SiRF Binary Protocol Reference Manual

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SiRF Binary Protocol Reference Manual

About This Document

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If you have any problems, contact your SiRF representative or call or send an e-mail to the SiRF Technology support group:

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Preface

The *SiRF Binary Protocol Reference Manual* provides detailed information about the SiRF Binary protocol – the standard protocol used by the SiRFstar family of products.

Who Should Use This Guide

This manual was written assuming the user is familiar with serial communications interface protocols, including their definitions and use.

How This Guide Is Organized

Chapter 1, “Protocol Layers” information about SiRF Binary protocol layers.

Chapter 2, “Input Messages” definitions and examples of each available SiRF Binary input messages.

Chapter 3, “Output Messages” definitions and examples of each available SiRF Binary output messages.

Chapter 4, “Additional Information” Other useful information pertaining to the SiRF Binary protocol.

Related Manuals

You can also refer to the following literature for additional information:

- *SiRF NMEA Reference Manual*
- *ICD-GPS-200*
- *RTCM Recommended Standards for Differential GNSS*

Troubleshooting/Contacting SiRF Technical Support

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Helpful Information When Contacting SiRF Technical Support

Receiver Serial Number: ___________________

Receiver Software Version: ________________

SiRFDemo Version: ________________________

Protocol Layers 1

SiRF Binary protocol is the standard interface protocol used by the SiRFstar family of products.

This serial communication protocol is designed to include:

- Reliable transport of messages
- Ease of implementation
- Efficient implementation
- Independence from payload

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.

Transport

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.

Message Validation

The validation layer is of part of the transport, but operates independently. The byte count refers to the payload byte length. The checksum is a sum on the payload.

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.

Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data may 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 Chapter 2, “Input Messages” and Chapter 3, “Output Messages” 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, and a letter that describes how to interpret the value. The letters and their description are shown in Table 1-1.

Table 1-1 Data Types in Bytes Field of Message ID Tables

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 Note after Table 3-68 on page 32 for a detailed description of this data type
Sgl	Single precision floating point – See Note after Table 3-68 on page 32 for a detailed description of this data type

Checksum

The checksum is transmitted high order byte first followed by the low byte. This is the so-called big-endian order.

High Byte	Low Byte
≤ 0x7F	Any value

The checksum is 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 (2^15-1).
    increment index
```

Input Messages 2

The following chapter provides full information about available SiRF Binary input messages. For each message, a full definition and example is provided.

Note – The input message buffer size limit is 912 bytes.

Table 2-1 describes the message list for the SiRF Binary input messages. Table 2-2 provides the Message Sub IDs for SiRFDRive Input Message ID 172 (0xAC). Table 2-3 provides information about which message is supported by which software.

Table 2-1 SiRF Messages – Input Message List

Hex	Decimal	Name	Description
35	53	Advanced Power Management	Power management scheme for SiRFLoc & SiRFXTrac
80	128	Initialize Data Source	Receiver initialization and associated parameters
81	129	Switch to NMEA Protocol	Enable NMEA messages, output rate, & bit rate
82	130	Set Almanac (upload)	Sends an existing almanac file to the receiver
83	131	Handle Formatted Dump Data	Outputs formatted data
84	132	Poll Software Version	Polls for the loaded software version
85	133	DGPS Source Control	DGPS correction source & beacon receiver information
86	134	Set Binary Serial Port	bit rate, data bits, stop bits, and parity
87	135	Set Protocol	Switches protocol
88	136	Mode Control	Navigation mode configuration
89	137	DOP Mask Control	DOP mask selection and parameters
8A	138	DGPS Mode	DGPS mode selection and timeout value
8B	139	Elevation Mask	Elevation tracking and navigation masks
8C	140	Power Mask	Power tracking and navigation masks
8F	143	Static Navigation	Configuration for static operation
90	144	Poll Clock Status	Polls the clock status
91	145	Set DGPS Serial Port	DGPS port bit rate, data bits, stop bits, & parity
92	146	Poll Almanac	Polls for almanac data
93	147	Poll Ephemeris	Polls for ephemeris data
94	148	Flash Update	On the fly software update
95	149	Set Ephemeris (upload)	Sends an existing ephemeris to the receiver
96	150	Switch Operating Mode	Test mode selection, SV ID, and period.
97	151	Set TricklePower Parameters	Push to fix mode, duty cycle, and on time
98	152	Poll Navigation Parameters	Polls for the current navigation parameters

Table 2-1 SiRF Messages – Input Message List *(Continued)*

Hex	Decimal	Name	Description
A5	165	Set UART Configuration	Protocol selection, bit rate, data bits, stop bits, & parity
A6	166	Set Message Rate	SiRF Binary message output rate
A7	167	Set Low Power Acquisition Parameters	Low power configuration parameters
A8	168	Poll Command Parameters	Poll for parameters: 0x80: Receiver initialized & associated params 0x85: DGPS source and beacon receiver info 0x88: Navigation mode configuration 0x89: DOP mask selection and parameters 0x8A: DGPS mode selection and timeout values 0x8B: Elevation tracking and navigation masks 0x8C: Power tracking and navigation masks 0x8F: Static navigation configuration 0x97: Low power parameters
AA	170	Set SBAS Parameters	SBAS configuration parameters
AC	172	SiRF Dead Reckoning Class of Input Messages	The Message ID is partitioned into messages identified by Message Sub IDs. Refer to Table 2-2.
AF	175	User Input Command	User settable input command string and parser.
B4-C7	180-199	MID_UserInputBegin – MID_UserInputEnd	Available for SDK user input messages only.
B4	180	Preset Software Configuration	Selection of the Preset Software Configurations as defined in bits [3:2] of the GSC2xr chip configuration register
B6	182	Set UART Configuration	Obsolete.
CD	205	Software Control	Generic Software Input Message
E4	228	SiRF internal message	Reserved
E8	232	Extended Ephemeris Proprietary	Extended Ephemeris and Debug Flag

Table 2-2 Message Sub IDs for SiRF Dead Reckoning Input Message ID 172 (0xAC)

Sub ID	Message	Supports SiRFDRive	Supports SiRFDiRect
1	Initialize GPS/DR Navigation	Yes	Yes
2	Set GPS/DR Navigation Mode	Yes	Yes
3	Set DR Gyro Factory Calibration	Yes, (SiRFDRive 1 only)	No
4	Set DR Sensors’ Parameters	Yes, (SiRFDRive 1 only)	No
5	Poll DR Validity (not implemented)	No	No
6	Poll DR Gyro Factory Calibration	Yes, (SiRFDRive 1 only)	No
7	Poll DR Sensors’ Parameters	Yes, (SiRFDRive 1 only)	No
9	Input Car Bus Data	Yes, (SiRFDRive 1.5 and 2)	No
10	Car Bus Enabled	Yes, (SiRFDRive 2 only)	No
11	Car Bus Disabled	Yes, (SiRFDRive 2 only)	No
14	Input Car Bus Data 2[1]	No	Yes

1. Output message only at this time.

SiRF Binary protocol is an evolving standard along with continued development of SiRF software and GPS solutions, not all SiRF Binary messages are supported by all SiRF GPS solutions.

Table 2-3 identifies the supported input messages for each SiRF architecture.

Table 2-3 Supported Input Messages

	SiRF Software Options					
Message ID	**GSW2**	**SiRFDRive**	**SiRFXTrac**	**SiRFLoc**	**GSW3 & GSWLT3**	**SiRFDiRect**
53	No	No	Yes	No	No	No
128	Yes	Yes	Yes	Yes	Yes	Yes
129	Yes	Yes	Yes	No	Yes	Yes
130	Yes	Yes	No	No	No	Yes
131	No	No	No	No	Yes	Yes
132	Yes	Yes	Yes	Yes	Yes	Yes
133	Yes	Yes	No	No	Yes	Yes
134	Yes	Yes	Yes	Yes	Yes	Yes
135	No	No	No	No	Yes	Yes
136	Yes	Yes	Yes	Yes	Yes	Yes
137	Yes	Yes	Yes	Yes	Yes	Yes
138	Yes	Yes	Yes	Yes	Yes	No
139	Yes	Yes	Yes	Yes	Yes	Yes
140	Yes	Yes	Yes	Yes	Yes	Yes
143	Yes	Yes	Yes	Yes	Yes	Yes
144	Yes	Yes	Yes	Yes	Yes	Yes
145	Yes	Yes	No	No	No	Yes
146	Yes	Yes	No	Yes	Yes	Yes
147	Yes	Yes	No	Yes	Yes	Yes
148	Yes	Yes	Yes	No	Yes	Yes
149	Yes	Yes	No	Yes	No	Yes
150	Yes	Yes	Yes	Yes	Yes	Yes
151	Yes	Yes	Yes	No	Yes	Yes
152	Yes	Yes	Yes	Yes	Yes	Yes
165	Yes	Yes	Yes	No	Yes	Yes
166	Yes	Yes	Yes	Yes	Yes	Yes
167	Yes	Yes	Yes	No	Yes	Yes
168	Yes	Yes	Yes	Yes	Yes	Yes
170	2.3 or above	Yes	No	No	Yes	No
172	No	Yes[1]	No	No	No	Yes[1]
175	No	No	No	No	Yes	Yes
180[2]	Yes	No	No	No	No	No
180-199	Yes	Yes	Yes	Yes	Yes	No
205	No	No	No	No	3.2.5 or above	No
228	No	No	No	No	Yes (reserved)	No
232	2.5 or above	No	2.3 or above	No	3.2.0 or above	Yes

1. Not all Message Sub IDs supported

2. Only with GSC2xr chip

Advanced Power Management – Message ID 53

Implements Advanced Power Management (APM). APM allows power savings while ensuring that the quality of the solution is maintained when signal levels drop. APM does not engage until all information is received.

Example:

The following example sets the receiver to operate in APM mode with 0 cycles before sleep (continuous operation), 20 seconds between fixes, 50% duty cycle, a time between fixes priority, and no preference for accuracy.

A0A2000C—Start Sequence and Payload Length

350100140003070000 0A0100—Payload

005FB0B3—Message Checksum and End Sequence

Table 2-4 Advanced Power Management – Message ID 53

		Binary (Hex)			
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Description**
Message ID	1		35		Decimal 53
APM Enabled	1		01		1 = True, 0 = False
Number Fixes	1		00		Number of requested APM cycles. Range 0-255[1]
Time Between Fixes	1	1	14	sec	Requested time between fixes. Range 0-255[2]
Spare Byte 1	1		00		Reserved
Maximum Horizontal Error	1		03		Maximum requested horizontal error (See Table 2-5).
Maximum Vertical Error	1		07		Maximum requested vertical error (See Table 2-5)
Maximum Response Time	1	1	00	sec	Maximum response time. Not currently used
Time Acc Priority	1		00		0x00 = No priority, 0x01 = Response Time Max has higher priority 0x02 = Horizontal Error Max has higher priority. Not currently used.
Power Duty Cycle	1	5	0A	%	Power Duty Cycle, defined as the time in full power to total operation time. 1->20; duty cycle (%) is this value *5.[3]
Time Duty Cycle	1		01		Time/Power Duty cycle priority. 0x01 = Time between two consecutive fixes has priority 0x02 = Power Duty cycle has higher priority. Bits 2..7 reserved for expansion.
Spare Byte 2	1		00		Reserved

Payload length: 12 bytes

1. A value of zero indicates that continuous APM cycles is requested.
2. It is bound from 10 to180 s.
3. If a duty-cycle of 0 is entered, it is rejected as out of range. If a duty cycle value of 20 is entered, the APM module is disabled and continuous power operation is resumed.

Table 2-5 Horizontal/Vertical Error

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

Initialize Data Source – Message ID 128

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

Note – Some software versions do not support use of the initializing data.

Table 2-6 contains the input values for the following example:

Command 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

80FFD700F9FFBE5266003AC57A000124F80083D600039C0C33—Payload

0A91B0B3—Message Checksum and End Sequence

Table 2-6 Initialize Data Source – Message ID 128

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		80		Decimal 128
ECEF X	4 S		FFD700F9	meters	
ECEF Y	4 S		FFBE5266	meters	
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 1-12
Reset Configuration Bit Map	1 D		33		See Table 2-7

Payload length: 25 bytes

Table 2-7 Reset Configuration Bit Map

Bit	Description
0	Data valid flag: 1 = Use data in ECEF X, Y, Z, Clock Offset, Time of Week and Week number to initialize the receiver; 0 = Ignore data fields
1	Clear ephemeris from memory: blocks Snap or Hot Start from occurring
2	Clear all history (except clock drift) from memory: blocks Snap, Hot, and Warm Starts
3	Factory Reset: clears all GPS memory including clock drift. Also clears almanac stored in flash memory
4	Enable Nav Lib data (YES = 1, NO = 0)[1]
5	Enable debug data (YES = 1, NO = 0)
6	Indicate that Real-Time Clock (RTC) is not precise: blocks Snap Start
7	SiRFstarII = clear user data in memory; SiRFstarIII = perform full system reset

1. If Nav Lib data are enabled, the resulting messages are enabled: Clock Status (Message ID 7), 50BPS (Message ID 8), Raw DGPS (Message ID 17), NL Measurement Data (Message ID 28), DGPS Data (Message ID 29), SV State Data (Message ID 30), and NL Initialized Data (Message ID 31). All messages sent at 1 Hz. If SiRFDemo is used to enable Nav Lib data, the bit rate is automatically set to 57600 by SiRFDemo.

Switch To NMEA Protocol – Message ID 129

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

Table 2-8 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 1sec,
GSV – ON at 5 sec, RMC – ON at 1sec, VTG-OFF, MSS – OFF, ZDA-OFF.

Example:

A0A20018—Start Sequence and Payload Length

810201010001010105010101000100010001000100012580—Payload

013AB0B3—Message Checksum and End Sequence

Table 2-8 Switch To NMEA Protocol – Message ID 129

Name	Bytes	Example	Unit	Description
Message ID	1 U	0x81		Decimal 129
Mode	1 U	0x02		See Table 2-9
GGA Message[1]	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum[2]	1 U	0x01		Send checksum with GGA message
GLL Message	1 U	0x00	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
GSA Message	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
GSV Message	1 U	0x05	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
RMC Message	1 U	0x01	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
VTG Message	1 U	0x00	sec	See 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		
Unused Field[3]	1 U	0x00		

Table 2-8 Switch To NMEA Protocol – Message ID 129 *(Continued)*

Name	Bytes	Example	Unit	Description
Unused Field[3]	1 U	0x00		
ZDA Message	1 U	0x00	sec	See NMEA Protocol Reference Manual for format
Checksum	1 U	0x01		
Unused Field[3]	1 U	0x00		
Unused Field[3]	1 U	0x00		
Bit Rate	2 U	0x2580		1200, 2400, 4800, 9600, 19200, 38400, and 57600

Payload length: 24 bytes

1. A value of 0x00 implies not to send 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). 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. These fields are available if additional messages have been implemented in the NMEA protocol.

Table 2-9 Mode Values

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

In TricklePower mode, update rate is specified by the user. 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, (2 X 5 = 10)).

Note – To return to the SiRF Binary protocol, send a SiRF NMEA message to revert to SiRF binary mode. (See the *SiRF NMEA Reference Manual* for more information).

Set Almanac – Message ID 130

Enables the user to upload an almanac file to the receiver.

Note – Some software versions do not support this command.

Example:

A0A20381 – Start Sequence and Payload Length

82xx………………….   – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-10 Set Almanac – Message ID 130

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

Payload length: 897 bytes

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 actually packed and the exact format of this representation and packing method can be extracted from the *ICD-GPS-200* document. The *ICD-GPS-200* document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

Handle Formatted Dump Data – Message ID 131

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

Note – The buffer size limit is 912 bytes.

Table 2-11 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

8303600001050050102010104486566C6C6F00253264202532642025326420253264 2025313

02E316C660000—Payload

0867B0B3—Message Checksum and End Sequence

Table 2-11 Handle Formatted Dump Data – Message Parameters

Name	Bytes	Binary (Hex) Example	Unit	Description
Message ID	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 2-12 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)

Table 2-11 Handle Formatted Dump Data – Message Parameters *(Continued)*

Name	Bytes	Binary (Hex) Example	Unit	Description
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

Payload length: Variable

Table 2-12 defines the values associated with the member size data type.

Table 2-12 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

Poll Software Version – Message ID 132

Requests the output of the software version string. Message ID 6 is sent in response.

Table 2-13 contains the input values for the following example:

Poll the software version

Example:

A0A20002—Start Sequence and Payload Length

8400—Payload

0084B0B3—Message Checksum and End Sequence

Table 2-13 Software Version – Message ID 132

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		84		Decimal 132
Control	1 U		00		Not used

Payload length: 2 bytes

DGPS Source – Message ID 133

Allows the user 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 (any serial port)

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

85020000000000—Payload

0087B0B3—Checksum and End Sequence

Table 2-14 DGPS Source Selection (Example 1)

Name	Bytes	Scale	Hex	Unit	Decimal	Description
Message ID	1 U		85		133	Message Identification
DGPS Source	1 U		02		2	See Table 2-16
Internal Beacon Frequency	4 U		00000000		0	Not used
Internal Beacon Bit Rate	1 U		0		0	Not used

Payload length: 7 bytes

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

Search Frequency 310000, Bit Rate 200

A0A200007—Start Sequence and Payload Length

85030004BAF0C802—Payload

02FEB0B3—Checksum and End Sequence

Table 2-15 DGPS Source Selection (Example 2)

Name	Bytes	Scale	Hex	Unit	Decimal	Description
Message ID	1 U		85		133	Message Identification
DGPS Source	1 U		03		3	See Table 2-16
Internal Beacon Frequency	4 U		0004BAF0	Hz	310000	See Note 1
Internal Beacon Bit Rate	1 U		C8	BPS	200	See Note 2

Payload length: 7 bytes

Note – 1 – Beacon frequency valid range is 283500 to 325000 Hz. A value of zero indicates the Beacon should be set to automatically scan all valid frequencies.

Note – 2 – Bit rates may be 25, 50, 100 or 200 BPS. A value of zero indicates the Beacon should be set to automatically scan all bit rates.

Table 2-16 DGPS Source Selections

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

Set Binary Serial Port – Message ID 134

Sets the serial port values that are used whenever the binary protocol is activated on a port. It also sets the current values for the port currently using the binary protocol. The values that can be adjusted are: bit rate, parity, data bits per character, stop bit length.

Table 2-17 contains the input values for the following example:

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

Example:

A0A20009—Start Sequence and Payload Length

860000258008010000—Payload

0134B0B3—Message Checksum and End Sequence

Table 2-17 Set Main Serial Port – Message ID 134

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	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

Payload length: 9 bytes

Set Protocol – Message ID 135

Switches the protocol to another protocol. For most software, the default protocol is SiRF binary. For SiRFstarIII software, refer to tCtrl_ProtocolEnum in ctrl_sif.h.

Table 2-18 contains the input values for the following example:

Set protocol to NMEA

Example:

A0A20002—Start Sequence and Payload Length

8702—Payload

0089B0B3—Message Checksum and End Sequence.

Table 2-18 Set Protocol – Message ID 135

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		87		Decimal 135
Protocol[1]	1 U		02		Null = 0 SiRF Binary = 1 NMEA = 2 ASCII = 3 RTCM = 4 USER1 = 5 (note1) SiRFLoc = 6 Statistic = 7

Payload length: 2 bytes

1. Use caution when switching to User1 protocol. Use it only when User1 protocol supports switching back to SiRF Binary protocol.

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

Mode Control – Message ID 136

Sets up the navigation operations. It controls use of fewer than four satellites, and enables or disables the track smoothing filter. Using fewer than four satellites results in what is commonly called a ‘2-D’ fix. Four or more satellites allow a ‘3-D’ fix.

Table 2-19 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

880000010000000000000000050201—Payload

0091B0B3—Message Checksum and End Sequence

Table 2-19 Mode Control – Message ID 136

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	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 2-20
Reserved	2 U		0000		Reserved
Altitude	2 S		0000	meters	User specified altitude, range -1,000 to +10,000
Alt Hold Mode	1 U		00		Controls use of 3-SV solution.See Table 2-21
Alt Hold Source	1 U		00		0 = Use last computed altitude, 1 = Use user-input altitude
Reserved	1 U		00		Reserved

Table 2-19 Mode Control – Message ID 136 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Degraded Time Out	1 U		05	sec	0 = disable degraded mode, 1-120 seconds degraded mode time limit
DR Time Out	1 U		02	sec	0 = disable dead reckoning, 1-120 seconds dead reckoning mode time limit
Track Smoothing	1 U		01		0 = disable, 1 = enable

Payload length: 14 bytes

1. Degraded Mode is not supported in GSW3.2.5 and later. This field should be set to four in these software versions.

Table 2-20 Degraded Mode

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)

Note – Degraded Mode is not supported in GSW3.2.5 and later. This field should be set to four in these software versions.

Table 2-21 Altitude Hold Mode

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 fixes

DOP Mask Control – Message ID 137

Dilution of Precision (DOP) is a measure of how the geometry of the satellites affects the current solution's accuracy. This message provides a method to restrict use of solutions when the DOP is too high. When the DOP mask is enabled, solutions with a DOP higher than the set limit is marked invalid. Table 2-22 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

8900080808—Payload

00A1B0B3—Message Checksum and End Sequence

Table 2-22 DOP Mask Control – Message ID 137

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		89		Decimal 137
DOP Selection	1 U		00		See Table 2-23
GDOP Value	1 U		08		Range 1 to 50
PDOP Value	1 U		08		Range 1 to 50
HDOP Value	1 U		08		Range 1 to 50

Payload length: 5 bytes

Table 2-23 DOP Selection

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

DGPS Control – Message ID 138

Enables users to control how the receiver uses differential GPS (DGPS) corrections.

Table 2-24 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

8A011E—Payload

00A9B0B3—Message Checksum and End Sequence

Table 2-24 DGPS Control – Message ID 138

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		8A		Decimal 138
DGPS Selection	1 U		01		See Table 2-25
DGPS Time Out:	1 U		1E	sec	Range 0 to 255

Payload length: 3 bytes

Table 2-25 DGPS Selection

Byte Value	Description
0	Auto = use corrections when available
1	Exclusive = include in navigation solution only SVs with corrections
2	Never Use = ignore corrections

Note – DGPS Timeout interpretation varies with DGPS correction source. For 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 1-255 means use the corrections for a maximum of this many seconds. For DGPS corrections from an SBAS source, the timeout value is ignored unless Message ID 170, Flag bit 0 is set to 1 (User Timeout). If Message ID 170 specifies User Timeout, a value of 1 to 255 here means that SBAS corrections may be used for the number of seconds specified. A value of 0 means to use the timeout specified in the SBAS satellite message (usually 18 seconds).

Elevation Mask – Message ID 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 permits the receiver to avoid using the low-elevation-angle satellites most likely to have multipath problems.

Table 2-26 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

8B0032009B—Payload

0158B0B3—Message Checksum and End Sequence

Table 2-26 Elevation Mask – Message ID 139

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	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

Payload length: 5 bytes

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

Power Mask – Message ID 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 2-27 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

8C1C21—Payload

00C9B0B3—Message Checksum and End Sequence

Table 2-27 Power Mask – Message ID 140

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		8C		Decimal 140
Tracking Mask	1 U		1C	dBHz	Not implemented
Navigation Mask	1 U		21	dBHz	Range 20[1] to 50

Payload length: 3 bytes

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 used in the navigation solution.

Static Navigation – Message ID 143

Allows the user to enable or disable static navigation to the receiver.

Example:

A0A20002 – Start Sequence and Payload Length

8F01 – Payload

0090B0B3 – Message Checksum and End Sequence

Table 2-28 Static Navigation – Message ID 143

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		8F		Decimal 143
Static Navigation Flag	1 U		01		1 = enable; 0 = disable

Payload length: 2 bytes

Note – Static navigation is a position filter designed to be used with applications intended for motor vehicles. When the vehicle's speed falls below a threshold, the position and heading are frozen, and speed is set to zero. 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.

Poll Clock Status – Message ID 144

Causes the receiver to report the most recently computed clock status. The resulting clock status is reported in Message ID 7.

Table 2-29 contains the input values for the following example:

Poll the clock status.

Example:

A0A20002—Start Sequence and Payload Length

9000—Payload

0090B0B3—Message Checksum and End Sequence

Table 2-29 Clock Status – Message ID 144

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		90		Decimal 144
Control	1 U		00		Not used

Payload length: 2 bytes

Note – Returned message is Message ID 7. See “Response: Clock Status Data – Message ID 7” on page 3-8.

Set DGPS Serial Port – Message ID 145

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. The values entered are stored in battery-backed RAM (called NVRAM in this document) 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 2-30 contains the input values for the following example:

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

Example:

A0A20009—Start Sequence and Payload Length

910000258008010000—Payload

013FB0B3—Message Checksum and End Sequence

Table 2-30 Set DGPS Serial Port – Message ID 145

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	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

Payload length: 9 bytes

Note – Setting the DGPS serial port using Message ID 145 affects COM-B only regardless of the port being used to communicate with the Evaluation Receiver.

Poll Almanac – Message ID 146

Causes the most recently stored almanacs to be reported by the receiver. Almanacs are reported in Message ID 14, with a total of 32 messages being sent in response.

Note – Some software versions do not support this command.

Table 2-31 contains the input values for the following example:

Poll for the almanac.

Example:

A0A20002—Start Sequence and Payload Length

9200—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-31 Almanac – Message ID 146

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		92		Decimal 146
Control	1 U		00		Not used

Payload length: 2 bytes

Note – Returned message is Message ID 14. See “Almanac Data – Message ID 14” on page 3-21.

Poll Ephemeris – Message ID 147

Causes the receiver to respond with the ephemeris of the requested satellite. The ephemeris is sent using Message ID 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 2-32 contains the input values for the following example:

Poll for Ephemeris Data for all satellites.

Example:

A0A20003—Start Sequence and Payload Length

930000—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-32 Poll Ephemeris – Message ID 147

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

Payload length: 3 bytes

1. A value of zero requests all available ephemeris records. This results in a maximum of twelve output messages. A value of 1 through 32 requests only the ephemeris of that SV.

Note – Returned message is Message ID 15. See “Ephemeris Data (Response to Poll) – Message ID 15” on page 3-22.

Flash Update – Message ID 148

Allows the user to command the receiver to enter internal boot mode without setting the hardware bootstrap configuration input. Internal boot mode allows the user to re-flash the embedded code in the receiver.

Note – It is highly recommended that all hardware designs provide access to the hardware bootstrap configuration input pin(s) in the event of a failed flash upload.

Example:

A0A20001 – Start Sequence and Payload Length

94 – Payload

0094B0B3 – Message Checksum and End Sequence

Table 2-33 Flash Update – Message ID 148

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		94		Decimal 148

Payload length: 1 bytes

Note – Some software versions do not support this command

Set Ephemeris – Message ID 149

Enables the user to upload an ephemeris file to the receiver.

Example:

A0A2005B – Start Sequence and Payload Length

95………………….   – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-34 Set Ephemeris – Message ID 149

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		95		Decimal 149
Ephemeris Data [45]	2 U		00		Reserved

Payload length: 91 bytes

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 Message ID 15 (“Ephemeris Data (Response to Poll) – Message ID 15” on page 3-22) for a detailed description of this data format.

Note – Some software versions do not support this command.

Switch Operating Modes – Message ID 150

Places the receiver in production test or normal operating mode.

Table 2-35 contains 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

961E510006001E—Payload

0129B0B3—Message Checksum and End Sequence

Table 2-35 Switch Operating Modes – Message ID 150

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		96		Decimal 150
Mode	2 U		1E51		0 = normal, 1E51 = Testmode1, 1E52 = Testmode2, 1E53 = Testmode3, 1E54 = Testmode4
SvID	2 U		0006		Satellite to Track
Period	2 U		001E	sec	Duration of Track

Payload length: 7 bytes

Note – In GSW3 and GSWLT3, processing this messages puts MaxOffTime and MaxAcqTime to default values. Requires Message ID 167 after this to restore those to non-default values.

Set TricklePower Parameters – Message ID 151

Allows the user to set some of the power-saving modes of the receiver.

Table 2-36 contains the input values for the following example:

Sets the receiver to low power modes.

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

A0A20009—Start Sequence and Payload Length

97000000C8000000C8—Payload

0227B0B3—Message Checksum and End Sequence

Table 2-36 Set TricklePower Parameters – Message ID 151

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		97		Decimal 151
Push-to-Fix Mode	2 S		0000		ON = 1, OFF = 0
Duty Cycle	2 S	*10	00C8	%	% Time ON. A duty cycle of 1000 (100%) means continuous operation
On-Time[1]	4 S		000000C8	msec	range 200 - 900 msec

Payload length: 9 bytes

1. On-time of 700, 800, or 900 ms is invalid if an update rate of 1 second is selected.

Computation of Duty Cycle and On-Time

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

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

Note – It is not possible to enter an on-time > 900 msec.

Following are some examples of selections:

Table 2-37 Example of Selections for TricklePower Mode of Operation

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

1. when the duty cycle is set to 100 %, the on time 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, we recommend that you set the on-time value to 200 ms.
2. When the duty cycle is set to 100%, the value in this field has no effect. Thus, any legal value (100 to 900) may be used.

Table 2-38 Duty Cycles for Supported TricklePower Settings

	Update Rates (sec)									
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

1. When the duty cycle is set to 100%, the on time has no effect. However, the command parser may still test the value against the 200-600 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 needed 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 re-calibrates and shuts down. In either case, the amount of time the receiver remains off is in proportion to how long it stayed on:

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

The off period has a possible range between 10 and 7200 seconds. The default is 1800 seconds. Push-to-Fix cycle period is set using Message ID 167.

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

Poll Navigation Parameters – Message ID 152

Requests the receiver to report its current navigation parameter settings. The receiver responds to this message with Message ID 19. Table 2-39 contains the input values for the following example:

Example: Poll receiver for current navigation parameters.

A0A20002—Start Sequence and Payload Length

9800—Payload

0098B0B3—Message Checksum and End Sequence

Table 2-39 Poll Receiver for Navigation Parameters – Message ID 152

Name	Bytes	Binary (Hex) Scale	Example	Unit	Description
Message ID	1 U		98		Decimal 152
Reserved	1 U		00		Reserved

Payload length: 2 bytes

Set UART Configuration – Message ID 165

Sets the protocol, bit rate, and port settings on any UART.

Note – This message supports setting up to four UARTs.

Table 2-40 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

A50001010000258008010000000100000000E1000801000000FF050500000000000000000000FF0505000000000000000000000—Payload

0452B0B3—Message Checksum and End Sequence

Table 2-40 Set UART Configuration – Message ID 165

Name	Bytes	Binary (Hex) Scale	Example	Unit	Description
Message ID	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 (Set to in protocol)
Bit Rate[3]	4 U		00002580		For UART 0
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

Table 2-40 Set UART Configuration – Message ID 165 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
In Protocol	1 U		05		For UART 2
Out Protocol	1 U		05		For UART 2
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

Payload length: 49 bytes

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. Any software version only supports some subset of these protocols. Selecting a protocol that is not supported by the software may cause unexpected results.
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.

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

Set Message Rate – Message ID 166

Controls the output rate of binary messages. Table 2-41 contains the input values for the following example:

Set Message ID 2 to output every five seconds starting immediately.

Example:

A0A20008—Start Sequence and Payload Length

A600020500000000—Payload

00ADB0B3—Message Checksum and End Sequence

Table 2-41 Set Message Rate – Message ID 166

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		A6		decimal 166
Mode[1]	1 U		00		00: enable/disable one message 01: poll one message instantly 02: enable/disable all messages 03: enable/disable default navigation messages (Message ID 2 and 4) 04: enable/disable default debug messages (Message ID 9 and 255) 05: enable/disable navigation debug messages (Message ID 7, 28, 29, 30, and 31
Message ID 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		No used, set to zero
Reserved	1 U		00		Not used, set to zero
Reserved	1 U		00		Not used, set to zero

Payload Length: 8 bytes

1. Values 02 - 05 are available for GSW3 and SLC3 software only.
2. A value of 0 means to stop sending the message. A value in the range of 1 - 30 specifies the cycle period.

Set Low Power Acquisition Parameters – Message ID 167

Provides tools to set MaxOffTime, MaxSearchTime, Push-to-Fix period and Adaptive TricklePower. These settings affect low-power modes 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 2-42 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

A7000075300001D4C00000003C0000—Payload

031DB0B3—Message Checksum and End Sequence

Table 2-42 Set Low Power Acquisition Parameters – Message ID 167

		Binary (Hex)			
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Description**
Message ID	1 U		A7		Decimal 167
Max Off Time	4 U		00007530	msec	Maximum time for sleep mode. Default value: 30 seconds
Max Search Time	4 U		0001D4C0	msec	Max. satellite search time. Default value: 120 seconds
Push-to-Fix Period	4 U		0000003C	sec	Push-to-Fix cycle period
Adaptive TricklePower	2 U		0001		To enable Adaptive TricklePower 0 = off; 1 = on

Payload length: 15 bytes

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

Poll Command Parameters – Message ID 168

Queries the receiver to send specific response messages for one of the following messages: 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, 0x97 and 0xAA. In response to this message, the receiver sends Message ID 43.

Table 2-43 contains the input values for the following example:

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

Example:

A0A20002–Start Sequence and Payload Length

A897-Payload

013FB0B3-Message Checksum and End Sequence

Table 2-43 Poll Command Parameters – Message ID 168

		Binary (Hex)			
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Description**
Message ID	1 U		A8		Decimal 168
Poll Msg ID	1 U		97		Requesting Msg ID 0x97[1]

Payload length: 2 bytes

1. Valid Message IDs are 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, 0x97, and 0xAA.

Set SBAS Parameters – Message ID 170

Allows the user to set the SBAS parameters.

Table 2-44 contains the input values for the following example:

Set automatic SBAS search and testing operating mode.

Example:

A0A20006—Start Sequence and Payload Length

AA0000010000—Payload

01B8B0B3—Message Checksum and End Sequence

Table 2-44 Set SBAS Parameters – Message ID 170

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		AA		Decimal 170
SBAS PRN	1 U		00		0 = Auto mode PRN 120-138 = Exclusive
SBAS Mode	1 U		00		0 = Testing, 1 = Integrity Integrity mode rejects SBAS corrections if the SBAS satellite is transmitting in a test mode Testing mode accepts/uses SBAS corrections even if satellite is transmitting in a test mode
Flag Bits[1]	1 D		01		Bit 0: Timeout; 0 = Default 1 = User Bit 1: Health; Reserved Bit 2: Correction; Reserved Bit 3: SBAS PRN; 0 = Default 1 = User
Spare	2		0000		

Payload length: 6 bytes

1. If Bit 0 = 1, user-specified timeout from Message ID 138 is used. If Bit 0 = 0, timeout specified by the SBAS satellite is used (this is 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.

Initialize GPS/DR Navigation – Message ID 172 (Sub ID 1)

Sets the navigation initialization parameters and commands a software reset based on these parameters.

Table 2-45 Navigation Initialization Parameters

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0xAC
Message Sub ID	1			= 0x01
Latitude	4		deg	for Warm Start with user input
Longitude	4		deg	for Warm Start with user input
Altitude (ellipsoid)	4		m	for Warm Start with user input
True heading	2		deg	for Warm Start with user input
Clock drift	4		Hz	for Warm Start with user input
GPS time of week	4	100	sec	for Warm Start with user input
GPS week number	2			for Warm Start with user input
Channel count	1			for Warm Start with user input

Table 2-45 Navigation Initialization Parameters *(Continued)*

Name	Bytes	Scale	Unit	Description
Reset configuration bits[1]	1			Bit 0: use initial data provided in this message for start-up Bit 1: clear ephemeris in memory Bit 2: clear all memory Bit 3: perform Factory Reset Bit 4: enable SiRF Binary output messages for raw track data, navigation library, 50 bps info, RTCM data, clock status, and DR status Bit 5: enable debug output messages Bit 6: Reserved Bit 7: Reserved

Payload length: 28 bytes

1. Bits 0 - 3 determine the reset mode: 0000 = Hot; 0010 = Warm; 0011 = Warm with user input; 0100 = Cold; 1000 = Factory.

Set GPS/DR Navigation Mode – Message ID 172 (Sub ID 2)

Sets the GPS/DR navigation mode control parameters.

Table 2-46 GPS/DR Navigation Mode Control Parameters – Message ID 172 (Sub ID 2)

Name	Bytes	Description
Message ID	1	= AC
Message Sub ID	1	= 0x02
Mode	1	Bit 0 : GPS-only navigation Bit 1 : DR nav acceptable with stored/default calibration Bit 2 : DR nav acceptable with current GPS calibration Bit 3 : DR-only navigation
Reserved	1	

Set DR Gyro Factory Calibration – Message ID 172 (Sub ID 3)

Sets DR gyro factory calibration parameters.

Table 2-47 DR Gyro Factory Calibration Parameters – Message ID 172 (Message Sub ID 3)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0xAC
Message Sub ID	1			= 0x03
Calibration	1			Bit 0 : Start gyro bias calibration Bit 1 : Start gyro scale factor calibration Bits 2 - 7 : Reserved
Reserved	1			

Payload length: 4 bytes

Set DR Sensors' Parameters – Message ID 172 (Sub ID 4)

Sets DR sensors parameters.

Table 2-48 DR Sensors Parameters – Message ID 172 (Message Sub ID 4)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0xAC
Message Sub ID	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

Poll DR Gyro Factory Calibration – Message ID 172 (Sub ID 6)

Polls the DR gyro factory calibration status.

Table 2-49 DR Gyro Factory Calibration Status – Message ID 172 (Message Sub ID 6)

Name	Bytes	Description
Message ID	1	= AC
Message Sub ID	1	= 0x06

Payload length: 2 bytes

Poll DR Sensors' Parameters – Message ID 172 (Sub ID 7)

Message 172 Sub IDs apply to SiRFDiRect only

Polls the DR sensors parameters.

Table 2-50 DR Sensors Parameters – Message ID 172 (Message Sub ID 7)

Name	Bytes	Description
Message ID	1	= AC
Message Sub ID	1	= 0x07

Payload length: 2 bytes

Input Car Bus Data to NAV – Message ID 172 (Sub ID 9)

Sensor data output converted into engineering units.

Table 2-51 Input Car Bus Data – Message ID 172 (Message Sub ID 9)

Byte	Field	Data Type	Bytes	Unit	Range	Res
1	Message ID	UINT8	1	N/A	0xAC	N/A
2	Message Sub-ID	UINT8	1	N/A	0x09	N/A
3	Sensor Data Type (depends on sensor)	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, Vertical Acceleration (Up)(Z), Longitudinal Acceleration (Front)(X), Lateral Acceleration (Left)(Y) 11-127: 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-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 second data set, etc.	N/A
7+(N-1)* 16[1]	Valid Sensor Indication	UINT8	1	N/A	Valid/Not Valid indication for each one of the four 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
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
16+(N-1)* 16[1]	**Data 2** Depends on SDT	INT16	2	Depends on SDT	Depends on SDT	Depends on SDT

Table 2-51 Input Car Bus Data – Message ID 172 (Message Sub ID 9) *(Continued)*

Byte	Field	Data Type	Bytes	Unit	Range	Res
	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: downward acceleration			m/sec^2	-15 to 15	0.001
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/sec^2	-15 to 15	0.001
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/sec^2	-15 to 15	0.001
22+(N-1)* 16[1]	Reserved	UINT8	1	N/A	N/A	N/A

Payload length: 22 to 182 bytes

Note 1: N indicates the number of valid data sets in the message

Car Bus Enabled – Message ID 172 (Sub ID 10)

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

Table 2-52 Bus Enabled – Message ID 172 (Message Sub ID 10)

Name	Bytes	Description
Message ID	1	0xAC
Message Sub ID	1	0xA
Mode	4	Undefined/not used

Payload length: 6 bytes

Car Bus Disabled – Message ID 172 (Sub ID 11)

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

Table 2-53 Bus Disabled – Message ID 172 (Message Sub ID 11)

Name	Bytes	Description
Message ID	1	0xAC
Message Sub ID	1	0xB
Mode	4	Undefined/not used

Payload length: 6 bytes

Input Car Bus Data 2 – Message ID 172 (Sub ID 14)

Message applies to SiRFDiRect only

Sensor data output converted into engineering units.

Table 2-54 Binary Message Definition – Message ID 172 (Message Sub ID 14)

Byte	Field	Data Type	Bytes	Unit	Range	Resolution
1	Message ID	UINT8	1	N/A	0xAC	N/A
2	Sub-ID	UINT8	1	N/A	0x0E	N/A
3	SensorDataType	UINT8	1	N/A	Fixed at 10	N/A
4	NumValidDataSets	UINT8	1	N/A	0 to 10 valid data sets in message	N/A
5	DataFrequency	UINT8	1	N/A	Fixed at 10	N/A
6	ValidSensorIndication[0]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid Bit 0xFF80: Reserved	N/A
8	DataSetTimeTag[0]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
12	Heading Gyro[0]	INT16	2	deg/sec	±60 degrees per second	1/1e2
14	Z-Axis[0]	INT16	2	M/sec^2	±2 Gs	1/1668.0
16	X-Axis[0]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
18	Y-Axis[0]	INT16	2	M/sec^2	±2 Gs	1/1668.0
20	Pitch Gyro[0]	INT16	2	deg/sec	±60 degrees per second	1/1e2
22	Reserved[0]	UINT8	1	N/A	0 to 0xff	1
23	ValidSensorIndication[1]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
25	DataSetTimeTag[1]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
29	Heading Gyro[1]	INT16	2	deg/sec	±60 degrees per second	1/1e2
31	Z-Axis[1]	INT16	2	M/sec^2	±2 Gs	1/1668.0
33	X-Axis[1]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
35	Y-Axis[1]	INT16	2	M/sec^2	±2 Gs	1/1668.0
37	Pitch Gyro[1]	INT16	2	deg/sec	±60 degrees per second	1/1e2
39	Reserved[1]	UINT8	1	N/A	0 to 0xff	1
40	ValidSensorIndication[2]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
42	DataSetTimeTag[2]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
46	Heading Gyro[2]	INT16	2	deg/sec	±60 degrees per second	1/1e2
48	Z-Axis[2]	INT16	2	M/sec^2	±2 Gs	1/1668.0
50	X-Axis[2]	INT16	2	M/sec^2	±2 Gs	1/1668.0
52	Y-Axis[2]	INT16	2	M/sec^2	±2 Gs	1/1668.0
54	Pitch Gyro[2]	INT16	2	deg/sec	±60 degrees per second	1/1e2

Table 2-54 Binary Message Definition – Message ID 172 (Message Sub ID 14) *(Continued)*

Byte	Field	Data Type	Bytes	Unit	Range	Resolution
56	Reserved[2]	UINT8	1	N/A	0 to 0xff	1
57	ValidSensorIndication[3]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
59	DataSetTimeTag[3]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
63	Heading Gyro[3]	INT16	2	deg/sec	±60 degrees per second	1/1e2
65	Z-Axis[3]	INT16	2	M/sec^2	±2 Gs	1/1668.0
67	X-Axis[3]	INT16	2	M/sec^2	±2 Gs	1/1668.0
69	Y-Axis[3]	INT16	2	M/sec^2	±2 Gs	1/1668.0
71	Pitch Gyro[3]	INT16	2	deg/sec	±60 degrees per second	1/1e2
73	Reserved[3]	UINT8	1	N/A	0 to 0xff	1
74	ValidSensorIndication[4]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
76	DataSetTimeTag[4]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
80	Heading Gyro[4]	INT16	2	deg/sec	±60 degrees per second	1/1e2
82	Z-Axis[4]	INT16	2	M/sec^2	±2 Gs	1/1668.0
84	X-Axis[4]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
86	Y-Axis[4]	INT16	2	M/sec^2	±2 Gs	1/1668.0
88	Pitch Gyro[4]	INT16	2	deg/sec	±60 degrees per second	1/1e2
90	Reserved[4]	UINT8	1	N/A	0 to 0xff	1
91	ValidSensorIndication[5]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
93	DataSetTimeTag[5]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
97	Heading Gyro[5]	INT16	2	deg/sec	±60 degrees per second	1/1e2
99	Z-Axis[5]	INT16	2	M/sec^2	±2 Gs	1/1668.0
101	X-Axis[5]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
103	Y-Axis[5]	INT16	2	M/sec^2	±2 Gs	1/1668.0
105	Pitch Gyro[5]	INT16	2	deg/sec	±60 degrees per second	1/1e2
107	Reserved[5]	UINT8	1	N/A	0 to 0xff	1
108	ValidSensorIndication[6]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
110	DataSetTimeTag[6]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
114	Heading Gyro[6]	INT16	2	deg/sec	±60 degrees per second	1/1e2
116	Z-Axis[6]	INT16	2	M/sec^2	±2 Gs	1/1668.0
118	X-Axis[6]]	INT16	2	M/sec^2	±2 Gs	1/1668.0

Table 2-54 Binary Message Definition – Message ID 172 (Message Sub ID 14) *(Continued)*

Byte	Field	Data Type	Bytes	Unit	Range	Resolution
120	Y-Axis[6]	INT16	2	M/sec^2	±2 Gs	1/1668.0
122	Pitch Gyro[6]	INT16	2	deg/sec	±60 degrees per second	1/1e2
124	Reserved[6]	UINT8	1	N/A	0 to 0xff	1
125	ValidSensorIndication[7]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
127	DataSetTimeTag[7]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
131	Heading Gyro[7]	INT16	2	deg/sec	±60 degrees per second	1/1e2
133	Z-Axis[7]	INT16	2	M/sec^2	±2 Gs	1/1668.0
135	X-Axis[7]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
137	Y-Axis[7]	INT16	2	M/sec^2	±2 Gs	1/1668.0
139	Pitch Gyro[7]	INT16	2	deg/sec	±60 degrees per second	1/1e2
141	Reserved[7]	UINT8	1	N/A	0 to 0xff	1
142	ValidSensorIndication[8]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
144	DataSetTimeTag[8]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
148	Heading Gyro[8]	INT16	2	deg/sec	±60 degrees per second	1/1e2
150	Z-Axis[8]	INT16	2	M/sec^2	±2 Gs	1/1668.0
152	X-Axis[8]	INT16	2	M/sec^2	±2 Gs	1/1668.0
154	Y-Axis[8]	INT16	2	M/sec^2	±2 Gs	1/1668.0
156	Pitch Gyro[8]	INT16	2	deg/sec	±60 degrees per second	1/1e2
158	Reserved[8]	UINT8	1	N/A	0 to 0xff	1
159	ValidSensorIndication[9]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
161	DataSetTimeTag[9]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
165	Heading Gyro[9]	INT16	2	deg/sec	±60 degrees per second	1/1e2
167	Z-Axis[9]	INT16	2	M/sec^2	±2 Gs	1/1668.0
169	X-Axis[9]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
171	Y-Axis[9]	INT16	2	M/sec^2	±2 Gs	1/1668.0
173	Pitch Gyro[9]	INT16	2	deg/sec	±60 degrees per second	1/1e2
175	Reserved[9]	UINT8	1	N/A	0 to 0xff	1

Payload length: 175 bytes

User Set Command – Message ID 175

Allows user to send an input command string and parse the associated functions.

Table 2-55 describes the message content.

Table 2-55 User Set Command – Message ID 175

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		AF		Decimal 175
User Set Command	Variable				Depends on user's input

Payload length: Variable bytes

Note – This message can only be used by SDK customers.

Preset Operating Configuration – Message ID 180

Note – This Message ID 180 is used only with GSC2xr chip.

Overrides the Preset Operating Configuration as defined in bits [3:2] of the GSC2xr chip configuration register. The valid input values mapped to the Preset Operating Configuration are described in Table 2-56.

Table 2-56 Valid Input Values

Mapping	
Input Values	Preset Configuration
0	1
1	2
2	3
3	4
4	Standard GSW2 and GSW2x software default configuration[1]

1. The default configuration is SiRF Binary at 38400 bps using UART A and RTCM at 9600 bps using UART B.

Table 2-57 contains the input values for the following example:

Set receiver to Standard GSW2 Default Configuration.

Example:

A0A20002—Start Sequence and Payload Length

B404—Payload

00B8B0B3—Message Checksum and End Sequence

Table 2-57 GSC2xr Preset Operating Configuration – Message ID 180

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		B4		Decimal 180
Input[1]	1		04		Valid input value from 0 to 4

Payload length: 2bytes

1. Invalid input value yields a Rejected MID_UserInputBegin while a valid input value yields a Acknowledged MID_UserInputBegin response in the SiRFDemo response view.

Table 2-58 GSC2xr Preset Operating Configurations

New Config	Nav Status	Config 4	Config 3	Config 2	Config 1
UARTA		NMEA v2.2	NMEA v2.2	SiRF Binary	NMEA v2.2
UARTB		RTCM	RTCM	NMEA v2.2	SiRF Binary
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
SiRF Binary 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
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

1. SiRF Binary 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.

Software Control – Message ID 205

Used by GSW3 and GSWLT3 software (versions 3.2.5 or above) for generic input. Based on the Message Sub ID, there are different interpretations.

Table 2-59 Software Control – Message ID 205

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		CD		Decimal 205
Message Sub ID	1		10		Message Sub ID
Data					Varies with Message Sub ID

Payload length: Variable

Software Commanded Off – Message ID 205 (Sub ID 16)

Shuts down the chip.

Table 2-60 Software Commanded Off – Message ID 205 (Message Sub ID 16)

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		CD		Decimal 205
Message Sub ID	1		10		Message Sub ID for software commanded off

Payload length: 0 bytes

Reserved – Message ID 228

SiRF proprietary

Extended Ephemeris – Message ID 232

Used by GSW2 (2.5 or above), SiRFXTrac (2.3 or above), and GSW3 (3.2.0 or above), and GSWLT3 software. This message has two Message Sub IDs.

Table 2-61 Extended Ephemeris – Message ID 232

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		E8		Decimal 232
Message Sub ID	1		01		Message Sub ID
Data					Varies with Message Sub ID

Payload length: variable (2 bytes + Message Sub ID payload bytes)

Extended Ephemeris Proprietary – Message ID 232 (Sub ID 1)

Output Rate: Depending on the Client Location Manager (CLM)

Example:

A0A201F6—Start Sequence and Payload Length

Table 2-62 Extended Ephemeris – Message ID 232 (Message Sub ID 1)

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		E8			232
Message Sub ID	1		01			Ephemeris input
SiRF Proprietary Ephemeris Format	500					Content proprietary

Payload length: variable

Format – Message ID 232 (Sub ID 2)

This message polls ephemeris status on up to 12 satellite PRNs. In response to this message, the receiver sends Message ID 56, Message Sub ID 3.

Table 2-63 Format – Message ID 232 (Message Sub ID 2)

Name	Bytes	Description
Message ID	1	Hex 0xE8, Decimal 232
Message Sub ID	1	2-Poll Ephemeris Status
SVID Mask	4	Bitmapped Satellite PRN[1]

Payload length: 6 bytes

1. 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.

Extended Ephemeris Debug – Message ID 232 (Sub ID 255)

Example:

A0A20006—Start Sequence and Payload Length

E8FF01000000 – Payload

01E8B0B3—Message Checksum and End Sequence

Table 2-64 Extended Ephemeris – Message ID 232 (Message Sub ID 255)

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1		E8			232
Message Sub ID	1		FF			255-EE Debug
DEBUG_FLAG	4					Proprietary

Payload length: 6 bytes

Output Messages 3

This chapter provides information about available SiRF Binary output messages. For each message, a full definition and example is provided.

Table 3-1 SiRF Binary Messages – Output Message List

Hex	Decimal	Name	Description
01	1	Reference Navigation Data	Not Implemented
02	2	Measured Navigation Data	Position, velocity, and time
03	3	True Tracker Data	Not Implemented
04	4	Measured Tracking Data	Satellite and C/N0 information
05	5	Raw Track Data	Not supported by SiRFstarII
06	6	SW Version	Receiver software
07	7	Clock Status	Current clock status
08	8	50 BPS Subframe Data	Standard ICD format
09	9	Throughput	Navigation complete data
0A	10	Error ID	Error coding for message failure
0B	11	Command Acknowledgment	Successful request
0C	12	Command NAcknowledgment	Unsuccessful request
0D	13	Visible List	Auto Output
0E	14	Almanac Data	Response to poll
0F	15	Ephemeris Data	Response to poll
10	16	Test Mode 1	For use with SiRFtest (Test Mode 1)
11	17	Differential Corrections	Received from DGPS broadcast
12	18	OkToSend	CPU ON / OFF (TricklePower)
13	19	Navigation Parameters	Response to Poll
14	20	Test Mode 2/3/4	Test Mode 2, 3, or 4 test data
1B	27	DGPS Status	Differential GPS status information
1C	28	Nav. Lib. Measurement Data	Measurement data
1D	29	Nav. Lib. DGPS Data	Differential GPS data
1E	30	Nav. Lib. SV State Data	Satellite state data
1F	31	Nav. Lib. Initialization Data	Initialization data
29	41	Geodetic Navigation Data	Geodetic navigation information
2B	43	Queue Command Parameters	Command parameters
2D	45	Raw DR Data	Raw DR data from ADC
2E	46	Test Mode 3 & 4 (GSW3 & SLC3)	Test data (Test Mode 3 and 4)
30	48[1]	Test Mode 4 for SiRFLoc v2.x only	Test data (Test Mode 4)

Table 3-1 SiRF Binary Messages – Output Message List *(Continued)*

Hex	Decimal	Name	Description
30	48	SiRF Dead Reckoning Class of Output Messages	The Message ID is partitioned into messages identified by Message Sub IDs, refer to Table 3-2
31	49	Test Mode 4 for SiRFLoc v2.x only	Additional test data (Test Mode 4)
32	50	SBAS Parameters	SBAS operating parameters
34	52	1 PPS Time Message	Time message for 1 PPS
37	55	Test Mode 4	Track Data
38	56	Extended Ephemeris Data	Extended Ephemeris Mask & Integrity Information
E1	225	SiRF internal message	Reserved
FF	255	Development Data	Various status messages

1. This Message ID 48 for Test Mode 4 is not to be confused with Message ID 48 for DR Navigation. SiRFLoc v2 Message ID 48 will be transferred to a different Message ID in the near future.

Table 3-2 Message Sub IDs for SiRFDRive and SiRFDiRect Output – Message ID 48 (0x30)

Sub ID	Message ID	SiRFDRive 1	SiRFDRive 2	SiRFDiRect
1	DR Navigation Status	Yes	Yes	Yes
2	DR Navigation State	Yes	Yes	Yes
3	Navigation Subsystem	Yes	Yes	Yes
4	Raw DRData (not implemented)	No	No	No
5	DR Validity	No	No	No
6	DR Gyro Factory Calibration	Yes	No	No
7	DR Sensors Parameters	Yes	No	No
8	DR Data Block	Yes	No	No
9	Generic Sensor Parameters (not implemented)	No	No	No

Since the SiRF Binary protocol is evolving along with continued development of SiRF software and GPS solutions, not all SiRF Binary messages are supported by all SiRF GPS solutions.

Table 3-3 identifies the supported output messages for each SiRF architecture.

Table 3-3 Supported Output Messages

Message ID	SiRF Software Options					
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3 & GSWLT3	SiRFDiRect
1	No	No	No	No	No	No
2	Yes	Yes	Yes	Yes	Yes	Yes
3	No	No	No	No	No	No
4	Yes	Yes	Yes	Yes	Yes	Yes
5	No	No	No	No	No	No
6	Yes	Yes	Yes	Yes	Yes	Yes
7	Yes	Yes	Yes	Yes	Yes	Yes
8	Yes	Yes	Yes	Yes	Yes	No
9	Yes	Yes	Yes	Yes	Yes GSW3; No GSWLT3	No
10	Yes	Yes	Yes	Yes	Yes	Yes
11	Yes	Yes	Yes	Yes	Yes	Yes
12	Yes	Yes	Yes	Yes	Yes	Yes

Table 3-3 Supported Output Messages *(Continued)*

Message ID	SiRF Software Options					
	GSW2	**SiRFDRive**	**SiRFXTrac**	**SiRFLoc**	**GSW3 & GSWLT3**	**SiRFDiRect**
13	Yes	Yes	Yes	Yes	Yes	No
14	Yes	Yes	No	Yes	Yes	Yes
15	Yes	Yes	No	Yes	Yes	Yes
16	Yes	Yes	No	No	No	No
17	Yes	Yes	No	No	No	No
18	Yes	Yes	Yes	Yes	Yes	Yes
19	Yes	Yes	Yes	Yes	Yes	Yes
20	Test Mode 2 only	Test Mode 2 only	Test Modes 2/3/4	Test Mode 4 (2.x only)	No	No
27	Yes	Yes	No	No	Yes	No
28	Yes	Yes	No	No	Yes	Yes
29	Yes	Yes	No	No	No	No
30	Yes	Yes	No	No	Yes	Yes
31	Yes	Yes	No	No	Yes	Yes
41	2.3 & above	Yes	2.0 & above	No	Yes	Yes
43	No	No	No	No	Yes	Yes
45	No	Yes	No	No	No	No
46	Yes	Yes	No	3.x & above	Yes	Yes
48[1] (Test Mode 4)	No	No	No	2.x only	No	No
48 (DR)	No	Yes[2]	No	No	No	Yes[2]
49	No	No	No	2.x only	No	No
50	2.3 & above	Yes	No	No	3.2.5 & above	No
52	2.3.2 & above	No	No	No	No	No
55	No	No	No	3.x & above	Yes	Yes
56	2.5 & above	No	2.3 & above	No	3.2.5 & above	No
56 (Sub ID 4)	No	Yes	No	No	3.2.5 & above	No
225	No	No	No	No	Yes (reserved)	No
232	No	No	No	No	Yes	Yes
255	Yes	Yes	Yes	Yes	Yes	No

1. This Message ID 48 for Test Mode 4 is not to be confused with Message ID 48 for DR Navigation. Message ID 48 for SiRFLoc will be transferred to a different Message ID in the near future.

2. Not all Message Sub IDs supported.

Reference Navigation Data – Message ID 1

This message is defined as Reference Navigation data but has not been implemented.

Measure Navigation Data Out – Message ID 2

Output Rate: 1 Hz

Table 3-4 lists the message data format for the measured navigation data.

Example:

A0A20029—Start Sequence and Payload Length

02FFD6F78CFFBE536E003AC004000000030001040A00036B039780E3
0612190E160F04000000000000—Payload

09BBB0B3—Message Checksum and End Sequence

Table 3-4 Measured Navigation Data Out – Message ID 2

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	ASCII (Decimal) Scale	ASCII (Decimal) 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/sec	Vx÷8	0
Y-velocity	2 S	*8	0003	m/sec	Vy÷8	0.375
Z-velocity	2 S	*8	0001	m/sec	Vz÷8	0.125
Mode 1	1 D		04	Bitmap[1]		4
HDOP[2]	1 U	*5	0A		^{3}5	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
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 12 PRN[5]	1 U		00			0

Payload length: 41 bytes

1. For further information see Table 3-5 and Table 3-6. Note that the Degraded Mode positioning mode is not supported in GSW3.2.5 and newer
2. HDOP value reported has a maximum value of 50.
3. For further information see Table 3-7.
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).

Mode 1 of Message ID 2 is a bit-mapped byte with five sub-values. Table 3-5 shows the location of the sub-values and Table 3-6 shows the interpretation of each sub-value.

Table 3-5 Mode 1

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Bit(s) Name	DGPS	DOP-Mask	ALTMODE		TPMODE	PMODE		

Table 3-6 Mode 1 Bitmap Information

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

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.

Mode 2 of Message ID bit-mapped byte information is described in Table 3-7.

Table 3-7 Mode 2 Bitmap

Bit	Description
0[1]	1 = sensor DR in use 0 = velocity DR if PMODE sub-value in Mode 1 = 7;else check Bits 6 & 7 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: 0 = enabled 1 = disabled (3-D fix only)
7,6[5]	Sensor DR error status: 00 = GPS-only navigation 01 = DR in calibration 10 = DR sensor errors 11 = DR in test mode

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.

True Tracker Data – Message ID 3

Defined as True Tracker data, but not yet implemented.

Measured Tracker Data Out – Message ID 4

Output Rate: 1 Hz

Table 3-8 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

Table 3-8 Measured Tracker Data Out – Message ID 4

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	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	El*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		29
C/N0 4	1 U		1D	dB-Hz		29
C/N0 5	1 U		19	dB-Hz		25
C/N0 6	1 U		1D	dB-Hz		29
C/N0 7	1 U		1A	dB-Hz		26
C/N0 8	1 U		1A	dB-Hz		26
C/N0 9	1 U		1D	dB-Hz		29
C/N0 10	1 U		1F	dB-Hz		31
2nd SVid	1 U		1D			29
Azimuth	1 U	Az*[2/3]	59	deg	^{3}[2/3]	89
Elev	1 U	El*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						

Payload length: 188 bytes

1. GPS week number is reported modulo 1024 (ten LSBs only).

2. For further information, see Table 3-9 for state values for each channel.

Table 3-9 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 Message ID 28 is also valid
2	Bit synchronization has been completed
3	Subframe synchronization has been completed
4[3]	Carrier pullin has been completed (Costas lock)
5	Code has been locked
6[4,5]	Satellite acquisition has failed
7	Ephemeris data is available
8-15	Reserved

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.
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. 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 0-7 to 1 (0xFF) to indicate that this channel is being used to test the indicated PRN for an auto or cross correlation.
5. Bit 6 is typically set to1 only when other bits are turned off. However, a special situation exists: when all bits are on (value 0xFF) there is a special meaning: this channel is being used to test for auto- and cross-correlations rather than tracking a satellite for use in the solution. When a 0xFF state exists in a channel, there often will be another channel that is actually tracking the SV PRN value shown.

Raw Tracker Data Out – Message ID 5

This message is not supported by the SiRFstarII or SiRFstarIII architecture.

Software Version String (Response to Poll) – Message ID 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

06322E332E322D475358322D322E30352E3032342D4331464C4558312E32 —Payload

0631B0B3—Message Checksum and End Sequence

Table 3-10 Software Version String – Message ID 6

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		06			6
Character [80]	1 U		[1]			[2]

Payload Length:1-81 bytes

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.

Response: Clock Status Data – Message ID 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.

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD021549240800012231000047281 4D4DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table 3-11 Clock Status Data – Message ID 7

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	sec	÷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

Payload length: 20 bytes

Table 3-12 Detailed Description of Message ID 7 Fields

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 SiRF 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.

1. Clock Drift in SiRF 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 "Computing GPS Clock Frequency" in Chapter 4.

50 BPS Data – Message ID 8

Output Rate: Approximately every six seconds for each channel

Example:

A0A2002B—Start Sequence and Payload Length

08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFFA
80365A867FC67708BEB5860F4—Payload

15AAB0B3—Message Checksum and End Sequence

Table 3-13 50 BPS Data – Message ID 8

		Binary (Hex)			**ASCII (Decimal)**	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		08			8
Channel	1 U		00			0
SV ID	1 U		19			25
Word[10]	4 U					

Payload length: 43 bytes

CPU Throughput – Message ID 9

Output Rate: 1 Hz

Example:

A0A20009—Start Sequence and Payload Length

09003B0011001601E5—Payload

0151B0B3—Message Checksum and End Sequence

Table 3-14 CPU Throughput – Message ID 9

		Binary (Hex)			**ASCII (Decimal)**	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		09			9
SegStatMax	2 U	*186	003B	ms	^{3}186	0.3172
SegStatLat	2 U	*186	0011	ms	÷186	0.0914
AveTrkTime	2 U	*186	0016	ms	÷186	0.1183
Last Millisecond	2 U		01E5	ms		485

Payload length: 9 bytes

Error ID Data – Message ID 10

Output Rate: As errors occur

Message ID 10 messages have a different format from other messages. Rather than one fixed format, there are several formats, each designated by an error ID. However, the format is standardized as indicated in Table 3-15. The specific format of each error ID message follows

Table 3-15 Message ID 10 Overall Format

Name	Bytes	Description
Message ID	1 U	Message ID number - 10
Error ID	2 U	Sub-message type
Count	2 U	Count of number of 4-byte values that follow
Data[n]	4 U	Actual data for the message, *n* is equal to Count

Error ID: 2

Code Define Name:ErrId_CS_SVParity

Error ID Description:Satellite subframe # failed parity check.

Example:

A0A2000D – Start Sequence and Payload Length

0A000200020000000100000002 – Payload

0011B0B3 – Message Checksum and End Sequence

Table 3-16 Error ID

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		0002			2
Count	2 U		0002			2
Satellite ID	4 U		00000001			1
Subframe No	4 U		00000002			2

Payload Length: 13 bytes

Table 3-17 Error ID 2 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
Satellite ID	Satellite pseudo-random noise (PRN) number
Subframe No	The associated subframe number that failed the parity check. Valid subframe number is 1 through 5.

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

0A0009000100000001 – Payload

0015B0B3 – Message Checksum and End Sequence

Table 3-18 Error ID 9 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		0009			9
Count	2 U		0002			2
Satellite ID	4 U		00000001			1

Payload Length: 9 bytes

Table 3-19 Error ID 9 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
Satellite ID	Satellite pseudo-random noise code number

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

0A000A000100001234 – Payload

005BB0B3 – Message Checksum and End Sequence

Table 3-20 Error ID 10 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		000A			10
Count	2 U		0001			1
Pseudorange	4 U		00001234			4660

Payload length: 9 bytes

Table 3-21 Error ID 10 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Pseudorange	Pseudo range.

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

0A000B0001xxxxxxxx – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-22 Error ID 11 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		000B			11
Count	2 U		0001			1
Doppler Frequency	4 U		xxxxxxxx			xxxxxxxx

Payload length: 9 bytes

Table 3-23 Error ID 11 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Doppler Frequency	Doppler frequency.

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

0A000C0002xxxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-24 Error ID 12 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		000C			12
Count	2 U		0002			2
Satellite ID	4 U		xxxxxxxx			xxxxxxxx
Age Of Ephemeris	4 U		aaaaaaaa	sec		aaaaaaaa

Payload Length: 13 bytes

Table 3-25 Error ID 12 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
Satellite ID	Satellite pseudo-random noise number
Age of Ephemeris	The satellite ephemeris age in seconds

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

0A000D0003xxxxxxxxaaaaaaaabbbbbbbb – Payload

xxxxB0B3 – Message Checksum and End Sequence0

Table 3-26 Error ID 13 Message

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		000D			13
Count	2 U		0003			3
X	4 U		xxxxxxxx			xxxxxxxx
Y	4 U		aaaaaaaa			aaaaaaaa
Z	4 U		bbbbbbbb			bbbbbbbb

Payload length: 17 bytes

Table 3-27 Error ID 13 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
X	X position in ECEF
Y	Y position in ECEF
Z	Z position in ECEF

Error ID: 4097 (0x1001)

Code Define Name:ErrId_MI_VCOClockLost

Error ID Description:VCO lost lock indicator.

Example:

A0A20009 – Start Sequence and Payload Length

0A1001000100000001 – Payload

001DB0B3 – Message Checksum and End Sequence

Table 3-28 Error ID 4097 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		1001			4097
Count	2 U		0001			1
VCOLost	4 U		00000001			1

Payload length: 9 bytes

Table 3-29 Error ID 4097 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
VCOLost	VCO lock lost indicator. If VCOLost ! = 0, then send failure message

Error ID: 4099 (0x1003)

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

0A1003000100000001 – Payload

001FB0B3 – Message Checksum and End Sequence

Table 3-30 Error ID 4099 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		1003			4099
Count	2 U		0001			1
InTrkCount	4 U		00000001			1

Payload Length: 9 bytes

Table 3-31 Error ID 4099 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
InTrkCount	False acquisition indicator. If InTrkCount < = 1, then send failure message and reset receiver

Error ID: 4104 (0x1008)

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

0A10080004xxxxxxxaaaaaaaa00000000cccccccc – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-32 Error ID 4104 Message

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		0A			10
Error ID	2 U		1008			4104
Count	2 U		0004 or 0003 or 0002			4 or 3 or 2
Computed Receiver Control Checksum	4 U		xxxxxxxx			xxxx
NVRAM Receiver Control Checksum	4 U		aaaaaaaa			aaaa
NVRAM Receiver Control OpMode	4 U		00000000			0
NVRAM Receiver Control Channel Count	4 U		cccccccc			cccc
Compute Clock Offset Checksum	4 U		xxxxxxxx			xxxx
NVRAM Clock Offset Checksum	4 U		aaaaaaaa			aaaa
NVRAM Clock Offset	4 U		bbbbbbbb			bbbb
Computed Position Time Checksum	4 U		xxxxxxxx			xxxx
NVRAM Position Time Checksum	4 U		aaaaaaaa			aaaa

Payload length: 21, 17, or 11 bytes

Table 3-33 Error ID 4104 Message Description

Name	**Description**
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
Computed Receiver Control Checksum	Computed receiver control checksum of SRAM.Data.Control structure
NVRAM Receiver Control Checksum	NVRAM receiver control checksum stored in SRAM.Data.DataBuffer. CntrlChkSum.
NVRAM Receiver Control OpMode	NVRAM receiver control checksum stored in SRAM.Data.Control.OpMode. Valid OpMode values are as follows: OP_MODE_NORMAL = 0 OP_MODE_TESTING = 0x1E51 OP_MODE_TESTING2 = 0x1E52 OP_MODE_TESTING3 = 0x1E53
NVRAM Receiver Control Channel Count	NVRAM receiver control channel count in SRAM.Data.Control.ChannelCnt Valid channel count values are 0-12

Table 3-33 Error ID 4104 Message Description *(Continued)*

Name	Description
Compute Clock Offset Checksum	Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.
NVRAM Clock Offset Checksum	NVRAM clock offset checksum of SRAM.Data.DataBuffer.clkChkSum
NVRAM Clock Offset	NVRAM clock offset value stored in SRAM.Data.DataBuffer,clkOffset
Computed Position Time Checksum	Computed position time checksum of SRAM.Data.DataBuffer.postime[1]
NVRAM Position Time Checksum	NVRAM position time checksum of SRAM.Data.DataBuffer.postimeChkSum[1]

Error ID: 4105 (0x1009)

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

0A10090002xxxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-34 Error ID 4105 Message

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		0A			10
Error ID	2 U		1009			4105
Count	2 U		0002			2
TOW	4 U		xxxxxxxx	sec		xxxx
Week Number	4 U		aaaaaaaa			aaaa

Payload length: 13 bytes

Table 3-35 Error ID 4105 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
TOW	GPS time of week in seconds. Range 0 to 604800 seconds
Week Number	GPS week number

Error ID: 4106 (0x100A)

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

0A100A0000 – Payload

0024B0B3 – Message Checksum and End Sequence

Table 3-36 Error ID 4106 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
Message ID	1 U		0A			10
Error ID	2 U		100A			4106
Count	2 U		0000			0

Payload length: 5 bytes

Table 3-37 Error ID 4106 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message

Error ID: 4107 (0x100B)

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

0A100B0000 – Payload

0025B0B3 – Message Checksum and End Sequence

Table 3-38 Error ID 4107 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
Message ID	1 U		0A			10
Error ID	2 U		100B			4107
Count	2 U		0000			0

Payload length: 5 bytes

Table 3-39 Error ID 4107 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message

Error ID: 8193 (0x2001)

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

0A2001000100000001 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-40 Error ID 8193 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		2001			8193
Count	2 U		0001			1
uartAllocError	4 U		00000001			1

Payload length: 9 bytes

Table 3-41 Error ID 8193 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
uartAllocError	Contents of variable used to signal UART buffer allocation error

Error ID: 8194 (0x2002)

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

0A200200020000000100000064 – Payload

0093B0B3 – Message Checksum and End Sequence

Table 3-42 Error ID 8194 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		2002			8194
Count	2 U		0002			2
Number of in process errors.	4 U		00000001			1
Millisecond errors	4 U		00000064			100

Payload length: 13 bytes

Table 3-43 Error ID 8194 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message
Number of in process errors	Number of one second updates not complete on entry
Millisecond errors	Millisecond errors caused by overruns

Error ID: 8195 (0x2003)

Code Define Name:ErrId_MI_MemoryTestFailed

Error ID Description:Failure of hardware memory test.

Example:

A0A20005 – Start Sequence and Payload Length

0A20030000 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-44 Error ID 8195 Message

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		2003			8195
Count	2 U		0000			0

Payload length: 5 bytes

Table 3-45 Error ID 8195 Message Description

Name	Description
Message ID	Message ID number
Error ID	Error ID (see Error ID description above)
Count	Number of 32 bit data in message

Command Acknowledgment – Message ID 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.

Output Rate: Response to successful input message

This is a successful almanac request (Message ID 0x92) example:

A0A20002—Start Sequence and Payload Length

0B92—Payload

009DB0B3—Message Checksum and End Sequence

Table 3-46 Command Acknowledgment – Message ID 11

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0x0B			11
ACK ID	1 U		0x92			146

Payload length: 2 bytes

Command Negative Acknowledgment – Message ID 12

This reply is sent when an input command to the receiver is rejected. Possible causes are: the input message failed checksum, contained an argument that was out of the acceptable range, or that the receiver was unable to comply with the message for some technical reason.

Output Rate: Response to rejected input message

This is an unsuccessful almanac request (Message ID 0x92) example:

A0A20002—Start Sequence and Payload Length

0C92—Payload

009EB0B3—Message Checksum and End Sequence

Table 3-47 Command Negative Acknowledgment – Message ID 12

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0x0C			12
N’Ack ID	1 U		0x92			146

Payload length: 2 bytes

Note – Commands can be Nack’d for several reasons including: failed checksum, invalid arguments, unknown command, or failure to execute command.

Visible List – Message ID 13

This message reports the satellites that are currently above the local horizon. Generally there are from 6 to 13 satellites visible at any one time. When more than 12 satellites are visible, this message only reports on the 12 highest in the sky. This message only reports on GPS satellites; it does not report on SBAS satellites.

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 3-48).

Example:

A0A2002A—Start Sequence and Payload Length

0D081D002A00320F009C0032....—Payload

....B0B3—Message Checksum and End Sequence

Table 3-48 Visible List – Message ID 13

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0D			13
Visible SVs	1 U		08			8
Ch 1 – SV ID	1 U		10			16
Ch 1 – SV Azimuth	2 S		002A	degrees		42
Ch 1 – SV Elevation	2 S		0032	degrees		50
Ch 2 – SV ID	1 U		0F			15
Ch 2 – SV Azimuth	2 S		009C	degrees		156
Ch 2 – SV Elevation	2 S		0032	degrees		50
...						

Payload length: variable (2 + 5 times number of visible SVs up to maximum of 62 bytes)

Almanac Data – Message ID 14

This message is sent in response to the Poll Almanac command, Message ID 146. When Message ID 146 is sent, the receiver responds with 32 individual Message ID 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

Table 3-49 Contents of Message ID 14

Name	Bytes	Description
Message ID	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] [12]	2 S	UINT16[12] array with sub-frame data
Checksum	2 S	

Payload length: 30 bytes

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 3-50 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.

Table 3-50 Byte Positions Between Navigation Message and Data Array

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
5	MSB	[3]	LSB	9	MSB	[9]	MSB
5	Middle	[3]	MSB	9	Middle	[9]	LSB

Table 3-50 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array		Navigation Message		Data Array	
Word	**Byte**	**Word**	**Byte**	**Word**	**Byte**	**Word**	**Byte**
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

Note – Message ID 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 (described in Table 3-49 above as 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.

Ephemeris Data (Response to Poll) – Message ID 15

This message is output in response to the Poll Ephemeris command, Message ID 147. If Message ID 147 specifies a satellite PRN, 1-32, a single Message ID 15 containing the ephemeris for that satellite PRN will be output. If Message ID 147 specifies satellite PRN 0, then the receiver sends as many Message ID 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

Table 3-51 Contents of Message ID 15

Name	Bytes	Description
Message ID	1 U	Hex 0x0E (decimal 14)
SV ID	1 U	SV PRN code, hex 0x01..0x02, decimal 1..32
Data[1] [45]	2 U	UINT16 [3][15] array with sub-frames 1..3 data

Payload length: 92 bytes

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 sub-frame, 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 sub-frame, 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 3-52 shows where each byte of the sub-frame is stored in the row of 16-bit words.

Table 3-52 Byte Positions Between Navigation Message and Data Array

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
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				

Note – Message ID 149 uses the same format, except the SV ID (the second byte in Message ID 15) is omitted. Message ID 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.

Test Mode 1 – Message ID 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 Message ID 150.

Output Rate: Variable – set by the period as specified in Message ID 150

Example:

A0A20011—Start Sequence and Payload Length

100015001E000588B800C81B5800040001—Payload

02D8B0B3—Message Checksum and End Sequence

Table 3-53 Test Mode 1 Data – Message ID 16

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		10			16
SV ID	2 U		0015			21
Period	2 U		001E	sec		30
Bit Sync Time	2 U		0005	sec		5
Bit Count	2 U		88B8			35000
Poor Status	2 U		00C8			200
Good Status	2 U		1B58			7000
Parity Error Count	2 U		0004			4
Lost VCO Count	2 U		0001			1

Payload length: 17 bytes

Table 3-54 Detailed Description of Test Mode 1 Data

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
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 (50BPS 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 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 parity of the transmitted word does not match the receiver's computed parity.
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.

Differential Corrections – Message ID 17

Message ID 17 provides the RTCM data received from a DGPS source. The data is sent as a SiRF Binary 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.

Table 3-55 RTCM message – Message ID 17

Name	Bytes	Example (Hex)	Example (Decimal)
Message ID	1 U	11	17
Data length	2 S	002D	45
Data[1]	variable U		

Payload length: variable

1. Data length and message output rate vary based on received data. Data consists of a sequence of bytes that are “Data length” long.

OkToSend – Message ID 18

The OkToSend message is sent by a receiver that is in power-saving mode such as TricklePower or Push-to-Fix. It is sent immediately upon powering up, with an argument indicating it is OK to send messages to the receiver, and 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

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table 3-56 Almanac Data – Message ID 18

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		12			18
Send Indicator[1]	1 U		00			00

Payload length: 2 bytes

1. 0 implies that CPU is about to go OFF, OkToSend==NO, 1 implies CPU has just come ON, OkToSend==YES

Navigation Parameters (Response to Poll) – Message ID 19

This message is sent in response to Message ID 152, Poll Navigation Parameters. It reports the current settings of various parameters in the receiver.

Output Rate: Response to Poll (See Message ID 152)

Example:

A0 A2 00 41 —Start Sequence and Payload Length

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—Payload

02 A4 B0 B3—Message Checksum and End Sequence

Table 3-57 Navigation Parameters – Message ID 19

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		13			19
Message Sub ID[1]	1 U		00			
Reserved	3 U		00			
Altitude Hold Mode[2]	1 U		00			
Altitude Hold Source[2]	1 U		00			
Altitude Source Input[2]	2 S		0000	m		
Degraded Mode[2]	1 U		00			
Degraded Timeout[2]	1 U		00	sec		
DR Timeout[2]	1 U		01	sec		
Track Smooth Mode[2]	1 U		1E			
Static Navigation[3]	1 U		0F			
3SV Least Squares[4]	1 U		01			
Reserved	4 U		00000000			
DOP Mask Mode[5]	1 U		04			
Navigation Elevation Mask[6]	2 S		004B			
Navigation Power Mask[7]	1 U		1C			
Reserved	4 U		00000000			
DGPS Source[8]	1 U		02			
DGPS Mode[9]	1 U		00			
DGPS Timeout[9]	1 U		1E	sec		
Reserved	4 U		00000000			
LP Push-to-Fix[10]	1 U		00			
LP On-time[10]	4 S		000003E8			

Table 3-57 Navigation Parameters – Message ID 19 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
LP Interval[10]	4 S		000003E8			
User Tasks Enabled[4]	1 U		00			
User Task Interval[4]	4 S		00000000			
LP Power Cycling Enabled[11]	1 U		00			
LP Max. Acq. Search Time[12]	4 U		00000000	sec		
LP Max. Off Time[12]	4 U		00000000	sec		
APM Enabled/Power Duty Cycle[13,14]	1 U		00			
Number of Fixes[14]	2 U		0000			
Time Between Fixes[14]	2 U		0000	sec		
Horizontal/Vertical Error Max[15]	1 U		00	m		
Response Time Max[14]	1 U		00	sec		
Time/Accu & Time/Duty Cycle Priority[16]	1 U		00			

Payload length: 65 bytes

1. 00 = GSW2 definition; 01 = SiRF Binary APM definition; other values reserved.
2. These values are set by Message ID 136. See description of values in Table 2-19. Note that Degraded Mode is not supported in GSW3.2.5 and newer.
3. These values are set by Message ID 143. See description of values in Table 2-28.
4. These parameters are set in the software and are not modifiable via the User Interface.
5. These values are set by Message ID 137. See description of values in Table 2-22.
6. These values are set by Message ID 139. See description of values in Table 2-26.
7. These values are set by Message ID 140. See description of values in Table 2-27.
8. These values are set by Message ID 133. See description of values in Table 2-14.
9. These values are set by Message ID 138. See description of values in Table 2-24.
10. These values are set by Message ID 151. See description of values in Table 2-36.
11. This setting is derived from the LP on-time and LP interval.
12. These values are set by Message ID 167. See description of values in Table 2-42.
13. Bit 7: APM Enabled, 1 = enabled, 0 = disabled; Bits 0-4: Power Duty Cycle, range: 1-20 scaled to 5%, 1 = 5%, 2 = 10%
14. Only used in SiRFLoc software.
15.These values are set by Message ID 53. See description of values in Table 2-4
16. 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.

Table 3-58 Horizontal/Vertical Error

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

Test Mode 2/3/4 – Message ID 20, 46, 48 (SiRFLoc v2.x), 49, and 55

Table 3-59 describes the SiRF software and test mode 2/3/4 with respect to their respective Message ID.

Table 3-59 SiRF Software and Test Mode in Relation with – Message ID 20, 46, 48, 49, and 55

Software	Test Mode	Message ID
GSW2	2	20
	3/4	46
SiRFDRive	2	20
	3/4	46
SiRFXTrac	2/3/4	20
SiRFLoc (version 2.x)	4	20, 48[1], and 49
SiRFLoc (version 3.x)	3	46
	4	46, 55
GSW3, GSWLT3	3	46
	4	46, 55

1. This Message ID 48 for Test Mode 4 is not to be confused with Message ID 48 for DR Navigation. Message ID 48 for SiRFLoc will be transferred to a different Message ID in a near future.

Refer to each specific Message ID for more details.

Test Mode 2/3/4 – Message ID 20

Test Mode 2

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

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A0000000000000 000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-60 Test Mode 2 – Message ID 20

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	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

Table 3-60 Test Mode 2 – Message *(Continued)*ID 20 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
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
Reserved	2 S		0000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			

Payload length: 51 bytes

Table 3-61 Detailed Description of Test Mode 2 Message ID 20

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
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.

Test Mode 3

This is supported by SiRFXTrac only as Message ID 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

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A000000000000000 00000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-62 Test Mode 3 – Message ID 20

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	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
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			

Payload length: 51 bytes

1. In some 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.

Table 3-63 Detailed Description of Test Mode 3 Message ID 20

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
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 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 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.

Table 3-63 Detailed Description of Test Mode 3 Message ID 20 *(Continued)*

Name	Description
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 ms 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

Test Mode 4

Supported by SiRFXTrac only. For other Test Mode 4 outputs, refer to MID 46.

Table 3-64 Test Mode 4 – Message ID 20

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		14			20
Test Mode	1 U		04			4
Message Variant	1 U		01			1
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 I20ms	4 S		0003AB88			240520
Abs Q1ms	4 S		0000AFF0			45040

Payload length: 29 bytes

Table 3-65 Detailed Description of Test Mode 4 Message ID 20

Name	Description
Message ID	Message ID number
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
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 ms 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 Q 1 ms	Absolute value of the 1 ms Q count over the duration of the test period

DGPS Status Format – Message ID 27

Reports on the current DGPS status, including the source of the corrections and which satellites have corrections available.

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

Example (with SBAS):

A0A20034—Start Sequence and Payload Length

1B14444444444007252864A2EC .... —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, 4, 0, 0, 7, 594, 8, 100, 10, 748

Table 3-66 DGPS Status Format – Message ID 27

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1 U		1B			27
DGPS source[1]	1 U		1			1 = SBAS
If the DGPS source is Beacon, next 14 bytes are interpreted as follows:						
Beacon Frequency	4 S	100	0 = 0xFFF 0 = 190K, 0xFFF = 599.5K Frequency = (190000)+(100*value)	Hz		
Beacon Bit Rate	1 U		Bits 2 - 0 : 000 25 bits/sec 001 50 bits/sec 010 100 bits/sec 011 110 bits/sec 100 150 bits/sec 101 200 bits/sec 110 250 bits/sec 111 300 bits/sec Bit 4 : modulation (0 = MSK, 1 = FSK) Bit 5 : SYNC type (0 = async, 1 = sync) Bit 6 : broadcast coding (0 = No Coding, 1 = FEC coding)	BPS		
Status	1 U		Bitmapped 0x01: signal valid 0x02: auto frequency used 0x04: auto bit rate used			Bitmapped 0x
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:						
Correction Age[2] [12]	1 x 12		4	sec		4
Reserved	2					
Remainder of the table applies to all messages, and reports on available corrections						

Table 3-66 DGPS Status Format – Message ID 27 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Satellite PRN Code	1 U		18			SV = 24
DGPS Correction	2 S		24E	meters	100	5.90
The above 3 bytes are repeated a total of 12 times. If less than 12 satellite corrections are available, the unused entries have values of 0.						

Payload length: 52 bytes

1. Possible values for this field are given in Table 3-67. If the GSPS source is set to none, three messages are being sent and then the message is disabled.

2. Correction age is reported in the same order as satellites are listed in the satellite PRN code fields that follow.

Table 3-67 DGPS Correction Types

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

Note – This message differs from others in that it has multiple formats. Further, not all SiRF 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.

Navigation Library Measurement Data – Message ID 28

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

Example:

A0A20038—Start Sequence and Payload Length

1C00000660D015F143F62C4113F42F417B235CF3FBE95E468C6964B8FBC582415
CF1C375301734.....03E801F400000000—Payload

1533B0B3—Message Checksum and End Sequence

Table 3-68 Navigation Library Measurement Data – Message ID 28

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	ms		135000
Satellite ID	1 U		15			20
GPS Software Time[2]	8 Dbl		41740B0B48353F7D	sec		2.4921113696e+005
Pseudorange[3]	8 Dbl		7D3F354A0B0B7441	m		2.1016756638e+007

Table 3-68 Navigation Library Measurement Data – Message ID 28 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
Carrier Frequency	4 Sgl		89E98246	m/s		1.6756767578e+004
Carrier Phase[4]	8 Dbl		A4703D4A0B0B7441	m		2.1016756640e+007
Time in Track	2 U		7530	ms		10600
Sync Flags	1 D		17			23
C/N0 1	1 U		34	dB-Hz		43
C/N0 2	1 U			dB-Hz		43
C/N0 3	1 U			dB-Hz		43
C/N0 4	1 U			dB-Hz		43
C/N0 5	1 U			dB-Hz		43
C/N0 6	1 U			dB-Hz		43
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[5]	2 S		0000	ms		
Phase Error Count	1 U		00			0
Low Power Count	1 U		00			0

Payload length: 56 bytes

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. Reserved for SiRF use with GSW3, GSWLT3, GSW2.0 or 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.

Message ID 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 Message ID 30 by (GPS Time $_{MID\ 30}$ – Time of Transmission) * V_{sat}.

Table 3-69 Sync Flag Fields (for GSW2 software ONLY)

Bit Fields	Description
[0]	Coherent Integration Time 0 = 2 ms 1 = 10 ms
[2:1]	Synch State 00 = Not aligned 01 = Consistent code epoch alignment 10 = Consistent data bit alignment 11 = No millisecond errors
[4:3]	Autocorrelation Detection State 00 = Verified not an autocorrelation 01 = Testing in progress 10 = Strong signal, autocorrelation detection not run 11 = Not used

Table 3-70 Detailed Description of the Measurement Data

Name	Description
Message ID	Message ID number
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: 1. The delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval. 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.

Table 3-70 Detailed Description of the Measurement Data *(Continued)*

Name	Description
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 3-69 for more details. For GSW3, this field contains a duplicate of the state field of Message ID 4. See Table 3-9 for details.
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
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
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.
Mean Delta Range Time	This is the mean calculated time of the delta-pseudorange interval in milliseconds measured from the end of the interval backwards
Extrapolatio n 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	This is the low power measurements for signals less than 28 dB-Hz in the preceding second as defined for a particular channel. Similar for GSW3 and GSWLT3 but does not use 28 dB-Hz; it uses a filter with time constant (t) that equals approximately 1 sec

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.

Navigation Library DGPS Data – Message ID 29

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

Example:

A0A2001A—Start Sequence and Payload Length

1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000—Payload

0956B0B3—Message Checksum and End Sequence

Table 3-71 Navigation Library DGPS Data – Message ID 29

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
Message ID	1 U		1D			29
Satellite ID	2 S		000F			15
IOD	2 S		00B5			181
Source[1]	1 U		01			1
Pseudorange Correction	4 Sgl		BFC97C67	m		-1.574109
Pseudorange rate Correction	4 Sgl		3CAAAAAB	m/sec		0.020833
Correction Age	4 Sgl		3FBFFE12	sec		1.499941
Reserved	4 Sgl					
Reserved	4 Sgl					

Payload length: 26 bytes

1. 0 = Use no corrections, 1 = SBAS channel, 2 = External source, 3 = Internal Beacon, 4 = Set Corrections via software

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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.

Navigation Library SV State Data – Message ID 30

The data in Message ID 30 reports the computed satellite position and velocity at the specified GPS time.

Note – When using Message ID 30 SV position, adjust for difference between GPS Time $_{\text{MID 30}}$ and Time of Transmission (see note in Message ID 28). Iono delay is not included in pseudorange in Message ID 28.

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

Example:

A0A20053—Start Sequence and Payload Length

1E15....2C64E99D01....408906C8—Payload

2360B0B3—Message Checksum and End Sequence

Table 3-72 Navigation Library SV State Data – Message ID 30

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
Message ID	1 U		1E			30
Satellite ID	1 U		15			21
GPS Time	8 Dbl			sec		
Position X	8 Dbl			m		
Position Y	8 Dbl			m		
Position Z	8 Dbl			m		
Velocity X	8 Dbl			m/sec		
Velocity Y	8 Dbl			m/sec		

Table 3-72 Navigation Library SV State Data – Message ID 30 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Velocity Z	8 Dbl			m/sec		
Clock Bias	8 Dbl			sec		
Clock Drift	4 Sgl		2C64E99D	s/s		744810909
Ephemeris Flag (see details in Table 3-73)	1 D		01			1
Reserved	4 Sgl					
Reserved	4 Sgl					
Ionospheric Delay	4 Sgl		408906C8	m		1082721992

Payload length: 83 bytes

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 Note in "Navigation Library Measurement Data – Message ID 28" on page 32 for byte orders.

Table 3-73 Ephemeris Flag Definition

Ephemeris Flag Value	Definition
0x00	No Valid SV state
0x01	SV state calculated from broadcast ephemeris
0x02	SV state calculated from almanac at least 0.5 week old
0x03	Assist data used to calculate SV state
0x04	SV state calculated from almanac less than 0.5 weeks old
0x11	SV state calculated from extended ephemeris with age of 1 day
0x12	SV state calculated from extended ephemeris with age of 2 days
0x13	SV state calculated from extended ephemeris with age of 3 days
0x14	SV state calculated from extended ephemeris with age of 4 days
0x15	SV state calculated from extended ephemeris with age of 5 days
0x16	SV state calculated from extended ephemeris with age of 6 days
0x17	SV state calculated from extended ephemeris with age of 7 days

Navigation Library Initialization Data – Message ID 31

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

Example:

A0A20054—Start Sequence and Payload Length

1F....00000000000001001E000F....00....000000000F....00....02....043402....

....02—Payload

0E27B0B3—Message Checksum and End Sequence

Table 3-74 Navigation Library Initialization Data – Message ID 31

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

Table 3-74 Navigation Library Initialization Data – Message ID 31 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Altitude	4 Sgl		00000000	m		0
Degraded Mode[2]	1 U		01			1
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		
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

Payload length: 84 bytes

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 note in Message ID 28 for byte orders.

Geodetic Navigation Data – Message ID 41

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

Example:

A0 A2 00 5B—Start Sequence and Payload Length

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 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

Table 3-75 Geodetic Navigation Data – Message ID 41

Name	Bytes	Description
Message ID	1 U	Hex 0x29 (decimal 41)
Nav Valid	2 D	0x0000 = valid navigation (any bit set implies navigation solution is not optimal); Bit 0 ON: solution not yet overdetermined[1] (< 5 SVs), OFF: solution overdetermined[1] (> = 5 SV) Bits 1 – 2 : Reserved Bits 8 – 14 : Reserved (The following are for SiRFDRive only) Bit 3 ON : invalid DR sensor data Bit 4 ON : invalid DR calibration Bit 5 ON : unavailable DR GPS-based calibration Bit 6 ON : invalid DR position fix Bit 7 ON : invalid heading (The following is for SiRFNav only) Bit 15 ON : no tracker data available

Table 3-75 Geodetic Navigation Data – Message ID 41 *(Continued)*

Name	Bytes	Description
NAV Type	2 D	Bits 2 – 0 : GPS position fix type 000 = no navigation fix 001 = 1-SV KF solution 010 = 2-SV KF solution 011 = 3-SV KF solution 100 = 4 or more SV KF solution 101 = 2-D least-squares solution 110 = 3-D least-squares solution 111 = DR solution (see bits 8, 14-15) Bit 3 : TricklePower in use Bits 5 – 4 : altitude hold status 00 = no altitude hold applied 01 = holding of altitude from KF 10 = holding of altitude from user input 11 = always hold altitude (from user input) Bit 6 ON : DOP limits exceeded Bit 7 ON : DGPS corrections applied Bit 8 : Sensor DR solution type (SiRFDRive only) 1 = sensor DR 0 = velocity DR[2] if Bits 0 – 2 = 111; else check Bits 14-15 for DR error status Bit 9 ON : navigation solution overdetermined[1] Bit 10 ON : velocity DR[2] timeout exceeded Bit 11 ON : fix has been edited by MI functions Bit 12 ON : invalid velocity Bit 13 ON : altitude hold disabled Bits 15 – 14 : sensor DR error status (SiRFDRive only) 00 = GPS-only navigation 01 = DR calibration from GPS 10 = DR sensor error 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	4 D	Bit map of SVs used in solution. Bit 0 = SV 1, Bit 31 = SV 32. A bit set ON means the corresponding SV was used in the solution
Latitude	4 S	In degrees (+ = North) x 10^7
Longitude	4 S	In degrees (+ = East) x 10^7
Altitude from Ellipsoid	4 S	In meters x 10^2
Altitude from MSL	4 S	In meters x 10^2
Map Datum[3]	1 S	See footnote
Speed Over Ground (SOG)	2 U	In m/s x 10^2
Course Over Ground (COG, True)	2 U	In degrees clockwise from true north x 10^2
Magnetic Variation	2 S	Not implemented
Climb Rate	2 S	In m/s x 10^2
Heading Rate	2 S	deg/s x 10^2 (SiRFDRive only)

Table 3-75 Geodetic Navigation Data – Message ID 41 *(Continued)*

Name	Bytes	Description
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 S	In m x 10^2
Clock Bias Error	4 U	In meters x 10^2 (SiRFDRive only)
Clock Drift[4]	4 S	In m/s x 10^2
Clock Drift Error	4 U	In m/s x 10^2 (SiRFDRive only)
Distance	4 U	Distance traveled since reset in meters (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: Bit 0: map matching mode for Map Matching only 0 = map matching feedback input is disabled 1 = map matching feedback input is enabled Bit 1: map matching feedback received for Map Matching only 0 = map matching feedback was not received 1 = map matching feedback was received Bit 2: map matching in use for Map Matching only 0 = map matching feedback was not used to calculate position 1 = map matching feedback was used to calculate position Bit 3-6: reserved Bit 7: DR direction for SiRFDRive only 0 = forward 1 = reserve

Payload length: 91 bytes

1. An overdetermined solution (see bit 0 from Nav Valid and bit 9 of Nav Type) is one where at least one additional satellite has been used to confirm the 4-satellite position solution. Once a solution has been overdetermined, it remains so even if several satellites are lost, until the system drops to no-navigation status (Nav Type bits 0-2 = 000).

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 thus 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.

3. Map Datum 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.

4. To convert Drift m/s to Hz: Drift (m/s) *L1(Hz)/c = Drift (Hz).

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.

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 SiRF Binary Protocol.

Example with MID_SET_STAT_NAV message:

A0A20003—Start Sequence and Payload Length

438F00—Payload

00D2B0B3—Message Checksum and End Sequence

Table 3-76 Queue Command Parameters – Message ID 43

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

Payload length: Variable length bytes (3 bytes in the example)

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 Chapter 2
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 2-6 on page 5 in Chapter 2, "Input Messages".

DR Raw Data – Message ID 45

Table 3-77 1-Hz DR Raw Data from ADC (Output After Collection of Data) – Message ID 45

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x2D
1st 100-ms time-tag	4		ms	
1st 100-ms ADC2 average measurement	2			
Reserved	2			
1st 100-ms odometer count	2			
1st 100-ms GPIO input states	1			Bit 0: reverse
2nd 100-ms time-tag	4		ms	
2nd 100-ms ADC2 average measurement	2			
Reserved	2			
2nd 100-ms odometer count	2			
2nd 100-ms GPIO input states	1			Bit 0: reverse
...				
10th 100-ms time-tag	4		ms	
10th 100-ms ADC2 average measurement	2			
Reserved	2			
10th 100-ms odometer count	2			
10th 100-ms GPIO input states	1			Bit 0: reverse

Payload length: 111 bytes

Test Mode 3/4 – 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

2E0001001E00023F70001F0D29000000000000601C600051B0E000EB41A0000000 000000000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Example for GSWLT3 and SLCLT3 software output:

A0A20033—Start Sequence and Payload Length

2E0001001E00023F70001F0D29000000000000601C600051B0E000EB41A0000000 00000000000000000000080000002F000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-78 Test Mode 3/4 – Message ID 46

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[1]	2 U		0002	sec		2
Bit Count[1]	2 U		3F70			16420
Poor Status[1]	2 U		001F			31
Good Status[1]	2 U		0D29			3369
Parity Error Count[1]	2 U		0000			0
Lost VCO Count[1]	2 U		0000			0
Frame Sync Time[1]	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
Δ Clock Drift	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
Abs Q1 ms[2]	4 S		000049E1	Counts		18913
Phase Lock Indicator[3]	4 S		00000000		0.001	0
RTC Frequency[4]	2 S		8000	Hz		32768
ECLK Ratio[3]	2 S		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					

Payload length: 51 bytes

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

Table 3-79 Detailed Description of Test Mode 3/4 Message ID 46

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.

Table 3-79 Detailed Description of Test Mode 3/4 Message ID 46 *(Continued)*

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	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.
Abs Q1 ms	Absolute value of the 20 ms Q count over the duration of the test period.
Phase Lock Indicator	Quality of the received signal with 1 being perfect and decreasing as noise level increases. A value of 0.9 to 1.0 generally indicates phase lock.
RTC Frequency[1]	F(RTC counts/CLCKACQ counts over test interval). 16-bit unsigned integer value of RTC frequency in Hz. Value = 0, no RTC Value = 1 to 65534, 32678±1 = good RTC frequency 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. Value = 0, no ECLK input 0< Value <3, Ratio = 3*Value/65535 Value >3, Ratio = 65535
Timer Synch[1]	Timer Synch input activity bit Value = 0, no Timer Synch input activity Value = 1, activity
AGC[1]	Automatic Gain Control value Value = 0, gain set to maximum saturated 1< Value > 62, active gain range Value = 63, gain set to minimum saturated

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.

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.

Table 3-80 Test Mode 4 – Message ID 48

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**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
Pseudo-range	4	A	0	m	10	0
Carrier Frequency	4	64	174ADC	m/sec	100	1526492

Payload length: 20 bytes

Table 3-81 Detailed Description of Test Mode 4 Message ID 48

Name	Description
Message ID	Message ID number
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: 1. Delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval 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

DR Navigation Status – Message ID 48 (Sub ID 1)

DR navigation status information (output on every navigation cycle).

Table 3-82 DR Navigation Status – Message ID 48 (Sub ID 1)

Name	Bytes	Description
Message ID	1	= 0x30
Message Sub ID	1	= 0x01
DR navigation	1	0x00 = valid DR navigation; else Bit 0 ON : GPS-only navigation required Bit 1 ON : speed not zero at start-up Bit 2 ON : invalid DR position Bit 3 ON : invalid DR heading Bit 4 ON : invalid DR calibration Bit 5 ON : invalid DR data Bit 6 ON : system in Cold Start Bit 7 : Reserved

Table 3-82 DR Navigation Status – Message ID 48 (Sub ID 1) *(Continued)*

Name	Bytes	Description
DR data	2	0x0000 = valid DR data; else Bit 0 ON : DR gyro subsystem not operational Bit 1 ON : DR speed subsystem not operational Bit 2 ON : DR measurement time < 80 ms Bit 3 ON : invalid serial DR message checksum Bit 4 ON : no DR data for > 2 sec Bit 5 ON : DR data timestamp did not advance Bit 6 ON : DR data byte stream all 0x00 or 0xFF Bit 7 ON : composite wheel-tick count jumped > 255 between successive DR messages Bit 8 ON : input gyro data bits (15) of 0x0000 or 0x3FFF Bit 9 ON : > 10 DR messages received in 1 sec Bit 10 ON : time difference between two consecutive measurements is < = 0 Bits 11 - 15 : Reserved.
DR calibration and DR gyro bias calibration	1	Bits 0 - 3 : 0000 = valid DR calibration; else Bit 0 ON : invalid DR gyro bias calibration Bit 1 ON : invalid DR scale factor calibration Bit 2 ON : invalid DR speed scale factor calibration Bit 3 ON : GPS calibration required but not ready Bits 4 - 6 : 000 = valid DR gyro bias calibration; else Bit 4 ON : invalid DR data Bit 5 ON : zero-speed gyro bias calibration not updated Bit 6 ON : heading rate scale factor < = -1 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 Bit 1 ON : invalid DR data Bit 2 ON : invalid DR position Bit 3 ON : heading rate scale factor < = -1 Bits 4 - 7 : 0000 = valid DR speed scale factor calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 ON : DR speed scale factor < = -1
DR Nav across reset and DR position	1	Bits 0 - 1 : 00 = valid DR nav across reset; else Bit 0 ON : invalid DR navigation Bit 1 ON : speed > 0.01 m/s Bit 2 : Reserved Bits 3 - 6 : 0000 = valid DR position; else Bit 3 ON : speed not zero at start-up Bit 4 ON : invalid GPS position Bit 5 ON : system in Cold Start Bit 6 ON : invalid DR data Bit 7 : Reserved
DR heading	1	Bits 0 - 6 : 0000000 = valid DR heading; else Bit 0 ON : speed not zero at start-up Bit 1 ON : invalid GPS position Bit 2 ON : invalid GPS speed Bit 3 ON : GPS did not update heading Bit 4 ON : delta GPS time < 0 and > 2 Bit 5 ON : system in Cold Start Bit 6 ON : invalid DR data Bit 7 : Reserved

Table 3-82 DR Navigation Status – Message ID 48 (Sub ID 1) *(Continued)*

Name	**Bytes**	**Description**
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 Bit 1 ON : invalid DR position Bit 2 ON : invalid GPS velocity for DR Bit 3 ON : GPS did not update heading Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 : 0 = updated DR navigation state
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 Bit 1 ON : EHPE > 50 Bit 2 ON : no previous GPS KF update Bit 3 ON : GPS EHPE < DR EHPE Bit 4 ON : DR EHPE < 50 Bit 5 ON : less than 4 SVs in GPS navigation Bit 6 ON : no SVs in GPS navigation 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 Bit 1 ON : invalid DR position Bit 2 ON : invalid GPS velocity for DR Bit 3 ON : GPS did not update heading Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR 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 Bit 1 ON : EHPE > 50 Bit 2 ON : no previous GPS KF update Bit 3 ON : GPS EHPE < DR EHPE Bit 4 ON : DR EHPE < 50 Bit 5 ON : less than four SVs in GPS navigation Bit 6 ON : no SVs in GPS navigation 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 m^2/s^2 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

Table 3-82 DR Navigation Status – Message ID 48 (Sub ID 1) *(Continued)*

Name	Bytes	Description
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

Payload length: 17 bytes

DR Navigation State – Message ID 48 (Sub ID 2)

DR speed, gyro bias, navigation mode, direction, and heading (output on every navigation cycle).

Table 3-83 DR Navigation State – Message ID 48 (Sub ID 2)

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) 2 = GPS + DR nav using default/stored calibration 3 = GPS + DR nav using current GPS calibration 4 = DR-only nav (no GPS nav allowed)
Reverse	1			DR direction: 0 = forward; 1 = reverse.
DR heading	2	10^2	deg/s	

Payload length: 32 bytes

Navigation Subsystem – Message ID 48 (Sub ID 3)

Heading, heading rate, speed, and position of both GPS and DR (output on every navigation cycle).

Table 3-84 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	10^2	m/s	
DR position error	4	10^2	m	
Reserved	2			

Payload length: 36 bytes

DR Gyro Factory Calibration – Message ID 48 (Sub ID 6)

DR gyro factory calibration parameters (response to poll).

Table 3-85 DR Gyro Factory Calibration – Message ID 48 (Sub ID 6)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x30
Message Sub ID	1			= 0x06
Calibration	1			Bit 0 : Start gyro bias calibration Bit 1 : Start gyro scale factor calibration Bits 2 - 7 : Reserved
Reserved	1			

Payload length: 4 bytes

DR Sensors Parameters – Message ID 48 (Sub ID 7)

DR sensors parameters (response to poll).

Table 3-86 DR Sensors Parameters – Message ID 48 (Sub ID 7)

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	

Payload length: 7 bytes

DR Data Block – Message ID 48 (Sub ID 8)

1-Hz DR data block (output on every navigation cycle).

Table 3-87 DR Data Block – Message ID 48 (Sub ID 8)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x30
Message Sub ID	1			= 0x08
Measurement type	1			0 = odometer and gyroscope (always); 1 .. 255 = Reserved
Valid count	1			Count (1 .. 10) of valid DR measurements
Reverse indicator	2			Bits 0 .. 9, each bit: 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	

Payload length: 86 bytes

SID_GenericSensorParam – 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*.

Table 3-88 DR Package Sensor Parameters – Message ID 48 (Sub ID 9)

Byte	Name	Data Type	Bytes	Unit	Description	Res
1	Message ID	UINT8	1	N/A	0x30	N/A
2	Sub-ID	UINT8	1	N/A	0x09	N/A
3	Sensors[0] SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
4	Sensors[0] ZeroRateVolts	UINT32	4	volts	0 to 5.0[1]	0.0001
8	Sensors[0] MilliVoltsPer	UINT32	4	millivolts	0 to 1000[2]	0.0001
12	Sensors[0] ReferenceVoltage	UINT32	4	volts	0 to 5.0	0.0001
16	Sensors[1] SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
17	Sensors[1] ZeroRateVolts	UINT32	4	volts	0 to 5.0	0.0001
21	Sensors[1] MilliVoltsPer	UINT32	4	millivolts	0 to 1000	0.0001

Table 3-88 DR Package Sensor Parameters – Message ID 48 (Sub ID 9) *(Continued)*

25	Sensors[1] ReferenceVoltage	UINT32	4	volts	0 to 5.0	0.0001
29	Sensors[2] SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
30	Sensors[2] ZeroRateVolts	UINT32	4	volts	0 to 5.0	0.0001
34	Sensors[2] MilliVoltsPer	UINT32	4	millivolts	0 to 1000	0.0001
38	Sensors[2] ReferenceVoltage	UINT32	4	volts	0 to 5.0	0.0001
39	Sensors[3] SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
43	Sensors[3] ZeroRateVolts	UINT32	4	volts	0 to 5.0	0.0001
47	Sensors[3] MilliVoltsPer	UINT32	4	millivolts	0 to 1000	0.0001
51	Sensors[3] ReferenceVoltage	UINT32	4	volts	0 to 5.0	0.0001

Payload length: 54 bytes

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

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.

Table 3-89 Test Mode 4 – Message ID 49

		Binary (Hex)			**ASCII (Decimal)**	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1		31			49
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
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	FFFFFFFFFFF C925C	chip	1576960	-224676

Payload length: 28 bytes

Table 3-90 Detailed Description of Test Mode 4 Message ID 49

Name	Description
Message ID	Message ID number
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

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

327A00120800000000000000000—Payload

00C6B0B3—Message Checksum and End Sequence

Table 3-91 SBAS Parameters – Message ID 50

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		32			50
SBAS PRN	1 U		7A			122
SBAS Mode	1 U		00			0
DGPS Timeout	1 U		12	sec		18
Flag bits	1 D		08			00001000
Spare	8 U		0000000000000000			

Payload length: 13 bytes

Table 3-92 Detailed Description of SBAS Parameters

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 0 = Auto mod SBAS PRN 120-138 = Exclusive (set by user)
SBAS Mode	0 = Testing, 1 = Integrity Integrity mode does not accept SBAS corrections if the SBAS satellite is transmitting in a test mode Testing mode accepts and use SBAS corrections even if the SBAS satellite is transmitting in a test mode

Table 3-92 Detailed Description of SBAS Parameters *(Continued)*

Name	Description
DGPS Timeout	Range 0-255 seconds. 0 returns to default timeout. 1-255 is value set by user. The default value is initially 18 seconds. However, the SBAS data messages may specify a different value. 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 Bit 1: Health; 0 = SBAS is healthy 1 = SBAS reported unhealthy and can't be used 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 Bit 3: SBAS PRN; 0 = Default 1 = User Note: 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

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

3415122A0E0A07D3000D000000050700000000—Payload

0190B0B3—Message Checksum and End Sequence

Table 3-93 Timing Message Data – Message ID 52

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	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 3-94)	1 D		7			7
Reserved	4 U		00000000			00000000

Payload length: 19 bytes

1. Difference between UTC and GPS time, integer, and fractional parts. GPS time = UTC time + UTCOffsetInt+UTCOffsetFrac x 10^{-9}.

Table 3-94 Status Byte Field in Timing Message

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

Test Mode 4 Track Data – Message ID 55

Message ID 55 is used by GSW3, GSWLT3, and SiRFLoc (v3.0 and above) software.

Table 3-95 Test Mode 4 – Message ID 55

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	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			

Payload length: 51 bytes

1. SiRFLocDemo combines MSec Number and Bit Number for this message output which gives the GPS time stamp.

Extended Ephemeris Data – Message ID 56

Message ID 56 is used by GSW2 (2.5 or above), SiRFXTrac (2.3 or above), and GSW3 (3.2.0 or above), and GSWLT3 software. This message has three Sub IDs.

Table 3-96 Extended Ephemeris – Message ID 56

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U		38			56
Message Sub ID	1 U		01			1

Payload length: variable (2 bytes + Sub ID payload bytes)

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

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

Table 3-97 GPS Data and Ephemeris Mask – Message ID 56 (Message Sub ID 1)

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		38			56
Message Sub ID	1 U		01			1
GPS_TIME_VALID_FLAG	1 U		01			1
GPS Week	2 U	1	091E			2334
GPS TOW	4 U	10	00000E74	sec		3700
EPH_REQ_MASK	4 D		02000001			SVs 30 and 1

Payload length: 13 bytes

Table 3-98 Detailed Description of GPS Data and Ephemeris Mask Parameters

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 LSB bit 0 = 0, GPS week is not valid LSB bit 1 = 1, GPS TOW is valid 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

Extended Ephemeris Integrity – Message ID 56 (Sub ID 2)

Output Rate: Upon host's request

Example:

A0A2000E—Start Sequence and Payload Length

380200000040000000040000000040 – 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

Table 3-99 Extended Ephemeris Integrity Parameters – Message 56 (Message Sub ID 2)

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		38			56
Message Sub ID	1 U		02			2
SAT_POS_VALIDITY_FLAG	4 D		00000040			flag = 1, SV = 7
SAT_CLK_VALIDITY_FLAG	4 D		00000040			flag = 1, SV = 7
SAT_HEALTH_FLAG	4 D		00000040			flag = 1, SV = 7

Payload length: 14 bytes

Table 3-100 Detailed Description of Extended Ephemeris Integrity Parameters

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 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 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 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

Extended Ephemeris Integrity – 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, Message Sub ID 2.

Table 3-101 Contents of Message ID 56 Message (Message Sub ID 3)

Name	Bytes	Description
Message 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 for 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)

Payload length: 98 bytes

1. Source for ephemeris: 0 = none; 1 = from network aiding; 2 = from SV; 3 = from extended ephemeris aiding

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.

EE Provide Synthesized Ephemeris Clock Bias Adjustment Message – Message ID 56 (Sub ID 4)

Output Rate: Variable

Example:

A0A20056 – Start Sequence and Payload Length

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

*Table 3-102*EE Provide Synthesized Ephemeris Clock Bias Adjustment Message – Message 56 (Message Sub ID 4)

		Binary (Hex)			ASCII (Decimal)
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**
Message ID	1		38		Decimal 56
Message Sub-ID	1		04		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 af0)

Payload length: 84 bytes

Ephemeris Extension Messages – Message ID 56 (Sub ID 38)

Used for the ephemeris extension feature. Four sub-messages are created with the same Message ID.

Table 3-103 General Structure for the Ephemeris Extension Messages – Message ID 56 (Message Sub ID 38)

		Binary (Hex)			ASCII (Decimal)
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**
Message ID	1		38		Decimal 56
Message Sub-ID	1		01		Message Sub-ID for the Ephemeris Extension Message
EE Payload	Variable				Payload length depends on Sub-ID

Payload length: 2 + EE Payload

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. Refer to Chapter 2, “Input Messages” for more details on Message ID 232.

Example:

A0A20004—Start Sequence and Payload Length

E8FFE8FF – Payload (ACK for message 232 Message Sub ID 255)

03CEB0B3—Message Checksum and End Sequence

*Table 3-104*Extended Ephemeris Ack – Message 56 (Message Sub ID 255)

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	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

Payload length: 4 bytes

*Table 3-105*Detailed Description of Extended Ephemeris Ack Parameters

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

Reserved – Message ID 225

This output message is SiRF proprietary except for Message Sub ID 6.

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 (Message 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 (Message 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

E106—Message ID and Message Sub ID

0100000000000000000000000000000000000000000000000000000010100000
00—Payload

0107B0B3—Message Checksum and End Sequence

*Table 3-106*Statistic Channel – Message ID 225 (Message Sub ID 6)

Name	Sub Field	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
			Scale	Example		Scale	Example
Message ID		1 U		E1			225
Message Sub ID		1 U		06			6
TTFF	Since reset	2 U			sec	0.1	range from 0 .0 to 6553.5
	Since all aiding received[1]	2 U					0
	First nav since reset[1]	2 U					0
Position Aiding Error	North[1]	4 S					0
	East[1]	4 S					0
	Down[1]	4 S					0
Time Aiding Error[1]		4 S					0
Frequency Aiding Error[1]		2 S					0
Position Uncertainty	Horizontal[1]	1 U					0
	Vertical[1]	2 U					0
Time Uncertainty[1]		1 U					0
Frequency Uncertainty[1]		1 U					0
Number of Aided Ephemeris[1]		1 U					0
Number of Aided Acquisition Assistance[1]		1 U					0
Navigation and Position Status	Navigation Mode	1 D					see Table 3-107
	Position Mode	1 D					see Table 3-108
	Status	2 D					see Table 3-109 and Table 3-110
Start Mode		1 D					see Table 3-111
Reserved[1]		1 U					

Payload length: 39 bytes

1. Valid with SiRFLoc only

*Table 3-107*Description of the Navigation Mode Parameters

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 3-108 Description of the Position 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 3-109
5	KF mode – Kalman Filtering
6	No position
7	Not used

Table 3-109 Description of the Status for Navigation LSQ Fix Mode

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 3-110 Description of the Status for Navigation KF Mode

Value	Status
0	Solution is good
1	No solution
2	Altitude is out of range
3	Velocity is out of range

Table 3-111 Description of the Start Mode

Value	Description
0x00	Cold
0x01	Warm
0x02	Hot
0x03	Fast

Development Data – Message ID 255

Output Rate: Receiver generated.

Example:

A0A2....—Start Sequence and Payload Length

FF....—Payload

....B0B3—Message Checksum and End Sequence

*Table 3-112*Development Data – Message ID 255

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		FF			255
Data[1]	variable U					

Payload length: variable

1. Data area consists of at least 1 byte of ASCII text information.

Note – Message ID 255 is output when SiRF Binary 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.

Additional Information 4

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.

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).

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.

ADDITIONAL AVAILABLE PRODUCT INFORMATION

Part Number	Description
1050-0042	NMEA Reference Manual
1050-0041	SiRF Binary Protocol Reference Manual

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