	
31	Health of Satellite # 32	BYTE	*flag*	Health status of satellite 32 (see Byte 0)

0x4A Report Packet 0x4A

Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report

Report Packet 0x4A has two forms. It provides current GPS position fix in LLA (latitude, longitude, and altitude) coordinates or reference altitude parameters. The length of the received packet can be used to determine which version is received. If the received packet length is 20 bytes (or 24 bytes, see the footnotes in Table 3-17), the receiver sends the Single Precision LLA Position Fix Report. If the received packet length is 9 bytes, the receiver sends the Manual 2D Reference Altitude Parameters Report.

If the I/O position option is set to LLA and the I/O precision of position output is set to single-precision, the receiver sends this packet each time a fix is computed if selected by the I/O timing option. Table 3-17 shows the data format for the single-precision LLA Position Fix.

Table 3-17 Single-Precision LLA Position Fix Report

Byte #	Item	Type	Value/Units	Meaning
0-3	Latitude	SINGLE	*radians*	Latitude used on position solution computation. + for North, – for South
4-7	Longitude	SINGLE	*radians*	Longitude used in position solution computation. + for East, – for West
8-11	Altitude	SINGLE	*meters*	Altitude used in position solution computation
12-15	Clock Bias	SINGLE	*meters*	Clock bias
16-19[†]	Time of fix	SINGLE[†]	*seconds*	Time when position solution is computed

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes 16-23. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

Depending on which I/O LLA altitude option is selected, altitude refers to either WGS-84 HAE or WGS-84 MSL.

Depending on which I/O timing option is selected, the time of fix represents either GPS or UTC.

The receiver also sends Report Packet 0x4A at start-up with a negative time of fix to report the last computed position.

Report Packet 0x84 provides a double-precision version of this information.

Caution – When converting from radians to degrees, significant errors are introduced by using an imprecise approximation for pi(π). The value of π as specified in ICD-GPS-200 is 3.1415926535898.

The receiver also sends Report Packet 0x4A in response to the setting of or requesting of the Reference Altitude Parameters using Command Packet 0x2A. The parameters used in the Manual 2D mode are described in Table 3-18.

Table 3-18 Manual 2D Reference Altitude Parameters Report

Byte #	Item	Type	Value/Units	Meaning
0-3	Reference Altitude	SINGLE	*meters*	Used for manual 2D positions if the altitude flag is set. Altitude is in units of WGS-84 HAE or MSL depending on the selected I/O options for the position.
4-7	Inverse Altitude Variance	SINGLE	10.0-100.0	Scale factor for estimating the accuracy of the reference altitude. Ranges from 10.0 (indicating an accuracy of 10 cm) to 100.0 (indicating an accuracy of 1 cm) (*default*: 100.0).
8	Altitude Flag	BYTE	*flag*	Determines whether or not the Reference Altitude and Inverse Altitude Variance are enabled. 0 Disabled 1 Enabled The two parameters are used when the flag is enabled, and altitude hold (last 3D altitude) is used when the flag is cleared.

0x4B

Report Packet 0x4B
Machine / Code ID and Additional Status Report

The receiver transmits Report Packet 4B in response to Command Packet 0x25 and Command Packet 0x26 and following a change in state. In conjunction with Report Packet 0x46, health of receiver, this packet identifies the receiver and may present error messages. The machine ID can be used by equipment communicating with the receiver to determine the type of receiver to which the equipment is connected. The interpretation and use of packets can then be adjusted accordingly. Table 3-19 and Table 3-20 show the data format.

Table 3-19 Machine / Code ID and Additional Status

Byte #	Item	Type	Value/Units	Meaning
0	Machine ID	BYTE	*varies*	Machine ID for receiver. Values are listed in the product-specific appendices.
1	Status Flags 1	BYTE	Table 3-20	Status information
2	Status Flags 2	BYTE	Table 3-21	Status information

Table 3-20 Byte 1 Bit Encoding, Status 1 Flag

Bit #	Meaning
0 (LSB)	Reserved (set to zero).
1	Battery Powered Time Clock Fault Status: 0: No fault 1: Fault
2	A-to-D Converter Fault Status: 0: No fault 1: Fault
3	Status of Almanac Stored in Receiver Memory: 0: Complete & current1:Not complete or current.
4	Receiver Reset Status acknowledged with Command Packet 0x1F: 0: Not acknowledged1: Acknowledged
5-7	Reserved (set to zero).

Table 3-21 Byte 2 Bit Encoding, Status 2 Flag

Bit #	Meaning
0 (LSB)	Output of TSIP Superpackets (Report Packet 0x8F 0x20): 0: Not supported 1: Supported
1-7	Reserved (set to zero).

0x4C Report Packet 0x4C
Operating Parameters Report

Report Packet 0x4C reports several GPS operating parameter values. The receiver sends this packet after receiving Command Packet 0x2C (which either requests a report of current GPS parameter values or sets the operating GPS parameter values of a receiver). The receiver retains this information in battery-backed memory. Table 3-22 and Table 3-23 show the data format.

Table 3-22 Report Operating Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Dynamics Code	BYTE	Table 3-23	Reports the expected vehicle dynamics and is used to assist the initial solution (*default*: 1 = Land)
1-4	Elevation Mask	SINGLE	*radians*	Reports the lowest angle at which the receiver can use a satellite in a position fix
5-8	Signal Level Mask	SINGLE	*AMUs*†	Reports the minimum signal level for a satellite to be used for position fixes
9-12	PDOP Mask	SINGLE	*PDOP*	Reports the maximum PDOP for calculating position fixes
13-16	PDOP Switch	SINGLE	*PDOP*	Influences whether the receiver will calculate a 2D or 3D fix depending on the PDOP. If 4 or more satellites are available and the resulting PDOP is less than the PDOP Switch value, then 3D fixes are calculated. The PDOP Switch is used only in automatic 2D/3D mode.

† See Report Packet 0x5A for AMU definition.

Table 3-23 Byte 0, Dynamics Range Settings

Dec	Hex	Meaning	Assumed Acceleration
0	0x00	Current value is left unchanged.	
1	0x01	Land	< 2 g
2	0x02	Sea	< 1 g
3	0x03	Air	< 4 g
4	0x04	Static	Stationary

0x4D Report Packet 0x4D
Oscillator Offset Report

Packet 0x4D reports the current value of the GPS oscillator offset in Hertz at the L1 carrier. This packet contains one Single number. The receiver sends this packet in response to Command Packet 0x2D. The permissible offset varies with the receiver.

0x4E Report Packet 0x4E
GPS Time Command Verification

Report Packet 0x4E reports whether or not the receiver accepted the time given in a Set GPS Time Packet (Command Packet 0x2E). This packet contains one data byte. Table 3-24 shows the data format.

Table 3-24 Response to Set GPS Time

Dec	Hex	Meaning
89 ('Y')	0x59	The receiver accepted the time in Command Packet 0x2E, but the receiver has not yet received the time from a satellite
78 ('N')	0x4E	The receiver did not accept the time in Command Packet 0x2E, but the receiver did receive the time from a satellite and is using that time. The receiver ignores the time setting in Command Packet 0x2E

0x4F Report Packet 0x4F
UTC Parameters Report

Report Packet 0x4F is sent in response to Command Packet 0x2F to report the UTC information broadcast by the GPS system. For details on the meanings of the following parameters, consult ICD-GPS-200, Sections 20.3.3.5.2.4, 20.3.3.5.1.8, and Table 20-IX.

Tip – On the simplest level, you can calculate UTC time from GPS time by subtracting ΔT_{LS} seconds.

The remaining bytes in this packet indicate when the next leap second is scheduled to occur. Table 3-25 shows the data format.

Table 3-25 UTC Parameters

Byte #	Item	Type	Value/Units	Meaning
0-7	A0	DOUBLE		Refer to ICD-GPS-200 specification
8-11	A1	SINGLE		Refer to ICD-GPS-200 specification
12-13	ΔT_{LS}	INTEGER		Refer to ICD-GPS-200 specification
14-17	TOT	SINGLE		Refer to ICD-GPS-200 specification
18-19	WN_T	INTEGER		Refer to ICD-GPS-200 specification
20-21	WN_{LSF}	INTEGER		Refer to ICD-GPS-200 specification
22-23	DN	INTEGER		Refer to ICD-GPS-200 specification
24-25	ΔT_{LSF}	INTEGER		Refer to ICD-GPS-200 specification

0x53 Report Packet 0x53
Analog-to-Digital Readings Report

The receiver sends Report Packet 0x53 when reporting the converted output of eight monitored analog signals on request (Command Packet 0x33). Table 3-26 shows the data format. Not all receivers support all of the fields in this packet.

Table 3-26 Analog-to-Digital Readings

Byte #	Item	Type	Value/Units
0-3	Temperature inside receiver	SINGLE	0x00
4-7	Reserved (set to zero)	SINGLE	0x00
8-11	Reserved (set to zero)	SINGLE	0x00
12-15	Voltage of antenna DC power supply/automatic gain control	SINGLE	*volts*
16-19	Voltage of battery or source supplying receiver with DC power†	SINGLE	*volts*
20-23	Antenna current in Amps multiplied by 10.34	SINGLE	0x00
24-27	Voltage of +2.5V (nominal) power	SINGLE	0x00
28-31	Voltage of +5.0V (nominal) power	SINGLE	0x00

† The reported voltage is 1/10th of the actual voltage. For example, a voltage of 10.5 Volts is reports as 1.05 Volts.

Caution – Report Packet 0x53 is provided primarily for Trimble production test and field diagnostics. Users should never need to use this packet.

The temperature is obtained as follows from the SINGLE value received: Temp (° C) = 25 + (value - 2.98) x 100. For example, if the SINGLE value received for temperature is 3.06, the temperature inside the receiver is: 25 + (3.06 - 2.98) x 100 = 33 (° C).

0x54 Report Packet 0x54
One Satellite Bias and Bias Rate Report

Report Packet 0x54 reports the computed clock-only solution when the receiver is in manual or automatic one-satellite mode. Table 3-28 shows the data format.

Table 3-27 One Satellite Bias and Bias Rate Report

Byte #	Item	Type	Value/Units	Meaning
0-3	Bias	SINGLE	*meters*	One satellite bias, in meters
4-7	Bias Rate	SINGLE	*meters/sec*	Clock bias rate, in meters per second
8-11†	Time of Fix	SINGLE	*seconds*	Time of position fix, in GPS seconds

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes 16-23. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

The bias is the offset of the receiver internal time clock from GPS time. Bias is expressed as meters of apparent range from the satellites. It is used to correct the 1 PPS output. Bias rate is the frequency error of the receiver's internal oscillator. It is expressed as apparent range rate.

Caution – For accurate interpretation of the propagation delay, the precise constant for the speed of light must be used. The WGS-84 value for the speed of light is 299,792,458 meters per second.

0x55 Report Packet 0x55
I/O Options Report

Report Packet 0x55 provides current I/O options in effect in response to Command Packet 0x35. Table 3-28 shows the data format, which is the same as for Command Packet 0x35. For default values, consult product-specific appendix.

Table 3-28 I/O Options

Byte #	Item	Type	Value/Units	Meaning
0	Position Flags	BYTE	Table 3-29	Position flags (bits) show current status of automatic position reporting options, position precision, etc.
1	Velocity Flags	BYTE	Table 3-30	Velocity flags (bits) show current status of automatic velocity reports
2	Timing Flags	BYTE	Table 3-31	Timing flags (bits) show current status of time and position fix timing parameters
3	Auxiliary Flags	BYTE	Table 3-32	Auxiliary flags (bits) show current status of raw measurement output parameter, codephase output parameter, and automatic output of additional fix reports

Table 3-29 Byte 0 Bit Encoding, Position Flags

Bit #	Meaning
0 (LSB)	Automatic Output of XYZ ECEF Position Report (Report Packet 0x42 or 0x83 enabled depending on current setting for bit 4): 0: Off 1: On
1	Automatic Output of LLA Position Report (Report Packet 0x4A or 0x84 enabled depending on current setting for bit 4): 0: Off 1: On
2	Units of LLA Altitude Output (Report Packet 0x84 or 0x4A enabled depending on current setting for bit 4): 0: WGS-84 HAE 1: WGS-84 MSL
3	Units of Altitude Input (Command Packet 0x2A): 0: WGS-84 HAE 1: WGS-84 MSL
4	Precision of Position Data in Automatic Reports: 0: Single-Precision 1: Double-Precision
5	Automatic output of Super Packet data in Report Packet 0x8F 0x20: 0: Off 1: On
6-7	Reserved (set to zero)

Table 3-30 Byte 1 Bit Encoding, Velocity Flags

Bit #	Meaning
0 (LSB)	Automatic Output of XYZ ECEF Velocity Report (Report Packet 0x43): 0: Off 1: On
1	Automatic Output of ENU Velocity Report (Report Packet 0x56): 0: Off 1: On
2-7	Reserved (set to zero)

Table 3-31 Byte 2 Bit Encoding, Timing Flags

Bit #	Meaning
0 (LSB)	Time Type: 0: GPS time 1: UTC
1	Fix Computation Time: 0: ASAP 1: At Integer Second
2	Automatic Output of Fix Time (Command Packet 0x37): 0: When computed 1: On request
3	Simultaneous Measurements: 0: Off 1: On
4	Minimum Projection: 0: Off 1: On
5-7	Reserved (set to zero)

Table 3-32 Byte 3 Bit Encoding, Auxiliary Flags

Bit #	Meaning
0 (LSB)	Measurement output: 0: Off 1: On
1	Codephase Measurement Data Source: 0: Raw 1: Filtered
2	Automatic Output of Additional Fix Status Report (Report Packet 0x5E): 0: Off 1: On
3	Units for Signal Level Output: 0: AMUs 1: dBHz
4-7	Reserved (set to zero)

0x56 Report Packet 0x56
Velocity Fix East-North-Up (ENU) Report

If East-North-Up (ENU) coordinates are selected for the I/O position option, the receiver sends this packet each time that a fix is computed if selected by the I/O timing option or in response to Command Packet 0x37 (last known fix). Table 3-33 shows the data format.

Table 3-33 Velocity Fix East-North-Up

Byte #	Item	Type	Value/Units	Meaning
0-3	East Velocity	SINGLE	*meters/sec*	East velocity, + for east, – for west
4-7	North Velocity	SINGLE	*meters/sec*	North velocity, + for north, – for south
8-11	Up Velocity	SINGLE	*meters/sec*	Up velocity, + for up, – for down
12-15	Clock Bias Rate	SINGLE	*meters/sec*	Clock bias rate
16-19†	Time of Fix	SINGLE†	*seconds*	Time when position solution is computed

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes #16-23. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

The time of fix is in GPS or UTC time as selected by the I/O timing option.

0x57 Report Packet 0x57

Last Computed Fix Report

Report Packet 0x57 provides information concerning the time and origin of the previous position fix. The receiver sends this packet, among others, in response to Command Packet 0x37. Table 3-34 show the data format.

Table 3-34 Information About Last Computed Fix

Byte #	Item	Type	Value/Units	Meaning
0	Info Source	BYTE	*flag*	Source of Information: 0 None 1 Regular fix 2 Initialization diagnostic 4 Initialization diagnostic 5 Entered by Command Packet 0x23 or 0x2B 6 Entered by Command Packet 0x31 or 0x32 8 Default position after RAM battery fail
1	Diagnostic Code	BYTE	—	Manufacturing diagnostic code
2-5†	Fix Time	SINGLE†	*seconds*	Time of last position fix, in GPS seconds
6-7†	Fix Week	INTEGER	*GPS week*	Week of last position fix, in GPS weeks

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes. The time of last fix is obtained from bytes # 2-9 and the week of last fix is obtained from bytes #10-11. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

0x58 Report Packet 0x58
Satellite System Data Reports

Report Packet 0x58 provides GPS data (almanac, ephemeris, etc.). The receiver sends this packet on request or in response to Command Packet 0x38 (acknowledging the loading of data). Table 3-35 shows the data format. The binary almanac, health page, and UTC data streams are similar to Report Packet 0x40, 0x49, and 0x4F respectively, and those reports are preferred. To get ionosphere or ephemeris, this report packet must be used. See Table 3-36 through Table 3-40.

Table 3-35 Satellite System Data Report

Byte #	Item	Type	Value/Units	Meaning
0	Operation	BYTE	*flag*	Type of satellite information operation: 0 Request acknowledged/Cannot grant request 1 Request acknowledged 2 Requested data included in this report 3 Requested data not available for SV
1	Data Type	BYTE	*flag*	Type of satellite information included in this report: 1 Reserved value 2 Almanac (see Table 3-36) 3 Health page, T_oa, WN_oa (see Table 3-37) 4 Ionosphere (see Table 3-38) 5 UTC (see Table 3-39) 6 Ephemeris (see Table 3-40)
2	SV PRN #	BYTE	*flag*	Satellite information in the report is for all satellites or a specific satellite: 0 Data that is not satellite ID specific 1-32 Satellite PRN number
3	Length (n)	BYTE	—	Number of bytes of data to be loaded
Begin Output of Requested Satellite Information				
4 to n + 3	Data	n BYTEs		Actual satellite information begins at byte 4 and continues for a specified number of bytes, depending on the Type of Data (Byte 1)

Table 3-36 Almanac Report Data Format

Byte #	Item	Type	Meaning
4	t_oa_raw	BYTE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
5	SV_HEALTH	BYTE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
6-9	e	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
10-13	t_oa	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
14-17	i_o	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
18-21	OMEGADOT	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
22-25	sqrt_A	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
26-29	OMEGA_0	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
30-33	omega	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
34-37	M_0	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
38-41	a_f0	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
42-45	a_f1	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
46-49	Axis	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
50-53	n	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
54-57	OMEGA_n	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
58-61	ODOT_n	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
62-65	t_zc	SINGLE	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
66-67	Weeknum	INTEGER	Refer to ICD-GPS-200, Section 20.3.3.5.1.2
68-69	wn_oa	INTEGER	Refer to ICD-GPS-200, Section 20.3.3.5.1.2

Table 3-37 Almanac Health Report Data Format

Byte #	Item	Type	Meaning
4	Week # for health	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.3
5-36	SV_health	32 BYTES	Refer to ICD-GPS-200, Sec 20.3.3.5.1.
37	t_oa for health	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.
38	Current t_oa	BYTE	Units = seconds/4096
39-40	Current week #	INTEGER	

Table 3-38 Ionosphere Report Data Format

Byte #	Item	Type	Meaning
4-11	—	—	Compact storage of the following information
12-15	Alpha_0	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
16-19	Alpha_1	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
20-23	Alpha_2	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
24-27	Alpha_3	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
28-31	Beta_0	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
32-35	Beta_1	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
36-39	Beta_2	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9
40-43	Beta_3	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.9

Table 3-39 UTC Report Data Format

Byte #	Item	Type	Meaning
4-16	---	---	Compact storage of the following information
17-24	A_0	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
25-28	A_1	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
29-30	Delta_t_LS	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
31-34	t_ot	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
35-36	WN t	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
37-38	WN_LSF	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
39-40	DN	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8
41-42	Delta_t_LSF	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.5.1.8

Table 3-40 Ephemeris Report Data Format

Byte #	Item	Type	Meaning
4	SV_number	BYTE	SV PRN number
5-8	t_ephem	SINGLE	Time of collection
9-10	weeknum	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
11	CodeL2	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
12	L2Pdata	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
13	SVacc_raw	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
14	SV_health	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
15-16	IODC	INTEGER	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
17-20	T_GD	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
21-24	t_oc	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
25-28	a_f2	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.

Table 3-40 Ephemeris Report Data Format (Continued)

Byte #	Item	Type	Meaning
29-32	a_f1	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
33-36	a_f0	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
37-40	SVacc	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.3, Table 20-I.
41	IODE	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.4
42	fit_interval	BYTE	Refer to ICD-GPS-200, Sec 20.3.3.4
43-46	C_rs	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
47-50	Delta_n	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
51-58	M_0	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.4
59-62	C_uc	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
63-70	e	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.4
71-74	C_us	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
75-82	sqrt_A	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.4
83-86	t_oe	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
87-90	C_ic	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
91-98	OMEGA_0	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.4
99-102	C_is	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
103-110	i_0	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.4
111-114	C_rc	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
115-122	Omega	DOUBLE	Refer to ICD-GPS-200, Sec 20.3.3.4
123-126	OMEGADOT	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
127-130	IDOT	SINGLE	Refer to ICD-GPS-200, Sec 20.3.3.4
131-138	Axis	DOUBLE	= $(\text{sqrt\_A})^2$
139-146	n	DOUBLE	Derived from delta_n
147-154	r1me2	DOUBLE	= $\text{sqrt}(1.0\text{-}e^2)$
155-162	OMEGA_n	DOUBLE	Derived from OMEGA_0, OMEGADOT
163-170	ODOT_n	DOUBLE	Derived from OMEGADOT

0x59 Report Packet 0x59
Satellite Attribute Database Status Report

Displays current Enable/Disable or Heed/Ignore Health attribute settings for the 32 satellite records in the satellite attribute database. Normally the attribute is set to select satellites for use in a GPS solution depending on whether or not the candidate satellites are in good health and whether or not they satisfy the mask values for elevation angle, signal level, and PDOP. The receiver sends this packet in response to Command Packet 0x39.

The report is useful for determining whether or not the attribute bit in the satellite records changed since the receiver was powered on or since battery-backed memory was cleared. Table 3-41 shows the data format.

Table 3-41 Status of Satellite Disable or Ignore Health

Byte #	Item	Type	Value/Units	Meaning
0	Operation	BYTE	Table 3-42	Determines whether the data in bytes 1-32 show the Enable/Disable attribute status or Heed/Ignore Health attribute status for the 32 satellites
1-32	SV Flags	32 BYTEs (1 byte per satellite)	*flags*	State of 32 single byte flags used to identify the Enable/Disable attribute status or the Heed/Ignore Health attribute status for the 32 satellites: 0 Enable satellite/Heed health 1 Disable satellite/Ignore health

Table 3-42 Byte 0, Operation

Dec	Hex	Meaning
3	0x03	The 32 single-byte flags (byte 1-32) identify the Enable/Disable attribute status for the 32 satellites. Disabled satellites are not used, even when the satellite is in good health. The flags identify any satellites which are manually disabled by user. The factory default setting is to enable all satellites for inclusion in position solution computations if they are in good health and conform with the mask values for elevation angle, signal level, PDOP, and PDOP Switch
6	0x06	The 32 single-byte flags (byte 1-32) identify the Heed/Ignore Health attribute status for the 32 satellites. Flags with the Ignore attribute set indicate that the satellite can be used in the position solution, regardless of whether the satellite is in good or bad health. The factory default setting is to heed satellite health when choosing the satellites included in a position solution computation

0x5A

Report Packet 0x5A
Raw Measurement Data Report

Report Packet 0x5A provides raw GPS measurement data. If the appropriate I/O auxiliary option is selected, the receiver sends this data automatically as measurements are taken. The receiver also sends this packet in response to Command Packet 0x3A. Table 3-43 shows the data format and the information provided immediately afterwards provides a more detailed description of each parameter.

Table 3-43 Raw Measurement Data

Byte #	Item	Type	Value/Units	Meaning
0	SV PRN	BYTE	0x01-0x20	Satellite pseudorandom number (1-32)
1-4	Sample Length	SINGLE	*msec*	Time elapsing while a measurement is averaged. See Sample Length on page 3-41
5-8	Signal Level	SINGLE	*AMUs*	Approximation of C/N_0, stated in antenna amplitude measurement units (AMU's). See Signal Level on page 3-42
9-12	Code phase	SINGLE	*chips/16*	Average C/A (Coarse/Acquisition) code delay over the sample interval is measured with respect to the receiver's millisecond timing reference (bytes 1-4). See Codephase on page 3-42
13-16	Doppler	SINGLE	*hertz*	Apparent carrier frequency offset averaged over the sample interval. The Doppler is measured with respect to the nominal GPS L1 frequency of 1575.42 MHz, referenced to the receiver's internal oscillator. See Doppler on page 3-42
17-24	Measure Time	DOUBLE	*seconds*	Center of the sample interval adjusted by adding the averaged codephase value (modulo 1ms). See Measure Time on page 3-43

Note – Packet 0x5A identifies the raw satellite signal measurement data used in position solution computations.

Sample Length

The Sample Length parameter (Bytes 1-4) is the number of milliseconds over which the measurement is averaged. Thus, if the sample length is 428, then the receiver tracked the satellite and collected the measurement over a 428 millisecond period. The receiver uses a 500 millisecond dwell time per satellite. Therefore, Raw Measurement Data for each satellite currently being tracked is available every 1/2 second.

Signal Level

The Signal Level parameter (Byte 5-8) (an approximation of C/N_0) is stated in antenna amplitude measurement units (AMU's), a Trimble devised unit. An approximate correlation of AMU levels to C/N_0 follows:

5 AMUs ≅ 41 dB Hz

16 AMUs ≅ 51 dB Hz

26 AMUs ≅ 55 dB Hz

Formula: $C/N_0(\text{dBHz}) \cong 20 \log(\text{AMU}) + 27$

Four basic parameters affect C/N_0:

- Signal strength from the GPS satellite
- Receiver/antenna gain
- Pre-amplifier noise figure
- Receiver noise bandwidth

The approximation is accurate from 3 to 25 AMU's.

Codephase

The Codephase parameter (Byte 9-12) value is the average C/A code delay over the sample interval and is measured with respect to the receiver's millisecond timing reference. Thus, it includes all receiver, satellite, and propagation biases and errors. It is expressed in 1/16th of a C/A code chip, that corresponds to:

1/16 * C/A code chip ≅ 977.517ns/16 ≅ 61.0948 ns
≅ 61.0948 * speed of light, m/s
≅ 18.3158 meter

The I/O option auxiliary byte bit 2 determines whether raw or carrier filtered codephase data is received.

Doppler

The Doppler parameter (Byte 13-16) value is apparent carrier frequency offset averaged over the sample interval. It is measured with respect to the nominal GPS L1 frequency of 1575.42 MHz, referenced to the receiver's internal oscillator. Thus, it includes all receiver and satellite clock frequency errors. It is expressed in Hertz at the L1 carrier.

Measure Time

The Measure Time parameter (time of measurement, Byte 17-24) is the center of the sample interval adjusted by adding the averaged codephase value (modulo 1ms).

The codephase provides only a modulo 1ms measure of the pseudorange between the user and the satellite. The integer millisecond portion of the pseudorange must be derived by utilizing the approximate user and satellite positions. Rough user position (within a few hundred kilometers) must be known; the satellite position can be found from its almanac or ephemeris data.

Each ms integer corresponds to:

C/A code epoch * speed of light= 1 ms * speed of light, m/s
≅ 300 km (approximately)
≅ 299.792458 km (precise)

The satellite time of transmission for a measurement can be reconstructed using the code phase, the time of measurement, and the user-determined integer number of milliseconds. The receiver occasionally adjusts its clock to maintain time accuracy within ±0.5 milliseconds, at which time the integer millisecond values for all satellites are adjusted upward or downward by one millisecond.

0x5B Report Packet 0x5B
Satellite Ephemeris Status Report

The receiver sends Report Packet 0x5B in response to Command Packet 0x3B and when a new ephemeris (identified by the IODE) is received. It contains information on the status of the ephemeris stored in receiver memory for a specified satellite. Table 3-44 shows the data format.

Table 3-44 Satellite Ephemeris Status

Byte #	Item	Type	Value/Units	Meaning
0	SV PRN #	BYTE	1-32	Pseudorandom number of satellite
1-4	Collection Time	SINGLE	*seconds*	GPS time when Ephemeris data is collected from the satellite
5	Health	BYTE	ICD-GPS-200	The 6-bit ephemeris health
6	IODE	BYTE	ICD-GPS-200	Issue of Data Ephemeris. See the U.S. Government document ICD-GPS-200
7-10	t_{oe}	SINGLE	*seconds*	See the U.S. Government document ICD-GPS-200
11	Fit Interval Flag	BYTE	ICD-GPS-200	See the U.S. Government document ICD-GPS-200
12-15	URA	SINGLE	*meters*	User Range Accuracy of satellite, converted to meters from the 4-bit code described in ICD-GPS-200

0x5C Report Packet 0x5C
Satellite Tracking Status Report

Report Packet 0x5C provides tracking status data for a specified satellite. Some of the information is very implementation-dependent and is provided mainly for diagnostic purposes. The receiver sends this packet in response to Command Packet 0x3C. Table 3-45 shows the data format.

Table 3-45 Satellite Tracking Status

Byte #	Item	Type	Value/Units	Meaning
0	SV PRN #	BYTE	1-32	Pseudorandom number of satellite.
1	Channel and Slot Code	BYTE	Table 3-46	Internal code assigned to the hardware channel and slot used to track the specified satellite. For parallel tracking receivers (which includes most modern receivers), no sequencing of satellites is done and only one satellite is assigned to a hardware channel. Slot encoding is not used and bit positions 2-0 (LSB) within Byte 1 are always 0 0 0 (slot 1). Channel encoding for Byte 1 is in bit positions 7 (MSB) to 3
2	Acquisition Flag	BYTE	*flag*	Signal acquisition (lock) state of the satellite: 0 Never acquired 1 Acquired 2 Re-opened search
3	Ephemeris Flag	BYTE	*flag*	Status of Ephemeris received from specified satellite: 0 Ephemeris is not received from satellite *other* Good ephemeris received from satellite (< 4 hours old, good health). Note that some receivers use a value of 33 to indicate that the received ephemeris was not healthy.
4-7	Signal Level	SINGLE		Same as in Report Packet 0x5A
8-11	GPS Time	SINGLE	*flag*	GPS Time of Last Measurement: < 0 No measurements taken ≥ 0 Center of last measurement dwell taken from this satellite
12-15	Elevation	SINGLE	*radians*	Approximate elevation of satellite above the horizon. Used for searching and computing measurement correction factors
16-19	Azimuth	SINGLE	*radians*	Approximate azimuth from true north to satellite. Used for computing measurement correction factors

1 Not all GPS receivers actively report this status information. The value may always be set to zero

Table 3-45 Satellite Tracking Status (Continued)

Byte #	Item	Type	Value/Units	Meaning
20	Old Measurement Flag[1]	BYTE	*flag*	0 Flag not set, measurement is new *other* Measurement too old to be considered for position solutions
21	Integer msec Flag[1]	BYTE	*flag*	Status of the integer millisecond range to the specified satellite: 0 Unknown 1 Acquired from sub-frame data collection 2 Verified by a bit crossing time 3 Verified by a successful position fix 4 Suspected msec error
22	Bad Data Flag[1]	BYTE	*flag*	Current health status of the data: 0 Data presumed good 1 Bad parity 2 Bad ephemeris health
23	Data Collect Flag	BYTE	*flag*	Receiver is collecting data from satellite: 0 Not collecting data *other* Collecting data

1 Not all GPS receivers actively report this status information. The value may always be set to zero

Table 3-46 Byte 1, Channel and Slot Code Values

Hex	Binary	Meaning
0x00	00000000	Channel 1
0x08	00001000	Channel 2
0x10	00010000	Channel 3
0x18	00011000	Channel 4
0x20	00100000	Channel 5
0x28	00101000	Channel 6
0x30	00110000	Channel 7
0x38	00111000	Channel 8
0x40	01000000	Channel 9
0x48	01001000	Channel 10
0x50	01010000	Channel 11
0x58	01011000	Channel 12

0x5E

Report Packet 0x5E
Additional Fix Status Report

Report Packet 0x5E describes attributes of a position fix. The information is requested by Command Packet 0x3E or sent after each fix if bit 2 of AUX Byte in Command Packet 0x35 is set. Table 3-47 shows the data format.

Table 3-47 Additional Fix Status Report

Byte #	Item	Type	Value/Units	Meaning
0	Measurements Used in Previous Fix	BYTE	Table 3-48	Number of measurements in current fix used in the previous fix and status
1	Old Measurements	BYTE	Table 3-49	Number of old measurements in current fix (2-3 s)

Table 3-48 Byte 0, # Measurements Used in Previous Fix

Bit #	Meaning
0-3	Number of measurements in current fix used in the previous fix
4	Position fix computation status: 1: Fix still converging 0: Doing Fixes
5-7	Reserved (set to zero)

Table 3-49 Byte 1, Old Measurements

Bit #	Meaning
0-3	Number of old measurements in current fix (2-3 s)
4-7	Reserved (set to zero)

0x5F

Report Packet 0x5F
Severe Failure Notification

The GPS receiver sends Report Packet 0x5F when a failure prevents it from operating correctly. The packet data bytes consists of a 0x02 followed by an ASCII text message describing the failure.

0x60 Report Packet 0x60
Differential GPS Pseudorange Corrections Report

Report Packet 0x60 is only available in Reference Station mode for receivers with reference station capabilities and provides the differential correction information of RTCM SC-104 Version 2 message types 1 and 9 in TSIP format. This packet can be output instead of RTCM on Port A by selecting Port A Language for Transmission (Command Packet 0x3D, Byte 4) value of 7. This packet also can be output on Port B when Port A is outputting RTCM or Packet 0x60 by setting Bit 7 of Byte 1 in Command Packet 0x67 0x01.

Table 3-50 Differential GPS Pseudorange Corrections

Byte #	Item	Type	Value/Units	Meaning
0-1	Zcount	INTEGER		Modified Z-count in units of 0.6 seconds
2	Station Health	BYTE		Health of the reference station
3	Version/Type/SVs	BYTE	Table 3-51	Bit flags identify RTCM version number and record type
4,9,...†	Scale/UDRE/SV	BYTE†	Table 3-52	Bit flags identify RTCM scale factor, Version 2 UDRE, and satellite PRN
5-6, 10-11,...†	PRC	INTEGER†		Pseudorange correction
7,12,...†	RRC	BYTE†		Range rate correction, note signed
8,13,...†	IODE	BYTE†		The IODE used by the reference station

† These bytes are repeated for up to 12 SVs.

Table 3-51 Byte 3, Version/Type/SVs

Bit #	Item	Meaning
7 (MSB)	Version	RTCM SC-104 Version Number:† 0: Version 1 1: Version 2
6	Type	RTCM SC-104 Message Type: 0: Type 1 1: Type 9
5-0	# SVs	Number of SV corrections in this packet

† Only version 2 is supported.

Table 3-52 Byte 4,9, Scale/UDRE/SV

Bit #	Item	Meaning
7 (MSB)	Scale	RTCM SC-104 Version 2 Scale Factor
6-5	UDRE	RTCM SC-104 Version 2 UDRE
0-4	SV	SV PRN

0x61 Report Packet 0x61
Differential GPS Delta Pseudorange Corrections Report

Report Packet 0x61 is only available in Reference Station mode for Reference Station receivers and provides the differential correction information of RTCM SC-104 Version 2 message type 2 in TSIP format. This packet can be output instead of RTCM on Port A by selecting a Port A Language for Transmission (Command Packet 0x3D, Byte 4) value of 7. This packet also can be output on Port B when Port A is outputting RTCM or Report Packet 0x60 by setting Bit 7 of Byte 1 in Command Packet 0x67 0x01.

Table 3-53 Differential GPS Delta Pseudorange Corrections

Byte #	Item	Type	Value/Units	Meaning
0-1	Zcount	INTEGER		Modified Z count in units of 0.6 seconds
2	Version/# SVs	BYTE	Table 3-54	RTCM version and number of satellites included in report
3,6,...†	Scale/UDRE/SV	BYTE†	Table 3-55	Scale/UDRE/SV # of each satellite included in report
4-5, 7-8,...†	DPRC	INTEGER†		RTCM SC-104 delta pseudorange corrections for satellites

† These bytes are repeated for up to 12 SVs.

Table 3-54 Byte 2 Bit Position Encoding, Version/# SVs

Bit #	Meaning
7 (MSB)	RTCM SC-104 Version Number:† 0: Version 1 1: Version 2
6	Reserved (set to zero)
5-0	Number of SV delta corrections in this packet

† Only version 2 is supported.

Table 3-55 Byte 3,6,... Bit Position Encoding, Scale/UDRE/SV

Bit #	Meaning
7 (MSB)	RTCM SC-104 Version 2 Scale Factor
6-5	RTCM SC-104 Version 2 UDRE†
0-4	SV PRN

† Not used in Command Packet 0x61 by other TSIP receivers. The UDRE value is taken from Report Packet 0x60. The UDRE of the Version 2 message is encoded here to provide extra information.

0x6A Report Packet 0x6A
Differential Corrections Used in the Fix Reports

Report Packet 6A is used to report the differential corrections used in the fix.

0x6A 0x00 Report Packet 0x6A 0x00
Differential Corrections Used in Fix Report

Report Packet 0x6A 0x00 provides information about the differential corrections that were used in a position fix. If output of this packet is enabled via Command Packet 0x6D 0x01, this information is output when differential fixes are calculated.

Table 3-56 Differential Corrections Used in Fix

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Differential Corrections Used in Fix Report
1-4	Fix Time Tag	LONG	0 .. 604799999	Milliseconds into week of fix
5	# of Satellites	BYTE		Number of satellites used in the fix
The following three items are repeated “number of satellites” times 9 bytes per satellite				
6, 15, ..	Satellite ID	BYTE	0x01-0x20	Satellite PRN (1-32)
7-10, 16-19, ...	RC	SINGLE	*meters*	Range correction
11-14, 20-23, ...	RRC	SINGLE	*meters/sec*	Range rate correction (RRC)
6 + Nsvs*9	Checksum	INTEGER	0x0000 - 0xFFFF	Checksum across bytes 0 to End

0x6A 0x01 Report Packet 0x6A 0x01
Fix Differential Corrections Output Control Report

Report Packet 0x6A 0x01 indicates whether or not the receiver outputs the fix differential corrections packet 0x6A 0x00 when the receiver is calculating differential position fixes.

Table 3-57 Fix Differential Corrections Output Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Fix Differential Corrections Output Control
1	Output Enabled	BYTE	*flag*	Toggles differential corrections output for position fix: 0 Disabled 1 Enabled
2	Reserved	BYTE	0x00	Reserved (set to zero)
3	Reserved	BYTE	0x00	Reserved (set to zero)

0x6D Report Packet 0x6D
All-In-View Satellite Selection Report

Report Packet 0x6D provides a list of satellites used for position fixes by the receiver. The packet also provides the PDOP, HDOP, TDOP, and VDOP of that set and provides the current mode (automatic or manual, 3D or 2D). This packet has variable length equal to 16 + *Nsvs*, where *Nsvs* is the number of satellites used in the solution.

The receiver sends this packet in response to Command Packet 0x24 and whenever a new satellite selection is attempted. Table 3-58 and Table 3-66 show the data format.

Table 3-58 All-In-View Satellite Selection

Byte #	Item	Type	Value/Units	Meaning
0	Fix Mode	BYTE	Table 3-59	GPS position fix mode
1-4	PDOP	SINGLE	*PDOP*	Precision Dilution of Precision
5-8	HDOP	SINGLE	*HDOP*	Horizontal Dilution of Precision
9-12	VDOP	SINGLE	*VDOP*	Vertical Dilution of Precision
13-16	TDOP	SINGLE	*TDOP*	Time Dilution of Precision
17	SV PRN†	BYTE	0x01-0x20	Pseudorandom number (0-32) of first satellite in view
...				
(16 + *Nsvs*)	SV PRN†	BYTE	0x01-0x20	Pseudorandom numbers (1-32) of remaining satellites in view

† In overdetermined clock mode, the SV PRN may be "negative" if any TRAIM algorithms excluded the satellite from the fix.

Note – Negative PDOP values indicate that the PDOP is greater than the PDOP mask value and therefore the receiver is not performing fixes.

Table 3-59 Byte 0, Fix Mode

Bit #	Meaning
0-2	2D or 3D Mode: 0: Unknown 1: 0D 2: 2D Clock Hold 3: 2D 4: 3D 5: Overdetermined Clock 6: DGPS Reference Station
3	Auto or Manual Mode: 0: Auto 1: Manual
4-7	Number of satellites

0x6E Report Packet 0x6E Synchronized Measurement Parameters Reports

Report Packet 0x6E reports sychronized measurement output configuration as well as the synchronized measurement data. See Command Packet 0x6E for more information.

0x6E 0x01 Report Packet 0x6E 0x01 Synchronized Measurement Output Parameters Report

Report Packet 0x6E 0x01 shows the current setting of the synchronized measurements output parameters. Table 3-60 shows the values.

Table 3-60 Synchronized Measurement Output Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Synchronized Measurement output parameters
1	Enable Flag	BYTE	*flag*	Current status of synchronized measurements: 0 Outputs disabled 1 Outputs enabled, filtered pseudorange 3 Outputs enabled, raw pseudorange
2	Output Interval	BYTE	0x01-0xFF	Output interval in seconds (ranges from 1-255), synchronized to GPS time of week

0x6F Report Packet 0x6F Synchronized Measurements Reports

Report Packet 0x6F contains the values shown in Table 3-61 and Table 3-62.

0x6F 0x01 Report Packet 0x6F 0x01 Synchronized Measurements Report

Table 3-61 Synchronized Measurements

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Synchronized Measurements
Begin Preamble				
1	Preamble	BYTE	0x02	Begin preamble
2-3	Length	INTEGER		Number of bytes: preamble to postamble inclusive
4-11	Receive Time	DOUBLE	*msecs*	Time of GPS week
12-19	Clock Offset	DOUBLE	*msecs*	Receiver clock offset
20	# of SVs	BYTE		Number of satellites in the packet
Begin Packet Data (bytes = number of SVs times 27 bytes per SV)				

† The number can be negative (signed 2’s complement form).

Table 3-61 Synchronized Measurements (Continued)

Byte #	Item	Type	Value/Units	Meaning
21,48,...	SV PRN	BYTE	0x01-0x20	Pseudorandom number of satellite (1-32)
22, 49,...	FLAGS1	BYTE	Table 3-62	Flag values show synchronized measurement status of satellite
23, 50,...	FLAGS2	BYTE	0x00	Reserved (set to zero)
24, 51,...	Elevation Angle†	BYTE	*degrees*	Satellite elevation angle
25-26, 52-53,...	Azimuth	INTEGER	*degrees*	Satellite azimuth
27, 54,...	SNR times 4	BYTE	*4*AMUs*	Number of AMUs times four
28-35, 55-62,...	Pseudorange	DOUBLE	*meters*	Full L1 C/A Pseudorange
36-43, 63-70,...	Carrier Phase	DOUBLE	*cycles*	L1 band Continuous Phase
44-47, 71-74,...	Doppler	SINGLE	*hertz*	L1 band Doppler
End of the packet data				
21+27n 22+27n	Checksum	INTEGER	—	Sum of bytes before checksum starting with preamble
23+27n	Postamble	BYTE	0x03	

† The number can be negative (signed 2's complement form).

Note – The sign convention is such that when the pseudorange increases, the carrier-phase decreases, and the doppler is negative.

Note – The pseudorange measurement obtained is carrier filtered or raw based on the ENABLE (byte 1 Command Packet 0x6E) byte.

Note – Not all receivers support output of accurate carrier phase information. Some receivers support this packet as it is a more fully-featured packet than Report Packet 0x5A, but do not provide carrier phase information.

Table 3-62 FLAGS1 Bit Assignments

Bit #	Meaning
0 (LSB)	Reserved (set to zero)
1	L1 Carrier-phase Cycle Slip: 0: No 1: Yes
2	Reserved (set to zero)
3	Reserved (set to zero)
4	Valid L1 Carrier-phase: 0: No 1: Yes
5	Reserved (set to zero)
6	Reserved (set to zero)
7 (MSB)	New Position Calculated: 0: No 1: Yes

0x70 Report Packet 0x70
Position/Velocity Filter Operation Report

Report Packet 0x70 indicates the operational state of the P/V filter, static filter, and/or altitude filter. The data format is shown in Table 3-63. Command Packet 0x70 is used to modify the state of these filters.

Table 3-63 Position/Velocity Filter Operation Packet

Byte #	Item	Type	Value/Units	Meaning
0	Dynamic Filter Switch	BYTE	*flag*	Toggles Dynamic Filter: 0 Disabled 1 Enabled
1	Static Filter Switch	BYTE	*flag*	Toggles Static Filter: 0 Disabled 1 Enabled
2	Altitude Filter Switch	BYTE	*flag*	Toggles Altitude Filter: 0 Disabled 1 Enabled
3	Reserved	BYTE	0x00	Reserved (set to zero)

Note – The dynamic filter must be on for the static filter to operate. If the dynamic filter is off, enabling the static filter will this packet will NOT turn the static filter on UNTIL the dynamic filter is enabled.

0x76 Report Packet 0x76
Overdetermined Mode Report

Report Packet 0x76 shows whether the receiver is in the overdetermined (non-weighted) or weighted overdetermined mode. It returns one byte with the values shown in Table 3-64. For additional information, see Command Packet 0x75.

Table 3-64 Overdetermined Mode

Byte #	Item	Type	Value/Units	Meaning
0	Fix type	BYTE	*flag*	Overdetermined position fix mode: 1 Overdetermined 2 Weighted Overdetermined

0x78 Report Packet 0x78
Maximum PRC Age Report

Report Packet 0x78 reports the amount of time in seconds that RTCM pseudorange corrections can be propagated in DGPS mode before they are no longer used. It returns 2 bytes, as described in Table 3-108.

Table 3-65 Maximum PRC Age

Byte #	Item	Type	Value/Units	Meaning
0-1	Max PRC Age	INTEGER	*seconds*	Maximum pseudorange correction age

For additional information, see Command Packet 0x77.

0x7B Report Packet 0x7B
NMEA Output Control Reports

Packet 0x7B has several forms that are differentiated by a Subpacket ID as the first data byte. Each 0x7B subpacket can be thought of as a separate report packet. These subpackets are divided into two groups: subcodes 0x00-0x7F correspond to NMEA output control for the opposite port to that from which the command is issued; subcodes 0x80-0xFF represent the same control offered in the 0x00-0x7F packets but the NMEA output control applies to the current port. For example, if the TSIP communication is occuring on Port A, subcodes 0x00-0x7F apply to the Port B NMEA configuration, but subcodes 0x80-0xFF apply to the Port A NMEA configuration. For more information about the data formats and message masks, see Command Packet 0x7A. Table 3-66 through Table 3-76 shows the various forms of Packet 0x7B.

0x7B 0x00 Report Packet 0x7B 0x00
NMEA Interval and Message Mask Report

Report Packet 0x7B 0x00 reports the NMEA message output interval and the current Message Mask for the opposite port.

Table 3-66 NMEA Interval and Message Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	NMEA interval and message mask
1	Interval	BYTE	*seconds*	Time between NMEA messages (position fix rate if 0)
2-5	Message Bit Mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages

0x7B 0x04 Report Packet 0x7B 0x04
NMEA Name List / Message Mask Report

Report Packet 0x7B 0x04 reports the comma-delimited Message List and/or Message Mask depending on the Contents byte for the opposite port.

Table 3-67 NMEA Name List Only

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	NMEA Name List / Message Mask
1	Contents	BYTE	0x01	Message name list only
2-end	Message List	MESSAGE LIST	*list*	Comma-delimited NMEA name list

Table 3-68 NMEA Message Mask Only

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	NMEA message mask and/or name list
1	Contents	BYTE	0x02	Message mask only
2-5	Message Mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages

Table 3-69 NMEA Message Mask and Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	NMEA message mask and/or name list
1	Contents	BYTE	0x03	Both message mask and name list
2-5	Message Mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages
6-end	Message List	MESSAGE LIST	*list*	Comma-delimited NMEA name list

0x7B 0x05 Report Packet 0x7B 0x05
NMEA Local Time Offsets Report

Report Packet 0x7B 0x05 reports the NMEA local time offset from Greenwich time for the opposite port.

Table 3-70 NMEA Local Time Offsets

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	NMEA local time offsets
1	Hour offset	BYTE	*hours*	GMT hours - Local hours
2	Minute offset	BYTE	*minutes*	GMT minutes - Local minutes

0x7B 0x06 Report Packet 0x7B 0x06
NMEA Message Options and Precision Report

Report Packet 0x7B 0x06 reports the NMEA option flag settings for the GGA, GLL, VTG, and RMC message sentences for the opposite port.

Note – Check the product-specific appendices for default NMEA options settings.

Table 3-71 NMEA GGA Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x00	GGA Options and Precision
2	Option Flags	BYTE	Table 3-72	GGA Option values
3	Precision	BYTE	0x00-0x07	GGA Precision (0-7 decimals)

Table 3-72 Byte 2, Option Flags Bit Assignments

Bit	Meaning
0 (LSB)	Reserved (set to zero)
1	Validity of GGA for old positions. In an old position the time in the GGA message is not the current time: 0: Valid 1: Invalid
2	Validity of GGA for non-differential positions when in auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GGA: 0: All null fields 1: ’0’ in status field
4	Precision of time in GGA (decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Table 3-73 Byte 2 NMEA GLL Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x01	GLL Options and Precision
2	Option Flags	BYTE	Table 3-74	Selected GLL options
3	Precision	BYTE	0x00-0x07	GLL Precision (0-7 decimals)

Table 3-74 Byte 2, Option Flags Bits

Bit	Meaning
0 (LSB)	NMEA Version of GLL: 0: Version 2.01 1: Version 1.5
1	Validity of GLL for old positions. In an old position the time in the GLL message is not the current time: 0: Valid 1: Invalid
2	Validity of GLL for non-differential positions when in auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GLL message: 0: All null fields 1: 'V' in status field
4	Precision of time in GLL (number of decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Table 3-75 NMEA VTG Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x02	VTG options
2	Option Flags	BYTE	Table 3-76	Selected VTG message VTG

Table 3-76 Byte 2, Options Flags Bit Assignments

Bit	Meaning
0 (LSB)	NMEA Version of VTG: 0: Version 2.01 1: Version 1.5
1-4	Reserved (set to zero)
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

Table 3-77 NMEA VTG Speed Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message-Specific Options
1	Message	BYTE	0x03	VTG Speed Precision
2	Precision	BYTE	0x00-0x03	VTG Speed Precision (0-3 decimals)

Table 3-78 NMEA RMC Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x04	RMC Options
2	Option Flags	BYTE	Table 3-76	Selected RMC message options
3	Position Precision	BYTE	0x00-0x07	RMC Position Precision (0-7 decimals)
4	Velocity Precision	BYTE	0x00-0x03	RMC Speed Precision (0-3 decimals)

Table 3-79 Byte 2 Bit Encoding, Options Flags Bit Assignments

Bit #	Meaning
0 (LSB)	Reserved (set to zero)
1	Validity of RMC for old positions. In an old position the time in the RMC message is not the current time: 0: Valid 1: Invalid
2	Validity of RMC for non-differential positions when in auto DGPS mode: 0: Valid 1: Invalid
4	Precision of time in RMC (decimal places): 0: Two 1: None
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

0x7B 0x80 Report Packet 0x7B 0x80
NMEA Interval and Message Mask Report

Report Packet 0x7B 0x80 reports the NMEA message output interval and the current Message Mask for the current port.

Table 3-80 NMEA Interval and Message Mask

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	NMEA interval and message mask
1	Interval	BYTE	*seconds*	Time between NMEA messages (position fix rate if 0)
2-5	Message Bit Mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages

0x7B 0x84 Report Packet 0x7B 0x84
NMEA Name List / Message Mask Report

Report Packet 0x7B 0x84 reports the comma-delimited Message List and/or Message Mask depending on the Contents byte for the current port.

Table 3-81 NMEA Name List Only

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	NMEA Name List / Message Mask
1	Contents	BYTE	0x01	Message name list only
2-end	Message List	MESSAGE LIST	*list*	Comma-delimited NMEA name list

Table 3-82 NMEA Message Mask Only

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	NMEA message mask and/or name list
1	Contents	BYTE	0x02	Message mask only
2-5	Message Mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages

Table 3-83 NMEA Message Mask and Name List

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	NMEA message mask and/or name list
1	Contents	BYTE	0x03	Both message mask and name list
2-5	Message Mask	MESSAGE MASK	*mask*	NMEA bit-mask for outputting messages
6-end	Message List	MESSAGE LIST	*list*	Comma-delimited NMEA name list

0x7B 0x85 Report Packet 0x7B 0x85
NMEA Local Time Offsets Report

Report Packet 0x7B 0x85 reports the NMEA local time offset from Greenwich time for the current port.

Table 3-84 NMEA Local Time Offsets

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	NMEA local time offsets
1	Hour offset	BYTE	*hours*	GMT hours - Local hours
2	Minute offset	BYTE	*minutes*	GMT minutes - Local minutes

0x7B 0x86 Report Packet 0x7B 0x86

NMEA Message Options and Precision Report

Report Packet 0x7B 0x86 reports the NMEA option flag settings for the GGA, GLL, VTG, and RMC message sentences for the current port.

Note – Check the product-specific appendices for default NMEA options settings.

Table 3-85 NMEA GGA Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x00	GGA Options and Precision
2	Option Flags	BYTE	Table 3-86	GGA Option values
3	Precision	BYTE	0x00-0x07	GGA Precision (0-7 decimals)

Table 3-86 Byte 2, Option Flags Bit Assignments

Bit	Meaning
0 (LSB)	Reserved (set to zero)
1	Validity of GGA for old positions. In an old position the time in the GGA message is not the current time: 0: Valid 1: Invalid
2	Validity of GGA for non-differential positions when in auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GGA: 0: All null fields 1: ’0’ in status field
4	Precision of time in GGA (decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Table 3-87 Byte 2 NMEA GLL Options and Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x01	GLL Options and Precision
2	Option Flags	BYTE	Table 3-88	Selected GLL options
3	Precision	BYTE	0x00-0x07	GLL Precision (0-7 decimals)

Table 3-88 Byte 2, Option Flags Bits

Bit	Meaning
0 (LSB)	NMEA Version of GLL: 0: Version 2.01 1: Version 1.5
1	Validity of GLL for old positions. In an old position the time in the GLL message is not the current time: 0: Valid 1: Invalid
2	Validity of GLL for non-differential positions when in auto DGPS mode: 0: Valid 1: Invalid
3	Representation of invalid GLL message: 0: All null fields 1: 'V' in status field
4	Precision of time in GLL (number of decimal places): 0: Two 1: None
5-7	Reserved (set to zero)

Table 3-89 NMEA VTG Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x02	VTG options
2	Option Flags	BYTE	Table 3-90	Selected VTG message VTG

Table 3-90 Byte 2, Options Flags Bit Assignments

Bit	Meaning
0 (LSB)	NMEA Version of VTG: 0: Version 2.01 1: Version 1.5
1-4	Reserved (set to zero)
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

Table 3-91 NMEA VTG Speed Precision

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message-Specific Options
1	Message	BYTE	0x03	VTG Speed Precision
2	Precision	BYTE	0x00-0x03	VTG Speed Precision (0-3 decimals)

Table 3-92 NMEA RMC Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Message Specific Options
1	Message	BYTE	0x04	RMC Options
2	Option Flags	BYTE	Table 3-93	Selected RMC message options
3	Position Precision	BYTE	0x00-0x07	RMC Position Precision (0-7 decimals)
4	Velocity Precision	BYTE	0x00-0x03	RMC Speed Precision (0-3 decimals)

Table 3-93 Byte 2 Bit Encoding, Options Flags Bit Assignments

Bit #	Meaning
0 (LSB)	Reserved (set to zero)
1	Validity of RMC for old positions. In an old position the time in the RMC message is not the current time: 0: Valid 1: Invalid
2	Validity of RMC for non-differential positions when in auto DGPS mode: 0: Valid 1: Invalid
4	Precision of time in RMC (decimal places): 0: Two 1: None
5	NMEA Speed to Output: 0: 2D SOG 1: 3D SOG
6-7	Reserved (set to zero)

0x7D Report Packet 0x7D
Position Fix Rate Configuration Reports

The 0x7D subpackets are sent in response to corresponding Command Packet 0x7C subpackets. Each subpacket contains the requested position fix rate configuration information requested by the corresponding Command Packet 0x7C subpacket.

0x7D 0x00 Report Packet 0x7D 0x00
ASAP Fix Rate Report

Report Packet 0x7D 0x00 reports the number of position fixes per second.

Table 3-94 ASAP Fix Rate

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	ASAP Position Fix Rate
1	ASAP Rate†	BYTE	0x01-0x0A	Position fixes per second (1-10)

† The ASAP Fix Rate applies only if the Fix Computation Time is set to ASAP mode in the I/O Options Timing byte (Command Packet 0x35, Byte 2). If the Fix Computation Time is at to At Integer Second, then position fixes are computed only at integer seconds irrespective of the ASAP Fix Rate entered.

0x7D 0x01 Report Packet 0x7D 0x01
Position Fix Rate Options Report

Report Packet 0x7D 0x01 reports the Position Fix Rate Option Flag settings.

Table 3-95 Position Fix Rate Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Position Fix Rate Options
1	Option 1 Flags	BYTE	Table 3-96	Various Options
2	Option 2 Flags	BYTE	Table 3-97	Various Options

Table 3-96 Byte 1 Bit Encoding, Option Flags 1 Bit Assignments

Bit #	Option
0 (LSB)	Precision of Time for Report Packet 0x42, 0x43, 0x4A, 0x54, 0x56, 0x57, 0x83, and 0x84: 0: Single (*default*) 1: Double
1	Timestamp of Velocity:† 0: Same as timestamp of position (default): 1: True time of velocity
2-7	Reserved (set to zero)

† The true time of velocity is different from the time of position only for fix rates greater than 5 Hz (DSM receivers).

Table 3-97 Byte 2, Option Flags 2 Bit Assignments

Bit #	Option
0 (LSB)	Port A automatic control for all automatic packets that cannot be controlled in another way: 0: Output automatic report packets on Port A (*default*) 1: Do not output automatic report packets on Port A
1	Port B automatic control for a all automatic packets that cannot be controlled in another way: 0: Output automatic report packets on Port B (*default*) 1: Do not output automatic report packets on Port B
2	Time only (0D) packet output (Report Packet 0x54): 0: On (*default*) 1: Off
3	Output full satellite data for ephemeris and UTC report when data is received (Report Packet 0x58): 0: Off (*default*) 1: On
4	Echo RTCM Port A input (Report Packet 0x1A 0x00): 0: Off (*default*) 1: On
5-7	Reserved (set to zero)

0x7D 0x02 Report Packet 0x7D 0x02

Position Fix Output Interval and Offset Report

The *Interval* and *Offset* parameters allow for outputting positions at a slower rate than the current position fix rate setting. For example, if the *At Integer Second* mode is in effect and the *Interval* is 5 and *Offset* is 0, then the position output occurs at the 0, 5, 10, 15,... GPS time of week seconds. If the *Offset* value is changed from 0 to 1, then the position output occurs at the 1, 6, 11, 16,... GPS time of the week seconds. In another example, if the position fix rate is 5 Hz, the *Interval* is 3, and the *Offset* is 0, then the position output occurs at 0, 0.6, 1.2, 1.8, 2.4, 3.0,... GPS time of the week seconds.

Table 3-98 Position Fix Output Interval and Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Position Fix Output Interval and Offset
1-2	Interval	INTEGER	*interval*	Output one of every *interval* position fixes
3-4	Offset	INTEGER	*offset*	Change which position is output within an interval

0x7D 0x03 Report Packet 0x7D 0x03
Maximum Measurement Age Report

Report Packet 0x7D 0x03 reports the maximum age of measurements included in a position fix solution.

Table 3-99 Maximum Measurement Age Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Maximum Measurement Age
1-2	Max Age	INTEGER	0-5000 *millisececonds*	Allow measurements used in position fix to be at most this old

0x7D 0x05 Report Packet 0x7D 0x05
CTS to Transmit Delay Report

The CTS to Transmit Delay Time parameter reports the delay time before the transmission of data. This is typically used with radio transmitter setups to allow the transmitter to obtain maximum power before any data is sent.

Table 3-100 CTS to Transmit Delay

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	CTS to Tx Delay
1-2	CTS to Tx Delay	INTEGER	0x00-0x7D00	Delay time in milliseconds (0-32000)

If the Heed CTS mode parameter is selected in Report Packet 0x3D, the delay time begins when a signal is received on the CTS input. If the Ignore CTS mode parameter is selected in Report Packet 0x3D, the programmed delay is still used. The delay time begins when the reciever is ready to send data.

0x7D 0x06 Report Packet 0x7D 0x06
RTS Trailing Edge Delay Report

The RTS Trailing Edge Delay Time parameter allows the user to set a delay time for the deactivation of the RTS signal after the last bit of data is sent. This feature could be used in radio data transmission systems where RTS is used for the Push-to-Talk signal.

Table 3-101 RTS Trailing Edge Delay

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	Set RTS Trailing Edge Delay
1-2	RTS Delay	INTEGER	0x00-0x7D00	Delay time in milliseconds (0–32000)

0x7D 0x09 Report Packet 0x7D 0x09
Time-Based Message Interval Report

Report Packet 0x7D 0x09 is used to report the current message interval relative to a fixed time base (instead of relative to the fix rate as in packet 0x7D 0x02). See Command Packet 0x7C 0x09 for more information. The format of this report is shown in Table 3-102.

Table 3-102 Time-Based Message Interval Report

Byte #	Item	Type	Value/ Units	Meaning
0	Subpacket ID	BYTE	0x09	Time-based message interval report
1	Port	BYTE		Interval data reported applies to a specific port: 0 Port 0 1 Port 1
2	Message Protocol	BYTE		Protocol to which the interval applies 0 TSIP 1 NMEA
3	Message Interval	BYTE		Output interval for messages of protocol specified in byte 2 0 Custom 1 5 seconds 2 1 second 3 200 milliseconds[1] 4 100 milliseconds[1] 5 50 milliseconds[1]
4-11	Reserved	BYTE	0	Reserved
12-13	Checksum	INTEGER	*checksum*	Checksum

[1]If Fast rate option is purchased and fix update rate is supported by receiver.

0x7D 0x7F Report Packet 0x7D 0x7F
Fast Rate Option Not Installed Notification

Notification sent to calling software when Fast Rate Option is not installed on receiver.

Table 3-103 Fast Rate Option Not Installed

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7F	Fast Rate Option Not Installed

0x82 Report Packet 0x82
Differential Position Fix Mode Report

Report Packet 0x82 reports the differential position fix mode and other RTCM receiver parameters. Two versions of Report Packet 0x82 are available—one version reports the Mode only as a single data byte and the second version reports the Mode and additional parameters.

The receiver sends Report Packet 0x82 in response to Command Packet 0x62 and whenever a satellite selection is made while the receiver is operating in one of the Auto DGPS modes (mode 2 and 3). The packet is sent before position and velocity fix packets whenever a GPS/DGPS mode change occurs. The packet indicates the current GPS/DGPS mode in effect.

The receiver switches automatically between modes 2 and 3 based on the availability of differential corrections for a constellation of satellites meeting all mask requirements. If the required number of satellites is not available to form the constellation, then the receiver stays in its current automatic mode (2 or 3) and does not compute position solutions. Table 3-104 lists the valid modes. If the packet contains the additional parameters, it contains three additional bytes in the format shown in Table 3-105.

Table 3-104 Differential Position Fix Mode Byte

Mode	Meaning
0	Manual GPS (Differential off) – receiver computes position solutions without differential corrections, even when corrections are available
1	Manual DGPS (Differential on) – receiver only computes position solutions when valid RTCM corrections are available
2	Auto GPS (Differential currently off) – receiver does not receive differential correction data for all satellites in constellation meeting all mask requirements, and is not computing differential position solutions
3	Auto DGPS (Differential currently on) – receiver receives differential correction data for all satellites in constellation meeting masks requirements, and is computing differential position solutions

Table 3-105 Differential Position Fix Mode, Additional Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Mode	BYTE	*flag*	Manual GPS (Differential Off) 0 Manual GPS (Differential Off) 1 Manual DGPS (Differential On) 2 Auto GPS (Differential Currently Off) 3 Auto DGPS (Differential Currently On)
1	RTCM version	BYTE	*flag*	RTCM version used to compute positions: 0 Auto (Version 1, 2, or PRC Type 9) 1 Version 1 only 2 Version 2 or PRC Type 9 only
2-3	Reference Station ID	INTEGER		Station number assigned to the selected reference station for receivers supporting input from reference stations 0xFFFF (-1)Accept any reference station for use other Accept only given reference station ID

0x83 Report Packet 0x83

Double-Precision XYZ Position Fix & Clock Bias Report

Report Packet 0x83 provides current GPS position fix in XYZ ECEF coordinates. If the I/O position option is set to XYZ ECEF and the I/O double-precision of position option is selected, the receiver sends this packet each time a fix is computed if selected by the I/O timing option. Table 3-106 shows the data format.

Table 3-106 Double-Precision XYZ Position Fix & Clock Bias

Byte #	Item	Type	Value/Units	Meaning
0-7	X	DOUBLE	*meters*	X coordinate along the x-axis of Earth-Centered, Earth-Fixed (ECEF) coordinate system
8-15	Y	DOUBLE	*meters*	Y coordinate along the y-axis of ECEF coordinate system
16-23	Z	DOUBLE	*meters*	Z coordinate along the z-axis of ECEF coordinate system
24-31	Clock Bias	DOUBLE	*meters*	Clock bias
32-35†	Time of Fix	SINGLE†	*seconds*	GPS time or UTC, as selected by the I/O timing option

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes 32-39. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

The time of fix is in GPS time or UTC, as selected by the I/O timing option. At start-up, if the I/O double-precision of position option is selected, the receiver also sends this packet with a negative time of fix to report the last computed position. Report Packet 0x42 provides a single-precision version of this information.

0x84

Report Packet 0x84
Double-Precision LLA
Position Fix & Clock Bias Report

Report Packet 0x84 provides current GPS position fix in LLA coordinates. If the I/O position option is set to LLA and the double-precision of position option is selected, the receiver sends this packet each time a fix is computed if selected by the I/O timing option.

Table 3-107 Double-Precision LLA Position Fix & Clock Bias

Byte #	Item	Type	Value/Units	Meaning
0-7	Latitude	DOUBLE	*radians*	Latitude of position. + for north, - for south
8-15	Longitude	DOUBLE	*radians*	Longitude of position. + for east, - for west
16-23	Altitude	DOUBLE	*meters*	WGS-84 HAE or MSL altitude as selected by the I/O position option
24-31	Clock Bias	DOUBLE	*meters*	Clock bias
32-35	Time of Fix†	SINGLE	*seconds*	GPS time or UTC, as selected by the I/O timing option

† The time of fix precision can be selected as either Single or Double in bit #0 of Command Packet 0x7C 0x01, Option 1 byte. If Double precision is selected, the packet length increases by 4 bytes and the time of fix is obtained from bytes 32-39. Also note that at fix rates of 5 Hz and above, the time field automatically becomes a Double to ensure sufficient precision throughout the GPS week.

Altitude is in WGS-84 HAE or WGS-84 MSL, as selected by the I/O position option. The time of fix is in GPS time or UTC, as selected by the I/O timing option. At start-up, the receiver sends this packet with a negative time of fix to report the last computed position. Report Packet 0x4A provides a single-precision version of this information.

Caution – When converting from radians to degrees, significant errors are introduced by using an approximation for pi (π). The value of π as specified in ICD-GPS-200 is 3.1415926535898.

0x85

Report Packet 0x85
Differential Correction Status Report

Report Packet 0x85 provides the status of differential corrections for a specific satellite. It is sent in response to Command Packet 0x65. Table 3-108 and Table 3-109 show the data format.

Table 3-108 Differential Correction Status

Byte #	Item	Type	Value/Units	Meaning
0	SV PRN #	BYTE	0x01-0x20	Pseudorandom number of satellite (1-32)
1	Status Code Flag	BYTE	Table 3-109	Flag values summarize current status of differential corrections
2	Station Health	BYTE		Health of reference station used by receiver
3	SV Health (UDRE)	BYTE	See ICD-GPS-200	See the U.S. Government document, ICD-GPS-200
4	IODE 1	BYTE	See ICD-GPS-200	Issue of Data Ephemeris for pseudorange correction
5	IODE 2	BYTE	See ICD-GPS-200	Delta Issue of Data Ephemeris that may be used during an ephemeris change
6-9	Z count	SINGLE	*seconds*	Z count as Time of week
10-13	PRC	SINGLE	*meters*	Pseudorange Correction (PRC)
14-17	RRC	SINGLE	*m/sec*	Range-Rate Correction
18-21	Delta PRC	SINGLE	*meters*	Delta pseudorange correction

Table 3-109 Byte 1, Summary Status Code

Bit #	Meaning
0 (LSB)	Good correction data: 0: No 1: Yes
1	Good delta correction data: 0: No 1: Yes
2	Station health bad (5 or 7): 0: No 1: Yes
3	Data too old: 0: No 1: Yes
4	UDRE too high (>4): 0: No 1: Yes
5	IODE mismatch with Ephemeris and no delta correction data available: 0: No 1: Yes
6	Reserved (set to zero)
7	Receiver is not attempting to track satellite: 0: No 1: Yes

Note – For DSM Reference Station receivers, this packet reports received corrections when the unit is not in Reference Station mode. This packet reports the generated corrections when it is in Reference Station Mode.

0x87 Report Packet 0x87
Reference Station Parameters Report

Note – Report Packet 0x87 subpackets are only available for receivers with reference station capabilities.

Report Packet 0x87 has several forms that are differentiated by the Subpacket ID as the first data byte. Each 0x87 subpackets can be thought of as a different report packet. Table 3-110 through Table 3-134 show the data format. This report packet is sent in response to the corresponding Command Packet 0x67 subpackets.

0x87 0x00 Report Packet 0x87 0x00
Reference Station Control Report

Report Packet 0x87 0x00 reports the current operating state (on or off) of the reference station in response to Command Packet 0x67 0x00.

Table 3-110 Reference Station Control

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Reference Station control
1	Control	BYTE	*flag*	Reports if reference station is turned on of off: 0 Off 1 On

0x87 0x01 Report Packet 0x87 0x01
Reference Station Options Report

Report Packet 0x87 0x01 reports the reference station option flag settings in response to Command Packet 0x67 0x01.

Table 3-111 Reference Station Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Reference Station Options
1	Options 1	BYTE	Table 3-112	Reference Station Options 1
2	Options 2	BYTE	Table 3-113	Reference Station Options 2

Table 3-112 Byte 1, Options 1 Flags

Bit #	Option
0 (LSB)	Output RTCM Type 16 Record: 0: No 1: Yes
1	Output ASCII Carriage Return after RTCM messages: 0: No 1: Yes
2	Output ASCII Line Feed after RTCM messages: 0: No 1: Yes
3	Output TSIP wrapper (Report Packet 0x1A 0x00) around RTCM messages: 0: No 1: Yes
4	Output RTCM Type 2 in PRC Type 9 mode: 0: No 1: Yes
5	Output TSIP RTCM Output Notification (Report Packet 0x87 0x08): 0: No 1: Yes
6	Output RTCM PRC (Type 1 or 9): 0: No 1: Yes
7	Output Report Packet 0x60 and Report Packet 0x61 on Port B: 0: No 1: Yes

Table 3-113 Byte 2 Bit Positioning

Bit #	Option	Associated Packets
0 (LSB)	Automatically transfer the average position to the reference position and start the reference station when the minimum *Number* and/or *Duration* is satisfied. See the next note for additional information. 0: Off 1: On	0x67 0x03, 0x67 0x00
1	Outputs a warning if the reference station is enabled and generating corrections, but the Port A language for transmission is not set to RTCM or Command Packet 0x60 and Command Packet 0x61: 0: Send warning 1: Do not send warning	0x87 0x7E, 0x3D
2	Auxiliary Message Scheduling: 0: PRC Based – interval PRC messages per auxiliary message, Command Packet 0x67 0x06 1: Time Based – interval and offset within the hour, Command Packet 0x67 0x0A)	
3-7	Reserved (set to zero)	

Note – When the time duration and/or the number of positions requirement is satisfied and Bit 0 of Byte 2 in Command Packet 0x67 0x01 is set, the equivalent of the following two commands are performed:

Command Packet 0x67 0x03, Type Value of 5 – Copy current average position to reference position.
Command Packet 0x67 0x00, Control Value of 1 – Turn the reference station on.

0x87 0x02 Report Packet 0x87 0x02
Reference Station Output Version Report

Report Packet 0x87 0x02 reports the RTCM version output from the reference station in response to Command Packet 0x67 0x02.

Table 3-114 Reference Station Output Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Reference Station Output Version
1	Version	BYTE	Table 3-115	Reports the RTCM version.

Table 3-115 Byte 1, Version

Dec	Hex	Meaning
2	0x02	RTCM Version 2
255	0xFF	RTCM PRC Type 9

0x87 0x03 Report Packet 0x87 0x03
Reference Station Position Report

Report Packet 0x87 0x03 reports the reference station position in one of several formats depending on the request issued with Command Packet 0x67 0x03.

Table 3-116 shows the packet structure when reporting the position in XYZ ECEF coordinates.

Table 3-116 Reference Station Position, XYZ ECEF

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Reference Station Position
1	Type	BYTE	0x00	XYZ ECEF
2-9	X	DOUBLE	*meters*	X coordinate
10-17	Y	DOUBLE	*meters*	Y coordinate
18-25	Z	DOUBLE	*meters*	Z coordinate

Table 3-117 shows the packet structure when reporting the position in LLA WGS-84 HAE coordinates.

Table 3-117 Reference Station Position, LLA WGS-84 HAE

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Reference Station Position
1	Type	BYTE	0x01	LLA, WGS-84 HAE
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*radians*	Altitude in meters, WGS-84 HAE

Table 3-118 shows the packet structure used to confirm whether or not the current position could be set to the reference station position.

Table 3-118 Reference Station Position Set from the Current Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Reference Station Position
1	Type	BYTE	0x02	Copied from current position
2	Confirmation	BYTE	*flag*	Position not copied: 0 Not copied 1 Copied

Table 3-119 shows the packet structure when no reference station position is available to report.

Table 3-119 No Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Reference Station Position
1	Type	BYTE	0x03	No Reference Station Position

Table 3-120 shows the packet structure when reporting the position in LLA WGS-84 MSL coordinates.

Table 3-120 Reference Station Position, LLA, WGS-84 MSL

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Reference Station Position
1	Type	BYTE	0x04	LLA, WGS-84 MSL
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*radians*	Altitude in meters, WGS-84 MSL

Table 3-121 shows the packet structure used to confirm whether or not the average position could be copied to the reference station position.

Table 3-121 Reference Station Position Set from Average Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Reference Station Position
1	Type	BYTE	0x05	Copied from current average position
2	Confirmation	BYTE	*flag*	Copy average position to the reference station position: 0 Not copied. Average position not available 1 Copied

0x87 0x04 Report Packet 0x87 0x04 Reference Station ID Report

Report Packet 0x87 0x84 reports the reference station ID in response to Command Packet 0x67 0x04.

Table 3-122 Reference Station ID

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Reference Station ID
1-2	ID	INTEGER	0x00-0x3FF	Reference Station ID value (0-1023)

0x87 0x05 Report Packet 0x87 0x05 RTCM Type 16 Text Report

Report Packet 0x87 0x05 sends the text included in an RTCM Type 16 message in response to Command Packet 0x67 0x05.

Table 3-123 RTCM Type 16 Text

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	RTCM Type 16 Text
1	Length	BYTE	*bytes*	Number of bytes in Type 16 text
2-end	Text	BYTE	*text*	Up to 90 characters of ASCII text which is zero padded to the next multiple of three and truncated at 90 characters to represent the actual data to be sent in a type 16

0x87 0x06 Report Packet 0x87 0x06
RTCM Type Specific Output Intervals Report

The reference station can be configured to output some RTCM messages every *n* corrections. Report Packet 0x87 0x06 reports the PRC-based scheduling for other RTCM messages in response to Command Packet 0x67 0x06.

Table 3-124 RTCM Type Specific Output Intervals

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x06	RTCM Type Specific Output Intervals
1	Type	BYTE	*flag*	Report the type of RTCM output interval: 2 Type 2 Interval 3 Type 3 Interval 6 Type 6 Interval 16 Type 16 Interval
2	Interval	BYTE	0x00-0xFF	Report the RTCM output interval: 0 Message output is off 1-250 One message is output for every *interval* pseudorange correction (PRC, Type 1 or 9) 254 Send now acknowledge 255 Invalid message type

0x87 0x08 Report Packet 0x87 0x08
TSIP Notification of Sent Version 2 RTCM Report

Report Packet 0x87 0x08 is used to notify the user or application that the reference station has sent out a new RTCM report.

Table 3-125 TSIP Notification of Sent Version 2 RTCM

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x08	TSIP Notification of Sent Version 2 RTCM Report
1	Type	BYTE		RTCM Message Type sent
2-3	Station ID	INTEGER	*ID*	RTCM Station ID sent
4-5	Z Count	INTEGER	*Zcount*	RTCM Z Count sent
6-7	Delta Time	INTEGER	Table 3-126	GPS time at transmission minus message Z count time
8	Sequence Number	BYTE	*number*	RTCM Sequence Number sent
9	Length	BYTE	*length*	RTCM Length sent
10	Health	BYTE	*health*	RTCM Station Health sent
11	SV count	BYTE	*flag*	Number of satellites sent in this message: 0 None 1-255 Number of satellites
12-end	SV PRN	BYTE	0x01-0x20	PRN of satellites sent (1-32)

Table 3-126 Bytes 6-7, Delta time

Dec	Hex	Meaning
-32767 to -32736	-0x7FFF to -0x7FE0	Reserved
-32735	-0x7FDF	< -5.5 seconds
n	*n*	-5.5 through 60 seconds: *n* + 27234 = Delta Time in milliseconds
32767	0x7FFF	> 60 seconds

0x87 0x09 Report Packet 0x87 0x09

Average Position – Reference Station Position Report

Report 0x87 0x09 reports the position difference between the average position and the reference station position in one of several formats as requested by Command Packet 0x67 0x09.

Table 3-127 shows the packet structure when reporting the average position delta in XYZ coordinates.

Table 3-127 Average Position – Reference Station Position (XYZ)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x09	Average Position - Reference Station
1	Type	BYTE	0x00	XYZ delta
2-5	X	SINGLE		Delta in X coordinate
6-9	Y	SINGLE		Delta in Y coordinate
10-13	Z	SINGLE		Delta in Z coordinate

Table 3-128 shows the packet structure when reporting the position difference in ENU (East, North, Up) coordinates.

Table 3-128 Average Position – Reference Station Position (ENU)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x09	Average Position - Reference Station
1	Type	BYTE	0x01	ENU delta
2-5	E	SINGLE		Delta in East direction
6-9	N	SINGLE		Delta in North direction
10-13	U	SINGLE		Delta in Up direction

Table 3-129 shows the packet structure when no average position is available.

Table 3-129 No Average Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x09	Average Position - Reference Station
1	Type	BYTE	0x02	No Average Position

0x87 0x0A Report Packet 0x87 0x0A
Time Schedule Message Interval and Offset Report

The RTCM messages can be scheduled for output at a given time interval and offset. The time-based scheduling information is reported in Report Packet 0x87 0x0A.

Table 3-130 Time Schedule Message Interval and Offset

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x0A	Time Schedule Interval and Offset
1	Type	BYTE	*flag*	Reports the RTCM record type: 2 Type 2 interval and offset 3 Type 3 interval and offset 6 Type 6 interval and offset 16 Type 16 interval and offset
2-3	Interval	INTEGER	Table 3-131	Reports the time in seconds between RTCM message output.
4-5	Offset	INTEGER	*seconds*	Reports the delay (offset) of RTCM message output

Table 3-131 Byte 2, Interval

Dec	Hex	Meaning
0	0x00	Message output is off
1-3600	0x01-0xE10	The time in seconds between message transmissions
65535	0xFFFF	Invalid message type

0x87 0x7D Report Packet 0x87 0x7D
Mobile Packet Ignored by Reference Station Notification

Notifies the calling software when a mobile packet is ignored by the reference station.

Table 3-132 Mobile Packet Ignored by Reference Station

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7D	Mobile Packet Ignored: a packet was received in Reference Station mode which is a mobile control packet, and it has been ignored
1	ID	BYTE	*ID*	The packet ID of the ignored packet
2	Length	BYTE	*bytes*	The length of the ignored packet
3	First Byte	BYTE		The first byte of the ignored packet, or 255 if there is none

0x87 0x7E Report Packet 0x87 0x7E
Reference Station Warnings Notification

Notifies the calling software when a reference station warning occurs.

Table 3-133 Reference Station Warnings

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7E	Reference Station Warning
1	Warning	BYTE	0x00	Port A Output Language is not RTCM or not Packet 0x60 or 0x61

0x87 0x7F Report Packet 0x87 0x7F
Reference Station Option Not Installed Notification

Notifies the calling software with the reference station option is not installed on the receiver.

Table 3-134 Reference Station Option Not Installed

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7F	Requested option is not installed

0x88 Report Packet 0x88
Mobile Differential Parameters Report

Report Packet 0x88 has several forms that are differentiated by the subpacket ID as the first data byte. Each 0x88 subpacket can be thought of as a different report packet.

0x88 0x00 Report Packet 0x88 0x00
Mobile Differential Mode Control Report

Report Packet 0x88 0x00 reports the Mobile Differential Control mode in response to a request from Command Packet 0x68 0x00

Table 3-135 Differential Mode Control (duplicates Packet 82)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Mobile Differential Mode
1	Mode	BYTE	*flag*	Differential GPS mode: 0 Differential Off (Manual GPS) 1 Differential On Manual (Manual DGPS) 2 Auto differential currently off (GPS) 3 Auto differential currently on (DGPS)

0x88 0x01 Report Packet 0x88 0x01
Mobile Differential Options Report

Report Packet 0x88 0x01 reports the Mobile Differential Option flag settings in response to a request from Command Packet 0x68 0x01.

Table 3-136 Mobile Differential Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Mobile Differential Options
1	Options 1	BYTE	Table 3-137	Various Mobile Differential Options
2	Options 2	BYTE	0x00	Reserved (set to zero)

Table 3-137 Byte 1 Bit Position Encoding

Bit #	Option
0 (LSB)	Output last received RTCM Type 16 record in Report Packet 0x88 0x05: 0: No (*default*) 1: Yes
1-4	Reserved (set to zero)
5	Output TSIP RTCM Version 2 Reception Notification in Report Packet 0x88 0x08: 0: No (*default*) 1: Yes
6-7	Reserved (set to zero)

0x88 0x02 Report Packet 0x88 0x02
Mobile Differential Input Version Report

Report Packet 0x88 0x02 reports the Mobile Differential RTCM Input Version setting in response to a request from Command Packet 0x68 0x02.

Table 3-138 Mobile Differential Input Version

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Mobile Differential Input Version
1	Version	BYTE	*flag*	Reports the RTCM version number: 0 Automatic (RTCM Version 1, 2, or PRC Type 9) 1 Accept RTCM Version 1 only 2 Accept RTCM Version 2 or PRC Type 9 only

0x88 0x03 Report Packet 0x88 0x03
Masking Reference Station Position

Report Packet 0x88 0x03 reports the Masking Reference Station Position in one of several formats depending on the byte settings in Command Packet 0x68 0x03.

The report is output in the format shown in Table 3-139 when the position is requested in XYZ ECEF coordinates.

Table 3-139 Masking Reference Station Position, XYZ ECEF

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x00	XYZ Earth-Centered, Earth-Fixed (ECEF) Coordinates
2-9	X	DOUBLE	*meters*	X value in meters
10-17	Y	DOUBLE	*meters*	Y value in meters
18-25	Z	DOUBLE	*meters*	Z value in meters

The report is output in the format shown in Table 3-140 when the position is requested in LLA, WGS-84 HAE coordinates.

Table 3-140 Masking Reference Station Position, LLA, WGS-84 HAE

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x01	LLA, WGS-84
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*radians*	Altitude in meters WGS-84 HAE

The report is output in the format shown in Table 3-141 after Command Packet 0x68 0x03 is used copy the current position coordinates to the Masking Reference Station Position parameter.

Table 3-141 Masking Reference Station Position Set to Current Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x02	Set to the current position.
2	Confirmation	BYTE	*flags*	Status of position copy: 0 Position not copied 1 Position copied

The report is output in the format shown in Table 3-142 after Command Packet 0x68 0x03 is used to disable the Masking Reference Station position.

Table 3-142 No Masking Reference Station Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x03	Masking Reference Station Position Disabled

The report is output in the format shown in Table 3-143 when reporting the Masking Reference Station position in LLA WGS-84 MSL coordinates.

Table 3-143 Masking Reference Station Position, LLA, WGS-84 MSL

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Masking Reference Station Position
1	Type	BYTE	0x04	LLA WGS-84 MSL
2-9	Latitude	DOUBLE	*radians*	Latitude in radians, north
10-17	Longitude	DOUBLE	*radians*	Longitude in radians, east
18-25	Altitude	DOUBLE	*radians*	Altitude in meters, WGS-84 MSL

0x88 0x04 Report Packet 0x88 0x04
Input Reference Station ID Report

Report Packet 0x88 0x04 reports the method used to select the reference station ID in response to Command Packet 0x68 0x04.

Table 3-144 Input Reference Station ID

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Input Reference Station ID
1-2	ID	INTEGER		Sets the reference station ID: -1 Accept any Reference Station ID (0xFFFF) *other* Accept only this Reference Station ID

0x88 0x05 Report Packet 0x88 0x05
Last Received RTCM Type 16 Report

Report Packet 0x88 0x05 is output in the format shown in Table 3-145 when Command Packet 0x68 0x05 requests the last RTCM Type 16 record received from the reference station.

Table 3-145 Last Received RTCM Type 16

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Last received RTCM Type 16
1	Length	BYTE	0x00-0x5A	Number of characters received (0-90)
2-3	ID	INTEGER	*ID*	ID of the reference station that sent the Type 16 record
4-7	Time	LONG	*msecs*	Z count of RTCM Type 16 record converted to GPS time of week in milliseconds
8-end	Text	BYTE	*text*	Received text, including zero padding, if any

Report Packet 0x88 0x05 is output in the format shown in Table 3-146 when Command Packet 0x68 0x05 requests the last RTCM Type 16 record received from the reference station and a Type 16 record is not available.

Table 3-146 No Received RTCM Type 16

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x05	Last received RTCM Type 16
1	Length	BYTE	0xFF	No Type 16 received

0x88 0x08 Report Packet 0x88 0x08

TSIP Notification of Received Version 2 RTCM Report

Report Packet 0x88 0x08 is output in the format shown in Table 3-147 when a RTCM Version 2, Type 16 record is received if the receiver is configured to automatically output this report (see byte 1, bit 5 of Report Packet 0x88 0x01).

Table 3-147 TSIP Notification of Received Version 2 RTCM Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x08	TSIP notification of received Version 2 RTCM
1	Type	BYTE	*record type*	RTCM Message Type Received
2-3	Station ID	INTEGER	*identifier*	RTCM Station ID
4-5	Z Count	INTEGER	*Z count*	RTCM Z count received
6-7	Delta Time ()	INTEGER	Table 3-148	GPS time at reception, minus message Z count time
8	Sequence Number	BYTE	*number*	RTCM Sequence Number received
9	Length	BYTE	*length*	Length of RTCM record
10	Health	BYTE	*health*	RTCM Station Health
11	SV Count	BYTE	*flag*	Satellite count included in RTCM record: 0 No satellites received in this message 1-254 Number of satellites received in this message 255 RTCM message received from the wrong Reference Station
12-end	SV PRN	BYTE	0x01-0xFF	Satellite PRNs received (1-32)

Table 3-148 Bytes 6-7, Delta Time

Dec	Hex	Meaning
-32768	-0x8000	GPS Time not known
-32767 to -32736	-0x7FFF to -0x7FE0	Reserved
-32735	-0x7FDF	< -5.5 seconds
n	*n*	-5.5 through 60 seconds: *n* + 27234 = Delta Time in milliseconds
32767	0x7FFF	> 60 seconds

0x88 0x7F Report Packet 0x88 0x7F
Mobile Differential Option Not Installed Notification

Report Packet 0x88 0x7F is sent when the Mobile Differential Option is not installed on the receiver.

Table 3-149 Mobile Differential Option Not Installed

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7F	Requested option is not installed

0x8B Report Packet 0x8B QA/QC Reports

Report Packet 0x8B has several forms that are differentiated by the subpacket ID as the first data byte. Each (0x8B subpacket) packet can be thought of as a different report packet. Table 3-150 through Table 3-153 show the data formats. This report packet is sent in response to Command Packet 0x6B subpackets.

0x8B 0x00 Report Packet 0x8B 0x00 Position Sigma Information Parameters Report

Reports the position sigma information parameters in response to Command Packet 0x6B 0x00.

Table 3-150 Position Sigma Information Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Position Sigma Information Parameters Report
1	Enabled	BYTE	*flag*	Automatic output of information: 0 Disabled 1 Enabled
2-5	Reserved	BYTE	0	Reserved (set to 0)
6-7	Checksum	INTEGER	*checksum*	Checksum

0x8B 0x01 Report Packet 0x8B 0x01 Position VCV Parameters Report

Reports the position VCV parameters in response to Command Packet 0x6B 0x01.

Table 3-151 Position VCV Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Position VCV Parameters Report
1	Enabled	BYTE	*flag*	Automatic output of information: 0 Disabled 1 Enabled
2-5	Reserved	BYTE	0	Reserved (set to 0)
6-7	Checksum	INTEGER	*checksum*	Checksum

0x8B 0x02 Report Packet 0x8B 0x02
Position Sigma Information Report

Reports the position sigma information for a position. This packet is sent in response to Command Packet 0x6B 0x02 or when the sigma information outputs are enabled via Command Packet 0x6B 0x00. If enabled for automatic output, this packet will be sent out before the corresponding position packet.The sigma values are scaled by unit variance. If byte 1 is set to zero, the data is unavailable from the receiver and the remainder of the packet should be ignored. If byte 22 is set to 0, the semi-major axis, semi-minor axis and orientation values are not valid and must be derived from the sigmas and covariance.

Table 3-152 Position Sigma Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Position Sigma Parameters Report
1-4	Time of Fix	LONG	*msecs*	Time of position to which the data pertains in milliseconds since start of GPS week
5	Data Valid	BYTE	*flag*	Data validity: 0 Unavailable or invalid. The remainder of the packet should be ignored. 1 Valid
6-9	RMS	SINGLE		Position residual root mean square (RMS)
10-13	Sigma East	SINGLE	*meters*	Sigma east in meters
14-17	Sigma North	SINGLE	*meters*	Sigma north in meters
18-21	Cov. E-N	SINGLE		East-north covariance
22-25	Sigma Up	SINGLE	*meters*	Sigma up in meters
26	Axes Valid	BYTE	*flag*	Validity of axes values: 0 Invalid. The semi-major axis, semi-minor axis and orientation values are not valid and must be derived from the sigmas and covariance. 1 Valid
27-30	Semi-major	SINGLE	*meters*	Semi-major axis in meters
31-34	Semi-minor	SINGLE	*meters*	Semi-minor axis in meters
35-38	Orientation	SINGLE	*radians*	Orientation of semi-major axis from true north
39-42	Unit Variance	SINGLE		Unit variance
43-44	# of epochs	INTEGER		Used only for RTK
45-46	D.O.F.	INTEGER		Degrees of freedom
47-48	Flags	INTEGER	0	Reserved (set to 0)
49-52	Reserved	BYTE	0	Reserved (set to 0)
53-54	Checksum	INTEGER	*checksum*	Checksum

0x8B 0x03 Report Packet 0x8B 0x03

Position VCV Information Report

Reports the position VCV information for a position. The VCV matrix elements refer to the ECEF coordinates. This packet is sent in response to Command Packet 0x6B 0x03 or when the VCV information outputs are enabled via Command Packet 0x6B 0x01. If enabled for automatic output, this packet will be sent out before the corresponding position packet. The VCV matrix elements are scaled by unit variance. If byte 1 is set to zero, the data is unavailable from the receiver and the remainder of the packet should be ignored.

Table 3-153 Position VCV Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Position VCV Parameters Report
1-4	Time of Fix	LONG	msecs	Time of position to which the data pertains in milliseconds since start of GPS week
5	Data Valid	BYTE	*flag*	Data validity: 0 Unavailable or invalid. The remainder of the packet should be ignored. 1 Valid
6-9	RMS	SINGLE		Position residual root mean square (RMS)
10-13	VCV XX	SINGLE		VCV matrix element XX
14-17	VCV XY	SINGLE		VCV matrix element XY
18-21	VCV XZ	SINGLE		VCV matrix element XZ
22-25	VCV YY	SINGLE		VCV matrix element YY
26-29	VCV YZ	SINGLE		VCV matrix element YZ
30-33	VCV ZZ	SINGLE		VCV matrix element ZZ
34-37	Unit Variance	SINGLE		Unit variance
38-39	# of epochs	INTEGER		Used only for RTK
40-41	D.O.F.	INTEGER		Degrees of freedom
42-43	Flags	INTEGER	0	Reserved (set to 0)
44-47	Reserved	BYTE	0	Reserved (set to 0)
48-49	Checksum	INTEGER		Checksum

0x8D Report Packet 0x8D
Average Position Reports

Report Packet 0x8D has several forms that are differentiated by the subpacket ID as the first data byte. Each (0x8D subpacket) packet can be thought of as a different report packet. Table 3-154 through Table 3-168 show the data formats. This report packet is sent in response to Command Packet 0x6D subpackets.

0x8D 0x00 Report Packet 0x8D 0x00
Average Position Start/Stop Control Report

Reports the reason why position averaging has stopped and the current state of position averaging in response to Command Packet 0x6D 0x00.

Table 3-154 Average Position

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x00	Average Position Start/Stop Control Report
1	Stop Code	BYTE	*flag*	Shows if position averaging is turned on or reason why position averaging stopped: 0 Averaging is currently on 1 Averaging has never been started 2 Averaging stopped by manual stop command 3 Averaging stopped by a position offset beyond the maximum limit 4 Averaging stopped due to number and/or duration minimums being met. Note that the value of 7 below overrides this value 5 Averaging stopped by manually entering Reference Station mode 6 Averaging stopped due to upper limit of time or number of positions occurrence (upper limit is about two billion seconds or positions). When this happens, the process must be restarted and cannot be continued 7 Averaging stopped due to automatic transfer of Reference Station mode
2	Status	BYTE	Table 3-155	Average position status byte

Table 3-155 Byte 2, Status Codes

Bit #	Meaning if Bit Value = 1
0 (LSB)	Number of averages requirement has been satisfied†
1	Time duration of average requirement has been satisfied†
2	A Position Offset beyond maximum limit caused a restart since the last manual start or continue
3-7	Reserved

† If autostop on number and/or time is disabled, then Bits 0 and 1 are kept at a value of 0.

0x8D 0x01 Report Packet 0x8D 0x01
Average Position Options Report

Reports the current averaging options in response to a request received in Command Packet 0x6D 0x01.

Table 3-156 Average Position Options

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x01	Average Position Options
1	Option 1 Flags	BYTE	Table 3-157	First set of option flags
2	Option 2 Flags	BYTE	Table 3-158	Second set of option flags

Table 3-157 Byte 1 Bit Encoding, Option 1 Flags

Bit #	Option
0 (LSB)	Output Report Packet 0x87 0x03 with Average Position options reported in XYZ ECEF:† 0: No (*default*) 1: Yes
1	Output Report Packet 0x87 0x03 with Average Position options reported in LLA, WGS-84 HAE:† 0: No (*default*) 1: Yes
2	Output Report Packet 0x87 0x03 with Average Position options reported in LLA, WGS-84 MSL:† 0: No (*default*) 1: Yes
3	Reserved, set to zero to ensure future compatibility
4	Output Report Packet 0x87 0x04 with Delta Average Position options reported in XYZ:† 0: No (*default*) 1: Yes
5	Output Report Packet 0x87 0x04 with Delta Average Position options reported in ENU:† 0: No (*default*) 1: Yes
6-7	Reserved (set to zero)

† When a particular output format is enabled, the packet for that data is output every time a new position is included in the average.

Table 3-158 Byte 2 Bit Encoding, Option 1 Flags

Bit #	Option
0 (LSB)	Average Position behavior upon reset or power cycle 0: Continue Averaging (*default*) 1: Restart Averaging
1-7	Reserved (set to zero)

0x8D 0x02 Report Packet 0x8D 0x02
Auto Stop Parameters (Control / Options) Report

The report is output in one of several formats depending on the byte settings in Command Packet 0x6D 0x02.

The format shown in Table 3-159 reports the Auto-Stop configuration options.

Table 3-159 Auto Stop Parameters (Control / Options)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto stop parameters
1	Type	BYTE	0x00	Auto stop control/options
2	Options 1	BYTE	Table 3-160	Various Auto Stop Options
3	Options 2	BYTE	0x00	Reserved (set to zero)

Table 3-160 Type 0 Byte 2, Options 1 Bit Encoding

Bit #	Option
0 (LSB)	Stop or Restart† Averaging when the Maximum Coordinate Offset from the initial position is met: 0: Disable (*default*) 1: Enable
1	Stop Averaging when the Minimum Number and/or Duration is met: 0: Disable (*default*) 1: Enable
2-7	Reserved (set to zero)

† Stop or Restart is selected in Byte 6 of Command Packet 0x6D 0x02 Type 1. Also, changing the maximum offset enable/disable state clears the maximum offset status (Bit 2) in the status byte.

The format shown in Table 3-161 reports the configuration of position averaging auto-stop based on maximum coordinate offset from the initial position and the maximum offset from the initial position.

Table 3-161 Auto Stop Parameters (Maximum Coordinate Offset from Initial)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto stop parameters
1	Type	BYTE	0x01	Maximum coordinate offset from initial position
2-5	Max Offset	SINGLE		Maximum offset from initial position
6	Options	BYTE	Table 3-162	Options for Maximum Offset

Table 3-162 Type 1 Byte 6 Bit Encoding, Options

Bit #	Option
0 (LSB)	Behavior when Maximum Offset is met: 0: Restart Averaging. In this case, the position offset occurrence bit (Bit 2) in the status byte is set and remains set until the process is manually restarted (*default*) 1: Stop Averaging. In this case, the position offset occurrence bit (Bit 2) in the status byte is set. This bit gets cleared if the process is restarted or continued
1-7	Reserved (set to zero)

The format shown in Table 3-163 reports the configuration of position averaging auto-stop based on the number of positions included in the average position or the time duration.

Table 3-163 Auto Stop Parameters (Number and/or Duration)

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x02	Auto Stop Parameters
1	Type	BYTE	0x02	Number and Duration
2-5	Number†	LONG	*position count*	Auto stop after *Number* positions are included in the average (*default* = 1)
6-9	Duration	LONG	*seconds*	Auto stop after the averaging is on for *Duration* seconds (*default* = 0)
10	Options	BYTE	Table 3-164	Number and Duration auto stop options

† Negative numbers entered for *number* or *duration* are ignored.

Table 3-164 Type 2 Byte 10, Options Bit Encoding

Bit #	Option
0 (LSB)	Number and/or Duration 0: Auto stop averaging process if **both** *Number* **and** *Duration* conditions are satisfied (*default*) 1: Auto stop averaging process if **either** the *Number* **or** *Duration* conditions are satisfied, whichever comes first
1-7	Reserved (set to zero)

0x8D 0x03 Report Packet 0x8D 0x03
Current Average Position XYZ ECEF Report

Reports the current average position in XYZ ECEF or LLA WGS-84 HAE units depending on the request sent in Command Packet 0x6D 0x03. Table 3-165 shows the format for reporting the current average position in XYZ ECEF units.

Table 3-165 Current Average Position XYZ ECEF

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Current average position
1	Type	BYTE	0x00	XYZ ECEF
2-5	Number	LONG		Number of positions in the average
6-9	Duration	LONG	*seconds*	Average duration in seconds
10-17†	X	DOUBLE		If no positions (zero) are included in the average, the average position coordinates and the time are not output at all. The number and duration fields do accurately reflect the state of the averaging process, however.
18-25†	Y	DOUBLE		
26-33†	Z	DOUBLE		
34-37†	Time	LONG	*seconds*	Average time is seconds. If MSB = 1, process is stopped and lower bits indicate total averaging time

† These bytes only exist if *Number* is greater than zero.

Table 3-165 shows the format for reporting the current average position in LLA WGS-84 HAE units.

Table 3-166 Current Average Position LLA WGS-84 HAE

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Current average position
1	Type	BYTE	0x00	LLA WGS-84 HAE
2-5	Number	LONG		Number of positions in the average
6-9	Duration	LONG	*seconds*	Average duration in seconds
10-17†	Latitude	DOUBLE		If no positions (zero) are included in the average, the average position coordinates and the time are not output at all. The number and duration fields do accurately reflect the state of the averaging process, however.
18-25†	Longitude	DOUBLE		
26-33†	Altitude	DOUBLE		WGS-84 HAE
34-37†	Time	LONG	*seconds*	Average time is seconds. If MSB = 1, process is stopped and lower bits indicate total averaging time

† These bytes only exist if *Number* is greater than zero (0).

Table 3-167 Current Average Position LLA WGS-84 MSL

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x03	Current average position
1	Type	BYTE	0x04	LLA WGS-84 MSL
2-5	Number	LONG		Number of positions in the average
6-9	Duration	LONG	*seconds*	Average duration in seconds
10-17†	Latitude	DOUBLE		If no positions (zero) are included in the average, the average position coordinates and the time are not output at all. The number and duration fields do accurately reflect the state of the averaging process, however.
18-25†	Longitude	DOUBLE		
26-33†	Altitude	DOUBLE		WGS-84 MSL
34-37†	Time	LONG	*seconds*	Average time in seconds. If MSB = 1, process is stopped and lower bits indicate total averaging time

† These bytes only exist if *Number* is greater than zero (0).

0x8D 0x04 Report Packet 0x8D 0x04
Average Position Delta from Last XYZ or ENU Report

Reports the change in average position from the last XYZ or ENU average position in response to Command Packet 0x6D 0x04.

Table 3-168 Average Position Delta from Last XYZ or ENU

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x04	Average position delta from last
1	Type	BYTE	*flag*	Geographic coordinates: 0 XYZ 1 ENU
2-5	Number	LONG		Number of positions in the average
6-9	Duration	LONG	*seconds*	Averaging duration in seconds
10-13†	X or E	SINGLE		If the position average currently consists of 0 or 1 positions, a delta computation cannot be performed. The Last Average Delta Position values and the time are not output at all. The number and duration fields do accurately reflect the state of the averaging process, however.
14-17†	Y or N	SINGLE		
18-21†	Z or U	SINGLE		
22-25†	Time	LONG	*seconds*	Average time in seconds. If MSB = 1, process is stopped and lower bits indicate total averaging time

† These bytes only exist if *Number* is greater than one (1).

0x8F Report Packet 0x8F
Application Reports

Report Packet 0x8F subpackets are responses to the Command Packet 0x8E subpackets. For a detailed description of subpacket structures, see TSIP Packet Structure on page 1-3.

0x8F 0x20 Report Packet 0x8F 0x20
Super Packet Output Report

Report Packet 0x8F 0x20 is sent in response to Command Packet 0x8E 0x20. The Super Packet data includes detailed information about the last position and velocity solutions, including the information required to perform inverted differential GPS postprocessing. For more information, see Command Packet 0x8E 0x20.

Note – The GPS receiver may not support Super Packet Output unless the Super Packet Option is installed. Check the product-specific appendices for more information.

Table 3-169 Super Packet Output Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x20	Super Packet Output Report
1	Key Byte	BYTE	*key*	Interpreted only by Trimble postprocessing software
2-3	East Velocity	INTEGER	*meters/sec*	East velocity in 0.005 meter per second increments
4-5	North Velocity	INTEGER	*meters/sec*	North velocity in 0.005 meter per second increments
6-7	Up Velocity	INTEGER	*meters/sec*	Up velocity in 0.005 meter per second increments
8-11	Time of Week	LONG	*msec*	GPS time of the week, in milliseconds
12-15	Latitude	LONG	-2^{30} to 2^{30}	Latitude indicated on WGS-84 datum. Units = 2^{-31} semicircle Range = -2^{30} to 2^{30}
16-19	Longitude	LONG	0 to 2^{30}	Longitude east of the meridian indicated on WGS-84 datum Units = 2^{-31} semicircle Range = 0 to 2^{30}
20-23	Altitude	LONG	*millimeters*	Altitude for position above the WGS-84 ellipsoid.
24-26	Reserved	BYTE	0x00	Reserved (set to zero)
27	Position Fix Flags	BYTE	Table 3-170	Bits of byte used as flags for identifying the characteristics of the position fix

Table 3-169 Super Packet Output Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
28	Number of SVs	BYTE	0x01-0x08	Number of SVs (1-8) contributing data used to compute position solution
29	UTC Offset	BYTE	*seconds*	Number of leap seconds between UTC and GPS time
30-31	Week	INTEGER	*week*	GPS time of position solution, in weeks
32-47	SV PRNX and IODE	BYTE	Table 3-171	Repeated in groups of two bytes, one group of two bytes for each of the eight satellites tracked on the eight L1 band channels. The two bytes are set to zero if the group is not applicable
48-56	Ionospheric Data	BYTE	ICD-GPS-200	Ionospheric data considered when computing position solution. See the ICD-GPS-200 specification for details

Table 3-170 Byte 27 Bit Encoding, Position Fix Flags

Bit #	Meaning
0 (LSB)	Position Fix Availability: 0: Position fix is available 1: No Position Fix available; last position fix used to compute solution
1	DGPS Corrections Used in Position Solution: 0: GPS position fix 1: RTCM corrections used to compute position solution
2	Type of GPS Position Fix used for position solution: 0: 3D Position Fix 1: 2D Position Fix
3	Altitude used for 2D Position Fix: 0: Altitude from last computed 3D position fix is used 1: User-defined altitude is used
4	Position or Altitude Filter: 0: Off 1: On (*default*)
5-7	Reserved (set to zero)

Table 3-171 Bytes 32–47, SVs

Dec	Hex	Meaning
0	0x00	Even numbered bytes contain the PRNX value (Satellite PRN and IODC - IODE value). PRN = lower six bits of PRNX. IODC = (PRNX/64) x 256 + IODE
1	0x01	Odd numbered bytes identify the IODE (Issue of Data Ephemeris)

0x8F 0x60 Report Packet 0x8F 0x60

DR Calibration and Status Report

Report Packet 0x8F 0x60 reports the dead reckoning sensor calibration values in response to a request sent in Command Packet 0x8E 0x60.

Table 3-172 DR Calibration and Status

Byte #	Item	Type	Value/Units	Meaning
1	Subpacket	BYTE	0x60	DR Calibration and Status Report
2-5	Odometer Scale Factor	FLOAT	*pulses/mile*	Calibrated number of pulses per mile output by odometer
5-9	Gyro Left Scale Factor	FLOAT	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
10-13	Gyro Right Scale Factor	FLOAT	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
14	Digital/Analog Odometer Switch	BYTE	*flag*	Type of odometer: 1 Digital 2 Analog

0x8F 0x62 Report Packet 0x8F 0x62
GPS/DR Position/Velocity Report

Report Packet 0x8F 0x62 is sent in response to a request for the current GPS/DR position and velocity solution received in Command Packet 0x8E 0x62. Command Packet 0x8E 0x65 can be used to enable automatic transmission of this report once per second.

Table 3-173 GPS/DR Position/Velocity

Byte #	Item	Type	Value/Units	Meaning
1	Subpacket	BYTE	0x62	GPS/DR Position/Velocity Report
2-9	Time Tag	DOUBLE	*hh:mm:ss*	Time when position/velocity solution computed
10-17	Latitude	DOUBLE	*meters*	Latitude of vehicle in the WGS-84 datum
18-25	Longitude	DOUBLE	*meters*	Longitude of vehicle in the WGS-84 datum
26-33	Altitude	DOUBLE	*meters*	Altitude of vehicle above mean sea level
34-41	Clock Bias	DOUBLE	*seconds*	Clock bias of position solution
42-43	Position Source	INTEGER	Table 3-174	Position fix method used to compute position solution
44-51	East Velocity	DOUBLE	*meters/second*	Easterly speed of vehicle, in meters per second
52-59	North Velocity	DOUBLE	*meters/second*	Northerly speed of vehicle, in meters per second
60-67	Up Velocity	DOUBLE	*meters/second*	Vertical speed of vehicle in meters per second.
68-75	Clock Bias Velocity	DOUBLE	*meters/second*	Clock bias of velocity solution
76	Velocity Source	BYTE	*flag*	Method used to compute velocity solution: 0 Velocity Fix, East-North-Up (ENU) 1 Velocity Fix, XYZ Cartesian ECEF
77	S/H Status	BYTE	flag	Speed/Heading Status: 1 Heading filter successfully run 2 S/A-compensated heading available 3 Odometer scale factor updated

Table 3-173 GPS/DR Position/Velocity

Byte #	Item	Type	Value/Units	Meaning
78	# SVs in Solution	BYTE	1-8	Number of satellites used in position solution computation
The next byte is repeated for the number of SVs included in position solution				
varies	SV PRN	BYTE	1-32	Pseudorandom number of satellite included in position and velocity solution

Table 3-174 Byte 42-43, Position Source

Bit	Meaning
0-3	Underlying GPS Source Information: 0: 2D GPS 1: 3D GPS 15: No GPS
4	Differential Corrections Used: 0: False 1: True
5	Integrated GPS + DR Solution:[1] 0: False 1: True
6	Solution is more than 10 seconds old: 0: False 1: True
7	Solution is valid: 0: False: 1: True
8	DR is used in solution: 0: False 1: True
9	DR solution is degraded:[2] 0: False 1: True
10-15	Reserved (set to zero)

1 Combined bits 5 and 8 indicate: 0 0 = GPS only, 0 1 = DR without GPS, 1 1 = Integrated GPS and DR solution.

2 Estimated horizontal position error is greater than 300 meters.

0x8F 0x64 Report Packet 0x8F 0x64
Firmware Version and Configuration Report

Report Packet 0x8F 0x64 is sent in response to a request received in Command Packet 0x8E 0x64. Two types of reports can be sent, depending on the setting of Byte 1 in Command Packet 0x8E 0x64. The data structures for the two reports is shown in Table 3-175 and Table 3-176.

The Board Configuration and Immediate Frequency form of the report is sent when Byte 1 of Command Packet 0x8E 0x64 is set to 0x00. The Board Configuration and IF Configuration strings describe the hardware architecture of the receiver. New strings are added as new receiver architectures are introduced.

Table 3-175 Board Configuration and Immediate Frequency Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x64	Firmware Version and Configuration Report
1	Report Type	BYTE	0x00	Reports the board configuration and intermediate frequency
varies	Board Configuration	BYTE	*string*	Board Configuration string
varies	IF Configuration	BYTE	*string*	Intermediate Frequency (IF) string
	Checksum	INTEGER	*checksum*	Checksum of packet data bytes

The Firmware Version and Configuration form of the report are sent when Byte 1 of Command Packet 0x8E 0x6F is set to 0x01. The report identifies the firmware version name, version number, and receiver configuration information.

Table 3-176 Firmware Version and Configuration Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket	BYTE	0x64	Firmware Version and Configuration Report
1	Report Type	BYTE	0x01	Reports the firmware version name, version number, and configuration
2	Port Number	BYTE	flag	Receiver port number: 0 Port B 1 Port A Port A and Port B are internal circuit designations for the first and second serial port. See the receiver manual to learn the port label name imprinted on the receiver's connector panel.
3-22	Firmware Name	BYTE	*string*	Firmware version name
23	Major Version	BYTE	0x01-0xFF	Major part of firmware release number (X if format is X.Y) (1-255)

Table 3-176 Firmware Version and Configuration Report

Byte #	Item	Type	Value/Units	Meaning
24	Minor Version	BYTE	0x01-0xFF	Minor part of firmware release number (Y if format is X.Y) (1-255)
25	FW Month	BYTE	0x01-0x0C	Firmware version release month (1-12)
26	FW Day	BYTE	0x01-0x1F	Firmware version release day (1-31)
27	FW Year	BYTE	96-*nn*	Firmware version release year
Begin configuration block				
28	Configuration Block Header	BYTE	0x55	Marks the beginning of the configuration block
29	Configuration Version	BYTE	0x00-0x01	Version number of firmware configuration block
30-61	Serial Number	BYTE		Receiver serial number
62	Manufacturing Day	BYTE	0x01-0x0C	Day of month of receiver manufacture (1-31)
63	Manufacturing Month	BYTE	0x01-0x1F	Month of year of receiver manufacture (1-12)
64	Manufacturing Year	BYTE	96-*nn*	Year of receiver manufacture
65	Product ID	BYTE	*flag*	Product identification code: 0 Placer GPS 450 1 Placer GPS 455
66	Network Type	BYTE	*flag*	Type of network supported: 0 None 1 MAP27 2 CDPD 3 RDI 4 AXION 5 TAIP (Direct Connection)
67	Input Protocol	BYTE	Table 3-177	Input protocols used by Port #. Multiple protocols may be enabled by setting bits, with the exception of RTCM SC-104 (bit 8). When bit 8 is set to True to enable RTCM, all other protocol bit settings are ignored.
68	Output Protocol	BYTE	Table 3-177	Output protocols used by Port #. Multiple protocols may be enabled by setting bits. All protocol settings remain in effect even when the RTCM SC-104 bit (bit 8) is set to True.

Table 3-176 Firmware Version and Configuration Report

Byte #	Item	Type	Value/Units	Meaning
69	Input Baud Rate	BYTE	*flag*	Throughput of data input on port (see Port #, above), in bits per second: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps
70	Output Baud Rate	BYTE	*flag*	Throughput of data output on port (see Port #, above), in bits per second: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps
71	Parity	BYTE	*flag*	Parity of data: 0 None 1 Odd 2 Even
72	Data Bits	BYTE	*flag*	Number of data bits: 0 5 data bits 1 6 data bits 2 7 data bits 3 8 data bits
73	Stop Bits	BYTE	*flag*	Number of stop bits: 0 1 stop bit 1 2 stop bits
74	Flow Control	BYTE	*flag*	Flow control negotiation: 0 Disabled 1 Enabled

Table 3-176 Firmware Version and Configuration Report

Byte #	Item	Type	Value/Units	Meaning
75	P/V Filter	BYTE	*flag*	Position/Velocity Filter: 0 Disabled 1 Enabled
76	1 PPS Output	BYTE	*flag*	Enables or disables 1 PPS (pulse per second) output for time synchronization with external instruments: 0 Disabled 1 Enabled
77	Event Marker Input	BYTE	*flag*	Event Marker Input: 0 Disabled 1 Enabled
78-142	Reserved	BYTE	0x00	Reserved (set to zero)
143-150	Configuration Block Tail	BYTE	0xAA55	Marks the end of the configuration block
End Configuration block				
151-152	Checksum	INTEGER	*checksum*	Checksum of configuration block
153-154	Checksum	INTEGER	*checksum*	Checksum of bytes 0-152

Table 3-177 Input and Output Protocols

Bit #	Meaning
0 (LSB)	None (disable all input or output protocols): 0: False 1: True
1	TAIP: 0: False 1: True
2	TSIP: 0: False 1: True
3	Reserved (set to zero)
4	NMEA-0183: 0: False 1: True
5-7	Reserved (set to zero)
8	RTCM SC-104: 0: False 1: True **Note –** For Byte 67, Input Protocol, all other protocol bit settings are ignored, regardless of their current bit setting. For Byte 68, Output Protocol, there is no restriction. All protocol bit settings are applied.
9-15	Reserved (set to zero)

0x8F 0x6B Report Packet 0x8F 0x6B
Last Gyroscope Readings Report

Report Packet 0x8F 0x6B is sent in response to Command Packet 0x8E 0x6B when requesting the last gyroscope reading values. Command Packet 0x8E 0x65 can be used to enable automatic transmission of this report once per second.

Table 3-178 Gyroscope Values

Byte #	Item	Type	Value/Units	Meaning
1	Subpacket	BYTE	0x6B	Last Gyroscope Reading Report
2-9	Gyro Heading	DOUBLE	*radians*	Current heading of vehicle
10-17	Gyro Heading Rate	DOUBLE	*radians/second*	Compensated turn rate based on gyro measurement
18-25	Gyro Heading Rate Bias	DOUBLE	*degrees/second*	Bias rate of gyroscope recorded during calibration. Bias rate is not used in the actual calibration but should be within -10 to +10 degrees per second if the gyroscope is operating correctly.
26-33	Time Tag	DOUBLE	*hh:mm:ss*	Time when gyroscope reading is computed
34-41	Gyro Duty Cycle	DOUBLE	—	Fraction of 1, representing the heading sensor output (no units)
42	Health Status	BYTE	*flag*	Health status of gyroscope: 0 No errors *other* Errors
43-50	Gyro Scale Factor 1	DOUBLE	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
51-58	Gyro Scale Factor 2	DOUBLE	*unitless*	Ratio of actual gyro scale factor to nominal gyro scale factor. This value is measured during the gyro calibration procedure.
59-62	Gyro Variance	FLOAT	*radians*^{2}	Variance of heading indicates uncertainty
63-66	Heading Correction	FLOAT	*radians*	Size of heading correction made this second

0x8F 0x6D Report Packet 0x8F 0x6D
Last Odometer Readings Report

Report Packet 0x8F 0x6D is sent in response to Command Packet 0x8E 0x6D when requesting the vehicle's last odometer readings. Command Packet 0x8E 0x65 can be used to enable automatic transmission of this report once per second.

Table 3-179 Odometer Readings Values

Byte #	Item	Type	Value/Units	Meaning
1	Subpacket	BYTE	0x6D	Last Odometer Readings Report
2-3	Last Second Count	BYTE	*pulses/second*	Pulses counted during last second of reading
4-11	Odometer Speed	DOUBLE	*miles/hour*	Reports computed speed of vehicle
12-19	Odometer Sample Time	DOUBLE	*seconds*	Reports the time, in seconds, elapsing while number of odometer pulses are recorded
20-27	Time Tag	DOUBLE	*hh:mm:ss*	Reports the time recorded when odometer speed reading is computed
28-31	Odometer Scale Factor	FLOAT	*pulses/mile*	Reports the calibrated number of pulses per mile output by odometer
32-35	Odometer Variance	FLOAT	*pulses/mile*	Reports the difference, in pulses per mile, between calibrated odometer scale factor and most recent scale factor computation
36	Health Status	BYTE	*flag*	Reports the health status of odometer: 00 System healthy 01 No pulses since power is on 02 Odometer scale factor invalid 04 Backup light active 08 Invalid time 10 Odometer speed is invalid
37	A/D Switch	BYTE	*flag*	Reports the Analog or Digital Odometer potentiometer setting type: 0 Custom (load potentiometer values from packet) 1 Digital (potentiometer values set to their digital default levels, 0xB000 in version 2.30) 2 Analog (potentiometer values set to their digital default levels, 0x1000 in version 2.30)

Table 3-179 Odometer Readings Values

Byte #	Item	Type	Value/Units	Meaning
38	Potentiometer Value	BYTE	0x1000 to 0xB000	Reports the sensitivity of the odometer input circuit. The valid range is 0x1000 for the most sensitive setting (Analog) to 0xB000 for the lease sensitive setting (Digital)
39	Odometer Status	BYTE		Health of odometer: 0 Bad health: speed is either invalid or system does not have valid time 1 Healthy
40-41	Checksum	INTEGER	checksum	Checksum of bytes 0-39

0x8F 0x6F Report Packet 0x8F 0x6F Firmware Version Name Report

Report Packet 0x8F 0x6F is sent in response to Command Packet 0x8E 0x6F when requesting the receiver's firmware name.

Table 3-180 Firmware Version Name Report Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x6F	Firmware Version Name
1-20	Firmware Version Name	BYTE	*string*	Name assigned to the receiver's firmware
21-22	Checksum	INTEGER	*checksum*	Checksum of bytes 0-20

0x8F 0x70 Report Packet 0x8F 0x70 (Obsolete)
Beacon Channel Status Report (Obsolete)

Note – Command Packet 0x8E 0x70 and Report Packet 0x8F 0x70 continue to be supported in firmware releases after version 1.04. However, the preferred packets to use are Command Packet 0x8E 0x85 and Report Packet 0x8F 0x85.

Report Packet 0x8F 0x70 is sent in response to Command Packet 0x8E 0x70 (Obsolete). The report contains the current status of the two Beacon channels.

Table 3-181 Beacon Channel Status Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x70	Beacon Channel Status
1	Channels	BYTE	0x02	Number of Beacon channels (2)
Begin Channel 1 Data Block				
2-3	Frequency	INTEGER	2835-3250	Beacon Channel 0 frequency when searching for or tracking radiobeacon[1]
4	Mode	BYTE	*flag*	Beacon Channel 0 acquisition mode: 0 Manual - Channel tracks user-defined radiobeacon frequency 1 Auto Range - Channel tracks one of the two closest radiobeacon frequencies 2 Auto Power - Channel tracks one of the two most powerful radiobeacon frequencies 3 Reserved (set to zero) 4 Disabled – Beacon channel is powered off

1 MF (medium frequency) band ranges from 283.5-325.0 kHz, in 100 Hz increments.

2 Quality of Beacon signal lock is the ratio of samples collected at peak and trough. The lock indicator is scaled by 16 to improve resolution at low SNR values. Values ranges from 0 to 255 divided by 16.

3 Electromagnetic field intensity values (256 levels) range from 0 to 127.5 DBUV/M, in 0.5 DBUV/M units (decibels above one microvolt per meter)

4 Signal to noise levels range from 0-25.5 Db, in 0.1 Db units.

5 Values range from -12.8 to 12.7 Hz, in 0.1 Hz units.

Table 3-181 Beacon Channel Status Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
5	Status	BYTE	*flag*	Beacon Channel 0 status: 0 Channel is idle 1 Wideband FFT being performed 2 Channel searching for radiobeacon signal 3 Channel acquired a radiobeacon signal 4 Good RTCM collected from radiobeacon 5 Channel is disabled
6	RTCM Used Flag	BYTE	*flag*	RTCM Used Flag status for Beacon Channel 0: 0 Not source of differential corrections 1 Source of differential corrections
7	SNR	BYTE	0x00-0xFF	Beacon Channel 0 Signal to Noise level[4] (0-255)
8	Input Level	BYTE	0x00-0xFF	Beacon Channel 0 Electromagnetic field intensity level[3] (0-255)
9	Rate Index	BYTE	*flag*	Beacon Channel 0 data modulation rate index: 0 25 bps 1 50 bps 2 100 bps 3 200 bps
10	Lock Indicator	BYTE	0x00-0xFF	Beacon Channel 0 signal lock quality[2] (0-255)
11	Carrier Offset	BYTE	0x00-0xFF	Beacon Channel 0 frequency difference between transmitter and receiver oscillators[5] (0-255)
12	Bit Rate Offset	BYTE	0x00-0xFF	Beacon Channel 0 difference (0-255) between calculated bit rate and theoretical bit rate[5]
13	Word Error Rate	BYTE	0x00-0xFF	Number of RTCM word errors (0-255) in last 255 words on Beacon Channel 0
14	Beacon Health	BYTE	*Not defined*	Beacon Channel 0 radiobeacon health status

1 MF (medium frequency) band ranges from 283.5-325.0 kHz, in 100 Hz increments.

2 Quality of Beacon signal lock is the ratio of samples collected at peak and trough. The lock indicator is scaled by 16 to improve resolution at low SNR values. Values ranges from 0 to 255 divided by 16.

3 Electromagnetic field intensity values (256 levels) range from 0 to 127.5 DBUV/M, in 0.5 DBUV/M units (decibels above one microvolt per meter)

4 Signal to noise levels range from 0-25.5 Db, in 0.1 Db units.

5 Values range from -12.8 to 12.7 Hz, in 0.1 Hz units.

Table 3-181 Beacon Channel Status Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
Begin Channel 2 Data Block				
15-16	Frequency	INTEGER	2835-3250	Beacon Channel 1 Frequency when searching for or tracking radiobeacon[1]
17	Mode	BYTE	*flag*	Beacon Channel 1 Beacon Acquisition Mode: 0 Manual - Channel tracks user-defined radiobeacon frequency 1 Auto Range - Channel tracks one of the two closest radiobeacon frequencies 2 Auto Power - Channel tracks one of the two most powerful radiobeacon frequencies 3 Reserved (set to zero) 4 Disabled – Beacon channel is powered off
18	Status	BYTE	*flag*	Beacon Channel 1 status: 0 Channel is idle 1 Wideband FFT being performed 2 Channel searching for radiobeacon signal 3 Channel acquired a radiobeacon signal 4 Good RTCM collected from radiobeacon 5 Channel is disabled
19	RTCM Used Flag	BYTE	*flag*	RTCM Used Flag status of Beacon Channel 1: 0 Not source of differential corrections 1 Source of differential corrections
20	SNR	BYTE	0x00-0xFF	Beacon Channel 1 Signal to Noise level[4] (0-255)
21	Input Level	BYTE	0x00-0xFF	Beacon Channel 1 Electromagnetic field intensity level[3] (0-255)

1 MF (medium frequency) band ranges from 283.5-325.0 kHz, in 100 Hz increments.

2 Quality of Beacon signal lock is the ratio of samples collected at peak and trough. The lock indicator is scaled by 16 to improve resolution at low SNR values. Values ranges from 0 to 255 divided by 16.

3 Electromagnetic field intensity values (256 levels) range from 0 to 127.5 DBUV/M, in 0.5 DBUV/M units (decibels above one microvolt per meter)

4 Signal to noise levels range from 0-25.5 Db, in 0.1 Db units.

5 Values range from -12.8 to 12.7 Hz, in 0.1 Hz units.

Table 3-181 Beacon Channel Status Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
22	Rate Index	BYTE	*flag*	Beacon Channel 1 data modulation rate index: 0 25 bps 1 50 bps 2 100 bps 3 200 bps
23	Lock Indicator	BYTE	0x00-0xFF	Beacon Channel 1 signal lock quality[2] (0-255)
24	Carrier Offset	BYTE	0x00-0xFF	Beacon Channel 1 frequency difference between transmitter and receiver oscillators[5] (0-255)
25	Bit Rate Offset	BYTE	0x00-0xFF	Beacon Channel 1 difference between calculated bit rate and theoretical bit rate[5] (0-255)
26	Word Error Rate	BYTE	0x00-0xFF	Number of RTCM word errors in last 255 words on Beacon Channel 1 (0-255)
27	Beacon Health	BYTE	Not defined	Beacon Channel 1 radiobeacon health status
28-29	Checksum	INTEGER	*checksum*	Checksum of bytes 0-27

1 MF (medium frequency) band ranges from 283.5-325.0 kHz, in 100 Hz increments.

2 Quality of Beacon signal lock is the ratio of samples collected at peak and trough. The lock indicator is scaled by 16 to improve resolution at low SNR values. Values ranges from 0 to 255 divided by 16.

3 Electromagnetic field intensity values (256 levels) range from 0 to 127.5 DBUV/M, in 0.5 DBUV/M units (decibels above one microvolt per meter)

4 Signal to noise levels range from 0-25.5 Db, in 0.1 Db units.

5 Values range from -12.8 to 12.7 Hz, in 0.1 Hz units.

0x8F 0x71 Report Packet 0x8F 0x71
DGPS Station Database Reports

Report Packet 0x8F 0x71 is sent is response to Command Packet 0x8E 0x71. The receiver generates one report packet for each of the ten records in the DGPS station database. Either the beacon station database or satellite station database may be requested via Command Packet 0x8E 0x71 and 0x8E 0x86, respectively. Data in beacon records is derived from the Radiobeacon almanac.

Table 3-182 DGPS Station Database Reports (Modified)

Byte #	Item	Type	Value	Meaning
0	Subpacket ID	BYTE	0x71	Database reports
1	Record Index and Flags	BYTE	Table 3-183	Index Number of database record (0-9) and source of differential corrections
2-3	Station ID	INTEGER	-1 or 0-1023	Station identification number
4-5	Frequency	INTEGER	0 or 2835-3250	Beacon frequency[1] or 0 if satellite database is used
6	Modulation Rate	BYTE	*flag*	Modulation rate: 0 25 bps 1 50 bps 2 100 bps 3 200 bps 4 600 bps 5 1200 bps 6 2400 bps 7 4800 bps
7	Health	BYTE	*flag*	Health of station: 0 Normal Health 1 Not monitored 2 No information available 3 Do not use 0x80 Data invalid
8-11	Latitude	SINGLE	*radians*	Latitude of reference station, in radians
12-15	Longitude	SINGLE	*radians*	Longitude of reference station, in radians
16-19	Distance	SINGLE	*meters*	Computed distance to reference station, in meters
20-23	Range	SINGLE	*meters*	Reported range of transmission, in meters (Beacon only)
24-27	Seconds	LONG	*seconds*	Number of seconds since database record was updated

Table 3-182 DGPS Station Database Reports (Modified) (Continued)

Byte #	Item	Type	Value	Meaning
28	USCG Index	BYTE	1-10 or 128[2]	Index of the beacon frequency used in Auto Range mode[2] (Beacon only). for more information, see the USCG COMDTINST M16577.1 specification
29-30	Checksum	INTEGER	*checksum*	Packet checksum

1 Beacon MF (medium frequency) band ranges from 283.5-325.0 kHz, in 100 Hz increments.

2 The radiobeacon database contains a maximum of 10 radiobeacons. Any radiobeacon not included in the Auto Range list is assigned an index number of 128.

Table 3-183 Byte 1 Bit Encoding, Record Index

Bit #	Meaning
0-3	Index number of database record (0-9)
4	If satellite DGPS database: 0: database of Racal LandStar stations 1: database of Omnistar stations (not currently available)
5	Station used as RTCM source, if set
6	Station providing network corrections, if set
7	Database type: 0: Beacon DGPS Database 1: Satellite DGPS Database

0x8F 0x73 Report Packet 0x8F 0x73 (Obsolete)

Beacon Channel Control Acknowledgment (Obsolete)

Note – Command Packet 0x8E 0x73 and Report Packet 0x8F 0x73 continue to be supported in firmware releases after version 1.04. However, the preferred packets to use are Command Packet 0x8E 0x89 and Report Packet 0x8F 0x89.

Report Packet 0x8F 0x73 is sent to acknowledge Command Packet 0x8F 0x73.

Table 3-184 Receiver Control Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x73	Beacon Channel Control Acknowledgment
1-2	Checksum	INTEGER	—	Checksum of Byte 0

0x8F 0x74 Report Packet 0x8F 0x74
Clear Beacon Database Acknowledgment

Report Packet 0x8F 0x74 is sent to acknowledge Command Packet 0x8E 0x74. For more information, see Command Packet 0x8E 0x74 on page 2-93.

Table 3-185 Clear Radiobeacon Database Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x74	Clear Beacon Database Acknowledgment
1-2	Checksum	INTEGER	—	Checksum of Byte 0

0x8F 0x75 Report Packet 0x8F 0x75
FFT Start Acknowledgment

Report Packet 0x8F 0x75 is sent to acknowledge Command Packet 0x8E 0x75. For more information, see Command Packet 0x8E 0x75 on page 2-93.

Table 3-186 FFT Start Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x75	FFT Start Acknowledgment
1-2	Checksum	INTEGER	*checksum*	Checksum of Byte 0

0x8F 0x76 Report Packet 0x8F 0x76
FFT Stop Acknowledgment

Report Packet 0x8F 0x76 is sent to acknowledge Command Packet 0x8E 0x76. For more information, see Command Packet 0x8E 0x76 on page 2-94.

Table 3-187 FFT Stop Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x76	FFT Stop Acknowledgment
1-2	Checksum	INTEGER	*checksum*	Checksum of Byte 0

0x8F 0x77 Report Packet 0x8F 0x77
FFT Reports

Report Packet 0x8F 0x77 is generated after Command Packet 0x8E 0x75 is acknowledged with Report Packet 0x8F 0x75. The receiver performs a 1024-point Fast Fourier Transform (FFT) by the number of times specified by the Number of Integrations parameter in Command Packet 0x8E 0x75. Once the FFT report is completed, the receiver begins the next FFT. The FFT reports are generated and sent continuously until the FFT Stop Command (Command Packet 0x8E 0x76) is issued.

Because the amount of data contained in the FFT report exceeds 123 bytes, the report is divided into multiple packets (pages).

Even if all data bytes are DLEs (which would transmit 2 TSIP bytes for each data byte), the message structure does not overflow the 255 byte TSIP buffer length.

The contents of the message packet pages are described in Table 3-189 through Table 3-191. Each page contains a maximum of 123 data bytes, so multiple pages are generated until all of the data bytes in the report are transmitted. A total of nine pages are generated for narrowband FFT reports, five pages are generated for wideband FFT reports. All of the message packets must be concatenated together to form one data block.

Table 3-188 describes the different parameters used in the wideband and narrowband FFTs.

Table 3-188 Wideband and Narrowband FFT Parameters

	Wideband FFT	**Narrowband FFT**
Sample frequency	$F_s = \frac{25x10^6}{9 \times 16}$ Hz $\cong 173.6$ kHz	$F_{sNB} = \frac{F_s}{128}$ Hz $\cong 1356.3$ Hz
FFT bin size	$\frac{F_s}{1024} \cong 169.54$ Hz	$\frac{F_s}{128 \times 1024} \cong 1.32$ Hz
Number of frequency bins in report	512 bins	1024 bins
Center frequency	$1.75 \times F_S \cong 296.7$ kHz)	Specified by bytes 2-9 below

The block of wideband FFT data lies in the range of $\frac{3F_s}{2}$ to $2F_s$ (260.416 to 346.883 kHz).

Table 3-189 FFT Report Packet, First Page

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x77	FFT Report
1	Page Number	BYTE	0x00	First page number
2-9	Frequency	DOUBLE	*frequency*	Center frequency of narrowband/wideband spectral plot in Hz.
10-17	Bin Size	DOUBLE	1.32 or 169.54	FFT bin size in Hz.
18	Input Squared Flag	BYTE	*flag*	FFT input squaring option is only used in narrowband mode: 0 No input squaring 1 Input squaring on
19	Number of Integrations	BYTE	*flag*	Number of post FFT power sums: 5 Recommended for narrowband FFT 33 Recommended for wideband FFT
20-21	Number of Bins	INTEGER	*flag*	Number of FFT bins: 512 Wideband Report 1024 Narrowband Report
22-25	Maximum Level	SINGLE	0-127.5 dBuV	Maximum power level
26	Averaged Power Sample†	BYTE	0x00-0xFF	Averaged power sample of first bin of first report page (0-255)†
124	Averaged Power Sample†	BYTE	0x00-0xFF	Averaged power sample of last bin of first report page (0-255)†
125-126	Checksum	INTEGER	*checksum*	Checksum of Bytes 0-124

† Measured in units of 0.5 dB, ranging from 0-127.5 dB.

Table 3-190 FFT Report Packet, Intermediate Pages

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x77	FFT Report
1	Page Number	BYTE	0x01	Second page of report
2	Averaged Power Sample	BYTE	0x00-0xFF	The averaged power sample of first bin of second report page (0-255) to last bin of second report page†
. . .	Averaged Power Sample	BYTE	0x00-0xFF	
124	Averaged Power Sample	BYTE	0x00-0xFF	
125-126	Checksum	INTEGER	*checksum*	Checksum (bytes 0-124)

† Measured in units of 0.5 dB, ranging from 0-127.5 dB.

Table 3-191 FFT Report Packet, Last Page

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x77	FFT Report
1	Page Number	BYTE	*flag*	Last page of report: 4 Narrowband 8 Wideband
2	Averaged Power Sample	BYTE	0x00-0xFF[1]	Averaged power sample of first bin in the last page of the report to the average power sample of last bin (512th bin for wideband or 1024th bin for narrowband) in report (0-255)[1]
. . .	Averaged Power Sample	BYTE	0x00-0xFF[1]	
x	Average Power Sample[2]	BYTE	0x00-0xFF[1]	
x+1 - *x*+2	Checksum[2]	INTEGER	*checksum*	Checksum[2] of Bytes 0-*x*

1 Measured in units of 0.5 dB, ranging from 0–127.5 dB.

2 Where *x* is 65 for narrowband FFT and 46 for wideband FFT.

0x8F 0x78 Report Packet 0x8F 0x78
RTCM Reports

Report Packet 0x8F 0x78 (see Table 3-192) is sent to acknowledge to Command Packet 0x8E 0x78. Once the command packet is acknowledged, the first RTCM report (see Table 3-193), containing raw demodulated RTCM bytes, is generated and the report is transmitted as Report Packet 0x8F 0x78. RTCM reports are continuously generated and transmitted until report generation is stopped.

Table 3-192 RTCM Reports Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x78	RTCM Reports
1-2	Checksum	INTEGER	—	Checksum of Byte 0

Table 3-193 RTCM Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x78	RTCM Report
1	Channel Number	BYTE	0x00 or 0x01	RTCM Channel Number: 0 Channel 0 1 Channel 1
2-5	Time	LONG	0-2147483648	Transmit time, in milliseconds, since the start of the week. Used to compute RTCM latency
6-*x*	RTCM bytes†	BYTE	0x00-0xFF	Total number of bytes (0-255) contained in the report
(*x* + 1) to (x + 2)	Checksum	INTEGER	*checksum*	Checksum of Byte 0-*x*

† A variable length buffer is sent out. To reduce any buffering latency, a report is generated whenever a good RTCM message is decoded by the receiver or a maximum of 64 bytes are collected.

0x8F 0x79 Report Packet 0x8F 0x79
Beacon Station Attributes Acknowledgment

Report Packet 0x8F 0x79 is sent to acknowledge Command Packet 0x8E 0x79. For more information, see Command Packet 0x8E 0x79 on page 2-95.

Table 3-194 Input Station Attributes Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x79	Beacon Station Attributes Acknowledgment
1-2	Checksum	INTEGER	—	Checksum of Byte 0

0x8F 0x7A Report Packet 0x8F 0x7A
Beacon Station Attributes Report

Report Packet 0x8F 0x7A is sent in response to Command Packet 0x8E 0x7A. The report contains a list of the attribute settings for the 84 radiobeacon station frequencies supported by the receiver. The actual station attributes are set using Command Packet 0x8E 0x79. For more information, see Command Packet 0x8E 0x7A on page 2-95 and Command Packet 0x8E 0x79 on page 2-95.

Table 3-195 Output Station Attributes Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7A	Output Station Attributes Report
1	Attribute	BYTE	*flag*	Attributes for the 283.5 KHz station through the 325.0 KHz station (in 0.5 KHz increments) 0 Beacon enabled/Health heeded 1 Beacon enabled/Health ignored 2 Beacon disabled 3 Beacon is not monitored When station health is unmonitored, it is treated as a healthy station in the Auto Range mode selection process
. . .	Attribute	BYTE	*flag*	
84	Attribute	BYTE	*flag*	
85-86	Checksum	INTEGER	*checksum*	Checksum of Bytes 0-84

0x8F 0x7B Report Packet 0x8F 0x7B
DGPS Receiver RAM Configuration Block Report

Report Packet 0x8F 0x7B is sent in response to Command Packet 0x8E 0x7B. The report contains current receiver configuration parameter settings and a software version report. The actual receiver configuration parameters are set using Command Packet 0x8E 0x7C. For more information, see Command Packet 0x8E 0x7B on page 2-96 and Command Packet 0x8E 0x7C on page 2-96.

Table 3-196 DGPS Receiver Configuration Block Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7B	Receiver Configuration Block Report
1	Port Number	BYTE	0x00-0x01	Receiver port number. 0 Port B 1 Port A See the product-specific appendices for more information about port designators.
2-21	Name	STRING		Software Name
22	Major Version	BYTE	0x01-0xFF	Major part of software release number (X if format is X.Y) (1-255)
23	Minor Version	BYTE	0x01-0xFF	Minor part of software release number (Y if format is X.Y) (1-255)
24	Month	BYTE	0x01-0x0C	Software version release month (1-12)
25	Day	BYTE	0x01-0x1F	Software version release day (1-31)
26	Year	BYTE	*year minus 1900*	Software version release year minus 1900
Begin configuration block				
27	Head	BYTE	0x55h	Beginning of receiver configuration block
28	Version	BYTE	0x00-0x01	Version number of software configuration block
29-60	Serial Number	STRING	*ASCII*	Serial number of receiver as an ASCII NULL terminated string
61	Day	BYTE	0x01-0x1F	Day of receiver manufacture (1-31)
62	Month	BYTE	0x01-0x0C	Month of receiver manufacture (1-12)
63-64	Year	INTEGER	*year*	Year of receiver manufacture
65-66	Superpacket Option Flag	INTEGER	*flag*	Superpacket option flag – DGPS postprocessing with Report Packet 0x8F 0x20: 0 Unavailable 1 Available

Table 3-196 DGPS Receiver Configuration Block Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
67	Input Protocol	BYTE	*flag*	Port B Input Protocol: 0 None 1 TSIP 4 RTCM 11 ASCII IN then OUTPUT PORT A (DataMerge) 12 ASCII IN then OUTPUT PORT B (DataMerge) 14 LBAR (from Lightbar)
68	Output Protocol	BYTE	*flag*	Port B Output Protocol: 0 None 2 TSIP 3 NMEA 5 Internally-generated RTCM (i.e. Base Station) 10 Externally-generated RTCM (i.e. Flow-thru RTCM) 15 LBAR (to Lightbar)
69	Input Baud Rate	BYTE	*flag*	Port B Input Baud Rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps If Output Baud Rate is set to None and Input Baud Rate is set to a specified value, Output Baud Rate is set to the same value as Input Baud Rate.
70	Output Baud Rate	BYTE	*flag*	Port B Output Baud Rate flag settings are identical to Port B Input Baud Rate
71	Parity	BYTE	*flag*	Port B Parity setting: 0 None 1 Odd 2 Even

Table 3-196 DGPS Receiver Configuration Block Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
72	Data Bits	BYTE	*flag*	Port B Data Bits setting: 0 5 1 6 2 7 3 8
73	Stop Bits	BYTE	*flag*	Port B Stop Bits: 0 1 1 2
74	Reserved	BYTE	0x00	Reserved (set to zero)
75	Input Protocol	BYTE	*flag*	Port A Input Protocol: 0 None 1 TSIP 4 RTCM 11 ASCII IN then OUTPUT PORT A (DataMerge) 12 ASCII IN then OUTPUT PORT B (DataMerge) 14 LBAR (from Lightbar)
76	Output Protocol	BYTE	*flag*	Port A Output Protocol: 0 None 2 TSIP 3 NMEA 5 Internally-generated RTCM (i.e. Base Station) 10 Externally-generated RTCM (i.e. Flow-thru RTCM) 15 LBAR (to Lightbar)
77	Input Baud Rate	BYTE	*flag*	Port A Input Baud Rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps If Output Baud Rate is set to None and Input Baud Rate is set to a specified value, Output Baud Rate is set to the same value as Input Baud Rate.

Table 3-196 DGPS Receiver Configuration Block Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
78	Output Baud Rate	BYTE	*flag*	Port A Output Baud Rate flag settings are identical to Port A Input Baud Rate
79	Parity	BYTE	*flag*	Port A Parity setting: 0 None 1 Odd 2 Even
80	Data Bits	BYTE	*flag*	Port A Data Bits setting: 0 5 1 6 2 7 3 8
81	Stop Bits	BYTE	*flag*	Port A Stop Bits: 0 1 1 2
82	Reserved	BYTE	0x00	Reserved (set to zero)
83	Product ID	BYTE		Receiver Product ID. Values are listed in the product-specific appendices.
84	P/V Filter Flag	BYTE	*flag*	Position/Velocity filter state: 0 Disabled 1 Enabled
85	Carrier Phase Flag	BYTE	*flag*	Carrier phase processing state: 0 Disabled 1 Enabled
86	1 PPS Flag	BYTE	*flag*	Enables or disables 1 PPS (pulse per second) output for time synchronization with external instruments: 0 Disabled 1 Enabled
87-90	Antenna Gain	REAL	*decibels*	Antenna Gain factor, in dB
91	Event Flag	BYTE	*flag*	Event Marker Input enabled: 0 Disabled 1 Enabled The Event Marker parameter setting is ignored if the receiver does not support Event Marker input.
92	Beacon Enabled Flag	BYTE	*flag*	Beacon is enabled: 0 Disabled 1 Enabled

Table 3-196 DGPS Receiver Configuration Block Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
93	Maximum Position Rate	BYTE	*flag*	Maximum position rate allowed: 0 1 Hz 1 5 Hz 2 10 Hz
94	Beacon Attribute	BYTE	*flag*	Default beacon attribute used by the receiver: 0 Beacon enabled/Health heeded 1 Beacon enabled/Health ignored 2 Beacon disabled 3 Beacon is not monitored
95	RTCM Time-out	BYTE	*seconds*	Time-out for external RTCM input, in seconds
96	Scorpio Decoding	BYTE	*flag*	Scorpio decoding availability: 0 Not available 1 Available
97	Base Station	BYTE	*flag*	Reference station support availability: 0 Not available 1 RTCM Type 1 corrections available 2 RTCM Type 1 and 9 corrections available
98	Everest	BYTE	*flag*	Everest Multipath Reduction availability: 0 Not available 1 Available
99	Modem Control	BYTE	*flag*	Modem control available: 0 Not available 1 Available
100	Reserved	BYTE	0x00	Reserved (set to zero)
101-102	D&E Subscription	INTEGER	week number	D&E subscription week number
103	Guidance	BYTE	*flag*	Guidance option is installed and enabled: 0 Not installed 1 Installed and currently disabled 2 Installed and currently enabled
104	Satellite Differential Satellite Provider	BYTE	*flag*	Satellite differential service providers available: 0 All 1 Racal only 2 Omnistar only

Table 3-196 DGPS Receiver Configuration Block Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
105	Language	BYTE	*flag*	Language used on display: 0 English 1 Spanish 2 French 3 German 4 Portugese
106	Hardware name	BYTE		Hardware type: 0 Unknown 1 Beast 2 Spot 3 Bascom 4 Taz 5 EuroBeast
107-108	TNL Subscription	INTEGER	*week*	TNL subscription week number
109	Display units	BYTE		Display units: 0 Metric 1 U.S.
110	Disabled streams	BYTE	0x00	Set to zero
111-150	Reserved	BYTE	0x00	Reserved (set to zero)
151-152	End	INTEGER	0xAA55h	End of configuration block
End configuration block				
153-154	Checksum	INTEGER	*checksum*	Checksum of configuration block computed as (0 - sum of bytes 27 through 152)
155-156	Checksum	INTEGER	*checksum*	Checksum of bytes 0-154

0x8F 0x7C Report Packet 0x8F 0x7C
DGPS Receiver Configuration Block Acknowledgment

Report Packet 0x8F 0x7C is sent to acknowledge Command Packet 0x8E 0x7C. For more information, see Command Packet 0x8E 0x7C on page 2-96.

Table 3-197 Input Receiver Configuration Block Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7C	Input Receiver Configuration Block Acknowledgment
1-2	Checksum	INTEGER	*checksum*	Checksum of Byte 0

0x8F 0x7E Report Packet 0x8F 0x7E
Satellite Line-of-Sight (LOS) Message

Automatic output of Report Packet 0x8F 0x7E is enabled by sending Command Packet 0x8E 0x7E.

Table 3-198 Satellite Line-of-Sight (LOS) Message

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7E	Satellite Line-of-Sight (LOS) Message
1	Byte Count	BYTE	80	Total number of bytes in packet
2-9	User Time of Data	DOUBLE	*seconds*	User Time of Data, *t*, in seconds of the week. This differs from GPS time by +/- 0,5 msecs and by several seconds from UTC time.
10-11	Channel Status Flags	BYTEs	Table 3-199	Status of satellite tracking channel
12-19	Pseudorange	DOUBLE	*meters*	Pseudorange value
20-23	Delta Pseudorange	SINGLE	*meters*	Delta Pseudorange value
24-27	Pseudorange Variance	SINGLE	*meters*	Pseudorange Variance
28-31	Delta Pseudorange Variance	SINGLE	*meters*	Delta Pseudorange Variance
32-39	SV X Position (t) ECEF	DOUBLE	*meters*	X Position (*t*) of satellite in ECEF (Earth Centered, Earth Fixed) coordinates
40-47	SV Y Position (t) ECEF	DOUBLE	*meters*	Y Position (*t*) of satellite in ECEF coordinates
48-55	SV Z Position (t) ECEF	DOUBLE	*meters*	Z Position (*t*) of satellite in ECEF coordinates
56-59	SV X Delta Position ECEF	SINGLE	*meters*	X Delta Position of satellite in ECEF coordinates
60-63	SV Y Delta Position ECEF	SINGLE	*meters*	Y Delta position of satellite in ECEF coordinates
64-67	SV Z Delta Position ECEF	SINGLE	*meters*	Z Delta Position of satellite in ECEF coordinates
68-71	Ionospheric Correction	SINGLE	*meters*	Ionospheric Correction
72-73	Ephemeris URA Word	INTEGER	Table 3-200	Ephemeris URA Word
74-77	Delta Pseudorange Interval	SINGLE	*seconds*	Delta Pseudorange Interval
78-79	Checksum	INTEGER	*checksum*	Checksum

Table 3-199 Bytes 10 and 11, Channel Status Flags

Bit	Meaning
0-4	Satellite ID, a value ranging from 0-31 (0=32)
5	ICD 225 Corrected: 0: S/A corrected 1: S/A not corrected
6-7	Reserved (set to zero)
8	Y-code: 0: Disabled 1: Enabled
9-11	Satellite Tracking State: 0: No data 1: State 1 – C/A search 2: State 2 – P-code/Y-code search 3: State 3 – Code lock 4: State 4 – AFC lock 5: State 5 – Costas 6: State 6 – Sequential synchronization 7: State 7 – Signal reacquisition
12	Code Type: 0: P-code or Y-code 1: C/A code
13	Ionospheric Correction: 0: Modeled 1: L1/L2 Bands
14	Antenna Used (set to zero)
15	Channel Byte Status (1 = Failed)

Table 3-200 Bytes 72 and 73, Ephemeris URA Word

Bit #	Meaning
0-3	URA† (as per ICD-CPS-200) (setting = 0-3)
4	Availability: 0: No ephemeris 1: Valid ephemeris
5	NAV Data Validity: 0: Data valid 1: Data invalid
6	Differential Corrected: 0: Not corrected 1: Corrected
7	Reserved (set to zero)
8-15	Differential GPS UDRE Byte, in meters

† The Ephemeris URA is the SPS (broadcast) URA if bit 6 of the channel status word (bytes 8 and 9) in this block are set to TRUE. Otherwise it is the PPS URA.

0x8F 0x7F Report Packet 0x8F 0x7F
DGPS Receiver ROM Configuration Block Report

Report Packet 0x8F 0x7F is sent in response to Command Packet 0x8E 0x7F. The report contains receiver configuration parameter settings and a software version report that are stored in ROM. For more information, see Command Packet 0x8E 0x7F on page 2-102.

Table 3-201 DGPS Receiver ROM Configuration Block

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x7B	Receiver Configuration Block Report
1	Port Number	BYTE	0x00 or 0x01	Receiver port number. Port B = 0. Port A =1
2-21	Name	STRING	*string*	Software Name
22	Major Version	BYTE	0x01-0xFF	Major part of software release number (X if format is X.Y) (1-255)
23	Minor Version	BYTE	0x01-0xFF	Minor part of software release number (Y if format is X.Y) (1-255)
24	Month	BYTE	0x01-0x0C	Software version release month (1-12)
25	Day	BYTE	0x01-0x1F	Software version release day (1-31)
26	Year	BYTE	*year minus 1900*	Software version release year minus 1900
27	Head	BYTE	0x55h	Beginning of receiver configuration block
28	Version	BYTE	0x00-0x01	Version number of software configuration block
29-60	Serial Number	STRING	ASCII	Serial number of receiver as an ASCII NULL terminated string
61	Day	BYTE	0x01-0x1F	Day of receiver manufacture (1-31)
62	Month	BYTE	0x01-0x0C	Month of receiver manufacture (1-12)
63-64	Year	INTEGER	*year*	Year of receiver manufacture
65-66	Superpacket Option Flag	INTEGER	*flag*	Superpacket option flag – DGPS postprocessing with Report Packet 0x8F 0x20: 0 Unavailable 1 Available
67	Input Protocol	BYTE	*flag*	Port B Input Protocol: 0 None 1 TSIP 4 RTCM 11 ASCII IN then OUTPUT PORT A (DataMerge) 12 ASCII IN then OUTPUT PORT B (DataMerge) 14 LBAR (from Lightbar)

Table 3-201 DGPS Receiver ROM Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
68	Output Protocol	BYTE	*flag*	Port B Output Protocol: 0 None 2 TSIP 3 NMEA 5 Internally-generated RTCM (i.e. Base Station) 10 Externally-generated RTCM (i.e. Flow-thru RTCM) 15 LBAR (to Lightbar)
69	Input Baud Rate	BYTE	*flag*	Port B Input Baud Rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps If Output Baud Rate is set to None and Input Baud Rate is set to a specified value, Output Baud Rate is set to the same value as Input Baud Rate.
70	Output Baud Rate	BYTE	*flag*	Port B Output Baud Rates are identical to Port B Input Baud Rate (see above)
71	Parity	BYTE	*flag*	Port B Parity setting: 0 None 1 Odd 2 Even
72	Data Bits	BYTE	*flag*	Number of Port B data bits: 0 5 1 6 2 7 3 8
73	Stop Bits	BYTE	*flag*	Number of Port B stop bits: 0 1 1 2
74	Reserved	BYTE	0x00	Reserved (set to zero)

Table 3-201 DGPS Receiver ROM Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
75	Input Protocol	BYTE	*flag*	Port A Input Protocol: 0 None 1 TSIP 4 RTCM 11 ASCII IN then OUTPUT PORT A (DataMerge) 12 ASCII IN then OUTPUT PORT B (DataMerge) 14 LBAR (from Lightbar)
76	Output Protocol	BYTE	*flag*	Port A Output Protocol: 0 None 2 TSIP 3 NMEA 5 Internally-generated RTCM (i.e. Base Station) 10 Externally-generated RTCM (i.e. Flow-thru RTCM) 15 LBAR (to Lightbar)
77	Input Baud Rate	BYTE	*flag*	Port A Input Baud Rate: 0 None 1 110 bps 2 300 bps 3 600 bps 4 1200 bps 5 2400 bps 6 4800 bps 7 9600 bps 8 19200 bps 9 38400 bps If Output Baud Rate is set to None and Input Baud Rate is set to a specified value, Output Baud Rate is set to the same value as Input Baud Rate.
78	Output Baud Rate	BYTE	*flag*	Port A Output Baud Rate are identical to Input Baud Rate (see above).
79	Parity	BYTE	*flag*	Port A Parity setting: 0 None 1 Odd 2 Even

Table 3-201 DGPS Receiver ROM Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
80	Data Bits	BYTE	*flag*	Number of Port A data bits: 0 5 1 6 2 7 3 8
81	Stop Bits	BYTE	*flag*	Number of Port A stop bits: 0 1 1 2
82	Reserved	BYTE	0x00	Reserved (set to zero)
83	Product ID	BYTE		Receiver Product ID. Values are listed in the product-specific appendices.
84	P/V Filter	BYTE	*flag*	Toggles Position/Velocity filter: 0 Disabled 1 Enabled
85	Carrier Phase Flag	BYTE	*flag*	Carrier phase processing: 0 Disabled 1 Enabled
86	1 PPS Flag	BYTE	*flag*	Toggles 1 PPS (pulse per second) output for time synchronization with external instruments: 0 Disabled 1 Enabled
87-90	Antenna Gain	REAL	*decibels*	Antenna Gain factor, in db
91	Event Flag	BYTE	*flag*	Event Marker Input: 0 Disabled 1 Enabled The Event Flag setting is ignored if the receiver does not support Event Marker input.
92	Beacon Enabled Flag	BYTE	*flag*	Flag value indicates whether or not beacon is enabled: 0 Disabled 1 Enabled
93	Maximum Position Rate	BYTE	*flag*	Maximum position rate allowed: 0 1 Hz 1 5 Hz 2 10 Hz

Table 3-201 DGPS Receiver ROM Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
94	Beacon Attribute	BYTE	*flag*	Default beacon attributes used by the receiver: 0 Beacon enabled/Health heeded 1 Beacon enabled/Health ignored 2 Beacon disabled 3 Beacon is not monitored
95	RTCM Time-out	BYTE	*seconds*	Time-out for external RTCM input, in seconds.
96	Scorpio decoding	BYTE	*flag*	Scorpio decoding availability: 0 Not available 1 Available
97	Base station	BYTE	*flag*	Reference station availability: 0 Base station not available 1 Base station RTCM Type 1 corrections available 2 Base station RTCM Type 1 and 9 corrections available
98	Everest	BYTE	*flag*	Everest Multipath Reduction availability: 0 Not available 1 Available
99	Modem control	BYTE	*flag*	Availability of RTS/CTS modem control: 0 Not available 1 Available
100	Reserved	BYTE	0x00	Reserved (set to zero)
101-102	D&E Subscription	INTEGER	*week number*	D&E subscription week number
103	Guidance	BYTE	*flag*	Guidance option is installed and enabled: 0 Not installed 1 Installed and disabled by default 2 Installed and enabled by default
104	Satellite Differential Satellite Provider	BYTE	*flag*	Satellite differential service provider availability: 0 All 1 Racal only 2 Omnistar only
105	Language	BYTE	*flag*	Language used on display: 0 English 1 Spanish 2 French 3 German 4 Portugese

Table 3-201 DGPS Receiver ROM Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
106	Hardware name	BYTE		Hardware type: 0 Unknown 1 Beast 2 Spot 3 Bascom 4 Taz 5 EuroBeast
107-108	TNL Subscription	INTEGER	*week*	TNL subscription week number
109	Display units	BYTE		Display units: 0 Metric 1 U.S.
110	Disabled streams	BYTE	0x00	Set to zero
111-150	Reserved	BYTE	0x00	Reserved (set to zero)
151-152	End	INTEGER	0xAA55h	End of configuration block
153-154	Checksum	INTEGER	*checksum*	Checksum of configuration block computed as (0 - sum of bytes 27 through 152)
155-156	Checksum	INTEGER	*checksum*	Checksum of Byte 0-154

0x8F 0x80 Report Packet 0x8F 0x80

DGPS Service Provider System Information Report

Report Packet 0x8F 0x80 reports information about the current status of the DGPS service provider in response to Command Packet 0x8E 0x80. Due to operational differences among service providers, the decoder state and access information is interpreted slightly differently for each service provider.

Racal Service

At all times, the user access information accurately reflects the current access state, where “Access information available” indicates that no access information has been received yet. The initial confirmation of user access typically occurs after decoder initialization is complete.

Omnistar Service

Once the initialization sequence is complete, the user access information is valid. Before initialization is completed, the access may not accurately reflect the final access state. To help determine whether the user access will become enabled when initialization is complete, the user may wish to look at the activation stop date provided by Report Packet 0x8F 0x8B. If the activation stop date is a future date, user access will become enabled when initialization is completed.

Table 3-202 DGPS Service Provider System Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x80	Service Provider System Information Report
1	User Access	BYTE	*flag*	Reports current state of User Access information: 0 Access information unavailable 1 User disabled 2 User enabled
2-5	User ID Code	LONG	*ID*	Decoder user ID
6-9	Firmware Version	SINGLE		Decoder firmware version

Table 3-202 DGPS Service Provider System Information (Continued)

Byte #	Item	Type	Value/Units	Meaning
10	Decoder State	BYTE	*flag*	Reports the current state of the decoder: 0-4 Initialization in progress 5 Initialization complete 6 User access confirmed 7 RTCM data received 8 Decoder reset detected 9 Decoder unavailable 10 No new RTCM data 11 Need data update from master station 12 No offshore operation permitted 13 Invalid region of operation 14 Invalid satellite link Note that the decoder state can only report one error/warning at a time. To get complete error information for Omnistar operation, use Errors/Warnings entry.
11	Service Provider	BYTE	*flag*	Identifies the satellite station DGPS corrections service provider: 3 Racal 4 Omnistar 255 Unknown
12-13	Errors/Warnings	INTEGER	Table 3-203	All current error or initialization conditions (Omnistar only)
14	Reserved	BYTE	0x00	Reserved (set to zero)
15-16	Checksum	INTEGER	*checksum*	Packet checksum

Table 3-203 Errors/Warnings Bit Descriptions (OmniSTAR Only)

Bit #	Meaning
0 (LSB)	Expiration Date Restrictions: 0: Valid 1: Expiration is Invalid
1	Region Restriction: 0: Valid 1: Current position outside of valid regions
2	Offshore Restriction: 0: Valid 1: Current position is restricted
3	Satellite Link Restriction: 0: Valid 1: Current satellite link is restricted
4	Site Information: 0: Valid 1: None available yet (still initializing)
5	Almanac Information: 0: Valid 1: None available yet (still initializing)
6	Position Information: 0: Valid 1: None available yet (still initializing)
7	Timing Information: 0: Valid 1: None available yet (still initializing)
8-14	Reserved (set to zero)
15	Operational warning which may cause no DGPS corrections: 0: All data valid 1: Need data update from central hub

0x8F 0x81 Report Packet 0x8F 0x81
Decoder Station Information Report and Selection Acknowledgment

The Racal DGPS service provides RTCM from multiple stations on the same link. Report Packet 0x8F 0x81 is used to both acknowledge a change in decoder station selection information and to output the requested station information.

Table 3-204 Decoder Station Selection Acknowledgment Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x81	Decoder Station Selection Modification Received
1-2	Checksum	INTEGER	*checksum*	Checksum

Table 3-205 Decoder Stations Info Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x81	Decoder stations information
1	# of Stations	BYTE		Number of stations available on satellite link
For each of n stations, the following three bytes are sent				
2-3, 5-6, ...	Station ID	INTEGER	*identifier*	Reference station identifier
4, 7 ...	Flags	BYTE	Table 3-207	Station access flags
2+3*n	Reserved	INTEGER	0x00	Reserved (set to zero)
4+3*n	Selection preference	BYTE	preference	Station selection preference: 0 Prefer network station 1 Prefer closest station
5+3*n	Reserved	BYTE	0x00	Reserved (set to zero)
6+3*n	Reserved	BYTE	0x00	Reserved (set to zero)
7+3*n	Reserved	BYTE	0x00	Reserved (set to zero)
8+3*n	Checksum	INTEGER	*checksum*	Checksum

Table 3-207 Bytes 4, 7, ... Station Options

Bit #	Meaning
0 (LSB)	User access to station: 0: No access 1: Access granted
1	User selected to receive RTCM from this station: 0: Not selected 1: Selected
2-7	Reserved (set to zero)

0x8F 0x82 Report Packet 0x8F 0x82
Decoder Diagnostic Information Report

Report Packet 0x8F 0x82 includes diagnostic information for evaluating the quality of the decoded data received from the service provider. This is a good indicator of whether there is currently data on the signal and whether the receiver is able to decode the signal well. The statistics are collected over a set data block size which can take 3-5 minutes to collect the data provided the receiver is configured to track the signal.

Table 3-208 Decoder Diagnostic Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x82	Decoder diagnostic information
1-4	Quality Figure	SINGLE	0-100%	Percentage of error-free data received in last data block For Racal, the maximum quality figure is about 97.7% due to way it is calculated. For Omnistar, the maximum quality figure is 100%. Low quality figures indicate that the data link is poor either due to low signal level or a noisy environment.
5-6	Tracking Errors	INTEGER	*ratio*	Number of times the decoder has lost synchronization with the incoming control blocks per 1000 block interval
7-8	Decoding Errors	INTEGER	*ratio*	Number of incorrectly decoded data blocks per 1000 block interval.
9-12	Age of Data	LONG	*seconds*	Age of diagnostic data. An age greater than 0 and less than 5 minutes indicates fresh, valid data.
13	Provider	BYTE	*flag*	Service provider name: 3 Racal 4 Omnistar 255 Unknown
14-16	Reserved	BYTE	0x00	Reserved (set to zero)
17-18	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x84 Report Packet 0x8F 0x84
Satellite FFT Control Acknowledgment

Report Packet 0x8F 0x84 acknowledges the start and stop of satellite FFT diagnostics.

Table 3-209 Satellite FFT Control Acknowledgment Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x84	Satellite FFT control
1-2	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x85 Report Packet 0x8F 0x85
DGPS Source Tracking Status Report

Report Packet 0x8F 0x85 is intended to replace Report Packet 0x8F 0x70. This packet is used to convey the DGPS tracking status for either beacon or satellite differential signals. Some fields have duplicate meanings depending on the mode (beacon or satellite). In satellite mode, the second channel of data (channel 1) is meaningless. Report Packet 0x8F 0x70 is still supported, but this is the preferred packet to use.

Table 3-210 DGPS Source Tracking Status Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x85	DGPS Tracking Status
1-2	Reserved	BYTE	0x00	Reserved (set to zero)
Begin Beacon Channel 0 or Satellite Channel Data Block				
3-10	Frequency	DOUBLE	Hz	Channel 0 frequency
11	Acquisition Mode	BYTE	*flag*	Channel 0 signal acquisition mode: 0 Manual mode 1 Auto Distance mode 2 Auto Power mode 4 Disabled 5 Satellite mode
12	Status	BYTE	*flag*	Channel 0 status: 0 Idle - channel is powered down 1 Wideband FFT search 2 Searching for signal 3 Channel acquired signal 4 Channel is locked on signal 5 Channel is disabled
13	RTCM Used Flag	BYTE	*flag*	Channel 0 RTCM Flag settings: 0 Channel 0 is not the source of RTCM differential corrections 1 Channel 0 is the source of RTCM differential corrections
14	SNR	BYTE	0x00-0xFF	Channel 0 signal to noise ratio ranging from 0-25.5 dB, in 0.1 dB units
15	Input Level	BYTE	0x00-0xFF	Beacon: Channel 0 electromagnetic field intensity level Satellite: ADC input voltage level Ranges from 0-127.5 dBuV/m in 0.5 dBuV/m units (decibels above one microvolt/meter) (0-255)

Table 3-210 DGPS Source Tracking Status Packet

Byte #	Item	Type	Value/Units	Meaning
16	Rate Index	BYTE	*flag*	Channel 0 data transfer rate: 0 25 bps 1 50 bps 2 100 bps 3 200 bps 4 600 bps 5 1200 bps 6 2400 bps 7 4800 bps
17	Lock Indicator	BYTE	0x00-0xFF	Channel 0 signal lock quality. Ratio of the samples collected at peak and trough. This lock indicator is scaled by 16 to improve resolution at low SNR values. Values range from 0-255 divided by 16
18-21	Carrier Offset	LONG	units of 0.1 Hz	Channel 0 frequency difference between transmitter and receiver oscillators. Values in 0.1 Hz units.
22	Time Since Last Synchronization	BYTE	0x00-0xFF	Channel 0 time since last synchronization in units of 0.1 seconds (0-255). A sync time less than 3 seconds is a good indicator that the receiver is correctly tracking a satellite differential signal. If the sync time is greater than 4 seconds, check for correct receiver configuration and verify good signal levels. (Satellite mode only)
23	Word Error Rate/ Time Since Last RTCM	BYTE	0x00-0xFF	Beacon: Number of RTCM word errors in last 255 words received on Channel 0 Satellite: time since last RTCM received in units of 0.1 seconds (0-255)
24	Health Status	BYTE	*bit pattern*	Bit pattern of Channel 0 health status (bits 0-2): 111 Reference station not working 110 Reference station transmission not monitored 101 Specified by service provider 100 Specified by service provider 011 Specified by service provider 010 Specified by service provider 001 Specified by service provider 000 Specified by service provider
25	DGPS Source Auto Switching	BYTE	*flag*	Channel 0 DGPS source auto-switching state: 0 Disabled 1 Enabled

Table 3-210 DGPS Source Tracking Status Packet

Byte #	Item	Type	Value/Units	Meaning
26	Satellite Unique Word Polarity	BYTE	*flag*	Channel 0 Satellite unique word polarity: 0 Positive 1 Negative
27-28	Satellite Service Identifier	INTEGER	identifier	Satellite DGPS service identifier 0x8E20Racal LandStar 0xC685OmniStar 0x2873OmniStar 0xFFFFUnknown
29-32	Reserved	BYTE	0x00	Reserved (set to zero)
Begin Beacon Channel 1 Data Block (invalid data for Satellite)				
33-40	Frequency	DOUBLE		Channel 1 frequency
41	Acquisition Mode	BYTE	*flag*	Channel 1 signal acquisition mode: 0 Manual mode 1 Auto Distance mode 2 Auto Power mode 4 Disabled 5 Satellite mode
42	Status	BYTE	*flag*	Channel 1 status: 0 Idle - channel is powered down 1 Wideband FFT search 2 Searching for signal 3 Channel acquired signal 4 Channel is locked on signal 5 Channel is disabled
43	RTCM Used Flag	BYTE	*flag*	Channel 1 RTCM Flag settings: 0 Channel 0 is not the source of RTCM differential corrections 1 Channel 0 is the source of RTCM differential corrections
44	SNR	BYTE	0x00-0xFF	Channel 1 signal to noise ratio ranging from 0-25.5 dB, in 0.1 dB units (0-255)
45	Input Level	BYTE	0x00-0xFF	Beacon: Channel 1 electromagnetic field intensity level (0-255) Satellite: ADC input voltage level (0-255) Ranges from 0-127.5 dBuV/m in 0.5 dBuV/m units (decibels above one microvolt/meter)

Table 3-210 DGPS Source Tracking Status Packet

Byte #	Item	Type	Value/Units	Meaning
46	Rate Index	BYTE	*flag*	Channel 1 data transfer rate: 0 25 bps 1 50 bps 2 100 bps 3 200 bps 4 600 bps 5 1200 bps 6 2400 bps 7 4800 bps
47	Lock Indicator	BYTE	0x00-0xFF	Channel 1 signal lock quality. Ratio of the samples collected at peak and trough. This lock indicator is scaled by 16 to improve resolution at low SNR values. Values range from 0-255 divided by 16
48-51	Carrier Offset	LONG	units of 0.1 Hz	Channel 1 frequency difference between transmitter and receiver oscillators. Values in 0.1 Hz units.
52	Time Since Last Synchronization	BYTE	0x00-0xFF	Channel 1 time since last synchronization in units of 0.1 seconds (0-255). A sync time less than 3 seconds is a good indicator that the receiver is correctly tracking a satellite differential signal. If the sync time is greater than 4 seconds, check for correct receiver configuration and verify good signal levels. (Satellite mode only)
53	Word Error Rate/ Time Since Last RTCM	BYTE	0x00-0xFF	Beacon: Number of RTCM word errors in last 255 words received on Channel 1 Satellite: time since last RTCM received in units of 0.1 seconds
54	Health Status	BYTE	*bit pattern*	Bit pattern of Channel 1 Health status (bits 0-2): 111 Reference station not working 110 Reference station transmission not monitored 101 Specified by service provider 100 Specified by service provider 011 Specified by service provider 010 Specified by service provider 001 Specified by service provider 000 Specified by service provider
55	DGPS Source Auto Switching	BYTE	*flag*	Channel 1 DGPS source auto-switching state: 0 Disabled 1 Enabled

Table 3-210 DGPS Source Tracking Status Packet

Byte #	Item	Type	Value/Units	Meaning
56	Satellite Unique Word Polarity	BYTE	*flag*	Channel 1 Satellite unique word polarity: 0 Positive 1 Negative
57-58	Satellite Service Identifier	INTEGER	0x8E20	Satellite DGPS service identifier 0x8E20Racal LandStar 0xC685OmniStar 0x2873OmniStar 0xFFFFUnknown
59-62	Reserved	BYTE	0x00	Reserved (set to zero)
63-64	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x86 Report Packet 0x8F 0x86 Clear Satellite Database Acknowledgment

Report Packet 0x8F 0x86 acknowledges receipt of Command Packet 0x8E 0x86 after clearing the Satellite Database.

Table 3-211 Clear Satellite Database Acknowledgment Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x86	Clear Satellite Database
17-18	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x87 Report Packet 0x8F 0x87
Network Statistics Report

Report Packet 0x8F 0x87 reports the VRS network statistics in response to Command Packet 0x8E 0x87.

Table 3-212 Network Statistics Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x87	Network Statistics
1	Channel	BYTE	*flag*	Network channel used to acquire corrections: 0 Satellite 1 External RTCM
2-3	Station ID	INTEGER	*ID*	Reference station identifier
4-7	Ionospheric Model Age	LONG	*age*	Age of Ionospheric model parameters
8	Satellite ID	BYTE	0x01-0x20	Satellite PRN (1-32)
9	IODE	BYTE	*IODE*	IODE
10	Ionospheric State	BYTE	*flag*	Ionospheric data validity (state): 0 Invalid Ionospheric data 2 Valid Ionospheric data
11-14	Network Model Age	LONG	*age*	Age of network model parameters
15-18	Network Correction Age	LONG	*age*	Age of network corrections
19-22	Reserved	BYTE	0x00	Reserved (set to zero)
23-24	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x88 Report Packet 0x8F 0x88
Diagnostic Output Options Report

Report Packet 0x8F 0x88 reports the Satellite Output options in response to Command Packet 0x8E 0x88.

Table 3-213 Satellite Output Options Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x88	Diagnostic Output Options
1	Port Number	BYTE	0x00-0x01	Serial port number (0-1)
2	I/O Options	BYTE	*flag*	Enable automatic output of Racal decoder diagnostics: bit 0 Enable automatic output of Racal LandStar decoder diagnostics bit 1 Enable automatic output of OmniStar decoder diagnostics
3-6	Reserved	BYTE	0x00	Reserved (set to zero)
7-8	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x89 Report Packet 0x8F 0x89
DGPS Source Control Report /Acknowledgment

Report Packet 0x8F 0x89 is used to both acknowledge that the DGPS source parameters have been changed and to report source parameters in response to a query.

Table 3-214 DGPS Source Control Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x89	DGPS Source Control Acknowledge
1-2	Checksum	INTEGER	*checksum*	Packet checksum

Table 3-215 DGPS Source Control Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x89	DGPS Source Control Report
1	DGPS Source Mode	BYTE	*flag*	Source mode for DGPS corrections: 0 Beacon differential only 1 Satellite differential only 2 Automatic switching between beacon and satellite DGPS sources (not recommended)
2	Beacon Acquisition Mode	BYTE	*flag*	Beacon signal acquisition mode: 0 Beacon Manual mode 1 Beacon Auto Distance mode 2 Beacon Auto Power mode 3 Beacon Auto-combination mode
3-4	Beacon Frequency 0	INTEGER	0.1 kHz	Channel 0 manual beacon frequency for manual beacon mode and DGPS source auto-switching mode (units of 0.1 kHz). Value 0 = unchanged
5-6	Beacon Frequency 1	INTEGER	0.1 kHz	Channel 1 manual beacon frequency for manual beacon mode and DGPS source auto-switching mode (units of 0.1 kHz). Value 0 = unchanged
7-8	Beacon RTCM Time-out	INTEGER	*seconds*	Time to wait for RTCM corrections before switching to Satellite in DGPS source auto-switching mode (seconds). Default is 30 seconds (value 0 = unchanged)
9-16	Satellite Frequency	DOUBLE	*hertz*	Satellite frequency for manual Satellite mode and DGPS source auto-switching mode (value 0 = unchanged)
17-20	Satellite Bit Rate	SINGLE	*baud*	Satellite bit rate (600, 1200, 2400 baud)
21-22	Satellite RTCM Time-out	INTEGER	*seconds*	Time to wait for RTCM corrections before switching to Beacon in DGPS source auto-switching mode (seconds). Default is 60 seconds (value 0 = unchanged)
23-26	Reserved	BYTE	0x00	Reserved (set to zero)
27-28	Checksum	INTEGER	*checksum*	Packet checksum

0x8F 0x8A Report Packet 0x8F 0x8A
Service Provider Information Report and Acknowledgment

Report Packet 0x8F 0x8A is used to both acknowledge that a service provider has been added and to report service provider information upon query with Command Packet 0x8E 0x8A.

Table 3-216 Service Provider Change Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8A	Service provider information
1-2	Checksum	INTEGER	*checksum*	Packet checksum

Table 3-217 Service Provider Information Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8A	Service provider information
1	Number of entries	BYTE		Number of service provider entries in packet
2	Total entries	BYTE		Total number of entries available
3-4	Reserved	BYTE	0x00	Reserved (set to zero)
For each service provider entry:				
5, 18, 31, ...	Service Provider	BYTE	*flag*	Service Provider Name: 3 Racal 4 Omnistar 255 Unknown Service (empty entry)
6-7, ...	Service Identifier	INTEGER		Service identifier for particular link 0x8E20 Racal LandStar service 0xC685 OmniStar service 0x2873 OmniStar service 0xFFFF Unknown service
8-9, ...	Scrambler 1 generator	INTEGER		Generator polynomial for first scrambler
10-11, ...	Scrambler 1 initial state	INTEGER		Initial state of first scrambler
12-13, ...	Scrambler 2 generator	INTEGER		Generator polynomial for second scrambler
14-15, ...	Scrambler 2 initial state	INTEGER		Initial state of second scrambler
16-17, ...	Reserved	INTEGER	0x00	Reserved (set to zero)
last 2 bytes	Checksum	INTEGER	*checksum*	Packet checksum

0x8F 0x8B Report Packet 0x8F 0x8B
Service Provider Activation Information Report and Acknowledgment

Report Packet 0x8F 0x8B is used to both acknowledge that the service provider activation has been modified and to report service provider activation information upon query with Command Packet 0x8E 0x8B. Both brief and extended information reports are available, and either can be queried with Command Packet 0x8E 0x8B.

Table 3-218 Service Provider Activation Change Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8B	Service provider activation
1	Provider	BYTE	0x04	Omnistar
2	Activation confirmation	BYTE	*flag*	Activation confirmation: 0 Activation failed 1 Activation succeeded 2 Duplicate activation sent. An activation code may only be entered once.
3	Reserved	BYTE	0x00	Reserved (set to zero)
4-5	Checksum	INTEGER	*checksum*	Packet checksum

Table 3-219 Service Provider Activation Brief Information Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8B	Service provider activation information
1	Service Provider	BYTE	0x04	OmniStar
2-25	ASCII Activation Code	BYTE	*code*	User activation code provided by OmniStar upon subscription
26	Activation Month	BYTE	0x01-0x0C	Month that current activation period began (1-12)
27	Activation Day	BYTE	0x01-0x1F	Day that current activation period began (1-31)
28	Activation Year	BYTE	*year minus 1900*	Year - 1900 that current activation period began
29	Deactivation Month	BYTE	0x01-0x0C	Month that current activation period ends (1-12)
30	Deactivation Day	BYTE	0x01-0x1F	Day that current activation period ends (1-31)
31	Deactivation Year	BYTE	*year minus 1900*	Year - 1900 that current activation period ends
32	Information Type	BYTE	0	Type of activation information: 0 Brief description (this packet) 1 Extended description
33-36	Elapsed Time Activation	SIGNED LONG INTEGER		Type of activation information: 0 No elapsed timer subscription. Use start/stop date subscription information. > 0 Elapsed time, in seconds, left on subscription before it expires.
37-39	Reserved	BYTE	0x00	Reserved (set to zero)
40-41	Checksum	INTEGER	*checksum*	Checksum

Table 3-220 Service Provider Activation Extended Information Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8B	Service provider activation information
1	Service Provider	BYTE	0x04	OmniStar
2-25	ASCII Activation Code	BYTE	*code*	User activation code provided by OmniStar upon subscription
26	Activation Month	BYTE	0x01-0x0C	Month that current activation period began (1-12)
27	Activation Day	BYTE	0x01-0x1F	Day that current activation period began (1-31)
28	Activation Year	BYTE	*year minus 1900*	Year - 1900 that current activation period began
29	Deactivation Month	BYTE	0x01-0x0C	Month that current activation period ends (1-12)
30	Deactivation Day	BYTE	0x01-0x1F	Day that current activation period ends (1-31)
31	Deactivation Year	BYTE	*year minus 1900*	Year - 1900 that current activation period ends
32	Information Type	BYTE	1	Type of activation information: 0 Brief description 1 Extended description (this packet)
33-36	Elapsed Time Activation	SIGNED LONG INTEGER		Type of activation information: 0 No elapsed timer subscription. Use start/stop date subscription information. > 0 Elapsed time, in seconds, left on subscription before it expires.
37	Service Type	BYTE		Type of correction service provided: 0 Virtual Base Station (VBS) 1 Virtual Reference Cell (VRC) 2 Single Station
38-39	Subscription Options	INTEGER	Table 3-221	Subscription Options
40-41	Single Station ID	INTEGER		If the service type is Single Station, the subscription is valid only for the single station described by this station ID (range 0-1023).
42-43	Accuracy Level	INTEGER	0-7	Level of DGPS correction accuracy provided by subscription (0 = high accuracy)
44-47	Satellite Links	LONG INTEGER		Bit array indicating which satellite links are authorized for this subscription
48-61	Reserved	BYTE	0x00	Reserved (set to zero)

Table 3-220 Service Provider Activation Extended Information Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
62	Number of subscription regions	BYTE		Number of subscription regions described below
For each circular subscription region, n, in byte 61:				
63-66, 77-80, etc.	Latitude	SINGLE	radians	Latitude of center of region
67-70, 81-84, etc.	Longitude	SINGLE	radians	Longitude of center of region
71-74, 85-88, etc.	Radius	SINGLE	meters	Radius of region. For VRC regions, the radius value has no meaning.
75, 89, etc.	Type of region	BYTE		Type of region: 1 Subscription includes area defined within region 2 Subscription excludes region 3 Region defines virtual reference cell area applicable if service type is VRC service.
76, 90, etc.	Reserved	BYTE	0	Reserved (set to zero)
63+ (14*n) thru 64 +(14*n)	Checksum	INTEGER	*checksum*	Checksum

Table 3-221 Subscription Options

Bit #	Meaning
0 (LSB)	Offshore operation: 0: No access 1: Access granted
1-7	Reserved (set to zero)

Note – This packet is only supported for OmniStar activation, and the activation date information is not available for OmniStar service. Only the deactivation date or elapsed timer activation should be used. If the elapsed timer value is zero, the activation is controlled by the deactivation date; if no valid deactivation date information is available, the deactivation year is set to 1980. Non-zero elapsed timer values indicate the subscription is controlled by the elapsed timer.

0x8F 0x8E Report Packet 0x8F 0x8E

Service Provider Data Load Report

Report Packet 0x8E 0x8E reports the downloaded service provider data (almanac and reference station lists) as requested by Command Packet 0x8E 0x8E. Since the amount of downloaded or uploaded data exceeds 114 bytes, the data is divided among several packets called pages. Even when all of the data bytes are DLEs (which transmits 2 TSIP bytes for each data bytes), the packet structure does not overflow the 255 byte TSIP buffer length.

The data structure of the packets is described in Table 3-222 and Table 3-223. Each page contains a maximum of 114 bytes, so multiple pages are generated until all of the data bytes are transmitted. All of the pages (packets) must be merged together to form one data block.

Table 3-222 Service Provider Data Download Report Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8E	Service Provider Data Load Command
1	Data Type	BYTE	0x02	Download data
2	Service Provider Type	BYTE		Service provider: 4 Omnistar
3-6	Version	SINGLE		Service provider version
7	Page Number	BYTE	*number*	Page number (number of 114 byte packet)
8	Transfer Complete	BYTE	*flag*	Flag setting determines if this is last page (packet) of data, signifying the end of transmission: 0 More pages left to transmit 1 Transfer complete
9	Byte Count	BYTE	1-114	Number of data bytes in packet, *n*
10-(10 + *n*)	Data	BYTE	0-255	Service provider upload data
(11 + *n*)-(12 + *n*)	Checksum	INTEGER	*checksum*	Checksum of bytes 0-124

Table 3-223 Service Provider Data Acknowledgment Packet

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8E	Service Provider Data Load Command
1	Data Type	BYTE	0x00	Data request
2	Service Provider Type	BYTE	0x04	Service provider: 4 Omnistar
3	Page Number	BYTE		Page number of data acknowledged
4	Load Result	BYTE		Result of data loading: 0 Load of this page failed 1 Load of this page succeeded
5	Reserved	BYTE	0x00	Reserved
6-7	Checksum	INTEGER	*checksum*	Checksum of bytes 0-5

0x8F 0x8F Report Packet 0x8F 0x8F
Receiver Identity Report

Report Packet 0x8F 0x8F is sent when the receiver is powered on and can be sent in response to Command Packet 0x8E 0x8F. The packet indicates the type of receiver and why the receiver restarted if an error caused the receiver to reset. If this packet is requested using Command Packet 0x8E 0x8F, the restart code may have been previously cleared (set to zero) after the receiver powered on, so only the Machine ID and Product ID are valid and the Restart Code is set to 0. Table 3-224 shows the data structure.

Table 3-224 Receiver Identity Request

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x8F	Receiver Identity Request
1	Machine ID	BYTE	*Machine ID*	Receiver Machine ID. See product-specific appendices for values.
2	Product ID	BYTE	*Product ID*	Receiver Product ID. See product-specific appendices for values.
3-6	Restart Code	BYTE	Table 3-225	Reasons for receiver reset
7-13	Reserved	BYTE	0x00	Reserved (set to zero)
14-15	Checksum	INTEGER	*checksum*	Checksum of byte 0-13

Table 3-225 Receiver Restart Codes (Bytes 3-6)

Value	Meaning
0	Normal power cycle occurred
0x20000001	Receiver reset after Omnistar activation code confirmation
0x20000002	Error in configuration block occurred and has been corrected
0x20000003	Receiver reset after Omnistar data upload
0x20000004	Receiver reset after CSI subscription updated
All others	An error occurred

0x8F 0x90 Report Packet 0x8F 0x90
Guidance Status Report

Report Packet 0x8F 0x90 may be sent in response to a query packet Command Packet 0x8E 0x90 or it may be automatically output if configured for auto-output with Command Packet 0x8E 0x91. This packet contains the current state of guidance operation.

Table 3-226 Guidance Status Information

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x90	Guidance status report
1	Enabled	BYTE	*flag*	Guidance operation 0 Off 1 On
2-9	Time tag	DOUBLE	*seconds*	Time of validity of guidance data. Zero if no guidance available.
10-11	GPS status	BYTE	Table 3-227	GPS error status indicators that would preclude guidance operation
12	Baseline status	BYTE	Table 3-228	Baseline validity information required for guidance operation
13-14	Current swath	SIGNED INTEGER	*flag*	Current swath used to compute cross-track error. 0 A-B Line < 0 Swaths right of A-B line > 0 Swaths left of A-B line Curved guidance swaths are all positive (no baseline defines left and right)
15	Turn direction	BYTE	*flag*	Turn direction relative to AB line 0 Left 1 Right 2 Auto detect

Table 3-226 Guidance Status Information (Continued)

Byte #	Item	Type	Value/Units	Meaning
16	Proximity	BYTE		Indicator LED state. See Figure 3-1 for illustration of indicator LED when using headlands, And PAUSE discussion in manual for description of indicator LED coloring when guidance is paused. The indicator LED will glow red when GPS conditions are invalid, and when user data are needed (e.g., point A or B). These states are not reflected by the proximity byte. 0 Off 1 Far (Red) 2 Near (Orange) 3 On (Green) **Note –** See Table 3-229 for information about these proximity states relative to different headland types.
17-20	Ground speed	SINGLE	*meters/ second*	GPS-derived ground speed
21-24	True heading	SINGLE	*radians*	GPS-derived true heading
25-28	Cross-track error	SINGLE	*meters*	Perpendicular distance between current position and current swath < 0 Current position is right of current swath > 0 Current position is left of current swath
29-32	Predicted cross-track error	SINGLE	*meters*	Perpendicular distance between the current swath and the predicted position after time specified by look-ahead value < 0 Predicted position is right of current swath > 0 Predicted position is left of current swath
33-36	Heading error	SINGLE	*radians, -pi/ 2 to pi/2*	Directional error between current heading and direction of current swath
37-40	SOL Distance	SINGLE	*meters*	Distance from start of current swath to current position
41-44	EOL Distance	SINGLE	*meters*	Distance to end of current swath from current position
	Curve Turn Signal Angle		*radians*	When Curve follow or Spiral pattern is set, this is the heading error used to drive turn signal LEDs and text arrows. **Note –** EOL distance does not apply to curved guidance, so the EOL bytes are used.

Table 3-226 Guidance Status Information (Continued)

Byte #	Item	Type	Value/Units	Meaning
45-48	Pause Distance	SINGLE	*meters*	Distance to pause point from current position.
49-52	Local plane heading	SINGLE	*radians, -pi to pi*	Vehicle heading relative to the guidance plane defined by the A-B line
53-58	Reserved	BYTE	0	Reserved
59-60	Checksum	INTEGER	*checksum*	Checksum

Table 3-227 GPS Error Status Flags

Bit #	Meaning
0 (LSB)	GPS Position Fix Available: 0: Fix available 1: No fix available
1	Searching for satellites (prior to computing a fix): 0: Satellites avail. 1: Currently searching for satellites
2	Age of fix: 0: Fix is recent 1: Fix is old
3	Differential GPS Position Fix Available: 0: Differential fix 1: Fix is autonomous
4	3D GPS Position Fix Available: 0: 3D fix available 1: 2D fix available
5-14	Reserved (set to zero)
15	Guidance Option Availability: 0: Available 1: Not Installed

Table 3-228 Baseline Status Flags

Bit #	Meaning
0 (LSB)	Point A Validity: 0: No valid point 1: Have valid point A
1	Point B Validity: 0: No valid point 1: Have valid point B
2	Point C Validity: 0: No valid point 1: Have valid point C
3	Pause Guidance: 0: Guidance active 1: Guidance is paused
4-7	Reserved (set to zero)

Table 3-229 Headland Types and Proximity Indicators (State of indicator LED when guidance paused also indicated here)

Indicator Type	None	Curved Headland (see Figure 3-2)	Closed Circuit (see Figure 3-3)	A-B End zones (see Figure 3-1)
Red	Not Applicable	Less than 1/2 swath width from headland boundary.	Outside field defined by closed headland boundary	Outside field defined by extending the A-B line sideways
Orange	Not Applicable	Between 1/2 and 1 swath width from headland boundary.	Not Applicable	Not Applicable
Green	Not Applicable	Further than 1 swath width from headland boundary.	Inside field defined by closed headland.	Between lines perpendicular to A-B line, extending from A and B less *proximity distance.*

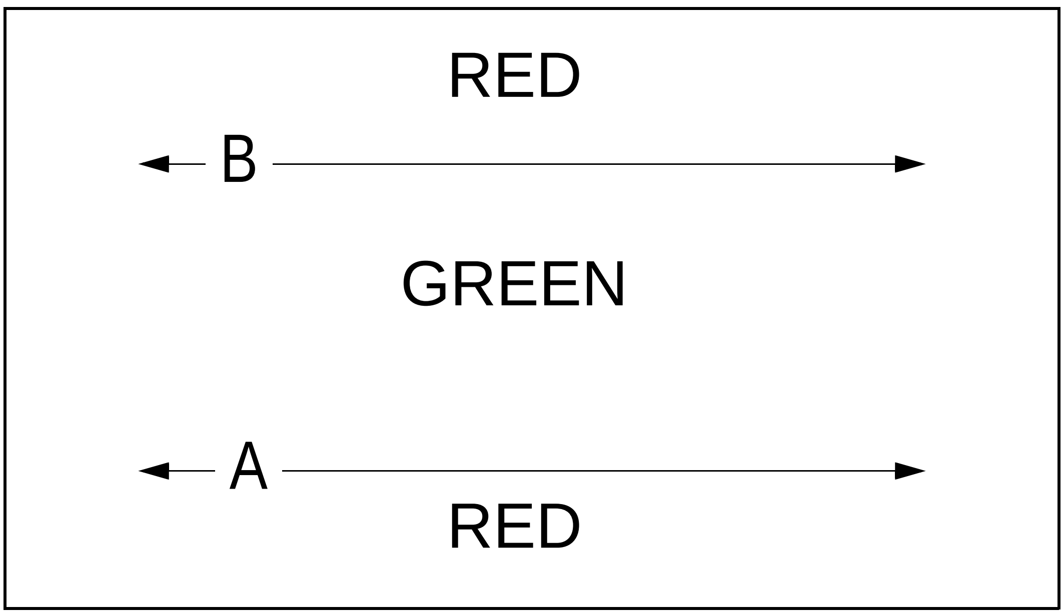


Figure 3-1 Proximity Indicator for A-B Endzone Headland

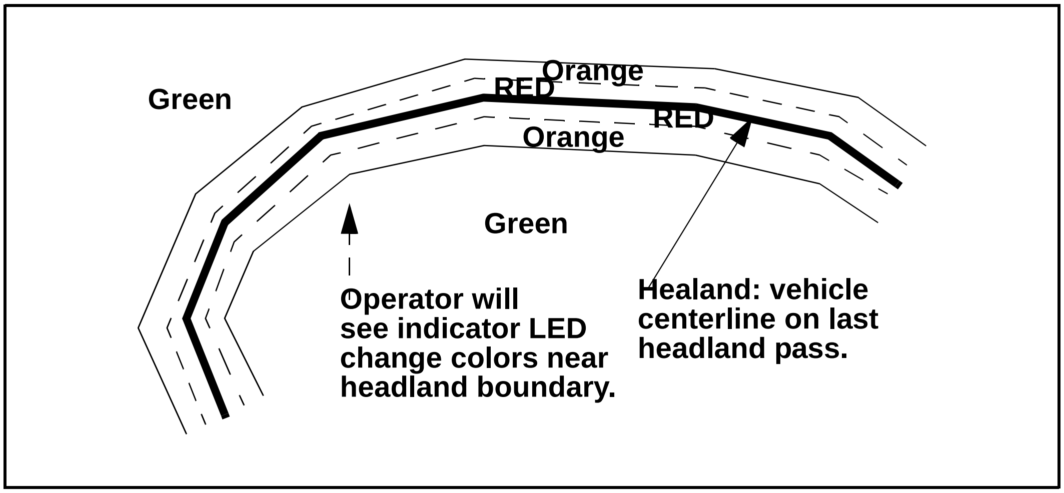


Figure 3-2 Proximity Indicator for Curved Headland

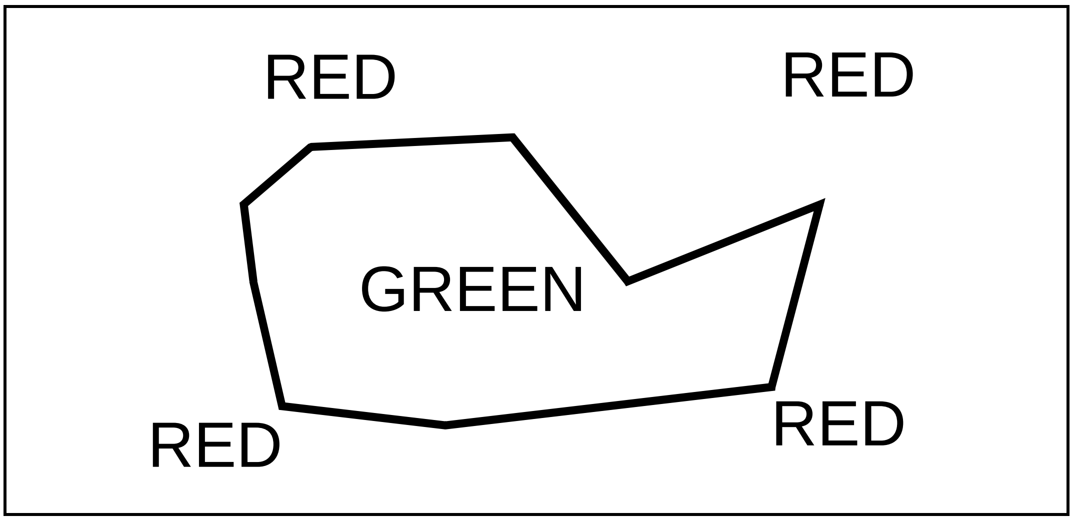


Figure 3-3 Proximity Indicator for Closed Circuit Headland

0x8F 0x91 Report Packet 0x8F 0x91
Guidance Configuration Report

Report Packet 0x8F 0x91 reports information about the current guidance configuration in response to Command Packet 0x8E 0x91. Table 3-230 describes the format of this packet. For more information, see Command Packet 0x8E 0x91 on page 2-113.

Table 3-230 Guidance Configuration Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x91	Guidance configuration report
1	Units	BYTE	*flag*	Specifies what units will be used for the lightbar text display and lightbar LEDs 0 Metric 1 English
2	Display Mode	BYTE	*flag*	Determines in which direction the lightbar LEDs light and arrow indicators point to indicate error. 0 Show Correction - configures the LEDs to light in the direction to steer. Set this to follow the LEDs. 1 Show Error - configures the LEDs to reflect the error with respect to the current swath. Set this to "pull" the LEDs.
3	Boundary Mode	BYTE	Table 2-207	Boundary mode determines what kind of boundary will be specified with the headland points. Headland points are used to describe the field edges so that the receiver can provide an indicator of where the vehicle is relative to the field edges.
4	Pattern Mode	BYTE	Table 2-210	Guidance pattern to use
5-6	Look Ahead	INTEGER	*seconds*	Allows the system to predict future error. This accounts for system delays, including operator response time. The recommended setting is 2 seconds.

Table 3-230 Guidance Configuration Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
7	Swath Direction	BYTE	*flag*	The swath direction setting determines whether the swaths are generated to the left or right of the A-B line. A setting of *Auto Detect* establishes swaths in the direction turned after the first swath. When *Automatic Turn Detection* is configured, swaths automatically increment when the equipment turns approximately 110° with respect to the active swath. Note: manually incrementing or otherwise changing the current swath number temporarily overrides *Automatic Turn Detection* and *Snap to Swath*. See Command Packet 0x8E 0x91 for more information 0 Left 1 Right 2 Automatic turn detection 3 Snap to closest swath
8-11	Swath Width	SINGLE	*meters*	The swath width parameter is set according to the width of the applicator or spray boom, where the total width is measured from one end of the boom to the other. Note: When calculating coverage area, half the configured width is added.
12-15	Antenna Offset	SINGLE	*meters*	Antenna position offset fore or aft of the applicator boom > 0 The antenna is ahead of the boom < 0 The antenna is behind the boom
16-19	Guidance Output Rate	LONG	*msecs*	The output rate controls how often the guidance status packet is sent. The output rate is selectable in 200 msec increments up to integer seconds (1000 msecs). A value of 0 turns automatic output off.
20-22	Number of Swaths to Skip	INTEGER	*swaths*	Number of swaths to skip when using Skip 'N' pattern. Unused when pattern is not Skip N. 0 to 999 is valid range.
22-34	Reserved	BYTE	0	Reserved
35-36	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x92 Report Packet 0x8F 0x92
Lightbar Configuration Report

This packet reports the current lightbar configuration and is sent in response to Command Packet 0x8E 0x92. For more information about the contents of this packet, see Command Packet 0x8E 0x92.

Table 3-231 Lightbar Configuration Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x92	Lightbar configuration report
1	Lightbar Mounting	BYTE	*flag*	Specifies how lightbar is mounted 0 Dash mounted (upright mounting) 1 Ceiling mounted (inverts lightbar text)
2	Lightbar Intensity	BYTE	1-5	Determines the LED brightness and text base on a scale of 1 to 5.
3	Lightbar Text Type	BYTE	*flag*	Specifies what kind of information will be provided on the small text display below the LEDs on the lightbar. 0 No text 1 Swath # and predicted cross-track error 2 GPS status information 3 Current swath number 4 Distance from start of current swath 5 Distance to end of current swath 6 GPS-derived true heading 7 Predicted cross-track error 8 Directional error between current heading and direction of A-B line 9 Ground speed 10 Current swath number and ground speed 11 Lightbar demo text 12 Turn signal arrows for curved guidance 13 Number of points logged on a curved swath. **Note –** Setting the text type to Demo Text will put the lightbar into a demo mode where the lightbar continually cycles through its initialization lightshow. This is primarily intended as an eye-catcher for trade shows.

Table 3-231 Lightbar Configuration Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
4	LED Spacing Mode	BYTE	*flag*	This setting configures the lightbar for linear or scaled display 0 Linear display - allows an LED interval to be specified, and spaces each of the 17 LEDs to either side of center by this distance. 1 Scaled display - allows specification of an LED interval and a distance which the end LED represents.
5-8	Lightbar LED Interval	SINGLE	*meters*	If linear spacing is selected, the interval is used as the interval represented by each LED. If scaled spacing is selected, the interval represents the LED spacing at the center of the lightbar.
9-12	Lightbar LED End Interval			If scaled spacing is selected, the end interval represents the LED spacing at the far ends of the lightbar.
13-16	Proximity Indicator Sensitivity	SINGLE	*meters*	The indicator LED sensitivity defines the sensitivity of the lightbar's large, center LED. This setting determines how near a PAUSE point a vehicle must be before turning ORANGE and GREEN.
17	Event Option	BYTE	*bitmask, see Table 3-232*	Lightbar event output designed to sound alarm.
18-21	Cross-Track-Error Alarm Tolerance	SINGLE	*meters*	Applies when event option 0x08 is active. Lightbar event outpu continuously active when cross-track-error exceeds this value.
22-29	Reserved	BYTE	0	Reserved
30-31	Checksum	INTEGER	*checksum*	Checksum

Table 3-232 Lightbar Event Options

Bit #	Meaning
0 (LSB)	When swath number changes: 0: No event 1: Short beep
1	When crossing field boundary (boundaries defined by RED zone for indicator LED. See Figure 3-1, Figure 3-2, Figure 3-3): 0: No event 1: Long beep
2	When inside field (GREEN and ORANGE zones): 0: No event 1: Continuous output
3	When cross-track error exceeds cross-track-error alarm tolerance: 0: No event 1: Continuous output
4	When switch pressed: 0: No event 1: Beep
5-7	Reserved (set to zero)

0x8F 0x94 Report Packet 0x8F 0x94
Guidance Operation Acknowledgment

This packet acknowledges guidance actions taken via Command Packet 0x8E 0x94.

Table 3-233 Guidance Operation Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x94	Acknowledge guidance operation
1	Operation	BYTE	*flag*	Type of operation 0 Set point A 1 Set point B 2 Set point C 3 Increment swath number 4 Decrement swath number 5 Pause guidance 6 Resume guidance 7 Jump to a specific swath number 8 Reset guidance
2	Operation Status	BYTE	*flag*	Operation status: 0 Operation failed; check guidance and GPS status 1 Operation successful
3	Guidance Status	BYTE	*flag*	Guidance validity information required for operation 0 Status valid 1 Status unknown 2 Guidance off 3 Need point A 4 Need point B 5 Need point C 6 Guidance paused 7 Cannot resume without pause first 255 Guidance option not installed
4-5	GPS status	BYTE	Table 3-227	GPS error status indicators that would preclude guidance operation (0=valid)
6-9	Reserved	BYTE	0	Reserved
10-11	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x95 Report Packet 0x8F 0x95
Button Box Configuration Type Report

This packet reports the type of button box configuration currently in use in response to Command Packet 0x8E 0x95. See Command Packet 0x8E 0x95 for more information.

Table 3-234 Button Box Configuration Type Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x95	Button box configuration type report
1	Button Configuration Type	BYTE	*flag*	Buttons configured according to: 0 Default button box definitions 1 Default external switch definitions 2 Custom button configuration 3 Button configuration cleared
2-6	Reserved	BYTE	0	Reserved
7-8	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x96 Report Packet 0x8F 0x96
Point Manipulation Report

To acknowledge the capture, deletion or clearing of headland points and area points via Command Packet 0x8E 0x96, the packet described in Table 3-235 is sent.

Table 3-235 Point Manipulation Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x96	Point manipulation report
1	Operation	BYTE	*flag*	Point operation: 0 Capture of current position 1 Delete last point of type specified 2 Delete all points of type specified 3 Capture of provided position
2	Point Type	BYTE	*flag*	Type of point 0 Headlands point 1 Area point
3	Operation Status	BYTE	*flag*	Operation status: 0 Operation failed; check GPS status 1 Operation succeeded
4-5	GPS Status	BYTE	Table 3-227	GPS error status indicators that would preclude point operation
6-9	Reserved	BYTE	0	Reserved
10-11	Checksum	INTEGER	*checksum*	Checksum

To report how many points of a particular type have been stored, the packet format described in Table 3-236 is sent.

Table 3-236 Point Quantity Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x96	Point manipulation report
1	Operation	BYTE	*flag*	Point operation: 4 Report number of points.
2	Point Type	BYTE	*flag*	Type of point 0 Headlands point 1 Area point
3-4	Number of Points	INTEGER	*points*	Number of points of type "Point Type"
5-8	Reserved	BYTE	0	Reserved
9-10	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x97 Report Packet 0x8F 0x97 Utility Information Report

This packet reports various utility information including the current area and the coverage area determined from the area points in response to Command Packet 0x8E 0x97.

Table 3-237 Utility Information Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x97	Utility information report
1	Data Type	BYTE	*flag*	Information type in bytes 2-9: 0 Area within points 1 Adjusted area (includes area flaps for boom width). 2 Path length (connect area points) 3 Perimeter (path length closed back to first area point). 4 Length of last segment: distance between last two points in area-point vector
2-3	Number of Points	INTEGER	*points*	Number of points used in area, path length, and perimeter calculations
4-11	Information	DOUBLE	*meters*^{2} or *meters*	See above data types.
12-19	Reserved	BYTE	0	Reserved
20-21	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x98 Report Packet 0x8F 0x98
Individual Button Configuration Report

The individual button configuration packet is used to report the configuration for each button on the button box as shown in Table 3-238. These button configurations may represent a preset factory configuration or a user-defined configuration. Report Packet 0x8F 0x95 may be requested to determine if a factory set or user-defined set is being used.

Table 3-238 Individual Button Configuration Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x98	Individual button configuration report
1	Number of buttons	BYTE	*buttons*	Number of buttons described in this report
2-6	Reserved	BYTE	0	Reserved
For each button, n, specified in byte 1				
7, 10, 13, etc.	Button	SIGNED BYTE	-6 thru 6, excluding 0	Button number according to Trimble cable pin out. Negative numbers indicate the shift key is pressed before this button, i.e -5 indicates the button combination Shift 5.
8, 11, 14, etc.	Operation	BYTE	Table 2-221	When button is pressed, this operation occurs.
9, 12, 15, etc.	Reserved	BYTE	0	Reserved
(7 + 3*n) - (8+ 3*n)	Checksum	INTEGER	*checksum*	Checksum

0x8F 0x9A Report Packet 0x8F 0x9A
Differential Correction Information Report

Report Packet 0x8F 0x9A is sent in response to a query packet Command Packet 0x8E 0x9A. This packet contains information about the last differential correction set that was received and used by the receiver..

Table 3-239 Differential Correction Information Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x9A	Differential Correction Information Report
1-2	Data Source	INTEGER	*flag*	Source of corrections: 0 Beacon Channel 0 1 Beacon Channel 1 2 External RTCM 3 Racal LandStar satellite service 4 OmniSTAR satellite service
3-4	Station ID	SIGNED INTEGER	*0–1023*	Reference station identifier from RTCM message header
5-12	Age	DOUBLE	*seconds*	Age of last corrections received and used
13	Partial Flag	BYTE	*flag*	Partial Flag: 0 Not partial correction set (i.e. Type 1’s) 1 Partial correction set (i.e. Type 9’s)
14-22	Reserved	BYTE	0	Reserved
23-24	Checksum	INTEGER	*checksum*	Checksum

0xB0 Report Packet 0xB0
PPS and Event Report Packets

Report Packet 0xB0 subpackets are sent in response to Command Packet 0xB0 subpackets.

0xB0 0x80 Report Packet 0xB0 0x80
PPS Signal Configuration Report

Report Packet 0xB0 0x80 contains the configuration parameter settings for a specified PPS Number (PPS signal). The report packet is sent in response to Command Packet 0xB0 0x00. The remote device can send an abbreviated form of Command Packet 0xB0 0x00 to request the report, and the report packet is automatically sent when the remote device uses Command Packet 0xB0 0x00 to configure parameter settings for a specified PPS Number.

Table 3-240 PPS Signal Configuration Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x80	PPS Signal Configuration Report
1	PPS Number	BYTE	0x01	Currently supports the output of one PPS signal (PPS Number = 1).
2	Enable Flag	BYTE	*flag*	Identifies the current state of the specified PPS signal (PPS Number): 0 Disabled 1 Enabled
3	PPS Timebase	BYTE	*flag*	Identifies the timebase used for outputting the specified PPS signal (PPS Number): 0 GPS time 1 UTC (Universal Time Coordinated) 2 Receiver’s internal clock (user-defined)
4	PPS Polarity	BYTE	*flag*	Identifies the polarity of the specified PPS signal (PPS Number) The PPS polarity only refers to a negative or positive PPS pulse. There is no interrupt associated with the signal—the leading edge of the PPS pulse is not affected by the polarity setting: 0 Negative 1 Positive
5	Auto Generate Reports	BYTE	*flag*	Identifies whether or not Report Packet 0xB0 0x82 is automatically generated for the PPS signal (PPS Number) and sent to the remote device: 0 Disabled 1 Enabled

Table 3-240 PPS Signal Configuration Report (Continued)

Byte #	Item	Type	Value/Units	Meaning
6-9	Reserved	BYTE	0x00	Reserved (set to zero)
10-17	Period	DOUBLE	1.0 Hz	Identifies the PPS signal output frequency rate for the specified PPS Number. The receiver currently supports a 1 Hz PPS (pulse per second) output signal rate.
18-25	Offset	DOUBLE	*seconds*	Identifies the PPS output signal offset in seconds for the specified PPS Number. For example, a you can offset the PPS output signal to account for a 100 nsec delay attributed to a GPS antenna cable run. A positive value causes the signal to occur later and a negative value causes the signal to occur sooner
26-29	Max UNC Threshold	SINGLE	*seconds*	Maximum allowable clock uncertainty threshold, in seconds, for the specified PPS Number. If the Maximum UNC Threshold is set to a large value (e.g. 1 second), the GPS receiver continues to produce a PPS signal even when a position fix is not available (satellites are not tracked). If the Maximum UNC Threshold is set to a small value (e.g. 1 msec, the PPS signal is disabled a few seconds after a position is no longer available (satellites are no longer tracked). The PPS signal drifts when a position fix is not available and snaps back to the correct position once a position fix becomes available again.
30-31	Checksum	INTEGER	*checksum*	Checksum

0xB0 0x81 Report Packet 0xB0 0x81
PPS Signal Enable/Disable Acknowledgment

Report Packet 0xB0 0x81 is returned to acknowledge completion of the request to enable or disable a specified PPS signal (PPS Number) sent in Command Packet 0xB0 0x01. For more information, see Command Packet 0xB0 0x01 on page 2-132.

Table 3-241 PPS Signal Enable/Disable Acknowledgment

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x81	PPS Signal Enable/Disable Acknowledgment
1	PPS Number	BYTE	0x01	Identifies the number assigned to the PPS signal. The receiver currently supports the output of one PPS signal (PPS Number 1).
2	Enable Flag	BYTE	*flag*	Identifies the current enable/disable state of the specified PPS signal (PPS Number): 0 Disabled 1 Enabled
3-4	Checksum	INTEGER	*checksum*	Checksum of bytes 0-2

0xB0 0x82 Report Packet 0xB0 0x82
PPS Signal Auto-Generated Report

Report Packet 0xB0 0x82 is automatically generated for a specific PPS Number (PPS signal) if the Auto Generated Reports parameter (byte 5 of Command Packet 0xB0 0x00) is set to 1. Each report packet contains information about the preceding PPS signal output for the specified PPS Number.

If the serial port is unloaded, the report packet is typically generated and sent to the remote device 10 milliseconds after the PPS signal is sent.

The Time value of the specified PPS signal (PPS Number) is based on the selected PPS Timebase, PPS Polarity and PPS Offset parameter values.

Table 3-242 PPS Signal Auto-Generated Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0x82	PPS Signal Auto-Generated Report
1	PPS Number	BYTE	0x01	Identifies the number assigned to the PPS signal. The receiver currently supports the output of one PPS signal (PPS Number 1).
2	PPS Timebase	BYTE	*flag*	Identifies the timebase used for outputting the specified PPS signal (PPS Number): 0 GPS time 1 UTC (Universal Time Coordinated) 2 User-defined timebase
3	Reserved	BYTE	0x00	Reserved (set to zero)
4-11	Time	DOUBLE	*seconds*	GPS or UTC time of the week when the PPS event took place
12-15	Max UNC	SINGLE	*seconds*	Clock uncertainty at pulse time, in seconds, for the specified PPS Number
16-17	Checksum	INTEGER	*checksum*	Checksum

0xB0 0xC0 Report Packet 0xB0 0xC0
Event Timestamp Selection Report

Report Packet 0xB0 0xC0 contains the timestamp configuration settings for timestamping of event inputs. The report packet is sent in response to Command Packet 0xB0 0x40. The remote device can send an abbreviated form of Command Packet 0xB0 0x40 to request the report, and the report packet is automatically sent when the remote device uses Command Packet 0xB0 0x40 to configure parameter settings for a specified event.

Table 3-243 Event Timestamp Selection Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0xC0	Event Timestamp Selection Report
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Slope	BYTE		Event input configuration: 0 Disabled 1 Enabled. Timestamp positive edge 2 Enabled. Timestamp negative edge

0xB0 0xC1 Report Packet 0xB0 0xC1
Event Packet Options Report

Report Packet 0xB0 0xC1 contains the output packet configuration settings for event inputs. The report packet is sent in response to Command Packet 0xB0 0x41. The remote device can send an abbreviated form of Command Packet 0xB0 0x41 to request the report, and the report packet is automatically sent when the remote device uses Command Packet 0xB0 0x41 to configure output options for a specified event.

Table 3-244 Event Packet Options Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0xC1	Event Timestamp Options Report
1	Event selected	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Options 1	BYTE	Table 3-245	Output options 1
3	Options 2	BYTE	Table 3-246	Output options 2
4	Options 3	BYTE	Table 3-247	Output options 3

Table 3-245 Byte 2 Output options 1

Bit #	Meaning
0 (LSB)	Automatic output of event plus position packet XX-XX upon event reception 0: Disabled 1: Enabled
1	Automatic output of event only packet XX-XX upon event reception 0: Disabled 1: Enabled
2-7	Reserved (set to zero)

Table 3-246 Byte 3 Output options 2

Bit #	Meaning
0-7	Reserved (set to zero)

Table 3-247 Byte 4 Output options 3

Bit #	Meaning
0-7	Reserved (set to zero)

0xB0 0xC2 Report Packet 0xB0 0xC2
Event Plus Position Report

Report Packet 0xB0 0xC2 contains the timestamp and position information output when an event is received. The report packet is automatically output if Byte 2, bit 0 is set in Command Packet 0xB0 0x41, or it may be output in response to Command Packet 0xB0 0x42.

Table 3-248 Event Timestamp Selection Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0xC2	Event Plus Position Report
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Flag 1	BYTE	Table 3-249	Time type and status
3	Flag 2	BYTE	Table 3-250	Position type and status
4-5	Count	INTEGER		Event count since reset
6-13	Time	DOUBLE	*seconds*	Event time (seconds from beginning of week)
14-21	X or Lat	DOUBLE	*radians*	Latitude in radians, ECEF X in meters
22-29	Y or Lon	DOUBLE	*radians*	Longitude in radians, ECEF Y in meters
30-37	Z or Alt	DOUBLE	*meters*	Altitude in meters, ECEF Z in meters
38-39	Checksum	INTEGER	*checksum*	Checksum

Table 3-249 Byte 2 Time Type and Status Options

Bit #	Meaning
0 (LSB)	Time tag: 0: GPS 1: UTC
1	Accurate GPS time: 0: Available 1: Not available
2	UTC offset information: 0: Valid 1: Not current or don't yet have time from a satellite to verify. Use Command Packet 0x2F to request present UTC parameters for applicability
3-7	Reserved (set to zero)

Table 3-250 Byte 3 Position Type and Status Options

Bit #	Meaning
0-1	Position reference frame: 0: ECEF XYZ 1: LLA HAE 2: LLA MSL 3: Not used
2	Position quality: 0: Good 1: Sub-optimal
3	Position availability: 0: Available 1: Not available
4-7	Reserved (set to zero)

0xB0 0xC3 Report Packet 0xB0 0xC3
Event Only Report

Report Packet 0xB0 0xC3 contains the timestamp information output when an event is received. The report packet is automatically output if Byte 2, bit 1 is set in Command Packet 0xB0 0x41, or it may be output in response to Command Packet 0xB0 0x43.

Table 3-251 Event Timestamp Selection Report

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0xC3	Event Only Report
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Flag 1	BYTE	Table 3-252	Time type and status
3-4	Count	INTEGER	*counter*	Event count since reset
5-12	Time	DOUBLE	*seconds*	Event time (seconds from beginning of week)
13-14	Checksum	INTEGER	*checksum*	Checksum

Table 3-252 Byte 2 Time Type and Status Options

Bit #	Meaning
0 (LSB)	Time tag: 0: GPS 1: UTC
1	Accurate GPS time: 0: Available 1: Not available
2	UTC offset information: 0: Valid 1: Not current or don’t yet have time from a satellite to verify. Use Command Packet 0x2F to request present UTC parameters for applicability
3-7	Reserved (set to zero)

0xB0 0xC4 Report Packet 0xB0 0xC4
Event Marker Miscellaneous Action Taken

Report Packet 0xB0 0xC4 is used to acknowledge that an event marker action was taken as commanded in Report Packet 0xB0 0xC4.Table 3-253 shows the structure of Report Packet 0xB0 0xC4.

Table 3-253 Event Marker Miscellaneous Action Taken

Byte #	Item	Type	Value/Units	Meaning
0	Subpacket ID	BYTE	0xC4	Event marker action taken
1	Select	BYTE	*1-n*	Event selection, depends on number of events supported by receiver.
2	Action complete	BYTE	*flag*	Action taken: 0: Event forced 1: Event count reset to zero

0xBB Report Packet 0xBB
Receiver Configuration Parameters Reports

Command Packet 0xBB sets or displays the receiver configuration parameters.

0xBB 0x00 Report Packet 0xBB 0x00
Primary Receiver Configuration Parameters Report

Report Packet 0xBB 0x00 contains the primary receiver configuration parameters that a user usually needs to modify, sent in response to Command Packet 0xBB 0x00.

Table 3-254 Primary Receiver Configuration Block

Byte #	Item	Type	Value/Units	Meaning
0	Subcode	BYTE	0x00	Primary Receiver Configuration Block
1	Operating Dimension	BYTE	*flag*	Operation dimension: 0 Automatic 1 Time Only (1 SV) 3 Horizontal (2) 4 Full Position (3D) 5 DGPS Reference 6 2D Clock Hold 7 Overdetermined Clock
2	DGPS Mode	BYTE	*flag*	Differential GPS mode: 0 DGPS Off 1 DGPS Only 3 DGPS Auto
3	Dynamics Code	BYTE	*flag*	Vehicle dynamics code: 1 Land 2 Sea 3 Air 4 Stationary
4	Solution Mode	BYTE	*flag*	Overdetermined mode used to compute position solution: 1 Overdetermined fix 2 Weighted overdetermined fix
5-8	Elevation Mask	SINGLE	0-PI/2	Lowest satellite elevation for fixes (radians)
9-12	AMU Mask	SINGLE	*AMUs*	Minimum signal level for fixes
13-16	PDOP Mask	SINGLE	*PDOP*	Reports the maximum PDOP for calculating position fixes
17-20	PDOP Switch	SINGLE	*PDOP*	Influences whether the receiver will calculate a 2D or 3D fix depending on the PDOP. If 4 or more satellites are available and the resulting PDOP is less than the PDOP Switch value, then 3D fixes are calculated. The PDOP Switch is used only in automatic 2D/3D mode.

Table 3-254 Primary Receiver Configuration Block (Continued)

Byte #	Item	Type	Value/Units	Meaning
21	DGPS Age Limit	BYTE	*seconds*	Maximum time to use a DGPS correction, in seconds
22	Foliage Mode	BYTE	*flag*	Foliage mode: 0 Never 1 Sometimes 2 Always
23	Low Power Mode	BYTE	*flag*	Low power mode: 0 Disabled 1 Auto
24	Clock Hold Mode	BYTE	*flag*	Clock Hold mode: 0 Off 1 On
25	Measurement Rate	BYTE	*flag*	Measurement rate: 0 1 Hz 1 5 Hz 2 10 Hz
26	Position Fix Rate	BYTE	*flag*	Position Fix rate: 0 1 Hz 1 5 Hz 2 10 Hz 3 Position at measurement rate
27-39	Reserved	BYTE	-1	Reserved for future use

0xBC Report Packet 0xBC
Serial Port Configuration Parameters Report

Report Packet 0xBC reports the serial port configuration parameters, in response to a request sent in Command Packet 0xBC. The data format is shown in Table 3-255.

The operation type is used to specify special protocol operation such as reference station output. For example, if the receiver protocol is set to reference station mode and TSIP is active on a port, then only DGPS corrections packets 0x60 and 0x61 will be output on that port.

Table 3-255 Set Serial Port Configuration Parameters

Byte #	Item	Type	Value/Units	Meaning
0	Port #	BYTE	*flag*	Number of receiver's serial port: 0 Port 0 1 Port 1 2 Port 2 3 Port 3 255 Current port **Note –** See product-specific appendices for more information on port naming conventions.
1	Input Baud Rate	BYTE	*flag*	Throughput of data input through serial port, in bits per second: 0 None 1 110 baud 2 300 baud 3 600 baud 4 1200 baud 5 2400 baud 6 4800 baud 7 9600 baud 8 19200 baud 9 38400 baud
2	Output Baud Rate	BYTE	*flag*	Throughput of data output through serial port, in bits per second. Same options as Input Baud Rate.
3	# Data Bits	BYTE	*flag*	Number of data bits transmitted: 0 5 bits 1 6 bits 2 7 bits 3 8 bits
4	Parity	BYTE	*flag*	Parity of transmitted data: 0 None 1 Odd 2 Even

Table 3-255 Set Serial Port Configuration Parameters (Continued)

Byte #	Item	Type	Value/Units	Meaning
5	# Stop Bits	BYTE	*flag*	Number of stop bits in transmitted data: 0 1 bit for 6-8 data bits/1.5 bits for 5 data bits 1 2 bits
6	Flow Control	BYTE	Table 3-256	Method of flow control negotiation
7	Input Protocols	BYTE	Table 3-257	Input protocol used by serial port
8	Output Protocols	BYTE	Table 3-257	Output protocol used by serial port
9	Protocol Operation Mode	BYTE	Table 3-258	Special operation mode of protocols

Table 3-256 Byte 6 Flow Control

Bit #	Meaning
0 (LSB)	RTS CTS: 0: Disabled 1: Enabled
1	Transmit XON/XOFF: 0: Disabled 1: Enabled
2	Transmit XANY: 0: Disabled 1: Enabled
3	Receive XON/XOFF: 0: Disabled 1: Enabled
4-7	Reserved (set to zero)

Table 3-257 Protocols

Bit #	Meaning
0 (LSB)	TAIP: 0: Disabled 1: Enabled
1	TSIP: 0: Disabled 1: Enabled
2	NMEA: 0: Disabled 1: Enabled
3	RTCM: 0: Disabled 1: Enabled
4	DCOL: 0: Disabled 1: Enabled
5-7	Reserved (set to zero)

Table 3-258 Byte 9 Special Operation Modes

Bit #	Meaning
0 (LSB)	Reference station mode: 0: Disabled 1: Enabled
1-7	Reserved (set to zero)

A Packet Usage Summary

Table A-1 includes a numerical listing of TSIP command and report packets and identifies the products supported by each packet.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x13	TSIP Parsing Error Notification		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x1A	TSIP RTCM Wrapper Command						✔															
0x1A 0x00	Raw RTCM Data Packet Request						✔															
0x1A	TSIP RTCM Wrapper / Port A Echo Report	✔					✔				✔											
0x1A 0x00	Raw RTCM Wrapper / Port A Echo Report	✔					✔				✔											
0x1D	Oscillator Offset Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x1E	Clear Battery-Backed Memory Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x1F	Receiver Firmware Information Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x20	Almanac Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x21	Current Time Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x22	Position Fix Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x23	Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x24	GPS Position Fix Mode Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x25	Soft Reset / Self Test Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x26	Health Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x27	Signal Levels Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x28	GPS System Message Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x29	Almanac Health Page Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2A	Altitude for 2D Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2B	Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2C	Operating Parameters Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2D	Oscillator Offset Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2E	GPS Time Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2F	UTC Parameters Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x31	Accurate Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x32	Accurate Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x33	Analog-to-Digital Readings Command		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔			✔	✔		
0x34	Satellite Number For One-Satellite Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x35	I/O Option Flags Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x36	Velocity Aiding of Acquisition Command	✔					✔				✔	✔										
0x37	Last Position and Velocity Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x38	Download and Upload Satellite System Data	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x39	Satellite Attribute Database Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3A	Last Raw Measurement Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x3B	Satellite Ephemeris Status Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3C	Satellite Tracking Status Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3D	Serial Port A Communication Parameters Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3D	Serial Port A Configuration Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3E	Additional Fix Parameters Request	✔					✔				✔	✔										
0x40	Almanac Data for Single Satellite Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x41	GPS Time Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x42	Single-Precision Position Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x43	Velocity Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x44	Non-Overdetermined Satellite Selection Report	✔					✔				✔	✔										

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x45	Receiver Firmware Information Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x46	Health of Receiver Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x47	Signal Levels for All Satellites Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x48	GPS System Message Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x49	Almanac Health Page Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4A	Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4B	Machine / Code ID and Additional Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4C	Operating Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4D	Oscillator Offset Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4E	GPS Time Command Verification	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x4F	UTC Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x53	Analog-to-Digital Readings Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x54	One Satellite Bias and Bias Rate Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x55	I/O Options Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x56	Velocity Fix East-North-Up (ENU) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x57	Last Computed Fix Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x58	Satellite System Data Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x59	Satellite Attribute Database Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5A	Raw Measurement Data Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5B	Satellite Ephemeris Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5C	Satellite Tracking Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5E	Additional Fix Status Report	✔				✔	✔				✔	✔										

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x5F	Severe Failure Notification	✔				✔	✔				✔	✔										
0x60	DGPS Pseudorange Corrections Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x60	Differential GPS Pseudorange Corrections Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x61	DGPS Delta Pseudorange Corrections Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x61	Differential GPS Delta Pseudorange Corrections Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x62	DGPS Position Fix Mode Command		✔	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x65	Differential Correction Status Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67	Reference Station Parameters Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x00	Reference Station Control Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x67 0x01	Reference Station Options Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x02	Reference Station Output Version Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x03	Reference Station Position Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x04	Reference Station ID Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x05	RTCM Type 16 Text Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x06	RTCM Type Specific Output Intervals Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x09	Average Position Reference Station Position Request[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x67 0x0A	Time Schedule Message Interval and Offset Request[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x68	Mobile Differential Parameters Command	✔					✔				✔	✔										
0x68 0x00	Mobile Differential Mode Command	✔					✔				✔	✔										

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x68 0x01	Mobile Differential Options Command	✔					✔				✔	✔										
0x68 0x02	Mobile Differential Input Version Command	✔					✔				✔	✔										
0x68 0x03	Masking Reference Station Position Command	✔					✔				✔	✔										
0x68 0x04	Input Reference Station ID Command	✔					✔				✔	✔										
0x68 0x05	Last Received RTCM Type 16 Request	✔					✔				✔	✔										
0x6A	Differential Corrections Used in the Fix Commands		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔		✔
0x6A 0x01	Fix Differential Corrections Output Control Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔		✔
0x6A	Differential Corrections Used in the Fix Reports		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔		✔
0x6A 0x00	Differential Corrections Used in Fix Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔		✔

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x6A 0x01	Fix Differential Corrections Output Control Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔		✔
0x6B	QA/QC Commands																					
0x6B 0x00	Position Sigma Information Parameters Command																					
0x6B 0x01	Position VCV Parameters Command																					
0x6B 0x02	Position Sigma Information Request																					
0x6B 0x03	Position VCV Information Request																					
0x6D	Average Position Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x6D	All-In-View Satellite Selection Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6D 0x00	Average Position Start/Stop Control Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x6D 0x01	Average Position Options Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x6D 0x02	Auto Stop Parameter Options Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x6D 0x03	Current Average Position Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x6D 0x04	Average Position Delta from Last Position	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x6E	Synchronized Measurement Parameters Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Parameters Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E	Synchronized Measurement Parameters Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Output Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6F	Synchronized Measurements Reports[2]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x6F 0x01	Synchronized Measurements Report[2]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x70	Position/Velocity Filter Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x70	Position/Velocity Filter Operation Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x75	Overdetermined Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x76	Overdetermined Mode Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x77	Maximum PRC Age Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x78	Maximum PRC Age Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A	NMEA Output Configuration Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x00	NMEA Interval and Message Mask Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x01	NMEA Messages to Output By Name List Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x02	NMEA Messages Now By Mask Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x7A 0x03	NMEA Messages Now By Name List Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x04	Current NMEA Output Messages Mask and/or Name List Request	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x05	NMEA Local Time Offset Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x06	NMEA Message Options Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7A 0x80	NMEA Interval and Message Mask Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7A 0x81	NMEA Messages to Output By Name List Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7A 0x82	NMEA Messages Now By Mask Request																					
0x7A 0x83	NMEA Messages Now By Name List Request																					

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x7A 0x84	Current NMEA Output Messages Mask and/or Name List Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7A 0x85	NMEA Local Time Offset Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7A 0x86	NMEA Message Options Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7B	NMEA Output Control Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7B 0x00	NMEA Interval and Message Mask Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7B 0x04	NMEA Name List / Message Mask Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7B 0x05	NMEA Local Time Offsets Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7B 0x06	NMEA Message Options and Precision Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7B 0x80	NMEA Interval and Message Mask Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7B 0x84	NMEA Name List / Message Mask Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x7B 0x85	NMEA Local Time Offsets Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7B 0x86	NMEA Message Options and Precision Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7C	Position Fix or PRC Rate Configuration Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7C 0x00	ASAP Fix Rate Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7C 0x01	Fast Rate I/O Options Command	✔					✔				✔	✔										
0x7C 0x02	Position Fix Output Interval and Offset Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7C 0x03	Maximum Measurement Age Command	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7C 0x05	CTS to Transmit Delay Command[1]	✔					✔				✔	✔										
0x7C 0x06	RTS Trailing Edge Delay Command[1]	✔					✔				✔	✔										
0x7C 0x09	Time-Based Message Interval Command[1]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x7D	Position Fix Rate Configuration Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7D 0x00	ASAP Fix Rate Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7D 0x01	Position Fix Rate Options Report	✔					✔				✔	✔										
0x7D 0x02	Position Fix Output Interval and Offset Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7D 0x03	Maximum Measurement Age Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔	✔		
0x7D 0x05	CTS to Transmit Delay Report[1]						✔				✔								✔	✔		
0x7D 0x06	RTS Trailing Edge Delay Report[1]						✔				✔								✔	✔		
0x7D 0x09	Time-Based Message Interval Report[1]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x7D 0x7F	Fast Rate Option Not Installed Notification	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔										
0x82	Differential Position Fix Mode Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x83	Double-Precision XYZ Position Fix & Clock Bias Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x84	Double-Precision LLA Position Fix & Clock Bias Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x85	Differential Correction Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87	Reference Station Parameters Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x00	Reference Station Control Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x01	Reference Station Options Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x02	Reference Station Output Version Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x03	Reference Station Position Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x04	Reference Station ID Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x05	RTCM Type 16 Text Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x06	RTCM Type Specific Output Intervals Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x08	TSIP Notification of Sent Version 2 RTCM Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x87 0x09	Average Position – Reference Station Position Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x0A	Time Schedule Message Interval and Offset Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x7D	Mobile Packet Ignored by Reference Station Notification[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x7E	Reference Station Warnings Notification[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x87 0x7F	Reference Station Option Not Installed Notification[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔			✔				✔	✔		
0x88	Mobile Differential Parameters Report	✔					✔				✔	✔										
0x88 0x00	Mobile Differential Mode Control Report	✔					✔				✔	✔										
0x88 0x01	Mobile Differential Options Report	✔					✔				✔	✔										
0x88 0x02	Mobile Differential Input Version Report	✔					✔				✔	✔										

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x88 0x03	Masking Reference Station Position	✔					✔				✔	✔										
0x88 0x04	Input Reference Station ID Report	✔					✔				✔	✔										
0x88 0x05	Last Received RTCM Type 16 Report	✔					✔				✔	✔										
0x88 0x08	TSIP Notification of Received Version 2 RTCM Report	✔					✔				✔	✔										
0x88 0x7F	Mobile Differential Option Not Installed Notification	✔					✔				✔	✔										
0x8B	QA/QC Reports																					
0x8B 0x00	Position Sigma Information Parameters Report																					
0x8B 0x01	Position VCV Parameters Report																					
0x8B 0x02	Position Sigma Information Report																					
0x8B 0x03	Position VCV Information Report																					

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8D	Average Position Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x8D 0x00	Average Position Start/Stop Control Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x8D 0x01	Average Position Options Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x8D 0x02	Auto Stop Parameters (Control / Options) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x8D 0x03	Current Average Position XYZ ECEF Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x8D 0x04	Average Position Delta from Last XYZ or ENU Report	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔				✔	✔		
0x8E	Application Commands		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8E 0x20	Super Packet Output Request[3]																		✔	✔		
0x8E 0x60	DR Calibration Command																	✔				
0x8E 0x62	GPS/DR Position/ Velocity Request																	✔				
0x8E 0x64	Firmware Name Request																✔	✔			✔	✔

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8E 0x6B	Gyroscope Calibration Values Command																	✔				
0x8E 0x6D	Odometer Calibration Values Command																	✔				
0x8E 0x6F	Firmware Version Name and Configuration Block Request																✔	✔			✔	✔
0x8E 0x70	Beacon Channel Status Request (Obsolete)		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x71	Beacon DGPS Station Database Report Request		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x73	Beacon Channel Control Command (Obsolete)		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x74	Clear Beacon Database Command		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x75	FFT Start Command		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x76	FFT Stop Command		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x78	RTCM Reports Request		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8E 0x79	Beacon Station Attributes Command		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x7A	Beacon Station Attributes Report Request		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x7B	Receiver Configuration Block and Software Version Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x7C	Receiver Configuration Block Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x7E	Satellite Line-of-Sight (LOS) Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x7F	Receiver ROM Configuration Block and Software Version Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8E 0x80	DGPS Service Provider System Information Request				✔					✔										✔		
0x8E 0x81	Decoder Station Information Command				✔					✔										✔		

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8E 0x82	Decoder Diagnostic Information Request				✔					✔										✔		
0x8E 0x84	Satellite FFT Control Command				✔					✔										✔		
0x8E 0x85	DGPS Source Tracking Status Request		✔	✔	✔	✔			✔	✔			✔	✔	✔				✔	✔		
0x8E 0x86	Satellite Database Control				✔					✔										✔		
0x8E 0x87	Network Statistics Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x88	Diagnostic Output Options Command				✔					✔										✔		
0x8E 0x89	DGPS Source Control Command		✔	✔	✔	✔			✔	✔			✔	✔	✔				✔	✔		
0x8E 0x8A	Service Provider Information Request				✔					✔										✔		
0x8E 0x8B	Service Provider Activation Information Command				✔					✔										✔		
0x8E 0x8E	Service Provider Data Load Command				✔					✔										✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8E 0x8F	Receiver Identity Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x90	Guidance Status Request[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x91	Guidance Configuration Command[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x92	Lightbar Configuration Command[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x94	Guidance Operation Command[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x95	Button Box Configuration Type Command[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x96	Point Manipulation Command[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x97	Utility Information Request[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x98	Individual Button Configuration Command[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8E 0x9A	Differential Correction Information Request		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F	Application Reports		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8F 0x20[3]	Super Packet Output Report																		✔	✔		
0x8F 0x60	DR Calibration and Status Report																	✔				
0x8F 0x62	GPS/DR Position/ Velocity Report																	✔				
0x8F 0x64	Firmware Version Name Report																✔	✔			✔	✔
0x8F 0x6B	Last Gyroscope Readings Report																	✔				
0x8F 0x6D	Last Odometer Readings Report																	✔				
0x8F 0x6F	Firmware Version and Configuration Report																✔	✔			✔	✔
0x8F 0x70	Beacon Channel Status Report (Obsolete)		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x71	DGPS Station Database Reports		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x73	Beacon Channel Control Acknowledgment (Obsolete)		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x74	Clear Beacon Database Acknowledgment		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8F 0x75	FFT Start Acknowledgment		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x76	FFT Stop Acknowledgment		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x77	FFT Reports		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x78	RTCM Reports		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x79	Beacon Station Attributes Acknowledgment		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x7A	Beacon Station Attributes Report		✔	✔	✔	✔			✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x7B	DGPS Receiver RAM Configuration Block Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x7C	DGPS Receiver Configuration Block Acknowledgment		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x7E	Satellite Line-of-Sight (LOS) Message		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x7F	DGPS Receiver ROM Configuration Block Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0x8F 0x80	DGPS Service Provider System Information Report				✔					✔										✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8F 0x81	Decoder Station Information Report and Selection Acknowledgment				✔					✔										✔		
0x8F 0x82	Decoder Diagnostic Information Report				✔					✔										✔		
0x8F 0x84	Satellite FFT Control Acknowledgment				✔					✔										✔		
0x8F 0x85	DGPS Source Tracking Status Report		✔	✔	✔	✔			✔	✔			✔	✔	✔				✔	✔		
0x8F 0x86	Clear Satellite Database Acknowledgment				✔					✔										✔		
0x8F 0x87	Network Statistics Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x88	Diagnostic Output Options Report				✔					✔										✔		
0x8F 0x89	DGPS Source Control Report / Acknowledgment		✔	✔	✔	✔			✔	✔			✔	✔	✔				✔	✔		
0x8F 0x8A	Service Provider Information Report and Acknowledgment				✔					✔										✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8F 0x8B	Service Provider Activation Information Report and Acknowledgment				✔					✔										✔		
0x8F 0x8E	Service Provider Data Load Report				✔					✔										✔		
0x8F 0x8F	Receiver Identity Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x90	Guidance Status Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x91	Guidance Configuration Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x92	Lightbar Configuration Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x94	Guidance Operation Acknowledgment[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x95	Button Box Configuration Type Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x96	Point Manipulation Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x97	Utility Information Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		

[1] Requires Reference Station option.

[2] Not all receivers support carrier phase information.

[3] May require Post-Processing option.

[4] Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0x8F 0x98	Individual Button Configuration Report[4]		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0x8F 0x9A	Differential Correction Information Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔				✔	✔		
0xB0	PPS Signal and Event Commands		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0xB0 0x00	PPS Signal Configuration Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0xB0 0x01	PPS Signal Enable/Disable Command		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0xB0 0x40	Event Timestamp Selection Command		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0x41	Event Packet Options Command		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0x42	Event Plus Position Request		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0x43	Event Only Request		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0x44	Event Marker Miscellaneous Command						✔															
0xB0	PPS and Event Report Packets		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0xB0 0x80	PPS Signal Configuration Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0xB0 0x81	PPS Signal Enable/Disable Acknowledgment		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0xB0 0x82	PPS Signal Auto-Generated Report		✔	✔	✔	✔		✔	✔	✔			✔	✔	✔	✔			✔	✔		
0xB0 0xC0	Event Timestamp Selection Report		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0xC1	Event Packet Options Report		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0xC2	Event Plus Position Report		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0xC3	Event Only Report		✔	✔	✔	✔	✔	✔	✔	✔			✔	✔	✔				✔	✔		
0xB0 0xC4	Event Marker Miscellaneous Action Taken						✔															
0xBB	Receiver Configuration Parameters Commands																✔	✔			✔	✔
0xBB 0x00	Primary Receiver Configuration Parameters Request																✔	✔			✔	✔

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

Table A-1 TSIP Packet Usage Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	AL9000	DSM EuroCard	BD-112	BD-122	BD-132	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D	Placer GPS 450	Placer GPS 455/455DR	GPS Pathfinder ProXR	GPS Pathfinder ProXRS	CrossCheck AMPS	CrossCheck XR
0xBB	Receiver Configuration Parameters Reports																✔	✔			✔	✔
0xBB 0x00	Primary Receiver Configuration Parameters Report																✔	✔			✔	✔
0xBC	Serial Port Configuration Parameters Command																✔	✔			✔	✔
0xBC	Serial Port Configuration Parameters Report																✔	✔			✔	✔
0xC2	Port A Data Transmission Command						✔				✔											

1 Requires Reference Station option.

2 Not all receivers support carrier phase information.

3 May require Post-Processing option.

4 Requires Guidance option.

B Mapping Products

TSIP (Trimble Standard Interface Protocol) support for Mapping products are summarized in this chapter. The Mapping products are identified and the TSIP command and report packets supported by each product are summarized. Application notes are provided for each Mapping product to clarify the TSIP implementation and identify the default settings for key GPS parameters and receiver configuration options.

B.1 Supported Mapping Products

TSIP information is provided for these Mapping receivers:

- GPS Pathfinder Pro XR (section B.5 on page B-15)
- GPS Pathfinder Pro XRS (section B.6 on page B-18)

B.1.1 Identification

In TSIP, each product is uniquely identified by a product ID and a machine ID, much like people are named with a first and last name. The machine ID, like a last name, associates the GPS receiver with a particular family of Trimble receivers. The product ID, like a first name, uniquely specifies the product within its family. The machine ID is used in Report Packet 0x45, Report Packet 0x4B, and Report Packet 0x8F 0x8F. The product ID is used in Report Packet 0x45, Report Packet 0x8F 0x64, Report Packet 0x8F 0x7B, and Report Packet 0x8F 0x8F. The machine and product IDs for the supported products listed above are defined in Table B-1.

Table B-1 Mapping Product Identification

Name	Machine ID		Product ID	
	Decimal	Hex	Decimal	Hex
GPS Pathfinder Pro XR (P/N 29654-11)	97	0x61	2	0x02
GPS Pathfinder Pro XR (P/N 38073-80)	104	0x68	23	0x17
GPS Pathfinder Pro XRS (P/N 33302-50)	65	0x41	6	0x06
GPS Pathfinder Pro XRS (P/N 33302-51)	69	0x45	22	0x16

B.2 Supported TSIP Packets

Table B-2 includes a numerical listing of TSIP command and report packets and identifies the products supported by each packet.

Table B-2 Mapping Products TSIP Packet Summary

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x13	TSIP Parsing Error Notification	✔	✔
0x1A	TSIP RTCM Wrapper Command		
0x1A 0x00	Raw RTCM Data Packet Request		
0x1A	TSIP RTCM Wrapper / Port A Echo Report		
0x1A 0x00	Raw RTCM Wrapper / Port A Echo Report		
0x1D	Oscillator Offset Command	✔	✔
0x1E	Clear Battery-Backed Memory Command	✔	✔
0x1F	Receiver Firmware Information Request	✔	✔
0x20	Almanac Request	✔	✔
0x21	Current Time Request	✔	✔
0x22	Position Fix Mode Command	✔	✔
0x23	Initial Position (XYZ Cartesian ECEF) Command	✔	✔
0x24	GPS Position Fix Mode Request	✔	✔
0x25	Soft Reset / Self Test Command	✔	✔
0x26	Health Request	✔	✔
0x27	Signal Levels Request	✔	✔
0x28	GPS System Message Request	✔	✔
0x29	Almanac Health Page Request	✔	✔
0x2A	Altitude for 2D Mode Command	✔	✔
0x2B	Initial Position (Latitude, Longitude, Altitude) Command	✔	✔
0x2C	Operating Parameters Command	✔	✔
0x2D	Oscillator Offset Request	✔	✔
0x2E	GPS Time Command	✔	✔
0x2F	UTC Parameters Request	✔	✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x31	Accurate Initial Position (XYZ Cartesian ECEF) Command	✔	✔
0x32	Accurate Initial Position (Latitude, Longitude, Altitude) Command	✔	✔
0x33	Analog-to-Digital Readings Command	✔	✔
0x34	Satellite Number For One-Satellite Mode Command	✔	✔
0x35	I/O Option Flags Command	✔	✔
0x36	Velocity Aiding of Acquisition Command		
0x37	Last Position and Velocity Request	✔	✔
0x38	Download and Upload Satellite System Data	✔	✔
0x39	Satellite Attribute Database Command	✔	✔
0x3A	Last Raw Measurement Request	✔	✔
0x3B	Satellite Ephemeris Status Request	✔	✔
0x3C	Satellite Tracking Status Request	✔	✔
0x3D	Serial Port A Communication Parameters Command	✔	✔
0x3D	Serial Port A Configuration Report	✔	✔
0x3E	Additional Fix Parameters Request		
0x40	Almanac Data for Single Satellite Report	✔	✔
0x41	GPS Time Report	✔	✔
0x42	Single-Precision Position Fix (XYZ Cartesian ECEF) Report	✔	✔
0x43	Velocity Fix (XYZ Cartesian ECEF) Report	✔	✔
0x44	Non-Overdetermined Satellite Selection Report		
0x45	Receiver Firmware Information Report	✔	✔
0x46	Health of Receiver Report	✔	✔
0x47	Signal Levels for All Satellites Report	✔	✔
0x48	GPS System Message Report	✔	✔
0x49	Almanac Health Page Report	✔	✔
0x4A	Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report	✔	✔
0x4B	Machine / Code ID and Additional Status Report	✔	✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x4C	Operating Parameters Report	✔	✔
0x4D	Oscillator Offset Report	✔	✔
0x4E	GPS Time Command Verification	✔	✔
0x4F	UTC Parameters Report	✔	✔
0x53	Analog-to-Digital Readings Report	✔	✔
0x54	One Satellite Bias and Bias Rate Report	✔	✔
0x55	I/O Options Report	✔	✔
0x56	Velocity Fix East-North-Up (ENU) Report	✔	✔
0x57	Last Computed Fix Report	✔	✔
0x58	Satellite System Data Reports	✔	✔
0x59	Satellite Attribute Database Status Report	✔	✔
0x5A	Raw Measurement Data Report	✔	✔
0x5B	Satellite Ephemeris Status Report	✔	✔
0x5C	Satellite Tracking Status Report	✔	✔
0x5E	Additional Fix Status Report		
0x5F	Severe Failure Notification		
0x60	DGPS Pseudorange Corrections Command	✔	✔
0x60	Differential GPS Pseudorange Corrections Report	✔	✔
0x61	DGPS Delta Pseudorange Corrections Command	✔	✔
0x61	Differential GPS Delta Pseudorange Corrections Report	✔	✔
0x62	DGPS Position Fix Mode Command	✔	✔
0x65	Differential Correction Status Request	✔	✔
0x67	Reference Station Parameters Command	✔	✔
0x67 0x00	Reference Station Control Command	✔	✔
0x67 0x01	Reference Station Options Command	✔	✔
0x67 0x02	Reference Station Output Version Command	✔	✔
0x67 0x03	Reference Station Position Command	✔	✔
0x67 0x04	Reference Station ID Command	✔	✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x67 0x05	RTCM Type 16 Text Command	✔	✔
0x67 0x06	RTCM Type Specific Output Intervals Command	✔	✔
0x67 0x09	Average Position Reference Station Position Request	✔	✔
0x67 0x0A	Time Schedule Message Interval and Offset Request	✔	✔
0x68	Mobile Differential Parameters Command		
0x68 0x00	Mobile Differential Mode Command		
0x68 0x01	Mobile Differential Options Command		
0x68 0x02	Mobile Differential Input Version Command		
0x68 0x03	Masking Reference Station Position Command		
0x68 0x04	Input Reference Station ID Command		
0x68 0x05	Last Received RTCM Type 16 Request		
0x6A	Differential Corrections Used in the Fix Commands	✔	✔
0x6A 0x01	Fix Differential Corrections Output Control Command	✔	✔
0x6A	Differential Corrections Used in the Fix Reports	✔	✔
0x6A 0x00	Differential Corrections Used in Fix Report	✔	✔
0x6A 0x01	Fix Differential Corrections Output Control Report	✔	✔
0x6B	QA/QC Commands		
0x6B 0x00	Position Sigma Information Parameters Command		
0x6B 0x01	Position VCV Parameters Command		
0x6B 0x02	Position Sigma Information Request		
0x6B 0x03	Position VCV Information Request		
0x6D	Average Position Commands	✔	✔
0x6D	All-In-View Satellite Selection Report	✔	✔
0x6D 0x00	Average Position Start/Stop Control Command	✔	✔
0x6D 0x01	Average Position Options Command	✔	✔
0x6D 0x02	Auto Stop Parameter Options Command	✔	✔
0x6D 0x03	Current Average Position Request	✔	✔
0x6D 0x04	Average Position Delta from Last Position	✔	✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x6E	Synchronized Measurement Parameters Commands	✔	✔
0x6E 0x01	Synchronized Measurement Parameters Command	✔	✔
0x6E	Synchronized Measurement Parameters Reports	✔	✔
0x6E 0x01	Synchronized Measurement Output Parameters Report	✔	✔
0x6F	Synchronized Measurements Reports	✔	✔
0x6F 0x01	Synchronized Measurements Report	✔	✔
0x70	Position/Velocity Filter Command	✔	✔
0x70	Position/Velocity Filter Operation Report	✔	✔
0x75	Overdetermined Mode Command	✔	✔
0x76	Overdetermined Mode Report	✔	✔
0x77	Maximum PRC Age Command	✔	✔
0x78	Maximum PRC Age Report	✔	✔
0x7A	NMEA Output Configuration Commands	✔	✔
0x7A 0x00	NMEA Interval and Message Mask Command	✔	✔
0x7A 0x01	NMEA Messages to Output By Name List Command	✔	✔
0x7A 0x02	NMEA Messages Now By Mask Request	✔	✔
0x7A 0x03	NMEA Messages Now By Name List Request	✔	✔
0x7A 0x04	Current NMEA Output Messages Mask and/or Name List Request	✔	✔
0x7A 0x05	NMEA Local Time Offset Command	✔	✔
0x7A 0x06	NMEA Message Options Command	✔	✔
0x7A 0x80	NMEA Interval and Message Mask Command	✔	✔
0x7A 0x81	NMEA Messages to Output By Name List Command	✔	✔
0x7A 0x82	NMEA Messages Now By Mask Request		
0x7A 0x83	NMEA Messages Now By Name List Request		
0x7A 0x84	Current NMEA Output Messages Mask and/or Name List Request	✔	✔
0x7A 0x85	NMEA Local Time Offset Command	✔	✔
0x7A 0x86	NMEA Message Options Command	✔	✔
0x7B	NMEA Output Control Reports	✔	✔

1 Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

2 Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x7B 0x00	NMEA Interval and Message Mask Report	✔	✔
0x7B 0x04	NMEA Name List / Message Mask Report	✔	✔
0x7B 0x05	NMEA Local Time Offsets Report	✔	✔
0x7B 0x06	NMEA Message Options and Precision Report	✔	✔
0x7B 0x80	NMEA Interval and Message Mask Report	✔	✔
0x7B 0x84	NMEA Name List / Message Mask Report	✔	✔
0x7B 0x85	NMEA Local Time Offsets Report	✔	✔
0x7B 0x86	NMEA Message Options and Precision Report	✔	✔
0x7C	Position Fix or PRC Rate Configuration Commands	✔	✔
0x7C 0x00	ASAP Fix Rate Command	✔	✔
0x7C 0x01	Fast Rate I/O Options Command	✔	✔
0x7C 0x02	Position Fix Output Interval and Offset Command	✔	✔
0x7C 0x03	Maximum Measurement Age Command	✔	✔
0x7C 0x05	CTS to Transmit Delay Command		
0x7C 0x06	RTS Trailing Edge Delay Command		
0x7C 0x09	Time-Based Message Interval Command	✔	✔
0x7D	Position Fix Rate Configuration Reports	✔	✔
0x7D 0x00	ASAP Fix Rate Report	✔	✔
0x7D 0x01	Position Fix Rate Options Report		
0x7D 0x02	Position Fix Output Interval and Offset Report	✔	✔
0x7D 0x03	Maximum Measurement Age Report	✔	✔
0x7D 0x05	CTS to Transmit Delay Report		
0x7D 0x06	RTS Trailing Edge Delay Report		
0x7D 0x09	Time-Based Message Interval Report		
0x7D 0x7F	Fast Rate Option Not Installed Notification		
0x82	Differential Position Fix Mode Report	✔	✔
0x83	Double-Precision XYZ Position Fix & Clock Bias Report	✔	✔
0x84	Double-Precision LLA Position Fix & Clock Bias Report	✔	✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x85	Differential Correction Status Report	✔	✔
0x87	Reference Station Parameters Report	✔	✔
0x87 0x00	Reference Station Control Report	✔	✔
0x87 0x01	Reference Station Options Report	✔	✔
0x87 0x02	Reference Station Output Version Report	✔	✔
0x87 0x03	Reference Station Position Report	✔	✔
0x87 0x04	Reference Station ID Report	✔	✔
0x87 0x05	RTCM Type 16 Text Report	✔	✔
0x87 0x06	RTCM Type Specific Output Intervals Report	✔	✔
0x87 0x08	TSIP Notification of Sent Version 2 RTCM Report	✔	✔
0x87 0x09	Average Position – Reference Station Position Report	✔	✔
0x87 0x0A	Time Schedule Message Interval and Offset Report	✔	✔
0x87 0x7D	Mobile Packet Ignored by Reference Station Notification	✔	✔
0x87 0x7E	Reference Station Warnings Notification	✔	✔
0x87 0x7F	Reference Station Option Not Installed Notification	✔	✔
0x88	Mobile Differential Parameters Report		
0x88 0x00	Mobile Differential Mode Control Report		
0x88 0x01	Mobile Differential Options Report		
0x88 0x02	Mobile Differential Input Version Report		
0x88 0x03	Masking Reference Station Position		
0x88 0x04	Input Reference Station ID Report		
0x88 0x05	Last Received RTCM Type 16 Report		
0x88 0x08	TSIP Notification of Received Version 2 RTCM Report		
0x88 0x7F	Mobile Differential Option Not Installed Notification		
0x8B	QA/QC Reports		
0x8B 0x00	Position Sigma Information Parameters Report		
0x8B 0x01	Position VCV Parameters Report		
0x8B 0x02	Position Sigma Information Report		

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x8B 0x03	Position VCV Information Report		
0x8D	Average Position Reports	✔	✔
0x8D 0x00	Average Position Start/Stop Control Report	✔	✔
0x8D 0x01	Average Position Options Report	✔	✔
0x8D 0x02	Auto Stop Parameters (Control / Options) Report	✔	✔
0x8D 0x03	Current Average Position XYZ ECEF Report	✔	✔
0x8D 0x04	Average Position Delta from Last XYZ or ENU Report	✔	✔
0x8E	Application Commands	✔	✔
0x8E 0x20	Super Packet Output Request	✔	✔
0x8E 0x60	DR Calibration Command		
0x8E 0x62	GPS/DR Position/Velocity Request		
0x8E 0x64	Firmware Name Request		
0x8E 0x6B	Gyroscope Calibration Values Command		
0x8E 0x6D	Odometer Calibration Values Command		
0x8E 0x6F	Firmware Version Name and Configuration Block Request		
0x8E 0x70	Beacon Channel Status Request (Obsolete)	✔	✔
0x8E 0x71	Beacon DGPS Station Database Report Request	✔	✔
0x8E 0x73	Beacon Channel Control Command (Obsolete)	✔	✔
0x8E 0x74	Clear Beacon Database Command	✔	✔
0x8E 0x75	FFT Start Command	✔	✔
0x8E 0x76	FFT Stop Command	✔	✔
0x8E 0x78	RTCM Reports Request	✔	✔
0x8E 0x79	Beacon Station Attributes Command	✔	✔
0x8E 0x7A	Beacon Station Attributes Report Request	✔	✔
0x8E 0x7B	Receiver Configuration Block and Software Version Request	✔	✔
0x8E 0x7C	Receiver Configuration Block Command	✔	✔
0x8E 0x7E	Satellite Line-of-Sight (LOS) Request	✔	✔
0x8E 0x7F	Receiver ROM Configuration Block and Software Version Request	✔	✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x8E 0x80	DGPS Service Provider System Information Request		✔
0x8E 0x81	Decoder Station Information Command		✔
0x8E 0x82	Decoder Diagnostic Information Request		✔
0x8E 0x84	Satellite FFT Control Command		✔
0x8E 0x85	DGPS Source Tracking Status Request	✔	✔
0x8E 0x86	Satellite Database Control		✔
0x8E 0x87	Network Statistics Request	✔	✔
0x8E 0x88	Diagnostic Output Options Command		✔
0x8E 0x89	DGPS Source Control Command	✔	✔
0x8E 0x8A	Service Provider Information Request		✔
0x8E 0x8B	Service Provider Activation Information Command		✔
0x8E 0x8E	Service Provider Data Load Command		✔
0x8E 0x8F	Receiver Identity Request	✔	✔
0x8E 0x90	Guidance Status Request[1]	✔	✔
0x8E 0x91	Guidance Configuration Command[1]	✔	✔
0x8E 0x92	Lightbar Configuration Command[1]	✔	✔
0x8E 0x94	Guidance Operation Command[1]	✔	✔
0x8E 0x95	Button Box Configuration Type Command[1]	✔	✔
0x8E 0x96	Point Manipulation Command[1]	✔	✔
0x8E 0x97	Utility Information Request[1]	✔	✔
0x8E 0x98	Individual Button Configuration Command[1]	✔	✔
0x8E 0x9A	Differential Correction Information Request	✔	✔
0x8F	Application Reports	✔	✔
0x8F 0x20	Super Packet Output Report	✔	✔
0x8F 0x60	DR Calibration and Status Report		
0x8F 0x62	GPS/DR Position/Velocity Report		
0x8F 0x64	Firmware Version Name Report		
0x8F 0x6B	Last Gyroscope Readings Report		

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x8F 0x6D	Last Odometer Readings Report		
0x8F 0x6F	Firmware Version and Configuration Report		
0x8F 0x70	Beacon Channel Status Report (Obsolete)	✔	✔
0x8F 0x71	DGPS Station Database Reports	✔	✔
0x8F 0x73	Beacon Channel Control Acknowledgment (Obsolete)	✔	✔
0x8F 0x74	Clear Beacon Database Acknowledgment	✔	✔
0x8F 0x75	FFT Start Acknowledgment	✔	✔
0x8F 0x76	FFT Stop Acknowledgment	✔	✔
0x8F 0x77	FFT Reports	✔	✔
0x8F 0x78	RTCM Reports	✔	✔
0x8F 0x79	Beacon Station Attributes Acknowledgment	✔	✔
0x8F 0x7A	Beacon Station Attributes Report	✔	✔
0x8F 0x7B	DGPS Receiver RAM Configuration Block Report	✔	✔
0x8F 0x7C	DGPS Receiver Configuration Block Acknowledgment	✔	✔
0x8F 0x7E	Satellite Line-of-Sight (LOS) Message	✔	✔
0x8F 0x7F	DGPS Receiver ROM Configuration Block Report	✔	✔
0x8F 0x80	DGPS Service Provider System Information Report		✔
0x8F 0x81	Decoder Station Information Report and Selection Acknowledgment		✔
0x8F 0x82	Decoder Diagnostic Information Report		✔
0x8F 0x84	Satellite FFT Control Acknowledgment		✔
0x8F 0x85	DGPS Source Tracking Status Report	✔	✔
0x8F 0x86	Clear Satellite Database Acknowledgment		✔
0x8F 0x87	Network Statistics Report	✔	✔
0x8F 0x88	Diagnostic Output Options Report		✔
0x8F 0x89	DGPS Source Control Report /Acknowledgment	✔	✔
0x8F 0x8A	Service Provider Information Report and Acknowledgment		✔
0x8F 0x8B	Service Provider Activation Information Report and Acknowledgment		✔
0x8F 0x8E	Service Provider Data Load Report		✔

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0x8F 0x8F	Receiver Identity Report	✔	✔
0x8F 0x90	Guidance Status Report[1]	✔	✔
0x8F 0x91	Guidance Configuration Report[1]	✔	✔
0x8F 0x92	Lightbar Configuration Report[1]	✔	✔
0x8F 0x94	Guidance Operation Acknowledgment[1]	✔	✔
0x8F 0x95	Button Box Configuration Type Report[1]	✔	✔
0x8F 0x96	Point Manipulation Report[1]	✔	✔
0x8F 0x97	Utility Information Report[1]	✔	✔
0x8F 0x98	Individual Button Configuration Report[1]	✔	✔
0x8F 0x9A	Differential Correction Information Report	✔	✔
0xB0	PPS Signal and Event Commands	✔	✔
0xB0 0x00	PPS Signal Configuration Command	✔	✔
0xB0 0x01	PPS Signal Enable/Disable Command	✔	✔
0xB0 0x40	Event Timestamp Selection Command [2]	✔	✔
0xB0 0x41	Event Packet Options Command [2]	✔	✔
0xB0 0x42	Event Plus Position Request [2]	✔	✔
0xB0 0x43	Event Only Request [2]	✔	✔
0xB0 0x44	Event Marker Miscellaneous Command		
0xB0	PPS and Event Report Packets	✔	✔
0xB0 0x80	PPS Signal Configuration Report	✔	✔
0xB0 0x81	PPS Signal Enable/Disable Acknowledgment	✔	✔
0xB0 0x82	PPS Signal Auto-Generated Report	✔	✔
0xB0 0xC0	Event Timestamp Selection Report [2]	✔	✔
0xB0 0xC1	Event Packet Options Report [2]	✔	✔
0xB0 0xC2	Event Plus Position Report [2]	✔	✔
0xB0 0xC3	Event Only Report [2]	✔	✔
0xB0 0xC4	Event Marker Miscellaneous Action Taken		
0xBB	Receiver Configuration Parameters Commands		

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

Table B-2 Mapping Products TSIP Packet Summary (Continued)

ID	Name	GPS Pathfinder Pro XR	GPS Pathfinder Pro XRS
0xBB 0x00	Primary Receiver Configuration Parameters Request		
0xBB	Receiver Configuration Parameters Reports		
0xBB 0x00	Primary Receiver Configuration Parameters Report		
0xBC	Serial Port Configuration Parameters Command		
0xBC	Serial Port Configuration Parameters Report		
0xC2	Port A Data Transmission Command		

[1] Requires Guidance option. Not available in GPS Pathfinder Pro XR (P/N 29654-11, machine ID = 97)

[2] Requires Event In option.

B.3 Supported NMEA Messages

Table B-3 shows which NMEA messages are supported by each product. For more information on these messages, see TSIP Command Packet 0x7A.

Table B-3 Mapping NMEA Message Summary

Message	Pro XR	Pro XRS
ALM	✔	✔
GBS		
GGA	✔	✔
GLL	✔	✔
GRS	✔	✔
GSA	✔	✔
GST	✔	✔
GSV	✔	✔
MSS	✔	✔
PTNLAG001	✔	✔
PTNLDG	✔	✔
PTNL,GGK	✔	✔
PTNLID	✔	✔
PTNLSM	✔	✔
RMC	✔	✔
VTG	✔	✔
ZDA	✔	✔

B.4 Key Configuration Parameter Settings

Correctly selecting the proper GPS operating parameters is important to get the best performance from the GPS sensor. Command Packets are available for changing the receiver setup for the specific conditions of a particular user, including packets:

- 0x22 (Position Fix Mode Command)
- 0x2C (Operating Parameters Command)
- 0x35 (I/O Option Flags Command)
- 0x62 (DGPS Position Fix Mode Command)

The default values for the parameters in these packets allow the receiver to operate under a wide variety of demanding conditions. You can choose to change the default parameters if the receiver is required to perform only in a specific or limited environment.

Warning – When the receiver is exposed to operating conditions different from those described in the setup, performance can be degraded.

B.5 GPS Pathfinder Pro XR

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the GPS Pathfinder Pro XR receiver are covered in this section.

B.5.1 GPS Pathfinder Pro XR TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for GPS Pathfinder Pro XR receiver.

GPS Pathfinder Pro XR Port Naming Conventions

The TSIP packets for configuring serial ports refer to the first serial port on the receiver electronics board as Port A and the second serial port as Port B. The GPS Pathfinder Pro XR serial port connectors are labeled Port A and Port B. These port connector names are equivalent to the Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

GPS Pathfinder Pro XR Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for GPS Pathfinder Pro XR

The standard GPS Pathfinder Pro XR is manufactured to support a 1 Hz positioning rate. GPS Pathfinder Pro XR receivers with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

GPS Pathfinder Pro XR Key Configuration Parameter Settings

Table B-4 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table B-4 GPS Pathfinder Pro XR Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	15°
• Signal Level Mask (SNR)	0x2C	2.0 AMUs
• PDOP Mask	0x2C	12.0
• PDOP Switch	0x2C	8.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	On
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	Off
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	GPS
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	On

Table B-4 GPS Pathfinder Pro XR Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Filtered
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
• Units for signal-to-noise output data	0x35	AMUs
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Valid
• Precision of time in RMC (decimal places)	0x7A	2
• NMEA Speed to Output	0x7A	2D SOG

B.6 GPS Pathfinder Pro XRS

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the GPS Pathfinder Pro XRS receiver are covered in this section.

B.6.1 GPS Pathfinder Pro XRS TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the GPS Pathfinder Pro XRS receiver.

GPS Pathfinder Pro XRS Port Naming Conventions

The TSIP packets for configuring serial ports refer to the first serial port on the receiver electronics board as Port A and the second serial port as Port B. The GPS Pathfinder Pro XRS serial port connectors are labeled Port A and Port B. These port connector names are equivalent to the Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

GPS Pathfinder Pro XRS Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for GPS Pathfinder Pro XRS

The standard GPS Pathfinder Pro XRS is manufactured to support a 1 Hz positioning rate. Pro XRS receivers with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz.The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

GPS Pathfinder Pro XRS Key Configuration Parameter Settings

Table B-4 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table B-5 GPS Pathfinder Pro XRS Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	15°
• Signal Level Mask (SNR)	0x2C	2.0 AMUs
• PDOP Mask	0x2C	12.0
• PDOP Switch	0x2C	8.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	On
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	Off
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	GPS
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	On

Table B-5 GPS Pathfinder Pro XRS Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Filtered
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
• Units for signal-to-noise output data	0x35	AMUs
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Valid
• Precision of time in RMC (decimal places)	0x7A	2
• NMEA Speed to Output	0x7A	2D SOG

C Marine Products

TSIP (Trimble Standard Interface Protocol) support for Marine products are summarized in this chapter. The Marine products are identified and the TSIP command and report packets supported by each product are summarized. Application notes are provided for each Marine product to clarify the TSIP implementation and identify the default settings for key GPS parameters and receiver configuration options.

C.1 Supported Marine Products

TSIP information is provided for the these Marine products:

- DSM and DSM Reference Station (section C.5 on page C-17)
- DSMPro (section C.6 on page C-21)
- DSM12 (section C.7 on page C-24)
- DSM212H and DSM212L (section C.8 on page C-27)
- DSM12RS (section C.9 on page C-30)
- NT300D (section C.10 on page C-33)

C.1.1 Identification

In TSIP, each product is uniquely identified by a product ID and a machine ID, much like people are named with a first and last name. The machine ID, like a last name, associates the GPS receiver with a particular family of Trimble receivers. The product ID, like a first name, uniquely specifies the product within its family. The machine ID is used in Report Packet 0x45, Report Packet 0x4B, and Report Packet 0x8F 0x8F. The product ID is used in Report Packet 0x45, Report Packet 0x8F 0x64, Report Packet 0x8F 0x7B, and Report Packet 0x8F 0x8F. The machine and product IDs for the supported products listed above are defined in Table C-1.

Table C-1 Marine Product Identification

Name	Machine ID Decimal	Machine ID Hex	Product ID Decimal	Product ID Hex
DSM and DSM Reference Station	37	0x25	2	0x02
DSMPro	37	0x25	6	0x06
DSM12 (P/N 29654-20)	97	0x61	1	0x01
DSM12 (P/N 38073-20)	104	0x68	24	0x18
DSM12RS (P/N 29654-25)	97	0x61	1	0x01
DSM12RS (P/N 38073-25)	104	0x68	24	0x18
DSM212H and DSM212L (P/N 29654-30, 29654-35)	97	0x61	1	0x01
DSM212H and DSM212L (P/N 38073-30, 38073-35)	104	0x68	24	0x18
NT300D	101	0x65	0	0x00

C.2 Supported TSIP Packets

Table C-2 includes a numerical listing of TSIP command and report packets and identifies the Marine products supported by each packet.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x13	TSIP Parsing Error Notification			✔	✔	✔	✔
0x1A	TSIP RTCM Wrapper Command	✔					
0x1A 0x00	Raw RTCM Data Packet Request	✔					
0x1A	TSIP RTCM Wrapper / Port A Echo Report	✔	✔				
0x1A 0x00	Raw RTCM Wrapper / Port A Echo Report	✔	✔				
0x1D	Oscillator Offset Command	✔	✔	✔	✔	✔	✔
0x1E	Clear Battery-Backed Memory Command	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x1F	Receiver Firmware Information Request	✔	✔	✔	✔	✔	✔
0x20	Almanac Request	✔	✔	✔	✔	✔	✔
0x21	Current Time Request	✔	✔	✔	✔	✔	✔
0x22	Position Fix Mode Command	✔	✔	✔	✔	✔	✔
0x23	Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔	✔
0x24	GPS Position Fix Mode Request	✔	✔	✔	✔	✔	✔
0x25	Soft Reset / Self Test Command	✔	✔	✔	✔	✔	✔
0x26	Health Request	✔	✔	✔	✔	✔	✔
0x27	Signal Levels Request	✔	✔	✔	✔	✔	✔
0x28	GPS System Message Request	✔	✔	✔	✔	✔	✔
0x29	Almanac Health Page Request	✔	✔	✔	✔	✔	✔
0x2A	Altitude for 2D Mode Command	✔	✔	✔	✔	✔	✔
0x2B	Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔	✔
0x2C	Operating Parameters Command	✔	✔	✔	✔	✔	✔
0x2D	Oscillator Offset Request	✔	✔	✔	✔	✔	✔
0x2E	GPS Time Command	✔	✔	✔	✔	✔	✔
0x2F	UTC Parameters Request	✔	✔	✔	✔	✔	✔
0x31	Accurate Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔	✔
0x32	Accurate Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔	✔
0x33	Analog-to-Digital Readings Command	✔		✔	✔	✔	✔
0x34	Satellite Number For One-Satellite Mode Command	✔	✔	✔	✔	✔	✔
0x35	I/O Option Flags Command	✔	✔	✔	✔	✔	✔
0x36	Velocity Aiding of Acquisition Command	✔	✔				
0x37	Last Position and Velocity Request	✔	✔	✔	✔	✔	✔
0x38	Download and Upload Satellite System Data	✔	✔	✔	✔	✔	✔
0x39	Satellite Attribute Database Command	✔	✔	✔	✔	✔	✔
0x3A	Last Raw Measurement Request	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x3B	Satellite Ephemeris Status Request	✔	✔	✔	✔	✔	✔
0x3C	Satellite Tracking Status Request	✔	✔	✔	✔	✔	✔
0x3D	Serial Port A Communication Parameters Command	✔	✔	✔	✔	✔	✔
0x3D	Serial Port A Configuration Report	✔	✔	✔	✔	✔	✔
0x3E	Additional Fix Parameters Request	✔	✔				
0x40	Almanac Data for Single Satellite Report	✔	✔	✔	✔	✔	✔
0x41	GPS Time Report	✔	✔	✔	✔	✔	✔
0x42	Single-Precision Position Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔	✔
0x43	Velocity Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔	✔
0x44	Non-Overdetermined Satellite Selection Report	✔	✔				
0x45	Receiver Firmware Information Report	✔	✔	✔	✔	✔	✔
0x46	Health of Receiver Report	✔	✔	✔	✔	✔	✔
0x47	Signal Levels for All Satellites Report	✔	✔	✔	✔	✔	✔
0x48	GPS System Message Report	✔	✔	✔	✔	✔	✔
0x49	Almanac Health Page Report	✔	✔	✔	✔	✔	✔
0x4A	Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report	✔	✔	✔	✔	✔	✔
0x4B	Machine / Code ID and Additional Status Report	✔	✔	✔	✔	✔	✔
0x4C	Operating Parameters Report	✔	✔	✔	✔	✔	✔
0x4D	Oscillator Offset Report	✔	✔	✔	✔	✔	✔
0x4E	GPS Time Command Verification	✔	✔	✔	✔	✔	✔
0x4F	UTC Parameters Report	✔	✔	✔	✔	✔	✔
0x53	Analog-to-Digital Readings Report	✔	✔	✔	✔	✔	✔
0x54	One Satellite Bias and Bias Rate Report	✔	✔	✔	✔	✔	✔
0x55	I/O Options Report	✔	✔	✔	✔	✔	✔
0x56	Velocity Fix East-North-Up (ENU) Report	✔	✔	✔	✔	✔	✔
0x57	Last Computed Fix Report	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x58	Satellite System Data Reports	✔	✔	✔	✔	✔	✔
0x59	Satellite Attribute Database Status Report	✔	✔	✔	✔	✔	✔
0x5A	Raw Measurement Data Report	✔	✔	✔	✔	✔	✔
0x5B	Satellite Ephemeris Status Report	✔	✔	✔	✔	✔	✔
0x5C	Satellite Tracking Status Report	✔	✔	✔	✔	✔	✔
0x5E	Additional Fix Status Report	✔	✔				
0x5F	Severe Failure Notification	✔	✔				
0x60	DGPS Pseudorange Corrections Command	✔	✔	✔	✔	✔	✔
0x60	Differential GPS Pseudorange Corrections Report[1]	✔	✔			✔	
0x61	DGPS Delta Pseudorange Corrections Command	✔	✔	✔	✔	✔	✔
0x61	Differential GPS Delta Pseudorange Corrections Report[1]	✔	✔			✔	
0x62	DGPS Position Fix Mode Command	✔		✔	✔	✔	✔
0x65	Differential Correction Status Request	✔	✔	✔	✔	✔	✔
0x67	Reference Station Parameters Command[1]	✔	✔			✔	
0x67 0x00	Reference Station Control Command[1]	✔	✔			✔	
0x67 0x01	Reference Station Options Command[1]	✔	✔			✔	
0x67 0x02	Reference Station Output Version Command[1]	✔	✔			✔	
0x67 0x03	Reference Station Position Command[1]	✔	✔			✔	
0x67 0x04	Reference Station ID Command[1]	✔	✔			✔	
0x67 0x05	RTCM Type 16 Text Command[1]	✔	✔			✔	
0x67 0x06	RTCM Type Specific Output Intervals Command[1]	✔	✔			✔	
0x67 0x09	Average Position Reference Station Position Request[1]	✔	✔			✔	
0x67 0x0A	Time Schedule Message Interval and Offset Request[1]	✔	✔			✔	
0x68	Mobile Differential Parameters Command	✔	✔				
0x68 0x00	Mobile Differential Mode Command	✔	✔				
0x68 0x01	Mobile Differential Options Command	✔	✔				

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x68 0x02	Mobile Differential Input Version Command	✔	✔				
0x68 0x03	Masking Reference Station Position Command	✔	✔				
0x68 0x04	Input Reference Station ID Command	✔	✔				
0x68 0x05	Last Received RTCM Type 16 Request	✔	✔				
0x6A	Differential Corrections Used in the Fix Commands			✔	✔	✔	✔
0x6A 0x01	Fix Differential Corrections Output Control Command			✔	✔	✔	✔
0x6A	Differential Corrections Used in the Fix Reports			✔	✔	✔	✔
0x6A 0x00	Differential Corrections Used in Fix Report			✔	✔	✔	✔
0x6A 0x01	Fix Differential Corrections Output Control Report			✔	✔	✔	✔
0x6B	QA/QC Commands						
0x6B 0x00	Position Sigma Information Parameters Command						
0x6B 0x01	Position VCV Parameters Command						
0x6B 0x02	Position Sigma Information Request						
0x6B 0x03	Position VCV Information Request						
0x6D	Average Position Commands	✔	✔	✔	✔	✔	
0x6D	All-In-View Satellite Selection Report	✔	✔	✔	✔	✔	✔
0x6D 0x00	Average Position Start/Stop Control Command	✔	✔	✔	✔	✔	
0x6D 0x01	Average Position Options Command	✔	✔	✔	✔	✔	
0x6D 0x02	Auto Stop Parameter Options Command	✔	✔	✔	✔	✔	
0x6D 0x03	Current Average Position Request	✔	✔	✔	✔	✔	
0x6D 0x04	Average Position Delta from Last Position	✔	✔	✔	✔	✔	
0x6E	Synchronized Measurement Parameters Commands	✔	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Parameters Command	✔	✔	✔	✔	✔	✔
0x6E	Synchronized Measurement Parameters Reports	✔	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Output Parameters Report	✔	✔	✔	✔	✔	✔
0x6F	Synchronized Measurements Reports	✔	✔	✔	✔	✔	✔
0x6F 0x01	Synchronized Measurements Report	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x70	Position/Velocity Filter Command			✔	✔	✔	✔
0x70	Position/Velocity Filter Operation Report			✔	✔	✔	✔
0x75	Overdetermined Mode Command	✔	✔	✔	✔	✔	✔
0x76	Overdetermined Mode Report	✔	✔	✔	✔	✔	✔
0x77	Maximum PRC Age Command	✔	✔	✔	✔	✔	✔
0x78	Maximum PRC Age Report	✔	✔	✔	✔	✔	✔
0x7A	NMEA Output Configuration Commands	✔	✔	✔	✔	✔	✔
0x7A 0x00	NMEA Interval and Message Mask Command	✔	✔	✔	✔	✔	✔
0x7A 0x01	NMEA Messages to Output By Name List Command	✔	✔	✔	✔	✔	✔
0x7A 0x02	NMEA Messages Now By Mask Request	✔	✔	✔	✔	✔	✔
0x7A 0x03	NMEA Messages Now By Name List Request	✔	✔	✔	✔	✔	✔
0x7A 0x04	Current NMEA Output Messages Mask and/or Name List Request	✔	✔	✔	✔	✔	✔
0x7A 0x05	NMEA Local Time Offset Command	✔	✔	✔	✔	✔	✔
0x7A 0x06	NMEA Message Options Command	✔	✔	✔	✔	✔	✔
0x7A 0x80	NMEA Interval and Message Mask Command			✔	✔	✔	
0x7A 0x81	NMEA Messages to Output By Name List Command			✔	✔	✔	
0x7A 0x82	NMEA Messages Now By Mask Request						
0x7A 0x83	NMEA Messages Now By Name List Request						
0x7A 0x84	Current NMEA Output Messages Mask and/or Name List Request			✔	✔	✔	
0x7A 0x85	NMEA Local Time Offset Command			✔	✔	✔	
0x7A 0x86	NMEA Message Options Command			✔	✔	✔	
0x7B	NMEA Output Control Reports	✔	✔	✔	✔	✔	✔
0x7B 0x00	NMEA Interval and Message Mask Report	✔	✔	✔	✔	✔	✔
0x7B 0x04	NMEA Name List / Message Mask Report	✔	✔	✔	✔	✔	✔
0x7B 0x05	NMEA Local Time Offsets Report	✔	✔	✔	✔	✔	✔
0x7B 0x06	NMEA Message Options and Precision Report	✔	✔	✔	✔	✔	✔
0x7B 0x80	NMEA Interval and Message Mask Report			✔	✔	✔	

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x7B 0x84	NMEA Name List / Message Mask Report			✔	✔	✔	
0x7B 0x85	NMEA Local Time Offsets Report			✔	✔	✔	
0x7B 0x86	NMEA Message Options and Precision Report			✔	✔	✔	
0x7C	Position Fix or PRC Rate Configuration Commands	✔	✔	✔	✔	✔	✔
0x7C 0x00	ASAP Fix Rate Command	✔	✔	✔	✔	✔	✔
0x7C 0x01	Fast Rate I/O Options Command	✔	✔				
0x7C 0x02	Position Fix Output Interval and Offset Command	✔	✔	✔	✔	✔	✔
0x7C 0x03	Maximum Measurement Age Command	✔	✔	✔	✔	✔	✔
0x7C 0x05	CTS to Transmit Delay Command[1]	✔	✔				
0x7C 0x06	RTS Trailing Edge Delay Command[1]	✔	✔				
0x7C 0x09	Time-Based Message Interval Command[1]			✔	✔	✔	
0x7D	Position Fix Rate Configuration Reports	✔	✔	✔	✔	✔	✔
0x7D 0x00	ASAP Fix Rate Report	✔	✔	✔	✔	✔	✔
0x7D 0x01	Position Fix Rate Options Report	✔	✔				
0x7D 0x02	Position Fix Output Interval and Offset Report	✔	✔	✔	✔	✔	✔
0x7D 0x03	Maximum Measurement Age Report	✔	✔	✔	✔	✔	✔
0x7D 0x05	CTS to Transmit Delay Report[1]	✔					
0x7D 0x06	RTS Trailing Edge Delay Report[1]	✔					
0x7D 0x09	Time-Based Message Interval Report[1]			✔	✔	✔	
0x7D 0x7F	Fast Rate Option Not Installed Notification	✔	✔				
0x82	Differential Position Fix Mode Report	✔	✔	✔	✔	✔	✔
0x83	Double-Precision XYZ Position Fix & Clock Bias Report	✔	✔	✔	✔	✔	✔
0x84	Double-Precision LLA Position Fix & Clock Bias Report	✔	✔	✔	✔	✔	✔
0x85	Differential Correction Status Report	✔	✔	✔	✔	✔	✔
0x87	Reference Station Parameters Report[1]	✔	✔			✔	
0x87 0x00	Reference Station Control Report[1]	✔	✔			✔	
0x87 0x01	Reference Station Options Report[1]	✔	✔			✔	

1 Requires Reference Station option.

2 Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

3 Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x87 0x02	Reference Station Output Version Report[1]	✔	✔			✔	
0x87 0x03	Reference Station Position Report[1]	✔	✔			✔	
0x87 0x04	Reference Station ID Report[1]	✔	✔			✔	
0x87 0x05	RTCM Type 16 Text Report[1]	✔	✔			✔	
0x87 0x06	RTCM Type Specific Output Intervals Report[1]	✔	✔			✔	
0x87 0x08	TSIP Notification of Sent Version 2 RTCM Report[1]	✔	✔			✔	
0x87 0x09	Average Position – Reference Station Position Report[1]	✔	✔			✔	
0x87 0x0A	Time Schedule Message Interval and Offset Report[1]	✔	✔			✔	
0x87 0x7D	Mobile Packet Ignored by Reference Station Notification[1]	✔	✔			✔	
0x87 0x7E	Reference Station Warnings Notification[1]	✔	✔			✔	
0x87 0x7F	Reference Station Option Not Installed Notification[1]	✔	✔			✔	
0x88	Mobile Differential Parameters Report	✔	✔				
0x88 0x00	Mobile Differential Mode Control Report	✔	✔				
0x88 0x01	Mobile Differential Options Report	✔	✔				
0x88 0x02	Mobile Differential Input Version Report	✔	✔				
0x88 0x03	Masking Reference Station Position	✔	✔				
0x88 0x04	Input Reference Station ID Report	✔	✔				
0x88 0x05	Last Received RTCM Type 16 Report	✔	✔				
0x88 0x08	TSIP Notification of Received Version 2 RTCM Report	✔	✔				
0x88 0x7F	Mobile Differential Option Not Installed Notification	✔	✔				
0x8B	QA/QC Reports						
0x8B 0x00	Position Sigma Information Parameters Report						
0x8B 0x01	Position VCV Parameters Report						
0x8B 0x02	Position Sigma Information Report						
0x8B 0x03	Position VCV Information Report						
0x8D	Average Position Reports	✔	✔	✔	✔	✔	
0x8D 0x00	Average Position Start/Stop Control Report	✔	✔	✔	✔	✔	

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x8D 0x01	Average Position Options Report	✔	✔	✔	✔	✔	
0x8D 0x02	Auto Stop Parameters (Control / Options) Report	✔	✔	✔	✔	✔	
0x8D 0x03	Current Average Position XYZ ECEF Report	✔	✔	✔	✔	✔	
0x8D 0x04	Average Position Delta from Last XYZ or ENU Report	✔	✔	✔	✔	✔	
0x8E	Application Commands			✔	✔	✔	✔
0x8E 0x20	Super Packet Output Request						
0x8E 0x60	DR Calibration Command						
0x8E 0x62	GPS/DR Position/Velocity Request						
0x8E 0x64	Firmware Name Request						
0x8E 0x6B	Gyroscope Calibration Values Command						
0x8E 0x6D	Odometer Calibration Values Command						
0x8E 0x6F	Firmware Version Name and Configuration Block Request						
0x8E 0x70	Beacon Channel Status Request (Obsolete)			✔	✔	✔	✔
0x8E 0x71	Beacon DGPS Station Database Report Request			✔	✔	✔	✔
0x8E 0x73	Beacon Channel Control Command (Obsolete)			✔	✔	✔	✔
0x8E 0x74	Clear Beacon Database Command			✔	✔	✔	✔
0x8E 0x75	FFT Start Command			✔	✔	✔	✔
0x8E 0x76	FFT Stop Command			✔	✔	✔	✔
0x8E 0x78	RTCM Reports Request			✔	✔	✔	✔
0x8E 0x79	Beacon Station Attributes Command			✔	✔	✔	✔
0x8E 0x7A	Beacon Station Attributes Report Request			✔	✔	✔	✔
0x8E 0x7B	Receiver Configuration Block and Software Version Request			✔	✔	✔	✔
0x8E 0x7C	Receiver Configuration Block Command			✔	✔	✔	✔
0x8E 0x7E	Satellite Line-of-Sight (LOS) Request			✔	✔	✔	✔
0x8E 0x7F	Receiver ROM Configuration Block and Software Version Request			✔	✔	✔	✔
0x8E 0x80	DGPS Service Provider System Information Request						
0x8E 0x81	Decoder Station Information Command						

1 Requires Reference Station option.

2 Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

3 Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x8E 0x82	Decoder Diagnostic Information Request						
0x8E 0x84	Satellite FFT Control Command						
0x8E 0x85	DGPS Source Tracking Status Request			✔	✔	✔	
0x8E 0x86	Satellite Database Control						
0x8E 0x87	Network Statistics Request			✔	✔	✔	
0x8E 0x88	Diagnostic Output Options Command						
0x8E 0x89	DGPS Source Control Command			✔	✔	✔	
0x8E 0x8A	Service Provider Information Request						
0x8E 0x8B	Service Provider Activation Information Command						
0x8E 0x8E	Service Provider Data Load Command						
0x8E 0x8F	Receiver Identity Request			✔	✔	✔	
0x8E 0x90	Guidance Status Request[2]			✔	✔	✔	
0x8E 0x91	Guidance Configuration Command[2]			✔	✔	✔	
0x8E 0x92	Lightbar Configuration Command[2]			✔	✔	✔	
0x8E 0x94	Guidance Operation Command[2]			✔	✔	✔	
0x8E 0x95	Button Box Configuration Type Command[2]			✔	✔	✔	
0x8E 0x96	Point Manipulation Command[2]			✔	✔	✔	
0x8E 0x97	Utility Information Request[2]			✔	✔	✔	
0x8E 0x98	Individual Button Configuration Command[2]			✔	✔	✔	
0x8E 0x9A	Differential Correction Information Request			✔	✔	✔	
0x8F	Application Reports			✔	✔	✔	✔
0x8F 0x20	Super Packet Output Report						
0x8F 0x60	DR Calibration and Status Report						
0x8F 0x62	GPS/DR Position/Velocity Report						
0x8F 0x64	Firmware Version Name Report						
0x8F 0x6B	Last Gyroscope Readings Report						
0x8F 0x6D	Last Odometer Readings Report						

1 Requires Reference Station option.

2 Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

3 Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x8F 0x6F	Firmware Version and Configuration Report						
0x8F 0x70	Beacon Channel Status Report (Obsolete)			✔	✔	✔	✔
0x8F 0x71	DGPS Station Database Reports			✔	✔	✔	✔
0x8F 0x73	Beacon Channel Control Acknowledgment (Obsolete)			✔	✔	✔	✔
0x8F 0x74	Clear Beacon Database Acknowledgment			✔	✔	✔	✔
0x8F 0x75	FFT Start Acknowledgment			✔	✔	✔	✔
0x8F 0x76	FFT Stop Acknowledgment			✔	✔	✔	✔
0x8F 0x77	FFT Reports			✔	✔	✔	✔
0x8F 0x78	RTCM Reports			✔	✔	✔	✔
0x8F 0x79	Beacon Station Attributes Acknowledgment			✔	✔	✔	✔
0x8F 0x7A	Beacon Station Attributes Report			✔	✔	✔	✔
0x8F 0x7B	DGPS Receiver RAM Configuration Block Report			✔	✔	✔	✔
0x8F 0x7C	DGPS Receiver Configuration Block Acknowledgment			✔	✔	✔	✔
0x8F 0x7E	Satellite Line-of-Sight (LOS) Message			✔	✔	✔	✔
0x8F 0x7F	DGPS Receiver ROM Configuration Block Report			✔	✔	✔	✔
0x8F 0x80	DGPS Service Provider System Information Report						
0x8F 0x81	Decoder Station Information Report and Selection Acknowledgment						
0x8F 0x82	Decoder Diagnostic Information Report						
0x8F 0x84	Satellite FFT Control Acknowledgment						
0x8F 0x85	DGPS Source Tracking Status Report			✔	✔	✔	
0x8F 0x86	Clear Satellite Database Acknowledgment						
0x8F 0x87	Network Statistics Report			✔	✔	✔	
0x8F 0x88	Diagnostic Output Options Report						
0x8F 0x89	DGPS Source Control Report /Acknowledgment			✔	✔	✔	
0x8F 0x8A	Service Provider Information Report and Acknowledgment						

1 Requires Reference Station option.

2 Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

3 Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0x8F 0x8B	Service Provider Activation Information Report and Acknowledgment						
0x8F 0x8E	Service Provider Data Load Report						
0x8F 0x8F	Receiver Identity Report			✔	✔	✔	
0x8F 0x90	Guidance Status Report[2]			✔	✔	✔	
0x8F 0x91	Guidance Configuration Report[2]			✔	✔	✔	
0x8F 0x92	Lightbar Configuration Report[2]			✔	✔	✔	
0x8F 0x94	Guidance Operation Acknowledgment[2]			✔	✔	✔	
0x8F 0x95	Button Box Configuration Type Report[2]			✔	✔	✔	
0x8F 0x96	Point Manipulation Report[2]			✔	✔	✔	
0x8F 0x97	Utility Information Report[2]			✔	✔	✔	
0x8F 0x98	Individual Button Configuration Report[2]			✔	✔	✔	
0x8F 0x9A	Differential Correction Information Report			✔	✔	✔	
0xB0	PPS Signal and Event Commands			✔	✔	✔	✔
0xB0 0x00	PPS Signal Configuration Command			✔	✔	✔	✔
0xB0 0x01	PPS Signal Enable/Disable Command			✔	✔	✔	✔
0xB0 0x40	Event Timestamp Selection Command			✔	✔	✔	✔
0xB0 0x41	Event Packet Options Command			✔	✔	✔	✔
0xB0 0x42	Event Plus Position Request			✔	✔	✔	✔
0xB0 0x43	Event Only Request			✔	✔	✔	✔
0xB0 0x44	Event Marker Miscellaneous Command						
0xB0	PPS and Event Report Packets			✔	✔	✔	✔
0xB0 0x80	PPS Signal Configuration Report			✔	✔	✔	✔
0xB0 0x81	PPS Signal Enable/Disable Acknowledgment			✔	✔	✔	✔
0xB0 0x82	PPS Signal Auto-Generated Report			✔	✔	✔	✔
0xB0 0xC0	Event Timestamp Selection Report			✔	✔	✔	
0xB0 0xC1	Event Packet Options Report			✔	✔	✔	

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

Table C-2 Marine Products TSIP Packet Usage Summary

ID	Name	DSM	DSMPro	DSM12	DSM212H and DSM121L	DSM12RS	NT300D
0xB0 0xC2	Event Plus Position Report			✔	✔	✔	
0xB0 0xC3	Event Only Report			✔	✔	✔	
0xB0 0xC4	Event Marker Miscellaneous Action Taken						
0xBB	Receiver Configuration Parameters Commands						
0xBB 0x00	Primary Receiver Configuration Parameters Request						
0xBB	Receiver Configuration Parameters Reports						
0xBB 0x00	Primary Receiver Configuration Parameters Report						
0xBC	Serial Port Configuration Parameters Command						
0xBC	Serial Port Configuration Parameters Report						
0xC2	Port A Data Transmission Command	✔					

[1] Requires Reference Station option.

[2] Requires Guidance option. Not available in products with machine ids = 37, 97, and 101

[3] Requires Event In option.

C.3 Supported NMEA Messages

Table C-3 shows which NMEA messages are supported by each product. For more information on these messages, see TSIP Command Packet 0x7A.

Table C-3 Marine NMEA Message Summary

Message	DSM	DSMPro	DSM12	DSM12RS	DSM212H	DSM212L	NT300D
ALM	✔	✔	✔	✔	✔	✔	✔
GBS							
GGA	✔	✔	✔	✔	✔	✔	✔
GLL	✔	✔	✔	✔	✔	✔	✔
GRS			✔	✔	✔	✔	✔
GSA	✔	✔	✔	✔	✔	✔	✔
GST			✔	✔	✔	✔	✔
GSV	✔	✔	✔	✔	✔	✔	✔
MSS			✔	✔	✔	✔	✔
PTNLAG001			✔	✔	✔	✔	
PTNLDG			✔	✔	✔	✔	
PTNL,GGK			✔	✔	✔	✔	
PTNLID			✔	✔	✔	✔	
PTNLSM			✔	✔	✔	✔	
RMC			✔	✔	✔	✔	✔
VTG	✔	✔	✔	✔	✔	✔	✔
ZDA	✔	✔	✔	✔	✔	✔	✔

C.4 Key GPS Configuration Parameters

Correctly selecting the proper GPS operating parameters is important to get the best performance from the GPS sensor. Command Packets are available for changing the receiver setup for the specific conditions of a particular user, including packets:

- 0x22 (Position Fix Mode Command)
- 0x2C (Operating Parameters Command)
- 0x35 (I/O Option Flags Command)
- 0x62 (DGPS Position Fix Mode Command)

The default values for the parameters in these packets allow the receiver to operate under a wide variety of demanding conditions. You can choose to change the default parameters if the receiver is required to perform only in a specific or limited environment.

Warning – When the receiver is exposed to operating conditions different from those described in the setup, performance can be degraded.

C.5 DSM and DSM Reference Station

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the DSM and DSM Reference Station are covered in this section. A DSM Reference Station is a DSM receiver with the factory-installed Reference Station Option.

C.5.1 DSM and DSM Reference Station TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the DSM and DSM Reference Station.

DSM and DSM Reference Station Port Naming Conventions

The DSM and DSM Reference Station feature a multi-port cable. The *TSIP Reference* uses the terms Port A and Port B to refer to the receivers first and second serial ports. Table C-4 matches the *TSIP Reference* names for serial ports to the connector names on the multi-port cable.

Table C-4 DSM Serial Port Names

Multiport Cable	TSIP Serial Port Designation
NMEA/RTCM out	Port A
RTCM in	Port A
Control	Port B

DSM and DSM Reference Station Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and ZDA.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

DSM and DSM Reference Station Key Configuration Parameter Settings

Table C-5 identifies key configuration parameters, their associated command and report packets, default settings and recommended settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table C-5 DSM Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	1 = Land
• Elevation Mask	0x2C	0.1309 radians (7.5°)
• Signal Level Mask (SNR)	0x2C	6.0 AMUs
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	0= Off
• Automatic LLA Position Data Report Output Flag	0x35	1 = On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	0 = HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	0 = HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Double
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	0 = Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	1 = On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	1 = UTC
• Fix Computation Time Flag	0x35	0 = ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	0 = When computed
• Simultaneous Measurements Status Flag	0x35	0 = Off
• Minimum Projection Flag	0x35	0 = Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	0 = Off
• Raw or Filtered Codephase Measurements Flag	0x35	0 = Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	0 = Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	0 = Any Station

Table C-5 DSM Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	0
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

C.5.2 Accuracy Versus Fix Density for DSM Receivers

Table C-6 shows suggested parameter selections for the DSM receiver as a function of signal blockage and whether accuracy or fix density is important.

Table C-6 Suggested Parameter Settings for DSM Receivers

	High Signal Blockage		Clear Sky	
Parameter	**Accuracy**	**Fix Density**	**Accuracy**	**Fix Density**
Fix Mode	Manual 3-D	Auto	Manual 3-D	Auto
Elevation Mask	10	5	10	5
SNR Mask	6.0	4.0	6.0	4.0
PDOP Mask	6.0	12.0	6.0	12.0
PDOP Switch	N/A	8.0	N/A	8.0
Minimum Projection	OFF	OFF	ON	OFF
Simultaneous Measurement	OFF	OFF	ON	ON
DGPS Mode	Manual ON	AUTO or OFF	Manual ON	AUTO or OFF

C.5.3 Accuracy Versus Fix Density for DSM Reference Stations

Table C-7 shows suggested parameter selections for the DSM Reference Station as a function of signal blockage and whether accuracy or fix density is important.

Table C-7 Suggested Parameter Settings for the DSM Reference Station

	High Signal Blockage		Clear Sky	
Parameter	**Accuracy**	**Fix Density**	**Accuracy**	**Fix Density**
Elevation Mask	7.5	5	7.5	5
SNR Mask	6.0	4.0	6.0	4.0
Minimum Projection	OFF	OFF	ON	OFF
Simultaneous Measurement	OFF	OFF	ON	ON
Dynamics Code	Static	Static	Static	Static

C.6 DSM*Pro*

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the DSM*Pro* receiver are covered in this section.

C.6.1 DSM*Pro* TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the DSM*Pro* receiver.

DSM*Pro* Port Naming Conventions

The DSM*Pro* receiver includes one RS-232 serial port and two RS-422 serial ports. One RS-422 port (Port 3) is reserved for sending and receiving TSIP packets. The DSM*Pro* Port 3 is referred to as Port B in this publication. The DSM*Pro* Port 1 is referred to as Port A in this publication.

DSM*Pro* Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and Table F-20 identifies the VTG message fields..

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

DSM*Pro* Key GPS Configuration Parameter Settings

Table C-8 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table C-8 DSM*Pro* Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	6.0
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0

Table C-8 DSM*Pro* Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	Off
• Automatic LLA Position Data Report Output Flag	0x35	On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2

Table C-8 DSM*Pro* Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	0
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

C.6.2 Accuracy Versus Fix Density DSM*Pro* Receivers

Table C-6 shows suggested parameter selections as a function of signal blockage and whether accuracy or fix density is important.

Table C-9 Suggested Parameter Settings

	High Signal Blockage		Clear Sky	
Parameter	**Accuracy**	**Fix Density**	**Accuracy**	**Fix Density**
Fix Mode	Manual 3-D	Auto	Manual 3-D	Auto
Elevation Mask	10	5	10	5
SNR Mask	6.0	4.0	6.0	4.0
PDOP Mask	6.0	12.0	6.0	12.0
PDOP Switch	N/A	8.0	N/A	8.0
Minimum Projection	OFF	OFF	ON	OFF
Simultaneous Measurement	OFF	OFF	ON	ON
DGPS Mode	Manual ON	AUTO or OFF	Manual ON	AUTO or OFF

C.7 DSM12

Product support information, TSIP implementation clarifications, and product-specific TSIP requirements for the DSM12 are covered in this section.

C.7.1 DSM12 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the DSM12 receiver by providing product-specific information.

DSM12 Port Naming Conventions

The DSM12 serial port connectors are labeled Port A and Port B. These port connector names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

DSM12 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for DSM12

The DSM12 receiver is manufactured to support a 5 Hz positioning rate.

DSM12 Key Configuration Parameter Settings

Table C-10 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table C-10 DSM12 Key Configuration Parameter Settings

Parameter	Command	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	2.0 AMUs
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	5 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	Off
• Automatic LLA Position Data Report Output Flag	0x35	On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Double precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off

Table C-10 DSM12 Key Configuration Parameter Settings (Continued)

Parameter	Command	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Valid
• Precision of time in RMC (decimal places)	0x7A	2
• NMEA Speed to Output	0x7A	2D SOG

C.8 DSM212H and DSM212L

Product support information, TSIP implementation clarifications, and product-specific TSIP requirements for the DSM212H and DSM212L receivers are covered in this section.

C.8.1 DSM212H and DSM212L TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the DSM212H and DSM212L receivers by providing product-specific information.

DSM212H and DSM212L Port Naming Conventions

The DSM212H and DSM212L serial port connectors are labeled Port A and Port B. These port connector names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

DSM212H and DSM212L Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for DSM212H and DSM212L Receivers

The DSM212L receiver is manufactured to support a 1 Hz positioning rate, and the DSM212H receiver includes the 10 Hz positioning rate option, supporting positioning rates of 5 or 10 Hz. The Maximum Positioning Rate for the DSM212H can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

DSM212H and DSM212L Key Configuration Parameter Settings

Table C-10 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table C-11 DSM212H and DSM212L Key Configuration Parameter Settings

Parameter	Command	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	2.0 AMUs
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz (DSM212L) 5 Hz (DSM212H)
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	Off
• Automatic LLA Position Data Report Output Flag	0x35	On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Double precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off

Table C-11 DSM212H and DSM212L Key Configuration Parameter Settings (Continued)

Parameter	Command	Default
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Valid
• Precision of time in RMC (decimal places)	0x7A	2
• NMEA Speed to Output	0x7A	2D SOG

C.9 DSM12RS

Product support information, TSIP implementation clarifications, and product-specific TSIP requirements for the DSM12RS receiver are covered in this section.

C.9.1 DSM12RS TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the DSM12RS receiver by providing product-specific information.

DSM12RS Port Naming Conventions

The DSM12RS serial port connectors are labeled Port A and Port B. These port connector names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

DSM12RS Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for DSM12RS Receiver

The DSM12RS receiver is manufactured to support a 1 Hz positioning rate. The Maximum Positioning Rate is set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

DSM12RS Key Configuration Parameter Settings

Table C-10 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table C-12 DSM12RS Key Configuration Parameter Settings

Parameter	Command	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	2.0 AMUs
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	Off
• Automatic LLA Position Data Report Output Flag	0x35	On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Double precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off

Table C-12 DSM12RS Key Configuration Parameter Settings (Continued)

Parameter	Command	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	2D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Valid
• Precision of time in RMC (decimal places)	0x7A	2
• NMEA Speed to Output	0x7A	2D SOG

C.10 NT300D

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the NT300D receiver are covered in this section.

C.10.1 NT300D TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for NT300D receiver.

NT300D Port Naming Conventions

The NT300D features two serial ports called Serial Port 1 and Serial Port 2. Either port can be configured for TSIP input and output. The port currently used to input and output TSIP packets is referred to as Port B in this publication. The port used to output RTCM data is referred to as Port A in this publication. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

NT300D Default Port Configurations

The default input and output protocols for both Port A and Port B are set to Off (no protocols are selected by default). The default baud rate is 4800 baud for both ports. For all input and output protocols on both ports, the NT300D is hard-wired to support 8 characters, no parity, and 1 stop bit.

NT300D Default NMEA Sentences

The default NMEA messages are DTM, GGA, VTG, XTE, and ZDA.

NT300D Key Configuration Parameter Settings

Table C-13 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table C-13 NT300D Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Manual 3D
Operating Parameters		
• Dynamics Code	0x2C	Sea
• Elevation Mask	0x2C	10°
• Signal Level Mask (SNR)	0x2C	6.0 (M)
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0

Table C-13 NT300D Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	Off
• Automatic LLA Position Data Report Output Flag	0x35	On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Double precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2

Table C-13 NT300D Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Valid
• Precision of time in RMC (decimal places)	0x7A	2
• NMEA Speed to Output	0x7A	SOG

D Mobile Positioning and Communication Products

TSIP (Trimble Standard Interface Protocol) support for Mobile Positioning and Communications products are summarized in this chapter. The Mobile Positioning and Communications products are identified and the TSIP command and report packets supported by each product are summarized. Application notes are provided for each Mobile Positioning and Communications product to clarify the TSIP implementation and identify the default settings for key GPS parameters and receiver configuration options.

D.1 Supported Mobile Positioning and Communications Products

TSIP information is provided for these receivers:

- CrossCheck AMPS Cellular (section D.5 on page D-15)
- CrossCheck XR (section D.6 on page D-18)
- Placer GPS 450 (section D.7 on page D-21)
- Placer GPS 455 and Placer GPS 455DR (section D.8 on page D-24)

D.1.1 Identification

In TSIP, each product is uniquely identified by a product ID and a machine ID, much like people are named with a first and last name. The machine ID, like a last name, associates the GPS receiver with a particular family of Trimble receivers. The product ID, like a first name, uniquely specifies the product within its family. The machine ID is used in Report Packet 0x45, Report Packet 0x4B, and Report Packet 0x8F 0x8F. The product ID is used in Report Packet 0x45, Report Packet 0x8F 0x64, Report Packet 0x8F 0x7B, and Report Packet 0x8F 0x8F. The machine and product IDs for the supported products listed above are defined in Table D-1.

Table D-1 Mobile Positioning and Communications Product Identification

Name	Machine ID		Product ID	
	Decimal	Hex	Decimal	Hex
CrossCheck AMPS Cellular	100	0x64	0	0x00
CrossCheck XR			0	0x00
Placer GPS 450	84	0x54	0	0x00
Placer GPS 455 and Placer GPS 455DR	85	0x55	0	0x00

D.2 TSIP Packet Summary

Table D-2 includes a numerical listing of TSIP command and report packets and identifies the products supported by each packet.

Table D-2 Mobile Positioiing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x13	TSIP Parsing Error Notification	✔	✔	✔	✔	✔
0x1A	TSIP RTCM Wrapper Command					
0x1A 0x00	Raw RTCM Data Packet Request					
0x1A	TSIP RTCM Wrapper / Port A Echo Report					
0x1A 0x00	Raw RTCM Wrapper / Port A Echo Report					
0x1D	Oscillator Offset Command	✔	✔	✔	✔	✔
0x1E	Clear Battery-Backed Memory Command	✔	✔	✔	✔	✔
0x1F	Receiver Firmware Information Request	✔	✔	✔	✔	✔
0x20	Almanac Request	✔	✔	✔	✔	✔
0x21	Current Time Request	✔	✔	✔	✔	✔
0x22	Position Fix Mode Command	✔	✔	✔	✔	✔
0x23	Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔
0x24	GPS Position Fix Mode Request	✔	✔	✔	✔	✔
0x25	Soft Reset / Self Test Command	✔	✔	✔	✔	✔
0x26	Health Request	✔	✔	✔	✔	✔
0x27	Signal Levels Request	✔	✔	✔	✔	✔
0x28	GPS System Message Request	✔	✔	✔	✔	✔
0x29	Almanac Health Page Request	✔	✔	✔	✔	✔
0x2A	Altitude for 2D Mode Command	✔	✔	✔	✔	✔
0x2B	Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔
0x2C	Operating Parameters Command	✔	✔	✔	✔	✔
0x2D	Oscillator Offset Request	✔	✔	✔	✔	✔
0x2E	GPS Time Command	✔	✔	✔	✔	✔
0x2F	UTC Parameters Request	✔	✔	✔	✔	✔
0x31	Accurate Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔
0x32	Accurate Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x33	Analog-to-Digital Readings Command					
0x34	Satellite Number For One-Satellite Mode Command	✔	✔	✔	✔	✔
0x35	I/O Option Flags Command	✔	✔	✔	✔	✔
0x36	Velocity Aiding of Acquisition Command					
0x37	Last Position and Velocity Request	✔	✔	✔	✔	✔
0x38	Download and Upload Satellite System Data	✔	✔	✔	✔	✔
0x39	Satellite Attribute Database Command	✔	✔	✔	✔	✔
0x3A	Last Raw Measurement Request	✔	✔	✔	✔	✔
0x3B	Satellite Ephemeris Status Request	✔	✔	✔	✔	✔
0x3C	Satellite Tracking Status Request	✔	✔	✔	✔	✔
0x3D	Serial Port A Communication Parameters Command	✔	✔	✔	✔	✔
0x3D	Serial Port A Configuration Report	✔	✔	✔	✔	✔
0x3E	Additional Fix Parameters Request					
0x40	Almanac Data for Single Satellite Report	✔	✔	✔	✔	✔
0x41	GPS Time Report	✔	✔	✔	✔	✔
0x42	Single-Precision Position Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔
0x43	Velocity Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔
0x44	Non-Overdetermined Satellite Selection Report					
0x45	Receiver Firmware Information Report	✔	✔	✔	✔	✔
0x46	Health of Receiver Report	✔	✔	✔	✔	✔
0x47	Signal Levels for All Satellites Report	✔	✔	✔	✔	✔
0x48	GPS System Message Report	✔	✔	✔	✔	✔
0x49	Almanac Health Page Report	✔	✔	✔	✔	✔
0x4A	Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report	✔	✔	✔	✔	✔
0x4B	Machine / Code ID and Additional Status Report	✔	✔	✔	✔	✔
0x4C	Operating Parameters Report	✔	✔	✔	✔	✔
0x4D	Oscillator Offset Report	✔	✔	✔	✔	✔
0x4E	GPS Time Command Verification	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x4F	UTC Parameters Report	✔	✔	✔	✔	✔
0x53	Analog-to-Digital Readings Report					
0x54	One Satellite Bias and Bias Rate Report	✔	✔	✔	✔	✔
0x55	I/O Options Report	✔	✔	✔	✔	✔
0x56	Velocity Fix East-North-Up (ENU) Report	✔	✔	✔	✔	✔
0x57	Last Computed Fix Report	✔	✔	✔	✔	✔
0x58	Satellite System Data Reports	✔	✔	✔	✔	✔
0x59	Satellite Attribute Database Status Report	✔	✔	✔	✔	✔
0x5A	Raw Measurement Data Report	✔	✔	✔	✔	✔
0x5B	Satellite Ephemeris Status Report	✔	✔	✔	✔	✔
0x5C	Satellite Tracking Status Report	✔	✔	✔	✔	✔
0x5E	Additional Fix Status Report					
0x5F	Severe Failure Notification					
0x60	DGPS Pseudorange Corrections Command	✔	✔	✔	✔	✔
0x60	Differential GPS Pseudorange Corrections Report[1]					
0x61	DGPS Delta Pseudorange Corrections Command	✔	✔	✔	✔	✔
0x61	Differential GPS Delta Pseudorange Corrections Report[1]					
0x62	DGPS Position Fix Mode Command	✔	✔	✔	✔	✔
0x65	Differential Correction Status Request	✔	✔	✔	✔	✔
0x67	Reference Station Parameters Command[1]					
0x67 0x00	Reference Station Control Command[1]					
0x67 0x01	Reference Station Options Command[1]					
0x67 0x02	Reference Station Output Version Command[1]					
0x67 0x03	Reference Station Position Command[1]					
0x67 0x04	Reference Station ID Command[1]					
0x67 0x05	RTCM Type 16 Text Command[1]					
0x67 0x06	RTCM Type Specific Output Intervals Command[1]					
0x67 0x09	Average Position Reference Station Position Request[1]					
0x67 0x0A	Time Schedule Message Interval and Offset Request[1]					

1 Requires Reference Station option.

2 No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x68	Mobile Differential Parameters Command					
0x68 0x00	Mobile Differential Mode Command					
0x68 0x01	Mobile Differential Options Command					
0x68 0x02	Mobile Differential Input Version Command					
0x68 0x03	Masking Reference Station Position Command					
0x68 0x04	Input Reference Station ID Command					
0x68 0x05	Last Received RTCM Type 16 Request					
0x6A	Differential Corrections Used in the Fix Commands	✔	✔	✔		✔
0x6A 0x01	Fix Differential Corrections Output Control Command	✔	✔	✔		✔
0x6A	Differential Corrections Used in the Fix Reports	✔	✔	✔		✔
0x6A 0x00	Differential Corrections Used in Fix Report	✔	✔	✔		✔
0x6A 0x01	Fix Differential Corrections Output Control Report	✔	✔	✔		✔
0x6B	QA/QC Commands					
0x6B 0x00	Position Sigma Information Parameters Command					
0x6B 0x01	Position VCV Parameters Command					
0x6B 0x02	Position Sigma Information Request					
0x6B 0x03	Position VCV Information Request					
0x6D	Average Position Commands					
0x6D	All-In-View Satellite Selection Report	✔	✔	✔	✔	✔
0x6D 0x00	Average Position Start/Stop Control Command					
0x6D 0x01	Average Position Options Command					
0x6D 0x02	Auto Stop Parameter Options Command					
0x6D 0x03	Current Average Position Request					
0x6D 0x04	Average Position Delta from Last Position					
0x6E	Synchronized Measurement Parameters Commands	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Parameters Command	✔	✔	✔	✔	✔
0x6E	Synchronized Measurement Parameters Reports	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Output Parameters Report	✔	✔	✔	✔	✔
0x6F	Synchronized Measurements Reports[2]	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x6F 0x01	Synchronized Measurements Report[2]	✔	✔	✔	✔	✔
0x70	Position/Velocity Filter Command	✔	✔	✔	✔	✔
0x70	Position/Velocity Filter Operation Report	✔	✔	✔	✔	✔
0x75	Overdetermined Mode Command	✔	✔	✔	✔	✔
0x76	Overdetermined Mode Report	✔	✔	✔	✔	✔
0x77	Maximum PRC Age Command	✔	✔	✔	✔	✔
0x78	Maximum PRC Age Report	✔	✔	✔	✔	✔
0x7A	NMEA Output Configuration Commands					
0x7A 0x00	NMEA Interval and Message Mask Command					
0x7A 0x01	NMEA Messages to Output By Name List Command					
0x7A 0x02	NMEA Messages Now By Mask Request					
0x7A 0x03	NMEA Messages Now By Name List Request					
0x7A 0x04	Current NMEA Output Messages Mask and/or Name List Request					
0x7A 0x05	NMEA Local Time Offset Command					
0x7A 0x06	NMEA Message Options Command					
0x7A 0x80	NMEA Interval and Message Mask Command					
0x7A 0x81	NMEA Messages to Output By Name List Command					
0x7A 0x82	NMEA Messages Now By Mask Request					
0x7A 0x83	NMEA Messages Now By Name List Request					
0x7A 0x84	Current NMEA Output Messages Mask and/or Name List Request					
0x7A 0x85	NMEA Local Time Offset Command					
0x7A 0x86	NMEA Message Options Command					
0x7B	NMEA Output Control Reports					
0x7B 0x00	NMEA Interval and Message Mask Report					
0x7B 0x04	NMEA Name List / Message Mask Report					
0x7B 0x05	NMEA Local Time Offsets Report					
0x7B 0x06	NMEA Message Options and Precision Report					
0x7B 0x80	NMEA Interval and Message Mask Report					
0x7B 0x84	NMEA Name List / Message Mask Report					

1 Requires Reference Station option.

2 No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x7B 0x85	NMEA Local Time Offsets Report					
0x7B 0x86	NMEA Message Options and Precision Report					
0x7C	Position Fix or PRC Rate Configuration Commands					
0x7C 0x00	ASAP Fix Rate Command					
0x7C 0x01	Fast Rate I/O Options Command					
0x7C 0x02	Position Fix Output Interval and Offset Command					
0x7C 0x03	Maximum Measurement Age Command					
0x7C 0x05	CTS to Transmit Delay Command[1]					
0x7C 0x06	RTS Trailing Edge Delay Command[1]					
0x7C 0x09	Time-Based Message Interval Command[1]					
0x7D	Position Fix Rate Configuration Reports					
0x7D 0x00	ASAP Fix Rate Report					
0x7D 0x01	Position Fix Rate Options Report					
0x7D 0x02	Position Fix Output Interval and Offset Report					
0x7D 0x03	Maximum Measurement Age Report					
0x7D 0x05	CTS to Transmit Delay Report[1]					
0x7D 0x06	RTS Trailing Edge Delay Report[1]					
0x7D 0x09	Time-Based Message Interval Report					
0x7D 0x7F	Fast Rate Option Not Installed Notification					
0x82	Differential Position Fix Mode Report	✔	✔	✔	✔	✔
0x83	Double-Precision XYZ Position Fix & Clock Bias Report	✔	✔	✔	✔	✔
0x84	Double-Precision LLA Position Fix & Clock Bias Report	✔	✔	✔	✔	✔
0x85	Differential Correction Status Report	✔	✔	✔	✔	✔
0x87	Reference Station Parameters Report[1]					
0x87 0x00	Reference Station Control Report[1]					
0x87 0x01	Reference Station Options Report[1]					
0x87 0x02	Reference Station Output Version Report[1]					
0x87 0x03	Reference Station Position Report[1]					
0x87 0x04	Reference Station ID Report[1]					

1 Requires Reference Station option.

2 No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x87 0x05	RTCM Type 16 Text Report[1]					
0x87 0x06	RTCM Type Specific Output Intervals Report[1]					
0x87 0x08	TSIP Notification of Sent Version 2 RTCM Report[1]					
0x87 0x09	Average Position – Reference Station Position Report[1]					
0x87 0x0A	Time Schedule Message Interval and Offset Report[1]					
0x87 0x7D	Mobile Packet Ignored by Reference Station Notification[1]					
0x87 0x7E	Reference Station Warnings Notification[1]					
0x87 0x7F	Reference Station Option Not Installed Notification[1]					
0x88	Mobile Differential Parameters Report					
0x88 0x00	Mobile Differential Mode Control Report					
0x88 0x01	Mobile Differential Options Report					
0x88 0x02	Mobile Differential Input Version Report					
0x88 0x03	Masking Reference Station Position					
0x88 0x04	Input Reference Station ID Report					
0x88 0x05	Last Received RTCM Type 16 Report					
0x88 0x08	TSIP Notification of Received Version 2 RTCM Report					
0x88 0x7F	Mobile Differential Option Not Installed Notification					
0x8B	QA/QC Reports					
0x8B 0x00	Position Sigma Information Parameters Report					
0x8B 0x01	Position VCV Parameters Report					
0x8B 0x02	Position Sigma Information Report					
0x8B 0x03	Position VCV Information Report					
0x8D	Average Position Reports					
0x8D 0x00	Average Position Start/Stop Control Report					
0x8D 0x01	Average Position Options Report					
0x8D 0x02	Auto Stop Parameters (Control / Options) Report					
0x8D 0x03	Current Average Position XYZ ECEF Report					
0x8D 0x04	Average Position Delta from Last XYZ or ENU Report					
0x8E	Application Commands	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x8E 0x20	Super Packet Output Request					
0x8E 0x60	DR Calibration Command			✔		
0x8E 0x62	GPS/DR Position/Velocity Request			✔		
0x8E 0x64	Firmware Name Request	✔	✔	✔	✔	✔
0x8E 0x6B	Gyroscope Calibration Values Command			✔		
0x8E 0x6D	Odometer Calibration Values Command			✔		
0x8E 0x6F	Firmware Version Name and Configuration Block Request	✔	✔	✔	✔	✔
0x8E 0x70	Beacon Channel Status Request (Obsolete)					
0x8E 0x71	Beacon DGPS Station Database Report Request					
0x8E 0x73	Beacon Channel Control Command (Obsolete)					
0x8E 0x74	Clear Beacon Database Command					
0x8E 0x75	FFT Start Command					
0x8E 0x76	FFT Stop Command					
0x8E 0x78	RTCM Reports Request					
0x8E 0x79	Beacon Station Attributes Command					
0x8E 0x7A	Beacon Station Attributes Report Request					
0x8E 0x7B	Receiver Configuration Block and Software Version Request					
0x8E 0x7C	Receiver Configuration Block Command					
0x8E 0x7E	Satellite Line-of-Sight (LOS) Request					
0x8E 0x7F	Receiver ROM Configuration Block and Software Version Request					
0x8E 0x80	DGPS Service Provider System Information Request					
0x8E 0x81	Decoder Station Information Command					
0x8E 0x82	Decoder Diagnostic Information Request					
0x8E 0x84	Satellite FFT Control Command					
0x8E 0x85	DGPS Source Tracking Status Request					
0x8E 0x86	Satellite Database Control					
0x8E 0x87	Network Statistics Request					
0x8E 0x88	Diagnostic Output Options Command					
0x8E 0x89	DGPS Source Control Command					

[1] Requires Reference Station option.

[2] No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x8E 0x8A	Service Provider Information Request					
0x8E 0x8B	Service Provider Activation Information Command					
0x8E 0x8E	Service Provider Data Load Command					
0x8E 0x8F	Receiver Identity Request					
0x8E 0x90	Guidance Status Request					
0x8E 0x91	Guidance Configuration Command					
0x8E 0x92	Lightbar Configuration Command					
0x8E 0x94	Guidance Operation Command					
0x8E 0x95	Button Box Configuration Type Command					
0x8E 0x96	Point Manipulation Command					
0x8E 0x97	Utility Information Request					
0x8E 0x98	Individual Button Configuration Command					
0x8E 0x9A	Differential Correction Information Request					
0x8F	Application Reports	✔	✔	✔	✔	✔
0x8F 0x20	Super Packet Output Report					
0x8F 0x60	DR Calibration and Status Report			✔		
0x8F 0x62	GPS/DR Position/Velocity Report			✔		
0x8F 0x64	Firmware Version Name Report	✔	✔	✔	✔	✔
0x8F 0x6B	Last Gyroscope Readings Report			✔		
0x8F 0x6D	Last Odometer Readings Report			✔		
0x8F 0x6F	Firmware Version and Configuration Report	✔	✔	✔	✔	✔
0x8F 0x70	Beacon Channel Status Report (Obsolete)					
0x8F 0x71	DGPS Station Database Reports					
0x8F 0x73	Beacon Channel Control Acknowledgment (Obsolete)					
0x8F 0x74	Clear Beacon Database Acknowledgment					
0x8F 0x75	FFT Start Acknowledgment					
0x8F 0x76	FFT Stop Acknowledgment					
0x8F 0x77	FFT Reports					
0x8F 0x78	RTCM Reports					

[1] Requires Reference Station option.

[2] No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0x8F 0x79	Beacon Station Attributes Acknowledgment					
0x8F 0x7A	Beacon Station Attributes Report					
0x8F 0x7B	DGPS Receiver RAM Configuration Block Report					
0x8F 0x7C	DGPS Receiver Configuration Block Acknowledgment					
0x8F 0x7E	Satellite Line-of-Sight (LOS) Message					
0x8F 0x7F	DGPS Receiver ROM Configuration Block Report					
0x8F 0x80	DGPS Service Provider System Information Report					
0x8F 0x81	Decoder Station Information Report and Selection Acknowledgment					
0x8F 0x82	Decoder Diagnostic Information Report					
0x8F 0x84	Satellite FFT Control Acknowledgment					
0x8F 0x85	DGPS Source Tracking Status Report					
0x8F 0x86	Clear Satellite Database Acknowledgment					
0x8F 0x87	Network Statistics Report					
0x8F 0x88	Diagnostic Output Options Report					
0x8F 0x89	DGPS Source Control Report /Acknowledgment					
0x8F 0x8A	Service Provider Information Report and Acknowledgment					
0x8F 0x8B	Service Provider Activation Information Report and Acknowledgment					
0x8F 0x8E	Service Provider Data Load Report					
0x8F 0x8F	Receiver Identity Report					
0x8F 0x90	Guidance Status Report					
0x8F 0x91	Guidance Configuration Report					
0x8F 0x92	Lightbar Configuration Report					
0x8F 0x94	Guidance Operation Acknowledgment					
0x8F 0x95	Button Box Configuration Type Report					
0x8F 0x96	Point Manipulation Report					
0x8F 0x97	Utility Information Report					
0x8F 0x98	Individual Button Configuration Report					
0x8F 0x9A	Differential Correction Information Report					
0xB0	PPS Signal and Event Commands					

[1] Requires Reference Station option.

[2] No carrier phase information supported.

Table D-2 Mobile Positioing Products TSIP Packet Summary

ID	Name	Placer GPS 450	Placer GPS 455	Placer GPS 455DR	CrossCheck AMPS	CrossCheck XR
0xB0 0x00	PPS Signal Configuration Command					
0xB0 0x01	PPS Signal Enable/Disable Command					
0xB0 0x40	Event Timestamp Selection Command					
0xB0 0x41	Event Packet Options Command					
0xB0 0x42	Event Plus Position Request					
0xB0 0x43	Event Only Request					
0xB0 0x44	Event Marker Miscellaneous Command					
0xB0	PPS and Event Report Packets					
0xB0 0x80	PPS Signal Configuration Report					
0xB0 0x81	PPS Signal Enable/Disable Acknowledgment					
0xB0 0x82	PPS Signal Auto-Generated Report					
0xB0 0xC0	Event Timestamp Selection Report					
0xB0 0xC1	Event Packet Options Report					
0xB0 0xC2	Event Plus Position Report					
0xB0 0xC3	Event Only Report					
0xB0 0xC4	Event Marker Miscellaneous Action Taken					
0xBB	Receiver Configuration Parameters Commands	✔	✔	✔	✔	✔
0xBB 0x00	Primary Receiver Configuration Parameters Request	✔	✔	✔	✔	✔
0xBB	Receiver Configuration Parameters Reports	✔	✔	✔	✔	✔
0xBB 0x00	Primary Receiver Configuration Parameters Report	✔	✔	✔	✔	✔
0xBC	Serial Port Configuration Parameters Command	✔	✔	✔	✔	✔
0xBC	Serial Port Configuration Parameters Report	✔	✔	✔	✔	✔
0xC2	Port A Data Transmission Command					

[1] Requires Reference Station option.

[2] No carrier phase information supported.

D.3 Supported NMEA Messages

Table 4-3 shows which NMEA messages are supported by each product. Mobile Positioning products do not support the NMEA configuration available in TSIP Command Packet 0x7A.

Table 4-3 Mobile Positioning NMEA Message Summary

Message	Placer GPS			Crosscheck	
	450	455	455DR	AMPS	XR
ALM					
GBS					
GGA	✔	✔	✔	✔	✔
GLL	✔	✔	✔	✔	✔
GRS					
GSA	✔	✔	✔	✔	✔
GST					
GSV					
MSS					
PTNLAG001					
PTNLDG					
PTNL,GGK					
PTNLID					
PTNLSM					
VTG	✔	✔	✔	✔	✔
RMC	✔	✔	✔	✔	✔
ZDA	✔	✔	✔	✔	✔

D.4 Key GPS Configuration Parameter Settings

Correctly selecting the proper GPS operating parameters is important to get the best performance from the GPS sensor. Command Packets are available for changing the receiver setup for the specific conditions of a particular user, including packets:

- 0x22 (Position Fix Mode Command)
- 0x2C (Operating Parameters Command)
- 0x35 (I/O Option Flags Command)
- 0x62 (DGPS Position Fix Mode Command)

The default values for the parameters in these packets allow the receiver to operate under a wide variety of demanding mobile positioning and tracking applications. You can choose to change the default parameters if the receiver is required to perform only in a specific or limited environment.

Warning – When the receiver is exposed to operating conditions different from those described in the setup, performance can be degraded.

D.5 CrossCheck AMPS Cellular

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the Crosscheck AMPS Cellular unit are covered in this appendix.

D.5.1 Crosscheck AMPS Cellular TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for Crosscheck AMPS Cellular unit.

CrossCheck AMPS Cellular Port Naming Conventions

The TSIP packets for configuring serial ports refer to the first serial port on the unit's electronics board as Port A and the second serial port as Port B. The Crosscheck AMPS Cellular unit uses a descriptive name to label the single serial port connector on the back panel of the receiver processing unit. The connector label name, AUX (MDT) reflects the default function assigned to the port. The AUX (MDT) port can be used to transmit TSIP data and is referred to as Port B in this publication.

Note – The Crosscheck AMPS Cellular unit is factory configured to use TAIP (Trimble ASCII Interface Protocol) rather than TSIP. To use TSIP instead of TAIP, use the TAIP PR (Protocol) message to select TSIP as both the input and output protocols for controlling the selected port.

Crosscheck AMPS Cellular Key GPS Configuration Parameter Settings

Table D-4 identifies key configuration parameters, their associated command packets, and default settings. If the unit fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table D-4 Crosscheck AMPS Cellular Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	10.0°
• Signal Level Mask (SNR)	0x2C	6.0
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0

Table D-4 Crosscheck AMPS Cellular Key Configuration Parameter Settings

Parameter	Packet	Default
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	N/A
• Validity of GGA for non-differential positions	0x7A	N/A
• Representation of invalid GGA	0x7A	N/A
• Precision of time in GGA (decimal places)	0x7A	N/A

Table D-4 Crosscheck AMPS Cellular Key Configuration Parameter Settings

Parameter	Packet	Default
GLL Message		
• GLL NMEA Version	0x7A	N/A
• Validity of GLL for old positions	0x7A	N/A
• Validity of GLL for non-differential positions	0x7A	N/A
• Representation of invalid GLL message	0x7A	N/A
• Precision of time in GLL (number of decimal places)	0x7A	N/A
VTG Message		
• VTG NMEA Version	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

D.6 CrossCheck XR

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the CrossCheck XR units are covered in this appendix.

D.6.1 CrossCheck XR TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for CrossCheck XR units.

CrossCheck XR Port Naming Conventions

The TSIP packets for configuring serial ports refer to the first serial port on the unit's electronics board as Port A and the second serial port as Port B. The CrossCheck XR unit uses descriptive names to label the port connectors on the back panel of the processing unit. The connector label names reflect the default function assigned to each port.

CrossCheck XR units can transmit TSIP data from any serial port, but only one port is used to transmit TSIP data at any given time. The CrossCheck XR port currently used to transmit TSIP data is referred to as Port B in this publication. The CrossCheck XR RTCM Port is referred to as Port A in this publication.

Note – CrossCheck XR operating parameters are configured locally with TSIP packets or TAIP messages using the MDT port. When the CrossCheck XR operates in mobile tracking applications, TSIP or TAIP messages are transmitted over a wireless communications link to the Radio port. TSIP or TAIP input and output is disabled on the MDT port when the Radio port is used and vice versa.

Note – CrossCheck XR units are factory configured to use TAIP (Trimble ASCII Interface Protocol) rather than TSIP. To use TSIP instead of TAIP, use the TAIP PR (Protocol) message to select TSIP as both the input and output protocols for controlling the selected port.

CrossCheck XR Key GPS Configuration Parameter Settings

Table D-4 identifies key configuration parameters, their associated command packets, and default settings. If the unit fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table D-5 Crosscheck XR Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	10.0°
• Signal Level Mask (SNR)	0x2C	6.0
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station

Table D-5 Crosscheck XR Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	N/A
• Validity of GGA for non-differential positions	0x7A	N/A
• Representation of invalid GGA	0x7A	N/A
• Precision of time in GGA (decimal places)	0x7A	N/A
GLL Message		
• GLL NMEA Version	0x7A	N/A
• Validity of GLL for old positions	0x7A	N/A
• Validity of GLL for non-differential positions	0x7A	N/A
• Representation of invalid GLL message	0x7A	N/A
• Precision of time in GLL (number of decimal places)	0x7A	N/A
VTG Message		
• VTG NMEA Version	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

D.7 Placer GPS 450

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the Placer GPS 450 unit are covered in this section.

D.7.1 Placer GPS 450 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for Placer GPS 450 unit.

Placer GPS 450 Port Naming Conventions

The TSIP packets for configuring serial ports refer to the first serial port on the unit's electronics board as Port A and the second serial port as Port B. The Placer GPS 450 unit uses descriptive names to label the port connectors on the back panel of the processing unit. The connector label names reflect the default function assigned to each port.

Placer GPS 450 units can transmit TSIP data from any serial port, but only one port is used to transmit TSIP data at any given time. The Placer GPS 450 port currently used to transmit TSIP data is referred to as Port B in this publication. The use of the term Port A does not apply to the Placer GPS 450 unit.

Note – Placer GPS operating parameters are configured locally with TSIP packets or TAIP messages using the MDT port. When the Placer GPS operates in mobile tracking applications, TSIP packets or TAIP messages are transmitted over a wireless communications link to the Radio port.

Note – Placer GPS units are factory configured to use TAIP (Trimble ASCII Interface Protocol) rather than TSIP. To use TSIP instead of TAIP, use the TAIP PR (Protocol) message to select TSIP as both the input and output protocols for controlling the selected port.

Placer GPS 450 Key GPS Configuration Parameter Settings

Table D-4 identifies key configuration parameters, their associated command packets, and default settings. If the unit fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table D-6 Placer GPS 450 Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	10.0°
• Signal Level Mask (SNR)	0x2C	6.0
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off

Table D-6 Placer GPS 450 Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	N/A
• Validity of GGA for non-differential positions	0x7A	N/A
• Representation of invalid GGA	0x7A	N/A
• Precision of time in GGA (decimal places)	0x7A	N/A
GLL Message		
• GLL NMEA Version	0x7A	N/A
• Validity of GLL for old positions	0x7A	N/A
• Validity of GLL for non-differential positions	0x7A	N/A
• Representation of invalid GLL message	0x7A	N/A
• Precision of time in GLL (number of decimal places)	0x7A	N/A
VTG Message		
• VTG NMEA Version	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

D.8 Placer GPS 455 and Placer GPS 455DR

Product support information, TSIP implementation clarifications, and product-specific TSIP requirements for Placer GPS 455 and Placer GPS 455DR units are covered in this section. The Placer GPS 455DR is a Placer GPS 455 with the Heading Sensor Option.

D.8.1 Placer GPS 455/455DR TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the Placer GPS 455 and Placer GPS 455DR units by providing product-specific information.

Placer 455/455DR Port Naming Conventions

The TSIP packets for configuring serial ports refer to the first serial port on the unit's electronics board as Port A and the second serial port as Port B. The Placer GPS 455 and Placer GPS 455DR units use descriptive names to label the port connectors on the back panel of the processing unit. The connector label names reflect the default function assigned to each port.

Placer GPS units can transmit TSIP data from any serial port, but only one port is used to transmit TSIP data at any given time. The Placer GPS port currently used to transmit TSIP data is referred to as Port B in this publication. The Placer GPS RTCM Port is referred to as Port A in this publication.

Note – Placer GPS operating parameters are configured locally with TSIP packets or TAIP messages using the MDT port. When the Placer GPS operates in mobile tracking applications, TSIP packets or TAIP messages are transmitted over a wireless communications link to the Radio port. TSIP or TAIP input and output is disabled on the MDT port when the Radio port is used and vice versa.

Note – Placer GPS units are factory configured to use TAIP (Trimble ASCII Interface Protocol) rather than TSIP. To use TSIP instead of TAIP, use the TAIP PR (Protocol) message to select TSIP as both the input and output protocols for controlling the selected port.

Placer GPS 455/455DR Key GPS Configuration Parameter Settings

Table D-4 identifies key configuration parameters, their associated command packets, and default settings. If the unit fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table D-7 Placer GPS 455/455DR Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	0.0° (Urban mode)
• Signal Level Mask (SNR)	0x2C	6.0
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off

Table D-7 Placer GPS 455/455DR Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	N/A
• Validity of GGA for non-differential positions	0x7A	N/A
• Representation of invalid GGA	0x7A	N/A
• Precision of time in GGA (decimal places)	0x7A	N/A
GLL Message		
• GLL NMEA Version	0x7A	N/A
• Validity of GLL for old positions	0x7A	N/A
• Validity of GLL for non-differential positions	0x7A	N/A
• Representation of invalid GLL message	0x7A	N/A
• Precision of time in GLL (number of decimal places)	0x7A	N/A
VTG Message		
• VTG NMEA Version	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

E Machine Control Products

TSIP (Trimble Standard Interface Protocol) support for Machine Control products are summarized in this chapter. The Machine Control products are identified and the TSIP command and report packets supported by each product are summarized. Machine Control products are available for these applications:

- Agriculture
- Construction
- Mining
- Precise Positioning board sets

Application notes are provided for each Machine Control product to clarify the TSIP implementation and identify the default settings for key GPS parameters and receiver configuration options.

E.1 Supported Machine Control Products

TSIP information is provided for these Machine Control products:

- AgGPS 120 (section E.5 on page E-17)
- AgGPS 122 (section E.6 on page E-20)
- AgGPS 124 (section E.7 on page E-23)
- AgGPS 132 (section E.8 on page E-26)
- DSM EuroCard (section E.9 on page E-29)
- BD112 (section E.10 on page E-31)
- BD122 (section E.11 on page E-32)
- BD132 (section E.12 on page E-33)

E.1.1 Identification

In TSIP, each product is uniquely identified by a product ID and a machine ID, much like people are named with a first and last name. The machine ID, like a last name, associates the GPS receiver with a particular family of Trimble receivers. The product ID, like a first name, uniquely specifies the product within its family. The machine ID is used in Report Packet 0x45, Report Packet 0x4B, and Report Packet 0x8F 0x8F. The product ID is used in Report Packet 0x45, Report Packet 0x8F 0x64, Report Packet 0x8F 0x7B, and Report Packet 0x8F 0x8F. The machine and product IDs for the supported products listed above are defined in Table E-1. Due to hardware feature additions, some of the products listed in this table have two different sets of hardware associated with them. These products have two sets of IDs to uniquely identify the hardware used. The product part number (or for board sets, the part number printed on the PCB) is provided here to help developers identify which system they may be using.

Table E-1 Machine Control Product Identification

	Machine ID		Product ID	
Name	**Decimal**	**Hex**	**Decimal**	**Hex**
AgGPS 120	37	0x25	7	0x07
AgGPS 122	97	0x61	0	0x00
AgGPS 122A (P/N 29654-53)	97	0x61	4	0x04
AgGPS 122 (P/N 38073-00)	104	0x68	27	0x1B
AgGPS 124	104	0x68	11	0x0B
AgGPS 132 (P/N 33302-00)	65	0x41	5	0x05
AgGPS 132 (P/N 33302-01)	69	0x45	10	0x0A
AgGPS 132 Air (P/N 33302-10)	65	0x41	9	0x09
AgGPS 132 Air (P/N 33302-11)	69	0x45	21	0x15
DSM EuroCard	37	0x25	2	0x02
BD112	105	0x69	19	0x13
BD122 (PCB P/N 26901)	97	0x61	16	0x10
BD122 (PCB P/N 37785)	104	0x68	17	0x11
BD132 (PCB P/N 31640)	65	0x41	8	0x08
BD132 (PCB P/N 36219)	69	0x45	18	0x12
CASE SB2400 (P/N 33302-20)	65	0x41	7	0x07
CASE SB2400 (P/N 33302-21)	69	0x45	20	0x14
AL9000	97	0x61	3	0x03
AL9001	104	0x68	14	0x0E
AL9100	65	0x41	13	0x0D
AL9101	69	0x45	15	0x0F

E.2 Supported TSIP Packets

Table E-2 includes a numerical listing of TSIP command and report packets and identifies the Machine Control products supported by each packet.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x13	TSIP Parsing Error Notification		✔	✔	✔	✔	✔	✔	✔	✔
0x1A	TSIP RTCM Wrapper Command					✔				
0x1A 0x00	Raw RTCM Data Packet Request					✔				
0x1A	TSIP RTCM Wrapper / Port A Echo Report	✔				✔				
0x1A 0x00	Raw RTCM Wrapper / Port A Echo Report	✔				✔				
0x1D	Oscillator Offset Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x1E	Clear Battery-Backed Memory Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x1F	Receiver Firmware Information Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x20	Almanac Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x21	Current Time Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x22	Position Fix Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x23	Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x24	GPS Position Fix Mode Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x25	Soft Reset / Self Test Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x26	Health Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x27	Signal Levels Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x28	GPS System Message Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x29	Almanac Health Page Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2A	Altitude for 2D Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2B	Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2C	Operating Parameters Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2D	Oscillator Offset Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2E	GPS Time Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x2F	UTC Parameters Request	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

[4] Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x31	Accurate Initial Position (XYZ Cartesian ECEF) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x32	Accurate Initial Position (Latitude, Longitude, Altitude) Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x33	Analog-to-Digital Readings Command		✔	✔	✔	✔	✔	✔	✔	✔
0x34	Satellite Number For One-Satellite Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x35	I/O Option Flags Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x36	Velocity Aiding of Acquisition Command	✔				✔				
0x37	Last Position and Velocity Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x38	Download and Upload Satellite System Data	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x39	Satellite Attribute Database Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3A	Last Raw Measurement Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3B	Satellite Ephemeris Status Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3C	Satellite Tracking Status Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3D	Serial Port A Communication Parameters Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3D	Serial Port A Configuration Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x3E	Additional Fix Parameters Request	✔				✔				
0x40	Almanac Data for Single Satellite Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x41	GPS Time Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x42	Single-Precision Position Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x43	Velocity Fix (XYZ Cartesian ECEF) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x44	Non-Overdetermined Satellite Selection Report	✔				✔				
0x45	Receiver Firmware Information Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x46	Health of Receiver Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x47	Signal Levels for All Satellites Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x48	GPS System Message Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x49	Almanac Health Page Report	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

[4] Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x4A	Single-Precision LLA Position Fix Report or Manual 2D Reference Altitude Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4B	Machine / Code ID and Additional Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4C	Operating Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4D	Oscillator Offset Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4E	GPS Time Command Verification	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x4F	UTC Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x53	Analog-to-Digital Readings Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x54	One Satellite Bias and Bias Rate Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x55	I/O Options Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x56	Velocity Fix East-North-Up (ENU) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x57	Last Computed Fix Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x58	Satellite System Data Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x59	Satellite Attribute Database Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5A	Raw Measurement Data Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5B	Satellite Ephemeris Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5C	Satellite Tracking Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x5E	Additional Fix Status Report	✔				✔	✔			
0x5F	Severe Failure Notification	✔				✔	✔			
0x60	DGPS Pseudorange Corrections Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x60	Differential GPS Pseudorange Corrections Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x61	DGPS Delta Pseudorange Corrections Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x61	Differential GPS Delta Pseudorange Corrections Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x62	DGPS Position Fix Mode Command		✔	✔	✔	✔	✔	✔	✔	✔
0x65	Differential Correction Status Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67	Reference Station Parameters Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x00	Reference Station Control Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x67 0x01	Reference Station Options Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x02	Reference Station Output Version Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x03	Reference Station Position Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x04	Reference Station ID Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x05	RTCM Type 16 Text Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x06	RTCM Type Specific Output Intervals Command[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x09	Average Position Reference Station Position Request[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x67 0x0A	Time Schedule Message Interval and Offset Request[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x68	Mobile Differential Parameters Command	✔				✔				
0x68 0x00	Mobile Differential Mode Command	✔				✔				
0x68 0x01	Mobile Differential Options Command	✔				✔				
0x68 0x02	Mobile Differential Input Version Command	✔				✔				
0x68 0x03	Masking Reference Station Position Command	✔				✔				
0x68 0x04	Input Reference Station ID Command	✔				✔				
0x68 0x05	Last Received RTCM Type 16 Request	✔				✔				
0x6A	Differential Corrections Used in the Fix Commands		✔	✔	✔		✔	✔	✔	✔
0x6A 0x01	Fix Differential Corrections Output Control Command		✔	✔	✔		✔	✔	✔	✔
0x6A	Differential Corrections Used in the Fix Reports		✔	✔	✔		✔	✔	✔	✔
0x6A 0x00	Differential Corrections Used in Fix Report		✔	✔	✔		✔	✔	✔	✔
0x6A 0x01	Fix Differential Corrections Output Control Report		✔	✔	✔		✔	✔	✔	✔
0x6B	QA/QC Commands									
0x6B 0x00	Position Sigma Information Parameters Command									
0x6B 0x01	Position VCV Parameters Command									
0x6B 0x02	Position Sigma Information Request									
0x6B 0x03	Position VCV Information Request									
0x6D	Average Position Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x6D	All-In-View Satellite Selection Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6D 0x00	Average Position Start/Stop Control Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6D 0x01	Average Position Options Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6D 0x02	Auto Stop Parameter Options Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6D 0x03	Current Average Position Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6D 0x04	Average Position Delta from Last Position	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E	Synchronized Measurement Parameters Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Parameters Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E	Synchronized Measurement Parameters Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6E 0x01	Synchronized Measurement Output Parameters Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6F	Synchronized Measurements Reports[2]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x6F 0x01	Synchronized Measurements Report[2]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x70	Position/Velocity Filter Command		✔	✔	✔		✔	✔	✔	✔
0x70	Position/Velocity Filter Operation Report		✔	✔	✔		✔	✔	✔	✔
0x75	Overdetermined Mode Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x76	Overdetermined Mode Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x77	Maximum PRC Age Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x78	Maximum PRC Age Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A	NMEA Output Configuration Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x00	NMEA Interval and Message Mask Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x01	NMEA Messages to Output By Name List Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x02	NMEA Messages Now By Mask Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x03	NMEA Messages Now By Name List Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x04	Current NMEA Output Messages Mask and/or Name List Request	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x05	NMEA Local Time Offset Command	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x7A 0x06	NMEA Message Options Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7A 0x80	NMEA Interval and Message Mask Command		✔	✔	✔		✔	✔	✔	✔
0x7A 0x81	NMEA Messages to Output By Name List Command		✔	✔	✔		✔	✔	✔	✔
0x7A 0x82	NMEA Messages Now By Mask Request									
0x7A 0x83	NMEA Messages Now By Name List Request									
0x7A 0x84	Current NMEA Output Messages Mask and/or Name List Request		✔	✔	✔		✔	✔	✔	✔
0x7A 0x85	NMEA Local Time Offset Command		✔	✔	✔		✔	✔	✔	✔
0x7A 0x86	NMEA Message Options Command		✔	✔	✔		✔	✔	✔	✔
0x7B	NMEA Output Control Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7B 0x00	NMEA Interval and Message Mask Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7B 0x04	NMEA Name List / Message Mask Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7B 0x05	NMEA Local Time Offsets Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7B 0x06	NMEA Message Options and Precision Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7B 0x80	NMEA Interval and Message Mask Report		✔	✔	✔		✔	✔	✔	✔
0x7B 0x84	NMEA Name List / Message Mask Report		✔	✔	✔		✔	✔	✔	✔
0x7B 0x85	NMEA Local Time Offsets Report		✔	✔	✔		✔	✔	✔	✔
0x7B 0x86	NMEA Message Options and Precision Report		✔	✔	✔		✔	✔	✔	✔
0x7C	Position Fix or PRC Rate Configuration Commands	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7C 0x00	ASAP Fix Rate Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7C 0x01	Fast Rate I/O Options Command	✔				✔				
0x7C 0x02	Position Fix Output Interval and Offset Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7C 0x03	Maximum Measurement Age Command	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7C 0x05	CTS to Transmit Delay Command[1]	✔				✔				
0x7C 0x06	RTS Trailing Edge Delay Command[1]	✔				✔				
0x7C 0x09	Time-Based Message Interval Command[1]		✔	✔	✔		✔	✔	✔	✔
0x7D	Position Fix Rate Configuration Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x7D 0x00	ASAP Fix Rate Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7D 0x01	Position Fix Rate Options Report	✔				✔				
0x7D 0x02	Position Fix Output Interval and Offset Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7D 0x03	Maximum Measurement Age Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x7D 0x05	CTS to Transmit Delay Report[1]					✔				
0x7D 0x06	RTS Trailing Edge Delay Report[1]					✔				
0x7D 0x09	Time-Based Message Interval Report[1]		✔	✔	✔		✔	✔	✔	✔
0x7D 0x7F	Fast Rate Option Not Installed Notification	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x82	Differential Position Fix Mode Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x83	Double-Precision XYZ Position Fix & Clock Bias Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x84	Double-Precision LLA Position Fix & Clock Bias Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x85	Differential Correction Status Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87	Reference Station Parameters Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x00	Reference Station Control Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x01	Reference Station Options Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x02	Reference Station Output Version Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x03	Reference Station Position Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x04	Reference Station ID Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x05	RTCM Type 16 Text Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x06	RTCM Type Specific Output Intervals Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x08	TSIP Notification of Sent Version 2 RTCM Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x09	Average Position – Reference Station Position Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x0A	Time Schedule Message Interval and Offset Report[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x7D	Mobile Packet Ignored by Reference Station Notification[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x87 0x7E	Reference Station Warnings Notification[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔

[1] Requires Reference Station option.

[2] No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

[4] Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x87 0x7F	Reference Station Option Not Installed Notification[1]	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x88	Mobile Differential Parameters Report	✔				✔				
0x88 0x00	Mobile Differential Mode Control Report	✔				✔				
0x88 0x01	Mobile Differential Options Report	✔				✔				
0x88 0x02	Mobile Differential Input Version Report	✔				✔				
0x88 0x03	Masking Reference Station Position	✔				✔				
0x88 0x04	Input Reference Station ID Report	✔				✔				
0x88 0x05	Last Received RTCM Type 16 Report	✔				✔				
0x88 0x08	TSIP Notification of Received Version 2 RTCM Report	✔				✔				
0x88 0x7F	Mobile Differential Option Not Installed Notification	✔				✔				
0x8B	QA/QC Reports									
0x8B 0x00	Position Sigma Information Parameters Report									
0x8B 0x01	Position VCV Parameters Report									
0x8B 0x02	Position Sigma Information Report									
0x8B 0x03	Position VCV Information Report									
0x8D	Average Position Reports	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8D 0x00	Average Position Start/Stop Control Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8D 0x01	Average Position Options Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8D 0x02	Auto Stop Parameters (Control / Options) Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8D 0x03	Current Average Position XYZ ECEF Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8D 0x04	Average Position Delta from Last XYZ or ENU Report	✔	✔	✔	✔	✔	✔	✔	✔	✔
0x8E	Application Commands		✔	✔	✔		✔	✔	✔	✔
0x8E 0x20	Super Packet Output Request									
0x8E 0x60	DR Calibration Command									
0x8E 0x62	GPS/DR Position/Velocity Request									
0x8E 0x64	Firmware Name Request									

[1] Requires Reference Station option.

[2] No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

[4] Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x8E 0x6B	Gyroscope Calibration Values Command									
0x8E 0x6D	Odometer Calibration Values Command									
0x8E 0x6F	Firmware Version Name and Configuration Block Request									
0x8E 0x70	Beacon Channel Status Request (Obsolete)		✔	✔	✔		✔		✔	✔
0x8E 0x71	Beacon DGPS Station Database Report Request		✔	✔	✔		✔		✔	✔
0x8E 0x73	Beacon Channel Control Command (Obsolete)		✔	✔	✔		✔		✔	✔
0x8E 0x74	Clear Beacon Database Command		✔	✔	✔		✔		✔	✔
0x8E 0x75	FFT Start Command		✔	✔	✔		✔		✔	✔
0x8E 0x76	FFT Stop Command		✔	✔	✔		✔		✔	✔
0x8E 0x78	RTCM Reports Request		✔	✔	✔		✔		✔	✔
0x8E 0x79	Beacon Station Attributes Command		✔	✔	✔		✔		✔	✔
0x8E 0x7A	Beacon Station Attributes Report Request		✔	✔	✔		✔		✔	✔
0x8E 0x7B	Receiver Configuration Block and Software Version Request		✔	✔	✔		✔	✔	✔	✔
0x8E 0x7C	Receiver Configuration Block Command		✔	✔	✔		✔	✔	✔	✔
0x8E 0x7E	Satellite Line-of-Sight (LOS) Request		✔	✔	✔		✔	✔	✔	✔
0x8E 0x7F	Receiver ROM Configuration Block and Software Version Request		✔	✔	✔		✔	✔	✔	✔
0x8E 0x80	DGPS Service Provider System Information Request				✔					✔
0x8E 0x81	Decoder Station Information Command				✔					✔
0x8E 0x82	Decoder Diagnostic Information Request				✔					✔
0x8E 0x84	Satellite FFT Control Command				✔					✔
0x8E 0x85	DGPS Source Tracking Status Request		✔	✔	✔		✔		✔	✔
0x8E 0x86	Satellite Database Control				✔					✔
0x8E 0x87	Network Statistics Request		✔	✔	✔		✔	✔	✔	✔
0x8E 0x88	Diagnostic Output Options Command				✔					✔
0x8E 0x89	DGPS Source Control Command		✔	✔	✔		✔		✔	✔
0x8E 0x8A	Service Provider Information Request				✔					✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x8E 0x8B	Service Provider Activation Information Command				✔					✔
0x8E 0x8E	Service Provider Data Load Command				✔					✔
0x8E 0x8F	Receiver Identity Request		✔	✔	✔		✔	✔	✔	✔
0x8E 0x90	Guidance Status Request[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x91	Guidance Configuration Command[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x92	Lightbar Configuration Command[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x94	Guidance Operation Command[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x95	Button Box Configuration Type Command[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x96	Point Manipulation Command[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x97	Utility Information Request[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x98	Individual Button Configuration Command[3]		✔	✔	✔		✔	✔	✔	✔
0x8E 0x9A	Differential Correction Information Request[3]		✔	✔	✔		✔	✔	✔	✔
0x8F	Application Reports		✔	✔	✔		✔	✔	✔	✔
0x8F 0x20	Super Packet Output Report									
0x8F 0x60	DR Calibration and Status Report									
0x8F 0x62	GPS/DR Position/Velocity Report									
0x8F 0x64	Firmware Version Name Report									
0x8F 0x6B	Last Gyroscope Readings Report									
0x8F 0x6D	Last Odometer Readings Report									
0x8F 0x6F	Firmware Version and Configuration Report									
0x8F 0x70	Beacon Channel Status Report (Obsolete)		✔	✔	✔		✔		✔	✔
0x8F 0x71	DGPS Station Database Reports		✔	✔	✔		✔		✔	✔
0x8F 0x73	Beacon Channel Control Acknowledgment (Obsolete)		✔	✔	✔		✔		✔	✔
0x8F 0x74	Clear Beacon Database Acknowledgment		✔	✔	✔		✔		✔	✔
0x8F 0x75	FFT Start Acknowledgment		✔	✔	✔		✔		✔	✔
0x8F 0x76	FFT Stop Acknowledgment		✔	✔	✔		✔		✔	✔
0x8F 0x77	FFT Reports		✔	✔	✔		✔		✔	✔
0x8F 0x78	RTCM Reports		✔	✔	✔		✔		✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x8F 0x79	Beacon Station Attributes Acknowledgment		✔	✔	✔		✔		✔	✔
0x8F 0x7A	Beacon Station Attributes Report		✔	✔	✔		✔		✔	✔
0x8F 0x7B	DGPS Receiver RAM Configuration Block Report		✔	✔	✔		✔	✔	✔	✔
0x8F 0x7C	DGPS Receiver Configuration Block Acknowledgment		✔	✔	✔		✔	✔	✔	✔
0x8F 0x7E	Satellite Line-of-Sight (LOS) Message		✔	✔	✔		✔	✔	✔	✔
0x8F 0x7F	DGPS Receiver ROM Configuration Block Report		✔	✔	✔		✔	✔	✔	✔
0x8F 0x80	DGPS Service Provider System Information Report				✔					✔
0x8F 0x81	Decoder Station Information Report and Selection Acknowledgment				✔					✔
0x8F 0x82	Decoder Diagnostic Information Report				✔					✔
0x8F 0x84	Satellite FFT Control Acknowledgment				✔					✔
0x8F 0x85	DGPS Source Tracking Status Report		✔	✔	✔		✔		✔	✔
0x8F 0x86	Clear Satellite Database Acknowledgment				✔					✔
0x8F 0x87	Network Statistics Report		✔	✔	✔		✔	✔	✔	✔
0x8F 0x88	Diagnostic Output Options Report				✔					✔
0x8F 0x89	DGPS Source Control Report /Acknowledgment		✔	✔	✔		✔		✔	✔
0x8F 0x8A	Service Provider Information Report and Acknowledgment				✔					✔
0x8F 0x8B	Service Provider Activation Information Report and Acknowledgment				✔					✔
0x8F 0x8E	Service Provider Data Load Report				✔					✔
0x8F 0x8F	Receiver Identity Report		✔	✔	✔		✔	✔	✔	✔
0x8F 0x90	Guidance Status Report[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x91	Guidance Configuration Report[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x92	Lightbar Configuration Report[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x94	Guidance Operation Acknowledgment[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x95	Button Box Configuration Type Report[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x96	Point Manipulation Report[3]		✔	✔	✔		✔	✔	✔	✔

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

Table E-2 Machine Control Product TSIP Packet Summary

ID	Name	AgGPS 120	AgGPS 122	AgGPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
0x8F 0x97	Utility Information Report[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x98	Individual Button Configuration Report[3]		✔	✔	✔		✔	✔	✔	✔
0x8F 0x9A	Differential Correction Information Report[3]		✔	✔	✔		✔	✔	✔	✔
0xB0	PPS Signal and Event Commands		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0x00	PPS Signal Configuration Command		✔	✔	✔		✔	✔	✔	✔
0xB0 0x01	PPS Signal Enable/Disable Command		✔	✔	✔		✔	✔	✔	✔
0xB0 0x40	Event Timestamp Selection Command [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0x41	Event Packet Options Command [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0x42	Event Plus Position Request [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0x43	Event Only Request [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0x44	Event Marker Miscellaneous Command [4]									
0xB0	PPS and Event Report Packets		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0x80	PPS Signal Configuration Report		✔	✔	✔		✔	✔	✔	✔
0xB0 0x81	PPS Signal Enable/Disable Acknowledgment		✔	✔	✔		✔	✔	✔	✔
0xB0 0x82	PPS Signal Auto-Generated Report		✔	✔	✔		✔	✔	✔	✔
0xB0 0xC0	Event Timestamp Selection Report [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0xC1	Event Packet Options Report [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0xC2	Event Plus Position Report [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0xC3	Event Only Report [4]		✔	✔	✔	✔	✔	✔	✔	✔
0xB0 0xC4	Event Marker Miscellaneous Action Taken [4]					✔				
0xBB	Receiver Configuration Parameters Commands									
0xBB 0x00	Primary Receiver Configuration Parameters Request									
0xBB	Receiver Configuration Parameters Reports									
0xBB 0x00	Primary Receiver Configuration Parameters Report									
0xBC	Serial Port Configuration Parameters Command									
0xBC	Serial Port Configuration Parameters Report									
0xC2	Port A Data Transmission Command					✔				

1 Requires Reference Station option.

2 No carrier phase information supported.

3 Requires Guidance option. Not available in products with machine id 37 or 97.

4 Requires Event In option.

E.3 Supported NMEA Messages

Table E-3 shows which NMEA messages are supported by each product. For more information on these messages, see TSIP Command Packet 0x7A.

Table E-3 Machine Control NMEA Message Summary

Message	AgGPS 120	AgGPS 122	Ag•GPS 124	AgGPS 132	DSM EuroCard	AL9000	BD112	BD122	BD132
ALM	✔	✔	✔	✔	✔	✔	✔	✔	✔
GBS									
GGA	✔	✔	✔	✔	✔	✔	✔	✔	✔
GLL	✔	✔	✔	✔	✔	✔	✔	✔	✔
GRS		✔	✔	✔		✔	✔	✔	✔
GSA	✔	✔	✔	✔	✔	✔	✔	✔	✔
GST		✔	✔	✔		✔	✔	✔	✔
GSV	✔	✔	✔	✔	✔	✔	✔	✔	✔
MSS		✔	✔	✔		✔		✔	✔
PTNLAG001		✔	✔	✔		✔	✔	✔	✔
PTNLDG		✔	✔	✔		✔		✔	✔
PTNL,GGK		✔	✔	✔		✔	✔	✔	✔
PTNLID		✔	✔	✔		✔	✔	✔	✔
PTNLSM		✔	✔	✔		✔	✔	✔	✔
RMC		✔	✔	✔		✔	✔	✔	✔
VTG	✔	✔	✔	✔	✔	✔	✔	✔	✔
ZDA	✔	✔	✔	✔	✔	✔	✔	✔	✔

E.4 Key GPS Parameter Settings

Correctly selecting the proper GPS operating parameters is important to get the best performance from the GPS sensor. Command Packets are available for changing the receiver setup for the specific conditions of a particular user, including packets:

- 0x22 (Position Fix Mode Command)
- 0x2C (Operating Parameters Command)
- 0x35 (I/O Option Flags Command)
- 0x62 (DGPS Position Fix Mode Command)

The default values for the parameters in these packets allow the Precision Agricultural receivers to operate under a wide variety of demanding conditions. You can choose to change the default parameters if the *r*eceiver is required to perform only in a specific or limited environment.

Warning – When the receiver is exposed to operating conditions different from those described in the setup, performance can be degraded.

E.5 *Ag*GPS 120

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the *Ag*GPS 120 receiver are covered in this appendix.

E.5.1 *Ag*GPS 120 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the *Ag*GPS 120 receiver.

*Ag*GPS 120 Port Naming Conventions

The *Ag*GPS 120 receiver features one RS-232 serial port and two RS-422 serial ports. One RS-422 port (Port 3) is reserved for sending and receiving TSIP packets. The Port 3 is referred to as Port B in this publication. The Port 1 is referred to as Port A in this publication.

*Ag*GPS 120 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and ZDA.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

*Ag*GPS 120 Key GPS Configuration Parameter Settings

Table E-4 identifies key configuration parameters, their associated command packet, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table E-4 *Ag*GPS 120 Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask	0x2C	6.0 AMUs
• PDOP Mask	0x2C	8.0
• PDOP Switch	0x2C	6.0

Table E-4 *Ag*GPS 120 Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	Off
• Automatic LLA Position Data Report Output Flag	0x35	On
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	Off
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	On
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	UTC
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	Off
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Raw
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
• Units for signal-to-noise output data	0x35	AMUs
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Valid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2

Table E-4 *Ag*GPS 120 Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	‘V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	3D
RMC Message		
• Validity of RMC for old positions	0x7A	N/A
• Validity of RMC for non-differential positions	0x7A	N/A
• Precision of time in RMC (decimal places)	0x7A	N/A
• NMEA Speed to Output	0x7A	N/A

E.5.2 Accuracy Versus Fix Density for *Ag*GPS 120 Receivers

Table E-5 shows suggested parameter selections as a function of signal blockage and whether accuracy or fix density is important.

Table E-5 *Ag*GPS 120 Suggested Parameter Settings

	High Signal Blockage		Clear Sky	
Parameter	**High Accuracy**	**High Fix Density**	**High Accuracy**	**High Fix Density**
Fix Mode	Manual 3-D	Auto 2D/3D	Manual 3-D	Auto 2D/3D
Elevation Mask	10	5	10	5
SNR Mask	6.0	4.0	6.0	4.0
PDOP Mask	6.0	12.0	4.0	12.0
PDOP Switch	N/A	8.0	N/A	8.0
Minimum Projection	OFF	OFF	ON	OFF
Simultaneous Measurement	OFF	OFF	ON	OFF
DGPS Mode	Manual ON	AUTO	Manual ON	AUTO

E.6 *Ag*GPS 122

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the *Ag*GPS 122 and *Ag*GPS 122A receivers are covered in this section.

E.6.1 *Ag*GPS 122 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the *Ag*GPS 122 receiver.

*Ag*GPS 122 Port Naming Conventions

The AgGPS 122 serial port connectors are labeled Port A and Port B. These port connector names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

*Ag*GPS 122 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and RMC.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for *Ag*GPS 122 Receivers

The standard *Ag*GPS 122 receiver is manufactured to support a 1 Hz positioning rate. *Ag*GPS 122 receiver models with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current positioning rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

*Ag*GPS 122 Key Configuration Parameter Settings

Table E-4 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table E-6 *Ag*GPS 122 Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	6.0 AMUs
• PDOP Mask	0x2C	12.0
• PDOP Switch	0x2C	8.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	On
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	Off
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	GPS
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	On

Table E-6 *Ag*GPS 122 Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Filtered
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
• Units for signal-to-noise output data	0x35	AMUs
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	3D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Invalid
• Precision of time in RMC (decimal places)	0x7A	0
• NMEA Speed to Output	0x7A	3D SOG

E.7 *Ag*GPS 124

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the *Ag*GPS 124 receiver is covered in this section.

E.7.1 *Ag*GPS 124 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the *Ag*GPS 124 receiver.

*Ag*GPS 124 Port Naming Conventions

The AgGPS 124 serial port connectors are labeled Port A and Port B. These port connector names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

*Ag*GPS 124 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and RMC.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for *Ag*GPS 124 Receivers

The standard *Ag*GPS 124 receiver is manufactured to support a 1 Hz positioning rate. *Ag*GPS 124 receiver models with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current positioning rate by requesting Report Packet 0x8F 0x7C.

*Ag*GPS 124 Key Configuration Parameter Settings

Table E-4 identifies key configuration parameters, their associated command packets, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table E-7 *Ag*GPS 124 Key Configuration Parameter Settings

Parameter	Packet	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	6.0 AMUs
• PDOP Mask	0x2C	12.0
• PDOP Switch	0x2C	8.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	On
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	Off
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	GPS
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	On

Table E-7 *Ag*GPS 124 Key Configuration Parameter Settings (Continued)

Parameter	Packet	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Filtered
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
• Units for signal-to-noise output data	0x35	AMUs
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	'0' in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	'V' in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	3D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Invalid
• Precision of time in RMC (decimal places)	0x7A	0
• NMEA Speed to Output	0x7A	3D SOG

E.8 *Ag*GPS 132

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the *Ag*GPS 132 receiver are covered in this section.

E.8.1 *Ag*GPS 132 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the *Ag*GPS 132 receiver.

*Ag*GPS 132 Port Naming Conventions

The AgGPS 132 and BD-132 serial port connectors are labeled Port A and Port B. These port connector names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

*Ag*GPS 132 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and RMC.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for *Ag*GPS 132 Receivers

The standard *Ag*GPS 132 receiver is manufactured to support a 1 Hz positioning rate. *Ag*GPS 132 receiver model with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

*Ag*GPS 132 Key Configuration Parameter Settings

Table E-4 identifies key configuration parameters, their associated command packet, and default settings. If the receiver fails to operate correctly after changing parameter values, reset the configuration settings to their default values.

Table E-8 *Ag*GPS 132 Key Configuration Parameter Settings

Parameter	Command	Default
GPS Position Fix Mode	0x22	Auto 2D/3D
Operating Parameters		
• Dynamics Code	0x2C	Land
• Elevation Mask	0x2C	7.5°
• Signal Level Mask (SNR)	0x2C	6.0 AMUs
• PDOP Mask	0x2C	12.0
• PDOP Switch	0x2C	8.0
Key Receiver Configuration Block Settings		
Positioning Rate	0x8E 0x7C	1 Hz
I/O Option Flags		
I/O Options Position Flags		
• Automatic XYZ ECEF Position Data Report Output Flag	0x35	On
• Automatic LLA Position Data Report Output Flag	0x35	Off
• Format of LLA Altitude Data Output in Report Packet 0x42 or 0x83 Flag	0x35	HAE WGS-84
• Format of Altitude Data Input in Command Packet 0x2A Flag	0x35	HAE WGS-84
• Numeric Precision of Data in Automatic Reports Flag	0x35	Single precision
I/O Options Velocity Flags		
• Automatic output of XYZ ECEF data in Report Packet 0x43 Flag	0x35	On
• Automatic output of ENU data in Report Packet 0x55 Flag	0x35	Off
I/O Options Timing Flags		
• Type of Time Data Flag	0x35	GPS
• Fix Computation Time Flag	0x35	ASAP
• Time of Position Fix Output in Command Packet 0x37 Flag	0x35	When computed
• Simultaneous Measurements Status Flag	0x35	Off
• Minimum Projection Flag	0x35	On

Table E-8 *Ag*GPS 132 Key Configuration Parameter Settings (Continued)

Parameter	Command	Default
I/O Options Auxiliary Flags		
• Automatic Output of Raw Measurement Data in Report Packet 0x5A Flag	0x35	Off
• Raw or Filtered Codephase Measurements Flag	0x35	Filtered
• Automatic Output of Additional Fix Status Information in Report Packet 0x5E Flag	0x35	Off
• Units for signal-to-noise output data	0x35	AMUs
DGPS Mode Parameters		
• Mode	0x62	Auto
• Max PRC Age	0x77	30
• Reference Station ID	0x62	Any Station
NMEA Message Parameters		
GGA Message		
• Validity of GGA for old positions	0x7A	Invalid
• Validity of GGA for non-differential positions	0x7A	Valid
• Representation of invalid GGA	0x7A	’0’ in status field
• Precision of time in GGA (decimal places)	0x7A	2
GLL Message		
• GLL NMEA Version	0x7A	2.01
• Validity of GLL for old positions	0x7A	Valid
• Validity of GLL for non-differential positions	0x7A	Valid
• Representation of invalid GLL message	0x7A	’V’ in status field
• Precision of time in GLL (number of decimal places)	0x7A	2
VTG Message		
• VTG NMEA Version	0x7A	2.01
• NMEA Speed to Output	0x7A	3D SOG
RMC Message		
• Validity of RMC for old positions	0x7A	Invalid
• Validity of RMC for non-differential positions	0x7A	Invalid
• Precision of time in RMC (decimal places)	0x7A	0
• NMEA Speed to Output	0x7A	3D SOG

E.9 DSM EuroCard

TSIP implementation clarifications for the DSM EuroCard and DSM EuroCard Reference Station are covered in this section. A DSM EuroCard Reference Station is a DSM EuroCard with the factory-installed Reference Station Option.

E.9.1 DSM EuroCard TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the DSM EuroCard and DSM EuroCard Reference Station.

DSM EuroCard Port Naming Conventions

On the DSM EuroCard and DSM EuroCard Reference Station I/O connector pin-out, pins 3 and 5 correspond to the transmit and receive lines for Port A. Pins 13 and 15 correspond to the transmit and receive lines for Port B. These port names are equivalent Port A and Port B names used in this publication. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

DSM EuroCard Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

DSM EuroCard Key Configuration Parameter Default Settings

The default settings for key configuration parameters are identical to the DSM and DSM Reference Station settings. For more information, see DSM and DSM Reference Station on page C-17.

E.9.2 Accuracy Versus Fix Density for DSM EuroCard

Table E-5 shows suggested parameter selections for the DSM EuroCard as a function of signal blockage and whether accuracy or fix density is important.

Table E-9 Suggested Parameter Settings for DSM EuroCard

	High Signal Blockage		Clear Sky	
Parameter	**Accuracy**	**Fix Density**	**Accuracy**	**Fix Density**
Fix Mode	Manual 3-D	Auto	Manual 3-D	Auto
Elevation Mask	10	5	10	5
SNR Mask	6.0	4.0	6.0	4.0
PDOP Mask	6.0	12.0	6.0	12.0
PDOP Switch	N/A	8.0	N/A	8.0
Minimum Projection	OFF	OFF	ON	OFF
Simultaneous Measurement	OFF	OFF	ON	ON
DGPS Mode	Manual ON	AUTO or OFF	Manual ON	AUTO or OFF

E.9.3 Accuracy Versus Fix Density for DSM EuroCard Reference Stations

Table E-10 shows suggested parameter selections for the DSM EuroCard Reference Station with the Reference Station Option as a function of signal blockage and whether accuracy or fix density is important.

Table E-10 Suggested Parameter Settings for the DSM EuroCard Reference Station

	High Signal Blockage		Clear Sky	
Parameter	**Accuracy**	**Fix Density**	**Accuracy**	**Fix Density**
Elevation Mask	7.5	5	7.5	5
SNR Mask	6.0	4.0	6.0	4.0
Minimum Projection	OFF	OFF	ON	OFF
Simultaneous Measurement	OFF	OFF	ON	ON
Dynamics Code	Static	Static	Static	Static

E.10 BD112

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the BD112 are covered in this section.

E.10.1 BD112 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the BD-112.

BD112 Port Naming Conventions

On the BD112 I/O connector pin-out, pins 3 and 5 correspond to the transmit and receive lines for Port A. Pins 13 and 15 correspond to the transmit and receive lines for Port B. These port names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 0 and Port B corresponds to port number 1. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

BD112 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA and VTG.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for BD112

The standard BD112 is manufactured to support a 1 Hz positioning rate. BD112 models with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

BD112 Key Configuration Parameter Settings

The default settings for key configuration parameters are identical to the AgGPS 122 settings. For more information, see AgGPS 122 TSIP Implementation Clarifications on page E-20.

E.11 BD122

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the BD132 receivers are covered in this section.

E.11.1 BD122 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the BD122 receiver.

BD122 Port Naming Conventions

On the BD122 I/O connector pin-outfor both PCB P/N 26901 and PCB P/N 37785, pins 8 and 9 correspond to the receive and transmit lines for Port A. Pins 10 and 11 correspond to the receive and transmit lines for Port B. These port names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

BD122 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and RMC.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for BD122 Receivers

The standard BD122 receiver is manufactured to support a 1 Hz positioning rate. BD122 receiver models with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current positioning rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

BD122 Key Configuration Parameter Settings

The default settings for key configuration parameters are identical to the AgGPS 122 settings. For more information, see AgGPS 122 TSIP Implementation Clarifications on page E-20.

E.12 BD132

TSIP implementation clarifications, default GPS parameter and configuration settings, and application-specific information for the BD132 receiver are covered in this section.

E.12.1 BD132 TSIP Implementation Clarifications

The following sections clarify the TSIP implementation for the BD132 receiver.

BD132 Port Naming Conventions

On the BD132 I/O connector pin-outfor both PCB P/N 31640 and PCB P/N 36219, pins 8 and 9 correspond to the receive and transmit lines for Port A. Pins 10 and 11 correspond to the receive and transmit lines for Port B. These port names are equivalent Port A and Port B names used in this publication. Where ports are referenced by number, Port A corresponds to port number 1 and Port B corresponds to port number 0. This publication assumes that Port B is used for TSIP transmissions even though the user can reverse the communications role of the two ports. Note that when using TSIP packet 0x3D to configure port parameters, the configuration data applies to the opposite port from the one the command is issued from.

BD132 Default Port Configurations

The Port A default input protocol is RTCM at 9600 baud with 8 data bits, no parity, and 1 stop bit. The default output protocol is NMEA at 4800 baud with 8 data bits, no parity, and 1 stop bit. The default NMEA messages are GGA, GSA, VTG, and RMC.

Port B defaults to TSIP input and output at 9600 baud with 8 data bits, odd parity, and 1 stop bit.

Maximum Positioning Rate for BD132 Receivers

The standard BD132 receiver is manufactured to support a 1 Hz positioning rate. BD132 receiver model with the factory-installed 10 Hz option can support positioning rates of 5 or 10 Hz. The Maximum Positioning Rate can be set using Command Packet 0x8E 0x7C, Byte 67. You can learn the current Positioning Rate by requesting Report Packet 0x8F 0x7C.

Note – The 5 Hz and 10 Hz positioning rates are available only if the 10 Hz Option is installed on the receiver.

BD132 Key Configuration Parameter Settings

The default settings for key configuration parameters are identical to the AgGPS 132 settings. For more information, see AgGPS 132 TSIP Implementation Clarifications on page E-26.

F NMEA-0183 Messages

Trimble receivers can output a selection of NMEA-0183 messages. NMEA-0183 messages are normally generated and output to Port A, allowing the receiver to interface with external instruments. Only the NMEA-0183 standard and Trimble proprietary messages configured using TSIP command packets are described here. Some Trimble products support additional NMEA-0183 standard messages and Trimble proprietary messages which cannot be configured using TSIP command packets. These are described separately in the receiver's operation manual.

F.1 NMEA-0183 Message Structure

NMEA-0183 messages are strings of comma-delimited text. Figure F-1 shows the structure of an NMEA-0183 message.

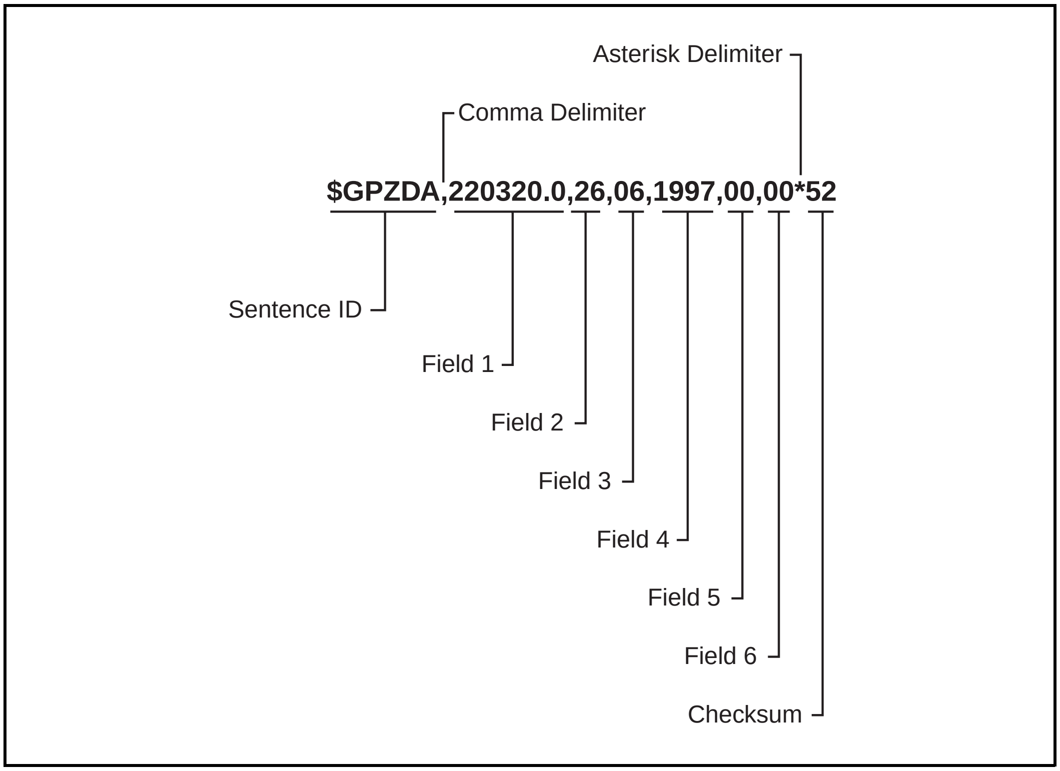


Figure F-1 Sample ZDA Message Structure

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

The message structure of the sample ZDA message, shown below and the message fields are described in Table F-1.

$GPZDA,220320.0,26,06,1997,00,00*52

Table F-1 Sample ZDA Message Structure

Field	Description
1	Time, in UTC. (220320.0 in the sample message)
2	Day, 01 to 31. (26 in the sample message)
3	Month, 01 to 12. (06 in the sample message)
4	Year. (1997 in the sample message)
5	Local time zone offset from GMT, 00 to ±13 hours. (00 in the sample message)
6	Local time zone offset from GMT, minutes. Fields 5 and 6, together, yield the total offset. For example, if field 5 is '-5' and field 6 is '15', local time is 5 hours and 15 minutes earlier than GMT. (00 in the sample message)

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

The numbers in the Field column represent the message fields in left-to-right order. Field 1 is the first field following the first comma delimiter. In the sample message, field 1 contains the UTC Time value (220320.0). The last field in the message is preceded by the last comma in the message (00 in the sample message).

F.1.1 Symbols and Delimiters

All messages conform to the NMEA-0183 Version 2.1 format. Symbols and delimiters are used to identify or separate the various kinds of data included in the message.

NMEA-0183 messages always begin with a dollar sign character ($) followed by a talker ID code and a message ID code. For the sample ZDA message, GP is the talker ID, and ZDA is the message ID.

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

220320.0,26,06,1997,00,00

The first field contains the UTC time value (220320.0), the second field contains the Day value (26), and so on.

NMEA-0183 messages include a checksum value which is preceded by an asterisk character (*). For more information about checksum values, see section F.1.2 on page F-3.

NMEA-0183 messages are always terminated with a carriage return and line feed. The carriage return and line feed pair marks the end of the message.

F.1.2 Checksum Values

Newer Trimble receivers conform to NMEA-0183 Version 2.1 which states that checksums are mandatory for all messages. Checksum values are always included in output messages, but are optional for input messages.

Checksum values are used to verify the integrity of the data included in the message. The sample message, shown in Table F-1, includes a checksum value. An asterisk character (*) is used to delimit the last data field from the checksum value (52 in the sample message).

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

F.1.3 Field Formats

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

F.1.4 Null Fields

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

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

F.1.5 Talker ID Codes

The Talker ID code identifies the source of the data (GPS, Loran C, Sounder, etc.). The NMEA-0183 standard defines 35 Talker ID codes. The Talker ID codes available for NMEA-0183 output from the most Trimble receivers are described in Table F-2.

Table F-2 Supported Talker ID Codes

Code	Description
GP	GPS
LG	Loran C/ GPS
LC	Loran C
II	Integrated Instrumentation

Note – Older marine electronic equipment, designed prior to the introduction of GPS may only accept the LC Talker ID. The Trimble receivers are designed to support the LC Talker ID to remain compatible with older equipment interfaces.

F.1.6 Latitude and Longitude Values

The latitude and longitude values included in NMEA messages are presented in degrees, minutes, and decimal minutes. Latitude is presented as ddmm.mmmm in a single field, and longitude is presented as dddmm.mmmm in a single field. Within the field, degree values are in *dd* or *ddd* format, and minutes and fractions of minutes are in *mm.mmmm* format.

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

F.1.7 Time Values

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

F.1.8 Other Values

The NMEA-0183 standard established the format of the data included in message fields.

F.2 NMEA Message Summary

Table F-3 describes the NMEA-0183 message set supported by various receivers and identifies the page number where you can find detailed information about each message. Some messages are only supported when specific Trimble options are installed on the receiver. Messages beginning with PTNL are Trimble proprietary messages.

Table F-3 Supported NMEA-0183 Messages

Message	Message Contents
ALM	GPS week number, SV health, and complete almanac data for one SV. One message per SV, up to a maximum of 32
DTM	Local geodetic datum
GBS	GNSS Satellite Fault Detection
GGA	Time, position, and fix related data
GLL	Position fix, time of position fix, and status
GRS	GPS Range Residuals
GSA	GPS position fix mode, SVs used for navigation and DOP values
GST	GPS Pseudorange Noise Statistics
GSV	Number of SVs visible, PRN numbers, elevation, azimuth and SNR values
MSS	Signal strength, signal-to-noise ratio, beacon frequency, and beacon bit rate
PTNLAG001	66 character message available when TEXTA or TEXTB are selected as the port input protocol.
PTNLDG	Beacon channel strength, channel SNR, channel frequency, channel bit rate, channel number, channel tracking status, RTCM source, and channel performance indicator.
PTNL,GGK	Time, Position, Position Type and DOP Values
PTNLID	Receiver machine ID, product ID, major and minor release numbers, and firmware release date.
PTNLSM	Reference Station Number ID and the contents of the Special Message included in valid RTCM Type 16 records.
RMC	UTC time, status, latitude, longitude, speed over ground (SOG), date, and magnetic variation of the position fix
VTG	Actual track made good and speed over ground
XTE	Cross-track error
ZDA	UTC time, day, month, and year, local zone number and local zone minutes.

ALM

ALM Message
GPS Almanac Data

The ALM message identifies the GPS week, SV health, and contains the almanac for one satellite. The message structure is shown below:

$GPALM,1,1,03,698,00,6ae6,1d,779f,fdef,a10d68,6469a6,7c1f62,5f5839,*43

Table F-4 identifies the ALM message fields.

Table F-4 ALM Message Fields

Field	Description
1	Total number of ALM messages for this cycle
2	Message sequence number
3	SV PRN number, 01 to 32
4	GPS week number
5	SV health status
6	Eccentricity
7	Almanac reference time
8	Inclination angle
9	Rate of right ascension
10	Root of semi-major axis
11	Argument of perigee
12	Longitude of ascension node
13	Mean anomaly
14	A f0, clock parameter
15	A f1, clock parameter

DTM

DTM Message
Datum Reference

The DTM message identifies the local geodetic datum. Latitude, longitude, and altitude offsets from the reference datum and the selection of the reference datum, if not WGS-84, are also included in the message. The message is used to identify the datum of the position reported by the GGA and GLL messages.

The message structure is shown below, and Table F-5 identifies the DTM message fields.

$GPDTM,W84,,0.0,N,0.0,E,0.0,W84*6F

Table F-5 DTM Message Fields

Field	Description
1	Local datum
2	Local datum subdivision code
3	Latitude offset in minutes North or South
4	Longitude offset in minutes East or West
5	Altitude offset in meters
6	Reference datum

GBS

GBS Message
GNSS Satellite Fault Detection

The GBS message is used to support Receiver Autonomous Integrity Monitoring (RAIM). The data structure is shown below:

$GBS,183059.30,0.0,0.0,0.0,0.0,0.0,0.0*6F

The message fields are described in Table F-6.

Table F-6 GBS Message Fields

Field	Description
1	UTC time of the GGA or GNS fix associated with this message.
2	Expected error in latitude.†
3	Expected error in longitude.†
4	Expected error in altitude.†
5	ID number of most likely failed satellite.
6	Probability of missed detection for most likely failed satellite.
7	Estimate of bias, in meters, on most likely failed satellite.
8	Standard deviation of bias estimate.

† Expected error in meters due to bias with noise equals 0.

GGA

GGA Message
GPS Fix Data

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

$GPGGA,151924,3723.454444,N,12202.269777,W,2,09,1.9,–17.49,M,–25.67,M,1,0000*57

Table F-7 identifies the GGA message fields.

Table F-7 GGA Message Fields

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

GLL

GLL Message
Position Data

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

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

Table F-8 identifies the GLL message fields.

Table F-8 GLL Message Fields

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

GRS

GRS Message
GPS Range Residuals

The GRS message is used to support the Receiver Autonomous Integrity Monitoring (RAIM). The message structure is shown below, and Table F-9 describes the message fields.

$GPGRS,220320.0,0,-0.8,-0.2,-0.1,-0.2,0.8,0.6,,,,,,*55

Table F-9 GRS Message Fields

Field	Description
1	UTC time of GGA position fix
2	Residuals: 0: Residuals used to calculate position given in the matching GGA line 1: Residuals recomputed after the GGA position was computed
3-14	Range residuals for satellites used in the navigation solution, in meters

GSA

GSA Message
GPS DOP and Active Satellites

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

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

Table F-10 identifies the GSA message fields.

Table F-10 GSA Message Fields

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

GST

GST Message
GPS Pseudorange Noise Statistics

The GST message is used to support Receiver Autonomous Integrity Monitoring (RAIM). The message structure is shown below, and Table F-11 describes the message fields.

$GPGST,220320.0,1.3,0.8,0.5,166.1,0.8,0.5,1.6,*4F

Table F-11 GST Message Fields

Field	Description
1	UTC time of GGA fix
2	RMS value of the standard deviation of the range inputs to the navigation process (range inputs include pseudoranges and DGPS corrections)
3	Standard deviation of semi-major axis of error ellipse, in meters
4	Standard deviation of semi-minor axis of error ellipse, in meters
5	Orientation of semi-major axis of error ellipse, in degrees from true north
6	Standard deviation of latitude error, in meters
7	Standard deviation of longitude error, in meters
8	Standard deviation of altitude error, in meters

GSV

GSV Message
GPS Satellites in View

The GSV message identifies the number of SVs in view, the PRN numbers, elevation, azimuth and SNR values. The message structure is shown below:

$GPGSV,4,1,13,02,02,213,,03,-3,000,,11,00,121,,14,13,172,05*67

Table F-12 identifies the GSV message fields.

Table F-12 GSV Message Fields

Field	Description
1	Total number of messages of this type in this cycle
2	Message number
3	Total number of SVs visible
4	SV PRN number
5	Elevation in degrees, 90½ maximum
6	Azimuth, degrees from true north, 000½ to 359½
7	SNR, 00-99 dB (null when not tracking)
8-11	Information about second SV, same format as fields 4-7
12-15	Information about third SV, same format as fields 4-7
16-19	Information about fourth SV, same format as fields 4-7

MSS

MSS Message
Beacon Receiver Signal Status

The MSS message identifies the status of the beacon signal, including the beacon signal strength, beacon signal-to-noise ratio (SNR), beacon frequency, and beacon bit rate.

$GPMSS,52.5,23.7,287.0,100*4C

Table F-13 MSS Message Fields

Field	Description
1	Signal Strength (SS), dB ref: 1 υV/m
2	Signal-to-Noise Ratio (SNR), dB
3	Beacon Frequency, 283.5 to 325.0 kHz
4	Beacon Bit Rate (25, 50, 100, 200) bits per second

PTNLAG001

PTNLAG001 Message
Text Message

The PTNLAG001 message is a proprietary Trimble NMEA message which sets the 66 character message string output when TEXTA or TEXTB are selected as port input options. The message structure is shown below:

$PTNLAG001,XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX*XX

Table F-14 identifies the PTNLAG001 message fields.

Table F-14 PTNLAG001 Message Fields

Field	Description
1	66 character text string received when TEXTA or TEXTB is enabled as a port input option

PTNLDG

PTNLDG Message
Trimble Beacon Receiver Status

The PTNLDG message is a Trimble proprietary message for identifying the Beacon receivers channel strength, channel SNR, channel frequency, channel bit rate, channel number, channel tracking status, RTCM source, and channel performance indicator. The message structure is shown below:

$PTNLDG,XXX,XXX,XXXX,25,3,1,3*XX

The PTNLDG message fields are defined in free format with the maximum number of characters in the field indicated in above (i.e. 25 bps displayed as xxx,25,xxx instead of xxx,00025,xxx). Additionally, if a channel is disabled, the channel fields may be null fields (commas only). If more than one channel is available, the message should be repeated for each channel. Table F-15 identifies the message structure.

Table F-15 PTNLDG Message Fields

Field	Description
1	Beacon channel signal strength, in 1 dBuV/m. This is the electromagnetic field intensity level.
2	Beacon channel signal to noise (SNR) level, in dB.
3	Beacon channel frequency, in kHz (ranges from 283.5 kHz to 325 kHz)
4	Beacon channel bit rate, in bits per second (bps)
5	Beacon channel number, 0-99
6	Beacon channel tracking status: 0: Channel idle 1: Wideband FFT search 2: Searching for signal 3: Channel has acquired signal 4: Channel has locked on signal 5: Channel disabled
7	Specified channel is used as RTCM source: 0: Not used 1: Used
8	Channel tracking performance indicator is the number of errors in the last 255 words received in RTCM records.

PTNL,GGK

PTNL,GGK Message

Time, Position, Position Type and DOP Values

The PTNL,GGK message string is shown below, and Table 6-16 describes the message fields.

```
$PTNL,GGK,172814.00,071296,3723.46587704,N,12202.269578
64,W,3,06,1.7,EHT-6.777,M*48
```

Table 6-16 PTNL,GGK Message Fields

Field	Meaning
1	UTC of position fix, in hhmmss.ss format
2	UTC Date of position, in mmddyy format
3	Latitude, in degrees and decimal minutes (e.g. dddmm.mmmmmmm)
4	Direction of latitude: N: North S: South
5	Longitude, in degrees and decimal minutes (e.g. dddmm.mmmmmmm)
6	Direction of Longitude: E: East W: West
7	GPS Quality indicator: 0: Fix not available or invalid 1: Autonomous GPS fix 4: Differential, code phase only solution (DGPS)
8	Number of satellites used in GPS solution
9	DOP of fix
10	Ellipsoidal height of fix (antenna height above ellipsoid)
11	M: Ellipsoidal height is measured in meters

PTNLID

PTNLID Message
Trimble Receiver Identity

The PTNLID message is a Trimble proprietary message for identifying the receiver's machine ID, product ID, major and minor release numbers, and firmware release date. The message structure is shown below:

$PTNLID,097,01,XXX,XXX,DDMMYY*XX

Table F-17 identifies the PTNLID message fields.

Table F-17 PTNLID Message Fields

Field	Description
1	Machine ID
2	Product ID
3	Major firmware release number
4	Minor firmware release number
5	Firmware release date, in DD/MM/YY format

The PTNLID message is enabled using TSIP.

PTNLSM

PTNLSM Message
RTCM Special Message

The PTNLSM message is a Trimble proprietary message for identifying the Reference Station ID and the ASCII Text message included in a RTCM Type 16 Special Message. The PTNLSM message is generated anytime a RTCM stream receives a valid Type 16 Special Message. The message structure is shown below:

$PTNLSM,0022,This is a message,*.XX

Table 6-18 PTNLSM Message Fileds

Field	Description
1	Reference Station ID number, ranging from 0 to 1023. Leading zeros must be added to fill 4-digit field.
2	ASCII text message sentnence contained within the Type 16 RTCM message.

RMC

RMC Message
Recommended Minimum Specific GPS Data

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

$GPRMC,184804.00,A,3723.476543,N,12202.239745,W,000.0,0.0,051196,15.6,E
*7C

Table F-19 RMC Message Fields

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

VTG

VTG Message
Course Over Ground and Ground Speed

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

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

Table F-20 identifies the VTG message fields.

Table F-20 VTG Message Fields

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

XTE

XTE Message
Cross-Track Error

The XTE message reports the vessel's cross-track error. The message structure is shown below and Table F-21 describes the message fields.

$GPXTE,A,A,0.050,L,N*5E

Table F-21 XTE Message Fields

Field	Description
1	A:Valid (fixed)
2	A:Valid (fixed)
3	Cross-track Error, in nautical miles
4	Direction to Steer: L: Left R: Right
5	N:Nautical mile units

Note – For the NT300D, steering direction in XTE is opposite of the direction shown on the display. The display shows which side on the track you are on.

ZDA

ZDA Message
Time and Date

The ZDA message identifies UTC time, day, month, and year, local zone number and local zone minutes. The message structure is shown below:

$GPZDA,184830.15,05,11,1996,00,00*66

Table F-22 identifies the ZDA message fields.

Table F-22 ZDA Message Fields

Field	Description
1	UTC time
2	Day
3	Month
4	Year
5	Local Zone Number (– for East Longitude)
6	Local Zone Minutes

Alphabetical Packet Index

Command Packets and Report Packets are listed alphabetical order by packet name. Column 1identifies the packet name, column 2 indicates whether the packet is a command or report packet, column 3 lists the packet identifier code (hexadecimal), and column 4 lists the page number where detailed information about the packet is found.

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