# SiRFstar®

## One Socket Protocol Interface Control Document

Issue 15

# Document History

| Revision | Date | Change Reason |
|---|---|---|
| 1 | 29 JUL 09 | Original publication of this document. |
| 2 | 25 SEP 09 | Updated issue, to include *SiRF Binary Protocol Reference Manual*. |
| 3 | 21 MAY 10 | Not issued. |
| 4 | 25 MAY 10 | Added and updated technical content for MIDs 10, 11, 12, 19, 41, 46, 56, 70, 72, 77, 93, 128, 136, 178, 210, 212, 215, 218, 225, 232, 234.<br>Restructured document to organise SSB and OSP messages into common Input and Output sections and formats. |
| 5 | 18 JUN 10 | Added and updated technical content for MIDs 72, 210.<br>Editorial updates. |
| 6 | 02 JUL 10 | Added and updated technical content for MIDs 41, 128, 232. |
| 7 | 08 JUL 10 | Added and updated technical content for MIDs 41, 133. |
| 8 | 13 JUL 10 | Added Build Number table to Section 1. |
| 9 | 21 DEC 10 | Updated technical content for MIDs 6, 19, 30, 45, 53, 56, 69, 72, 73, 81, 93, 128, 132, 136, 140, 150, 166, 178, 205, 209, 210, 211, 217, 218, 232, 234.<br>Removed Message Processing Procedures, Message Flow, Typical Low Power Operation. |
| 10 | 04 NOV 11 | Updated technical content for MIDs 7, 19, 30, 41, 63, 72, 136, 150, 178, 218.<br>Editorial updates. |
| 11 | 13 DEC 11 | Updated technical content for MIDs: 19, 30, 41, 63, 72, 90, 136, 150, 178, 218.<br>Editorial updates. |
| 12 | 12 JAN 12 | Updated technical content for MIDs: 41, 56, 63, 72, 91, 93, 128, 136, 177, 178, 225, 232, 234.<br>Editorial updates. |
| 13 | 30 JAN 12 | Editorial and content updates. |
| 14 | 28 MAR 13 | Editorial updates. Section 1 content updates.<br>If you have any comments about this document, send an email to comments@csr.com, giving the document number, title and section with your feedback. |
| 15 | 15 APR 13 | Errata updates: Errata registered against Issue 13 applied to Issue 14. |

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[1] Data field size is variable, up to a maximum of 500 bytes. Size can be determined by using message length minus 2.

# 1 Overview

This document defines the One Socket Protocol (OSP) customer-facing messages and the binary interface protocol for all SiRFstar® products.

Note:

This document does not include messages reserved for internal CSR use or for future use.

Table 1.1 lists the applicable Issue number of this document and software versions.

| Document Issue Number | GSD4t | GSD4e | CSR05t | CSR05e, CSR05ea and CSR05xp |
|---|---|---|---|---|
| 2 | 4.0.0 | 4.0.0 | - | - |
| 4 | 4.0.1 | 4.0.1 | - | - |
| 8 | 4.0.2 | 4.0.2 | - | - |
| 9 | 4.1.0 | 4.1.0 | - | - |
| 11 | 4.1.0 | 4.1.0[(1)] | - | - |
| 13 | 4.1.2 | 4.1.2 | - | - |
| 14 | 4.1.2 | 4.1.2 | 5.3.1[(2)] | ROM: 5.5.2; Flash: 5.6.1[(2)] [(3)] |

**Table 1.1: OSP ICD and OSP Software Versions.**

(1) Issue 11 describes additional operational details. See *Document History* for a list of updated messages.

(2) Issue 14 extended with *SiRFstarV™ OSP Multi-constellation Extensions Design Document*.

(3) Issue 14 extended with *SiRFstarV™ Engine Product OSP ICD Extensions Specification*.

Note:

Document issues are backwards compatible. They describe software versions up to and including the software listed for that issue.

# 2 References

| Number | Title | Reference |
|---|---|---|
| 1 | *Aiding Independent Interoperability Interface* | Rev 2.2, 2008-03-26 |
| 2 | *SiRFLoc Client Interface Control Document* | Rev 2.1, 2007-08-15 |
| 4 | *SiRFHost Programmer Reference Manual* | CS-129333-MA, Draft I, April 12, 2011 |
| 5 | *IO Pin Configuration Message* | CS-203047-SP, Issue 2, June 3, 2010 |
| 6 | *Power Management Modes Application Note* | CS-104545-AN |
| 7 | *SiRFstarV™ OSP Multi-constellation Extensions Design Document* | CS-225221-DD |
| 8 | *SiRFstarV™ Engine Product OSP ICD Extensions Specification* | CS-234842-DD |

# 3 Message Structure and Transport Mechanism

The transport layer of the protocol encapsulates a GPS message in two start-of-message characters and two end-of-message characters. The values are chosen to be easily identifiable and unlikely to occur frequently in the data. In addition, the transport layer prefixes the message with a 2-byte (15-bit) message length, and adds a 2-byte (15-bit) checksum before the two stop characters. The values of the start and stop characters and the choice of a 15-bit value for length and checksum ensure message length and checksum cannot alias with either the stop or start code.

## 3.1 Transport Message

| Start Sequence | Payload Length | PAYLOAD | Checksum of Payload | End Sequence |
|---|---|---|---|---|
| 0xA0, 0xA2 | 2 Bytes (15 bits) | Up to $(2^{11} - 1)$ Bytes | 2 Bytes (15 bits) | 0xB0, 0xB3 |

**Table 3.1: Generic Packet Format**

## 3.2 Payload Structure

The payload always starts with a 1-byte Message ID (MID) field. Depending on the MID value, a 1-byte Sub ID (SID) field may follow it. Subsequently, and again depending on the value of the MID field and the value of the SID field if it exists, a variable number of message parameter fields follow. This document describes the parameter fields as follows:

- The parameter field name
- Purpose of the value
- Length
- Type
- Units of measurement
- Value range
- Scale of the value of each field

Several messages have fields or bits described as `Reserved`. These provide space for future features. All such message spaces sent to a receiver should be set to 0. All such message spaces received from a receiver should be ignored. The reserved space should be used in computing the message checksum.

In this document, all values are sent as integers unless specifically designated as floating point or double floating point. Integer values may be scaled so that fractional values can be represented. When scaled, the scale factor will indicate the value the number has been multiplied by before encoding into the message. For example, if a value is indicated to have a scale of 100, a value of 345 in the message actually represents the value 3.45. Similarly a value of latitude might be indicated as "degrees x $10^7$", so that a value of 221234567 received in the message represents a latitude of 22.1234567°."

**Note:**

> Multi-byte values are transmitted MSB first unless noted in the message tables. However, there are exceptions for floating-point and double-precision values.

The sum of the length of all payload fields, including the MID and SID fields, is noted in the payload length field of the message header as a number of bytes, preceding the payload data. This number can not exceed $2^{11} - 1$, i.e. 2047.

# 4 OSP Message Mappings

## 4.1 Access to OSP Messages and Their Documentation

| | |
|---|---|
| OSP | New SiRFstarIV message first described in this volume, previously not supported in the SiRFstar III SSB. These messages are supported in products configured for assisted operation. |
| SSB | SSB message previously descibed in *SiRFBinary Protocol Reference Manual* as SiRFstarIII message. These are now included in this document. Some of the previous SSB messages have been enhanced, but all of them are backwards compatible. Previous applications using them should be able to execute on SiRFstarIV OSP products without any change. |
| SiRFNav Host Library Access Only | An OSP-SSB message that is currently described only in the SiRFNav Host Programmer's Reference Manual . CSR assumes that you will only invoke these OSP messages through the library functions. These messages are shown in Table 3.1, column labelled **1**. |
| Reserved for SDK Customer Use | The message is described in SDK documentation. These messages are shown in Table 3.1, column labelled **2**. |
| Reserved for CSR Use | A MID that has never been assigned to a CSR product, or is used only for internal CSR development purposes, or is obsolete but not reusable. Any SID of any MID in any of the above categories that has not yet been assigned in the documents listed above is reserved for CSR use. If such a reserved MID or SID is assigned to an OSP function, the resulting message definition is included in this document in the appropriate message description format. These messages are shown in Table 3.1, column labelled**3**. |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 0 | MID_LookInMessage | | | | | | | | X |
| 1 | MID_TrueNavigation | | | | | X | | | |
| 2 | MID_MeasuredNavigation | | | | | X | | | |
| 3 | MID_TrueTracker | | | | | X | | | |
| 4 | MID_MeasuredTracker | | | | | X | | | |
| 5 | MID_RawTrkData | | | | | X | | | |
| 6 | MID_SWVersion | | | | | X | | | |
| 7 | MID_ClockStatus | | | | | X | | | |
| 8 | MID_50BPS | | | | | X | | | |
| 9 | MID_ThrPut | | | | | X | | | |
| 10 | MID_Error | | | | | X | | | |
| 11 | MID_Ack | | | | | X | | | |
| 12 | MID_Nak | | | | | X | | | |
| 13 | MID_VisList | | | | | X | | | |
| 14 | MID_Almanac | | | | | X | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 15 | MID_Ephemeris | | | | | X | | | |
| 16 | MID_TestModeData | | | | | X | | | |
| 17 | MID_RawDGPS | | | | | X | | | |
| 18 | MID_OkToSend | | | | | X | | | |
| 19 | MID_RxMgrParams | | | | | X | | | |
| 20 | MID_TestModeData2 | | | | | X | | | |
| 21 | MID_NetAssistReq | | | | | | | | X |
| 22 | MID_StopOutput | | | | | | | | X |
| 23 | MID_CompactTracker | | | | | | | | X |
| 24 | MID_DRCritSave | | | | | | | | X |
| 25 | MID_DRStatus | | | | | | | | X |
| 26 | MID_DRHiRateNav | | | | | | | | X |
| 27 | MID_DGPSStatus | | | | | X | | | |
| 28 | MID_NL_MeasData | | | | | X | | | |
| 29 | MID_NL_DGPSData | | | | | X | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 30 | MID_NL_SVStateData | | | | | X | | | |
| 31 | MID_NL_InitData | | | | | X | | | |
| 32 | MID_MeasureData | | | | | | | | X |
| 33 | MID_NavData | | | | | | | | X |
| 34 | MID_SBASData | | | | | | | | X |
| 35 | MID_TrkComplete | | | | | | | | X |
| 36 | MID_TrkRollover | | | | | | | | X |
| 37 | MID_TrkInit | | | | | | | | X |
| 38 | MID_TrkCommand | | | | | | | | X |
| 39 | MID_TrkReset | | | | | | | | X |
| 40 | MID_TrkDownload | | | | | | | | X |
| 41 | MID_GeodNavState | | | | | X | | | |
| 42 | MID_TrkPPS | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 43 | MID_CMD_PARAM | 0x80 | 128 | SSB_QUEUE_CMD_NI | | X | | | |
| | | 0x85 | 133 | SSB_QUEUE_CMD_DGPS_SRC | | X | | | |
| | | 0x88 | 136 | SSB_QUEUE_CMD_SNM | | X | | | |
| | | 0x89 | 137 | SSB_AUEUE_CMD_SDM | | X | | | |
| | | 0x8A | 138 | SSB_QUEUE_CMD_SDGPSM | | X | | | |
| | | 0x8B | 139 | SSB_QUEUE_CMD_SEM | | X | | | |
| | | 0x8C | 140 | SSB_QUEUE_CMD_SPM | | X | | | |
| | | 0x8F | 143 | SSB_QUEUE_CMD_SSN | | X | | | |
| | | 0x97 | 151 | SSB_QUEUE_CMD_LP | | X | | | |
| | | 0xAA | 170 | SSB_QUEUE_CMD_SSBAS | | X | | | |
| 44 | MID_LLA | | | | | | | | X |
| 45 | MID_TrkADCOdoGPIO | | | | | X | | | |
| 46 | MID_TestModeData3 | | | | | X | | | |
| 47 | MID_NavComplete | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 48 | MID_DrOut | 0x01 | 1 | SID_DrNavStatus | | X | | | |
| | | 0x02 | 2 | SID_DrNavState | | X | | | |
| | | 0x03 | 3 | SID_NavSubsys | | X | | | |
| | | 0x04 | 4 | SID_RawDr | | X | | | |
| | | 0x05 | 5 | SID_DrValid | | X | | | |
| | | 0x06 | 6 | SID_GyrFactCal | | X | | | |
| | | 0x07 | 7 | SID_DrSensParam | | X | | | |
| | | 0x08 | 8 | SID_DrDataBlk | | X | | | |
| | | 0x09 | 9 | SID_GenericSensorParam | | X | | | |
| | | 0x0A | 10 | SID_GenericRawOutput | X | | | | |
| | | 0x50 | 80 | SID_MMFStatus | X | | | | |
| 49 | MID_OemOut | | | | | X | | | |
| 50 | MID_SbasParam | | | | | X | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 51 | MID_SiRFNavNotification | 0x01 | 1 | SID_GPS_SIRFNAV_COMPLETE | | | X | | |
| | | 0x02 | 2 | SID_GPS_SIRFNAV_TIMING | | | | | X |
| | | 0x03 | 3 | SID_GPS_DEMO_TIMING | | | | | X |
| | | 0x04 | 4 | SID_GPS_SIRFNAV_TIME_TAGS | | | X | | |
| | | 0x05 | 5 | SID_GPS_NAV_IS801_PSEUDORANGE_ DATA | | | | | X |
| | | 0x06 | 6 | GPS_TRACKER_LOADER_STATE | X | | | | |
| | | | 7 | SSB_SIRFNAV_START | | | | | X |
| | | | 8 | SSB_SIRFNAV_STOP | | | | | X |
| | | 0x09 | 9 | SSB_RESULT | | | | | X |
| | | 0x0A - 0x0F | 10 - 15 | | | | | | X |
| | | 0x10 | 16 | DEMO_TEST_STATUS | | | | | X |
| | | 0x11 | 17 | DEMO_TEST_STATE | | | | | X |
| | | 0x12 | 18 | DEMO_TEST_DATA | | | | | X |
| | | 0x13 | 19 | DEMO_TEST_STATS | | | | | X |
| | | 0x14 | 20 | DEMO_TEST_ERROR | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 52 | MID_PPS_Time | | | | | X | | | |
| 53 | | | | | | | | | X |
| 54 | SSB_EVENT | 0x01 | 1 | SSB_STARTUP_INFO | | | X | | |
| 55 | MID_TestModeTrackData | | | | | X | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 56 | SSB_EE | 0x01 | 1 | SSB_EE_GPS_TIME_INFO | | X | | | |
| | | 0x02 | 2 | SSB_EE_INTEGRITY | | X | | | |
| | | 0x03 | 3 | SSB_EE_STATE | | X | | | |
| | | 0x04 | 4 | SSB_EE_CLK_BIAS_ADJ | | X | | | |
| | | 0x05 | 5 | SSB_EE_X-CORR_FREE | | | | | X |
| | | 0x11 | 17 | SSB_EE_EPHEMERIS_AGE | | | X | | |
| | | 0x12 | 18 | | | | X | | |
| | | 0x20 | 32 | ECLM Ack/Nack | X | | | | |
| | | 0x21 | 33 | ECLM EE Age | X | | | | |
| | | 0x22 | 34 | ECLM SGEE Age | X | | | | |
| | | 0x23 | 35 | ECLM Download Initiate Request | X | | | | |
| | | 0x24 | 36 | ECLM Erase Storage File | X | | | | |
| | | 0x25 | 37 | ECLM Update File Content | X | | | | |
| | | 0x26 | 38 | ECLM Request File Content | X | | | | |
| | | 0x27 | 39 | ECLM BBRAM Header Data | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | SSB_EE (Cont.) | 0x2A | 42 | SIRF_MSG_SSB_SIF_STATUS | X | | | | |
| | | 0xFF | 255 | SSB_EE_ACK | | X | | | |
| 57 | MID_SYNEPHINT | | | | | | | | X |
| 58 | MID_GPIO_OUTPUT | 0x01 | 1 | SID_GPIOParam | | | | | X |
| | | 0x02 | 2 | SID_GPIOStatus | | | | | X |
| 59 | MID_BT_OUTPUT | | | | | | | | X |
| 60 | MID_AutoCorr | | | | | | | | X |
| 61 | MID_FAILURE_STATUS_RESPONSE | | | | | | | | X |
| 62 | MID_ExceptionInfo | | | | | | | | X |
| 63 | MID_TESTMODE_OUTPUT | 0x07 | 7 | SSB_TEST_MODE_DATA_7 | | X | | | |
| | | 0x08 | 8 | SIRF_MSG_SSB_TEST_MODE_DATA_8 | X | | | | |
| | | 0x09 | 9 | SIRF_MSG_SSB_TEST_MODE_DATA_9 | X | | | | |
| 64 | | 0x00 | 0 | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 64 | MID_NL_AuxData | 0x01 | 1 | NL_AUX_INIT_DATA | X | | | | |
| | | 0x02 | 2 | NL_AUX_MEAS_DATA | X | | | | |
| | | 0x03 | 3 | NL_AUX_AID_DATA | X | | | | |
| 65 | SSB_TRACKER_DATA _GPIO_STATE | 0xC0 | 192 | | | X | | | |
| 66 | SSB_DOP_VALUES | | | | X | | | | |
| 67 | | | | | | | | | X |
| 68 | MID_MEAS_ENG_OUT | | | | | | X | | |
| 69 | MID_POS_MEAS_RESP | 0x01 | 1 | POS_RESP | X | | | | |
| | | 0x02 | 2 | MEAS_RESP | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 70 | MID_STATUS_RESP | 0x01 | 1 | EPH_RESP | X | | | | |
| | | 0x02 | 2 | ALM_RESP | X | | | | |
| | | 0x03 | 3 | B_EPH_RESP | X | | | | |
| | | 0x04 | 4 | TIME_FREQ_APPROX_POS_RESP | X | | | | |
| | | 0x05 | 5 | CH_LOAD_RESP | X | | | | |
| | | 0x06 | 6 | CLIENT_STATUS_RESP | X | | | | |
| | | 0x07 | 7 | OSP_REV_RESP | X | | | | |
| | | 0x08 | 8 | SERIAL_SETTINGS_RESP | X | | | | |
| | | 0x09 | 9 | TX_BLANKING_RESP | X | | | | |
| 71 | MID_HW_CONFIG_REQ | | | | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 72 | MID_SensorData | 0x01 | 1 | SENSOR_READINGS | X | | | | |
| | | 0x02 | 2 | FACTORY_STORED_PARAMS | X | | | | |
| | | 0x03 | 3 | RECV_STATE | X | | | | |
| | | 0x04 | 4 | POINT_N_TELL_OUTPUT | X | | | | |
| | | 0x05 | 5 | SENSOR_CALIBRATION_PARAMS | X | | | | |
| | | 0x06 | 6 | SENSOR_MAG_MODEL_PARAMS | X | | | | |
| | | 0x07 | 7 | SENSOR_PEDESTRIAN_DR_INFO_MESSAGE | X | | | | |
| 73 | MID_AIDING_REQ | 0x01 | 1 | APPROX_MS_POS_REQ | X | | | | |
| | | 0x02 | 2 | TIME_TX_REQ | X | | | | |
| | | 0x03 | 3 | FREQ_TX_REQ | X | | | | |
| | | 0x04 | 4 | NBA_REQ | X | | | | |
| 74 | MID_SESSION_CONTROL_RESP | 0x01 | 1 | SESSION_OPEN_RESP | X | | | | |
| | | 0x02 | 2 | SESSION_CLOSE_RESP | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 75 | MID_MSG_ACK_OUT | 0x01 | 1 | ACK_NACK_ERROR | X | | | | |
| | | 0x02 | 2 | REJECT | X | | | | |
| 76 | | | | | | | | | X |
| 77 | MID_LP_OUTPUT | 0x01 | 1 | MPM_ERR | X | | | | |
| 78 | | | | | | | | | X |
| 79 | | | | | | | | | X |
| 80 | | | | | | | | | X |
| 81 | MID_QUERY_RESP | All (see ICD) | | | X | | | | |
| 82 | | | | | | | | | X |
| 83 | | | | | | | | | X |
| 84 | | | | | | | | | X |
| 85 | | | | | | | | | X |
| 86 | | | | | | | | | X |
| 87 | | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 88 | | | | | | | | | X |
| 89 | | 0x01 | 1 | Reserving for known need. Waiting for def'n. | | | | | X |
| 90 | MID_PWR_MODE_RESP | 0x00 | 0 | ERR_RESP | X | | | | |
| | | 0x01 | 1 | APM_RESP | X | | | | |
| | | 0x02 | 2 | MPM_RESP | X | | | | |
| | | 0x03 | 3 | TP_RESP | X | | | | |
| | | 0x04 | 4 | PTF_RESP | X | | | | |
| 91 | MID_HW_CTRL_OUT | 0x01 | 1 | VCTCXO | X | | | | |
| | | 0x02 | 2 | ON_OFF_SIG_CONFIG | X | | | | |
| | | 0x02 | 3 | SIRF_MSG_SSB_AGC_GAIN_OUTPUT | X | | | | |
| 92 | MID_CW_CONTROLLER_RESP | 0x01 | 1 | SCAN_RESULT | X | | | | |
| | | 0x02 | 2 | FILTER_CONDITIONS | X | | | | |
| | | 0x03 | 3 | MON_RESULTS | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 93 | MID_TCXO_LEARNING_OUT | 0x00 | 0 | Not Used | | | | | X |
| | | 0x01 | 1 | CLOCK_MODEL_DATA_BASE_OUT | X | | | | |
| | | 0x02 | 2 | TEMPERATURE_TABLE | X | | | | |
| | | 0x03 | 3 | Not Used | | | | | X |
| | | 0x04 | 4 | TEMP_RECORDER_MESSAGE | X | | | | |
| | | 0x05 | 5 | EARC | X | | | | |
| | | 0x06 | 6 | RTC_ALARM | X | | | | |
| | | 0x07 | 7 | RTC_CAL | X | | | | |
| | | 0x08 | 8 | MPM_ACQUIRED | X | | | | |
| | | 0x09 | 9 | MPM_SEARCHES | X | | | | |
| | | 0x0A | 10 | MPM_PREPOS | X | | | | |
| | | 0x0B | 11 | MICRO_NAV_MEASUREMENT | X | | | | |
| | | 0x0C | 12 | TCXO UNCERTAINTY | X | | | | |
| | | 0x0D | 13 | SYSTEM_TIME_STAMP | X | | | | |
| | | 0x12 | 18 | SIRF_MSG_SSB_XO_TEMP_REC_VALUE | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 94 | | | | | | | | | X |
| 95 | | | | | | | | | X |
| 96 | MID_Peek_Response | | | | | | | | X |
| 97 | MID_UserOutputBegin | | | | | | | | X |
| 98 | RESERVED for SDK User | | | | | | | X | |
| 99 | RESERVED for SDK User | | | | | | | X | |
| 100 | RESERVED for SDK User | | | | | | | X | |
| 101 | RESERVED for SDK User | | | | | | | X | |
| 102 | RESERVED for SDK User | | | | | | | X | |
| 103 | RESERVED for SDK User | | | | | | | X | |
| 104 | RESERVED for SDK User | | | | | | | X | |
| 105 | RESERVED for SDK User | | | | | | | X | |
| 106 | RESERVED for SDK User | | | | | | | X | |
| 107 | RESERVED for SDK User | | | | | | | X | |
| 108 | RESERVED for SDK User | | | | | | | X | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 109 | RESERVED for SDK User | | | | | | | X | |
| 110 | RESERVED for SDK User | | | | | | | X | |
| 111 | RESERVED for SDK User | | | | | | | X | |
| 112 | RESERVED for SDK User | | | | | | | X | |
| 113 | RESERVED for SDK User | | | | | | | X | |
| 114 | RESERVED for SDK User | | | | | | | X | |
| 115 | RESERVED for SDK User | | | | | | | X | |
| 116 | RESERVED for SDK User | | | | | | | X | |
| 117 | RESERVED for SDK User | | | | | | | X | |
| 118 | RESERVED for SDK User | | | | | | | X | |
| 119 | RESERVED for SDK User | | | | | | | X | |
| 120 | RESERVED for SDK User | | | | | | | X | |
| 121 | RESERVED for SDK User | | | | | | | X | |
| 122 | RESERVED for SDK User | | | | | | | X | |
| 123 | RESERVED for SDK User | | | | | | | X | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 124 | RESERVED for SDK User | | | | | | | X | |
| 125 | RESERVED for SDK User | | | | | | | X | |
| 126 | RESERVED for SDK User | | | | | | | X | |
| 127 | MID_UserOutputEnd | | | | | | | | X |
| 128 | MID_NavigationInitialization | | | | | X | | | |
| 129 | MID_SetNMEAMode | | | | | X | | | |
| 130 | MID_SetAlmanac | | | | | X | | | |
| 131 | MID_FormattedDump | | | | | X | | | |
| 132 | MID_PollSWVersion | | | | | X | | | |
| 133 | MID_DGPSSourceControl | | | | | X | | | |
| 134 | MID_SetSerialPort | | | | | X | | | |
| 135 | MID_SetProtocol | | | | | X | | | |
| 136 | MID_SET_NAV_MODE | | | | | X | | | |
| 137 | MID_SET_DOP_MODE | | | | | X | | | |
| 138 | MID_SET_DGPS_MODE | | | | | X | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 139 | MID_SET_ELEV_MASK | | | | | X | | | |
| 140 | MID_SET_POWER_MASK | | | | | X | | | |
| 141 | MID_SET_EDITING_RES | | | | | X | | | |
| 142 | MID_SET_SS_DETECTOR | | | | | X | | | |
| 143 | MID_SET_STAT_NAV | | | | | X | | | |
| 144 | MID_PollClockStatus | | | | | X | | | |
| 145 | MID_SetDGPSPort | | | | | X | | | |
| 146 | MID_PollAlmanac | | | | | X | | | |
| 147 | MID_PollEphemeris | | | | | X | | | |
| 148 | MID_FlashUpdate | | | | | X | | | |
| 149 | MID_SetEphemeris | | | | | X | | | |
| 150 | MID_SwitchOpMode | | | | | X | | | |
| 151 | MID_LowPower | | | | | X | | | |
| 152 | MID_PollRxMgrParams | | | | | X | | | |
| 153 | MID_TOWSync | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 154 | MID_PollTOWSync | | | | | | | | X |
| 155 | MID_EnableTOWSyncInterrupt | | | | | | | | X |
| 156 | MID_TOWSyncPulseResult | | | | | | | | X |
| 157 | MID_DRSetup | | | | | | | | X |
| 158 | MID_DRData | | | | | | | | X |
| 159 | MID_DRCritLoad | | | | | | | | X |
| 160 | MID_HeadSync0 | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 161 | MID_SSB_SIRFNAV_COMMAND | 0x01 | 1 | SSB_DEMO_SET_RESTART_MODE | | | | | X |
| | | 0x02 | 2 | SSB_DEMO_TEST_CPU_STRESS | | | | | X |
| | | 0x03 | 3 | SSB_DEMO_STOP_TEST_APP | | | | | X |
| | | 0x04 | 4 | Not specified | | | | | X |
| | | 0x05 | 5 | SSB_DEMO_START_GPS_ENGINE | | | | | X |
| | | 0x06 | 6 | SSB_DEMO_STOP_GPS_ENGINE | | | | | X |
| | | 0x07 | 7 | SSB_SIRFNAV_STORE_NOW | X | | | | |
| | | 0x08 | 8 | SSB_DEMO_START_NAV_ENGINE | | | | | X |
| | | 0x09 | 9 | SSB_SET_IF_TESTPOINT | | | | | X |
| | | 0x0A - 0x0F | 10 - 15 | | | | | | X |
| | | 0x10 | 16 | SSB_DEMO_TEST_CFG_CONTINUOUS | | | | | X |
| | | 0x11 | 17 | SSB_DEMO_TEST_CFG_RESTARTS | | | | | X |
| | | 0x12 | 18 | SSB_DEMO_TEST_CFG_RF_ON_OFF | | | | | X |
| | | 0x13 - 0x1D | 19 - 29 | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | MID_SSB_SIRFNAV_COMMAND (Cont.) | 0x1E | 30 | SSB_DEMO_TEST_CFG_DELETE | | | | | X |
| | | 0x1F | 31 | SSB_DEMO_TEST_CFG_POLL | | | | | X |
| | | 0x20 | 32 | SSB_DEMO_TEST_START | | | | | X |
| | | 0x21 | 33 | SSB_DEMO_TEST_STOP | | | | | X |
| | | 0x22 - 0x2F | 34 - 47 | | | | | | X |
| | | 0x30 | 48 | SSB_DEMO_TEST_POLL_STATUS | | | | | X |
| | | 0x31 | 49 | SSB_DEMO_TEST_RF_ATTENUATION | | | | | X |
| | | 0x32 - 0x3F | 50 - 63 | | | | | | X |
| | | 0x40 | 64 | SSB_DEMO_TEST_REF_POSITION | | | | | X |
| | | 0x41 | 65 | SSB_DEMO_TEST_PFC_CONTINUOUS | | | | | X |
| | | 0x42 | 66 | SSB_DEMO_TEST_PFC_RESTARTS | | | | | X |
| 162 | MID_HeadSync1 | | | | | | | | X |
| 163 | | | | | | | | | X |
| 164 | | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 165 | MID_ChangeUartChnl | | | | | X | | | |
| 166 | MID_SetMsgRate | | | | | X | | | |
| 167 | MID_LPAcqParams | | | | | X | | | |
| 168 | MID_POLL_CMD_PARAM | | | | | X | | | |
| 169 | MID_SetDatum | | | | | X | | | |
| 170 | | | | MID_SetSbasParam | | X | | | |
| 171 | MID_AdvancedNavInit | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 172 | MID_DrIn | 0x01 | 1 | SID_SetDrNavInit | | X | | | |
| | | 0x02 | 2 | SID_SetDrNavMode | | X | | | |
| | | 0x03 | 3 | SID_SetGyrFactCal | | X | | | |
| | | 0x04 | 4 | SID_SetDrSensParam | | X | | | |
| | | 0x05 | 5 | SID_PollDrValid | | X | | | |
| | | 0x06 | 6 | SID_PollGyrFactCal | | X | | | |
| | | 0x07 | 7 | SID_PollDrSensParam | | X | | | |
| | | 0x08 | 8 | reserved | | | | | X |
| | | 0x09 | 9 | SID_ InputCarBusData | | X | | | |
| | | 0x0A | 10 | SID_CarBusEnabled | | X | | | |
| | | 0x0B | 11 | SID_CarBusDisabled | | X | | | |
| | | 0x0C | 12 | SID_SetGenericSensorParam | | | | | |
| | | 0x0D | 13 | SID_PollGenericSensorParam | | | | | |
| | | 0x0E | 14 | SID_InputCarBusData2 | | X | | | |
| | | 0x0F | 15 | SID_DR_Factory_Test_Calibration | | | | | X |
| | | 0x10 | 16 | SID_DR_Initial_User_Information | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | MID_DrIn(Continued) | 0x11 | 17 | SID_DR_Output_Nav_Information | | | | | X |
| | | 0x12 | 18 | SID_DR_Uncertainty_Information | | | | | X |
| | | 0x13 | 19 | SID_DR_Debug_Information | | X | | | |
| | | 0x50 | 80 | SSB_MMF_DATA | | | | | |
| | | 0x51 | 81 | SSB_MMF_SET_MODE | | | | | |
| 173 | MID_OemPoll | | | | | | | | X |
| 174 | MID_OemIn | | | | | | | | X |
| 175 | MID_SendCommandString | | | | | X | | | |
| 176 | MID_TailSync0 | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 177 | GPS_NAV_LPL_CMDR | 0x00 | 0 | LPL_CMDR_POLL_STATUS | | | | | X |
| | | 0x01 | 1 | LPL_CMDR_POLL_STATUS_RESP | | | | | X |
| | | 0x02 | 2 | LPL_CMDR_SESSION_START | | | | | X |
| | | 0x03 | 3 | LPL_CMDR_SESSION_START_RESP | | | | | X |
| | | 0x04 | 4 | LPL_CMDR_SESSION_STOP | | | | | X |
| | | 0x05 | 5 | LPL_CMDR_SESSION_IN_PROGRESS | | | | | X |
| | | 0x06 | 6 | LPL_CMDR_SESSION_IN_PROGRESS_RESP | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | GPS_NAV_LPL_CMDR (Continued) | 0x07 | 7 | LPL_CMDR_SESSION_STATUS | | | | | X |
| | | 0x08 | 8 | LPL_CMDR_SET_PLATFORM_CONFIG | | | | | X |
| | | 0x09 | 9 | LPL_CMDR_GET_PLATFORM_CONFIG_REQST | | | | | X |
| | | 0x0A | 10 | LPL_CMDR_GET_PLATFORM_CONFIG_RESP | | | | | X |
| | | 0x0B | 11 | LPL_CMDR_LOAD_NMR_FILE | | | | | X |
| | | 0x0C | 12 | LPL_CMDR_GET_NMR_FILE_STATUS | | | | | X |
| | | 0x0D | 13 | LPL_CMDR_START_LOGFILE | | | | | X |
| | | 0x0E | 14 | LPL_CMDR_STOP_LOGFILE | | | | | X |
| | | 0x0F | 15 | LPL_CMDR_GET_LOGFILE_STATUS_RE | | | | | X |
| | | 0x10 | 16 | LPL_CMDR_GET_LOGFILE_STATUS_RESP | | | | | X |
| | | 0x11 | 17 | LPL_CMDR_IS_EE_AVAILABLE_REQST | | | | | X |
| | | 0x12 | 18 | LPL_CMDR_IS_EE_AVAILABLE_RESP | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | GPS_NAV_LPL_CMDR (Continued) | 0x13 | 19 | LPL_CMDR_GET_EE_DATA | | | | | X |
| | | 0x14 | 20 | LPL_CMDR_GET_EE_DATA_RESP | | | | | X |
| | | 0x15 | 21 | LPL_CMDR_SET_POWER_MODE | | | | | X |
| | | 0x16 | 22 | LPL_CMDR_GET_POWER_MODE_REQST | | | | | X |
| | | 0x17 | 23 | LPL_CMDR_GET_POWER_MODE_RESP | | | | | X |
| | | 0x40 | 64 | SIRF_MSG_SSB_DL_CONTROL | X | | | | |
| | | 0x41 | 65 | SIRF_MSG_SSB_DL_INTRVL | X | | | | |
| | | 0x42 | 66 | SIRF_MSG_SSB_DL_THRESH | X | | | | |
| | | 0x43 | 67 | SIRF_MSG_SSB_DL_MEM | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 178 | SIRF_MSG_SSB_TRACKER_IC | 0x00 | 0 | Reserved | X | | | | |
| | | 0x01 | 1 | SIRF_MSG_SSB_MEI_TO_CUSTOMIO | X | | | | |
| | | 0x02 | 2 | SIRF_MSG_SSB_TRKR_CONFIG | X | | | | |
| | | 0x03 | 3 | SIRF_MSG_SSB_TRKR_PEEKPOKE_CMD | X | | | | |
| | | 0x04 | 4 | SIRF_MSG_SSB_TRKR_PEEKPOKE_RSP | X | | | | |
| | | 0x05 | 5 | SIRF_MSG_SSB_TRKR_FLASHSTORE_RSP | X | | | | |
| | | 0x06 | 6 | SIRF_MSG_SSB_TRKR_FLASHERASE_RSP | X | | | | |
| | | 0x07 | 7 | SIRF_MSG_SSB_TRKR_HWCONFIG_RSP | X | | | | |
| | | 0x08 | 8 | SIRF_MSG_SSB_TRKR_CUSTOMIO_RSP | X | | | | |
| | | 0x09 | 9 | SIRF_MSG_SSB_TRKR_CONFIG_POLL | X | | | | |
| | | 0x0A | 10 | SIRF_MSG_SSB_TRKR_CONFIG_POLL_RSP | X | | | | |
| | | 0x0B | 11 | SIRF_MSG_SSB_CCK_POLL | X | | | | |
| | | 0x0C | 12 | SIRF_MSG_SSB_POLL_RSP | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | SIRF_MSG_SSB_TRACKER_IC (Continued) | 0x14 | 20 | PATCH_STORAGE_CONTROL | X | | | | |
| | | 0x22 | 34 | PATCH MEMORY LOAD REQUEST | X | | | | |
| | | 0x26 | 38 | PATCH MEMORY EXIT REQUEST | X | | | | |
| | | 0x28 | 40 | PATCH MEMORY START REQUEST | X | | | | |
| | | 0x90 | 144 | PATCH MANAGER PROMPT | X | | | | |
| | | 0x91 | 145 | PATCH MANAGER ACKNOWLEDGEMENT | X | | | | |
| 179 | MID_TailSync1 | | | | | | | | X |
| 180 | MID_UserInputEnd | | | | | | | | X |
| 181 | RESERVED for SDK User | | | | | | | X | |
| 182 | RESERVED for SDK User | | | | | | | X | |
| 183 | RESERVED for SDK User | | | | | | | X | |
| 184 | RESERVED for SDK User | | | | | | | X | |
| 185 | RESERVED for SDK User | | | | | | | X | |
| 186 | RESERVED for SDK User | | | | | | | X | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 187 | RESERVED for SDK User | | | | | | | X | |
| 188 | RESERVED for SDK User | | | | | | | X | |
| 189 | RESERVED for SDK User | | | | | | | X | |
| 190 | RESERVED for SDK User | | | | | | | X | |
| 191 | RESERVED for SDK User | | | | | | | X | |
| 192 | RESERVED for SDK User | | | | | | | X | |
| 193 | RESERVED for SDK User | | | | | | | X | |
| 194 | RESERVED for SDK User | | | | | | | X | |
| 195 | RESERVED for SDK User | | | | | | | X | |
| 196 | RESERVED for SDK User | | | | | | | X | |
| 197 | RESERVED for SDK User | | | | | | | X | |
| 198 | RESERVED for SDK User | | | | | | | X | |
| 199 | MID_UserInputEnd | | | | | | | X | |
| 200 | MID_GPIO_INPUT | 0x01 | 1 | SID_PollGPIOParam | | | | | X |
| | | 0x02 | 2 | SID_SetGPIO | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 201 | MID_BT_INPUT | | | | | | | | X |
| 202 | MID_POLL_FAILURE_STATUS | | | | | | | | X |
| 203 | GPS_TRK_TESTMODE_COMMAND | | | | | | | | X |
| 204 | MID_MEAS_ENG_IN | | | | | | | | X |
| 205 | MID_SetGenericSWControl | 0x10 | 16 | SSB_SW_COMMANDED_OFF | | | X | | |
| 206 | MID_RF_Test_Point | | | | | | X | | |
| 207 | MID_INT_CPUPause | | | | | | X | | |
| 208 | MID_SiRFLoc | | | | | | | | X |
| 209 | MID_QUERY_REQ | | | | X | | | | |
| 210 | MID_POS_REQ | | | | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 211 | MID_SET_AIDING | 0x01 | 1 | SET_IONO | X | | | | |
| | | 0x02 | 2 | SET_EPH_CLOCK | X | | | | |
| | | 0x03 | 3 | SET_ALM | X | | | | |
| | | 0x04 | 4 | SET_ACQ_ASSIST | X | | | | |
| | | 0x05 | 5 | SET_RT_INTEG | X | | | | |
| | | 0x06 | 6 | SET_UTC_MODEL | X | | | | |
| | | 0x07 | 7 | SET_GPS_TOW_ASSIST | X | | | | |
| | | 0x08 | 8 | SET_AUX_NAV | X | | | | |
| | | 0x09 | 9 | SET_AIDING_AVAIL | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 212 | MID_STATUS_REQ | 0x01 | 1 | EPH_REQ | X | | | | |
| | | 0x02 | 2 | ALM_REQ | X | | | | |
| | | 0x03 | 3 | B_EPH_REQ | X | | | | |
| | | 0x04 | 4 | TIME_FREQ_APPROX_POS_REQ | X | | | | |
| | | 0x05 | 5 | CH_LOAD_REQ | X | | | | |
| | | 0x06 | 6 | CLIENT_STATUS_REQ | X | | | | |
| | | 0x07 | 7 | OSP_REV_REQ | X | | | | |
| | | 0x08 | 8 | SERIAL_SETTINGS_REQ | X | | | | |
| | | 0x09 | 9 | TX_BLANKING_REQ | X | | | | |
| 213 | MID_SESSION_CONTROL_REQ | 0x01 | 1 | SESSION_OPEN_REQ | X | | | | |
| | | 0x02 | 2 | SESSION_CLOSE_REQ | X | | | | |
| 214 | MID_HW_CONFIG_RESP | | | | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 215 | MID_AIDING_RESP | 0x01 | 1 | APPROX_MS_POS_RESP | X | | | | |
| | | 0x02 | 2 | TIME_TX_RESP | X | | | | |
| | | 0x03 | 3 | FREQ_TX_RESP | X | | | | |
| | | 0x04 | 4 | SET_NBA_SF1_2_3 | X | | | | |
| | | 0x05 | 5 | SET_NBA_SF4_5 | X | | | | |
| 216 | MID_MSG_ACK_IN | 0x01 | 1 | ACK_NACK_ERROR | X | | | | |
| | | 0x02 | 2 | REJECT | X | | | | |
| 217 | | 0x01 | 1 | SENSOR_ON_OFF | | | | | X |
| 218 | MID_PWR_MODE_REQ | 0x00 | 0 | FP_MODE_REQ | X | | | | |
| | | 0x01 | 1 | APM_REQ | X | | | | |
| | | 0x02 | 2 | MPM_REQ | X | | | | |
| | | 0x03 | 3 | TP_REQ | X | | | | |
| | | 0x04 | 4 | PTF_REQ | X | | | | |
| 219 | MID_HW_CTRL_IN | 0x01 | 1 | VCTCXO | X | | | | |
| | | 0x02 | 2 | ON_OFF_SIG_CONFIG | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 220 | MID_CW_CONTROLLER_REQ | 0x01 | 1 | CONFIG | X | | | | |
| | | 0x02 | 2 | EVENT_REG | | | | | X |
| | | 0x03 | 3 | COMMAND_SCAN | | | | | X |
| | | 0x04 | 4 | CUSTOM_MON_CONFIG | | | | | X |
| | | 0x05 | 5 | FFT_NOTCH_SETUP | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 221 | MID_TCXO_LEARNING_IN | 0x00 | 0 | OUTPUT_REQUEST | X | | | | |
| | | 0x01 | 1 | CLOCK_MODEL_DATA_BASE | X | | | | |
| | | 0x02 | 2 | TEMPERATURE_TABLE | X | | | | |
| | | 0x03 | 3 | TEST_MODE_CONTROL | X | | | | |
| | | 0x04 | 4 | Not Used | | | | | X |
| | | 0x05 | 5 | Not Used | | | | | X |
| | | 0x06 | 6 | Not Used | | | | | X |
| | | 0x07 | 7 | Not Used | | | | | X |
| | | 0x08 | 8 | Not Used | | | | | X |
| | | 0x09 | 9 | Not Used | | | | | X |
| | | 0x0A | 10 | Not Used | | | | | X |
| | | 0x0B | 11 | Not Used | | | | | X |
| | | 0x0C | 12 | Not Used | | | | | X |
| 222 | | | | | | | | | X |
| 223 | | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 224 | MID_Peek_Poke_Command | | | | | | | | X |
| 225 | MID_SiRFOutput | 0x06 | 6 | STATISTICS | | X | | | |
| | | 0x07 | 7 | Statistics with Aiding | X | | | | |
| | | 0x20 | 32 | SIRF_MSG_SSB_DL_COMPAT_REC_OUT | X | | | | |
| | | 0x21 | 33 | SIRF_MSG_SSB_DL_OUT_TERM | X | | | | |
| | | 0x22 | 34 | SIRF_MSG_SSB_DL_STATUS_OUT | X | | | | |
| | | 0x23 | 35 | SIRF_MSG_SSB_DL_REC_OUT | X | | | | |
| 226 | MID_UI_LOG | | | | | | | | |
| 227 | MID_NL_MeasResi | | | | | | | | |
| 228 | MID_SiRFInternal | | | | | | | | |
| 229 | MID_SysInfo | | | | | | | | X |
| 230 | MID_SysInfoOut | | | | | | | | X |
| 231 | MID_UserDebugMessage | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 232 | MID_EE_INPUT | 0x01 | 1 | SSB_EE_SEA_PROVIDE_EPH | | | X | | |
| | | 0x02 | 2 | SSB_EE_POLL_STATE | | | X | | |
| | | 0x10 | 16 | SSB_EE_FILE_DOWNLOAD | | | | | X |
| | | 0x11 | 17 | SSB_EE_QUERY_AGE | | | | | X |
| | | 0x12 | 18 | SSB_EE_FILE_PART | | | | | X |
| | | 0x13 | 19 | SSB_EE_DOWNLOAD_TCP | | | | | X |
| | | 0x14 | 20 | SSB_EE_SET_EPHEMERIS | | | | | X |
| | | 0x15 | 21 | SSB_EE_FILE_STATUS | | | | | X |
| | | 0x16 | 22 | ECLM Start Download | X | | | | |
| | | 0x17 | 23 | ECLM File Size | X | | | | |
| | | 0x18 | 24 | ECLM Packet Data | X | | | | |
| | | 0x19 | 25 | Get EE Age | X | | | | |
| | | 0x1A | 26 | Get SGEE Age | X | | | | |
| | | 0x1B | 27 | ECLM Host File Content | X | | | | |
| | | 0x1C | 28 | ECLM Host ACK/NACK | X | | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| | MID_EE_INPUT (Continued) | 0x1D | 29 | ECLM Get NVM Header | X | | | | |
| | | 0xFD | 253 | EE_STORAGE_CONTROL | X | | | | |
| | | 0xFE | 254 | SSB_EE_DISABLE_EE_SECS | | | | | X |
| | | 0xFF | 255 | SSB_EE_DEBUG | | X | | | |
| 233 | MID_SetRFParams | 0x01 | 1 | SET_GRF3iPLUS_IF_BANDWIDTH | | X | | | |
| | | 0x02 | 2 | SET_GRF3iPLUS_POWER_MODE | | X | | | |
| | | 0x0A | 10 | POLL_GRF3iPLUS_IF_BANDWIDTH | | X | | | |
| | | 0x0B | 11 | POLL_GRF3iPLUS_POWER_MODE | | X | | | |
| | | 0xA5 | 165 | SET_GRF3iPLUS_IF_TESTPOINT_PARAM | | | | | |
| | | 0xA6 | 166 | SET_GRF3iPLUS_AGC_MODE | | | | | |
| | | 0xFE | 254 | OUTPUT_GRF3iPLUS_POWER_MODE | | X | | | |
| | | 0xFF | 255 | OUTPUT_GRF3iPLUS_IF_BANDWIDTH | | X | | | |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 234 | MID_SensorControl | 0x01 | 1 | SENSOR_CONFIG | X | | | | |
| | | 0x02 | 2 | SENSOR_SWITCH | X | | | | |
| | | 0x03 | 3 | SENSORS_POLL_PARAMETER_MESSAGE | X | | | | |
| 235 | | | | | | | | | X |
| 236 | | | | | | | | | X |
| 237 | | | | | | | | | X |
| 238 | | | | | | | | | X |
| 239 | | | | | | | | | X |
| 240 | | | | | | | | | X |
| 241 | | | | | | | | | X |
| 242 | | | | | | | | | X |
| 243 | | | | | | | | | X |
| 244 | MID_BufferFull | | | | | | | | X |
| 245 | MID_ParityError | | | | | | | | X |

| MID (dec) | Definition | Sub ID (hex) | Sub ID (dec) | Definition | OSP | SSB | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|---|---|
| 246 | MID_RcvFullError | | | | | | | | X |
| 247 | MID_RcvOverrunError | | | | | | | | X |
| 248 | MID_FrameError | | | | | | | | X |
| 249 | MID_BreakInterrupt | | | | | | | | X |
| 250 | MID_BufferTerminated | | | | | | | | X |
| 251 | MID_TransportDataErr | | | | | | | | X |
| 252 | MID_CheckSumError | | | | | | | | X |
| 253 | MID_LengthError | | | | | | | | X |
| 254 | MID_MessageTypeError | | | | | | | | X |
| 255 | MID_ASCIIData | | | | X | | | | |

Table 4.1: OSP Message Access

## 4.2 Mapping between AI3 Messages and OSP Messages

| AI3 Message | OSP Message | Input or Output |
|---|---|---|
| AI3 Request | Position Request | I |
| | Set Ionospheric Model | I |
| | Set Satellite Ephemeris and Clock Corrections | I |
| | Set Almanac Assist Data | I |
| | Set Acquisition Assistance Data | I |
| | Set Real-Time Integrity<br>Deleted ICD_REV_NUM, ALM_REQ_FLAG, IONO_FLAG | I |
| | Move NEW_ENHANCE_TYPE to Hardware Configuration Response message | |
| | Does not support coarse location method anymore, deleted COARSE_POS_REF_LAT and COARSE_POS_REF_LON | |
| AI3 Response | Position Response | O |
| | Measurement Response | O |
| | Deleted fields from SUBALM_FLAG to SUBALM_TOA | |
| | Deleted fields from CP_VALID_FLAG to PR_ERR_TH | |
| ACK/NACK Message<br>SLC/CP Message<br>ACK.NACK | ACK/NACK/Error Notification | I and O |
| SLC Ephemeris Status Request | Ephemeris Status Request | I |
| Unsolicited SLC Ephemeris Status Response | Ephemeris Status Response | O |
| Solicited SLC Ephemeris Status Response | | |
| Ephemeris Status Response | | |
| Poll Almanac Request | Almanac Request | I |

| AI3 Message | OSP Message | Input or Output |
|---|---|---|
| Poll Almanac Response | Almanac Response | O |
| Unsolicited SLC EE Integrity Warning | Replaced by existing SSB message: Extended Ephemeris Integrity – Message ID 56 (Sub ID 2) | |
| Unsolicited SLC EE Clock Bias Adjustment | Replaced by existing SSB message: EE Provide Synthesized Ephemeris Clock Bias Adjustment Message – Message ID 56 (Sub ID 4) | I |
| CP Send Auxiliary | Set UTC Model | |
| NAV Message | Set GPS TOW Assist | I |
| | Set Auxiliary Navigation Model Parameters | I |
| Aiding Request Message | Deleted because RRC/RRLP does not provide NAV subframe aiding | |
| NAV Subframe 1_2_3 Aiding Response Message | NAV Subframe 1_2_3 Aiding Response Message | |
| NAV Subframe 4_5 Aiding Response Message | NAV Subframe 4_5 Aiding Response Message | |
| Broadcast Ephemeris Request Message | Broadcast Ephemeris Request | I |
| Broadcast Ephemeris Response Message | Broadcast Ephemeris Response | O |

Table 4.2: Mapping between A13 Messages and OSP Messages

## 4.3 Mapping between F Messages and OSP Messages

| F Message | OSP Message | Input or Output |
|---|---|---|
| Session Open Request | Session Open Request | I |
| Session Open Notification | Session Open Notification | O |
| Error Notification | Replaced by ACK/NACK/Error Notification message | |
| SLC Status | SLC Status | O |
| Session Closing Request | Session Closing Request | I |
| Session Closing Notification | Session Closing Notification | O |

| F Message | OSP Message | Input or Output |
|---|---|---|
| Hardware Configuration Request | Hardware Configuration Request | O |
| Hardware Configuration Response | Hardware Configuration Response | I |
| Time Transfer Request | Time Transfer Request | O |
| Time Transfer Response | Time Transfer Response | I |
| Frequency Transfer Request | Frequency Transfer Request | O |
| Frequency Transfer Response | Frequency Transfer Response | I |
| Approximate MS Position Request | Approximate MS Position Request | O |
| Approximate MS Position Response | Approximate MS Position Response | I |
| Time_Frequency_Approximate Position Status Request | Time_Frequency_Approximate_Position Status Request | I |
| Time_Frequency_Approximate Position Status Response | Time_Frequency_Approximate_Posit ion Status Response | O |
| Push Aiding Availability | Push Aiding Availability | I |
| ACK/NACK for Push Aiding Availability | ACK/NACK for Push Aiding Availability | O |
| Wireless Power Request | Deleted since we have not implemented this feature | |
| Wireless Power Response | Deleted since we have not implemented this feature | |
| Reject | Reject | O |
| Reset GPS Command | Replaced by the existing Initialize Data Source – Message ID 128 message | |
| Software Version Request | Poll Software Version | I |
| Software Version Response | Software Version String (Response to Poll) | O |
| Set APM | Power Mode Request Message ID 218 subsumes | I |
| Ack APM | Power Mode Response Message ID 90 subsumes | O |
| Serial Port Setting Request | Serial Port Setting Request | I |

| F Message | OSP Message | Input or Output |
|---|---|---|
| Serial Port Setting Response | Serial Port Setting Response | O |
| Channel Open Request | Deleted because there is no logical channel anymore | |
| Channel Open Response | | |
| Channel Close Request | | |
| Channel Close Response | | |
| Channel Priority Request | | |
| Channel Priority Response | | |
| Priority Query | | |
| Priority Response | | |
| Channel Load Query | Channel Load Query | I |
| Channel Load Response | Channel Load Response | O |
| Tx Blanking Request | Tx Blanking Request | I |
| Tx Blanking Response | Tx Blanking Response | O |
| Test Mode Configuration Request | Extended Ephemeris Debug | I |
| Test Mode Configuration Response | Extended Ephemeris ACK | O |
| ICD Version Request | Deleted because CSR cannot trace AI3 and F ICD version anymore | |
| ICD Version Response | | |

Table 4.3: Mapping between F Messages and OSP Messages

# 5 Input Message Definitions

## 5.1 Poll GRF3i+ Normal/Low Power Mode - MID 233, SID 11

Use this message to poll whether the GRF3i+ is currently in normal or low power mode. The SID is fixed to 0x0B.

Table 5.1 contains the input values for the following example:

SID = 0x0B

Example:

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `E90B` – Payload
- `00F4B0B3` – Message checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1U | E9 | Decimal 233 |
| SID | 1U | 0B | 0B: Poll GRF3i+ IF power mode |

**Table 5.1: Poll GRF3i+ Normal/Low Power Mode - MID 233, SID 11**

**Note:**

This message shows:

- Success: acknowledged with `Ack: MID_GRF3iPlusParams` using Command Acknowledgment – SSB MID 11.
- Failure: acknowledged with `Rejected: MID_GRF3iPlusParams` using Command Negative Acknowledgment – SSB MID 12.

A corresponding output message (MID: 233 with SubMsgID 0xFE) with parameters status is also sent as a response to this query message.

## 5.2 SiRFDRive Input Messages - MIDs 45 and 172

### 5.2.1 Input Tracker to NAV – ADC/Odometer Data - MID 45

This message is sent at a rate of 1 Hz (default) or 10 Hz whenever it is enabled by the control words in the Track Reset message on the GSP2t. Both ADC channels are sampled in a round-robin way at 50 Hz. Raw measurements are then averaged every 100 ms in the tracker interrupt along with the current odometer counter value and GPIO states. The GSP2t Rev D on-chip ADC is a 14-bit successive approximation two-channel ADC outputting signed 16-bit values from –12000 to 28000.

The GSP2eLP with DR option currently only has one ADC input that is sampled at 50 Hz. Raw measurements are then averaged every 100 ms in the tracker interrupt along with the current odometer counter and GPIO state. The DR option is a Maxim MAX1240 12-bit ADC on a daughterboard installed on the SDKL. The 12-bit resolution provides unsigned values from 0 to 4095.

On the GSP2t, this message can be transmitted in 1 Hz mode or 10 Hz mode. On the GSP2eLP, this message is only transmitted in 1 Hz mode. In 1Hz mode, there are 10 data measurement blocks in one single message. In 10 Hz mode, there is one data measurement per message.

**Message Length:** 111 bytes @ 1 Hz or 12 bytes @ 10 Hz

**Rate:** 111 bytes @ 1 Hz or 12 bytes @ 10 Hz

Note:

InputCarBusData message, MID 172, SID 9, replaces this message for SiRFstarIII and SiRFstarIV products.

| Byte # | Name | Bytes | Units | Description |
|---|---|---|---|---|
| 1 | MID | 1U | - | Input tracker to NAV – ADC/odometer data, 0x2D, `MID_TrkADCOdoGPIO`, |
| 2 + (n- 1)*11(1) | - | 4U | m/s | Tracker time, millisecond counts, 0 to 4294967295 |
| 6 + (n- 1)*11(1) | - | 2(2) | - | 0 to 4095 (GSP2eLP w/ DR) or -12000 to 28000 (GSP2t)<br>Averaged measurement from Gyro input. On GSP2t, this is the ADC[2] input. On GSP2eLP, this is the Maxim ADC input |
| 8 + (n- 1)*11(1) | adc3Avg | 2(2) | - | 0 (GSP2eLP w/ DR option) or -12000 to 28000 (GSP2t)<br>On GSP2eLP, there is currently only one ADC input so this field is always 0. |
| 10 + (n- 1)*11(1) | - | 2U | - | 0 to 65535.<br>Odometer counter measurement at the most recent 100mSec tracker interrupt. This field rolls over to 0 after 65535. |
| 12 + (n- 1)*11(1) | gpioStat | 1D | Bit map | Bit 0 = 1: Reverse is on<br>Bits [7:1] Reserved<br>GPIO input states at the most recent 100 mSec tracker interrupt |

Table 5.2: Input Tracker to NAV – ADC/Odometer Data - MID 45

(1) n is either 1 or 1-10 depending whether the message comes out a 10Hz (10 messages 1 data set) or 1Hz (1 message 10 data sets)

(2) Unsigned in GSD2eLP with DR option, range 0 to 4095. Signed in GSP2t, range -12000 to +28000.

**API:**

```
#define NUM_OF_DR_RAW 10
typedef struct
{
    UINT32 currentTime;
    UINT16 adc2Avg;
    UINT16 adc3Avg;
    UINT16 odoCount;
    UINT8  gpioStat;
} tADCOdometer;
typedef struct
{
    struct
    {
        tADCOdometer ADCOdometer[NUM_OF_DR_RAW];
    } DrRaw;
} tDrRawData, *tDrRawDataPtr;
```

### 5.2.2 SetDrNavInit - MID 172, SID 1

**MSG ID:**

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x01 |
| SID Name: | SID_SetDrNavInit |
| SID Purpose: | DR NAV Initialization Input Message |

**Table 5.3: SetDrNavInit - MID 172 (0xAC), SID 1 (0x01)**

**Message Length:** 28 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1 U | - | 0xAC | - |
| 2 | SID | 1 U | - | 0x01 | - |
| 3-6 | Latitude | 4 S | deg | -90 to 90 | $10^{-7}$ |
| 7-10 | Longitude | 4 S | deg | -180 to 180 | $10^{-7}$ |
| 11-14 | Altitude (from Ellipsoid) | 4 S | meters | -2000 to 100000.0 | 0.01 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 15-16 | Heading (True) | 2 U | deg | 0 to 360 | 0.01 |
| 17-20 | Clock Offset | 4 S | Hz | 25000 to 146000 | - |
| 21-24 | Time Of Week | 4 U | secs | 0 to 604800.00 | 0.001 |
| 25-26 | Week Number | 2 U | - | 0 to 1023 | - |
| 27 | Number of Channels | 1 U | - | 1 - 12 | - |
| 28 | Reset Configuration | 1 D | BitMap | Bit 0: Data valid flag (set warm/hot start)<br>Bit 1: Clear ephemeris (set warm start)<br>Bit 2: Clear memory (set cold start)<br>Bit 3: Factory reset<br>Bit 4: Enable raw track data<br>Bit 5: Enable debug data<br>Bit 6: Reserved<br>Bit 7: Reserved | - |

Table 5.4: SetDrNavInit Message

API:

```
typedef struct
{
    INT32     Lat;
    INT32  Lon;
    INT32  Alt;
    UINT16 Hd;
    INT32  clkOffset;
    UINT32 timeOfWeek;
    UINT16 weekno;
    UINT8  chnlCnt;
    UINT8  resetCfg;
} MI_DR_NAV_INIT;
```

### 5.2.3 SetDrNavMode - MID 172, SID 2

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x02 |
| SID Name: | SID_SetDrNavMode |
| SID Purpose: | DR NAV Mode Control Input Message |

**Table 5.5: SetDrNavMode - MID 172, SID 2**

**Message Length:** 4 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range |
|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC |
| 2 | SID | 1U | - | 0x02 |
| 3 | DR NAV Mode Control | 1D | Bit Map | Bit settings are exclusive<br>Bit 0: 1 = GPS Nav Only<br>Bit 1: 1 = DR Nav Ok (with Stored or Default Calibration)<br>Bit 2: 1 = DR Nav Ok with Current GPS calibration<br>Bit 3: 1 = DR NAV Only<br>Bits 4-7: Reserved |
| 4 | Reserved | 1U | - | Undefined |

**Table 5.6: SetDrNavMode Message**

**API:**

```
typedef struct
{
    UINT8 Mode;
    INT8 Reserved;
} MI_DR_NAV_MODE;
```

### 5.2.4 SetGyrFactCal - MID 172, SID 3

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x03 |
| SIDName: | SID_SetGyrFactCal |
| SIDPurpose: | Gyro Factory Calibration Control Input Message |

Table 5.7: SetGyrFactCal - MID 172, SID 3

**Message Length:** 4 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range |
|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC |
| 2 | SID | 1U | - | 0x03 |
| 3 | Gyro Factory Calibration Control(1) | 1U | - | Bit 0 = 1: Start Gyro Bias calibration<br>Bit 1 = 1: Start Gyro Scale Factor calibration(2) |
| 4 | Reserved | 1U | - | undefined |

Table 5.8: SetGyrFactCal Message

(1) The Field variable bit map controls the gyro factory calibration stages. First the Gyro Bias Calibration is done while the gyro is stationary. Next the Gyro Scale Factor Calibration is done while the gyro rotates smoothly through 360 degrees.

(2) The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the least significant byte.

**API:**

```
typedef struct
{
    UINT8 Cal;
    UINT8 Reserved;
} MI_GYR_FACT_CAL;
```

## 5.2.5 SetDrSensParam - MID 172, SID 4

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x04 |
| SID Name: | SID_SetDrSensParam |
| SID Purpose: | DR Sensor's Parameters Input Message |

**Table 5.9: SetDrSensParam - MID 172, SID 4**

**Message Length:** 7 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | Message ID | 1U | - | 0xAC | - |
| 2 | Sub-ID | 1U | - | 0x04 | - |
| 3 | Baseline Speed Scale Factor | 1U | ticks/m | 1 to 255 (default: 4) | 1 |
| 4-5 | Baseline Gyro Bias | 2U | zero rate Volts | 2.0 to 3.0 (default:2.5) | 0.0001 |
| 6-7 | Baseline Gyro Scale Factor | 2U | mV / (deg/sec) | 1 to 65 (default: 22) | 0.001 |

**Table 5.10: SetDrSensParam Message**

**API:**

```
typedef struct
{
    UINT8  BaseSsf;
    UINT16 BaseGb;
    UINT16 BaseGsf;
} MI_DR_SENS_PARAM;
```

### 5.2.6 PollDrValid - MID 172, SID 5

**MSG ID:**

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x05 |
| SID Name: | SID_PollDrValid |
| SID Purpose: | Request output of Dr Valid |

Table 5.11: PollDrValid - MID 172, SID 5

**Message Length:** 10 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range |
|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC |
| 2 | SID | 1U | - | 0x05 |
| 3-6 | Data Valid | 4D | BitMap | Bit 0: 1 = invalid position<br>Bit 1: 1 = invalid position error<br>Bit 2: 1 = invalid heading<br>Bit 3: 1 = invalid heading error<br>Bit 4: 1 = invalid speed scale factor<br>Bit 5: 1 = invalid speed scale factor error<br>Bit 6: 1 = invalid gyro bias<br>Bit 7: 1 = invalid gyro bias error<br>Bit 8: 1 = invalid gyro scale factor<br>Bit 9: 1 = invalid gyro scale factor error<br>Bit 10: 1 = invalid baseline speed scale factor<br>Bit 11: 1 = invalid baseline gyro bias<br>Bit 12: 1 = invalid baseline gyro scale factor<br>Bit 13 - 31: reserved |
| 7-10 | Reserved | 4U | - | Undefined |

Table 5.12: PollDrValid Message

**API:**

```
typedef struct
{
    UINT32 Valid;
    UINT32 Reserved;
} MI_DR_VALID;
```

### 5.2.7 PollGyrFactCal - MID 172, SID 6

| | |
|---|---|
| Number: | 0xAC |
| Name: | MID_DrIn |
| Number: | 0x06 |
| Name: | SID_PollGyrFactCal |
| Purpose: | Request gyro calibration data to be outputted |

Table 5.13: PollGyrFactCal - MID 172, SID 6

**Message Length:** 4 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range |
|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC |
| 2 | SID | 1U | - | 0x06 |
| 3 | Calibration | 1D | Bitmap | Bit 0: 1 = start gyro bias calibration<br>Bit 1: 1 = start gyro scale factor calibration |
| 4 | Reserved | 1U | - | undefined |

Table 5.14: PollGyrFactCal Message

**API:**

```
typedef struct
{
    UINT8 Cal;
    UINT8 Reserved;
} MI_GYR_FACT_CAL;
```

## 5.2.8 PollDrSensParam - MID 172, SID 7

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x07 |
| SID Name: | SID_PollDrSensParam |
| SID Purpose: | Request output of gyro and odo scale factors |

Table 5.15: PollDrSensParam - MID 172, SID 7

**Message Length:** 7 bytes

**Rate:** Input

**Binary Message Definition:**

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC | - |
| 2 | SID | 1U | - | 0x07 | - |
| 3 | Baseline Speed Scale Factor | 1U | ticks/m | 1 to 255<br>Default:4 | 1 |
| 4-5 | Baseline Gyro Bias | 2U | zero rate Volts | 2.0 to 3.0<br>Default: 2.5 | 0.0001 |
| 6-7 | Baseline Gyro Scale Factor | 2U | mV / (deg/sec) | 1 to 65<br>Default: 22 | 0.001 |

Table 5.16: PollDrSensParam Message

**API:**

```
typedef struct
{
    UINT8  BaseSsf;
    UINT16 BaseGb;
    UINT16 BaseGsf;
} MI_DR_SENS_PARAM;
```

## 5.2.9 InputCarBusData - MID 172, SID 9

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x09 |
| SID Name: | SID_InputCarBusData |
| SID Purpose: | Input Car Bus Data to NAV |

**Table 5.17: InputCarBusData - MID 172, SID 9**

**Message Length:** 22 to 182 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC | - |
| 2 | SID | 1U | - | 0x09 | - |
| 3 | Sensor Data Type (SDT) | 1U | - | 0-127<br>1: Gyro, Speed Data, and Reverse<br>2: 4 Wheel Pulses, and Reverse<br>3: 4 Wheel Speed, and Reverse<br>4: 4 Wheel Angular Speed, and Reverse<br>5: Gyro, Speed Data, NO Reverse<br>6: 4 Wheel Pulses, NO Reverse<br>7: 4 Wheel Speed, NO Reverse<br>8: 4 Wheel Angular Speed, NO Reverse<br>9: Gyro, Speed Data, Reverse, Steering Wheel Angle, Longitudinal Acceleration, Lateral Acceleration<br>10: Yaw Rate Gyro, Downward Acceleration (Z), Longitudinal Acceleration (X), Lateral Acceleration (Y)<br>10-127: Reserved | - |
| 4 | Number of Valid data sets | 1U | - | 0-11 | - |
| 5 | Reverse Bit Map not applicable for SDT = 10 | 2D | - | Bit-wise indication of REVERSE status corresponding to each sensor data set, i.e. bit 0 corresponds to the first data set, bit 1 corresponds to the second data set, etc. | - |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 7+(N- 1)* 16(1) | Valid Sensor Indication | 1U | - | Valid/Not Valid indication for each one of the 4 possible sensor inputs in a individual data set; when a particular bit is set to 1 the corresponding data is Valid, when the bit is set to 0 the corresponding data is NOT valid. Bit 0 corresponds to Data Set Time Tag Bit 1 corresponds to Odometer Speed Bit 2 corresponds to Data 1 Bit 3 corresponds to Data 2 Bit 4 corresponds to Data 3 Bit 5 corresponds to Data 4 Bits 6-7 : Reserved | - |
| 8+(N- 1)* 16(1) | Data Set Time Tag | 4U | m/s | 0-4294967295 | 1 |
| 12+ (N- 1)*16(1) | Odometer Speed (also known as VSS) N/A for SDT = 10 | 2U | m/s | 0 to 100 | 0.01 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 14+(N- 1)* 16(1) | Data 1 (Depends on SDT) | 2S | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1,5, 9,10: Gyro Rate | | Deg/sec | -120 to 120 | 0.01 |
| | SDT = 2, 6: Right Front Wheel Pulses | | - | 4000 | 1 |
| | SDT = 3, 7: Right Front Wheel Speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: Right Front Wheel Angular Speed | | rad/sec | -327.67 to 327.67 | 0.01 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 16+(N- 1)* 16(1) | Data 2 (Depends on SDT) | 2S | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1: N/A | | - | - | - |
| | SDT =2 , 6: Left Front Wheel Pulses | | - | 4000 | 1 |
| | SDT = 3, 7: Left Front Wheel Speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: Left Front Wheel Angular Speed | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9: Steering Wheel Angle | | deg | -720 to 720 | 0.05 |
| | SDT = 10: Downwards Acceleration | | m/sec² | -15 to 15 | 0.001 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 18+(N- 1)* 16[1] | Data 3 (Depends on SDT) | 2S | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1: not applicable | | - | - | - |
| | SDT = 2, 6: Right Rear Wheel Pulses | | - | 4000 | 1 |
| | SDT = 3, 7: Right Rear Wheel Speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: Right Rear Wheel Speed | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9,10:Longitudinal Acceleration | | $m/sec^2$ | -15 to 15 | 0.001 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 20+(N- 1)* 16[1] | Data 4 (Depends on SDT) | 2S | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1: not applicable | | - | - | - |
| | SDT = 2, 6: Left Rear Wheel Pulses | | - | 4000 | 1 |
| | SDT = 3, 7: Left Rear Wheel Speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: Left Rear Wheel Speed | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9,10: Lateral Acceleration | | $m/sec^2$ | -15 to 15 | 0.001 |
| 22+(N- 1)* 16[1] | Reserved | 1U | - | - | - |

Table 5.18: InputCarBusData Message

[1] N indicates the number of valid data sets in the message

API:

```
typedef struct
{
    UINT8  ValidSensorIndication;
    UINT32 DataSetTimeTag;
    UINT16 OdometerSpeed;
    INT16  Data1;
    INT16  Data2;
    INT16  Data3;
    INT16  Data4;
    UINT8  Reserved;
} tCarSensorData;

typedef struct
{
    UINT8  SensorDataType;
    UINT8  NumValidDataSets;
    UINT16 ReverseBitMap;
    tCarSensorData CarSensorData[11];
} tCarBusData;
```

### 5.2.10 CarBusEnabled - MID 172, SID 10

| | |
|---|---|
| Number: | 0xAC |
| Name: | MID_DrIn |
| Number: | 0x0A |
| Name: | SID_CarBusEnabled |
| Purpose: | Indicates Car Bus is enabled and ready for function |

Table 5.19: CarBusEnabled - MID 172, SID 10

**Message Length:** 6 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range |
|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC |
| 2 | SID | 1U | - | 0x0A |
| 3-6 | Mode(1) | 4U | - | Undefined |

Table 5.20: CarBusEnabled Message

(1) For future use.

**API:**

```
typedef struct
{
    UINT32 Mode;
} MI_DR_CAR_BUS_ENABLED;
```

### 5.2.11 CarBusDisabled - MID 172, SID 11

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x0B |
| SID Name: | SID_CarBusDisabled |
| SID Purpose: | Indicates Car Bus is disabled |

Table 5.21: CarBusDisabled - MID 172, SID 11

**Message Length:** 6 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range |
|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC |
| 2 | SID | 1U | - | 0x0B |
| 3-6 | Mode(1) | 4U | - | Undefined |

Table 5.22: CarBusDisabled Message

(1) For future use.

**API:**

```
typedef struct
{
    UINT32 Mode;
} MI_DR_CAR_BUS_DISABLED;
```

## 5.2.12 SetGenericSensorParam - MID 172, SID 12

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x0C |
| SID Name: | SID_SetGenericSensorParam |
| SID Purpose: | DR set Sensor's Parameters Input Message |

**Table 5.23: SetGenericSensorParam - MID 172, SID 12**

**Message Length:** 30 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC | - |
| 2 | SID | 1U | - | 0x0C | - |
| 3 | Sensors[0].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 4 – 5 | Sensors[0].ZeroRateVolts | 2U | volts | 0 to 5.0(1) | 0.0001 |
| 6– 7 | Sensors[0].MilliVoltsPer | 2U | millivolts | 0 to 1000(2) | 0.0001 |
| 8 – 9 | Sensors[0].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |
| 10 | Sensors[1].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 11 – 12 | Sensors[1].ZeroRateVolts | 2U | volts | 0 to 5.0 | 0.0001 |
| 13 – 14 | Sensors[1].MilliVoltsPer | 2U | millivolts | 0 to 1000 | 0.0001 |
| 15 – 16 | Sensors[1].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |
| 17 | Sensors[2].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 18 – 19 | Sensors[2].ZeroRateVolts | 2U | volts | 0 to 5.0 | 0.0001 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 20 – 21 | Sensors[2].MilliVoltsPer | 2U | millivolts | 0 to 1000 | 0.0001 |
| 22 – 23 | Sensors[2].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |
| 24 | Sensors[3].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 25 – 26 | Sensors[3].ZeroRateVolts | 2U | volts | 0 to 5.0 | 0.0001 |
| 27 – 28 | Sensors[3].MilliVoltsPer | 2U | millivolts | 0 to 1000 | 0.0001 |
| 29 – 30 | Sensors[3].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |

Table 5.24: SetGenericSensorParam Message

(1) To restore ROM defaults for ALL sensors enter the value 0xdeadabba here. You must still include the remainder of the message but these values will be ignored.

(2) For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

API:

```
typedef struct
{
    UINT8  SensorType;
    UINT32 ZeroRateVolts;
    UINT32 MilliVoltsPer;
    UINT32 ReferenceVoltage;

}MI_SensorDescriptionType;

typedef struct
{
    MI_SensorDescriptionType Sensors[MAX_NUMBER_OF_SENSORS];

} MI_DR_SENS_PARAM;
```

### 5.2.13 PollGenericSensorParam - MID 172, SID 13

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x0D |
| SID Name: | SID_PollGenericSensorParam |
| SID Purpose: | Request output of sensor scale factors |

Table 5.25: PollGenericSensorParam - MID 172, SID 13

**Message Length:** 30 bytes

**Rate:** Input

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC | - |
| 2 | SID | 1U | - | 0x0D | - |
| 3 | Sensors[0].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 4 – 5 | Sensors[0].ZeroRateVolts | 2U | volts | 0 to 5.0(1) | 0.0001 |
| 6– 7 | Sensors[0].MilliVoltsPer | 2U | millivolts | 0 to 1000(2) | 0.0001 |
| 8 – 9 | Sensors[0].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |
| 10 | Sensors[1].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 11 – 12 | Sensors[1].ZeroRateVolts | 2U | volts | 0 to 5.0 | 0.0001 |
| 13 – 14 | Sensors[1].MilliVoltsPer | 2U | millivolts | 0 to 1000 | 0.0001 |
| 15 – 16 | Sensors[1].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |
| 17 | Sensors[2].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 18 – 19 | Sensors[2].ZeroRateVolts | 2U | volts | 0 to 5.0 | 0.0001 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 20 – 21 | Sensors[2].MilliVoltsPer | 2U | millivolts | 0 to 1000 | 0.0001 |
| 22 – 23 | Sensors[2].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |
| 24 | Sensors[3].SensorType | 1U | - | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | - |
| 25 – 26 | Sensors[3].ZeroRateVolts | 2U | volts | 0 to 5.0 | 0.0001 |
| 27 – 28 | Sensors[3].MilliVoltsPer | 2U | millivolts | 0 to 1000 | 0.0001 |
| 29 – 30 | Sensors[3].ReferenceVoltage | 2U | volts | 0 to 5.0 | 0.0001 |

Table 5.26: PollGenericSensorParam Message

(1) To restore ROM defaults for ALL sensors enter the value 0xDEADABBA here. You must still include the remainder of the message but these values will be ignored.

(2) For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

API:

```
#define MAX_NUMBER_OF_SENSORS 0x4
typedef struct
{
    UINT8  SensorType;
    UINT32 ZeroRateVolts;
    UINT32 MilliVoltsPer
    UINT32 ReferenceVoltage;

}MI_SensorDescriptionType;

typedef struct
{

MI_SensorDescriptionType Sensors[MAX_NUMBER_OF_SENSORS];

} MI_DR_SENS_PARAM;
```

### 5.2.14 InputMMFData - MID 172, SID 80

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x50 |
| SID Name: | SID_InputMMFData |
| SID Purpose: | Input MMF data into Nav |

**Table 5.27: InputMMFData - MID 172, SID 80**

**Message Length:** 86 bytes

**Rate:** Input at 1Hz

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC | - |
| 2 | SID | 1U | - | 0x50 | - |
| 3 - 6 | RefGpsTow | 4U | sec | 0 to 604800.00 | 0.001 |
| 7 | NumValidDataSets(1) | 1U | - | 0 to 3 | - |
| 8 | UseDataBitMap | 1D | - | Bit 0 is LSB<br>Bit 0 :<br>1 = Position must be updated if bit 3 = 1<br>0 = Position may be updated if bit 3 = 1<br>Bit 1:<br>1 = Heading must be updated if bit 4 = 1<br>0 = Heading may be updated if bit 4 = 1<br>Bit 2:<br>1 = Altitude must be updated if bit 5 = 1<br>0 = Altitude may be updated if bit 5 = 1<br>Bit 3:<br>1 = Position provided is valid<br>0 = Position provided is NOT valid<br>Bit 4:<br>1 = Heading provided is valid<br>0 = Heading provided is NOT valid<br>Bit 5:<br>1 = Altitude provided is valid<br>0 = Altitude provided is NOT valid<br>Bit 6 to 7: Reserved. | - |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 9 – 12 | Latitude[0] | 4S | deg | -90 to 90 | 1e-7f |
| 13 – 16 | Longitude[0] | 4S | deg | -180 to 180 | 1e-7f |
| 17-20 | HorPosUncert[0] | 4U | metres | 0 to 0xffffffff | 0.01 |
| 21-24 | Altitude[0] | 4S | metre | -2000 to 120000 | 0.1 |
| 25-28 | VerPosUncert[0] | 4U | metre | 122000 | 0.1 |
| 29-30 | Heading[0] | 2U | deg | 0 to 360 | 0.01 |
| 31-32 | HeadingUncert[0] | 2U | deg | 0 to 180 | 0.01 |
| 33-34 | Reserved[0] | 2U | - | undefined | - |
| 35-38 | Latitude[1] | 4S | deg | -90 to 90 | 1e-7f |
| 39-42 | Longitude[1] | 4S | deg | -180 to 180 | 1e-7f |
| 43-46 | HorPosUncert[1] | 4U | metres | 0 to 0xffffffff | 0.01 |
| 47-50 | Altitude[1] | 4S | metre | -2000 to 120000 | 0.1 |
| 51-54 | VerPosUncert[1] | 4U | metre | 122000 | 0.1 |
| 55-56 | Heading[1] | 2U | deg | 0 to 360 | 0.01 |
| 57-58 | HeadingUncert[1] | 2U | deg | 0 to 180 | 0.01 |

| Byte # | Field | Bytes | Units | Range | Res |
|---|---|---|---|---|---|
| 59-60 | Reserved[1] | 2U | - | undefined | - |
| 61-64 | Latitude[2] | 4S | deg | -90 to 90 | 1e-7f |
| 65-68 | Longitude[2] | 4S | deg | -180 to 180 | 1e-7f |
| 69-72 | HorPosUncert[2] | 4U | metres | 0 to 0xffffffff | 0.01 |
| 73-76 | Altitude[2] | 4S | metre | -2000 to 120000 | 0.1 |
| 77-80 | VerPosUncert[2] | 4U | metre | 122000 | 0.1 |
| 81-82 | Heading[2] | 2U | deg | 0 to 360 | 0.01 |
| 83-84 | HeadingUncert[2] | 2U | deg | 0 to 180 | 0.01 |
| 85-86 | Reserved[2] | 2U | - | Undefined | - |

Table 5.28: InputMMFData Message

(1) Current implementation considers one and only one MMF packet.

API:

```
typedef struct
{
    FLOAT32     Latitude;
    FLOAT32    Longitude;
    FLOAT32    HorPosUncert;
    FLOAT32    Altitude;
    FLOAT32    VerPosUncert;
    FLOAT32    Heading;
    FLOAT32    HeadingUncert;
    UINT16    Reserved;
} tMapFeedbackData2NAV;

typedef struct
{
    UINT32    MeasurementTime;
    FLOAT32    RefGpsTow;
    UINT16    NumValidDataSets;
    UINT16    UseDataBitMap;
    tMapFeedbackData2NAV MMFData[3];
} tMapMatchedData2NAV;
```

### 5.2.15 SetMMFMode - MID 172, SID 81

**Note:**

This is defined but not used by MMF.

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x51 |
| SID Name: | SID_SetMMFMode |
| SID Purpose: | Enable or disable MMF feedback processing within NAV |

Table 5.29: SetMMFMode - MID 172, SID 81

**Message Length:** 3 bytes

**Rate:** Input

| Byte # | Field | Bytes | Range |
|---|---|---|---|
| 1 | MID | 1U | 0xAC |
| 2 | SID | 1U | 0x51 |

Table 5.30: SetMMFMode Message

**API:**

```
typedef struct
{
    FLOAT32 Latitude;
    FLOAT32 Longitude;
    FLOAT32 HorPosUncert;
    FLOAT32 Altitude;
    FLOAT32 VerPosUncert;
    FLOAT32 Heading;
    FLOAT32 HeadingUncert;
    UINT16  Reserved;
} tMapFeedbackData2NAV;


typedef struct
{
    UINT32  MeasurementTime;
    FLOAT32 RefGpsTow;
    UINT16  NumValidDataSets;
    UINT16  UseDataBitMap;
tMapFeedbackData2NAV MMFData[3];
} tMapMatchedData2NAV;
```

## 5.3 Initialize Data Source – MID 128

This message causes the receiver to restart. Optionally, it can provide position, clock drift and time data to initialize the receiver.

| | |
|---|---|
| MID (Hex) | 0x80 |
| MID (Dec) | 128 |
| Message Name in Code | `MID_NavigationInitialization` |

Table 5.31: Initialize Data Source – MID 128

Note:

Some software versions do not support this feature.

Table 5.32 contains the input values for the following example:

Do a warm start with the following initialization data: ECEF XYZ (-2686727 m, -4304282 m, 3851642 m), Clock Offset (75,000 Hz), Time of Week (86,400 sec), Week Number (924), and Channels (12). Raw track data enabled, Debug data enabled.

Example:

- `A0A20019` - Start Sequence and Payload Length (25 bytes)
- `80FFD700F9FFBE5266003AC57A000124F80083D600039C0C33` - Payload
- `0A91B0B3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| MID | 1 U | - | 80 | - | Messege ID |
| ECEF X | 4 S | - | FFD700F9 | meters | - |
| ECEF Y | 4 S | - | FFBE5266 | meters | - |

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| ECEF Z | 4 S | - | 003AC57A | meters | - |
| Clock Drift | 4 S | - | 000124F8 | Hz | - |
| Time of Week | 4 U | *100 | 0083D600 | sec | - |
| Week Number | 2 U | - | 51F | - | Extended week number (0 = no limit) |
| Channels | 1 U | - | 0C | - | Range [12:1] |
| Reset Configuration Bit Map | 1 D | - | 33 | - | See Table 5.33 |

Table 5.32: Bit Field Description

| Bit | Description |
|---|---|
| 0 | If Bit 1 = 1 and bit 3 = 0, Data valid flag:<br>0 = Ignore all earlier fields except Channels<br>1 = All earlier fields contain valid data<br><br>If Bit 3 = 1, see Table 5.34 |
| 1 | If Bit 3 = 0, warm start flag<br>1 = clear ephemeris from memory, blocks Snap or Hot start<br>If Bit 3 = 1, see Table 5.34 |
| 2 | If Bit 3 = 0, cold start flag<br>1 = clear ephemeris, last position and current time, blocks warm start<br>If Bit 3 = 1, see Table 5.34 |
| 3 | Factory start flag (1) (5)<br>0 = not a factory start<br>1 = factory start, see Table 5.34 for new meaning of other bits |
| 4 | 1 = Enable Nav Lib messages after reset |
| 5 | 1 = Enable Debug messages after reset |
| 6 | If Bit 3 = 0, no function<br>If Bit 3 = 1, see Table 5.34 (3) (5) (4) (5). |
| 7 | If Bit 3 = 0, system reset flag<br>0 = No system reset, just do GPS Stop and GPS Start for reset<br>1 = System reset, reload SRAM, restart all hardware and tasks<br>If Bit 3 = 1, no function |

Table 5.33: Reset Configuration Bits

(1) During a factory reset, if Bit 3 = 1 and Bit 0 = 1, it requests a factory reset without clearing the almanac and EE stored in flash memory. If Bit 3 = 1 and Bit 0 = 0, it requests a factory reset and clears the almanac and EE stored in flash memory.

(3) Reset of Xo model supported starting from SiRFstarIV.

(4) Clearing CW controller config settings is supported starting from the second product build release of GSD4t , and including all GSD4e product builds.

(5) During a factory reset, if Bit 3 =1 and Bit 6 =1, it requests a factory reset including clearing XO Model and CW controller configuration settings.

| Bit | Function |
|---|---|
| 0 | Non-Volatile Memory flag<br>0 = Clear data from flash memory or EEPROM<br>1 = preserve data in flash memory or EEPROM |
| [2:1] | Restart Protocol [(1)]<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 = Default protocol of receiver (reserved for later option) |
| 3 | Factory start flag = 1 |
| 4 | 1 = Enable Nav Lib messages after reset |
| 5 | 1 = Enable Debug messages after reset |
| 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) |
| 7 | No function during factory reset |

**Table 5.34: Reset Configuration Bits during Factory Reset**

[(1)] Supported only in GSD4e 4.1.2 and later.

## 5.4 Switch To NMEA Protocol – MID 129

This message switches a serial port from binary to NMEA protocol and sets message output rates and bit rate on the port.

Section 7.18 describes the scope of this message and the rules for overriding other settings of these values that may have already been stored.

Table 5.35 contains the input values for the following example:

Request the following NMEA data at 9600 bits per second:

GGA – ON at 1 sec, GLL – OFF, GSA – ON at 1 sec,

GSV – ON at 5 sec, RMC – ON at 1sec, VTG-OFF, MSS – OFF, ZDA-OFF.

Example:

- `A0A20018`-Start Sequence and Payload Length (24 bytes)
- `810201010001010105010101000100010001000100012580` - Payload
- `013AB0B3` - Message Checksum and End Sequence

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | `0x81` | - | Decimal 129 |
| Mode | 1 U | `0x02` | - | See Table 5.36 |
| GGA Message(1) | 1 U | `0x01` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum(2) | 1 U | `0x01` | - | Send checksum with GGA message |
| GLL Message | 1 U | `0x00` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum | 1 U | `0x01` | - | - |
| GSA Message | 1 U | `0x01` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum | 1 U | `0x01` | - | - |
| GSV Message | 1 U | `0x05` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum | 1 U | `0x01` | - | - |
| RMC Message | 1 U | `0x01` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum | 1 U | `0x01` | - | - |
| VTG Message | 1 U | `0x00` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum | 1 U | `0x01` | - | - |
| MSS Message | 1 U | `0x00` | sec | Output rate for MSS message |
| Checksum | 1 U | `0x01` | - | - |
| EPE Message(3) | 1 U | `0x00` | - | - |

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| Checksum[3] | 1 U | `0x00` | - | - |
| ZDA Message | 1 U | `0x00` | sec | Refer to the *NMEA Protocol Reference Manual* for format |
| Checksum | 1 U | `0x01` | - | - |
| Unused Field[4] | 1 U | `0x00` | - | - |
| Unused Field[4] | 1 U | `0x00` | - | - |
| Bit Rate[5] | 2 U | `0x2580` | - | 1200, 2400, 4800, 9600, 19200, 38400 and 57600 |

Table 5.35: Switch To NMEA Protocol – MID 129

(1) A value of 0x00 implies not to send the message. Otherwise, data is sent at 1 message every X seconds requested. E.g., to request a message to be sent every 5 seconds, request the message using a value of 0x05. The maximum rate is 1/255 sec.

(2) A value of 0x00 implies the checksum is not transmitted with the message (not recommended). A value of 0x01 has a checksum calculated and transmitted as part of the message (recommended).

(3) In SiRFNavIII software, this field is reserved for CSR's proprietary $PSRFEPE message. Otherwise it is unused.

(4) These fields are available if additional messages have been implemented in the NMEA protocol.

(5) Bit rate changes are not supported in SiRFNavIII software.



| Value | Meaning |
|---|---|
| 0 | Enable NMEA debug messages |
| 1 | Disable NMEA debug messages |
| 2 | Do not change last-set value for NMEA debug messages |

Table 5.36: Mode Values

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. E.g., TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds. i.e. (2 X 5 = 10)).

## 5.5 Set Almanac – MID 130

This message enables you to upload an almanac file to the receiver.

Note:

Some software versions do not support this command.

Example:

- `A0A20381` – Start Sequence and Payload Length (897 bytes)
- `82xx`……………….. – Payload
- `xxxxB0B3` – Message checksum and end sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1 U | - | 82 | - | Decimal 130 |
| Almanac[448] | 2 S | - | 00 | - | Reserved |

Table 5.37: Set Almanac - MID 130

The almanac data is stored in the code as a 448-element array of INT16 values. These elements are partitioned as a 32 x 14 two-dimensional array where the row represents the satellite ID minus 1 and the column represents the number of INT16 values associated with this satellite. The data is packed. The exact data format of every GPS navigation subframe and packing method is described in the *ICD-GPS-200* document, available from http://www.arinc.com.

## 5.6 Handle Formatted Dump Data – MID 131

This message requests the output of formatted data from anywhere within the receiver's memory map. It supports software development and can handle complex data types up to an array of structures. MID 10 Error 255 is sent in response to this message.

**Note:**

MID 131 is supported only in the SiRFstarII product family.

The buffer size limit is 912 bytes.

Table 5.38 contains the input values for the following example. This example shows how to output an array of elements. Each element structure appears as follows:

```
Typedef structure // structure size = 9 bytes
{
    UINT8 Element 1
    UINT16 Element 2
    UINT8 Element 3
    UINT8 Element 4
    UINT32 Element 5
} tmy_struct
tmy_struc my_struct [3]
```

Example:

- `A0A2002B` - Start Sequence and Payload Length (variable)
- `8303600010500501020101044865 6C6C6F0025326420253264202532642025326420 25313`
- `02E316C660000` - Payload
- `0867B0B3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | Unit | Description |
|---|---|---|---|---|
| | | Example | | |
| MID | 1 U | 83 | - | Decimal 131 |
| Elements | 1 U | 03 | - | Number of elements in array to dump (minimum 1) |
| Data address | 4 S | 60000150 | - | Address of the data to be dumped |
| Members | 1 U | 05 | - | Number of items in the structure to be dumped |
| Member Size | Elements S | 01 02 01 01 04 | bytes | List of element sizes in the structure. See Table 5.39 for definition of member size (total of 5 for this example) |
| Header | String length + 1 S | "Hello"0 | - | String to print out before data dump (total of 8 bytes in this example) |
| Format | String length + 1 S | "%2d %2d %2d %2d %10.1lf"0 | - | Format string for one line of output (total of 26 bytes in this example) with 0 termination |
| Trailer | String length + 1 S | 00 | - | Not used |

Table 5.38: Handle Formatted Dump Data – MID 131

Table 5.39 defines the values associated with the member size data type.

| Data Type | Value for Member Size (Bytes) |
|---|---|
| char, INT8, UINT8 | 1 |
| short int, INT16, UINT16, SINT16, BOOL16 | 2 |
| long int, float, INT32, UINT32, SINT32, BOOL32, FLOAT32 | 4 |
| long long, double INT64, DOUBLE64 | 8 |

Table 5.39: Member Size Data Type

## 5.7 Poll Software Version – MID 132

This message requests the output of the software version string. MID 6 is sent in response.

Table 5.40 contains the input values for the following example:

Poll the software version

Example:

- A0A20002 - Start Sequence and Payload Length (2 bytes)
- 8400 - Payload
- 0084B0B3 - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| MID | 1 U | - | 84 | - | Decimal 132 |
| Control | 1 U | - | 00 | - | Not used |

Table 5.40: Poll Software Version - MID 132

## 5.8 DGPS Source – MID 133

This message enables you to select the source for Differential GPS (DGPS) corrections. The default source is external RTCM SC-104 data on the secondary serial port. Options available are:

- External RTCM SC-104 Data (on any serial port prior to SiRFstarIII, but not supported in SiRFstarIII and in later product lines)
- Satellite Based Augmentation System (SBAS) – subject to SBAS satellite availability
- Internal DGPS beacon receiver (supported only on specific GPS receiver hardware)

Example 1: Set the DGPS source to External RTCM SC-104 Data

- A0A200007 - Start Sequence and Payload Length (7 bytes)
- 85020000000000 - Payload
- 0087B0B3 - Checksum and End Sequence

| Name | Bytes | Hex | Decimal | Description |
|---|---|---|---|---|
| MID | 1 U | 85 | 133 | Message Identification |
| DGPS Source | 1 U | 02 | 2 | See Table 5.43 |
| Internal Beacon Frequency | 4 U | 00000000 | 0 | Not used |
| Internal Beacon Bit Rate | 1 U | 0 | 0 | Not used |

Table 5.41: DGPS Source – MID 133, Example 1

Example 2: Set the DGPS source to Internal DGPS Beacon Receiver

Search Frequency 310000, Bit Rate 200

- A0A2007 - Start Sequence and Payload Length (7 bytes)
- 85030004BAF0C802 - Payload
- 02FEB0B3 - Checksum and End Sequence

| Name | Bytes | Hex | Unit | Decimal | Description |
|---|---|---|---|---|---|
| MID | 1 U | 85 | - | 133 | Message Identification |
| DGPS Source | 1 U | 03 | - | 3 | See Table 5.43 |
| Internal Beacon Frequency | 4 U | 0004BAF0 | Hz | 310000 | See (1) |
| Internal Beacon Bit Rate | 1 U | C8 | BPS | 200 | See (2) |

Table 5.42: DGPS Source – MID 133, Example 2

(1) Beacon frequency valid range is 283500 to 325000 Hz. A value of 0 indicates the Beacon should be set to automatically scan all valid frequencies.

(2) Bit rates can be 25, 50, 100 or 200 BPS. A value of 0 indicates the Beacon should be set to automatically scan all bit rates.

| Value | DGPS Source | Description |
|---|---|---|
| 0 | None | DGPS corrections are not used (even if available) |
| 1 | SBAS | Uses SBAS satellite (subject to availability) |
| 2 | External RTCM Data | External RTCM input source (e.g., Coast Guard Beacon) |
| 3 | Internal DGPS Beacon Receiver | Internal DGPS beacon receiver |
| 4 | User Software | Corrections provided using a module interface routine in a custom user application |

Table 5.43: DGPS Source Selections

## 5.9 Set Binary Serial Port – MID 134

This message sets the serial port values that are used when the binary protocol is activated on a 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.

Table 5.44 contains the input values for the following example:

Set Binary serial port to 9600,n,8,1.

Example:

- `A0A20009` - Start Sequence and Payload Length (9 bytes)
- `860000258008010000` - Payload
- `0134B0B3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 86 | Decimal 134 |
| Bit Rate | 4 U | 00002580 | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 |
| Data Bits | 1 U | 08 | 8 |
| Stop Bit | 1 U | 01 | 1 = 1 stop bit |
| Parity | 1 U | 00 | None = 0, Odd = 1, Even = 2 |
| Pad | 1 U | 00 | Reserved |

Table 5.44: Set Main Serial Port – MID 134

## 5.10 Set Protocol – MID 135

This message switches the protocol to another protocol. For most software, the default protocol is OSP. For SiRFstarIII software, refer to `tCtrl_ProtocolEnum in ctrl_sif.h`.

Table 5.45 contains the input values for the following example:

Set protocol to NMEA

Example:

- `A0A20002` - Start Sequence and Payload Length (2 bytes)
- `8702` - Payload
- `0089B0B3` - Message checksum and end sequence.

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 87 | Decimal 135 |
| Protocol(1) | 1 U | 02 | Null = 0<br>OSP = 1<br>NMEA = 2<br>ASCII = 3<br>RTCM = 4<br>USER1 = 5 (note1)<br>SiRFLoc = 6<br>Statistic = 7 |

Table 5.45: Set Protocol - MID 135

(1) Take care when switching to User1 protocol. Use it only when User1 protocol supports switching back to OSP.

Note:

In any system, only some of these protocols are present. Switching to a protocol that is not implemented may cause unpredictable results.

## 5.11 Mode Control – 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 results in a 2-D fix. 4 or more satellites allow a 3-D fix.

| | |
|---|---|
| MID (Hex) | 0x88 |
| MID (Dec) | 136 |
| Message Name in Code | `SIRF_MSG_SSB_SET_MODE` |

Table 5.46: Mode Control – MID 136

Table 5.47 contains the input values for the following example:

- Alt Constraining = Yes, Degraded Mode = clock then direction
- Altitude = 0, Alt Hold Mode = Auto, Alt Source = Last Computed,
- Degraded Time Out = 5, DR Time Out = 2, Track Smoothing = Yes

Example:

- `A0A2000E` - Start Sequence and Payload Length
- `880000010000000000000050201` - Payload
- `0091B0B3` - Message Checksum and End Sequence

| Name | Byte | Bineary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | 88 | - | Decimal 136 |
| Reserved | 2 U | 0000 | - | Reserved |
| Degraded Mode(1) | 1 U | 01 | - | Controls use of 2-SV and 1-SV solutions. See Table 5.50. |
| Position Calc Mode(2) | 1 D | 01 | - | See Table 5.50 |
| Reserved | 1 U | 00 | - | Reserved |
| Altitude | 2 S | 0000 | meters | User-specified altitude for Altitude Hold Mode, range -1000 to 10,000 |

| Name | Byte | Bineary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| Alt Hold Mode | 1 U | 00 | - | Controls use of 3-SV solution. See Table 5.51. |
| Alt Hold Source | 1 U | 00 | - | 0 = Use last computed altitude<br>1 = Use user-input altitude |
| Reserved | 1 U | 00 | - | Reserved |
| Degraded Time Out | 1 U | 05 | sec | 0 = disable degraded mode, 1 to 120 seconds degraded mode time limit |
| DR Time Out | 1 U | 02 | sec | 0 = disable dead reckoning, 1 to 120 seconds dead reckoning mode time limit |
| Measurement and Track Smoothing | 1 D | 03 | - | See Table 5.48 |

Table 5.47: Mode Control – MID 136

(1) Degraded Mode is not supported in GSW 3.2.5 and later. For these software versions, set this field to 4.

(2) The Position Calc Mode field is supported only for the GSD4e product and later.

| Bit Field | Description |
|---|---|
| 0 | Track Smoothing, 1 = enable |
| 1 | Measurements, 0 = Raw, 1 = smoothed |
| 2 | Software Tracking Loops 0 = enable |
| [4:3] | Channel Usage[1]<br>0 0 Acq & Nav: Full<br>0 1 Acq: Limited, Nav: Full<br>1 0 Acq: Full, Nav: Limited<br>1 1 Acq & Nav: Limited |
| [7:5] | Reserved |

Table 5.48: Measurement and Track Smoothing Field

(1) Channel Usage provides a means to control power used during acquisition (Acq) and tracking (Nav). Full uses all resources available and the most power. Limited uses less power and restricts usage to the minimum necessary to find satellites. This feature applies to GSD4t and GSD4e for software version 4.1.2 and later.

| Bit Field | Description |
|---|---|
| 0 | Almanac-Based Positioning enabled(2) |
| 1 | Reverse EE enabled(1) |
| 2 | 5 Hz Navigation enabled (1) |
| 3 | SBAS Ranging enabled(1) |
| 4 | Fast time Sync (3) (4) |
| 5-7 | Reserved |

Table 5.49: Bit Field Description, Position Calc Mode Field

(1) This option is supported on version 4.1.0 and later.

(2) This option is supported in GSD4t, GSD4e and beyond.

(3) This option is supported on version 4.1.2 and later.

(4) This option is a 4e only feature.

| Byte Value | Description |
|---|---|
| 0 | Allow 1 = SV navigation, freeze direction for 2-SV fix, then freeze clock drift for 1-SV fix |
| 1 | Allow 1 = SV navigation, freeze clock drift for 2-SV fix, then freeze direction for 1-SV fix |
| 2 | Allow 2 = SV navigation, freeze direction. Does not allow 1-SV solution. |
| 3 | Allow 2 = SV navigation, freeze clock drift. Does not allow 1-SV solution. |
| 4 | Do not allow Degraded Modes (2-SV and 1-SV navigation) |

Table 5.50: Degraded Mode

Note:

Degraded mode is not supported in GSW3.2.5 and later. Set this field to 4 for these software versions.



| Byte Value | Description |
|---|---|
| 0 | Automatically determine best available altitude to use |
| 1 | Always use user-input altitude |
| 2 | Do not use altitude hold = forces all fixes to be 3-D |

Table 5.51: Altitude Hold Mode

## 5.12 DOP Mask Control – MID 137

Dilution of Precision (DOP) is a measure of how the geometry of the satellites affects the current solution's accuracy. This message restricts use of solutions when the DOP is too high. When the DOP mask is enabled, solutions with a DOP higher than the set limit are marked invalid.

Table 5.52 contains the input values for the following example:

Auto PDOP/HDOP, GDOP = 8 (default), PDOP = 8, HDOP = 8

Example:

- `A0A20005` - Start Sequence and Payload Length (5 bytes)
- `8900080808` - Payload
- `00A1B0B3` - Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Description | tSIRF_MSG_SSB_SET_DOP_MODE | |
|---|---|---|---|---|---|
| | | | | Structure Member | Data Type |
| MID | 1 U | 89 | Decimal 137 | | |
| DOP Selection | 1 U | 00 | See Table 5.53 | mode | tSIRF_UINT8 |
| GDOP Value | 1 U | 08 | Range 1 to 50 | gdop_th | tSIRF_UINT8 |
| PDOP Value | 1 U | 08 | Range 1 to 50 | pdop_th | tSIRF_UINT8 |
| HDOP Value | 1 U | 08 | Range 1 to 50 | hdop_th | tSIRF_UINT8 |

**Table 5.52: DOP Mask Control – MID 137**

| Byte Value | Description |
|---|---|
| 0 | Auto: PDOP for 3-D fix; HDOP for 2-D fix |
| 1 | PDOP |
| 2 | HDOP |
| 3 | GDOP |
| 4 | Do Not Use |

**Table 5.53: DOP Selection**

## 5.13 DGPS Control – MID 138

This message enables you to control how the receiver uses differential GPS (DGPS) corrections.

Table 5.54 contains the input values for the following example:

Set DGPS to exclusive with a time out of 30 seconds.

Example:

- `A0A20003` - Start Sequence and payload length (3 bytes)
- `8A011E` - Payload
- `00A9B0B3` - Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | 8A | - | Decimal 138 |
| DGPS Selection | 1 U | 01 | - | See Table 5.55 |
| DGPS Time Out | 1 U | 1E | sec | Range 0 to 255 |

Table 5.54: DGPS Control – MID 138

| Byte Value | Description |
|---|---|
| 0 | Auto = Use corrections when available |
| 1 | Exclusive = Include in navigation solution only SVs with corrections |
| 2 | Never Use = Ignore corrections |

Table 5.55: DGPS Selection



Note:

DGPS Timeout interpretation varies with DGPS correction source. For an internal beacon receiver or RTCM SC-104 external source, a value of 0 means infinite timeout. (Use corrections until another one is available.) A value of 1 to 255 means use the corrections for a maximum of this many seconds.

For DGPS corrections from an SBAS source, the timeout value is ignored unless MID 170, Flag bit 0 = 1 (User Timeout). If MID 170 specifies User Timeout, a value of 1 to 255 means that SBAS corrections can be used for the number of seconds specified. A value of 0 uses the timeout specified in the SBAS satellite message (usually 18 seconds).

## 5.14 Elevation Mask – MID 139

Elevation mask is an angle above the horizon. Unless a satellite's elevation is greater than the mask, it is not used in navigation solutions. This message enables the receiver to avoid using the low elevation-angle satellites most likely to have multipath problems.

Table 5.56 contains the input values for the following example:

Set Navigation Mask to 15.5 degrees (Tracking Mask is defaulted to 5 degrees).

Example:

- `A0A20005` - Start Sequence and payload length (5 bytes)
- `8B0032009B` - Payload
- `0158B0B3` - Message checksum and end sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| MID | 1 U | - | 8B | - | Decimal 139 |
| Tracking Mask | 2 S | *10 | 0032 | degrees | Not implemented |
| Navigation Mask | 2 S | *10 | 009B | degrees | Range -20.0 to 90.0 |

Table 5.56: Elevation Mask – MID 139

Note:

A satellite with an elevation angle that is below the specified navigation mask angle is not used in the navigation solution.

## 5.15 Power Mask – MID 140

The power mask is a limit on which satellites are used in navigation solutions. Satellites with signals lower than the mask are not used.

Table 5.57 contains the input values for the following example:

Navigation mask to 33 dB-Hz (tracking default value of 28)

Example:

- `A0A20003` - Start sequence and payload length (3 bytes)
- `8C1C21` - Payload
- `00C9B0B3` - Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 U | 8C | - | Decimal 140 |
| Tracking Mask | 1 U | 1C | dBHz | Not implemented |
| Navigation Mask | 1 U | 21 | dBHz | Range 8(1) to 50 |

Table 5.57: Power Mask – MID 140

(1) The range for GSW3 and GSWLT3 is 12 to 50.

Note:

Satellites with received signal strength below the specified navigation mask signal level are not used in the navigation solution.

## 5.16 Static Navigation – MID 143

This message allows you to enable or disable static navigation to the receiver.

Example:

- A0A20002 – Start sequence and payload length (2 bytes)
- 8F01 – Payload
- 0090B0B3 – Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 8F | Decimal 143 |
| Static Navigation Flag | 1 U | 01 | 1 = enable<br>0 = disable |

Table 5.58: Static Navigation - MID 143

Note:

Static navigation is a position filter for use with motor vehicle applications. When the vehicle's speed falls below a threshold, the position and heading are frozen, and speed is set to 0. This condition continues until the computed speed rises above 1.2 times the threshold, or until the computed position is at least a set distance from the frozen place. The threshold speed and set distance may vary with software versions.

## 5.17 Poll Clock Status – MID 144

This message causes the receiver to report the most recently computed clock status. The resulting clock status is reported in MID 7.

Table 5.59 contains the input values for the following example:

Poll the clock status.

Example:

- A0A20002 - Start sequence and payload length (2 bytes)
- 9000 - Payload
- 0090B0B3 - Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 90 | Decimal 144 |
| Control | 1 U | 00 | Not used |

Table 5.59: Clock Status - MID 144

Note:

Returned message is MID 7. See Section 6.7.

## 5.18 Set DGPS Serial Port – MID 145

This message sets the serial port settings associated with the RTCM SC-104 protocol. If the RTCM SC-104 protocol is currently assigned to a port, it also changes that port's settings. Values entered are stored in *NVRAM*, battery-backed RAM, and are used whenever the RTCM protocol is assigned to a port. The settings control:

- Serial bit rate
- Parity
- Bits per character
- Stop bit length

Table 5.60 contains the input values for the following example:

Set DGPS Serial port to 9600,n,8,1.

Example:

- A0A20009 - Start sequence and payload length (9 bytes)
- 910000258008010000 - Payload
- 013FB0B3 - Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 91 | Decimal 145 |
| Bit Rate | 4 U | 00002580 | 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 |
| Data Bits | 1 U | 08 | 8,7 |
| Stop Bit | 1 U | 01 | 0,1 |
| Parity | 1 U | 00 | None = 0, Odd = 1, Even = 2 |
| Pad | 1 U | 00 | Reserved |

Table 5.60: Set DGPS Serial Port - MID 145

**Note:**

Setting the DGPS serial port using MID 145 affects COM-B only, regardless of the port being used to communicate with the evaluation receiver.

## 5.19 Poll Almanac - MID 146

This message causes the receiver to report the most recently stored almanacs. Almanacs are reported in MID 14, with a total of 32 messages sent in response.

**Note:**

Some software versions do not support this command.

Table 5.61 contains the input values for the following example:

Poll for the almanac.

Example:

- `A0A20002` - Start Sequence and payload length (2 bytes)
- `9200` - Payload
- `0092B0B3` - Message checksum and end sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 92 | Decimal 146 |
| Control | 1 U | 00 | Not used |

Table 5.61: Poll Almanac - MID 146

**Note:**

Returned message is MID 14. See *Almanac Data – MID 14*.

## 5.20 Poll Ephemeris - MID 147

This message causes the receiver to respond with the ephemeris of the requested satellite. The ephemeris is sent using MID 15. It can also request all ephemerides, resulting in as many Message 15s as there are ephemerides currently stored in the receiver.

**Note:**

Some software versions do not support this command.

Table 5.62 contains the input values for the following example:

Poll for Ephemeris Data for all satellites.

Example:

- `A0A20003` - Start sequence and payload length (3 bytes)
- `930000` - Payload
- `0092B0B3` - Message checksum and end sequence

| Name | Bytes | Binary (Hex) | Description |
|---|---|---|---|
| | | Example | |
| MID | 1 U | 93 | Decimal 147 |
| Sv ID[(1)] | 1 U | 00 | Range 0 to 32 |
| Control | 1 U | 00 | Not used |

**Table 5.62: Poll Ephemeris - MID 147**

(1) A value of 0 requests all available ephemeris records. This results in a maximum of twelve output messages. A value of 1 to 32 requests only the ephemeris of that SV.

**Note:**

Returned message is MID 15. See *Ephemeris Data (Response to Poll) – MID 15*.

## 5.21 Flash Update - MID 148

This message enables you to command the receiver to enter internal boot mode without setting the hardware bootstrap configuration input. Internal boot mode allows you to reflash the embedded code in the receiver.

**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.

Example:

- `A0A20001` – Start sequence and payload length (1 byte)
- `94` – Payload
- `0094B0B3` – Message checksum and end sequence

| Name | Bytes | Binary (Hex)<br>Example | Description |
|---|---|---|---|
| MID | 1 U | 94 | Decimal 148 |

Table 5.63: Flash Update - MID 148

Note:

Some software versions do not support this command

## 5.22 Set Ephemeris - MID 149

This message enables you to upload an ephemeris file to the receiver.

Example:

- `A0A2005B` – Start Sequence and Payload Length (91 bytes)
- `95.......` – Payload
- `xxxxB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex)<br>Example | Description |
|---|---|---|---|
| Message ID | 1 U | 95 | Decimal 149 |
| Ephemeris Data [45] | 2 U | 00 | Reserved |

Table 5.64: Set Ephemeris - MID 149

The ephemeris data for each satellite is stored as a two-dimensional array of [3][15] UNIT16 elements. The row represents three separate sub-frames. See *Ephemeris Data (Response to Poll) – MID 15*.

Note:

Some software versions do not support this command.

## 5.23 Switch Operating Modes – MID 150

This command sets the receiver into production test or normal operating mode. This version of MID 150 is supported by all products before GSD3tw.

This sets the receiver to track SV ID 6 on all channels and to collect test mode performance statistics for 30 seconds.Table 5.65 contains the input values for the following example.

Example:

- `A0A20007` – Start Sequence and Payload Length
- `961E510006001E` – Payload
- `0129B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 | 96 | - | Decimal 150 |
| Mode | 2 | 1E55 | - | 0 = Normal,<br>IE51 = Testmode1<br>IE52 = Testmode2<br>IE53 = Testmode3<br>IE54 = Testmode4 |
| SVID | 2 | 0006 | - | Satellite to track |
| Period | 2 | 001E | Second | Duration of track |

Table 5.65: Switch Operating Modes – MID 150 (all software options prior to GSD3tw)

Table 5.66 lists the input values for the following example:

Sets the receiver to track SV ID 6 on all channels and to collect test mode performance statistics for 30 seconds.

Example:

- `A0A20007` – Start Sequence and Payload Length (7 bytes)
- `961E510006001E` – Payload
- `0129B0B3` – Message Checksum and End Sequence

Test mode 5:

Example:

- `A0A2000D` – Start Sequence and Payload Length (13 bytes)
- `961E550001601E001400140014` – Payload
- `01C4B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 | 96 | - | Decimal 150 |
| Mode | 2 | 1E55 | - | 0 = normal,<br>IE51 = Testmode1<br>IE52 = Testmode2<br>IE53 = Testmode3<br>IE54 = Testmode4<br>IE55 = Testmode5 |
| SVID | 2 | 0006 | - | Satellite to track |
| Period | 2 | 001E | Second | Duration of track. Minimum duration for track in Test Mode 5 is at least 15 seconds. The recommended value = 20 seconds. |
| The following fields are only required for testmode 5 | | | | |
| Test Mode 4 Period | 2 | 0014 | Second | Test Mode 4 period. Minimum recommended period is at least 10 seconds |
| Test Mode 4 max Period | 2 | 0014 | Second | Maximum duration of testmode 4. Maximum recommended value = 60 seconds. |
| Attenuation Period | 2 | 0014 | Second | Dead time allowed for signal to drop. Maximum recommended value = 20 seconds. |

Table 5.66: Switch Operating Modes – MID 150 (LT SLC version 3.3 or later)

Table 5.67 lists the input values for the following example:

Sets the receiver to track SV ID 6 on all channels and to collect test mode performance statistics for 30 seconds.

Example:

- `A0A20008` – Start Sequence and Payload Length (8 bytes)
- `961E510006001E00` – Payload
- `0129B0B3` – Message Checksum and End Sequence

**Important Note:**

This message is supported starting at version 4.1.2 or this feature.

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| MID | 1 | - | 96 | - | Decimal 150 |
| Mode | 2 | - | 1E58 | - | 0 = normal<br>IE51 = Test Mode 1<br>IE52 = Test Mode 2<br>IE53 = Test Mode 3<br>IE54 = Test Mode 4<br>IE55 = Test Mode 5<br>IE56 = Test Mode 6<br>IE57 = Test Mode 7<br>IE58 = Test Mode 8[1]<br>IE59 = Test Mode 9[3] |
| SVID[2] | 2 | - | 6 | - | Satellite to track |
| Period[2] | 2 | - | 001E | Second | Duration of track |
| Test Mode 5 Command | 2 U | - | 0 | - | Test Mode 5 weak signal stage command. Not applicable in other test modes:<br>0 = strong signal stage (test mode step 1)<br>1 = weak signal stage (test mode step 2) |

Table 5.67: Switch Operating Modes - Message ID 150 (GSD3tw, SiRFstarIV and Later)

[1] Supported only in release 4.1.0 and later.

[2] Not applicable for TM7 and TM8.

[3] This feature is available only in TM9 specific custom builds of GSD4t, Release 4.1.2 and later.

**Note:**

In GSW3 and GSWLT3, processing this message sets MaxOffTime and MaxAcqTime to default values. This message requires MID 167 afterwards to restore these values to non-default values.

## 5.24 Set TricklePower Parameters – MID 151

This message enables you to set some of the power-saving modes of the receiver.

Table 5.68 contains the input values for the following example:

Sets the receiver to low power modes.

Example: Set the receiver to TricklePower at 1 Hz update and 200 ms on-time.

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `97000000C8000000C8` – Payload
- `00227B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| MID | 1 U | - | 97 | - | Decimal 151 |
| Push-to-Fix Mode | 2 S | - | 0000 | - | 0 = Off<br>1 = On |
| Duty Cycle | 2 S | *10 | 00C8 | % | % time On. A duty cycle of 1000 (100%) means continuous operation. |
| On-Time[(1)] | 4 S | - | 000000C8 | msc | Range 200 to 900 ms |

**Table 5.68: Set TricklePower Parameters - MID 151**

(1) On-time of 700, 800, or 900 ms is invalid if you select an update rate of 1 second.

**Computation of Duty Cycle and On Time**

Duty Cycle is the required time to be spent tracking. On-Time is the duration of each tracking period (range is 200 to 900 ms). To calculate the TricklePower update rate as a function of Duty Cycle and On Time use:

$$\text{Update Rate} = \frac{\text{On-Time (in sec)}}{\text{Duty Cycle}}$$

**Note:**

You cannot enter an on-time value > 900 msec.

Table 5.69lists examples of selections.

| Mode | On Time (ms) | Duty Cycle (%) | Interval Between Updates (sec) |
|---|---|---|---|
| Continuous[1] | 200[2] | 100 | 1 |
| TricklePower | 200 | 20 | 1 |
| TricklePower | 200 | 10 | 2 |
| TricklePower | 300 | 10 | 3 |
| TricklePower | 500 | 5 | 10 |

Table 5.69: Example Selections for TricklePower Mode of Operation

(1) When Duty Cycle is set to 100 %, the On-Time value has no effect. However, the command parser might still test the value against the 200-600 ms limits permitted for a 1-second cycle time. Therefore, CSR recommends that you set On-Time to 200 ms.

(2) When Duty Cycle is set to 100%, the value in this field has no effect. Therefore, you can use any suitable value from 100 to 900.

| On-Time (ms) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 200[1] | 200 | 100 | 67 | 50 | 40 | 33 | 29 | 25 | 22 | 20 |
| 300 | 300 | 150 | 100 | 75 | 60 | 50 | 43 | 37 | 33 | 30 |
| 400 | 400 | 200 | 133 | 100 | 80 | 67 | 57 | 50 | 44 | 40 |
| 500 | 500 | 250 | 167 | 125 | 100 | 83 | 71 | 62 | 56 | 50 |
| 600 | 600 | 300 | 200 | 150 | 120 | 100 | 86 | 75 | 67 | 60 |
| 700 | Value not permitted | 350 | 233 | 175 | 140 | 117 | 100 | 88 | 78 | 70 |
| 800 | Value not permitted | 400 | 267 | 200 | 160 | 133 | 114 | 100 | 89 | 80 |
| 900 | Value not permitted | 450 | 300 | 225 | 180 | 150 | 129 | 112 | 100 | 90 |

Table 5.70: Duty Cycles for Supporting TricklePower Settings

(1) When Duty Cycle is set to 100%, the On-Time value has no effect. However, the command parser may still test the value against the 200 to 600 ms limits permitted for a 1-second cycle time. Therefore, set the On-Time value to 200 ms.

Note:

Values are in % times 10 as required for the Duty Cycle field. For 1-second update rate, On-Times greater than 600 ms are not allowed.

Push-to-Fix

In this mode the receiver turns on every cycle period to perform a system update consisting of an RTC calibration and satellite ephemeris data collection if required (i.e. a new satellite has become visible) as well as all software tasks to support Snap Start in the event of a Non-Maskable Interrupt (NMI). Ephemeris collection time in general takes 18 to 36 seconds. If ephemeris data is not required then the system recalibrates and shuts down. In both cases, the amount of time the receiver remains off is in proportion to how long it stayed on:

$$\text{Off Period} = \frac{\text{On Period*(1-Duty Cycle)}}{\text{Duty Cycle}}$$

The off period has a possible range between 10 and 7200 seconds. The default is 1800 seconds. Use MID 167Set the Push-to-Fix cycle period.

Note:

When MID 151 is issued in GSW3 software, the receiver resets both MaxOffTime and MaxSearchTime to default values. If different values are needed, MID 151 must be issued before MID 167.

## 5.25 Poll Navigation Parameters – MID 152

This message requests the receiver to report its current navigation parameter settings. The receiver responds to this message with MID 19. Table 5.71 contains the input values for the following example:

Example: Poll receiver for current navigation parameters.

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `9800` – Payload
- `0098B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Exampl e | Description |
|---|---|---|---|
| MID | 1U | 98 | Decimal 152 |
| Reserved | 1U | 00 | Reserved |

Table 5.71: Poll Navigation Parameters – MID 152

## 5.26 SiRFNAV Command Messages

The host sends a command message to the SLC.

### 5.26.1 Store GPS Snapshot Information - MID 161, SID 7

TThis message commands the SLC to save all GPS data in non-volatile memory when this command is executed. The GPS data saved includes, but is not restricted to, AGC value, crystal uncertainty, position, ephemeris, almanac, UTC offset, SV health status, IONO, SBAS data, software version, power control parameters, SV visible list and other receiver data.

| | |
|---|---|
| Message Name | MID_SIRFNAV_COMMAND |
| MID (Hex) | 0xA1 |
| MID (Dec) | 161 |
| Message Name in Code | `MID_SSB_SIRFNAV_COMMAND` |
| SID (Hex) | 0x07 |
| SID (Dec) | 7 |
| SID Name in Code | `SSB_SIRFNAV_STORE_NOW` |

Table 5.72: Store GPS Snapshot Information - MID 161, SID 7

| Name | Bytes | Binary (Hex) Example | ASCII (Dec) Example | Description |
|---|---|---|---|---|
| MID | U1 | `0xA1` | 161 | - |
| SID | U1 | `0x07` | 7 | - |
| Reserved | U1 | - | - | - |

Table 5.73: Store GPS Snapshot Information Message

## 5.27 Set UART Configuration – MID 165

This message sets the protocol, bit rate, and port settings on any UART.

**Note:**

This message supports setting up to four UARTs.

Section 7.18 describes the scope of this message and the rules for overriding previously stored settings of these values. Table 5.74 contains the input values for the following example:

Example: Set port 0 to NMEA with 9600 bits per second, 8 data bits, 1 stop bit, no parity. Set port 1 to SiRF binary with 57600 bits per second, 8 data bits, 1 stop bit, no parity. Do not configure ports 2 and 3.

Example:

- `A0A20031` – Start Sequence and Payload Length (49 bytes)
- `A5000101000025800801000000010000000000E1000801000000FF05050000000000 000000FF0505000000000000000000` – Payload
- `0452B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | Description |
|---|---|---|---|
| | | Example | |
| MID | 1 U | A5 | Decimal 165 |
| Port[1] | 1 U | 00 | For UART 0 |
| In Protocol[2] | 1 U | 01 | For UART 0 |
| Out Protocol | 1 U | 01 | For UART 0 |
| Bit Rate[3] | 4 U | 00002580 | For UART 0 (Set to in protocol) |
| Data Bits[4] | 1 U | 08 | For UART 0 |
| Stop Bits[5] | 1 U | 01 | For UART 0 |
| Parity[6] | 1 U | 00 | For UART 0 |
| Reserved | 1 U | 00 | For UART 0 |
| Reserved | 1 U | 00 | For UART 0 |
| Port | 1 U | 01 | For UART 1 |
| In Protocol | 1 U | 00 | For UART 1 |
| Out Protocol | 1 U | 00 | For UART 1 |
| Bit Rate | 4 U | 0000E100 | For UART 1 |
| Data Bits | 1 U | 08 | For UART 1 |
| Stop Bits | 1 U | 01 | For UART 1 |
| Parity | 1 U | 00 | For UART 1 |
| Reserved | 1 U | 00 | For UART 1 |
| Reserved | 1 U | 00 | For UART 1 |
| Port | 1 U | FF | For UART 2 |
| In Protocol | 1 U | 05 | For UART 2 |
| Out Protocol | 1 U | 05 | For UART 2 |

| Name | Bytes | Binary (Hex) | Description |
|---|---|---|---|
| | | Example | |
| Bit Rate | 4 U | 00000000 | For UART 2 |
| Data Bits | 1 U | 00 | For UART 2 |
| Stop Bits | 1 U | 00 | For UART 2 |
| Parity | 1 U | 00 | For UART 2 |
| Reserved | 1 U | 00 | For UART 2 |
| Reserved | 1 U | 00 | For UART 2 |
| Port | 1 U | FF | For UART 3 |
| In Protocol | 1 U | 05 | For UART 3 |
| Out Protocol | 1 U | 05 | For UART 3 |
| Bit Rate | 4 U | 00000000 | For UART 3 |
| Data Bits | 1 U | 00 | For UART 3 |
| Stop Bits | 1 U | 00 | For UART 3 |
| Parity | 1 U | 00 | For UART 3 |
| Reserved | 1 U | 00 | For UART 3 |
| Reserved | 1 U | 00 | For UART 3 |

Table 5.74: Set UART Configuration – MID 165

(1) 0xFF means to ignore this port; otherwise, put the port number in this field (e.g. 0 or 1).

(2) 0 = SiRF Binary, 1 = NMEA, 2 = ASCII, 3 = RTCM, 4 = User1, 5 = No Protocol. All software versions only support a subset of these protocols. You may get unexpected results if you select a protocol that is not supported by the software.

(3) Valid values are 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.

(4) Valid values are 7 and 8.

(5) Valid values are 1 and 2.

(6) 0 = None, 1 = Odd, 2 = Even.

While this message supports four UARTs, the specific baseband chip in use may contain fewer.

## 5.28 Set Message Rate - MID 166

This message controls the output rate of binary messages. Table 5.75 contains the input values for the following example:

Set MID 2 to output every five seconds starting immediately.

The scope of this message and the rules for overriding other settings of these values that may have already been stored are described in Section 7.18.

Example:

- `A0A20008` – Start Sequence and Payload Length (8 bytes)
- `A6000205000000000` – Payload
- `00ADB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | Unit | Description |
|---|---|---|---|---|
| | | Example | | |
| MID | 1 U | A6 | - | - |
| Mode[1] | 1 U | 00 | - | 00: enable/disable one message<br>01: poll one message instantly<br>02: enable/disable all messages<br>03: enable/disable default navigation messages (MID 2 and 4)<br>04: enable/disable default debug messages (MID 9 and 255)<br>05: enable/disable navigation debug messages (MID 7, 28, 29, 30, and 31 |
| MID to be set | 1 U | 02 | - | - |
| Update Rate[2] | 1 U | 05 | sec | Range = 0 - 30 |
| Reserved | 1 U | 00 | - | Not used, set to zero |
| Reserved | 1 U | 00 | - | Not used, set to zero |
| Reserved | 1 U | 00 | - | Not used, set to zero |
| Reserved | 1 U | 00 | - | Not used, set to zero |

Table 5.75: Set Message Rate - MID 166

(1) Values 02 to 05 are available for GSW3, SLC3, GSD4t, GSD4e and GSD4te software only.

(2) A value of 0 stops sending the message. A value of 1 to 30 specifies the cycle period. If the value is 0, then the exception is MID 18, OkToSend. This is needed so the host side knows when it can communicate with the receiver during low-power scenarios.

## 5.29 Set Low Power Acquisition Parameters - MID 167

This message provides tools to set MaxOffTime, MaxSearchTime, Push-to-Fix period and Adaptive TricklePower as follows:

MaxOffTime: when the receiver 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 the receiver 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).

Table 5.76 contains the input values for the following example:

Set maximum time for sleep mode and maximum satellite search time to default values. Also set Push-to-Fix cycle time to 60 seconds and disable Adaptive TricklePower.

Example:

- `A0A2000F` – Start Sequence and Payload Length (15 bytes)
- `A70000753000001D4C00000003C0000` – Payload
- `031DB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | Unit | Description |
|---|---|---|---|---|
| | | Example | | |
| MID | 1 U | A7 | - | Decimal 167 |
| Max Off Time | 4 U | 00007530 | m/s | Maximum time for sleep mode. Default: 30 seconds |
| Max Search Time | 4 U | 0001D4C0 | m/s | Maximum satellite search time. Default: 120 seconds |
| Push-to-Fix Period | 4 U | 0000003C | sec | Push-to-Fix cycle period |
| Adaptive TricklePower | 2 U | 0001 | - | To enable Adaptive TricklePower:<br>0 = off<br>1 = on |

Table 5.76: Set Low Power Acquisition Parameters - MID 167

**Note:**

When MID 151 is issued in GSW3 software, the receiver resets both MaxOffTime and MaxSearchTime to default values. If you require different values, you must issue MID 151 before MID 167.

## 5.30 Poll Command Parameters - MID 168

This message queries the receiver to send specific response messages for one of the following messages: 128, 133, 136, 137, 138, 139, 140, 143 and 151. In response to this message, the receiver sends MID 43.

Table 5.77 contains the input values for the following example:

Query the receiver for current low power parameter settings set by MID 0x97.

Example:

- A0A20002 – Start Sequence and Payload Length (2 bytes)
- A897 – Payload
- 013FB0B3 – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | A8 | Decimal 168 |
| Poll Msg ID | 1 U | 97 | Requesting Msg ID 0x97(1) |

Table 5.77: Poll Command Parameters - MID 168

(1) Valid MIDs are 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8F and 0x97.

## 5.31 Set SBAS Parameters - MID 170

This message enables you to set the SBAS parameters.

Table 5.78 contains the input values for the following example:

Set WAAS (2) Regional Search Mode and assign PRN 122(7A) to region WAAS (2)

Example:

- A0A20006 – Start Sequence and Payload Length (6 bytes)
- AA020001027A – Payload Message
- 0129B0B3 – Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example |
|---|---|---|
| MID | 1 U | AA |
| SBAS PRN or Region | 1 U | 02 |
| SBAS Mode | 1 U | 00 |
| Flag Bits(1) | 1 D | 01 |
| region(2) | 1 | 02 |
| regionPrn | 1 | 7A |

Table 5.78: Set SBAS Parameters - MID 170

(1) If Bit 0 = 1, your specified timeout from MID 138 is used. If Bit 0 = 0, timeout specified by the SBAS satellite is used (usually 18 seconds). If Bit 3 = 1, the SBAS PRN specified in the SBAS PRN field is used. If Bit 3 = 0, the system searches for any SBAS PRN.

(2) Region designations are only supported in a GSW3 version to be designated. Current releases only allow auto mode and PRN in the SBAS field, and do not recognize region and regionPRN fields.

| Name | Description |
|---|---|
| MID | Decimal 170 |
| SBAS PRN or Region | Defines the SBAS to use:<br>0 = auto mode. The system chooses the best SBAS based on its internal almanacs.<br>2 to 5: specifies a system to use. The receiver selects a PRN from those designated as belonging to that system:<br>2 = WAAS<br>3 = EGNOS<br>4 = MSAS<br>5 = GAGAN.<br>20 to 138: specifies a PRN to be used as first choice. If that PRN is not found, the system searches using its defined search sequence starting at that PRN. |
| SBAS Mode | 0 = Testing mode: accepts/uses SBAS corrections even if satellite is transmitting in a test mode<br>1 = Integrity mode: rejects SBAS corrections if the SBAS satellite is transmitting in a test mode |
| Flag Bits | If Bit 0 = 1, your specified timeout from MID 138 is used.<br>If Bit 0 = 0, timeout specified by the SBAS satellite is used ( usually 18 seconds).<br>If Bit 3 = 1, the SBAS PRN specified in the SBAS PRN field is used.<br>If Bit 3 = 0, the system searches for any SBAS PRN. |
| region | Assigns a PRN to a defined region<br>0 = this feature is not being updated by this message.<br>2 to 5 designates one of the defined regions/systems. |
| regionPrn | When region field is non-zero, this field specifies the PRN to assign to the region designated in region field. |

Table 5.79: MID 170 Detailed Description

## 5.32 Initialize GPS/DR Navigation - MID 172, SID 1

This message sets the navigation initialization parameters and commands a software reset based on these parameters.

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| MID | 1 | - | - | = 0xAC |
| SID | 1 | - | - | = 0x01 |
| Latitude | 4 | - | deg | For Warm Start with user input |
| Longitude | 4 | - | deg | |
| Altitude (ellipsoid) | 4 | - | m | |
| True heading | 2 | - | deg | |
| Clock drift | 4 | - | Hz | |
| GPS time of week | 4 | 100 | sec | |
| GPS week number | 2 | - | - | |
| Channel count | 1 | - | - | |
| Reset configuration bits[1] | 1 | - | - | Bit 0: use initial data provided in this message for start-up<br>Bit 1: clear ephemeris in memory<br>Bit 2: clear all memory<br>Bit 3: perform Factory Reset<br>Bit 4: enable OSP output messages for raw track data, navigation library, 50 bps info, RTCM data, clock status, and DR status<br>Bit 5: enable debug output messages<br>Bit 6: Reserved<br>Bit 7: Reserved |



Table 5.80: Initialize GPS/DR Navigation - MID 172, SID 1

[1] Bits 0 - 3 set the reset mode: 0000 = Hot, 0010 = Warm, 0011 = Warm with user input, 0100 = Cold, 1000 = Factory.

Note:

Payload length: 28 bytes

## 5.33 Set GPS/DR Navigation Mode - MID 172, SID 2

This message sets the GPS/DR navigation mode control parameters.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | = AC |
| SID | 1 | = 0x02 |
| Mode | 1 | Bit 0 : GPS-only navigation<br>Bit 1 : DR nav acceptable with stored/default calibration<br>Bit 2 : DR nav acceptable with current GPS calibration<br>Bit 3 : DR-only navigation |
| Reserved | 1 | - |

Table 5.81: Set GPS/DR Navigation Mode - MID 172, SID 2

## 5.34 Set DR Gyro Factory Calibration - MID 172, SID 3

This message sets DR gyro factory calibration parameters.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | = 0xAC |
| SID | 1 | = 0x03 |
| Calibration | 1 | Bit 0 : Start gyro bias calibration<br>Bit 1 : Start gyro scale factor calibration<br>Bits [7:2] : Reserved |
| Reserved | 1 | - |
| Payload length: 4 bytes | | |

**Table 5.82: Set DR Gyro Factory Calibration - MID 172, SID 3**

## 5.35 Set DR Sensors' Parameters - MID 172, SID 4

Sets DR sensors parameters.

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| MID | 1 | - | - | = 0xAC |
| SID | 1 | - | - | = 0x04 |
| Base speed scale factor | 1 | - | ticks/m | - |
| Base gyro bias | 2 | $10^4$ | mV | - |
| Base gyro scale factor | 2 | $10^3$ | mV/deg/s | - |
| Payload length: 7 bytes | | | | |

Table 5.83: Set DR Sensors' Parameters - MID 172, SID 4

## 5.36 Poll DR Gyro Factory Calibration – MID 172, SID 6

This message polls the DR gyro factory calibration status.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | = AC |
| SID | 1 | = 0x06 |
| Payload length: 2 bytes | | |

Table 5.84: Poll DR Gyro Factory Calibration – MID 172, SID 6

## 5.37 Poll DR Sensors' Parameters - MID 172, SID 7

This message polls the DR sensors parameters.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | = AC |
| SID | 1 | = 0x07 |
| Payload length: 2 bytes | | |

Table 5.85: Poll DR Sensors' Parameters - MID 172, SID 7

## 5.38 Input Car Bus Data to NAV - MID 172, SID 9

This message converts sensor data output into engineering units.

| Byte | Field | Bytes | Unit | Range | Res |
|---|---|---|---|---|---|
| 1 | MID | 1U | - | 0xAC | - |
| 2 | SID | 1U | - | 0x09 | - |
| 3 | Sensor Data Type (depends on sensor) | 1U | - | 0-127<br>1: Gyro, Speed Data, and Reverse<br>2. 4 Wheel Pulses, and Reverse<br>3: 4 Wheel Speed, and Reverse<br>4: 4 Wheel Angular Speed, and Reverse<br>5: Gyro, Speed Data, NO Reverse<br>6: 4 Wheel Pulses, NO Reverse<br>7: 4 Wheel Speed, NO Reverse<br>8: 4 Wheel Angular Speed, NO Reverse<br>9: Gyro, Speed Data, Reverse, Steering Wheel Angle, Longitudinal Acceleration, Lateral Acceleration<br>10: Yaw Rate Gyro, Vertical Acceleration (Up)(Z), Longitudinal Acceleration (Front)(X), Lateral Acceleration (Left)(Y)<br>11-127: Reserved | - |
| 4 | Number of Valid data sets | 1U | - | 0-11 | - |
| 5 | Reverse Bit Map<br>N/A for SDT = 10 | 2U | - | Bit-mapped indication of REVERSE status corresponding to each sensor data set, i.e. Bit 0 corresponds to the first data set, Bit 1 corresponds to the the second data set, etc. | - |

| Byte | Field | Bytes | Unit | Range | Res |
|---|---|---|---|---|---|
| 7+(N-1)*16(1) | Valid Sensor Indication | 1U | - | Valid/Not Valid indication for all four possible sensor inputs in an individual data set.<br>Bit = 1: corresponding data is Valid<br>Bit = 0: corresponding data is not valid.<br>Bit 0 = Data Set Time Tag<br>Bit 1 = Odometer Speed<br>Bit 2 = Data 1<br>Bit 3 = Data 2<br>Bit 4 = Data 3<br>Bit 5 = Data 4<br>Bits 6-7 : Reserved | - |
| 8+(N-1)*16(1) | Data Set Time Tag | 4U | m/s | 0-4294967295 | 1 |
| 12+(N-1)*16(1) | Odometer Speed (also known as VSS), not applicable for SDT = 10 | 2U | m/s | 0 to 100 | 0.01 |
| 14+(N-1)*16(1) | **Data 1** Depends on SDT | 2S | Depends on SDT | Depends on SDT | Depends on SDT |
| | SDT = 1, 5, 9, 10: gyro rate | | Deg/sec | -120 to 120 | 0.01 |
| | SDT = 2, 6: right front wheel pulses | | - | 4000 | 1 |
| | SDT = 3, 7: right front wheel speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: right front wheel angular speed | | rad/sec | -327.67 to 327.67 | 0.01 |

| Byte | Field | Bytes | Unit | Range | Res |
|---|---|---|---|---|---|
| 16+(N-1)* 16[(1)] | **Data 2** Depends on SDT | 2S | Depends on SDT | Depends on SDT | Depends on SDT |
| | SDT = 1: not applicable | | - | - | - |
| | SDT = 2, 6: left front wheel pulses | | - | 4000 | 1 |
| | SDT = 3, 7: left front wheel speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: left front wheel angular speed | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9: steering wheel angle | | deg | -720 to 720 | 0.05 |
| | SDT = 10: downward acceleration | | $m/s^2$ | -15 to 15 | 0.001 |
| 18+(N-1)* 16[(1)] | **Data 3** Depends on SDT | 2S | Depends on SDT | Depends on SDT | Depends on SDT |
| | SDT = 1: not applicable | | - | - | - |
| | SDT = 2, 6: right rear wheel pulses | | - | 4000 | 1 |
| | SDT = 3, 7: right rear wheel speed | | m/s | 0 to 100 | 0.01 |
| | SDT = 4, 8: right rear wheel speed | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9, 10: longitudinal acceleration | | $m/s^2$ | -15 to 15 | 0.001 |

| Byte | Field | Bytes | Unit | Range | Res |
|---|---|---|---|---|---|
| 20+(N-1)* 16[1] | **Data 4** Depends on SDT | 2S | Depends on SDT | Depends on SDT | Depends on SDT |
| | SDT = 1: not applicable | | - | - | - |
| | SDT 2, 6: left rear wheel pulses | | - | 4000 | 1 |
| | SDT 3, 7: left rear wheel speed | | m/s | 0 to 100 | 0.01 |
| | SDT 4, 8: left rear wheel speed | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT 9, 10: lateral acceleration | | $m/s^2$ | -15 to 15 | 0.001 |
| 22+(N-1)* 16[1] | Reserved | 1U | - | - | - |
| Payload length: 22 to 182 bytes | | | | | |

Table 5.86: Input Car Bus Data to NAV - MID 172, SID 9

[1] N indicates the number of valid data sets in the message.

## 5.39 Car Bus Enabled - MID 172, SID 10

This message enables the car bus. Mode is reserved for future use.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | 0xAC |
| SID | 1 | 0xA |
| Mode | 4 | Reserved |
| Payload length: 6 bytes | | |

Table 5.87: Car Bus Enabled - MID 172, SID 10

## 5.40 Car Bus Disabled - MID 172, SID 11

This message disables the car bus. Mode is reserved for future use.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | 0xAC |
| SID | 1 | 0xB |
| Mode | 4 | Reserved |
| Payload length: 6 bytes | | |

**Table 5.88: Car Bus Disabled - MID 172, SID 11**



## 5.41 Input Car Bus Data 2 - MID 172, SID 14

This message converts sensor data output into engineering units.

| Byte | Field | Bytes | Unit | Range | Resolution |
|---|---|---|---|---|---|
| 1 | Message ID | 1U | - | 0xAC | - |
| 2 | Sub ID | 1U | - | 0x0E | - |
| 3 | SensorDataType | 1U | - | Fixed at 10 | - |
| 4 | NumValidDataSets | 1U | - | 0 to 10 valid data sets in message | - |
| 5 | DataFrequency | 1U | - | Fixed at 10 | - |
| 6 | ValidSensorIndication[0] | 2S | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid<br>Bit 0xFF80: Reserved | - |
| 8 | DataSetTimeTag[0] | 4U | - | 0 to 0xFFFFFFFF | - |
| 12 | Heading Gyro[0] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 14 | Z-Axis[0] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 16 | X-Axis[0]] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |

| Byte | Field | Bytes | Unit | Range | Resolution |
|---|---|---|---|---|---|
| 18 | Y-Axis[0] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 20 | Pitch Gyro[0] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 22 | Reserved[0] | 1U | - | 0 to 0xFF | 1 |
| 23 | ValidSensorIndication[1] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 25 | DataSetTimeTag[1] | 4U | - | 0 to 0xFFFFFFFF | - |
| 29 | Heading Gyro[1] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 31 | Z-Axis[1] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 33 | X-Axis[1]] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 35 | Y-Axis[1] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 37 | Pitch Gyro[1] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 39 | Reserved[1] | 1U | - | 0 to 0xFF | 1 |
| 40 | ValidSensorIndication[2] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 42 | DataSetTimeTag[2] | 4U | - | 0 to 0xFFFFFFFF | - |
| 46 | Heading Gyro[2] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 48 | Z-Axis[2] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 50 | X-Axis[2] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 52 | Y-Axis[2] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 54 | Pitch Gyro[2] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |

| Byte | Field | Bytes | Unit | Range | Resolution |
|---|---|---|---|---|---|
| 56 | Reserved[2] | 1U | - | 0 to 0xFF | 1 |
| 57 | ValidSensorIndication[3] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 59 | DataSetTimeTag[3] | 4U | - | 0 to 0xFFFFFFFF | - |
| 63 | Heading Gyro[3] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 65 | Z-Axis[3] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 67 | X-Axis[3] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 69 | Y-Axis[3] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 71 | Pitch Gyro[3] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 73 | Reserved[3] | 1U | - | 0 to 0xFF | 1 |
| 74 | ValidSensorIndication[4] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 76 | DataSetTimeTag[4] | 4U | - | 0 to 0xFFFFFFFF | - |
| 80 | Heading Gyro[4] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 82 | Z-Axis[4] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 84 | X-Axis[4] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 86 | Y-Axis[4] | 2S | M/<br>Sec^2 | ±2 Gs | 1/1668.0 |
| 88 | Pitch Gyro[4] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 90 | Reserved[4] | 1U | - | 0 to 0xFF | 1 |

| Byte | Field | Bytes | Unit | Range | Resolution |
|---|---|---|---|---|---|
| 91 | ValidSensorIndication[5] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 93 | DataSetTimeTag[5] | 4U | - | 0 to 0xFFFFFFFF | - |
| 97 | Heading Gyro[5] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 99 | Z-Axis[5] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 101 | X-Axis[5] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 103 | Y-Axis[5] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 105 | Pitch Gyro[5] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 107 | Reserved[5] | 1U | - | 0 to 0xFF | 1 |
| 108 | ValidSensorIndication[6] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 110 | DataSetTimeTag[6] | 4U | - | 0 to 0xFFFFFFFF | - |
| 114 | Heading Gyro[6] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 116 | Z-Axis[6] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 118 | X-Axis[6] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 120 | Y-Axis[6] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 122 | Pitch Gyro[6] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 124 | Reserved[6] | 1U | - | 0 to 0xFF | 1 |

| Byte | Field | Bytes | Unit | Range | Resolution |
|---|---|---|---|---|---|
| 125 | ValidSensorIndication[7] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 127 | DataSetTimeTag[7] | 4U | - | 0 to 0xFFFFFFFF | - |
| 131 | Heading Gyro[7] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 133 | Z-Axis[7] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 135 | X-Axis[7] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 137 | Y-Axis[7] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 139 | Pitch Gyro[7] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 141 | Reserved[7] | 1U | - | 0 to 0xFF | 1 |
| 142 | ValidSensorIndication[8] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 144 | DataSetTimeTag[8] | 4U | - | 0 to 0xFFFFFFFF | - |
| 148 | Heading Gyro[8] | 2 | deg/sec | ±60 degrees per second | 1/1e2 |
| 150 | Z-Axis[8] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 152 | X-Axis[8] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 154 | Y-Axis[8] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 156 | Pitch Gyro[8] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 158 | Reserved[8] | 1U | - | 0 to 0xFF | 1 |

| Byte | Field | Bytes | Unit | Range | Resolution |
|---|---|---|---|---|---|
| 159 | ValidSensorIndication[9] | 2U | - | Bit 0x1: Time tag valid<br>Bit 0x2: Reserved<br>Bit 0x4: Data[0] valid<br>Bit 0x8: Data[1] valid<br>Bit 0x10: Data[2] valid<br>Bit 0x20: Data[3] valid<br>Bit 0x40: Data[4] valid | - |
| 161 | DataSetTimeTag[9] | 4U | - | 0 to 0xFFFFFFFF | - |
| 165 | Heading Gyro[9] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 167 | Z-Axis[9] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 169 | X-Axis[9] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 171 | Y-Axis[9] | 2S | M/sec^2 | ±2 Gs | 1/1668.0 |
| 173 | Pitch Gyro[9] | 2S | deg/sec | ±60 degrees per second | 1/1e2 |
| 175 | Reserved[9] | 1U | - | 0 to 0xFF | 1 |
| Payload length: 175 bytes | | | | | |

Table 5.89: Input Car Bus Data 2 - MID 172, SID 14

## 5.42 User Set Command - MID 175

This message enables you to send an input command string and parse the associated functions.

Table 5.90 describes the message content.

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 | AF | Decimal 175 |
| User Set Command | Variable | - | Depends on your input |
| Payload length: Variable bytes | | | |

Table 5.90: User Set Command - MID 175

**Note:**

Only SDK customers can use this message.

## 5.43 Data Logger Command - MID 177

### 5.43.1 Data Logger Command - MID 177, SID 64

This message controls the state of the data logger allowing it to be started, stopped, cleared, retrieve logged data, and retrieve general status. The minimum logging interval is specified as a parameter of the start command. Current position data will be logged if the interval and other threshold criteria are met.

**Important Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | B1 |
| MID (Dec) | 177 |
| Message Name in Code | `SIRF_MSG_SSB_DL_COMMAND` |
| SID (Hex) | 40 |
| SID (Dec) | 64 |
| SID Name in Code | `SIRF_MSG_SSB_DL_CONTROL` |

Table 5.91: Data Logger Command - MID 177, SID 64

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | B1 | 177 | - | - | - | - |
| SID | U1 | 40 | 64 | - | - | - | - |
| Command | U1 | 00 | 0 | - | - | 0 - 4 | 0: Start<br>1: Stop<br>2: Clear<br>3: Retrieve Data<br>4: Retrieve Status |
| Logging Interval | U2 | 0A | 10 | sec | - | - | Minimum seconds between logging each record. Only applicable for the Start command |

Table 5.92: Message Field Description

| Message | MsgID | Command | Response (s) | MsgID |
|---|---|---|---|---|
| `DATA_LOGGING_COMMAND` | B14003 | 3 | `DATA_LOG_RECORD_OUTPUT` | E120, E121 |
| `DATA_LOGGING_COMMAND` | B14004 | 4 | `DATA_LOG_STATUS_OUTPUT` | E122 |

Table 5.93: Data Logger Command Description

### 5.43.2 Data Logger Interval - MID 177, SID 65

This message sets the minimum data logging interval. When this time is exceeded, data records will be logged if other threshold criteria are also met. This interval can be changed at any time even while data logging is active. This message will override the ‘minimum logging interval’ value set in the Data Logger Command Message.

**Important Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | B1 |
| MID (Dec) | 177 |
| Message Name in Code | `SIRF_MSG_SSB_DL_COMMAND` |
| SID (Hex) | 41 |
| SID (Dec) | 65 |
| SID Name in Code | `SIRF_MSG_SSB_DL_INTRVL` |

Table 5.94: Data Logger Interval - MID 177, SID 65

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | B1 | 177 | - | - | - | - |
| SID | U1 | 41 | 65 | - | - | - | - |
| Logging Interval | U2 | 0A | 10 | sec | - | 1-65535 | Minimum seconds between logging each record. |

Table 5.95: Message Field Description

### 5.43.3 Data Logger Threshold - MID 177, SID 66

This message sets the minimum distance and speed thresholds that must be met before logging a record. When the distance change from the last logged record exceeds the distance threshold or when the current record's speed over ground exceeds the speed threshold and when the minimum time interval has been exceeded, the data record will be logged.

These thresholds can be changed at any time even while data logging is active. Zero threshold values are always exceeded. Thresholds are OR'ed with each other and when either is zero, will result in logging at the interval controlled rate. Default Distance Threshold is 0 meters. Default Speed threshold is 0 m/s.

**Important Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | B1 |
| MID (Dec) | 177 |
| Message Name in Code | `SIRF_MSG_SSB_DL_COMMAND` |
| SID (Hex) | 42 |
| SID (Dec) | 66 |
| SID Name in Code | `SIRF_MSG_SSB_DL_THRESH` |



Table 5.96: Data Logger Threshold - MID 177, SID 66

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | B1 | 177 | - | - | - | - |
| SID | U1 | 42 | 66 | - | - | - | - |
| Distance Threshold | U2 | 0F | 15 | m | - | 0 - 65535 | Distance between current record and the previously logged record that must be exceeded to log the current record. |
| Speed Threshold | U2 | 02 | 2 | m/s | - | 0 - 65535 | The speed the current record must exceed to be logged. |

### 5.43.4 Data Logger Memory Management - MID 177, SID 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. Default record type is type 0.

Important Note:

This message is supported starting at version 4.1.2

| | |
|---|---|
| MID (Hex) | B1 |
| MID (Dec) | 177 |
| Message Name in Code | SIRF_MSG_SSB_DL_COMMAND |
| SID (Hex) | 43 |
| SID (Dec) | 67 |
| SID Name in Code | SIRF_MSG_SSB_DL_MEM |

Table 5.97: Data Logger Memory Management - MID 177, SID 67

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | B1 | 177 | - | - | - | - |
| SID | U1 | 43 | 67 | - | - | - | - |
| Stop On Memory Full | U2 | 01 | 1 | - | - | 0-1 | 0 – Circular Buffering<br>1 – Stop on full (one pass) |
| Data Record Type | U2 | 04 | 4 | - | - | 0-4 | 0 – Compatibility format<br>1 – Position<br>2 – Position + Altitude<br>3 – Position + Altitude + Speed<br>4 – Position + Altitude + Speed + Accuracy |

Table 5.98: Message Field Description

## 5.44 SW Toolbox Input - MID 178

These messages enable your system to access Tracker features via the Host. The Host maps the SSB requests from your system to MEI requests for the Tracker. This mapping is required because a direct pass-through is not always allowed. Some system requests require a corresponding change to the Host. For example, a change to the Tracker baud rate necessitates a change to the Host or communication is lost.

| | |
|---|---|
| MID (Hex) | 0xB2 |
| MID (Dec) | 178 |
| Message Name in Code | MID_TrackerIC (see PROTOCOL.H) |
| SID (Hex) | As described in this section |
| SID (Dec) | |
| SID Name in Code | |

**Table 5.99: SW Toolbox Input - MID 178, SIDs 1, 2, 3, 9, 10, 11, 20, 34, 38, 40, 66**

### 5.44.1 MeiToCustomIo - MID 178, SID 1

Message format depends on the custom I/O. Therefore, this document does not list message content. Customers will receive a separate ICD describing this message and the associated custom I/O.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | `0xB2` |
| SID | 1 | `0x01` |
| Varies | n | Depends on custom I/O |

**Table 5.100: MeiToCustomIo - MID 178, SID 1**

Response on completed command: `0x0B` (MID_ACK). On output of the SSB `0x0B` (MID_ACK) response, the Host sends the appropriate `MEI 0x1F` (Select Custom I/O) command to the Tracker.

### 5.44.2 Tracker Configuration message - MID 178, SID 2

Table 5.101 describes the scope of this message and rules for overriding settings already stored. To determine the receiver's current settings for the parameters in this message, use MID 178 SID 9. The receiver will respond with MID 178 SID 10. The payload of MID 178 SID 10 is the same format as this message.

**Note:**

When the message is processed, some items in this message take effect immediately, while others require a reset of the receiver (see table footnotes).

| Name | Bytes | Example (Hex) | Units | Example (Decimal) | Description |
|---|---|---|---|---|---|
| MID | 1U | B2 | | 178 | - |
| SID | 1U | 02 | | 2 | - |
| Reference Clock Frequency[1] | 4U | 00F9C568 (default) | Hz | 16369000 (default) | Value of attached GPS Reference Clock in Hz |
| Reference Clock Start-up Delay[1] | 2U | 03FF (default) | RTC clock cycles (31.5176 µs each) | 1023 (default) | Tracker inserts the start-up delay on GPS Reference Clock power-up. The units are RTC clock cycles (30.5176 µs each), and start-up delay can range from 0 to 2 seconds. The Tracker default is 0x03FF or 31.2 ms. |
| Reference Clock Initial Uncertainty[1] | 4U | 00000BB8 (default) | ppb | 3000 (default) | Initial GPS Reference Clock uncertainty in ppb. The value 0xFFFFFFFF means initial uncertainty unknown, and the Tracker will use the default uncertainty. |
| Clock Drift Initial Frequency[1] | 4S | 000177FA (default) | Hz | 96250 (default) | Initial Clock Drift frequency in Hz. **Note:** This value is signed. The value 0x7FFFFFFF means the initial offset is unknown, and the Tracker will use the default offset. |
| LNA [1] | 1D | 00 (default) | | 0 (default) | Bit 0 = high gain (default)<br>1 = low gain (external LNA use) |
| Configuration Enable[1] | 1D | 01 (default) | | 1 (default) | Bit 0 = IO Pin Configuration field is ignored, 1 = Use IO Pin Configuration field to set up GPIOs |

| Name | Bytes | Example (Hex) | Units | Example (Decimal) | Description |
|---|---|---|---|---|---|
| IO Pin Configuration(1) | 22U(3) | | | | Details are product specific: see Ref. 5 for IO Pin Configuration Message Application Note |
| UART Wake Up Max Preamble(2) | 1U | `00` (default) | | 0 (default) | Number of preamble byte pattern transmissions. The tracker will use this spec in subsequent transmissions to the host. |
| UART Idle byte wake up delay(2) | 1U | `00` (default) | | 0 (default) | Number of byte worth of delay between preamble transmissons. The tracker will use this spec in subsequent transmissions to the host. |
| UART Baud Rate(2) | 4U | `1C200` (default) | Baud | 115200 (default) | UART baud rate. The following is the list of valid bauds - 900, 1200, 1800, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 153600, 230400, 307200, 460800, 614400, 921600, 1228800, and 1843200. |
| UART Flow Control(2) | 1U | `00` (default) | | 0 (default) | 0 = Disable hardware flow control<br>1 = Enable hardware flow control |
| $I^2C$ Master Address (user system)(2) | 2U | `0062` (default) | | 98 (default) | Either a 7-bit or a 10-bit $I^2C$ address. If this 16-bit field begins with 0xF, then this is a flag indicating 10-bit $I^2C$ addressing is being used.<br>For a 7-bit address, only the lower 7 bits are used. For a 10-bit address, only the lower 10-bits are used.<br>For a 7-bit $I^2C$ address, this field will range from 0x0008 through 0x007F. Values lower than 0x08 have special uses (see the I2C Bus Specification for a description).<br>For a 10-bit $I^2C$ address, this field will range from 0xF000 through 0xF3FF. |

(1) These items in the message will not take effect until after the next reset of the receiver.

(2) These items in the message will take effect immediately upon completion of message processing.

(3) The length of this field was increased from 20 bytes to 22 bytes, signifying an increase in the number of IO pins from 10 to 11 for GSD4t build numbers >= 4.0.2 and for GSD4e build numbers >= 4.0.1.

| Name | Bytes | Example (Hex) | Units | Example (Decimal) | Description |
|---|---|---|---|---|---|
| $I^2C$ Slave Address (GSD4t or GSD4e) | 2U | 60 (default) | | 96 (default) | Either a 7-bit or a 10-bit $I^2C$ address. If this 16-bit field begins with 0xF, then this is a flag indicating 10-bit $I^2C$ addressing is being used. For a 7-bit address, only the lower 7 bits are used. For a 10-bit address, only the lower 10-bits are used. For a 7-bit $I^2C$ address, this field will range from 0x0008 through 0x007F. Values lower than 0x08 have special uses (see the $I^2C$ Bus Specification for a description). For a 10-bit $I^2C$ address, this field will range from 0xF000 through 0xF3FF. |
| $I^2C$ Rate | 1U | 1 (default) | | 1 (default) | 0 = 100 Kbps<br>1 = 400 Kbps (default)<br>2 = 1 Mbps (not available on GSD4t or GSD4e)<br>3 = 3.4 Mbps (not available on GSD4t or GSD4e) |
| $I^2C$ Mode | 1U | 1 (default) | | 1 (default) | 0 = Slave<br>1 = Multi-Master (default)<br>$I^2C$ Max message length 2 1F4 (default) Bytes 500 (default) Maximum message length in $I^2C$ mode |
| $I^2C$ Max message length | 2U | 1F4 | Bytes | 500 (default) | Maximum message length in $I^2C$ mode |
| Power control on/off | 1U | 0 (default) | | 0 (default) | See Table 5.102 for bit field description. |
| Power Supply Config Select | 1U | 0 (default) | | 0 (default) | 0 = Switching regulator<br>1 = Internal LDO<br>2 = External voltage<br>3 = Backup LDO |

Table 5.101: Tracker Configuration Command

| Power Control On/Off | |
|---|---|
| **Bit Field** | **Description** |
| [2:0] | Edge type |
| 0 | On/Off disabled or not detected |
| 1 | Enable Falling edge On/Off IRQ |
| 2 | Enable Rising edge On/Off IRQ |
| 3 | Enable Rising edge On, Falling edge Off IRQ |
| 4 | Enable Falling edge On, Rising edge Off IRQ |
| [4:3] | Usage type |
| 0 | No On/Off used |
| 1 | GPIO controlled On/Off |
| 2 | UartA Rx controlled On/Off |
| 3 | UartB CTS controlled On/Off |
| [5] | OFF enabled/disabled |
| 0 | OFF disabled |
| 1 | OFF enabled |
| [7:6] | Reserved |

**Table 5.102: Power Control ON/OFF Field Description**

Response on completed command: `0x0B` (MID_ACK). On SSB `0x0B` (MID_ACK) response output, the Host sends the appropriate MEI `0x0A` (Tracker Configuration) command to the Tracker if the product is a tracker product.

Note:

*SiRFHost Reference Manual* also describes the tracker configuration message in the parameters of the SiRFNav_Start() API call.

All tracker configuration setting requests in MID 178, SID 2 apply after the next reset, except UART and I²C parameter setting requests which apply immediately.

## 5.44.3 PeekPoke - Message ID 178, Sub ID 3

### 5.44.3.1 Tracker Peek and Poke Command: 4-byte Peek

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | `0xB2` |
| SID | 1 | `0x03` |
| Type | 1 | 0 = Peek, always four bytes |
| Access | 1 | 1 = 8-bit access, byte access<br>2 = 16-bit access, half-word access<br>4 = 32-bit access, word access |
| Address | 4 | Unsigned integer |
| Data | 4 | Ignored, usually filled with 0 |

**Table 5.103: Tracker Peek and Poke Command: 4-byte Peek**

Response on completed command: `0x0B` (MID_ACK). On SSB `0x0B` (MID_ACK) response output, the Host sends the appropriate MEI `0x1E` (Peek and Poke Command) command to the Tracker.

### 5.44.3.2 Tracker Peek and Poke Command: 4-byte Poke

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | `0xB2` |
| SID | 1 | `0x03` |
| Type | 1 | 1 = Poke (always four bytes) |
| Access | 1 | 1 = 8-bit access, byte access<br>2 = 16-bit access, half-word access<br>4 = 32-bit access, word access |
| Address | 4 | Unsigned integer |
| Data | 4 | - |

**Table 5.104: Tracker Peek and Poke Command:4-byte Poke**

Response on completed command: `0x0B` (MID_ACK). On SSB `0x0B` (MID_ACK) response output, the Host sends the appropriate MEI `0x1E` (Peek and Poke Command) command to the Tracker.

5.44.3.3 Tracker Peek and Poke Command: n-byte Peek

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | `0xB2` |
| SID | 1 | `0x03` |
| Type | 1 | 2 = Multi-peek |
| Access | 1 | 1 = 8-bit access, byte access<br>2 = 16-bit access, half-word access<br>4 = 32-bit access, word access |
| Address | 4 | Unsigned integer<br>Beginning address |
| Number of Bytes | 2 | Unsigned integer<br>Range: 0 to 1000<br>If 0, no data is read |

**Table 5.105: Tracker Peek and Poke Command: n-byte Peek**

Response on completed command: `0x0B` (MID_ACK). On SSB `0x0B` (MID_ACK) response output, the Host sends the appropriate MEI `0x1E` (Peek and Poke Command) command to the Tracker.

#### 5.44.3.4 Tracker Peek and Poke Command: n-byte Poke

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | `0xB2` |
| SID | 1 | `0x03` |
| Type | 1 | 3 = Multi-poke |
| Access | 1 | 1 = 8-bit access, byte access<br>2 = 16-bit access, half-word access<br>4 = 32-bit access, word access |
| Address | 4 | Unsigned integer<br>Beginning address |
| Number of Bytes | 2 | Unsigned integer:<br>Range: 0 to 1000<br>If 0, no data is written |
| Data | Number of bytes | - |

**Table 5.106: Tracker Peek and Poke Command: n-byte Poke**

Response on completed command: `0x0B` (MID_ACK). On SSB `0x0B` (MID_ACK) response output, the Host sends the appropriate MEI `0x1E` (Peek and Poke Command) command to the Tracker.

### 5.44.4 Poll Tracker Configuration - MID 178, SID 9

This message requests current tracker configuration from the receiver that will respond with SID 10.

**Note:**

This message is supported starting at 4.1.0 and supports only GSD4e (does not include GSD4t).

| | |
|---|---|
| MID (Hex) | B2 |
| MID (Dec) | 178 |
| Message Name in Code | `SIRF_MSG_SSB_TRACKER_IC` |
| SID (Hex) | 9 |
| SID (Hex) | 9 |
| SID Name in Code | `SIRF_MSG_SSB_TRKR_CONFIG_POLL` |

**Table 5.107: Poll Tracker Configuration - MID 178, SID 9**

| Name | Byte | Example |
|---|---|---|
| MID | 1U | B2 |
| SID | 1U | 09 |

Table 5.108: Message Fields Description

### 5.44.5 Poll Customer Configuration Kit Parameters – MID 178, SID 11

This message polls Customer Configuration Kit (CCK) parameters from GSD4e and later. In response the receiver will send the OSP MID 178, SID 12.

| | |
|---|---|
| MID (Hex) | B2 |
| MID (Dec) | 178 |
| Message Name in Code | SIRF_MSG_SSB_TRACKER_IC |
| SID (Hex) | 0x0B |
| SID (Dec) | 11 |
| SID Name in Code | SIRF_MSG_SSB_CCK_POLL |

Table 5.109: Poll Customer Configuration Kit Parameters – MID 178, SID 11

| Name | Bytes | Example | Example |
|---|---|---|---|
| MID | 1 | B2 | 178 |
| SID | 1 | 0B | 11 |

Table 5.110: Poll Customer Configuration Kit Parameters Message

## 5.44.6 Patch Storage Control Input - MID 178, SID 20

This message specifies where to store the patches. This message is only valid for GSD4e and PVT products and later. Section 7.18describes the scope of this message and rules for overriding settings that are already stored.

**Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | 0xB2 |
| MID (Dec) | 178 |
| Message Name in Code | `SIRF_MSG_SSB_TRACKER_IC` |
| SID (Hex) | 0x14 |
| SID (Dec) | 20 |
| SID Name in Code | `PATCH_STORAGE_CONTROL` |

Table 5.111: PatchStorageControlInput - MID 178, SID 20

| Name | Bytes | Binary (Hex) Example | ASCII (Dec) Example | Description |
|---|---|---|---|---|
| MID | 1 | `0xB2` | 178 | Message ID |
| SID | 1 | `0x14` | 20 | Sub ID |
| Patch Storage Control | 1 | - | - | See Table 5.113 |

Table 5.112: Patch Storage Control Message

| Bit Field | Description |
|---|---|
| [0] | 0 = do not store to external memory(1)<br>1 = store to external memory (default)(1) |
| [7:1] | Reserved |

Table 5.113: Patch Storage Control Message Bit Fields

(1) External memory could be I2C serial flash (EEPROM) or SPI Flash as determined by the Auto-detect feature in GSD4e ROM. For GSD4e ROM, versions prior to 4.1.2, 0 = do not store to I2C Serial flash and 1 = store to I2C serial flash.

## 5.44.7 Initial Patch Memory Load Request - MID 178, SID 34

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x22 |
| Sequence No | 2 | = 1 indicates that this load message contains patch overlay data. |
| 1st Load Type Character | 1 | If Load Patch Memory Request is being used to load patch data, then this value is set to `P` |
| 2nd Load Type Character | 1 | If Load Patch Memory Request is being used to load patch data, then this value is set to `M` |
| ROM Version Code | 2 | - |
| Patch Revision Code | 2 | - |
| Patch Data Base Address | 4 | - |
| Patch Data Length | 2 | The total byte length of the patch overlay and non-overlay sections + 2 bytes for CRC16 found in the patch file being loaded |
| Patch RAM Start Offset | 2 | Value is the offset indicating the start of the patch non-overlay section which also includes a 2 byte CRC16 value of the patch overlay section. If patch non-overlay section is not available, then this value is 0. |
| Patch Load Data | Variable ( <= 998 bytes) | The sequence of bytes to be loaded in the patch overlay section of Patch RAM. There may be one or more segment offset, segment type, segment length and segment data values embedded in the Patch Load Data and the last 2 bytes contain the 2 byte CRC16 value of the patch overlay section. |

**Table 5.114: Initial Patch Memory Load Request - MID 178, SID 34**

#### 5.44.7.1 Subsequent Patch Memory Load Request(s) (if needed)

| Field | Length (bytes) | Description |
|---|---|---|
| Message Id | 1 | 0xB2 |
| Sub Id | 1 | 0x22 |
| Sequence No | 2 | Message Sequence Number (2,...X). Message Sequence Numbers > 1 are used to indicate that the load message contains patch non-overlay data. |
| Patch Load Data | variable ( <= 1012 bytes) | Patch Load Data (The last PM Load Request will contain the Patch Payload CRC16 value) |

**Table 5.115: Subsequent Patch Memory Load Request Message Definition**

| Sequence No: | |
|---|---|
| The Sequence No is greater than 1. A Sequence No > 1 indicates load messages used to load the Patch Load Data bytes into the non-overlay section of Patch RAM. | |
| Patch Load Data: | |
| This field contains the sequence of bytes that is loaded into the non-overlay section of Patch RAM. The load message with Sequence No of 2 will contain the non-overlay segment offset and non-overlay segment length is embedded in the Patch Load Data. The last load message will also contain a 2 byte CRC16 value for the patch non-overlay section. | |

### 5.44.8 Patch Manager Exit Request - MID 178, SID 38

This message contains no MSG_DATA. It informs the GSD4e that all patch-related exchanges are complete.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x26 |

**Table 5.116: Patch Manager Exit Request - MID 178, SID 38**

## 5.44.9 Patch Manager Start Request - MID 178, SID 40

This message queries the GSD4e for its Patch Manager Prompt message. It usually indicates the start of the Patch Protocol to load a patch. This message contains no MSG_DATA.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x28 |

Table 5.117: Patch Manager Start Request - MID 178, SID 40

## 5.44.10 SW Toolbox - MID 178, SID 66

This message allows the User System to access Tracker features via the Host. The Host will map the SSB requests from the User System to MEI requests for the Tracker. The mapping is required since a direct pass-through is not always allowed. Some User System requests will require a corresponding change to the Host (for example, a change to the Tracker baud rate will require a change at the Host or communication will be lost). This message contains Tracker Configuration information, see Table 2 for message definitions of the tracker configuration.

| | |
|---|---|
| MID (Hex) | 0xB2 |
| MID (Dec) | 178 |
| Message Name in Code | SIRF_MSG_SSB_IC_CONTROL |
| SID (Hex) | 0x42 |
| SID (Dec) | 66 |
| SID Name in Code | SIRF_MSG_SSB_TRKR_CONFIG_WDELAY |

Table 5.118: SW Toolbox - MID 178, SID 66

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| MID | 1U | B2 | 178 | - | Message ID |
| SID | 1U | 42 | 66 | - | Sub ID |
| Reference Clock Frequency | 4U | 00F9C568 (default) | 16369000 (default) | Hz | Value of attached TCXO in Hz |

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| Reference Start-up Delay | 2U | 03FF (default) | 1023 (default) | RTC clock cycles | Tracker inserts the start-up delay on TCXO power-up. The units are RTC clock cycles, and start-up delay can range from 0 to 2 seconds. The Tracker default is 0x03FF or 31.2 ms |
| Reference Initial Uncertainty | 4U | 00000BB8 (default) | 3000 (default) | ppb | Initial TCXO uncertainty in ppb. The value 0xFFFFFFFF means initial uncertainty unknown, and the Tracker will use the default uncertainty. |
| Reference Initial Offset | 4S | 000177FA (default) | 96250 | Hz | Initial TCXO offset in Hz. Note this value is signed. The value 0x7FFFFFFF means the initial offset is unknown, and the Tracker will use the default offset. |
| LNA | 1U | 00 (default) | 0 (default) | - | 0 = Use Internal LNA (Tracker default)<br>1 = Use External LNA IO Pin |

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| Configuration Enable | 1U | 01 (default) | 1 (default) | - | 0 = Disable (also means all IO pins are disabled)<br>1 = Enable (use IO Pin Configuration field) |
| IO Pin Configuration | 22U | - | - | - | Details are product specific: see Ref. 5 for “IO Pin Configuration Message” Document |
| UART Wake Up Max Preamble | 1U | 00 (default) | 0 (default) | - | Number of preamble byte pattern transmissions. The tracker will use this spec in subsequent transmissions to the host. |
| UART Idle byte wake up delay | 1U | 00 (default) | 0 (default) | - | Number of byte worth of delay between preamble transmissons. The tracker will use this spec in subsequent transmissions to the host. |

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| UART Baud Rate | 4U | 0001C200 (default) | 115200 (default) | Baud | valid bauds: 900, 1200, 1800, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 153600, 230400, 307200, 460800, 614400, 921600, 1228800, and 1843200. |
| UART Flow Control | 1U | 00 (default) | 0 (default) | - | 0 = Disable hardware flow control<br>1 = Enable hardware flow Control. |

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| I²C Master Address (user system) | 2U | 0062 (default) | 98 (default) | - | Either a 7-bit or a 10-bit I²C address. If this 16-bit field begins with 0xF, then this is a flag indicating 10-bit I²C addressing is being used. For a 7-bit address, only the lower 7 bits are used. For a 10-bit address, only the lower 10-bits are used. For a 7-bit I²C address, this field will range from 0x0008 through 0x007F. Values lower than 0x08 have special uses (see the I²C Bus Specification for a description). For a 10-bit I²C address, this field will range from 0xF000 through 0xF3FF. |

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| $I^2C$ Slave Address (GSD4t or GSD4e) | 2U | 60 (default) | 96 (default) | - | Either a 7-bit or a 10-bit $I^2C$ address. If this 16-bit field begins with 0xF, then this is a flag indicating 10-bit $I^2C$ addressing is being used. For a 7-bit address, only the lower 7 bits are used.<br>For a 10-bit address, only the lower 10-bits are used. For a 7-bit $I^2C$ address, this field will range from 0x0008 through 0x007F.<br>Values lower than 0x08 have special uses (see the $I^2C$ Bus Specification for a description).<br>For a 10-bit $I^2C$ address, this field will range from 0xF000 through 0xF3FF. |
| $I^2C$ Rate | 1U | 01 (default) | 1 (default) | - | 0 = 100 Kbps<br>1 = 400 Kbps (default)<br>2 = 1 Mbps (not available on GSD4t or GSD4e)<br>3 = 3.4 Mbps (not available on GSD4t or GSD4e) |

| Name | Bytes | Example (Optional) | | Unit | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| $I^2C$ Mode | 1U | 01 (default) | 1 (default) | - | 0 = Slave<br>1 = Multi-Master (default)<br>$I^2C$ Max message length 2 1F4 (default) Bytes 500 (default) Maximum message length in $I^2C$ mode |
| $I^2C$ Max | 2U | 1F4 | 500 | Bytes | Maximum message |
| message length | - | (default) | (default) | - | length in $I^2C$ mode |
| Power control on/off | 1U | 00 (default) | 0 (default) | - | - |
| Power Supply Configuration Select | 1U | 00 (default) | 0 (default) | - | 0 = Switching regulator<br>1 = Internal LDO<br>2 = External voltage<br>3 = Backup LDO |
| Host Wake-Up Delay | 1U | 00 (default) | 0 (default) | usec | Message is delayed by this value after the Host Wake-Up Pin has been toggled to ACTIVE |
| Host Wake-Up Pin Polarity | 1U | 01 (default) | 1 (default) | - | 0 = Active HIGH (IO Pin is toggled to HIGH state)<br>1 = Active LOW (IO Pin is toggled to LOW state)S |

## 5.45 GSC2xr Preset Operating Configuration - MID 180

**Note:**

This Message ID (180) is used only with GSC2xr chip.

This message overrides the Preset Operating Configuration as defined in bits [3:2] of the GSC2xr chip configuration register. Table 5.119describes the valid input values mapped to the Preset Operating Configuration.

| Mapping | |
|---|---|
| Input Values | Preset Configuration |
| 0 | 1 |
| 1 | 2 |
| 2 | 3 |
| 3 | 4 |
| 4 | Standard GSW2 and GSW2x software configuration Default(1) |

**Table 5.119: Valid Input Values**

(1) The default configuration is OSP at 38400 bps using UART A and RTCM at 9600 bps using UART B.

Table 5.120 contains the input values for the following example:

Set receiver to Standard GSW2 Default Configuration.

Example:

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `B404` – Payload
- `00B8B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 | B4 | Decimal 180 |
| Input(1) | 1 | 04 | Valid input value from 0 to 4 |

**Table 5.120: GSC2xr Preset Operating Configuration - MID 180**

(1) In the SiRFDemo response view, invalid input values produce a Rejected MID_UserInputBegin message. Valid input values produce an Acknowledged MID_UserInputBegin response.

| New Config | Nav Status | Config 4 | Config 3 | Config 2 | Config 1 |
|---|---|---|---|---|---|
| UARTA | - | NMEA v2.2 | NMEA v2.2 | OSP | NMEA v2.2 |
| UARTB | - | RTCM | RTCM | NMEA v2.2 | OSP |
| Build | - | GSWx2.4.0 and greater | GSWx2.4.0 and greater | GSWx2.4.0 and greater | GSWx2.4.0 and greater, Adaptive TricklePower @ 300,1 |
| UARTA bit rate | - | 4800 n, 8, 1 | 19200 n, 8, 1 | 57600 n, 8, 1 | 4800 n, 8, 1 |
| UARTB bit rate | - | 9600 n, 8, 1 | 9600 n, 8, 1 | 115200 n, 8, 1 | 38400 n, 8, 1 |
| OSP Output Messages[(1)] | - | 2, 4, 9, 13, 18, 27, 41, 52 | 2, 4, 9, 13, 18, 27, 41, 52 | 2, 4, 9, 13, 18, 27, 41, 52 | 2, 4, 9, 13, 18, 27, 41, 52 |
| NMEA Messages | - | RMC, GGA, VTG, GSA (GSV@ 1/5 Hz), ZDA | GGA, GLL, GSA, GSV, RMC, VTG, ZDA | GGA, GLL, GSA, GSV, RMC, VTG, ZDA | GGA, GLL, GSA, GSV, RMC, VTG, ZDA |
| GPIO A (GPIO 1) | No Nav | On | On | On | On |
| | Nav | 100 ms on, 1 Hz | 100 ms on, 1 Hz | 100 ms on, 1 Hz | 100 ms on, 1 Hz |
| GPIO B (GPIO 3) | No Nav | Off | Off | Off | Off |
| | Nav | 100 ms on, 1 Hz | 100 ms on, 1 Hz | 100 ms on, 1 Hz | 100 ms on, 1 Hz |
| GPIO C (GPIO 13) | No Nav | On | On | On | On |
| | Nav | 1s on, 1s off | 1s on, 1s off | 1s on, 1s off | 1s on, 1s off |

| New Config | Nav Status | Config 4 | Config 3 | Config 2 | Config 1 |
|---|---|---|---|---|---|
| GPIO D (GPIO 2) | No Nav | Off | Off | Off | Off |
| | Nav | On | On | On | On |
| Static Filter | - | Off | Off | Off | Off |
| Track Smoothing | - | On | On | On | On |
| WAAS | - | Disabled | Enabled | Enabled | Disabled |
| DR | - | Off | Off | Off | Off |

Table 5.121: GSC2xr Preset Operating Configurations

(1) OSP Messages: 2 – Measured Nav Data, 4 – Measured Track Data, 9 – Through Put, 13 – Visible List, 18 – OK to Send, 27 – DGPS Status, 41 – Geodetic Nav Data, 52 – 1 PPS Time Message.

## 5.46 Software Control - MID 205

This message is used by GSW3 and GSWLT3 software (versions 3.2.5 and later) and by subsequent product lines for generic input.

| Field | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 | CD | Decimal 205 |
| SID | 1 | 10 | Sub-ID |
| Data | - | - | Varies with SID |
| Payload length: Variable | | | |

Table 5.122: Software Control - MID 205

### 5.46.1 Software Commanded Off - MID 205, SID 16

This message shuts down the chip.

| Field | Bytes | Binary (Hex) | Description |
|---|---|---|---|
| | | Example | |
| MID | 1 | CD | Decimal 205 |
| SID | 1 | 10 | Message Sub ID for software commanded off |
| Payload length: 2 bytes | | | |

Table 5.123: Software Commanded Off - M ID 205, SID 16

## 5.47 Position Request - MID 210

| | |
|---|---|
| MID (Hex) | 0xD2 |
| MID (Dec) | 210 |
| Message Name in Code | `MID_POS_REQ` |

Table 5.124: Position Request - MID 210

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| MID | 1 | - | - |
| POS_REQ_ID | 1 | - | - |
| NUM_FIXES | 1 | - | - |
| TIME_BTW_FIXES | 1 | 1 | Second |
| HORI_ERROR_MAX | 1 | - | Metres |
| VERT_ERROR_MAX | 1 | - | - |
| RESP_TIME_MAX | 1 | 1 | Second |
| TIME_ACC_PRIORITY | 1 | - | - |
| LOCATION_METHOD | 1 | - | - |

Table 5.125: Position Request Message

POS_REQ_ID: Position request identifier: a number from 0 to 255 for the SLC to identify the position response (69, 1) and the corresponding measurement response (69, 2) Messages with this associated position request MID 210.

NUM_FIXES: Number of requested MS positions (fixes): The CP sets this field to the number of MS Position messages it requires the CP to return. If NUM_FIXES = 0, SLC sends MS position continuously to CP. If NUM_FIXES = 1, TIME_BTW_FIXES is ignored.

TIME_BTW_FIXES: Time elapsed between fixes: The CP sets this field to the minimum time between two consecutive fixes of the NUM_FIXES sequence triggered by this request, in second units, from 0 to 255 seconds. 0 = one fix case. The time is minimized so that if the tracking is temporarily lost during the sequence of fixes, the time between two consecutive fixes can be larger than TIME_BET_FIXES to enable the receiver to reacquire satellites and resume the position fixes delivery. Advanced Power Management (APM) can also affect the actual time between fixes.

HORI_ERROR_MAX: Maximum requested horizontal error: The CP sets this field in meters fro 1 to 30,600. 0x00 = No Maximum. The SLC tries to provide a position with horizontal error less than this specified value in more than 95% of the cases.

The scaling factor in the 4 MSB's of the Time Accuracy field is used to derive the maximum horizontal error value in meters from the value of the HOR_ERROR_MAX field in this message as Table 5.126 shows.

| 4 MSB from Time Accuracy Priority | Scale Factor | Horizontal Error Value Range (m) | HOR_ERROR_MAX Field Value Range |
|---|---|---|---|
| 0 | 1/1 | 0–255 | 0–255 |
| 1 | 1/5 | 0–1275 | 0–255 |
| 2 | 1/10 | 0–2550 | 0–255 |
| 3 | 1/20 | 0–5100 | 0–255 |
| 4 | 1/30 | 0–7650 | 0–255 |
| 5 | 1/40 | 0–10200 | 0–255 |
| 6 | 1/50 | 0–12750 | 0–255 |
| 7 | 1/60 | 0–15300 | 0–255 |
| 8 | 1/70 | 0–17850 | 0–255 |
| 9 | 1/80 | 0–20400 | 0–255 |
| 10 | 1/90 | 0–22950 | 0–255 |
| 11 | 1/100 | 0–25500 | 0–255 |
| >11 | 1/120 | 0–30600 | 0–255 |

Table 5.126: Maximum Horizontal Error Description

Note:

Scale factors other than 1/1 are supported in PVT products starting from build 4.1.0.

VERT_ERROR_MAX: Maximum requested vertical error

The CP sets this field to the maximum requested vertical position error according to Table 5.127.

| Values | Position Error (in metres) |
|---|---|
| 0x00 | <1 |
| 0x01 | <5 |
| 0x02 | <10 |
| 0x03 | <20 |
| 0x04 | <40 |
| 0x05 | <80 |
| 0x06 | <160 |
| 0x07 | No Maximum |
| 0x08 – 0xFF | Reserved |

Table 5.127: Vertical Error Field

The SLC tries to provide a position with vertical error less than this specified value in more than 95% of the cases.

Note:

> The Position Request OSP message and the APM request message both specify QoS parameters and time between fixes. The APM request overrides the Position Request parameter values override the values in the APM tranzition request. After the response sequence to the Position Request message has completed, the QoS criteria revert back to the APM specified values.

RESP_TIME_MAX: Maximum response time

The CP sets this field to the maximum requested response time, as an unsigned binary, in seconds. The value 0 is reserved for No Time Limit.

TIME_ACC_PRIORITY: Time/accuracy priority

The 4 MSBs determine whether TTFF or the position accuracy criteria has priority. To indicate no time limit for a fix, MAX_RESP_TIME is set to 0. Otherwise, if MAX_RESP_TIME and the HORI_ERROR_MAX/VERT_ERROR_MAX fields contradict eachother, the TIME_ACC_PRIORITY field determines which one has priority as coded according to Table 5.128.

| TIME_ACC_PRIORITY | Description |
|---|---|
| 0x00 | No priority imposed |
| 0x01 | RESP_TIME_MAX has priority over HORI_ERROR_MAX/VERT_ERROR_MAX |
| 0x02 | HORI_ERROR_MAX/VERT_ERROR_MAX has priority over RESP_TIME_MAX |
| 0x03 | Entire RESP_TIME_MAX used. Effective only in builds SN4_GSD4t_4.0.2-B7 or later. |
| 0x04 – 0x0F | Reserved |

Table 5.128: Time/Accuracy Priority Field

The 4 MSBs determine the scale of maximum horizontal error as code in Table 5.129.

| 4 MSBs from Time Accuracy Priority | Scale Factor |
|---|---|
| 0 | 1/1 |
| 1 | 1/5 |
| 2 | 1/10 |
| 3 | 1/20 |
| 4 | 1/30 |
| 5 | 1/40 |
| 6 | 1/50 |
| 7 | 1/60 |
| 8 | 1/70 |
| 9 | 1/80 |
| 10 | 1/90 |
| 11 | 1/100 |
| >11 | 1/120 |

Table 5.129: Time Accuracy Priority 4 MSBs Description

**Note:**

The 4 MSB values are supported in PVT products starting from build 4.1.0.

0x00: Position fix is reported when either TTFF or the position accuracy criteria is met, whichever event occurs first.

0x01: TTFF has priority. The position fix is reported when RESP_TIME_MAX expires, regardless of the estimated position accuracy at that time and specified in this request.

0x02: Position accuracy has priority. The position fix is not reported until the position accuracy is estimated to be less than HORI_ERROR_MAX and/or VERT_ERROR_MAX.

0x03: Position fixes are reported at RESP_TIME_MAX, regardless of the position accuracy estimated at that time and specified in this request. Even if a good fix meets HORI_ERROR_MAX and/or VERT_ERROR_MAX earlier than RESP_TIME_MAX, the position fix is not reported until time reaches RESP_TIME_MAX. This setting is supported only in builds SN4_GSD4t_4.0.2-B7 and later.

LOCATION_METHOD: GPS Location Method

The CP sets this field according to the requested location method as described in Table 5.130.

| LOCATION_METHOD | Description |
|---|---|
| xxxx 0000 | MS Assisted |
| xxxx 0001 | MS Based |
| xxxx 0010 | MS Based is preferred, but MS Assisted is allowed |
| xxxx 0011 | MS Assisted is preferred, but MS Based is allowed |
| xxxx 0100 | Simultaneous MS Based and MS Assisted |
| xx00 xxxx | No change to default ABP processing setting |
| xx01 xxxx | Enable ABP processing with override of default setting |
| xx10 xxxx | Disable ABP processing with override of default setting |
| 00xx xxxx | No change to default Reverse EE processing setting |
| 01xx xxxx | Enable Reverse EE processing with override of default setting |
| 10xx xxxx | Disable Reverse EE processing with override of default setting |
| All others | Reserved |

Table 5.130: GPS Location Method Description

Note:

PVT builds from 4.1.0 and later support reverse EE bits.

## 5.48 Set Ionospheric Model - MID 211, SID 1

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | SET_IONO |

Table 5.131: Set Ionospheric Model - MID 211, SID 1

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| MID | 8 | - | - | - |
| SID | 8 | - | - | - |
| ALPHA_0 | 8(1) | $2^{-30}$ | Seconds | Ionosphere correction parameter $\beta_3$: The CP sets this field to the value contained in the associated parameter of the specified GPS ephemeris. |
| ALPHA_1 | 8(1) | $2^{-27}$ | sec/semicircles | |
| ALPHA_2 | 8(1) | $2^{-24}$ | sec/(semicircles)$^2$ | |
| ALPHA_3 | 8(1) | $2^{-24}$ | sec/(semicircles)$^3$ | |
| BETA_0 | 8(1) | $2^{11}$ | Seconds | |
| BETA_1 | 8(1) | $2^{14}$ | sec/semicircles | |
| BETA_2 | 8(1) | $2^{16}$ | sec/(semicircles)$^2$ | |
| BETA_3 | 8(1) | $2^{16}$ | sec/(semicircles)$^3$ | |

Table 5.132: Set Ionospheric Model Message

(1) Two's complement with the bit sign (+ or -) occupying the MSB

## 5.49 Set Satellite Ephemeris and Clock Corrections - MID 211, SID 2

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | SET_EPH_CLOCK |

**Table 5.133: Set Satellite Ephemeris and Clock Corrections - MID 211, SID 2**

| Field | Length (bits) | Description |
|---|---|---|
| MID | 8 | - |
| SID | 8 | - |
| NUM_SVS | 8 | Number of satellites for which satellite ephemeris and clock corrections are being given with this message |
| EPH_FLAG | 8 | Ephemeris parameter validity flag: The CP sets this field.<br>= 1 if fields from SV_PRN_NUM to AF0 are valid broadcast ephemeris parameters. If these fields are not valid, The CP sets this field and the following fields from SV_PRN_NUM to AF0 to 0.<br>= 0 if ephemeris parameters are not present in this AI3 message. The client then keeps its internal ephemeris data.<br>= 2 if the following fields from SV_PRN_NUM to AF0 are valid synthesized ephemeris parameters (ephemeris extension). |
| SV_PRN_NUM | 8 | Satellite PRN number: The CP sets this field to the value of the PRN number for which the ephemeris is valid. It is represented as an unsigned binary value from 1 to 32. |
| URA_IND | 8 | User range accuracy index: The CP sets this field to the URA index of the SV. The URA index is a number from 0 to 15. Table 5.136 shows URA coding. |

**Table 5.134: Set Satellite Ephemeris and Clock Corrections Message part 1**

**Note:**

The structure of ephemeris parameters repeats for the number of times indicated in the NUM_SVS field.

**EPH_FLAG**: Other values are interpreted as follows:

- Bit 5 (Bit 0 is LSB) = the type of ephemeris extension (EE):
  - 0 = server-based EE
  - 1 = client-based EE
- Bit 0 to Bit 4 represents the age of EE:
  - 2 = valid ephemeris extension of age of 1-day
  - 3 = valid ephemeris extension of age of 2-day
  - 4 = valid ephemeris extension of age of 3-day
  - 5 = valid ephemeris extension of age of 4-day
  - 6 = valid ephemeris extension of age of 5-day
  - 7 = valid ephemeris extension of age of 6-day
  - 8 = valid ephemeris extension of age of 7-day

For example: 0x22 represents a client-based ephemeris extension of age 1, while 0x02 represents a server-based ephemeris extension of age 1.

For an unhealthy SV, i.e. when SV health is not equal to 0, a separate UNHEALTHY_SAT_FLAG section might be included.

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| IODE | 8 | - | - | Issue of data |
| C_RS | 16(1) | $2^{-5}$ | Meters | Amplitude of the sine harmonic correction term to the orbit radius |
| DELTA_N | 16(1) | $2^{-43}$ | semi-circles/sec | Mean motion difference from the computed value |
| M0 | 32(1) | $2^{-31}$ | semi-circles | Mean anomaly at the reference time |
| C_UC | 16(1) | $2^{-29}$ | Radians | Amplitude of the cosine harmonic correction term to the argument of latitude |
| ECCENTRICITY | 32 | $2^{-33}$ | N/A | Eccentricity |
| C_US | 16(1) | $2^{-29}$ | Radians | C_US Amplitude of the sine harmonic correction term to the argument of latitude |
| A_SQRT | 32 | $2^{-19}$ | meters | Square root of the semi-major axis |
| TOE | 16 | $2^{4}$ | Seconds | Ephemeris reference time. The SLC accepts the associated parameter if:<br>1. The internal ephemeris has a TOE (e.g. int_TOE) that is in the past compared to this TOE<br>2. int_TOE is in the future compared to this TOE, and ((TOE * 16) mod 3600) != 0 |
| C_IC | 16(1) | $2^{-29}$ | Radians | Amplitude of the cosine harmonic correction term to the angle of inclination |

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| OMEGA_0 | 32(1) | $2^{-31}$ | semi-circles | Longitude of ascending node of orbit plane at weekly epoch |
| C_IS | 16(1) | $2^{-29}$ | Radians | Amplitude of the sine harmonic correction term to the angle of inclination. ANGLE_INCLINATION Inclination angle at reference time. The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris. |
| ANGLE_INCLINATION | 32(1) | $2^{-31}$ | semi-circles | - |
| C_RC | 16(1) | $2^{-5}$ | Meters | Amplitude of the cosine harmonic correction term to the orbit radius |
| OMEGA | 32(1) | $2^{-31}$ | semi-circles | Argument of perigee |
| OMEGADOT | 32(1) | $2^{-43}$ | semi-circles/sec | Rate of right ascension |
| IDOT | 16(1) | $2^{-43}$ | semi-circles/sec | Rate of inclination angle |
| TOC | 16 | 24 | Seconds | Clock data reference time |
| T_GD | 8(1) | $2^{-31}$ | Seconds | L1 and L2 correction term |
| AF2 | 8(1) | $2^{-55}$ | sec/sec² | Apparent satellite clock correction $\alpha_{f2}$ |
| AF1 | 16(1) | $2^{-43}$ | sec/sec | Apparent satellite clock correction $\alpha_{f1}$ |
| AF0 | 32(1) | $2^{-31}$ | Seconds | Apparent satellite clock correction $\alpha_{f0}$ |

**Table 5.135: Set Satellite Ephemeris and Clock Corrections Message part 2**

(1) Two's complement with the bit sign (+or-) occupying the MSB

**Note:**

The CP sets these fields to the value contained in the associated parameter of the specified GPS ephemeris.

| URA Index | URA (meters) |
|---|---|
| 0 | 0.00 < URA ≤ 2.40 |
| 1 | 2.40 < URA ≤ 3.40 |
| 2 | 3.40 < URA ≤ 4.85 |
| 3 | 4.85 < URA ≤ 6.85 |

| URA Index | URA (meters) |
|---|---|
| 4 | 6.85 < URA ≤ 9.65 |
| 5 | 9.65 < URA ≤ 13.65 |
| 6 | 13.65 < URA ≤ 24.00 |
| 7 | 24.00 < URA ≤ 48.00 |
| 8 | 48.00 < URA ≤ 96.00 |
| 9 | 96.00 < URA ≤ 192.00 |
| 10 | 192.00 < URA ≤ 384.00 |
| 11 | 384.00 < URA ≤ 768.00 |
| 12 | 768.00 < URA ≤ 1536.00 |
| 13 | 1536.00 < URA ≤ 3072.00 |
| 14 | 3072.00 < URA ≤ 6144.00 |
| 15 | 6144.00 < URA (or no accuracy prediction is available) |

**Table 5.136: URA Coding**

## 5.50 Set Almanac Assist Data - MID 211, SID 3

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | SET_ALM |

**Table 5.137: Set Almanac Assist Data - MID 211, SID 3**

| Field | Length (bits) | Description |
|---|---|---|
| MID | 8 | - |
| SID | 8 | - |
| ALM_WEEK_NUM | 16 | The GPS week number of the almanac: equals the 10 least significant bits of the GPS week number of the almanac, from 0 to 1024 |
| NUM_SVS | 8 | Number of satellites for which almanac assistance is being given with this message |

Table 5.138: Set Almanac Assist Data Message part 1

Note:

The structure of ephemeris parameters repeats for the number of times indicated in the NUM_SVS field.

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| ALM_VALID_FLAG | 8 | N/A | N/A | Almanac validity flag.<br>= 1 if fields ALM_SV_PRN_NUM to ALM_AF1 are valid. If these fields are not valid, the CP sets this field and fields ALM_SV_PRN_NUM to ALM_AF1 to 0. For a sub-almanac that is not present (i.e. not because of SV bad health, but because aiding data is absent), ALM_VALID_FLAG is set to 0 (0x00). In this case, the client preserves the sub-almanac it has in its memory without overwriting it with the sub-almanac data in this message. |
| ALM_SV_PRN_NUM | 8 | N/A | N/A | The value of the SV PRN number for which the almanac is valid as an unsigned value from 1 to 32. |
| ALM_ECCENTRICITY | 16 | $2^{-21}$ | Dimensionl ess | Eccentricity: the value contained in the associated parameter of the specified GPS almanac |
| ALM_TOA | 8 | $2^{12}$ | Seconds | The reference time of the almanac: unit is 4096 seconds, from 0 to 602,112 seconds |
| ALM_DELTA_INCL | 16[1] | $2^{-19}$ | Semicircles | Delta inclination |
| ALM_OMEGADOT | 16[1] | $2^{-38}$ | Semicircles/ sec | Rate of right ascension |

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| ALM_A_SQRT | 24 | $2^{-11}$ | $\text{Meters}^{1/2}$ | Square root of the semi-major axis |
| ALM_OMEGA_0 | 24(1) | $2^{-23}$ | Semicircles | Longitude of ascending node of orbit plane at weekly epoch |
| ALM_OMEGA | 24(1) | $2^{-23}$ | Semicircles | Argument of perigee |
| ALM_M0 | 24(1) | $2^{-23}$ | Semicircles | Mean anomaly at reference time |
| ALM_AF0 | 16(1) | $2^{-20}$ | Seconds | Apparent satellite clock correction $a_{f0}$ |
| ALM_AF1 | 16(1) | $2^{-38}$ | Sec/sec | Apparent satellite clock correction $a_{f1}$ |

Table 5.139: Set Almanac Assist Data Message part 2

(1) Two's complement with the bit sign (+or-) occupying the MSB

Note:

Fields ALM_DELTA_INCL to ALM_AF1 are set to the value contained in the associated parameter of the specified GPS almanac.

## 5.51 Set Acquisition Assistance Data - MID 211, SID 4

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name in Code | SET_ACQ_ASSIST |

Table 5.140: Set Acquisition Assistance Data - MID 211, SID 4

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| MID | 8 | - | - | |
| SID | 8 | - | - | |
| REFERENCE_TIME | 32 | 0.001 | Seconds | GPS Time Reference for Acquisition Assistance Data: the CP sets this field to the GPS seconds since the beginning of the current GPS week at which the acquisition assistance data is valid, in binary format, in units of 1/1000 seconds, from 0s to 604,799.999 seconds. |
| NUM_SVS | 8 | - | - | Number of satellites for which acquisition assistance data is being set with this message |

Table 5.141: Set Acquisition Assistance Data Message

Note:

The acquisition assistance parameters structure repeats the number of times set by the NUM_SVS field.

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| ACQ_ASSIST_VALID_FLAG | 8 | - | - | Acquisition Assistance Data Validity Flag: the CP sets this field to 1 if the fields SV_PRN_NUM to ELEVATION are valid. If these fields are not valid, the CP sets this field and the following fields from SV_PRN_NUM to ELEVATION to 0. |
| SV_PRN_NUM | 8 | - | - | Satellite PRN Number: the CP sets this field to the value of the PRN number for which acquisition assistance data is valid. It is an unsigned binary value from 1 to 32, where the binary value of the field is the satellite PRN number. |
| DOPPLER0 | 16(1) | 2.5 | Hz | The 0th Order Doppler: the CP sets this field to the two's complement value of the 0th order Doppler, in units of 2.5 Hz, from –5,120 Hz to 5,120 Hz. The CP shall set this field to 0xF7FF (decimal -2049) if the 0th order Doppler is unknown. |
| DOPPLER1 | 8 | 1/64 | Hz/s | The 1st Order Doppler: CP sets this field to the two's complement value of the1st order Doppler, in units of 1/64 Hz/s from –1 Hz/s to +1 Hz/s. The CP sets this field to 0xBF (decimal -65) if the 1st order Doppler is unknown. |
| DOPPLER_UNCERTAINTY | 8 | See Table 5.143 | | The Doppler uncertainty: |

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| SV_CODE_PHASE | 16 | 1 | Chips | Code Phase: The CP sets this field to the code phase in units of 1 C/A code chip from 0 to 1022 chips. The offset is specified in reference to the current millisecond boundary. |
| SV_CODE_PHASE_INT | 8 | 1 | Millise conds | The Integer Number of C/A Code Periods That Have Elapsed Since The Latest GPS Bit Boundary: The CP sets this field to the number of the C/A code periods that have elapsed since the latest GPS bit boundary, in units of C/A code period (1 ms), from 0 to 19. |
| GPS_BIT_NUM | 8 | - | - | The Two Least Significant Bits of The Bit Number (Within The GPS Frame) Being Currently Transmitted: The CP sets this field to represent the two least significant bits of the bit number being received at REFERENCE_TIME, from 0 to 3. |
| CODE_PHASE_UNCERTAINTY | 16 | 1 | Chips | Code Phase Uncertainty: The CP sets this field to the value of the code phase uncertainty, in units of 1 C/A code chip, from 0 to 1023 chips. |
| AZIMUTH | 16 | 1 | Degre es | Azimuth Angle of the GPS Satellite: The CP sets this field to the azimuth, in units of 1 degree, from 0 to 359 degrees. The CP sets this field to 0xFFFF if the azimuth angle is unknown. |
| ELEVATION | 8 | 1 | Degre es | Elevation Angle of the GPS Satellite: The CP sets this field to the elevation angle, in units of 1 degree, from -90 to 90 degrees. The CP sets this field to 0xFF if the elevation angle is unknown |

**Table 5.142: Set Acquisition Assistance Data Message**

(1) Two's complement with the bit sign (+or-) occupying the MSB

| DOPPLER_UNCERTAINTY Value | Doppler Uncertainty |
|---|---|
| ‘00000000’ | 200 Hz |
| ‘00000001’ | 100 Hz |
| ‘00000010’ | 50 Hz |
| ‘00000011’ | 25 Hz |
| ‘00000100’ | 12.5 Hz |
| ‘00000101’ – ‘11111110’ | Reserved |
| ‘11111111’ | Doppler uncertainty is unknown |

Table 5.143: DOPPLER_UNCERTAINTY Field

## 5.52 Set Real-Time Integrity - MID 211, SID 5

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | SET_RT_INTEG |

Table 5.144: Set Real-Time Integrity - MID 211, SID 5

| Field | Bytes | Description |
|---|---|---|
| MID | 1 | - |
| SID | 1 | - |
| UNHEALTHY_SAT_INFO | 4 | Information on unhealthy satellite: A 32-bit field indicates which satellite is unhealthy.<br>Bit 0 = satellite PRN number 1<br>Bit 31 = satellite PRN number 32<br>Bit set to 1 = unhealthy satellite. If a satellite is considered unhealthy, the SLC does not use it for search or position computation.<br>Bit set to 0 = the satellite is considered healthy by the aiding source.<br>For all position modes the SLC tries to collect satellite health information on its own. SLC uses the latest satellite health information (either from OSP messages or from self collection). If this information is never received by the SLC during a session, SLC shall use its internal information. |

Table 5.145: Set Real-Time Integrity Message

## 5.53 Set UTC Model - MID 211, SID 6

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x06 |
| SID (Dec) | 6 |
| SID Name in Code | SET_UTC_MODEL |

Table 5.146: Set UTC Model - MID 211, SID 6

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| MID | 8 | - | - | - |
| SID | 8 | - | - | - |
| R_A0 | 32 | $2^{-30}$ | seconds | Constant term of polynomial (raw) |
| R_A1 | 32(24) | $2^{-50}$ | sec/sec | The first order term of polynomial (raw) |

| Field | Length (bits) | Scale | Unit | Description |
|---|---|---|---|---|
| R_DELTA_TLS | 8 | 1 | seconds | Delta time due to leap seconds (raw) |
| R_T_OT | 8 | $2^{12}$ | seconds | Reference time for UTC Data (raw) |
| R_WN_T | 8 | 1 | weeks | UTC reference week number (raw) |
| R_WN_LSF | 8 | 1 | weeks | Week number at which the scheduled future or recent past leap second becomes effective (raw) |
| R_DN | 8 | 1 | days | Day number at the end of which the scheduled future or recent past leap second becomes effective (raw) |
| R_ DELTA_T_LSF | 8 | 1 | seconds | Delta time due to the scheduled future or recent past leap second (raw) |

Table 5.147: Set UTC Model Message

**Note:**

The CP sets all fields (except DELTA_T_LSF which is set by the GPS Data Center) to the value contained in the associated parameter of the UTC data.

## 5.54 Set GPS TOW Assist - MID 211, SID 7

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x07 |
| SID (Dec) | 7 |
| SID Name in Code | SET_GPS_TOW_ASSIST |

Table 5.148: Set GPS TOW Assist - MID 217, SID 7

| Field | Length (bits) | Description |
|---|---|---|
| M ID | 8 | - |
| SID | 8 | - |
| NUM_SVS | 8 | Number of satellites for which GPS TOW assistance data is being given with this message |
| TOW_ASSIST_SV_PRN_NUM | 8 | Satellite PRN Number that the GPS_TOW_ASSIST information belongs to. The value 0 indicates that the corresponding GPS_TOW_ASSIST parameters are not valid. |
| TLM_MSG | 16(14) | Telemetry work Telemetry word broadcast by the specified satellite |
| TOW_ASSIST_INFO<br>(This field contains the Anti-Spoof, Alert and TLM Reserved parameters) | 8(1+1+2) | Additional TOW Assist Information:<br>Bit 3 = 1-bit Anti-Spoof parameter broadcast by the specified satellite<br>Bit 2 = 1-bit Alert parameter broadcast by the specified satellite<br>Bits [1:0] (LSB) = 2-bit TLM Reserved parameter broadcast by the specified satellite |

Table 5.149: Set GPS TOW Assist Message I

Note:

The structure of the GPS TOW assistance parameters repeats the number of times indicated by the NUM_SVS field.

## 5.55 Set Auxiliary Navigation Model Parameters - MID 211, SID 8

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x08 |
| SID (Dec) | 8 |
| SID Name in Code | SET_AUX_NAV |

Table 5.150: Set Auxiliary Navigation Model Parameters - MID 211, SID 8

| Field | Length (bits) | Description |
|---|---|---|
| MID | 8 | - |
| SID | 8 | - |
| NUM_SVS | 8 | Number of satellites for which auxiliary navigation model parameters are being given with this message |
| NAVMODEL_SV_PRN_NUM | 8 | Satellite ID number for the NAVMODEL PRN number of the satellite that the NAVMODEL belongs to:<br>0 = corresponding NAVMODEL parameters are not valid |
| NAVMODEL_TOE | 16 | Time of Ephemeris of the NAVMODEL in seconds. Scale is $2^4$ [(2)].<br>The SLC accepts the associated parameter if:<br>■ The internal NavModel parameters have a TOE, e.g int_TOE, that is in the past compared to this NAVMODEL_TOE<br>■ int_TOE is in the future compared to NAVMODEL_TOE, and ((TOE * 16) mod 3600) != 0. |
| NAVMODEL_IODC | 16(10)[(1)] | Issue of Data, Clock of the NAVMODEL: the 10-bit IODC that corresponds to the ephemeris of the specified satellite |
| NAVMODEL_SF1_L2_INFO | 8(2+1)[(1)] | Bit 0 (LSB) = 1-bit L2 P Data Flag found in bit 91 of subframe 1 of the specified satellite's navigation message.<br>Bits [2:1] = the 2-bit C/A or P on L2 found in Bits 71 and 72 of subframe 1 of the specified satellite's navigation message |
| NAVMODEL_SF1_SV_HEALTH | 8(6)[(1)] | Bits [5:0] (LSB) = 6-bit SV Health found in subframe 1 of the specified satellites' navigation message |
| NAVMODEL_SF1_RESERVED | 88(87)[(1)] | The LSB 7 bits of the first byte and the next 10 bytes = the 87 reserved bits found in subframe 1 of the specified satellites' navigation message. The MSB valid bit in the first byte is transmitted from the satellite first. |
| NAVMODEL_SF2_AODO_FIT_INTERVAL | 8(1+5) | Bit 5 = 1-bit Fit Interval Flag found in subframe 2 of the specified satellite's navigation message<br>Bits [4:0] (LSB) = 5-bit AODO found in subframe 2 of the specified satellite's navigation message |

Table 5.151: Set Auxiliary Navigation Model Parameters message

[(1)] The number in parentheses indicates the actual number of bits of the parameter. If multiple parameters are included in a field, the number of bits for each parameter are connected by the + sign.

[(2)] ICD GPS 200C describes the parameters in detail.

Note:

The structure of auxiliary navigation model parameters repeats the number of times indicated by the NUM_SVS field.

## 5.56 Push Aiding Availability - MID 211, SID 9

| | |
|---|---|
| MID (Hex) | 0xD3 |
| MID (Dec) | 211 |
| Message Name in Code | MID_SET_AIDING |
| SID (Hex) | 0x09 |
| SID (Dec) | 9 |
| SID Name in Code | SET_AIDING_AVA IL |

Table 5.152: Push Aiding Availability - MID 211, SID 9

| Field | Length (Bytes) | Description |
|---|---|---|
| MID | 1 | - |
| SID | 1 | - |
| AIDING_AVAILABILITY_MASK | 1 | Mask to indicate the type of aiding available<br>Bit 0=1: Position aiding accuracy has improved, EST_HOR_ER and EST_VER_ER are valid;<br>Bit 0=0: Position aiding status has not changed<br>Bit 1=1: Frequency aiding available, REL_FREQ_ACC valid;<br>Bit 1=0: Frequency aiding status has not changed<br>Bit 2=1: Time aiding available, TIME_ACCURACY valid;<br>Bit 2=0: Time aiding status has not changed<br>The SLC may or may not request for aiding based on this availability mask. Once the aiding response is sent to the SLC, the SLC may not use the new aiding if the uncertainty level of the new aiding is not as good as SLC's internal information. |

| Field | Length (Bytes) | Description |
|---|---|---|
| FORCED_AIDING_REQ_MASK | 1 | Mask to indicate the type of aiding that the CP would like to force the SLC to re-request<br>Bit 0=1: Position aiding source has changed, SLC shall re-request for new aiding;<br>Bit 1=1: Frequency aiding source has changed, SLC shall re-request for new aiding;<br>Bit 2 = 1: SLC shall re-request for new time aiding<br>■ This mask indicates the type(s) of aiding that the SLC shall request again. The SLC shall re-request regardless of the uncertainty level of the new aiding, but shall accept and use the aiding response only if the uncertainty is better than what the SLC has internally when the SLC is not navigating.<br>■ When the SLC is navigation, the SLC may accept the aiding with better uncertainty. For example, if SLC is navigating with a 2D-position with no GPS week number, when a forced time and position aiding re-request comes in, the SLC shall request for time and position (using Time Transfer Request and Approximate MS Position Request). The SLC will only accept and use the GPS week number, and the height information in the new aiding. However, if the SLC is navigating with full knowledge of time, when a forced time aiding comes in, the SLC will request for time aiding, but it will not use the new time aiding. |
| EST_HOR_ER | 1 | See Table 5.186 |
| EST_VER_ER | 2 | |
| REL_FREQ_ACC | 1 | See Table 5.193 |
| TIME_ACCURACY_SCALE | 1 | Scale factor used to encode the time accuracy:<br>TIME_ACCURACY_SCALE =0 => time_scale = 1.0<br>TIME_ACCURACY_SCALE =1 => time_scale = 0.125<br>TIME_ACCURACY_SCALE =0xFF => time accuracy unknown<br>All other values are reserved. |
| TIME_ACCURACY | 1 | Time accuracy of the aiding:<br>If time_scale (obtained from TIME_ACCURACY_SCALE) is 1.0, Table 5.189 is used to get the time accuracy.<br>If time_scale is 0.125, Table 5.190 is used to get the time accuracy.<br>0xFF = unknown accuracy |
| SPARE | 2 | |

Table 5.153: Push Aiding Availability Message

## 5.57 Ephemeris Status Request - MID 212, SID 1

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| MID Name | MID_STATUS_REQ |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name | EPH_REQ |

Table 5.154: Ephemeris Status Request - MID 212, SID 1

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |

Table 5.155: Ephemeris Status Request Message

## 5.58 Almanac Request - MID 212, SID 2

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| MID Name | MID_STATUS_REQ |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name | ALM_REQ |

Table 5.156: Almanac Request - MID 212, SID 2

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |

Table 5.157: Almanac Request Message

## 5.59 Broadcast Ephemeris Request - MID 212, SID 3

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| MID Name | MID_STATUS_REQ |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name | B_EPH_REQ |

Table 5.158: Broadcast Ephemeris Request - MID 212, SID 3

| Field | Lenght (Bytes) | Description |
|---|---|---|
| MID | 1 | - |
| SID | 1 | - |
| EPH_RESP_TRIGGER | 2 | Broadcast Ephemeris Response Message Trigger(s):<br>Bit 0 (LSB): 1 = output the available broadcast ephemeris once if the available broadcast ephemeris is newer than the one specified by valid GPS_WEEK and TOE (EPH_INFO_FLAG = 1). When GPS_WEEK and TOE are not valid (EPH_INFO_FLAG = 0), output the available broadcast ephemeris once<br>Bit 1: 1 = output broadcast ephemeris according to rules specified in Bit 0, then output broadcast ephemeris only when the broadcast ephemeris is updated (not necessarily changed)<br>Bit 2: 1 = output broadcast ephemeris according to rules specified in Bit 0, then output broadcast ephemeris only when the broadcast ephemeris is changed<br>Bits [15:3]: (MSB) Reserved<br>Only 1 of Bits 0, 1 and 2 can be set at one time |
| NUM_SVS | 1 | Number of satellites for which broadcast ephemeris is being requested with this message |
| EPH_INFO_FLAG | 1 | Broadcast Ephemeris Information Validity Flag:<br>Set to 1 if fields from SV_PRN_NUM to TOE are valid<br>Set to 0 if fields from SV_PRN_NUM to TOE are not valid |
| SV_PRN_NUM | 1 | Value of the PRN number for which the broadcast ephemeris information is valid. This is an unsigned binary value from 1 to 32. When EPH_INFO_FLAG = 0, set SV_PRN_NUM = 0. |
| GPS_WEEK | 2 | Broadcast Ephemeris Reference Week: the value of GPS week number of the broadcast ephemeris. When EPH_INFO_FLAG = 0, set GPS_WEEK = 0. |
| TOE | 2 | Broadcast Ephemeris Reference Time in seconds. Scale = 16.<br>When EPH_INFO_FLAG = 0, set TOE = 0.<br>Seconds |

**Table 5.159: Broadcast Ephemeris Request Message**



Note:

The structure of auxiliary navigation model parameters below repeats a number of times as indicated by the NUM_SVS field.

# 5.60 Time Frequency Approximate Position Status Request - MID 212, SID 4

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| MID Name | MID_STATUS_REQ |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name | TIME_FREQ_APPROX_POS_REQ |

Table 5.160: Time Frequency Approximate Position Status Request - MID 212, SID 4

| Field | Length (Bytes) | Description |
|---|---|---|
| M ID | 1 | - |
| SID | 1 | - |
| REQ_MASK | 1 | Request mask:<br>Bit 0 (LSB): {0,1} => {Time status not requested, Time (gps week number and tow) status requested}<br>Bit 1 (LSB): {0,1} => {Time accuracy status not requested, Time accuracy status requested}<br>Bit 2: {0,1} => {Frequency status not requested, Frequency status requested}<br>Bit 3: {0,1} => {ApproximatePosition status not requested, ApproximatePosition status requested} |

Table 5.161: Time Frequency Approximate Position Status Request Message

## 5.61 Channel Load Query - MID 212, SID 5

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| Message Name in Code | MID_STATUS_REQ |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | CH_LOAD_REQ |

Table 5.162: Channel Load Query - MID 212, SID 5

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| PORT | 1 |
| MODE | 1 |

Table 5.163: Channel Load Query Message

**PORT**: Serial Port A or B:

The CP sets this field to the port number you want to query the load:

0 = Port A

1 = Port B

Other values are meaningless.

**MODE**: Response Mode:

The CP sets this field according to Table 5.164. If the periodic mode is enabled, the Channel load response is output once per second.

| Values | Description |
|---|---|
| 0x00 | Turn off sending periodic message[(1)] |
| 0x01 | Turn on sending periodic message[(2)] |
| 0x02 | Send message only once |
| 0x03 to 0xFF | Reserved |

Table 5.164: MODE Field

(1) No specific acknowledge nor further Channel Load Response message shall be sent after reception of this message.

(2) Periodic response is sent every second.

## 5.62 Client Status Request - MID 212, SID 6

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| MID Name | MID_STATUS_REQ |
| SID (Hex) | 0x06 |
| SID (Dec) | 6 |
| SID Name | CLIENT_STATUS_REQ |

Table 5.165: Client Status Request - MID 212, SID 6

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |

Table 5.166: Client Status Request Message

## 5.63 OSP Revision Request - MID 212, SID 7

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| MID Name | MID_STATUS_REQ |
| SID (Hex) | 0x07 |
| SID (Dec) | 7 |
| SID Name | OSP_REV_REQ |

Table 5.167: OSP Revision Request - MID 212, SID 7

| Field | Length (Bytes) |
|---|---|
| MID | 1 |
| SID | 1 |

Table 5.168: OSP Revision Request Message

## 5.64 Serial Port Setting Request - MID 212, SID 8

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| Message Name in Code | MID_STATUS_REQ |
| SID (Hex) | 0x08 |
| SID (Dec) | 8 |
| SID Name in Code | SERIAL_SETTINGS_REQ |

Table 5.169: Serial Port Setting Request - MID 212, SID 8

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| BAUD_RATE | 4 |
| DATA_BITS | 1 |
| STOP_BIT | 1 |
| PARITY | 1 |
| PORT | 1 |
| Reserved | 1 |

Table 5.170: Serial Port Setting Request Message

BAUD_RATE: The CP sets this field to the required baud rate.

Current baud rates supported are 4800, 9600, 19200, 38400, 57600, and 115200 bps. Other values are illegal. The baud rate is coded as its equivalent binary value, for example:

4800 bps is coded as 000012C0 in hexadecimal equivalent.

115200 bps is coded 0001C200 in hexadecimal equivalent.

Important Note:

> Warning note for 4e: Operation at speeds below 38400 bps carries a risk of dropped messages when using SGEE.

DATA_BITS: Represents how many data bits are used per character.

STOP_BIT: Stop bit lengthm, e.g. 1 = 1 stop bit.

PARITY: None = 0, Odd = 1, Even = 2

PORT: Serial Port A or B: The CP sets this value to the port number that is being configured:

0 = port A, 1 = port B. Any other value are meaningless.

## 5.65 TX Blanking Request - MID 212, SID 9

| | |
|---|---|
| MID (Hex) | 0xD4 |
| MID (Dec) | 212 |
| Message Name in Code | `MID_STATUS_REQ` |
| SID (Hex) | 0x09 |
| SID (Dec) | 9 |
| SID Name in Code | `TX_BLANKING_REQ` |

Table 5.171: TX Blanking Request - MID 212, SID 9

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| COMMAND | 1 |
| AIR_INTERFACE | 1 |
| MODE | 1 |
| Reserved | 4 |

Table 5.172: TX Blanking Request Message

COMMAND: Message command:

Valid values are:

0 = enable the receiver to start TX Blanking

1 = stop TX Blanking

AIR_INTERFACE: The air interface for which the SLC should perform the TX blanking. 0 = the GSM air interface.Other values are currently invalid.

MODE: TheTX Blanking Mode the receiver should do.

| Values | Description |
|---|---|
| 0x00 | Reserved |
| 0x01 | Required for GSM in SiRFstarIV products |
| 0x02 to 0xFF | Reserved |

Table 5.173: MODE Field

## 5.66 Session Opening Request - MID 213, SID 1

| | |
|---|---|
| MID (Hex) | 0xD5 |
| MID (Dec) | 213 |
| Message Name in Code | MID_SESSION_CONTROL_REQ |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | SESSION_OPEN_REQ |

Table 5.174: Session Opening Request - MID 213, SID 1

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| SESSION_OPEN_REQ_INFO | 1 |

Table 5.175: Session Opening Request Message

SESSION_OPEN_REQ_INFO: Session open request information. Set value according toTable 5.176.

| Value | Description |
|---|---|
| 0x00 to 0x70 | Reserved |
| 0x71 | Session opening request |
| 0x72 to 0x7F | Reserved |
| 0x80 | Session resume requested |
| 0x81 to 0xFF | Reserved |

Table 5.176: SESSION_OPEN_REQ_INFO Field

## 5.67 Session Closing Request - MID 213, SID 2

| | |
|---|---|
| MID (Hex) | 0xD5 |
| MID (Dec) | 213 |
| Message Name in Code | MID_SESSION_CONTROL |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | SESSION_CLOSE_REQ |

Table 5.177: Session Closing Request - MID 213, SID 2

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| SESSION_CLOSE_REQ_INFO | 1 |

Table 5.178: Session Closing Request Message

**SESSION_CLOSE_REQ_INFO**: Session closing request information. Set the value according to Table 5.179.

| Value | Description |
|---|---|
| 0x00 | Session Closing requested |
| 0x01 to 0x7F | Reserved |
| 0x80 | Session Suspend requested |
| 0x81 to 0xFF | Reserved |

Table 5.179: SESSION_CLOSE_REQ_INFO Field

## 5.68 Hardware Configuration Response - MID 214

| | |
|---|---|
| MID (Hex) | 0xD6 |
| MID (Dec) | 214 |
| Message Name in Code | `MID_HW_CONFIG_RESP` |

Table 5.180: Hardware Configuration Response - MID 214

The Hardware Configuration Response message is output by the CP after startup when receives the hardware config request message from the SLC. After each startup and the hardware config request message is received, a Hardware Configuration Response message should be sent.

| Field | Bytes |
|---|---|
| MID | 1 |
| HW_CONFIG | 1 |
| NOMINAL_FREQ | 5 |
| NW_ENHANCE_TYPE | 1 |

Table 5.181: Hardware Configuration Response Message

**HW_CONFIG**: Hardware configuration information: set according to Table 5.182.

| Bits in HW_CONFIG | Value | CONFIGURATION |
| --- | --- | --- |
| Bit 1 (LSB) | 0: No<br>1: Yes | Precise Time Transfer Availability |
| Bit 2 | 0: CP → SLC<br>1: CP ↔ SLC | Precise Time Transfer direction between CP and SLC |
| Bit 3 | 0: No<br>1: Yes | Frequency Transfer Availability |
| Bit 4 | 1: No Counter<br>0: Counter | Frequency Transfer Method |
| Bit 5 | 1: Yes<br>0: No | RTC Availability |
| Bit 6 | 1: Internal to GPS<br>0: External to GPS | RTC for GPS |
| Bit 7 | 0: No<br>1: Yes | Coarse Time Transfer Availability: Either Precise Time Transfer or Coarse Time Transfer can be available for a hardware configuration, but not both simultaneously. |
| Bit 8 | 0: Reference clock is on<br>1: Reference clock is off | Valid only if Bit 4 = 0, Reference Clock Status for Counter type Frequency Transfer |

Table 5.182: HW_CONFIG Field

NOMINAL_FREQ: Nominal CP Frequency:

If, in HW_CONFIG Bit 3 = 1 and Bit 4 = 0 (counter method), the CP sets this field to the absolute frequency value of the clock derived from CP by division and delivered to the SLC for 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, the CP sets this field to all zeros.

NW_ENHANCE_TYPE: Network Enhancement Type: The CP uses this field to inform the SLC which network enhanced features are available.

| NW_ENHANCE_TYPE | Description |
|---|---|
| Bit 0 | Reserved |
| Bit 1 | Reserved |
| Bit 2 | 0 = AUX_NAVMODEL Aiding is not supported<br>1 = AUX_NAVMODEL Aiding is supported |
| Bit 3 | 0 = NAVBit Subframe 1, 2, and 3 Aiding is not supported<br>1 = NAVBit Subframe 1, 2, and 3 Aiding is supported |
| Bit 4 | 0 = NavBit Subframe 4 and 5 Aiding is not supported<br>1 = NavBit Subframe 4 and 5 Aiding is supported |
| Bit 5 | Reserved |
| Bit 6 | Reserved |
| Bit 7 | Reserved |

Table 5.183: NW_ENHANCE_TYPE Field

Note:

> Network providers tend to support these enhancement types consistently in their coverage zone. Therefore, you need only specify the supported types at the initial configuration time in MID 214. When roaming into a different provider's network seamlessly in a single navigation session, the support configuration might change. If the new network does not support types originally declared in the NW_ENHANCE_TYPE field, the change becomes visible in the first position Navbit request response message if the SLC requested it.

## 5.69 Approximate MS Position Response - MID 215, SID 1

| | |
|---|---|
| MID (Hex) | 0xD7 |
| MID (Dec) | 215 |
| Message Name in Code | `MID_AIDING_RESP` |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | `APPROX_MS_POS_RESP` |

Table 5.184: Approximate MS Position Response - MID 215, SID 1

The Approximate MS Position Response message is output in response to Approximate MS Position Request message.

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| LAT | 4 |
| LON | 4 |
| ALT | 2 |
| EST_HOR_ER | 1 |
| EST_VER_ER | 2 |
| USE_ALT_AIDING | 1 |

Table 5.185: Approximate MS Position Response Message

**LAT**: Approximate MS Latitude:

The CP sets this field to the Approximate MS Latitude in units of $180/2^{32}$ degrees in a range from –90 degrees to $+90x(1-2^{-31})$degrees

**LON**: Approximate MS Longitude:

The CP shall set this field to the Approximate MS Longitude in units of $360/2^{32}$ degrees in a range from –180 degrees to $+180x(1-2^{-31})$degrees.

**ALT**: Approximate MS Altitude:

The CP sets this field to the approximate MS altitude in units of 0.1meters in the range of –500 meters to +6053.5 meters, in Unsigned Binary Offset coding. The formula to apply is:

ALT(in m)= Bx0.1-500

where B is the unsigned binary value of the ALT field from 0 to 65535: all zeros represents –500m, all ones represents +6053.5m.

**EST_HOR_ER**: Estimated Horizontal Error:

The CP sets this field using the estimated error in the Approximate MS location. The error corresponds to radius of the maximum search domain the CP requires the SLC to search and is encoded according to Table 5.186.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Horizontal Error (meters) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 24 | < 24 |
| 0000 | 0001 | 1 | 25.5 | $24 \leq \sigma < 25.5$ |
| X | Y | $2 \leq I \leq 253$ | $24.(1 + Y/16).2^x$ | $f_{i-1} \leq \sigma < f_i$ |
| 1111 | 1110 | 254 | 1474560 | $1425408 \leq \sigma < 1474560$ |
| 1111 | 1111 | 255 | Not Applicable | $\geq 1474560$ |

Table 5.186: EST_HOR_ER Field

EST_VER_ER: Estimated Vertical Error:

The CP sets this field using the estimated vertical error in the Approximate MS location. The error corresponds to the standard deviation of the error in MS altitude in units of 0.1 meters, from 0 meters to 6553.5 meters, in Unsigned Binary Offset coding. The formula is:

EST_VER_ER (in m)= Vx0.1

where V is the unsigned binary value of the EST_VER_ER field from 0 to 65535: all zeros represents 0m, all ones represents +6553.5m.

USE_ALT_AIDING: Use Altitude Aiding:

If the LSB byte = 1 then altitude aiding is used.

## 5.70 Time Transfer Response - MID 215, SID 2

The Time Transfer Response message is output in response to Time Transfer Request message. Depending on the hardware configuration, this message can be returned along with a hardware timing pulse (Precise Time Transfer mode) or without hardware timing pulse (Coarse Time Transfer mode).

The SLC knows which case is implemented by checking the HW_CONFIG field in the Hardware Configuration Response message. Given the high resolution of the GPS_TIME field, the timing pulse can be sent any time convenient for the CP, provided the GPS_TIME is reported in the Time Transfer Response message consistently.

| | |
|---|---|
| MID (Hex) | 0xD7 |
| MID (Dec) | 215 |
| Message Name in Code | `MID_AIDING_RESP` |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | `TIME_TX_RESP` |

Table 5.187: Time Transfer Response - MID 215, SID 2

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| TT_TYPE | 1 |
| GPS_WEEK_NUM | 2 |
| GPS_TIME | 5 |
| DELTAT_UTC | 3 |
| TIME_ACCURACY | 1 |

Table 5.188: Time Transfer Response Message

TT_TYPE: Time Transfer Type:

Coarse Time Transfer method = all zero

Precise Time Transfer method = all 1s

GPS_WEEK_NUM: GPS Week Number: The GPS sets this field to the value of the absolute Week number and not rolled over to Modulo 1024.

GPS_TIME: GPS Time: The SLC sets this field to the time of the week in Units of 1 microsecond, from 0 to 604800 seconds. This is the GPS time valid at the preceding time pulse (for Precise Time Transfer mode), or at the time of the transmission of the message (for Coarse Time Transfer mode).

DELTAT_UTC: GPS Time to UTC Time Correction: Correction in milliseconds to apply to the full GPS time (counted from GPS zero time point) to get UTC time from same zero time point. The formula to apply is: TUTC=$T_{GPS}$-DELTAT_UTC. The format is in two's complement, in units of 1ms, in the range from –8388. 608 seconds to +8388.607 seconds.

TIME_ACCURACY: Time Transfer Accuracy: The CP sets this field equal to the estimated accuracy of the time in this message. This field is used to set the maximum search domain the SLC will search.

Note:

> The SLC only guarantees to search in a domain just large enough to encompass the search uncertainty engendered by the TIME_ACCURACY field, but not beyond. It is the CP's responsibility to choose this field value large enough.
>
> The TIME_ACCURACY is one-sided: the SLC considers that the actual GPS time lies in the interval between GPS_TIME - TIME_ACCURACY and GPS_TIME + TIME_ACCURACY.

If the Coarse Time Transfer is used (see TT_TYPE field), this field is in units of 1 milliseconds and encoded as in Table 5.189.

If the Precise Time Transfer is used (see TT_TYPE field), this field is in units of 1 microsecond and encoded as in Table 5.190

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Accuracy Milliseconds |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 1.0 | $< 1.0$ |
| 0000 | 0001 | 1 | 1.0625 | $1.0 < \sigma < 1.0625$ |
| X | Y | $2 \le I \le 253$ | $1.0\ (1 + Y/16).\ 2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 61440 | $59392 \le \sigma < 61440$ |
| 1111 | 1111 | 255 | Not Applicable | $\ge 61440$ |

Table 5.189: TIME_ACCURACY Field - Coarse Time Transfer Method

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Accuracy Milliseconds |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | $< 0.125$ |
| 0000 | 0001 | 1 | 0.1328125 | $0.125 < \sigma < 0.1328125$ |
| X | Y | $2 \le I \le 253$ | $0.125\ (1 + Y/16).\ 2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | $7424 \le \sigma < 7680$ |
| 1111 | 1111 | 255 | Not Applicable | $\ge 7680$ |

Table 5.190: TIME_ACCURACY Field - Precise Time Transfer Method

## 5.71 Frequency Transfer Response - MID 215, SID 3

The Frequency Transfer Response message is output in response to Frequency Transfer Request message.

Note:

> The frequency offset returned in this message is the CP clock error from the nominal value, scaled to the GPS L1 frequency; it is not the SLC clock error.

| | |
|---|---|
| MID (Hex) | 0xD7 |
| MID (Dec) | 215 |
| Message Name in Code | MID_AIDING_RESP |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | FREQ_TX_RESP |

Table 5.191: Frequency Transfer Response - MID 215, SID 3

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| SCALED_FREQ_OFFSET | 2 |
| REL_FREQ_ACC | 1 |
| TIME_TAG | 4 |
| REF_CLOCK_INFO | 1 |
| NOMINAL_FREQ | 5(1) |

Table 5.192: Frequency Transfer Response Message

(1) This field is presented only if Bit 4 of REF_CLOCK_INFO is '1'

SCALED_FREQ_OFFSET: SCALED_Frequency Offset (in Hz): The CP sets the bits in this field equal to the relative frequency difference between the theoretical and the real value of the CP clock, multiplied by the L1 frequency (1575.42 Mhz). If the theoretical value is higher than the real one, the value is positive. Values range from –214Hz to +214-1Hz. Encoding is in two's complement. E.g. if the nominal CP clock is 10 Mhz, and the real CP clock frequency is 9.999975 Mhz , the relative frequency difference is +2.5 ppm, the value of the SCALED_FREQ_OFFSET field is: 2.5e-6.1575.42e6=3938.6 Hz, rounded to the closest integer number of Hz, and coded as 0x0F63.

REL_FREQ_ACC: Relative Frequency Offset Accuracy:

The CP sets this field based on the estimated accuracy of the frequency offset.

Note:

> The SLC only guarantees to search in a domain just large enough to encompass the search uncertainty engendered by the REL_FREQ_ACC field, but no more. It is the CP's responsibility to choose this field value large enough.
>
> The REL_FREQ_ACC is one-sided: the SLC consider that the actual scaled frequency lies in the interval between SCALED_FREQ_OFFSET – REL_FREQ_ACCxL1 and SCALED_FREQ_OFFSET+ REL_FREQ_ACCxL1 where L1=1575.42 MHz.

Encoding is according to Table 5.193.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Accuracy (ppm) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.00390625 | < 0.00390625 |
| 0000 | 0001 | 1 | 0.004150390625 | 0.00390625 < σ < 0.004150390625 |
| X | Y | 2 ≤ I ≤ 253 | 0.00390625( 1 + Y/ 16). $2^X$ | $f_{i-1} \leq \sigma < f_i$ |
| 1111 | 1110 | 254 | 240 | 232 ≤ σ < 240 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 240 |

Table 5.193: REL_FREQ_ACC Field

**TIME_TAG**: Time Tag of the measurement contents of the Frequency response message: The CP sets this field to the start time of the period when the message contents are valid. The time tag is seconds elapsed since the beginning of the current GPS week in Unsigned Binary coding of 32 bits. The resolution of the time tag message is 1 ms. When time tag is not available (e.g. where precise time transfer did not precede frequency transfer), the CP sets the TIME_TAG field as follows:

- 0xFFFFFFFE = message is valid from the time of reception forward and do not change until notified with another Frequency Response message.

  **Note:**

  The CP must ensure that the clock is on and stable prior to sending the Frequency Transfer Response message with the TIME_TAG field set to 0xFFFFFFFE.
- 0xFFFFFFFF = inform the SLC that message is invalid. Note: GPS_WEEK_NUM rollover is handled by SLC.

  **Note:**

  The rollover of the GPS_WEEK_NUM will be handled by SLC.

**REF_CLOCK_INFO**: Reference clock information for frequency transfer message

| Bits in REF_CLOCK_INF | Description |
|---|---|
| Bit 1 (LSB) | Bit1 = 0 implies that this frequency transfer message is related to the reference clock input to the counter (and thus use of counter method)<br>Bit1 = 1 implies that this frequency transfer message is related to the SLC clock |
| Bit 2 | Valid only if the frequency transfer method is counter:<br>Bit 2 = 0: Reference clock is on<br>Bit 2 = 1: Reference clock is off |
| Bit 3 | Valid only if the frequency transfer method is counter:<br>Bit 3 = 0: Don't request to turn off reference clock<br>Bit 3 = 1: Request to turn off reference clock |
| Bit 4 | Bit 4 = 0: NOMINAL_FREQ field is not included in this message<br>Bit 4 = 1: NOMINAL_FREQ field is included in this message |
| Bit 5 to Bit 7 | Reserved |
| Bit 8 | **Build numbers up to and including 4.0.1:** Reserved<br>**Build numbers 4.0.2 and later:**<br>Bit 8 = 0: Update internal frequency values if needed<br>Bit 8 = 1: Force update internal frequency values to transferred data |

Table 5.194: REF_CLOCK_INFO Field

**NOMINAL_FREQ**: Nominal CP Frequency: The CP sets this field to the absolute frequency value of the clock derived from CP by division and delivered to the SLC for counter frequency measurement. Resolution is in 10-3 Hz. The format is unsigned binary over 40 bits. The range is from 0.001Hz to 1.0995GHz. Otherwise, the CP sets this field to all zeros. This field is presented only if Bit 4 of REF_CLOCK_INFO = 1.

## 5.72 Nav Subframe 1_2_3 Aiding Response - MID 215, SID 4

This message is in response to the Nav Bit Aiding Request Message, NBA_REQ.

| | |
|---|---|
| MID (Hex) | 0xD7 |
| MID (Dec) | 215 |
| Message Name in Code | MID_AIDING_RESP |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name in Code | SET_NBA_SF1_2_3 |

Table 5.195: Nav Subframe 1_2_3 Aiding Response - MID 215, SID 4

| Field | Length (bits) |
|---|---|
| MID | 8 |
| SID | 8 |
| NUM_SVS | 8 |
| SUBF_1_2_3_FLAG | 8 |
| SAT_PRN_NUM | 8 |
| SUBF_1_2_3 | 904 |

Table 5.196: Nav Subframe 1_2_3 Aiding Response Message

**NUM_SVS**: Number of satellites for which ephemeris status parameters are given.

**SUBF_1_2_3_FLAG**: Subframe 1, 2, and 3:

0x00 = SAT_PRN_NUM and SUBFRAME_1_2_3 fields are invalid and must be set to 0

0x01 = SAT_PRN_NUM and SUBFRAME_1_2_3 fields are valid

**SAT_PRN_NUM**: Satellite PRN number for which SUBF_1_2_3 is valid. It is an unsigned binary value from 1 to 32.

**SUBF_1_2_3**: Subframe 1, 2 and 3 of the navigation message bits for the satellite specified by SV_PRN_NUM, in the order transmitted by the satellite. The MSB of the first byte contains the first bit of Subframe 1. There should be 900 valid bits. Therefore, the least significant 4 bits of the last byte are set to zeros.

Note:

The fields are repeated a number of times specified in the NUM_SVS.

## 5.73 Nav Subframe 4_5 Aiding Response - MID 215, SID 5

This message is in response to the Nav Bit Aiding Request Message, NBA_REQ. There may be one or two messages in response to a single NBA_REQ message. The NBA_REQ always requests SF45 data for all satellites. Generally, a single SF45_data set applies to all satellites and then a single response message carries the SF45 data for all satellites. However, at least one day per week, there are two versions of the Almanac broadcast, each of them applicable to two disjunctive sets of satellites. In these cases there are two response messages, and the SAT_LINK bitmaps in them should complement each other to cover all satellites.

| | |
|---|---|
| MID (Hex) | 0xD7 |
| MID (Dec) | 215 |
| Message Name in Code | `MID_AIDING_RESP` |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | `SET_NBA_SF4_5` |

Table 5.197: Nav Subframe 4_5 Aiding Response - MID 215, SID 5

| Field | Length (bits) |
|---|---|
| MID | 8 |
| SID | 8 |
| SAT_LIST | 32 |
| FRAME_NUM | 8 |
| SUBF_4_5 | 600 |

Table 5.198: Nav Subframe 4_5 Aiding Response Message

Note:

FRAME_NUM and SUBF_4_5 are repeated 25 times.

**SAT_LIST**:Satellite List: This is a bitmap representing the satellites for which SUBF_4_5 are valid, whether they were specified in the NBA_REQ Navbit aiding request message or not. If SUBF_4_5 are valid for the satellite represented by a bit of this field, CP sets that bit to 1:

Bit 0 (LSB) = satellite PRN 1.

Bit 31 (MSB) = satellite PRN 32.

**FRAME_NUM**: GPS frame number for which the data in SUBF_4_5 is valid for, within the 12.5 minute of the GPS superframe, from 1 to 25 where the binary value of the field conveys the GPS frame number. The CP sets this field to 0 if the data in SUBF_4_5 is invalid.

**SUBF_4_5**: Subframe 4 and 5 of the navigation message bits in the order transmitted by the satellite. MSB of the first byte contains the first bit of the subframe 4. There should be 600 valid bits.

## 5.74 OSP ACK/NACK/ERROR Notification - MID 216, SID 1

This message is intended for both autonomous and aided ACK/NACK input. For autonomous cases, some fields are not applicable and are zeroed out.

| | |
|---|---|
| MID (Hex) | 0xD8 |
| MID (Dec) | 216 |
| MID Name | MID_MSG_ACK_IN |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name | ACK_NACK_ERROR |

Table 5.199: OSP ACK/NACK/ERROR Notification - MID 216, SID 1

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| Echo Message ID | 1 |
| Echo Message Sub ID | 1 |
| ACK/NACK/ERROR | 1 |
| Reserved | 2 |

Table 5.200: ACK/NACK/ERROR Notification Message

| Value | Description |
|---|---|
| 0x00 | Acknowledgement |
| 0x01 – 0xF9 | Reserved |
| 0xFA | Message ID and/or Message Sub ID not recognized |
| 0xFB | Parameters cannot be understood by the recipient of the message |
| 0xFC | OSP Revision Not Supported |
| 0xFD | CP does not support this type of NAV bit aiding (0 during autonomous operation) |
| 0xFE | CP does not accept ephemeris status response (0 during autonomous operation) |
| 0xFF | Non-acknowledgement |

Table 5.201: ACK/NACK/ERROR Fields

## 5.75 Reject - MID 216, SID 2

| | |
|---|---|
| MID (Hex) | 0xD8 |
| MID (Dec) | 216 |
| Message Name in Code | `MID_MSG_ACK_IN` |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | `REJECT` |

Table 5.202: Reject - MID 216, SID 2

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| REJ_MESS_ID | 1 |
| REJ_MESS_SUB_ID | 1 |
| REJ_REASON | 1 |

Table 5.203: Reject Message

REJ_MESS_ID: Message ID of Rejected Message

REJ_MESS_SUB_ID: Message Sub ID of Rejected Message

REJ_REASON: Reject Reason

| Bit Number | Bit Value | Description |
|---|---|---|
| Bit 1 (LSB) | 1 = true, 0 = false | (Reserved) |
| Bit 2 | 1 = true, 0 = false | Not Ready |
| Bit 3 | 1 = true, 0 = false | Not Available |
| Bit 4 | 1 = true, 0 = false | Wrongly formatted message(1) |
| Bit 5 | 1 = true, 0 = false | No Time Pulse during Precise Time Transfer |
| Bit 6 | - | Unused |
| Bit 7-8 | 0 | Reserved |

Table 5.204: REJ_REASON Field

## 5.76 Power Mode Request - MID 218, SID 0, 1, 2, 3, 4

| | |
|---|---|
| MID (Hex) | 0xDA |
| MID (Dec) | 218 |
| Message Name in Code | `MID_PWR_MODE_REQ` |
| SID (Hex) | Listed below |
| SID (Dec) | Listed below |
| SID Name in Code | Listed below |

Table 5.205: Power Mode Request - Message ID 218, Sub IDs 0, 1, 2, 3, 4

APM_REQ: Request to transition to Advanced Power Management mode

When sent in a full power mode, a direct transition is requested to the APM low power mode. When sent from any other low power mode, first a default transition is performed to full power mode and then, immediately a transition from the full power mode to the Advanced Power Management low power mode is performed. In either case, a single Power Mode Response message will confirm this message.

MPM_REQ: Request to enable transition to Micro Power Management mode

When sent in a full power mode, enabling a direct transition is requested to the Micro Power Management low power mode as soon as sufficient ephemeris data is available and a valid navigation position solution is calculated at near zero user velocity. When sent from any other low power mode, first a default transition is performed to full power mode and then, immediately a transition is enabled from the full power mode to the Micro Power Management low power mode as described above is performed. In either case, a single Power Mode Response message will confirm this message.

TP_REQ: Request to transition to TricklePower Management mode

When sent in a full power mode, a direct transition is requested to the TricklePower Management low power mode. When sent from any other low power mode, first a default transition is performed to full power mode and then, immediately a transition from the full power mode to the TricklePower Management low power mode is performed. In either case, a single Power Mode Response message will confirm this message.

PTF_REQ: Request to transition to Push-To-Fix Power Management mode

When sent in a full power mode, a direct transition is requested to the Push-To-Fix Power Management low power mode. When sent from any other low power mode, first a default transition is performed to full power mode and then, immediately a transition from the full power mode to the Push-To-Fix Power Management low power mode is performed. In either case, a single Power Mode Response message will confirm this message.

FP_MODE_REQ: Request to transition to Full Power mode

When sent in a any of the low power modes, the current low power mode is cancelled and a direct transition is requested to the full power mode.

The scope of this message and the rules of overriding other power mode setting values that may have already been stored are described in Section 7.18.

The message description for each SID follows.

### 5.76.1 Request Transition to Full Power Mode - MID 218, SID 0

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| MID | 1 | - | - |
| SID | 1 | - | - |

**Table 5.206: Request Transition to Full Power Mode - MID 218, SID 0**

When this message is received, any LP mode which is currently active is disabled and full power mode is entered.

### 5.76.2 Request Transition to Advanced Power Management Mode - MID 218, SID 1

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| MID | 1 | - | - |
| SID | 1 | - | - |
| NUM_FIXES | 1 | - | - |
| TBF | 1 | - | sec |
| POWER_DUTY_CYCLE | 1 | *0.2 | % |
| MAX_HOR_ERR | 1 | - | - |

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| MAX_VERT_ERR | 1 | - | - |
| PRIORITY | 1 | - | - |
| MAX_OFF_TIME | 4 | - | m/s |
| MAX_SEARCH_TIME | 4 | - | m/s |
| TIME_ACC_PRIORITY | 1 | - | - |
| Reserved | - | - | - |

**Table 5.207: Request Transition to Advanced Power Management Mode - MID 218, SID 1**

NUM_FIXES: Number of requested APM cycles. Valid range is 0 to 255. A value of 0 indicated that continuous APM cycles are requested. The default value is zero.

TBF: Time between fixes: Requested time between fixes. 1 to 180 seconcds. In SLC, if this value is equal or less than 10 sec, the POWER_DUTY_CYCLE parameter is disregarded and a TricklePower mode is engaged where the TBF value also derives the On Time length, as Table 5.208 shows.

POWER_DUTY_CYCLE Duty cycle of the APM mode: The CP sets this field to the power duty cycle desired. The values in this field ranges from 1 to 20. 1 represents a 5% duty cycle and 20 shall represent a 100%. The default value is 50%.

MAX_HOR_ERR Maximum requested horizontal error: The maximum requested horizontal position error, in unit of 1 meter: 0x00 indicates "No Maximum". The range of HORI_ERROR_MAX is from 1 meter to 255 meters. The client tries to provided a position with horizontal error less than this specified value in more than 95% of the cases.

MAX_VERT_ERR Maximum requested vertical error: The maximum requested vertical position error according to the table below. The client tries to provide a position with vertical error less than this specified value in more than 95% of the cases.

PRIORITY Specifies if time or power duty has priority:

0x01 = Time between two consecutive fixes has priority

0x02 = Power duty has higher priority

Bits 2–7 reserved for expansion

MAX_OFF_TIME Maximum time for sleep mode: Default value is 30s. When the receiver is unable to acquire satellites for a TricklePower cycle, it returns to sleep mode for this period of time before it tries again.

MAX_SEARCH_TIME Maximum satellite search time: Default value is 120s. When the receiver 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 such that when the receiver attempts 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 NA and ignored.

IME_ACC_PRIORITY Time/Accuracy Priority:

0x00 No priority imposed (default)

0x01 MAX_SEARCH_TIME has higher priority

0x02 MAX_HOR_ERR has higher priority

0x03-0xFF Reserved

**Reserved**: Byte reserved for future use.

| Time Between Fixes (sec) | On Time (m/s) |
|---|---|
| 1 | 300 |
| 2 | 400 |
| 3 | 400 |
| 4 | 400 |
| 5 | 500 |
| 6 | 600 |
| 7 | 700 |
| 8 | 800 |
| 9 | 900 |
| 10 | 900 |

Table 5.208: TBF Cycle Time Derived On Time Period Length

| Value | Position Error |
|---|---|
| 0x00 | < 1 meter |
| 0x01 | < 5 meters |
| 0x02 | < 10 meters |
| 0x03 | < 20 meters |
| 0x04 | < 40 meters |
| 0x05 | < 80 meters |
| 0x06 | <160 meters |
| 0x07 | No Maximum |
| 0x08-0xFF | Reserved |

Table 5.209: Maximum Vertical Error

Note:

For GSD4e products configured by eFUSE settings as Standard Part lacking A-GPS support, this message is rejected by the SLC.

Note:

The Position Request OSP message and the APM request message both specify QoS parameters and time between fixes. The Position Request parameter values overrides the QoS value in the APM request. After the sequence of responses to the Position Request has been completed, the original APM QoS values become valid again.

### 5.76.3 Request Transition to Micro Power Mode - MID 218, SID 2

| Field | Bytes | Value/Range | Scale | Unit |
|---|---|---|---|---|
| MID | 1 | 218 | - | - |
| SID | 1 | 2 | - | - |
| TIME_OUT(1) | 1 | 0-255 | - | - |
| CONTROL(2) | 1 | Bitfield see Table 5.211 | - | - |
| Reserved | 2 | - | - | - |

**Table 5.210: Request Transition to Micro Power Management Mode - MID 218, SID 2**

(1) This field contains the maximum time limit in seconds for MP Mode preconditions to be met from the time the MP Mode Enable message arrives. The range of values for this field is 0-255. 0 is the default and indicates that if the preconditions are not met immediately the system gotes into permanent hibernate. This is called requesting a HARD MPM. If the value of this field is greater than 0 the system will either wait until preconditions are met (if this happens before the time out expires) or until the time out expires. This is called requesting a SOFT MPM. If by the end of this time limit the preconditions are not met, the system enters into permanent hibernate.

(2) This field is used to specify control values for MPM. Table 5.211 describes the control values.

| Bits | Control Parameter | Values |
|---|---|---|
| 0-1 | RTC uncertainty margin(1) | 0 = 250 µs(default) |
| | | 1 = 125 µs |
| | | 2,3 = Reserved |
| 2-7 | Reserved | Must be 0 |

**Table 5.211: Bit Fields Description**

(1) The system is in Recovery mode if the RTC uncertainty is accumulated to a value of 250 µS. There is the option to restrict this limit to a lower value. In MP Mode 2.0 a value of 0 in this field represents the default RTC uncertainty margin of 250 µS and a value of 1 in this field will represent 125 µS. The remaining two values, 2 and 3, are reserved for future expansion.

### 5.76.4 Request Transition to TricklePower Management Mode - MID 218, SID 3

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | - | - |
| Message Sub ID | 1 | - | - |
| DUTY_CYCLE | 2 | *10 | % |
| ON_TIME | 4 | - | m/s |
| MAX_OFF_TIME | 4 | - | m/s |
| MAX_SEARCH_TIME | 4 | - | m/s |

**Table 5.212: Request Transition to TricklePower Management Mode - MID 218, SID 3**

DUTY_CYCLE: Percent time on: Required time to be spent tracking with full power. A duty cycle of 1000 (100%) means continuous operation. When the duty cycle is set to 100% the on-time has no effect. The default value is 50%. Scale *10.

ON_TIME: Actual time on from 100 to 900 msec. When the cycle time is 1 second, ON_TIME should be specified as less than 700 ms. For any other cycle times, the ON_TIME field value should be specified as less than or equal to 900 ms. The TBF time is derived from the values specified here in the ON_TIME and in the DUTY_CYCLE fields. If the resulting TBF value is too low and not supported, the request is rejected with an error message. When the specified ON_TIME and DUTY_CYCLE values can not be enforced to get a fix, power management reverts back to full power mode, until the signal conditions improve again to meet the specified ON_TIME and DUTY_CYCLE values.

MAX_OFF_TIME: Maximum time for sleep mode: Default value is 30 s. When the receiver is unable to acquire satellites for a TricklePower cycle, it returns to sleep mode for this period of time before it tries again.

MAX_SEARCH_TIME: Maximum satellite search time: Default value is 120s. When the receiver 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 such that when the receiver attempts 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 NA and ignored.

**Note:**

> In TricklePower mode, request parameters may contradict with the similar parameters defined in the POS_REQ message. Therefore, the responses to the POS_REQ request may get suspended while in TricklePower mode in which case only the MID 2 Measure Navigation Data Out SSB PVT messages are generated using TricklePower mode.

### 5.76.5 Request to Transition to Push-To-Fix Power Management Mode - MID 218, SID 4

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| MID | 1 | - | - |
| SID | 1 | - | - |
| PTF_PERIOD | 4 | - | sec |
| MAX_SEARCH_TIME | 4 | - | m/s |
| MAX_OFF_TIME | 4 | - | m/s |

**Table 5.213: PRequest to Transition to Push-To-Fix Power Management Mode - MID 218, SID 4**

**PTF_PERIOD**: Push-To-Fix cycle time in seconds: Default value is 1800s. Value range: 10 – 7200 sec.

**MAX_SEARCH_TIME**: Maximum satellite search time: Default value is 120s. When the receiver 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. A value of 0 in this field results in the rejection of Message ID 218, 4.

**MAX_OFF_TIME**: Maximum time for sleep mode: The longest period in msec for which the receiver will deactivate due to the MAX_SEARCH_TIME timeout. When the receiver is unable to acquire satellites for a cycle, it returns to sleep mode for this period of time before it tries again. Default value is 30000ms. Value range: 1000 – 180000 msec.

**Note:**

In Push-to-Fix power mode, the parameters of this request may contradict with the similar parameters defined in the POS_REQ message. Therefore, the responses to the POS_REQ request may get suspended while in TricklePower mode in which case only the MID 2 Measure Navigation Data Out SSB PVT messages are generated using TricklePower mode.

## 5.77 Hardware Control Input - MID 219

This MID is reserved for future hardware control features, including VCTCXO and on/off signal configuration. The two SIDs specified in the master MID list are placeholders to show which features would use this MID. There can be additions/subtractions to the

| | |
|---|---|
| MID (Hex) | 0xDB |
| MID (Dec) | 219 |
| MID Name | MID_HW_CTRL_IN |
| SID (Hex) | TBD |
| SID (Dec) | TBD |
| SID Name | TBD |

**Table 5.214: Hardware Control Input - MID 219**

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |
| Message details | TBD |

Table 5.215: Hardware Control Input Message

## 5.78 CW Configuration - MID 220, SID 1

This message enables control (enable/disable) of specific hardware and software features of the CW Controller. You can disable scanning or set to run the automatic scan progression as specified in the system design. You can disable filtering, force to just the 2MHz filter or the OFFT notch filter, or set to automatic.

| | |
|---|---|
| MID (Hex) | 0xDC |
| MID (Dec) | 220 |
| MID Name | MID_CW_INPUT |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name | CW_CONFIG |

Table 5.216: CW Configuration - MID 220, SID 1

| Field | Bytes | Description |
|---|---|---|
| MID | U1 | 0xDC |
| SID | U1 | 0x01 |
| Configuration Mode | U1 | Configuration Mode U1 Enumeration of configuration modes:<br>0: Enable scan, enable filtering<br>1: Enable scan, use OFFT<br>2: Enable scan, use 2MHz<br>3: Enable scan, no filter<br>4: Disable scan, disable filtering<br>254: Factory Scan (not for 4t, reserved only)<br>255: Disable scan, disable filtering. Use only complex 8$f_0$. |

Table 5.217: CW Configuration Message

The SLC responds to this message with an ACK/NACK/ERROR 0x4B output message.

Note:

The MID 150 Switch Operating Modes message always overrides these configuration settings. This CW configuration message is received and processed only if the SLC 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 Xo (Msg ID 128).

## 5.79 TCXO Learning Input - MID 221, SID 0, 1, 2, 3

| | |
|---|---|
| MID (Hex) | 0xDD |
| MID (Dec) | 221 |
| Message Name in Code | MID_TCXO_LEARNING_IN |
| SID (Hex) | See below |
| SID (Dec) | See below |
| SID Name in Code | See below |

Table 5.218: TCXO Learning Input - MID 221, SID 0, 1, 2, 3

| SID Field | Description | Inclusion in Builds |
|---|---|---|
| 0x00 | Clock Model Output Control | All builds |
| 0x01 | Clock Model Data Base | All builds |
| 0x02 | Clock Model TCXO Temperature Table | Xo Test Builds Only |
| 0x03 | Clock Model Test Mode Control | Xo Test Builds Only |

Table 5.219: TCXO Learning Input SID Descriptions

Messages marked with “Xo Test Builds Only” in the above table are missing in standard builds for products to be shipped to customers. These messages are present in special test builds only made for the purpose of testing the TCXO features.

### 5.79.1 TCXO Learning Clock Model Output Control - MID 221, SID 0

| | |
|---|---|
| Message Name | TCXO_LEARNING |
| MID (Hex) | 0xDD |
| MID (Dec) | 221 |
| MID Name | MID_TCXO_LEARNING_IN |
| SID (Hex) | 0x00 |
| SID (Dec) | 0 |
| SID Name | CLOCK MODEL OUTPUT CONTROL |

Table 5.220: TCXO Learning Clock Model Output Control - MID 221, SID 0

| Name | Bytes | ASCII (Dec) Example | Description |
|---|---|---|---|
| MID | U1 | 221 | TCXO Learning In |
| SID | U1 | 0 | Clock Model Output Control. The following fields are Bit Masks for message 0x5D output enabling.<br>The bit position corresponds to the SID for 0x5D where Bit 0 = SID 0. If the SID is not defined it is ignored.<br>Disable all output by setting both lists to 0. |
| One Time SID List | U2 | - | One Time SID List |
| Continuous SID List | U2 | - | Continuous SID List |
| Output Request | U2 | - | Requested control for Output SIDs.<br>Bit 0:<br>0 = TRec Msg (0x5D,4) outputs current value only<br>1 = TRec Msg (0x5D,4) outputs all queued values |
| spare | U2 | - | - |

Table 5.221: Clock Model Output Message

## 5.79.2 TCXO Learning Clock Model Data Base Input - MID 221, SID 1

| | |
|---|---|
| Message Name | TCXO_LEARNING |
| Input or Output | Input |
| MID (Hex) | 0xDD |
| MID (Dec) | 221 |
| MID Name | MID_TCXO_LEARNING_IN |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name | CLOCK_MODEL_DATA_BASE |

**Table 5.222: TCXO Learning Clock Model Data Base Input - MID 221, SID 1**

| Name | Bytes | Unit | Ascii (Dec) | | Description |
|---|---|---|---|---|---|
| | | | Scale | Example | |
| MID | U1 | - | - | 221 | TCXO Learning In |
| SID | U1 | - | - | 1 | Clock Model Data Base |
| Source | - | - | - | - | Bit mask indicating source of the clock model:<br>0x0 = NOT_SET<br>0x1 = ROM<br>0x2 = DEFAULTS<br>0x4 = MFG<br>0x8 = TEST_MODE<br>0x10 = FIRST_NAV |
| Aging Rate Uncertainty | U1 | Ppm /year | 0.1 | 10 | Aging rate of uncertainty |

| Name | Bytes | Unit | Ascii (Dec) | | Description |
|---|---|---|---|---|---|
| | | | Scale | Example | |
| Initial Offset Uncertainty | U1 | ppm | 0.1 | 10 | Initial Frequency offset of the TCXO |
| Spare1 | U1 | - | - | - | - |
| Clock Drift | S4 | ppb | 1 | 60105 | Clock drift |
| Temp Uncertainty | U2 | ppm | 0.01 | 50 | Temperature uncertainty |
| Manufacturing Week Number | U2 | GPS Week # | 1 | 1465 | TCXO Manufacturing week number in full GPS weeks |
| Spare2 | U4 | - | - | - | - |

Table 5.223: Clock Model Data Base Input Message

### 5.79.3 TCXO Learning Temperature Table Input - MID 221, SID 2

This message is missing in standard builds. They occur in special test builds made only for testing TCXO features.

| | |
|---|---|
| Message Name | TCXO_LEARNING |
| MID (Hex) | 0xDD |
| MID (Dec) | 221 |
| MID Name | MID_TCXO_LEARNING_IN |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name | TEMPERATURE_TABLE |

Table 5.224: TCXO Learning Temperature Table Input - MID 221, SID 2

| Name | Bytes | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|
| | | | Scale | Example | |
| MID | U1 | - | - | 221 | TCXO Learning In |
| SID | U1 | - | - | 2 | TCXO Temperature Table |
| Counter | U4 | - | - | - | Counter updates by 1 for each output. Rolls over on overflow. |

| Name | Bytes | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|
| | | | Scale | Example | |
| Offset | S2 | ppb | 1 | -331 | Frequency offset bias of the table from the CD default |
| Global Min | S2 | ppb | 1 | -205 | Minimum XO error observed |
| Global Max | S2 | ppb | 1 | 442 | Maximum XO error observed |
| First Week | U2 | GPS Week # | 1 | 1480 | Full GPS week of the first table update |
| Last Week | U2 | GPS Week # | 1 | 1506 | Full GPS week of the last table update |
| LSB | U2 | ppb | 1 | 4 | Array LSB Scaling of Min[] and Max[] |
| Aging Bin | U1 | - | 1 | 37 | Bin of last update |
| Aging Up Count | S1 | - | 1 | 4 | Aging up or down count accumulator |
| Bin Count | U1 | - | - | - | Count of bins filled |
| Spare2 | U1 | - | - | - | - |
| Min [] | 1 * 64 | Ppb * LSB | - | - | Min XO error at each temp scaled by LSB |
| Max[] | 1 * 64 | Ppb * LSB | - | - | Max XO error at each temp scaled by LSB |

Table 5.225: TCXO Learning Temperature Table Input Message

### 5.79.4 TCXO Learning Test Mode Control - MID 221, SID 3

This message is missing in standard builds. They occur in special test builds made only for testing TCXO features.

| | |
|---|---|
| Message Name | TCXO_LEARNING |
| MID (Hex) | 0xDD |
| MID (Dec) | 221 |
| MID Name | MID_TCXO_LEARNING_IN |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name | TEST_MODE_CONTROL |

Table 5.226: TCXO Learning Test Mode Control - MID 221, SID 3

| Name | Bytes | ASCII (Dec) Example | Description |
|---|---|---|---|
| MID | U1 | 221 | TCXO Learning In |
| SID | U1 | 3 | Clock Model Test Mode Control |
| TM Enable / Disable | U1 | 1 | Bit Field for control of TCXO Test Mode. Scale = 1.<br>Bit 0:<br>0 = Rtc Cal uses Host updates<br>1 = Rtc Cal ignores Host updates<br>Bit 1:<br>0 = New TRec readings will update Temperature Table<br>1 = Ignore updates to the Temperature Table |
| spare1 | U1 | - | - |
| spare2 | U2 | - | - |

Table 5.227: Test Mode Control Message

## 5.80 Reserved - MID 228

CSR proprietary.

## 5.81 Extended Ephemeris - MID 232

GSW2 (2.5 or above), SiRFXTrac (2.3 or above), and GSW3 (3.2.0 or above), and GSWLT3 software use this message.

### 5.81.1 Extended Ephemeris Proprietary - MID 232, SID 1

This message is used to send an SGEE file retrieved from the server to the receiver. Note that length may vary. The size of the data area will be equal to the reported message length minus 2 bytes to allow for the MID and SID fields.

Example:

- `A0A201F6` – Start Sequence and Payload Length (variable)

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 | E8 | 232 |
| SID | 1 | 01 | Ephemeris input |
| Data | 1U * size | - | Content proprietary |

Table 5.228: Extended Ephemeris Proprietary - MID 232, SID 1[2]

### 5.81.2 Poll Ephemeris Status - MID 232, SID 2

This message polls ephemeris status on up to 12 satellite PRNs. In response to this message, the receiver sends MID 56, SID 3.

| Name | Bytes | Description |
|---|---|---|
| MID | 1 | Hex 0xE8, Decimal 232 |
| SID | 1 | 2-Poll Ephemeris Status |
| SVID Mask | 4 | Bitmapped Satellite PRN. SVID Mask is a 32-bit value with a 1 set in each location for which ephemeris status is requested. Bit 0 represents PRN 1, …, Bit 31 represents PRN 32. If more than 12 bits are set, the response message responds with data on only the 12 lowest PRNs requested. |
| Payload length: 6 bytes | | |

Table 5.229: Format - MID 232, SID 2

### 5.81.3 ECLM Start Download - MID 232, SID 22

This message is sent from Host EE Downloader to the SLC to indicate that the host EE downloader is initiating the SGEE download procedure.

Example:

`A0 A2 00 02 E8 16 00 FE B0 B3` - Message

`A0 A2 00 02` - Start Sequence and Payload Length (2 bytes)

`E8 16` - Payload

`00FEB0B3` - Message Checksum and End Sequence

[2] Data field size is variable, up to a maximum of 500 bytes. Size can be determined by using message length minus 2.

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | E8 | Decimal 232 |
| SID | 1U | 16 | 22: Start Download |

Table 5.230: ECLM Start Download - MID 232, SID 22

Success/failure response on completion of the command: `MID 0x38, SID 0x20`.

### 5.81.4 SGEE Download File Size - MID 232, SID 23

This message is sent from Host EE Downloader to the SLC to indicate that the host EE downloader is initiating the size of the SGEE file to be downloaded.. The table below contains the input values for the following example:

Sub Message ID = 23, File Length = 10329

Example:

`A0 A2 00 06 E8 17 00 00 28 59 01 80 B0 B3` - Message

`A0A20006` - Start Sequence and Payload Length (6 bytes)

`E8 17 00 00 28 59` - Payload

`01 80 B0 b3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | E8 | Decimal 232 |
| SID | 1U | 17 | 23 : SID ECLM File Size |
| File Length | 4U | 00 00 28 59 | Length of the SGEE File to be downloaded |

Table 5.231: ECLM File Size - MID 232, SID 23

Success/failure response upon completion of the command: `MID 0x38, SID 0x20`

### 5.81.5 SGEE Download Data- MID 232, SID 24

This message sends the SGEE data from host downloader to the GPS Receiver to be processed by CLM modules and saved in NVM.

Table 5.232 contains the input values for the following example:

Sub Message ID = 24, SGEE Data

Example:

`A0 A2 00 26 E8 18 00 01 00 20 62 12 31 06 03 02 07 D9 07 07 00 00 39 6D 8F 12 00 00 00 00 00 00 01 2D 9A E7 05 02 FF FE 28 05 07 E6 B0 B3` - Message

`A0 A2 00 26` - Start Sequence and Payload Length (6+ packet length bytes)

`E8 18 00 01 00 20 62 12 31 06 03 02 07 D9 07 07 00 00 39 6D 8F 12 00 00 00 00 00 00 01 2D 9A E7 05 02 FF FE 28 05` - Payload

`07 E6 B0 B3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | E8 | Decimal 232 |
| SID | 1U | 18 | 24 : SGEE Packet Data SubMsgId |
| Packet Sequence Number | 2U | 00 01 | Packet Sequence number of the current packet Starting from 1 |
| Packet Length | 2U | 0020 | Length of the sgee data in current packet |
| Packet Data | 1U *Packet Length | -- | SGEE Data of length indicated in Packet Length field |

Table 5.232: ECLM Packet Data - MID 232, SID 24

Success/failure response upon completion of the command: `MID 0x38, SID 0x20`

## 5.81.6 Get EE Age - MID 232, SID 25

This message is sent to the GPS Receiver to get the age of extended ephemeris stored there. In response to this message the receiver will send MID 56 SID 33.

Table 5.233 contains the input values for the following example:

Sub Message ID = 25, Number of Sat = 1, Prn Num = 1

Example:

`A0 A2 00 12 E8 19 01 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01 03 B0 B3` - Message

`A0 A2 00 12` - Start Sequence and Payload Length (18 bytes)

`E8 19 01 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00` - Payload

01 03 B0 B3 - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | E8 | Decimal 232 |
| SID | 1U | 19 | 25 : Get EE Age |
| numSats | 1U | 01 | Number of satellites |
| prnNum | 1U | 01 | Prn Number |
| ephPosFlag | 1U | 00 | - |
| eePosAge | 2U | 0000 | - |
| cgeePosGPSWeek | 2U | 0000 | - |
| cgeePosTOE | 2U | 0000 | - |
| ephClkFlag | 1U | 00 | - |
| eeClkAge | 2U | 0000 | - |
| cgeeClkGPSWeek | 2U | 0000 | - |
| cgeeClkTOE | 2U | 0000 | - |

Table 5.233: Get EE Age - MID 232, SID 25

Successful response on completion of the command is acknowledged with SSB MID 56, SID 0x21 plus EE Age of the satellite(s).

Failed response on completion of the command is acknowledged with Nack using Command Negative Acknowledgement MID 0x38, SID 0x20.

### 5.81.7 Get SGEE Age - MID 232, SID 26

This message is sent to the GPS Receiver to get the age of SGEE stored in GPS Receiver.

Table 5.234 contains the input values for the following example:

SID = 26, Satellite ID =1

Example:

A0 A2 00 03 E8 1A 01 01 03 B0 B3 - Message

A0A20003 - Start Sequence and Payload Length (3 bytes)

E81A01 - Payload

01 03 B0 B3 - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Exampl e | Description |
|---|---|---|---|
| MID | 1U | E8 | Decimal 232 |
| SID | 1U | 1A | 26 : Get SGEE Age |
| Sat ID | 1U | 01 | Satellite ID for which SGEE Age is requested |

Table 5.234: Get SGEE Age - MID 232, SID 26

Successful response on completion of the command is acknowledged using Command Acknowledgement MID 56, SID 0x22 plus SGEE Age of the satellite(s).

Failed response on completion of the command is acknowledged with `Rejected: MID_ECLMAckNack` using Command Negative Acknowledgement, MID 0x38, SID 0x20.

### 5.81.8 Host Storage File Content - MID 232, SID 27

This message is sent to the GPS Receiver in response to ECLM Request File Content message.

The SID for this message is fixed to 0x1B.

Table 5.235 contains the input values for the following example:

Example:

- `A0 A2` - Start Bytes
- `00 BC E8 1b 00 01 03 01 00 b0 00 00 00 00 00 00 00 00 00`
  `00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00`
  `00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00`
  `00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 2E 00 23`
  `06 E0 67 03 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 21 00 23 06 E0`
  `67 03 00 00 00 00 00 00 00 00 00 2A 00 23 06 E0 67 03 00 00 00 00 00 00 00 00`
  `00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00`
  `00 00 00 00 00 00 00 3E 00 23 06 E0 67 03 00` - Payload
- `08 3B` - CheckSum
- `B0 B3` - End Bytes

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | 0xE8 | Decimal 232 |
| SID | 1U | 0x1B | Request for file content specified by NVM ID |
| Sequence No | 2U | 0x00 0x01 | Sequence number of message |

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| NVM ID | 1U | 0x03 | Storage ID:<br>01: SGEE file<br>02: CGEE file<br>03: BE File |
| Blocks | 1U | 0x01 | Number of Blocks to read |
| Size | 2U | 0x00 0xb0 | Size of each block |
| Offset | 4U | 0x00 0x00 0x00 0x00 | Offset of each block in given storage file |
| Data | (summation of all sizes)U | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00<br>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00<br>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00<br>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00<br>2e 00 23 06 e0 67 03 00 00 00 00 00 00 00 00 00 00 00 00 00<br>00 00 00 00 21 00 23 06 e0 67 03 00 00 00 00 00 00 00 00 00<br>2a 00 23 06 e0 67 03 00 00 00 00 00 00 00 00 00 00 00 00 00<br>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00<br>00 00 00 00 00 00 00 00 3e 00 23 06 e0 67 03 00 | File Content |
| Payload length: (6+size*Blocks+4*Blocks+ summation of all sizes) bytes | | | |

**Table 5.235: ECLM Host File Content - MID 232, SID 27**

### 5.81.9 SIF Host Ack/Nack - MID 232, SID 28

This is the response message to Output MID 56, SID 35 or 36.

Following is an example of Ack to MID 56, SID 35 (ECLM Update file content).

Example:

```
0xA0 0xA2 0x00 0x06
     0xE8 0x1C 0x38 0x25 0x00 0x00
0x01 0x61 0xB0 0xB3
```
- Message

`A0A20006` - Start Sequence and Payload Length (6 bytes)

`0161B0B3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | 0xE8 | Decimal 232 |
| SID | 1U | 0x1C | ECLM Host Ack/Nack |
| Ack Msg Id | 1U | 0x38 | Ack Message Id 56 |
| Ack Sub Id | 1U | 0x25 | Ack Sub Id, ECLM Update file content 0x25 |
| Ack/Nack | 1U | 0x00 | 0 = Ack |
| Ack Nack Reason | 1U | 0x00 | ECLM_SUCCESS = 0<br>ECLM_SPACE_UNAVILABLE = 1<br>ECLM_PKT_LEN_INVALID = 2<br>ECLM_PKT_OUT_OF_SEQ = 3<br>ECLM_DOWNLOAD_SGEE_NONE WFILE = 4<br>ECLM_DOWNLOAD_CORRUPTFIL E_ERROR = 5<br>ECLM_DOWNLOAD_GENERIC_FAI LURE = 6<br>ECLM_API_GENERIC_FAILURE = 7 |

**Table 5.236: ECLM Host Ack/Nack - MID 232, SID 28**

### 5.81.10 Fetch EE Header Response - MID 232, SID 30

This message responds to the Fetch EE Header Request (MID 56, SID 40). It delivers the EE header content received from the CP host to the SLC. The EE Header can be sent in packets of the max length size permissible.

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 U | 0xE8 | Decimal 232 |
| SID | 1 U | 0x27 | Decimal 39 |
| Sequence | 2 U | 0x0001 | Packet number, starting at 1 |
| Size | 2 U | 0x00C8 | Number of bytes in data area |
| Offset | 4 U | 0x0000 0000 | Offset from begining of file in bytes |
| Data | 1 U * Size | -- | Data to store |

Table 5.237: Fetch EE Header Response Message Fields

Data area will vary up to maximum packet length of 600 bytes, although specific builds may limit to fewer

Note:

This message is only supported in GSD4e v4.0.4 and later in PVT products.

### 5.81.11 Disable SIF Aiding - MID 232, SID 32

The following example disables CGEE aiding and enables SGEE. This message generates response ACK if successful or NACK if failure.

Example:

A0A20004e82000010109B0B3 - Message

A0 A2 00 04 - Start Sequence Payload Length

e8 20 00 01 - Payload

01 09 B0 B3 - Checksum and End Sequence

Note:

Disabling CGEE aiding does not disable CGEE prediction.

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | 0xE8 | Decimal 232 |
| SID | 1U | Ox20 | Disable SGEE and/or CGEE.<br>Decimal 32. |
| Disable SGEE | 1U | 0x00 | 0: Enable<br>1: Disable<br>Any other value is ignored. |
| Disable CGEE | 1U | 0x01 | 0: Enable<br>1: Disable<br>Any other value is ignored. |

**Table 5.238: Disable SIF Aiding - MID 232, SID 32**



**Note:**

This message is only supported for products with the embedded SIF feature starting from GSD4e release 2.0.

### 5.81.12 Get SIF Aiding Status - MID 232, SID 33

The following example retrieves the SIF Aiding status. This request generates an Aiding Status Message.

Example:

`A0A20003e821000109B0B3`

`A0 A2 00 03` - Start Sequence Payload Length

`e8 21 00` - Payload

`01 09 B0 B3` - Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | 0xE8 | Decimal 232. |
| SID | 1U | 0x21 | Get SIF Aiding Status<br>Decimal 33. |
| Reserved | 1U | 0x00 | Reserved |

**Table 5.239: Get SIF Aiding Status - MID 232, SID 33**

**Note:**

This message is only supported for products with the embedded SIF feature starting from GSD4e release 2.0.

### 5.81.13 Partial Geotag Conversion Request - MID 232, SID 208

This message is supported in PVT products starting from build 4.1.0.

This message is received as a request to convert partial geotag to full geotag and is processed only if Reverse EE is enabled.

| | |
|---|---|
| MID (Hex) | 0xE8 |
| MID (Dec) | 232 |
| Message name in code | - |
| SID (Hex) | 0xD0 |
| SID (Dec) | 208 |
| SID name in code | MID_POS_FROMPART_REQ |

**Table 5.240: Position from Partial Geotag Request**

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1 | 0xE8 | - |
| SID | 1 | 0xD0 | - |
| pos_req_id | 1 | - | Same as MID 69 SID 3 |
| pos_results_flag | 1 | - | |
| pos_err_status | 1 | - | |
| qos_value | 2 | - | |
| pos _type | 1 | - | |
| dgps_cor | 1 | - | |
| gps_week | 2 | - | |
| Lat | 4 | - | |
| Lon | 4 | - | |
| vert_pos_height | 2 | - | |
| velocity_horizontal | 2 | - | |
| velocity_heading | 2 | - | |
| velocity_vertical | 1 | - | |
| meas_time | 8 | - | |
| num_sv_meas_cnt | 1 | - | - |
| svid | 1 | - | Same as Message ID 69,03. These fields repeat for num_sv_meas_cnt. |
| pseudorange | 8 | - | |
| carrier_freq | 4 | - | |
| sync_freq | 1 | - | |
| ctoN | 1 | - | |
| state_time | 8 | - | Same as MID 69, SID 03 |

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| num_sv_state_cnt | 1 | - | - |
| svid | 1 | - | Same as MID 69 SID 03. These fields repeat for num_sv_state_cnt. |
| Pos[0] | 8 | - | |
| Pos[1] | 8 | - | |
| Pos[2] | 8 | - | |
| Vel[0] | 8 | - | |
| Vel[1] | 8 | - | |
| Vel[2] | 8 | - | |
| clk_bias | 8 | - | |
| clk_drift | 4 | - | |
| pos_var | 4 | - | |
| clk_var | 4 | - | |
| iono | 4 | - | |
| status | 1 | - | |

Table 5.241: Message Fields Description

### 5.81.14 EE Storage Control Input - MID 232, SID 253

This message determines where to store extended ephemeris. This message is supported only for GSD4e and for products beyond. The scope of this message and the rules of overriding other settings of this value that may have already been stored are described in Section 7.18.

**Important Note:**

This message is supported starting at version 4.1.2 or this feature.

| | |
|---|---|
| MID (Hex) | 0xE8 |
| MID (Dec) | 232 |
| Message Name in Code | MID_EE_INPUT |
| SID (Hex) | 0xFD |
| SID (Dec) | 253 |
| SID Name in Code | EE_STORAGE_CONTROL |

Table 5.242: EE Storage Control Input - MID 232, SID 253

| Name | Bytes | Binary (Hex) | | Unit | ASCII(Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| MID | 1 | - | 0xE8 | - | - | 232 | Message ID |
| SID | 1 | - | 0xFD | - | - | 253 | Sub ID |
| EE Storage Control | 1 | - | - | - | - | - | See Table 5.244 |

Table 5.243: EE Storage Control Input Message

| Bit Field | Description |
|---|---|
| [1:0] | 00 = storage available on host (default)<br>01 = I2C EEROM provided for GSD4e access<br>10 = store to FLASH[1]<br>11 = no storage |
| [7:2] | Reserved |

Table 5.244: EE Storage Control Input Message Bit-Fields

[1] Storage will be either to parallel or SPI flash. SPI flash only applies to GSD4E ROM. If a SPI flash part is detected on GSD4E ROM, then 0x02 means store to SPI flash. Otherwise, 0x02 shall be interpreted to mean parallel flash. For GSD4E versions prior to 4.1.2 and all 4t versions, 0x02 means store to parallel flash.

### 5.81.15 Disable CGEE Prediction - MID 232, SID 254

This message is sent to the GPS Receiver to disable CGEE prediction after specified number of seconds. Ack/Nack is received indicating success/failure.

Table 5.245 contains the input values for the following example:

Example:

`A0A20006e8feffffffff05E2B0B3` - Message

`a0 a2` - Start Sequence

`00 06 e8 fe ff ff ff ff` - Payload

`05 e2 b0 b3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Unit | Description |
|---|---|---|---|---|
| MID | 1U | 0xE8 | - | Decimal 232 |
| SID | 1U | 0xFE | - | 254: Disable CGEE prediction |
| Time | 4U | 0xFF 0xFF 0xFF 0xFF | Seconds | 0x00000000 = Immediately disable<br>0xFFFFFFFF = Permanently enable<br>Any other number = Disable prediction after given number of seconds |

Table 5.245: Disable CGEE Prediction

### 5.81.16 Extended Ephemeris Debug - MID 232, SID 255

| | |
|---|---|
| MID (Hex) | 0xE8 |
| MID (Dec) | 232 |
| MID Name | MID_SSB_EE_INPUT |
| SID (Hex) | 0xFF |
| SID (Dec) | 255 |
| SID Name | SSB_EE_DEBUG |

**Table 5.246: Extended Ephemeris Debug - MID 232, SID 255**

Example:

- A0A20006 – Start Sequence and Payload Length (6 bytes)
- E8FF01000000 – Payload
- 01E8B0B3 – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | ASCII (Decimal) Example |
|---|---|---|---|
| MID | 1 | E8 | 232 |
| SID | 1 | FF | 255-EE Debug |
| DEBUG_FLAG | 4 | - | Proprietary |

**Table 5.247: Extended Ephemeris Debug Message Fields**

## 5.82 Set GRF3i+ IF BW Mode - MID 233, SID 1

This message enables you to set the IF bandwidth for GRF3i+. SID is fixed at 0x01.

**Note:**

MID 233, SID 1 only applies to GRF3i+ RF products.

Table contains the input values for the following example:

SID = 0x1, GRF3i+ Bandwidth Mode Selection = 0x1

Example:

- A0A20003 – Start Sequence and Payload Length (3 bytes)
- E90101 – Payload
- 00EBB0B3 – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | E9 | Decimal 233 |
| SID | 1U | 01 | 01: Set GRF3i+ IF Bandwidth Mode |
| GRF3i+ IF Bandwidth Mode Selection | 1U | 01 | 0 = Wideband Mode<br>1 = Narrowband Mode [default] |

Note:

GRF3i+ IF Bandwidth Mode is internally saved to NVM.

## 5.83 Set GRF3i+ Normal/Low Power RF Mode - MID 233, SID 2

This message enables you to set the RF power mode to normal or low. SID is fixed at 0x02.

Note:

MID 233, SID 2 is applicable only to GRF3i+ RF chip products.

Table 5.248 contains the input values for the following example:

SID = 0x2, GRF3i+ power mode =0x1

Example:

- `A0A20003` – Start Sequence and Payload Length (3 bytes)
- `E90201` – Payload
- `00ECB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Description |
|---|---|---|---|
| MID | 1U | E9 | Decimal 233 |
| SID | 1U | 02 | 02: Set GRF3i+ power mode |
| GRF3i+ power mode | 1U | 01 | 0 = Normal power [default]<br>1 = Low power |

Table 5.248: Set GRF3i+ Normal/Low Power RF Mode - MID 233, SID 2

Note:

GRF3i+ power mode would be internally saved to NVM.

## 5.84 Poll GRF3i+ IF Bandwidth Mode - MID 233, SID 10

This message allows user to poll the IF bandwidth mode for GRF3i+.

The Sub Message ID for this message is fixed to 0x0A.

Table Table 5.249 contains the input values for the following example:

SID = 0x0A

Example:

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `E90A` - Payload

| Name | Bytes | Binary (hex) Example | Description |
|---|---|---|---|
| MID | 1U | `E9` | Decimal 233 |
| SID | 1U | `0A` | 0A: Poll GRF3i+ IF bandwidth mode |

Table 5.249: Bandwidth Mode - MID 233, SID 10

Note:

A corresponding output message, MID 233 with SubMsgID 0xFF, with parameters status is also sent as a response to this query message.

## 5.85 Sensor Control Input - MID 234

Note:

These message's specifications apply starting at GSD4e/GSD4t version 4.1.2 and replaces all previous versions.

### 5.85.1 Sensor Configuration Input - MID 234, SID 1

A sensor configuration message is sent from the host processor to the Measurement or Location Engine at startup. Figure 5.1 shows how the Location Manager software is implemented on the Measurement Engine (tracker) and the Host processor.

The tracker performs:

- MEMS sensor data acquisition
- limited error checking
- packaging of sensor data into a message

The host processor performs the rest of the sensor data processing.

A sensor configuration message is sent from the host processor to the Measurement or Location Engine at the time of startup.

This message describes:

- The sensor set connected to the sensor I²C port on the Measurement or Location Engine.
- The process of initialization and data acquisition for the sensors connected to the I²C port.

Note:

This message specification is supported starting at GSD4e/GSD4t version 4.1.2 and replaces all previous verisons.

| | |
|---|---|
| Message Name | SENSOR_CONTROL |
| MID (Hex) | 0xEA |
| MID (Dec) | 234 |
| Message Name in Code | MID_SensorControl |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | SENSOR_CONFIG |

Table 5.250: Sensor Configuration Input - MID 234, SID 1



Figure 5.1 shows how this mechanism enables you to select the sensor set to be attached to the I²C port of the Measurement or Location Engine chip. The data acquisition software in the Measurement Engine conducts limited error checking and packaging of the sensor data into a message which can be sent back to the host.

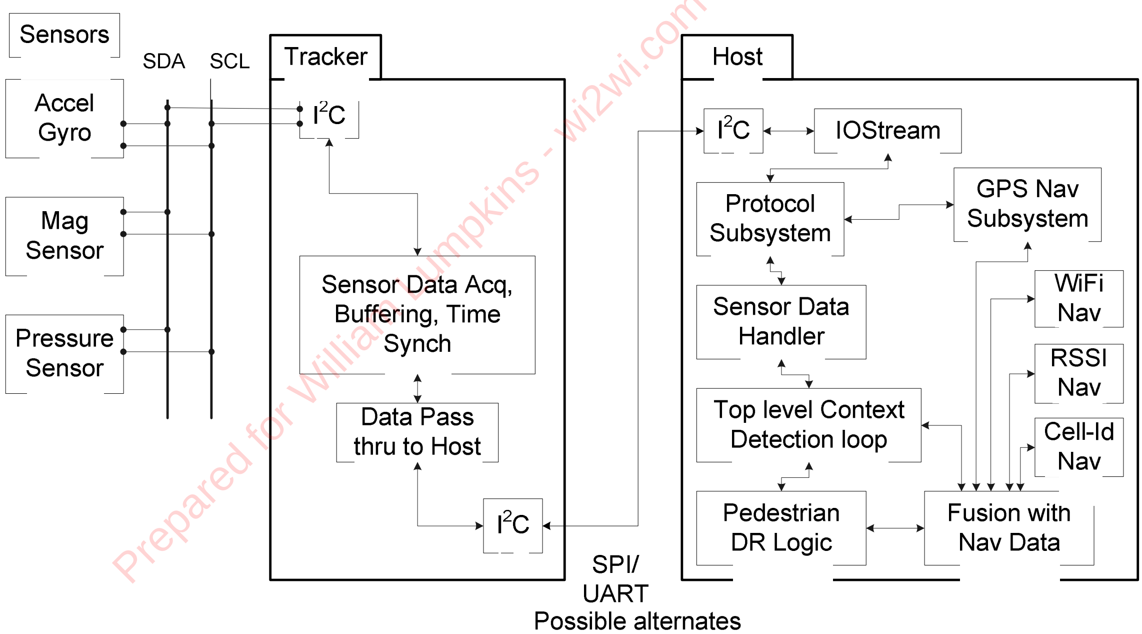


Figure 5.1: Sensor Control Architecture Block Diagram

| Bit Field | Description |
|---|---|
| 0x01 | SENSOR_CONFIG |
| 0x02 | SENSOR_SWITCH |

Table 5.251: Sensor Control Input SID Descriptions

Each sensor control input message sent by the Host is responded to by a MID_MSG_ACK_OUT, ACK_NACK_ERROR SID message.

A sensor configuration message is generated on the Host and sent to the Measurement or Location Engine to provide the configuration information to the sensor data acquisition logic for the sensor(s) attached to the $I^2C$ DR port. This information is stored in a configuration file on the Host. This file is read by the host application at startup. Then a sensor configuration message (SSB) is formed and sent to the Nav thread running on the Host. The Host application creates the sensor configuration MEI message which is then sent to the Measurement Engine. The SSB message contains additional information, such as zero point and scale factor for each sensor, which does not need to be sent to the Measurement Engine. This information is extracted on the Host and stored on appropriate structures for use by the sensor data processing logic running on the Host.

| Name | Bytes | ASCII (Dec)<br>Example | Description |
|---|---|---|---|
| MID | U1 | 234 | SENSOR_CONTROL, binary (hex) example = `0xEA` |
| SID | U1 | 1 | SENSOR_CONFIGI, binary (hex) example = `0x01` |
| NUM_SENS | U1 | 1 | Number of sensors in the sensor set connected to the DR sensor $I^2C$ port of GSD4t |
| I2C_SPEED_EIT_SET | U1 | 3 | Lower 4 bits are for $I^2C$ bus speed setting:<br>0 = Low Speed<br>1 = Standard<br>2 = Fast Mode<br>3 = Fast mode Plus<br>4 = High speed<br>Sensor with the lowest speed setting in the sensor set determines the speed mode for all sensors.<br>Upper 4 bits are for EIT wakeup configuration:<br>Bit 4: Enable/disable bit:<br>■ 0 = Wakeup disabled<br>■ 1 = Wakeup enabled<br>Bit 5: EIT pin:<br>■ 0 = EIT1<br>■ 1 = EIT2<br>Bit 6: EIT INT Active method, if level-triggered, i.e. Bit 7 = 0:<br>■ 0 = low<br>■ 1 = high<br>if edge-triggered, i.e. Bit 7=1<br>■ 0 = falling<br>■ 1 = rising<br>Bit 7: EIT INT trigger method:<br>■ 0 = level trigger<br>■ 1 = edge trigger |
| SDA_SENS1 | U2 | 24 | Slave Device Address for sensor supports 10 - bit addressing |

| Name | Bytes | ASCII (Dec)<br>Example | Description |
|---|---|---|---|
| SENSR_TYPE _SEN1 | U1 | 1 | Sensor Type for Sensor 1:<br>1 = Accelerometer<br>2 = Magnetic sensor<br>3 = Pressure sensor<br>4 = Gyroscope<br>5 = Accelerometer + Gyroscope<br>6 = Accelerometer + Magnetic sensor<br>7 = Gyroscope + Magnetic sensor<br>8 = Accelerometer + Magnetic sensor + Gyro |
| SEN_INIT_TIME1 | U1 | 0 | Sensor 1 initialization period in ms, scale = 10 |
| NUM_BYTES_ RES_SENS1 | U1 | 198 | Number of Bytes to be read from Register 1 and bit resolution in data read, sensor 1, Bits [4:2]. Bytes = 2, 4, 6 based on 1, 2 or 3 sensor axes.<br>Bits [8:5]: Resolution for each axis. Value = 9 to 32.<br>Bit 1: Data type is unsigned or signed 2's complement. Value = 0 or 1<br>Resolution: MEASUREMENT_MODE1 and Bit [8:5] of this field. |
| SAMP_RATE1 | U1 | 6 | Sample Rate for Sensor 1 in Hz.<br>Values are:<br>1 = 1Hz<br>2 = 2Hz<br>3 = 5Hz<br>4 = 10 Hz<br>5 = 25Hz<br>6 = 50Hz<br>7 = 100Hz<br>[15:8] = reserved |
| SND_RATE1 | U1 | 3 | Sending rate of Sensor 1 data back to the Host , in Hz.<br>Values are:<br>1 = 1Hz<br>2 = 2Hz<br>3 = 5Hz<br>4 = 10 Hz<br>5 = 25Hz<br>6 = 50Hz<br>7 = 100Hz<br>[15:8] = reserved.<br>SND_RATE cannot be greater than SAMP_RATE. |

| Name | Bytes | ASCII (Dec) | Description |
|---|---|---|---|
| | | Example | |
| DECM_METHOD_FACTOR1 | U1 | 0 | Data decimation method and factory setting. Values are:<br>0 = raw<br>1 = averaging<br>2 = sliding median<br>Lower 3 bits are used for data decimation method<br>Upper 5 bits are used for decimation factor:<br>1 = SENS_DECIM_FACTOR_2<br>2 = SENS_DECIM_FACTOR_4<br>3 = SENS_DECIM_FACTOR_5<br>4 = SENS_DECIM_FACTOR_6<br>5 = SENS_DECIM_FACTOR_8<br>6 = SENS_DECIM_FACTOR_10<br>7 = SENS_DECIM_FACTOR_12<br>8 = SENS_DECIM_FACTOR_15<br>9 = SENS_DECIM_FACTOR_20<br>10 = SENS_DECIM_FACTOR_25<br>11 = SENS_DECIM_FACTOR_30 |
| ACQ_TIME_DELAY1 | U1 | 32 | Acquisition time delay for Sensor 1 (microsecond x 10). This is the time between triggering the sensor data acquisition and the sensor read operation. |
| NUM_SEN_READ_REG1 | U1 | 1 | Number of registers to read sensor data from READ_OPR_REG1_SEN1. Read operation method for Register 1 for Sensor 1. 0 = read-only from SENS_DATA_READ_ADD. Other values = write with repeated start read. |
| MEASUREMENT_MODE1 | U1 | 0 | Bit 1 = Measurement Mode:<br>0 = auto (Sensor configured)<br>1 = forced (SW controlling)<br>Bit 2 = add-on bit for data resolution. This is the most signification bit for data resolution. |
| READ_OPR_REG1_SEN1 | U1 | 1 | Read operation method for Register 1 for Sensor 1.<br>Bit definition:<br>Bits [7:4]: Number of right shifts before sending to host<br>Bits [3:2]: Reserved<br>Bit 1: Endian:<br>■ 0 = big<br>■ 1 = little<br>Bit 0: Read mode:<br>■ 0 = read-only<br>■ 1 = write with repeated start read |

| Name | Bytes | ASCII (Dec) | Description |
|---|---|---|---|
| | | Example | |
| SENS_DATA_ READ_ADD1 | U1 | 0 | Register 1 address to read Sensor 1 data |
| SENS_DATA_READ_ADD2 | | | Register 2 address to read Sensor 2 data |
| Only one sensor register to be read for data | | | |
| LO_PWR_REG _SEN1 | U1 | 13 | Register to put Sensor 1 into Low Power mode |
| LO_PWR_MODE_SET1 | U1 | 0 | Setting for LO_PWR_REG_SEN1 to affect Low Power Mode for Sensor 1 |
| NRML_PWR_MODE_SET1 | U1 | 64 | Setting for LO_PWR_REG_SEN1 to affect normal power consumption mode for Sensor 1 |
| NUM_INIT_READ_REG_SEN1 | U1 | 2 | Number of registers to read sensor-specific data from Sensor 1 at the time of initialization. If value = 0, then no register addresses are specified. |
| INIT_READ_ REG1 | U1 | 12 | Register 1 address to read at time of initialization |
| NUM_BYTES_ REG1 | U1 | 1 | Number of bytes to read from Register 1 at initialization |
| INIT_READ_ REG2 | U1 | 13 | Register 2 address to read at time of initialization |
| NUM_BYTES_ REG2 | U1 | 1 | Number of bytes to read from Register 2 at initialization |
| ………………End of init registers (only 2)details for sensor 1………………… | | | |
| NUM_CNTRL_ REG_SEN1 | U1 | 2 | Number of Control registers for Sensor 1 to configure. Configuring control registers occurs at initialization of sensors. |
| REG_WRITE_ DELAY1 | U1 | 0 | Time delay between two consecutive register writes, in ms, scale = 1 |
| CNTRL_REG1 | U1 | 12 | Control Register 1 address for Sensor 1 |
| CNTRL_REG1_SET | U1 | 227 | Register 1 setting to be sent to Sensor 1. If setting is 0xFF then CNTRL_REG1 address is used as a write command only. |
| CNTRL_REG2 | U1 | 13 | Control Register 2 address for Sensor 1. If the setting is 0xFF then CNTRL_REG2 address is used as a write command only. |
| CNTRL_REG2 _SET | U1 | 64 | Register 2 setting to be sent to Sensor 1 |
| ……………………End of ctrl registers (only 2) details for Sensor 1………………… | | | |

| Name | Bytes | ASCII (Dec) | Description |
|---|---|---|---|
| | | Example | |
| SDA_SENS2 | U1 | - | **Note:** This is not used. There is currently only one sensor attached.<br>Slave device address for Sensor 2 |
| SENSR_TYPE _SEN2 | U1 | - | Sensor Type of Sensor 2:<br>1 = Accelerometer<br>2 = Magnetic sensor<br>3 = Pressure sensor<br>4 = Gyroscope<br>5 = Accelerometer + Gyroscope<br>6 = Accelerometer + Magnetic sensor<br>7 = Gyroscope + Magnetic sensor<br>8 = Accelerometer + Magnetic sensor + Gyro |
| SEN_INIT_TIME2 | U1 | - | Sensor 2 initialization period after power-up (milliseconds x 10) |
| ... | | | |
| SEN_DATA_PROC_RATE | U1 | 1 | Sensor data processing rate on the Host, in Hz, from 1 to 256 Hz. Value can not be higher than SND_RATE. |
| ZERO_PT_SEN1 | U2 | 248 | Zero Point Value for Sensor 1: the bias value that is subtracted from the sensor data measurement (in ADC counts) for sensor 1 |
| SF_SEN1 | U2 | 410 | Scale Factor (sensitivity) for Sensor 1: To convert the sensor measurement in ADC counts to Engineering units use the expression:<br>Sensor 1 measurement = (sensor 1 ADC counts – ZERO_PT_SEN1) / SF_SEN1 |
| ZERO_PT_SEN2 | U2 | - | **Note:** This is not used. There is currently only one sensor attached.<br>Zero Point Value for Sensor 2 |
| SF_SEN2 | U2 | - | Scale Factor (sensitivity) for Sensor 2 |
| ... | | | |

Table 5.252: Sensor Control Input Message - MID 234, SID 1

Note:

- This is a variable length message. The minimum number of sensor is 1 and the maximum number is 4.
- Init or control registers are sensor specific registers. Number of Init or control registers depends on the design of the sensors.
- SAMP_RATE: The first release will support 50 Hz as the highest sampling rate. Other supported sample rates are 25 Hz, 10 Hz, 5 Hz, 2 Hz, 1 Hz, and 0.5 Hz.
- SND_RATE: The first implementation has the highest rate at which data can be sent from GSD4t to Host is 25 Hz. SND_RATE cannot be higher than SAMP_RATE.
- LO_PWR_MODE_SET1: If a sensor does not have the capability to switch to low power mode, then, LO_PWR_REG_SEN1, LO_PWR_MODE_SET1 and NRML_PWR_MODE_SET1 contain 0x0.
- The data acquisition software on GSD4t has these limitations for the maximum number of registers for each sensor:
  - Maximum number of sensor data read registers NUM_SEN_READ_REG = 12
  - Maximum number of initialization data registers NUM_INIT_READ_REG_SE = 12
  - Maximum number of Bytes read from initialization data read register NUM_BYTES_REG = 20
  - Maximum number of Control registers NUM_CNTRL_REG_SEN = 32

### 5.85.2 Sensor Switch Input - MID 234, SID 2

This message, sent from the Host to the Measurement or Location Engine, turns the attached entire sensor set Off/On anytime after the configuration message has been sent. This message is logged with sensor data for post processing in NavOffline.

| | |
|---|---|
| MID Name | MID_SensorControl |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name | SENSOR_SWITCH |

Table 5.253: Sensor Switch Input Message - MID 234, SID 2

| Name | Bytes | Binary (Hex) | ASCII (Dec) | Description |
|---|---|---|---|---|
| | | Example | Example | |
| MID | U1 | 0xEA | 234 | SENSOR_CONTROL |
| SID | U1 | 0x02 | 2 | SENSOR_SWITCH |
| STATE_SENSOR_SET | U1 | 0x8F | 143 | For bit field details, seeTable 5.255<br>Bits [6:4]: Reserved |

Table 5.254: Sensor Switch Message

| Bit Field | Description |
| --- | --- |
| Bit 0 | 0 = turn sensor set OFF<br>1 = turn sensor set ON |
| Bit 1 | 0 = turn the receiver state change notifications OFF<br>1 = turn the receiver state change notifications ON |
| Bit 2 | 0 = turn the Point and Tell notifications OFF<br>1 = turn the Point and Tell notifications ON<br>(1) |
| Bit 3 | 0 = turn the Pedestrian DR notifications OFF<br>1 = turn the Pedestrian DR notifications ON |
| Bit [6:4] | Reserved |
| Bit 7 | 0 = turn the walking angle usage OFF<br>1 = turn the walking angle usage ON<br>(1) |

Table 5.255: Bit Field Description (STATE_SENSOR_SET)

(1) Not supported prior to 4.1.2

### 5.85.3 Poll Sensor Parameters - MID 234, SID 3

This message requests output of sensor parameters related to:

- Sensor Software version
- Current sensor configuration
- State of location manager
- Sensor Calibration parameters
- Magnetic model parameters

**Note:**

This message is not supported prior to version 4.1.2.

| | |
| --- | --- |
| MID (Hex) | 0xEA |
| MID (Dec) | 234 |
| Message Name in Code | SENSORS_POLL_PARAMETER_MESSAGE |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |

Table 5.256: Poll Sensor Parameters - MID 234, SID 3

| Name | Bytes | Example (Optional) | | Description |
|---|---|---|---|---|
| | | Hex | Dec | |
| MID | U1 | 0XEA | 234 | Message ID |
| SID | U1 | 0X03 | 3 | Sub ID |
| SENSOR_PARAMS_TO_POLL_SET | U2 | 0x00 0F | 15 | If 0x0000 is assigned, the poll message shall not output anything. If 0xFFFF is assigned, all parameters shall be output. See Table 5.258for the bit pattern value assignments. |

Table 5.257: Message Fields Description

| Bit Field | Description |
|---|---|
| Bit 0 | Sensor SW version |
| Bit 1 | Sensor configuration parameters |
| Bit 2 | Sensor state parameters |
| Bit 3 | Sensor calibration parameters |
| Bit 4 | Sensor IGRF parameters |
| Bit [15:5] | Reserved |

Table 5.258: Bit Field Description (SENSOR_PARAMS_TO_POLL_SET)

| | |
|---|---|
| Bit 0 = 1 | Output Sensor SW version |
| Bit 1 = 1 | Output Message MID: 234 SID:1 |
| Bit 2 = 1 | Output Message MID: 234 SID:2 |
| Bit 3 = 1 | Output Message MID: 72 SID:5 |
| Bit 4 = 1 | Output Message MID: 72 SID:6 |

Table 5.259: Command/Response Pairs for this Message

# 6 Output Message Definition

## 6.1 Reference Navigation Data – MID 1

This message is not yet implemented.

## 6.2 Measure Navigation Data Out - MID 2

Output Rate: 1 Hz

Table 6.1 lists the message data format for the measured navigation data.

Example:

- `A0A20029` – Start Sequence and Payload Length (41 bytes)
- `02FFD6F78CFFBE536E003AC004000000030001040A00036B039780E30612190E160F04000000000000` – Payload
- `09BBB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | - | 02 | - | - | 2 |
| X-position | 4 S | - | FFD6F78C | m | - | -2689140 |
| Y-position | 4 S | - | FFBE536E | m | - | -4304018 |
| Z-position | 4 S | - | 003AC004 | m | - | 3850244 |
| X-velocity | 2 S | *8 | 0000 | m/s | Vx÷8 | 0 |
| Y-velocity | 2 S | *8 | 0003 | m/s | Vy÷8 | 0.375 |
| Z-velocity | 2 S | *8 | 0001 | m/s | Vz÷8 | 0.125 |
| Mode 1 | 1 D | - | 04 | Bitmap(1) | - | 4 |
| HDOP2(2) | 1 U | *5 | 0A | - | 5(3) | 2.0 |
| Mode 2 | 1 D | - | 00 | Bitmap(3) | - | 0 |
| GPS Week(4) | 2 U | - | 036B | - | - | 875 |
| GPS TOW | 4 U | *100 | 039780E3 | sec | ÷100 | 602605.79 |
| SVs in Fix | 1 U | - | 06 | - | - | 6 |
| CH 1 PRN(5) | 1 U | - | 12 | - | - | 18 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| CH 2 PRN(5) | 1 U | - | 19 | - | - | 25 |
| CH 3 PRN(5) | 1 U | - | 0E | - | - | 14 |
| CH 4 PRN(5) | 1 U | - | 16 | - | - | 22 |
| CH 5 PRN(5) | 1 U | - | 0F | - | - | 15 |
| CH 6 PRN(5) | 1 U | - | 04 | - | - | 4 |
| CH 7 PRN(5) | 1 U | - | 00 | - | - | 0 |
| CH 8 PRN(5) | 1 U | - | 00 | - | - | 0 |
| CH 9 PRN(5) | 1 U | - | 00 | - | - | 0 |
| CH 10 PRN(5) | 1 U | - | 00 | - | - | 0 |
| CH 11 PRN(5) | 1 U | - | 00 | - | - | 0 |
| CH 1 2PRN(5) | 1 U | - | 00 | - | - | 0 |

Table 6.1: Measure Navigation Data Out - MID 2

(1) For further information see Table 6.2 and Table 6.3. Note that the Degraded Mode positioning mode is not supported in version GSW3.2.5 and later.

(2) HDOP value reported has a maximum value of 50.

(3) For further information see Table 6.4.

(4) GPS week reports only the ten LSBs of the actual week number.

(5) PRN values are reported only for satellites used in the navigation solution.



**Note:**

Binary units scaled to integer values must be divided by the scale value to receive true decimal value (i.e., decimal $X_{vel}$ = binary $X_{vel}$ ÷ 8).

MID 2 Mode 1 is a bit-mapped byte with five sub-values. Table 6.2 shows the location of the sub-values and Table 6.3 shows the interpretation of each sub-value.

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Bit(s) Name | DGPS | DOP-Mask | ALTMODE | | TPMODE | PMODE | | |

Table 6.2: Mode 1

| Bit(s) Name | Name | Value | Description |
|---|---|---|---|
| PMODE | Position mode | 0 | No navigation solution |
| | | 1 | 1-SV solution (Kalman filter) |
| | | 2 | 2-SV solution (Kalman filter) |
| | | 3 | 3-SV solution (Kalman filter) |
| | | 4 | > 3-SV solution (Kalman filter) |
| | | 5 | 2-D point solution (least squares) |
| | | 6 | 3-D point solution (least squares) |
| | | 7 | Dead-Reckoning[1] solution (no satellites) |
| TPMODE | TricklePower mode | 0 | Full power position |
| | | 1 | TricklePower position |
| ALTMODE | Altitude mode | 0 | No altitude hold applied |
| | | 1 | Holding of altitude from KF |
| | | 2 | Holding of altitude from user input |
| | | 3 | Always hold altitude (from user input) |
| DOPMASK | DOP mask status | 0 | DOP mask not exceeded |
| | | 1 | DOP mask exceeded |
| DGPS | DGPS status | 0 | No differential corrections applied |
| | | 1 | Differential corrections applied |

Table 6.3: Mode 1 Bitmap Information

[1] In standard software, Dead Reckoning solution is computed by taking the last valid position and velocity and projecting the position using the velocity and elapsed time.

Table 6.4 describes Mode 2 bitmap.

| Bit | Description |
|---|---|
| 0(1) | 1 = sensor DR in use<br>0 = velocity DR if PMODE sub-value in Mode<br>1 = 7; else check Bits [7:6] for DR error status |
| 1(2) | If set, solution is validated (5 or more SVs used)(3) |
| 2 | If set, velocity DR timeout |
| 3 | If set, solution edited by UI (e.g., DOP Mask exceeded) |
| 4(4) | If set, velocity is invalid |
| 5 | Altitude hold mode:<br>0 = enabled<br>1 = disabled (3-D fix only) |
| 7,6(5) | Sensor DR error status:<br>00 = GPS-only navigation<br>01 = DR in calibration<br>10 = DR sensor errors<br>11 = DR in test mode |

Table 6.4: Mode 2 Bitmap

(1) Bit 0 is controlled by the acquisition hardware. The rest of the bits are controlled by the tracking hardware, except that in SiRFstarIII receivers, Bit 2 is also controlled by the acquisition hardware.

(2) Bit 1 set means that the phase relationship between the I and Q samples is being tracked.

(3) From an unvalidated state, a 5-SV fix must be achieved to become a validated position. If the receiver continues to navigate in a degraded mode (less than 4 SVs), the validated status remains. If navigation is lost completely, an unvalidated status results.

(4) Bit 4 set means that the Doppler corrections have been made so that the phase between the I and Q samples is stable.

(5) Generally, bit 6 cannot be set at the same time other bits are set. However, some firmware versions use the special case of setting

**Note:**

Mode 2 of Message ID 2 is used to define the Fix field of the Measured Navigation Message View. It should be used only as an indication of the current fix status of the navigation solution and not as a measurement of TTFF.

## 6.3 True Tracker Data – MID 3

This message is not yet implemented.

## 6.4 Measured Tracker Data Out - MID 4

Output Rate: 1 Hz

Table 6.5 lists the message data format for the measured tracker data.

Example:

- `A0A200BC` – Start Sequence and Payload Length
- `04036C0000937F0C0EAB46003F1A1E1D1D191D1A1A1D1F1D59423F1A1A...` - Payload
- `....B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| MID | 1 U | - | 04 | - | - | 4 |
| GPS Week[1] | 2 S | - | 036C | - | - | 876 |
| GPS TOW | 4 U | S*100 | 0000937F | sec | S÷100 | 37759 |
| Chans | 1 U | - | 0C | - | - | 12 |
| 1st SVid | 1 U | - | 0E | - | - | 14 |
| Azimuth | 1 U | Az*[2/3] | AB | deg | $^{3}$[2/3] | 256.5 |
| Elev | 1 U | E1*2 | 46 | deg | $^{3}$2 | 35 |
| State | 2 D | - | 003F | Bitmap[2] | - | 63 |
| C/N0 1 | 1 U | - | 1A | dB-Hz | - | 26 |
| C/N0 2 | 1 U | - | 1E | dB-Hz | - | 30 |
| C/N0 3 | 1 U | - | 1D | dB-Hz | - | 0 |
| C/N0 4 | 1 U | - | 1D | dB-Hz | - | 0 |
| C/N0 5 | 1 U | - | 19 | dB-Hz | - | 0 |
| C/N0 6 | 1 U | - | 1D | dB-Hz | - | 0 |
| C/N0 7 | 1 U | - | 1A | dB-Hz | - | 0 |
| C/N0 8 | 1 U | - | 1A | dB-Hz | - | 0 |
| C/N0 9 | 1 U | - | 1D | dB-Hz | - | - |
| C/N0 10 | 1 U | - | 1F | dB-Hz | - | - |
| 2nd SVid | 1 U | - | 1D | - | - | 29 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Azimuth | 1 U | Az*[2/3] | 59 | deg | [3][2/3] | 89 |
| Elev | 1 U | E1*2 | 42 | deg | [3]2 | 66 |
| State | 2 D | - | 003F | Bitmap(2) | - | 63 |
| C/N0 1 | 1 U | - | 1A | dB-Hz | - | 26 |
| C/N0 2 | 1 U | - | 1A | dB-Hz | - | 63 |
| SVid, Azimuth, Elevation, State, and C/N0 1-10 values are repeated for each of the 12 channels | | | | | | |

Table 6.5: Measured Tracker Data Out - MID 4

(1) GPS week number is reported modulo 1024 (ten LSBs only).

(2) For further information, see Table 6.6 for state values for each channel.

| Bit | Description When Bit is Set to 1 |
|---|---|
| 0(1) | Acquisition/re-acquisition has been completed successfully |
| 1(2) | The integrated carrier phase is valid – delta range in MID 28 is also valid |
| 2 | Bit synchronization has been completed |

| Bit | Description When Bit is Set to 1 |
|---|---|
| 3 | Subframe synchronization has been completed |
| 4(3) | Carrier pullin has been completed (Costas lock) |
| 5 | Code has been locked |
| 6(4) (5) | Multiple uses. |
| 7 | 1 = Ephemeris data is available |
| [15:8] | Reserved |

**Table 6.6: State Values for Each Channel**

(1) Bit 0 is controlled by the acquisition hardware. The rest of the bits are controlled by the tracking hardware except in SiRFstarIII receivers, where bit 2 is also controlled by the acquisition hardware.

(2) Bit 1 set means that the phase relationship between the I and Q samples is being tracked. When this bit is cleared, the carrier phase measurements on this channel are invalid.

(3) Bit 4 set means that the Doppler corrections have been made so that the phase between the I and Q samples is stable.

(4) Most code versions use this bit to designate that a track has been lost. Generally, Bit 6 cannot be set at the same time other bits are set. However, some firmware versions use the special case of setting all Bits [7:0] to 1 (0xFF) to show that this channel is being used to test the indicated PRN for an auto or cross correlation. When used like this, only 1 or 2 channels report state 0xFF at any one time.

(5) In some code versions, this bit is used to denote the presence of scalable tracking loops. In those versions, every track will have this bit set. When that is the case, there will be no reports for tracks being tested for auto- and cross-correlation testing as it will be done in another part of the code and not reported in this field.

## 6.5 Raw Tracker Data Out - MID 5

**Note:**

This message is not supported by the SiRFstarII or SiRFstarIII architecture.

## 6.6 Software Version String (Response to Poll) – MID 6

This message has a variable length from 1 to 81 bytes.

Output Rate: Response to polling message

Example:

- `A0A2001F` – Start Sequence and Payload Length (1–81 bytes)
- `06322E332E322D475358322D322E30352E3032342D4331464C4558312E32` – Payload
- `0631B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 06 | | | 6 |
| Character [80] | 1 U | | (1) | | | (2) |

Table 6.7: Software Version String (Response to Poll) – MID 6

(1) Payload example is shown above.

(2) 2.3.2-GSW2-2.05.024-C1FLEX1.2

Note:

Convert ASCII to symbol to assemble message (i.e., 0x4E is 'N'). Effective with version GSW 2.3.2, message length was increased from 21 to 81 bytes to allow for up to an 80-character version string.

For SiRFstarIV products and beyond, the software version response is extended to specify customer SW version as well:

| Field | Bytes |
|---|---|
| Message ID | 1 |
| SIRF_VERSION_ID | [0…80] (variable) |
| LENGTH_SIRF_VERSION_ID | 1 |
| LENGTH_CUSTOMER_VERSION_ID | 1 |
| CUSTOMER_VERSION_ID | [0…80] (variable) |

Table 6.8: Software Version Response Message

SIRF_VERSION_ID: Length of Software Version String

Number of characters in SIRF_VERSION_ID, including the null terminator, from 0 to 80. Other values have no meaning. For example, if the SIRF_VERSION_ID is the character string A, then including the null terminator this is 2 bytes long, and this field is 0000 0010 in binary.

CUSTOMER_VERSION_ID: Length of Customer String

Number of characters in CUSTOMER_VERSION_ID, including the null terminator, from 0 to 80 Other values have no meaning. For example, if the CUSTOMER_VERSION_ID is the character string A, then including the null terminator this is 2 bytes long, and so this field is represented by 0000 0010 in binary.

SIRF_VERSION_ID: Software Version String

The ASCIIrepresentation of the character string, with the null terminator at the end, is used. The number of characters, including the null terminator, should equal that set by LENGTH_SIRF_VERSION_ID. For example, the software version ID string denoted by A is 0100 0001 0000 0000 including the null terminator

CUSTOMER_VERSION_ID: Customer Software Version ID

The ASCIIrepresentation of the character string, with the null terminator at the end, is used. The number of characters, including the null terminator, should equal that in LENGTH_CUSTOMER_VERSION_ID. For example, the software version ID string denoted by A is 0100 0001 0000 0000, including the null terminator.

## 6.7 Clock Status Data - MID 7

This message is output as part of each navigation solution. It tells the actual time of the measurement in GPS time, and gives the computed clock bias and drift information computed by the navigation software.

Control of this message is unique. In addition to control using the message rate commands, it also acts as part of the Navigation Library messages controlled by MID 128 Reset Configuration Bit Map bit 4. When navigation library messages are enabled or disabled, this message is enabled or disabled. It is also enabled by default whenever a system reset occurs.

Output Rate: 1Hz or response to polling message

Example:

- `A0A20014` – Start Sequence and Payload Length (20 bytes)
- `0703BD021549240800012231000047281 4D4DAEF` – Payload
- `0598B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 07 | | | 7 |
| Extended GPS Week | 2 U | | 03BD | | | 957 |
| GPS TOW | 4 U | *100 | 02154924 | s | ÷100 | 349494.12 |
| SVs | 1 U | | 08 | | | 8 |
| Clock Drift | 4 U | | 00012231 | Hz | | 74289 |
| Clock Bias | 4 U | | 00004728 | ns | | 18216 |
| Estimated GPS Time | 4 U | | 14D4DAEF | ms | | 349493999 |

Table 6.9: Clock Status Data - MID 7

| Field | Description |
|---|---|
| Extended GPS Week | GPS week number is reported by the satellites with only 10 bits. The receiver extends that number with any higher bits and reports the full resolved week number in this message. |
| GPS TOW | Seconds into the current week, accounting for clock bias, when the current measurement was made. This is the true GPS time of the solution. |
| SVs | Total number of satellites used to compute this solution. |
| Clock Drift[(1)] | Rate of change of the Clock Bias. Clock Drift is a direct result of the GPS crystal frequency, so it is reported in Hz. |
| Clock Bias | This is the difference in nanoseconds between GPS time and the receiver's internal clock. In different CSR receivers this value has different ranges, and as the computed bias approaches the limit of the range, the next measurement interval will be adjusted to be longer or shorter so that the bias remains in the selected range. |
| Estimated GPS Time[(2)] | This is the GPS time of the measurement, estimated before the navigation solution is computed. Due to variations in clock drift and other factors, this will normally not equal GPS TOW, which is the true GPS time of measurement computed as part of the navigation solution. |

Table 6.10: Detailed Description of MID 7 Fields

(1) Clock Drift in CSR receivers is directly related to the frequency of the GPS clock, derived from the GPS crystal. From the reported frequency, you can compute the GPS clock frequency, and you can predict the next clock bias. Clock drift also appears as a Doppler bias in Carrier Frequency reported in Message ID 28.

(2) Estimated GPS time is the time estimated when the measurements were made. Once the measurements were made, the GPS navigation solution was computed, and true GPS time was computed. Variations in clock drift and measurement intervals generally make the estimate slightly wrong, which is why GPS TOW and Estimated GPS time typically disagree at the microsecond level.

For detailed information about computing GPS clock frequency, see Appendix A.2.

## 6.8 50 BPS Data - MID 8

Output Rate: Approximately every six seconds for each channel

Example:

- `A0A2002B` – Start Sequence and Payload Length (43 bytes)
- `08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFFA80365A867FC67708BEB5860F4` – Payload
- `15AAB0B3` – Message Checksum and End Sequence

| Name | Byte | Example |
|---|---|---|
| MID | 1 U | 08 |
| Channel | 1 U | 00 |
| SV ID | 1 U | 19 |
| Word[10] | 4 U | - |

Table 6.11: 50 BPS Data - MID 8



## 6.9 CPU Throughput - MID 9

Output Rate: 1 Hz

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `09003B0011001601E5` – Payload
- `0151B0B3` – Message Checksum and End Sequence

| Name | Bytes | Scale | Example | Unit |
|---|---|---|---|---|
| MID | 1 U | | 09 | |
| SegStatMax | 2 U | *186 | 003B | ms |
| SegStatLat | 2 U | *186 | 0011 | ms |
| AveTrkTime | 2 U | *186 | 0016 | ms |
| Last Millisecond | 2 U | | 01E5 | ms |

Table 6.12: CPU Throughput - MID 9

## 6.10 Error ID Data – MID 10

MID 10 messages have a different format to other messages. There are several formats, each designated by an Error ID. Table 6.13 shows a standardized format. Specific Error ID messages follow.

Output Rate: As errors occur

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | 10. MID name in code is `SSB_ERROR`. |
| Error ID | 2 U | Sub-message type |
| Count | 2 U | Number of 4-byte values that follow |
| Data[n] | 4 U | Data for the message where n = Count |

Table 6.13: Error ID Format

### 6.10.1 Error ID 2

Code Define Name: `ErrId_CS_SVParity`

Error ID Description: Satellite subframe # failed parity check

Example:

- `A0A2000D` – Start Sequence and Payload Length (13 bytes)
- `0A00020002000000010000002` – Payload
- `0011B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 0002 | Sub-message type |
| Count | 2 U | 0002 | Number of 4-byte values that follow |
| Satellite ID | 4 U | 00000001 | Satellite pseudo-random noise (PRN) number |
| Subframe No | 4 U | 00000002 | The associated subframe number that failed the parity check, from 1 to 5 |

Table 6.14: Error ID 2 Message

### 6.10.2 Error ID 9

Code Define Name: `ErrId_RMC_GettingPosition`

Error ID Description: Failed to obtain a position for acquired satellite ID

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `0A000900010000001` – Payload
- `0015B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 0009 | Sub-message type |
| Count | 2 U | 0002 | Number of 4-byte values that follow |
| Satellite ID | 4 U | 00000001 | Satellite pseudo-random noise (PRN) number |

Table 6.15: Error ID 9 Message

### 6.10.3 Error ID 10

Code Define Name: `ErrId_RXM_TimeExceeded`

Error ID Description: Conversion of Nav Pseudo Range to Time of Week (TOW) for tracker exceeds limits: Nav Pseudo Range > 6.912e5 (1 week in seconds) || Nav Pseudo Range < -8.64e4.

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `0A000A000100001234` – Payload
- `005BB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 000A | Sub-message type |
| Count | 2 U | 0001 | Number of 4-byte values that follow |
| Pseudorange | 4 U | 00001234 | Pseudo range |

Table 6.16: Error ID 10 Message

### 6.10.4 Error ID 11

Code Define Name: `ErrId_RXM_TDOPOverflow`

Error ID Description: Convert pseudorange rate to Doppler frequency exceeds limit.

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `0A000B0001xxxxxxxx` – Payload
- `xxxxB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 000B | Sub-message type |
| Count | 2 U | 0001 | Number of 4-byte values that follow |
| Doppler Frequency | 4 U | xxxxxxxx | - |

Table 6.17: Error ID 11 Message

### 6.10.5 Error ID 12

Code Define Name: `ErrId_RXM_ValidDurationExceeded`

Error ID Description: Satellite ephemeris age has exceeded 2 hours (7200 s).

Example:

- `A0A2000D` – Start Sequence and Payload Length (13 bytes)
- `0A000C0002xxxxxxxxaaaaaaaa` – Payload
- `xxxxB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | 0A | - | 10 |
| Error ID | 2 U | 000C | - | Sub-message type |
| Count | 2 U | 0002 | - | Number of 4-byte values that follow |
| Satellite ID | 4 U | xxxxxxxx | - | Satellite pseudo-random noise number |
| Age of Ephemeris | 4 U | aaaaaaaa | sec | The satellite ephemeris age in seconds |

Table 6.18: Error ID 12 Message

### 6.10.6 Error ID 13

Code Define Name: `ErrId_STRTP_BadPostion`

Error ID Description: SRAM position is bad during a cold start.

Example:

- `A0A20011` – Start Sequence and Payload Length (17 bytes)
- `0A000D0003xxxxxxxxaaaaaaaabbbbbbbb` – Payload
- `xxxxB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 000D | Sub-message type |
| Count | 2 U | 0003 | Number of 4-byte values that follow |
| X | 4 U | xxxxxxxx | X position in ECEF |
| Y | 4 U | aaaaaaaa | Y position in ECEF |
| Z | 4 U | bbbbbbbb | Z position in ECEF |

Table 6.19: Error ID 13 Message

### 6.10.7 Error ID 4097

Code Define Name: `ErrId_MI_VCOClockLost`

Error ID Description: VCO lost lock indicator.

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `0A1001000100000001` – Payload
- `001DB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 1001 | Sub-message type |
| Count | 2 U | 0001 | Number of 4-byte values that follow |
| VCOLost | 4 U | 00000001 | VCO lock lost indicator. If VCOLost ! = 0, then send failure message |

Table 6.20: Error ID 4097 Message

### 6.10.8 Error ID 4099

Code Define Name: `ErrId_MI_FalseAcqReceiverReset`

Error ID Description: Nav detect false acquisition, reset receiver by calling NavForceReset routine.

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `0A1003000100000001` – Payload
- `001FB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 1003 | Sub-message type |
| Count | 2 U | 0001 | Number of 4-byte values that follow |
| InTrkCount | 4 U | 00000001 | False acquisition indicator. If InTrkCount < = 1, then send failure message and reset receiver |

**Table 6.21: Error ID 4099 Message**

### 6.10.9 Error ID 4104

Code Define Name: `ErrId_STRTP_SRAMCksum`

Error ID Description: Failed SRAM checksum during startup.

- Four field message indicates receiver control flags had checksum failures.
- Three field message indicates clock offset checksum failure or clock offset value is out of range.
- Two field message indicates position and time checksum failure forces a cold start.

Example:

- `A0A2xxxx` – Start Sequence and Payload Length (21, 17 or 11 bytes)
- `0A10080004xxxxxxxaaaaaaaa00000000cccccccc` – Payload
- `xxxxB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 1008 | Sub-message type |
| Count | 2 U | 0004 or 0003 or 0002 | Number of 4-byte values that follow |
| Computed Receiver Control Checksum | 4 U | xxxxxxxx | Computed receiver control checksum of SRAM. |
| NVRAM Receiver Control Checksum | 4 U | aaaaaaaa | NVRAM receiver control checksum stored in SRAM.Data.DataBuffer. CntrlChkSum. |
| NVRAM Receiver Control OpMode | 4 U | 00000000 | NVRAM receiver control checksum stored in SRAM.Data.Control.OpMode. Valid OpMode values:<br>OP_MODE_NORMAL = 0<br>OP_MODE_TESTING = 0x1E51<br>OP_MODE_TESTING2 = 0x1E52<br>OP_MODE_TESTING3 = 0x1E53 |

| Name | Bytes | Example | Description |
|---|---|---|---|
| NVRAM Receiver Control Channel Count | 4 U | cccccccc | NVRAM receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are 0-12 |
| Compute Clock Offset Checksum | 4 U | xxxxxxxx | Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset. |
| NVRAM Clock Offset Checksum | 4 U | aaaaaaaa | NVRAM clock offset checksum of SRAM.Data.DataBuffer.clkChkSum |
| NVRAM Clock Offset | 4 U | bbbbbbbb | NVRAM clock offset value stored in SRAM.Data.DataBuffer,clkOffset |
| Computed Position Time Checksum | 4 U | xxxxxxxx | Computed position time checksum of SRAM.Data.DataBuffer.postime[1] |
| NVRAM Position Time Checksum | 4 U | aaaaaaaa | NVRAM position time checksum of SRAM.Data.DataBuffer.postimeChkSum[1] |

Table 6.22: Error ID 4104 Message

### 6.10.10 Error ID 4105

Code Define Name: `ErrId_STRTP_RTCTimeInvalid`

Error ID Description: 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.

Example:

- `A0A2000D` – Start Sequence and Payload Length (13 bytes)
- `0A10090002xxxxxxxxaaaaaaaa` – Payload
- `xxxxB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | 0A | - | 10 |
| Error ID | 2 U | 1009 | - | Sub-message type |
| Count | 2 U | 0002 | - | Number of 4-byte values that follow |
| TOW | 4 U | xxxxxxxx | sec | GPS time of week in seconds, from 0 to 604800 seconds |
| Week Number | 4 U | aaaaaaaa | - | GPS week number |

Table 6.23: Error ID 4105 Message

### 6.10.11 Error ID 4106

Code Define Name: `ErrId_KFC_BackupFailed_Velocity`

Error ID Description: Failed saving position to NVRAM because the ECEF velocity sum was greater than 3600.

Example:

- `A0A20005` – Start Sequence and Payload Length (5 bytes)
- `0A100A0000` – Payload
- `0024B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | - |
| Error ID | 2 U | 100A | Sub-message type |
| Count | 2 U | 0000 | Number of 4-byte values that follow |

Table 6.24: Error ID 4106 Message

### 6.10.12 Error ID 4107

Code Define Name: `ErrId_KFC_BackupFailed_NumSV`

Error ID Description: Failed saving position to NVRAM because current navigation mode is not KFNav and not LSQFix.

Example:

- `A0A20005` – Start Sequence and Payload Length (5 bytes)
- `0A100B0000` – Payload
- `0025B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 100B | Sub-message type |
| Count | 2 U | 0000 | Number of 4-byte values that follow |

Table 6.25: Error ID 4107 Message

### 6.10.13 Error ID 8193

Code Define Name: `ErrId_MI_BufferAllocFailure`

Error ID Description: Buffer allocation error occurred. Does not appear to be active because uartAllocError variable never gets set to a non-zero value in the code.

Example:

- `A0A20009` – Start Sequence and Payload Length (9 bytes)
- `0A2001000100000001` – Payload
- `002DB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 2001 | Sub-message type |
| Count | 2 U | 0001 | Number of 4-byte values that follow |
| uartAllocError | 4 U | 00000001 | Contents of variable used to signal UART buffer allocation error |

**Table 6.26: Error ID 8193 Message**

### 6.10.14 Error ID 8194

Code Define Name: `ErrId_MI_UpdateTimeFailure`

Error ID Description: PROCESS_1SEC task was unable to complete upon entry. Overruns are occurring.

Example:

- `A0A2000D` – Start Sequence and Payload Length (13 bytes)
- `0A20020002000000010000064` – Payload
- `0093B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 2002 | Sub-message type |
| Count | 2 U | 0002 | Number of 4-byte values that follow |
| Number of in-process errors | 4 U | 00000001 | Number of one-second updates not complete on entry |
| Millisecond errors | 4 U | 00000064 | Millisecond errors caused by overruns |

**Table 6.27: Error ID 8194 Message**

### 6.10.15 Error ID: 8195

Code Define Name: `ErrId_MI_MemoryTestFailed`

Error ID Description: Failure of hardware memory test.

Example:

- `A0A20005` – Start Sequence and Payload Length (5 bytes)
- `0A20030000` – Payload
- `002DB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 0A | 10 |
| Error ID | 2 U | 2003 | Sub-message type |
| Count | 2 U | 0000 | Number of 4-byte values that follow |

Table 6.28: Error ID 8195 Message

### 6.10.16 Error ID 8196

Code Define Name: `ErrID_WatchDogOrExceptionCondition`

This message notifies a PVT product host of a watchdog time-out or processor exception in the receiver. The consistent accumulation of these notification messages by the host can be used to produce statistics for:

- Reliability measurement and analysis
- Troubleshooting purposes

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.

Typically, upon the receipt of this message, the host polls the software version of the receiver, and the typical response contains the actual patch status of the receiver. 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.

Example:

- `A0A2001D` – Start Sequence and Payload Length (29 bytes)
- `0A20040006050000000002450535246313630 2C572C312C302A35410D0A` – Payload
- `0422B0B3` – Message Checksum and End Sequence

**Note:**

This message is *not* supported for the GSD4t or earlier products.

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 | 04 | 10 |
| Error ID | 2 | 2004 | Sub-message type |
| Count (n) | 2 | - | Number of 4-byte values that follow |
| Condition Code | 1 | 05 | Table 6.30 specifies the bit value assignments of the condition code byte. The Corrupted Patch RAM Detected bit value should ideally be consistent with the results of a subsequent SW Version Response message analysis performed by the host, while matching the patch version stored in the host with the one detected by the receiver in the patch-memory. This consistency check could make it safer to reload the patch if needed and provide more complete diagnostic data on the state of the receiver. |
| Exception Code | 4 | 00000000 | Reserved. (This will enable the host to perform more extensive analysis similar to the watch-dog event notification processing. Actual values of this code are product specific and depend on the processor type applied in the receiver hardware.) |
| NMEA String | n*4-5 | - | 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 the receiver is unknown. When the host knows the receiver 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 6.29: Error ID 8196 Message

| Condition Code | Description |
|---|---|
| xxxxxx01 | Watchdog time-out condition |
| xxxxxx10 | Reserved for exception conditions |
| xxxxx1xx | Corrupted patch-RAM detected |
| xxxxx0xx | No corrupted patch-RAM detected |

Table 6.30: Error ID 8196 Message Condition Code

## 6.11 Command Acknowledgment - MID 11

This reply is sent in response to messages accepted by the receiver. If the message being acknowledged requests data from the receiver, the data is sent first, then this acknowledgment.

From SiRFstarIII, a second ACK ID byte is also accepted, bringing the overall payload length to 3 bytes. Typically, the first ACK ID is used as the message ID of the received message to be acknowledged, while the second one identifies the message SID.

Output Rate: Response to successful input message

This is a successful almanac request (MID 0x92) example:

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `0B0092` – Payload
- `009DB0B3` – Message Checksum and End Sequence

| Name | Byte | Example |
|---|---|---|
| MID | 1 U | 0x0B |
| SID | 1 U | 0x00 |
| ACI ID | 1 U | 92 |

Table 6.31: Command Acknowledgment - MID 11

**Note:**

The SID was added to the message in GSD4e and later products.

## 6.12 Command Negative Acknowledgment - MID 12

This reply is sent when an input command to the receiver is rejected. Possible causes are:

- The input message failed checksum
- The input message contained an argument that was out of the acceptable range
- The receiver was unable to comply with the message for a technical reason

From SiRFstarIII, a second NACK ID byte is also accepted, bringing the overall payload length to 3 bytes. Typically, the first NACK ID is used as the message ID of the received message to be NACKed, while the second one identifies the message SID.

Output Rate: Response to rejected input message

This is an unsuccessful almanac request (MID 0x92) example:

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `0C0092` – Payload
- `009EB0B3` – Message Checksum and End Sequence

| Name | Bytes | Example |
|---|---|---|
| Message ID | 1 U | 0x0C |
| SID | 1 U | 0x00 |
| N'ACK ID | 1 U | 92 |

Table 6.32: Command Negative Acknowledgment - MID 12

Note:

Commands can be NACKed for several reasons including: failed checksum, invalid arguments, unknown command, or failure to execute command.

The SID field was added to the message in GSD4e and later products.

## 6.13 Visible List - MID 13

This message reports the satellites that are currently above there are from 6 to 13 satellites visible at any one time.

Output Rate: Updated approximately every 2 minutes

Note:

This is a variable length message. Only the number of visible satellites are reported (as defined by Visible SVs in Table 6.33).

Example:

- `A0A2002A` – Start Sequence and Payload Length (Variable (2 + 5 times number of visible SVs))
- `0D081D002A00320F009C0032....` – Payload
- `...B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Unit |
|---|---|---|---|
| MID | 1 U | 0D | - |
| Visible SVs | 1 U | 08 | - |
| Ch 1 – SV ID | 1 U | 10 | - |
| Ch 1 – SV Azimuth | 2 S | 002A | degrees |
| Ch 1 – SV Elevation | 2 S | 0032 | degrees |
| Ch 2 – SV ID | 1 U | 0F | - |
| Ch 2 – SV Azimuth | 2 S | 009C | degrees |
| Ch 2 – SV Elevation | 2 S | 0032 | degrees |
| ... | | | |

Table 6.33: Visible List - MID 13

## 6.14 Almanac Data - MID 14

This message is sent in response to the Poll Almanac command, MID 146. When MID 146 is sent, the receiver responds with 32 individual MID 14 messages, one for each of the possible satellite PRNs. If no almanac exists for a given PRN, the data in that message is all zeros.

Output Rate: Response to poll

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | Hex 0x0E (decimal 14) |
| SV ID | 1 U | SV PRN code, hex 0x01..0x02, decimal 1..32 |
| Almanac Week & Status | 2 S | 10-bit week number in 10 MSBs, status in 6 LSBs (1 = good; 0 = bad) |
| Data[(1)] [(2)][12] | 2 S | UINT16[12] array with sub-frame data |
| Checksum | 2 S | - |

Table 6.34: Almanac Data - MID 14

(1) The data area consists of an array of 12 16-bit words consisting of the data bytes from the navigation message sub-frame. Table 6.35 shows how the actual bytes in the navigation message correspond to the bytes in this data array. Note that these are the raw navigation message data bits with any inversion removed and the parity bits removed.

(2) For a complete description of almanac and Ephemeris data representation for Data[12], see Appendix A.



**Note:**

Payload Length: 30 bytes

| Navigation Message | | Data Array | | Navigation Message | | Data Array | |
|---|---|---|---|---|---|---|---|
| Word | Byte | Word | Byte | Word | Byte | Word | Byte |
| 3 | MSB | [0] | LSB | 7 | MSB | [6] | MSB |
| 3 | Middle | [0] | MSB | 7 | Middle | [6] | LSB |
| 3 | LSB | [1] | LSB | 7 | LSB | [7] | MSB |
| 4 | MSB | [1] | MSB | 8 | MSB | [7] | LSB |
| 4 | Middle | [2] | LSB | 8 | Middle | [8] | MSB |
| 4 | LSB | [2] | MSB | 8 | LSB | [8] | LSB |

| Navigation Message | | Data Array | | Navigation Message | | Data Array | |
|---|---|---|---|---|---|---|---|
| Word | Byte | Word | Byte | Word | Byte | Word | Byte |
| 5 | MSB | [3] | LSB | 9 | MSB | [9] | MSB |
| 5 | Middle | [3] | MSB | 9 | Middle | [9] | LSB |
| 5 | LSB | [4] | LSB | 9 | LSB | [10] | MSB |
| 6 | MSB | [4] | MSB | 10 | MSB | [10] | LSB |
| 6 | Middle | [5] | LSB | 10 | Middle | [11] | MSB |
| 6 | LSB | [5] | MSB | 10 | LSB | [11] | LSB |

Table 6.35: Byte Positions Between Navigation Message and Data Array

Note:

MID 130 uses a similar format, but sends an array of 14 16-bit words for each SV and a total of 32 SVs in the message (almanac for SVs 1..32, in ascending order). For that message, a total of 448 words constitutes the data area. For each of 32 SVs, that corresponds to 14 words per SV. Those 14 words consist of one word containing the week number and status bit (see Table 6.35as Almanac Week & Status), 12 words of the same data as described for the data area above, then a single 16-bit checksum of the previous 13 words. The SV PRN code is not included in the message 130 because the SV ID is inferred from the location in the array.

## 6.15 Ephemeris Data (Response to Poll) - MID 15

This message is output in response to the Poll Ephemeris command, M ID 147. If MID 147 specifies a satellite PRN, 1-32, a single MID 15 containing the ephemeris for that satellite PRN will be output. If MID 147 specifies satellite PRN 0, then the receiver sends as many MID 15 messages as it has available ephemerides.

The ephemeris data that is polled from the receiver is in a special SiRF format based on the ICD-GPS-200 format for ephemeris data.

Output Rate: Response to poll

| Name | Bytes | Description |
|---|---|---|
| Message ID | 1 U | `0x0F (decimal 15)` |
| SV ID | 1 U | SV PRN code, hex 0x01..0x02, decimal 1..32 |
| Data(1) (2)[45] | 2 U | UINT16 [3][15] array with sub-frames 1..3 data |

Table 6.36: Ephemeris Data (Response to Poll) - MID 15

(1) The data area consists of a 3x15 array of unsigned integers, 16 bits long. The first word of each row in the array ([0][0], [1][0], and [2][0]) contain the SV ID. The remaining words in the row contain the data from the navigation message subframe, with row [0] containing sub-frame 1, row [1] containing sub-frame 2, and row [2] containing sub-frame 3. Data from the sub-frame is stored in a packed format, meaning that the 6 parity bits of each 30-bit navigation message word have been removed, and the remaining 3 bytes are stored in 1.5 16-bit words. Since the first word of the sub-frame, the telemetry word (TLM), does not contain any data needed by the receiver, it is not saved. Thus, there are 9 remaining words, with 3 bytes in each sub-frame. This total of 27 bytes is stored in 14 16-bit words. The second word of the subframe, the handover word (HOW), has its high byte (MSB) stored as the low byte (LSB) of the first of the 16-bit words. Each following byte is stored in the next available byte of the array. Table 6.37 shows where each byte of the sub-frame is stored in the row of 16-bit words.

(2) For a complete description of almanac and Ephemeris data representation for Data[45], see Appendix A.

Note:

Payload Length: 92 bytes

| Navigation Message | | Data Array | | Navigation Message | | Data Array | |
|---|---|---|---|---|---|---|---|
| Word | Byte | Word | Byte | Word | Byte | Word | Byte |
| 2 (HOW) | MSB | [][1] | LSB | 7 | MSB | [][9] | MSB |
| 2 | Middle | [][2] | MSB | 7 | Middle | [][9] | LSB |
| 2 | LSB | [][2] | LSB | 7 | LSB | [][10] | MSB |
| 3 | MSB | [][3] | MSB | 8 | MSB | [][10] | LSB |
| 3 | Middle | [][3] | LSB | 8 | Middle | [][11] | MSB |
| 3 | LSB | [][4] | MSB | 8 | LSB | [][11] | LSB |
| 4 | MSB | [][4] | LSB | 9 | MSB | [][12] | MSB |
| 4 | Middle | [][5] | MSB | 9 | Middle | [][12] | LSB |
| 4 | LSB | [][5] | LSB | 9 | LSB | [][13] | MSB |

| Navigation Message | | Data Array | | Navigation Message | | Data Array | |
|---|---|---|---|---|---|---|---|
| Word | Byte | Word | Byte | Word | Byte | Word | Byte |
| 5 | MSB | [][6] | MSB | 10 | MSB | [][13] | LSB |
| 5 | Middle | [][6] | LSB | 10 | Middle | [][14] | MSB |
| 5 | LSB | [][7] | MSB | 10 | LSB | [][14] | LSB |
| 6 | MSB | [][7] | LSB | | | | |
| 6 | Middle | [][8] | MSB | | | | |
| 6 | LSB | [][8] | LSB | | | | |

Table 6.37: Byte Positions Between Navigation Message and Data Array

Note:

MID 149 uses the same format, except the SV ID (the second byte in MID 15) is omitted. MID 149 is thus a 91-byte message. The SV ID is still embedded in elements [0][0], [1][0], and [2][0] of the data array.

## 6.16 Test Mode 1 - MID 16

This message is output when the receiver is in test mode 1. It is sent at the end of each test period as set by MID 150.

Output Rate: Variable – set by the period as specified in MID 150

Example:

- `A0A20011` – Start Sequence and Payload Length (17 bytes)
- `100015001E000588B800C81B5800040001` – Payload
- `02D8B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | 10 | - | Message ID |
| SV ID | 2 U | 0015 | - | The number of the satellite being tracked |
| Period | 2 U | 001E | sec | The total duration of time (in seconds) that the satellite is tracked |

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| Bit Sync Time | 2 U | 0005 | sec | The time it takes for channel 0 to achieve the status of 37 |
| Bit Count | 2 U | 88B8 | - | The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20sec x 12 channels). |
| Poor Status | 2 U | 00C8 | - | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 / sec). |
| Good Status | 2 U | 1B58 | - | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count. |
| Parity Error Count | 2 U | 0004 | - | The number of word parity errors. This occurs when the parity of the transmitted word does not match the receiver's computed parity. |
| Lost VCO Count | 2 U | 0001 | - | The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and/or phase causes a VCO lost lock. |

Table 6.38: Test Mode 1 - MID 16

## 6.17 Differential Corrections – MID 17

MID 17 provides the RTCM data received from a DGPS source. The data is sent as an OSP message and is based on the RTCM SC-104 format. To interpret the data, see *RTCM Recommended Standards for Differential GNSS* by the Radio Technical Commission for Maritime Services. Data length and message output rate vary based on received data.

| Field | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 11 | - |
| Data length | 2 S | 002D | - |
| Data | Variable U | - | Data length and message output rate vary based on received data. Data consists of a sequence of bytes that are "Data length" long. |

Table 6.39: Detailed Description of Test Mode 1 Data

**Note:**

Payload length: variable

## 6.18 OkToSend - MID 18

This message is sent by a receiver that is in power-saving mode such as TricklePower or Push-to-Fix. It is sent immediately on powering up with an argument indicating it is OK to send messages to the receiver. It is sent just before turning off power with an argument that indicates no more messages should be sent.

Output Rate: Two messages per power-saving cycle

Example:

- `A0A20002` – Start Sequence and Payload Length (2 bytes)
- `1200` – Payload
- `0012B0B3` – Message Checksum and End Sequence

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | 1 U | 12 | Message ID |
| Send Indicator | 1 U | 00 | 0 implies CPU is about to go Off, OkToSend==NO<br>1 implies CPU has just come On, OkToSend==YES |

Table 6.40: OkToSend - MID 18

## 6.19 Navigation Parameters (Response to Poll) - MID 19

This message is sent in response to MID 152, Poll Navigation Parameters. It reports the current settings of various parameters in the receiver.

Output Rate: Response to Poll (See MID 152)

Example:

- `A0 A2 00 41` – Start Sequence and Payload Length (65 bytes)
- `13 00 00 00 00 00 00 00 00 01 1E 0F 01 00 01 00 00 00 00 04 00 4B 1C 00 00 00 00 02 00 1E 00 00 00 00 00 00 00 03 E8 00 00 03 E8 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00` – Payload
- `02 A4 B0 B3` – Message Checksum and End Sequence



| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) Example |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1 U | - | 0x13 | - | 19 |
| Message Sub ID(1) | 1 U | - | 00 | - | - |
| Reserved | 2 U | - | 00 | - | 0x00 |
| Position Calc Mode(2) (3) | 1 U | - | 01 | - | 0x01(4) |
| Altitude Hold Mode(5) | 1 U | - | 00 | - | - |
| Altitude Hold Source(5) | 1 U | - | 00 | - | - |
| Altitude Source Input(5) | 2 S | - | 0000 | m | - |
| Degraded Mode(5) (19) | 1 U | - | 00 | - | - |
| Degraded Timeout(5) | 1 U | - | 00 | sec | - |
| DR Timeout(5) | 1 U | - | 01 | sec | - |
| Track Smooth Mode(5) | 1 U | - | 1E | - | - |
| Static Navigation(6) | 1 U | - | 0F | - | - |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) Example |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| 3SV Least Squares(7) | 1 U | - | 01 | - | - |
| Reserved | 4 U | - | 00000000 | - | - |
| DOP Mask Mode(8) | 1 U | - | 04 | - | - |
| Navigation Elevation Mask(9) | 2 S | - | 004B | - | - |
| Navigation Power Mask(10) | 1 U | - | 1C | - | - |
| Reserved | 4 U | - | 00000000 | - | - |
| DGPS Source(11) | 1 U | - | 02 | - | - |
| DGPS Mode(12) | 1 U | - | 00 | - | - |
| DGPS Timeout(12) | 1 U | - | 1E | sec | - |
| Reserved | 4 U | - | 00000000 | - | - |
| LP Push-to-Fix(13) | 1 U | - | 00 | - | - |
| LP On-time(13) | 4 S | - | 000003E8 | - | - |
| LP Interval(13) | 4 S | - | 000003E8 | - | - |
| User Tasks Enabled(7) | 1 U | - | 00 | - | - |
| User Task Interval(7) | 4 S | - | 00000000 | - | - |
| LP Power Cycling Enabled(14) | 1 U | - | 00 | - | - |
| LP Max. Acq. Search Time(15) | 4 U | - | 00000000 | sec | - |
| LP Max. Off Time(15) | 4 U | - | 00000000 | sec | - |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) Example |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| APM Enabled/ Power Duty Cycle(16) (17) | 1 U | - | 00 | - | - |
| Number of Fixes(17) | 2 U | - | 0000 | - | - |
| Time Between Fixes(17) | 2 U | - | 0000 | sec | - |
| Horizontal/ Vertical Error Max(17) | 1 U | - | 00 | m | - |
| Response Time Max(17) | 1 U | - | 00 | sec | - |
| Time/Accu & Time/Duty Cycle Priority(18) | 1 U | - | 00 | - | - |

Table 6.41: Navigation Parameters (Response to Poll) - MID 19

(1) 00 = GSW2 definition; 01 = OSP APM definition; other values reserved.

(2) Supported in GSD4t, GSD4e and beyond.

(3) The Position Calc Mode field bit-map. See description of values in Table 5.49.

(4) To set the Position Calc Mode value, use MID 136.

(5) These values are set by MID 136. See description of values in Table 5.47.

(6) These values are set by MID 143. See description of values in Table 5.58.

(7) These parameters are set in the software and are not modifiable via the User Interface.

(8) These values are set by MID 137. See description of values in Table 5.52.

(9) These values are set by MID 139. See description of values in Table 5.56.

(10) These values are set by MID 140. See description of values in Table 5.57.

(11) These values are set by MID 133. See description of values in Table 5.41.

(12) These values are set by MID 138. See description of values in Table 5.54.

(13) These values are set by MID 151. See description of values in Table 5.68.

(14) This setting is derived from the LP on-time and LP interval.

(15) These values are set by Message ID 167. See description of values in Table 5.76.

(16) Bit 7: APM Enabled, 1 = enabled, 0 = disabled; Bits 0-4: Power Duty Cycle, range: 1-20 scaled to 5%, 1 = 5%, 2 = 10%

(17) Only used in SiRFLoc software.

(18) Bits 2-3: Time Accuracy, 0x00 = no priority imposed, 0x01 = RESP_TIME_MAX has higher priority, 0x02 = HORI_ERR_MAX has higher priority, Bits 0-1: Time Duty Cycle, 0x00 = no priority imposed, 0x01 = time between two consecutive fixes has priority, 0x02 = power duty cycle has higher priority.

(19) No longer supported from version 3.2.5 and later.

| Bit | Description |
|---|---|
| 0 | ABP enabled[1] |
| 1 | Reverse EE enabled[1] [3] |
| 2 | 5 Hz Navigation enabled[1] [3] |
| 3 | SBAS Ranging enabled[1] |
| 4 | Fast time Sync[2] |
| 5-7 | Reserved |

Table 6.42: Bit Field Description, Position Calc Mode Field

[1] This option is supported on version 4.1.0 and later.

[2] This option is supported on version 4.1.2 and later.

[3] This is a 4e only feature.

| Value | Position Error |
|---|---|
| 0x00 | <1 meter |
| 0x01 | <5 meters |
| 0x02 | <10 meters |
| 0x03 | <20 meters |
| 0x04 | <40 meters |
| 0x05 | <80 meters |
| 0x06 | <160 meters |
| 0x07 | No Maximum (disabled) |
| 0x08 - 0xFF | Reserved |

Table 6.43: Horizontal/Vertical Error

## 6.20 Test Mode 2/3/4 – MIDs 20, 46, 48 (SiRFLoc v2.x), 49 and 55

Table 6.44 describes the software and Test Mode 2/3/4 for MIDs 20, 46, 48 (SiRFLoc v2.x), 49 and 55. See specific MIDs for details.

| Software | Test Mode | MID |
|---|---|---|
| GSW2 | 2 | 20 |
| | 3/4 | 46 |
| SiRFDRive | 2 | 20 |
| | 3/4 | 46 |
| SiRFXTrac | 2/3/4 | 20 |
| SiRFLoc (version 2.x) | 4 | 20, 48, and 49<br>Do not confuse this MID 48 with MID 48 for DR Navigation. MID 48 for SiRFLoc will be transferred to a different MID in future. |
| SiRFLoc (version 3.x) | 3 | 46 |
| | 4 | 46, 55 |
| GSW3, GSWLT3 | 3 | 46 |
| | 4 | 46, 55 |

**Table 6.44: Test Mode 2/3/4 – MIDs 20, 46, 48 (SiRFLoc v2.x), 49 and 55**

## 6.20.1 Test Mode 2/3/4 - MID 20

### 6.20.1.1 Test Mode 2 - MID 20

This is supported by either GSW2, SiRFDRive, and SiRFXTrac. Test Mode 2 requires approximately 1.5 minutes of data collection before sufficient data is available.

The definition of Message ID 20 is different depending on the version and type of software being used.

Example:

- `A0A20033` – Start Sequence and Payload Length (51 bytes)
- `140001001E00023F70001F0D2900000000000601C600051B0E000EB41A000000000`
  `00000000000000000000000000000000000` – Payload
- `0316B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| MID | 1 U | - | 14 | - | - | 20 |
| SV ID | 2 U | - | 0001 | - | - | 1 |
| Period | 2 U | - | 001E | sec | - | 30 |
| Bit Sync Time | 2 U | - | 0002 | sec | - | 2 |
| Bit Count | 2 U | - | 3F70 | - | - | 13680 |
| Poor Status | 2 U | - | 001F | - | - | 31 |
| Good Status | 2 U | - | 0D29 | - | - | 3369 |
| Parity Error Counts | 2 U | - | 0000 | - | - | 0 |
| Lost VCO Count | 2 U | - | 0000 | - | - | 0 |
| Frame Sync Time | 2 U | - | 0006 | sec | - | 6 |
| C/N0 Mean | 2 S | *10 | 01C6 | - | ÷10 | 45.4 |
| C/N0 Sigma | 2 S | *10 | 0005 | - | ÷10 | 0.5 |
| Clock Drift Change | 2 S | *10 | 1B0E | Hz | ÷10 | 692.6 |
| Clock Drift | 4 S | *10 | 000EB41A | Hz | ÷10 | 96361.0 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Reserved | 2 S | - | 0000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |

Table 6.45: Test Mode 2 - MID 20

| Name | Description |
| --- | --- |
| MID | Message ID |
| SV ID | The number of the satellite being tracked |
| Period | The total duration of time (in seconds) that the satellite is tracked |
| Bit Sync Time | The time it takes for channel 0 to achieve the status of 37 |
| Bit Count | The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20 sec x 12 channels). |
| Poor Status | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec) |
| Good Status | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count. |
| Parity Error Count | The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check. |
| Lost VCO Count | The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock. |
| Frame Sync | The time it takes for channel 0 to reach a 3F status. |
| C/N0 Mean | Calculated average of reported C/N0 by all 12 channels during the test period. |
| C/N0 Sigma | Calculated sigma of reported C/N0 by all 12 channels during the test period. |
| Clock Drift Change | Difference in clock frequency from start and end of the test period. |
| Clock Drift | Rate of change in clock bias. |

Table 6.46: Detailed Description of Test Mode 2 MID 20

6.20.1.2 Test Mode 3 - MID 20

This is supported by SiRFXTrac only as MID 20. Test Mode 3 requires approximately 10 seconds of measurement data collection before sufficient summary information is available.

Example:

- `A0A20033` – Start Sequence and Payload Length (51 bytes)
- `140001001E00023F70001F0D29000000000000601C600051B0E000EB41A000000000 0000000000000000000000000000000000` – Payload
- `0316B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| MID | 1 U | - | 14 | - | - | 20 |
| SV ID | 2 U | - | 0001 | - | - | 1 |
| Period | 2 U | - | 001E | sec | - | 30 |
| Bit Sync Time | 2 U | - | 0002 | sec | - | 2 |
| Bit Count | 2 U | - | 3F70 | - | - | 13680 |
| Poor Status | 2 U | - | 001F | - | - | 31 |
| Good Status | 2 U | - | 0D29 | - | - | 3369 |
| Parity Error Count | 2 U | - | 0000 | - | - | 0 |
| Lost VCO Count | 2 U | - | 0000 | - | - | 0 |
| Frame Sync Time | 2 U | - | 0006 | sec | - | 6 |
| C/N0 Mean | 2 S | *10 | 01C6 | - | ÷10 | 45.4 |
| C/N0 Sigma | 2 S | *10 | 0005 | - | ÷10 | 0.5 |
| Clock Drift Change | 2 S | *10 | 1B0E | Hz | ÷10 | 692.6 |
| Clock Drift | 4 S | *10 | 000EB41A | Hz | ÷10 | 96361.0 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Bad 1 kHz Bit Count | 2 S | - | 0000 | - | - | - |
| Abs I20 ms | 4 S | - | 00000000 | - | - | - |
| Abs Q1 ms | 4 S | - | 00000000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |
| Reserved[1] | 4 S | - | 00000000 | - | - | - |
| Reserved | 4 S | - | 00000000 | - | - | - |

Table 6.47: TTest Mode 3 - MID 20

(1) In certain later versions of GSW3 (3.2.4 or later) this field is split into two new fields: RTC Frequency 2 U (in Hz) and Reserved 2 U.

| Name | Description |
|---|---|
| MID | Message ID |
| SV ID | The number of the satellite being tracked |
| Period | The total duration of time (in seconds) that the satellite is tracked |
| Bit Sync Time | The time it takes for channel 0 to achieve the status of 37 |
| Bit Count | The total number of data bits that the receiver is able to demodulate during the test period. For example, a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20sec x 12 channels). |
| Poor Status | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 m/s of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec) |
| Good Status | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 m/s of phase lock equates to 1 good status count. |

| Name | Description |
| --- | --- |
| Parity Error Count | The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check. |
| Lost VCO Count | The number of 1 m/s VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and/or phase causes a VCO lost lock. |
| Frame Sync | The time it takes for channel 0 to reach a 3F status. |
| C/N0 Mean | Calculated average of reported C/N0 by all 12 channels during the test period |
| C/N0 Sigma | Calculated sigma of reported C/N0 by all 12 channels during the test period |
| Clock Drift Change | Difference in clock frequency from start and end of the test period |
| Clock Drift | Rate of change of clock bias |
| Bad 1 kHz Bit Count | Errors in 1 m/s post correlation I count values |
| Abs I20 ms | Absolute value of the 20 ms coherent sums of the I count over the duration of the test period |
| Abs Q20 ms | Absolute value of the 20 ms Q count over the duration of the test period |
| RTC Frequency | The measured frequency of the RTC crystal oscillator, reported in Hertz |

**Table 6.48: Detailed Description of test Mode 3 MID 20**

#### 6.20.1.3 Test Mode 4 - MID 20

Supported by SiRFXTrac only. For other Test Mode 4 outputs, refer to MID 46.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
| --- | --- | --- | --- | --- | --- | --- |
| | | Scale | Example | | Scale | Example |
| MID | 1 U | - | 14 | - | - | 20 |
| Test Mode | 1 U | - | 4 | - | - | 4 |
| Message Variant | 1 U | - | 01 | - | - | 1 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| SV ID | 2 U | - | 0001 | - | - | 1 |
| Period | 2 U | - | 001E | sec | - | 30 |
| Bit Sync Time | 2 U | - | 0002 | sec | - | 2 |
| C/N0 Mean | 2 S | *10 | 01C6 | - | ÷10 | 45.4 |
| C/N0 Sigma | 2 S | *10 | 0005 | | ÷10 | 0.5 |
| Clock Drift Change | 2 S | *10 | 1B0E | Hz | ÷10 | 692.6 |
| Clock Drift | 4 S | *10 | 000EB41A | Hz | ÷10 | 96361.0 |
| I Count Errors | 2 S | - | 0003 | - | - | 3 |
| Abs I20 m/s | 4 S | - | 0003AB88 | - | - | 240520 |
| Abs Q1 m/s | 4 S | - | 0000AFF0 | - | - | 45040 |

Table 6.49: Test Mode 4 - MID 20

Note:

Payload length: 29 bytes

| Name | Description |
|---|---|
| MID | Message ID |
| Test Mode | 3 = Testmode 3, 4 = Testmode 4 |
| Message Variant | The variant # of the message (variant change indicates possible change in number of fields or field description) |
| SV ID | The number of the satellite being tracked |
| Period | The total duration of time (in seconds) that the satellite is tracked |
| Bit Sync Time | The time it takes for channel 0 to achieve the status of 37 |
| C/N0 Mean | Calculated average of reported C/N0 by all 12 channels during the test period |

| Name | Description |
|---|---|
| C/N0 Sigma | Calculated sigma of reported C/N0 by all 12 channels during the test period |
| Clock Drift Change | Difference in clock frequency from start and end of the test period |
| Clock Drift | The internal clock offset |
| I Count Errors | Errors in 1 m/s post correlation I count values |
| Abs I20 m/s | Absolute value of the 20 m/s coherent sums of the I count over the duration of the test period |
| Abs Q1 m/s | Absolute value of the 1 ms Q count over the duration of the test period |

**Table 6.50: Detailed Description of Test Mode 4 MID 20**

## 6.21 DGPS Status Format - MID 27

This message reports on the current DGPS status, including the source of the corrections and which satellites have corrections available.

This message differs from others in that it has multiple formats. Also, not all software versions implement all of the features. All versions implement the first 2 bytes and the last 3 x 12 bytes (3 bytes per satellite times 12 satellites) the same. The 14 bytes in between these two sections vary depending on the source of the DGPS information. If the source is an internal beacon, the 14 bytes are used to display information about the beacon itself (frequency, bit rate, etc.). If the source is something other than an internal beacon, some software versions display the age of the corrections while other versions only fill this area with zeroes.

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

Example (with SBAS):

- `A0A20034` – Start Sequence and Payload Length (52 bytes)
- `1B1444444444007252864A2EC ...` – Payload
- `1533B0B3` – Message Checksum and End Sequence

The above example looks as follows in ASCII format:

`27, 1, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 0, 0, 7, 594, 8, 100, 10, 748`

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| MID | 1 U | 1B | - | - |
| DGPS source | 1 U | 1 | - | Possible values for this field are given in Table 6.52. If the GSPS source is set to none, three messages are being sent and then the message is disabled. |
| If the DGPS source is Beacon, next 14 bytes are interpreted as follows: | | | | |

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| Beacon Frequency | 4 S | 0 = 0xFFF<br>0 = 190K, 0xFFF = 599.5K<br>Frequency = (190000)+(100*value) | Hz | - |
| Beacon Bit Rate | 1 U | Bits [2:0]:<br>000 = 25 bits/sec<br>001 = 50 bits/sec<br>010 = 100 bits/sec<br>011 = 110 bits/sec<br>100 = 150 bits/sec<br>101 = 200 bits/sec<br>110 = 250 bits/sec<br>111 = 300 bits/sec<br>Bit 4: modulation:<br>0 = MSK<br>1 = FSK<br>Bit 5: SYNC type<br>0 = async<br>1 = sync<br>Bit 6: broadcast coding:<br>0 = No Coding<br>1 = FEC coding) | BPS | - |
| Status | 1 U | Bitmapped:<br>0x01: signal valid<br>0x02: auto frequency used<br>0x04: auto bit rate used | - | - |
| Signal Magnitude | 4 S | - | Internal counts | - |
| Signal Strength | 2 S | - | dB | - |
| SNR | 2 S | - | dB | - |
| If the DGPS source is not Beacon, next 14 bytes are interpreted as follows: | | | | |

| Name | Bytes | Example | Unit | Description |
|---|---|---|---|---|
| Correction Age [12] | 1 x 12 | 4 | sec | Correction age is reported in the same order as satellites are listed in the satellite PRN code fields that follow. |
| Reserved | 2 | - | - | - |
| Remainder of the table applies to all messages, and reports on available corrections | | | | |
| Satellite PRN Code | 1 U | 18 | - | - |
| DGPS Correction | 2 S | 24E | meters | See Table 6.52 for types |
| The above 3 bytes are repeated 12 times. If less than 12 satellite corrections are available, the unused entries have values of 0. | | | | |

Table 6.51: DGPS Status Format - MID 27

| DGPS Correction Types | Value | Description |
|---|---|---|
| None | 0 | No DGPS correction type have been selected |
| SBAS | 1 | SBAS |
| Serial Port | 2 | RTCM corrections |
| Internal Beacon | 3 | Beacon corrections (available only for GSW2 software) |
| Software | 4 | Software Application Program Interface (API) corrections |

Table 6.52: DGPS Correction Types

## 6.22 Navigation Library Measurement Data - MID 28

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

Example:

- `A0A20038` – Start Sequence and Payload Length (56 bytes)
- `1C00000660D015F143F62C4113F42F417B235CF3FBE95E468C6964B8FBC582415CF 1C375301734.....03E801F400000000` – Payload
- `1533B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | - | 1C | - | - | 28 |
| Channel | 1 U | - | 00 | - | - | 0 |
| Time Tag(1) | 4 U | - | 000660D0 | m/s | - | 135000 |
| Satellite ID | 1 U | - | 15 | - | - | 20 |
| GPS Software Time(2) | 8 Dbl | - | 41740B0B48 353F7D | sec | - | 2.492111369 6e+005 |
| Pseudorange (3) | 8 Dbl | - | 7D3F354A0B 0B7441 | m | - | 2.101675663 8e+007 |
| Carrier Frequency | 4 Sgl | - | 89E98246 | m/s | - | 1.675676757 8e+004 |
| Carrier Phase(4) | 8 Dbl | - | A4703D4A0B 0B7441 | m | - | 2.101675664 0e+007 |
| Time in Track | 2 U | - | 7530 | m/s | - | 10600 |
| Sync Flags(5) | 1 D | - | 17 | - | - | 23 |
| C/N0 1 | 1 U | - | 34 | dB-Hz | ÷10 | 43 |
| C/N0 2 | 1 U | - | - | dB-Hz | ÷10 | 43 |
| C/N0 3 | 1 U | - | - | dB-Hz | ÷10 | 43 |
| C/N0 4 | 1 U | - | - | dB-Hz | ÷10 | 43 |
| C/N0 5 | 1 U | - | - | dB-Hz | - | 43 |
| C/N0 6 | 1 U | - | - | dB-Hz | - | 43 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| C/N0 7 | 1 U | - | - | dB-Hz | - | 43 |
| C/N0 8 | 1 U | - | - | dB-Hz | - | 43 |
| C/N0 9 | 1 U | - | - | dB-Hz | - | 43 |
| C/N0 10 | 1 U | - | - | dB-Hz | - | 43 |
| Delta Range Interval | 2 U | - | 03E801F4 | ms | - | 1000 |
| Mean Delta Range Time | 2 U | - | 01F4 | ms | - | 500 |
| Extrapolation Time(6) | 2 S | - | 0000 | ms | - | - |
| Phase Error Count | 1 U | - | 00 | - | - | 0 |
| Low Power Count | 1 U | - | 00 | - | - | 0 |

Table 6.53: Navigation Library Measurement Data - MID 28

(1) Internal time for relative measure only.

(2) GPS software time minus clock bias = GPS time of measurement.

(3) Pseudorange does not contain ionospheric, tropospheric or clock corrections

(4) GSW3 and GSWLT3 software does not report the Carrier Phase.

(5) In GSW2 software this is sync flags, see Table 6.54. In GSW3 code this field is a duplicate of the State field from MID 4. See Table 6.6.

(6) Reserved for SiRF use with GSW3, GSWLT3, GSW3.0 and above.

Note:

For GPS Software Time, Pseudorange, Carrier Frequency, and Carrier Phase, the fields are floating point (4-byte fields) or double-precision floating point (8-byte fields), per IEEE-754 format. The byte order may have to be changed to be properly interpreted on some computers. Also, GSW3.x and GSWLT3 use the same byte ordering method as the GSW 2.2.0. Therefore, GSW 2.2.0 (and older) and GSW 3.0 (and newer) use the original byte ordering method; GSW 2.3.0 through 2.9.9 use an alternate byte ordering method.

To convert the data to be properly interpreted on a PC-compatible computer, do the following: For double-precision (8-byte) values: Assume the bytes are transmitted in the order of B0, B1, ... , B7. For version 2.2.0 and earlier software, rearrange them to B3, B2, B1, B0, B7, B6, B5, B4. For version 2.3.0 and later software, rearrange them to B7, B6, B5, ... , B0. For single-precision (4-byte) values: Assume bytes are transmitted in the order of B0, B1, B2, B3. Rearrange them to B3, B2, B1, B0 (that is, byte B3 goes into the lowest memory address, B0 into the highest).

With these remappings, the values should be correct. To verify, compare the same field from several satellites tracked at the same time. The reported exponent should be similar (within 1 power of 10) among all satellites. The reported Time of Measurement, Pseudorange and Carrier Phase are all uncorrected values.

MID 7 contains the clock bias that must be considered. Adjust the GPS Software time by subtracting clock bias, adjust pseudorange by subtracting clock bias times the speed of light, and adjust carrier phase by subtracting clock bias times speed of light/GPS L1 frequency. To adjust the reported carrier frequency do the following: Corrected Carrier Frequency (m/s) = Reported Carrier Frequency (m/s) – Clock Drift (Hz)*C / 1575420000 Hz. For a nominal clock drift value of 96.25 kHz (equal to a GPS Clock frequency of 24.5535 MHz), the correction value is 18315.766 m/s.

Note:

GPS Software Time – Clock Bias = Time of Receipt = GPS Time. GPS Software Time – Pseudorange (sec) = Time of Transmission = GPS Time. Adjust SV position in MID 30 by (GPS Time MID 30 – Time of Transmission) * Vsat.

| Bit Fields | Description |
|---|---|
| [0] | Coherent Integration Time<br>0 = 2 m/s<br>1 = 10 m/s |
| [2:1] | Synch State<br>00 = Not aligned<br>01 = Consistent code epoch alignment<br>10 = Consistent data bit alignment<br>11 = No millisecond errors |
| [4:3] | Autocorrelation Detection State<br>00 = Verified not an autocorrelation<br>01 = Testing in progress<br>10 = Strong signal, autocorrelation detection not run<br>11 = Not used |

Table 6.54: Sync Flag Fields (for GSW2 software ONLY)

| Bit Fields | Description |
|---|---|
| MID | Message ID |
| Channel | Receiver channel number for a given satellite being searched or tracked. Range of 0 - 11 for channels 1 - 12, respectively |
| Time Tag | This is the Time Tag in milliseconds of the measurement block in the receiver software time. Time tag is an internal millisecond counter which has no direct relationship to GPS time, but is started as the receiver is turned on or reset. |
| Satellite ID | Pseudo-Random Noise (PRN) number. |
| GPS Software Time | This is GPS Time of Week (TOW) estimated by the software in millisecond |
| Pseudorange | This is the generated pseudorange measurement for a particular SV. When carrier phase is locked, this data is smoothed by carrier phase. |
| Carrier Frequency | This can be interpreted in two ways:<br>1. The delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval.<br>2. The frequency from the AFC loop. If, for example, the delta pseudorange interval computation for a particular channel is zero, it can be the AFC measurement, otherwise it is a delta pseudorange computation.(1) |
| Carrier Phase | For GSW2 software, the integrated carrier phase (meters), which initially is made equal to pseudorange, is integrated as long as carrier lock is retained. Discontinuity in this value generally means a cycle slip and renormalization to pseudorange. |
| Time in Track | The Time in Track counts how long a particular SV has been in track. For any count greater than zero (0), a generated pseudorange is present for a particular channel. The length of time in track is a measure of how large the pull-in error may be. |
| Sync Flags | For GSW2, this byte contains two 2-bit fields and one 1-bit field that describe the Autocorrelation Detection State, Synch State and Coherent Integration Time. Refer to Table 6.55 for more details. For GSW3, this field contains a duplicate of the state field of Message ID 4. See Table 6.6 for details. In builds with Scalable Tracking Loops, including SiRFNav that supports GSD3tw hardware, note that some bits are given additional duties or definitions. See specifically bits 1 and 6. |
| C/N0 1 | This array of Carrier To Noise Ratios is the average signal power in dB-Hz for each of the 100-millisecond intervals in the previous second or last epoch for each particular SV being track in a channel. First 100 millisecond measurement |
| C/N0 2 | Second 100 millisecond measurement |
| C/N0 3 | Third 100 millisecond measurement |
| C/N0 4 | Fourth 100 millisecond measurement |

| Bit Fields | Description |
|---|---|
| C/N0 5 | Fifth 100 millisecond measurement |
| C/N0 6 | Sixth 100 millisecond measurement |
| C/N0 7 | Seventh 100 millisecond measurement |
| C/N0 8 | Eighth 100 millisecond measurement |
| C/N0 9 | Ninth 100 millisecond measurement |

| Bit Fields | Description |
|---|---|
| C/N0 10 | Tenth 100 millisecond measurement |
| Delta Range Interval | This is the delta-pseudorange measurement interval for the preceding second. A value of zero indicated that the receiver has an AFC measurement or no measurement in the Carrier Frequency field for a particular channel When carrier phase measurement is impossible, some software versions will report the low-power count threshold in dBHz in this field. See Low Power Counts field description for details. |
| Mean Delta Range Time | When carrier phase is locked, the delta-range interval is measured for a period of time before the measurement time. By subtracting the time in this field, reported in milliseconds, from the reported measurement time (Time Tag or GPS Software Time) the middle of the measurement interval will be computed. The duration of the measurement interval is double the value in this field. In SiRFstarIII receivers, this value is always 500 since the measurement interval is always 1 second. Because of this fact, the two LSBs have been given new uses in some code versions starting with SiRFNav for GSD3tw. The LSB, bit 0, will be set to 1 whenever a measurement was made in a TricklePower period. Since TricklePower measurements may be made in either of 2 methods, bit 1 will be used to indicate the measurement type. A 1 in bit 1 means the TricklePower measurement was made using Tracking Algorithm, while a 0 means that the measurement was made using the Acquisition/ Reacquisition Interpolation Algorithm. These bits are useful only to SiRF and may be ignored by other users. |
| Extrapolation Time | In GSW2, this is the pseudorange extrapolation time, in milliseconds, to reach the common Time tag value. Reserved for SiRF use in GSW3 and GSWLT3. |
| Phase Error Count | This is the count of the phase errors greater than 60 degrees measured in the preceding second as defined for a particular channel |
| Low Power Count | Whenever low power counts occur in a measurement interval, this field will record how many of the 20 ms measurements reported low power. The range of this field is 0 to 50. In SiRFstarIII receivers the low-power threshold is not well defined, but varies under various software versions. For that reason, later versions of software, beginning with SiRFNav for GSD3tw may report the threshold for low power in dBHz. In software implementing this feature, it is necessary to examine bit 1 of the Sync Flags field. When that bit is set, low power counts should not occur. When it is clear, carrier phase tracking is impossible, and the threshold for low power counts will be reported in the Delta Range Interval field. Field Delta Range Interval, Description, add at the end: “In SiRFstarIII later software versions, starting with SiRFNav for the GSD3tw, this field may have a secondary use. When bit 1 of the Sync Flags (or State) field is set to 0, carrier phase tracking is not possible. This field becomes unnecessary and can be used for the second purpose. Since the threshold for declaring a measurement as a low power measurement varies, this field can be used to report that threshold, in dB-Hz. This field reports low-power threshold only when bit 1 of the Sync Flags field is 0. |

Table 6.55: Detailed Description of the Measurement Data

(1) Carrier frequency may be interpreted as the measured Doppler on the received signal. The value is reported in metres per second but can be converted to hertz using the Doppler equation:

Doppler frequency / Carrier frequency = Velocity / Speed of light, where Doppler frequency is in Hz; Carrier frequency = 1,575,420,000 Hz; Velocity is in m/s; Speed of light = 299,792,458 m/s.

Note that the computed Doppler frequency contains a bias equal to the current clock drift as reported in Message ID 7. This bias, nominally 96.250 kHz, is equivalent to over 18 km/s.

## 6.23 Navigation Library DGPS Data - MID 29

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

Example:

- `A0A2001A` – Start Sequence and Payload Length (26 bytes)
- `1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000` – Payload
- `0956B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) Example | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|
| | | | | Scale | Example |
| Message ID | 1 U | 1D | - | - | 29 |
| Satellite ID | 2 S | 000F | - | - | 15 |
| IOD | 2 S | 00BF | - | - | 181 |
| Source[(1)] | 1 U | 01 | - | - | 1 |
| Pseudorange Correction | 4 Sgl | BFC97C67 | m | - | -1.574109 |
| Pseudorange rate Correction | 4 Sgl | 3CAAAAAB | m/s | - | 0.020833 |
| Correction Age | 4 Sgl | 3FBFFE12 | sec | - | 1.499941 |
| Reserved | 4 Sgl | - | - | - | - |
| Reserved | 4 Sgl | - | - | - | - |

Table 6.56: Navigation Library DGPS Data - MID 29

[(1)] 0 = Use no corrections, 1 = SBAS channel, 2 = External source, 3 = Internal Beacon, 4 = Set Corrections via software

Note:

The fields Pseudorange Correction, Pseudorange Rate Correction, and Correction Age are floating point values per IEEE-754. To properly interpret these in a computer, the bytes must be rearranged in reverse order.

## 6.24 Navigation Library SV State Data - MID 30

| | |
|---|---|
| MID (Hex) | 1E |
| MID (Dec) | 30 |
| SID (Hex) | - |
| SID (Dec) | - |
| Message Name in Code | - |

The data in MID 30 reports the computed satellite position and velocity at the specified GPS time.

**Note:**

When using MID 30 SV position, adjust for difference between GPS Time MID 30 and Time of Transmission (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)

Example:

- `A0A20053` – Start Sequence and Payload Length (83 bytes)
- `1E15....2C64E99D01....408906C8` – Payload
- `2360B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| MID | 1 U | - | 1E | - | - | 30 |
| Satellite ID | 1 U | - | 15 | - | - | 21 |
| GPS Time | 8 Dbl | - | 00BF | sec | - | - |
| Position X | 8 Dbl | - | 01 | m | - | - |
| Position Y | 8 Dbl | - | BFC97C67 | m | - | - |
| Position Z | 8 Dbl | - | 3CAAAAAB | m | - | - |
| Velocity X | 8 Dbl | - | 3FBFFE12 | m/s | - | - |
| Velocity Y | 8 Dbl | - | - | m/s | - | - |
| Velocity Z | 8 Dbl | - | - | m/s | - | - |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Clock Bias | 8 Dbl | - | - | sec | - | - |
| Clock Drift | 4 Sgl | - | 2C64E99D | s/s | - | 744810909 |
| Ephemeris Flag (see details in Table 6.58) | 1 D | - | 01 | - | - | 1 |
| Reserved | 4 Sgl | - | - | - | - | - |
| Reserved | 4 Sgl | - | - | - | - | - |
| Ionospheric Delay | 4 Sgl | - | 408906C8 | m | - | 1082721992 |

Table 6.57: Navigation Library SV State Data - MID 30

Note:

Each of the 8-byte fields as well as Clock Drift and Ionospheric Delay fields are floating point values per IEEE-754. To properly interpret these in a computer, the bytes must be rearranged. See Section 6.22 for byte orders.

| 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 |

| Ephemeris Flag Value (EFV) | Ephemeris Age in days | Definition |
|---|---|---|
| 0x11 -:- 0x1F | EFV - 0x10 | SV state calculated from server-based synthesized ephemeris with age of 1 - 15 days(1) |
| 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(2) |
| 0x60 -:- 0xFF | - | Reserved |

**Table 6.58: Ephemeris Flag Value Descriptions**

(1) Age of 8 - 15 days supported only. Starting from release 4.1.0.

(2) Age of 16 - 31 days supported only. Starting from release 4.1.2.

## 6.25 Navigation Library Initialization Data - MID 31

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

Example:

- `A0A20054` – Start Sequence and Payload Length (84 bytes)
- `1F....00000000000001001E000F....00....000000000F....00....02....043402........02` – Payload
- `0E27B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | - | 1F | - | - | 31 |
| Reserved | 1 U | - | - | - | - | - |
| Altitude Mode(1) | 1 U | - | 00 | - | - | 0 |
| Altitude Source | 1 U | - | 00 | - | - | 0 |
| Altitude | 4 Sgl | - | 00000000 | m | - | 0 |
| Degraded Mode(2) | 1 U | - | 01 | - | - | 1 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Degraded Timeout | 2 S | - | 001E | sec | - | 30 |
| Dead-reckoning Timeout | 2 S | - | 000F | sec | - | 15 |
| Reserved | 2 S | - | - | - | - | - |
| Track Smoothing Mode(3) | 1 U | - | 00 | - | - | 0 |
| Reserved | 1 U | - | - | - | - | - |
| Reserved | 2 S | - | - | - | - | - |
| Reserved | 2 S | - | - | - | - | - |
| Reserved | 2 S | - | - | - | - | - |
| DGPS Selection(4) | 1 U | - | 00 | - | - | 0 |
| DGPS Timeout | 2 S | - | 0000 | sec | - | 0 |
| Elevation Nav. Mask | 2 S | 2 | 000F | deg | - | 15 |
| Reserved | 2 S | - | - | - | - | - |
| Reserved | 1 U | - | - | - | - | - |
| Reserved | 2 S | - | - | - | - | - |
| Reserved | 1 U | - | - | - | - | - |
| Reserved | 2 S | - | - | - | - | - |
| Static Nav. Mode(5) | 1 U | - | 00 | - | - | 0 |
| Reserved | 2 S | - | - | - | - | - |
| Position X | 8 Dbl | - | - | m | - | - |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Position Y | 8 Dbl | - | - | m | - | - |
| Position Z | 8 Dbl | - | - | m | - | - |
| Position Init. Source[6] | 1 U | - | 02 | - | - | 2 |
| GPS Time | 8 Dbl | - | - | sec | - | - |
| GPS Week | 2 S | - | 0434 | | | 1076 |
| Time Init. Source[7] | 1 U | - | 02 | sec | - | 2 |
| Drift | 8 Dbl | - | - | Hz | - | - |
| Drift Init. Source[8] | 1 U | - | 02 | sec | - | 2 |

Table 6.59: Navigation Library Initialization Data - Message ID 31

(1) 0 = Use last know altitude, 1 = Use user input altitude, 2 = Use dynamic input from external source

(2) 0 = Use direction hold and then time hold, 1 = Use time hold and then direction hold, 2 = Only use direction hold, 3 = Only use time hold, 4 = Degraded mode is disabled. Note that Degraded Mode is not supported in GSW3.2.5 and newer.

(3) 0 = True, 1 = False

(4) 0 = Use DGPS if available, 1 = Only navigate if DGPS corrections are available, 2 = Never use DGPS corrections

(5) 0 = True, 1 = False

(6) 0 = ROM position, 1 = User position, 2 = SRAM position, 3 = Network assisted position

(7) 0 = ROM time, 1 = User time, 2 = SRAM time, 3 = RTC time, 4 = Network assisted time

(8) 0 = ROM clock, 1 = User clock, 2 = SRAM clock, 3 = Calibration clock, 4 = Network assisted clock

Note:

Altitude is a single-precision floating point value while position XYZ, GPS time, and drift are double-precision floating point values per IEEE-754. To properly interpret these values in a computer, the bytes must be rearranged. See the Note in Section 6.22 for byte orders.

## 6.26 Geodetic Navigation Data - MID 41

| | |
|---|---|
| MID (Hex) | 0x29 |
| MID (Dec) | 41 |
| Message Name in Code | SIRF_MSG_SSB_GEODETIC_NAVAGATION |

Table 6.60: Geodetic Navigation Data - MID 41

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

Example:

- A0 A2 00 5B – Start Sequence and Payload Length (91 bytes)
- 29 00 00 02 04 04 E8 1D 97 A7 62 07 D4 02 06 11 36 61 DA 1A 80
  01 58 16 47 03 DF B7 55 48 8F FF FF FA C8 00 00 04 C6 15 00 00
  00 00 00 00 00 00 00 00 00 00 00 BB 00 00 01 38 00 00 00 00 00
  00 6B 0A F8 61 00 00 00 00 00 1C 13 14 00 00 00 00 00 00 00 00
  00 00 00 00 08 05 00 – Payload
- 11 03 B0 B3 – Message Checksum and End Sequence

| Name | Bytes | Description |
|---|---|---|
| MID | 1 U | Hex 0x29 (decimal 41) |
| Nav Valid | 2 D | 0x0000 = valid navigation (any bit set implies navigation solution is not optimal);<br>Bit 0:<br>On = solution not yet overdetermined(1) (< 5 SVs),<br>Off = solution overdetermined(1) (> = 5 SV)<br>Bit 1: Reserved<br>Bit 2:<br>On = If using default week number and NavType is No Nav fix<br>Off = If using fresh week number and NavType is No Nav fix<br>Bit 3 On = invalid DR sensor data (SiRFDRive only)<br>Bit 4 On = invalid DR calibration (SiRFDRive only)<br>Bit 5 On = unavailable DR GPS-based calibration (SiRFDRive only)<br>Bit 6 On = invalid DR position fix SiRFDRive only)<br>Bit 7 On = invalid heading (SiRFDRive only)<br>Bit 8 On = Almanac Based Position (ABP) (GSD4e and later only)<br>Bits [10:9] : Reserved<br>Bit 11 On = Position can only be derived by reverse EE (GSD4e and later only)<br>Bit 12 : Reserved<br>Bit 13 On = GPS in text mode (not supported in SiRFstarIV)<br>Bit 14 On = Tracker is loading (not supported in SiRFstarIV)<br>Bit 15 On = no tracker data available (SiRFNav only) |
| Nav Type | 2 D | Bits [2:0]: GPS position fix type:<br>000 = no navigation fix<br>001 = 1-SV KF solution<br>010 = 2-SV KF solution<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 = TricklePower in use<br>Bits [5:4]: altitude hold status<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: 1 = DOP limits exceeded<br>Bit 7: 1 = DGPS corrections applied<br>Bit 8: Sensor DR solution type (SiRFDRive only):<br>1 = sensor DR<br>0 = velocity DR(2) if Bits [2:0] = 111; else check Bits [15:14] for DR error status<br>Bit 9: 1 = navigation solution overdetermined1<br>Bit 10: 1 = velocity DR(2) timeout exceeded |

| Name | Bytes | Description |
|---|---|---|
| Nav Type | 2 D | Bit 11 = Reserved<br>Bit 12: 1 = invalid velocity<br>Bit 13: 1 = altitude hold disabled<br>Bits [15:14]: sensor DR error status (SiRFDRive only):<br>00 = GPS-only navigation<br>01 = DR calibration from GPS<br>10 = DR sensor error<br>11 = DR in test |
| Extended Week Number | 2 U | GPS week number: week 0 started January 6 1980. This value is extended beyond the 10-bit value reported by the SVs. |
| TOW | 4 U | GPS time of week in seconds x $10^3$ |
| UTC Year | 2 U | UTC time and date. Seconds reported as integer milliseconds only |
| UTC Month | 1 U | |
| UTC Day | 1 U | |
| UTC Hour | 1 U | |
| UTC Minute | 1 U | |
| UTC Second | 2 U | |
| Satellite ID List | 4D | Bit map of SVs used in solution. Bit 0 = SV 1, Bit 31 = SV 32. A bit set to 1 means the corresponding SV was used in the solution. |
| Latitude | 4S | In degrees (+ = North) x $10^7$ |
| Longitude | 4S | In degrees (+ = East) x $10^7$ |
| Altitude from Ellipsoid | 4S | In meters x $10^2$ |
| Altitude from MSL | 4S | In meters x $10^2$ |
| Map Datum | 1U | Indicates the datum to which latitude, longitude, and altitude relate. 21 = WGS-84, by default. Other values are defined as other datums are implemented. Available datums include: 21 = WGS-84, 178 = Tokyo Mean, 179 = Tokyo Japan, 180 = Tokyo Korea, 181 = Tokyo Okinawa. |
| Speed Over Ground (SOG) | 2U | In m/s x $10^2$ |
| Course Over Ground (COG, True) | 2U | In degrees clockwise from true north x $10^2$ |
| Magnetic Variation | 2S | Not implemented |
| Climb Rate | 2S | In m/s x $10^2$ |

| Name | Bytes | Description |
|---|---|---|
| Heading Rate | 2S | deg/s x $10^2$ (SiRFDRive only) |
| Estimated Horizontal Position Error | 4 U | EHPE in meters x $10^2$ |
| Estimated Vertical Position Error | 4 U | EVPE in meters x $10^2$ |
| Estimated Time Error | 4 U | ETE in seconds x $10^2$ (SiRFDRive only) |
| Estimated Horizontal Velocity Error | 2 U | EHVE in m/s x $10^2$ (SiRFDRive only) |
| Clock Bias | 4 U | In m x $10^2$<br>**Note:**<br>The clock bias value here can be used only for a range up to 40,000,000.00m. For values above this limit, use the clock bias reported in MID 7.<br>**Note:**<br>Prior to Release 4.1.2, the data type of this field was 4S with a much smaller positive range than 4U |
| Clock Bias Error | 4 U | In meters x $10^2$ (SiRFDRive only) |
| Clock Drift | 4 S | In m/s x $10^2$<br>To convert Drift m/s to Hz: Drift (m/s) *L1(Hz)/c = Drift (Hz). |
| Clock Drift Error | 4 U | In m/s x $10^2$ (SiRFDRive only) |

| Name | Bytes | Description |
|---|---|---|
| Distance | 4 U | Distance traveled since reset in meters (prior to version 4.1.x in SiRFDRive only) |
| Distance error | 2 U | In meters (SiRFDRive only) |
| Heading Error | 2 U | In degrees x $10^2$ (SiRFDRive only) |
| Number of SVs in Fix | 1 U | Count of SVs indicated by SV ID list |
| HDOP | 1 U | Horizontal Dilution of Precision x 5 (0.2 resolution) |
| AdditionalModeInfo | 1 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 (The following are for SiRFstarIII and beyond only)<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 (supported from build 4.1.0)<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 = Reserve |



**Table 6.61: Message Field Description**

(1) An overdetermined solution is at least one additional satellite has been used to confirm the 4-satellite position solution. When a solution has been overdetermined it remains so until the system drops to no-navigation status (Nav Type bits 0-2 = 000), even if several satellites are lost.

(2) Velocity Dead Reckoning (DR) is a method by which the last solution computed from satellite measurements is updated using the last computed velocity and time elapsed to project the position forward in time. It assumes heading and speed are unchanged, and is reliable for only a limited time. Sensor DR is a position update method based on external sensors (e.g., rate gyroscope, vehicle speed pulses, accelerometers) to supplement the GPS measurements. Sensor DR is only applicable to SiRFDRive products.

Note:

Values are transmitted as integer values. When scaling is indicated in the description, the decimal value has been multiplied by the indicated amount and then converted to an integer. Example: Value transmitted: 2345; indicated scaling: $10^2$; actual value: 23.45.

## 6.27 Queue Command Parameters - Message ID 43

This message is output in response to Message ID 168, Poll Command Parameters. The response message will contain the requested parameters in the form of the requested message. In the example shown below, in response to a request to poll the static navigation parameters, this message has been sent with the payload of Message ID 143 (0x8F) contained in it. Since the payload of Message ID 143 is two bytes long, this message is sent with a payload 3 bytes long (Message ID 43, then the 2-byte payload of message 143).

Output Rate: Response to poll

This message outputs Packet/Send command parameters under OSP.

Example with MID_SET_STAT_NAV message:

- `A0A20003` – Start Sequence and Payload Length (Variable length: 3 bytes in the example).
- `438F00` – Payload
- `00D2B0B3` – Message Checksum and End Sequence

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 U | | | = 0x2B |
| Polled Msg ID(1) | 1 U | | | = 0x8F (example) |
| Data(2) | Variable(3) | | | Depends on the polled Message ID length |

**Table 6.62: Queue Command Parameters - Message ID 43**

(1) Valid Message IDs are 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, 0x97, and 0xAA.

(2) The data area is the payload of the message whose Message ID is listed in the Polled Msg ID field. For the specific details of the possible payloads, see the description of that message in Section 5

(3) Data type follows the type defined for the Polled Message ID. For example, if the Polled Message ID is 128, see Message ID 128 payload definition in Table 5.32.

## 6.28 DR Raw Data - Message ID 45

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 | | | = 0x2D |
| 1st 100ms time-tag | 4 | | ms | |
| 1st 100ms ADC2 average measurement | 2 | | | |
| Reserved | 2 | | | |
| 1st 100ms odometer count | 2 | | | |
| 1st 100ms GPIO input states | 1 | | | Bit 0: reverse |
| 2nd 100ms time-tag | 4 | | ms | |

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| 2nd 100ms ADC2 average measurement | 2 | | | |
| Reserved | 2 | | | |
| 2nd 100ms odometer count | 2 | | | |
| 2nd 100ms GPIO input states | 1 | | | Bit 0: reverse |
| ... | | | | |
| 10th 100ms time-tag | 4 | | ms | |
| 10th 100ms ADC2 average measurement | 2 | | | |
| Reserved | 2 | | | |
| 10th 100ms odometer count | 2 | | | |
| 10th 100ms GPIO input states | 1 | | | Bit 0: reverse |

Table 6.63: DR Raw Data - Message ID 45

Note:

Payload length: 111 bytes.

This message is only used in the SiRFstarII SiRFDRive software.

## 6.29 Test Mode 3/4/5/6 - Message ID 46

Message ID 46 is used by GSW2, SiRFDRive, SiRFLoc v3.x, GSW3, GSWLT3, and SLCLT3 software.

Output Rate: Variable – set by the period as defined in Message ID 150.

Example for GSW2, SiRFDRive, SiRFLoc v3.x, and GSW3 software output:

- `A0A20033` – Start Sequence and Payload Length (51 bytes)
- `2E0001001E00023F70001F0D29000000000000601C600051B0E000EB41A0000000000 000000000000000000000000000000000000` – Payload
- `0316B0B3` – Message Checksum and End Sequence

Example for GSWLT3 and SLCLT3 software output:

- `A0A20033` – Start Sequence and Payload Length
- `2E0001001E00023F70001F0D29000000000000601C600051B0E000EB41A0000000000 000000000000000000008000000002F000000` – Payload
- `0316B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 2E | | | 46 |
| SV ID | 2 U | | 0001 | | | 1 |
| Period | 2 U | | 001E | sec | | 30 |
| Bit Sync Time | 2 U | | 0002 | sec | | 2 |
| Bit Count | 2 U | | 3F70 | | | 16420 |
| Poor Status | 2 U | | 001F | | | 31 |
| Good Status | 2 U | | 0D29 | | | 3369 |
| Parity Error Count | 2 U | | 0000 | | | 0 |
| Lost VCO Count | 2 U | | 0000 | | | 0 |
| Frame Sync Time | 2 U | | 0006 | sec | | 6 |
| C/N0 Mean | 2 S | *10 | 01C6 | dB/Hz | ÷10 | 45.4 |
| C/N0 Sigma | 2 S | *10 | 0005 | dB/Hz | ÷10 | 0.5 |
| Clock Drift Change | 2 S | *10 | 1B0E | Hz | ÷10 | 692.6 |
| Clock Drift | 4 S | *10 | 000EB41A | Hz | ÷10 | 96361.0 |
| Bad 1 kHz Bit Count(1) | 2 S | | 0000 | | | 0 |
| Abs I20 ms(2) | 4 S | | 000202D5 | Counts | | 131797 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Abs Q20 ms(2) | 4 S | | 000049E1 | Counts | | 18913 |
| Phase Lock Indicator(3) | 4 S | | 00000000 | | 0.001 | 0 |
| RTC Frequency(4) | 2 U | | 8000 | Hz | | 32768 |
| ECLK Ratio(3) | 2 U | | 0000 | | 3*Value/ 65535 | 0 (no ECLK input) |
| Timer Synch input(3) (bit 7) AGC(3) (bit 0 - 6) | 1 D | | 2F | Timer Synch = True/False AGC = ~0.8 dB per step | | TS 0 = no activity and 47 for AGC |
| Reserved | 3 U | | | | | |

Table 6.64: Test Mode 3/4/5/6 - Message ID 46

(1) Field not filled for GSW3 and GSWLT3 software in Test Mode 3/4.

(2) Phase error = (Q20 ms)/(I20 ms).

(3) A value of 0.9 to 1.0 generally indicates phase lock

(4) Only for GSWLT3 and SLCLT3 software

| Name | Description |
|---|---|
| Message ID | Message ID number |
| SV ID | The number of the satellite being tracked |
| Period | The total duration of time (in seconds) that the satellite is tracked. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Bit Sync Time | The time it takes for channel 0 to achieve the status of 0x37. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Bit Count | The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20 sec x 12 channels). This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |

| Name | Description |
|---|---|
| Poor Status | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 100-ms intervals). This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Good Status | This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Parity Error Count | The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Lost VCO Count | The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Frame Sync Time | The time it takes for channel 0 to reach a 0x3F status. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| C/N0 Mean | Calculated average of reported C/N0 by all 12 channels during the test period. |
| C/N0 Sigma | Calculated sigma of reported C/N0 by all 12 channels during the test period. |
| Clock Drift Change | Difference in clock drift from start and end of the test period. |
| Clock Drift | The measured internal clock drift. |
| Bad 1 kHz Bit Count | Errors in 1 ms post correlation I count values. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4. |
| Abs I20 ms | Absolute value of the 20 ms coherent sums of the I count over the duration of the test period. |

| Name | Description |
|---|---|
| Abs Q20 ms | Absolute value of the 20 ms Q count over the duration of the test period. |
| Phase Lock Indicator | Absolute value of the 20 ms Q count over the duration of the test period. |
| RTC Frequency(1) | F(RTC counts/CLCKACQ counts over test interval). 16-bit unsigned integer value of RTC frequency in Hz.<br>Value = 0, no RTC<br>Value = 1 to 65534, 32678±1 = good RTC frequency<br>Value = 65535, RTC frequency = 65535 Hz of higher |
| ECLK Ratio(1) | F(ECLK counts/CLCKACQ counts over test interval). 16-bit unsigned integer value of scaled value of ratio.<br>Value = 0, no ECLK input<br>0< Value <3, Ratio = 3*Value/65535<br>Value >3, Ratio = 65535 |
| Timer Synch(1) | Timer Synch input activity bit<br>Value = 0, no Timer Synch input activity<br>Value = 1, activity |
| AGC(1) | Automatic Gain Control value<br>Value = 0, gain is set to maximum, noise is at minimum or external gain is insufficient for the receiver's proper operation Maximum value depends on receiver type. GSW3: 63; GSD4: 31. Maximum value means minimum IF gain and receiver saturated, too much gain from circuits external to the IC. |

Table 6.65: Detailed Description of Test Mode 3/4/5/6 - Message ID 46

(1) Supported only by GSWLT3 and SLCLT3 software. When test mode command is issued, test report interval time value and PRN are specified. Reports every interval whether SV signals or not and data is accumulated every interval period. Continuous output until software is reset or unit is restarted.

## 6.30 Test Mode 4 – Message ID 48 (SiRFLoc v2.x only)

SiRFLoc results from Test Mode 4 are output by Message IDs 48 and 49. Message ID 48 for Test Mode 4 used by SiRFLoc version 2.x only is not to be confused with SiRFDRive Message ID 48.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 | | 30 | | | 48 |
| nChannel | 1 | | 01 | | | 1 |
| Reserved | 4 | | 00000000 | | | 0 |
| Channel | 1 | | 00 | | | 0 |
| Satellite ID | 1 | | 18 | | | 24 |
| Receiver Time Tag | 4 | | 000660D0 | ms | | 30995 |
| Pseudorange | 4 | A | 0 | m | 10 | 0 |
| Carrier Frequency | 4 | 64 | 174ADC | m/sec | | 1526492 |

Table 6.66: Test Mode 4 – Message ID 48

Note:

Payload Length: 20 bytes

| Name | Description |
|---|---|
| Message ID | Message ID |
| nChannel | Number of channels reporting |
| Reserved | Reserved |
| Channel | Receiver channel number for a given satellite being searched or tracked |
| Satellite ID | Satellite or Space Vehicle (SV ID number or Pseudo-Random Noise (PRN) number |
| Receiver Time Tag | Count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock |
| Pseudorange | Generated pseudorange measurement for a particular SV |
| Carrier Frequency | Can be interpreted in two ways:<br>1. Delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval<br>2. Frequency from the AFC loop. If, for example, the delta pseudorange interval computation for a particular channel is zero, it can be the AFC measurement, otherwise it is a delta pseudorange computation |

Table 6.67: Detailed Description of Test Mode 4 Message ID 48

## 6.31 DR Navigation Status - Message ID 48, Sub ID 1

DR navigation status information (output on every navigation cycle).

| Name | Bytes | Description |
|---|---|---|
| Message ID | 1 | = 0x30 |
| Message Sub ID | 1 | = 0x01 |
| DR navigation | 1 | 0x00 = valid DR navigation; else<br>Bit 0 ON : GPS-only navigation required<br>Bit 1 ON : speed not zero at start-up<br>Bit 2 ON : invalid DR position<br>Bit 3 ON : invalid DR heading<br>Bit 4 ON : invalid DR calibration<br>Bit 5 ON : invalid DR data<br>Bit 6 ON : system in Cold Start<br>Bit 7 : Reserved |

| Name | Bytes | Description |
|---|---|---|
| DR data | 2 | 0x0000 = valid DR data; else<br>Bit 0 ON : DR gyro subsystem not operational<br>Bit 1 ON : DR speed subsystem not operational<br>Bit 2 ON : DR measurement time < 80 ms<br>Bit 3 ON : invalid serial DR message checksum<br>Bit 4 ON : no DR data for > 2 sec<br>Bit 5 ON : DR data timestamp did not advance<br>Bit 6 ON : DR data byte stream all 0x00 or 0xFF<br>Bit 7 ON : composite wheel-tick count jumped > 255 between successive DR messages<br>Bit 8 ON : input gyro data bits (15) of 0x0000 or 0x3FFF<br>Bit 9 ON : > 10 DR messages received in 1 sec<br>Bit 10 ON : time difference between two consecutive measurements is < = 0<br>Bits 11 - 15 : Reserved. |
| DR calibration and DR gyro bias calibration | 1 | Bits 0 - 3 : 0000 = valid DR calibration; else<br>Bit 0 ON : invalid DR gyro bias calibration<br>Bit 1 ON : invalid DR scale factor calibration<br>Bit 2 ON : invalid DR speed scale factor calibration<br>Bit 3 ON : GPS calibration required but not ready<br>Bits 4 - 6 : 000 = valid DR gyro bias calibration; else Bit 4 ON : invalid DR data<br>Bit 5 ON : zero-speed gyro bias calibration not updated<br>Bit 6 ON : heading rate scale factor < = -1<br>Bit 7 : Reserved |
| DR gyro scale factor calibration and DR speed scale factor calibration | 1 | Bits 0 - 3 : 0000 = valid DR gyro scale factor calibration; else Bit 0 ON : invalid DR heading<br>Bit 1 ON : invalid DR data<br>Bit 2 ON : invalid DR position<br>Bit 3 ON : heading rate scale factor < = -1 Bits 4 - 7 : 0000 = valid DR speed scale factor calibration; else<br>Bit 4 ON : invalid DR data<br>Bit 5 ON : invalid DR position<br>Bit 6 ON : invalid GPS velocity for DR<br>Bit 7 ON : DR speed scale factor < = -1 |

| Name | Bytes | Description |
|---|---|---|
| DR Nav across reset and DR position | 1 | Bits 0 - 1 : 00 = valid DR nav across reset; else Bit 0 ON : invalid DR navigation<br>Bit 1 ON : speed > 0.01 m/s<br>Bit 2 : Reserved<br>Bits 3 - 6 : 0000 = valid DR position; else Bit 3 ON : speed not zero at start-up<br>Bit 4 ON : invalid GPS position<br>Bit 5 ON : system in Cold Start<br>Bit 6 ON : invalid DR data<br>Bit 7 : Reserved |
| DR heading | 1 | Bits 0 - 6 : 0000000 = valid DR heading; else<br>Bit 0 ON : speed not zero at start-up<br>Bit 1 ON : invalid GPS position<br>Bit 2 ON : invalid GPS speed<br>Bit 3 ON : GPS did not update heading<br>Bit 4 ON : delta GPS time < 0 and > 2<br>Bit 5 ON : system in Cold Start<br>Bit 6 ON : invalid DR data<br>Bit 7 : Reserved |
| DR gyro subsystem and DR speed subsystem | 1 | Bits 0 - 3 : 0000 = updated DR gyro bias and scale factor calibration; else Bit 0 ON : invalid DR data<br>Bit 1 ON : invalid DR position<br>Bit 2 ON : invalid GPS velocity for DR<br>Bit 3 ON : GPS did not update heading<br>Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data<br>Bit 5 ON : invalid DR position<br>Bit 6 ON : invalid GPS velocity for DR<br>Bit 7 : 0 = updated DR navigation state |

| Name | Bytes | Description |
|---|---|---|
| DR Nav state integration ran and zero-speed gyro bias calibration updated | 1 | Bits 0 - 7 : 00000000 = GPS updated position; else Bit 0 ON : update mode != KF<br>Bit 1 ON : EHPE > 50<br>Bit 2 ON : no previous GPS KF update<br>Bit 3 ON : GPS EHPE < DR EHPE<br>Bit 4 ON : DR EHPE < 50<br>Bit 5 ON : less than 4 SVs in GPS navigation<br>Bit 6 ON : no SVs in GPS navigation<br>Bit 7 ON : DR-only navigation required |
| Updated DR gyro bias/scale factor calibration, updated DR speed calibration, and updated DR Nav state | 1 | Bits 0 - 3 : 0000 = updated DR gyro bias and scale factor calibration; else Bit 0 ON : invalid DR data<br>Bit 1 ON : invalid DR position<br>Bit 2 ON : invalid GPS velocity for DR<br>Bit 3 ON : GPS did not update heading<br>Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data<br>Bit 5 ON : invalid DR position<br>Bit 6 ON : invalid GPS velocity for DR<br>Bit 7 : 0 = updated DR navigation state |
| GPS updated position | 1 | Bits 0 - 7 : 00000000 = GPS updated position; else Bit 0 ON : update mode != KF<br>Bit 1 ON : EHPE > 50<br>Bit 2 ON : no previous GPS KF update<br>Bit 3 ON : GPS EHPE < DR EHPE<br>Bit 4 ON : DR EHPE < 50<br>Bit 5 ON : less than four SVs in GPS navigation<br>Bit 6 ON : no SVs in GPS navigation<br>Bit 7 ON : DR-only navigation required |
| GPS updated heading | 1 | Bits 0 - 6 : 0000000 = GPS updated heading; else Bit 0 ON : update mode != KF Bit 1 ON : GPS speed < = 5 m/s Bit 2 ON : less than 4 SVs in GPS navigation Bit 3 ON : horizontal velocity variance > 1 m2/s2 Bit 4 ON : GPS heading error > = DR heading error Bit 5 ON : GPS KF not updated Bit 6 ON : incomplete initial speed transient Bit 7 : Reserved |
| GPS position & GPS velocity | 1 | Bits 0 - 2 : 000 = valid GPS position for DR; else Bit 0 ON : less than 4 SVs in GPS navigation Bit 1 ON : EHPE > 30 Bit 2 ON : GPS KF not updated Bit 3 : Reserved Bits 4 - 7 : 0000 = valid GPS velocity for DR; else Bit 4 ON : invalid GPS position for DR Bit 5 ON : EHVE > 3 Bit 6 ON : GPS speed < 2 m/s Bit 7 ON : GPS did not update heading. |
| Reserved | 2 | Reserved |

Table 6.68: DR Navigation Status - Message ID 48, Sub ID 1

Note:

Payload length: 17 bytes

## 6.32 DR Navigation State - Message ID 48, Sub ID 2

DR speed, gyro bias, navigation mode, direction, and heading (output on every navigation cycle).

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 | | | = 0x30 |
| Message Sub ID | 1 | | | = 0x02 |
| DR speed | 2 | $10^2$ | m/s | |
| DR speed error | 2 | $10^4$ | m/s | |
| DR speed scale factor | 2 | $10^4$ | | |
| DR speed scale factor error | 2 | $10^4$ | | |
| DR heading rate | 2 | $10^2$ | deg/s | |
| DR heading rate error | 2 | $10^2$ | deg/s | |
| DR gyro bias | 2 | $10^2$ | deg/s | |
| DR gyro bias error | 2 | $10^2$ | deg/s | |
| DR gyro scale factor | 2 | $10^4$ | | |
| DR gyro scale factor error | 2 | $10^4$ | | |
| Total DR position error | 4 | $10^2$ | m | |
| Total DR heading error | 2 | $10^2$ | deg | |
| DR Nav mode control | 1 | | | 1 = GPS-only nav required (no DR nav allowed)<br>2 = GPS + DR nav using default/stored calibration<br>3 = GPS + DR nav using current GPS calibration<br>4 = DR-only nav (no GPS nav allowed) |
| Reverse | 1 | | | DR direction: 0 = forward; 1 = reverse |
| DR heading | 2 | $10^2$ | deg/s | |

Table 6.69: DR Navigation State - Message ID 48, Sub ID 2

Note:

Payload length: 32 bytes

## 6.33 Navigation Subsystem - Message ID 48, Sub ID 3

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 | | | = 0x30 |
| Message Sub ID | 1 | | | = 0x03 |
| GPS heading rate | 2 | $10^2$ | deg/s | |
| GPS heading rate error | 2 | $10^2$ | deg/s | |
| GPS heading | 2 | $10^2$ | deg | |
| GPS heading error | 2 | $10^2$ | deg | |
| GPS speed | 2 | $10^2$ | m/s | |
| GPS speed error | 2 | $10^2$ | m/s | |
| GPS position error | 4 | $10^2$ | m | |
| DR heading rate | 2 | $10^2$ | deg/s | |
| DR heading rate error | 2 | $10^2$ | deg/s | |
| DR heading | 2 | $10^2$ | deg | |
| DR heading error | 2 | $10^2$ | deg | |
| DR speed | 2 | $10^2$ | m/s | |
| DR speed error | 2 | $10^4$ | m/s | |
| DR position error | 2 | $10^4$ | m | |
| Reserved | 2 | | | |

Table 6.70: Navigation Subsystem - Message ID 48, Sub ID 3

Note:

Payload length: 36 bytes.

## 6.34 DR Gyro Factory Calibration - Message ID 48, Sub ID 6

DR Gyro factory calibration parameters (response to poll).

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 | | | = 0x30 |
| Message Sub ID | 1 | | | = 0x06 |
| Calibration | 1 | | | Bit 0 : Start gyro bias calibration<br>Bit 1 : Start gyro scale factor calibration<br>Bits 2 - 7 : Reserved |
| Reserved | 1 | | | |

Table 6.71: DR Gyro Factory Calibration - Message ID 48, Sub ID 6

Note:

Payload length: 4 bytes.

## 6.35 DR Sensors Parameters - Message ID 48, Sub ID 7

DR sensors parameters (response to poll).

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 | | | = 0x30 |
| Message Sub ID | 1 | | | = 0x07 |
| Base speed scale factor | 1 | | ticks/m | |
| Base gyro bias | 2 | $10^4$ | mV | |
| Base gyro scale factor | 2 | $10^3$ | mV/deg/s | |

Table 6.72: DR Sensors Parameters - Message ID 48, Sub ID 7

Note:

Payload length: 7 bytes.

## 6.36 DR Data Block - Message ID 48, Sub ID 8

1-Hz DR data block (output on every navigation cycle).

| Name | Bytes | Scale | Unit | Description |
|---|---|---|---|---|
| Message ID | 1 | | | = 0x30 |
| Message Sub ID | 1 | | | = 0x08 |
| Measurement type | 1 | | | 0 = odometer and gyroscope (always);<br>1 .. 255 = Reserved |
| Valid count | 1 | | | Count (1 .. 10) of valid DR measurements |
| Reverse indicator | 2 | | | Bits 0 .. 9, each bit:<br>ON = reverse, OFF = forward |
| 1st 100-ms time-tag | 4 | | ms | |
| 1st 100-ms DR speed | 2 | $10^2$ | m/s | |
| 1st 100-ms gyro heading rate | 2 | $10^2$ | deg/s | |
| 2nd 100-ms time-tag | 4 | | ms | |
| 2nd 100-ms DR speed | 2 | $10^2$ | m/s | |
| 2nd 100-ms gyro heading rate | 2 | $10^2$ | deg/s | |
| ... | | | | |
| 10th 100-ms time-tag | 4 | | ms | |
| 10th 100-ms DR speed | 2 | $10^2$ | m/s | |
| 10th 100-ms gyro heading rate | 2 | $10^2$ | deg/s | |

**Table 6.73: DR Data Block – Message ID 48, Sub ID 8**

**Note:**

Payload length: 86 bytes.

## 6.37 DR Package Sensor Parameters - Message ID 48, Sub ID 9

Output message of Sensor Package parameters

**Note:**

This message is not Supported by SiRFDemoPPC.

The user can enable a one time transmission of this message via the SiRFDemo Poll command for SiRFDRive. In the SiRFDRive menu, select *Poll Sensors Parameters*.

| Byte | Name | Data Type | Bytes | Unit | Description | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | = 0x30 | |
| 2 | Sub-ID | UINT8 | 1 | N/A | = 0x09 | |
| 3 | Sensors[0] SensorType | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2 | |
| 4 | Sensors[0] ZeroRateVolts | UINT32 | 4 | volts | 0 to 5.0(1) | |
| 8 | Sensors[0] MilliVoltsPer | UINT32 | 4 | millivolts | 0 to 1000(2) | |
| 12 | Sensors[0] ReferenceVoltage | UINT32 | 4 | volts | 0 to 5.0 | |
| 16 | Sensors[1] SensorType | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2 | |
| 17 | Sensors[1] ZeroRateVolts | UINT32 | 4 | volts | 0 to 5.0 | |
| 21 | Sensors[1] MilliVoltsPer | UINT32 | 4 | millivolts | 0 to 1000 | |
| 25 | Sensors[1] ReferenceVoltage | UINT32 | 4 | volts | 0 to 5.0 | |
| 29 | Sensors[2] SensorType | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2 | |
| 30 | Sensors[2] ZeroRateVolts | UINT32 | 4 | volts | 0 to 5.0 | |

| Byte | Name | Data Type | Bytes | Unit | Description | Res |
|---|---|---|---|---|---|---|
| 34 | Sensors[2] MilliVoltsPer | UINT32 | 4 | millivol ts | 0 to 1000 | |
| 38 | Sensors[2] ReferenceVoltage | UINT32 | 4 | volts | 0 to 5.0 | |
| 39 | Sensors[3] SensorType | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2 | |
| 43 | Sensors[3] ZeroRateVolts | UINT32 | 4 | volts | 0 to 5.0 | |
| 47 | Sensors[3] MilliVoltsPer | UINT32 | 4 | millivol ts | 0 to 1000 | |
| 51 | Sensors[3] ReferenceVoltage | UINT32 | 4 | volts | 0 to 5.0 | |

**Table 6.74: DR Package Sensor Parameters - Message ID 48, Sub ID 9**

(1) To restore ROM defaults for ALL sensors, enter the value 0xdeadabba here. You must still include the remainder of the message, but these values will be ignored.

(2) For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

**Note:**

Payload length: 54 bytes.

## 6.38 Test Mode 4 – Message ID 49

SiRFLoc results from Test Mode 4 are output by Message IDs 48 and 49. Message ID 48 for Test Mode 4 used by SiRFLoc version 2.x only is not to be confused with SiRFDRive Message ID 48.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 | | 31 | | | 49 |
| nChannel | 1 | | 01 | | | 1 |
| Reserved | 4 | | 00000000 | | | 0 |
| Channel | 1 | | 00 | | | 0 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Satellite ID | 1 | | 18 | | | 24 |
| Receiver Time Tag | 4 | | 000660D0 | ms | | 31085 |
| Carrier Doppler Rate | 4 | 100000 | 796D | carrier cycles/ 2 ms/10 ms | 1048576 | 271 |
| Carrier Doppler | 4 | 100000 | 10F | carrier cycles/ 2 ms | 1048576 | 168229578 |
| Carrier Phase | 4 | 400 | | carrier cycles | 1024 | 94319770 |
| Code Offset | 4 | 181000 | FFFFFFFFFF F C925C | chip | 1576960 | -224676 |

Table 6.75: Test Mode 4 – Message ID 49

Note:

Payload Length: 28 bytes

| Name | Description |
|---|---|
| Message ID | Message ID |
| nChannel | Number of channels reporting |
| Channel | Receiver channel number for a given satellite being searched or tracked |
| Satellite ID | Satellite or Space Vehicle (SV ID number or Pseudo-Random Noise (PRN) number |
| Receiver Time Tag | Count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock |
| Carrier Doppler Rate | Carrier Doppler Rate value from the Costas tracking loop for the satellite ID on channel 0 |
| Carrier Doppler | Frequency from the Costas tracking loop for the satellite ID on channel 0 |
| Carrier Phase | Carrier phase value from the Costas tracking loop for the satellite ID on channel 0 |
| Code Offset | Code offset from the Code tracking loop for the satellite ID on channel 0 |

Table 6.76: Detailed Description of Test Mode 4 Message ID 49

## 6.39 SBAS Parameters - Message ID 50

Outputs SBAS operating parameter information including SBAS PRN, mode, timeout, timeout source, and SBAS health status.

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

Example:

- `A0A2000D` – Start Sequence and Payload Length (13 bytes)
- `327A00120800000000000000000` – Payload
- `00C6B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 0x32 | | | 50 |
| SBAS PRN | 1 U | | 0x7A | | | 122 |
| SBAS Mode | 1 U | | 0x00 | | | 0 |
| DGPS Timeout | 1 U | | 0x12 | sec | | 18 |
| Flag bits | 1 D | | 0x08 | | | 00001000 |
| Spare | 8 U | | 0000000000000000 | | | |

Table 6.77: SBAS Parameters - Message ID 50

| Name | Description |
| --- | --- |
| Message ID | Message ID number |
| SBAS PRN | This is the PRN code of the SBAS either selected by the user, the default PRN, or that currently in use<br>0 = Auto mod<br>SBAS PRN 120 to 138 = Exclusive (set by user) |
| SBAS Mode | 0 = Testing, 1 = Integrity<br>Integrity mode does not accept SBAS corrections if the SBAS satellite is transmitting in a test mode<br>Testing mode accepts and use SBAS corrections even if the SBAS satellite is transmitting in a test mode |
| DGPS Timeout | Range 0 to 255 seconds. 0 returns to default timeout. 1 to 255 is value set by user.<br>The default value is initially 18 seconds. However, the SBAS data messages may specify a different value.<br>The last received corrections continue to be applied to the navigation solution for the timeout period. If the timeout period is exceeded before a new correction is received, no corrections are applied. |
| Flag bits | Bit 0: Timeout; 0 = Default 1 = User<br>Bit 1: Health; 0 = SBAS is healthy, 1 = SBAS reported unhealthy and cannot be used<br>Bit 2: Correction; 0 = Corrections are being received and used , 1 = Corrections are not being used because: the SBAS is unhealthy, they have not yet been received, or SBAS is currently disabled in the receiver<br>Bit 3: SBAS PRN; 0 = Default , 1 = User<br>**Note:**<br>Bits 1 and 2 are only implemented in GSW3 and GSWLT3, versions 3.3 and later |
| Spare | These bytes are currently unused and should be ignored |

**Table 6.78: Detailed Description of SBAS Parameters**

## 6.40 Tracker Load Status Report - Message ID 51, Sub ID 6

This is message is sent by the SLC asynchronously whenever a tracker load starts or completes.

| | |
|---|---|
| Message Name | Tracker Code Load Status |
| Input or Output | Output |
| MID (Hex) | 0x33 |
| MID (Dec) | 51 |
| SID (Hex) | 0x06 |
| SID (Dec) | 6 |
| SID Name in Code | GPS_TRACKER_LOADER_STATE |

**Table 6.79: Tracker Load Status Report - Message ID 51, Sub ID 6**

The Tracker Code Load Status message reports the tracker code loading progress, often at the start of the process and at the end of the process.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | 1 | | 0x33 | | | 51 | Message ID |
| Message Sub ID | 1 | | 0x06 | | | 6 | Message Sub ID |
| Load State | 4 | | 0x000000 06 | | | 6 | 0 = Start loading 6 = Load completed |
| Reserved | 4 | | | | | | Reserved for future use |
| Load Error | 4 | | 0x000000 00 | | | 0 | 0 = Success Non-Zero = Fail |
| Time Tag | 4 | msec | 0x1DF1E 81B | | msec | 50239285 9 | System time (ms) at the time of message generation. |

**Table 6.80: Tracker Load Status Report Message**

## 6.41 1 PPS Time – Message ID 52

Output time associated with current 1 PPS pulse. Each message is output within a few hundred ms after the 1 PPS pulse is output and tells the time of the pulse that just occurred. The Message ID 52 reports the UTC time of the 1 PPS pulse when it has a current status message from the satellites. If it does not have a valid status message, it reports time in GPS time, and so indicates by means of the status field.

This message may not be supported by all SiRF Evaluation receivers

Output Rate: 1 Hz (Synchronized to PPS)

Example:

`A0A20013` – Start Sequence and Payload Length (19 bytes)

`3415122A0E0A07D3000D000000050700000000` – Payload

`0190B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 34 | | | 52 |
| Hour | 1 U | | 15 | | | 21 |
| Minute | 1 U | | 12 | | | 18 |
| Second | 1 U | | 2A | | | 42 |
| Day | 1 U | | 0E | | | 15 |
| Month | 1 U | | 0A | | | 10 |
| Year | 2 U | | 07D3 | | | 2003 |
| UTCOffsetInt(1) | 2 S | | 000D | | | 13 |
| UTCOffsetFrac(1) | 4 U | $10^9$ | 00000005 | sec | $10^9$ | 0.000000005 |
| Status (see Table 6.82) | 1 D | | 7 | | | 7 |
| Reserved | 4 U | | 00000000 | | | 00000000 |

Table 6.81: 1 PPS Time – Message ID 52

(1) Difference between UTC and GPS time, integer, and fractional parts. GPS time = UTC time + UTCOffsetInt+UTCOffsetFrac x $10^{-9}$.



| Bit Fields | Meaning |
|---|---|
| 0 | When set, bit indicates that time is valid |
| 1 | When set, bit indicates that UTC time is reported in this message. Otherwise, GPS time. |
| 2 | When set, bit indicates that UTC to GPS time information is current, (i.e., IONO/UTC time is less than 2 weeks old). |
| 3-7 | Reserved |

Table 6.82: Status Byte Field in Timing Message

## 6.42 Test Mode 4 Track Data – Message ID 55

Message ID 55 is used by GSW3, GSWLT3, and SiRFLoc (v3.0 and above) software.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 37 | | | 55 |
| SV ID | 2 U | | 0001 | | | 1 |
| Acqclk Lsq | 4 U | | 12345678 | | | 12345678 |
| Code Phase | 4 U | $2^{-11}$ | 0000 | Chips | | 0 |
| Carrier Phase | 4 S | $2^{-32}$ | 0000 | Cycles | | 0 |
| Carrier Frequency | 4 S | 0.000476 | 0000 | Hz | 0.000476 | 0 |
| Carrier Acceleration | 2 S | 0.476 | 0000 | Hz/sec | 0.476 | 0 |
| Code Corrections | 4 S | | 0000 | | | 0 |
| Code Offset | 4 S | $2^{-11}$ | 0000 | Chips | $2^{-11}$ | 0 |
| MSec Number(1) | 2 S | ms | 0006 | ms | 0.001 | 0.006 |
| Bit Number(1) | 4 S | 20 ms | 01C6 | 20 ms | 0.02 | 9.08 |
| Reserved | 4 U | | 0000 | | | |
| Reserved | 4 U | | 0000 | | | |
| Reserved | 4 U | | 0000 | | | |
| Reserved | 4 U | | 0000 | | | |

**Table 6.83: Test Mode 4 – Message ID 55**

(1) SiRFLocDemo combines MSec Number and Bit Number for this message output which gives the GPS time stamp.

**Note:**

Payload Length: 51 bytes

## 6.43 Extended Ephemeris Data/SGEE Download Output - Message ID 56

Message ID 56 is comprised of a number of Sub IDs, as Table 6.84 shows.

| Sub-Message ID | Message Name |
|---|---|
| 0x01 (Decimal 1) | GPS Data and Ephemeris Mask |
| 0x02 (Decimal 2) | Extended Ephemeris Integrity |
| 0x03 (Decimal 3) | Extended Ephemeris Integrity |
| 0x04 (Decimal 4) | EE Provide Synthesized Ephemeris Clock Bias Adjustment |
| 0x05 (Decimal 5) | Verified 50 bps Broadcast Ephemeris and Iono Data |
| 0xFF (Decimal 255) | Extended Ephemeris ACK |
| 0x20 (Decimal 32) | ECLM Ack/Nack |
| 0x21 (Decimal 33) | ECLM EE Age |
| 0x22 (Decimal 34) | ECLM SGEE Age |
| 0x23 (Decimal 35) | ECLM Download Initiate Request |
| 0x24 (Decimal 36) | ECLM Erase Storage File |
| 0x25 (Decimal 37) | ECLM Update File Content |
| 0x26 (Decimal 38) | ECLM Request File Content |
| 0x27 (Decimal 39) | ECLM Store EE Header Contents |
| 0x28 (Decimal 40) | Fetch EE Header Request |
| 0x29 (Decimal 41) | SIF Aiding Status |

Table 6.84: Message ID 56 Sub IDs

These are split into:

- **Extended Ephemeris Data**: These functions are used by GSW2 (2.5 or above), SiRFXTrac (2.3 or above), and GSW3 (3.2.0 or above), and GSWLT3 software.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 38 | | | 56 |
| Message Sub ID | 1 U | | 01 | | | 1 |

Table 6.85: Extended Ephemeris: Message ID 56

Note:

Payload length: variable (2 bytes + Sub ID payload bytes)

- **SGEE Download Data**: These functions are needed to respond to messages requesting download of the SGEE data into the SLC Flash and to get the SGEE and EE age from the SLC.

  These SGEE file download input messages used Message ID 232 (MID_EE_INPUT) and the output responses here have Message ID 56. While the core OSP 56 messages used the literal of SSB_EE for the Message ID 56, the SGEE downloader software is using the literal MID_EEGPSTimeInfo.

  Table 6.86 shows the Message IDs assigned to the output messages.

| | |
|---|---|
| MID (Hex) | 0x38 |
| MID (Dec) | 56 |
| Message Name in Code | SSB_EE (MID_EEGPSTimeInfo) |
| SID (Hex) | See Table 6.84 |
| SID (Dec) | See Table 6.84 |
| SID Name in Code | See Table 6.84 |

Table 6.86: SGEE Download Output: Message ID 56

### 6.43.1 GPS Data and Ephemeris Mask - Message ID 56, Sub ID 1

Output Rate: Six seconds until extended ephemeris is received

Example:

- A0A2000D – Start Sequence and Payload Length (13 bytes)
- 380101091E00000E7402000001 – Payload (Message ID, Message Sub ID, time valid; GPS week = 2334; GPS TOW = 37000 seconds; request flag for satellite 30 and 1)
- 00E6B0B3 – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 0x38 | | | 56 |
| Message Sub ID | 1 U | | 0x01 | | | 1 |
| GPS_TIME_VALID_FLAG | 1 U | | 0x01 | | | 1 |
| GPS Week | 2 U | 1 | 0x091E | | | 2334 |
| GPS TOW | 4 U | 10 | 0x00000E74 | sec | | 3700 |
| EPH_REQ_MASK | 4 D | | 0x02000001 | | | SVs 30 and 1 |

Table 6.87: GPS Data and Ephemeris Mask - Message ID 56, Sub ID 1

| Name | Description |
|---|---|
| Message ID | Message ID number |
| Message Sub ID | Message Sub ID number |
| GPS_TIME_VALID_FLAG | LSB bit 0 = 1, GPS week is valid<br>LSB bit 0 = 0, GPS week is not valid<br>LSB bit 1 = 1, GPS TOW is valid<br>LSB bit 1 = 0, GPS TOW is not valid |
| GPS Week | Extended week number. Range from 0 to no limit |
| GPS TOW | GPS Time of Week. Multiply by 10 to get the time in seconds. Range 0 to 604800 seconds. |
| EPH_REQ_MASK | Mask to indicate the satellites for which new ephemeris is needed MSB is used for satellite 32, and LSB is for satellite 1 |

Table 6.88: Detailed Description of GPS Data and Ephemeris Mask Parameters

Note:

GSD4e does not provide this message, as only embedded SiRFInstantFix is provided by GSD4e.

### 6.43.2 Extended Ephemeris Integrity - Message ID 56, Sub ID 2

Output Rate: Upon host's request

Example:

- A0A2000E – Start Sequence and Payload Length (14 bytes)
- 3802000000400000004000000040 – Payload (Message ID, Message Sub ID, invalid position and clocks for SVID 7, and unhealthy bit for SVID 7)
- 00FAB0B3 – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | | 0x38 | | | 56 |
| Message Sub ID | 1 U | | 0x02 | | | 2 |
| SAT_POS_VALIDITY_FLAG | 4 D | | 0x00000040 | | | flag = 1, SV = 7 |
| SAT_CLK_VALIDITY_FLAG | 4 D | | 0x00000040 | | | flag = 1, SV = 7 |
| SAT_HEALTH_FLAG | 4 D | | 0x00000040 | | | flag = 1, SV = 7 |

Table 6.89: Extended Ephemeris Integrity - Message ID 56, Sub ID 2

| Name | Description |
|---|---|
| Message ID | Message ID number |
| Message Sub ID | Message Sub ID number |
| SAT_POS_VALIDITY_FLAG | 1 = invalid position found, 0 = valid position<br>SVID 1 validity flag is in LSB and subsequent bits have validity flags for SVIDs in increasing order up to SVID 32 whose validity flag are in MSB |
| SAT_CLK_VALIDITY_FLAG | 1 = invalid clock found, 0 = valid clock<br>SVID 1 validity flag is in LSB and subsequent bits have validity flags for SVIDs in increasing order up to SVID 32 whose validity flag are in MSB |
| SAT_HEALTH_FLAG | 1 = unhealthy satellite, 0 = healthy satellite<br>SVID 1 health flag is in the LSB and subsequent bits have health flags for SVIDs in increasing order up to SVID 32 whose validity flag are in MSB |

Table 6.90: Detailed Description of Extended Ephemeris Integrity Parameters

Note:

GSD4e does not provide this message, as only embedded SiRFInstantFix is provided by GSD4e.

### 6.43.3 Ephemeris Status Response - Message ID 56, Sub ID 3

This is the ephemeris status response message. It is output in response to Poll Ephemeris Status message Message ID 232, Sub ID 2.

| Name | Bytes | Description |
|---|---|---|
| Mesage ID | 1 | Hex 0x38, Decimal 56 |
| Message Sub ID | 1 | Message Sub ID 3 |
| The following data are repeated 12 times: | | |
| SVID | 1 | Satellite PRN, range 0-32 |
| Source | 1 | Source of this ephemeris(1) |
| Week | 2 | Week number for ephemeris |
| Time of ephemeris | 2 | toe: effective time of week for ephemeris (seconds / 16, range 0 to 37800) |
| Integrity | 1 | Not used |
| Age | 1 | Age of ephemeris (days).<br>Bit 0 to 3 contain the age of the ephemeris.<br>Bit 4 and bit 5 are bit-mapped to indicate the source of ephemeris.<br>▪ When bit 4 is set, the source is server-generated.<br>▪ When bit 5 is set, the source is client-generated. |

**Table 6.91: Extended Ephemeris Integrity - Message ID 56, Sub ID 3**

(1) Source for ephemeris: 0 = none; 1 = from network aiding; 2 = from SV; 3 = from extended ephemeris aiding

Note:

Payload length: 98 bytes

The Poll Ephemeris Status input message includes a satellite ID mask that specifies the satellite PRN codes to output. This message reports on the ephemeris of the requested satellites, up to a maximum of 12. If more than 12 PRN codes are requested, this message reports on the 12 with the lowest PRN codes. If the receiver does not have data for a requested PRN, the corresponding fields are set to 0. If fewer than 12 satellites are requested, the unused fields in the message are set to 0.

## 6.43.4 EE Provide Synthesized Ephemeris Clock Bias Adjustment - Message ID 56, Sub ID 4

Output Rate: Variable

Example:

- `A0A20056` – Start Sequence and Payload Length (84 bytes)
- `3804 0170801E000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000`

  (Payload, Message ID, Sub ID, SV_ID, SE_TOE and Clock_Bias_Adjust for 12 satellites).
- `3992B0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) |
|---|---|---|---|---|---|
| | | Scale | Example | | Scale |
| Message ID | 1 | | 0x38 | | Decimal 56 |
| Message Sub ID | 1 | | 0x04 | | Message Sub_ID for the Ephemeris Extension Message |
| The following 3 fields are repeated 12 times | | | | | |
| SV_ID | 1 | 1 | | Dimensionless | SV_ID = 0 means fields SE_TOE and Clock_Bias_Adjust are invalid |
| SE_TOE | 2 | 2^4 | | Seconds | The TOE of the synthesized Ephemeris for which the clock bias adjustment is being reported |
| Clock_Bias_Adjust | 4 | 2^-31 | | Second | Clock bias adjustment (for aff) |

Table 6.92: EE Provide Synthesized Ephemeris Clock Bias Adjustment - Message ID 56, Sub ID 4

Note:

GSD4e does not provide this message, as only embedded SiRFInstantFix is provided by GSD4e.

## 6.43.5 Verified 50 bps Broadcast Ephemeris and Iono Data - Message ID 56, Sub ID 5

| | |
|---|---|
| MID (Hex) | 0x38 |
| MID (Dec) | 56 |
| Message Name in Code | SSB_EE |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | SSB_EE_X-CORR_FREE |

**Table 6.93: Verified 50 bps Broadcast Ephemeris and Iono Data - Message ID 56, Sub ID 5**

This message sends verified data containing broadcast ephemeris and iono parameters for Ephemeris Extension. The payload of this message is 42 bytes long, similarly to OSP Message 8, which contains 50 bps data in standard GPS ICD format. The payload here has the following sub-frames:

- Sub-frames 1, 2 and 3 containing broadcast ephemeris data that is verified to be free from cross-correlation and verified to have broadcast ephemeris with good health. These subframes would be sent per SV each time when a new broadcast ephemeris is received and is verified to be free from cross-correlation and in good health.
- Sub-frame 4 containing Klobucher inonspheric model parameters. This would be sent once only.
- Sub-frame 5 will not be present.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | U1 | | |
| Message Sub ID | U1 | | |
| Channel | U1 | | |
| SV ID | U1 | | |
| Word[10] | U4 | | |

**Table 6.94: Verified 50 bps Broadcast Ephemeris and Iono Data Message**

## 6.43.6 SIF Ack / Nack - Message ID 56, Sub ID 32

This is the response message to the Input Message ID 232, Sub IDs 22, 23, 24, 25 or 26.

The following example shows the Ack to Message ID 232, Sub ID 22 ( ECLM Start Download).

Example:

Ack/Nack for ECLM_StartDownload Sub ID = `0x16`

`a0 a2 00 06 38 20 e8 16 00 00 01 56 b0` - Message

`A0A20006` - Start Sequence and Payload Length (6 bytes)

3820E8160000 - Payload

0156B0B3 - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | E.g. | | |
| Message ID | 1U | | 38 | | Decimal 56: SSB_EE (MID_EEGPSTimeInfo) |
| Sub Message ID | 1U | | 20 | | ECLM Ack/Nack |
| Ack Msg Id | 1U | | E8 | | Ack Message ID 232 |
| Ack Sub Id | 1U | | 16 | | Ack Sub ID, ECLM Start Download 0x16 |
| Ack/Nack | 1U | | 00 | | 0 = Ack |
| Ack Nack Reason | 1U | | 00 | | ECLM_SUCCESS = 0, ECLM_SPACE_UNAVILABLE = 1 ECLM_PKT_LEN_INVALID = 2, ECLM_PKT_OUT_OF_SEQ = 3, ECLM_DOWNLOAD_SGEE_NONE WFILE = 4, ECLM_DOWNLOAD_CORRUPTFIL E_ERROR = 5, ECLM_DOWNLOAD_GENERIC_FAI LURE = 6, ECLM_API_GENERIC_FAILURE = 7 |

Table 6.95: ECLM Ack / Nack Message Fields

### 6.43.7 EE Age - Message ID 56, Sub ID 33

This is the response message to the Input Message ECLM Get EE Age with Message ID 232, Sub ID 25.

Example:

For SatID = 2 Message = a0 a2 00 12 38 21 01 02 02 00 00 00 00 00 00 02 00 00 00 00 00 00 00 00 60 b0 b3

A0 A2 00 12 - Start Sequence and Payload Length (18 bytes)

38 21 01 02 02 00 00 00 00 00 00 02 00 00 00 00 00 00 - Payload

`00 60 b0 b3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1U | | `38` | | Decimal 56 |
| Sub Message ID | 1U | | `21` | | Response to ECLM Get EE Age |
| numSAT | U1 | | `01` | | This field indicates the number of times the following sequence of fields are repeated in the message. |
| prnNum | U1 | | `02` | | PRN number of satellite for which age is indicated in other fields. |
| ephPosFlag | U1 | | `02` | | 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 | U2 | | `00 00` | | Age of EE in 0.01 days (Position Age) |

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| cgeePosGPS Week | U2 | | 00 00 | | GPS week of BE used in the CGEE generation; 0 if ephPosFlag is not set to 3 or set to 0.(Position Age) |
| cgeePosTOE | U2 | | 00 00 | | TOE of BE used in the CGEE generation; 0 if ephPosFlag is not set to 3.or set to 0 (Position Age) |
| ephClkFlag | U1 | | 02 | | Ephemeris flag to indicate the type of ephemeris available for the satellite:(Clock Age) |
| eeClkAge | U2 | | 00 00 | | Age of EE in 0.01 days(Clock Age) |
| cgeeClkGPS Week | U2 | | 00 00 | | GPS week of BE used in the CGEE generation; 0 if ephClkFlag is not set to 3 or set to 0.(Clock Age) |
| cgeeClkTOE | U2 | | 00 00 | | TOE of BE used in the CGEE generation; 0 if ephClkFlag is not set to 3.or set to 0(Clock Age) |

Table 6.96: ECLM EE Age Message Fields

### 6.43.8 SGEE Age - Message ID 56, Sub ID 34

This is the response message to the Input Message ECLM Get SGEE Age with Message ID 232, SubMsgID 26 SGEE Age and Prediction Interval has 32-bit length.

Example:

`a0 a2 00 0a 38 22 00 00 80 ea 00 01 51 80 02`
`96 b0 b3` - Message

`A0A2000A` - Start Sequence and Payload Length (10 bytes)

`38 22 00 00 80 ea 00 01 51`
`80` - Payload

`02 96 b0 b3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1U | | 38 | | Decimal 56 |
| Sub Message ID | 1U | | 0x22 | | Response to ECLM Get SGEE Age |
| SGEE Age | 4U | | 00<br>00<br>80<br>ea | | SGEE age for the Requested Satellite |
| Prediction Interval | 4U | | 00<br>01<br>51<br>80 | | Prediction Interval |

Table 6.97: ECLM SGEE Age Message Fields

### 6.43.9 SGEE Download Initiate - Message ID 56, Sub ID 35

This request is sent out if new SGEE file need is observed

Example:

```
0xA0 0xA2 0x00 0x07 0x38 0x23 0x01 0x00
0x00 0x00 0x00 0x00 0x5C 0xB0 0xB3 0xA0
```

`0xA2 0x00 0x07` - Start Sequence and Payload Length (7 bytes)

`0x38 0x23 0x01 0x00 0x00`
`0x00 0x00` - Payload

`0x00 0x5C 0xB0 0xB3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | E.g. | | |
| Message ID | 1U | | 38 | | Decimal 56 |
| Sub Message ID | 1U | | 23 | | Download initiate request |
| Start | 1U | | 1 | | 1-start<br>0-stop |
| Wait Time | 4U | | 0 | Sec | Time in seconds after which downloading should be started |

Table 6.98: ECLM Download Initiate Request Message Fields

## 6.43.10 Host Storage File Erase - Message ID 56, Sub ID 36

Erase Storage file specified by NVMID

Example:

`A0 A2 00 03 38 24 03 00 5F B0 B3 0xA0 0xA2 0x00 0x03` - Start Sequence and Payload Length (3 bytes)

`0x38`
`0x24 0x03` - Payload

`0x00 0x5F 0xB0 0xB3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | E.g. | | |
| Message ID | 1U | | 38 | | Decimal 56 |
| Sub Message ID | 1U | | 24 | | Erase storage file |
| NVMID | 1U | | 03 | | 01: SGEE file<br>02: CGEE file<br>03: BE File |

Table 6.99: ECLM Erase Storage File Message Fields

## 6.43.11 Host Storage File Content Update - Message ID 56, Sub ID 37

This message is sent to request Update file content of EE file stored on host identified by NVMID

The following gives an example for an SGEE content update message.

Example:

Message =

- `A0 A2` - Start Bytes
- `00 13 38 25 03 00 08 00 00 00 b0 00`
  `01 13 00 23 06 E0 67 03 00` - Payload
- `02 9F` - Checksum
- `B0 B3` - End Bytes

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1U | | 38 | | Decimal 56 |
| Sub Message ID | 1U | | 25 | | Request to Store file content |
| NVM ID | 1U | | 03 | | Storage ID (1= SGEE, 2= CGEE, 3 = BE) |
| Size | 2U | | 00 08 | | Size of content |
| Offset | 4U | | 00 00 00 B0 | | Offset of content in given storage file |
| Sequence No | 2U | | 00 01 | | Sequence number of message |
| Data | (size)U | | 13 00 23 06 E0 67 03 00 | | File content |

Table 6.100: ECLM Update file content: Message ID 56, Sub ID 37

Note:

Payload length: (11 + Size) bytes

### 6.43.12 Host Storage File Content Request - Message ID 56, Sub ID 38

Request for specific file content from Host identified by NVMID

Following is example for SGEE message content request.

Example:

```
0xA0 0xA2 0x00 0x0C
     0x38 0x26 0x03 0x00 0x01 0x01 0x00 0xB0
      0x00 0x00 0x00 0x00
0x01 0x13 0xB0 0xB3
```
- Message

`A0A2000C` - Start Sequence and Payload Length ((6 + 2 * Blocks+ 4 * Blocks) bytes)

`01 13 B0 B3` - Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1U | | 38 | | Decimal 56 |
| Sub Message ID | 1U | | 26 | | Request for file content specified by NVM ID |
| NVM ID | 1U | | 03 | | Storage ID (1= SGEE, 2= CGEE, 3 = BE) |
| Sequence No | 2U | | 0001 | | Sequence number of message |
| Blocks | 1U | | 01 | | Number of Blocks to read |
| Size | (2*Blocks)U | | 00B0 | | Size of each block |
| Offset | (4*Blocks)U | | 00000000 | | Offset of each block in given storage file |
| Size and offset fields will repeat for number of Blocks | | | | | |

Table 6.101: ECLM Request File Content Message Fields

### 6.43.13 Store EE Header Contents - Message ID 56, Sub ID 39

This message supports the host-based storage of receiver-collected ephemeris data. It contains the EE header content to store on the host.

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1 U | | 38 | | Decimal 56 |
| Sub ID | 1 U | | 27 | | Decimal 39 |
| Offset | 2 U | | 0x0000 | | Offset from start |
| Size | 2 U | | 0x00C6 | | Number of bytes |
| Data | 1 U * Size | | -- | | Data to Store |

Table 6.102: Store EE Header Contents Message Fields

Note:

This message is only supported in GSD4e v4.0.4 and later in PVT products.

This header is updated more frequently than the EE Aiding data itself which is sent to the host separately via Message ID 56, Sub ID 37. The header contains state-related parameters, such as the availability of SGEE, which satellites are supported with predictions, the clock corrections for different SVIDs, etc.

Data area will vary up to maximum packet length of 600 bytes, although specific builds may limit to fewer.

### 6.43.14 Fetch EE Header Request - Message ID 56, Sub ID 40

This message requests the CP on the host to retrieve the entire EE header information it stores.

The receiver sends this request at start-up if and only if the default selection of EE aiding data storage is set to the Host Storage (via eFuse settings or CCK); in response to this request host sends EE header contents to the receiver using `MID 232 SID 30`.

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1 | | 38 | | Decimal 56 |
| Sub ID | 1 | | 28 | | Decimal 40 |

**Table 6.103: Fetch EE Header Request Message Fields**

**Note:**

This message is only supported in GSD4e v4.0.4 and later in PVT products.

### 6.43.15 SIF Aiding Status - Message ID 56, Sub ID 41

This message is generated in response to a Get Aiding Status message.

Example:

`A0A2000C38290001FFFFFFFF014E12960555B0B3`

`A0 A2 00 0C` - Start Sequence Payload Length

`38 29 00 01 FF FF FF FF 01 4E 12 96` - Payload

`05 55 B0 B3` - Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | e.g. | | |
| Message ID | 1U | | 38 | | Decimal 56 |
| Sub Message ID | 1U | | 29 | | SIF aiding status report<br>Decimal 41 |
| SGEE Status | 1U | | 00 | | 0: Enabled<br>1: Disabled<br>Any other value: Enabled. |
| CGEE Status | 1U | | 01 | | 0: Enabled<br>1: Disabled<br>Any other value: Enabled. |
| CGEE Prediction Disable Time in Seconds | 4U | | FF FF FF FF | Multiples of 16 seconds | `0xFFFFFFFF`: Never stop prediction.<br>`0x00000000`: Prediction stopped immediately.<br>Any other value: GPS Time at which prediction will be stopped. |
| Current Receiver Time in Seconds | 4U | | 01 4E 12 96 | Multiples of 16 seconds | `0x00000000`: Could not get Receiver time.<br>Any other value is the GPS Time of the receiver. |

**Table 6.104: This message is only supported for products with the embedded SIF feature starting from GSD4e release 2.0.**

### 6.43.16 SIF Status Message - MID 56, SID 42

The SIF status message is sent once in every 5 navigation cycles (equivalent to 5 seconds in full power mode) to report the SIF status comprising of SIF State, CGEE Prediction State, Remaining Prediction Time, Type of Aiding, SGEE Downloading in progress, CGEE prediction pending SV,CGEE prediction in progress, SGEE EE Age validity, CGEE Age Validity.

**Important Note:**

This message is supported starting at version 4.1.2.

The SIRF_MSG_SSB_SIF_STATUS message is output every 5th measurement cycle (5 seconds in full power/ continuous).

Note:

The measurement cycle in full power / continuous is 1 Hz.

| | |
|---|---|
| MID (Hex) | 0x38 |
| MID (Dec) | 56 |
| Message Name in Code | SIRF_MSG_SSB_EE |
| SID (Hex) | 0x2A |
| SID (Dec) | 42 |
| SID Name in Code | SIRF_MSG_SSB_SIF_STATUS |

Table 6.105: SIF Status Message - MID 56, SID 42

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | 0x38 | 56 | - | - | - | Message ID |
| SID | U1 | 0x2A | 42 | - | - | - | Sub ID |
| SIFState | U1 | 0x01 | 1 | - | - | 1: enabled<br>0: disabled | Indicates the status of SIF if it is active or not. An output of 1 indicates enabled and 0 indicates disabled. In GSD4e and 4t, it is got from CLM_isStarted(). |
| cgeePredictionState | U1 | 0 | 0 | - | - | 0 : CGEE Prediction Enabled<br>1: Disabled<br>2: Programmed to Stop. | Indicates the prediction state of CGEE. |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| sifAidingType | U1 | 2 | 2 | - | - | 0: SGEE<br>1: CGEE<br>2: Mix | Indicates the aiding state of SIF. It indicates whether both CGEE and SGEE are used for aiding or they are used individually. |
| sgeeDwldInProgress | U1 | 0 | 0 | - | - | 0: Disabled<br>1:Enabled | Indicates if SGEE download is in progress or not. |
| cgeePredictionTimeLeft | U4 | 0 | 0 | Seconds | - | - | This value is reported when CGEE Prediction State is set to Programmed to Stop based on the current GPS time. |
| cgeePredictionPendingMask | U4 | 0 | 0 | - | - | Bit Map:<br>bit 0 – SV1<br>bit1 – SV2<br>bit 2–SV3…… | Indicates which satellite prediction is pending. Each bit indicates one satellite. |
| svidCGEEPredictInProgress | U1 | 0 | 0 | - | - | SV number 0 to 31. | Returns a satellite id for which CGEE prediction is in progress. |
| sgeeAgeValidity | U1 | 0x91 | 145 | Hours or days | - | bit 8:<br>:0 - In Days/<br>:1 – In Hours,<br>bit 7-1: No of Days / in hours.<br>**Note:**<br>Common for all SVs. | Indicates the remaining time until the stored SGEE becomes invalid for the satellites<br>It is either indicated in hours if value is less then 128 and msb is set to 1, otherwise in days with msb = 0. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| cgeeAgeValidity[SIRF_MAX_SVID_CNT] | U32 (array of 32 bytes) | 00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00<br>00 00 | - | Hours or days | - | bit 8:<br>:0 - In Days/<br>:1 – In Hours,<br>bit 7-1: No of Days / in hours.<br>**Note:**<br>Common for all SVs. | Indicates the remaining time until the stored SGEE becomes invalid for the satellites.<br>It indicates how far a satellite is from the 3 days(3*24*60*60 seconds) validity. |

Table 6.106: Message Field Description



| Bit Field | Description |
|---|---|
| cgeePredictionPendingMask | Bit Map : bit 0 – SV1 bit1 – SV2 bit 2– SV3…… |
| sgeeAgeValidity | bit 8 :<br>:0 - In Days/<br>:1 – In Hours,<br>bit 7-1:<br>No of Days / in hours. |
| cgeeAgeValidity[SIRF_MAX_SVID_CNT] | Each index represent the CGEE Age Validitiy.<br>As described in Table, each array index is a bit map bit 8:<br>: 0 - In Days/<br>: 1 – In Hours,<br>bit 7-1: |

Table 6.107: Bit Field Description

### 6.43.17 Extended Ephemeris ACK - Message ID 56, Sub ID 255

Output Rate: Variable.

This message is returned when input Message ID 232 Message Sub ID 255 is received. See Section 5 for more details on Message ID 232.

Example:

- `A0A20004` – Start Sequence and Payload Length (4 bytes)
- `E8FFE8FF` – Payload (ACK for Message 232 Message Sub ID 255)
- `03CEB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Bytes | Example | | Scale | Example |
| Message ID | 1 U | | E8 | | | 232 |
| Message Sub ID | 1 U | | FF | | | 255 |
| ACK ID | 1 U | | E8 | | | 232 |
| ACK Sub ID | 1 U | | FF | | | 255 |

Table 6.108: Extended Ephemeris ACK - Message ID 56, Sub ID 255

| Name | Description |
|---|---|
| Message ID | Message ID number |
| Message Sub ID | Message Sub ID number |
| ACK ID | Message ID of the message to ACK |
| ACK Sub ID | Message Sub ID of the message to ACK |

Table 6.109: Detailed Description of Extended Ephemeris ACK Parameters

## 6.44 Test Mode Output - MID 63, SID 7

SSB MID 63 (0x3f), sub ID 7 has been defined to output suspected CW spurs.

This message contains information on four CW spurs, C/N0 estimate and frequency. This message will be output under two circumstances:

1. Four CW spurs have been detected. This would completely fill one MID 63. Then, MID 63 is output with the test status set to test in progress.
2. When Test Mode 7 has completed. Then, MID 63 is output with the test status indicating test completed. Any remaining CW spurs not yet output will also be included in this message.

Example:

- `A0A2001B` – Start Sequence and Payload Length (27 bytes)
- `3F07 01 5DF52B05 012C 5DF52D95 0125 00000000 0000 00000000 0000` (Payload, message id, sub-id, test_status, spur1_frequency, . . .).
- `0430B0B3` – Message Checksum and End Sequence

| Value | Macro |
|---|---|
| 63 (0x3f, 0x07) | SIRF_MSG_SSB_TEST_MODE_DATA_7 |

Table 6.110: Test Mode Output - MID 63, SID 7

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| test_status | 1 U | 1 | 01 | - | - | 1 |
| spur1_frequency | 4 U | 1 | 5DF52B05 | Hz | - | 1576348421 |
| spur1_sig_to_noise | 2 U | 0.1 | 012C | dB.Hz | - | 30.0 |
| spur2_frequency | 4 U | 1 | 5DF52D95 | Hz | - | 1576349077 |
| spur2_sig_to_noise | 2 U | 0.1 | 0125 | dB.Hz | - | 29.3 |
| spur3_frequency | 4 U | 1 | 00000000 | Hz | - | 0 |
| spur3_sig_to_noise | 2 U | 0.1 | 0000 | dB.Hz | - | 0 |
| spur4_frequency | 4 U | 1 | 00000000 | Hz | - | 0 |
| spur4_sig_to_noise | 2 U | 0.1 | 0000 | dB.Hz | - | 0 |

Table 6.111: Message Structure

| Name | Description |
|---|---|
| test_status | Test Status. See below for details |
| spur1_frequency | Frequency of detected spur. 0 if not detected. See below for details. |
| spur1_sig_to_noise | Signal to noise of detected spur. 0 if not detected |

| Name | Description |
|---|---|
| spur2_frequency | Frequency of detected spur. 0 if not detected |
| spur2_sig_to_noise | Signal to noise of detected spur. 0 if not detected |
| spur3_frequency | Frequency of detected spur. 0 if not detected. |
| spur3_sig_to_noise | Signal to noise of detected spur. 0 if not detected. |
| spur4_frequency | Frequency of detected spur. 0 if not detected. |
| spur4_sig_to_noise | Signal to noise of detected spur. 0 if not detected. |

Table 6.112: Detailed Description

### 6.44.1 Test Mode Output - MID 63, SID 8

TM8 performs a CW scan similar to TM7. In addition, TM8 locates the CW input and uses the stability of the CW clock source to measure the TCXO jitter. It also measures the precise frequency and the perceived C/No of the CW tone.

| | |
|---|---|
| MID (Hex) | 0x3f |
| MID (Dec) | 63 |
| Message Name in Code | `SIRF_MSG_SSB_TEST_MODE_DATA_8` |
| SID (Hex) | 0x08 |
| SID (Dec) | 8 |
| SID Name in Code | 8 |

Table 6.113: Test Mode Output - MID 63, SID 8

| Value | Macro |
|---|---|
| 63 (0x3f, 0x08) | `SIRF_MSG_SSB_TEST_MODE_DATA_8` |

Note:

SiRFstarIV release 4.1.0 and later.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| spurDoppler | 4 | - | 5DE70060 | Hz | - | 1575420000 |
| spurCN0 | 2U | - | 1388 | .01dBHz | - | 50.00 |
| jitter | 2U | - | C8 | .01deg/ sqrt Hz | - | 2.00 |
| RTC Frequency | 2U | - | 8000 | Hz | - | 32768 |
| ECLK Ratio | 2U | - | 0 | - | 3*Value/ 65535 | 0 (no ECLK input) |
| Timer Synch input (bit7) AGC (bit 0-6) | 1D | - | 0F | Timer Synch = True/ False AGC = ~1.4dB per step | - | TS 0 = no activity and 15 for AGC |

Table 6.114: Message Field Description

| Structure Member | Data Type | Data Range (after de-scaling) | Scale Factor | Units | Description |
|---|---|---|---|---|---|
| spur doppler | INT32 | -2,147,483,648 to 2,147,483,647 | 1 | Hz | Frequency of detected spur |
| spur C/N0 | UINT16 | 0 ... 6553.5 | 0.01 | dBHz | Carrier to noise of detected spur |
| jitter | UINT16 | 0 ... 6553.5 | 0.01 | deg/sqrt(Hz) | TCXO Phase Jitter |
| rtcFrequency | UINT16 | 0 ... 6553.5 | 1 | Hz | RTC oscillator frequency |
| etoAcqRatio | UINT16 | 0 ... 6553.5 | 1 | - | ECLK to ACQ Clock ratio |
| tSyncAGCGain | UINT8 | 0 to 255 | 1 | TS = TRUE/ FALSE, AGC = ~1.4dB per Unit | Tsync and AGC Gain value |

Table 6.115: Structure Member Description

## 6.44.2 Test Mode Output - MID 63, SID 9

These messages are generated as output each time Test Mode 9 is requested by sending MID 150. For each request MID 150, 128KB IQ sample buffer content is output in a sequence of 63, 9 messages.

**Important Note:**

This message is supported starting at version 4.1.2. but only in special GSD4t custom builds.

| Field | Length (bytes) | Example | Description |
|---|---|---|---|
| Reserved | 1 | 0 | Reserved byte. Currently hard coded to 0, later it could be used to indicate which insamp buffer 0, 1 or 2. |
| Packet Sequence Number of Current IQ Buffer | 1 | 0xAF | One IQ buffer consists of 256 packets or MEI messages, which is the sequence number of current packet.<br>Range: 0 to 255 |
| IQ Samples | 512 | 0x89, 0xAB, 0xCD, 0xEF,... | IQ samples in 2-bit format. |

**Table 6.116: Message Field Description**

## 6.44.3 Test_status

| Value | Description |
|---|---|
| 0 | Test in progress |
| 1 | Test complete |

**Table 6.117: Test Status**

## 6.44.4 Spur Frequency

The spur frequency will be the full frequency value. For example, if a CW is detected 100 kHz below L1, the spur frequency will be reported as (1575.42 MHz – 100 kHz) = 1,575,320,000 Hz.

## 6.45 Navigation Library Messages - Mesage ID 64

### 6.45.1 Navigation Library (NL) Auxiliary Initialization Data - Message ID 64, Sub ID 1

| | |
|---|---|
| MID (Hex) | 40 |
| MID (Dec) | 64 |
| Message Name in Code | MID_NL_AuxData |
| SID (Hex) | 01 |
| SID (Dec) | 1 |
| SID Name in Code | NL_AUX_INIT_DATA |

Table 6.118: Navigation Library (NL) Auxiliary Initialization Data - Message ID 64, Sub ID 1

| Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|
| | Scale | Example | | Scale | Example | |
| 1 U | | 40 | | | 64 | Message ID |
| 1 U | | 01 | | | 1 | Sub ID |
| 4 U | | 0000015 5 | µsec | | 341 | Uncertainty of the initial software time estimate. |
| 2 U | | 0619 | | | 1561 | Whole week number of recorded position if initializing from saved position, or zero otherwise. |
| 4 U | | 000067AA | sec | | 26538 | Time of week of recorded position if initializing from saved position, or zero otherwise. |
| 2 U | | 0001 | 100m | | 1 | Horizontal Position Uncertainty, 2dRMS, of the recorded position if initializing from saved position, or zero otherwise. |
| 2 U | | 0004 | m | | 4 | Altitude uncertainty, 1σ, of the recorded position if initializing from saved position, or zero otherwise. |

| Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|
| | Scale | Example | | Scale | Example | |
| 1 U | | 30 | | | 48 | Software version of the Tracker. |
| 1 U | | 16 | | | 22 | ICD version |
| 2 U | | 0038 | | | 56 | HW ID |
| 4 U | | | 00F9C57C | Hz | 16369020 | Default clock rate of the Tracker's internal clock. |
| 4 U | | | 00017FCE | Hz | 98254 | Default frequency offset of the Tracker's internal clock. |
| 4 U | | 0000000 6 | | | 6 | Tracker System Status, see bit field definition. |
| 4 U | | 0 | | | 0 | Reserved |

Table 6.119: Navigation Library (NL) Auxiliary Initialization Data Message

| Bit Number | Field | Description |
|---|---|---|
| [0] | Status | 0=Good<br>1=Bad |
| [1] | Cache | 0=Disabled<br>1=Enabled |
| [2] | RTC Status | 0=Invalid<br>1=Valid |
| [3-31] | Reserved | Reserved |

Table 6.120: Navigation Library (NL) Auxiliary Initialization Data Bit Fields

## 6.45.2 Navigation Library (NL) Auxiliary Measurement Data - Message ID 64, Sub ID 2

| | |
|---|---|
| MID (Hex) | 40 |
| MID (Dec) | 64 |
| Message Name in Code | MID_NL_AuxData |
| SID (Hex) | 02 |
| SID (Dec) | 2 |
| SID Name in Code | NL_AUX_MEAS_DATA |

**Table 6.121: Navigation Library (NL) Auxiliary Measurement Data - Message ID 64, Sub ID 2**

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | 1 U | | 40 | | | 64 | Message ID |
| Sub ID | 1 U | | 02 | | | 2 | Sub ID |
| SV ID | 1 U | | 0E | | | 14 | Satellite PRN number |
| Status | 1 U | | 06 | | | 6 | General Tracker Status, see bit field definition. |
| Extended Status | 1 U | | 02 | | | 2 | Tracker Channel Status, see bit field definition. |
| Bit Sync Quality | 1 U | | FF | | | 255 | Confidence metric for bit sync. |
| Time Tag | 4 U | | DAC9762E | acqc lk | | 3670636078 | Measurement time tag. |
| Code Phase | 4 U | | 64BB16B9 | $2^{-11}$ chips | | 1689982649 | Code Phase |
| Carrier Phase | 4 S | | 230D018A | L1 cycles | | 588054922 | Carrier Phase |
| Carrier Frequency | 4 S | | 0C800F43 | 0.000476 Hz | | 209719107 | Carrier Frequency |

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| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Carrier Acceleration | 2 S | | 00000.1 | m/s/s | | 0 | Carrier Acceleration (Doppler Rate) |
| Millisecond number | 2 U | | 0008 | | | 8 | Millisecond number, range 0 to 19. |
| Bit number | 4 U | | 0186B15E | | | 25604446 | Bit number, range 0 to 30239999. |
| Code corrections | 4 S | | 0000002E | 1 cycle | | 46 | For code smoothing |
| Smoothed code | 4 S | | FFFFF769 | $2^{-10}$ cycles | | -2199 | For PR smoothing |
| Code offset | 4 S | | 00001900 | $2^{-11}$ chips | | 6400 | Code offset |
| Pseudorange Noise (Code Variance if soft tracking) | 2 S | | 002E | | | 46 | Pseudorange noise estimate (one sigma). Normalized and left-shifted 16 bits. |
| Delta Range Quality (AFC Variance if soft tracking) | 2 S | | 0077 | | | 119 | Delta Range accuracy estimate (one sigma). Normalized and left-shifted 16 bits. |
| Phase Lock Quality (N/A if soft tracking) | 2 S | | FFDA | | | -38 | Phase Lock accuracy estimate. Normalized and left-shifted 8 bits. |
| Milliseconds uncertainty | 2 S | | 0000 | | | 0 | Not implemented |
| Sum Abs I | 2 U | | DD8A | | | 56714 | Sum \|I\| for this measurement |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Sum Abs Q | 2 U | | 0532 | | | 1330 | Sum \|Q\| for this measurement |
| SV Bit Number | 4 S | | 0186B130 | | | 25604400 | Bit number of last SV bit available. |
| Mpath LOS Det Value | 2 S | | 0002 | | | 2 | Multipath line-of-sight detection value |
| Mpath Only Det Value | 2 S | | FFFF | | | -1 | Multipath-only line-of-sight detection value |
| Recovery Status | 1 U | | 00 | | | 0 | Tracker Recovery Status, see bit field definition. |
| SW Time Uncertainty | 4 U | | 00000065 | usec | | 101 | SW Time Uncertainty |

Table 6.122: Navigation Library (NL) Auxiliary Measurement Data Message

| Bit Field | Description |
|---|---|
| [0] | 1 = Trickle Power Active |
| [1] | 1 = Scalable Tracking Loop (STL) Active 0 = HW Tracking Loop (HWTL) Active |
| [2] | 1 = SCL_MEAS Active |

Table 6.123: Navigation Library (NL) Auxiliary Measurement Data Status Bit Fields

| Bit Field | Description |
|---|---|
| [0] | Not use |
| [1] | 1 = Subframe sync verified |
| [2] | 1 = Possible cycle slip |
| [3] | 1 = Subframe sync lost |
| [4] | 1 = Multipath detected |
| [5] | 1 = Multipath-only detected |
| [6] | 1 = Weak frame sync done |
| [7] | Not used |

Table 6.124: Navigation Library (NL) Auxiliary Measurement Data Extended Status Bit Field definitions

| Bit Field | Description |
|---|---|
| [0] | 1 = Weak Bit Sync (WBS) Active |
| [1] | 1 = False Lock (not implemented) |
| [2] | 1 = Bad PrePos, wrong Bit Sync |
| [3] | 1 = Bad PrePos, wrong Frame Sync (not implemented) |
| [4] | 1 = Bad PrePos, other |
| [5] | Not used |
| [6] | Not used |
| [7] | Not used |

Table 6.125: Navigation Library (NL) Auxiliary Measurement Data Recovery Status Bit Fields

### 6.45.3 Navigation Library (NL) Aiding Initialization - Message ID 64, Sub ID 3

| | |
|---|---|
| MID (Hex) | 40 |
| MID (Dec) | 64 |
| Message Name in Code | MID_NL_AuxData |
| SID (Hex) | 03 |
| SID (Dec) | 3 |
| SID Name in Code | NL_AUX_AID_DATA |

Table 6.126: Navigation Library (NL) Aiding Initialization - Message ID 64, Sub ID 3

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | 1 U | | 40 | | | 64 | Message ID |
| Sub ID | 1 U | | 03 | | | 3 | Sub ID |
| Position X | 4 S | | FFD700F9 | m | | -2686727 | User Position X in ECEF |
| Position Y | 4 S | | FFBE5266 | m | | -4304282 | User Position Y in ECEF |
| Position Z | 4 S | | 003AC57A | m | | 3851642 | User Position Z in ECEF |
| Horz Pos Unc | 4 U | | 00007200 | m | | 29184 | Horizontal Position Uncertainty, 2σ |
| Alt Unc | 2 U | | 0064 | m | | 100 | Vertical Position Uncertainty |
| TOW | 4 U | | 05265C00 | msec | | 86400000 | Software Time of Week |

Table 6.127: Navigation Library (NL) Aiding Initialization Message

## 6.46 GPIO State Output - Message ID 65, Sub ID 192

Example:

`A0A2XXXX` – Start Sequence and Payload Length (4 bytes)

`XXXXB0B3` – Message Checksum and End Sequence

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | |
|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example |
| Message ID | 1 U | 1 | 41 | n/a | | 65 |
| Sub ID | 1U | 1 | C0 | | | 192 |
| gpio_state | 2D | | | Bitmap | | |

Table 6.128: Message Structure

| Name | Description |
|---|---|
| Message ID | 65 |
| Sub ID | 192 |
| gpio_state | State of each GPIO, where bit 0 = GPIO 0, bit 1 = GPIO 1, etc. |

Table 6.129: Detailed Description

## 6.47 DOP Values Output - Message ID 66

This message provides all DOP information: GDOP, PDOP, HDOP, VDOP, and TDOP. This message is sent at 1 Hz rate. The DOP values validity is determined by the DOP limit Exceeded flag in the SSB_GEODETIC_NAVIGATION message. A value of 50 is used for any DOP of value 50 or more, and for invalid values.

| | |
|---|---|
| MID (Hex) | 0x42 |
| MID (Dec) | 66 |
| Message Name in Code | SSB_DOP_VALUES |

Table 6.130: DOP Values Output - Message ID 66

| Field | Bytes | Scale | Unit | Data range (after descaling) | Description |
|---|---|---|---|---|---|
| Message ID | 1 | | | | |
| gps_tow | 4 | 0.001 | sec | 0 to 604799.999 | GPS time of the week |
| gdop | 2 | 0.1 | | 0 to 50 | Geometric DOP |
| pdop | 2 | 0.1 | | 0 to 50 | Position DOP |
| hdop | 2 | 0.1 | | 0 to 50 | Horizontal DOP |
| vdop | 2 | 0.1 | | 0 to 50 | Vertical |
| tdop | 2 | 0.1 | | 0 to 50 | Time DOP |

Table 6.131: DOP Value Output Message

## 6.48 Measurement Engine - Message ID 68

| | |
|---|---|
| Message Name | MEAS_ENG_OUTPUT |
| Input or Output | Output |
| MID (Hex) | 0x44 |
| MID (Dec) | 68 |
| Message Name in Code | MID_MEAS_ENG_OUT |
| SID (Hex) | See below |
| SID (Dec) | See below |
| SID Name in Code | See below |

Table 6.132: Measurement Engine - Message ID 68

This message wraps the content of another OSP message and outputs it to SiRFLive. The SID of this message equals to the MID of the message to be wrapped. The wrapped content includes the entire target message, comprising the start sequence, payload length, payload content, checksum and end sequence fields, as well.

| SID | | Description |
|---|---|---|
| Hex Value | Decimal Value | |
| 0x04 | 4 | MID_MeasuredTracker |
| 0xE1 | 225 | MID_SiRFOutput |
| 0xFF | 255 | MID_ASCIIData |

Table 6.133: Measurement Engine Output SIDs

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | | |
| Sub ID | U1 | | 0xFF | | | 255 | The MID of the target message to be wrapped for output. The current value range is: 4, 225, 255. |
| Target Message | Variable | | | | | | This is the entire target message including the message header and trailer. |

Table 6.134: Measurement Engine Message Fields

## 6.49 Position Response - Message ID 69, Sub ID 1

| | |
|---|---|
| MID (Hex) | 0x45 |
| MID (Dec) | 69 |
| Message Name in Code | MID_POS_MEAS_RESP |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | POS_RESP |

Table 6.135: Position Response - Message ID 69, Sub ID 1

| Field | | Length (bits) |
|---|---|---|
| Message ID | | 8 |
| Message Sub ID | | 8 |
| POS_REQ_ID | | 8 |
| POS_RESULTS_FLAG | | 8 |
| POSITION_ERROR_ STATUS | | 8 |
| POS_ACC_MET | | 8 |
| POSITION MAIN SECTION | POS_TYPE | 8 |
| | DGPS_COR | 8 |
| | MEAS_GPS_WEEK | 16 |
| | MEAS_GPS_SECONDS | 32 |
| | MEAS_LAT | 32 |
| | MEAS_LONG | 32 |
| | OTHER SECTIONS | 8 |
| Following sections from Horizontal Error to Position Correction are always present, but their validity depends on the value of OTHER_SECTIONS | | |
| HORIZONTAL ERROR SECTION | ER_EL_ANG | 8 |
| | MAJ_STD_ER | 8 |
| | MIN_STD_ER | 8 |
| | | |
| VERTICAL POSITION SECTION | HEIGHT | 16 |
| | HEIGHT_STD_ER | 8 |
| | | |

| Field | | Length (bits) |
|---|---|---|
| VELOCITY SECTION | HOR_VEL | 16 |
| | HEADING | 16 |
| | VER_VEL | 8 |
| | VEL_ER_EL_ANG | 8 |
| | VEL_MAJ_STD_ER | 8 |
| | VEL_MIN_STD_ER | 8 |
| | VER_VEL_STD_ER | 8 |
| | | |
| CLOCK CORRECTION SECTION | TIME_REF | 8 |
| | CLK_BIAS | 16 |
| | CLK_DRIFT | 16 |
| | CLK_STD_ER | 8 |
| | UTC_OFF | 8 |
| | | |
| POSITION CORRECTION SECTION | NB_SV | 8 |
| | Two following fields are repeated 16 times, only the first “NB_SV” fields are valid. | |
| | SV_PRN | 8 |
| | C_N0 8 bits INV_WEIGHTS | 8 |



**Table 6.136: Position Response Message**

POS_REQ_ID: Position/measurement response identifier

This is the POS_REQ_ID (sent in a request) that the returned position/measurements are associated with.

POSITION_RESULTS_FLAG: Position Results flag

If set to “0x00”, all fields of the position result section from POSITION_ERROR_STATUS to INV_WEIGHTS are invalid and must be set to zero. No position information (even the “no position” information) is delivered. If set to “0x01”, some fields in the position result section are valid.

POSITION_ERROR_STATUS: Position Error Status

If set to 0x00, position information is delivered. POSITION MAIN SECTION is valid, plus other optional fields (see OTHER_SECTIONS field).

If set to any other value, the rest of the position results block is invalid and must be set to all zeros. The non-zero value provides information about the reason of the “no position delivered” information, according to Table 6.137.

| Status | Value |
|---|---|
| Valid Position | 0x00 |
| Not Enough satellites tracked(1) | 0x01 |
| GPS Aiding data missing (not supported) | 0x02 |
| Need more time | 0x03 |
| No fix available after full search | 0x04 |
| Unused | 0x05 |
| Position Reporting Disabled | 0x06 |
| Rejected Position Reporting for QoP | 0x07 |
| Reserved | 0x08-0xff |

Table 6.137: POSITION_ERROR_STATUS Field

(1) This case has been added to be compatible with the reporting capabilities defined in the GSM standard. From the document, there is no clear definition when this error case should be reported.

The following list details each situation:

**Valid Position**: Position is available in the next fields.

**Not Enough Satellites tracked**: SLC is tracking some satellites already, but not enough to compute a position.

**GPS Aiding data missing**: Defined but not available aiding information to compute a position with satisfactory QoP.

**Need more time**: No position was available within the RESP_TIME_MAX requested in the last data message.

**No fix available after full search**: SLC went through all search strategy once and we could not compute a fix (all cases are covered here).

**Position Reporting Disabled**: When the QoP specification in the originating POS_REQ can not be met any longer due to a low power transition request with conflicting QoP specification, POS_RESP messages are not generated while in the conflicting low power mode. This might occur after transitioning to trickle power or push-to-fix low power mode.

**Rejected Position Reporting for QoP**: When the QoP specification in the originating POS_REQ could not be met due to an exisitng low power mode with conflicting QoP specification, the POS_REQ request is rejected and no POS_RESP messages are generated, even after transitioning out of the current low power mode.

**POS_ACC_MET**: Position Accuracy Flag

If set to 1 (0) then horizontal error as well as vertical error in the position are estimated to be respectively less (more) than the maximum requested horizontal error and maximum requested vertical error with a confidence level of 95%.

**POS_TYPE**: Position Type

The SLC shall set this field according to what is shown in Table 98 (x indicates a don’t care bit).

| POS_TYPE field value | Position Type |
|---|---|
| ‘xxxxxx00’ | 2D |
| ‘xxxxxx01’ | 3D |
| ‘xx0xxxxx’ | Not a trickle power solution. |
| ‘xx10xxxx’ | Trickle power solution ( QoP ignored ) |
| ‘x00000xx’ | QoP guaranteed |
| ‘xxxxx1xx’ | Reserved for future use |
| ‘xxxx1xxx’ | Almanac derived coarse solution |
| ‘xx01xxxx’ | Reserved for future use |
| ‘x1xxxxxx’ | Reverse EE candidate |
| All others' | (Reserved) |

Table 6.138: POS_TYPE Field

**Almanac derived coarse solution**: Position was calculated based on one or more of the SVs having their states derived from almanac parameters as opposed to ephemerides.

**Reverse EE candidate**: Reverse EE processing may be used for the data provided, which is populated in the measurement section and in the SV state section.

**DGPS_COR**: DGPS correction type

The SLC shall set this field according to Table 6.139.

| DGPS_COR field Value | Correction Type |
|---|---|
| ‘00’ | No DGPS correction |
| ‘01’ | Local DGPS correction |
| ‘02’ | WAAS correction |
| All others | Other Corrections (Reserved) |

Table 6.139: DGPS_COR Field

**MEAS_GPS_WEEK**: Extended GPS week number

The SLC shall set this field to the extended number of GPS weeks since the beginning of the GPS reference, in binary format, in number of weeks

Note:

For the period from August 21st 1999 23:59.47, UTC time, to around midnight the night between April 7th 2019/ April 8th 2019.

MEAS_GPS_WEEK=GPS_WEEK NUMBER+1024

Where GPS_WEEK NUMBER is the equivalent unsigned binary value of the ten most significant bits of the Z-count found in the GPS satellites broadcast message. The UTC time of the next rollover is specified above only approximately because of the possibility of the introduction of additional leap seconds.

Note:

The leap seconds are defined as the difference between UTC and GPS time, Leap seconds = GPS - UTC. As of 1 January 2012, Leap seconds = 15; on 30 June 2012 an additional leap second will be added so that Leap seconds = 16.

MEAS_GPS_SECONDS: GPS time in the week when the position was computed

The SLC shall set this field to the number of elapsed seconds since the beginning of the current GPS week, in binary format, in units of 1/1000 seconds, in the range from 0s to 604,799.999 seconds.

MEAS_LAT: Measured Latitude

The SLC shall set this field to the two's complement value of the latitude, in units of $180/2^{32}$ degrees, in the range from -90 degrees to $+90x(1-2^{-31})$ degrees, referenced to the WGS84 reference ellipsoid, counting positive angles north of the equator, and negative angles south of the equator.

MEAS_LONG: Measured Longitude

The SLC shall set this field to the two's complement value of the longitude, in units of $360/2^{32}$ degrees, in the range from -180 degrees to $+180x(1-2^{-31})$ degrees, referenced to the WGS84 reference ellipsoid, counting positive angles East of the Greenwich Meridian, and negative angles West of the Greenwich Meridian.

OTHER_SECTIONS: Indicates the validity status of other sections

The SLC shall indicate what sections are valid in the message. All non valid sections are filled with zeros. OTHER_SECTIONS consists of 8 bits; each of the bits represents one section. The mapping of the bits is listed in the following table. If a section is valid, the SLC shall set the corresponding bit to '1'; otherwise, the SLC shall set the corresponding bit to '0'. See Table 6.140 for detailed specification.

| Bits in OTHER_SECTIONS | Value | SECTION |
|---|---|---|
| Bit 0 (LSB) | 1: Valid<br>0: Not Valid | Horizontal Error Section |
| Bit 1 | 1: Valid<br>0: Not Valid | Vertical Position Section |
| Bit 2 | 1: Valid<br>0: Not Valid | Velocity Section |
| Bit 3 | 1: Valid<br>0: Not Valid | Clock Correction Section |
| Bit 4 | 1: Valid<br>0: Not Valid | Position Correction Section |
| Bit 5-7(MSB) | 0 | (Reserved) |

Table 6.140: OTHER_SECTIONS Field

ER_EL_ANG: Error Ellipse Angle

The SLC shall set this field to the binary value of the Error Ellipse major axis angle with respect to True North in WGS84. The units shall be 180/28degrees, with a range from 0 to +180x(1-$2^{-7}$) degrees, where 0 degrees is True North, and the angle is measured rotating toward the East.

MAJ_STD_ER: Major Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation along the axis specified by the ER_EL_ANG field. The GPS shall set this field according to the following table.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Horizontal Error (meters) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^x$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 |

Table 6.141: MAJ_STD_ER Field

MIN_STD_ER: Minor Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation perpendicular to the axis specified by the ER_EL_ANG field according to the following table.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Horizontal Error (meters) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 |

Table 6.142: MIN_STD_ER Field Specification



**HEIGHT**: Height

Units of 0.1 m in the range of –500 m to +6053.5 m with respect to WGS84 reference ellipsoid, in Unsigned Binary Offset coding. The formula to apply is:

HEIGHT(in m)= Bx0.1-500

where B is the unsigned binary value of the "HEIGHT" field from 0 to 65535. "all zeros" represents –500m, "all ones" represents +6053.5m.

**HEIGHT_STD_ER**: Height Standard Deviation Error

The SLC shall set this field to the Vertical Error Standard Deviation as specified in the table below.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Vertical Error (meters) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 |

Table 6.143: HEIGHT_STD_ER Field

**HOR_VEL**: Horizontal Velocity

The SLC shall set this field to the horizontal velocity, in units of 0.0625 meters/second, in the range from 0 to 4095 m/s

**HEADING**: Heading

The SLC shall this field to the velocity heading, in units of 360/216 degrees, in the range from 0 to 360x(1-2-16) degrees. '0' degrees is True North, and the angle increases towards the East.

VER_VEL: Vertical Velocity

The SLC shall set this field to the two's complement value of Vertical Velocity, in units of 0.5m/s in the range from -64m/s to +63.5 m/s.

VEL_ER_EL_ANG: Error Ellipse Angle

The SLC shall set this field to the binary value of the Error Ellipse major axis angle with respect to True North in WGS84. The units shall be 0.75 degrees, with a range from 0 to +180x($1-2^{-7}$) degrees, where 0 degrees is True North, and the angle is measured rotating toward the East.

VEL_MAJ_STD_ER: Major Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation along the axis specified by the ER_EL_ANG field. The SLC shall set this field according to the table below.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Horizontal Velocity Error (meters/second) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 or unknown |

Table 6.144: VEL_MAJ_STD_ER Field

VEL_MIN_STD_ER: Minor Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation perpendicular to the axis specified by the ER_EL_ANG field. The SLC shall set this field according to the following table.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Horizontal Velocity Error (meters/second) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^X$ | $f_{i-1} \leq \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 or unknown |

Table 6.145: VEL_MIN_STD_ER Field

**VER_VEL_STD_ER**: Height Standard Deviation Error

The SLC shall set this field to the Vertical Error Standard Deviation as specified in the table below.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Vertical Velocity Error (meters/second) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^X$ | $f_{i-1} \leq \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 or unknown |

Table 6.146: VER_VEL_STD_ER Field

**TIME_REF**: Time reference in clock computation

The SLC shall set this field to ‘0’ to indicate the tie reference is the local clock. ‘1’ value is reserved.

**CLK_BIAS**: Clock Bias

The SLC shall set this field to the clock bias, in the range from –429.287 seconds to +429.287 seconds with a minimum non-zero value of 100ns. A "floating-point" representation is used where the most significant bit is the sign, the following 5 most significant bits constitute the exponent and the 10 least significant bits constitute the mantissa.

With:

S being "0" or "1"

X being the binary value of the exponent field, (0≤X≤31)

Y being the binary value of the mantissa field, $(0 \le Y \le 1023)$

The CLOCK_BIAS parameter is given in units of 1 second by the formula:

$CLK\_BIAS=(-1)^S . 100 . 10^{-9} (1+Y/1024) . 2^X$ seconds

**CLK_DRIFT**: Clock Drift

The SLC shall set this field to the clock drift in the range of –327.52ppm (or us/s) to +327.52 ppm, with a minimum non-zero value of 0.0025ppm. A “floating-point” representation is used where the most significant bit is the sign, the following 4 most significant represent the exponent, and the 11 least significant bits constitute the mantissa.

With:

S being "0" or "1"

X being the binary value of the exponent field, $(0 \le X \le 15)$

Y being the binary value of the mantissa field, $(0 \le Y \le 2047)$

The CLOCK_BIAS parameter is given in units of 1 part-per-million (or us/s) by the formula:

$CLK\_DRIFT=(-1)^S . 5 . 10^{-3} (1+Y/2048) . 2^X$ ppm

**CLK_STD_ER**: Estimated Time Accuracy.

The SLC shall set this field as defined in Table 6.147.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Estimated Time Accuracy (Microseconds) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | $0.125 < \sigma < 0.1328125$ |
| X | Y | $2 \le I \le 253$ | $0.125 ( 1 + Y/16) \times 2^x$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | $7424 \le \sigma < 7680$ |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 or unknown |

**Table 6.147: CLK_STD_ER Field**

**UTC_OFF**: The offset between GPS time and UTC time in units of seconds.

The SLC shall set this field to the value of the offset between GPS time and UTC time at the time of location computation in units of seconds: range of 0-255 seconds.

**NB_SV**: Number of Satellite Vehicles Currently Tracked

For MS-Based mode, the SLC shall set this field to the number of GPS satellites currently tracked, in the range from 1 to 10, where the binary value of the field conveys the number of satellites.

**SV_PRN**: Satellite PRN number

For MS-Based mode, the SLC shall set this field to the value of the PRN signal number of the SV which is being tracked. It is represented as an unsigned value in the range from 1 to 32, where the binary value of the field conveys the satellite PRN number.

**C_N0**: Satellite C/N0

The SLC shall set this field to the C/N0 value in units of 1 dB-Hz in the range from 0 to 60, in Unsigned binary format.

**INV_WEIGHTS**: Inverse of Weighting Factor in position computation

For MS-Based mode, this field has a dual purpose: -to report whether the satellite is used in the position fix, -if it used in the fix, the value of the inverse weighting factor. If the satellite is not used in the fix, INV_WEIGHTS shall be set to "0". If the satellite is used in the fix, SLC shall set INV_WEIGHTS to the inverse of the weighting factor used for the satellite, in the range from 0.125 to 3968m. A "floating-point" representation is used where the 4 most significant bits constitute the exponent and the 4 least significant bits constitute the mantissa as specified in the table below.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Inverse Weighting Factor (meters) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 0.125 | < 0.125 |
| 0000 | 0001 | 1 | 0.1328125 | 0.125 < σ < 0.1328125 |
| X | Y | 2 ≤ I ≤ 253 | 0.125 ( 1 + Y/16) x $2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 7680 | 7424 ≤ σ < 7680 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 7680 or unknown |

Table 6.148: INV_WEIGHTS Field

## 6.50 Measurement Response - Message ID 69, Sub ID 2

| | |
|---|---|
| MID (Hex) | 0x45 |
| MID (Dec) | 69 |
| Message Name in Code | MID_POS_MEAS_RESP |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | MEAS_RESP |

Table 6.149: Measurement Response - Message ID 69, Sub ID 2

| Field | | Length(bits) |
|---|---|---|
| Message ID | | 8 |
| Message Sub ID | | 8 |
| POS_REQ_ID | | 8 |
| MEASUREMENT SECTION | GPS_MEAS_FLAG | 8 |
| | MEAS_ERROR_STATUS | 8 |
| | MEAS_GPS_WEEK | 16 |
| | MEAS_GPS_SECONDS | 32 |
| | TIME_ACCURACY | 8 |
| | NUM_SVS | 8 |
| | The following fields are repeated a number of times indicated by the value of the NUM_SVS field. | |
| | SV_PRN | 8 |
| | C_N0 | 8 |
| | SV_DOPPLER | 16 |
| | SV_CODE_PHASE_WH | 16 |
| | SV_CODE_PHASE_FR | 16 |
| | MULTIPATH_INDICATOR | 8 |
| | PSEUDORANGE_RMS_ERROR | 8 |

Table 6.150: Measurement Response Message



**POS_REQ_ID**: Position/measurement request identifier

This is the POS_REQ_ID (sent in a request) that the returned position/measurements are associated with.

**GPS_MEAS_FLAG**: GPS Measurement Flag

If set to 0x00, all fields of the GPS measurement section from MEAS_ERROR_STATUS to PSEUDORANGE_RMS_ERROR are invalid and must be set to zero. No GPS measurement information is delivered. If set to 0x01, some fields in the GPS measurement section are valid.

**MEAS_ERROR_STATUS**: GPS Measurement Error Status

If set to 0x00, GPS measurement information is delivered and the MEASUREMENT SECTION is valid. If set to any other value, the MEASUREMENT SECTION is invalid and must be set all zeros. The non zero value provides information about the reason of the “no GPS measurement delivered” information, according to Table 6.151.

| MEAS_ERROR_STATUS | Value Description |
|---|---|
| 0x00 | Valid GPS Measurements |
| 0x01 | No Enough Satellites Tracked |
| 0x02 | GPS Aiding Data Missing |
| 0x03 | Need More Time |
| 0x04 – 0xFE | Reserved |
| 0xFF | Requested Location Method Not Supported |

Table 6.151: MEAS_ERROR_STATUS Field

TIME_ACCURACY: Accuracy of GPS Measurement Time Tag

The SLC shall set this field to the estimated accuracy of GPS measurement time tag according to Table 6.152.

| Exponent X | Mantissa Y | Index value I= Y + 16 X | Floating Point Value $f_i$ | Inverse Weighting Factor (meters) |
|---|---|---|---|---|
| 0000 | 0000 | 0 | 1.0 | < 1.0 |
| 0000 | 0001 | 1 | 1.0625 | 0.125 < σ < 1.0625 |
| X | Y | 2 ≤ I ≤ 253 | $1.0 ( 1 + Y/16) \times 2^X$ | $f_{i-1} \le \sigma < f_i$ |
| 1111 | 1110 | 254 | 61440 | 59392 ≤ σ < 61440 |
| 1111 | 1111 | 255 | Not Applicable | ≥ 61440 |

Table 6.152: TIME_ACCURACY Field

NUM_SVS: Number of Satellite Measurements

The SLC shall set this field to the number of valid GPS measurements included in MEASUREMENT SECTION. It is represented an unsigned value in the range from 1 to 32, where the binary value of the field conveys the number of measurements. The valid value is from 1 to 16.

SV_DOPPLER: Satellite Doppler Measurement

The SLC shall set this field to the two's complement value of the measured Doppler, in units of 0.2 Hz, in the range from –6,553.6 Hz to +6,553.6 Hz.

SV_CODE_PHASE_WH: Satellite Code Phase Measurement – Whole Chips

The SLC shall set this field to the satellite code phase measured as a number of C/A code chips, in units of 1 C/A code chip, in the range from 0 to 1022 chips.

SV_CODE_PHASE_FR: Satellite Code Phase Measurement – Fractional Chips

The SLC shall set this field to the fractional value of the satellite code phase measurement, in units of $2^{-10}$ of C/A code chips, in the range from 0 to $(2^{-10}-1)/ 2^{-10}$ chips.

**MULTIPATH_INDICATOR**: Multipath Indicator

The SLC shall set this field to the value shown in Table 6.153.

| MULTIPATH_INDICATOR Value | Description |
|---|---|
| '00000000' | Not Measured |
| '00000001' | Low, Multipath Error ≤ 5 meters |
| '00000010' | Medium, 5 <Multipath Error ≤ 43 meters |
| '00000011' | High, Multipath Error > 43 meters |
| '00000100' – '11111111' | Reserved |

**Table 6.153: MULTIPATH_INDICATOR Field**

**PSEUDORANGE_RMS_ERROR**: Pseudorange RMS Error

The SLC shall set this field to the pseudorange RMS error, in the range from 0.5m to 112m. A "floating-point" representation is used where the 3 least significant bits (Bit 0, 1, and 2) constitute the mantissa and Bit 3, 4, and 5 constitute the exponent as specified in Table 6.154.

| Exponent X | Mantissa Y | Index value I= Y + 8 X | Floating Point Value $f_i$ | Inverse Weighting Factor (meters) |
|---|---|---|---|---|
| 000 | 000 | 0 | 0.5 | P < 0.5 |
| 000 | 001 | 1 | 0.5625 | 0.5 < P < 0.5625 |
| X | Y | 2 ≤ I ≤ 61 | $0.5 ( 1 + Y/8) \times 2^x$ | $f_{i-1} \leq P < f_i$ |
| 111 | 110 | 62 | 112 | 104 ≤ P < 112 |
| 111 | 111 | 63 | Not Applicable | 112 ≤ P |

**Table 6.154: Pseudorange RMS Error Representation**

## 6.51 Partial Geotag Response - Message ID 69, Sub ID 3

**Note:**

This message is supported in PVT products starting from build 4.1.0.

This message is output only if Reverse EE is enabled and the GPS receiver is unable to compute a valid position fix.

| | |
|---|---|
| MID (Hex) | 0x45 |
| MID (Dec) | 69 |
| Message Name in Code | Partial Position Response |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | MID_PARTPOS_RSP |

Table 6.155: Partial Geotag - Message ID 69, SID 03

Table 6.156 describes the fields (including any bitmaps).

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | 1 | | 0x45 | | | | |
| Sub ID | 1 | | 0x03 | | | | |
| pos_req_id | 1 | | | | | | Same as Message ID 69, 01 |
| pos_results_flag | 1 | | | | | | Same as Message ID 69, 01 |
| pos_err_status | 1 | | | | | | Same as Message ID 69, 01 |
| qos_value | 2 | | | | | | Horizontal Error sent by user in 210 |
| pos_type | 1 | | | | | | Same as Message ID 69, 01 |
| dgps_cor | 1 | | | | | | Same as Message ID 69, 01 |
| gps_week | 2 | | | | | | Same as Message ID 69, 01 |
| Lat | 4 | | | | | | Same as Message ID 69, 01 |
| Lon | 4 | | | | | | Same as Message ID 69, 01 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| vert_pos_height | 2 | | | | | | Same as Message ID 69, 01 |
| velocity_horizontal | 2 | | | | | | Same as Message ID 69, 01 |
| velocity_heading | 2 | | | | | | Same as Message ID 69, 01 |
| velocity_vertical | 1 | | | | | | Same as Message ID 69, 01 |
| meas_time | 8 | | | | | | Same as Message ID 28 |
| num_sv_meas_cnt | 1 | | | | | | |
| The following section repeats for num_sv_meas_cnt | | | | | | | |
| Svid | 1 | | | | | | Same as Message ID 28 |
| pseudorange | 8 | | | | | | Same as Message ID 28 |
| carrier_freq | 4 | | | | | | Same as Message ID 28 |
| sync_flags | 1 | | | | | | Same as Message ID 28 |
| ctoN | 1 | | | | | | |
| state_time | 8 | | | | | | Same as Message ID 30 |
| num_sv_state_cnt | 1 | | | | | | |
| The following section repeats for num_sv_state_cnt | | | | | | | |
| svid | 1 | | | | | | Same as Message ID 30 |
| Pos[0] | 8 | | | | | | Same as Message ID 30 |
| Pos[1] | 8 | | | | | | Same as Message ID 30 |
| Pos[2] | 8 | | | | | | Same as Message ID 30 |
| Vel[0] | 8 | | | | | | Same as Message ID 30 |
| Vel[1] | 8 | | | | | | Same as Message ID 30 |
| Vel[2] | 8 | | | | | | Same as Message ID 30 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| clk_bias | 8 | | | | | | Same as Message ID 30 |
| clk_drift | 4 | | | | | | Same as Message ID 30 |
| pos_var | 4 | | | | | | Same as Message ID 30 |
| clk_var | 4 | | | | | | Same as Message ID 30 |
| iono | 4 | | | | | | Same as Message ID 30 |
| status | 1 | | | | | | 0 - No SV states data<br>1 - SV states computed using the ephemeris<br>2 - SV states computed using the almanac<br>3 - SV states computed using the acquisition assist<br>4 - SV states computed using the current almanac<br>5 - SV states computed from ephemeris extension server<br>6 - SV states computed from ephemeris extension client<br>7 - SV states computed from ephemeris extension client |

Table 6.156: Message Fields Description



## 6.52 Ephemeris Status Response - Message ID 70, Sub ID 1

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | EPH_RESP |

Table 6.157: Ephemeris Status Response - Message ID 70, Sub ID 1

The Ephemeris Status Response message is output in response to Ephemeris Status Request message. There is at least one solicited Ephemeris Status Response output message sent in response to a received Ephemeris Status Request input message. Optionally, several more unsolicited Ephemeris Status Response output messages can follow the solicited response message, while the current session is open.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| GPS_TIME_FLAG | 1 | | |
| EXTD_GPS_WEEK | 2 | | |
| GPS_TOW | 4 | | |
| EPH_STATUS_TYPE | 1 | | |
| GPS_T_TOE_LIMIT | 1 | | |
| NUM_SVS | 1 | | |
| The following structure should repeat a number of times as indicated by the value of the “NUM_SVS” field above. | | | |
| SATID | 1 | | |
| SAT_INFO_FLAG | 1 | | |
| GPS_WEEK | 2 | | |
| GPS_TOE | 2 | | |
| IODE | 1 | | |
| AZIMUTH | 2 | | |
| ELEVATION | 1 | | |

Table 6.158: Ephemeris Status Response Message

**GPS_TIME_FLAG**: Flag for the GPS time section

Bit0 -> isExtdGPSWeekValid {0,1} = {FALSE, TRUE}

Bit1 -> isGPSTOWValid {0,1} = {FALSE, TRUE}

**EXTD_GPS_WEEK**: Extended GPS week number

The SLC shall fill in the current GPS week. This field is only valid if isExtdGPSWeekValid (GPS_TIME_FLAG) is TRUE.

**GPS_TOW**: GPS time of week

The SLC shall fill in the current GPS time of week in the unit of 0.1 seconds. This field is only valid if isGPSTOWValid (GPS_TIME_FLAG) is TRUE.

**EPH_STATUS_TYPE**: The type of ephemeris status report

If set to 1 -> Aiding server shall make the decision on what to send. The SLC does not provide parameters from "GPS T-TOE Limit" to the "SatList" structure. The server can send all available in visible list, or all satellites that the server has.

If set to 3, "Status Report" -> The SLC shall fill parameters from "GPS T-TOE Limit" to the "SatList" structure with the current satellite states in SLC. The SLC may fill each SatList element partially or fully based on the information it has about the satellite:

- SATID=0 implies that the SLC has no ephemeris information about the satellite
- SATID only
- SATID with GPS_WEEK, GPS_TOE, IODE
- SATID with GPS_WEEK, GPS_TOE, IODE, AZIMUTH & ELEVATION
- SATID with AZIMUTH and ELEVATION

The CP or the server shall decide on what aiding to send based on this information.

All other values are invalid.

**GPS_T_TOE_LIMIT**: Tolerance of the TOE age

GPS time of ephemeris time tolerance, in unit of hours. The valid range is from 0 to 10. This parameter is currently set to 2.

**NUM_SVS**: Number of satellites

This is the number of satellites for which ephemeris status parameters are given by this message.

**SATLIST**: A structure that contains satellite ephemeris status information

This is a structure containing the following sub-elements This structure can be repeated up to 32 times. SATID The satellite ID (PRN number) A value of zero means SATID is invalid.

**SAT_INFO_FLAG**: The satellite info flag

If this flag is set to 0, the parameters from GPS_WEEK to ELEVATION are not valid. If bit 0 of this flag is set to 1, the parameters from GPS_WEEK to IODE are valid. If bit 1 of this flag is set to 1, the parameters from AZIMUTH to ELEVATION are valid. Otherwise, the specified parameters are not valid. If bit 2 (SLC_EPH_REQ) is set to 1, the corresponding satellite requires ephemeris aiding as determined by the SLC internal algorithm.

**GPS_WEEK**: The GPS week number

The GPS week of the ephemeris in SLC for SATID. Value={0…1023} For an invalid satellite, this value should be set to 0.

**GPS_TOE**: The GPS time of ephemeris

GPS time of ephemeris in hours of the latest ephemeris set contained by the SLC for satellite SATID. For an invalid satellite, this value should be set to 0.

**IODE**: The issue of data of ephemeris Issue of Data Ephemeris for SATID

For an invalid satellite, this value should be set to 0.

**AZIMUTH**: Azimuth angle of the GPS satellite

The SLC shall set this field to the azimuth, in units of 1 degree. The valid value is from 0 to 359 degrees. The CP shall set this field to 0xFFFF if the azimuth angle is unknown.

**ELEVATION**: Elevation angle of the GPS satellite

The SLC shall set this field to the elevation angle, in units of 1 degree. The valid value is form -90 to 90 degrees. The CP shall set this field to 0xFF if the elevation angle is unknown

## 6.53 Almanac Response - Message ID 70, Sub ID 2

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | ALM_RESP |

**Table 6.159: Almanac Response - Message ID 70, Sub ID 2**

The Almanac Response message is output in response to Almanac Request message.

| Field | Length (nr of Bits) | Scale Factor | Unit |
|---|---|---|---|
| Message ID | 8 | | |
| Message Sub ID | 8 | | |
| ALM_DATA_FLAG | 8 | N/A | N/A |
| EXTD_GPS_WEEK | 16 | N/A | weeks |
| GPS_TOW | 32 | 0.1 | seconds |
| NUM_SVS | 8 | | |
| The structure of almanac parameters below shall repeat a number of times as indicated by the value of the NUM_SVS field above. | | | |
| ALM_VALID_FLAG | 8 | N/A | N/A |
| ALM_SV_PRN_NUM | 8 | N/A | N/A |
| ALM_WEEK_NUM | 16 | N/A | N/A |
| ALM_ECCENTRICITY | 16 | $2^{-21}$ | dimensionless |
| ALM_TOA | 8 | $2^{12}$ | Seconds |
| ALM_DELTA_INCL | 16 | $2^{-19}$ | semi-circles |
| ALM_OMEGADOT | 16 | $2^{-38}$ | semi-circles/sec. |

| Field | Length (nr of Bits) | Scale Factor | Unit |
|---|---|---|---|
| ALM_A_SQRT | 24 | $2^{-11}$ | meters |
| ALM_OMEGA_0 | 24 | $2^{-23}$ | semi-circles |
| ALM_OMEGA | 24 | $2^{-23}$ | semi-circles |
| ALM_M0 | 24 | $2^{-23}$ | semi-circles |
| ALM_AF0 | 16 | $2^{-20}$ | Seconds |
| ALM_AF1 | 16 | $2^{-38}$ | sec/sec |

Table 6.160: Almanac Response Message

All parameters (from ALM_VALID_FLAG to ALM_AF1) have the same definition as the ones defined in Section 6.1 (AI3 Request) except that ALM_WEEK_NUM is the week number of the corresponding subalmanac.

**ALM_DATA_FLAG**: Flag for each data section

Bit 0 -> isAlmanacValid {0,1} = {No almanac data, at least one sub-almanac present in the message}

Bit1 -> isExtdGPSWeekValid {0,1} = {FALSE, TRUE}

Bit2 -> isGPSTOWValid {0,1} = {FALSE, TRUE}

**EXTD_GPS_WEEK**: Extended GPS week number

The SLC shall fill in the current GPS week. This field is only valid if isExtdGPSWeekValid (ALM_DATA_FLAG) is TRUE.

**GPS_TOW**: GPS time of week

The SLC shall fill in the current GPS time of week in the unit of 0.1 seconds. This field is only valid if isGPSTOWValid (ALM_DATA_FLAG) is TRUE.

**NUM_SVS**: Number of satellites

This is the number of satellites for which almanac information is being given with this message.

## 6.54 Broadcast Ephemeris Response - Message ID 70, Sub ID 3

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | B_EPH_RESP |

Table 6.161: Broadcast Ephemeris Response - Message ID 70, Sub ID 3

The Broadcast Ephemeris Response message is output in response to Broadcast Ephemeris Request message.

| Field | Length (bits) | Scale Factor | Unit |
|---|---|---|---|
| Message ID | | | |
| Message Sub ID | | | |
| RESERVED | 8 | N/A | N/A |
| IONO_FLAG | 8 | N/A | N/A |
| ALPHA_0 | 8 | $2^{-30}$ | Seconds |
| ALPHA_1 | 8 | $2^{-27}$ | sec/semi-circles |
| ALPHA_2 | 8 | $2^{-24}$ | sec/(semi-circles)$^2$ |
| ALPHA_3 | 8 | $2^{-24}$ | sec/(semi-circles)$^3$ |
| BETA_0 | 8 | $2^{11}$ | Seconds |
| BETA_1 | 8 | $2^{14}$ | sec/semi-circles |
| BETA_2 | 8 | $2^{16}$ | sec/(semi-circles)$^2$ |
| BETA_3 | 8 | $2^{16}$ | sec/(semi-circles)$^3$ |
| TIME_FLAG | 8 | N/A | N/A |
| EXTD_GPS_WEEK | 16 | 1 | Week |
| GPS_TOW | 32 | 0.1 | Seconds |
| NUM_SVS | 8 | | |
| The following fields are repeated a number of times indicated by the value of the NUM_SVS field above. | | | |
| EPH_FLAG | 8 | N/A | N/A |
| HEALTH | 8 | N/A | N/A |
| GPS_WEEK | 16 | N/A | N/A |
| SV_PRN_NUM | 8 | N/A | N/A |
| URA_IND | 8 | N/A | N/A |
| IODE | 8 | N/A | N/A |
| C_RS | 16 | $2^{-5}$ | Meters |

| Field | Length (bits) | Scale Factor | Unit |
|---|---|---|---|
| DELTA_N | 16 | $2^{-43}$ | semi-circles/sec |
| M0 | 32 | $2^{-31}$ | semi-circles |
| C_UC | 16 | $2^{-29}$ | Radians |
| ECCENTRICITY | 32 | $2^{-33}$ | N/A |
| C_US | 16 | $2^{-29}$ | Radians |
| A_SQRT | 32 | $2^{-19}$ | meters |
| TOE | 16 | $2^{4}$ | Seconds |
| C_IC | 16 | $2^{-29}$ | Radians |
| OMEGA_0 | 32 | $2^{-31}$ | semi-circles |
| C_IS | 16 | $2^{-29}$ | Radians |
| ANGLE_INCLINATION | 32 | $2^{-31}$ | semi-circles |
| C_RC | 16 | $2^{-5}$ | Meters |
| OMEGA | 32 | $2^{-31}$ | semi-circles |
| OMEGADOT | 32 | $2^{-43}$ | semi-circles/sec |
| IDOT | 16 | $2^{-43}$ | semi-circles/sec |
| TOC | 16 | $2^{4}$ | Seconds |
| T_GD | 8 | $2^{-31}$ | Seconds |
| AF2 | 8 | $2^{-55}$ | sec/sec2 |
| AF1 | 16 | $2^{-43}$ | sec/sec |
| AF0 | 32 | $2^{-31}$ | Seconds |

Table 6.162: Broadcast Ephemeris Response Message

**TIME_FLAG**: Time parameter validity flag

The SLC shall set this field to 1 if the following fields from EXTD_GPS_WEEK to GPS_TOW are valid. If the fields are not valid, the SENDER shall set this field and the following fields from EXTD_GPS_WEEK to GPS_TOW to 0.

**EXTD_GPS_WEEK**: Extended GPS week number

This is the extended GPS week number of the current time of the current time inside the SLC.

**GPS_TOW**: GPS time of week

This is the time of week in unit of 0.1 seconds of the current time inside the SLC.

**NUM_SVS**: Number of satellites

This is the number of satellites for which broadcast ephemeris is being given with this message. This needs to match the NUM_SVS field of the "Broadcast Ephemeris Request" message, for which this is the response pair. Please see *AI3 Request* for description of all other fields.

**HEALTH**: Broadcast Ephemeris Health

This field is used to indicate the health of the satellite. A value of 0 means the satellite is health, a value of 1 means the satellite is unhealthy.

## 6.55 Time Frequency Approximate Position Status Response - Message ID 70, Sub ID 4

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name in Code | TIME_FREQ_APPROX_POS_RESP |

**Table 6.163: Time Frequency Approximate Position Status Response - Message ID 70, Sub ID 4**

The Time Frequency Approximate Position Status Response message is output in response to Time Frequency Approximate Position Status Request message. Each time a Time Frequency Approximate Position Status Request message is received, a Time Frequency Approximate Position Status Response message or a Reject message should be sent.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Sub Message ID | 1 | | |
| STATUS_RESP_MASK | 1 | | |
| GPS_WEEK | 2 | | |
| GPS_TOW | 4 | | |
| STATUS_TIME_ACC_SCALE | 1 | | |
| STATUS_TIME_ACCURACY | 1 | | |
| STATUS_FREQ_ACC_SCALE | 1 | | |

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| STATUS_FREQ_ACCURACY | 1 | | |
| STATUS_SCALED_FREQ_OFFSET | 2 | 1 | Hz |
| STATUS_FREQ_TIME_TAG | 4 | | |
| SLC_HOR_UNC | 4 | | |
| SLC_VER_UNC | 2 | | |
| SPARE | 8 | | |

Table 6.164: Time Frequency Approximate Position Status Response Message

**STATUS_RESP_MASK**: status response mask

When Bit 0 (LSB) of this mask is set to 1, GPS_WEEK is valid; 0 otherwise. When Bit 1 of this mask is set to 1, GPS_TOW is valid; 0 otherwise. When Bit 2 of this mask is set to 1, STATUS_TIME_ACC_SCALE and STATUS_TIME_ACCURARY are valid; 0 otherwise. When Bit 3 of this mask is set to 1, STATUS_FREQ_ACC_SCALE and STATUS_FREQ_ACCURARY are valid; 0 otherwise. When Bit 4 of this mask is set to 1, SLC_HOR_UNC is valid; 0 otherwise. When Bit 5 of this mask is set to 1, SLC_VER_UNC is valid; 0 otherwise.

**GPS_WEEK**: extended GPS week

This is the internal extended GPS week number. GPS_TOW This is the internal GPS_TOW time of the receiver, rounded to the nearest second.

**STATUS_TIME_ACC_SCALE**: scale factor for the time accuracy status

This represents the scale factor used to encode the internal time accuracy of the receiver. STATUS_TIME_ACC_SCALE =0 => time_scale = 1.0 STATUS_TIME_ACC_SCALE=1 => time_scale = 0.125 STATUS_TIME_ACC_SCALE=0xFF => internal time accuracy unknown All other values are reserved.

**STATUS_TIME_ACCURACY**: time accuracy status

This is the internal time accuracy of the receiver. If time_scale (obtained from STATUS_TIME_ACC_SCALE) is 1.0, Table 5.189 shall be used to get the time accuracy. If time_scale (obtained from STATUS_TIME_ACC_SCALE) is 0.125, Table 5.189 shall be used to get the time accuracy. A value of 0xFF means “unknown accuracy”

**STATUS_FREQ_ACC_SCALE**: scale factor of the frequency accuracy

This represents the scale factor used to encode the internal frequency accuracy of the receiver. STATUS_FREQ_ACC_SCALE =0 => frequency_scale = 0.00390625 STATUS_FREQ_ACC_SCALE=0xFF => internal frequency accuracy unknown All other values are reserved.

**STATUS_FREQ_ACCURACY**: frequency accuracy status

This is the internal frequency accuracy of the receiver. If frequency_scale (obtained from STATUS_FREQ_ACC_SCALE) is 0.00390625, Table 5.193 shall be used to get the frequency accuracy. A value of 0xFF means “unknown accuracy”

**STATUS_SCALED_FREQ_OFFSET**: Scaled frequency offset

This parameter to the scaled frequency offset from its nominal clock drift as measured by the receiver, in Units of 1Hz. This offset is represented as a 16-bit two's complement.

For example, the measured clock drift of receiver is 97000 Hz. This field would be returned as 96250Hz – 97000 = -750Hz.

STATUS_FREQ_TIME_TAG: Time tag of the frequency status

This field shall be set to the time when the frequency status measurement is taken. The unit and encoding of this parameter is the same as TIME_TAG used in Section 5.71.

SLC_HOR_UNC: This field shall be set to the estimated horizontal uncertainty of the internal approximate position.

The unit is 1 meter. A value of 0xFFFFFFFF means "unknown".

SLC_VER_UNC:

This field shall be set to the estimated vertical uncertainty of the internal approximate MS location. The error shall correspond to the standard deviation of the error in MS altitude in units of 0.1 meters in the range of 0 meters to 6553.5 meters, in Unsigned Binary Offset coding. The formula to apply is:

EST_VER_ER (in m)= Vx0.1

where V is the unsigned binary value of the "EST_VER_ER" field from 0 to 65534. 0x0000 represents 0m, 0xFFFF represents "unknown".

## 6.56 Channel Load Response - Message ID 70, Sub ID 5

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | CH_LOAD_RESP |

**Table 6.165: Channel Load Response - Message ID 70, Sub ID 5**

The Channel Load Response message is output in response to Channel Load Request message. Each time a Channel Load Request message is received, a Channel Load Response message, multiple Channel Load Response messages, a Reject message, or no message should be sent. The Channel Load Response messages will be reported at a rate depending on the value of the MODE field in the Channel Load Request message. The reported values shall be calculated as the average during one entire second preceding the message transmission. They will represent a percentage of the total theoretical limit of the port at the current baud rate.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| PORT | 1 | | |
| TOTAL_LOAD | 1 | | |
| NUMBER_OF_CHANNELS | 1 | | |
| The following two fields should be repeated for “NUMBER_OF_CHANNELS” times | | | |
| CHANNEL_LOAD | 1 | | |

Table 6.166: Channel Load Response Message

PORT: Serial Port A or B

This field shall be set to the port number for which the load information has been requested. “0” represents the SiRF port A and “1” represents SiRF port B. Any other value has no meaning.

TOTAL_LOAD: Total Load of the Port

This field shall be set to the percentage of the total port bandwidth of the currently opened channels. The value will range from 0 to 100.

NUMBER_OF_CHANNELS: The number of channels with data in message

This field shall be set to the number of logical channels that have load data in the response message. All currently opened channels shall be reported.

CHANNEL_LOAD: Total Load of the logical channel

This field shall be set to the load that the logical channel is using. The value will range from 0 to 100.

## 6.57 Client Status Response - Message ID 70, Sub ID 6

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x06 |
| SID (Dec) | 6 |
| SID Name in Code | CLIENT_STATUS_RESP |

Table 6.167: Client Status Response - Message ID 70, Sub ID 6

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| STATUS | 1 | | |

Table 6.168: Client Status Response Message

**STATUS**: Client Status

This field shall be set to the appropriate value as specified in Table 6.169.

| Bits in STATUS | Description |
|---|---|
| Bit 7-1: STATUS BITS | 'xxxxxx1'0x01:No fix available after full search<br>'xxxx10x': OK to send (SLC ready to receive message, e.g. wake-up from standby mode)<br>'xxxx01x': NOT OK to send (SLC not ready to receive message, e.g. in standby mode during trickle power). |
| Bit 8: EXTENSION BIT | `0`: no byte extension<br>`1`: reserved |

Table 6.169: STATUS Field

Bit 7-1: STATUS BITS: This field contains a bit pattern describing

Bit 8: EXTENSION BIT: In the future, this bit will be used as a condition acceptable value is `0` (no extensions)

## 6.58 OSP Revision Response - Message ID 70, Sub ID 7

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x07 |
| SID (Dec) | 7 |
| SID Name in Code | OSP_REV_RESP |

Table 6.170: OSP Revision Response - Message ID 70, Sub ID 7

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| OSP Revision | 1 | *10 | unitless |

Table 6.171: OSP Revision Response Message

The OSP Revision field has a valid range of 1.0 – 25.5. Since there is one byte allotted, the value in this field should be divided by 10 to get the revision number (ex. A value of 10 in this field translates to OSP rev 1.0).

## 6.59 Serial Port Settings Response - Message ID 70, Sub ID 8

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x08 |
| SID (Dec) | 8 |
| SID Name in Code | SERIAL_SETTINGS_RESP |

Table 6.172: Serial Port Settings Response - Message ID 70, Sub ID 8

The Serial Port Settings Response message is output in response to Serial Port Settings Request message. Each time a Serial Port Settings Request message is received, a Serial Port Settings Response message or a Reject message should be sent.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| PORT | 1 | | |
| BAUD_RATE | 4 | | |
| ACK_NUMBER | 1 | | |

Table 6.173: Serial Port Settings Response Message

**PORT**: Serial Port A or B

This field shall be set to the port number that has been configured. “0” represents the port A and “1” represents the port B. Any other value has no meaning.

**BAUD_RATE**: Baud Rate

This field shall be set to the desired baud rate. The current baud rates that are supported are 4800, 9600, 19200, 38400, 57600, and 115200. Any other value is illegal and is not supported. The Baud rate shall be coded as its equivalent binary value.

Example 1: “4800 bps” shall be coded as “000012C0” in hexadecimal equivalent.

Example 2: “115200bps” shall be coded “0001C200” in hexadecimal equivalent.

Note:

4e Only: Operation at speeds below 38400 carries risk of dropped messages when using SGEE

**ACK_NUMBER**: Acknowledge Number

This field can take 2 values only, “1” and “2”. In the serial port settings protocol, two acknowledgements shall be sent, one at the old baud rate (“1”), and the second one at the new baud rate (“2”). This field allows to distinguish between both acknowledges.

## 6.60 Tx Blanking Response - Message ID 70, Sub ID 9

| | |
|---|---|
| MID (Hex) | 0x46 |
| MID (Dec) | 70 |
| Message Name in Code | MID_STATUS_RESP |
| SID (Hex) | 0x09 |
| SID (Dec) | 9 |
| SID Name in Code | TX_BLANKING_RESP |

**Table 6.174: Tx Blanking Response - Message ID 70, Sub ID 9**

The Tx Blanking Response message is output in response to Tx Blanking Request message. Each time a Tx Blanking Request message is received, a Tx Blanking Response message should be sent.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| ACK_NACK | 1 | | |
| Reserved | 1 | | |

**Table 6.175: Tx Blanking Response Message**

**ACK_NACK**: Acknowledge or Non-Acknowledge

The value `0` represents ACK, and the value `1` represents NACK. NACK shall be sent if the requested Tx Blanking mode is not supported.

## 6.61 Hardware Configuration Request - Message ID 71

| | |
|---|---|
| MID (Hex) | 0x47 |
| MID (Dec) | 71 |
| Message Name in Code | MID_HW_CONFIG_REQ |

Table 6.176: Hardware Configuration Request - Message ID 71

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |

Table 6.177: Hardware Configuration Request Message



## 6.62 Sensor Data Output Messages - MID 72

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | MID_SensorData |
| SID (Hex) | Listed below |
| SID (Dec) | Listed below |
| SID Name in Code | Listed below |

Table 6.178: Sensor Data Output Messages - MID 72

| Bit Field | Description |
|---|---|
| 0x01 | SENSOR_READINGS |
| 0x02 | FACTORY_STORED_PARAMETERS |
| 0x03 | RCVR_STATE |
| 0x04 | POINT_N_TELL_OUTPUT |
| 0x05 | SENSOR_CALIBRATION_PARAMS |

Table 6.179: Sensor Control Input SIDs

**Note:**

These message specifications apply starting at GSD4e/GSD4t version 4.1.2 and replaces all previous verisons.

### 6.62.1 Sensor Data Readings Output - MID 72, SID 1

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | `MID_SensorData` |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | `SENSOR_READINGS` |

**Table 6.180: Sensor Data Readings Output - MID 72, SID 1**

This message is sent from the Measurement Engine to the host containing sensor data. It is logged so that the sensordata can be post-processed in NavOffline

| Name | Bytes | Binary (Hex) Example | ASCII (Dec) Example | Description |
|---|---|---|---|---|
| MID | U1 | 0x48 | 72 | SENSOR_DATA |
| SID | U1 | 0x01 | 1 | SENSOR_READINGS |
| SENSOR_ID | U2 | - | 24 | Identification for sensor |
| DATA_SET_LENGTH | U1 | - | 6 | Number of Bytes per sensor data set |
| NUM_DATA_SET | U1 | - | 10 | Number of data sets in the message |
| DATA_MODE | U1 | - | 0 | 0 - Raw, 1 - Average, |
| TIMESTMP1 | U4 | - | 1163496250 | Time stamp for Data set 1 |
| DATA_1_XS1 | U1 | - | 7 | Data for Axis 1 for Set 1 MSB |
| … | U1 | - | 120 | Data for Axis 1 for Set 1 LSB |
| DATA_2_XS1 | U1 | - | 7 | Data for Axis 2 for Set 1 MSB |
| … | U1 | - | 135 | Data for Axis 2 for Set 1 LSB |
| DATA_3_XS1 | U1 | - | 10 | Data for Axis 3 for Set 1 MSB |
| … | U1 | - | 31 | Data for Axis 3 for Set 1 LSB |
| TIMESTMP2 | U4 | - | 1163823798 | Time stamp for Data set 2 |

| Name | Bytes | Binary (Hex) Example | ASCII (Dec) Example | Description |
|---|---|---|---|---|
| DATA_1_XS2 | U1 | - | 7 | Data for Axis 1 for Set 2 MSB |
| … | U1 | - | 127 | Data for Axis 1 for Set 2 LSB |
| DATA_2_XS2 | U1 | - | 7 | Data for Axis 2 for Set 2 MSB |
| … | U1 | - | 143 | Data for Axis 2 for Set 2 LSB |
| DATA_3_XS2 | U1 | - | 10 | Data for Axis 3 for Set 2 MSB |
| … | U1 | - | 31 | Data for Axis 3 for Set 2 LSB |
| ... | - | - | - | - |
| TIMESTMP10 | U4 | - | 1166442866 | Time stamp for Data set 10 |
| DATA_1_XS10 | U1 | - | 7 | Data for Axis 1 for Set 10 MSB |
| … | U1 | - | 120 | Data for Axis 1 for Set 10 LSB |
| DATA_2_XS10 | U1 | - | 7 | Data for Axis 2 for Set 10 MSB |
| … | U1 | - | 131 | Data for Axis 2 for Set 10 LSB |
| DATA_3_XS10 | U1 | - | 10 | Data for Axis 3 for Set 10 MSB |
| … | U1 | - | 48 | Data for Axis 3 for Set 10 LSB |

Table 6.181: Sensor Data Readings Output Message Fields

SENSOR_ID: Identification for sensor. This can be the slave device address of the sensor. This field can support 10 bit addressing.

This can be the slave device address of the sensor. This field can support 10 bit addressing.

DATA_SET_LENGTH: Number of bytes per sensor data set. Number of bytes is 2, 4, or 6 based on 1, 2, or 3 sensor axes.

NUM_DATA_SET: Number of data sets in the message.

DATA_MODE: Date Mode.

Bit map is: 0 - Raw, 1 - Average, 2- Sliding median, 3 through 15 – reserved, 16 through 32: Error codes

TIMESTMP1: Time stamp for Data set 1. Time stamp is 4 Bytes of AcqClkCount recorded at the time of sampling sensor data.

DATA_1_XS1: Data for Axis 1 for Set 1

…

DATA_1_XS_NXS: Data for Axis (NUM_AXES) for Set 1

TIMESTMP2 : Time stamp for Data set 2.

Time stamp is 4 Bytes of AcqClkCount recorded at the time of sampling sensor data

**DATA_2_XS1**: Data for Axis 1 for Set 2

… 2 …

**DATA_2_AXIS_NXS**: Data for Axis (NUM_AXES) for Set 2

…

**TIMESTMP_ND**: Time stamp for Data set ND.

Time stamp is 4 Bytes of AcqClkCount recorded at the time of sampling sensor data

**DATA_ND_XS1**: Data for Axis 1 for Set ND

… 2 …

**DATA_ND_AXIS_NXS**: Data for Axis (NUM_AXES) for Set ND

**Note:**

(1) The sensor data message is being sent for each sensor separately.
(2) This is a variable length message. The message payload length is contained in the message header.
(3) Only ADC counts for sensor measurements are being sent across. Conversion into appropriate units will be performed on the host. This host has the configuration information for each sensor identified with SENSOR_ID.
(4) Time stamp is applied to the sensor data after the data has been read. For example, when reading, 3-axes accelerometer, time-stamp is applied to the acceleration data when all three axes have been read.
(5) If the DATA_MODE is selected for averaging or sliding median, the applied time stamp corresponds to the time stamp for the last sample collected.

### 6.62.2 Factory Stored Output - MID 72, SID 2

This message is only sent out after sensor initialization if any value of NUM_INIT_REG_READ_SEN_ is non-zero in the sensor configuration message received from the Host. This message transfers a set of parameters that are stored in sensor EPROM at the time of factory testing. These parameters need to be read at the time of sensor module initialization and sent over to the Host so that they can be used in subsequent calculations. These parameters also need to be logged so that they can be used in post-processing in NavOffline.

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | `MID_SensorData` |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | `FACTORY_STORED_PARAMETERS` |

**Table 6.182: Factory Stored Output - MID 72, SID 2**

| Name | Bytes | Binary (Hex) Example | ASCII (Dec) Example | Description |
|---|---|---|---|---|
| MID | U1 | 0x48 | 72 | SENSOR_DATA |
| SID | U1 | 0x02 | 2 | FACTORY_STORED_PARAMETERS |
| SENSOR_ID | U2 | - | - | Sensor ID |
| NUM_INIT_READ_REG_SEN | 1 | - | - | Number of registers to read from Sensor at the time of initialization |
| NUM_BYTES_REG1 | 1 | - | - | Data read from Register 1 address at initialization |
| DATA_REG1 | NUM_BYTES_REG1 | - | - | Number of bytes read from Register 1 at initialization |
| NUM_BYTES_REG2 | 1 | - | - | Data read from Register 2 address at time of initialization |
| DATA_REG2 | NUM_BYTES_REG2 | - | - | Number of bytes read from Register 2 at initialization |
| ... | - | - | - | - |

Table 6.183: Sensor Data Readings Output Message Fields

SENSOR_ID: Identification for sensor. This identification is the unique slave device address of the sensor. This field can support 10 bit addressing.

NUM_INIT_READ_REG_SEN: Number of registers to read from Sensor at the time of initialization.

NUM_BYTES_REG1: Data read from Register 1 address at time of initialization

DATA_REG1

NUM_BYTES_REG1: Number of bytes read from Register 1 at initialization

NUM_BYTES_REG2: Data read from Register 2 address at time of initialization

DATA_REG2

NUM_BYTES_REG2: Number of bytes read from Register 2 at initialization

### 6.62.3 Receiver State Output - MID 72, SID 3

This message provides the receiver context as determined by MEMS sensors. Context provides for both vehicle and pedestrian states. If uncertainties are large enough, both contexts will be reported in one message, otherwise the receiver will select one to report. Output rate for this message is set by MID 234, SID 2. When set for state change notifications, output will be whenever the receiver detects a change in condition. When set for other types of notifications, output will be once per second

**Note:**

This message is supported starting at version 4.1.0 and has pedestrian states starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | SENSORS_RECEIVER_STATE_MESSAGE |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | RCVR_STATE |

Table 6.184: Receiver State Output - MID 72, SID 3

| Name | Bytes | Binary (Hex) Example | ASCII (Dec) Example | Description |
|---|---|---|---|---|
| MID | U 1 | 0x48 | 72 | SENSOR_DATA |
| SID | U 1 | 0x03 | 3 | RCVR_STATE |
| TIME TAG | U 4 | - | 12345 | Acquisition clock count |
| RCVR_PHYSICAL_STATE | D 1 | 0x01 | 1 | State of the Receiver:<br>0 = Unknown<br>1 = Stationary<br>2 = Moving<br>3 = Walking<br>4 = Fast Walking<br>5 = Jogging<br>6 = Stairs Up<br>7 = Stairs Down<br>8 = Ramp Up<br>9 = Ramp Down<br>10 = Elevator Up<br>11 = Elevator Down<br>12 = Escalator Up<br>13 = Escalator Down |

| | | | | |
|---|---|---|---|---|
| RCVR_PHYSICAL_STATE (Cont.) | D 1 | 0x01 | 1 | State of the receiver. See Table 6.186for field description<br>Vehicle values:<br>MEMS_CONTEXT_UNKNOWN<br>MEMS_CONTEXT_STATIONARY<br>MEMS_CONTEXT_MOVING<br>Pedestrian Values:<br>MEMS_CONTEXT_UNKNOWN<br>MEMS_CONTEXT_STATIONARY<br>MEMS_CONTEXT_WALKING<br>MEMS_CONTEXT_FAST_WALKING<br>MEMS_CONTEXT_JOGGING<br>MEMS_CONTEXT_STAIRS_UP<br>MEMS_CONTEXT_STAIRS_DOWN<br>MEMS_CONTEXT_RAMP_UP<br>MEMS_CONTEXT_RAMP_DOWN<br>MEMS_CONTEXT_ELEVATOR_UP<br>MEMS_CONTEXT_ELEVATOR_DOWN<br>MEMS_CONTEXT_ESCALATOR_UP<br>MEMS_CONTEXT_ESCALATOR_DOWN |

Table 6.185: Receiver State Output Message Fields

| Bit Field | Description |
|---|---|
| [2:0] | Used for Vehicle:<br>000 = UNKNOWN<br>001 = STATIONARY<br>010 = MOVING<br>011 – 111 = Reserved |
| [7:3] | Used for Pedestrian:<br>00000 = UNKNOWN<br>00001 = STATIONARY<br>00011 = WALKING<br>00100 = FAST_WALKING<br>00101 = JOGGING<br>00110 = STAIRS_UP<br>00111 = STAIRS_DOWN<br>01000 = RAMP_UP<br>01001 = RAMP_DOWN<br>01010 = ELEVATOR_UP<br>01011 = ELEVATOR_DOWN<br>01100 = ESCALATOR_UP<br>01101 = ESCALATOR_DOWN<br>01110 – 11111 = Reserved |

Table 6.186: RCVR_PHYSICAL_STATE Bit Field Description

### 6.62.4 Sensor Point and Tell - MID 72, SID 4

This message is sent out at the sensor data processing rate (set in sensor configuration message). You can enable/ disable this in the SENSOR_SWITCH input message.

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | `MID_SensorData` |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name in Code | `POINT_N_TELL_OUTPUT` |

Table 6.187: Sensor Point and Tell - MID 72, SID 4

| Name | Bytes | Binary (Hex) Example | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|
| | | | | Scale | Example | |
| MID | U1 | 0x48 | - | - | 72 | SENSOR_DATA |
| SID | U1 | 0x04 | - | - | 4 | POINT_N_TELL_OUTPUT |
| TIME TAG | U4 | - | - | - | 12345 | Acquisition clock count |
| LATITUDE | S4 | - | Degrees | - | - | In degrees (+ = North) x $10^7$ |
| LONGITUDE | S4 | - | Degrees | - | - | In degrees (+ = East) x $10^7$ |
| HEADING | U2 | - | Degrees | - | 21100 | In degrees x $10^2$ |

| Name | Bytes | Binary (Hex) Example | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|
| | | | | Scale | Example | |
| PITCH | S2 | - | Degrees | - | - 9800 | In degrees x $10^2$ |
| ROLL | S2 | - | - | - | 19800 | In degrees x $10^2$ |
| HEADING UNCERTAINITY | U2 | - | Degrees | - | - | In degrees x $10^2$ |
| PITCH UNCERTAINITY | U2 | - | Degrees | - | - | In degrees x $10^2$ |
| ROLL UNCERTAINITY | U2 | - | Degrees | - | - | In degrees x $10^2$ |
| CALIBRATION STATUS | U1 | - | - | - | 0x21 | Lower 4 Bits magnetic sensor calibration status:<br>0 = COMPASS_CALIB_UNKNOWN<br>1 = COMPASS_CALIBRATED<br>2 = COMPASS_CALIB_REQUIRED<br>3 = COMPASS_MAG_DISTURBED<br>Upper 4 Bits Accelerometer sensor calibration status:<br>0 = ACCEL_CALIB_UNKNOWN<br>1 = ACCEL_CALIBRATED<br>2 = ACCEL_CALIB_REQUIRED<br>For example, 0x21 = Accelerometer requires that calibration and compass are calibrated. |

Table 6.188: Sensor Point and Tell Output Message Fields

## 6.62.5 Sensor Calibration Parameters Report - MID 72, SID 5

This message outputs calibration parameters for the sensor and is outputted every time any sensor is calibrated/recalibrated. These parameters are output for each sensor when the calibration parameters are read from NVM.

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | `SENSORS_CALIBRATION_MESSAGE` |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | `SENSOR_CALIBRATION_PARAMS` |

Table 6.189: Sensor Calibration - MID 72, SID 5

The structure of this message depends on the sensor type used in your product. This is described in a separate application note.

| Name | Bytes | Example | Description |
|---|---|---|---|
| MID | U1 | 0X48 | - |
| SID | U1 | 0X05 | - |
| MsgDescriptor | U2 | - | Describes the content of this message and specifies the number of valid fields. See (1) |

| Name | Bytes | Example | Description |
| --- | --- | --- | --- |
| Sensor ID | U1 | - | Identifies the sensor:<br>1 = Accelerometer<br>2 = Magnetic sensor<br>3 = Pressure sensor<br>4 = Gyroscope |
| TIME TAG | U4 | - | Acquisition clock count in m/s |
| CAL_FLD8_# (where # is 1-3) (1) | S8 | - | Offset value (Double). Default value is 0. Range = ±1200. |
| CAL_FLD8_# (where # is 4-6) (1) | S8 | - | Scale value (Double). Default value = 1. Range = 0.5 - 1.5. |
| CAL_FLD4_# (where # is 1-21) (1) | S4 | - | Element of P error covariance matrix (Float) |
| CAL_FLD4_# (where # is 22-24) (1) | S4 | - | Orientation detection information (Float) |

Table 6.190: Sensor Calibration Output Message Fields

(1) There are 30 fields with every sensor message. However, not all of these are valid for all the sensors. MsgDescriptor specifies the number of valid fields. See Table 6.191 and Table 6.192

| Bits | Description |
| --- | --- |
| Bit 0 | 0 = calibration values are picked from NVM or are init time values<br>1 = calibration values are as a result of calibration performed using run time data |
| Bit 1 | 0 = this message is meant to output only offset and scale values<br>1 = this message contains the all calibration parameters for this sensor |
| Bit [7:2] | Reserved |
| Bits [15:8] | Number of valid calibration fields in this message |

Table 6.191: Bit Field Description

| Accelerometer Sensor (Sensor ID = 1) | |
|---|---|
| **Bit** | **Description** |
| Bit 1 = 0 | 6 valid parameters:<br>Offset 'CAL_FLD8_1' corresponds to scale value 'CAL_FLD8_4'<br>Offset 'CAL_FLD8_2' corresponds to scale value 'CAL_FLD8_5'<br>Offset 'CAL_FLD8_3' corresponds to scale value 'CAL_FLD8_6' |
| Bit 1 = 1 | 30 valid parameters:<br>Offset 'CAL_FLD8_1' corresponds to scale value 'CAL_FLD8_4'<br>Offset 'CAL_FLD8_2' corresponds to scale value 'CAL_FLD8_5'<br>Offset 'CAL_FLD8_3' corresponds to scale value 'CAL_FLD8_6'<br>CAL_FLD4_# (where # is 1-21) are the upper-half 21 values of the symmetric 6x6 P (error covariance) matrix. Once the upper half of the P matrix is obtained, the complete matrix can be generated, assuming that it is symmetric.<br>CAL_FLD4_# (where # is 22-24) are 3 orientation detection information variables. |
| Magnetometer Sensor (Sensor ID = 2) | |
| Bit 1= 0 | 6 valid parameters:<br>Offset 'CAL_FLD8_1' corresponds to scale value 'CAL_FLD8_4'<br>Offset 'CAL_FLD8_2' corresponds to scale value 'CAL_FLD8_5'<br>Offset 'CAL_FLD8_3' corresponds to scale value 'CAL_FLD8_6' |
| Bit 1=1 | 4 valid parameters:<br>Offset 'CAL_FLD8_1' corresponds to scale value 'radii'<br>Offset 'CAL_FLD8_2' corresponds to scale value 'rho'<br>Offset 'CAL_FLD8_3' corresponds to scale value 'phi'<br>Offset 'CAL_FLD8_4' corresponds to scale value 'lemda' |

**Table 6.192: Sensor Specific Representation and Interpretation of the Calibration Data Fields**

### 6.62.6 IGRF Magnetic Model Parameter Report - MID 72, SID 6

This message outputs the parameters for the IGRF model. At the start this is output when the magnetic model parameters are read from NVM or default values are used every time the IGRF model parameters change.

| Name | Bytes | Binary (Hex) Example | Unit | ASCII (Dec)<br>Example | Description |
|---|---|---|---|---|---|
| MID | U1 | Ox48 | - | 72 | SENSOR_DATA |
| SID | U1 | Ox06 | - | 6 | SENSOR_MAG_MODEL_PARAMS |
| Source of Parameter | U1 | - | - | - | Describes whether the source of the parameters to the IGRF model is reading default values, NVM reading or derived from a recent GPS fix.<br>Default = 0<br>NVM = 1<br>GPS Fix = 2 |
| LATITUDE | S4 | - | Degrees | 285797000 | In degrees (+ = North) x $10^7$ |
| LONGITUDE | S4 | - | Degrees | 773152800 | In degrees (+ = East) x $10^7$ |
| ALTITUDE above sea level | S4 | - | Meters | 21600 | In meters x $10^2$ |
| YEAR | U2 | - | - | 2010 | Year part of the date for when to compute the values |
| MONTH | U1 | - | - | 4 | Month part of the date for when to compute the values |
| DAY | U1 | - | - | 21 | Day part of the date for when to compute the values |
| Declination | F4 | - | Decimal degrees | 0.79698467 | Magnetic declination |

| Name | Bytes | Binary (Hex) Example | Unit | ASCII (Dec) Example | Description |
|---|---|---|---|---|---|
| Total Field | F4 | - | nT | 47760.633 | Total magnetic field strength |
| Horizontal Field | F4 | - | nT | 34253.074 | Magnetic field horizontal strength |
| Inclination | F4 | - | Decimal degrees | 44.177677 | Magnetic inclination |
| North Comp | F4 | - | nT | 34249.762 | Magnetic field, North component |
| East Comp | F4 | - | nT | 476.44513 | Magnetic field, East component |
| Down Comp | F4 | - | nT | 33283.703 | Magnetic field, down component |

Table 6.193: Magnetic Model Parameter Message Field Description



### 6.62.7 1.1 Sensor Pedestrian DR Info Reporting Message - MID 72, SID 7

This message provides step count, stride length, walking direction, heading, pitch, roll, floor number, total distance covered and other similar fields. It provides information about the calibration status of sensors and the relative user position with respect to the initialized location.

| | |
|---|---|
| MID (Hex) | 0x48 |
| MID (Dec) | 72 |
| Message Name in Code | `SENSOR_PEDESTRIAN_DR_INFO_MESSAGE` |
| SID (Hex) | 0x07 |
| SID (Dec) | 7 |
| SID Name in Code | - |

Table 6.194: Sensor Pedestrian DR Info Reporting Message - MID 72, SID 7

Note:

This message will only be supported for future releases.

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | 0X48 | 72 | - | - | - | SENSOR_MSG |
| SID | U1 | 0X07 | 7 | - | - | - | SENSOR_PDR_INFO |
| TIME TAG | U4 | 0x0000 3039 | 12345 | m/s | - | - | Acquisition clock count |
| DELTA_LAT | S4 | 0x0000 00020 | 32 | Degrees | 10 ^ 7 | - | PDR delta latitude relative to the last epoch position. |
| DELTA_LONG | S4 | 0x0000 0011 | 17 | Degrees | 10 ^ 7 | - | PDR delta longitude relative to the last epoch position. |
| LATITUDE | S4 | 0x1108 EA88 | 285797 000 | Degrees | 10 ^ 7 | - | PDR position after initialization. |
| LONGITUDE | S4 | 0x2E1 56020 | 773152 800 | Degrees | 10 ^ 7 | - | PDR position after initialization. |
| ALTITUDE | S4 | 0x0000 8357 | 33631 | Meters | 10 ^ 2 | - | Altitude as per fusion with altimeter and GPS relative to Mean Sea Level (MSL). |
| STEP_CNT | U4 | 0x0000 0019 | 25 | Meters | - | - | Number of steps taken since the start of PDR application. |
| STRIDE_LEN | U2 | 0x0032 | 50 | Meters | 10 ^ 2 | - | Length of last completed stride. |
| WALK_DIR | S2 | 0x52 6C | 21100 | Degree | 10 ^ 2 | ±18000 | In degrees. This is angle between direction of walking and the heading of the module (as described in HEADING field below) |
| SPEED | U2 | 0x03 FF | 1023 | m/s | 10 ^ 3 | - | Speed calculated from PDR. It is average speed for the epoch. |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| HEADING | U2 | 0x52 6C | 21100 | Degrees | 10 ^ 2 | 0-3600 0 | Heading of module with respect to true North. |
| PITCH | S2 | 0xDD 3C | -8900 | Degrees | 10 ^ 2 | ±9000 | Pitch in NED (North East Down) frame of reference. |
| ROLL | S2 | 0x45 EC | 17900 | Degrees | 10 ^ 2 | ±1800 0 | Roll in NED (North East Down) frame of reference. |
| FLOOR | S2 | 0x00 0A | 10 | - | - | - | Current floor number with respect to start floor number. Starting floor number is initialized as 0th floor. |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| Context | U1 | 0x02 | 2 | - | - | - | Pedestrian context:<br>0 = MEMS_CONTEXT_UNKNOWN<br>1 = MEMS_CONTEXT_STATIONARY<br>3 = MEMS_CONTEXT_WALKING<br>4 = MEMS_CONTEXT_FAST_WALKING<br>5 = MEMS_CONTEXT_JOGGING<br>6 = MEMS_CONTEXT_STAIRS_UP<br>7 = MEMS_CONTEXT_STAIRS_DOWN<br>8 = MEMS_CONTEXT_RAMP_UP<br>9 = MEMS_CONTEXT_RAMP_DOWN<br>10 = MEMS_CONTEXT_ELEVATOR_UP<br>11 = MEMS_CONTEXT_ELEVATOR_DOWN |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| Context(Cont.) | U1 | 0x02 | 2 | - | - | - | 12 = MEMS_CONTEXT_ESCALATOR_UP<br>13 = MEMS_CONTEXT_ESCALATOR_DOWN<br>Values greater than 13 are reserved. UNKNOWN context would mean that logic could not place current motion in any of the predefined motion types.<br>WALKING to ESCALATOR context is for pedestrians. DRIVING context is when module is with a person inside a vehicle. |
| BODY_POS | U1 | 0x01 | 1 | - | - | - | 0 = MEMS_RCVR_BP_UNKNOWN<br>1 = MEMS_RCVR_BP_ARM_SWING<br>2 = MEMS_RCVR_BP_TROUSER_POCKET<br>3 = MEMS_RCVR_BP_FIXEDWITHTORSO<br>Values greater than 3 are reserved. |
| FIT | U2 | 0x2530 | 9520 | - | - | - | Ellipsoidal FIT (in %) for compass calibration. A FIT of 100 indicates that the ellipsoidal model perfectly fits the data. |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| TOTAL DISTANCE | U4 | 0x0000 0384 | 900 | Meters | 10 ^ 2 | - | Total distance traveled in meters since the start of PDR application. |
| FUSED SOLUTION TYPE | U1 | 0x00 | 0 | - | - | - | 0 = DR<br>1 = GPS based<br>2 = GPS + DR solution<br>3 = Invalid solution<br>This field indicates methods used for computing fused latitude and longitude in this message. |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| CALIBRATION STATUS | U2 | 0x0111 | 273 | - | - | - | [3:0] Bits indicate Magnetic sensor calibration status:<br>0 = COMPASS_CALIB_UNKNOWN<br>1 = COMPASS_CALIBRATED<br>2 = COMPASS_CALIB_REQUIRED<br>3 = COMPASS_MAG_DISTURBED<br>[7:4] bits indicate Accelerometer sensor<br>calibration status: 0 = ACCEL_CALIB_UNKNOWN<br>1 = ACCEL_CALIBRATED<br>2 = ACCEL_CALIB_REQUIRED<br>[11:8] bits indicate Gyro sensor calibration status:<br>0 = GYRO_CALIB_UNKNOWN<br>1 = GYRO_CALIBRATED<br>2 = GYRO_CALIB_REQUIRED |
| CONFIDENCE HEADING | U2 | 0x0BB8 | 3000 | - | 10 ^ 2 | 0-10000 | Confidence level in heading with 1σ = 5 |
| CONFIDENCE PITCH | U2 | 0x1194 | 4500 | - | 10 ^ 2 | 0-10000 | Confidence level in pitch with 1σ = 5 |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| CONFIDENCE ROLL | U2 | 0x26AC | 9900 | - | 10 ^ 2 | 0-10000 | Confidence level in roll with 1σ = 5 |
| CONFIDENCE POSITION | U2 | 0x23F0 | 9200 | Meters | - | - | Absolute error in position in NED frame. It is cumulative position error since the last reset. |
| DELTA_LAT_ERROR | U4 | 0x0000 0002 | 2 | Degree | 10 ^ 7 | - | Estimated error in DELTA_LAT as computed by PDR. |
| DELTA_LONG_ERROR | U4 | 0x0000 0007 | 7 | Degree | 10 ^ 7 | - | Estimated error in DELTA_LONG as computed by PDR. |
| ALTITUDE_ERROR | U4 | 0x0000 0005 | 5 | Meters | 10 ^ 2 | - | Estimated error in ALTITUDE as computed by PDR. |
| SPEED_ERROR | U2 | 0x0032 | 50 | m/s | 10 ^ 3 | - | Estimated error in SPEED as computed by PDR. |

Table 6.195: Sensor Pedestrian DR Info Reporting Message Field Descriptions

Note:

MEMS_CONTEXT_RAMP_UP and MEMS_CONTEXT_RAMP_DOWN are not currently implemented.

| Bit Field | Description |
|---|---|
| Bit [3:0] | Indicate Magnetic sensor calibration status:<br>0 = COMPASS_CALIB_UNKNOWN<br>1 = COMPASS_CALIBRATED<br>2 = COMPASS_CALIB_REQUIRED<br>3 = COMPASS_MAG_DISTURBED |
| Bit [7:3] | Indicate Accelerometer sensor calibration status:<br>0 = ACCEL_CALIB_UNKNOWN<br>1 = ACCEL_CALIBRATED<br>2 = ACCEL_CALIB_REQUIRED |
| Bit [11:8] | Indicate Gyro sensor calibration status:<br>0 = GYRO_CALIB_UNKNOWN<br>1 = GYRO_CALIBRATED<br>2 = GYRO_CALIB_REQUIRED |
| Bit [15:12] | Reserved |

**Table 6.196: CALIBRATION STATUS Bit Field Description**

## 6.63 Approximate MS Position Request - Message ID 73, Sub ID 1

| | |
|---|---|
| MID (Hex) | 0x49 |
| MID (Dec) | 73 |
| Message Name in Code | MID_AIDING_REQ |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | APPROX_MS_POS_REQ |

**Table 6.197: Approximate MS Position Request - Message ID 73, Sub ID 1**

Request approximate MS position.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Sub Message ID | 1 | | |

**Table 6.198: Approximate MS Position Request Message**

## 6.64 Time Transfer Request - Message ID 73, Sub ID 2

| | |
|---|---|
| MID (Hex) | 0x49 |
| MID (Dec) | 73 |
| Message Name in Code | MID_AIDING_REQ |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | TIME_TX_REQ |

Table 6.199: Time Transfer Request - Message ID 73, Sub ID 2

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Sub Message ID | 1 | | |

Table 6.200: Time Transfer Request Message

## 6.65 Frequency Transfer Request - Message ID 73, Sub ID 3

| | |
|---|---|
| MID (Hex) | 0x49 |
| MID (Dec) | 73 |
| Message Name in Code | MID_AIDING_REQ |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | FREQ_TX_REQ |

Table 6.201: Frequency Transfer Request - Message ID 73, Sub ID 3

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Sub Message ID | 1 | | |
| FREQ_REQ_INFO | 1 | | |

Table 6.202: Frequency Transfer Request Message

**FREQ_REQ_INFO**: Information field about frequency request

The SLC shall set this field according to Table 6.203.

| Bits in FREQ_REQ_INFO | Value | Description |
|---|---|---|
| Bit 1(LSB ) | 0 = single request<br>1 = multiple request | If single request, only one response message is requested. Bit 2 is ignored<br>If multiple request, multiples responses are requested. Depending on Bit 2, this mode shall be turned ON or OFF |
| Bit 2 | 1 = ON<br>0 = OFF | Valid only if Bit 1 is 1:<br>If ON, periodic Frequency Transfer Response mode is turned ON<br>If OFF, periodic Frequency Transfer Response mode is stopped |
| Bit 3 | 0 = don't turn off<br>1 = turn off | 0 = Don't turn off reference clock<br>1 = Turn off reference clock |
| Bit 4 to 8 | 0 | Reserved |

**Table 6.203: FREQ_REQ_INFO Field**

## 6.66 Nav Bit Aiding (NBA) Request - Message ID 73, Sub ID 4

| | |
|---|---|
| MID (Hex) | 0x49 |
| MID (Dec) | 73 |
| Message Name in Code | MID_AIDING_REQ |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name in Code | NBA_REQ |

**Table 6.204: Nav Bit Aiding (NBA) Request - Message ID 73, Sub ID 4**

This message is requesting the Nav Bit Aiding Response Messages (215 (MID_AIDING_RESP), 4 (SET_NBA_SF1_2_3)) and/or (215, (MID_AIDING_RESP), 5, (SET_NBA_SF4_5)), depending on the value of the NAVBIT_REQ_FLAG bit settings in the parameter block below. The message contains a SECTION_VALIDITY_FLAG field followed by request sections. Each request section has a SECTION_SIZE as the first byte to indicate the number of bytes in the associated section. The existence of SECTION_SIZE, and proper handling of this field by SLC and CP supports forward compatibility.

| Field | | Length (bits) | Description |
|---|---|---|---|
| SECTION_VALIDITY_FLAG | | 16 | Bit 0:<br>0 = NAVBIT section is NOT valid<br>1 = NAVBIT section is valid |
| NAVBIT SECTION | SECTION_SIZE | 8 | The size of this section in bytes, including "SECTION_SIZE" field. For this release, SECTION_SIZE should be set to 6. |
| | SAT_MASK_NAVBIT | 32 | This is a bitmap representing the satellites for which subframe 1, 2, and 3 NavBit aiding is requested . If SLC requests such NAV bit aiding for the satellite represented by a bit of this field, SLC shall set that bit to '1'. The LSB (Bit 0) of this field represents satellite PRN number 1. The MSB (Bit 31) of this field represents satellite PRN 32.[a] |
| | NAVBIT_REQ_FLAG | 8 | Bit 0:<br>0 => Subframe 1, 2, and 3 are NOT requested<br>1 => Subframe 1, 2, and 3 are requested<br>Bit 1:<br>0 => Subframe 4 and 5 are NOT requested<br>1 => Subframe 4 and 5 are requested<br>Bit 2 – 7: Reserved |

**Table 6.205: Nav Bit Aiding Request Message**

[a] This field is reserved for future use. The content of this field is now ignored in the response message. Aiding information is included in the response message for all satellites where available, regardless of the content of this bit mask.

## 6.67 Session Opening Response - Message ID 74, Sub ID 1

| | |
|---|---|
| MID (Hex) | 0x4A |
| MID (Dec) | 74 |
| Message Name in Code | MID_SESSION_CONTROL_RESP |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | SESSION_OPEN_RESP |

Table 6.206: Session Opening Response - Message ID 74, Sub ID 1

The Session Opening Notification message is output in response to Session Opening Request message. Each time a Session Opening Request message is received, a Session Opening Notification message or a Reject message should be sent.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| SESSION_OPEN_STATUS | 1 | | |

Table 6.207: Verified 50 bps Broadcast Ephemeris Message

**SESSION_OPEN_STATUS**: Session Open Status

The field shall be set to an appropriate value as specified in Table 6.208.

| Value | Description |
|---|---|
| 0x00 | Session Opening succeeded |
| 0x01 | Session Opening failed |
| 0x02 to 0x7F | Reserved |
| 0x80 | Session Resume succeeded |
| 0x81 | Session Resume failed |
| 0x82 to 0xFF | Reserved |

Table 6.208: SESSION_OPEN_STATUS Field

## 6.68 Session Closing Notification - Message ID 74, Sub ID 2

| | |
|---|---|
| MID (Hex) | 0x4A |
| MID (Dec) | 74 |
| Message Name in Code | MID_SESSION_CONTROL_RESP |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | SESSION_CLOSE_RESP |

Table 6.209: Session Closing Notification - Message ID 74, Sub ID 2

The Session Closing Notification message is output in response to Session Closing Request message. Each time a Session Closing Request message is received, a Session Closing Notification message or a Reject message should be sent.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| SESSION_CLOSE_STATUS | 1 | | |

Table 6.210: Session Closing Notification Message

SESSION_CLOSE_STATUS: Session closing status.

This field shall be set to an appropriate value as specified in the table below.

| Value | Description |
|---|---|
| 0x00 | Session closed |
| 0x01 | Session closing failed |
| 0x02 to 0x7F | Reserved |
| 0x80 | Session suspended |
| 0x81 | Session suspension failed |
| 0x82 to 0xFF | Reserved |

Table 6.211: SESSION_CLOSE_STATUS Field

## 6.69 ACK/NACK/ERROR Notification - Message ID 75, Sub ID 1

| | |
|---|---|
| MID (Hex) | 0x4B |
| MID (Dec) | 75 |
| Message Name in Code | MID_MSG_ACK_OUT |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | ACK_NACK_ERROR |

Table 6.212: ACK/NACK/ERROR Notification - Message ID 75, Sub ID 1

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| Echo Message ID | 1 | | |
| Echo Message Sub ID | 1 | | |
| ACK/NACK/ERROR | 1 | | |
| Reserved | 2 | | |

Table 6.213: ACK/NACK/ERROR Notification Message

| Value | Description |
|---|---|
| 0x00 | Acknowledgement |
| 0x01 – 0xF9 | Reserved |
| 0xFA | Message ID and/or Message Sub ID not recognized |
| 0xFB | Parameters cannot be understood by the recipient of the message |
| 0xFC | OSP Revision Not Supported |
| 0xFD | CP doesn't support this type of NAV bit aiding (0 during autonomous operation) |
| 0xFE | CP doesn't accept ephemeris status response (0 during autonomous operation) |
| 0xFF | Non-acknowledgement |

Table 6.214: ACK/NACK/ERROR Field

Note:

At the time of releasing the 4t product, the support of this message for use by new 4t applications will coexist with the support of the SSB ACK (`0x0B`) and SSB NACK (`0x0C`) messages for use by legacy applications of earlier products.

## 6.70 Reject - Message ID 75, Sub ID 2

| | |
|---|---|
| MID (Hex) | 0x4B |
| MID (Dec) | 75 |
| Message Name in Code | MID_MSG_ACK_OUT |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | REJECT |

Table 6.215: Reject - Message ID 75, Sub ID 2

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Sub Message ID | 1 | | |
| REJ_MESS_ID | 1 | | |
| REJ_MESS_SUB_ID | 1 | | |
| REJ_REASON | 1 | | |

Table 6.216: Reject Message

**REJ_MESS_ID**: Message ID of Rejected Message

**REJ_MESS_ID**: Message Sub ID of Rejected Message

**REJ_REASON**: Reject Reason

The answering entity shall set this field to the reason of the reject according to Table 6.217.

| Bit Number | Bit Value | Description |
|---|---|---|
| Bit 1 (LSB) | 1 = true<br>0 = false | (Reserved) |
| Bit 2 | 1 = true<br>0 = false | Not Ready |
| Bit 3 | 1 = true<br>0 = false | Not Available |
| Bit 4 | 1 = true<br>0 = false | Wrongly formatted message(1) |
| Bit 5 | 1 = true<br>0 = false | No Time Pulse during Precise Time Transfer |
| Bit 6 | | Unused |
| Bit 7-8 | “0” | Reserved |

Table 6.217: REJ_REASON Field

## 6.71 Low Power Mode Output - Message ID 77

This message currently only has one SID defined, though the intent is to have more output messages while in low power (LP) modes put under this MID in the future.

### 6.71.1 Micro Power Mode Error - Message ID 77, Sub ID 1

This message is only output if there is a problem with going into or maintaining Micro Power Mode (MPM).

| | |
|---|---|
| MID (Hex) | 0x4D |
| MID (Dec) | 77 |
| Message Name in Code | MID_LP_OUTPUT |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | MPM_ERR |

Table 6.218: Micro Power Mode Error - Message ID 77, Sub ID 1

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | | |
| Message Sub ID | 1 | | |
| ERR_REASON | 1 | | |
| Reserved | 4 | | |

Table 6.219: Micro Power Mode Error Message

ERR_REASON: Reason for exiting MPM mode

The exact details are TBD for this message but this byte will be a bit field which points to the reason MPM did not operate as anticipated. More input is needed from Kevin Powell, but these error conditions will include the following:

- Error exceeds preset threshold values
- No navigation

Reserve: Reserved for future use/definition

## 6.72 Power Mode Response - MID 90

This message is output in response to the MID_PWR_MODE_REQ message. This response echoes back the low power mode which was set and it acknowledges either the completion of the transition to the requested power mode or the failure of the transition by remaining in the original power mode from where the MID_PWR_MODE_REQ request was issued.

| | |
|---|---|
| MID (Hex) | 0x5A |
| MID (Dec) | 90 |
| Message Name in Code | `MID_PWR_MODE_RESP` |
| SID (Hex) | Listed below |
| SID (Dec) | Listed below |
| SID Name in Code | Listed below |

Table 6.220: Power Mode Response - Message ID 90

| | | |
|---|---|---|
| 0x00 | 0 | FP_MODE_RESP |
| 0x01 | 1 | APM_RESP |
| 0x02 | 2 | MPM_RESP |
| 0x03 | 3 | ATP_RESP |
| 0x04 | 4 | PTF_RESP |

Table 6.221: SIDs for Power Mode Response Message

The SID value is equal to the SID value in the requesting `MID_PWR_MODE_REQ` message in this response, whether the transition to this requested new mode was successful or not.

| Field | Bytes | Scale | Unit |
|---|---|---|---|
| Message ID | 1 | - | - |
| Message Sub ID | 1 | - | - |
| ERROR_CODE | 1 | - | - |

Table 6.222: Power Mode Response Error Code Values

| Value | Condition |
|---|---|
| 0x00 | No error, requested transition performed successfully |
| 0x01 | Specified mode is same as current, no transition occurred |
| 0x02 | Specified power mode is not supported in current product |
| 0x03 | Unmet preconditions when transitioning to requested mode |
| 0x04-0xFF | Reserved |

Table 6.223: Power Mode Response Error Code Values

## 6.73 MPM Enable Response Message - MID 90, SID 2

For MPM 2.0 the SLC will respond to an Enable MPM message (MID 218, SID 2) when:

1. Conditions are met: the system transitions into MPM mode and sends a response indicating a SUCCESS.
2. Conditions are not met:
   - 2.1 Soft MPM: The system sends a response indicating that an MPM transition is PENDING and is waiting for conditions to be met for a timout period specified in the enable command. If conditions are not met within the timout period the system sends an ERROR CODE indicating reason for failure and system enters Hibernate. If MPM entry conditions are met prior to the timout expiring, MPM cycling starts and a SUCCESS response is returned.
   - 2.2 Hard MPM: The system immediately sends an ERROR CODE indicating reason for failure and system enters Hibernate.

The OSP message for the MPM response is defined below:

| Field | Bytes | Value/Range | Scale | Unit |
|---|---|---|---|---|
| MID | 1 | 90 | - | - |
| SID | 1 | 2 | - | - |
| `ERROR_CODE` | 2 | Bitfields see Table 6.225 | - | - |
| Reserved | 2 | - | - | - |

Table 6.224: MPM Enable Response Message - MID 90, SID 2

| Bits | Description | |
|---|---|---|
| 0-3 | Generic Error Codes[1] | |
| 4-15 | MPM-specific Error Codes | |
| | Bit | Condition |
| | 4 | Success |
| | 5 | Kalman filter Nav Solution not reached |
| | 6 | RTC not calibrated |
| | 7 | Estimated horizontal position error > 100 m |
| | 8 | MPM is still pending |
| | 9-15 | Reserved |

Table 6.225: Error Code Bits

[1] Reserved for generic error codes to be assigned.



## 6.74 Hardware Control Output - MID 91

This MID is reserved for future hardware control features, including VCTCXO and on/off signal configuration.

| | |
|---|---|
| MID (Hex) | 0x5B |
| MID (Dec) | 91 |
| MID Name in Code | `MID_HW_CTRL_OUT` |

Table 6.226: Hardware Control Output - MID 91

| Field | Bytes |
|---|---|
| MID | 1 |
| SID | 1 |

Table 6.227: Hardware Control Output Message

### 6.74.1 AGC Gain Output - MID 91, SID 3

Outputs AGC Gain value information Output Rate: By default it's not enabled. If the Navigation Library bit is set in reset config field of MID 172, SID 1, MID 91 is output every measurement cycle (1Hz) and if it's not set, it disables MID 91. MID 166 can be used to enable, disable or set output rate of MID 91. The valid values for AGC Gain are 0 - 31. An invalid value of AGC Gain is reported by 33 indicating that RF is shut off and cannot read the AGC Gain register (e.g. when in low power modes).

| | |
|---|---|
| MID (Hex) | 0x5B |
| MID (Dec) | 91 |
| SID (Hex) | 0x03 |
| SID (Dec) | 3 |
| SID Name in Code | SIRF_MSG_SSB_AGC_GAIN_OUTPUT |

Table 6.228: AGC Gain Output - MID 91, SID 3

| Name | Bytes | Example (Optional) | | Range | Description |
|---|---|---|---|---|---|
| | | Hex | Dec | | |
| MID | 1U | 0x5B | 91 | - | Message ID |
| SID | 1U | 0x03 | 03 | - | Sub ID |
| AGC Gain | 1U | 0x13 | 19 | 0 – 31 and 33 | AGC Gain value<br>0 - 31 = Valid Values<br>33 = Invalid Value |
| Reserved | 1U | 0x00 | 00 | - | Reserved |
| Reserved | 1U | 0x00 | 00 | - | Reserved |
| Reserved | 1U | 0x00 | 00 | - | Reserved |
| Reserved | 1U | 0x00 | 00 | - | Reserved |
| Reserved | 1U | 0x00 | 00 | - | Reserved |
| Reserved | 1U | 0x00 | 00 | - | Reserved |
| Reserved | 1U | 0x00 | 00 | - | Reserved |

Table 6.229: AGC Gain Value Message Fields

## 6.75 CW Controller Output - Message ID 92

### 6.75.1 CW Interference Report - Message ID 92

CW Interference message reports the presence of at most 8 interferences detected as a result of the most recent CW scan or monitor.

| | |
|---|---|
| MID (Hex) | 0x5C |
| MID (Dec) | 92 |
| Message Name in Code | MID_CW_OUTPUT |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | CW_DATA |

Table 6.230: CW Interference Report - Message ID 92

| Field | Bytes | Unit | Scale | Description |
|---|---|---|---|---|
| Message ID | U1 | | | Message ID (0x5C) |
| Sub ID | U1 | | | Sub ID (0x01) |
| Frequency 0 | U4 | Hz | | Frequency of peak 0 |
| … | | | | Repeat for each peak |
| Frequency 7 | U4 | Hz | | Frequency of peak 7 |
| C/No 0 | U2 | dB-Hz | 0.01 | Signal to Noise of peak 0 |
| … | | | | Repeat for each peak |
| C/No 7 | U2 | dB-Hz | 0.01 | Signal to Noise of peak 7 |

Table 6.231: CW Interference Report Message

### 6.75.2 CW Mitigation Report - MID 92, SID 2

CW Mitigation message reports filtering employed to mitigate the effects of the interference

| | |
|---|---|
| MID (Hex) | 0x5C |
| MID (Dec) | 92 |
| Message Name in Code | MID_CW_OUTPUT |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | CW_FILTER |

Table 6.232: CW Mitigation Report - MID 92, SID 2

| Field | Bytes | Description |
| --- | --- | --- |
| MID | U1 | Message ID (0x5C) |
| SID | U1 | Sub ID (0x02) |
| Sampling Mode | U1 | Enumeration of sampling modes:<br>0: Use complex 8f0, no filter<br>1: Use complex 2f0, no filter<br>2: Use 2MHz filter<br>3: Use OFFT filter |
| A/D Mode | U1 | Enumeration of A/D modes:<br>0: Use 2-bit A/D<br>1: Use 4-bit A/D |
| Center freq bin of freq 0 | S1 | Center frequency bin of the frequency 0.<br>Range: -128 to 127<br>When the number of bins field (below) is 0, this field will be 0. |
| Number of bins for freq 0 | U1 | Number of bins excised on one side of the center frequency bin.<br>Total number of bins excised = 2 x this number + 1.<br>0: no bin excised |
| … | | Repeat these two fields above for each frequency. |
| Center freq bin of freq 7 | S1 | Center frequency bin of the frequency 7.<br>Range: -128 to 127<br>When the number of bins field (below) is 0, this field will be 0. |
| Number of bins for freq 7 | U1 | Number of bins excised on one side of the center frequency bin.<br>Total number of bins excised = 2 x this number + 1.<br>0: no bin excised |

Table 6.233: CW Mitigation Report Message

## 6.76 TCXO Learning Output Response - MID 93

| | |
| --- | --- |
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| MID Name in Code | `MID_TCXO_LEARNING_OUT` |

Table 6.234: TCXO Learning Output Response - MID 93

| Bits | Description | Inclusion |
|---|---|---|
| 0x00 | Not used | - |
| 0x01 | Clock model data base output | In all builds |
| 0x02 | Temperature table output | |
| 0x03 | Not used | - |
| 0x04 | Temp recorder output | In TCXO test builds only(1) |
| 0x05 | EARC output | |
| 0x06 | RTC alarm output | |
| 0x07 | RTC calibration output | |
| 0x08 | Not used | - |
| 0x09 | MPM searches output | In TCXO test builds only(1) |
| 0x0A | MPM prepos output | |
| 0x0B | Micro Nav measurements output | |
| 0x0C | TCXO uncertainty output | |
| 0x0D | System time stamps output | |

**Table 6.235: TCXO Learning Output Response Message**

(1) These messages are missing in standard builds for customer products. These messages are present in special test builds only, made to test the TCXO features.

### 6.76.1 TCXO Learning Clock Model Data Base - Message ID 93, Sub ID 1

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x01 |
| SID (Dec) | 1 |
| SID Name in Code | CLOCK_MODEL_DATA_BASE_OUT |

**Table 6.236: TCXO Learning Clock Model Data Base - Message ID 93, Sub ID 1**

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 1 | Clock model data base output |
| Source | U1 | | | | | | Bit mask indicating source of the clock model.<br>0x0 = NOT_SET<br>0x1 = ROM<br>0x2 = DEFAULTS<br>0x4 = MFG<br>0x8 = TEST_MODE<br>0x10 = FIRST_NAV |
| Aging Rate Uncertainty | U1 | | | Ppm /year | 0.1 | 10 | Aging rate of uncertainty |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Initial Offset Uncertainty | U1 | | | ppm | 0.1 | 10 | Initial Frequency offset of the TCXO |
| Spare | U1 | | | | | | |
| Clock Drift | S4 | | | ppb | 1 | 60105 | Clock drift |
| Temp Uncertainty | U2 | | | ppm | 0.01 | 50 | Temperature uncertainty |
| Manufacturing Week number | U2 | | | GPS Week # | 1 | 1465 | TCXO Manufacturing week number in full GPS weeks |
| Spare | U4 | | | | | | |

Table 6.237: Clock Model Data Base Message

### 6.76.2 TCXO Learning Temperature Table - Message ID 93, Sub ID 2

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x02 |
| SID (Dec) | 2 |
| SID Name in Code | TEMPERATURE_TABLE |

**Table 6.238: TCXO Learning Temperature Table - Message ID 93, Sub ID 2**

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 2 | Temperature table output |
| Spare1 | U4 | | | | | | |
| Offset | S2 | | | ppb | 1 | -331 | Frequency offset bias of the table from the CD default |
| Global Min | S2 | | | ppb | 1 | -205 | Minimum XO error observed |
| Global Max | S2 | | | ppb | 1 | 442 | Maximum XO error observed |
| First Week | U2 | | | GPS Week # | 1 | 1480 | Full GPS week of the first table update |
| Last Week | U2 | | | GPS Week # | 1 | 1506 | Full GPS week of the last table update |
| LSB | U2 | | | Ppb | 1 | 4 | Array LSB Scaling of Min[] and Max[] |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Aging Bin | U1 | | | | 1 | 37 | Bin of last update |
| Aging Up Count | S1 | | | | 1 | 4 | Aging up / down count accumulator |
| Bin Count | U1 | | | | | | Count of bins filled |
| Spare2 | U1 | | | | | | |
| Min [] | 1 * 64 | | | Ppb * LSB | | | Min XO error at each temp scaled by LSB |
| Max[] | 1 * 64 | | | Ppb * LSB | | | Max XO error at each temp scaled by LSB |

Table 6.239: TCXO Learning Temperature Table Message

### 6.76.3 TCXO Learning Temperature Recorder - Message ID 93, Sub ID 4

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x04 |
| SID (Dec) | 4 |
| SID Name in Code | TEMP_RECORDER_MESSAGE |

**Table 6.240: TCXO Learning Temperature Recorder - Message ID 93, Sub ID 4**

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 4 | Temp recorder output |
| Current | U4 | | | ms | | | Time since power on |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Time Count RTC 1 sec time tag | U2 | | | sec | | | RTC One Second Time of the TR value |
| TR value | U1 | | | C | 140/ 256 – 40C | | Temperature Recorder value |
| N Count | U1 | | | | | | TR Queue rec count |
| Total Count | U1 | | | | | | TR Queue total count |
| Status | U1 | | | | | | Bit 1:<br>0 = New TRec readings will update Temperature Table<br>1 = Ignore updates to the Temperature Table |
| Seq number | U2 | | | | | | Sequence number counter. Set to 0 at startup, incremented for each output and rollover on overflow |

Table 6.241: TCXO Learning Temperature Recorder Message

## 6.76.4 TCXO Learning EARC - Message ID 93, Sub ID 5

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x05 |
| SID (Dec) | 5 |
| SID Name in Code | EARC |

Table 6.242: TCXO Learning EARC - Message ID 93, Sub ID 5

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 5 | EARC output |
| Current Time Count | U4 | | | ms | | | Time since power on |
| Acqclk lsw | U4 | | | | | | EARC latched time |
| RTC Wclk Secs | U4 | | | | | | EARC latched RTC Wclk Secs |
| RTC Wclk Counter | U2 | | | ms | | | EARC latched RTC Wclk Counter |
| EARC r0 | U2 | | | | | | EARC r0 |
| EARC r1 | U2 | | | | | | EARC r1 |
| spare | U2 | | | | | | |

Table 6.243: TCXO Learning EARC Message

## 6.76.5 TCXO Learning RTC Alarm - Message ID 93, Sub ID 6

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x06 |
| SID (Dec) | 6 |
| SID Name in Code | RTC_ALARM |

Table 6.244: TCXO Learning RTC Alarm - Message ID 93, Sub ID 6

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 6 | RTC alarm output |
| Current Time Count | U4 | | | ms | | | Time since power on |
| Acq Clock LSW | U4 | | | | | | Latched Acq clock least significant word |
| RTC Wclk Secs | U4 | | | | | | Latched RTC Wclk Secs |
| RTC Wclk Counter | U2 | | | | | | Latched RTC Wclk counter |
| spare | U2 | | | | | | |

Table 6.245: TCXO Learning RTC Alarm Message

### 6.76.6 TCXO Learning RTC Cal - Message ID 93, ID 7

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x07 |
| SID (Dec) | 7 |
| SID Name in Code | RTC_CAL |

Table 6.246: TCXO Learning RTC Cal - Message ID 93, ID 7

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 7 | RTC calibration output |
| Current Time Count | U4 | | | ms | | | Time since power on |
| ACQ Clock LSW | U4 | | | ns | 60.99 | | ACQ Clock LSW in 60.99 ns resolution |
| GPS Time Int | U4 | | | | | | Integer part of GPS Time |
| GPS Time Frac | U4 | | | ns | | | Fractional part of GPS Time |
| RTC WClk Sec | U4 | | | sec | | | RTC WClk Seconds |
| RTC WClk Ctr | U2 | | | sec | 1/ 32768 | | Rtc Wclk counter |
| RTC Freq Unc | U2 | | | ppb | 1e-3 | | RTC Freq Unc |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| RTC / Acq Drift Int | U4 | | | | | | Integer part of RTC Drift RTC |
| Drift Frac | U4 | | | | | | Fractional part of RTC Drift |
| RTC Time Unc | U4 | | | sec | 1e-6 | | RTC Time Unc |
| RTC / GPS Drift | I4 | | | Hz | 1/L1 | | RTC / GPS Drift |
| Xo Freq Offset | U4 | | | Hz | 1/L1 | | XO Frequency offset |
| GPS Week | U2 | | | | | | |
| GPS Week Spare | U2 | | | | | | |

Table 6.247: TCXO Learning RTC Cal Message

### 6.76.7 TCXO Learning TBD (Not Used) - Message ID 93, Sub ID 8

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x08 |
| SID (Dec) | 8 |
| SID Name in Code | Not used |

**Table 6.248: TCXO Learning TBD (Not Used) - Message ID 93, Sub ID 8**

### 6.76.8 TCXO Learning MPM Searches - Message ID 93, Sub ID 9

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x09 |
| SID (Dec) | 9 |
| SID Name in Code | MPM_SEARCHES |

**Table 6.249: TCXO Learning MPM Searches - Message ID 93, Sub ID 9**

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 9 | MPM searches output |
| Number of records | U1 | | | | | | Number of records |
| Spare1 | U1 | | | | | | |
| Spare2 | U2 | | | | | | |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Current Time Count | U4 | | | ms | | | Time since power on |
| Acqclk lsw | U4 | | | | | | |
| following fields are based on number of records | | | | | | | |
| Code Phase record [num] | U4 | | | | | | Code phase |
| Doppler [num] | I4 | | | | | | |
| Frequency Code Offset | U4 | | | | | | |
| Peak Mag | U4 | | | dB-Hz | | | Peak Magnitude |
| Status [num] | U2 | | | | | | |
| SVID [num] | U1 | | | | | | SVID searched |
| Spare [num] | U1 | | | | | | |

Table 6.250: TCXO Learning MPM Searches Message

### 6.76.9 TCXO Learning MPM Pre-Positioning - Message ID 93, Sub ID 10

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x0A |
| SID (Dec) | 10 |
| SID Name in Code | MPM_PREPOS |

**Table 6.251: TCXO Learning MPM Pre-Positioning - Message ID 93, Sub ID 10**

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 10 | MPM prepos output |
| Number of records | U1 | | | | | | Number of records |
| Spare1 | U1 | | | | | | |
| Spare2 | U2 | | | | | | |
| Current Time Count | U4 | | | ms | | | Time since power on |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Acqclk lsw | U4 | | | | | | acqclk, lsw |
| following fields are based on number of records | | | | | | | |
| Pseudo Range [num] | U4 | | | m | | | Pseudo Range of the SVID |
| Pseudo Range Rate [num] | U2 | | | m/s | | | Pseudo Range Rate of the SVID |
| SVID [num] | U1 | | | | | | SVIDs searched in MPM search list |
| Spare [num] | | | | | | | |

Table 6.252: TCXO Learning MPM Pre-Positioning Message

## 6.76.10 TCXO Learning Micro-Nav Measurement - Message ID 93, Sub ID 11

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x0B |
| SID (Dec) | 11 |
| SID Name in Code | MICRO_NAV_MEASUREMENT |

Table 6.253: TCXO Learning Micro-Nav Measurement - Message ID 93, Sub ID 11

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 11 | Micro Nav measurements output |
| Number of measure ments | U1 | | | | | | Number of measurements in the message |
| Mode | U1 | | | | | | Operational mode |
| Spare | U2 | | | | | | |
| Current Time Count | U4 | | | ms | | | Time since power on |
| Acqclk lsw | U4 | | | | | | acqclk, lsw |
| Time Corr | S4 | | | ms | 1e6 | | Time Correction |
| Time Corr Unc | U4 | | | ms | 1e6 | | Time Correction Uncertainty |
| Freq Corr | S2 | | | MHz | 1575<br>0.42 | | TCXO Oscillator Frequency Correction; Scale by L1 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Freq Corr Unc | U2 | | | MHz | 1575 0.42 | | TCXO Oscillator Frequency Correction Uncertainty; Scale by L1 |
| following fields are based on number of measurements | | | | | | | |
| Pseudo | U4 | | | m | 10 | | PR |
| Range[num] | | | | | | | |
| Pseudo Range Rate [num] | S2 | | | m/s | | | PRR |
| C/No [num] | U2 | | | | 10 | | |
| C/No SVID [num] | U1 | | | | | | SVID |
| Spare1[num ] | U1 | | | | | | |
| Spare | U1 | | | | | | |

Table 6.254: TCXO Learning Micro-Nav Measurement Message

## 6.76.11 TCXO Learning TCXO Uncertainty - Message ID 93, Sub ID 12

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x0C |
| SID (Dec) | 12 |
| SID Name in Code | TCXO_UNCERTAINTY |

Table 6.255: TCXO Learning TCXO Uncertainty - Message ID 93, Sub ID 12

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 12 | TCXO Uncertainty |
| Current Time Count | U4 | | | Ms | | | Time since power on |
| Acqclk.lsw | U4 | | | | | | Acqclk.lsw |
| Frequency | U4 | | | Hz | | | Clock Drift Frequency |
| Frequency Uncertainty Nominal | U2 | | | ppb | | | Nominal Frequency uncertainty = A + T + M |
| Frequency Uncertainty Full | U2 | | | Ppb | | | Full Frequency Uncertainty = A + T + M |
| Temperature Uncertainty Nominal | U2 | | | Ppb | | | Temperature (T) uncertainty component, nominal |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Temperature Uncertainty | U2 | | | Ppb | | | Temperature (T) uncertainty component, full |
| Full Aging Uncertainty Nominal | U2 | | | Ppb | | | Aging (A) uncertainty component, nominal |
| Measurement Uncertainty Nominal | U2 | | | ppb | | | Measurement (M) uncertainty component, nominal |
| Measurement Uncertainty Full | U2 | | | ppb | | | Measurement (M) uncertainty component, full |
| GPS Week # | U2 | | | GPS Week # | | | Current GPS Week number of the uncertainty data |
| Temperature | U1 | | | Deg C | 140/ 256 - 40 | | Raw temperature in 0.549 degrees resolution |
| Spare | U1 | | | | | | |
| Spare | U4 | | | | | | |

Table 6.256: TCXO Learning TCXO Uncertainty Message

## 6.76.12 TCXO Learning System Time Stamp - Message ID 93, Sub ID 13

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | MID_TCXO_LEARNING_OUT |
| SID (Hex) | 0x0D |
| SID (Dec) | 13 |
| SID Name in Code | SYSTEM_TIME_STAMP |

Table 6.257: TCXO Learning System Time Stamp - Message ID 93, Sub ID 13

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| Message ID | U1 | | | | | 93 | TCXO Learning Output |
| Sub ID | U1 | | | | | 13 | System time stamps |
| Current Time Count | U4 | | | Ms | | | Time since power on |
| ACQ Clk msw | U4 | | | ns | | | Acq Clock Msw |
| ACQ Clk lsw | U4 | | | ns | | | Acq Clock Lsw |
| TOW Int | U4 | | | Sec | | | Integer part of TOW |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Description |
|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | |
| TOW Frac Ns | U4 | | | Nsec | | | Fractional part of TOW |
| RTC Seconds | U4 | | | sec | 1 | | RTC Seconds |
| RTC Counter | U2 | | | us | 1/ 32768 | | RTC Counter Value |
| Clock Bias | I4 | | | | | | Clock Bias, m |
| Clock Drift | I4 | | | | | | Clock Drift, m/s |
| Spare | U2 | | | | | | |

Table 6.258: TCXO Learning System Time Stamp Message

### 6.76.13 Temperature Value Output - MID 93, SID 18

This message transmits temperature and related data.

**Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | 0x5D |
| MID (Dec) | 93 |
| Message Name in Code | `MID_XoLearningOut` |
| SID (Hex) | 0x12 |
| SID (Dec) | 18 |
| SID Name in Code | `SIRF_MSG_SSB_XO_TEMP_REC_VALUE` |

**Table 6.259: Temperature Value Output - MID 93, SID 18**

| Name | Bytes | Unit | Scale | Range | Description |
|---|---|---|---|---|---|
| MID | 1 | - | - | - | Message ID |
| SID | 1 | - | - | - | Sub ID |
| GPS TOW | 4 | Sec | - | - | - |
| GPS Week | 2 | - | - | - | - |
| Time Status | 1 | - | - | 0 - 7 | For bit field information seeTable 6.261 |
| Clock Offset | 1 | Sec | - | - | - |
| Clock Drift | 4 | Hz | - | - | - |

| Name | Bytes | Unit | Scale | Range | Description |
|---|---|---|---|---|---|
| Clock Drift Uncertainty | 4 | Hz | - | - | - |
| Clock Bias | 4 | nsec | - | - | - |
| Temperature | 1 | degrees Celcius | 0.54902 | 0 - 255 | 0 = -40 degrees Celcius<br>255 = 100 degrees Celcius |
| Reserved | 1 | - | - | - | - |
| Reserved | 1 | - | - | - | - |
| Reserved | 1 | - | - | - | - |

Table 6.260: Message Fields Description

| Time Status | |
|---|---|
| **Bit Field** | **Description** |
| [0] | Week is set (T/F) |
| [1] | TOW is available (T/F) |
| [2] | TOW is precise (T/F) |

Table 6.261: Bit Field Description

## 6.77 SW Toolbox Output - Message ID 178

(Remember, Output means Host to User System.) These messages allow the User System to access Tracker features via the Host. The Host will essentially map the MEI responses from the Tracker to SSB responses for the User System. The mapping is required since a direct pass-through is not always allowed. Some Tracker responses will require a corresponding change to the Host (for example, a change to the Tracker baud rate will necessitate a change at the Host or communication will be lost).

| | |
|---|---|
| MID (Hex) | 0xB2 |
| MID (Dec) | 178 |
| Message Name in Code | MID_TrackerIC (see PROTOCOL.H) |
| SID (Hex) | As below |
| SID (Dec) | As below |
| SID Name in Code | As below |

**Table 6.262: SW Toolbox Output - Message ID 178**

## 6.77.1 Peek/Poke Response- Message ID 178, Sub ID 4

### 6.77.1.1 Tracker Peek Response (four-byte peek) (unsolicited)

Upon reception of the MEI 0xA0 (Peek Response) from the Tracker, the Host will generate this response for the User System.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x04 |
| Type | 1 | enumeration<br>0 = Peek results<br>10 = eFUSE peek results (4e and beyond only) |
| Address | 4 | unsigned integer |
| Data | 4 | always four bytes |

**Table 6.263: Tracker Peek Response (four-byte peek) (unsolicited)**

### 6.77.1.2 Tracker Poke Response (four-byte poke or n-byte poke) (unsolicited)

Upon reception of the MEI 0x81 (Acknowledge for poke) from the Tracker, the Host will generate this response for the User System.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x04 |
| Type | 1 | enumeration<br>1 = Poke command received |

Table 6.264: Tracker Poke Response (four-byte poke or n-byte poke) (unsolicited)

#### 6.77.1.3 Tracker Peek Response (n-byte peek) (unsolicited)

Upon reception of the MEI 0xA0 (Peek Response) from the Tracker, the Host will generate this response for the user system.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x04 |
| Type | 1 | enumeration<br>2 = Multi-peek response<br>12 = eFUSE multi-peek response (4e and beyond only) |
| Address | 4 | unsigned integer<br>Beginning address |
| Number of Bytes | 2 | unsigned integer<br>Range: 0 to 1000 |
| Data | Number of Bytes | |

Table 6.265: Tracker Peek Response (n-byte peek) (unsolicited)

### 6.77.2 FlashStore Response - Message ID 178, Sub ID 5

Upon reception of the Bootloader ACK/NAK (for the FS command) from the Tracker, the Host will generate this response for the User System.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x05 |
| Result | 4 | Zero = Flash write successful<br>Non-zero = Flash write unsuccessful |

Table 6.266: FlashStore Response - Message ID 178, Sub ID 5

### 6.77.3 FlashErase Response - Message ID 178, Sub ID 6

Upon reception of the Bootloader ACK/NAK (for the FE command) from the Tracker, the Host will generate this response for the User System.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x06 |
| Result | 4 | Zero = Flash erase successful<br>Non-zero = Flash erase unsuccessful |

Table 6.267: FlashErase Response - Message ID 178, Sub ID 6

### 6.77.4 TrackerConfig Response - Message ID 178, ID 7

Upon reception of the MEI 0x81 (Acknowledge for MEI 0x0A) from the Tracker, the Host will generate this response for the User System.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x07 |

Table 6.268: TrackerConfig Response - Message ID 178, ID 7

### 6.77.5 MeiToCustomIo Response - Message ID 178, Sub ID 8

Upon reception of the MEI 0x81 (Acknowledge for MEI 0x1F) from the Tracker, the Host will generate this response for the User System.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x08 |

Table 6.269: MeiToCustomIo Response - Message ID 178, Sub ID 8

Once the custom I/O has been started, note a hard reset will NOT restore the Tracker to the MEI protocol. The custom I/O selection is remembered as long as BBRAM is maintained or, depending on the firmware loaded, external flash memory is used.

### 6.77.6 Tracker Configuration Poll Response - MID 178, SID 10

This message allows the User System to access Tracker features via the Host. The Host will map the SSB requests from the User System to MEI requests for the Tracker. The mapping is required since a direct pass-through is not always allowed. Some User System requests will require a corresponding change to the Host (for example, a change to the Tracker baud rate will require a change at the Host or communication will be lost). This message contains Tracker Configuration information, see Table 2 for message definitions of the tracker configuration.

Also, this message reports current tracker configuration. Output is in response to poll (MID 178, SID 9).

On receipt of the OSP Message 0xB2 0x09, Tracker Configuration Poll, GSD4e generates this response message.

**Important Note:**

This message is supported starting at version 4.1.0.

| | |
|---|---|
| MID (Hex) | B2 |
| MID (Dec) | 178 |
| MID Name in Code | `SIRF_MSG_SSB_TRACKER_IC` |
| SID (Hex) | 0A |
| SID (Dec) | 10 |
| SID Name in Code | `SIRF_MSG_SSB_TRKR_CONFIG_POLL_RSP` |

Table 6.270: Tracker Configuration Poll Response - MID 178, SID 10

| Name | Byte | ASCII (Dec) | Description |
|---|---|---|---|
| | | Example | |
| MID | 1U | B2 | Message ID |
| SID | 1U | OA | Sub ID |

Table 6.271: Message Fields Description

### 6.77.7 Customer Configuration Kit Poll Response – MID 178, SID 12

On reception of the OSP message 0xB2 0x0B (Poll CCK Parameters) from the CP, the SLC of a GSD4e or any subsequent SiRFstar 'e' location engine chip product will generate this response message.

**Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | B2 |
| MID (Dec) | 178 |
| Message Name in Code | `SIRF_MSG_SSB_TRACKER_IC` |
| SID (Hex) | 0C |
| SID (Dec) | 12 |
| SID Name in Code | `SIRF_MSG_SSB_CCK_POLL_RSP` |

Table 6.272: Customer Configuration Kit Poll Response – MID 178, SID 12

Additional fields added to this message to output the data logger CCK values.

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| MID | 1 | - | B2 | - | - | 178 | - | Message ID |
| SID | 1 | - | 0C | - | - | 12 | - | Sub ID |
| Baud rate | 4 | - | 00 01 C2 00 | Baud | - | 115200 | - | Baud rate. Default 115200 baud |
| I2C host address | 4 | - | 00 00 00 62 | - | - | 98 | - | I2C address of Host Default 98 |
| I2C 4e address | 4 | - | 00 00 00 60 | - | - | 96 | - | I2C addreess of GSD4e. Default 96 |
| Wait states | 4 | - | 00 00 00 0A | - | - | 10 | - | 4E flash wait states. Default 10 wait states. |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| TCXO Warm up delay | 4 | - | 00 00 03 FF | RTC clock ticks | - | 1023 | - | TCXO Warm up delay in RTC clock ticks. Default 1023 |
| CGEE disable num seconds | 4 | - | FF FF FF FF | sec | - | 4294967295 | - | Number of seconds after which to disable CGEE. (default 0xFFFFFFFF means this field is not set by the user - CGEE always enabled, 0 means disable CGEE permanently, x=disable CGEE after x seconds) |
| Max EPE limit | 4 | - | 45 83 40 00 | meter (Float value) | - | 4200.00f | - | Autonomous OoS limit. Default 4200.00 m |
| GPIO0 | 2 | - | 03 FC | - | - | 1020 | - | GPIO 0 configuration. (2) |
| GPIO1 | 2 | - | 03 FC | - | - | 1020 | - | GPIO 1 configuration. (2) |
| GPIO2 | 2 | - | 00 04 | - | - | 4 | - | GPIO 2 configuration. (2) |
| GPIO3 | 2 | - | 00 3E | - | - | 62 | - | GPIO 3 configuration. (2) |
| GPIO4 | 2 | - | 00 00 | - | - | 0 | - | GPIO 4 configuration. (2) |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| GPIO5 | 2 | - | 00 7C | - | - | 124 | - | GPIO 5 configuration. (2) |
| GPIO6 | 2 | - | 00 00 | - | - | 0 | - | GPIO 6 configuration. (2) |
| GPIO7 | 2 | - | 00 00 | - | - | 0 | - | GPIO 7 configuration. (2) |
| Rx pin | 2 | - | 00 00 | - | - | 0 | - | Rx pin configuration (2) |
| Tx pin | 2 | - | 00 00 | - | - | 0 | - | Tx pin configuration. (2) |
| GPIO8 | 2 | - | 00 00 | - | - | 0 | - | GPIO 8 configuration. (2) |
| Max Altitude | 2 | - | 09 60 | meter | - | 2400 | - | Maximum allowed altitude for a position fix. |
| MEMS I2C address 0 | 1 | - | 18 | - | - | 24 | - | Default Sensor 0 address |
| MEMS I2C address 1 | 1 | - | 00 | - | - | 0 | - | Default Sensor 1 address |
| MEMS I2C address 2 | 1 | - | 00 | - | - | 0 | - | Default Sensor 2 address |
| MEMS 12C address 3 | 1 | - | 00 | - | - | 0 | - | Default Sensor 3 address |
| Flash I2C address | 1 | - | 50 | - | - | 80 | - | Default EEPROM I2C address |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| IO protocol | 1 | - | 00 | enum[1] | - | 0 | - | IO protocol. Default 0 (OSP) |
| IO Rate 0 | 1 | - | 00 | enum[1] | - | 0 | - | 50 bps message. Default 0 = (50 bps Msg 8 disabled) |
| IO Rate 1 | 1 | - | 00 | enum[1] | - | 0 | - | Raw debug. Default 0 = (Msg 28-31 disabled) |
| IO Rate 2 | 1 | - | 00 | enum[1] | - | 0 | - | Debug messages. Default 0 (Debug messages disabled) |
| IO Rate 3 | 1 | - | 01 | enum[1] | - | 1 | - | GCA rate. Default 1s |
| IO Rate 5 | 1 | - | 00 | enum[1] | - | 0 | - | GLL rate. Default disabled |
| IO Rate 5 | 1 | - | 01 | enum[1] | - | 1 | - | GSA rate. Default 1s |
| IO Rate 6 | 1 | - | 03 | enum[1] | - | 3 | - | GSV rate. Default 5s |
| IO Rate 7 | 1 | - | 01 | enum[1] | - | 1 | - | RMC rate. Default 1s |
| IO Rate 8 | 1 | - | 00 | enum[1] | - | 0 | - | VTG rate. Default disabled |
| IO Rate 9 | 1 | - | 00 | enum[1] | - | 0 | - | ZDA rate. Default disabled |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| UART flow control | 1 | - | 01 | enum(1) | - | 1 | - | UART flow control. Default 1 (disabled) |
| TCXO frequency | 1 | - | 01 | enum(1) | - | 1 | - | TCXO frequency. Default 1 (16.369 MHz) |
| TCXO uncertainty | 1 | - | 04 | enum(1) | - | 4 | - | TCXO undertainty. Default 04 (2.5 ppm) |
| Tracker Smoothing | 1 | - | 01 | enum(1) | - | 1 | - | Tracker smoothing. Default 1 (disabled) |
| Static Nav | 1 | - | 01 | enum(1) | - | 1 | - | Static Nav. Default 1 (disabled) |
| DR Timeout | 1 | - | 04 | enum(1) | - | 4 | - | DR Timeout. Default 4 (15s) |
| Reverse EE support | 1 | - | 01 | enum(1) | - | 1 | - | Reverse EE. Default 1 (disabled) |
| Startup power mode | 1 | - | 00 | enum(1) | - | 0 | - | Startup power mode Default 0 (full power) |
| Power cycle time | 1 | - | 10 | enum(1) | - | 16 | - | Power cycle time. Default - invalid |
| SPI first bit | 1 | - | 00 | enum(1) | - | 0 | - | SPI first bit. Default 0 (MSB first) |
| SPI mode | 1 | - | 00 | enum(1) | - | 0 | - | SPI first bit. Default 0 (Mode 1) |
| LNA setting | 1 | - | 00 | enum(1) | - | 0 | - | Default 0 = Internal LNA |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| EE storage | 1 | - | 02 | enum(1) | - | 2 | - | Default 2 = parallel flash |
| 12C clock rate | 1 | - | 01 | enum(1) | - | 1 | - | Default 1 = 400 kbps |
| I2C mode | 1 | - | 01 | enum(1) | - | 1 | - | Default 1 = Multi master |
| I2C address type | 1 | - | 00 | enum(1) | - | 0 | - | Default 0 = 7 bit addressing |
| IO Pin config enable | 1 | - | 00 | enum(1) | - | 0 | - | Default 0 = Pin config enabled |
| Host port select | 1 | - | 03 | enum(1) | - | 3 | - | Default 3 = UART |
| Backup LDO control | 1 | - | 01 | enum(1) | - | 1 | - | Default = LDO |
| DR 12C rate | 1 | - | 02 | enum(1) | - | 2 | - | Default 2 = 400 kbps |
| CGEE enable/ disable | 1 | - | 00 | enum(1) | - | 0 | - | Default 0 = CGEE enabled |
| 5 Hz Nav | 1 | - | 01 | enum(1) | - | 1 | - | Default 1 = 5 Hz nav disabled |
| SGEE support | 1 | - | 02 | enum(1) | - | 2 | - | Default 2 = 14 SGEE |
| I2C EEPROM part | 1 | - | 01 | enum(1) | - | 1 | - | Default 1 = ST 128 kB serial flash |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| Low Power Control | 1 | - | 18 | - | - | 24 | - | Default = Limit Pre-Nav Acq and Post - Nav Acq for Almanac SVs<br>0x00 = Do not limit Acq capabilities for Almanac SVs<br>0x08 = limit Acq capability for Almanac SVs prior to Nav<br>0x10 = limit Acq capability for Almanac SVs post Nav (Nav – Navigation, Acq – Acquisition) |
| Fast Time Sync support[3] | 1 | - | 01 | enum[1] | - | 1 | - | Fast Time Sync. Default 1 (disabled) |
| Altitude Source[2] | 4 | - | 00 | - | - | 0 | - | Default 0 – Altitude hold uses Nav Altitude |
| Altitude Mode[2] | 4 | - | 00 | - | - | 0 | - | Default 0 – Altitude hold enabled and uses Nav Altitude |
| Commanded Nav Mode[2] | 4 | - | 05 | - | - | 5 | - | Default Kalman filtering mode |
| Elevation Nav Mask[2] | 2 | - | 32 | 1/10 degrees | - | 50 | - | Default elevation mask for Kalman filtering usage, 1/10 degrees above horizon |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| Nav Power Mask(2) (dbHz) | 1 | - | 08 | - | - | 8 | - | Default 8 dBHz |
| Enable 3SV LSQ(2) | 4 | - | 01 | - | - | 1 | - | Default 1 = enabled |
| DGPS Selection(2) | 4 | - | 00 | - | - | 0 | - | Default 0 = enabled (use if available) |
| Use Smooth Measurements(2) | 4 | - | 01 | - | - | 1 | - | Default 1 = enabled |
| Parity(2) | 4 | - | 00 | - | - | 0 | - | Default Uart Parity = Off |
| Stop(2) | 4 | - | 00 | - | - | 0 | - | Default = Stop Bit 1 |
| DOP Mask Mode(2) | 1 | - | 04 | - | - | 4 | - | Default = enabled |
| GDOP threshold(2) | 1 | - | 0A | - | - | 10 | - | Default 10 |
| PDOP threshold(2) | 1 | - | 0A | - | - | 10 | - | Default 10 |
| HDOP threshold(2) | 1 | - | 0A | - | - | 10 | - | Default 10 |
| Elevation Tracker Mask(2) | 2 | - | 4B | 1/10 degrees | - | 75 | - | Default track mask for Kalman filtering usage, 1/10 degrees above the horizon |
| Position Mode Enable(2) | 1 | - | 00 | - | - | 0 | - | Default 0 |

| Name | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | | Range | Description |
|---|---|---|---|---|---|---|---|---|
| | | Scale | Example | | Scale | Example | | |
| Max Speed[2] | 2 | - | 5DC | m/s | - | 1500 | - | Default 1500 = meters/sec |
| Minimum Altitude[2] | 2 | - | - | 10 meters | - | -500 | - | Default = 50 meters |
| Record Type | U 1 | - | 00 | - | - | 0 | 0 - 4 | Record Type |
| Stop On Memory Full | U 1 | - | 00 | - | - | 0 | 0 - 1 | 0 = Circular buffering<br>1 = Stop logging at end of first pass through store. |
| Distance Threshold | U 2 | - | 05 | m | - | 5 | 0 - 65535 | Current distance threshold setting. |
| Speed Threshold | U 2 | - | 01 | m/s | - | 1 | 0 - 65535 | Current speed threshold setting. |
| Logging Interval | U 2 | - | 0A | sec | - | 10 | 1 - 65535 | Minimum seconds between logging each record. |
| Reserved 1 | 4 | - | 00 00 00 00 | - | - | 0 | - | Reserved Field |
| Reserved 2 | 4 | - | 00 00 00 00 | - | - | 0 | - | Reserved Field |

Table 6.273: Message Field Description

[(1)] See CCK User Guide for enumerated type values. Cognidox reference number is CS-206097-UG.

[(2)] See GSD4e SDK User Guide for supported value types.Cognidox reference number is CS-210291-UG.

[(3)] This feature is supported in GSD4e 4.1.2 or later software.

### 6.77.8 SID_Patch Manager Prompt - Message ID 178, Sub ID 144

This message is sent by the 4e to acknowledge a Patch Manager Start Request.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x90 |
| Chip Id | 2 | 4e Chip Id (0x41) |
| Silicon Id | 2 | 4e Silicon Id (0..15) |
| ROM Version Code | 2 | ROM Version code embedded in the 4e code in armstart.s |
| Patch Revision Code | 2 | Current version of Patch applied to the Flash/ROM code |

Table 6.274: SID_Patch Manager Prompt - Message ID 178, Sub ID 144

**Chip Id**: This field contains the chip version extracted from 4e chip version register.

**Silicon Version**: This field contains the silicon version extracted from 4e chip version register.

**ROM Version Code**: This field indicates a unique version code by which the ROM code running on the Target is identified. Value is interpreted as big endian number.

**Patch Revision Code**: This field contains the version of Patch Code currently applied to the ROM chip. A value of 0 indicates that no Patch is applied. The value is interpreted as big endian number.

### 6.77.9 Patch Manager Acknowledgement - Message ID 178, Sub ID 145

This message is sent by the 4e to acknowledge the Host Patch Protocol messages: Patch Memory Load Request and Patch Manager Exit Request. If 4e is acknowledging the Patch Manager Exit Request the Message Sequence Number is set to 0, since there is no Message Sequence Number in the Patch Manager Exit Request.

| Field | Length (bytes) | Description |
|---|---|---|
| MID | 1 | 0xB2 |
| SID | 1 | 0x91 |
| Message Sequence Number | 2 | Message Sequence Number |
| Sub Id Acknowledged | 1 | The Host Sub Id message being acknowledged |
| Acknowledge Status | 1 | Status response |

Table 6.275: Patch Manager Acknowledgement - Message ID 178, Sub ID 145

**Message Sequence Number**: The Sequence No field of the Patch Memory Load Request message being acknowledged. This field is set to 0, when acknowledging the Patch Manager Exit Request.

**Sub Id Acknowledged**: This field echoes back the Sub Id of the Host message that is being acknowledged.

**Acknowledge Status**: This field describes the status of the requested operation as in Table 6.276:

| Bit 1 | Bit 0 (LSB) | Status |
|---|---|---|
| 1 | 1 | Message successfully received, Operation successful |
| 1 | 0 | Message successfully received, Operation unsuccessful.<br>/* Reason for Operation Failure */<br>#define PATCH_RAM_CRC_FAILURE 0x04<br>#define DEVICE_OPEN_ERROR 0x08<br>#define DEVICE_CLOSE_ERROR 0x10<br>#define DEVICE_WRITE_ERROR 0x20<br>#define DEVICE_READ_ERROR 0x40 |

Table 6.276: Patch Manager Acknowledge Status Bit Fields

## 6.78 Message ID 225

This output message is CSR proprietary except for Message Sub ID 6.

## 6.79 Statistics Channel – Message ID 225, Sub ID 6

The message is only used by GSW3, GSWLT3, and SiRFLoc v3.x software and outputs the TTFF, aiding accuracy information and navigation status.

Output Rate: Once after every reset.

**Note:**

> Message ID 225, Sub ID 6 only comes out when the debug messages are enabled. The debug message feature is enabled by either setting the output rate of message 225 using Message ID 166 or by setting bit 5 (enable debug data bit) in the configuration bit map of Message ID 128.

**Note:**

> Message ID 225, Sub ID 6 may not be output when the system is not able to compute a navigation solution. This message is not supported by APM.

Example:

`A0A20027` – Start Sequence and Payload Length (39 bytes)

`E106` – Message ID and Message Sub ID

`01000000000000000000000000000000000000000000000000000000000000001010000`
`000` – Payload

`0107B0B3` – Message Checksum and End Sequence

| Name | Sub Field | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | | Range | Invalid Data |
|---|---|---|---|---|---|---|---|---|---|
| | | | Scale | Example | | Scale | Example | | |
| Message ID | | 1 U | | E1 | | | 225 | | |
| Message Sub ID | | 1 U | | 06 | | | 6 | | |
| TTFF | Since reset[1] | 2 U | | | sec | 0.1 | range from 0 .0 to 6553.5 | 0 to 6553.5 | 0xFF |
| | Since all aiding received[2] | 2 U | | | sec | | 0 | 0 to 6553.5 | |
| | First nav since reset[1] | 2 U | | | sec | | 0 | 0 to 6553.5 | |
| Position Aiding Error | North[1] | 4 S | | | meter | | | 0 $-2^{31}$ to $(2^{31}-1)$ | 0xFF |
| | East[1] | 4 S | | | meter | | | 0 $-2^{31}$ to $(2^{31}-1)$ | 0xFF |
| | Down[1] | 4 S | | | meter | | | 0 $-2^{31}$ to $(2^{31}-1)$ | 0xFF |
| Time Aiding Error[1] | | 4 S | | | μs for Precise Time ms for Coarse Time | | 0 | 0 to $2^{32}$ | 0xFF |
| Frequency Aiding Error[1] | | 2 S | | | 0.001 ppm | | 0 | 0 to 65535 | 0xFF |
| Position Uncertainty Horizontal[1] | | 1 U | | | | | 0 | | N/A |
| Vertical[1] | | 2 U | | | | | 0 | | N/A |
| Time Uncertainty[1] | | 1 U | | | | | 0 | | N/A |
| Frequency Uncertainty[1] | | 1 U | | | | | 0 | | N/A |

| Name | Sub Field | Bytes | Binary (Hex) | | Unit | ASCII (Decimal) | | Range | Invalid Data |
|---|---|---|---|---|---|---|---|---|---|
| | | | Scale | Example | | Scale | Example | | |
| Number of Aided Ephemeris[(1)] | | 1 U | | | | | 0 | | 0x00 |
| Number of Aided Acquisition Assistance[(1)] | | 1 U | | | | | 0 | | 0x00 |
| Navigation and Position Status Navigation Mode[(2)] | | 1 D | | | | | See Table 6.278 | | N/A |
| Position Mode[(2)] | | 1 D | | | | | See Table 6.279 | | N/A |
| Status[(2)] | | 2 D | | | | | See Table 6.280 and Table 6.281 | | N/A |
| Start Mode[(2)] | | 1 D | | | | | See Table 6.282 | | N/A |
| Reserved[(1)] | | 1 U | | | | | | | |

**Table 6.277: Statistic Channel - Message ID 225, Sub ID 6**

(1) Valid for GSW only

(2) Valid with SiRFLoc only

| Bit Fields | Description |
|---|---|
| 0 | No Nav |
| 1 | Approximate from SV records |
| 2 | Time transfer |
| 3 | Stationary mode |
| 4 | LSQ fix |
| 5 | KF nav |
| 6 | SiRFDRive |
| 7 | DGPS base |

Table 6.278: Description of the Navigation Mode Parameters

| Bit Fields | Description |
|---|---|
| 0 | Least Square (LSQ) mode 0 – no bit sync, approximate GPS time |
| 1 | LSQ mode 1 – no bit sync, accurate GPS time |
| 2 | LSQ mode 2 – bit sync, no frame sync, approximate GPS time |
| 3 | LSQ mode 3 – bit sync, no frame sync, accurate GPS time |
| 4 | LSQ mode 4 – bit and frame sync, user time (without aiding) See Table 6.280 |
| 5 | KF mode – Kalman Filtering |
| 6 | No position |
| 7 | Not used |

Table 6.279: Description of the Position Mode Parameters

| Value | Status |
|---|---|
| 0x00 | Good solution |
| 0x01 | Uncertainty exceeded maximum (UNCER_EXCEED) |
| 0x02 | Input information to navigation had error (INPUT_ERR) |
| 0x04 | Not sufficient information to have a fix position (UNDER_DETERM) |
| 0x08 | Matrix inversion failed (MATR_INVT) |
| 0x010 | LSQ iteration exceeds predefined maximum (ITER_OUT) |
| 0x020 | Altitude check failed (ALT_OUT) |
| 0x040 | GPS time check failed (TIME_OFF) |
| 0x080 | Failure found in measurements (FDI_FAIL) |
| 0x100 | DOP exceeded threshold (DOP_FAIL) |
| 0x200 | Velocity check failed (VEL_FAIL) |

Table 6.280: Description of the Status for Navigation LSQ Fix Mode



| Value | Status |
|---|---|
| 0 | Solution is good |
| 1 | No solution |
| 2 | Altitude is out of range |
| 3 | Velocity is out of range |

Table 6.281: Description of the Status for Navigation KF Mode

| Value | Description |
|---|---|
| 0x00 | Cold |
| 0x01 | Warm |
| 0x02 | Hot |
| 0x03 | Fast |

**Table 6.282: Description of the Start Mode**

## 6.80 Statistics Channel – Message ID 225, Message Sub ID 7

This message serves for development purposes only. It is sent only after receiveing a MID_POS_REQ 0xD2 message. The content, the format and the enabling conditions are identical to those for the 225, 6 message which is documented in the SSB ICD. The last, “Aiding Flags” field is specific to 225, 7.

| Name | Sub Field | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | |
|---|---|---|---|---|---|---|---|
| | | | Scale | Example | | Scale | Example |
| Message ID | | 1U | | E1 | | | 225 |
| Message Sub ID | | 1U | | 07 | | | 7 |
| TTFF | Since reset | 2U | | | sec | 0.1 | Range from 0 .0 to 6553.5 |
| | Since all aiding received(1) | 2U | | | | | 0 |
| | First nav since reset(1) | 2U | | | | | 0 |
| Position Aiding Error | North(1) | 4S | | | | | 0 |
| | East(1) | 4S | | | | | 0 |
| | Down(1) | 4S | | | | | 0 |
| Time Aiding Error(1) | | 4S | | | | | 0 |
| Frequency Aiding Error(1) | | 2S | | | | | 0 |
| Position Uncertainty | Horizontal(1) | 1U | | | | | 0 |
| | Vertical(1) | 2U | | | | | 0 |
| Time Uncertainty(1) | | 1U | | | | | 0 |

| Name | Sub Field | Bytes | Binary (Hex) | | Unit | ASCII (Dec) | |
|---|---|---|---|---|---|---|---|
| | | | Scale | Example | | Scale | Example |
| Frequency Uncertainty[1] | | 1U | | | | | 0 |
| Number of Aided Ephemeris[2] | | 1U | | | | | 0 |
| Number of Aided Acquisition Assistance[1] | | 1U | | | | | 0 |
| Navigation and Position Status | Navigation Mode | 1D | | | | | See Table 6.284, Table 6.285 |
| | Position Mode | 1D | | | | | See Table 6.286 |
| | Status | 2D | | | | | See Table 6.287 and Table 6.288 |
| Start Mode | | 1D | | | | | see Table 6.289 |
| Aiding Flags[1] | | 1U | | | | | see Table 6.290 |
| System Clock Drift | | 4U | | | Hz | | |
| Reserved | | 4U | | | | | |

Table 6.283: Statistics Channel – Message ID 225, Message Sub ID 7

[1] Valid with SiRFLoc only

[2] Not currently used

Note:

Payload length: 39 bytes

| Bit Field | Description |
|---|---|
| 0 | No Nav |
| 1 | Approximate from SV records |
| 2 | Time transfer |
| 3 | Stationary mode |

Table 6.284: Description of the Navigation Mode Parameters

| Bit Field | Description |
| --- | --- |
| 4 | LSQ fix |
| 5 | KF nav |
| 6 | SiRFDRive |
| 7 | DGPS base |

Table 6.285: Description of the Navigation Mode Parameters

| Bit Field | Description |
| --- | --- |
| 0 | Least Square (LSQ) mode 0 – no bit sync, approximate GPS time |
| 1 | LSQ mode 1 – no bit sync, accurate GPS time |
| 2 | LSQ mode 2 – bit sync, no frame sync, approximate GPS time |
| 3 | LSQ mode 3 – bit sync, no frame sync, accurate GPS time |
| 4 | LSQ mode 4 – bit and frame sync, user time (without aiding) See Table 6.287 |
| 5 | KF mode – Kalman Filtering |
| 6 | No position |
| 7 | Not used |

Table 6.286: Description of the Position Mode Parameters

| Value | Status |
| --- | --- |
| 0x00 | Good solution |
| 0x01 | Uncertainty exceeded maximum (UNCER_EXCEED) |
| 0x02 | Input information to navigation had error (INPUT_ERR) |
| 0x04 | Not sufficient information to have a fix position (UNDER_DETERM) |
| 0x08 | Matrix inversion failed (MATR_INVT) |

| Value | Status |
|---|---|
| 0x10 | LSQ iteration exceeds predefined maximum (ITER_OUT) |
| 0x20 | Altitude check failed (ALT_OUT) |
| 0x40 | GPS time check failed (TIME_OFF) |
| 0x80 | Failure found in measurements (FDI_FAIL) |
| 0x0100 | DOP exceeded threshold (DOP_FAIL) |
| 0x0200 | Velocity check failed (VEL_FAIL) |

Table 6.287: Description of the Status for Navigation LSQ Fix Mode

| Value | Status |
|---|---|
| 0 | Solution is good |
| 1 | No solution |
| 2 | Altitude is out of range |
| 3 | Velocity is out of range |

Table 6.288: Description of the Status for Navigation KF Mode

| Value | Description |
|---|---|
| 0x00 | Cold |
| 0x01 | Warm |
| 0x02 | Hot |
| 0x03 | Fast |

Table 6.289: Description of the Start Mode

| Value | Description |
|---|---|
| 0x00 | There was NO time transfer |
| 0x01 | Precise Time transfer has taken place, with or without aiding |
| 0x02 | Coarse Time transfer has taken place, with or without aiding |

| Value | Description |
|---|---|
| 0x04 | External Position Aiding Received and Used |
| 0x08 | External Position Aiding Received but Not Used |
| 0x10 | External Time Aiding Received and Used |
| 0x20 | External Time Aiding Received but Not Used |
| 0x40 | External Frequency Aiding Received and Used |
| 0x80 | External Frequency Aiding Received but Not Used |

**Table 6.290: Description of the Aiding Flags (Build Numbers 4.0.2 and later)**

## 6.81 ASCII Development Data Output - Message ID 255

Output Rate: Receiver generated.

Example:

`A0A2....` – Start Sequence and Payload Length (Length variable)

`FF....` – Payload

`....B0B3` – Message Checksum and End Sequence

| Field | Type | Length (bytes) | Description |
|---|---|---|---|
| Message ID | U1 | 1 | 0xFF |
| msg_text | U256 | 256 | ASCII string of the message. The actual text length is determined by message length parameter in the header. The msg_text string in this field is not nullterminated. |

**Table 6.291: ASCII Development Data Output - Message ID 255**

Note:

Message ID 255 is output when OSP is selected and development data is enabled. It can also be enabled by setting its output rate to 1 using Message ID 166. The data output using Message ID 255 is essential for SiRF-assisted troubleshooting support.

The ASCII text output can be enabled or disabled after restart using the restart flags of the initialization message MID 128.

## 6.82 Data Log Compatibility Record - MID 225, SID 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.

**Important Note:**

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | E1 |
| MID (Dec) | 225 |
| Message Name in Code | `SIRF_MSG_SSB_SIRF_INTERNAL_OUT` |
| SID (Hex) | 20 |
| SID (Dec) | 32 |
| SID Name in Code | `SIRF_MSG_SSB_DL_COMPAT_REC_OUT` |

Table 6.292: Data Log Compatibility Record - MID 225, SID 32

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | E1 | 225 | - | - | - | Message ID |
| SID | U1 | 20 | 32 | - | - | - | Sub ID |
| Latitude | S4 | 13E49AB2 | 33378914 | degree | x $10^7$ | +/- 90 | + = North |
| Longitude | S4 | BD41CA24 | -1119761884 | degree | x $10^7$ | +/- 180 | + = East |
| Altitude | S4 | 00009495 | 38292 | meter | x $10^2$ | - | Altitude from mean sea level |
| UTC Year | U2 | 08 | 8 | year | - | 2011+ | UTC Year |
| UTC Month | U1 | 04 | 4 | month | - | 1-12 | UTC Month |
| UTC Day | U1 | 15 | 21 | day | - | 1-31 | UTC Day |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| UTC Hour | U1 | 39 | 57 | hour | - | 0-23 | UTC Hour |
| UTC Min | U1 | 9088 | 37000 | minute | - | 0-59 | UTC Minute |
| UTC Sec | U2 | 08 | 8 | millisec | - | 0-59 | Integer milliseconds |
| SV Count | U1 | 0C | 12 | - | - | 0-12 | Count of SVs in fix |
| HDOP | U1 | 03 | 3 | - | X 5 | 0-51 | Horizontal Dilution of Precision |
| CRC-16 | U2 | - | - | - | - | - | CRC-16 value of the record |

Table 6.293: Message Field Description

## 6.83 Data Log Terminator - MID 225, SID 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.

| | |
|---|---|
| MID (Hex) | E1 |
| MID (Dec) | 225 |
| Message Name in Code | SIRF_MSG_SSB_DL_OUT_TERM |
| SID (Hex) | 21 |
| SID (Hex) | 33 |
| SID Name in Code | SIRF_MSG_SSB_DL_OUT_TERM |

Table 6.294: Data Log Terminator - MID 225, SID 33

| Name | Bytes | Examle (Optional) | | Description |
|---|---|---|---|---|
| | | Hex | Dec | |
| MID | U1 | E1 | 225 | Message ID |
| SID | U1 | 21 | 33 | Sub ID |

Table 6.295: Message Field Description

Note:

This message is supported starting at version 4.1.2.

## 6.84 Data Log Status Output - MID 225, SID 34

This message provides the current data logger status including:

- threshold settings
- memory usage
- record type
- activity

This message can be requested at anytime even while the data logger is active.

"Memory used" indicates the amount of memory written to that has not yet been read back. It is valid only for "stop-on-memory-full" management and zero otherwise. When all data has been read or the data logger is restarted after a memory full condition, "memory used" returns to zero.

"Memory available" is the complement of "memory used", indicating memory available for writing. It is only useful for "stop-on-memory-full" management and shows the full store size otherwise. When all data has been read or the data logger is restarted after a memory full condition, "memory available" returns to the full store size

Note:

This message is supported starting at version 4.1.2.

| | |
|---|---|
| MID (Hex) | E1 |
| MID (Dec) | 225 |
| Message Name in Code | SIRF_MSG_SSB_DL_STATUS_OUT |
| SID (Hex) | 22 |
| SID (Dec) | 34 |
| SID Name in Code | SIRF_MSG_SSB_DL_STATUS_OUT |

Table 6.296: Data Log Status Output - MID 225, SID 34

| Name | Bytes | Example (Optional) | | Unit | Range | Description |
|---|---|---|---|---|---|---|
| | | Hex | Dec | | | |
| MID | U1 | E1 | 225 | - | - | Message ID |
| SID | U1 | 22 | 34 | - | - | Sub ID |
| Active | U1 | 00 | 0 | - | 0-1 | 0 = Not Active<br>1= Logging Active |
| Record Type | U1 | 02 | 2 | - | 0 - 4 | Record Type |
| Logging Interval | U2 | 0A | 10 | sec | 1 - 65535 | Minimum seconds between logging each record |
| Distance Threshold | U2 | 00 | 0 | m | 0 - 65535 | Current distance threshold setting |

| Name | Bytes | Example (Optional) | | Unit | Range | Description |
|---|---|---|---|---|---|---|
| | | Hex | Dec | | | |
| Speed Threshold | U2 | 00 | 0 | m/s | 0 - 65535 | Current speed threshold setting |
| Memory Available | U4 | 014E50 | 85584 | bytes | - | Size of the data store, or if stopping on full, unused memory |
| Memory Used | U4 | 1B0 | 432 | bytes | - | If stopping on full, indicates memory used, zero otherwise |
| Stop on Memory Full | U1 | 01 | 1 | - | 0 - 1 | 0 = Circular mode<br>1 = Stop logging at end of first pass through store |
| Memory Full | U1 | 00 | 0 | - | 0 - 1 | 0 = Not full<br>If stopping on full, 1 = memory is full (logging stopped) |
| Reserved | U7 | 00 | 0 | - | 0 | Always zero |

**Table 6.297: Message Field Description**

## 6.85 Data Log Record Output - MID 225, SID 35

This message consists of data read from the data log store using a single record type of 1 through 4. It uses its own sub-address to prevent interference 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. Not all fields are populated for all record types. Such fields are zero padded when not applicable and not included in the CRC-32. Record type one is the smallest type, each subsequent type includes the previous type plus appends additional fields. All fields within the message remain in the same position.

Note:

> Requesting this message while the data logger is active will stop data logging before output begins. A new Start Log command is required to continue logging after the data is read completely. No other OSP output messages are output while retrieving logged data.

Important Note:

This message is supported starting at version 4.1.2

| | |
|---|---|
| MID (Hex) | E1 |
| MID (Dec) | 225 |
| Message Name in Code | SIRF_MSG_SSB_SIRF_INTERNAL_OUT |
| SID (Hex) | 23 |
| SID (Dec) | 35 |
| SID Name in Code | SIRF_MSG_SSB_DL_REC_OUT |

Table 6.298: Data Log Record - MID 225, SID 35

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| MID | U1 | E1 | 225 | - | - | - | - |
| SID | U1 | 23 | 35 | - | - | - | - |
| Record Type | U1 | 02 | 2 | - | - | 1-4 | Record Type |
| UTC Year | U2 | 07DB | 2011 | year | - | 2011+ | UTC Year (rec type 1-4) |
| UTC Month | U1 | 08 | 8 | month | - | 1-12 | UTC Year (rec type 1-4) |
| UTC Day | U1 | 04 | 4 | day | - | 1-31 | UTC Year (rec type 1-4) |
| UTC Hour | U1 | 15 | 21 | hour | - | 0-23 | UTC Year (rec type 1-4) |
| UTC Min | U1 | 39 | 57 | minute | - | 0-59 | UTC Year (rec type 1-4) |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| UTC Sec | U2 | 9088 | 37000 | millisec | - | 0-59 | Integer millisecs (rec type 1-4) |
| Latitude | S4 | 13E49AB2 | 33378914 | degree | x $10^7$ | +/- 90 | + = North (rec type1-4) |
| Longitude | S4 | BD41CA24 | -1119761884 | degree | x $10^7$ | +/- 180 | + = East (rec type 1-4) |
| Altitude | S4 | 00009495 | 38292 | meter | x $10^2$ | - | Altitude from mean sea level (rec type 2-4 ) |

| Name | Bytes | Example (Optional) | | Unit | Scale | Range | Description |
|---|---|---|---|---|---|---|---|
| | | Hex | Dec | | | | |
| Speed | U2 | 0 | 0 | m/s | - | - | (rec type 3-4) |
| SV Count | U1 | 0 | 0 | - | - | 0-12 | Count of SVs in fix (rec type 4) |
| HDOP | U1 | 0 | 0 | - | X 5 | 0-51 | Horizontal Dilution of Precision (rec type 4) |
| EHPE | U4 | 0 | 0 | - | - | - | Estimated Horizontal Position Error (rec type 4) |
| TOW | U4 | 0 | 0 | - | - | - | Time of Week (rec type 4) |
| CRC-32 | U2 | D73266B4 | - | - | - | - | CRC-32 value of non-zero-padded playload (rec type 1-4) |

Table 6.299: Message Field Description

## 6.86 Output GRF3i+ IF Bandwidth Mode - Message ID 233, Sub ID 255

This is the response message to the Input Message “Poll GRF3i+ IF Bandwidth Mode” with Message ID 233, Sub ID 10

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1U | | E9 | | Decimal 233 |
| Sub Message ID | 1U | | FF | | OxFF: Output Message for Message ID 233 with SubMsgID 0x02 |
| Band Mode Status | 1U | | 01 | | 0 = Indicates Wideband 1 = Indicates Narrowband |

Table 6.300: Output GRF3i+ IF Bandwidth Mode - Message ID 233, Sub ID 255

**Note:**

Payload length: 3 bytes

## 6.87 Output GRF3i+ Normal/Low Power Mode - Message ID 233, Sub ID 254

This is the response message to the Input Message "Output GRF3i+ Normal/Low Power Mode - Message ID 233, Sub ID 254" with Message ID 233, Sub ID 11.

| Name | Bytes | Binary (Hex) | | Unit | Description |
|---|---|---|---|---|---|
| | | Scale | Example | | |
| Message ID | 1U | | E9 | | Decimal 233 |
| Sub Message ID | 1U | | FE | | 0xFE : Output Message for Message ID 233 with SubMsgID 0x0B |
| Power Mode Status | 1U | | 01 | | 0 = Normal power<br>1 = Low power |

Table 6.301: Output GRF3i+ Normal/Low Power Mode - Message ID 233, Sub ID 254

**Note:**

Payload length: 3 bytes

## 6.88 SiRFDRive Output Messages

### 6.88.1 Geodetic Navigation State Output - Message ID 29

| | |
|---|---|
| Number: | 0x29 |
| Name: | MID_GeodNavState |
| Purpose: | Geodetic Navigation State Output Message |

**Message Length**: 91 bytes

**Rate**: Output at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | | 0x29 | 1 |
| 2-3 | Nav Validity | UINT16 | 2 | Bitmap | Any bits not 0: Nav is Invalid<br>Bit 0=1: GPS Fix Invalid<br>Bit 1=1: EHPE exceeded (reserved)<br>Bit 2=1: EVPE exceeded (reserved)<br>Bit 3=1: DR data Invalid<br>Bit 4=1: DR Cal Invalid<br>Bit 5=1: GPS-based Cal not Available<br>Bit 6=1: DR Pos Invalid<br>Bit 7=1: DR Heading Invalid<br>Bits 8-14: Reserved<br>Bit 15 = 1: No Tracker Data | 1 |
| 4-5 | NAV Mode | UINT16 | 2 | Bitmap | NAV Mode Bits definition(1):<br>GPS Fix Type:<br>bits 2-0: SVs Used<br>000 No NAV<br>001 1 SV solution<br>010 2 SV solution<br>011 3 SV solution (2D)<br>100 4 or More SV (3D)<br>101 Least Sq 2D fix<br>110 Least Sq 3D fix<br>111 DR solution (0 SV)<br>bit 3 =1: TricklePower On<br>bits 5-4 Altitude hold<br>00 No Altitude Hold<br>01 Filter Altitude used<br>10 Use Altitude used<br>11 User Forced Altitude | 1 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 4-5 *(Continued)* | | | | | bit 6 = 1: DOP exceeded<br>bit 7 = 1: DGPS corrections<br>bit 8 = 1: Sensor Based DR = 0: if bit 2-0=111, Velocity DR<br>bit 9 = 1: Sol Validated<br>bit 10 = 1: VEL DR Timeout<br>bit 11 = 1: Edited by UI<br>bit 12 = 1: Velocity Invalid<br>bit 13 = 1: Altitude Hold disabled<br>bits 15-14 – SiRFDRive DR status:<br>00 – GPS Only<br>01 – Calibrating<br>10 – DR sensor error<br>11 – DR Test mode | |
| 6-7 | Extended Week Number | UINT16 | 2 | week | 0 to 65535 | 1 |
| 8-11 | TOW | UINT32 | 4 | sec | 0 to 604800.00 | 0.001 |
| 12-13 | UTC Year | UINT16 | 2 | year | 1980 to 3000 | 1 |
| 14 | UTC Month | UINT8 | 1 | month | 1 to 12 | 1 |
| 15 | UTC Day | UINT8 | 1 | day | 1 to 31 | 1 |
| 16 | UTC Hour | UINT8 | 1 | hr | 0 to 23 | 1 |
| 17 | UTC Minute | UINT8 | 1 | min | 0 to 59 | 1 |
| 18-19 | UTC Second | UINT16 | 2 | sec | 0 to 59 | 0.001 |
| 20-23 | Satellites in Solution | UINT32 | 4 | Bitmap | Bit 0 = 1: SV1 Bit 1 = 1: SV2 … Bit 31 = 1: SV32 | |
| 24-27 | Latitude | INT32 | 4 | deg | -90 to 90 | $10^{-7}$ |
| 28-31 | Longitude | INT32 | 4 | deg | -180 to 180 | $10^{-7}$ |
| 32-35 | Altitude from Ellipsoid | INT32 | 4 | meters | -2000 to 100000.0 | 0.01 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 36-39 | Altitude from MSL(2) | INT32 | 4 | meters | -2000 to 100000.0 | 0.01 |
| 40 | Map Datum | UINT8 | 1 | | 0 to 255 | |
| 41-42 | Speed Over Ground (SOG) | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 43-44 | Course Over Ground (COG, True) (3) | UINT16 | 2 | deg | 0 to 360 | 0.01 |
| 45-46 | Magnetic Variation (RESERVED) | INT16 | 2 | deg | -90 to 90 | 0.01 |
| 47-48 | Climb Rate | INT16 | 2 | m/sec | -300 to 300 | 0.01 |
| 49-50 | Heading Rate | INT16 | 2 | deg /sec | -300 to 300 | 0.01 |
| 51-54 | Expected Horizontal Position Error (EHPE) | UINT32 | 4 | meters | 0 to 6000000 | 0.01 |
| 55-58 | Expected Vertical Position Error (EVPE) | UINT32 | 4 | meters | 0 to 24000 | 0.01 |
| 59-62 | Expected Time Error (ETE) | UINT32 | 4 | meters | 0 to 6000000 | 0.01 |
| 63-64 | Expected Horizontal Velocity Error (EHVE) | UINT16 | 2 | m/sec | 655 | 0.01 |
| 65-68 | Clock Bias | INT32 | 4 | meters | 0 to -21474837 to 21474837 | 0.01 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 69-72 | Clock Bias Error | UINT32 | 4 | meters | 0 to 6000000 | 0.01 |
| 73-76 | Clock Drift | INT32 | 4 | m/sec | -21474837 to 21474837 | 0.01 |
| 77-80 | Clock Drift Error | UINT32 | 4 | m/sec | 0 to 1000 | 0.01 |
| 81-84 | Distance Traveled since RESET | UINT32 | 4 | meters | 0 to 4294967295 | 1 |
| 85-86 | Distance Traveled error | UINT16 | 2 | meters | 65535 | 1 |
| 87-88 | Heading Error | UINT16 | 2 | deg | 0 to 180 | 0.01 |
| 89 | Number of Satellites in Solution | UINT8 | 1 | integer | 0 to 12 | 1 |
| 90 | HDOP | UINT8 | 1 | integer | 0 to 51 | 0.2 |
| 91 | AdditionalModeInfo | UINT8 | 1 | Bitmap | Bit 7: DR direction<br>0 = forward<br>1 = reverse<br>Bits 6-3: reserved<br>Bit 2: MMF usage<br>0 = used in solution<br>1 = not used in solution<br>Bit 1: MMF received<br>0 = not received<br>1 = received Bit 0: MMF mode<br>0 = disabled<br>1 = enabled | 1 |

Table 6.302: GeodNavState - Message ID 29

(1) Bits 15-14 only have meaning when bit 8 is 0.

(2) Altitude above MSL = Altitude from Ellipsoid – Geoidal Separation

(3) Also know as Heading(Hdg)

API:

```
typedef struct
{
    UINT16 Valid
    UINT16 Mode
    UINT16 Week
    UINT32 TOW
    UINT16 UtcYr;
    UINT8  UtcMth;
    UINT8  UtcDay;
    UINT8  UtcHr;
    UINT8  UtcMin;
    UINT16 UtcSec;
    UINT32 SVIDList;
    INT32  Lat;
    INT32  Lon;
    INT32  AltE;
    INT32  AltM;
    UINT8  Datum;
    UINT16 Sog;
    UINT16 Hdg;
    INT16  MagVar;
    INT16  ClmbRte;
    INT16  HdRte
    UINT32 Ehpe;
    UINT32 Evpe;
    UINT32 Ete
    UINT16 Ehve;
    INT32  ClkBias
    UINT32 ClkBiasE
    INT32  ClkDrift
    UINT32 ClkDriftE
    UINT32 Trvled;
    UINT16 TrvledE
    UINT16 HdE;
    UINT8  SVIDCnt;
    UINT8  HDOP;
    UINT8  AdditionalModeInfo;
} MI_GEOD_NAV_STATE;
```

### 6.88.2 Output Tracker to NAV – ADC/Odometer Data - Message ID 45

| | |
|---|---|
| Number: | 0x2D |
| Name: | MID_TrkADCOdoGPIO |
| Purpose: | Output Tracker to NAV – ADC/Odometer Data |

**Message Length**: 111 bytes @ 1Hz or 12 bytes @ 10Hz

**Rate**: 111 bytes @ 1Hz or 12 bytes @ 10Hz

**Binary Message Definition**:

This message is sent at a rate of 1Hz (default) or 10Hz whenever it is enabled by the control words in the Track Reset message on the GSP2t. Both ADC channels are sampled in a roundrobin fashion at 50Hz whose raw measurements are then averaged every 100mSeconds in the tracker interrupt along with the current odometer counter value and GPIO states. The GSP2t Rev D on-chip ADC is a 14-bit successive approximation two channel ADC outputting signed 16-bit values from –12000 to 28000.

The GSP2eLP with DR option currently only has one ADC input that is sampled at 50Hz and whose raw measurements are then averaged every 100mSeconds in the tracker interrupt along with the current odometer counter and GPIO state. The DR option is a Maxim MAX1240 12-bit ADC on a daughter-board installed on the SDKL. The 12-bit resolution provides unsigned values from 0 to 4095.

On the GSP2t, this message can be transmitted in 1Hz mode or 10Hz mode. On the GSP2eLP, this message is only transmitted in 1Hz mode. In 1Hz mode, there are 10 data measurements blocks in one single message. In 10Hz mode, there is a single data measurement per message.

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0x2D | n/a |
| 2 + (n- 1)*11[(1)] | currentTime[(2)] | UINT32 | 4 | ms | 0-4294967295 | n/a |
| 6 + (n- 1)*11[(1)] | Gyro adc Avg [(3)] | UINT16 Or INT16 | 2 | n/a | 0 to 4095 (GSP2eLP w/ DR option) Or -12000 to 28000 (GSP2t) | n/a |
| 8 + (n- 1)*11[(1)] | adc3Avg[(4)] | UNIT16 Or INT16 | 2 | n/a | 0 (GSP2eLP w/ DR option) Or -12000 to 28000 (GSP2t) | n/a |
| 10 + (n- 1)*11[(1)] | odoCount[(5)] | UINT16 | 2 | n/a | 0 to 65535 | n/a |
| 12 + (n- 1)*11[(1)] | gpioStat[(6)] | UINT8 | 1 | Bitmap | bit 0 – if = 1: Reverse “ON” bits 1 to 7 Reserved | n/a |

Table 6.303: TrkADCOdoGPIO - Message ID 45

(1) n corresponds to either 1 or 1-10 depending on whether the message comes out a 10Hz (10 messages 1 data set) or 1Hz (1 message 10 data sets)

(2) Tracker Time, millisecond counts

(3) Averaged measurement from Gyro input. On the GSP2t, this is the ADC[2] input, on the GSP2eLP, this is the Maxim ADC input

(4) On a GSP2eLP system, there is currently only one ADC input so this field is always 0.

(5) Odometer counter measurement at the most recent 100mSec tracker interrupt. This field will rollover to 0 after 65535

(6) GPIO input states at the most recent 100mSec tracker interrupt

API:

```
#define NUM_OF_DR_RAW 10
typedef struct
{
    UINT32 currentTime;
    UINT16 adc2Avg;
    UINT16 adc3Avg;
    UINT16 odoCount;
    UINT8 gpioStat;
} tADCOdometer;

typedef struct
{
    struct
    {
        tADCOdometer ADCOdometer[NUM_OF_DR_RAW];
    } DrRaw;
} tDrRawData, *tDrRawDataPtr;
```

### 6.88.3 DR NAV Status - Message ID 48, Sub ID 1

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x01 |
| SID Name: | SID_DrNavStatus |
| SID Purpose: | DR NAV Status Output Message |

Table 6.304: DR NAV Status - Message ID 48, Sub ID 1

**Message Length:** 20 bytes

**Rate:** Output at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | | 0x30 | 1 |
| 2 | Sub ID | UINT8 | 1 | | 0x01 | 1 |
| 3.0 – 3.6 | DR Navigation Valid (1) | Bit Map | 1 | N/A | All bits 0: True<br>Any bits != 0 : False<br>Bit 0 = 1: GPS Only Required<br>Bit 1 = 1: Speed != 0 at startup<br>Bit 2 = 1: DR Position Valid = False<br>Bit 3 = 1: DR Heading Valid = False<br>Bit 4 = 1: DR Calibration Valid = False<br>Bit 5 = 1: DR Data Valid = False<br>Bit 6 = 1: System has gone into Cold Start (2) | N/A |
| 3.7 | Reserved | | | | | |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 4 -5 | DR Data Valid [1] | Bit Map | 2 | N/A | All bits 0: True<br>Any bits != 0 : False<br>Bit 0 = 1: DR Gyro Subsystem Operational = False<br>Bit 1 = 1: DR Speed Subsystem Operational = False<br>Bit 2 = 1: DR. Measurement Time < 0<br>Bit 3 = 1: Input serial DR message checksum Invalid<br>Bit 4 = 1: No DR Data for > 2 seconds<br>Bit 5 = 1: DR Data timestamp did not advance<br>Bit 6 = 1: DR data bytes all 0x00 or all 0xFF<br>Bit 7 = 1: Composite wheeltick count jumped by more than 400 between successive DR messages<br>Bit 8 = 1: Input Gyro data bits (15) value of 0x0000 or 0x3FFF<br>Bit 9 = 1: More than 10 DR messages in one second<br>Bit 10 = 1: Delta Time <= 0<br>Bit 11-15: Reserved [2] | N/A |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 6.0 – 6.3 | DR Calibration Valid (1) | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Gyro Bias Cal Valid = False Bit 1 = 1: DR Gyro Scale Factor Cal Valid = False Bit 2 = 1: DR Speed Scale Factor Cal Valid = False Bit 3 = 1; GPS Calibration is required and is not yet available (2) | N/A |
| 6.4 – 6.6 | DR Gyro Bias Cal Valid (1) | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: Zero-Speed Gyro Bias Calibration was Updated = False Bit 2 = 1: Heading Rate Scale Factor <= -1 (2) | N/A |
| 6.7 | Reserved | | | | | |
| 7.0 – 7.3 | DR Gyro Scale Factor Cal Valid (1) | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Heading Valid = False Bit 1 = 1: DR Data Valid = False Bit 2 = 1: DR Position Valid = False Bit 3 = 1: Heading Rate Scale Factor <= -1 (2) | N/A |
| 7.4 – 7.7 | DR Speed Scale Factor Cal Valid (1) | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: DR Position Valid = False Bit 2 = 1: GPS Velocity Valid For Dr = False Bit 3 = 1: DR Speed Scale Factor <= -1(2) | N/A |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 8.0 – 8.1 | DR Nav Valid Across Reset (1) | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Navigation Valid = False Bit 1 = 1: Speed > 0.1 m/sec (2) | N/A |
| 8.2 | Reserved | | | | | |
| 8.3 – 8.6 | DR Position Valid (1) | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: Speed != 0 at startup Bit 1 = 1: Valid GPS Position is Required and GPS Position Valid = False Bit 2 = 1: System has gone into Cold Start Bit 3 = 1: DR Data Valid = False (2) | N/A |
| 8.7 | Reserved | | | | | |
| 9.0 – 9.6 | DR Heading Valid (1) | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: Speed != 0 at startup Bit 1 = 1: Valid GPS Position is Required and GPS Position Valid = False Bit 2 = 1: Valid GPS Speed is Required and GPS Speed Valid = False Bit 3 = 1: GPS Updated Heading = False Bit 4 = 1: (Delta GPS Time <= 0.0) \|\| (Delta GPS Time >= 2.0)) Bit 5 = 1: System has gone into Cold Start Bit 6 = 1: DR Data Valid = False (2) | N/A |
| 9.7 | Reserved | | | | | |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 10.0 – 10.2 | DR Gyro Subsystem Operational [1] | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: High, Persistent Turn Rate Bit 1 = 1: Low, Persistent Turn Rate Bit 2 = 1: Gyro Turn Rate Residual is Too Large [2] | N/A |
| 10.3 | Reserved | | | | | |
| 10.4 – 10.6 | DR Speed Subsystem Operational[1] | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Speed Data = 0 when GPS Speed != 0 Bit 1 = 1: DR Speed Data != 0 when GPS Speed = 0 Bit 2 = 1: DR Speed Residual is Too Large[2] | N/A |
| 10.7 | Reserved | | | | | |
| 11.0 – 11.2 | DR Nav State Integration Ran[1] | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Position Valid = False Bit 1 = 1: DR Heading Valid = False Bit 2 = 1: DR Data Valid = False [2] | N/A |
| 11.3 | Reserved | | | | | |
| 11.4 – 11.6 | Zero-Speed Gyro Bias Calibration was Updated[1] | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: GPS Speed > 0.1 m/sec Bit 1 = 1: Zero Speed During Cycle = False Bit 2 = 1: Zero Speed Previous = False [2] | N/A |
| 11.7 | Reserved | | | | | |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 12.0 – 12.3 | DR Gyro Bias and Scale Factor Calibration was Updated[1] | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: DR Position Valid = False Bit 2 = 1: GPS Velocity Valid For DR = False Bit 3 = 1: GPS Updated Heading = False[2] | N/A |
| 12.4 – 12.6 | DR Speed Calibration was Updated [1] | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: DR Position Valid = False Bit 2 = 1: GPS Velocity Valid For DR= False [2] | N/A |
| 12.7 | DR Updated the Navigation State [1] | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Navigation Valid = False [2] | N/A |
| 13.0 – 13.7 | GPS Updated Position [1] | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: Update Mode != KALMAN Bit 1 = 1: EHE too large (i.e. EHE > 10.0) Bit 2 = 1: no previous GPS Kalman update < 4 sats Bit 3 = 1: GPS EHPE > DR EHPE Bit 4 = 1: DR EHPE < 10 even if GPS EHPE < DR EHPE Bit 5 = 1: Less than 4 satellites Bit 6 = 1: 0 satellites Bit 7 = 1: DR NAV Only Required [2] | N/A |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 14.0 – 14.6 | GPS Updated Heading [1] | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: Update Mode != KALMAN Bit 1 = 1: GPS Speed <= 2.0 m/sec Bit 2 = 1: < 4 sats Bit 3 = 1: Horizontal Velocity Variance > 1.0 (m/sec)*(m/sec) Bit 4 = 1: GPS Heading Error >= DR Heading Error * 1.2 Bit 5 = 1: GPS Kalman Filter Updated = False Bit 6 = 1: Initial Speed Transient Complete = False [2] | N/A |
| 14.7 | Reserved | | | | | |
| 15.0 – 15.2 | GPS Position Valid for DR [1] | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: < 4 sats Bit 1 = 1: EHPE > 30 Bit 2 = 1: GPS Updated Position = False[2] | N/A |
| 15.3 | Reserved | | | | | |
| 15.4 – 15.7 | GPS Velocity Valid for DR[1] | Bit Map | | N/A | All bits 0: True Any bits != 0 : False Bit 0 = 1: GPS Position Valid for DR = False Bit 1 = 1: EHVE > 3 Bit 2 = 1: GPS Speed < 2 m/sec Bit 3 = 1: GPS did not update the Heading [2] | N/A |
| 16.0 – 16.1 | DWS Heading Rate Scale Factor Calibration Validity | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 : 1 = Heading Rate Scale Factor <= -1.0 Bits 1 – 7: = Reserved | N/A |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 16.2 – 16.7 | Reserved | | | | | |
| 17.0 – 17.6 | DWS Heading Rate Scale Factor Calibration Was Update | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 : 1 = GPS Heading Rate is not valid Bit 1 : 1 = Absolute value of GPS Heading Rate < 5.0 Bit 2 : 1 = Absolute value of GPS Heading Rate >= 90.0 Bit 3 : 1 = Left Rear Speed SF Cal is not valid Bit 4 : 1 = Right Rear Speed SF Cal is not valid Bit 5 : 1 = Absolute value of prev Rear Axle Hd Rt <= 0.0 Bit 6 : 1 = (GPS Hd Rt * prev Rear Axle Hd Rt) <= 1.0 Bit 7 : = reserved | N/A |
| 17.7 | Reserved | | | | | |
| 18.0 – 19.7 | DWS Speed Scale Factor Calibration Validity | Bit Map | 2 | N/A | All bits 0: True Any bits != 0 : False Bit 0 : 1 = Right Rear Speed SF <= -1.0 Bit 1 : reserved for RR status Bit 2 : reserved for RR status Bit 3 : reserved for RR status Bit 4 : 1 = Left Rear Speed SF <= -1.0 Bit 5 : reserved for LR status Bit 6 : reserved for LR status Bit 7 : reserved for LR status Bit 8 : 1 = Right Front Speed SF <= -1.0 Bit 9 : reserved for RF status Bit 10: reserved for RF status Bit 11: reserved for RF status Bit 12: 1 = Left Front Speed SF <= -1.0 Bit 13: reserved for LF status Bit 14: reserved for LF status Bit 15: reserved for LF status | N/A |
| 20.0 – 20.5 | DWS Speed Scale Factor Cal was updated | Bit Map | 1 | N/A | All bits 0: True Any bits != 0 : False Bit 0 : 1 = GPS Speed is not valid for DR Bit 1 : 1 = GPS Heading Rate is not valid Bit 2 : 1 = Absolute value of GPS Hd Rate >= 0.23 Bit 3 : 1 = GPS Heading Rate Error >= 0.5 Bit 4 : 1 = Average GPS Speed <= 0.0 Bit 5 : 1 = DR Position is not valid Bits 6 – 7 : reserved | N/A |
| 20.6 – 20.7 | Reserved | | | | | |

Table 6.305: DR NAV Status - Message ID 48, Sub ID 1

**API:**

```
typedef struct
{
UINT8 Nav;
UINT16 Data;
UINT8 Cal_GbCal;
UINT8 GsfCal_SsfCal;
UINT8 NavAcrossReset_Pos ;
UINT8 Hd;
UINT8 GyrSubOp_SpdSubOp;
UINT8 NavStIntRan_ZGbCalUpd;
UINT8 GbsfCalUpd_SpdCalUpd_UpdNavSt;
UINT8 GpsUpdPos;
UINT8 GpsUpdHd;
UINT8 GpsPos_GpsVel;
UINT8 DWSHdRtSFCalValid;
UINT8 DWSHdRtSFCalUpd;
UINT16 DWSSpdSFCalValid;
UINT8 DWSSpdSFCalUpd ;
}
MI_DR_NAV_STATUS;
```

### 6.88.4 DR NAV State - Message ID 48, Sub ID 2

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x02 |
| SID Name: | SID_DrNavState |
| SID Purpose: | DR NAV State Output Message |

Table 6.306: DR NAV State - Message ID 48, Sub ID 2

**Message Length:** 75 bytes

**Rate:** Output at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0x30 | 1 |
| 2 | Sub-ID | UINT8 | 1 | n/a | 0x02 | 1 |
| 3 – 4 | DR Speed | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 5 – 6 | DR Speed Error | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 7 – 8 | DR Speed Scale Factor(1) | INT16 | 2 | n/a | -1 to 3 | 0.0001 |
| 9 – 10 | DR Speed Scale Factor Error | UINT16 | 2 | n/a | 0 to 3 | 0.0001 |
| 11 – 12 | DR Heading Rate | INT16 | 2 | deg/sec | -300 to 300 | 0.01 |
| 13 – 14 | DR Heading Rate Error | UINT16 | 2 | deg/sec | 0 to 300 | 0.01 |
| 15 – 16 | DR Gyro Bias | INT16 | 2 | deg/sec | -300 to 300 | 0.01 |
| 17 – 18 | DR Gyro Bias Error | UINT16 | 2 | deg/sec | 0 to 300 | 0.01 |
| 19 – 20 | DR Gyro Scale Factor (1) | INT16 | 2 | n/a | -1 to 3 | 0.0001 |
| 21 – 22 | DR Gyro Scale Factor Error | UINT16 | 2 | n/a | 0 to 3 | 0.0001 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 23 – 26 | Total DR Position Error | UINT32 | 4 | meters | 0 to 6000000 | 0.01 |
| 27 – 28 | Total DR Heading Error | UINT16 | 2 | deg | 0 to 180 | 0.01 |
| 29 | DR Nav Mode Control | UINT8 | 1 | Bitmap | bit 0 :1 = GPS-Only Navigation required (No DR NAV Allowed)<br>bit 1: 1 = OK to do DR Nav with default or SRAM calibration<br>bit 2: 1 = DR Nav OK if using current GPS calibration<br>bit 3: 1 = DR Only Navigation | 1 |
| 30 | DR Direction | UINT8 | 1 | boolean | 0: forward 1: reverse | 1 |
| 31 – 32 | DR Heading | UINT16 | 2 | deg/sec | 0 to 360 | 0.01 |
| 33 | SensorPkg | UINT8 | 1 | n/a | 0 = Gyro and Odo 1 = Wheel Speed and Odo | 1 |
| 34 – 35 | Odometer Speed | UINT16 | 2 | m/sec | | 0.01 |
| 36 – 37 | Odometer Speed Scale Factor(1) | INT16 | 2 | n/a | | 0.0001 |
| 38 – 39 | Odometer Speed Scale Factor Error | UINT16 | 2 | n/a | | 0.0001 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 40 – 41 | Left Front Wheel Speed Scale Factor(1) | INT16 | 2 | n/a | | 0.0001 |
| 42 - 43 | Left Front Wheel Speed Scale Factor Error | UINT16 | 2 | n/a | | 0.0001 |
| 44 - 45 | Right Front Wheel Speed Scale Factor(1) | INT16 | 2 | n/a | | 0.0001 |
| 46 - 47 | Right Front Wheel Speed Scale Factor Error | UINT16 | 2 | n/a | | 0.0001 |
| 48 – 49 | Left Rear Wheel Speed Scale Factor(1) | INT16 | 2 | n/a | | 0.0001 |
| 50 – 51 | Left Rear Wheel Speed Scale Factor Error | UINT16 | 2 | n/a | | 0.0001 |
| 52 – 53 | Right Rear Wheel Speed Scale Factor(1) | INT16 | 2 | n/a | | 0.0001 |
| 54 – 55 | Right Rear Wheel Speed Scale Factor Error | UINT16 | 2 | n/a | | 0.0001 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 56 – 57 | Rear Axle Speed Delta | INT16 | 2 | m/sec | | 0.01 |
| 58 – 59 | Rear Axle Average Speed | UINT16 | 2 | m/sec | | 0.01 |
| 60 – 61 | Rear Axle Speed Error | UINT16 | 2 | m/sec | | 0.01 |
| 62 – 63 | Rear Axle Heading Rate | INT16 | 2 | deg/sec | | 0.01 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 64 – 65 | Rear Axle Heading Rate Error | UINT16 | 2 | deg/sec | | 0.01 |
| 66 – 67 | Front Axle Speed Delta | INT16 | 2 | m/sec | | 0.01 |
| 68 – 69 | Front Axle Average Speed | UINT16 | 2 | m/sec | | 0.01 |
| 70 – 71 | Front Axle Speed Error | UINT16 | 2 | m/sec | | 0.01 |
| 72 – 73 | Front Axle Heading Rate | INT16 | 2 | deg/sec | | 0.01 |
| 74 - 75 | Front Axle Heading Rate Error | UINT16 | 2 | deg/sec | | 0.01 |

Table 6.307: DR NAV State Message

(1) Scale Factor is defined: True = Measured / ( 1 + Scale Factor )

API:

```
typedef struct
{
    UINT16 Spd;
    UINT16 SpdE;
    INT16  Ssf;
    UINT16 SsfE;
    INT16  HdRte;
    UINT16 HdRteE;
    INT16  Gb;
    UINT16 GbE;
    INT16  Gsf;
    UINT16 GsfE;
    UINT32 TPE;
    UINT16 THE;
    UINT8  NavCtrl
    UINT8  Reverse;
    UINT16 Hd;
    UINT8  SensorPkg;
    UINT16 OdoSpd;
    INT16  OdoSpdSF;
    UINT16 OdoSpdSFErr
    INT16  LFWheelSpdSF
    UINT16 LFWheelSpdSFErr
    INT16  RFWheelSpdSF;
    UINT16 RFWheelSpdSFErr;
    INT16  LRWheelSpdSF;
    UINT16 LRWheelSpdSFErr;
    INT16  RRWheelSpdSF;
    UINT16 RRWheelSpdSFErr;
    INT16  RearAxleSpdDelta;
    UINT16 RearAxleAvgSpd;
    UINT16 RearAxleSpdErr;
    INT16  RearAxleHdRt;
    UINT16 RearAxleHdRtErr;
    INT16  FrontAxleSpdDelta;
    UINT16 FrontAxleAvgSpd;
    UINT16 FrontAxleSpdErr;
    INT16  FrontAxleHdRt
    UINT16 FrontAxleHdRtErr;
} MI_DR_NAV_STATE;
```

### 6.88.5 NAV Subsystems Data - Message ID 48, Sub ID 3

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x03 |
| SID Name: | SID_NavSubSys |
| SID Purpose: | NAV Subsystems Data Output Message |

Table 6.308: NAV Subsystems Data - Message ID 48, Sub ID 3

**Message Length:** 36 bytes

**Rate:** Output at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0x30 | n/a |
| 2 | Sub-ID | UINT8 | 1 | n/a | 0x03 | n/a |
| 3-4 | GPS Heading Rate | INT16 | 2 | deg/sec | -300 to 300 | 0.01 |
| 5-6 | GPS Heading Rate Error | UINT16 | 2 | deg/sec | 0 to 300 | 0.01 |
| 7-8 | GPS Heading (True) | UINT16 | 2 | deg | 0 to 360 | 0.01 |
| 9-10 | GPS Heading Error | UINT16 | 2 | deg | 0 to 180 | 0.01 |
| 11-12 | GPS Speed | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 13-14 | GPS Speed Error | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 15-18 | GPS Position Error | UINT32 | 4 | meters | 0 to 6000000 | 0.01 |
| 19-20 | DR Heading Rate | INT16 | 2 | deg/sec | -300 to 300 | 0.01 |
| 21-22 | DR Heading Rate Error | UINT16 | 2 | deg/sec | 0 to 300 | 0.01 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 23-24 | DR Heading (True) | UINT16 | 2 | deg | 0 to 360 | 0.01 |
| 25-26 | DR Heading Error | UINT16 | 2 | deg | 0 to 180 | 0.01 |
| 27-28 | DR Speed | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 29-30 | DR Speed Error | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 31-34 | DR Position Error | UINT32 | 4 | meters | 0 to 6000000 | 0.01 |
| 35-36 | Reserved | UINT16 | 2 | n/a | undefined | n/a |

Table 6.309: NAV Subsystems Data Message

**API:**

```
typedef struct
{
    INT16  GpsHdRte;
    UINT16 GpsHdRteE;
    UINT16 GpsHd;
    UINT16 GpsHdE;
    UINT16 GpsSpd;
    UINT16 GpsSpdE;
    UINT32 GpsPosE;
    INT16  DrHdRte;
    UINT16 DrHdRteE;
    UINT16 DrHd;
    UINT16 DrHdE;
    UINT16 DrSpd;
    UINT16 DrSpdE;
    UINT32 DrPosE;
    UINT8  Reserved[2];
} MI_NAV_SUBSYS;
```

### 6.88.6 Preserved DR Data Validity - Message ID 48, Sub ID 5

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x05 |
| SID Name: | SID_DrValid |
| SID Purpose: | Preserved DR Data Validity Output Message (RESERVED) |

**Table 6.310: Preserved DR Data Validity - Message ID 48, Sub ID 5**

**Message Length:** 10 bytes

**Rate:** Typically output at startup

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0x30 | n/a |
| 2 | Sub-ID | UINT8 | 1 | n/a | 0x05 | n/a |
| 3-6 | Valid[(1)] | UINT32 | 4 | bitmap | bit 0[(2)]: invalid position bit 1: invalid position error bit 2: invalid heading bit 3: invalid heading error bit 4: invalid speed scale factor bit 5: invalid speed scale factor error bit 6: invalid gyro bias bit 7: invalid gyro bias error bit 8: invalid gyro scale factor bit 9: invalid gyro scale factor error bit 10: invalid baseline speed scale factor bit 11: invalid baseline gyro bias bit 12: invalid baseline gyro scale factor bit 13 - 31: reserved | n/a |
| 7-10 | Reserved | UINT32 | 4 | n/a | n/a | n/a |

Table 6.311: Preserved DR Data Validity Message

(1) The bit map of the Field variable reports the status. If all the bits in the bit map are zero (0), then the status of the variable = Valid. Otherwise, if any of the bits in the bit map are set = 1, then the status of the variable = Not Valid, and the individual bits give the reason why.

(2) The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the Least-Significant byte.

**API:**

```
typedef struct
{
    UINT32 Valid;
    UINT32 Reserved;
} MI_DR_VALID;
```

### 6.88.7 Gyro Factory Calibration Response - Message ID 48, Sub ID 6

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x06 |
| SID Name: | SID_GyrFactCal |
| SID Purpose: | Gyro Factory Calibration Response Output Message |

**Table 6.312: Gyro Factory Calibration Response - Message ID 48, Sub ID 6**

**Message Length:** 4 bytes

**Rate:** Output after successful completion of each calibration stage; can be polled

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | 0x30 | N/A |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x06 | N/A |
| 3 | Gyro Factory Calibration Progress[(1)] | Bit Map | 1 | N/A | bit 0 = 1: Gyro Bias calibration completed bit 0 = 2: Gyro Scale Factor calibration completed[(2)] bits 3 –7: Reserved[(3)] | N/A |
| 4 | Reserved | | 1 | N/A | N/A | N/A |

Table 6.313: Gyro Factory Calibration Response Message

(1) The bit map of the Field variable reports the status of each calibration stage. All pertinent bits must be set to Valid before the calibration is considered successful.

(2) The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the Least-Significant byte.

(3) Bit 0 can’t equal 2??

API:

```
typedef struct
{
    UINT8 Cal;
    UINT8 Reserved;
} MI_GYR_FACT_CAL;
```

### 6.88.8 Sensor package parameters - Message ID 48, Sub ID 7

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x07 |
| SID Name: | SID_DrSensParam |
| SID Purpose: | Sensor package parameters output message |

**Table 6.314: Sensor package parameters - Message ID 48, Sub ID 7**

**Message Length:** 7 bytes

**Rate:** Input

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0xAC | n/a |
| 2 | Sub-ID | UINT8 | 1 | n/a | 0x07 | n/a |
| 3 | Baseline Speed Scale Factor | UINT8 | 1 | ticks/m | 1 to 255 (default:4) | 1 |
| 4-5 | Baseline Gyro Bias | UNIT16 | 2 | zero rate Volts | 2.0 to 3.0 (default:2.5) | 0.0001 |
| 6-7 | Baseline Gyro Scale Factor | UINT16 | 2 | mV / (deg/sec) | 1 to 65 (default: 22) | 0.001 |

Table 6.315: Sensor package parameters Message

API:

```
typedef struct
{
    UINT8  BaseSsf; /* in ticks/m */
    UINT16 BaseGb;  /* in zero rate volts */
    UINT16 BaseGsf; /* in mV / (deg/s) */
} MI_DR_SENS_PARAM;
```

### 6.88.9 DR Data Block Output - Message ID 48, Sub ID 8

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x08 |
| SID Name: | SID_DrDataBlk |
| SID Purpose: | DR Data Block Output Message |

Table 6.316: DR Data Block Output - Message ID 48, Sub ID 8

**Message Length:** 80 bytes

**Rate:** Output at 1 Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | 0x30 | N/A |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x08 | N/A |
| 3 | Measurement Type[3] | UINT8 | 1 | N/A | if = 0, Gyro and Odometer; if= 1, Differential Odometer;(RESERVED) if = 2, Compass and Odometer; (RESERVED) | 1 |
| 4 | Valid measurements in block | UINT8 | 1 | N/A | 1 to 10 | 1 |
| 5-6 | Backup Flags | UINT16 | 2 | N/A | bits 0 – 9: if set = 1: Backup = True if set = 0: Backup = False[4] | 1 |
| 7 + (n- 1)*8 [1] | TimeTag | UINT32 | 4 | msec | 0 to 4294967295 | 1 |
| 11 + (n-1)*8 [1] | DR Speed 1 | UINT16 | 2 | m/sec | 0 to 655 | 0.01 |
| 13 + (n-1)*8[1] | Gyro Heading Rate or DR Speed 2 (RESERVED) or Magnetic Compass Heading (RESERVED) [3] | INT16 or UINT16 (RESERVED) or UINT16 (RESERVED) | 2 | deg /sec or m/sec (RESERVED) or deg (RESERVED) | -300 to 300 or 0 to 655 (RESERVED) or 0 to 360 (RESERVED) | 0.01 or 0.01 (RESERVED) or 0.01 (RESERVED) |

Table 6.317: DR Data Block Output Message

(1) n = valid measurement sets in the block.

(3) The type of data in the second DR measurement in each set is controlled by the Measurement Type value.

(4) The bits index points to the corresponding data set; where the data set index goes from 0 to 9.

**API:**

```
typedef struct
{
    UINT32 Tag;
    UINT16 Data1;
    INT16  Data2;
} MI_DR_10HZ;

typedef struct
{
    UINT8  MeasType;
    UINT8  ValidCnt;
    UINT16 BkupFlgs;
    MI_DR_10HZ Blk[10];
} MI_DR_DATA_BLK;
```

### 6.88.10 Sensor Package Parameters - Message ID 48, Sub ID 9

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x09 |
| SID Name: | SID_GenericSensorParam |
| SID Purpose: | Sensor package parameters output message |

**Table 6.318: Sensor Package Parameters - Message ID 48, Sub ID 9**

**Message Length:** 30 bytes

**Rate:**

The user can enable a one time transmission of this message via SirfDemo's Poll command for SiRFDRive. In the SiRFDRive menu item select the Poll Sensor's Parameters shown below:

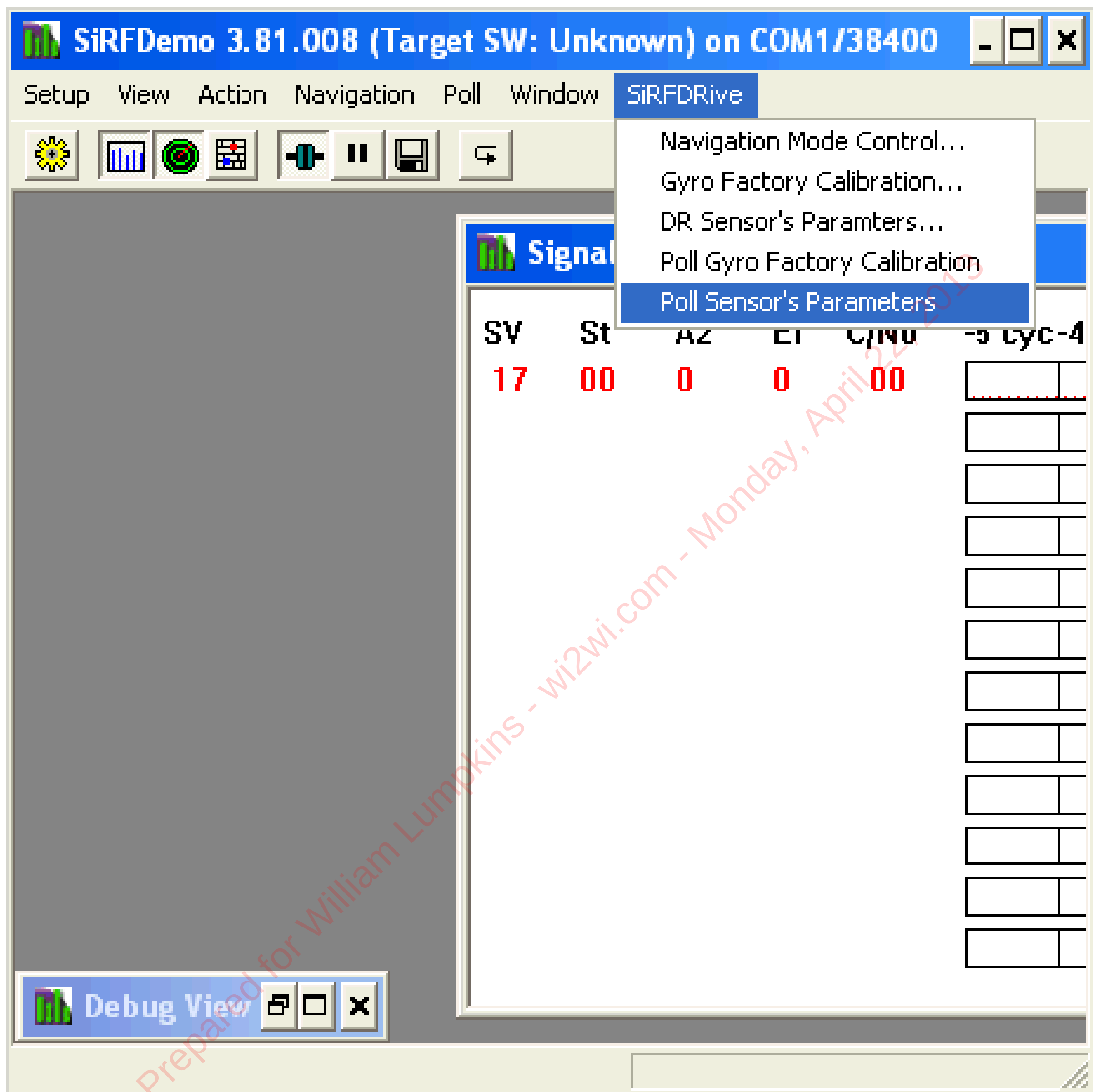


Figure 6.1: Poll Sensor's Parameters

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | 0x30 | N/A |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x09 | N/A |
| 3 | Sensors[0].Sensor Type | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | N/A |
| 4 – 5 | Sensors[0].ZeroRa teVolts | UINT16 | 2 | volts | 0 to 5.0(1) | 0.0001 |
| 6– 7 | Sensors[0].MilliVolt sPer | UINT16 | 2 | millivolts | 0 to 1000(2) | 0.0001 |
| 8 – 9 | Sensors[0].Refere nceVoltage | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |
| 10 | Sensors[1].Sensor Type | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | N/A |
| 11 – 12 | Sensors[1].ZeroRa teVolts | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |
| 13 – 14 | Sensors[1].MilliVolt sPer | UINT16 | 2 | millivolts | 0 to 1000 | 0.0001 |
| 15 – 16 | Sensors[1].Refere nceVoltage | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |
| 17 | Sensors[2].Sensor Type | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | N/A |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 18 – 19 | Sensors[2].ZeroRateVolts | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |
| 20 – 21 | Sensors[2].MilliVoltsPer | UINT16 | 2 | millivolts | 0 to 1000 | 0.0001 |
| 22 – 23 | Sensors[2].ReferenceVoltage | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |
| 24 | Sensors[3].SensorType | UINT8 | 1 | N/A | GYRO_SENSOR = 0x1<br>ACCELERATION_SENSOR = 0x2 | N/A |
| 25 – 26 | Sensors[3].ZeroRateVolts | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |
| 27 – 28 | Sensors[3].MilliVoltsPer | UINT16 | 2 | millivolts | 0 to 1000 | 0.0001 |
| 29 – 30 | Sensors[3].ReferenceVoltage | UINT16 | 2 | volts | 0 to 5.0 | 0.0001 |

Table 6.319: Sensor Package Parameters Message

(1) To restore ROM defaults for ALL sensors enter the value 0xdeadabba here. You must still include the remainder of the message but these values will be ignored.

(2) For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

**API:**

```
#define MAX_NUMBER_OF_SENSORS 0x4
typedef struct
{
    UINT8  SensorType;
    UINT32 ZeroRateVolts;
    UINT32 MilliVoltsPer
    UINT32 ReferenceVoltage;
}MI_SensorDescriptionType;

typedef struct
{
    MI_SensorDescriptionType Sensors[MAX_NUMBER_OF_SENSORS];
} MI_DR_SENS_PARAM;
```

### 6.88.11 Generic Sensors Raw Data - Message ID 48, Sub ID 10

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| Number: | 0x0A |
| Name: | SID_GenericRawOutput |
| Purpose: | Output raw data from generic sensors |

**Table 6.320: Generic Sensors Raw Data - Message ID 48, Sub ID 10**

**Message Length:** 152 bytes @ 1Hz or 16 bytes @ 10Hz

**Rate:** 152 bytes @ 1Hz or 16 bytes @ 10Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0x30 | n/a |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x0A | N/A |
| 3 – 6 | [0].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 7 – 8 | [0].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 9– 10 | [0].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 11 -12 | [0].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 13 – 14 | [0].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 15 – 16 | [0].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 17 | [0].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 18- 21 | [1].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 22 -23 | [1].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 24 -25 | [1].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 26 -27 | [1].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 28 – 29 | [1].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 30 -31 | [1].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 32 | [1].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 33 – 36 | [2].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 37 – 38 | [2].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 39 -40 | [2].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 41 -42 | [2].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 43 – 44 | [2].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 45 -46 | [2].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 47 | [2].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 48- 51 | [3].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 52 -53 | [3].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 54 – 55 | [3].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 56 – 57 | [3].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 58 -59 | [3].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 60 -61 | [3].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 62 | [3].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 63 – 66 | [4].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 67 – 68 | [4].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 69 – 70 | [4].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 71 – 72 | [4].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 73 – 74 | [4].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 75 – 76 | [4].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 77 | [4].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 78 – 81 | [5].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 82 – 83 | [5].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 84 – 85 | [5].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 86 -87 | [5].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 88 – 89 | [5].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 90 – 91 | [5].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 92 | [5].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 93 – 96 | [6].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 97 -98 | [6].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 99 - 100 | [6].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 101 - 102 | [6].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 103 - 104 | [6].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 105 – 106 | [6].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 107 | [6].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 108 – 111 | [7].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 112 – 113 | [7].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 114 – 115 | [7].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 116 – 117 | [7].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 118- 119 | [7].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 120- 121 | [7].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 122 | [7].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 123- 126 | [8].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 127- 128 | [8].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 129 – 130 | [8].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 131 – 132 | [8].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 133- 134 | [8].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 135 – 136 | [8].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 137 | [8].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |
| 138 – 141 | [9].CurrentTime | UINT32 | 4 | millisecs | 0 to 0xffffffff | n/a |
| 142- 143 | [9].AdcAvg[0] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 144- 145 | [9].AdcAvg[1] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 146- 147 | [9].AdcAvg[2] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 148- 149 | [9].AdcAvg[3] | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 150 – 151 | [9].OdoCount | UINT16 | 2 | raw count | 0 to 0xffff | n/a |
| 152 | [9].GPIOStat | UINT8 | 1 | n/a | 0 to 0xff | n/a |

Table 6.321: Generic Sensors Raw Data Message

API:

```
#define NUM_OF_DR_RAW 10
#define MAX_NUMBER_OF_SENSORS 0x4

typedef struct
{
    UINT32 currentTime;
    UINT16 adcAvg[MAX_NUMBER_OF_SENSORS];
    UINT16 odoCount;
    UINT8  gpioStat;
} tADCOdometer;

typedef struct
{
    struct
    {
        tADCOdometer ADCOdometer[NUM_OF_DR_RAW];
    } DrRaw;
} tDrRawData, *tDrRawDataPtr;
```

### 6.88.12 Map Matching Feedback State - Message ID 48, Sub ID 80

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| SID Number: | 0x50 |
| SID Name: | SID_MMFStatus |
| SID Purpose: | Map Matching Feedback State Output Message |

**Table 6.322: Map Matching Feedback State - Message ID 48, Sub ID 80**

**Message Length:** 42 bytes

**Rate:** Output at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | 0x30 | N/A |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x50 | N/A |
| 3 -6 | MMF_Status | UINT32 | 4 | bitmap | See “MMF_Status Bit Description“ below | 0 |
| 7 -8 | Heading | UINT16 | 2 | deg | 0 to 360 | 0.01 |
| 9 -12 | Latitude | INT32 | 4 | deg | -90 to 90 | $10^{-7}$ |
| 13 -16 | Longitude | INT32 | 4 | deg | -180 to 180 | $10^{-7}$ |
| 17 -20 | Altitude | INT32 | 4 | metre | -2000 to 120000 | 0.1 |
| 21-24 | TOW | UINT32 | 4 | sec | 0 to 604800.000 | 0.001 |
| 25-26 | MMF_Heading | UINT16 | 2 | deg | 0 to 360 | 0.01 |
| 27-30 | MMF_Latitude | INT32 | 4 | deg | -90 to 90 | $10^{-7}$ |
| 31-34 | MMF_Longitude | INT32 | 4 | deg | -180 to 180 | $10^{-7}$ |
| 35-38 | MMF_Altitude | INT32 | 4 | metre | -2000 to 120000 | 0.1 |
| 39-42 | MMF_TOW | UINT32 | 4 | sec | 0 to 604800.000 | 0.001 |

Table 6.323: Map Matching Feedback State Message

This represents what the MMF_Status was for the last received MMF packet.

Assuming Bit 0 is the Least Significant Bit:

| Bit # | Name | Description |
|---|---|---|
| 31 | MMF_STATUS_MMF_ENABLED_MASK | Map matching is enabled |
| 30 | MMF_STATUS_MMF_CALIBRATION_ENABLED_MASK | Map matching calibration is enabled |
| 29 | MMF_STATUS_MMF_RETROLOOP_ENABLED_MASK | Map matching retroloop is enabled |
| 28 | MMF_STATUS_GOT_DATA_MASK | Received a MMF packet |
| 27 | MMF_STATUS_SYSTEM_ALTITUDE_VALID_MASK | Altitude updated with MMF data |
| 26 | MMF_STATUS_SYSTEM_HEADING_VALID_MASK | Heading updated with MMF data |
| 25 | MMF_STATUS_SYSTEM_POSITION_VALID_MASK | Position updated with MMF data |
| 24 | MMF_STATUS_INVALID_DATA_SIZE_MASK | Incorrect number of data sets inside MMF packet |
| 23 | MMF_STATUS_HEADING_OUT_OF_RANGE_MASK | Hdg must 0 to 360 degrees |
| 22 | MMF_STATUS_POSITION_DRIFT_MASK | MMF solution failed position drift logic |
| 21 | MMF_STATUS_DATA_OVERFLOW_MASK | New MMF packet arrived before prior one used |
| 20 | MMF_STATUS_DATA_TOO_OLD_MASK | MMF Data was too old for processing |
| 19 | MMF_STATUS_NAV_UPDATED_MASK | Nav was updated with MMF feedback |
| 18 | MMF_STATUS_NAV_VALID_MASK | Nav is valid |
| 17 | MMF_MI_MALFORMED_INPUT_DATA_MASK | MI_MMF_InputData() found error in data |
| 16 | MMF_STATUS_HEADING_ERROR_RATE_TOO_BIG_MASK | MMF packet failed Heading Error logic |
| 15 | MMF_STATUS_HEADING_TURN_RATE_TOO_BIG_MASK | MMF packet failed Heading Rate logic |

| Bit # | Name | Description |
|---|---|---|
| 14 | MMF_STATUS_SPEED_TOO_LOW_MASK | MMF packet failed Speed logic |
| 13 to 8 | undefined | Reserved |
| 7 | MMF_BITMAP_RESERVED_TWO_MASK | Copy of MMF packet bitmap register |
| 6 | MMF_BITMAP_RESERVED_ONE_MASK | Copy of MMF packet bitmap register |
| 5 | MMF_BITMAP_ALTITUDE_VALID_MASK | Copy of MMF packet bitmap register |
| 4 | MMF_BITMAP_HEADING_VALID_MASK | Copy of MMF packet bitmap register |
| 3 | MMF_BITMAP_POSITION_VALID_MASK | Copy of MMF packet bitmap register |
| 2 | MMF_BITMAP_ALTITUDE_FORCED_MASK | Copy of MMF packet bitmap register |
| 1 | MMF_BITMAP_HEADING_FORCED_MASK | Copy of MMF packet bitmap register |
| 0 | MMF_BITMAP_POSITION_FORCED_MASK | Copy of MMF packet bitmap register |

Table 6.324: MMF Status Field Bits

API:

```
typedef struct
{
    UINT32 MMF_Status17;
    UINT16 Heading;
    INT32  Latitude;
    INT32  Longitude;
    INT32  Altitude;
    UINT32 TOW;
    UINT16 MMF_Heading;
    INT32  MMF_Latitude;
    INT32  MMF_Longitude;
    INT32  MMF_Altitude;
    UINT32 MMF_TOW;
} MI_MMF_State_Type;
```

## 6.88.13 OSP GSA - Message ID 48, Sub ID 100

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| Number: | 0x64 |
| Name: | SID_GSA |
| Purpose: | OSP equivalent of NMEA GSA message |

Table 6.325: OSP GSA - Message ID 48, Sub ID 100

**Message Length:** 32 bytes

**Rate:** Output when Nav is complete

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | integer | 0x30 | 1 |
| 2 | Sub-ID | UINT8 | 1 | integer | 0x64 | 1 |
| 3 | mode1 | UINT8 | 1 | integer | 1 = Manual-forced to operate in 2D or 3D mode 2 = 2D Automatic- allowed to automatically switch 2D/3D | 1 |
| 4 | mode2 | UINT8 | 1 | integer | 1 = Fix not available 2 = 2D(<4 SVs used) 3 = 3D(> 3 SVs used) | 1 |
| 5-8 | satellite_used_0_31 | UINT32 | 4 | bitmap | Bit 0 = SV 0 Bit 1 = SV 1 .. .. Bit 31 = SV 31 If bit is set to 1 then SV was used in solution. | 1 |
| 9-12 | satellite_used_32_63 | UINT32 | 4 | bitmap | Bit 0 = SV 32 Bit 1 = SV 33 .. .. Bit 31 = SV 63 If bit is set to 1 then SV was used in solution. | 1 |
| 13-16 | GDOP | FLOAT32 | 4 | metre | Geometric Dilution of Precision | 1 |
| 17-20 | HDOP | FLOAT32 | 4 | metre | Horizontal Dilution of Precision | 1 |
| 21-24 | PDOP | FLOAT32 | 4 | metre | Position Dilution of Precision | 1 |
| 25-28 | TDOP | FLOAT32 | 4 | metre | Time Dilution of Precision | 1 |
| 29-32 | VDOP | FLOAT32 | 4 | metre | Vertical Dilution of Precision | 1 |

Table 6.326: OSP GSA Message

**API:**

```
typedef struct
{
    UINT32  satellite_used_0_31;
    UINT32  satellite_used_32_63;
    FLOAT32 GDOP;
    FLOAT32 HDOP;
    FLOAT32 PDOP;
    FLOAT32 TDOP;
    FLOAT32 VDOP;
    UINT8   mode1;
    UINT8   mode2;
} MI_GSA;
```

### 6.88.14 SiRFDRive NVM at Boot - Message ID 48, Sub ID 105

| | |
|---|---|
| MID Number: | 0x30 |
| MID Name: | MID_DrOut |
| Number: | 0x65 |
| Name: | SID_DR_NVM |
| Purpose: | Output contents of SiRFDRive NVM at boot. Used to seed offline test runs. |

**Table 6.327: SiRFDRive NVM at Boot - Message ID 48, Sub ID 105**

**Message Length:** 167 bytes

**Rate:** Output once at start

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | 0x30 | 1 |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x65 | 1 |
| 3-4 | SeqNum | INT16 | 2 | integer | 2 to 32767 | 1 |
| 5-6 | OkAcrossReset | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 7-10 | DRHeading | FLOAT32 | 4 | degrees | 0.0 to 360.0 | 1 |
| 11-14 | DRHeadingError | FLOAT32 | 4 | degrees | 0.0 to 360.0 | 1 |
| 15-18 | DRSpeedError | FLOAT32 | 4 | m/sec | 0.0 to 600.018 | 1 |
| 19-22 | DRPositionError | FLOAT32 | 4 | metres | 0.0 to 6.0e6f | 1 |
| 23-26 | SpeedSf | FLOAT32 | 4 | dimensionless | +/- full res | 1 |
| 27-30 | OdoSpeedSf | FLOAT32 | 4 | dimensionless | +/- full res | 1 |
| 31-34 | HeadingRateBias | FLOAT32 | 4 | deg/sec | +/- full res | 1 |
| 35-38 | HeadingRateSf | FLOAT32 | 4 | dimensionless | +/- full res | 1 |
| 39-46 | HeadingRateSf_SD | DOUBLE64 | 8 | dimensionless | 0.0 to +full res | 1 |
| 47-50 | LFSpeedSF | FLOAT32 | 4 | dimensionless | +/- full res | 1 |
| 51-54 | RFSpeedSF | FLOAT32 | 4 | dimensionless | +/- full res | 1 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 55-58 | LRSpeedSF | FLOAT32 | 4 | dimensionless | +/- full res | 1 |
| 59-62 | RRSpeedSF | FLOAT32 | 4 | dimensionless | +/- full res | 1 |
| 63-66 | AxleLength | FLOAT32 | 4 | metres | 0.0 to 10.0 | 1 |
| 67-70 | AxleSep | FLOAT32 | 4 | metres | 0.0 to 50.0 | 1 |
| 71-74 | AntennaDist | FLOAT32 | 4 | metres | +/- 50.0 | 1 |
| 75-76 | FirstHRSFDone | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 77-78 | DiffWheelSpdCalOK | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 79-80 | LFSpeedSFCalOk | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 81-82 | RFSpeedSFCalOk | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 83-84 | LRSpeedSFCalOk | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 85-86 | RRSpeedSFCalOk | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 87-88 | DrNavControl | INT16 | 2 | bitmap | 0x1 = GPS_ONLY_REQUIRED 0x2=DR_NAV_WITH_STORED_CAL_OK 0x4 = DR_NAV_REQUIRES_GPS_CAL 0x8 = DR_NAV_ONLY_REQUIRED | 1 |
| 89-96 | RawLonAccel | DOUBLE64 | 8 | m/sec^2 | +/- 50.0 | 1 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 97- 104 | RawLatAccel | DOUBLE64 | 8 | m/sec^2 | +/- 50.0 | 1 |
| 105- 112 | RawUpAccel | DOUBLE64 | 8 | m/sec^2 | +/- 50.0 | 1 |
| 113- 120 | YawAngle_rads | DOUBLE64 | 8 | radians | 0.0 to (2.0 * PI) ?? | $10^{-7}$ |
| 121- 128 | YawAngleSD_rads | DOUBLE64 | 8 | radians | 0.0 to (2.0 * PI)?? | $10^{-7}$ |
| 129- 136 | PitchAngle_rads | DOUBLE64 | 8 | radians | 0.0 to (2.0 * PI)?? | $10^{-7}$ |
| 137- 144 | RollAngle_rads | DOUBLE64 | 8 | radians | 0.0 to (2.0 * PI)?? | $10^{-7}$ |
| 145- 146 | Sensor2YawedDone | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 147- 148 | YawAngleComputed | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 149- 150 | UserResetWithData | BOOL16 | 2 | boolean | 1= User has issued Reset with Data for us to update DR with. 0= No data from user to update DR with. | 1 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 151- 152 | ValidDrCal | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 153 – 154 | OdoSpeedSFCalOk | BOOL16 | 2 | boolean | 0 = false, 1 = true | 1 |
| 155 | SensorDataType | UINT8 | 1 | Bus Type | 0 = DIRECT_ODO_GYRO_REV 1= NETWORK_ODO_GYRO_REV 2= NETWORK_DIF_PULSES_REV 3=NETWORK_DIF_SPEEDS_REV 4=NETWORK_DIF_ANGLRT_REV 5=NETWORK_ODO_GYRO_NOREV 6 =NETWORK_DIF_PULSES_NOREV 7=NETWORK_DIF_SPEEDS_NOREV 8 =NETWORK_DIF_ANGLRT_NOREV 9=NET_GYRO_ODO_STEER_ACCEL 12= NET_ONE_GYRO_THREE_ACCELS | 1 |
| 156- 159 | CheckSum | UINT32 | 4 | CRC code | 0x0 to 0xFFFFFFFF | 1 |
| 160- 163 | Reserved1 | UINT32 | 4 | Undefined | Internal use | 1 |
| 164- 167 | Reserved2 | UINT32 | 4 | undefined | Internal use | 1 |

Table 6.328: SiRFDRive NVM at Boot Message

API:

```
typedef struct
{
INT16     SeqNum;
BOOL16    OkAcrossReset; // TRUE: DR data can be used after a RESET
                             // FALSE: DR data cannot be used after a RESET
FLOAT32   DRHeading;              // deg
FLOAT32   DRHeadingError;      // deg, 1-sigma
FLOAT32   DRSpeedError;          // m/sec, 1-sigma
FLOAT32   DRPositionError;      // meters, 1-sigma

//
// Odometer data
//
FLOAT32   SpeedSf;                   // dimensionless
FLOAT32   OdoSpeedSf;              // dimensionless

//
// Gyro Data
//
FLOAT32   HeadingRateBias;      // deg/sec
FLOAT32   HeadingRateSf;          // dimensionless
DOUBLE64 HeadingRateSf_SD; // dimensionless


//
// Differential Wheel Speed Data
//
FLOAT32   LFSpeedSF;  // Left Front Wheel Speed Scale Factor,
                            // dimensionless
FLOAT32 RFSpeedSF;     // Right Front Wheel Speed Scale Factor,
                            // dimensionless
FLOAT32 LRSpeedSF;   // Left Rear Wheel Speed Scale Factor,
                            // dimensionless
FLOAT32 RRSpeedSF;   // Right Rear Wheel Speed Scale Factor,
                            // dimensionless
FLOAT32 AxleLength; // Length of rear axle, meters
FLOAT32 AxleSep;     // Distance from rear to front axle, meters
                            // (positive forward)
FLOAT32 AntennaDist; // Distance from rear axle to GPS antenna,
                            //meters (positive forward)
BOOL16   FirstHRSFDone;// Indicates First Heading Rate Scale Factor
                            // estimate was done
BOOL16   DiffWheelSpdCalOK; // Indicates whether DWS calibration has been
                                // successful
BOOL16   LFSpeedSFCalOk; // Indicates whether individual speed has been
                                // calibrated
BOOL16   RFSpeedSFCalOk; // Indicates whether individual speed has been
                                // calibrated
BOOL16   LRSpeedSFCalOk; // Indicates whether individual speed has been
                                // calibrated
BOOL16   RRSpeedSFCalOk; // Indicates whether individual speed has been
                                // calibrated
INT16     DrNavControl;    // GPS Only, DR with Stored Cal, or DR with GPS Cal
DOUBLE64 RawLonAccel;
```

```
DOUBLE64 RawLatAccel;
DOUBLE64 RawUpAccel;
DOUBLE64 YawAngle_rads ;      // radians
DOUBLE64 YawAngleSD_rads;      // radians
DOUBLE64 PitchAngle_rads;      // radians
DOUBLE64 RollAngle_rads;      // radians

BOOL16   Sensor2YawedDone;
BOOL16   YawAngleComputed;
BOOL16   UserResetWithData; //TRUE = User has issued Reset with Data
                                     // for us to update DR with
                                     //FALSE = No data from user to update DR
                                     // with

BOOL16   ValidDrCal;
BOOL16   OdoSpeedSFCalOk;
UINT8    SensorDataType;     //Need to remember Bus Type Across reset
UINT32    CheckSum;

} tDrRamData, *tDrRamDataPtr;
```

### 6.88.15 GPIO State - Message ID 65, Sub ID 129

| | |
|---|---|
| MID Number: | 0x41 |
| MID Name: | MID_DrIn |
| Number: | 0x81 |
| Name: | MID_GPIO_State |

**Table 6.329: GPIO State - Message ID 65, Sub ID 129**

**Message Length:** 4 bytes

**Rate:** Output at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | n/a | 0x41 | 1 |
| 2 | Sub-ID | UINT8 | 1 | n/a | 0x81 | 1 |
| 3-4 | gpio_state | UINT16 | 2 | bitmap | Bit 0 is GPIO 0 Bit 1 is GPIO 1 .. .. Bit 15 is GPIO 15 | 1 |

Table 6.330: GPIO State Message

**API:**

```
UINT16
gpio_state;
```

### 6.88.16 Car Bus Data to NAV - Message ID 172, Sub ID 9

| | |
|---|---|
| MID Number: | 0xAC |
| MID Name: | MID_DrIn |
| SID Number: | 0x09 |
| SID Name: | SID_InputCarBusData |
| SID Purpose: | Output Car Bus Data to NAV |

**Table 6.331: Car Bus Data to NAV - Message ID 172, Sub ID 9**

**Message Length:** 22 to 182 bytes

**Rate:** Input at 1Hz

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 1 | Message ID | UINT8 | 1 | N/A | 0xAC | N/A |
| 2 | Sub-ID | UINT8 | 1 | N/A | 0x09 | N/A |
| 3 | Sensor Data Type (SDT) | UINT8 | 1 | N/A | 0-127 1: Gyro, Speed Data, and Reverse 2. 4 Wheel Pulses, and Reverse 3: 4 Wheel Speed, and Reverse 4: 4 Wheel Angular Speed, and Reverse 5: Gyro, Speed Data, NO Reverse 6: 4 Wheel Pulses, NO Reverse 7: 4 Wheel Speed, NO Reverse 8: 4 Wheel Angular Speed, NO Reverse 9: Gyro, Speed Data, Reverse, Steering Wheel Angle, Longitudinal Acceleration, Lateral Acceleration 10: Yaw Rate Gyro, Downward Acceleration (Z), Longitudinal Acceleration (X), Lateral Acceleration (Y) 10-127: Reserved | N/A |
| 4 | Number of Valid data sets | UINT8 | 1 | N/A | 0-11 | N/A |
| 5 | Reverse Bit Map N/A for SDT = 10 | UINT16 | 2 | N/A | Bit-wise indication of REVERSE status corresponding to each sensor data set, i.e. bit 0 corresponds to the first data set, bit 1 corresponds to the second data set, etc. | N/A |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 7+(N- 1)* 16[(1)] | Valid Sensor Indication | UINT8 | 1 | N/A | Valid/Not Valid indication for each one of the 4 possible sensor inputs in a individual data set; when a particular bit is set to 1 the corresponding data is Valid, when the bit is set to 0 the corresponding data is NOT valid. Bit 0 corresponds to Data Set Time Tag Bit 1 corresponds to Odometer Speed Bit 2 corresponds to Data 1 Bit 3 corresponds to Data 2 Bit 4 corresponds to Data 3 Bit 5 corresponds to Data 4 Bits 6-7 : Reserved | N/A |
| 8+(N- 1)* 16[(1)] | Data Set Time Tag | UINT32 | 4 | msec | 0-4294967295 | 1 |
| 12+ (N- 1)*16[(1)] | Odometer Speed (also known as VSS) N/A for SDT = 10 | UINT16 | 2 | m/sec | 0 to 100 | 0.01 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 14+(N- 1)* 16(1) | Data 1 (Depends on SDT) | INT16 | 2 | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1,5, 9,10: Gyro Rate | | | Deg/sec | -120 to 120 | 0.01 |
| | SDT = 2, 6: Right Front Wheel Pulses | | | N/A | 4000 | 1 |
| | SDT = 3, 7: Right Front Wheel Speed | | | m/sec | 0 to 100 | 0.01 |
| | SDT = 4, 8: Right Front Wheel Angular Speed | | | rad/sec | -327.67 to 327.67 | 0.01 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 16+(N- 1)* 16[1] | Data 2 (Depends on SDT) | INT16 | 2 | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1: N/A | | | N/A | N/A | N/A |
| | SDT =2 , 6: Left Front Wheel Pulses | | | N/A | 4000 | 1 |
| | SDT = 3, 7: Left Front Wheel Speed | | | m/sec | 0 to 100 | 0.01 |
| | SDT = 4, 8: Left Front Wheel Angular Speed | | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9: Steering Wheel Angle | | | deg | -720 to 720 | 0.05 |
| | SDT = 10: Downwards Acceleration | | | $m/sec^2$ | -15 to 15 | 0.001 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 18+(N- 1)* 16(1) | Data 3 (Depends on SDT) | INT16 | 2 | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1: N/A | | | N/A | N/A | N/A |
| | SDT = 2, 6: Right Rear Wheel Pulses | | | N/A | 4000 | 1 |
| | SDT = 3, 7: Right Rear Wheel Speed | | | m/sec | 0 to 100 | 0.01 |
| | SDT = 4, 8: Right Rear Wheel Speed | | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9,10:Longitudinal Acceleration | | | m/sec² | -15 to 15 | 0.001 |

| Byte # | Field | Data Type | Bytes | Units | Range | Res |
|---|---|---|---|---|---|---|
| 20+(N- 1)* 16[1] | Data 4 (Depends on SDT) | INT16 | 2 | (Depends on (SDT)) | (Depends on (SDT)) | (Depends on (SDT)) |
| | SDT = 1: N/A | | | N/A | N/A | N/A |
| | SDT = 2, 6: Left Rear Wheel Pulses | | | N/A | 4000 | 1 |
| | SDT = 3, 7: Left Rear Wheel Speed | | | m/sec | 0 to 100 | 0.01 |
| | SDT = 4, 8: Left Rear Wheel Speed | | | rad/sec | -327.67 to 327.67 | 0.01 |
| | SDT = 9,10: Lateral Acceleration | | | m/sec² | -15 to 15 | 0.001 |
| 22+(N- 1)* 16[1] | Reserved | UINT8 | 1 | N/A | N/A | N/A |

Table 6.332: Car Bus Data to NAV Message

[1] N indicates the number of valid data sets in the message

API:

```
typedef struct
{
    UINT8  ValidSensorIndication;
    UINT32 DataSetTimeTag;
    UINT16 OdometerSpeed;
    INT16  Data1;
    INT16  Data2;
    INT16  Data3;
    INT16  Data4;
    UINT8  Reserved;
} tCarSensorData;

typedef struct
{
    UINT8          SensorDataType;
    UINT8          NumValidDataSets;
    UINT16         ReverseBitMap;
    tCarSensorData CarSensorData[11];
} tCarBusData;
```

## 6.89 ACK/NACK for Push Aiding Availability

Removed. There is no need for a separate ACK/NACK for this message. No additional information was proposed here from the ACK/NACK message in Section 6.69.

# 7 Message Processing Procedures

## 7.1 Message Flow

### 7.1.1 Typical Message Flow in Stand-Alone Mode

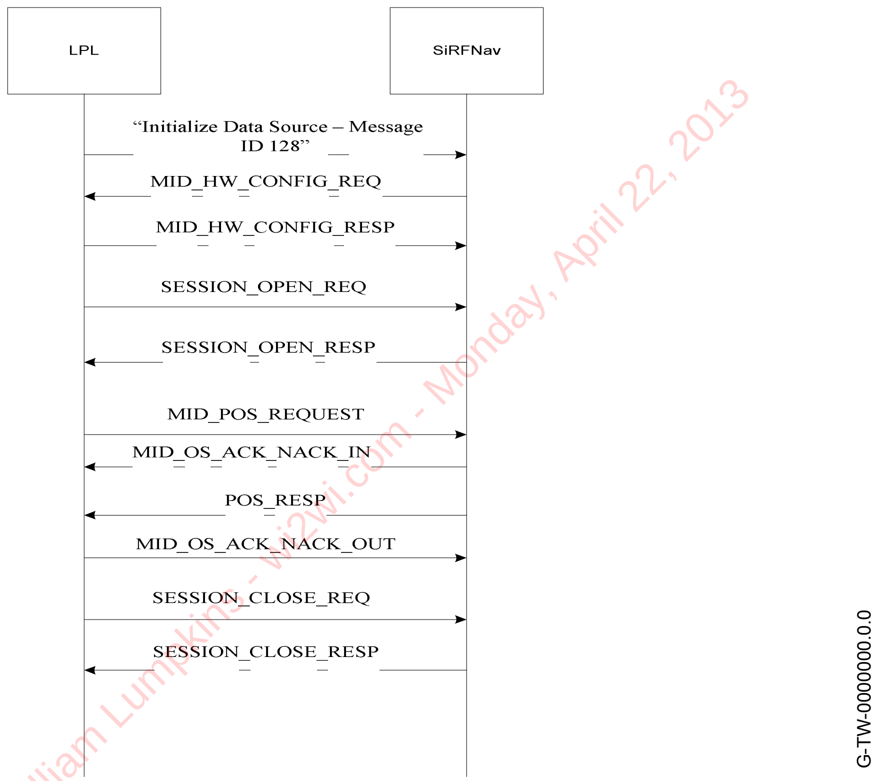


**Figure 7.1: Typical Message Flow in Stand-Alone Mode**

Figure 7.1 illustrates the message flow between a CP component, such as LPL and an SLC component, such as SiRFNav. This includes restarting the receiver with an "Initialize Data Source" message, exchanging HW configuration information, openin up a session, requesting position data and providing it, and finally, closing the session.

### 7.1.2 Typical Message Flow in Aided Mode

The overall message flow between CP and SLC interfaces during an aided GPS (AGPS) session is shown in Figure 7.2.

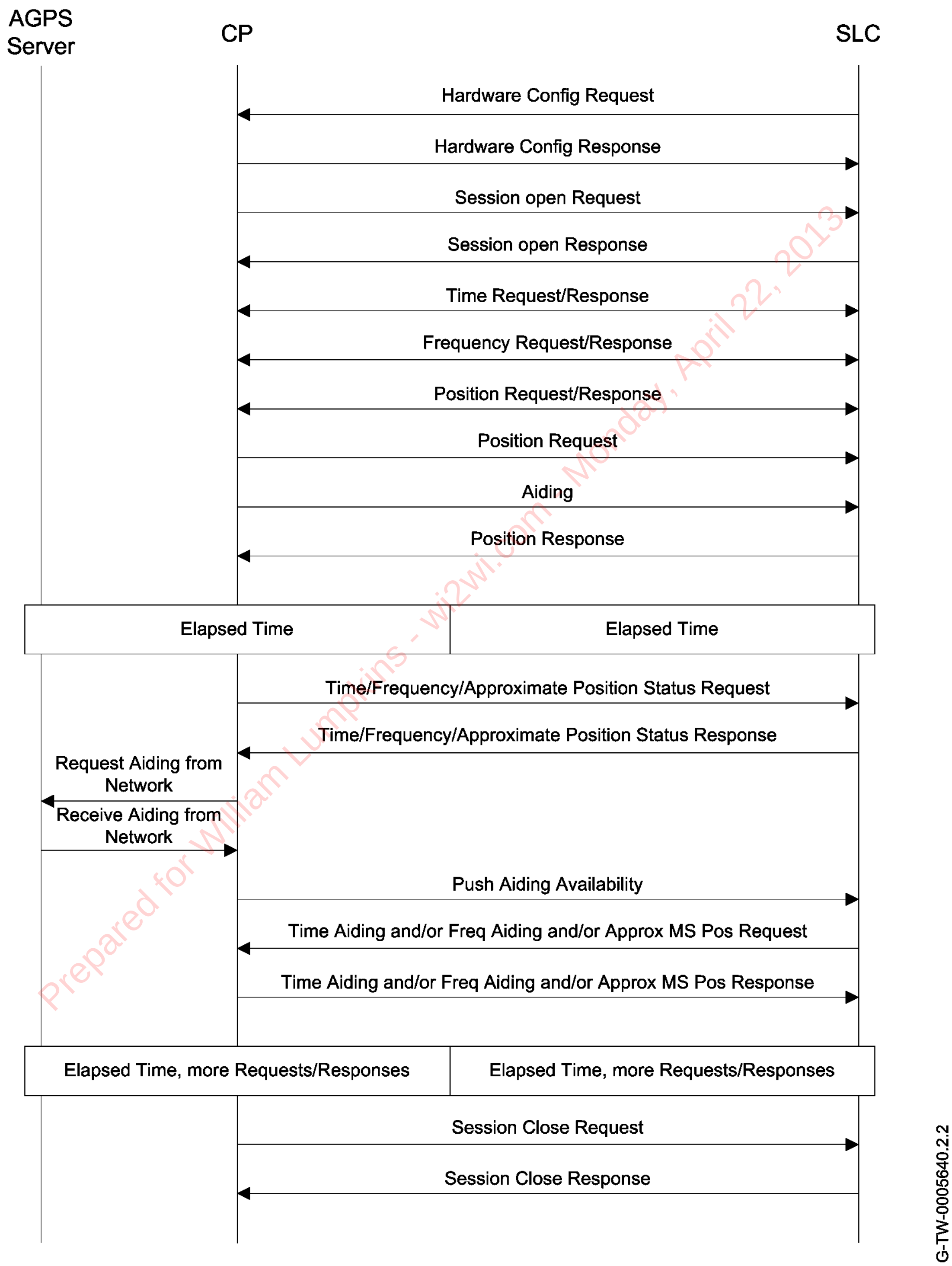


Figure 7.2: Typical Message Flow in Aided Mode

Similarly to the stand-alone mode, here a GPS session is also defined as the time between when the GPS receiver is started (e.g. power on) and when the GPS module is stopped (e.g. power off). A session is the time between "Session Open Request"/"Session Open Response" and "Session Close Request"/"Session Close Response". Figure 7.2 illustrates an example flow diagram from setting the hardware configuration to closing the session.

Here, aiding is also part of the position request / response message tranzaction flow. In other scenarios, aiding can also be provided at any time while the session is open. For example, ephemeris can be pushed at any time while the session is open, even as the first step right after the session open is acknowledged. Several other, alternative procedures such as the push-mode aiding procedure, and the time/frequency/approximate position status procedure are described further below in this section. These two procedures provide the CP with more flexibility to give aiding to the SLC during a GPS session.

### 7.1.3 Push-Mode Aiding Procedure

Anytime after the first set of Time Transfer Request/Response, Frequency Transfer Request/Response, Approximate MS Position Request/Response (right after "Hardware Configuration Response") and before power down, the CP may push aiding information on the F interface under the following conditions:

1. When the CP obtains improved aiding accuracy: The CP shall start the push-mode aiding procedure when new information about the accuracy of aiding information changes from the previous accuracy. The push-mode aiding procedure is triggered by a "Push Aiding Availability" with appropriate "AIDING_AVAILABILITY_MASK" from the CP.

   The SLC shall compare the information in "Push Aiding Availability" with the internal information, and request for the aiding information which is more accurate on the CP side (using "Time Transfer Request", "Frequency Transfer Request", or 'MS Approximate Position Request"). If none of the newly available aiding is more accurate than the SLC's internal state, the SLC may not request for aiding from the CP. Special note: The CP should only send this information when accuracy has improved significantly.
2. When the CP detects change of aiding source: If the position or frequency aiding sources have changed (e.g. base-station handover, a new network is entered), the CP may initiate a "forced aiding request" push-mode aiding procedure by sending a "Push Aiding Availability" with the appropriate "FORCED_AIDING_REQ_MASK". The SLC shall re-request aiding information indicated in the mask. If the SLC is not navigating, the SLC should use the new aiding information regardless of the uncertainty level of the new aiding. However, if SLC is navigating, the SLC will only use information which it currently does not have.

In terms of message handling:

Immediately after the reception of the "Push Aiding Availability" message, the SLC shall return a "Push_ACK_NACK" message before comparing the information in the message with its internal accuracy status. The SLC shall set the message to ACK if the SLC receives and understands the message properly. The SLC shall set the message to NACK if the SLC cannot properly understand the message (e.g. wrong parameter fields).

### 7.1.4 Time/Frequency/Approximate Position Status Procedure

At anytime after the "Hardware Configuration Response", the CP may query the internal status of the time, frequency and position accuracy from the SLC by sending the message "Time_Frequency_ApproximatePosition Request". The CP shall request the accuracy it wishes to query by setting the REQ_MASK of the message.

After the SLC receives the ""Time_Frequency_ApproximatePosition Request" message, the SLC shall immediately prepare the "Time_Frequency_ApproximatePosition Response" by filling the requested status (accordingly to REQ_MASK) with the current internal status. The STATUS_RESP_MASK in the response message shall match the REQ_MASK exactly. If a status is requested in the REQ_MASK, but the internal status is unknown, the SLC shall set the response status value(s) to "unknown", and keep the corresponding bit in STATUS_RESP_MASK as 1.

## 7.2 Message Organization

The Messages are organized by pairs of Request and Response (or Notification) messages. A Request Message can trigger the generation of a single or of a sequence of Response and/or Notification Messages. A requesting entity is allowed to have only one outstanding Request of a given type (specific MESS_ID) at any time. A Request is no longer outstanding as soon as any of the following events occurs:

- A Response or Notification of the corresponding type has been received.
- The elapsed time since the transmission of the request is larger than the current timeout value.

Every Response associated with a Request should be sent back to the requesting entity within the initial timeout delay. If the response did not arrive within the prescribed timeout delay to the requesting entity, the requesting entity can choose to send again the Request, or any other appropriate action. If the requesting entity resends the same request, the timeout value will be doubled from the timeout value used during the previous attempt. At the end of the third attempt without any response received from the other end, no further attempt will be tried. If the requested entity cannot send the response message within the timeout delay, it will retransmit a reject message instead. No response message can be spontaneously sent without having previously received the associated Request for the other entity. There are few exceptions to this general concept of associated Request/Responses pairs:

- Requests with no explicit response

  *Reset GPS Command:* As soon as the SLC receives this message, it shall reset itself. After noting a reset has occurred, the CP sees the hardware config request from the SLC and sends a hardware configuration response. No message has to be sent in reply to the Reset GPS Command.
- Unsolicited Information messages (no request)

  *SLC Status message:* SLC sends this message when one of the events described in the SLC Status event list has occurred. There is no obligation for the CP to act upon their reception.

  *Error Notification message:* SLC sends this message to inform the CP of an error occurrence part of the list predefined for the error notification list. There is no obligation for the CP to act upon their reception.

Illustrating such message organization, Figure 7.3 andFigure 7.4 show how to the message request / response and notifications would detail a generic AGPS message flow depicted above in Figure 7.2.

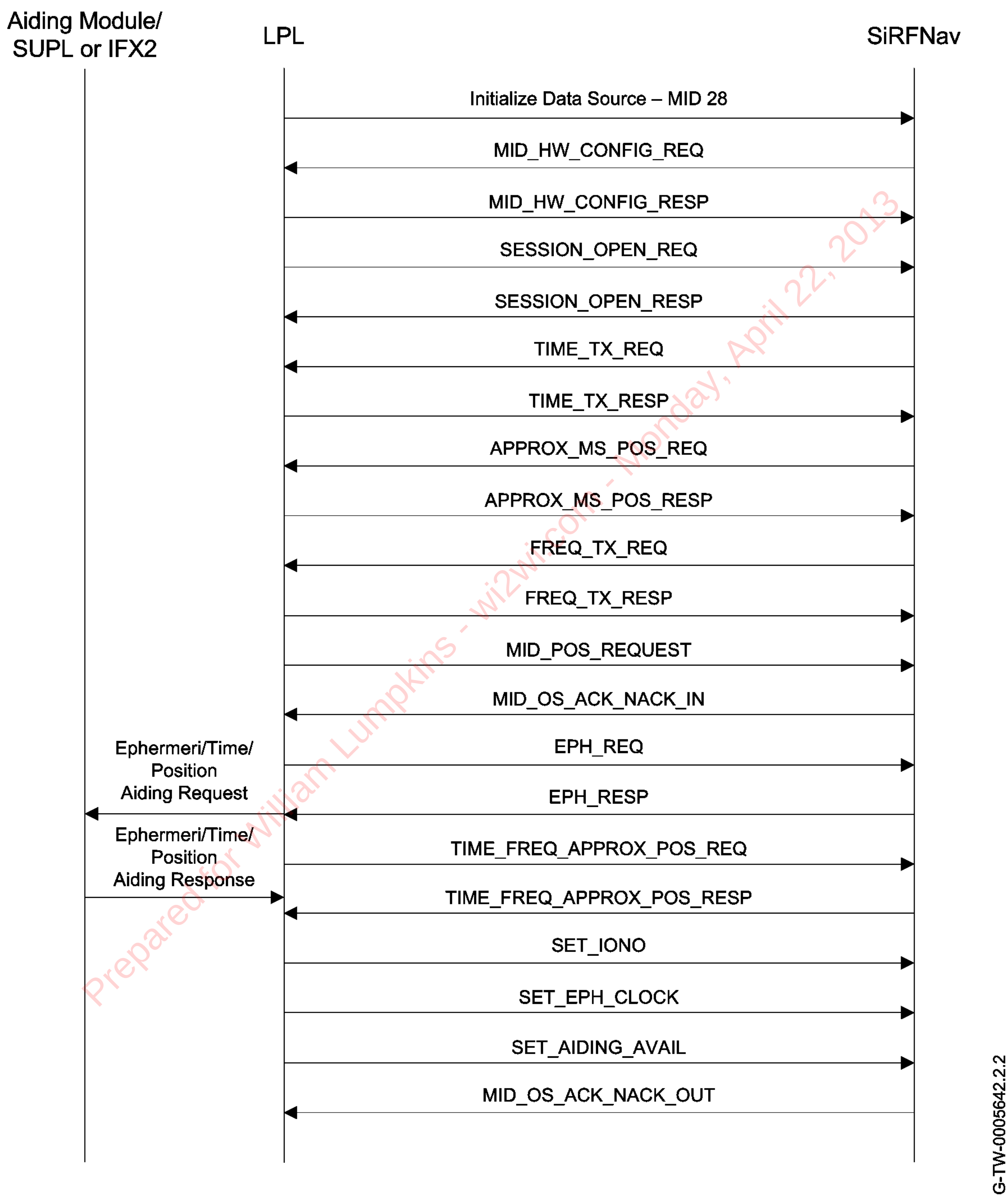


Figure 7.3: Example Request/Response

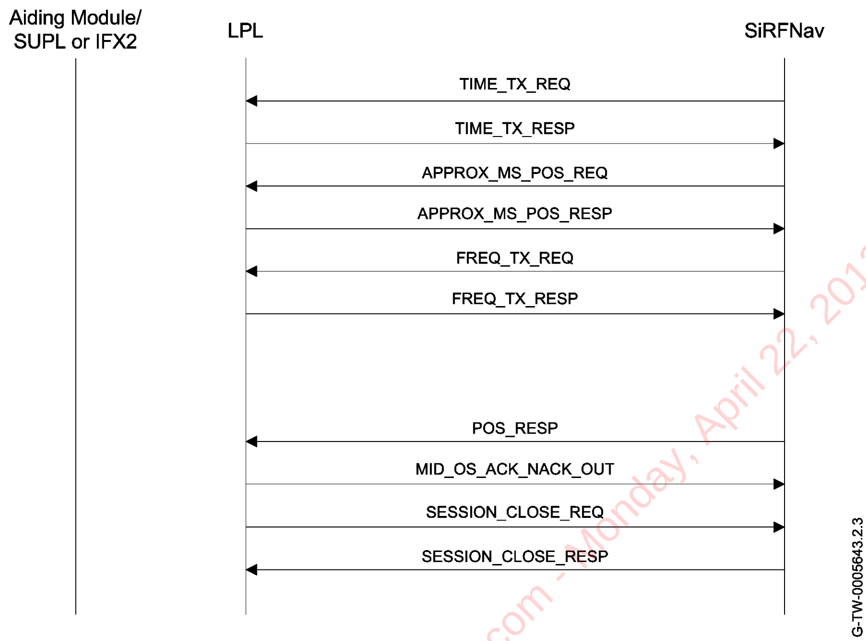


Figure 7.4: Example Notification Message

*General Error Handling Procedures on SLC side*

- Upon receiving any request, if data is not immediately available, the SLC shall respond with a Reject Message with REJ_REASON set to "not ready". It will send a response message any time, as soon as the data becomes available.
- Upon receiving any request, if data will not be available and will not be available until the next power cycle, the SLC shall send a Reject message with REJ_REASON set "not available". No other Response shall be sent afterwards.
- Upon receiving a Reject message with REJ_REASON set to "not available", the SLC shall not expect any response for this request, and shall not request the same information later on.
- Upon receiving a Reject message with REJ_REASON set to "Wrongly formatted message", and a request of the rejected message is still pending, the SLC shall send the request once again instantly; otherwise the SLC will take no action.
- Upon receiving a Wrongly Formatted Message, the SLC shall send a "Reject" Message with "REJ_REASON" field set to "Wrongly formatted message" (see Glossary for definition of Wrongly Formatted Messages).
- Upon receiving a message with a reserved MESS_ID (see Table 4.1), the SLC shall send an error notification message with ERROR_REASON field set to "MESS_ID not recognized".
- Upon receiving an error notification message with ERROR_REASON field set to "MESS_ID not recognized", the SLC shall silently discard the message.

*General Error Handling on CP side*

- Upon receiving any request (except HW Configuration Request), if data is not immediately available, the CP shall respond with a Reject Message with REJ_REASON set to “not ready”. It will send a response message any time, as soon as the data becomes available.
- Upon receiving any request (except HW configuration Request), if data will not be available and will not be available until the next power cycle, the CP shall send a Reject message with REJ_REASON set “not available”. No other Response shall be sent afterwards.
- Upon receiving a Reject message with REJ_REASON set to “not available”, the CP shall not expect any response for this request, and shall not Request the same information later on.
- Upon receiving a wrongly formatted query, the CP shall send a Reject message with REJ_REASON set to “Wrongly formatted message”.
- Upon receiving a Reject message with REJ_REASON set to “Wrongly formatted message”, and a request of the rejected message is still pending, the CP shall send the request once again instantly; otherwise the CP will take no action.
- Upon receiving a message with a reserved MESS_ID, the CP shall send an error notification message with ERROR_REASON field set to “MESS_ID not recognized”.
- Upon receiving an error notification message with ERROR_REASON field set to “MESS_ID not recognized”, the CP shall silently discard the message.

## 7.3 “Reject message” vs. “Error Notification” Messages

There are two methods of error reporting:

- Either a Request cannot be fulfilled, and a “Reject” message is sent instead of the normal Reply message, with an code to identify the reason of the reject; this is a “solicited” error reporting. In this category falls “data not available” or trying to open a session when the session has already been opened.
- Or a condition, not associated to a request arose, and the SLC needs to report the problem to the CP for possible action. The Error Notification message has been introduced specifically for this ; this is an unsolicited error reporting. In this situation falls the incompatibility between Air- Interface revision numbers.

## 7.4 Error handling

The errors can be classified in three categories:

- The ones sent in a Reject Message, informing the requesting entity that the requested action has not been completed and giving the reason for the non completion. This category usually leads to a correction of the problem and repetition of the request by the requesting entity.
- The ones sent in an Error Notification message, informing the other entity that a change in the environment (but not triggered by a Request) occurred, and needs intervention. In this category falls the Air-interface OSP revision number incompatibility.
- The ones reported in an Error Notification message, informing that some error has occurred, but not destined to the other entity. The other entity will silently discard the message (i.e. do nothing), and will continue the processing. Those messages are meant to be captured by any message collection device connected between communicating entities, and meant to inform of a problem during the integration phase. Wrongly formatted messages fall into this category.

## 7.5 Message Time-out Procedures

- When the CP sends a “Reject” message with reason as “Data Not Ready”, the SLC shall continuously send the request message every 4 seconds until the response message or the reject message with data not available is received.
- When a response message is not received, the sender of the request message shall re-try the sending of the message up to 3 times, starting after 6 seconds after the initial message, and doubling the time-out value at each retry.

## 7.6 Power ON/Power OFF

*Power ON procedure:*

- When the CP needs to start a Geolocation Session, it turns ON the SLC's power. After Initialization and self-check, the SLC shall send the hardware config request message, which notifies the CP that the SLC is alive, and the message transfer can start. The Power ON sequence also directs the SLC to immediately start the GPS processing, with whatever aiding information is available at the SLC at that time.

*Error Recovery on CP side:*

- If the hardware config request message is not received within *n* seconds, the CP shall cycle the SLC's power OFF and ON again. It is to note that CP needs to allow enough time for the SLC to send the hardware config request after power ON (compatible with *n* above), otherwise, the SLC will never start properly.

  **Note:**

  The value *n*, above, is product specific and is, therefore, not defined in this document.

*Error Recovery on SLC side:*

- The SLC shall wait (TIME_OUT at design phase on a case by case basis) seconds after outputting the hardware config request for the CP to send the Hardware Configuration Response message. If the Hardware configuration response never arrives at the SLC, then no session is opened and no aiding requests are sent. The SLC positions autonomously in this case.

*Power OFF procedure:*

- To power OFF the SLC, after having sent a "Session Closing Request" with "SESSION_CLOSE_REQ_INFO" set to "Session Closing Requested", the CP shall wait for the "Session Closing Notification" with "SESSION_CLOSE_STATUS" field set to "Session Closed" before turning the power off. The Response message notifies the CP that all context has been saved in non-volatile memory, and that the SLC can be safely turned OFF at any time.

## 7.7 GPS Soft Reset

Aside from the power cycle, or the hard reset using HW pin, it is possible to reset the GPS function by sending a Reset GPS Command.

*GPS Soft Reset Procedure:*

- When the CP wants to start a GPS session through software messaging only, it shall send a "Reset GPS Command" message and wait for *n* seconds to receive the hardware config request message.

  **Note:**

  The value *n*, above, is product specific and is, therefore, not defined in this document.

- Upon receiving a "Reset GPS Command" message with
  - 2.1 "RESET TYPE" field set to "Hot Reset", the SLC shall execute a Software Reset without clearing non volatile memory.
  - 2.2 "RESET TYPE" field set to "Cold Reset", the SLC shall clear stored ephemeris , RTC Time and stored MS location from non volatile memory and then execute a Software Reset.
  - 2.3 "RESET TYPE" field set to "Factory Reset", the SLC shall clear entire non volatile memory and then execute a Software Reset.

In all of the previous cases, the SLC shall flush the message buffers before restart.

*Error Handling:*

- If the CP does not receive a "Hardware Configuration Request" Message within the timeout, the CP shall cycle the power.

# 7.8 Low Power Management

## 7.8.1 Advanced Power Management (APM)

As described in the message specification sections above, the SiRFstarIV power management also includes a Micropower Management (MPM) mode. This is a more advanced, improved version of the SiRFstarIII power management solution, the flow of which is summarized below.

The APM is a sophisticated power control method applied between successive fixes, and between fixes requirements. It makes the assumption that the CP keeps the “Power ON” all the time on the SLC subassembly. After the CP enables it, it is under SLC’s control.

The CP turns the APM mode ON, by sending the “Power Mode Request, APM_REQ” message; the CP verifies that the command has been executed by checking the ERROR_CODE field in the “Power Mode Response, APM_RESP” message.

In the simplest manner, the SLC can be set to Hibernate mode immediately by the following procedure:

1. An OSP session is open (i.e. Session Open Request/Notification have been exchanged).
2. The CP sends “Power Mode Request, APM_REQ” and receives “Power Mode Response, APM_RESP”.
3. The CP sends “Session Close Request”, and receives “Session Close Response”.

After Step 3, the SLC is in Hibernate mode

Alternatively, the APM can be turned “ON”, either with priority to power reduction (the SLC shall try to keep the power duty cycle lower than or equal to the prescribed value in the POWER_DUTY_CYCLE field, possibly by slowing down the fix update rate), or to performance (the SLC shall try to keep up with the periodicity between fixes, possibly by increasing the power consumption) using the PRIORITY field.

*APM enable procedure:*

- The CP shall send a “Power Mode Request, APM_REQ” message with POWER_DUTY_CYCLE field set to the desired power consumption (from 1 for 5% , to 20 for 100% of the total power), and PRIORITY field set to “1” for priority to the performance and to “2” for priority for power reduction.
- The SLC shall send a “Power Mode Response, APM_RESP” message.

*APM disable procedure:*

- The CP shall send a “Power Mode Request, APM_REQ” message. The content of the fields POWER_DUTY_CYCLE and PRIORITY are not relevant.
- The SLC shall send a “Power Mode Response, APM_RESP” message with ERROR_CODE set to “0”.

For more details, see the *Power Management Modes Application Note* for specific products.

## 7.8.2 TricklePower Operation in DGPS Mode

When in TricklePower mode, serial port DGPS corrections are supported if the firmware supports them in full-power mode. If the CPU can be awakened from sleep mode by the UART receiving data (this feature exists in SiRFstarII receivers, not in SiRFstarIII), then the incoming corrections awaken the receiver, and it stores the incoming data in a buffer and applies them when it awakens. If the receiver cannot be awakened by UART interrupts, messages should only be sent when the receiver has indicated OK to send, or they will be lost.

When in TricklePower mode, the use of SBAS corrections is not supported in any receiver.

# 7.9 Hardware Configuration

As soon as the SLC is up and running it shall send a hardware config request message. The CP sends the hardware configuration response so that the software will know what the capabilities from the CP are, and won’t try to access capabilities that are not present. It will also allow the dynamic change of the HW capabilities from one power cycle to another one.

The hardware config request needs to be the first messages sent from the host. In a tracker product, the hardware config request should be sent at part of the SiRFNav Start/Stop messages (see product's MEI documentation for details). When the product is a PVT, the hardware config request message is still sent from the SLC and should be ignored (i.e. no response sent). Without a hardware config response message received, the OSP will be backwards compatible to SSIII GSW and thus the SLC will operate autonomously.

In this category, there are:

- Time transfer capabilities

  The time can be sent by CP to SLC as a H/W signal time tagging a particular event, followed by a "Time Transfer Response" message, indicating what was the time of the H/W event. This is the "Precise Time Transfer" Mode. If no H/W time transfer interface is present, the time can still be transmitted with a lower accuracy as an isolated "Time Transfer Response" message. This is the "Coarse Time Transfer" mode. Whether some time transfer capability is present, and which one if any, is found in the "Hardware Configuration Response" Message. Please note that "Precise Time Transfer" and "Coarse Time Transfer" are exclusive of each other.
- Frequency Transfer Capabilities

  The Frequency can be either referred to the SLC clock or to the reference clock input to the counter. The HW_Config shall indicate whether the frequency transfer is counter method or not. Also the frequency transfer response now has a bit which identifies the relation of each frequency transfer message to either SLC clock or the reference clock to the counter. Whether some Frequency transfer capability is present, and which one if any, is found in the "HW_CONFIG" field of the "Hardware Configuration Response" Message. Please note that all Frequency transfer methods are exclusive of each other.
- Nominal Frequency aiding

  If a "Counter" type frequency transfer is implemented, HW_CONFIG shall indicate whether the reference clock input to the counter is on or not. SLC shall NEVER read the counter when the reference clock is off. The "NOMINAL_FREQ" field in the "Hardware Configuration Response" Message gives the exact frequency (derived from the CP clock) applied to the counter input. This is necessary to determine the relative frequency error between CP clock and SLC clock from the absolute frequency difference measurement.

*Procedure*

- At the Power ON, the SLC shall send a hardware config request message.
- Upon receipt of the hardware config request the CP shall send a "Hardware Configuration Response" message describing the implemented hardware capabilities.
- Upon receiving a "Hardware Configuration Response" message, the SLC shall store the hardware capabilities only for the duration of the current power cycle. The subsequent request messages issued by the SLC will depend on HW configuration message. Most notably, time and frequency transfer requests will be issued depending on the contents of the HW configuration message.

*Error recovery*

- Check the Power ON/Power OFF error recovery section.

## 7.10 Serial Port management

Depending on the hardware configuration, the SLC has one or two serial ports available for communication. The ports are named "Port A", "Port B", up to the number of ports available.

- Only port A is available for all SiRFLoc communications.
- The baud rate settings for port A or port B can be changed through the "Serial Port Settings Request/ Response" pair, sent over port A only.
- The baud rate settings shall be stored in non-volatile memory.

Procedure for baud-rate change ON "port A" FROM port A:

*Normal procedure*

- CP sends a “Serial Port Settings Request” message with PORT field set to “0” , and BAUD_RATE field set to the “new” baud rate on port A. The message is transmitted at the “old” baud rate port A. It is the last message the CP shall transmit at the “old” baud rate on port A.
- Upon reception, the SLC shall flush the message buffer and then acknowledge by sending a “Serial Port Settings Response” message with PORT field set to ‘0’, BAUD_RATE field set to the “new” baud rate, and ACK_NUMBER field set to ‘1’. This message is transmitted at the “old” baud rate on port A. It is the last message sent at the “old” baud rate on the port A. Then the SLC waits one second during which it will transmit no message and accept no message.
- Upon reception of the first “Serial Port Setting Response” message, and within one second after reception, the CP will change the baud-rate settings on its Port. It shall transmit no message, but shall accept incoming messages at the “new” baud rate.
- After the one second delay, the SLC shall send a second “Serial Port Setting Response” message with PORT field set to ‘0’, BAUD_RATE field set to the “new” baud-rate, and ACK_NUMBER set to ‘2’, as an acknowledgement the baud rate has been effectively changed. This message shall be transmitted at the “new” baud rate on port A.
- Upon reception of the second “Serial Port Setting Response” message with ACK_NUMBER set to ‘2’, CP shall resume the normal exchanges using port A at the “new” baud rate.

*Error handling:*

- 1) If the CP does not receive “Serial Port Setting Response” message with ACK_NUMBER set to ‘1’ within 15 seconds after having sent “Serial Port Setting Request” message, the CP shall “hard reset” the SLC by HW pin, or “power cycle”.
- ) if CP does not receive “Serial Port Setting Response” message with ACK_NUMBER set to ‘2’ within 2 seconds from the first “Serial Setting Response” message with ACK_NUMBER set to ‘1’, the CP shall “hard reset” the SLC by HW pin, or power cycle. Then it shall try to communicate at “new” and then “old” baud rate.

Procedure for baud-rate change ON “port B” FROM “port A”:

*Normal procedure*

- CP flushes the buffer for the outgoing messages on port B, so no more messages shall be transmitted on port B. CP sends a “Serial Port Settings Request” message with PORT field set to “1”, and BAUD_RATE field set to the “new” baud rate on port B. The message is transmitted on port A at the baud rate in use on port A at that time.
- SLC flushes the message buffer on port B and then acknowledges by sending a “Serial Port Settings Response” message with PORT field set to ‘1’, BAUD_RATE field set to the “new” baud rate, and ACK_NUMBER field set to ‘1’. This message is transmitted on port A, at the baud rate in use on port A at that time.
- Then the SLC waits one second during which it will transmit no message and accept no message on port B. The message traffic on port A is unaffected, though.
- After the one second delay, the SLC shall send a second “Serial Port Settings Response” message with PORT field set to ‘1’, BAUD_RATE field set to the “new” baud-rate, and ACK_NUMBER set to ‘2’, as an acknowledgement the baud rate has been effectively changed. This message shall be transmitted on port A, at the baud rate in use on port A at that time. ☐ Upon reception of the second “Serial Port Setting Response” message with ACK_NUMBER set to ‘2’, CP shall resume the normal exchanges on port B, at the “new” baud rate.

*Error handling:*

- If CP does not receive “Serial Port Settings Response” message with ACK_NUMBER set to ‘1’ within 15 seconds after having sent “Serial Port Settings Request” message, the CP shall “hard reset” the SLC by HW pin, or “power cycle”.
- If CP does not receive “Serial Port Settings Response” message with ACK_NUMBER set to ‘2’ within 2 seconds from the first “Serial Settings Response” message with ACK_NUMBER set to ‘1’, the CP shall “hard reset” the SLC by HW pin, or power cycle.

## 7.11 Session Opening/Session Closing

After the SLC responded to an incoming HW_CONFIG_REQ message, it is ready to receive a “Session Opening Request” message. The latter message notifies the SLC that the connection with the SLS has been established and that air-interface messages can be exchanged. The SESSION_OPEN_REQ_INFO in the message allows the SLC to determine what “Geolocation Air-Interface protocol” to activate to dialog with the SLS. This allows the use of multi-mode MS’s. A multi-mode MS supports several Geolocation airinterfaces which are determined at the opening of the Geolocation session.

The special case of “request for standalone solution” means that the position request actually comes from MS user whether the user is out of the cell phone coverage area. The special case of “request without air-interface” means that the position request actually comes locally from the MS user but the cell phone can not obtain an air-interface connection, therefore no Geolocation aiding will be available from a remote SLS. The SLC will use all information available except Geolocation messages. The implicit aiding (time transfer, frequency transfer, approximate MS position) might be available, if the MS is in a wireless coverage area, and if the air-interface has the capability to provide the information. The Position Result will be obviously available only locally, and will be returned by a “Position Results” message to the CP (for local display to the MS user).

The “Session Closing Request” message with “SESSION_CLOSE_REQ_INFO” set to “Session Closed Requested” notifies the SLC that the Geolocation air-interface connection has been permanently broken. The SLC shall stop to send “Air-Interface” messages.

*Session Opening procedure*

When the CP is informed that an air-interface connection has been opened with the SLS or it has received an air-interface message from the SLS, it shall send a “Session Opening Request” message to the SLC, with the “SESSION_OPEN_REQ_INFO” field set to the appropriate air-interface identification.

Upon receiving a “Session Opening Request” message:

- If the SLC can open the session, it shall send a “Session Opening Notification” message with the “SESSION_OPEN_STATUS” field set to “Session Opening Succeeded”. The SLC shall immediately start the “Air-Interface” protocol and messages process.
- If the SLC cannot open the session, it shall send a “Session Opening Notification” message with the “SESSION_OPEN_STATUS” field set to “Session Opening Failed”.
- If the SLC cannot open the session within the timeout, it shall send a “Reject” message with “REJ_REASON” set to “Not ready”.

*Session Opening Error Handling*

- Upon receiving a Session Opening Request with SESSION_OPEN_REQ_INFO set to a valid opening mode, when the session is already open, the SLC shall send a Session Opening Notification message with SESSION_OPEN_STATUS set to “Session Opening Failed”.
- Upon receiving a ”Session Opening Notification” message with “SESSION_OPEN_STATUS” field set to “Session Opening Failed”, the CP shall retry a “Session Opening Request” for at most three times, before declaring SLC failure.

*Session Closing Procedure*

When the CP is informed that the air-interface connection has been permanently closed, it shall send a “Session Closing Request” message, with the “SESSION_CLOSE_REQ_INFO” field set to “Session Closing Requested”.

Upon receiving a “Session Closing Request” message:

- If the “SESSION_CLOSE_REQ_INFO” field is set to “Session Closing Requested”, the SLC shall stop sending any air-interface message, and shall close the air-interface process. It shall store all information necessary to keep from session to session in the local non-volatile memory.

  If this action is safely done within the timeout period, the SLC shall send a “Session Closing Notification” Message with “SESSION_CLOSE_STATUS” field set to “Session Closed”.

  If it is not done within the timeout, the SLC shall send a “Reject” message with “REJ_REASON” field set to “Not Ready”.

*Session Closing Error Handling*

Upon receiving a Session Closing Request with SESSION_CLOSE_REQ_INFO set to “Session Closing requested”, when no session is open, the SLC shall send a Session Closing Notification with SESSION_CLOSE_STATUS set to “Session closing failed”.

## 7.12 Session Suspend/Session Resume

The CP might know about a transitory situation (like hand-over) where the air-interface connection is temporarily broken. The CP shall notify the SLC of such an occurrence by sending a special “Session Closing Request” message with “SESSION_CLOSE_REQ_INFO” field set to “Session Suspend Requested”. Upon receiving such a message, the SLC will “freeze” the “geolocation air-interface protocol” (meaning that all timeout counters will be stopped).

When the CP knows about the reconnection, it shall send a special “Session Opening Request” with “SESSION_CLOSE_REQ_INFO” field set to “Session Resume Requested”. Upon receiving such a message, the SLC will restart the “Geolocation Air-Interface protocol” where it left it after receiving the “Session Closing Request” Message with “Suspend” bit set.

*Suspend Procedure*

When the CP has been informed that an air-interface connection with the SLS has been temporarily closed, it shall send a “Session Closing Request” message with “SESSION_CLOSE_REQ_INFO” field set to “Session Suspend Requested”.

Note:

> In parallel with notifying the CP, we assume that the network will have sent a similar “suspend” notification to the MAS that will suspend air-interface activity in the SLS in a similar way.

Upon receiving a “Session Closing Request” message with “SESSION_CLOSE_REQ_INFO” field set to “Session Suspend Requested”, the SLC shall “freeze” the air-interface process activity. In particular the timeout counters will be “frozen” at their current values. It shall send back a “Session Closing Notification” message with “SESSION_CLOSE_STATUS” field set to “Session Suspended”. If the air-interface was already in a suspend state, the SLC shall still send a “Session Closing Notification” message with “SESSION_CLOSE_STATUS” set to “Session Suspended”.

*Error Handling*

Upon receiving a Session Closing Request with SESSION_CLOSE_REQ_INFO set to “session Suspend requested”, when no session is open, the SLC shall send a Session Closing notification with SESSION_CLOSE_STATUS set to “Session suspend failed”.

*Resume Procedure*

When the CP has been informed that an air-interface connection with the SLS has been reestablished, it shall send a “Session Opening Request” message with “SESSION_OPEN_REQ_INFO” field set to “Session Resume Request”.

Note:

> In parallel with notifying the CP, we assume that the network will have sent a similar “Resume” notification to the MAS which will resume air-interface activity in the SLS in a similar way.

Upon receiving a “Session Opening Request” message with “SESSION_OPEN_REQ_INFO” field set to “Session Resume Request”, the SLC shall “unfreeze” the air-interface process activity. In particular the timeout counters will be “reactivated”. The SLC shall send a “Session Opening Notification” with the “SESSION_OPEN_STATUS” field set to “Session Resume Succeeded”. If the air-interface was not in a suspend state, the SLC shall still send a normal “Session Opening Notification”, with the “SESSION_OPEN_STATUS” field set to “Session Resume Succeeded”.

## 7.13 Approximate MS Position Management

To speed up the position computation, The SLC can request from the network its approximate position by the “Approximate MS Position Request/Response” message pair.

The normal procedure is as follows:

- The SLC sends an “Approximate MS Position Request” message.
- The CP sends an “Approximate MS Position Response” message with the LAT, LON, ALT fields set to the best estimate of the MS location, and “EST_HOR_ERR” field set to the maximum radius of the position uncertainty around the given position.

Error handling:

- If the CP does not have the information available (and will not get it even later), it shall send a “Reject” message, with the “REJ_REASON” filed set to “Not Available”.
- If the CP has no information ready (BUT could get the information eventually), it shall send a “Reject” message, with the “REJ_REASON” field set to “Not Ready”; if the information becomes available later, the CP shall immediately send an “Approximate MS Position Response” message, without waiting for a new request from the SLC.

## 7.14 Time Transfer

If some form of time transfer is available (as specified by the “Hardware Configuration Message”), the SLC may send “Time Transfer Request” Message. If the CP has access to the time, and depending on the HW_CONFIG word, it will:

- Either send a H/W pulse, then a “Time Transfer Response” Message in case the “Precise Time Transfer” mode has been activated.
- Send a “Time Transfer Response” Message in case the “Coarse Time Transfer” mode has been activated
- Send a Reject message.

All of these options must occur within a predetermined timeout period (defined at design time).

To assist in situations which could arise during the integration period, but should not occur in normal operation several special cases of “Reject” message have been added for situations where:

1. The Hardware Configuration Response has both bits “Precise Time Transfer” and “Coarse Time Transfer” asserted.
2. When a “Precise Time Transfer” mode has been declared in the “Hardware Configuration Response”, a “Time Transfer Response” message is received with TT_TYPE field to all ’0’s (i.e. of “Coarse” type).
3. Conversely, whereas a “Coarse Time Transfer” mode has been declared in the “Hardware Configuration Response”, a “Time Transfer Response” message is received with TT_TYPE field to all ‘1’s (i.e. of “Precise” type).

In all preceding cases, the SLC shall send a “REJECT” message with REJ_REASON field set to “Wrongly formatted message”.

*Time transfer Procedure*

Upon receiving a “Time transfer Request” Message

1. If the CP is capable of generating a time pulse (as described in "Hardware Configuration" information), it shall send the time pulse within the timeout from the request message, then the "Time Transfer Response" message, within the timeout counted from the time pulse rising edge. The TT_TYPE field shall be set to "Precise Time Transfer". The "times" field in the "Time Transfer Response" message shall be set to the GPS time of the rising edge of the pulse; the "accuracy" field shall be set to the appropriate value according to the origin of the time information.
2. If the CP is not capable of generating a time pulse (as described in "Hardware Configuration" information), it shall send a "Time Transfer Response" message, within the timeout counted from the reception of the Request message. The TT_TYPE field shall be set to "Coarse Time Transfer". The "times" field in the "Time Transfer Response" message shall be set to the approximate GPS time at the time of message transmission; the "accuracy" field shall be set to the appropriate value according to the origin of the time information.

*Error Handling*

- If the CP either is not capable of giving time, or is not currently ready to give time, the CP shall send a "Reject" Message.
- If the time will not be accessible at all, the CP shall set the "REJ_REASON" field to "Not available".
- If the CP was not able to provide the information within the timeout, BUT it can eventually provide the information after a sufficient delay, the CP shall set the "REJ_REASON" field to "Not ready" bit.
- Upon receiving a "Time Transfer Response" Message in a "Precise Time Transfer" mode without receiving first a hardware time pulse, or receiving it before the message, the SLC shall send a "Reject" message with "REJ_REASON" field set to "No Time Pulse during Precise Time Transfer".

## 7.15 Frequency Transfer

If some form of frequency transfer is available (see "Hardware Configuration"), the SLC shall send "Frequency Transfer Request" Message to start frequency transfer.

If the information is available at the CP, the SLC may either require it once, or periodically from the CP. The periodicity depends on the quality of the CP clock, and will be determined at design time in agreement with SiRF technical team to ensure that the total frequency budget error stays within the limits. This frequency error refers to the error on the CP clock provided to the SLC. Each frequency error measurement from CP will be time tagged or set to FFFFFFFE if time tagging is not available. The relative frequency difference between CP and SLC is directly measured by SLC, or is "zero" in the case where the frequency transfer is referred to the SLC clock. It is important that the time transfer shall occur before the frequency transfer if time tagging is used.

Note:

- Applicable to the frequency counter method only: The SLC internal frequency measurement hardware is designed to measure the frequency of a clock signal derived from the CP clock, NOT the CP clock itself. The CP crystal clock frequency can be between 7MHz and 40MHz. To measure the relative frequency error between CP clock and SLC clock, the SLC needs to know the exact frequency it should receive on its internal frequency input when the CP clock is exactly at its nominal frequency. This nominal frequency value is found in the "NOMINAL_FREQ" field of the "Hardware Configuration Response" Message or the "NOMINAL_FREQ" field of the "Frequency Transfer Response" message.
- There are multiple situations to transfer CP frequency error from CP to SLC. Each one of them uses the SCALED_FREQ_OFFSET, REL_FREQ_ACC and TIME_TAG fields differently. Please refer to the technical application note on frequency transfer for specifics on how to fill out those fields appropriately.
- Applicable to the frequency counter method only: SLC shall read the counter only when the reference clock is on and NEVER read the counter when the reference clock is off. Bit 8 of HW_CONFIG field in "Hardware Configuration Response" message and Bit2 of REF_CLOCK_INFO field in "Frequency Transfer Response" message indicate whether the reference clock input to the counter is on or off.

*Single frequency transfer procedure*

- The SLC shall send a “Frequency Transfer Request” Message to CP with Bit 1 in “FREQ_REQ_INFO” field set to “single request” or to “multiple request”.
- The CP shall reply a single “Frequency Transfer Response” message, with SCALED_FREQ_OFFSET field set to the CP relative frequency difference multiplied by 1575.42MHz, in Hz, and REL_FREQ_ACC in ppm. If the frequency measurements are not reliable then the CP shall set this to 0xFF.
- The CP shall set the TIME_TAG field if time is available, else it will need to set this field to 0xFFFFFFFF to indicate that time transfer is not available
- The CP shall indicate in the CLOCK_REF of the “frequency transfer response” the relation between this frequency transfer message and the clock used. If the message is related to the SLC clock then Bit1 = 1 and if the message is related to the CP clock then Bit1 = 0

*Multiple frequency transfers turn ON procedure*

- By default, SLC always request multiple frequency transfers. But the actually mode (single vs. multiple) shall be decided with the handset design team.
- It is expected that in the multiple frequency transfer case, precise time transfer precedes the frequency transfer. Otherwise the CP shall set the TIME_TAG field of the “Frequency Transfer Response” message to either 0xFFFFFFFE or 0xFFFFFFFF.
- The SLC shall send a “Frequency Transfer Request” Message to CP with Bit 1 in “FREQ_REQ_INFO” field set to “multiple request”, and Bit 2 set to “ON”
- If the frequency error is known, the CP shall periodically send a “Frequency Transfer Response” message, with the “SCALED_FREQ_OFFSET” field set to the frequency CP clock error between nominal and real value, in Hz scaled to GPS-L1 frequency. The periodicity of the message depends on the CP clock stability, and shall be determined at design time.
- Each of the frequency transfer message shall have a TIME_TAG field. The CP is responsible to time tag the frequency error measurements in terms of seconds elapsed since the beginning of the current GPS week. The SLC will be responsible for the rollover of the GPS_WEEK_NUM
- Each of the frequency transfer message shall also indicate in the REF_CLOCK_INFO the relation of this frequency transfer message and its relation to the clock. Bit1 = 1 implies that the message is related to the SLC clock and Bit1 = 0 implies that the message is related to the CP clock
- In APM, when the SLC is in full power mode and the reference clock input to the counter is on, the CP shall send “Frequency Transfer Response” message to restart the frequency transfer.

*Reference clock turn OFF procedure (applicable to the frequency counter method only)*

- If the CP wants to turn off the reference clock, the CP shall send a “Frequency Transfer Response” message with Bit 3 of REF_CLOCK_INFO field is ‘1’

  Upon receiving the “Frequency Transfer Response” message, the SLC shall stop reading frequency counter and send a “Frequency Transfer Request” message to allow turn off reference clock (Bit 3 of FREQ_REQ_INFO = 1). The SLC shall ALWAYS permit the CP to turn off the reference clock.

  The CP can turn off reference clock only if a “Frequency Transfer Request” message with Bit 3 of FREQ_REQ_INFO = 1 is received. When the reference clock is turned off, CP shall not send “Frequency Transfer Response” message anymore.

*Reference clock turn ON procedure (applicable to the frequency counter method only)*

The CP can turn on the reference clock at any time except when the SLC is in sleep mode and then send “Frequency Transfer Response” messages with Bit 2 of REF_CLOCK_INFO field is ‘0’.

*Change reference clock procedure (applicable to the frequency counter method only)*

- The CP shall send a “Frequency Transfer Response” message with Bit 3 of REF_CLOCK_INFO field is ‘1’, which informs the SLC that the CP wants to turn off the reference clock.
- Upon receiving the “Frequency Transfer Response” message, the SLC shall stop reading frequency counter and send a “Frequency Transfer Request” message to allow turn off reference clock (Bit 3 of FREQ_REQ_INFO = 1).
- Upon receiving the “Frequency Transfer Request” message, the CP turns off reference clock.
- The CP then switches to another reference clock and shall send a “Frequency Transfer Response” message with FREQ_REQ_INFO set to

  Bit 2 = 0: reference clock is on

  Bit 4 = 1: NOMINAL_FREQ field is presented

  and NOMINAL_FREQ field contains nominal frequency, which can be between 7 MHz to 40 MHz.

*Multiple frequency transfers turn off procedure*

Depending on the application, the SLC may send a request to disable the periodic frequency transfer. To disable the periodic frequency transfer from SLC, it shall send a “Frequency Transfer Request” Message to CP with Bit 1 in “FREQ_REQ_INFO” field set to “multiple request”, and Bit 2 set to “OFF” the CP shall stop to send the periodic “Frequency Transfer Response” message.

*General Error Handling*

- If the frequency difference between Base Station master clock and CP clock is not known (and will not be known any time), the CP shall send a “Request Rejected” message with “REJ_REASON” field set to “Not available”
- If the frequency difference between Base Station master clock and CP clock is not known (and but can be known eventually), the CP shall send a “Reject” message with “REJ_REASON” field set to “Not Ready”.

## 7.16 Interoperability between different Air-Interface ICD revision numbers

It can happen that a SLS and SLC with incompatible Air-Interface Revision numbers are put into communication. The way the Air-Interface is build, after SLS and SLC identify the problem by a simple message exchange common to all rev numbers, the Air-Interface message shall be stopped.

In such a case, the SLC must report back to the CP the problem, in order for the CP to take the appropriate action, which is to close the Air-Interface. An Error Notification message has been added to that effect.

*Air Interface Revision Incompatibility Reporting Procedure*

Upon detecting incompatibility between Air-Interface revision numbers, the SLC shall send an error notification message with the ERROR_REASON field set to “SLC does not support SLS’s Air-Interface revision number”. Upon receiving an error notification message with the ERROR_REASON field set to “SLC does not support SLS’s Air-Interface revision number” (signaling the end of all message exchange over the air), the CP shall close the Air-Interface session.

## 7.17 Software Version ID

The CP can query the SLC to determine the software version ID that is currently being used. In such instances, the request/response format shall be as outlined in the Poll Software Version / Software Version String (Response to Poll) message descriptions.

A value of zero in the LENGTH_SIRF_VERSION_ID and/or LENGTH_CUSTOMER_VERSION_ID field is valid and indicates that there is no corresponding version name.

*Error handling*

Fields out of range in the Software Version message:

If the LENGTH_SIRF_VERSION_ID field and/or the LENGTH_CUSTOMER_VERSION_ID field in the Software Version Response has values outside the range of 0 to 80, then this value and corresponding SIRF_VERSION_ID and/or CUSTOMER_VERSION_ID shall be ignored.

Fields do not match in the Software Version message:

The LENGTH_SIRF_VERSION_ID field and/or the LENGTH_CUSTOMER_VERSION_ID field in the Software Version Response do not match the number of characters in the corresponding SIRF_VERSION_ID and/or CUSTOMER_VERSION_ID. In this case this value and corresponding SIRF_VERSION_ID and/or CUSTOMER_VERSION_ID shall be ignored.

## 7.18 Configuration Option Selection Storage Control

### 7.18.1 Levels of Configuration Option Selection Value Storage

Configuration option selection values can be stored at several different levels, depending on the product and on the configuration option setting. But in general, the following levels can be applied for specifying configuration options:

1. Hardcoded in the receiver software at software build time
2. Defined in the eFUSE configuration storage at the end of the manufacturing process
3. Defined in the eFUSE Software Configuration Register, overriding the value provided in the eFUSE configuration storage
4. Stored in BBRAM
5. Stored in SRAM based on settings requested some of the OSP messages.

The next section below describes for the latter configuration setting OSP messages, how to apply the scope and the rules of overriding the configuration selection values already set in the receiver.

### 7.18.2 Scope and Rules of Configuration Option Storage Control

The scope and rules of the configuration option storage control can be sumamrized as follows:

1. The setting specified and requested in a OSP configuration option setting message will override any previous setting of this value, whether that setting was from default value in the software, an eFUSE setting, or from previous copy of this message.
   - 1.1 If the setting is controlled by eFUSE settings, this message will override the eFUSE setting.

     If the eFUSE setting is mirrored in the eFUSE SW Coonfiguration Register, the contents of this message will be set in the eFUSE SW Coonfiguration Register.
   - 1.2 If the storage control setting is saved in BBRAM, the contents of OSP configuration option setting message will be used to update the BBRAM.
   - 1.3 If neither eFUSE SW Coonfiguration Register nor BBRAM are used in a specific system, the setting will be saved in SRAM.
2. The setting in OSP configuration option setting message will remain valid as long as the specific storage method remains valid.
   - 2.1 For BBRAM, it will persist over resets as long as a factory reset does not reinitialize BBRAM, and as long as backup power is retained for the BBRAM
   - 2.2 For eFUSE SW Configuration Register, it will persist over resets as long as a factory reset does not reinitialize eFUSE SW Configuration Register, and as long as backup power is retained for the eFUSE SW Configuration Register
   - 2.3 For settings saved in SRAM, the setting will persist only until a reset occurs.

### 7.18.3 Configuration Option Setting Messages in OSP

Different product can support a different portfolio of OSP configurtation option setting messages. However, all of them are specified in the OSP ICD and they comprise the following OSP messages:

- The SW Toolbox tracker configuration message, described in section 5.41
- Switching between binary OSP and NMEA messaging modes, describend for message ID 129
- Setting message output rates as described for message ID 129 and 166
- Setting EE storage options as described for message ID 232
- Enabling/disabling DGPS for SBAS control as described for message 133
- Selecting mode control parameters for enabling/disabling track smoothing, DR time-out values for report propagation while no-fix outage, etc. as describe for message ID 136
- Enabling/disabling extended ephemenris support as described for message ID 232
- Setting power mode management options as described for message ID 218

# 8 Protocol Layers

OSP is the standard interface protocol used by the SiRFstar family of products. This serial communication protocol is designed to provide:

- Reliable transport of messages
- Ease of implementation
- Efficient implementation
- Independence from payload

## 8.1 Transport Message

| Start Sequence | Payload Length | Payload | Message Checksum | End Sequence |
|---|---|---|---|---|
| 0xA0[(1)], 0xA2 | Two-bytes (15-bits) | Up to $2^{10}$ -1(<1023) | Two-bytes (15-bits) | 0xB0, 0xB3 |

(1) Characters preceded by "0x" denotes a hexadecimal value. 0xA0 equals 160.

## 8.2 Transport

The transport layer of the protocol encapsulates a GPS message in two start-ofmessage characters and two end-of message characters. The values are chosen to be easily identifiable and unlikely to occur frequently in the data. In addition, the transport layer prefixes the message with a 2-byte (15-bit) message length, and adds a 2-byte (15-bit) checksum before the two stop characters. The values of the start and stop characters and the choice of a 15-bit value for length and checksum ensure message length and checksum cannot alias with either the stop or start code.

## 8.3 Message Validation

The validation layer is part of the transport, but operates independently. The byte count refers to the payload byte length. The checksum is a sum on the payload.

## 8.4 Payload Length

The payload length is transmitted high order byte first followed by the low byte.

| High Byte | Low Byte |
|---|---|
| ≤ 0x7F | Any value |

Even though the protocol has a maximum length of ($2^{15}$-1) bytes, practical considerations require the SiRF GPS module implementation to limit this value to a smaller number. The SiRF receiving programs, such as SiRFDemo, may limit the actual size to something less than this maximum.

## 8.5 Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data can contain any 8-bit value.

Where multi-byte values are in the payload data, neither the alignment nor the byte order are defined as part of the transport although SiRF payloads uses the big-endian order.

The Message ID tables in Section 5 and Section 6 describe the payload data, variable length and variable data type. The Bytes column contains:

- A number that specifies the number of bytes in each field of the message
- A letter that describes how to interpret the value

Table 8.1 lists the letters and their description.

| Letter | Description |
|---|---|
| D | Discrete – The field consists of a bit mapped value, or subfields of groups of bits that are described in the Description field. Values should be considered unsigned. |
| S | Signed – The field contains a signed integer value in two's complement format |
| U | Unsigned – The field contains an unsigned integer value |
| Dbl | Double precision floating point – See the Note in Section 6.22 for a detailed description of this data type |
| Sgl | Single precision floating point – See the Note in Section 6.22 for a detailed description of this data type |

Table 8.1: Data Types in Bytes Field of Message ID Tables

## 8.6 Checksum

The checksum is transmitted high order byte first, followed by the low byte.

| High Byte | Low Byte |
|---|---|
| ≤ 0x7F | Any value |

This is the so-called big-endian order. The checksum is a 15-bit checksum of the bytes in the payload data. The following pseudo code defines the algorithm used:

```
Let message be the array of bytes to be sent by the transport.
Let msgLen be the number of bytes in the message array to be
transmitted
     Index = first

     checkSum = 0

     while index < msgLen

        checkSum = checkSum + message[index]

     checkSum = checkSum AND (0x7FFF)

        increment index
```

# Appendix A GPS Data Representation and Conversion Detail Specification

## A.1 GPS Week Reporting

The GPS week number represents the number of weeks that have elapsed since the week of January 6, 1980. Per ICD-GPS-200, the satellites only transmit the 10 LSBs of the week number. On August 22, 1999, the week number became 1024, which was reported by the satellites as week 0. SiRF receivers resolve the reported week number internally. When messages report the week number, that value is either truncated to the 10 LSBs or is called an extended week number (see messages 7 and 41 for examples).

## A.2 Computing GPS Clock Frequency

To compute GPS clock frequency, you must know the receiver architecture. For receivers which use a GPS clock frequency of 16.369 MHz (newer SiRFstarII, most SiRFstarIII receivers), Crystal Factor in the below formula is 16. For receivers which use a GPS clock frequency of 24.5535 MHz (older SiRFstarII receivers such as those using GSP2e/LP), the Crystal Factor is 24. Refer to your receiver's data sheet to determine the GPS clock frequency for your receiver.

Clock Frequency = (GPS L1 Frequency + Clock Drift) * Crystal Factor / 1540

For example, in a SiRFstarIII receiver (Crystal Factor = 16), Clock Drift is reported to be 94.315 kHz.

Clock Frequency is: Clock Frequency = (1575.42 MHz + 94.315 kHz) * 16 / 1540 = 16.3689799 MHz

If this is used in a receiver where the GPS TCXO is nominally 16.369 MHz, then this frequency is the actual frequency of the crystal. If another frequency crystal is used, you must account for the frequency conversion factors in the synthesizer to compute the crystal frequency.

To predict clock bias, use the relationships between frequency and velocity. The reported clock drift value can be converted to a velocity using the Doppler formula, since in the SiRF architecture the clock drift value is a bias to the computed Doppler frequency:

Doppler Frequency / Carrier Frequency = Velocity / speed of light

Or:

Velocity = Doppler Frequency / Carrier Frequency * c Next, the velocity can be converted to a time factor by dividing by the speed of light:

Change in Clock Bias = Velocity / c

Combining the above 2 formulae,

Change in Clock Bias = Doppler Frequency / Carrier Frequency

For a Clock Drift of 94.315 kHz as used above,

Change in Clock Bias = 94315 Hz / 1575.42 MHz = 59.867 μs

**Note:**

> Reported clock bias and clock bias computed using the above formula will likely agree only to within a few nanoseconds because the actual measurement interval may be slightly more or less than an exact second, and the clock drift is only reported to a (truncated) 1 Hz resolution.

## A.3 Converting Sirf Message ID 14 (0x0E) and ID 15 (0x0F) into Engineering Units

Note:

It is essential to consult with GPS-ICD documentation to become more familiar with conversions. For more information, see http://www.navcen.uscg.gov/pubs/gps/icd200/default.htm

## A.4 Message # 14: Almanac Data

Message ID 14 is a packed field of the GPS navigation-message 50bps almanac data stream with the parity stripped out. Only the 24-bits of data are contained in message.

The data follows the format of the 50-bps message, subframe #5, pages 1-24.

"Data" is an array of 12-2byte integers: Data[12]

Only words 3 through 10 of the GPS-50bps Almanac data stream are stored.

The SiRF data aligns with the 24-data bits of the 50bps navigation message described in GPS ICD-200 as follows:

| | |
|---|---|
| 50-bps, 24-bit data word (See GPS ICD 200) Subframe 5 Words 3-10 | X (24-bits) |
| SiRF Data structure per subframe, D[0] -> D[12], 2 byte words | X (16-bits) |

<table>
<tr><td colspan="3">W3</td><td colspan="3">W4</td><td colspan="3">W5</td><td colspan="3">W6</td><td colspan="3">W7</td><td colspan="3">W8</td><td colspan="3">W9</td><td colspan="3">W10</td></tr>
<tr><td colspan="2">D[0]</td><td colspan="2">D[1]</td><td colspan="2">D[2]</td><td colspan="2">D[3]</td><td colspan="2">D[4]</td><td colspan="2">D[5]</td><td colspan="2">D[6]</td><td colspan="2">D[7]</td><td colspan="2">D[8]</td><td colspan="2">D[9]</td><td colspan="2">D[10]</td><td colspan="2">D[11]</td></tr>
</table>

S: is a signed integer, two's complement, sign bit is MSB.

U: is unsigned integer.

Scale factor (LSB) converts from Integer to scaled Engineering units.

| Sign | Conversion | Scale / Units |
|---|---|---|
| U | DataID=(D[0]&0xC000)>>14 | 1 |
| U | SVid = (D[0]&0x3F00)>>8 | 1 |
| U | Ecc=((D[0]&0x00FF)<<8)\|\|((D[1]&0xFF00)>>8) | 2^-21 |
| U | Toa = D[1]&0x00FF | 2^+21 (sec) |
| S | deltaInc = D[2] | 2^-19 (semiCirc) |
| S | OmegaDot = D[3] | 2^-38 (semiCirc/s) |
| U | SV Health = (D[4]&0xFF00)>>8 | 1 |

| Sign | Conversion | Scale / Units |
|---|---|---|
| U | SqrtA =((D[4]&0x00FF)<<16)\|\| D[5] | 2^-11 (m^ (-1/2)) |
| S | Omega0=(D[6]<<8)\|\|((D[7]&0xFF00)>>8) | 2^-23 (semiCirc) |
| S | Omega = ((D[7]&0x00FF)<<8)\|\|D[8] | 2^-23 (semiCirc) |
| S | Mo = (D[9]<<8)\|\|((D[10]&0xFF00)>>8) | 2^-23 (semiCirc) |
| S | Af0=((D[10]& 0x003F)<<5)\|\|((D[11]&0xC000)>>11) \|\| (D[11] & 0x0007) | 2^ (-20)(seconds) |
| S | Af1 = ((D[11] & 0x3FF8) >> 3) | 2^-38 (s/s) |

## A.5 Message # 15: Ephemeris Data

Message ID 15 is a packed field of the GPS navigation-message 50bps data stream, subframes 1,2,3 with the parity stripped out. Only the 24-bits of data are contained in message.

"Data" is an array of 45-2-byte integers, Data[45], or can be thought of as Data[3][15], with:

- Subframe 1 data: Data[0] -> Data[14] Or, Data[0][0] -> Data[0][14]
- Subframe 2 data: Data[15] -> Data[29] Or, Data[1][0] -> Data[1][14]
- Subframe 3 data: Data[30] -> Data[44] Or, Data[2][0] -> Data[0][14]

Only words 2 through 10 of the GPS-50bps data stream are stored.

The SiRF data aligns with the 24-data bits of the 50 bps navigation message described in GPS ICD-200 as follows:

| | |
|---|---|
| 50-bps, 24-bit data word (See GPS ICD 200) Subframe 1,2,3 Words 2-10 | X (24-bits) |
| SiRF Data structure per subframe, D[0] -> D[14], 2 byte words | X (16-bits) |

| | W2 | | W3 | W4 | | W5 | W6 | | W7 | W8 | | W9 | W10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D[0] | D[1] | D[2] | D[3] | D[4] | D[5] | D[6] | D[7] | D[8] | D[9] | D[10] | D[11] | D[12] | D[13] | D[14] |

S: is a signed integer, two's complement, sign bit is MSB.

U: is unsigned integer

Scale factor (LSB) converts from Integer to scaled Engineering units.

Subframe 1 = Data[0][0 -> 14] = D[0 -> 14 + i], i=0

| Sign | Conversion | Scale / Units |
|---|---|---|
| U | SVId = D[i+0] & 0x00FF | 1 (prn #) |
| U | Week# = (D[i+3] & 0xFFC0)>>6 | 1 |
| U | L2Code = (D[i+3] & 0x0030)>>4 | 1 |
| U | Health = (D[i+4] & 0xFC00)>>10 | 1 |
| U | L2Pflag = (D[i+4] & 0x0080)>>7 | 1 |
| S | TGD = (D[i+10] & 0xFF00)>>8 | 2^-31 (sec) |
| U | IODC = (D[i+10]&0x00FF)\|\|(D[i+4]&0x0300) | 1 |
| U | ToC = D[i+11] | 2^+4 (sec) |
| S | Af2 = (D[i+12]&0xFF00)>>8 | 2^-55 (sec/sec^2) |
| S | Af1 =((D[i+12]&0x00FF)<<8)\|\|((D[i+13]&0xFF00)>>8) | 2^-42 (sec/sec) |
| S | Af0=((D[i+13]&0x00FF)<<14)\|\|((D[i+14]&0xFFFC)>>2) | 2^-31 (sec) |

Subframe 2 = Data[1][0 -> 14] = D[0 -> 14 + i] i=15

| Sign | Conversion | Scale / Units |
|---|---|---|
| U | SVId = D[i+0] & 0x00FF | 1 (prn #) |
| U | IODE = (D[i+3]&0xFF00)>>8 | 1 |
| S | Crs =((D[i+3]&0x00FF)<<8)\|\|((D[i+4]&0xFF00)>>8) | 2^-5 (meters) |
| S | deltaN=((D[i+4]&0x00FF)<<8)\|\|((D[i+5]&0xFF00)>>8) | 2^-43 (semiCirc/s) |
| S | Mo=((D[i+5]&0x00FF)<<24)\|\|(D[i+6]<<8)\|\| ((D[i +7]&0xFF00)>>8) | 2^-31 (semiCirc) |

| Sign | Conversion | Scale / Units |
|---|---|---|
| S | Cuc =((D[i+7]&0x00FF)<<8)\|\|((D[i+8]&0xFF00)>>8) | 2^-29 (rads) |
| U | E=((D[i+8]&0x00FF)<<24) \|\| (D[i+9]<<8) \|\| ((D[i +10]&0xFF00)>>8) | 1 |
| S | Cuc =((D[i+10]&0x00FF)<<8)\|\|((D[i+11]&0xFF00)>>8) | 2^-29 (rads) |
| U | RootA=((D[i+11]&0x00FF)<<24) \|\| (D[i+12]<<8) \|\| ((D[i +13]&0xFF00)>>8) | 2^-19 (meters)^-(1/2) |
| U | Toe=((D[i+13]&0x00FF)<<8)\|\|((D[i+14]&0xFF00)>>8) | 2^+4 (sec) |
| U | FitFlag = (D[i+14]&0x0080)>>7 1 U AODO = (D[i +14]&0x007C)>>2 | 1 |

Subframe 3 = Data[1][0 -> 14] = D[0 -> 14 + i] i=30

| Sign | Conversion | Scale / Units |
|---|---|---|
| U | SVId = D[i+0] & 0x00FF | 1 (prn #) |
| S | Cic = D[i+3] | 2^-29 (rads) |
| S | Omega0 = (D[i+4]<<16)\|\|D[i+5] | 2^-31(semiCirc) |
| S | Cis = D[i+6] 2^-29 (rads) S i0 = (D[i+7]<<16)\|\|D[i+8] | 2^-31(semiCirc) |
| S | Crc = D[i+9] | 2^-5 (meters) |
| S | w = (D[i+10]<<16)\|\|( D[i+11]) | 2^-31(semiCirc) |
| S | OmegaDot = (d[i+12]<<8)\|\|((d[i+13]&0xFF00)>>8) | 2^-43(semiCirc/s) |
| U | IODE = (D[i+13] & 0x00FF) | 1 |
| S | Idot = (D[i+14]&0xFFFC)>>22 | 2^-43(semiCirc/s) |

# Terms and Definitions

| Term | Definition |
|---|---|
| A-GPS | Assisted Global Positioning System |
| ACK | ACKnowledge |
| API | Application Programming Interface |
| APM | Advanced Power Management |
| ASCII | American Standard Code for Information Interchange |
| BBRAM | Battery-Backed RAM |
| CGEE | Client Generated Extended Ephemeris |
| CP | Call Processor |
| CP | Contention Period |
| CPU | Central Processing Unit |
| CSR | Cambridge Silicon Radio |
| CTS | Clear To Send |
| DGPS | Differential Global Positioning System |
| EE | Extended Ephemeris |
| etc | *et cetera*, and the rest, and so forth |
| GPIO | General Purpose Input/Output |
| GPS | Global Positioning System, the US GNSS |
| I²C | Inter-Integrated Circuit Interface |
| ICD | Interface Control Document |
| IEEE | Institute of Electronic and Electrical Engineers |
| IRQ | Interrupt ReQuest |
| LDO | Low (voltage) Drop-Out |
| LP | Low Power |
| MPM | Micro Power Mode |
| MS | Mobile Station |
| MSB | Most Significant Bit (or Byte) |
| N/A | Not Applicable |
| NAK | Negative AcKnowledge |

| Term | Definition |
|---|---|
| NAV | Network Allocation Vector |
| OSP | One Socket Protocol |
| ppb | parts per billion |
| PRN | Pseudo-Random Noise |
| PTF | Push-To-Fix |
| PVT | Position, Velocity and Time |
| QoS | Quality of Service |
| RRLP | Radio Resource Location Services Protocol |
| RTC | Real-Time Clock |
| SBAS | Satellite Based Augmentation System |
| SDK | Software Development Kit |
| SGEE | Server Generated Extended Ephemeris |
| SLC | Service Level Connection |
| SRAM | Static Random Access Memory |
| SSB | Single Side-Band |
| SSB | SiRF Standard Binary |
| SV | Space Vehicle |
| SW | SoftWare |
| TBF | Time Between Fixes |
| TCXO | Temperature Compensated crystal Oscillator |
| TX | Transmit or Transmitter |
| UART | Universal Asynchronous Receiver Transmitter |
| UTC | Co-ordinated Universal Time |