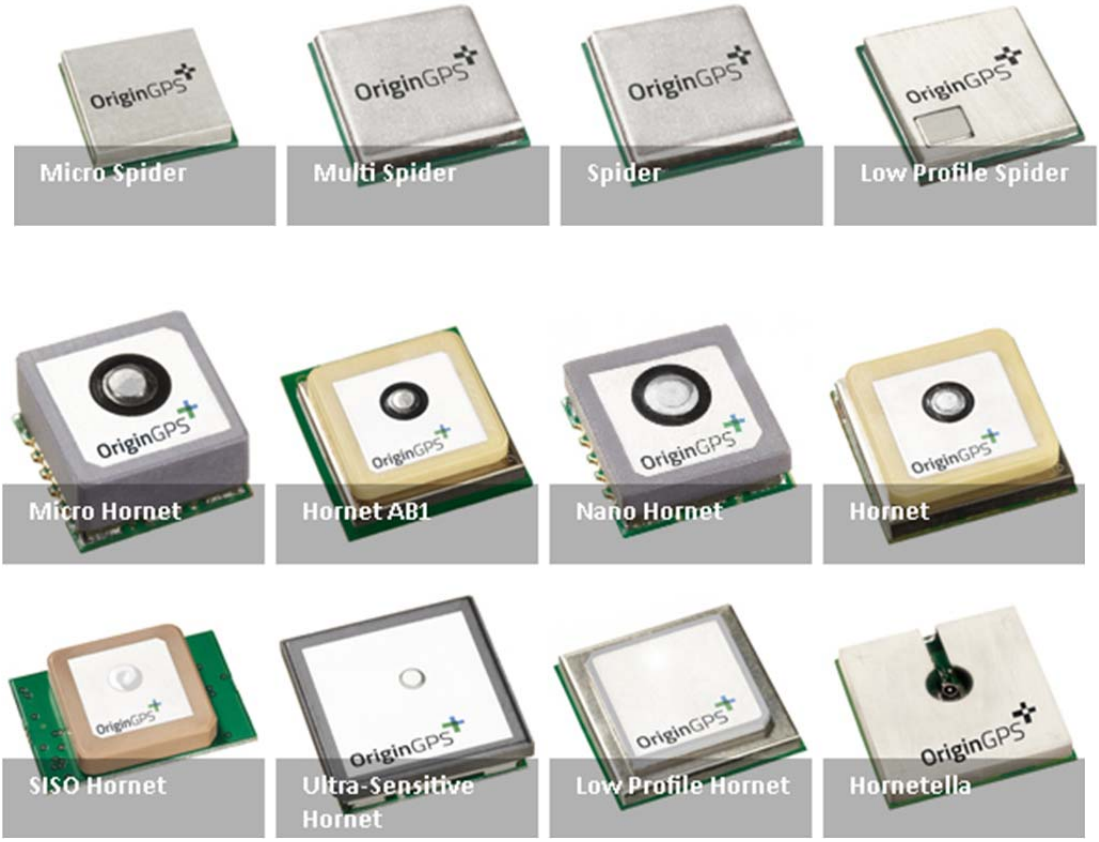
OriginGPS
mini+mighty




# SPIDER AND HORNET GPS /GNSS RECEIVER MODULES

One Socket Protocol GNSS Extensions Reference Manual

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## SCOPE

This document describes OSP® GNSS extensions associated with Spider and Hornet – GPS / GNSS receiver modules.

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## ESD SENSITIVITY

This product is ESD sensitive device and must be handled with care.

## CONTACT INFORMATION

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## RELATED DOCUMENTATION

| № | DOCUMENT NAME | ISSUED BY |
|---|---|---|
| 1 | Spider and Hornet - OSP® Reference Manual | OriginGPS |
| 2 | OSP® Extensions Specification – Issue 3 CS-303979-SPP3 | CSR |
| 3 | NAVSTAR GPS Interface Control Document – IS-GPS-200G | Global Positioning Systems Directorate |
| 4 | GLONASS Interface Control Document – Navigational Radiosignal In Bands L1, L2 Edition 5.1 | Russian Institute of Space Device Engineering |
| 5 | Spider and Hornet - Software User Manual | OriginGPS |
| 6 | Spider and Hornet - NMEA Protocol Reference Manual | OriginGPS |
| 7 | Spider and Hornet - Host Interface Application Note | OriginGPS |
| 8 | Spider and Hornet - Low Power Modes Application Note | OriginGPS |
| 9 | Spider and Hornet - Jammer Detector and Remover Application Note | OriginGPS |
| 10 | Spider and Hornet - Client Generated Extended Ephemeris Application Note | OriginGPS |
| 11 | Spider and Hornet - Server Generated Extended Ephemeris Application Note | OriginGPS |
| 12 | Spider and Hornet - Ephemeris Push Application Note | OriginGPS |
| 13 | Spider and Hornet – MEMS Sensors Interface Application Note | OriginGPS |

RELATED DOCUMENTATION

# REVISION HISTORY

| REVISION | DATE | CHANGE DESCRIPTION |
|---|---|---|
| 0.0 | April 10, 2014 | Draft |
| 1.0 | August 10, 2014 | Release |

REVISION HISTORY

# ABOUT SPIDER FAMILY

OriginGPS GNSS receiver modules have been designed to address markets where size, weight, stand-alone operation, highest level of integration, power consumption and design flexibility - all are very important.

OriginGPS' Spider family breaks size barrier, offering the industry's smallest fully-integrated, highly-sensitive GPS and GNSS modules.

Spider family features OriginGPS' proprietary NFZ™ technology for high sensitivity and noise immunity even under marginal signal condition, commonly found in urban canyons, under dense foliage or when the receiver's position in space rapidly changes.

Spider family enables the shortest TTM (Time-To-Market) with minimal design risks.

Just connect an antenna and power supply on a 2-layer PCB.

# ABOUT HORNET FAMILY

OriginGPS' Hornet family is offering the industry's smallest fully-integrated, highly-sensitive GPS and GNSS modules with integrated antennas or on-board RF connectors.

Hornet family features OriginGPS' proprietary NFZ™ technology for high sensitivity and noise immunity even under marginal signal condition, commonly found in urban canyons, under dense foliage or when the receiver's position in space rapidly changes.

Hornet family enables the shortest TTM (Time-To-Market) with minimal design risks.

Just connect power supply on a single layer PCB.

# ABOUT ORIGINGPS

OriginGPS is a world leading designer, manufacturer and supplier of miniature positioning modules, antenna modules and antenna solutions.

OriginGPS modules introduce unparalleled sensitivity and noise immunity by incorporating Noise Free Zone system (NFZ™) proprietary technology for faster position fix and navigation stability even under challenging satellite signal conditions.

Founded in 2006, OriginGPS is specializing in development of unique technologies that miniaturize RF modules, thereby addressing the market need for smaller wireless solutions.

# Contents

# Tables, Figures and Equations

# 1. Introduction

CSR has created a set of extensions to the OSP interface that are supported in all SSV products starting with the first release of 5t and apply to the SiRFstarIV One Socket Protocol Interface Control Document (OSP ICD). The need for changes to the OPS arouse from the new capabilities of SiRFstarV, including multi-constellation position determination.

In this document, the GNSS receiver is called SiRFstar, SiRFstarV, or as a specific 5t, 5e, 5ea or 5xp, as appropriate. The computer connected to SiRFstar will be referred to as the host. Input messages are those messages sent from the host to SiRFstar, and output messages are those sent from SiRFstar to the host.

OSP messages flow in both directions between your host implementation environment and SiRFstar. Figure 1.1 illustrates an example of the flow of the messages:

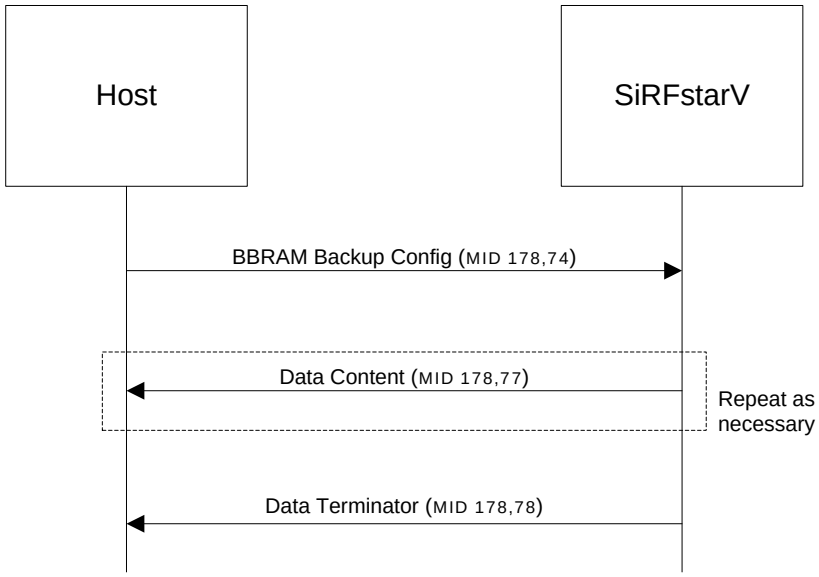


**Figure 1.1: Example OSP Message Flow**

# 2. Message Specifications

Messages in this document will be described in a manner similar to the descriptions in the One Socket Protocol Interface Control Document. In the individual message descriptions, only the payload of each message is described. The structure as physically transmitted from and to the host, is described in Section 2.1. Section 2.2 covers the way the content of the messages are described.

## 2.1. Message Structure

All messages are sent with a header, the payload, and a trailer. The structure of a complete message is described in this section.

All messages begin with a four-byte header consisting of a required preamble: `0xA0 0xA2`. The preamble is followed by a two-byte length field. The length tells how many bytes are in the payload section that follows and do not include either the header or trailer sizes. The length is sent most significant byte first, and has a valid range from `0x00 0x01` through `0x7F 0xFF`. However, under current protocol constraints, no message will be greater than 1032 bytes long including header, payload and trailer.

Most messages have a fixed length where every copy of that message sent will be the same length. But some messages are variable length. There may be fields that are an array of varying size, as in messages transferring files, or there may be structures that are repeated a variable number of times. For any variable-length message there will be a field in the message that tells how large the variable area is. It may tell the length of a variable-length array, or it may specify how many copies of a structure are in the message. The field telling this information is always placed before the variable area.

There is a four-byte trailer added to the message after the payload data. The trailer consists of a two-byte checksum and the closing two bytes, `0xB0 0xB3`. The checksum is computed by adding together the bytes of the payload and performing a logical `AND` of the result with `0x7FFF`. The resulting value is sent most significant byte first.

For example, you might receive the following message from the SiRFstarV to the host:

| | |
|---|---|
| A0 A2 00 06 | Header – saying the payload will be six bytes long |
| 38 5F 00 00 00 00 | Payload, starting with Message ID and Sub ID (**MID 56,95**), other data are zeroes. |
| 00 97 B0 B3 | Trailer – 00 97 is the sum of the bytes in the payload `AND 0x7FFF` |

## 2.2. Message Content

The content of the message payload is described in tabular format. There are three columns, which define the name of the field, the size in bytes with data type, and a description of the form and function of the field. Each row of the table corresponds to an individual field within the message. Table 1 shows the four possible formats of each line of the table.

| Name | Bytes | Description |
|---|---|---|
| MID {,SID} | 2 U or<br>1 U | <name of message > (<hex-value, hex-value>) MID and SID present<br>or<br><name of message > (<hex-value>) only MID present |
| <data field> | <number-type><br><optional array size> | <text description><br><optional unit type><br><optional valid ranges><br><optional scale factor> |

| Name | Bytes | Description |
|---|---|---|
| <structure-name> | <structure-size> | <text description>, see <table reference> for details |
| RESERVED | <reserve-number> | Reserved |

**Table 1: Payload Descriptions**

The payload of every message begins with a one-byte Message ID (MID), and may be followed by a one-byte Sub-ID (SID). For those messages do not use the SID, the length is one byte. Most messages have one or more additional bytes of data. Additional fields may be a single byte or may be multiple-byte values, or may be an array of several copies of the field. Table 2 gives the details of each of the cells in the payload descriptions that are set off by <angle brackets> in Table 3.

| Cell Descriptor | Meaning |
|---|---|
| <name of message > | Name of data structure type in CSR-supplied header file |
| <hex-value> | Hexadecimal value of the MID and, if present, |
| <data field> | Name of the data structure field in CSR-supplied header file |
| <number-type> | Sizes are given in terms of how many 8-bit bytes they occupy. Numeric values in the payload have specific types associated with them. Table 3 gives the designations and definitions used in this reference manual. |
| <optional array size> | Some fields are arrays of simple data types, which are indicated by square brackets enclosing the repeat factor. The repeat factor may be another field name.<br>For example, 4 U [num_rfpts] is an array of 4-byte unsigned integers with the number of elements specified by num_rfpts.<br>If the array being repeated is a structure, the size of the array (4 U in the previous example) will be omitted and the Description cell will have a reference to a table describing details of the data structure. |
| <text description> | Both data fields and structures have descriptions, often it will be an expanded version of the data field name. For example, num_rfpts would be expanded to Number of reference points. |
| <optional unit type> | Some fields have a unit of measure associated with the value they specify. For example, the unit field for a Time field may be seconds. |
| <optional valid ranges> | The minimum and maximum valid values of a field may need to be specified. The range specified is after scaling, if any, has been done. |
| <optional scale factor> | Fields with a scale factor specified must be converted to appropriate values by dividing the scale value into the value reported in the field. This will yield the true decimal value. For example, to obtain the decimal for field Xvel, scaled by 8, is the binary value Xvel divided by 8. |
| <structure-name> | The name of the data structure is the same as the type in CSR-supplied header file. A structure is a group of fields, which are defined in a separate table. A structure may contain other structures. The size of structures can be variable. |
| <structure-size> | If there is a single occurrence of the data structure, this field will be blank. An array of data structures is indicated by a number or field name in [square brackets]. |
| <table reference> | Details of the structure being defined are found in the table indicated. |

| Cell Descriptor | Meaning |
|---|---|
| <reserve-number> | Number of bytes in a field that is not for customer use. For request messages, Reserved fields must be set to zero unless a specified value is required. When receiving a message with a reserved field, always ignore that space. Do not assume a reserved field will be set to zero, since it may contain test data in some software versions. |

**Table 2: Details of Payload**

Fields in the payload are always sent most significant byte first. Most fields that are not structures will have a data type specified in the Bytes column of the table. Table 3 describes the data types.

| Data Type | Meaning |
|---|---|
| # U | Unsigned value of byte length # |
| # S | Signed value of byte length #. Signed values use the two's complement format. |
| # D | Discrete, bit-mapped values occupying # bytes. Discrete bit mapped fields are groups of bits that represent unique things. For example, a four-byte field may indicate which of 32 satellites are represented by setting an individual bit for each satellite. |
| # F | Floating point number: # may be either a 4 (4-byte field, indicating single-precision) or 8 (8-byte field, indicating double-precision), per IEEE-754 format. |

**Table 3: Data Types**

Some fields are marked as unsigned, but also have a set of packing parameters associated with them. The packing parameters are:

Scale factor: Number to divide results by

Signed: Yes = Result is signed
No = Unsigned

Exponent Size: Number of bits for the exponent in the packed integer representation, base 16.

Mantissa Size: Number of bits for the mantissa in the packed integer representation.

Many messages will have one or more fields marked as Reserved. When sending a message with a reserved field, that field should always be set to all zeroes. When receiving a message with a reserved field, ignore the field and do not assume it will be set to zero.

# 3. Deprecated and Replaced Messages

Deprecated messages are still supported in SiRFstarV, but their use is no longer recommended. In the future these deprecated messages will be replaced by the more-functional new messages specified in Table 4. Migration to these new messages is highly recommended, especially for new implementations.

| Deprecated Message Name | Old ID | New Message Name | New ID |
|---|---|---|---|
| Geodetic Navigation Data | **MID 41** | Multi-constellation Navigation Data | **MID 67,1** |
| GPS Data and Ephemeris Mask | **MID 56,1** | GNSS GPS Data and Ephemeris Mask | **MID 56,65** |
| Tracker Configuration | **MID 178,2** | Multi-constellation Tracker Configuration | **MID 178,70** |

**Table 4: Deprecated MIDs**

Replaced messages are no longer available, starting with SiRFstarV. These messages have been replaced with similar messages with improved capabilities. Migration to these new messages is required for SiRFstarV.

| Replaced Message Name | Old ID | New Message Name | New ID |
|---|---|---|---|
| Extended Ephemeris Integrity | **MID 56,2** | GNSS Extended Ephemeris Integrity | **MID 56,66** |
| Extended Ephemeris State | **MID 56,3** | GNSS Extended Ephemeris State | **MID 56,67** |
| EE Provide Synthesized Ephemeris Clock Bias adjustment | **MID 56,4** | GNSS EE Provide Synthesized Ephemeris Clock Bias Adjustment | **MID 56,68** |
| EE Store now | **MID 56,18** | GNSS EE Store Now | **MID 56,71** |
| SIF Ack/Nack | **MID 56,32** | GNSS SIF Ack/Nack | **MID 56,80** |
| SIF EE Age | **MID 56,33** | GNSS EE Age | **MID 56,81** |
| SIF SGEE Age | **MID 56,34** | GNSS SGEE Age | **MID 56,82** |
| SIF Download Initiate Request | **MID 56,35** | GNSS SGEE Download Initiate | **MID 56,83** |
| SIF Erase Storage File | **MID 56,36** | GNSS EE Erase Storage File | **MID 56,84** |
| SIF Update File Content | **MID 56,37** | GNSS SIF Update File Content | **MID 56,85** |
| SIF Request File Content | **MID 56,38** | GNSS SIF Request File Content | **MID 56,86** |
| SIF Store EE Header Contents | **MID 56,39** | GNSS SIF Store EE Header Contents | **MID 56,87** |
| Fetch EE Header Request | **MID 56,40** | GNSS Fetch EE Header Request | **MID 56,88** |
| SIF Aiding Status | **MID 56,41** | GNSS SIF Aiding Status | **MID 56,89** |
| SIF Status | **MID 56,42** | GNSS SIF Status | **MID 56,90** |

**Table 5: MIDs Replaced with New MIDs**

# 4. New and changed Message Specifications

The following sections describe messages that have been added to the OSP protocol or have been updated for the more-capable SiRFstarV receivers.

## 4.1. Measure Navigation Data Response — MID 2

MID 2 provides position and velocity in ECEF coordinates, plus information about the type of fix and satellites used in it. It reports the navigation solution in terms of Earth-Centred, Earth-Fixed coordinates (X, Y, Z), time, and velocity It is output once per fix by default (1 Hz or 5 Hz, depending on setting). The output rate can be modified by **MID 166**.

Table 6 lists the message data format for the measured navigation data.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | `SIRF_MSG_SSB_MEASURED_NAVIGATION (0x02)` |
| `ecef_x` | 4 S | X-position: Estimated ECEF X position in meters |
| `ecef_y` | 4 S | Y-position: Estimated ECEF Y position in meters |
| `ecef_z` | 4 S | Z-position: Estimated ECEF Z position in meters |
| `ecef_vel_x` | 2 S | X-velocity: Estimated ECEF X velocity in m/s scaled by 8 |
| `ecef_vel_y` | 2 S | Y-velocity: Estimated ECEF Y velocity in m/s scaled by 8 |
| `ecef_vel_z` | 2 S | Z-velocity: Estimated ECEF Z velocity in m/s scaled by 8 |
| `nav_mode` | 1 D | Current mode of operation bit map:<br>Bit [2:0] PMODE bit map<br>000 = No navigation solution<br>001 = 1-SV solution (Kalman filter<br>010 = 2-SV solution (Kalman filter)<br>011 = 3-SV solution (Kalman filter)<br>100 = > 3-SV solution (Kalman filter)<br>101 = 2-D point solution (least squares)<br>110 = 3-D point solution (least squares)<br>111 = Dead-Reckoning solution (no satellites) – see bit 0 of `nav_mode2` field<br>Bit 3: TPMODE<br>0 = Full power position<br>1 = TricklePower position<br>Bit [5:4] Alt TMODE bit map<br>00 = No altitude hold applied<br>01 = Holding of altitude from KF<br>10 = Holding of altitude from user input<br>11 = Always hold altitude (from user input)<br>Bit 6: DOP-Mask<br>0 = DOP mask not exceeded<br>1 = DOP mask exceeded<br>Bit 7: DGPS<br>0 = No differential corrections applied<br>1 = Differential corrections applied |
| `hdop` | 1 U | Horizontal Dilution of Precision, scaled by 5, maximum value of 50 |
| `nav_mode2` | 1 D | Bit 0<br>0 = Velocity Dead-Reckoning |

| Name | Bytes | Description |
|---|---|---|
| | | 1 = Sensor Dead-Reckoning in use; Bits [7:6] are error status<br>Bit 1<br>0 = solution has not been over-determined<br>1 = solution has been over-determined (5 or more SVs used)<br>Bit 2<br>0 = velocity DR has not timed out<br>1 = velocity DR timeout<br>Bit 3<br>0 = solution has not been edited by other features<br>1 = solution edited by other features (for example, DOP Mask exceeded)<br>Bit 4<br>0 = velocity is valid<br>1 = velocity is invalid<br>Bit 5<br>0 = Altitude hold mode enabled<br>1 = Disabled; 4 or more satellite (3-D) fix only<br>Bit [7:6] Sensor Dead-Reckoning error status:<br>00 = GPS-only navigation<br>01 = Dead-Reckoning in calibration<br>10 = Dead-Reckoning sensor errors<br>11 = Test mode |
| gps_week | 2 U | GPS Week |
| gps_tow | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.9 seconds, scaled by 10 |
| sv_used_cnt | 1 U | Number of satellites used in fix; range 0 to 18 |
| sv_used | [18] | Satellite ID; see Appendix A for details |

**Table 6: MID 2 - Measure Navigation Data Response**

## 4.2. Measured Tracker Data Response - MID 4

**MID 4** reports on up to 18 satellites currently in track, giving their signal strength ($C/N_o$), azimuth and elevation if known, and the state of each satellite's lock-on. This message has been expanded in SiRFstarV, but **MID 67,16** provides even more information on more satellites and different constellations and CSR recommends using it in place of **MID 4**.

This message reports on the satellites currently being searched, acquired and tracked. It is output once per navigation cycle by default (1 Hz or 5 Hz rate, depending on navigation setting).

Output Rate: 1 Hz or 5 Hz, depending on navigation rate

Table 7 lists the message data format for the measured tracker data.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SIRF_MSG_SSB_MEASURED_TRACKER (0x04) |
| gps_week | 2 U | GPS week number in weeks<br>GPS week number is reported modulo 1024 (ten LSBs only) |
| gps_tow | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.9 seconds, scaled by 10 |
| chnl_cnt | 1 U | Number of channels reported in SV_INFO |

| Name | Bytes | Description |
|---|---|---|
| SV_INFO | [18] | Tracker Data structure see Table 8 for details |

**Table 7: MID 4 – Tracker Data Response**

The data structure returned for each satellite is shown in Table 8.

| Name | Bytes | Description |
|---|---|---|
| svid | 1 U | Satellite ID; see Appendix A for details |
| azimuth | 1 U | Satellite position in degrees clockwise from true North, scaled by .667 |
| elevation | 1 U | Satellite position in degrees above local horizon, scaled by 2 |
| state | 2 D | Bit 0: This is the only bit that is controlled by the acquisition hardware<br>0 = Acquisition not complete<br>1 = Acquisition/re-acquisition completed successfully<br>Bit 1: The integrated carrier phase is valid – delta range in MID 28 is also valid<br>0 = Carrier phase measurements on this channel are invalid<br>1 = Phase relationship between the I and Q samples is being tracked.<br>Bit 2: Bit synchronization<br>0 = Bit synchronization not completed<br>1 = Bit synchronization completed<br>Bit 3: Subframe synchronization<br>0 = Subframe synchronization not completed<br>1 = Subframe synchronization completed<br>Bit 4: Carrier pull-in has been completed (Costas lock)<br>0 = Doppler corrections have not been made<br>1 = Doppler corrections have been made and phase between I and Q samples is stable<br>Bit 5: Code locked<br>0 = Code has not been locked<br>1 = Code has been locked<br>Bit 6: Track lost<br>0 = Track not lost<br>1 = Track lost: unless bits 0-5 and 7 are also set; then it indicates a track is being tested for auto- or cross-correlations<br>Bit 7: Ephemeris data<br>0 = Ephemeris data not available<br>1 = Ephemeris data is available<br>Bit [15:8]: Reserved |
| cno | 1 U [10] | 10 measurements that are the value of each 100 ms interval in dB-Hz for a period of 1 sec. |

**Table 8: Tracker Data Structure**

## 4.3. Software Version String Response – MID 6

This response reports the SiRFstar software version. If a customer-specific version string has been defined, such as with the Software Development Kit, that will be reported as well. If a patch has been installed in a ROM-based receiver, the patch will also be identified. This message is output in response to a Poll Software Version message **MID 132**.

This message has a variable length from 4 to 162 bytes.

Output Rate: Response to polling message

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_SW_VERSION (0x06) |
| sirf_ver_bytes | 1 U | Number of characters in SiRF Version ID, including terminating 0x00 |
| cust_ver_bytes | 1 U | Number of characters in Customer Version ID, including terminating 0x00 |
| sirf_ver_str | 1 U [sirf_ver_bytes] | SiRF Software Version ID, terminated by 0x00 |
| cust_ver_str | 1 U [cust_ver_bytes] | Customer Software Version ID, terminated by 0x00 |

**Table 9: MID 6 – Software Version String Response**

## 4.4. Clock Status Data Response – MID 7

This message reports the precise frequency of the GPS crystal. Part of the navigation solution is the determination of precise time, how SiRFstar's time differs from GPS time, and how the GPS clock is changing. A side effect of this is learning the precise frequency of the GPS crystal. This message is only output when it is explicitly activated or when "Nav Library" messages are turned on.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_CLOCK_STATUS (0x07) |
| gps_week | 2 U | GPS extended week number in weeks |
| gps_tow | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.99 seconds, scaled by 100 |
| sv_used_cnt | 1 U | Number of SVs used, range 0 to18 |
| clk_offset | 4 U | Clock Drift in Hz |
| clk_bias | 4 U | Clock Bias in nanoseconds |
| est_gps_time | 4 U | Estimated GPS time of measurement in milliseconds |

**Table 10: MID 7 – Clock Status Data Response**

## 4.5. 50 bps Data Response – MID 8

This message reports the raw data received from a satellite's navigation message. It is output once per completed data block for each satellite. For GPS satellites that is once every 6 seconds; for GLONASS satellites it is once every 2 seconds. If both types of satellites are being reported, then the rate of reports will be the sum of the two rates. In GSD4e and SiRFstarV receivers, this message is only output when Navigation Library messages are enabled, or when the output rate is set to one by **MID 166**. Table 11 shows the fields of the 50 bps Data Message.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_50BPS_DATA (0x08) |
| chnl | 1 U | Channel number where this satellite is tracked |
| svid | 1 U | Satellite PRN number (GPS,SBAS):<br>0 = No report<br>1 – 32 = GPS PRN<br>70 – 83 = GLONASS, (70 = channel -7; 83 = channel +6) |
| word | 4 U [10] | 0 = invalid data |

| Name | Bytes | Description |
|---|---|---|
| | | For GPS: up to ten 32-bit words of raw data per satellite<br>For GLONASS up to four 32-bit words every 2 seconds. |

**Table 11: MID 8 – 50 bps Data Output Message Fields**

## 4.6. Error ID Indication – MID 10

Whenever there is an error in SiRFstar or an event happens that should be reported to the host, this message sent by SiRFstar. There are multiple versions of the message depending on the specific situation being reported. Some reports are actual errors, such as the VCO has lost lock. Others are simply information about current conditions or events, such as a particular satellite's ephemeris has expired and needs to be recollected. There is no rate control for this message.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_ERR0R (0x0A) |
| `err_id` | 2 U | Error ID |
| `param_cnt` | 2 U | Number of 4-byte values that follow, range 0 to 6 |
| `param` | 4 U [param_cnt] | Error Data |

**Table 12: MID 10 – Error ID Response**

| Error Code (decimal value) | Description |
|---|---|
| `ErrId_CS_SVParity`(2) | Satellite subframe # failed parity check; two values returned per error condition:<br>▪ SVID: Satellite pseudo-random noise (PRN) number that failed<br>▪ Subframe No: Associated subframe number that failed the parity check, from 1 to 5 |
| `ErrId_RMC_GettingPosition`(9) | SVID which failed to obtain a position and had been previously acquired |
| `ErrId_RXM_TimeExceeded`(10) | SVID of unit that failed conversion of Nav Pseudo Range to Time of Week (ToW) for tracker exceeds limits: Nav must be:<br>Pseudo Range > 6.912 x $10^5$<br>(1 week in seconds) \|\| Nav Pseudo Range < -8.64 x $10^4$.Pseudo range |
| `ErrId_RXM_TDOPOverflow`(11) | SVID of unit that failed in conversion of pseudorange rate to Doppler frequency exceeds limit. |
| `ErrId_RXM_ValidDurationExceeded` (12) | Satellite ephemeris age has exceeded 2 hours (7200 s). |
| `ErrId_STRTP_BadPostion` (13) | SRAM position is bad during a cold start. |
| `ErrId_MI_VCOClockLost` (4097) | VCO lost lock indicator. |
| `ErrId_MI_FalseAcqReceiverReset` (4099) | Nav detect false acquisition, reset receiver by calling<br>NavForceReset routine. |

| Error Code (decimal value) | Description |
|---|---|
| `ErrId_STRTP_SRAMCksum` (4104) | Failed SRAM checksum during startup; 4, 3, or 2 values returned:<br>▪ Computed receiver control checksum of SRAM.<br>▪ NVRAM receiver control checksum stored in SRAM.Data.DataBuffer. CntrlChkSum.<br>▪ NVRAM receiver control checksum stored in SRAM.Data.Control.OpMode. Valid OpMode values:<br>`0` = OP_MODE_NORMAL<br>`0x1E51` = OP_MODE_TESTING<br>`0x1E52` = OP_MODE_TESTING2<br>`0x1E53` = OP_MODE_TESTING3<br>▪ NVRAM receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are: 0-12<br>▪ Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.<br>▪ NVRAM clock offset checksum of SRAM.Data.DataBuffer.clkChkSum<br>▪ NVRAM clock offset value stored in SRAM.Data.DataBuffer,clkOffset<br>▪ Computed position time checksum of SRAM.Data.DataBuffer.postime<br>▪ NVRAM position time checksum of SRAM.Data.DataBuffer.postimeChkSum[ |
| `ErrId_STRTP_RTCTimeInvalid` (4105) | Failed RTC SRAM checksum during startup. If one of the double buffered SRAM.Data.LastRTC elements is valid and RTC days is not 255 days, the GPS time and week number computed from the RTC is valid. If not, this RTC time is invalid.<br>Two values returned:<br>▪ GPS time of week in seconds, from 0 to 604800 seconds<br>▪ GPS week number |
| `ErrId_KFC_BackupFailed_Velocity` (4106) | Failed saving position to NVRAM because the ECEF velocity sum was greater than 3600. |
| `ErrId_KFC_BackupFailed_NumSV` (4107) | Failed saving position to NVRAM because current navigation mode is not KFNav and not LSQFix. |
| `ErrId_MI_BufferAllocFailure` (8193) | Buffer allocation error occurred. Does not appear to be active because uartAllocError variable never gets set to a non-zero value in the code. Returns: Contents of variable used to signal UART buffer allocation error |
| `ErrId_MI_UpdateTimeFailure` (8194) | PROCESS_1SEC task was unable to complete upon entry. Overruns are occurring. Returns two values:<br>▪ Number of one-second updates not complete on entry<br>▪ Millisecond errors caused by overruns |
| `ErrId_MI_MemoryTestFailed` (8195) | Failure of hardware memory test. |

| Error Code (decimal value) | Description |
|---|---|
| `ErrID_WatchDogOrExceptionCondition` (8196) | This message notifies a PVT product host of a watchdog time-out or processor exception in SiRFstar. The consistent accumulation of these notification messages by the host can be used to produce statistics for:<br>▪ Reliability measurement and analysis<br>▪ Troubleshooting purposes<br>For the GSD4e, it enables the host to determine if the patch RAM needs reloading. The watch-dog event and also some exception events are indications of potential corruption in the patch RAM. This message enables the host to initiate the patch download protocol.<br>Typically, upon the receipt of this message, the host polls the software version of SiRFstar, and the typical response contains the actual patch status of SiRFstar. The host then compares this status with the last applied patch according to the patch maintenance value stored in the host. If the software version response does not indicate the up-to-date patch status, the host initiates the (re)load of the required patch according to the latest patch maintenance value stored in the host.<br>Two values returned:<br>▪ Exception Code:<br>xxxxxx01 = Watchdog time-out condition<br>xxxxxx10 = Reserved for exception conditions<br>xxxxx1xx = Corrupted patch-RAM detected<br>xxxxx0xx = No corrupted patch-RAM detected<br>▪ NMEA String: NMEA syntax representing all fields of the OSP message. NMEA Reference Manual, **MID 160**, describes this. Including the NMEA string in the binary OSP message in this predefined field can simplify the interface between the binary OSP parser and the ASCII NMEA parser of the host software, when the integrity of SiRFstar is unknown. When the host knows SiRFstar is in an NMEA state, not a binary OSP state, but a received message is syntactically not NMEA compliant, a front-end of the receiving parser of the host can check if the beginning of the message is compliant with this binary OSP notification message up to the NMEA String field. If it is, it can pass the payload of the NMEA String to the host NMEA parser. |

**Table 13: MID 10 – Error ID Indication**

## 4.7. Command Acknowledgment Response – MID 11

This reply is sent in response to messages accepted by SiRFstar. It is commonly referred to as ACK in response to a Request message. When a Request is successful and has completed, including sending any resulting output messages, the ACK will be sent.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_ACK (0x0B) |
| `msg_id` | 1 U | MID that completed successfully |
| `sub_id` | 1 U | Optional SID of successful Request |

**Table 14: MID 11 – Command Acknowledgment Response**

## 4.8. Command Negative Acknowledgment Response – MID 12

This reply is sent in response to messages accepted by SiRFstar. It is commonly referred to as ACK in response to a Request message. When a Request is successful and has completed, including sending any resulting output messages, the ACK will be sent.

Commonly referred to as NACK, this message is output in response to a failure of an input message. For instance, if the incoming message fails checksum or contains illegal parameters the NACK will be output and generally the command will not be acted upon. This reply is sent when an input command to SiRFstar is rejected.

Possible causes are:

- The input message failed checksum
- The input message contained an argument that was out of the acceptable range
- SiRFstar was unable to comply with the message

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_NAK (0x0C) |
| msg_id | 1 U | MID of Request that did not complete successfully |
| sub_id | 1 U | Optional SID of Request |

**Table 15: MID 12 – Command Negative Acknowledgment Response**

## 4.9. Visible List Indication – MID 13

Periodically SiRFstar uses available ephemerides and almanacs and the current time to compute the location of each satellite in 3-dimensional space. It then uses its own computed position to determine which of the satellites should be above SiRFstar's horizon. The computation is done at specific times, and at a rate that may vary depending on version of firmware in SiRFstar. Common conditions for computing this list are:

- When the first satellite is acquired
- When SiRFstar first computes a position
- Periodically during normal tracking.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_VISIBILITY_LIST (0x0D) |
| svid_cnt | 1 U | Number of valid entries in array of visible satellites |
| visible | [svid_cnt] | The structure describing visible satellites, see Table 17 for details |

**Table 16: MID 13 – Visible List Indication**

| Name | Bytes | Description |
|---|---|---|
| svid | 1 U | Satellite ID; see Appendix A for details |
| azimuth | 2 U | Satellite position in degrees clockwise from true North , relative to the receiver. |
| elevation | 2 U | Satellite position in degrees above local horizon |

**Table 17: Visible Satellites**

## 4.10. Navigation Library SV State Indication – MID 30

Periodic MID 30 messages report the computed satellite position and velocity at the specified GPS time.

**Note:**

You must adjust for difference between GPS Time MID 30 and Time of Transmission when using **MID 30** SV position information. Also see the note in MID 28. Iono delay is not included in pseudorange in **MID 28**.

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SIRF_MSG_SSB_NL_SV_STATE_DATA (0x1E) |
| svid | 1 U | Satellite ID; see Appendix A for details |
| time | 8 F | GPS Time, in s |
| pos | 8 F[3] | Position X, Y, Z in m |
| vel | 8 F[3] | Position X, Y, Z in m/s |
| clk | 8 F | Clock Bias in s |
| clf | 4 F | Clock Drift in s/s |
| eph | 1 U | Ephemeris dlag (see Table 19 for details) |
| posvar | 4 F | Velocity Z, in m/s |
| clkvar | 4 F | Clock Bias, in s |
| iono | 4 F | Clock Drift, in s/s |
| RESERVED2 | 4 | Reserved, set to zero. |

**Table 18: Navigation Library SV State Indication**

| Ephemeris Flag Value (EFV) | Ephemeris Age in days | Definition |
|---|---|---|
| 0x00 | N/A | No Valid SV state |
| 0x01 | N/A | SV state calculated from broadcast ephemeris |
| 0x02 | N/A | SV state calculated from almanac at least 0.5 week old |
| 0x03 | N/A | Assist data used to calculate SV state |
| 0x04 | N/A | SV state calculated from almanac less than 0.5 weeks old |
| 0x05 -:- 0x10 | - | Reserved |
| 0x11 -:- 0x1F | EFV - 0x10 | SV state calculated from server-based synthesized ephemeris with age of 1 - 15 days |
| 0x20 | - | Reserved |
| 0x21 -:- 0x23 | EFV - 0x20 | SV state calculated from client-based synthesized ephemeris with age of 1 - 3 days |
| 0x24 -:- 0x4F | - | Reserved |
| 0x50 -:- 0x5F | EFV - 0x40 | SV state calculated from server-based synthesized ephemeris with age of 16 - 31 days |
| 0x60 -:- 0xFF | - | Reserved |

**Table 19: Ephemeris Flag Value Descriptions**

## 4.11. GNSS GPS Data and Ephemeris Mask – MID 56,65

The GNSS GPS Data and Ephemeris Mask message requests Ephemeris data for a specific satellite. The Output Rate is once every six seconds until the extended ephemeris data is received. In response to this message the host will send requested data using **MID 27** for SiRFstarIV products and **MID 232**,**78** for SiRFstarV products.

Table 20 shows the fields of the GNSS GPS Data and Ephemeris Mask message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_GPS_TIME_INFO_EXT (`0x38, 0x41`) |
| NAV_SYSTEM | 1 U | Navigation System<br>`0x00` = GPS<br>`0x01` = GLONASS |
| GPS_TIME_VALID_FLAG | 1 U | bit 0<br>`0` = GPS week is not valid<br>`1` = GPS week is valid<br>bit 1<br>`0` = GPS TOW is not valid<br>`1` = GPS TOW is valid |
| GPS Week | 2 U | Extended week number. Week 0 = January 6, 1980 |
| GPS TOW | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.9 seconds, scaled by 10 |
| EPH_REQ_MASK | 4 U | Mask to indicate the satellites for which new ephemeris is needed.<br>For GPS, bit 0 = PRN 1, bit 31 = PRN 32.<br>For GLONASS, bit 0 = slot 1, bit 23 = slot 24. |
| RESERVED | 1 | Reserved, set to zero. |

**Table 20: MID 56,65 – GPS Data and Ephemeris Mask Extension Fields**

## 4.12. GNSS Extended Ephemeris Integrity – MID 56,66

The GNSS Extended Ephemeris Integrity message reports the validity of various aspects of satellite data in SiRFstar. There is no fixed output Rate, the data is output upon host request. Table 21 shows the fields of the GNSS Extended Ephemeris Integrity message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_INTEGRITY_EXT (`0x38, 0x42`) |
| NAV_SYSTEM | 1 U | Navigation System<br>`0x00` = GPS<br>`0x01` = GLONASS |
| SAT_POS_VALIDITY_FLAG | 4 D | 1 = invalid position found, 0 = valid position.<br>For GPS, bit 0 = PRN 1, bit 31 = PRN 32.<br>For GLONASS, bit 0 = slot 1, bit 23 = slot 24. |
| SAT_CLK_VALIDITY_FLAG | 4 D | 1 = invalid clock found, 0 = valid clock.<br>For GPS, bit 0 = PRN 1, bit 31 = PRN 32.<br>For GLONASS, bit 0 = slot 1, bit 23 = slot 24. |
| SAT_HEALTH_FLAG | 4 U | 1 = unhealthy satellite, 0 = healthy satellite<br>For GPS, bit 0 = PRN 1, bit 31 = PRN 32. |

| Name | Bytes | Description |
|---|---|---|
| | | For GLONASS, bit 0 = slot 1, bit 23 = slot 24. |
| RESERVED | 4 | Reserved, set to zero. |

**Table 21: MID 56,66 – Extended Ephemeris Integrity Extension Fields**

## 4.13. GNSS Extended Ephemeris State – MID 56,67

The GNSS Extended Ephemeris State Message is output in response to "Poll GNSS Ephemeris Status", MID 232,66. Table 22 shows the fields of the GNSS Extended Ephemeris State message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_INTEGRITY_EXT (0x38, 0x43) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Satellite Info | [18] | The details of the structure are documented in Table 23 |
| RESERVED | 4 | Reserved, set to zero. |

**Table 22: MID 56,67 – GNSS Extended Ephemeris Status Message Fields**

| Name | Bytes | Description |
|---|---|---|
| SVID | 1U | Satellite PRN, range 0-32 |
| Source | 1 U | Source of this ephemeris<br>0 = none<br>1 = from network aiding<br>2 = from SV<br>3 = from extended ephemeris aiding |
| Week | 2 U | Extended GPS Week number for ephemeris. |
| Time of ephemeris | 2 U | TOE: effective Time Of Week for ephemeris (seconds / 16, range 0 to 37800) |
| Integrity | 1 | Reserved |
| Age | 1 D | Age of ephemeris (days)<br>Bit 0 to 3 contains the age of the ephemeris<br>Bit 4 = source is server-generated<br>Bit 5 = source is client-generated |

**Table 23: MID 56,67 – Satellite EES Information**

## 4.14. GNSS EE Provided Synthesized Ephemeris Clock Bias Adjustment – MID 56,68

The GNSS EE Synthesized Ephemeris Clock Bias Adjustment Message is used to report the clock bias adjustment for a specific time of ephemeris. The output rate is variable. Table 24 shows the fields of the GNSS EE Provided Synthesized Ephemeris Clock Bias Adjustment message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_STATE_EXT (0x38, 0x44) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| NUM_SATELLITES | 1 U | Number of valid Satellites, range 1-32 |
| SIRF_MSG_SSB_EE_STATE | [32] | Satellite EE Clock Adjustment Information, see Table 25 for details |
| RESERVED | 4 | Reserved, set to zero. |

**Table 24: MID 56,68 – GNSS EE Provide Synthesized Ephemeris Clock Bias Adjustment Message Fields**

| Name | Bytes | Description |
|---|---|---|
| SV_ID | 1 U | SV_ID = 0 means fields SE_TOE and Clock_Bias_Adjust are invalid<br>For GPS, range 1-32 = satellite PRN<br>For GLONASS, range 1-24 = slot number |
| SE_TOE | 2 U | The Time of Ephemeris of the synthesized Ephemeris for which the clock bias adjustment is being reported in seconds, scaled by 24. |
| Clock_Bias_Adjust | 4 S | Clock bias adjustment in seconds, scale: 2-31 |

**Table 25: Satellite EE Clock Adjustment Information**

## 4.15. GNSS SIF EE Age – MID 56,70

The GNSS SIF EE Age Message reports the age of the extended ephemeris in use. Table 26 shows the fields of the GNSS SIF EE Age message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_EPHEMERIS_AGE_EXT (0x38, 0x46) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| GPS_WEEK | 2 U | Extended GPS week number |
| TIME_OF_WEEK | 4 U | GPS Time Of Week of measurement. Range 0 to 604799 s |
| INDICATOR | 1 U | 0 = age is valid; non-zero indicates age is invalid. |
| AGE | 4 U | Age in seconds |
| AGE_IN_DAYS | 1 U | Age in days |
| RESERVED | 1 | Reserved, set to zero. |

**Table 26: MID 56,70 – GNSS SIF Ephemeris EE Age Message Fields**

## 4.16. GNSS EE Store Now – MID 56,71

The GNSS EE Store Now message is used to enforce write of Extended Ephemeris data from internal buffer to the flash or host NVM target. Table 27 shows the fields of the GNSS EE Store Now message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_STORE_NOW_EXT (0x38, 0x47) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED1 | 1 | Reserved, set to zero. |
| RESERVED2 | 4 | Reserved, set to zero. |

**Table 27: MID 56,71 – GNSS EE Store Now Extended Message Fields**

## 4.17. GNSS SIF Ack/Nack – MID 56,80

SIF Ack/Nack is the response message for the Input **MID 232, SIDs 73, 74, 75, 76 or 77**. Table 28 shows the fields of the SIF Ack/Nack message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 1 U | SIRF_MSG_SSB_SIF_ACK_NACK_EXT (0x38,0x50) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Ack Msg Id | 1 U | Ack Message ID |
| Ack Sub Id | 1 U | Ack Sub ID |
| Ack/Nack | 1 U | Response:<br>0 = Ack<br>1 = Nack |
| Ack Nack Reason | 1 U | Reason codes:<br>0 = Success<br>1 = Insufficient space available<br>2 = Invalid packet length<br>3 = Received packet out of sequence<br>4 = SGEE Download file not found<br>5 = Corrupt download File<br>6 = Generic download failure<br>7 = Generic API failure<br>8 = SIF aiding is in progress<br>9 = SIF has not started |
| RESERVED | 4 | Reserved, set to zero. |

**Table 28: MID 56,80 – GNSS SIF Ack/Nack Message Fields**

## 4.18. GNSS EE Age – MID 56,81

This is the response message to the Input Message GNSS Get EE Age with MID 232,76. Table 29 shows the fields of the GNSS EE Age message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_EE_AGE_EXT (0x38, 0x51) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| numSAT | 1 U | Number of satellites' data included in this message<br>GPS range 1-32<br>GLONASS range 1-24 |
| SIRF_MSG_SSB_CLM_EE_AGE | [32] | GNSS EE AGE Structure fields see Table 30 for details |
| RESERVED | 1 | Reserved, set to zero. |

**Table 29: MID 56,81 – GNSS EE Age Message Fields**

| Name | Bytes | Description |
|---|---|---|
| prnNum | 1 U | PRN number of satellite for which age is indicated in other fields.<br>GPS range 1-32<br>GLONASS range 1-24 |
| ephPosFlag | 1 U | Ephemeris flag to indicate the type of ephemeris available for the satellite:(Position Age)<br>0 = Invalid ephemeris, not available<br>1 = Broadcast Ephemeris<br>2 = SGEE<br>3 = CGEE |
| eePosAge | 2 U | Age of EE in 0.01 days (Position Age) |
| cgeePosGPS Week | 2 U | GPS week of BE used in the CGEE generation; 0 if ephPosFlag is not set to 3 or set to 0 (Position Age). |
| cgeePosTOE | 2 U | TOE of Broadcast Ephemeris used in the CGEE generation; 0 if ephPosFlag is not set to 3 (Position Age). |
| ephClkFlag | 1 U | Ephemeris flag to indicate the type of ephemeris available for the satellite: (Clock Age)<br>0 = Invalid<br>1 = BE<br>2 = SGEE<br>3 = CGEE<br>4-255 Reserved |
| eeClkAge | 2 U | Age of EE in 0.01 days (Clock Age) |
| cgeeClkGPS Week | 2 U | GPS week of Broadcast Ephemeris used in the CGEE generation; 0 if ephClkFlag is not set to 3 (Clock Age) |
| cgeeClkTOE | 2 U | TOE of Broadcast Ephemeris used in the CGEE generation; 0 if ephClkFlag is not set to 3 (Clock Age). |

**Table 30: GNSS EE AGE Structure Fields**

## 4.19. GNSS SGEE Age – MID 56,82

The GNSS SGEE Age message is the response message to the Input Message GNSS Get SGEE Age with MID 232,77.

Table 31 shows the fields of the GNSS SGEE Age message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_SGEE_AGE_EXT (0x38, 0x52) |
| NAV_SYSTEM | 1 U | Navigation System<br>0 = GPS<br>1 = GLONASS |
| SGEE Age | 4 U | SGEE age for the Requested Satellite in seconds |
| Prediction Interval | 4 U | Prediction Interval in seconds |
| RESERVED | 4 | Reserved, set to zero. |

**Table 31: MID 56,82 – GNSS SGEE Age Message Fields**

## 4.20. GNSS SGEE Download Initiate – MID 56,83

This message is used to initiate download of a new SGEE file. Table 32 shows the fields of the GNSS SGEE Download Initiate message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_PKT_INVOKE_DLD_EXT (0x38, 0x53) |
| NAV_SYSTEM | 1 U | Navigation System<br>0 = GPS<br>1 = GLONASS |
| Start | 1 U | 0 = stop<br>1 = start |
| Wait Time | 4 U | Time in seconds after which downloading should be started. |
| RESERVED | 4 | Reserved, set to zero. |

**Table 32: MID 56,83 – GNSS SGEE Download Initiate Message Fields**

## 4.21. GNSS SIF Erase Storage File Request – MID 56,84

The GNSS SIF Erase Storage File message will erase the data file at the storage location specified by NVMID. Table 33 shows the fields of the GNSS SIF Erase Storage File message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_SGEE_AGE_EXT (0x38, 0x54) |
| nav_system | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |

| Name | Bytes | Description |
|---|---|---|
| NVMID | 1 U | Storage area to erase<br>01 = GPS SGEE<br>02 = GPS CGEE<br>03 = GPS BE<br>05 = GPS Header<br>06 = GLONASS SGEE<br>07 = GLONASS CGEE<br>08 = GLONASS BE<br>10 = GLONASS Header |
| RESERVED | 4 | Reserved, set to zero. |

**Table 33: MID 56,84 – GNSS SIF Erase Storage File Request**

## 4.22. GNSS SIF Update File Content Request – MID 56,85

This message is used to update EE file content which is stored in the Host. The EE file to be used is identified by NVMID. Table 34 shows the fields of the GNSS SIF Update File Content Request.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_STR_PKT_DATA_EXT (0x38, 0x55) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| NVMID | 1 U | Storage area to update<br>01 = GPS SGEE<br>02 = GPS CGEE<br>03 = GPS BE<br>05 = GPS Header<br>06 = GLONASS SGEE<br>07 = GLONASS CGEE<br>08 = GLONASS BE<br>10 = GLONASS Header |
| size | 2 U | Number of bytes of data in the Data field, range 1 to 2000 |
| offset | 4 U | Offset of content in given storage file. |
| seqNum | 2 U | Packet Sequence Number |
| data | 1 U [size] | File content: array of length size. |
| reserved | 4 | Reserved, set to zero. |

**Table 34: MID 56,85 – GNSS SIF Update File Content Request**

## 4.23. GNSS SIF Request File Content Request – MID 56,86

This message is used to update EE file content which is stored in the Host. The EE file to be used is identified by NVMID. Table 35 shows the fields of the GNSS SIF Request File Content message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_RCV_PKT_DATA_EXT (0x38, 0x56) |
| nav_system | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| NVMID | 1 U | Storage area containing data requested<br>01 = GPS SGEE<br>02 = GPS CGEE<br>03 = GPS BE<br>05 = GPS Header<br>06 = GLONASS SGEE<br>07 = GLONASS CGEE<br>08 = GLONASS BE<br>10 = GLONASS Header |
| seqNum | 2 U | Sequence number of packet |
| numBlocks | 1 U | Number of Blocks to read (maximum 32) |
| blocks | [numBlocks] | See Table 36 for details |
| reserved | 4 | Reserved |

**Table 35: MID 56,86 – GNSS SIF Request File Content Request**

| Name | Bytes | Description |
|---|---|---|
| size | 2 U | Data size |
| offset | 4 U | Offset in Storage |

**Table 36: Block Descriptors**

## 4.24. GNSS SIF Store EE Header Contents – MID 56,87

The GNSS SIF Store EE Header Contents message supports the host-based storage of receiver-collected ephemeris data. It contains the EE header content to store on the host.

This header is updated more frequently than the EE Aiding data itself which is sent to the host separately via MID 56,87. The header contains state-related parameters, such as the availability of SGEE, which satellites are supported with predictions, the clock corrections for different SVIDs, and other information. Table 37 shows the fields of the GNSS SIF Store EE Header Contents message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_NVM_HEADER_DATA_EXT (0x38, 0x57) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Offset | 2 U | Offset from start of header file |
| PacketSize | 2 U | Size of this data block |

| Name | Bytes | Description |
|---|---|---|
| PacketData [Packetsize] | 1 U [PacketSize] | EE Header Data |
| RESERVED | 4 | Reserved, set to zero. |

**Table 37: MID 56,87 – GNSS SIF Store EE Header Contents Message Fields**

## 4.25. GNSS Fetch EE Header Request – MID 56,88

The GNSS Fetch EE Header Request message requests the host to retrieve the entire EE header information from storage.

SiRFstar sends this request at start-up if and only if the default selection of EE aiding data storage is set to Host Storage (via eFuse settings or CCK). In response to this request, the host sends EE header contents to the firmware. Table 38 shows the fields of the GNSS Fetch EE Header Request message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_GET_HOST_HEADER_EXT (`0x38,0x58`) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED1 | 1 | Reserved, set to zero. |
| RESERVED2 | 1 | Reserved, set to zero. |

**Table 38: MID 56,88 – GNSS Fetch EE Header Request Message Fields**

## 4.26. GNSS SIF Aiding Status – MID 56,89

The GNSS SIF Aiding Status message is generated in response to a Get Aiding Status message.

Table 39 shows the fields of the GNSS SIF Aiding Status message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_AIDING_STATUS_EXT (`0x38, 0x59`) |
| NAV_SYSTEM | 1 U | Navigation System<br>`0x00` = GPS<br>`0x01` = GLONASS |
| SGEE Status | 1 U | SGEE<br>0: Enabled<br>1: Disabled<br>Any other value: Enabled. |
| CGEE Status | 1 U | CGEE<br>0: Enabled<br>1: Disabled<br>Any other value: Enabled. |
| CGEE Prediction Disable Time | 4 U | `0x00000000`: Predictions are stopped.<br>`0xffffffff`: Predictions are continuing.<br>Any other value: GPS Time at which prediction will be stopped. Reported in seconds, scaled |

| Name | Bytes | Description |
|---|---|---|
| | | by 16. |
| Current Receiver Time | 4 U | `0x00000000`: Could not get Receiver time.<br>Any other value is the GPS Time Of Week in seconds |
| RESERVED | 4 | Reserved, set to zero. |

**Table 39: MID 56,89 – GNSS SIF Aiding Status**

## 4.27. GNSS SIF Status – MID 56,90

The GNSS SIF status message reports the SIF status. It is output every five navigation cycles (1/5 Hz when receiver is in full power 1 Hz output mode).

Table 40 shows the fields of the GNSS SIF Status message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_STATUS_EXT (`0x38, 0x5A`) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| SIFState | 1 U | Indicates the status of SIF<br>1: enabled<br>0: disabled |
| cgeePrediction State | 1 U | Indicates the prediction state of CGEE.<br>0: CGEE Prediction Enabled<br>1: Disabled<br>2: Programmed to Stop at some time in the future (see cgeePredictionTimeLeft field for remaining time). |
| sifAidingType | 1 U | Indicates type of SIF aiding currently enabled.<br>0: SGEE<br>1: CGEE<br>2: Mix |
| sgeeDwld InProgress | 1 U | Indicates if SGEE download is in progress or not.<br>0: Not active<br>1: Actively downloading SGEE data |
| cgeePrediction TimeLeft | 4 U | Reports time in seconds until CGEE Predictions will stop. 0 = not programmed to stop |
| cgeePrediction PendingMask | 4 U | Indicates which satellite prediction is pending. Each bit indicates one satellite. Bit Map:<br>For GPS, Bit 0 = PRN 1, Bit 31 = PRN 32<br>For GLONASS, Bit 0 = slot number 1, Bit 23 = slot number 24 |
| svidCGEEPredict InProgress | 1 U | Returns a satellite ID for which CGEE prediction is in progress. 0 = no CGEE prediction in progress.<br>For GPS, range = PRN 1-32.<br>For GLONASS range = slot number 1-24 |
| sgeeAgeValidity | 1 D | Remaining SGEE predictions available<br>Bits 6:0 specifies remaining validity in either hours (range 0-23) or days (range 1-127)<br>Bit 7 specifies the units, 0 = days, 1= hours<br>Value of 0 = no SGEE data available |

| Name | Bytes | Description |
|---|---|---|
| cgeeAgeValidity [SIRF_MAX _SVID_CNT] | 1 U * 32 | Remaining CGEE predictions available, one value per satellite in PRN or slot number order<br>Bits 6:0 specifies remaining validity in either hours (range 0-23) or days (range 1-3)<br>Bit 7 specifies the units, 0 = days, 1= hours<br>Value of 0 = no CGEE data available for this satellite |
| RESERVED | 4 | Reserved, set to zero. |

**Table 40: MID 56,90 – GNSS SIF Status Message Fields**

## 4.28. SIF Activity Indication – MID 56,95

This message indicates the status of SIF activity to the host system. This message provides the indication to the Host system that all data has been transferred.

Currently this message is sent in two situations:

1. Whenever SIF gets into IDLE state from ACTIVE state. IDLE state means SIF is not doing any:
   - CGEE prediction
   - Storage of data
   - Processing any aiding request
   - SGEE download
2. Whenever SGEE download is complete.

This message, shown in Table 41, is first available with SiRFstarV.

| Field | Byte(s) | Description |
|---|---|---|
| MID, | 2 U | SIRF_MSG_SSB_SIF_ACTIVITY_INDICATION (0x38, 0x5F) |
| NavSystem | 1U | Navigation System<br>0 = GPS<br>1 = GLONASS |
| activity | 1U | Activity Type:<br>0 = None<br>1 = SGEE Download<br>2, 3, 4 = Reserved<br>5 = SIF overall activity<br>All other values: reserved |
| indication | 2U | Activity Status<br>0 = Pending<br>1 = Completed |
| sifState | 2U | State of SIF module<br>0 = Active<br>1 = IDLE |
| Reserved | 4U | Reserved field |

**Table 41: MID 56,95 – CGEE Transfer Complete Message**

## 4.29. NL Auxiliary Measurement Data Indication – MID 64,2

This periodic message from the Navigation Library (NL) indicates the status of a single satellite.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | SSB_NL_AUX_MEAS_DATA (`0x40, 0x02`) |
| sv_prn | 1 U | Satellite ID; see Appendix A for details |
| status | 1 D | Tracker system status:<br>Bit 0: Trickle Power Active; 1 = TRUE<br>Bit 1: Scalable Tracking Loop Active; 1 = TRUE<br>Bit 2: Reserved |
| extended_status | 1 D | Tracker channel status:<br>Bit 0: Reserved<br>Bit 1: Subframe sync verified; 1 = TRUE<br>Bit 2: Possible cycle slip; 1 = TRUE<br>Bit 3: Subframe sync lost; 1 = TRUE<br>Bit 4: Multipath detected; 1 = TRUE<br>Bit 5: Multipath-only detected; 1 = TRUE<br>Bit 6: Weak frame sync done; 1 = TRUE |
| bit_sync_qual | 1 U | Confidence metric for bit-sync |
| time_tag | 4 U | Measurement time tag (acqclk) |
| code_phase | 4 U | Code Phase ($2^{-11}$ chip) |
| carrier_phase | 4 S | Carrier Phase (L1 cycle) |
| carrier_freq | 4 S | Carrier Frequency (0.000476Hz/LSB) |
| carrier_accel | 2 S | Carrier Acceleration: Doppler Rate (0.1m/s/s) |
| ms_num | 2 S | Millisecond number; range 0 to 19 |
| bit_num | 4 S | Bit number: range 0 to 30239999 |
| code_correction | 4 S | For code smoothing (cycle) |
| smooth_code | 4 S | For PR smoothing ($2^{-10}$ cycle) |
| code_offset | 4 S | Code offset ($2^{-11}$ chip) |
| pseudorange_noise | 2 S | Hardware Tracking:<br>Pseudorange noise estimate (one sigma). Normalized and left-shifted 16 bits.<br>Soft Tracking:<br>Code variance |
| delta_range_qual | 2 S | Tracking:<br>Delta Range accuracy estimate (one sigma). Normalized and left-shifted 16 bits.<br>Soft Tracking:<br>AFC variance |
| phase_lock_qual | 2 S | Tracking:<br>Phase Lock accuracy estimate. Normalized and left-shifted 8 bits.<br>Soft Tracking:<br>Not applicable |

| Name | Bytes | Description |
|---|---|---|
| ms_uncertainty | 2 S | Millisecond uncertainty |
| sum_abs_I | 2 U | Sum \|I\| for this measurement |
| sum_abs_Q | 2 U | Sum \|Q\| for this measurement |
| sv_bit_num | 4 S | Bit number of last SV bit |
| mp_los_det_value | 2 S | Multipath line-of-sight detection value |
| mp_only_det_value | 2 S | Multipath-only line-of-sight detection value |
| recovery_status | 1 D | Tracker recovery status:<br>Bit 0: 0x01: WBS active<br>Bit 1: False Lock<br>Bit 2: Bad pre-positioning , wrong BS<br>Bit 3: Bad pre-positioning, wrong FS<br>Bit 4: Bad pre-positioning, others |
| sw_time_uncertainty | 4 U | SW time uncertainty in µsec |

**Table 42: MID 64,2 – Navigation Library (NL) Auxiliary Measurement Data Indication**

## 4.30. GPIO State Indication – MID 65,192

When this message is active, it reports the state of all the GPIO input lines. MID 178,2, permits setting some GPIOs for customer use. When that is done, this is the message that reports the state of those pins that have been set for input.

**Note:**

This message is not available in versions of SiRFstarV firmware before B02.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | `SIRF_MSG_SSB_GPIO_READ (0x41, 0xC0)` |
| gpio_state | 2 D | Read state of all GPIOs<br>bit 0 = GPIO 0<br>bit 1 = GPIO 1<br>… |

**Table 43: MID 65,192 –GPIO State Indication**

## 4.31. Multi-constellation Navigation Data Response – MID 67,1

This is a new message for SiRFstarV. It is very similar to MID 41, with added features of specifying the satellites used from multiple constellations.

This GNSS Navigation Data message reports position, velocity, time and other related navigation data. The data is computed using information derived from GNSS. The output rate is variable (the default is 1 Hz).

This message is supported starting with SiRFstarV. Table 44 shows the fields of the Multi-constellation Navigation Data message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_GNSS_NAV_DATA (`0x43, 0x01`) |

| Name | Bytes | Description |
|---|---|---|
| solution_validity | 4 D | Solution Validity<br>0x0000 = Valid solution (any bit set implies solution is not optimal);<br>Bit 0: Solution not yet over-determined (< 5 SVs)<br>Bit 1: Reserved<br>Bit 2: Reserved<br>Bit 3: Invalid DR sensor data (SiRFDRive)<br>Bit 4: Invalid DR calibration (SiRFDRive)<br>Bit 5: Unavailable DR GPS-based calibration (SiRFDRive)<br>Bit 6: Invalid DR position fix (SiRFDRive )<br>Bit 7: Invalid heading (SiRFDRive)<br>Bit 8: Almanac Based Position (ABP)<br>Bits 9 – 12: Reserved<br>Bit 13: GPS in text mode<br>Bit 14: Tracker is loading (used in tracker operation only)<br>Bit 15: No tracker data available (used in tracker operation only)<br>Bits 16-31: Reserved |
| solution_info | 4 D | Solution Information<br>Bits [2:0]: Solution type<br>000 = No navigation fix<br>001 = not used<br>010 =not used<br>011 = 3-SV KF solution<br>100 = 4 or more SV KF solution<br>101 = 2-D least-squares solution<br>110 = 3-D least-squares solution<br>111 = DR solution (see bits 8, 14-15)<br>Bit 3: 1 = Trickle Power in use<br>Bits [5:4]: Altitude hold status<br>00 = No altitude hold applied<br>01 = Holding of altitude from last Kalman filter solution<br>10 = Holding of altitude from user input<br>11 = Always hold altitude (from user input)<br>Bit 6: 1 = DOP limits exceeded<br>Bit 7: 1 = DGPS corrections applied<br>Bit 8: Sensor DR solution type (SiRFDRive)<br>1 = Sensor DR<br>0 = Velocity DR if Bits 0 – 2 = 111;<br>else check Bits 14-15 for DR error status<br>Bit 9: 1 = Navigation solution over-determined<br>Bit 10: 1 = Velocity DR timeout exceeded<br>Bit 11: 1 = Fix has been edited by MI functions<br>Bit 12: 1 = Invalid velocity<br>Bit 13: 1 = Altitude hold disabled<br>Bits [15:14]: Sensor DR error status (SiRFDRive)<br>00 = GPS-only navigation<br>01 = DR calibration from GPS<br>10 = DR sensor error<br>11 = DR in test<br>Bits: [16:31] : Reserved |
| gps_week | 2 U | Best estimate GPS extended week number. Week 0 starts on 6th January 1980. |
| tow | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.999 seconds, scaled by 1000 |
| tow_sub_ms | 4 U | Time of week sub millisecond in s, scaled by $10^9$ |

| Name | Bytes | Description |
|---|---|---|
| time_bias | 2 S | The best estimate GPS time could be computed using information from other constellation in nanoseconds. This field reports the time bias between raw time and best estimate GPS time. If the time is derived from GPS, then this field will be 0.<br>Note:<br>This time bias does not include receiver clock bias. |
| time_accuracy | 1 U | Accuracy of best estimate GPS time. The values are defined in Table 45 |
| time_source | 1 U | Reserved |
| utc_year | 2 U | UTC Year |
| utc_month | 1 U | UTC Month, 1 to12 |
| utc_day | 1 U | UTC day of month, 1 to 31 |
| utc_hour | 1 U | UTC hour 0 to 23 |
| utc_min | 1 U | UTC minute 0 to 59 |
| utc_sec | 2 U | UTC second 0 to 59.999in s, scaled by $10^3$ |
| utc_offset | 1 U | Integer offset between UTC and GPS time in seconds |
| datum | 1 U | Map datum used for the position. Available values include:<br>21 = WGS-84<br>178 = Tokyo Mean<br>179 = Tokyo - Japan<br>180 = Tokyo - Korea<br>181 = Tokyo - Okinawa<br>Other values may be defined as other datums are implemented. |
| clk_bias | 8 S | Clock Bias<br>Difference between the indicated clock time in the GPS receiver and true universal time, reported in meters, scaled by $10^2$ |
| clk_bias_error | 4 U | Clock Bias Error: error estimate for clock bias, reported in meters, scaled by $10^2$ |
| clk_offset | 4 S | Clock Drift: rate of change of clock bias, reported in meters per second, scaled by $10^2$ |
| clk_offset_error | 4 U | Clock Drift Error: error estimate for clock drift, reported in meters per second, scaled by $10^2$ |
| lat | 4 S | Position Latitude. Positive value indicates North. Reported in degrees, scaled by $10^7$. |
| lon | 4 S | Position Longitude. Positive value indicates East. Reported in degrees, scaled by $10^7$. |
| alt_ellips | 4 S | Altitude relative to the WGS-84 ellipsoid, reported in meters, scaled by $10^2$ |
| alt_msl | 4 S | Altitude from mean sea level: altitude using geoid model, reported in meters, scaled by $10^2$ |
| sog | 2 U | Speed Over Ground – horizontal component of velocity, reported in meters per second, scaled by $10^2$ |
| cog | 2 U | Course over ground, clockwise from true north, reported in degrees, scaled by $10^2$ |
| climb_rate | 2 S | Vertical component of velocity, reported in meters per second, scaled by $10^2$ |

| Name | Bytes | Description |
|---|---|---|
| heading_rate | 2 S | Rate of change of course over ground (COG) , reported in degrees per second, scaled by $10^2$ |
| distance_travel | 4 U | Distance travelled since reset, reported in meters. |
| heading_error | 2 U | Estimate of error in course over ground (COG), reported in degrees, scaled by $10^2$ |
| distance_travel_error | 2 U | Estimate of error in Distance, reported in meters |
| ehpe | 4 U | Estimated Horizontal Position Error, reported in meters per second, scaled by $10^2$ |
| evpe | 4 U | Estimated Vertical Position Error, reported in meters per second, scaled by $10^2$ |
| ehve | 2 U | Estimated Horizontal Velocity Error, reported in meters per second, scaled by $10^2$ |
| gdop | 1 U | Geometric Dilution of Precision, scaled by 5 |
| pdop | 1 U | Position Dilution of Precision, scaled by 5 |
| hdop | 1 U | Horizontal Dilution of Precision, scaled by 5 |
| vdop | 1 U | Vertical Dilution of Precision, scaled by 5 |
| tdop | 1 U | Time Dilution of Precision, scaled by 5 |
| num_svs_in_sol | 1 U | Number of satellites used in solution |
| sv_list_1 | 4 D | List of GPS satellites used in solution.<br>Bits 0 – 31 correspond to PRNs 1 – 32. |
| sv_list_2 | 4 D | List of SBAS satellites used in solution.<br>Bits 0 – 18 correspond to PRNs 120 – 138. |
| sv_list_3 | 4 D | List of GLONASS satellites used in solution. Bits 0 – 23 correspond to Slot Numbers 1 – 24. |
| sv_list_4 | 4 D | List of QZSS and BDS GEO satellites used in solution.<br>Bits 0 - 4 correspond to Slot Numbers 193 – 197<br>Bits 5 - 9 are reserved for future QZSS satellites 198 – 202<br>Bits 10 – 14 correspond to BDS GEO PRN 150 – 154 |
| SV List 5 | 4 D | List of BDS MEO/IGSO satellites used in solution.<br>Bits 0 – 4 correspond to BDS IGSO PRN 155 – 159<br>Bits 5 – 31 correspond to BDS MEO PRN 38 – 64 |

| Name | Bytes | Description |
|---|---|---|
| additional_info | 4 D | Additional mode information:<br>Bit 0: Map matching mode for Map Matching only<br>0 = Map matching feedback input is disabled<br>1 = Map matching feedback input is enabled<br>Bit 1: Map matching feedback received for Map Matching only<br>0 = Map matching feedback was not received<br>1 = Map matching feedback was received<br>Bit 2: Map matching in use for Map Matching only<br>0 = Map matching feedback was not used to calculate position<br>1 = Map matching feedback was used to calculate position<br>Bit 3: GPS time and week setting<br>0 = GPS time and week are not set<br>1 = GPS time and week are set<br>Bit 4: UTC offset verification by satellite<br>0 = UTC offset not verified<br>1 = UTC offset verified<br>Bit 5: SBAS ranging<br>0 = SBAS ranging is not used in solution<br>1 = SBAS ranging is used in solution<br>Bit 6: Enabling Car Bus signal<br>0 = Car bus signal not enabled<br>1 = Car bus signal enabled<br>Bit 7: DR direction for SiRFDRive only<br>0 = Forward<br>1 = Reverse<br>Bit 8: GPS Week setting<br>0 = GPS Week not set<br>1 = GPS Week set<br>Bit 9: GPS TOW setting<br>0 = GPS TOW not set<br>1 = GPS TOW set<br>Bits 31-8 : Reserved |

**Table 44: MID 67,1 – Multi-constellation Navigation Data Response**

Table 45 shows how to set the value for Time Accuracy.

| Exponent X (Most Significant bits) | Mantissa Y (Least Significant bits) | Index Value I =Y * 16X | Floating Point Value fI | Estimated Time Accuracy (µs) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 01.25 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 (1 + Y/16) x 2X | $f_I$ -1 ≤ σ ≤ $f_I$ |
| 1111 | 1110 | 254 | 7680 | 7427 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 or unknown |

**Table 45: Time Accuracy**

## 4.32. Multi-constellation Satellite Data Response - MID 67,16

This message reports on the satellites currently being searched, acquired and tracked. It is output once per navigation cycle by default (typically 1 Hz or 5 Hz rate).

The Multi-constellation Satellite Data message reports satellite information and status of visible GNSS satellites.

One message reports information for 15 satellites. If there are more than 15 visible satellites to report, additional messages are sent. The “Message Information” field will specify the total number of messages output and the order of the messages within the group.

Output Rate: 1 Hz or 5 Hz, depending on navigation rate

Table 46 lists the message data format for the Multi-constellation tracker data.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SSB_GNSS_SAT_DATA (`0x43, 0x10`) |
| gps_week | 2 U | Best estimate GPS extended week number.<br>Week 0 started on January 6, 1980 |
| tow | 4 U | Time of week, reported in seconds, scaled by $10^3$ |
| tow_sub-ms | 4 U | Time of week sub millisecond, reported in seconds, scaled by $10^9$ |
| time_bias | 2 S | The best estimate GPS time could be computed using information from another constellation, reported in nanoseconds. This field reports the time bias between raw time and best estimate GPS time. If the time is derived from GPS, then this field will be 0.<br>Note:<br>This time bias does not include receiver clock bias reported in **MID 7** |
| time_accuracy | 1 U | Accuracy of best estimate GPS time. The values are defined in Table 45 |
| time_source | 1 U | Reserved |
| msg_info | 1 U | The information in this field reports the total number of messages output in this group, and the order of this message, packed as follows:<br>Bits 7-4 : total number of messages in this group<br>Bits 3-0 : order of this message |
| num_of_sats | 1 U | Total number of satellites reported in this group of messages. Range 0 to 15 |
| sat | [15] | See Table 47 for description of structure `tSIRF_MSG_SSB_GNSS_SAT_DATA_PER_SV` |

**Table 46: MID 4 – Multi-constellation Satellite Data Response**

Table 45 shows how to set the value for Time Accuracy.

| Name | Bytes | Description |
|---|---|---|
| sat_info | 2 U | Satellite information and status, packed as follows:<br>Bits 15-13: Constellation type enumeration<br>0 = GPS/QZSS<br>1 = SBAS<br>2 = GLONASS<br>3 = GALILEO<br>4 = BDS<br>5 -7 = reserved<br>Bits 12- 8 : Other info<br>For GLONASS, this field reports Frequency Channel -7 to 6.<br>For SBAS<br>0 = WAAS<br>1 = EGNOS<br>2 = MSAS<br>3 = GAGAN<br>others = reserved<br>Bits 7- 0 : ID<br>For GPS and SBAS, this field reports PRN.<br>For GLONASS, this field reports Slot Number 1-24.<br>For BDS, this field reports BDS PRN. |
| azimuth | 2 U | Satellite's azimuth in degrees clockwise from true north, relative to the receiver, scaled by 10 |
| elevation | 2 U | Satellite's elevation in degrees above horizon, reported in degrees, scaled by 10 |
| avg_cno | 2 U | Average Carrier to Noise Ratio, reported in dB per Hz, scaled by 10 |
| status | 4 D | Bitmap of the satellite's status. The following description of each bit is effective when the specified bit is set.<br>Bit 0: Successful acquisition/re-acquisition<br>Bit 1: The integrated carrier phase is valid.<br>Bit 2: Bit synchronization has been completed.<br>Bit 3: Frame synchronization has been completed.<br>Bit 4: Carrier pull-in has been completed (Costas lock).<br>Bit 5: Code lock has been completed.<br>Bit 6: Reserved<br>Bit 7: Ephemeris data is available.<br>Bits 8 - 14: Reserved<br>Bit 15: Satellite used in solution.<br>Bits 16-31: Reserved |

**Table 47:** Satellite Information **Tracker Data Structure**

## 4.33. Position Information Response - MID 69,1

Position response message is generated in response to the position request message MID 210. Table 46 lists the message data format for **MID 69,1**.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | `SIRF_MSG_SSB_POS_RSP(0x45, 0x01)` |

| Name | Bytes | Description |
|---|---|---|
| pos_req_id | 1 U | Position/measurement response identifier that was requested with **MID 210**, position request. |
| pos_results_flag | 1 U | Position results flag:<br>`0x00` = All fields of the position result section from POSITION_ERROR_STATUS to INV_WEIGHTS are invalid<br>`0x01` = At least some of the other fields in this message are valid |
| pos_err_status | 1 U | Position Error Status:<br>0 = Valid position<br>1 = Insufficient number of satellites<br>2 = Aiding data not available<br>3 = Did not meet position request in time requested<br>4 = No fix available after full search<br>5 = Unused<br>6 = Position reporting disabled<br>7 = Rejected Position Reporting for QoS because it's incompatible with current power mode |
| qos_pass_flag | 1 U | QoS Pass Bit Flag<br>0x00 = QoS fails<br>0x01 = The quality of position is estimated to be within the boundaries of the requested QoS with a confidence level of 95%. |
| pos_type | 1 D | Bit Mask for Position Type:<br>Bit [1:0] Position type<br>00: 2D if set<br>01: 3D if set<br>Bit [5:2] QoS<br>0000: QoS guaranteed<br>Bit 3: 1 = Almanac derived coarse solution; position was calculated based on one or more of the SVs having their states derived from almanac parameters and not ephemerides<br>Bit 5: 1 = Trickle power solution ( QoS ignored )<br>Bit 6: Reverse EE processing may be used for the data provided<br>Bit 7: Reserved |
| dgps_cor | 1 U | DGPS correction type<br>0 = No DGPS correction<br>1 = Local DGPS correction<br>2 = WAAS correction |
| gps_week | 2 U | Extended GPS week number |

| Name | Bytes | Description |
|---|---|---|
| time_of_week | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.999 seconds, scaled by 1000 |
| lat | 4 S | Measured Latitude in units of $180/2^{32}$ degrees;<br>range: -90 degrees to $+90x(1-2^{-32})$ degrees |
| lon | 4 S | Measured Longitude in units of $360/2^{32}$ degrees;<br>range: -180 degrees to $+180x(1-2^{-32})$ degrees |
| other_sections | 1 U | Indicates the validity status of fields, where bits are set to 1 when listed fields are valid.<br>Bit 0: Horizontal Error<br>hor_err_angle<br>hor_err_major<br>hor_err_minor<br>Bit 1: Vertical Position<br>vert_pos_height<br>vert_pos_std<br>Bit 2: Velocity<br>velocity_horizontal<br>velocity_heading<br>velocity_vertical<br>velocity_hor_err_ang<br>velocity_hor_err_maj_std<br>velocity_hor_err_min_std<br>velocity_ver_err<br>Bit 3: Clock Correction<br>clk_cor_time_ref<br>clk_cor_clk_bias<br>clk_cor_clk_drift<br>clk_cor_clk_std_err<br>clk_cor_utc_off<br>Bit 4: Position Correction<br>pos_corr_num_sat<br>pos_corr_sv_info |
| hor_err_angle | 1 U | Error Ellipse major axis angle with respect to True North in WGS-84; units of $180/2^{8}$ degrees, Range from 0 to $+180 \times (1-2^{-8})$ degrees |
| hor_err_major | 1 U | Major Axis Standard Deviation Error<br>Packing parameters:<br>Scale factor: 0.125<br>Signed: No<br>Exponent Size: 4<br>Mantissa Size: 4 |

| Name | Bytes | Description |
|---|---|---|
| hor_err_minor | 1 U | Minor Axis Standard Deviation Error<br>Packed value:<br>Scale factor: 0.125<br>Signed: No<br>Exponent Size: 4<br>Mantissa Size: 4 |
| vert_pos_height | 2 U | Height in metres , scaled by 10; range of -500 m to +6053.5 m with respect to WGS-84 reference ellipsoid |
| vert_pos_std | 1 U | Height Standard Deviation Error |
| velocity_horizontal | 2 U | Horizontal Velocity, units of 0.0625 m/s, range from 0 to 4095 m/s. |
| velocity_heading | 2 U | Heading in units of $360/2^{16}$ degrees, Range from 0 to 360 x $(1-2^{-16})$ degrees. |
| velocity_vertical | 1 S | Two's complement value of Vertical Velocity, in m/s scaled by 2; range 64 to +63.5. |
| velocity_hor_err_ang | 1 U | Error Ellipse major axis angle with respect to True North in WGS-84, in units of 0.75 degrees, Range from 0 to +180 x $(1-2^{-8})$ degrees |
| velocity_hor_err_maj_std | 1 U | Major Axis Standard Deviation Error |
| velocity_hor_err_min_std | 1 U | Minor Axis Standard Deviation Error |
| velocity_ver_err | 1 U | Vertical velocity standard deviation<br>Packed value:<br>Scale factor: 0.125<br>Signed: No<br>Exponent Size: 4<br>Mantissa Size: 4 |
| clk_cor_time_ref | 1 U | Reserved |
| clk_cor_clk_bias | 2 U | Clock Correlation Clock Bias: clock bias, range from -429.287 to +429.287 s with a minimum non-zero value of 100 ns<br>Packed value:<br>Scale factor: $10^{7}$<br>Signed: Yes<br>Exponent Size: 5<br>Mantissa Size: 10 |

| Name | Bytes | Description |
|---|---|---|
| clk_cor_clk_drift | 2 U | CLK_DRIFT clock drift in the range of -327.52 ppm (or µs/s) to +327.52 ppm, with a minimum non-zero value of 0.0025 ppm.<br>Packed value:<br>Scale factor: .005<br>Signed: Yes<br>Exponent Size: 4<br>Mantissa Size: 11 |
| clk_cor_clk_std_err | 1 U | CLK_STD_ER Estimated Time Accuracy<br>Packed value:<br>Scale factor: 0.125<br>Signed: No<br>Exponent Size: 4<br>Mantissa Size: 4 |
| clk_cor_utc_off | 1 U | UTC_OFF The offset between GPS time and UTC time in seconds; range 0-255 s |
| pos_corr_num_sat | 1 U | NB_SV Number of Satellite Vehicles Currently Tracked range from 1 to 10 |
| pos_corr_sv_info | [16] | Array of Position Response data, see Table 47 for details. |

**Table 48: MID 69,1 – Position Information Response**

The position response data structure is shown in Table 47.

| Name | Bytes | Description |
|---|---|---|
| sv_prn | 1 U | Satellite ID; see Appendix A for details |
| c_n0 | 1 U | Satellite $C/N_o$, units 1 dB-Hz, range from 0 to 60 |
| inv_weights | 1 U | Inverse of Weighting Factor in position computation, range 0.125 to 3968 m<br>Packed value:<br>Scale factor: 0.125<br>Signed: No<br>Exponent Size: 4<br>Mantissa Size: 4 |

**Table 49: Position Response Data Structure**

## 4.34. Measurement Response - MID 69,2

Measurement Response message for A-GNSS. Table 46 lists the message data format for **MID 62,2**.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | SIRF_MSG_SSB_MEAS_RSP (0x45, 0x02) |
| pos_req_id | 1 U | Position/measurement response identifier |
| gps_meas_flag | 1 U | GPS measurement valid flag:<br>0x00 = All subsequent fields are invalid.<br>0x01 = At least some of the other fields in this message are valid |
| meas_error_status | 1 U | GPS measurement information validity:<br>0 = Valid GPS Measurements<br>1 = Not Enough Satellites Tracked<br>2 = GPS Aiding Data Missing<br>3 = Need More Time<br>0xFF = Requested Location Method Not Supported |
| meas_gps_week | 2 U | Extended GPS week number |
| meas_gps_seconds | 4 U | GPS time in the week units of seconds; scaled by 1000; range from 0s to 604,799.999 seconds. |
| time_accuracy | 1 U | Accuracy of GPS Measurement Time Tag in ms during course aiding; µs during precise aiding. |
| num_sv | 1 U | Number of Satellite Measurements reported in meas_per_sv_data |
| meas_per_sv_data | [16] | Array of Measurement Response data, see Table 47 for details |

**Table 50: MID 69,2 – Measurement Response**

The measurement response data structure is shown in Table 47.

| Name | Bytes | Description |
|---|---|---|
| sv_prn | | Satellite ID; see Appendix A for details |
| c_n0 | 1 U | Satellite $C/N_o$ units of 1 dB-Hz in the range from 0 to 60 |
| sv_doppler | 2 S | Satellite Doppler Measurement |
| sv_code_phase_wh | 2 U | Satellite Code Phase Measurement - Whole Chips. units of C/A code chips, in the range from 0 to 1022 chips |

| Name | Bytes | Description |
|---|---|---|
| sv_code_phase_fr | 2 U | Satellite Code Phase Measurement - Fractional Chips, units of $2^{-10}$ of C/A code chips, in the range from 0 to ($2^{-10}$-1)/ $2^{-10}$ chips |
| multipath_indicator | 1 U | Multipath Indicator<br>0 = Not Measured<br>1 = Low, Multipath Error ≤ 5 meters<br>2 = Medium, 5 <Multipath Error ≤ 43 meters<br>3 = High, Multipath Error > 43 meters |
| pseudorange_rms_error | 1 U | Pseudorange RMS error range from 0.5 m to 112 m<br>Packed value:<br>Scale factor: 0.5<br>Signed: No<br>Exponent Size: 3<br>Mantissa Size: 3 |

**Table 51: Measurement Response Data Structure**

## 4.35. GLONASS Almanac Response – MID 70,11

The GLONASS Almanac Response message is output in response to a GLONASS Almanac Request (212, 11) message. The contents of this message contain the best available GLONASS almanac SiRFNav has in current use.

This message is supported starting with SiRFstarV. Table 52 shows the parameters of the GLONASS Almanac Response message. A AGPS session must be in place before using this message. See **MID 213,1**; **MID 213,2**; and **MID 214,0**.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_GLO_ALM_RSP (0x46, 0x0B) |
| data_flag | 1 U | Flag for common clock section<br>0: Fields TAU_GPS through KP are not valid<br>1: Fields TAU_GPS through KP are valid |
| tauGPS | 3 S | The sub-1-second time difference between GLONASS system time and GPS time, reported in seconds, scaled by $2^{30}$<br>TAU_GPS = GLONASS - GPS<br>**Note:**<br>There is an integer 3 hour offset as well as a varying integer UTC/GPS offset which the user must take into account for full time conversion. |
| tauUTC | 4 S | The sub-1-second time difference between GLONASS system time and UTC time, reported in seconds, scaled by $2^{31}$<br>TAU_UTC = GLONASS - UTC<br>**Note:**<br>There is an integer 3 hour offset as well as a varying integer UTC/GPS offset which the user must take into account for full time conversion |
| b1 | 2 S | The sub-1- second time difference between UT1 and UTC time scales, reported in seconds, scaled by $2^{10}$ |

| Name | Bytes | Description |
|---|---|---|
| | | B1 = UT1 minus UTC |
| b2 | 2 S | Drift of B1, reported in seconds-per-day, scaled by $2^{16}$ |
| NA | 2 U | Number of days of clock and almanac data within the current 4-year period |
| N4 | 1 U | Number of four-year intervals number starting at 1996 |
| kp | 1 D | Notification of forthcoming leap-second change, see GLONASS ICD for details |
| num_sv | 1 U | The number of valid almanac records in remainder of message |
| alm_per_sv_list | [24] | See Table 53 for details |

**Table 52: MID 70,11 – GLONASS Almanac Response**

| Name | Bytes | Description |
|---|---|---|
| valid_flag | 1 D | Validity flag for this almanac record<br>0: Fields SV_SLOT_NUM through DELTA_TDT do not contain valid data<br>1: Fields SV_SLOT_NUM through DELTA_TDT contain valid data |
| sv_slot_num | 1 U | Slot number of this satellite. Range 1-24 |
| sv_freq_num | 1 S | Frequency offset, range: -7 to +6<br>This is the integer multiple of 562.5 kHz offset from 1602 MHz that this satellite is transmitting |
| sv_health | 1 U | Satellite Health<br>0: SV is currently UN-HEALTHY (almanac parameters may still be valid)<br>1: SV is currently HEALTHY |
| t_lambda | 3 S | Time of ascending node passage on day indicated in field NA, reported in seconds, scaled by $2^5$ |
| lambda | 3 S | Longitude of ascending node at reference time, units of semi-circles. scaled by $2^{30}$, range ±1 |
| del_T | 3 S | Correction to nominal orbital period at reference time T_LAMBDA, reported in seconds per period, scaled by $2^9$<br>**NOTE:**<br>Actual orbital period = Delta_T + mean value of Draconian period (43200 seconds) |
| del_i | 3 S | Correction to nominal inclination at reference time T_LAMBDA, reported in semicircles, scaled by $\pi * 2^{20}$<br>**NOTE:**<br>Actual inclination = Delta_I + mean value of inclination (63 degrees) |
| arg_per | 2 S | Argument of perigee at reference time T_LAMBDA, reported in semicircles, scaled by $\pi * 2^{15}$ |
| tau_N | 2 S | Coarse time correction to satellite clock with respect to GLONASS system time, reported in seconds, scaled by $2^{18}$ |

| Name | Bytes | Description |
|---|---|---|
| ecc | 2 U | Orbit eccentricity at reference time T_LAMBDA, scaled by $2^{20}$ |
| del_Tdt | 1 S | Rate of change of Draconic period, reported in seconds per period2, scaled by $2^{14}$ |

**Table 53: Almanac Structure**

## 4.36. GLONASS Broadcast Ephemeris Response - MID 70,12

The GLONASS broadcast ephemeris response message is output in response to a GLONASS Broadcast Ephemeris Request message (MID 212, 12). The contents of this message contain the best available valid GLONASS ephemeris SiRFNav has in current use.

This message is supported starting with SiRFstarV. Table 54 shows the fields of the GLONASS Broadcast Ephemeris Response message. A AGPS session must be in place before using this message. See **MID 213,1**; **MID 213,2**; and **MID 214,0**.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_GLO_B_EPH_RSP (0x46, 0x0C) |
| data_flag | 1 U | Flag for common clock section<br>0: Fields TAU_GPS through KP are not valid.<br>1: Fields TAU_GPS through KP are valid. |
| tauGPS | 3 S | Time difference of GLONASS system time to GPS time in seconds, scaled by $2^{30}$<br>This value represents the sub-1-second difference between GLONASS and GPS time scales (TAU_GPS = GLONASS minus GPS).<br>**Note:**<br>There is an integer 3 hour offset as well as a varying integer UTC/GPS offset user must take into account for full time conversion. |
| tauUTC | 4 S | Time difference of GLONASS system time to UTC time in seconds, scaled by $2^{31}$<br>This value represents the sub-1-second difference between GLONASS and UTC time scales (TAU_UTC = GLONASS minus UTC).<br>**Note:**<br>There is an integer 3 hour offset as well as a varying integer UTC/GPS offset user must take into account for full time conversion. |
| b1 | 2 S | Time difference between UT1 and UTC time scales in seconds, scaled by $2^{10}$<br>This value represents the sub-1- second difference between UT1 and UTC time. (B1 = UT1 minus UTC). |
| b2 | 2 S | Drift of B1, in seconds per day, scaled by $2^{16}$ |
| N4 | 1 U | Current four-year interval number, starting at 1996 |
| kp | 1 S | Notification of forthcoming leap-second change, see GLONASS ICD for details |
| num_sv | 1 U | The number of almanac records in eph_per_sv_list |
| eph_per_sv_list | [14] | See Table 55 for details |

**Table 54: MID 70,12 – GLONASS Broadcast Ephemeris Response**

The data structure is shown in Table 55

| Name | Bytes | Description |
|---|---|---|
| valid_flag | 1 U | Validity flag for this almanac record<br>1: Fields SV_SLOT_NUM through DELTA_TDT contain valid data<br>0: Fields SV_SLOT_NUM through DELTA_TDT do not contain valid data |
| sv_slot_num | 1 U | Slot number of this satellite, range 1-24 |
| sv_freq_num | 1 S | Frequency offset, range: -7 to +6<br>This is the integer multiple of 562.5 kHz offset from 1602 MHz that this satellite is transmitting |
| sv_health | 1 U | Satellite Health Indicator<br>1: SV is currently HEALTHY<br>0: SV is currently UN-HEALTHY<br>(almanac parameters may still be valid) |
| day_num | 2 U | Day number within the current 4-year period (N4), range: 1-1461 |
| tb | 1 U | Ephemeris reference time, on day 'DAY_NUMBER' in seconds, scaled by 900 |
| age | 1 U | Age of operational information in days |
| posX | 4 S | Satellite position, X coordinate, in PE-90 reference frame in kilometres, scaled by $2^{11}$ |
| posY | 4 S | Satellite position, Y coordinate, in PE-90 reference frame in kilometres, scaled by $2^{11}$ |
| posZ | 4 S | Satellite position, Z coordinate, in PE-90 reference frame in kilometres, scaled by $2^{11}$ |
| velX | 3 S | Satellite velocity, X coordinate, in PE-90 reference frame in kilometres per second, scaled by $2^{20}$ |
| velY | 3 S | Satellite velocity, Y coordinate, in PE-90 reference frame in kilometres per second, scaled by $2^{20}$ |
| velZ | 3 S | Satellite velocity, Z coordinate, in PE-90 reference frame in kilometres per second, scaled by $2^{20}$ |
| accX | 1 S | Satellite acceleration, X coordinate, in PE-90 reference frame in kilometres per second squared, scaled by $2^{30}$ |
| accY | 1 S | Satellite acceleration, Y coordinate, in PE-90 reference frame in kilometres per second squared, scaled by $2^{30}$ |
| accZ | 1 S | Satellite acceleration, Z coordinate, in PE-90 reference frame in kilometres per second squared, scaled by $2^{30}$ |
| L1_L2 | 1 S | Group delay between L1 and L2 bands in seconds, scaled by $2^{30}$ |
| clock_offset | 3 S | Correction to satellite clock with respect to GLONASS system time in seconds, scaled by $2^{30}$ |
| clock_drift | 2 S | Rate of change of CLOCK_OFFSET in seconds per second, scaled by $2^{40}$ |

| Name | Bytes | Description |
|---|---|---|
| accuracy | 1 U | User expected ranging accuracy in metres |
| spare1 | 1 D | Bit [1:0] P1: Time interval between frames.<br>0: 0 minutes<br>1: 30 minutes<br>2: 45 minutes<br>3: 60 minutes<br>Bit 2: P2: Odd/even interval indicator<br>1: odd time index value<br>0: even time index value<br>Bit [4:3] M: Satellite Type<br>00: GLONASS<br>01: GLONASS- Type-M (modernized). |

**Table 55: Data Structure**

## 4.37. ACK/NAK/Error Indication - MID 75,1

**MID 75,1** supports both autonomous and aided operation with ACK/NACK indications. It provides extra information when the Host attempts operations that require aiding.

Table 46 lists the message data format for **MID 75,1**.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | SIRF_MSG_SSB_ACK_NACK_ERROR_OUT (0x4B, 0x01) |
| msg_id | 1 U | Echo MID: Message ID of the ACKed/NAKed message |
| sub_id | 1 U | Echo SID: Sub ID of the ACKed/NAKed message |
| session_error_reason | 1 U | 0x00 = Acknowledgement<br>0xFA = Message ID and/or Message Sub ID not recognized<br>0xFB = Invalid input parameter(s)<br>0xFC = OSP version not supported<br>0xFD = Nav bit aiding not supported<br>0xFE = Ephemeris status response not supported<br>0xFF = Negative Acknowledgement (NAK) |
| reserved | 2 | Reserved |

**Table 56: MID 75,1 – ACK/NAK Error Indication**

## 4.38. Location Technology Usage Status Response – MID 78,17

This Location Technology Usage Status Response reports what actual technologies were used in producing a specific position response message. This message is sent as a response to the Location Technology Usage Status Request message. Table 57 shows the fields of the Location Technology Usage Status Response message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_LOC_TECH_USAGE_RSP (0x4E, 0x11) |
| POS_REQ_ID | 1 U | Identifies the position request message.<br>The value is identical to that in the corresponding position response message. |
| MEAS_GPS_WEEK | 2 U | Week stamp of the position response message.<br>The value is identical to that in the corresponding position response message. |
| MEAS_GPS_SECONDS | 4 U | Time stamp of the position response message.<br>The value is identical to that in the corresponding position response message. |
| LOCATION _TECHNOLOGY | 4 U | Same as in the Location Technology Constraint Request. Not all values are supported in Release 1 of SiRFstarV |
| NR_EXC | 1 U | Same as in the Location Technology Constraint Request. |
| Reserved | 4 U | Reserved |

**Table 57: MID 78,17 – Location Technologies Usage Status Response Message Fields**

For 5t these fields apply to the position request and response messages. For 5xp, 5e and 5ea they will reflect the values in the most recent **MID 67,1**

## 4.39. GPS CW Interference Indication – MID 92,1

This message reports the highest 8 CW interferences detected on GPS path. It reports on the frequency and signal strength of signals that are present and includes a very accurate estimation of their frequencies. This information facilitates tracking and subsequent removal of jammers that originate in the product or its expected environment. When the unit is deployed, jamming mitigation can be set to remove jammers, and it would then remove not only any residual signals found originating locally, but any that are detected as SiRFstar is exposed to external sources.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | SSB_CW_DATA (0x5C, 0x01) |
| freq | 4 U [8] | Array of frequencies reported |
| cno | 2 U [8] | Array of corresponding signal-to-noise for each frequency reported |

**Table 58: MID 92,1 – GPS CW Interference Indication**

## 4.40. GPS CW Mitigation Indication – MID 92,2

This periodic message is a report on mitigation actions taken by SiRFstar. It specifies the filtering employed to mitigate the effects of the interference in the GPS path.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | SSB_CW_FILTER (0x5C, 0x02) |
| `sampling` | 1 U | Enumeration of sampling modes:<br>0: Use complex $8f_0$, no filter<br>1: Use complex $2f_0$, no filter<br>2: Use 2 MHz filter<br>3: Use OFFT filter |
| `adc` | 1 U | Enumeration of A/D modes:<br>0: Use 2-bit A/D<br>1: Use 4-bit A/D |
| `freqbin` | 1 U [8] | Centre frequency bin of frequency 0<br>Range: -128 to 127<br>When the `nbin` is 0, this field will be 0. |
| `nbin` | 1 U [8] | Number of bins excised on one side of the centre frequency bin.<br>Total number of bins excised = 2 x this number + 1.<br>0: no bin excised |

**Table 59: MID 92,2 – GPS CW Mitigation Indication**

## 4.41. GLONASS/BDS CW Interference Indication – MID 92,3

This message reports the highest 8 CW interferences detected on GLONASS/BDS path. This report is the GLONASS/BDS equivalent of **MID 92,1**.

User Application must be aware of current constellation setting, since BDS uses the same message id and sub-id as GLONASS.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_CW_DATA (0x5C, 0x03) |
| freq | 4 U [8] | Array of frequencies reported |
| cno | 2 U [8] | Array of corresponding signal-to-noise for each frequency reported |

Table 60: MID 92,3 – GLONASS/BDS CW Interference Indication

## 4.42. GLONASS/BDS CW Mitigation Indication – MID 92,4

GLONASS/BDS CW Mitigation message reports the filtering employed to mitigate the effects of the interference.

BDS uses the same message id and sub-id as GLONASS. User Application must be aware of current constellation setting, since BDS uses the same message id and sub-id as GLONASS.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_CW_CANCELLER (0x5C, 0x04) |
| `sampling` | 1 U | Enumeration of sampling modes:<br>0: Use complex $8f_0$, no filter |

| Name | Bytes | Description |
|---|---|---|
| | | 1: Use complex $2f_0$, no filter<br>2: Use 2 MHz filter<br>3: Use OFFT filter |
| adc | 1 U | Enumeration of A/D modes:<br>0: Use 2-bit A/D<br>1: Use 4-bit A/D |
| freqbin | 4 U [8] | Center freq bin of freq 0<br>Range: -128 to 127<br>When the nbin is 0, this field will be 0. |
| nbin | 2 U [8] | Number of bins excised on one side of the centre frequency bin.<br>Total number of bins excised = 2 x this number + 1.<br>0: no bin excised |

Table 61: MID 92,4 – GLONASS/BDS CW Mitigation Indication

## 4.43. Initialize Data Source Request – MID 128

Commands SiRFstar to do either a non-factory reset (stop GPS operations and restart) or a factory reset (stop all operations, restart receiver from starting address 0 where all hardware and memory is reinitialized). It also permits selectively invalidating some of the data in non-volatile memory so that SiRFstar can be forced to do a "hot" start, "warm" start, or "cold" start (designated based on available information when SiRFstar begins searching for satellites). In addition, it permits sending SiRFstar start-up information such as initial position, time, and GPS crystal frequency.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_INITIALIZE (0x80) |
| ecef_x | 4 S | Position - X in meters |
| ecef_y | 4 S | Position - Y in meters |
| ecef_z | 4 S | Position - Z in meters |
| clk_offset | 4 S | Clock Drift in Hz |
| gps_tow | 4 U | GPS Time Of Week of measurement. Range 0 to 604799.99 seconds, scaled by 100 |
| gps_week | 2 U | Week number |
| chnl_cnt | 1 U | Number of channels |

| Name | Bytes | Description |
|---|---|---|
| `restart_flags` | 1 U | Restart Configuration Bit Description:<br>Bit Description if Bit 3 = 0 – Not a factory reset<br>0: Data valid flag:<br>0 = Ignore all earlier fields except Channels<br>1 = All fields contain valid data<br>1: Warm start flag<br>0 = Do not clear warm start information<br>1 = Clear ephemeris from memory, blocks Snap or Hot start<br>2: Cold start flag<br>0 = Do not clear cold start information<br>1 = Clear ephemeris, last position and current time, blocks warm start<br>3: Factory reset **False**<br>4: Enable Nav Lib messages after reset<br>0 = Disable<br>1 = Enable<br>5: Enable Debug messages after reset<br>0 = Disable<br>1 = Enable<br>6: Reserved<br>7: System reset flag<br>0 = No system reset, perform GPS Stop and GPS Start<br>1 = System reset, reload SRAM, restart all hardware and tasks |
| | | Bit Description if Bit 3 = 1 – Factory reset requested<br>0: Non-Volatile Memory flag<br>0 = Clear data from flash memory or EEPROM<br>1 = preserve data in flash memory or EEPROM<br>[2:1] Restart Protocol<br>Bit 2:1 Restart Protocol:<br>0 0 = Default protocol of receiver (as built)<br>0 1 = NMEA at 4800 baud<br>1 0 = OSP at 115200 baud<br>1 1 = Reserved<br>3: Factory reset **True**<br>4: Enable Nav Lib messages after reset<br>0 = Disable<br>1 = Enable<br>5: Enable Debug messages after reset<br>0 = Disable<br>1 = Enable<br>6 XO Model and CW Controller flag<br>0 = Do not clear XO model or CW Controller setting<br>1 = Clear XO Model and set CW Controller setting to default (off)<br>7: Reserved, set to 0 |

**Table 62: MID 128 – Initialize Data Source Request**

Reset of Xo model supported starting with SiRFstarIV. Clearing CW controller configuration settings is supported starting with the second product build release of GSD4t , and including all GSD4e product builds.

## 4.44. Switch to NMEA Protocol Request – MID 129

This message allows designation of the data rate after the protocol switch, and setting of standard message output rates.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_INITIALIZE (0x81) |
| `mode` | 1 U | Debug Mode<br>0 = Enable NMEA debug messages<br>1 = Disable NMEA debug messages<br>2 = Do not change last-set value for NMEA debug messages |
| `SIRF_MSG_SSB_MAX_NUM_NMEA_MSG` | [10] | Array of time-repetition values and checksum flags. See Table 64 for details of the structure. The offset into the array corresponds to:<br>[0] = GGA<br>[1] = GLL<br>[2] = GSA<br>[3] = GSV<br>[4] = RMC<br>[5] = VTG<br>[6] = MSS<br>[7] = EPE<br>[8] = ZDA<br>[9] = GNS |
| baud_rate | 2 U | `Bit Rate requested for NMEA messages:` 4800, 9600, 19200, 38400 or 57600 |

**Table 63: MID 129 – Switch to NMEA Protocol Request**

| Name | Bytes | Description |
|---|---|---|
| `rate` | 1 U | Number of seconds between reports: a value of zero indicates a request not to send the corresponding message. Otherwise, data is sent at 1 message every X cycles requested. For example, to request a message to be sent every 5 seconds when using 1 Hz navigation cycles, request the message using a value of 0x05. The maximum rate is 1/255 cycles. |
| `cksum` | 1 U | Checksum present in message<br>0 = No<br>1 = Checksum transmitted with message (recommend) |

**Table 64: SIRF_MSG_SSB_MAX_NUM_NMEA_MSG Fields**

In TricklePower mode, you specify the update rate. When switching to NMEA protocol, the message update rate is also required. The resulting update rate is the product of the TricklePower update rate and the NMEA update rate.

## 4.45. Software Version Request – MID 132

The Software Version Request message causes software version string (and customer version string if defined) to be output. MID 6 is sent in response.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_INITIALIZE (0x84) |
| `reserved` | 1 U | Set to zero |

**Table 65: MID 132 – Software Version Request**

## 4.46. Set Binary Serial Port Request – MID 134

The Set Binary Serial Port Request message sets the serial port values that are used when the binary protocol is activated on that port. It also sets the current values for the port currently using the binary protocol. The values you can adjust are: Bit rate, parity, data bits per character and stop bit length.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_SET_PORT_VALUES (0x86) |
| baud_rate | 4 U | Valid data rates: 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 and 1228800 |
| data_bits | 1 U | Valid bits per byte: 8 |
| stop_bits | 1 U | Valid number of stop bits: 1 |
| parity | 1 U | 0 = None<br>1 = Odd<br>2 = Even |
| reserved | 1 U | Set to zero |

**Table 66: MID 134 – Set Binary Serial Port Request**

## 4.47. Mode Control Request – MID 136

This message sets up the navigation operations. It controls use of fewer than 4 satellites it enables or disables the tracking and navigation features. Using fewer than 4 satellites for calculations will result in a 2-D fix. 4 or more satellites allow a 3-D fix.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SIRF_MSG_SSB_SET_NAV_MODE (0x88) |
| enable_3d | 1 | Reserved, set to 0 |
| enable_con_alt | 1 | Reserved, set to 0 |
| degraded_mode | 1 | reserved |
| pos_mode_enable | 1 D | Selection of modes from which position can be calculated:<br>bit0: ABP<br>0 = disabled<br>1 = enabled)<br>bit1: RevEE – reserved<br>bit2: 5 Hz Nav<br>0 = disabled<br>1 = enabled)<br>bit3: SBAS Ranging<br>0 = disabled<br>1 = enabled)<br>bit4: SW fast time sync mode<br>0 = disabled<br>1 = enabled) |

| Name | Bytes | Description |
|---|---|---|
| dr_enable | 1 | Reserved, set to 0 |
| alt_input | 2 S | Minimum altitude for position fix, range -1000 to 10000 m |
| alt_mode | 1 U | Altitude hold mode.<br>0=auto<br>1=always<br>2=never |
| alt_src | 1 U | Altitude hold mode source<br>0 = last Kalman filter output<br>1 = fixed – use alt_input value<br>2 = dynamic |
| coast_timeout | 1 | Reserved, set to 0 |
| degraded_timeout | 1 | Reserved, set to 0 |
| dr_timeout | 1 U | Timeout limit for dead-reckoning mode, range 9 (no timeout) to 120 s. The last computed position will continue to be reported after the timeout occurs, until satellite reception is re-established. |
| acq_trk_ctrl | 1 U | Acquisition and tracking control<br>Bit 0:<br>0 = Disable track smoothing<br>1 = Enable track smoothing<br>Bit 1:<br>0 = Use raw carrier phase measurements<br>1 = Use smoothed carrier phase measurements<br>Bit 2:<br>0 = Allow soft tracks (enables satellite tracking below 15 dB-Hz)<br>1 = Disable soft tracks<br>Bit 3:<br>0 = Allow full acquisition capability for almanac SVs prior to navigation<br>1 = Limit acquisition capability for almanac SVs prior to navigation<br>Bit4:<br>0 = Allow full acquisition capability for almanac SVs post navigation<br>1 = Limit acquisition capability for almanac SVs post navigation |

**Table 67: MID 136 – Mode Control Request**

## 4.48. Flash Update Request – MID 148

This message enables you to command SiRFstar to enter internal boot mode without setting the hardware bootstrap configuration input. Internal boot mode allows you to program the flash-based code in SiRFstar.

**Note:**

CSR highly recommends that all hardware designs provide access to the hardware bootstrap configuration input pin(s) in case of a failed flash upload.

**Note:**

Some software versions do not support this command

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_INITIALIZE (0x94) |

**Table 68: MID 148 – Flash Update Request**

## 4.49. Switch Operation Modes Request – MID 150

This command is used to switch SiRFstar between normal operating mode and one of the test modes.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_SET_OP_MODE (0x96) |
| mode | 2 U | Operation Mode<br>0x0000: normal<br>0x0001: active<br>0x1E53: Testmode 3<br>0x1E54: Testmode 4<br>0x1E55: Testmode 5<br>0x1E56: Testmode 6<br>0x1E57: Testmode 7<br>0x1E58: Testmode 8 |
| svid | 2 U | SVID to search for (in test mode) |
| period | 2 U | Output message period (test mode), not applicable for TM7 or TM8 |
| tm5Cmd | 1 U | Testmode 5 Low Power Command (specific custom builds)<br>0 = No<br>1 = Yes |

**Table 69: MID 150 – Switch Operation Modes Request**

## 4.50. Set Low Power Parameters – MID 151

Allows the user to set some of the power-saving modes of SiRFstar. Used with **MID 167**

No MIDs are sent in response/request for this message.

| Name | Byte(s) | Description |
|---|---|---|
| MID | 1 U | SIRF_MSG_SSB_SET_LOW_POWER_PARAMS (0x97) |
| Push-to-Fix mode | 2 U | Mode:<br>0 = OFF<br>1 = ON |
| Duty Cycle | 2 U | % Time ON, scaled by 10. When the duty cycle is set to 100% (value 1000) TricklePower is disabled. |
| On-Time | 4 U | Duration of each tracking period in ms, range 100-900. When the duty cycle is |

| Name | Byte(s) | Description |
|---|---|---|
| | | set to 100%, the value in this field has no effect. |

**Table 70: MID 151 – Set Low Power Parameters**

## 4.51. Nav Start ETS Test – MID 161,35

This command is used to initiate an ETS test in a receiver working in the tracker configuration (receiver tracks signals, navigation solution is computed on the host processor)

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_DEMO_TEST_DUT_START (0xA1, 0x23) |
| Start Mode | 4 U | Values<br>0x00 Autonomous mode<br>0x01 Hot Start mode<br>0x02 Warm Start mode<br>0x03 Cold Start mode<br>0x04 Factory Start mode<br>0x05 Test mode only<br>0x40 Mask with (0x00-0x05) to disable Instant Fix |

**Table 71: MID 161,35 – Nav Start ETS Test**

## 4.52. Nav Stop ETS Test – MID 161,36

This message is use to stop ETS tests.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_DEMO_TEST_DUT_STOP (0xA1, 0x24) |
| Start Mode | 4 U | Reserved |

**Table 72: MID 161,36 – Nav Stop ETS Test**

## 4.53. Set Message Rate Request – MID 166

The output rate of most standard messages can be controlled by this command. The most common use is to specify mode 0 in the mode field and set the output rate of one message at a time. However, there are some other useful modes available, such as mode 02 which disables all messages with one command. As with the equivalent NMEA command, message rate is defined not as seconds, but as occurrences of the trigger for a message. Most common output messages do occur once per navigation cycle, and normal navigation cycle is one second. However, navigation cycles can be 5 times per second, or when using low-power modes such as TricklePower, as infrequent as once every 10 seconds. And some messages are not tied to the navigation cycle, but to other rates. For example, the message which outputs the raw navigation message data from satellites works on a 6-second cycle for GPS, and a 2-second cycle for GLONASS. A setting of 1 for that message (**MID 8**) would cause GPS satellite data every 6 seconds and GLONASS satellite data every 2 seconds.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SSB_SET_MSG_RATE (0xA6) |
| mode | 1 U | Rate request mode enumeration:<br>0 = enable/disable one message (MID specified in msg_id field) |

| Name | Bytes | Description |
|---|---|---|
| | | 1 = poll one message instantly (MID specified in msg_id field)<br>2 = enable/disable all messages<br>3 = enable/disable default navigation messages (**MID 2**; **MID 4**)<br>4 =: enable/disable default debug messages (**MID 9; MID 225,0**; **MID 255**)<br>5 = enable/disable navigation messages (**MID 7**; **MID 28**; **MID 29**; **MID 30; MID 31**) |
| msg_id | 1 U | **MID** to control, valid when mode = 1 or 2 |
| rate | 1 U | Rate of transmission (0: disable) |
| sub_id | 1 U | **Sub ID** to control |
| reserved | 1 | reserved |

**Table 73: MID 166 – Set Message Rate Request**

## 4.54. Set Low Power Acquisition Parameters Request – MID 167

Provides way to set MaxOffTime, MaxSearchTime, Push-to-Fix period and Adaptive TricklePower. These settings affect low-power modes as follows:

MaxOffTime: when SiRFstar is unable to acquire satellites for a TricklePower or Push-to-Fix cycle, it returns to sleep mode for this period of time before it tries again.

MaxSearchTime: in TricklePower and Push-to-Fix modes, when SiRFstar is unable to reacquire at the start of a cycle, this parameter sets how long it tries. After this time expires, the unit returns to sleep mode for MaxOffTime (if in TricklePower or ATP Mode) or Push-to-Fix cycle time (in Push-to-Fix mode).

Message sent in response/request for this message: None.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | SIRF_MSG_SSB_SET_LOW_POWER_PARAMS (0xA7) |
| Max Off Time | 4 U | Maximum time for sleep mode in milliseconds. Default value: 30 seconds |
| Max Search Time | 4 U | Maximum satellite search time in milliseconds. Default value: 120 seconds |
| Push-to-Fix Period | 4 U | Push-to-Fix cycle period in seconds |
| Adaptive TricklePower | 2 U | To enable Adaptive TricklePower<br>0 = off<br>1 = on |

**Table 74: MID 167,0 – Set Low Power Acquisition Parameters**

**Note:**

When Message ID 151 is issued, SiRFstar resets both MaxOffTime and MaxSearchTime to default values. If different values are needed, Message ID 151 must be issued before Message ID 167.

## 4.55. Data Logger Memory Management Request – MID 177,67

This message sets the type of memory management and the format of the data record to be stored. To have any effect, this command must be issued when the data logger is NOT active. The memory management types include:

- Stop-on-memory-full
- Circular data buffering, where oldest data is over written by new data for continuous logging

Logged data is stored and read back using the specified record type. Changing the record type invalidates all stored data and logging starts from the beginning of the allocated area. Default management type is circular buffering for

- GSD4e
- SiRFstarV when SPI Flash is attached to the engine.

If no SPI Flash is attached to the SiRFstarV engine, the default management type is stop-on-memory-full.

Default record type is Record Type 0 for the GSD4e and for the SiRFstarV with SPI Flash is attached. If no SPI Flash is attached to the SiRFstarV engine, the default record type is Record Type 5, and the records will be saved to internal Applications RAM rather than external SPI Flash.

For the SiRFstarV engine when internal Applications RAM is used, if GPIO2 has been configured to trigger on non-message conditions via the IO Pin Configuration field in the Tracker Configuration message (MID 178,70), the SiRFstarV engine will assert GPIO2 (low to high) when the management type is stop-on-memory-full and the memory is full. Once the records are read, the SiRFstarV engine will de-assert GPIO2 (high to low).

If GPIO2 has not been configured to trigger on non-message conditions via the IO Pin Configuration field in the Tracker Configuration message (**MID 178, 70**), then any GPIO2 functionality will be unrelated to the Data Logger.

**Note:**

This message is supported starting at version 4.1.2.

| Field | Byte(s) | Description |
|---|---|---|
| MID, | 2 U | SIRF_MSG_SSB_DL_MEM (`0xB1, 0x43`) |
| Stop On Memory Full | 2 U | Set memory usage:<br>0 – Circular Buffering<br>1 – Stop on full (one pass) |
| Data Record Type | 2 U | Type of record to store:<br>0 – Compatibility format<br>1 – Position<br>2 – Position + Altitude<br>3 – Position + Altitude + Speed<br>4 – Position + Altitude + Speed + Accuracy<br>5 – Extended Position (SiRFstarV engine only) |

**Table 75: MID 177,67 – Data Logger Memory Management Message**

## 4.56. PeekPoke – MID 178,3

Tracker Peek and Poke Command: This can be used without the Number of bytes field for a single 4-byte access or with the "Number of bytes" field for other length accesses. When the PeekPoke command completes a **MID 11**(MID_ACK)response is sent.

When the command is a Peek command, after the ACK, SiRFstar will follow with the response **MID 178, 3** containing the data requested. Table 76 shows the fields of the PeekPoke message.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_TRKR_PEEKPOKE_CMD (`0xB2, 0x03`) |
| Type | 1 U | Enumeration<br>0 = Peek four bytes<br>1 = Poke four bytes<br>2 = Multi-peek<br>3 = Multi-poke |

| Name | Byte(s) | Description |
|---|---|---|
| Access | 1 U | Bit Map<br>1 = 8-bit access, byte access<br>2 = 16 bit access, half-word access<br>4 = 32-bit access, word access |
| Address | 4 U | Starting address of access |
| Number of bytes | 4 U | This field is present only for Multi-peek and Multi-poke commands<br>Unsigned Integer, Range 0 to 1000, if 0 no data accessed. |
| Data | 4 or Number of bytes | For peek command ignored, set to 0<br>For poke command value to be written |

**Table 76: MID 178,3 – Tracker Peek and Poke Command Fields**

## 4.57. Tracker Configuration Poll – MID 178,09

Upon receipt of this message, receiver responds back with **MID178, 10**. This message has no payload.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_TRKR_CONFIG_POLL (0xB2, 0x09) |

**Table 77: MID 178,09 – Tracker Configuration Poll**

## 4.58. Tracker Configuration Response – MID 178,10

This message is sent in response to **MID 178,9**. It is identical to **MID 178,70**

| Field | Byte(s) | Description |
|---|---|---|
| MID | 1U | SIRF_MSG_SSB_IC_CONTROL(0xB2) |
| SID | 1U | SIRF_MSG_SSB_TRKR_CONFIG_POLL_RSP(0x0A) |
| **Rest of the message is identical to either MID 178,2 (for SiRFstarIV receivers) or MID 178,70 (for SiRFstarV receivers)** | | |

**Table 78: MID 178,10 – Tracker Configuration Response**

## 4.59. Poll CCK Parameters Request – MID 178,11

This message polls Customer Configuration Kit (CCK) parameters from GSD4e and later. In response SiRFstar will send the OSP **MID 178,13**.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_CCK_POLL (0xB2, 0x0B) |

**Table 79: MID 178,11 – Poll Customer Configuration Kit Parameters – MID 178,11**

## 4.60. Extended Poll CCK Response – 178,13

On reception of the OSP message **MID 178, 11** (Poll CCK Parameters) from the Host, SiRFstar will respond with this message.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_CCK_EXT_POLL_RSP (`0xB2, 0x0D`) |
| UART flow control | 1U | UART flow control.<br>0 = Enabled<br>1 = Disabled (default ) |
| TCXO frequency | 1U | TCXO frequency. Default 1 (26 MHz)<br>0 = 13 MHz<br>1 = 16_369 MHz<br>2 = 16_8MHz<br>3 = 19_2MHz<br>4 = 24_5535MHz<br>5 = 26MHz<br>6 = 33_6MHz<br>7 = 38_4MHz<br>8 = 40MHz |
| TCXO uncertainty | 1U | TCXO uncertainty. Default 04 (2.5 ppm)<br>0 = TCXO @ 0.1 ppm<br>1 = TCXO @ 0.25 ppm<br>2 = TCXO @ 0.5 ppm<br>3 = TCXO @ 1.0 ppm<br>4 = TCXO @ 2.5 ppm<br>5 = Bare crystal at 5 ppm<br>6 = Bare crystal at 10 ppm<br>7 = Bare crystal at 20 ppm<br>8 = Bare crystal at 40 ppm |
| Track Smoothing | 1U | Tracker smoothing.<br>0 = Enabled<br>1 = Disabled (default ) |
| Static Nav | 1U | Static Nav<br>0 = Enabled<br>1 = Disabled (default ) |
| DR Timeout | 1U | DR Timeout in seconds<br>0 = 0 s<br>1 = 1 s<br>2 = 4 s<br>3 = 8 s<br>4 = 15 s (default)<br>5 = 32 s<br>6 = 64 s<br>7 = 120 s |
| Reverse EE support | 1U | Reverse EE<br>0 = Enabled<br>1 = Disabled (default ) |

| Name | Byte(s) | Description |
|---|---|---|
| Fast Time Sync support | 1U | Fast Time Sync<br>0 = Enabled<br>1 = Disabled (default ) |
| Low Power Control | 1U | Default – Limit Pre-Navigation Acquisition and Post-Navigation Acquisition for Almanac SVs<br>0x00 – Don't Limit Acquisition capabilities for Almanac SVs<br>0x08 – Limit Acquisition capability for Almanac SVs prior to Navigation<br>0x10 – Limit Acquisition capability for Almanac SVs post Navigation |
| Startup power mode | 1 U | Startup power mode<br>0 = Full power (default)<br>1 = TricklePower<br>2 = Push-to-Fix |
| Power cycle time | 1 D | Low power cycle time(1)<br>0 = TricklePower 1 second<br>1 = TricklePower 2 seconds<br>2 = TricklePower 3 seconds<br>3 = TricklePower 4 seconds<br>4 = TricklePower 5 seconds<br>5 = TricklePower 6 seconds<br>6 = TricklePower 8 seconds<br>7 = TricklePower 10 seconds<br>8 = Push-to-Fix 10 seconds<br>9 = Push-to-Fix 30 seconds<br>10 = Push-to-Fix 60 seconds<br>11 = Push-to-Fix 600 seconds<br>12 = Push-to-Fix 1200 seconds<br>13 = Push-to-Fix 1800 seconds<br>14 = Push-to-Fix 3600 seconds<br>15 = Push-to-Fix 7200 seconds<br>16 = Power cycling disabled (default) |
| LNA setting | 1 U | bit 0: Internal LNA gain settings<br>0=high gain<br>1=low gain<br>bit 3: External LNA bias value<br>0=use default LNA bias<br>1=use LNA bias given in bits 4-7<br>bit [7:4]: external LNA Bias value |
| MEMS I2C address 0 | 1 U | Sensor 0 address |
| MEMS I2C address 1 | 1 U | Sensor 1 address |
| MEME I2C address 2 | 1 U | Sensor 2 address |
| MEMS I2C address 3 | 1 U | Sensor 3 address |
| IO protocol | 1 U | IO protocol. Default 0 (OSP).<br>0= OSP<br>1= NMEA<br>2= MEI |

| Name | Byte(s) | Description |
|---|---|---|
| IO Rate 0 | 1 U | 50 bps message. Default 0 – (50 bps Msg 8 disabled)<br>Rate values<br>0= Disabled<br>1= Once per cycle<br>2= Once per 2 cycles<br>3 = Once per 5 cycles<br>**Note**: these values apply to all IO Rate fields |
| IO Rate 1 | 1 U | Raw debug. Default 0 (Msg 28-31 disabled)<br>See IO Rate 0 for values of enumeration |
| IO Rate 2 | 1 U | Debug messages. Default 0 (Debug messages disabled)<br>See IO Rate 0 for values of enumeration |
| IO Rate 3 | 1 U | GGA rate. Default 1s<br>See IO Rate 0 for values of enumeration |
| IO Rate 4 | 1 U | GLL rate. Default disabled.<br>See IO Rate 0 for values of enumeration |
| IO Rate 5 | 1 U | GSA rate. Default 1s<br>See IO Rate 0 for values of enumeration |
| IO Rate 6 | 1 U | GSV rate. Default 5s<br>See IO Rate 0 for values of enumeration |
| IO Rate 7 | 1 U | RMC rate. Default 1s<br>See IO Rate 0 for values of enumeration |
| IO Rate 8 | 1 U | VTG rate. Default disabled |
| IO Rate 9 | 1 U | ZDA rate. Default disabled<br>See IO Rate 0 for values of enumeration |
| IO Rate 10 | 1 U | GNS rate. Default disabled<br>See IO Rate 0 for values of enumeration |
| Flash I2C address | 1 U | Will be set by auto detect. Not supported in SiRFstarV |
| SPI first bit | 1 U | SPI first bit.<br>0 = msb first (default)<br>1 = lsb first |
| SPI mode | 1 U | SPI mode.<br>0 = Mode 1 (default)<br>1 = Mode 3<br>No other modes supported. |
| EE storage | 1 U | Specifies where receiver will store EE data0 = HOST<br>1 = EEPROM<br>2 = FLASH (parallel or SPI flash)<br>3 = NONE (will store to host if commands come from host)<br>Default will be based on the auto-detect if the CCK did not set this parameter |

| Name | Byte(s) | Description |
|---|---|---|
| I2C clock rate | 1 U | Default 1 – 400 kbps<br>0 = 100 kbps<br>1 = 400 kbps (default) |
| I2C mode | 1 U | $I^2C$ master/slave mode<br>0 =Slave<br>1 = Multi-master (default) |
| I2C address type | 1 U | Addressing<br>0 = 7 bit address (default)<br>1 = 10 bit address |
| IO Pin config enable | 1 U | Pin configuration validity<br>0 = Enabled<br>1 = Invalid (default)<br>Invalid means that the IO Pin configuration has not been changed by CCK or command. |
| Host port select | 1 U | Host Port<br>0 = $I^2C$<br>1 = Slave SPI<br>2 = UART using ECLK for clock<br>3 = UART using DLL for clock (default) |
| DR I2C rate | 1 U | DR $I^2C$<br>0 = 10 kbps<br>1 = 100 kbps<br>2 = 400 kbps (default)<br>3 = 1 Mbps<br>4 = High (> 400 k, < 1 M) |
| CGEE enable/disable | 1 U | CGEE enabled<br>0 = Enabled (default )<br>1 = Disabled |
| CGEE enable/disable GLONASS | 1 U | GLONASS CGEE enabled<br>0 = Enabled (default )<br>1 = Disabled |
| 5 Hz Nav | 1 U | 5 Hz Nav<br>0 = Enabled<br>1 = Disabled (default ) |
| SGEE support | 1 U | SGEE<br>0 = SGEE disabled<br>1 = 7-day SGEE<br>2 = 14-day SGEE (default )<br>3 = 31-day SGEE |
| SGEE support GLONASS | 1 U | GLONASS SGEE<br>0 = GLONASS SGEE disabled<br>1 = 7-day GLONASS SGEE<br>2 = 14-day GLONASS SGEE (default)<br>3 = 31-day GLONASS SGEE |

| Name | Byte(s) | Description |
|---|---|---|
| I2C EEPROM part | 1 U | EEPROM support not available in SiRFstarV |
| Data Logger Record Type | 1 U | Record Type<br>0 = Record type 0<br>1 = Record type 1<br>2 = Record type 2<br>3 = Record type 3<br>4 = Record type 4<br>5 = Record type 5 |
| Data Logger Memory Management | 1 U | Logging<br>0 = Circular buffering<br>1 = Stop logging at end of first pass |
| Voltage control | 1 U | Voltage used to hold up the RTC and BBRAM during low-power states<br>0 = 1.2 V<br>1 = 0.95 V<br>2 = 0.85 V<br>3 = 0.77 V |
| Temp Recorder Control | 1 D | Default 0<br>Bits [3:0] control XO sensor temperature sensor<br>Bits [7:4] control the RTC sensor.<br>For each 4 bits, the meanings of the values are:<br>0 = no sensor (default)<br>1 = NPN Bipolar Junction transistor<br>2 = Silicon diode<br>3 = PTAT |
| Altitude Source | 1 U | Specifies the source for an altitude value to be used when altitude hold mode is active<br>0 = Last value from navigation (default)<br>1 = Use user-input value from MID 136<br>2 = Use dynamic input from external source (not used) |
| Altitude Mode | 1 U | Method of using altitude hold mode<br>0 = Use when needed (default)<br>1 = Always use altitude hold mode, using user-input value<br>2 = Use dynamic input from external source (not used) |
| Commanded Nav Mode | 1 U | Kalman filtering mode<br>0 = No navigation<br>1 = Approximation from satellite coordinates<br>2 = From network transfer mode<br>3 = Stationary mode<br>4 = Least Squares mode<br>5 = Kalman Filter navigation<br>6 = SiRFDRive<br>7 = DGPS Reference Station |
| Nav Power Mask (dbHz) | 1 U | Power mask in dB-Hz – limit of weakest signal strength for a satellite used in the navigation solution, range 1-50, default 8 dB-Hz |

| Name | Byte(s) | Description |
|---|---|---|
| Enable 3SV LSQ | 1 U | 0 = enabled (default)<br>1 = disabled |
| DGPS Selection | 1 U | DGPS operating mode<br>0 = Automatic (use DGPS corrections if available – default)<br>1 = Only create a solution when DGPS corrections can be used<br>2 = Never – do not use DGPS |
| Use Smooth Measurements | 1 U | 0 = enabled (default)<br>1 = disabled |
| Parity | 1 U | Parity for serial port<br>0 = Parity is off (default)<br>1 = reserved<br>2 = Even parity<br>3 = Odd parity |
| Stop | 1 U | Number of stop bits on UART characters<br>0 = 1 Stop bit (default)<br>1 = 2 Stop bits |
| Pos Mode Enable | 1 D | Position Calculation Modes<br>Bit Meaning when set to 1<br>0 = Use Almanac Based Positioning<br>1 = Use Reverse EE<br>2 = Enable 5 Hz Navigation<br>3 = Enable SBAS Ranging<br>4 = Use Fast Time Synchronization |
| Host Wake Control | 1 D | Host_wake_control: Bit definitions for this field:<br>0 - Reserved (set to zero)<br>1 - wake event control<br>0 = wake event is inactive<br>1 = IO pin control and host wake event control fields are valid<br>6:2 - Reserved (set to zero)<br>7 - master control<br>0 = host wake control is inactive<br>1 = bits (6:0) are valid |
| UART Max Preamble | 1 U | When Host Wake Control bits 0 and 1 are set to 1, this field sets the number of 0xFF bytes to be sent to wake up host, default = 0 |
| UART idle byte wakeup delay | 1 U | When Host Wake Control bits 0 and 2 or 3 are set to 1, this field specifies how many idle bytes to send. Bit set in Host Wake Control (2 or 3) specifies protocol on the UART port. Default = 0 |
| IO Pin Control | 1 D | When Host Wake Control bits 0 and either 5 or 6 are set to 1, this field specifies the IO Pin setup to use to wake the host. Default is 0<br>Bit [3:0] specify the GPIO, range 0-15<br>Bit [6:4] reserved<br>Bit 7 specifies the polarity, 0 = active low, 1 = active high |

| Name | Byte(s) | Description |
|---|---|---|
| DOP Mask Mode | 1 U | Default Automatic (0)<br>0 = Automatic (use PDOP when in 3-D fix, HDOP when in 2-D fix)<br>1 = Ues PDOP<br>2 = Use HDOP<br>3 = Use GDOP<br>4 = Do not use DOP mask |
| GDOP threshold | 1 | Range 1-50, default 10 |
| PDOP threshold | 1 | Range 1-50, default 10 |
| HDOP threshold | 1 | Range 1-50, default 10 |
| Elevation Nav Mask | 2 S | Mask to limit use of low-elevation satellites. Units of 0.1 degree, range -20.0 to +90.0 degrees. Default 5.0 degrees |
| Elevation Track Mask | 2 S | Mask to limit tracking of low-elevation satellites. Units of 0.1 degree, range -20.0 to +90.0 degrees. Default 5.0 degrees – not currently implemented. |
| Minimum Altitude | 2 S | Default -50 meters, scaled by 10 |
| Max Speed | 2 U | Default 1500 meters/sec |
| Pin SW Functions | 2 D | See *I/O Pin Configuration Application Note* (CS-231404-AN) for details of software pin configuration. |
| GPIO0 | 2 D | GPIO 0 configuration (See IO Pin Configuration document for details) |
| GPIO1 | 2 D | GPIO 1 configuration (See IO Pin Configuration document for details) |
| GPIO2 | 2 D | GPIO 2 configuration (See IO Pin Configuration document for details) |
| GPIO3 | 2 D | GPIO 3 configuration (See IO Pin Configuration document for details) |
| GPIO4 | 2 D | GPIO 4 configuration (See IO Pin Configuration document for details) |
| GPIO5 | 2 D | GPIO 5 configuration ((See IO Pin Configuration document for details) |
| GPIO6 | 2 D | GPIO 6 configuration (See IO Pin Configuration document for details) |
| GPIO7 | 2 D | GPIO 7 configuration (See IO Pin Configuration document for details) |
| GPIO8 | 2 D | GPIO 8 configuration (See IO Pin Configuration document for details) |
| GPIO9 | 2 D | GPIO 8 configuration (See IO Pin Configuration document for details) |
| GPIO10 | 2 D | GPIO 8 configuration (See IO Pin Configuration document for details) |
| GPIO11 | 2 D | GPIO 8 configuration (See IO Pin Configuration document for details) |
| RX pin | 2 D | Rx pin configuration (See IO Pin Configuration document for details) |
| TX pin | 2 D | Tx pin configuration (See IO Pin Configuration document for details) |
| Max Altitude | 2 U | Maximum allowed altitude for a position fix in meters |
| Data Logger Distance Threshold | 2 U | Distance threshold for logging data, range 0 – 65535 in meters |

| Name | Byte(s) | Description |
|---|---|---|
| Data Logger Speed Threshold | 2 U | Speed threshold for logging data, range 0 – 65535 in meters/s |
| Data Logger Storage Interval | 2 U | Minimum seconds between logging each record, range 1 – 65535 |
| Message Wait Control | 2 U | Not supported in SSV |
| Location Technology constraints | 2 D | Default 0x0023; 1 = enabled<br>Bit 0 = GPS_ENABLE<br>Bit 1 = GLONASS_ENABLE<br>Bit 2 = GALILEO_ENABLE<br>Bit 3 = COMPASS_ENABLE<br>Bit 4 = SBAS_ENABLE<br>Bit 5 = QZSS_ENABLE<br>Bit 6 = QZSS_IMES_ENABLE<br>Bit 7 = MGPS_ENABLE<br>Bit 10 = EOTD_ENABLE<br>Bit 11 = CELL_ENABLE<br>Bit 12 = WIFI_ENABLE<br>Bit 13 = FM_ENABLE<br>Bit 14 = BT_ENABLE<br>Bit 15 = EMS_ENABLE |
| IO Delay Control | 2 U | if bit(s) 0 and 5 of 'Host Wake Control' are set this field specifies a delay value in 100 µs increments |
| Break Length Control | 2 U | if bit(s) 0 and 4 of 'Host Wake Control' are set this field specifies the break length in ms increments |
| Pause Length Control | 2 U | if bit(s) 0 and 4 of 'Host Wake Control' are set this field specifies the pause length in ms increments |
| Sleep Length Control | 2 U | if bit(s) 0 and 4 of 'Host Wake Control' are set this field specifies the sleep timeout in ms increments |
| IOS ACK NACK Timeout | 2 U | I/O Stream timeout (not yet supported) |
| Wait states | 4 | Not supported in SSV |
| TCXO Warm up delay | 4 | RTC clock ticks. TCXO warm up delay in RTC clock ticks. Default 1023 |
| Baud rate | 4 | Data rate. Default 115200 bps for OSP, 4800 for NMEA protocol. Cannot be 0. Supported values are 4800, 9600, 19200, 38400, 57600, 115200, 230400 and 460800 bps |
| I2C host address | 4 | $I^2C$ address of Host. Default 98 |
| I2C ME address | 4 | $I^2C$ address of MEAS_ENG. Default 96 |
| CGEE disable num seconds | 4 | When CGEE enable/disable is set to 1 (disable), this field specifies the delay in seconds until CGEE will be disabled. 0 = immediately. |
| CGEE disable num seconds (GLONASS) | 4 | When CGEE enable/disable GLONASS is set to 1 (disable) this field specifies the delay in seconds until GLONASS CGEE will be disabled. 0 = disable immediately |

| Name | Byte(s) | Description |
|---|---|---|
| Host Wake Event Control | 4 | Bit Function enabled by 1<br>0 Receiver needs CGEE data1 Receiver has CGEE data to store<br>2 Data logging memory is Full<br>3 Watchdog interrupt has occurred4-31 Reserved |
| Max EPE limit | 4 S | Autonomous QoS limit in meters. Default 4200.00 m |

**Table** 80**: MID 178,13 – CCK Response Poll**

## 4.61. GPIO Mode Set – MID 178,49

This is an input message to set the GPIO Mode to input or output. Table 81 shows the parameters for this MID.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_GPIO_MODE_SET (0xB2, 0x31) |
| gpio_to_set | 2 D | This is bit mapped,<br>Bit 0 = GPIO0<br>Bit 1 = GPIO1<br>Bit 2 = GPIO2<br>(continues to maximum GPIO for product)<br>Value:<br>0 : Don't alter mode<br>1: Update the mode |
| gpio_mode | 2 D | This is bit mapped,<br>Bit 0 = GPIO0<br>Bit 1 = GPIO1<br>Bit 2 = GPIO2<br>… (continues to maximum GPIO for product)<br>Value:<br>0 : Make GPIO an input or restore GPIO original mode (see gpio_state)<br>1: Make GPIO an output |
| gpio_state | 2 D | This is bit mapped,<br>Bit 0 = GPIO0<br>Bit 1 = GPIO1<br>Bit 2 = GPIO2<br>… (continues to maximum GPIO for product)<br>Meaning depends on gpio_mode<br>If gpio_mode == 0<br>0 : Make GPIO an input<br>1: Restore GPIO original mode<br>If gpio_mode == 1<br>0:Make GPIO output low<br>1: Make GPIO output high |

**Table 81: MID 178,49 – GPIO Mode Set**

**Example:**

Set GPIO 2 as an output pin with output set to 1; values are shown below:

gpio_to_set = 0x04
gpio_mode = 0x04
gpio_state = 0x04

**Note:**

**MID 178, 49** is used for setting GPIOs of user-specified pins. You must set the pin as an output type in tracker configuration **MID 178,70**, then you can use **MID 178,49**.

## 4.62. GPIO Trigger Source Request – MID 178,62

When a GPIO has been configured to trigger on certain conditions, this message allows the Host system to determine the reason the GPIO was asserted. The format of the message is shown in Table 82.

To configure the GPIO for assertion on certain conditions, see the IO Pin Configuration field in the Tracker Configuration message (**MID 178,70**). For the SiRFstarV engine, only GPIO2 can be configured to trigger on certain conditions. One example of a specific condition: when internal Applications RAM is used for Data Logging, the SiRFstarV engine will assert GPIO2 (low to high) when the management type is stop-on-memory-full and the memory is full. See the Data Logger Memory Management message (**MID 177,67**) for more details.

**Note:**

This message is not available in versions prior to SiRFstarV.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_GPIO_TRIG_SOURCE_REQ (0xB2, 0x3E) |

**Table 82: MID 178,62 – GPIO Trigger Source Request Message**

## 4.63. GPIO Trigger Source Response – MID 178,63

When GPIO has been configured to trigger on certain conditions, this message indicates the reason the GPIO was asserted. For the SiRFstarV engine, only GPIO2 can be configured to trigger on some conditions, listed in Table 83. This message is the response to the GPIO Trigger Source Request query (**MID 178,62**), and the generation of this response message will de-assert the GPIO.

**Note:**

This message is not available in versions prior to SiRFstarV.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_GPIO_TRIG_SOURCE_RSP (0xB2, 0x3F) |
| Reason | 4 D | See Table 84 |
| Reserved1 | 4 | Set to 0 |
| Reserved2 | 4 | Set to 0 |
| Reserved3 | 4 | Set to 0 |
| Reserved4 | 4 | Set to 0 |
| Reserved5 | 4 | Set to 0 |
| Reserved6 | 4 | Set to 0 |
| Reserved7 | 4 | Set to 0 |
| Reserved8 | 4 | Set to 0 |

**Table 83: MID 178, 63 – GPIO Trigger Source Response**

| Bit Field | Description | Notes |
|---|---|---|
| Bit 0 | CGEE predictions stored on the Host system are needed | When this bit is set, the SiRFstarV engine will request saved CGEE predictions from the Host system immediately following this response message. This bit is reset following this response message. |
| Bit 1 | New CGEE predictions are available for storage on the Host system | When this bit is set, the data logger memory is full. The Host system must send the Data Logger Command (**MID 177, 64**) to retrieve the data before additional logging can occur. This bit is not reset until the Data Logger records have been retrieved. |
| Bit 2 | Data Logger memory full | When this bit is set, the Host system must send the Data Logger Command (**MID 177,64**) to retrieve the data. This bit is not reset until the Data Logger records have been retrieved. |
| Bit 3 | Watchdog Reset occurred | When this bit is set a Watchdog Reset has occurred in SiRFstar. The Host system should reload patch if available. This bit is reset following this response message. |
| Bit 4 - Bit 31 | Reserved | -- |

**Table 84: Reason Field Description**

## 4.64. Tracker-Only Mode Setting Request – MID 178,67

The Set Tracker-Only Mode message switches a 5xp between engine mode and tracker-only mode. A corresponding MEI message switches 5xp back to engine mode of operation.

Table 85 shows the format of the message.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_TRACKER_ONLY_MODE (0xB2, 0x43) |
| Mode requested | 1 U | 0 = Engine mode(default)<br>1 = Tracker-only mode |

**Table 85: MID 178, 67 – Tracker-Only Mode Setting Request message**

Standard acknowledgement responses:

- Command Acknowledgment (**MID 11**) operation succeeded or
- Command Negative Acknowledgment (**MID 12**) operation failed

## 4.65. Multi-constellation Tracker Configuration Request – MID178,70

The Multi-constellation Tracker Configuration message is a new, SiRFstarV version of the SiRFstarIV “Tracker Configuration” message. It is used to override the default configuration settings Multi-constellation CW Configuration.

This information is normally sent at startup by host-based software. Optionally, this OSP message can be used to change SiRFstar's operating configuration at any time. These settings are stored in battery-backed RAM and retained over any resets of SiRFstar as long as power is maintained. If backup power is lost, this command needs to be resent.

All tracker configuration setting requests in MID 178,70 apply on the next transition to full power GNSS, except Power Control on/off, Message Waiting Delay, Message Waiting GPIO select, Power Control, UART and I²C host port settings setting requests which apply immediately. Table 86 shows the fields of the Multi-constellation Tracker Configuration message.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_TRKR_CONFIG (0XB2, 0X46) |
| Reference Clock Frequency | 4 U | Value of attached TCXO in Hz.<br>**Takes effect after RESET** |
| Reference Start-up Delay | 2 U | Tracker inserts the start-up delay on TCXO power-up.<br>The units are RTC clock cycles (30.5176 µs each), and start-up delay can range from 0 to 2 seconds.<br>The Tracker default is 0x03ff or 31.2 ms.<br>**Takes effect after RESET** |
| Reference Initial Uncertainty | 4 U | Initial TCXO uncertainty in ppb.<br>The value 0xffffffff means initial uncertainty unknown, and the Tracker will use the default uncertainty.<br>**Takes effect after RESET** |
| Clock Drift Initial Frequency | 4 S | Initial Clock Drift Frequency in Hz.<br>**Note:**<br>This value is signed. The value 0x7fffffff means the initial offset is unknown, and the Tracker will use the default offset.<br>**Takes effect after RESET** |
| LNA | 1 D | Bit 0 : LNA Selection<br>0 = Use Internal LNA<br>1 = Use External LNA<br>Bit 3 : Custom Valid Field<br>0 = use default settings when External LNA selected<br>1 = use LNA bias override value provided in bits 7:4<br>Bit [7:4]: LNA bias value that can override External LNA default (only used when bit 0 and 3 are both 1)<br>**Takes effect after RESET** |
| Configuration Enable | 1 D | 0 = Disable (also means all I/O pins, except host ports, are disabled)<br>1 = Enable (use I/O Pin Configuration field)<br>The default is one.<br>**Takes effect after RESET** |
| IO Pin Configuration | 2 D [14] | I/O Pin setting to override default. Total number of pins for CSRG05xp is 14. Two bytes contain setting for each pin.<br>Details are product specific, the 5T does not use Pins 8,9,10 and 11.<br>**Takes effect after RESET** |
| UART Wake Up Max Preamble | 1 U | Number of MEI Level Preamble messages to be sent prior to valid messages.<br>0 = send forever until Preamble message is acknowledged by peer.<br>**Takes immediate effect** |

| Name | Byte(s) | Description |
|---|---|---|
| UART Idle Byte Wake Up Delay | 1 D | Enables the Preamble Wakeup Feature, either UART driver level or MEI Message Level (both cannot be enabled at the same time).<br><br>Bits 3 - 0 have two meanings, depending on bits 4 and 5.<br>If Bit 4=1: The number of idle bytes between MEI level preamble transmissions.<br>If Bit 5=1 the number of milliseconds worth of 0xff byte transmission preambles to be sent.<br>Bit 4:<br>1 = Enable MEI Protocol Level Preamble Messages, a series of Empty MEI messages transmitted prior to valid messages (see MEI Level Wakeup Max Preamble).<br>Bit 5:<br>1 = Enable UART Driver Level Preamble (Series of 0xff bytes are transmitted prior to valid messages).<br>**Takes immediate effect** |
| UART Baud | 4 U | Valid data rates: 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600 and 1228800.<br>**Takes immediate effect** |
| UART Flow Control | 1 D | 0 = Disable hardware flow control (default)<br>1 = Enable hardware flow control<br>**Note:**<br>GPIO 6 and 7 must also be programmed for CTS and RTS<br>**Takes immediate effect** |
| I2C Master Address (host system) | 2 U | Either a 7-bit or a 10-bit I2C address.<br>For 10-bit fields:<br>▪ Field begins with 0xf, indicating 10-bit I2C addressing is being used.<br>▪ Only the lower 10-bits are used.<br>▪ 10-bit I2C address will range from 0xf000 through 0xf3ff<br>For a 7-bit address<br>▪ Only the lower 7 bits are used.<br>▪ 7-bit I2C address will range from 0x0008 through 0x007f.<br>▪ Values lower than 0x08 have special uses (see the I2C Bus Specification for a description).<br>**Takes immediate effect** |

| Name | Byte(s) | Description |
|---|---|---|
| I2C Slave Address | 2 U | Either a 7-bit or a 10-bit I2C address.<br>For 10-bit fields:<br>▪ Field begins with 0xf, indicating 10-bit I2C addressing is being used.<br>▪ Only the lower 10-bits are used.<br>▪ 10-bit I2C address will range from 0xf000 through 0xf3ff<br>For a 7-bit address<br>▪ Only the lower 7 bits are used.<br>▪ 7-bit I2C address will range from 0x0008 through 0x007f.<br>▪ Values lower than 0x08 have special uses (see the I2C Bus Specification for a description).<br>**Takes immediate effect** |
| I2C Rate | 1 U | 0 = 100 Kbps<br>1 = 400 Kbps (default)<br>**Takes immediate effect** |
| I2C Mode | 1 U | 0 = Slave<br>1 = Multi-Master (default)<br>**Takes immediate effect** |
| I2C Max Message Length | 2 U | Maximum message length in I2C mode measured in bytes<br>default value 0x01f4<br>**Takes immediate effect** |
| Power Control On/Off | 1 D | Bits 2-0: Edge Type<br>0: On/Off disabled or not detected<br>1: Enable Falling edge On/Off IRQ<br>2: Enable Rising edge On/Off IRQ<br>3: Enable Rising edge On, Falling edge Off IRQ<br>4: Enable Falling edge On, Rising edge Off IRQ<br>Bits 4-3: Usage Type<br>0: No On/Off used<br>1: GPIO controlled On/Off<br>2: UARTA Rx controlled On/Off<br>3: UARTB CTS controlled On/Off<br>Bit 5: OFF Enable field<br>0: OFF disabled<br>1: OFF enabled<br>Bits 7-6: reserved<br>**Takes immediate effect** |

| Name | Byte(s) | Description |
|---|---|---|
| tcxo_control | 1 U | TCXO output control:<br>Bit 0:<br>0=ignore tcxo_control field<br>1=apply tcxo_control field<br>Bits [2:1]: PSU_TCXO voltage selection for linear regulator power mode<br>0=1.2V<br>1=1.8V<br>2=2.7V<br>3=3.0V<br>Bit 3: Power mode selection:<br>0= switch<br>1= LDO<br>**Takes effect after RESET** |
| sniffer_disable | 1 U | Sniffer disable<br>0=all sniffers enabled,<br>1=all sniffers disabled<br>**Takes effect after RESET** |
| Voltage Control | 1 D | Bits 1:0 KA (Keep Alive) Variable Voltage Selection<br>0x00 = 1.2V<br>0x01=0.95V<br>0x10=0.85V.<br>**Takes effect after RESET** |
| Power Supply Config Select | 1 U | Bit 1:0 Power config selection<br>0x00 = No change, use hardware default<br>0x01 = Linear Mode<br>0x10 = Switcher Mode<br>**Takes effect after RESET** |
| Message Waiting Control | 2 U | Delay between GPIO signal transition and output message in 0.1 ms units (16 bits), minimum is 0.<br>Message waiting GPIO must also be configured.<br>**Takes effect after RESET** |
| Temp Recorder Control | 1 D | Temp Recorder Sensor Configuration.<br>Bits 7-4: RTC Sensor configuration<br>Bits 3-0: XO Sensor configuration.<br>0 = Internal<br>1 = Si DIODE<br>2 = NPN BJT<br>3 = PTAT<br>**Takes effect after RESET** |
| Reserved | 1 | - |

| Name | Byte(s) | Description |
|---|---|---|
| pin_SWfunctions | 2 U | Pin assigned to function:<br>0 = un-assigned<br>1=GPIO0<br>2=GPIO1<br>… (Make sure IO Pin Configuration field in this message is set )<br>Bit [3:0] are for GNSS ON, 0 = invalid, 1=GPIO0, 2=GPIO1, etc.<br>Bit [7:4] are for DR Sync , 0 = invalid, 1=GPIO0, 2=GPIO1, etc.<br>Bit [11:8] are for Msg Wait , 0 = invalid, 1=GPIO0, 2=GPIO1, etc.<br>Bit [15:12] Unused /* Command assignment of a pin to a function.<br><br>**Takes effect after RESET** |

**Table 86: MID 178,70 – Multi-constellation Tracker Configuration Request**

## 4.66. BBRAM Backup Command Configuration – MID 178,74

This message specifies the minimum periodic backup interval and the backup destination. If the interval is zero, backup is initiated immediately on receipt of this message and cancels any existing periodic backup in effect. A zero destination value directs the backup to the host system via the OSP BBRAM data output message. A value of one directs the backup to SiRFstar's SPI flash memory, if available. Other values may indicate other destinations in the future. If a flash destination is specified, when no flash is connected to SiRFstar, an error message is returned to the host and no further action is taken.

| Field | Byte(s) | Description |
|---|---|---|
| MID | 2 U | SIRF_MSG_SSB_BBRAM_BACK_CMD_CONFIG (0xB2, 0x4A) |
| Backup Interval | 2 U | Range 0 – 65535 minutes<br>= 0 - Backup Once Now<br>> 0 - Minutes between backups |
| Backup Destination | 2 U | 0 - Backup to host system<br>1 - Backup to receiver's flash |

**Table 87: MID 178,74 – BBRAM Backup Command Configuration Message**

In response to this message SiRFstar will send a series of **MID 178,77** Data Content messages, followed by a single **MID 178,78** Data Terminator message.

## 4.67. BBRAM Restore Data Content Message – MID 178,75

This message is expected to be received multiple times to input the entire BBRAM restore data from a previous backup stored on the host system. The message contains the data segment sequence number, the number of data bytes that have been sent including the data in the current message, and the number of bytes remaining to be sent. The next group of fields comprise 1024 bytes of BBRAM data formatted as 256, four-byte unsigned long words. The last field is a four byte CRC-32 covering the BBRAM data words in the message.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_BBRAM_REST_DATA_CONTENT (0xB2, 0x4B) |
| Data Segment | 1 U | Order of this message in the stream of messages: range 1 – 255 |

| Field | Byte(s) | Description |
|---|---|---|
| Index | | |
| Bytes Sent | 4 U | Number of bytes sent so far including this message, up to the maximum physical size of BBRAM, range 1 – 16384 |
| Bytes Remaining | 4 U | Bytes remaining to be sent after this message, up to the maximum physical size of BBRAM, range 1 – 16384 |
| Content Data | 4 U * 256 | 256 unsigned long words of BBRAM content data. |
| CRC-32 | 4 U | CRC-32 value of Content Data only |

**Table 88: MID 178,75 – BBRAM Restore Data Content Message**

## 4.68. BBRAM Restore Data Terminator Message – MID 178,76

This message is sent to SiRFstar after the last BBRAM Restore Data message has been sent. This message contains the original UTC time of the backup. The time has been provided previously by the BBRAM_BACKUP_DATA_TERMINATOR message at the completion of the backup transmission from SiRFstar. If the terminator message is received before enough data has been accumulated to fill the used BBRAM space or the terminator is never received, the restore is cancelled and SiRFstar takes no further action regarding the restore. The terminator message is required to trigger data verification and writing valid recovery data to BBRAM.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_BBRAM_REST_DATA_TERM (0xB2, 0x4C) |
| UTC Week | 1 U | Coordinated Universal Time Week Number in the current year, range 0 - 51 |
| UTC Hour | 1 U | Coordinated Universal Time Hours into UTC Week, range 0 - 167 |
| UTC Min | 1 U | Coordinated Universal Time Minutes into UTC Hour, range 0 - 59 |
| UTC Sec | 1 U | Coordinated Universal Time Seconds into UTC Min, range 0 - 59 |

**Table 89: MID 178,76 – BBRAM Restore Data Terminator Message**

## 4.69. BBRAM Backup Data Content – MID 178,77

This message is sent multiple times from SiRFstar to output the entire BBRAM content to the host system. The message contains the data segment sequence number, the number of data bytes that have been sent including the data in the current message, and the number of bytes remaining to be sent. The next field contains 1024 bytes of BBRAM data formatted as 256 four-byte, unsigned long words. The last field is a four-byte CRC-32 covering the BBRAM data words in the message.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_BBRAM_BACK_DATA_CONTENT (0xB2, 0x4D) |
| Data Segment Index | 1 U | Order of this message in the stream of messages, range 1 – 255 |
| Bytes Sent | 4 U | Number of bytes sent so far including this message, up to the maximum physical size of BBRAM, range 1 – 16384 |
| Bytes Remaining | 4 U | Bytes remaining to be sent after this message, up to the maximum physical size of BBRAM, range 1 – 16384 |

| Field | Byte(s) | Description |
|---|---|---|
| Content Data | 4 U * 128 | 128 unsigned long words of BBRAM content data. |
| CRC-32 | 4 U | CRC-32 value of Content Data only. |

**Table 90: MID 178,77 – BBRAM Backup Data Content Message**

## 4.70. BBRAM Backup Data Terminator – MID 178,78

This message is sent one time by SiRFstar after all BBRAM backup data has been sent to the host system to indicate successful completion. This message contains the UTC time at the moment the backup started. The time is necessarily returned by the BBRAM_RESTORE_DATA_TERMINATOR when restoring, so the age of the backup can be determined.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_BBRAM_BACK_DATA_TERM (0xB2, 0x4E) |
| UTC Week | 1U | Coordinated Universal Time Week Number in the current year, range 0 - 51 |
| UTC Hour | 1U | Coordinated Universal Time Hours into UTC Week, range 0 - 167 |
| UTC Min | 1U | Coordinated Universal Time Minutes into UTC Hour, range 0 - 59 |
| UTC Sec | 1U | Coordinated Universal Time Seconds into UTC Min, range 0 - 59 |

**Table 91: MID 178,78 – BBRAM Backup Data Terminator Message**

## 4.71. BBRAM Restore Request – MID 178,79

This message is sent to the host system by SiRFstar to request the restoration of previously backed-up BBRAM data. Upon receipt, the host is expected to respond with the backup data in a sequence of messages followed by the data terminator message. If the host does not respond or the data terminator is never sent by the host, SiRFstar takes no further action regarding the backup restore.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_BBRAM_REST_REQ (0xB2, 0x4F) |

**Table 92: MID 178,79 – BBRAM Restore Request Message**

In response to this message the host must send the stored BBRAM data. The data are sent in a series of MID 178 SID 75 Data Content messages, followed by a single MID 178 SID 76 Data Terminator message.

## 4.72. Enhanced SW Commanded Off – MID 205,16

The SiRFstarV should not be turned off by simply removing power, since memory corruption could occur. This command provides a way for a proper shutdown. Alternately, the ON_OFF input pin may be set via hardware.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SW_COMMANDED_OFF (0xCD, 0x10) |

**Table 93: MID 205,16 – Enhanced SW Commanded Off**

## 4.73. Set GLONASS XYZ Ephemeris Request – MID 211,11

The Set GLONASS XYZ Ephemeris message is used to deliver GLONASS Cartesian-convention ephemeris parameters. Table 94 shows the fields of the Set GLONASS XYZ Ephemeris message.

This message is supported starting with SiRFstarV.

| Name | Bytes(s) | Description |
|---|---|---|
| MID, SID | 2 U | SET_GLO_XYZ_EPH (`0xD3,0x0B`) |
| NUM_SVS | 1 U | Number of satellites in this message |
| Reserved | 1 U | Set to 0 |
| GANSS Satellite Elements | array | See Table 95, repeated NUM_SVS times |

**Table 94: MID 211,11 – GLONASS XYZ Ephemeris**

| Name | Byte(s) | Description |
|---|---|---|
| EPH_FLAG | 1 U | Ephemeris validity flag is set to 1 if the satellite element contains broadcast ephemeris data. Invalid data is indicated by the flag set to 0. |
| SV_FREQ_NUM | 1 S | GLONASS frequency number range: -7 to +6.<br>This is the integer multiple of 562.5 kHz offset from 1602 MHz that this satellite is transmitting, if unknown, this field is set to 0xFF. |
| SV_SLOT_NUM | 1 U | GLONASS satellite slot number (= Satellite ID + 1) |
| RESERVED | 1 | Reserved, set to zero. |
| REF_TIME | 2 U | Ephemeris reference time |
| REF_DAY | 2 U | Ephemeris reference day of the satellite state vector parameters (within the 4-year cycle, starting from 1996).<br>Referred to as “NT“ in the GLONASS Interface Control Document<br>`0xFFFF` = Unknown- |
| X_POS | 4 S | ECEF X Position, in km scaled by 211 |
| Y_POS | 4 S | ECEF Y Position, in km scaled by 211 |
| Z_POS | 4 S | ECEF Z Position, in km scaled by 211 |
| X_VEL | 3 S | Velocity in X direction, in km / s scaled by 220 |
| Y_VEL | 3 S | Velocity in Y direction, in km / s scaled by 220 |
| Z_VEL | 3 S | Velocity in Z direction, in km / s scaled by 220 |
| CLOCK_OFFSET | 3 S | Satellite clock bias |
| CLOCK_DRIFT | 2 S | Satellite clock drift |
| HEALTH_FLAGS | 2 U | Satellite health flags |
| X_ACC | 1 S | Acceleration in X direction, in $km/s^2$ scaled by 230 |

| Name | Byte(s) | Description |
|---|---|---|
| Y_ACC | 1 S | Acceleration in Y direction, in km/s$^2$ scaled by 230 |
| Z_ACC | 1 S | Acceleration in Z direction, in km/s$^2$ scaled by 230 |
| RANGE_ACCURACY | 1 U | Modelled range accuracy |
| AGE | 1 U | UINT8(Model.Sat .Ecef.gloEn) |
| STRING_FLAGS | 1 D | Status flags<br>Bits 0:1 = P1,<br>Bit 2 = P2<br>Bits 3:4 = M per GLONASS specification |
| RESERVED | 2 | Reserved , set to zero. |

**Table 95: GANSS Satellite Element**

## 4.74. Set GLONASS Common Clock – MID 211,12

The Set GLONASS Common Clock message is used to convey timing information between GLONASS and GPS constellations as well as between GLONASS and UTC time scales. Table 96 shows the fields of the Set GLONASS Common Clock message.

This message is supported starting with SiRFstarV.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SET_GLO_CLOCK_INFO (`0xD3, 0x0C`) |
| REF_TIME | 1 U | Reference time (within REF_DAY) of the common clock data, scaled at 1/900 seconds<br>Referred to as “tb“ in GLONASS ICD, this is the time of the satellite state vector. |
| REF_DAY | 2 U | Reference Day (within 4-year interval) of the common clock data, scaled in days<br>Referred to as “ NT“ in GLONASS ICD, this is the day number within 4-year interval (starting from 1996) the satellite state vector. |
| DELTA_UTC | 4 S | Time difference between GLONASS system time and UTC time, scaled at 231 s<br>This value represents the sub-1-second difference between GLONASS and UTC time scales.<br>( DELTA_UTC = GLONASS minus UTC). |
| DELTA_GPS | 3 S | Time difference between GLONASS system time and GPS time, scaled at 230 s<br>This value represents the sub-1-second difference between GLONASS and GPS time scales.<br>( DELTA_GPS = GLONASS minus GPS ).<br>**Note:**<br>There is an integer 3 hour offset as well as a varying integer UTC/GPS offset user must take into account for full time conversion |
| B1 | 2 S | Time difference between UT1 and UTC time scales, scaled at 210 seconds<br>This value represents the sub-1-second difference between UT1 and UTC time scales.<br>( B1 = UT1 minus UTC). |
| B2 | 2 S | Drift of B1, in seconds per-day, scaled at 216 seconds per day |

| Name | Byte(s) | Description |
|---|---|---|
| NA | 2 U | Reference day number of clock-data within 4-year period, scaled per day |
| N4 | 1 U | Four-year interval/period number starting with 1996, scaled 4-year number |
| KP | 1 U | Notification of forthcoming leap-second change, see GLONASS ICD for details |
| Reserved | 2 | Reserved field |

**Table 96: MID 211,12 – Set GLONASS Common Clock Message Fields**

## 4.75. Set GNSS Ephemeris Clock – MID 211, 34

This message is used to initialize the clock model for the constellation. Its contents are proprietary to CSR.

Table 97 shows the fields of the Set GNSS Ephemeris Clock message.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SET_EPH_CLK_EXT (0xD3, 0x22) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| NUM_SV | 1 U | Number of satellites |
| Week | 2 U | Week Number |
| SV_MASK | 4 U | Satellite validity mask |
| Eph_Param [500] | array | CSR Proprietary - 500 bytes in length |
| RESERVED | 1 | Reserved, set to zero. |

**Table 97: MID 211, 34 – Set GNSS Ephemeris Clock Message Fields**

## 4.76. GLONASS Broadcast Almanac Request – MID 212, 11

This message requests GLONASS Broadcast Almanac status data and is supported starting with SiRFstarV. SiRFstar responds to this request with a 'GLONASS almanac' response (**MID 70,11**) message. Table 98 shows the fields of the GLONASS Broadcast Almanac Request message.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | GLO_ALM_REQ (0xD4, 0x0B) |

**Table 98: MID 212, 11 – GLONASS Broadcast Almanac Request Message Fields**

## 4.77. GLONASS Broadcast Ephemeris Request – MID 212,12

The GLONASS Broadcast Ephemeris Request message is sent by the host to request GLONASS broadcast ephemeris data. SiRFstar responds to this request with a 'GLONASS broadcast ephemeris' response message, **MID 70,12**. Table 99 shows the fields of the GLONASS Broadcast Ephemeris Request message.

This message is supported starting with SiRFstarV.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | GLO_B_EPH_REQ(0xD4, 0x0C) |

**Table 99: MID 212,12 – GLONASS Broadcast Ephemeris Request Message Fields**

## 4.78. Request Active Storage Type – MID 212, 14

This message is used by the host to request the active storage type in SiRFstar. The designated storage is used for storing EE data, Almanac, UTC Data and crystal data but not necessarily for Patches, Data Logger or NVM Backup data.

Upon receiving this message SiRFstar responds with message **MID 70, 14**

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_STORAGE_SETTINGS_REQ (0xD4, 0x0E) |

**Table 100: MID 212, 14 – Request storage Type**

## 4.79. Session Open Request - MID 213,1

Table 101 lists the message data format for initiating an AGPS session.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | SIRF_MSG_SSB_SESSION_OPEN_REQ |
| `ses_open_req` | 1 U | Session open request information<br>0x71 = Open a session<br>0x80 = Resume a suspended session |

**Table 101: MID 213,1 – Session Open Request**

## 4.80. Session Close Request - MID 213,2

Table 102 lists the message data format for a session closing request.

| Name | Bytes | Description |
|---|---|---|
| MID | 2 U | `SIRF_MSG_SSB_SESSION_CLOSE_REQ (0xD5, 0x02)` |
| `ses_close_req` | 1 U | Session closing request information<br>0x00 = Close an open session<br>0x80 = Suspend an open session (may be resumed) |

**Table 102: MID 213,2 – Session Close Request**

## 4.81. Hardware Configuration Indication - MID 214

The Hardware Configuration Response message is output after startup and when SiRFstar is sent in response to a hardware configuration request (**MID 71**) message.

Table 103 lists the message data format for **MID 214**.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | `SIRF_MSG_SSB_HW_CONFIG_RSP (0xD6)` |
| `hw_config_msg` | 1 U | Hardware configuration information<br><br>Bit 0: (LSB) Precise Time Transfer Available<br>0: No<br>1: Yes<br><br>Bit 1: unused<br><br>Bit 2: Frequency Transfer Available<br>0: No<br>1: Yes<br><br>Bit 3: Frequency Transfer Method<br>1: No Counter – frequency aid by message only<br>0: Counter– reference frequency applied to ECLK pin<br><br>Bit 4: RTC Availability<br>1: Yes<br>0: No<br><br>Bit 5: RTC for GPS<br>1: Internal to GPS<br>0: External to GPS<br><br>Bit 6: unused<br><br>Bit 7: Reference Clock Status for Counter type Frequency Transfer; valid only if Bit 4 = 0<br>0: Reference clock is on<br>1: Reference clock is off |
| `nominal_freq_high` | 1 U | Nominal Frequency, most-significant byte |
| `nominal_freq_low` | 4 U | Nominal Frequency, four least-significant bytes.<br><br>**NOTE:**<br>If HW_CONFIG Bit 3 = 1 and Bit 4 = 0 (counter method), this field is set to the absolute frequency value of the clock, reported as the counter frequency measurement. The resolution is in $10^{-3}$ Hz. The format is unsigned binary over 40 bits. The range is from 0.001Hz to 1.0995GHz. Otherwise, this field set to all zeros. |

| Name | Bytes | Description |
|---|---|---|
| nw_enhance_type | 1 U | Network enhancement features available<br>Bit 0: Reserved<br>Bit 1: Reserved<br>Bit 2:<br>0 = AUX_NAVMODEL Aiding is not supported<br>1 = AUX_NAVMODEL Aiding is supported<br>Bit 3:<br>0 = NAVBit Subframe 1, 2, and 3 Aiding is not supported<br>1 = NAVBit Subframe 1, 2, and 3 Aiding is supported<br>Bit 4:<br>0 = NavBit Subframe 4 and 5 Aiding is not supported<br>1 = NavBit Subframe 4 and 5 Aiding is supported<br>Bit 5: Reserved<br>Bit 6: Reserved<br>Bit 7: Reserved |

**Table 103: MID 214 – Hardware Configuration Indication**

## 4.82. Set TricklePower Mode – MID 218,3

This message will set the TricklePower mode. SiRFstar will accept this command only if it is in full power mode.
**Note:** for software versions 5.2 and later, we recommend that you use **MID 218, 6** rather than this message.

Message sent in response/request for this message: None.

| Name | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_PWR_MODE_TP_REQ (0xDA, 0x03) |
| DutyCycle | 2 U | Per cent time to be on, in milliseconds. |
| On_Time | 4 U | Time RF section is on, in milliseconds in multiples of 100 milliseconds only Range 100 to 900 |
| MaxOffTime | 4 U | Off-time in milliseconds when SiRFstar is unable to find signals during MaxSearchTime; range 1000 to 7200000 |
| MaxSearchTime | 4 U | Time in milliseconds SiRFstar searches for a signal in one cycle(1); range 10000 to 7200000 |

**Table 104: MID 218,3 – Set TricklePower Mode**

Fields MaxOffTime and MaxSearchTime specify the amount of time SiRFstar uses hibernating when it cannot find a signal and searching for signals when that period is complete.

## 4.83. Set Push-To-Fix – MID 218,4

This message set SiRFstar to Push To Fix mode Before sending this message to receiver make sure SiRFstar is in full power mode **Note:** for software versions 5.2 and later, we recommend that you use MID 218, 6 rather than this message.

Message sent in response/request for this message: None.

| Name | Byte(s) | Description |
|---|---|---|
| Message ID | 2 U | SIRF_MSG_SSB_PWR_MODE_PTF_REQ (0xDA, 0x04) |

| Name | Byte(s) | Description |
|---|---|---|
| Push-to-Fix Period | 4 U | Period for one cycle in seconds , range 30 to 7200 |
| MaxOffTime(1) | 4 U | Off time in milliseconds when SiRFstar is unable to find signals during MaxSearchTime(1), range 1000 to 7200000 |
| MaxSearchTime(1) | 4 U | Time in milliseconds SiRFstar searches for a signal in one cycle(1) , range 10000 to 7200000 |

**Table 105: MID 218,4 – Set Push-To-Fix**

Fields MaxOffTime and MaxSearchTime specify the amount of time SiRFstar uses hibernating when it cannot find a signal and searching for signals when that period is complete.

## 4.84. Set Push-to-FixII – MID 218,5

This message command puts SiRFstar in PTF2 mode. You must send it when SiRFstar is in Full Power Mode. This message is applicable to SiRFstarV and subsequent products.

The UserOptions field of the message has some QoS features that are new in SiRFstarV receivers. Use these features to control the time that SiRFstar remains on during each PTF2 cycle and to achieve the accuracy of a fix when you toggle the ON_OFF input to request a position.

When the QoS feature is disabled, SiRFstar remains on during each cycle only until the Kalman filter reaches a solution. When the QoS feature is enabled, the Kalman filter solution is tested against the QoS limit. SiRFstar remains on until the QoS limit is reached. This typically increases the length of time SiRFstar is on.

In addition to the options to enable or disable QoS limits, another option is to tighten the QoS limits. When this feature is activated, it reduces the QoS error limits, which further increase the time required to meet the limits. While activating the QoS limits it can increase the time for each cycle. Using these limits typically results in a more accurate position fix when there is a position request.

**Note:** for software versions 5.2 and later, we recommend that you use MID 218, 6 rather than this message.

Message sent in response/request for this message: None.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_PWR_MODE_PTF_V2_REQ (0xDA, 0x5) |
| Push-to-Fix Period | 4 U | Period for one cycle in seconds ; range 30 to 7200 |
| MaxOffTime(1) | 4 U | Off time in milliseconds when SiRFstar is unable to find signals during MaxSearchTime; range 1000 to 7200000 |
| MaxSearchTime(1) | 4 U | Time in milliseconds SiRFstar searches for a signal in one cycle(1); range 10000 to 7200000 |
| User Options | D 1 | See Table 9 for details of this field |

**Table 106: MID 218,5 – Set Push-to-FixII**

Table 107 lists user options field descriptions.

| Bit(s) | Function | Description |
|---|---|---|
| 0 | Shorten Cycle time on velocity | 0 = PTF period is not affected by vehicle velocity<br>1 = PTF period is affected by vehicle velocity:<br>• If the PTF_PERIOD is greater than 600 seconds, then this bit is ignored.<br>• If the PTF_PERIOD is greater than 300 seconds but less than or equal to 600 seconds, then while the speed exceeds 5 m/s, the PTF period is temporarily adjusted to 60 seconds.<br>• If the PTF_PERIOD is 30 seconds to 300 seconds, then while the speed exceeds 5 m/s, the PTF period is temporarily adjusted to 30 seconds.<br>• If the speed is below 5 m/s, the PTF_PERIOD is not adjusted. |
| 1 | Reserved | Set to 0 |
| 2 | Nav QoS Check | 0 = Enable QoS Check (default)<br>1 = Disable QoS Check |
| 3 | Tighter QoS | 0 = Disable Tight QoS (default)<br>1 = Enable Tight QoS |
| 31:4 | Reserved | Set to 0 |

**Table 107: Push-to-FixII User Options**

## 4.85. Set Low Power Mode Message – MID 218,6

The user can enable either Full Power Mode or one of the Low Power Modes by using this single message. For Low Power Modes, additional advanced control and configuration options can also be set. The currently supported Low Power sub-modes are Micro Power Mode (MPM), Trickle Power (TP) and Push-to-Fix (PTF). This message is supported in all CSR05XP, CSR05E and 5EA ROM P2.1 based products.

Table 108 shows the format of this message, followed by a discussion of some of the fields.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_PWR_MODE_LPM_REQ (0xDA, 0x6) |
| Power Mode | 1 U | Power Mode Selection<br>0 = Full Power Mode (FPM)<br>1 = Low power Mode (LPM) |
| Power Feature List | 1 U | Power Feature List. Bit Map.<br>0x1(b0) = Enable TricklePower 2, which is only active during Full Power. |
| Version | 1 U | Current Version = 0 (Software version use only) |
| Rate_upper | 1 U | Upper byte of LPM Rate in Seconds.<br>NOTE: The value for the LPM rate is computed by combining the value in this field is multiplied by $2^{16}$ and adding to `Rate_lower`. |
| Rate_lower | 2 U | Lower bytes of LPM Rate in seconds.<br>0 = MPM<br>1-10 = TP, except 6 = Push-to-FixII, when Use Mask = 0x04<br>30-86400 = PTFII, value will be rounded to nearest multiple of 30 s |

| Name | Bytes | Description |
|---|---|---|
| Use Mask | 2 D | Use Mask. Bit Map.<br>Bit 0:<br>0 = Use system LPM defaults<br>1 = Override LPM defaults and use the appropriate override settings from below (Defaults to be specified below for each power mode)).<br>Bit 1: reserved<br>Bit 2:<br>0 = disable automatic Push-to-FixII 6 sec interval<br>1 = enable automatic Push-to-FixII 6 sec interval (to ensure 6 seconds does not trigger TP1) |
| Max Search Time | 2 U | Max Search Time in seconds<br>**Note:** Actual value used will be a multiple of 30 seconds, for example: 30, 60, 90...<br>Used as overrides for both TP and Push-to-FixII. |
| Max Off Time | 2 U | Max Off Time in seconds when the search fails<br>**Note:** Actual value used will be a multiple of 30 seconds, for example: 30, 60, 90...<br>Used as overrides for both TP and Push-to-FixII. |
| MPM Time Out | 1 U | Micro Power Mode Time Out in seconds; range 0-255 |
| MPM Control | 1 U | Micro Power Mode Control.<br>0 = use 250 µs<br>1 = use 125 µs |
| Reserved | 2 | Reserved |
| Reserved | 2 | Reserved |
| TP RF On Time | 2 U | TricklePower RF On Time in ms; range 100-800 |
| Reserved | 2 | Reserved |
| Push-to-FixII User Options | 1 D | Refer to Table 109 for a list of user options field descriptions |
| Num Quad Byte Words | 1 U | Number of reserved Quad Words (4 byte field) that follow. |
| Reserved[Num Quad Byte Words] | 4 * Num Quad Byte Words | reserved |

**Table 108: MID 218,6 – Power Mode Request**

**Power Mode:**

The user can enable / disable Full Power Mode (FPM) by using this field. When Full Power Mode is selected, the sub-mode of TricklePower II can also be enabled / disabled by using the Power Feature List option. TP2 will only be active when FPM is also selected. Depending on the number of satellites providing measurements and the signal strength the unit will adapt to either FPM or TP2. When Low Power Mode is selected the Rate and Use Mask determine the Low Power sub-mode that is applied and how the Low power Mode is configured. The currently supported Low Power sub-modes are:

- Micro Power Mode (MPM)

- TricklePower
- Push-to-FixII

**Version:**

This field is currently set to version 0. The input version must match the SW version or else the message is rejected. If the message format changes, this field will be changed so the SW can validate that the correct message format is used.

**Rate:**

When Low Power Mode is selected the Rate determines the Low power Mode that is used. This is also the rate of the navigation solution interval. The Rate is in two fields an upper portion and a lower portion that is combined into the rate.

For TP, the unit will wake up at the rate select, enable the RF for the specified amount of On Time, make a set of measurements that are used to make a navigation solution and then go back to sleep.

For Push-to-FixII, the unit will wake up in Full Power similar to a Hot Start and make a navigation solution or timeout after the Search Time has been exceeded. The unit will then go back to sleep until the next interval is reached.

**Use Mask:**

When Bit 0 is set to zero, the default values for the corresponding Low power Mode is used. When Bit 0 is set to one, the defaults are over ridden by the values from the message. The default values can be overridden by setting the value for the Low Power sub mode in the corresponding message section for the Low power sub mode. The following are the default values for the corresponding Low Power sub modes.

- Default Values for TricklePower:
  - Max Search Time = 120 s
  - Max Off Time = 30 s
  - TP RF On Time = The RF On Time default values are based on the Rate that is entered in the message. The supported on times are 100 ms, 300 ms, 500 ms with a 1 Hz reporting rate
- Default values for Push-to-FixII:
  - Max Search Time = 120 s
  - Max Off Time = 30 s
  - Period = 1800 s
  - Push-to-FixII User Options = 0
  - Max Search Time

**Max (Satellite) Search Time:**

Default value is 120 s. When SiRFstar is unable to reacquire at the start of a cycle, this parameter determines how long it will try to reacquire for. After this time expires, the unit returns to sleep mode for the value set in the MAX_OFF_TIME field. Entering a value of 0 for this field makes max search time disabled and SiRFstar will attempt to reacquire continuously. When a value of 0 is entered for the MAX_SEARCH_TIME, the value entered in the MAX_OFF_TIME field is ignored. This field is only valid for TP and Push-to-FixII. The actual time value is resolved to increments of 30 seconds.

**Max Off Time:**

Maximum time for sleep mode between acquisition attempts. Default value is 30 s. When SiRFstar is unable to acquire satellites for a low power cycle, it returns to sleep mode for this period of time before it tries again. This field is only valid for TP and Push-to-FixII. Guidelines for balancing navigation update rate against search time are: with longer interval for update rate, the specified search time should also be increased. For example, when using data logging with 1 to 5 min off time, a six second search time will be suitable. If however, reporting interval is set to 2 hours, then the search time should be extended to 10 to 20 seconds to accommodate decrease in confidence of previous data such as time, position and calibrations. In both cases, the requirement to find ephemeris takes precedence. The actual time value is resolved to increments of 30 seconds.

**MPM Time Out:**

This field controls the start of MPM mode. It sets a limit on how many seconds SiRFstar will wait for all preconditions (e.g. collecting ephemeris, navigation completed and calibrating the clocks) to be met before entering MPM mode.

A time out value of 0 means that all preconditions must already be met when the message is received. If the preconditions are not met by the time out limit, SiRFstar will not enter MPM and will send a NAK message (MID 12) in response and will go to HIBERNATE with no wake up.

If all preconditions are met, SiRFstar will ACK the message before starting MPM cycling. This field contains the maximum time limit in seconds for MicroPower Mode preconditions to be met from the instant at which the MicroPower Mode enable message is received. The range of values for this field is 0 to 255.

**Note:**

Zero is the default value and indicates that if the preconditions are not met immediately, the system goes into permanent HIBERNATE with no subsequent self-timed wakeup, requiring a pulse to ON_OFF to re-awaken. If the value of the field is greater than zero, the system will either wait until preconditions are met (if this happens before the timeout expires) or until the time-out expires. If the preconditions are not met by the end of the timeout, the system enters into permanent HIBERNATE.

**MPM Control:**

Sets controls on MPM operation. A value of 0 sets RTC uncertainty limit of 250 µs for entering recovery mode (default value). A value of 1 sets the limit to 125 µs. When SiRFstar enters recovery mode, it will start a full-power maintenance cycle to re-calibrate the RTC frequency and phase. This field is valid only when MPM mode is selected.

**TP RF ON Time**

This is the amount of time, in 100 ms intervals for RF to be on to acquire and track the signal before creating a measurement. If The Use Mask for override is not set the RF On Time will be the default value for the Rate selected. The Rate selected is also the navigation update interval. This field is for TricklePower only.

Guidelines for choosing or setting values are as follows:

- 100 ms ON time gives worst position performance but best power consumption
- 300 ms ON time give the minimum reasonable trade off between accuracy and power consumption
- 500 ms ON time give a reasonable trade off between accuracy and power consumption.

**Push-to-FixII User Options:**

When this field is zero, all user options are off. Bit 0 controls modified update rate for higher velocities.
If bit 0 = 1, then velocities > 5 m/s cause the update rate to be modified as shown in Table 109.

| Preset stationary reporting Rate (seconds) | Reporting rate (in seconds) when speed exceeds threshold |
|---|---|
| 6 | 6 |
| 30 to 300 s | 30 s |
| >300 to 86400 | 60 s |

**Table 109: Push-to-FixII Rate Settings**

Bit 2 controls use of the Quality of Service filter:

- Bit 2 = 0 allows normal internal QoS checking of every update cycle, causing SiRFstar to remain on until the internal QoS limits are met.
- Bit 2 = 1 disables QoS checking so an update cycle will end when a Kalman filter solution is reached.

This field is for Push-to-FixII Only. QoS criteria are internal to SiRFstarV and are not user-settable.

## 4.86. Multi-constellation Set Full Power /TricklePowerII – MID 218,7

This message sets SiRFstar in to Full power mode or trickle power II mode. More information on Power mode definition is available in CS-233787-AN.

**Note:** for software versions 5.2 and later, we recommend that you use MID 218, 6 rather than this message.

Message sent in response/request for this message: None.

| Name | Byte(s) | Description |
|---|---|---|
| MID | 2 U | SIRF_MSG_SSB_PWR_MODE_FPM_REQ(0xDA, 0x07) |
| PwrFeatureList | 1 U | 0 = Full Power Mode<br>1 = Trickle Power II also known as Adaptive Continuous Tracking - ACT |

**Table 110: MID 218,0 – Set Full Power /TricklePowerII – MID 218,0**

## 4.87. CW Configuration Request – MID 220,1

The Multi-constellation CW Configuration message provides control (enable/disable) of constellation-specific hardware and software features of the CW Controller. In order to configure both GPS and GLONASS filters, send multiple copies of this message, one for each constellation.

By default, CW mitigation is enabled and works autonomously. It will detect and mitigate interference by the most appropriate filtering, and it will shut down to save power when no interference is detected.

Table 111 shows the fields of the Multi-constellation CW Configuration message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_CW_CONFIG (0xdc, 0x01) |
| CONFIGURATION_MODE | 1 U | Configuration modes:<br>`0x00`: GPS Enable scan, enable filtering<br>`0x01`: GPS Enable scan, use OFFT<br>`0x02`: GPS Enable scan, use 2 MHz<br>`0x03`: GPS Enable scan, no filter<br>`0x04`: GPS Disable scan, disable filtering<br><br>`0x05`: GLONASS Enable scan, enable cancelling<br>`0x06`: GLONASS Enable scan, disable cancelling<br>`0x07`: GLONASS Disable scan, disable cancelling<br><br>`0x80`: GPS force 2f0 sampling with 2 MHz filter.<br>`0x81`: GPS force 4x2f0 sampling with 2 MHz filter.<br>`0x82`: GPS force 8f0 sampling.<br>`0x83`: GPS force 2f0 sampling with 2 MHz filter + OFFT.<br>`0x84`: GPS force 4x2f0 sampling with 2 MHz filter+OFFT.<br>Modes 0x90-0x9a will only work if SiRFstar has first been put into Test Mode 9 by use of **MID 150**<br>`0x90`: TM9 GPS auto detect mode on (will output 1 8F0 IQ buffer upon detection)<br>`0x91`: TM9 GPS auto detect mode off<br>`0x92`: TM9 output 1 GPS 2F0 IQ buffer<br>`0x93`: TM9 output 10 GPS 2F0 IQ buffer<br>`0x94`: TM9 output 100 GPS 2F0 IQ buffer<br>`0x95`: TM9 output 1 GPS 8F0 IQ buffer |

| Name | Bytes | Description |
|---|---|---|
| | | 0x96: TM9 output 10 GPS 8F0 IQ buffer<br>0x97: TM9 output 100 GPS 8F0 IQ buffer<br><br>0x98: TM9 output 1 GLONASS 8F0 IQ buffer<br>0x99: TM9 output 10 GLONASS 8F0 IQ buffer<br>0x9A: TM9 output 100 GLONASS 8F0 IQ buffer<br><br>0xB0: Start GPS CW scan<br>0xB1: Start GLONASS CW scan<br><br>0xFE: Reserved<br>0xFF: GPS and GLONASS Disable scan, disable filtering. Use only complex 8f0. |

**Table 111: MID 220,1 – Multi-constellation CW Configuration Request**

SiRFstar responds to this message with an ACK/NACK/ERROR, **MID 75**.

The default settings are

0x0: GPS Enable scan, enable filtering

0x5: GLONASS Enable scan, enable cancelling (if GLONASS as a technology is successfully configured through OSP)

Output messages MID 92 will be produced unless both GPS and GLONASS scanning and filtering are disabled.

**Note:**

The **MID 150** Switch Operating Modes message always overrides these configuration settings. This CW configuration message is received and processed only if SiRFstar is in normal operating mode as defined in the Mode field of the **MID 150** message. The CW controller configuration settings are cleared ONLY through factory reset (**MID 128**) command, or complete loss of power).

## 4.88. Location Technology Constraints Request – MID 222, 16

The Location Technology Constraints Request sets the technologies to be used for location determination. If any of the technologies specified in this message have not been initialized in SiRFstar, it will reject this command. Table 112 shows the fields of the Location Technology Constraints Request message.

This message is supported in SiRFstarV and subsequent families of products.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_LOC_CONST_REQ (0x4E, 0x10) |
| reserved | 4 | Reserved, set to zero |
| LOCATION_TECHNOLOGY | 2 D | Set the following bits to enable technology to be activated<br>Bit 0: GPS enable<br>Bit 1: GLONASS enable<br>Bit 2: GALILEO enable<br>Bit 3: BDS enable<br>Bit 4: SBAS enabled if TRUE<br>Bit 5: QZSS enabled if TRUE<br>Bit [6:15]: Reserved |

| Field | Byte(s) | Description |
|---|---|---|
| | | **NOTE**:<br>Bit 1 (GLONASS) and Bit 3 (BDS or COMPASS?) must not be enabled at the same time. |
| LOCATION_TECH_EXT | 2 | Reserved, set to 0 |
| reserved | 3 | Reserved, set to 0 |
| NR_EXC | 1 U | Message extension count, which defines the length of potential future message extensions, currently the Value should be zero. |
| Future payload | 4 U * NR_EXC | Reserved |

**Table 112: MID 222, 16 – Location Technology Constraints Request**

The actual selection of a technology in the position calculation is determined both by the content of the LOCATION_TECHNOLOGY_field in this message, by the QoP, TTFF, power drain constraints and by the context states of SiRFstar. The LOCATION_TECHNOLOGY_field values can only enable the use of a specific technology. If the optimum technology configuration does not require the use of a specific technology, it will not be used even if enabled. If a technology selection bit is cleared, the use of the corresponding technology is disabled, even if the optimum technology configuration would require the use of it.

## 4.89. Location Technology Usage Status Request – MID 222,17

The Location Technology Usage Status Request message requests a report of what actual technologies were used in producing a specific position response message. In response to this message SiRFstar will send MID 78, 17, the Location Technology Usage Status Response message.

Table 113 shows the fields of the Location Technology Usage Status Request message.

| Name | Byte(s) | Description |
|---|---|---|
| MID | 2 U | SIRF_MSG_SSB_LOC_TECH_USAGE_REQ (0xDE 0x11) |
| POS_REQ_ID | 1 U | identifies the position request message |
| MEAS_GPS_WEEK | 2 U | week stamp of the position response message |
| MEAS_GPS_SECONDS | 4 U | time stamp of the position response message |

**Table 113: MID 222,17 – Location Technology Usage Status Request**

MEAS_GPS_WEEK and MEAS_GPS_SECONDS, if specified, will be copies of these field values in the received regular position response message. If they are zero and not used, then all position response messages with the specified POS_REQ_ID will be accompanied by a corresponding Location Technology Usage Status Response.

## 4.90. Data Log Compatibility Record – MID 225,32

This message is data read from the data log store of Record Type 0. It is on its own sub-address to maintain compatibility with previous data logging implementations. The message is a subset of fields from Message ID 41 and uses the same units, precision, and ranges for all values. Requesting this message while the data logger is active will stop data logging before output begins. No other messages are output while retrieving logged data. The output will consist of repeated copies of this message, each with one of the stored records, until all stored log records have been output. Following the last log record output message, one **MID 225,33** Data Log Terminator message will be output.

Note: This message is supported starting at version 4.1.2.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_DL_COMPAT_REC_OUT (0xE1, 0x20) |
| Latitude | 4 S | degree x 107 ±90 (signed value, + = North), |
| Longitude | 4 S | degree x 107 ±180 (signed value, + = East), |
| Altitude | 4 S | meter x 102 – Altitude from mean sea level; Range: -32767 to +32767 meters<br>(-32768 implies that the altitude is not known) |
| UTC Year | 2 U | Coordinated Universal Time Year |
| UTC Month | 1 U | Coordinated Universal Time Month |
| UTC Day | 1 U | COORDINATED UNIVERSAL TIME Day |
| UTC Hour | 1 U | COORDINATED UNIVERSAL TIME Hour |
| UTC Min | 1 U | Coordinated Universal Time Minute |
| UTC Sec | 2 U | Integer ms |
| SV Count | 1 U | Count of SVs in fix |
| HDOP | 1 U | Horizontal Dilution of Precision |
| CRC-16 | 2 U | CRC-16 value of the record |

**Table 114: MID 225,32 – Data Log Compatibility Record**

## 4.91. Data Log Terminator – MID 225,33

This message indicates data log output is complete. It is output once after all valid data records have been read from the data log store and sent out. Once log output is complete, regular OSP messaging is resumed. There is no payload data in this message. In order to start data logging again, a new 'Start Log' command has to be issued.

| Field | Byte(s) | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_DL_OUT_TERM (0xE1, 0x21) |

**Table 115: MID 225,33 – Data Log Terminator**

## 4.92. GNSS Extended Ephemeris -Proprietary – MID 232,65

The GNSS Extended Ephemeris - Proprietary message sends extended ephemeris data to SiRFstar. Starting with GSD5 receivers, this message replaces MID 232, SID1 in order to support multiple GNSS constellations.

Table 116 shows the fields of the GNSS Extended Ephemeris - Proprietary message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_SEA_PROVIDE_EPH_EXT (0xE8, 0x41) |
| Ephemeris | 500 U | Ephemeris data - 500 bytes long (proprietary contents) |

**Table 116: MID 232,65 – Extended Ephemeris Extension - Proprietary Message Fields**

## 4.93. GNSS Poll Ephemeris Status – MID 232,66

The GNSS Poll Ephemeris Status message polls ephemeris status data by satellite IDs. In response to this message, SiRFstar sends MID 56,43.

Starting with GSD5 receivers, this message replaces MID 232,2 in order to support multiple GNSS constellations. Table 117 shows the fields of the GNSS Poll Ephemeris Status message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_POLL_STATE_EXT (0xE8, 0x42) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| WEEK_NO | 2 U | Week Number |
| SVID_MASK | 4 U | Bitmask for SV numbers |

**Table 117: MID 232,66 – GNSS Poll Ephemeris Status**

## 4.94. GNSS SIF Download File – MID 232,67

The GNSS SIF Download File Message is the request from SIF for an SGEE file. The EE Downloader will start downloading the SGEE packet after this request. Starting with GSD5 receivers, this message replaces MID 232, SID16 in order to support multiple GNSS constellations. Table 118 shows the fields of the GNSS SIF Download File message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_FILE_DOWNLOAD_EXT (0xE8, 0x43) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED1 | 4 | Reserved, set to zero. |
| RESERVED2 | 1 | Reserved, set to zero. |

**Table 118: MID 232,67 – GNSS SIF Download File**

## 4.95. GNSS SIF Start Download – MID 232,73

This message is sent from Host EE Downloader to SiRFstar to indicate that the host EE downloader is initiating the SGEE download procedure. Starting with GSD5 receivers, this message replaces MID 232,22 in order to support multiple GNSS constellations. Table 119 shows the fields of the GNSS SIF Start Download message.

On completion of the command a success/failure response is sent using MID 0x56,0x80.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_START_DLD_EXT (0xE8, 0x49) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED1 | 1 | Reserved, set to zero. |

| Name | Bytes | Description |
|---|---|---|
| RESERVED2 | 1 | Reserved, set to zero. |

**Table 119: MID 232,73 –GNSS SIF Start Download**

## 4.96. GNSS SGEE Download File Size – MID 232,74

The GNSS SGEE Download File Size message is sent from Host EE Downloader to SiRFstar to report the size of the SGEE file to be downloaded. Starting with GSD5 receivers, this message replaces **MID 232,23** in order to support multiple GNSS constellations. Table 120 shows the fields of the GNSS SGEE Download File Size message.

Success/failure response upon completion of the command: **MID 56,80**.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_EE_FILE_SIZE_EXT (0xE8, 0x4A) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| FILE_LENGTH | 4 U | Size of the SGEE File in bytes to be downloaded |
| RESERVED | 1 | Reserved, set to zero. |

**Table 120: MID 232,74 – GNSS SGEE File Size**

## 4.97. GNSS SIF Packet Data – MID 232,75

The GNSS SIF Packet Data message sends the SGEE data from host downloader to the GPS Receiver to be processed by SIF modules and saved in NVM. Starting with GSD5 receivers, this message replaces MID 232,24 in order to support multiple GNSS constellations. Table 121 shows the fields of the GNSS SIF Packet Data message.

On completion of the command a success/failure response is returned in a message with MID = 0x56,= 0x80

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_PKT_DATA_EXT (0xE8, 0x4B) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| PACKET_SEQ_NO | 2 U | Packet Sequence number of the current packet Starting from 1 |
| PACKET_LENGTH | 2 U | Length of the SGEE data in current packet (maximum 400) |
| PACKET_DATA | 1 U * PACKET_LENGTH | SGEE Data |
| RESERVED | 1 | Reserved, set to zero. |

**Table 121: MID 232,75 – GNSS SIF Packet Data Message Fields**

## 4.98. GNSS Get EE Age – MID 232,76

The GNSS Get EE Age message is sent to the GNSS Receiver to get the age of extended ephemeris stored there. Starting with GSD5 receivers, this message replaces **MID 232,25** in order to support multiple GNSS constellations. Table 122 shows the fields of the GNSS Get EE Age message.

Successful response on completion of the command is acknowledged with SSB MID 56,0x51 plus EE Age of the satellite(s). Failed response on completion of the command is acknowledged with Nack using Command Negative Acknowledgement **MID 56,80**.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_GET_EE_AGE_EXT (0xE8, 0x4C) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| NUM_SATS | 1 U | Number of satellites for which EE age is requested |
| GNSS Age information | [32] | See Table 123 for details |
| RESERVED | 1 | Reserved |

**Table 122: MID 232,76 – GNSS Get EE Age**

| Name | Bytes | Description |
|---|---|---|
| prnNum | 1 U | PRN number of satellite for which age is indicated in other fields. |
| ephPosFlag | 1 U | Ephemeris flag to indicate the type of ephemeris available for the satellite:(Position Age)<br>0: Invalid ephemeris, not available<br>1: BE<br>2: SGEE<br>3: CGEE |
| eePosAge | 2 U | Age of EE in 0.01 days (Position Age) |
| cgeePosGPSWeek | 2 U | GPS week of BE used in the CGEE generation;<br>Valid if ephPosFlag is set to 3 |
| cgeePosTOE | 2 U | TOE of BE used in the CGEE generation;<br>Valid if ephPosFlag is set to 3 |
| ephClkFlag | 1 U | Ephemeris flag to indicate the type of ephemeris available for the satellite (Clock Age)<br>0: Invalid ephemeris, not available,<br>1: BE<br>2: SGEE<br>3: CGEE |
| eeClkAge | 2 U | Age of EE in 0.01 days(Clock Age) |
| cgeeClkGPSWeek | 2 U | GPS week of BE used in the CGEE generation;<br>Valid if ephPosFlag is set to 3 |
| cgeeClkTOE | 2 U | TOE of BE used in the CGEE generation;<br>Valid if ephPosFlag is set to 3 |

**Table 123: GNSS Age Information**

## 4.99. GNSS Get SGEE Age – MID 232,77

The GNSS Get SGEE Age message is sent to the GPS Receiver to get the age of SGEE stored in GPS Receiver.

Starting with GSD5 receivers, this message replaces MID 232,26 in order to support multiple GNSS constellations.

A successful response on completion of the command is acknowledged using Command Acknowledgement MID 56,0x52 plus SGEE Age of the satellite(s).

A failed response on completion of the command is acknowledged using a Reject message: using Command Negative Acknowledgement, MID 56,80.

Table 124 shows the fields of the GNSS Get SGEE Age message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_GET_SGEE_AGE_EXT (0xE8, 0x4D) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Sat ID | 1 U | Satellite ID for which SGEE Age is requested<br>For GPS, this is PRN, range 1-32<br>For GLONASS this is slot number, range 1-24 |
| RESERVED | 1 | Reserved, set to zero. |

**Table 124: MID 232,77 – GNSS Get SGEE Age**

## 4.100. GNSS Host Storage File Content Response – MID 232,78

The GNSS Host Storage File Content Response message is sent to the GNSS Receiver in response to GNSS SIF Request File Content Request (**MID 56,86**). Table 125 shows the fields of the GNSS Host Storage File Content message.

Starting with GSD5 receivers, this message replaces **MID 232,27** to enable support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_HOST_RCV_PKT_DATA_EXT (0xE8, 0x0E) |
| `nav_system` | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| `seqNum` | 2 U | Sequence number of message |
| `NVMID` | 1 U | Storage area where data was stored<br>01 = GPS SGEE<br>02 = GPS CGEE<br>03 = GPS BE<br>05 = GPS Header<br>06 = GLONASS SGEE<br>07 = GLONASS CGEE<br>08 = GLONASS BE<br>10 = GLONASS Header |

| Name | Bytes | Description |
|---|---|---|
| numBlocks | 1 U | Number of blocks of data in message. |
| size | 2 U [32] | Size of each block |
| offset | 4 U [32] | Offset of each block in given storage file |
| pktData | 1 U [400] | File Content |
| reserved | 1 | Reserved |

**Table 125: MID 232,78 – GNSS Host Storage File Content Response**

## 4.101. GNSS SIF Host Ack/Nack – MID 232,79

The GNSS SIF Host Ack/Nack is the response message to Output **MID 56,83** or **MID 56,84**. Table 126 shows the fields of the GNSS SIF Host Ack/Nack message.

Starting with GSD5 receivers, this message replaces MID 232,28 in order to support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_HOST_ACK_NACK_EXT (0xE8, 0x4F) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Ack Msg Id | 1 U | Message ID of message being acknowledged |
| Ack Sub Id | 1 U | Sub ID of message being acknowledged |
| Ack/Nack | 1 U | 0 = Ack<br>1 = Nack |
| Ack Nack Reason | 1 U | Enumeration<br>0 = Success<br>1 = Insufficient space available<br>2 = Invalid packet length<br>3 = Received packet out of sequence<br>4 = SGEE Download file not found<br>5 = Corrupt download File<br>6 = Generic download failure<br>7 = Generic API failure<br>8 = SIF aiding is in progress<br>9 = SIF has not started |
| RESERVED | 1 | Reserved, set to zero. |

**Table 126: MID 232,79 – GNSS SIF Host Ack/Nack**

## 4.102. GNSS SIF Get NVM Header – MID 232,80

The GNSS SIF Get NVM Header message requests SiRFstar to send EE data file header information to the host. Table 127 shows the fields of the GNSS SIF Get NVM Header message.

Starting with GSD5 receivers, this message replaces MID 232,29 in order to support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_GET_NVM_HEADER_EXT (0xE8, 0x50) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED1 | 1 | Reserved, set to zero. |
| RESERVED2 | 1 | Reserved, set to zero. |

**Table 127: MID 232,80 – GNSS SIF Get NVM Header**

## 4.103. GNSS Fetch EE Header Response – MID 232,81

The GNSS Fetch EE Header Response message responds to the GNSS Fetch EE Header Request (MID 56,88). It delivers the EE header content received from the host to SiRFstar. The EE Header can be sent in packets of the max length size permissible. Table 128 shows the fields of the GNSS Fetch EE Header Response message.

Starting with GSD5 receivers, this message replaces MID 232,30 in order to support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_UPDATE_NVM_HEADER_EXT (0xE8, 0x51) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Sequence Number | 2 U | Packet Sequence Number |
| Size | 2 U | Data size |
| Offset | 4 U | Data Offset from start of header file |
| Packet Data | 1 U * Size | Contains the EE Header information – maximum 400 bytes |

**Table 128: MID 232,81 – GNSS Fetch EE Header Response**

## 4.104. GNSS Disable SIF Aiding – MID 232,83

The GNSS Disable SIF Aiding Message is used to enable and disable SGEE and CGEE SIF Aiding. Table 129 shows the fields of the GNSS Disable SIF Aiding message.

Starting with GSD5 receivers, this message replaces MID 232,32 in order to support multiple GNSS constellations.

**Note:**

Disabling CGEE aiding does not disable CGEE prediction.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_DISABLE_AIDING_EXT (0xE8, 0x53) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |

| Name | Bytes | Description |
|---|---|---|
| Disable SGEE | 1 U | Command:<br>0: Enable<br>1: Disable<br>Any other value is ignored. |
| Disable CGEE | 1 U | Command:<br>0: Enable<br>1: Disable<br>Any other value is ignored. |
| RESERVED | 1 | Reserved, set to zero. |

**Table 129: MID 232,83 – GNSS Disable SIF Aiding**

## 4.105. GNSS Get SIF Aiding Status – MID 232,84

The GNSS Get SIF Aiding Status message retrieves the SIF Aiding status.

Starting with GSD5 receivers, this message replaces MID 232,33 in order to support multiple GNSS constellations.

Table 130 shows the fields of the GNSS Get SIF Aiding Status message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_GET_AIDING_STATUS_EXT (0xE8, 0x54) |
| NAV_SYSTEM | 1 U | System Enabled when set to 1<br>Bit 0: GPS<br>Bit 1: GLONASS<br>Bits 2-31: Reserved |
| Reserved | 1 U | Reserved, set to zero. |

**Table 130: MID 232,84 – GNSS Get SIF Aiding Status**

## 4.106. GNSS SIF Set Configuration – MID 232,85

The GNSS SIF Set Configuration Message is used to tell SiRFstar how to use extended ephemeris. It specifies what type(s) of data to use, where to store it, and for which GNSS constellations as well as the length of the data. Table 131 shows the fields of the GNSS SIF Set Configuration message.

Starting with GSD5 receivers, this message replaces MID 232,252 in order to support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_SET_CONFIG_EXT (0xE8,0x55) |
| NAV_SYSTEM_MASK | 4 U | 0x0001 = GPS_ENABLE<br>0x0002 = GLONASS_ENABLE<br>0x0003 = GPS_GLONASS_ENABLE |
| GNSS SIF Set Configuration Message Content | [2] | See Table 132 for details. |
| Reserved | 1 U | Reserved, set to zero. |

**Table 131: MID 232,85 – GNSS SIF Set Configuration**

| Name | Bytes | Description |
|---|---|---|
| OperationMode | 1 U | SIF Operation Mode<br>0: MIXED mode (Default)<br>1: SGEE mode<br>2: CGEE mode |
| FileFormat | 1 U | When used with SS4:SIF storage file format -<br>0: FF4 Storage : Default<br>1: FF1 Storage<br>2: FF3 Storage |
| ExtGpsTimeSource | 1 U | Input GPS Time from external source or from SSB Msg7, this is used when input CGEE method is SubFrame Data<br>Note: NOT used with SiRFStarV.<br>0: GPS Time Source Available. (Default: using SSB Msg7 to get GPS Time )<br>1: No Other GPS Time Source Available |
| CgeeInputMethod | 1 U | Input method for CGEE generation-<br>0: Sub frame data (Default)<br>1: BE and Ionosphere data<br>2: Both Subframe and BE/IONO data |
| SgeeInputMethod | 1 U | Input method for SGEE Data:<br>0: SGEE File retrieval using Built-in SiRFNav Scheduler, SGEE thread will be used by SiRFNav. (Default)<br>1: SGEE File retrieval using External SGEE File Downloader application, it may be built-in with Navigation APP and SIF SGEE thread can be used by APP. |
| SgeeMaxDays | 1 U | Maximum SGEE days to be supported<br>Default: 0, SGEE Max days will be initialized to Maximum supported SGEE Days. |
| CgeeMaxdays | 1 U | Maximum CGEE days to be supported;<br>CGEE Max days will be initialized to maximum supported 3 Days. |

**Table 132: GNSS SIF Set Configuration Message Content**

## 4.107. GNSS EE Storage Control Input – MID 232,86

The GNSS EE Storage Control Input message determines where to store extended ephemeris. The scope of this message and the rules of overriding other settings of these values that may have already earlier been stored are described in Section 7.18 of the OSP ICD. Table 133 shows the fields of the GNSS EE Storage Control Input message.

Starting with GSD5 receivers, this message replaces MID 232,253 in order to support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_STORAGE_CONTROL_EXT (0xE8,0x56 ) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| EE Storage Control | 1 U | Bits [3:0] storage type (see note 1)<br>--00 = storage available on host (default)<br>--01 = I2C EEPROM provided for 5xp access |

| Name | Bytes | Description |
|---|---|---|
| | | --10 = store to the flash<br>--11 = no storage<br>Bits [7:4] internal or external storage<br>00-- = internal storage<br>01-- = external storage |
| RESERVED | 1 | Reserved, set to zero. |

**Table 133: MID 232,86 – GNSS EE Storage Control Input**

**Note:**

(1) When storage type is flash (0010), ROM-based receivers will use SPI flash if it is detected, while flash-based receivers will use available sectors of parallel flash.

## 4.108. GNSS Disable CGEE Prediction – MID 232,87

The GNSS Disable CGEE Prediction message is sent to the GNSS Receiver to disable CGEE prediction after a specified number of seconds. Ack/Nack is received indicating success/failure. Table 134 shows the fields of the GNSS Disable CGEE Prediction message.

Starting with GSD5 receivers, this message replaces MID 232,254 in order to support multiple GNSS constellations.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_EE_DISABLE_EE_SECS_EXT (0xE8, 0x57) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Time | 4 U | Number of seconds to wait before disabling CGEE generation.<br>`0x00000000` = Immediately disable<br>`0xFFFFFFFF` = Permanently enable<br>Any other number = Disable prediction after given number of seconds |
| RESERVED | 1 | Reserved, set to zero. |

**Table 134: MID 232,87 – GNSS Disable CGEE Prediction**

## 4.109. GNSS SIF Process Request – MID 232, 89

The GNSS SIF Process Request Message is used to send an asynchronous request. This is indication to SIF to start a specific operation for example clear EE data, update NVM.

Table 135 shows the fields of the GNSS SIF Process Request message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_PROCESS_REQ (0xE8, 0x59) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| Request Type | 4 U | Type:<br>0x00: all<br>0x01: storage |

| Name | Bytes | Description |
|---|---|---|
| | | 0x02: 100ms alarm<br>0x03: NVM update<br>0x04: BE post<br>0x05: Clear EE<br>0x06: SIF_STATUS<br>0x07: RUN_TASK<br>0x08: Flash Init |
| RESERVED1 | 1 | Reserved, set to zero. |
| DATA_LENGTH | 1 U | If request type = 0x08, this field specifies data length, otherwise Reserved |
| SECTOR_SIZE | 4 U | If Request Type = 0x08, this field specifies sector size in bytes, otherwise Reserved |
| Data[DATA_LENGTH] | 1 U [DATA_LENGTH] | Actual payload/data. DATA_LENGTH bytes long, up to a maximum of 256 bytes |

**Table 135: MID 232, 89 – GNSS SIF Process Request**

## 4.110. GNSS SIF Set Start – MID 232,90

The GNSS SIF Set Start message tells SiRFstar to begin using extended ephemeris as configured by a preceding GNSS SIF Set Configuration (MID 232,85) message.

Table 136 shows the fields of the GNSS SIF Set Start message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_SET_START (0xE8, 0x5A) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED | 1 | Reserved |

**Table 136: MID 232,90 – GNSS SIF Set Start**

## 4.111. GNSS SIF Set Stop – MID 232,91

The GNSS SIF Set Stop message stops the SIF operations. To resume again SIF Set Start MID 232,90 should be used. Table 137 shows the fields of the GNSS SIF Set Stop message.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SIF_SET_STOP (0xE8, 0x5b) |
| NAV_SYSTEM | 1 U | Navigation System<br>0x00 = GPS<br>0x01 = GLONASS |
| RESERVED | 1 | Reserved |

**Table 137: MID 232,91 – GNSS SIF Set Stop**

## 4.112. Sensor Axis Orientation Matrix Message – MID 234,4

The Sensor Axis Orientation Matrix message sets sensor orientation transformation matrix parameters. The sensor orientation is relative to the device frame as a common sensor frame and it follows the right hand coordinate system. Table 138 shows the fields of the Sensor Axis Orientation Matrix message.

This message is supported starting with the SiRFstarV product family.

| Name | Bytes | Description |
|---|---|---|
| MID, SID | 2 U | SIRF_MSG_SSB_SENSOR_ORIENTATION (0xEA , 0x04) |
| NUM_OF _SENSOR | 1 U | Number of sensors used, range 1 - 5. |
| NUM_OF _AXIS | 1 U | Number of maximum axis from 1 to 3. This parameter will be equal to the MAX number of axis that any sensor can have among all the MEMS described in this message. For example, if there is one sensor of 3 axes and two sensors of 1 axis, then the value of this parameter is 3. Sensors having less axes then this parameter value will have the rest of their axis parameters set to zero. Range 1 - 3 |
| TYPE_OF _MATRIX | 1 U | If 0x01: the values in the Sensor Axis parameters below will be considered as just a notification.<br>For example {-2, 1, 3}<br>Where: 1 =x axis, 2 =y axis, 3=z axis.<br>If 0x02: Here the parameter (x, y, z) actually represent (roll, pitch, yaw) or {ϕ, θ, ψ } . These readings are in degrees but with a scale factor as defined in the next parameter. For a precision point of view, we can convert them to a decimal with a scale factor for example 100.<br>These degree values will be used once to calculate the matrix coefficient for sensor orientation. Range 1 - 2 |
| SCALE _FACTOR | 1 U | Scale factor in the case where type of matrix is 2. Range 1 - 255 |

**Table 138: MID 234,4 – Sensor Axis Orientation Matrix Setting**

# Appendix A Satellite ID Mapping

Several messages have a field for Satellite Identification. The value in that field indicates the specific satellite being reported. Values are to be interpreted according to the following table.

| Value | Constellation | Description |
|---|---|---|
| 0 | None | Indicates no report, contents of any associated data structure are invalid |
| 1-32 | GPS | Satellite PRN code |
| 33-37 | GPS | Pseudolite PRN code |
| 38-64 | BDS IDSO/MEO (for PRNs 11 to 37) | PRN + 27 |
| 65-88 | GLONASS | Channel (-7 to +6) + 77 |
| 120-138 | GPS SBAS | SBAS PRN code |
| 150-154 | BDS GEO (PRNs 1-5) | Satellite PRN + 149 |
| 155-159 | BDS IGSO/MEO (PRNs 6-10) | PRN + 149 |
| 173-182 | QZSS IMES | Satellite PRN code |
| 183-187 | QZSS SAIF (high-accuracy) | Satellite PRN code |
| 193-202 | QZSS LEX | Satellite PRN code |
| 205-254 | Galileo – Pilot channel E1C | Satellite PRN + 204 |

# Document References

| Document | Reference |
|---|---|
| GLONASS Interface Control Document | http://www.spacecorp.ru |
| One Socket Protocol Interface Control Document (OSP ICD) | CS-129291-DC |
| GSD4e CCK User Guide | CS-206097-UG |
| GSD4e SDK User Guide | CS-210291-UG |
| I/O Pin Configuration Application Note | CS-231404-AN |
| SiRFstarV CCK | CS-230940-DC |
| SiRFstarV 5xp, 5e, 5ea SDK | TBD |

# Terms and Definitions

| Term | Definition |
|---|---|
| 3GPP | GSM cellular protocol standard body |
| ABP | Almanac Based Position |
| Ack | Acknowledge - used to indicate successful reception of data. |
| ACQCLK | Acquisition clock. Used directly in SiRFstar receivers for GNSS acquisition |
| ADCCLK | A to D Convertor clock used to sample the RF. |
| ACT | Adaptive Continuous Tracking (TricklePowerII) |
| API | Application Programming Interface |
| APP | Application |
| A-GNSS | Assisted GNSS |
| BBRAM | Battery Backed up RAM |
| BE | Broadcast Ephemeris |
| CCK | Customer Configuration Kit |
| CGEE | Client Generated Extended Ephemeris |
| CTS | Clear To Send |
| CW | Continuous Wave |
| $C/N_o$ | Carrier to Noise Density Ratio in dB-Hz |
| D | Discrete - field is a bitmapped value, where individual bits or groups of bits within the field have different meanings. |
| DOP | Dilution of Precision |
| DR | Dead Reckoning |
| ECLM | Extended/Enhanced/embedded Client Location Manager (Host agent for processing extended ephemeris) Note this term has now been replaced with SIF |
| EE | Extended Ephemeris |
| EGNOS | European Geostationary Navigation Overlay Service |
| EOTD | Enhanced Observed Time Difference - standard for location of cellular phones |
| FFA | Fine Frequency Aiding |
| FTA | Fine Time Aiding |
| f0 | GPS chip rate (1.023 MHz) |
| GAGAN | GPS Aided Geo Augmented Navigation |

| Term | Definition |
|---|---|
| GANSS | Galileo and Additional Navigation Satellite Systems |
| GEO | Geostationary Earth Orbit |
| GSD4e | Product name for SiRFstarIVe |
| GSD4t | Product name for SiRFstarIVt |
| GLONASS | ГЛОбальная НАвигационная Спутниковая Система (GLObal'naya NAvigatsionnaya Sputnikovaya Sistema) |
| GLONASS System Time | Native GLONASS time at the UE inferred from the received GLONASS satellite data |
| GNSS | Global Navigation Satellite System |
| GPIO | General Purpose Input/Output |
| GPS | Global Positioning System (see IS-GPS-200E). |
| GPS System Time | The time at the UE inferred either from the received GPS satellite data or from the received GLONASS satellite data indicating equivalent GPS system time |
| GPS Time | Same as GPS System Time |
| ICD | Interface Control Document |
| ID | IDentifier |
| IGSO | Inclined Geosynchronous Satellite Orbit |
| IMES | Indoor MESsaging |
| IONO | Ionospheric model (for use with Broadcast Ephemeris data) |
| IQ | In-phase Quadrature |
| I/O | Input/Output |
| $I^2C$ | Inter-Integrated Circuit, a two wire serial interface |
| FCN | Frequency Channel Number – where the GLONASS SV operates |
| KA | Keep Alive |
| KF | Kalman Filter |
| LEX | Very-high-accuracy (< 1 cm) signal |
| LNA | Low Noise Amplifier |
| LP | Low Power |
| lsb | least significant bit |
| LSB | Least Significant Byte |

| Term | Definition |
|---|---|
| MEI | MEI – Measurement Engine Interface (interface between Tracker and Host / Navigator software) |
| MEO | Medium Earth Orbit |
| MI | MI – Module Interface (software module that serves as an interface between user requests and functional modules; MI functions are called to get data for OSP messages) |
| MID | Message Identifier |
| MSAS | Multi-functional Satellite Augmentation System |
| MSB | Most Significant Bit |
| Nack | Negative Acknowledge - used to indicate a problem with reception as an alternative to Ack |
| NVM | Non-Volatile Memory (storage which retains contents through a power cycle). |
| MEMS | Micro-Electro-Mechanical Systems |
| NPN BJT | Bipolar junction transistor having a layer of P (positive) doped semiconductor between two N (negative) doped layers |
| OFFT | Offset Fast Fourier Transform |
| OSP | One Socket Protocol |
| PA | Position Accelerated (Ephemeris data format) |
| PE-90 | Parameters of the Earth 1990, Ellipsoid used by GLONASS satellites |
| PRN number | Pseudo Random Noise number (as Satellite ID) |
| Pseudolite | Contraction of the term "pseudo-satellite." It used to refer to something that is not a satellite which performs a function commonly in the domain of satellites. Pseudolites are most often small transceivers that are used to create a local, ground-based GPS alternative. |
| PTAT | Proportional to Absolute Temperature |
| QoP | Quality of Position |
| QoS | Quality of Service |
| QZSS | Quasi-Zenith Satellite System |
| RAM | Random Access Memory |
| ROM | Read Only Memory |
| RRLP | Radio Resource LCS (Location services) Protocol |
| RTC | Real Time Clock OR Reference Temperature Control |
| RTS | Ready To Send |
| S | “Signed” integer field data type |
| SAIF | High-accuracy (<1 m) signal |

| Term | Definition |
|---|---|
| SBAS | Satellite Based Augmentation System |
| SGEE | Server Generated Extended Ephemeris |
| SI Diode | Silicon Diode |
| SID | Sub-identifier |
| SIF | SiRFInstantFix (Note this term replaces ECLM in older versions). |
| SPI | Serial Peripheral Interface |
| SSB | Sirf Standard Binary (old protocol; superseded by OSP) |
| SSIVe | SiRFstarIV engine |
| SSIVt | SiRFstarIV tracker |
| SV | Space Vehicle |
| SVID | Space Vehicle IDentifier |
| TCXO | Temperature Controlled Crystal Oscillator |
| TOE | Time of Ephemeris |
| TOW | GPS Time Of Week of measurement when signal was transmitted |
| TTFF | Time To First Fix |
| U | “Unsigned” integer field data type |
| UART | Universal Asynchronous Receiver/Transmitter |
| UE | User Equipment |
| UTC | Co-ordinated Universal Time, derived from an atomic clock and approximating UT1 |
| UT1 | Universal Time derived from stellar observations |
| WAAS | Wide Area Augmentation System |
| XO | Crystal Oscillator |