SiRF Binary Protocol Reference Manual

SiRF Technology, Inc.
148 East Brokaw Road
San Jose, CA 95112 U.S.A.
Phone: +1 (408) 467-0410
Fax: +1 (408) 467-0420
www.SiRF.com

1050-0041
September 2004, Revision 1.3

SiRF Binary Protocol Reference Manual

About This Document

This document contains information on SiRF products. SiRF Technology, Inc. reserves the right to make changes in its products, specifications and other information at any time without notice. SiRF assumes no liability or responsibility for any claims or damages arising out of the use of this document, or from the use of integrated circuits based on this document, including, but not limited to claims or damages based on infringement of patents, copyrights or other intellectual property rights. SiRF makes no warranties, either express or implied with respect to the information and specifications contained in this document. Performance characteristics listed in this data sheet do not constitute a warranty or guarantee of product performance. All terms and conditions of sale are governed by the SiRF Terms and Conditions of Sale, a copy of which you may obtain from your authorized SiRF sales representative.

Getting Help

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

phone	+1 (408) 467-0410
e-mail	support@sirf.com

Contents

Tables

Preface

The *SiRF Binary Protocol Reference Manual* provides detailed information about the SiRF Binary protocol - the standard protocol used by all SiRF architectures.

Who Should Use This Guide

This manual was written assuming the user is familiar with 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.

Troubleshooting/Contacting SiRF Technical Support

Address:

SiRF Technology Inc.
148 East Brokaw Road
San Jose, CA 95112 U.S.A.

SiRF Technical Support:

Phone: +1 (408) 467-0410 (9 am to 5 pm Pacific Standard Time)

Email: support@sirf.com

General enquiries:

Phone: +1 (408) 467-0410 (9 am to 5 pm Pacific Standard Time)

Email: gps@sirf.com

Helpful Information When Contacting SiRF Technical Support

Receiver Serial Number: ____________________

Receiver Software Version: ________________

SiRFdemo Version: ________________________

Protocol Layers 1

The SiRF Binary protocol is the standard interface protocol used by all SiRF-based 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 characters and two stop 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 two-byte (15-bit) message length and a two-byte (15-bit) checksum. 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 can not 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 (e.g., 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 will use the big-endian order.

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 to 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).
```

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.

Table 2-1 lists the message list for the SiRF Binary input messages.

Table 2-1 SiRF Messages - Input Message List

Hex	Decimal	Name	Description
35	53	Advanced Power Management	Power management scheme for SiRFLoc and SiRFXTrac.
80	128	Initialize Data Source	Receiver initialization and associated parameters
81	129	Switch to NMEA Protocol	Enable NMEA messages, output rate and baud rate
82	130	Set Almanac (upload)	Sends an existing almanac file to the receiver
84	132	Poll Software Version	Polls for the loaded software version
85	133	DGPS Source Control	DGPS correction source and beacon receiver information
86	134	Set Main Serial Port	Baud rate, data bits, stop bits, and parity
87	135	Switch Protocol	Obsolete
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
8D	141	Editing Residual	Not implemented
8E	142	Steady-State Detection (Not Used)	Not implemented
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 baud rate, data bits, stop bits, and 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

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

Hex	Decimal	Name	Description
98	152	Poll Navigation Parameters	Polls for the current navigation parameters
A5	165	Set UART Configuration	Protocol selection, baud rate, data bits, stop bits, and 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	SiRFDRive-specific Class of Input Messages	The MID is partitioned into messages identified by Sub IDs. Refer to Table 2-2.
B6	182	Set UART Configuration	Obsolete
E4	228	SiRF internal message	Reserved

Table 2-2 Sub IDs for SiRFDRive input MID 172 (0xAC)

Sub ID	Message
1	Initialise GPS/DR Navigation
2	Set GPS/DR Navigation Mode
3	Set DR Gyro Factory Calibration
4	Set DR Sensors' Parameters
5	Poll DR Validity (not implemented)
6	Poll DR Gyro Factory Calibration
7	Poll DR Sensors' Parameters

As the SiRF Binary protocol is 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

Message ID	SiRF Software Options				
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3
53	No	No	Yes	No	No
128	Yes	Yes	No	Yes	Yes
129	Yes	Yes	Yes	No	Yes
130	Yes	Yes	No	No	Yes
131	No	No	No	No	Yes
132	Yes	Yes	Yes	Yes	No
133	Yes	Yes	No	No	No
134	Yes	Yes	Yes	Yes	Yes

Table 2-3 Supported Input Messages *(Continued)*

Message ID	SiRF Software Options				
	GSW2	**SiRFDRive**	**SiRFXTrac**	**SiRFLoc**	**GSW3**
135	No	No	No	No	Yes
136	Yes	Yes	Yes	Yes	Yes
137	Yes	Yes	Yes	Yes	Yes
138	Yes	Yes	Yes	Yes	No
139	Yes	Yes	Yes	Yes	Yes
140	Yes	Yes	Yes	Yes	Yes
141	No	No	No	No	No
142	No	No	No	No	No
143	Yes	Yes	Yes	Yes	Yes
144	Yes	Yes	Yes	Yes	Yes
145	Yes	Yes	No	No	No
146	Yes	Yes	Yes	Yes	Yes
147	Yes	Yes	Yes	Yes	Yes
148	Yes	Yes	Yes	No	No
149	Yes	Yes	No	Yes	Yes
150	Yes	Yes	Yes	Yes	Yes
151	Yes	Yes	No	No	No
152	Yes	Yes	Yes	Yes	Yes
165	Yes	Yes	Yes	No	Yes
166	Yes	Yes	Yes	Yes	Yes
167	Yes	Yes	No	No	Yes
168	Yes	Yes	Yes	Yes	Yes
170	2.3 or above	Yes	No	No	Yes
172	No	Yes	No	No	Yes
175	No	No	No	No	Yes
182	No	No	No	No	No
228	No	No	No	No	Yes (reserved)

Advanced Power Management - Message ID 53

Used to implement Advanced Power Management (APM). APM will 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

3501001400030700000A0100—Payload

005FB0B3—Message Checksum and End Sequence

Table 2-4 Advanced Power Management Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
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).
Maximum Vertical Error	1		07		Maximum requested vertical error (See).
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 - 180 s.
3. If a duty-cycle of 0 is entered, it will be rejected as out of range. If a duty cycle value of 20 is entered, the APM module will be disabled and continuous power operation will resume.

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

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

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		80		Decimal 128
ECEF X	4		FFD700F	meters	
ECEF Y	4		FFBE5266	meters	
ECEF Z	4		003AC57A	meters	
Clock Offset	4		000124F8	Hz	
Time of Week	4	*100	0083D600	seconds	
Week Number	2		039C		
Channels	1		0C		Range 1-12
Reset Configuration Bit Map.	1		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 RTC is bad -- blocks Snap Start.
7	Clear user data in memory.

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

Switch To NMEA Protocol - Message ID 129

Table 2-8 contains the input values for the following example:

Request the following NMEA data at 9600 baud:
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

81020101000101010501010100010001000100010000012580—Payload

013AB0B3—Message Checksum and End Sequence

Table 2-8 Switch To NMEA Protocol

Name	Bytes	Example	Units	Description
Message ID	1	0x81		Decimal 129
Mode	1	0x02		See Table 2-9
GGA Message[1]	1	0x01	sec	See NMEA Protocol Reference Manual for format.
Checksum[2]	1	0x01		Send checksum with GGA message
GLL Message	1	0x00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
GSA Message	1	0x01	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
GSV Message	1	0x05	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
RMC Message	1	0x01	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
VTG Message	1	0x00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
MSS Message	1	0x00	sec	Output rate for MSS message
Checksum	1	0x01		
Unused Field[3]	1	0x00		
Unused Field[3]	1	0x00		
ZDA Message	1	0x00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1	0x01		
Unused Field[3]	1	0x00		
Unused Field[3]	1	0x00		
Baud Rate	2	0x2580		38400, 19200, 9600, 4800, or 2400

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 NOT transmitted with the message (not recommended). A value of 0x01 will have 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 you switch to NMEA protocol, 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 switch back to the SiRF Binary protocol, you must send a SiRF NMEA message to revert to SiRF binary mode. (See SiRF NMEA Reference Manual for more information).

Set Almanac - Message ID 130

This command enables the user to upload an almanac file to the receiver.

Example:

A0A20380 – Start Sequence and Payload Length

82xx………………… – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-10 Set Almanac Message

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		82		Decimal 130
Almanac	896		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

This command causes data to bbe output in a formatted manner. It is designed to handle complex data type up to an array of structures.

Table 2-11 contains the input values for the example below.

This example shows how to output an array of elements, where each elelemt is a structure that looks like this:

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:

A0A2002F—Start Sequence and Payload Length

8331E5151B81A—Payload

1F19B0B3—Message Checksum and End Sequence

Table 2-11 Set Send Command String Parameters

Name	Bytes	Binary (Hex) Example	Units	Description
Message ID	1	83		decimal 131
Elements	1	3		Number of elements in array to dump (minimum 1)
Data address	4	0x60xx xxxx		Address of the data to be dumped
Members	1	5		Number of items in the structure to be dumped
Member sizes	Elements	01 02 01 01 04	Bytes	List of element sizes in the structure. See Table 2-12 for definition of member sizes (total of 5 for this example)
Header	string length + 1	"Hello"0		String to print out before data dump (total of 8 bytes in this example)
Format	string length + 1	"%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	0		(not used)
Payload length: Variable				

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

Table 2-12 Member Sizes 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

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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		84		Decimal 132
Control	1		00		Not used
Payload length: 2 bytes					

DGPS Source - Message ID 133

This command allows the user to select the source for DGPS corrections. Options available are:

External RTCM Data (any serial port)

SBAS (subject to SBAS satellite availability)

Internal DGPS beacon receiver

Example 1: Set the DGPS source to External RTCM 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	Units	Decimal	Description
Message ID	1		85		133	Message Identification
DGPS Source	1		00		0	See Table 2-16.
Internal Beacon Frequency	4		00000000	Hz	0	See Table 2-17.
Internal Beacon Bit Rate	1		0	BPS	0	See Table 2-17.
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	Units	Decimal	Description
Message I.D.	1		85		133	Message Identification.
DGPS Source	1		03		3	See Table 2-16.
Internal Beacon Frequency	4		0004BAF0	Hz	310000	See Table 2-17.
Internal Beacon Bit Rate	1		C8	BPS	200	See Table 2-17.
Payload length: 7 bytes						

Table 2-16 DGPS Source Selections

DGPS Source	Hex	Decimal	Description
None	00	0	DGPS corrections are not used (even if available).
SBAS	01	1	Uses SBAS Satellite (subject to availability).
External RTCM Data	02	2	External RTCM input source (i.e., Coast Guard Beacon).
Internal DGPS Beacon Receiver	03	3	Internal DGPS beacon receiver.
User Software	04	4	Corrections provided using a module interface routine in a custom user application.

Table 2-17 Internal Beacon Search Settings

Search Type	Frequency[1]	Bit Rate[2]	Description
Auto Scan	0	0	Auto scanning of all frequencies and bit rates are performed.
Full Frequency scan	0	Non-zero	Auto scanning of all frequencies and specified bit rate are performed.
Full Bit Rate Scan	Non-zero	0	Auto scanning of all bit rates and specified frequency are performed.
Specific Search	Non-zero	Non-zero	Only the specified frequency and bit rate search are performed.

1. Frequency Range is 283500 to 325000 Hz.
2. Bit Rate selection is 25, 50, 100, and 200 BPS.

Set Main Serial Port - Message ID 134

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

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

Example:

A0A20009—Start Sequence and Payload Length

860000258008010000—Payload

0134B0B3—Message Checksum and End Sequence

Table 2-18 Set Main Serial Port

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		86		Decimal 134
Baud	4		00002580		115.2k, 57.6k, 38.4k, 19.2k, 9600, 4800, 2400, 1200
Data Bits	1		08		8
Stop Bit	1		01		1=1 Stop Bit
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved
Payload length: 9 bytes					

Switch Protocol - Message ID 135

This message is obsolete and is no longer used or supported.

Mode Control - Message ID 136

Table 2-19 contains the input values for the following example:

3D Mode = Always, Alt Constraining = Yes, Degraded Mode = clock then direction, TBD=1, DR Mode = Yes, Altitude = 0, Alt Hold Mode = Auto, Alt Source =Last Computed, Coast Time Out = 20, Degraded Time Out=5, DR Time Out = 2, Track Smoothing = Yes

Example:

A0A2000E—Start Sequence and Payload Length

8800000100000000000000050201—Payload

0091B0B3—Message Checksum and End Sequence

Table 2-19 Mode Control

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		88		Decimal 136
TBD	2		0000		Reserved
Degraded Mode	1		01		See Table 2-20
TBD	2		0000		Reserved
Altitude	2		0000	meters	User specified altitude, range -1,000 to +10,000
Alt Hold Mode	1		00		See Table 2-21
Alt Hold Source	1		00		0=Use last computed altitude, 1=Use user-input altitude
TBD	1		00		Reserved
Degraded Time Out	1		05	seconds	0=disable degraded mode, 1-120 seconds degraded mode time limit
DR Time Out	1		02	seconds	0=disable dead reckoning, 1-120 seconds dead reckoning mode time limit
Track Smoothing	1		01		0=disable, 1=enable
Payload length: 14 bytes					

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
3	Allow 2 SV navigation, freeze clock drift
4	Do not allow Degraded Modes (2 SV and 1 SV navigation)

Table 2-21 Altitude Hold Mode

Byte Value	Description
0	Automatically determine best available altitude to use
1	Always use input altitude
2	Do not use altitude hold

DOP Mask Control - Message ID 137

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

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

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

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		8A		Decimal 138
DGPS Selection	1		01		See Table 2-25
DGPS Time Out:	1		1E	seconds	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 into 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 MID 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

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

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		8B		Decimal 139
Tracking Mask	2	*10	0032	degrees	Not implemented
Navigation Mask	2	*10	009B	degrees	Range -20.0 to 90.0
Payload length: 5 bytes					

Note – Satellite with elevation angle relative to the local horizon that is below the specified navigation mask angle will not be used in the navigation solution.

Power Mask - Message ID 140

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

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		8C		Decimal 140
Tracking Mask	1		1C	dBHz	Not implemented
Navigation Mask	1		21	dBHz	Range 20 to 50
Payload length: 3 bytes					

Note – Satellite with received signal strength below the specified navigation mask signal level will not used in the navigation solution.

Editing Residual - Message ID 141

This message has not been implemented.

Steady State Detection - Message ID 142

This message has not been implemented.

Static Navigation - Message ID 143

This command 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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8F		Decimal 143
Static Navigation Flag	1		01		1 = enable; 0 = disable
Payload length: 2 bytes					

Note – Static navigation is a postion filter designed to be used with motor vehicles. When the vehicle's velocity falls below a threshold, the position and heading are frozen, and velocity is set to zero. This condition will continue until the computed velocity rises above 1.2 times the threshold or until the computed position is at least a set distance from the frozen place. The threshold velocity and set distance may vary with software versions.

Poll Clock Status - Message ID 144

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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		90		Decimal 144
Control	1		00		Not used
Payload length: 2 bytes					

Note – Returned message will be MID 7. See "Response: Clock Status Data - Message ID 7" on page 3-8.

Set DGPS Serial Port - Message ID 145

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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		91		Decimal 145
Baud	4		00002580		57.6k, 38.4k, 19.2k, 9600, 4800, 2400, 1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved
Payload length: 9 bytes					

Note – Setting the DGPS serial port using MID 145 will affect Com B only regardless of the port being used to communicate with the Evaluation Receiver.

Poll Almanac - Message ID 146

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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		92		Decimal 146
Control	1		00		Not used
Payload length: 2 bytes					

Note – Returned message will be MID 14. See “Almanac Data - Message ID 14” on page 3-22.

Poll Ephemeris - Message ID 147

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 Ephemeris

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

Payload length: 3 bytes

1. A value of zero requests all available ephemeris records. This will result in a maximum of twelve output messages. A value of 1 - 32 will request only the ephemeris of that SV.

Note – Returned message will be MID 15. See “Ephemeris Data (Response to Poll) – Message ID 15” on page 3-23.

Flash Update - Message ID 148

This command allows the user to command the receiver to go into internal boot mode without setting the boot switch. Internal boot mode allows the user to re-flash the embedded code in the receiver.

Note – It is highly recommended that all hardware designs should still provide access to the boot pin 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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		94		Decimal 148
Payload length: 1 bytes					

Set Ephemeris - Message ID 149

This command 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 Ephemeris

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		95		Decimal 149
Ephemeris Data	90		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 MID 15 (“Ephemeris Data (Response to Poll) – Message ID 15” on page 3-23) for a detailed description of this data format. See

Switch Operating Modes - Message ID 150

This command sets the receiver into either 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

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

Payload length: 7 bytes

Set TricklePower Parameters - Message ID 151

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

Sets the receiver into low power modes.

Example: Set receiver into 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 Trickle Power Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		97		Decimal 151
Push-to-Fix Mode	2		0000		ON = 1, OFF = 0
Duty Cycle	2	*10	00C8	%	% Time ON. A duty cycle of 1000 (100%) means continuous operation.
On-Time[1]	4		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]	1000	100	1
TricklePower	200	20	1
TricklePower	200	10	2
TricklePower	300	10	3
TricklePower	500	5	10

1. Continuous duty cycle is activated by setting Duty Cycle to 0 or 100 %.

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	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	*	350	233	175	140	117	100	88	78	70
800	*	400	267	200	160	133	114	100	89	80
900	*	450	300	225	180	150	129	112	100	90

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 will turn 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 an NMI (Non-Maskable Interrupt). Ephemeris collection time in general takes 18 to 36 seconds. If ephemeris data is not required then the system will re-calibrate and shut down. In either case, the amount of time the receiver remains off will be in proportion to how long it stayed on:

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

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

Poll Navigation Parameters - Message ID 152

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

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

Payload length: 2 bytes

Note – Returned message will be MID 19. See “Navigation Parameters (Response to Poll) - Message ID 19” on page 3-26.

Set UART Configuration - Message ID 165

Table 2-40 contains the input values for the following example:

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

Example:

A0A20031—Start Sequence and Payload Length

A50001010000258008010000000100000000E1000801000000FF050500000000000000000000FF0505000000000000000000—Payload

0452B0B3—Message Checksum and End Sequence

Table 2-40 Set UART Configuration

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		A5		Decimal 165
Port[1]	1		00		For UART 0
In Protocol[2]	1		01		For UART 0
Out Protocol	1		01		For UART 0 (Set to in protocol)
Baud Rate[3]	4		00002580		For UART 0
Data Bits[4]	1		08		For UART 0
Stop Bits[5]	1		01		For UART 0
Parity[6]	1		00		For UART 0
Reserved	1		00		For UART 0
Reserved	1		00		For UART 0
Port	1		01		For UART 1
In Protocol	1		00		For UART 1
Out Protocol	1		00		For UART 1
Baud Rate	4		0000E100		For UART 1
Data Bits	1		08		For UART 1
Stop Bits	1		01		For UART 1
Parity	1		00		For UART 1
Reserved	1		00		For UART 1
Reserved	1		00		For UART 1
Port	1		FF		For UART 2

Table 2-40 Set UART Configuration *(Continued)*

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
In Protocol	1		05		For UART 2
Out Protocol	1		05		For UART 2
Baud Rate	4		00000000		For UART 2
Data Bits	1		00		For UART 2
Stop Bits	1		00		For UART 2
Parity	1		00		For UART 2
Reserved	1		00		For UART 2
Reserved	1		00		For UART 2
Port	1		FF		For UART 3
In Protocol	1		05		For UART 3
Out Protocol	1		05		For UART 3
Baud Rate	4		00000000		For UART 3
Data Bits	1		00		For UART 3
Stop Bits	1		00		For UART 3
Parity	1		00		For UART 3
Reserved	1		00		For UART 3
Reserved	1		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.
3. Valid values are 1200, 2400, 4800, 9600, 19200, 38400, and 57600.
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

Table 2-41 contains the input values for the following example:

Set MID 2 to output every 5 seconds starting immediately.

Example:

A0A20008—Start Sequence and Payload Length

A600020500000000—Payload

00ADB0B3—Message Checksum and End Sequence

Table 2-41 Set Message Rate

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A6		decimal 166
Send Now[1]	1		00		Poll message; 0 = No, 1 = Yes
MID to be set	1		02		
Update Rate[2]	1		05	sec	Range = 0 - 30
Reserved	1		00		Not used, set to zero
Reserved	1		00		No used, set to zero
Reserved	1		00		Not used, set to zero
Reserved	1		00		Not used, set to zero

Payload Length: 8 bytes

1. 0 = No, set update rate; 1 = Yes, poll message now and ignore update rate.
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

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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A7		decimal 167
Max Off Time	4		00007530	msec	Maximum time for sleep mode. Default value: 30 seconds.
Max Search Time	4		0001D4C0	msec	Max. satellite search time. Default value: 120 seconds.
Push-to-Fix Period	4		0000003C	sec	Push-to-Fix cycle period
Adaptive TricklePower	2		0001		To enable Adaptive TricklePower 0 = off; 1 = on
Payload length: 15 bytes					

Poll Command Parameters - Message ID 168

This command 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 (see Table 2-1 message ID 168).

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

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

Example:

A0A20002–Start Sequence and Payload Length

A897-Payload

013FB0B3-Message Checksum and End Sequence

Table 2-43 Poll Command Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A8		Decimal 168
Poll Msg ID	1		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

This command 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

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		AA		decimal 170
SBAS PRN	1		00		0=Auto mode PRN 120-138= Exclusive
SBAS Mode	1		00		0=Testing, 1=Integrity Integrity mode will reject SBAS corrections if the SBAS satellite is transmitting in a test mode. Testing mode will accept/use SBAS corrections even if satellite is transmitting in a test mode.
Flag Bits[1]	1		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 will be used (this is usually 18 seconds). If Bit 3 = 1, the SBAS PRN specified in the SBAS PRN field will be used. If Bit 3 = 0, the system will search for any SBAS PRN.

Initialise GPS/DR Navigation - Message ID 172 (Sub ID 1)

Set the navigation initialisation parameters and command a software reset based on those parameters.

Name	Bytes	Scale	Units	Description
MID	1			=0xAC
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
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)

Set the GPS/DR navigation mode control parameters.

Name	Bytes	Description
MID	1	=AC
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)

Set DR gyro's factory calibration parameters.

Name	Bytes	Scale	Units	Description
MID	1			=0xAC
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)

Set DR sensors' parameters.

Name	Bytes	Scale	Units	Description
MID	1			=0xAC
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)

Poll the DR gyro's factory calibration status.

Name	Bytes	Description
MID	1	=AC
Sub ID	1	=0x06
Payload length: 2 bytes		

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

Poll the DR sensors' parameters.

Name	Bytes	Description
MID	1	=AC
Sub ID	1	=0x07
Payload length: 2 bytes		

Reserved - Message ID 228

This input message is SiRF proprietary.

Output Messages 3

The following chapter provides full 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/No 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
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
2D	45	Raw DR Data	Raw DR data from ADC
2E	46	Test Mode 3	Additional test data (Test Mode 3)
30	48	SiRFDRive-specific Class of Output Messages	The MID is partitioned into messages identified by Sub IDs. Refer to Table 3-2.
32	50	SBAS Parameters	SBAS operating parameters
34	52	PPS Time Message	Time message for PPS

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

Hex	Decimal	Name	Description
E1	225	SiRF internal message	Reserved
FF	255	Development Data	Various status messages

Table 3-2 Sub IDs for SiRFDRive output MID 48 (0x30)

Sub ID	Message
1	DR Navigation Status
2	DR Navigation State
3	Navigation Subsystem
4	Raw DR Data
5	DR Validity (not implemented)
6	DR Gyro Factory Calibration
7	DR Sensors' Parameters
8	DR Data Block

As 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

	SiRF Software Options				
Message ID	**GSW2**	**SiRFDRive**	**SiRFXTrac**	**SiRFLoc**	**GSW3**
1	Yes	Yes	No	No	No
2	Yes	Yes	Yes	Yes	Yes
3	No	No	No	No	No
4	Yes	Yes	Yes	Yes	Yes
5	No	No	No	No	No
6	Yes	Yes	Yes	Yes	Yes
7	Yes	Yes	Yes	Yes	Yes
8	Yes	Yes	Yes	Yes	Yes
9	Yes	Yes	Yes	Yes	Yes
10	Yes	Yes	Yes	Yes	Yes
11	Yes	Yes	Yes	Yes	Yes
12	Yes	Yes	Yes	Yes	Yes
13	Yes	Yes	Yes	Yes	Yes
14	Yes	Yes	Yes	Yes	Yes
15	Yes	Yes	Yes	Yes	Yes
16	Yes	Yes	No	No	No
17	Yes	Yes	No	No	No
18	Yes	Yes	Yes	Yes	Yes
19	Yes	Yes	Yes	Yes	Yes
20	Test Mode 2 only	Test Mode 2 only	Test Mode 2/3/4	Test Mode 2/3/4	No
28	Yes	Yes	No	No	Yes
29	Yes	Yes	No	No	No
30	Yes	Yes	No	No	Yes
31	Yes	Yes	No	No	Yes
41	2.3 or above	Yes	2.0 or above	No	Yes

Table 3-3 Supported output messages *(Continued)*

Message ID	SiRF Software Options				
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3
43	No	No	No	No	Yes
45	No	Yes	No	No	No
46	Yes	Yes	No	No	Test Mode 3/4
48	No	Yes	No	No	No
50	2.3 or above	Yes	No	No	No
52	2.3.2 or above	No	No	No	No
55	No	No	No	No	Yes (reserved)
225	No	No	No	No	Yes (reserved)
255	Yes	Yes	Yes	Yes	Yes

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

02FFD6F78CFFBE536E003AC004000000000030001040A00036B039780E3
0612190E160F04000000000000—Payload

09BBB0B3—Message Checksum and End Sequence

Table 3-4 Measured Navigation Data Out - Message Data Format

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		02			2
X-position	4		FFD6F78C	m		-2689140
Y-position	4		FFBE536E	m		-4304018
Z-position	4		003AC004	m		3850244
X-velocity	2	*8	0000	m/sec	Vx÷8	0
Y-velocity	2	*8	0003	m/sec	Vy÷8	0.375
Z-velocity	2	*8	0001	m/sec	Vz÷8	0.125
Mode 1	1		04	Bitmap[1]		4
HDOP[2]	1	*5	0A		÷5	20
Mode 2	1		00	Bitmap[3]		0
GPS Week[4]	2		036B			875
GPS TOW	4	*100	039780E3	seconds	÷100	602605.79
SVs in Fix	1		06			6
CH 1 PRN[5]	1		12			18

Table 3-4 Measured Navigation Data Out - Message Data Format *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
CH 2 PRN[5]	1		19			25
CH 3 PRN[5]	1		0E			14
CH 4 PRN[5]	1		16			22
CH 5 PRN[5]	1		0F			15
CH 6 PRN[5]	1		04			4
CH 7 PRN[5]	1		00			0
CH 8 PRN[5]	1		00			0
CH 9 PRN[5]	1		00			0
CH 10 PRN[5]	1		00			0
CH 11 PRN[5]	1		00			0
CH 12 PRN[5]	1		00			0

Payload length: 41 bytes

1. For further information, go to Table 3-5.
2. HDOP value reported has a maximum value of 50.
3. For further information, go to Table 3-6.
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 need to be divided by the scale value to receive true decimal value (i.e., decimal X_{vel} = binary X_{vel} ÷ 8).

Table 3-5 Mode 1

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

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. Format???In standard software, Dead Rechoning solution is computed by taking the last valid position and velocity and projecting the position using the velocity and elapsed time.

Note – Mode 1 of Message I.D. 2 is a bit-mapped byte with five sub-values in it. The first table above shows the location of the sub-values while the table directly above shows the interpretation of each sub-value.

Table 3-6 Mode 2

Bit	Description
0	1 = sensor DR in use 0 = velocity DR if PMODE sub-value in Mode 1 = 7; else check Bits 6 and 7 for DR error status
1	If set, solution is validated (5 or more SVs used)[1]
2	If set, velocity DR timeout
3	If set, solution edited by UI (e.g., DOP Mask exceeded)
4	If set, velocity is invalid
5	Altitude hold mode: 0 = enabled 1 = disabled (3-D fixes only)
7,6	Sensor DR error status: 00 = GPS-only navigation 01 = DR in calibration 10 = DR sensor errors 11 = DR in test mode

1. 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 will remain. If navigation is lost completely, an unvalidated statuswill result.

Note – Mode 2 of MID 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

This message is defined as True Tracker data but has not been implemented.

Measured Tracker Data Out - Message ID 4

Output Rate: 1 Hz

Table 3-7 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 3-7 Measured Tracker Data Out

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04			4
GPS Week[1]	2		036C			876
GPS TOW	4	s*100	0000937F	sec	s÷100	37759
Chans	1		0C			12
1st SVid	1		0E			14
Azimuth	1	Az*[2/3]	AB	deg	÷[2/3]	256.5
Elev	1	El*2	46	deg	÷2	35
State	2		003F	Bitmap[2]		0 x 3F
C/No 1	1		1A	dB-Hz		26
C/No 2	1		1E	dB-Hz		30
C/No 3	1		1D	dB-Hz		29
C/No 4	1		1D	dB-Hz		29
C/No 5	1		19	dB-Hz		25
C/No 6	1		1D	dB-Hz		29
C/No 7	1		1A	dB-Hz		26
C/No 8	1		1A	dB-Hz		26
C/No 9	1		1D	dB-Hz		29
C/No 10	1		1F	dB-Hz		31
2nd SVid	1		1D			29
Azimuth	1	Az*[2/3]	59	deg	÷[2/3]	89
Elev	1	El*2	42	deg	÷2	66
State	2		3F	Bitmap[2]		63
C/No 1	1		1A	dB-Hz		26
C/No 2	1		1A	dB-Hz		63
...						
SVid, Azimuth, Elevation, State, and C/No 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 3-8 for state values for each channel.

Table 3-8 State Values for Each Channel

Bit	Description when bit is set to 1
0x0001	Acquisition/re-acquisition has been completed successfully
0x0002	The integrated carrier phase is valid
0x0004	Bit synchronization has been completed
0x0008	Subframe synchronization has been completed
0x0010	Carrier pullin has been completed
0x0020	Code has been locked
0x0040	Satellite acquisition has failed
0x0080	Ephemeris data is available

Raw Tracker Data Out - Message ID 5

This message is not supported by the SiRFstarII architecture.

Software Version String (Response to Poll) - Message ID 6

Output Rate: Response to polling message

Example:

A0A20015—Start Sequence and Payload Length

06322E332E322D475358322D322E30352E3032342D4331464C4558312E3200000 000000000000000000000000000000000000000000000000000000000000000 00000000000000000000000000000—Payload

0631B0B3—Message Checksum and End Sequence

Table 3-9 Software Version String

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

Payload Length: 81 bytes

1. Repeat the payload sequence above minus the starting 0x06 byte.
2. 2.3.2-GSW2-2.05.024-C1FLEX1.2

Note – Convert ASCII to symbol to assemble message (i.e., 0x4E is 'N'). This is a low priority task and is not necessarily outputted at constant intervals. Effective with version GSW 2.3.2, message length was increased from 21 to 81 bytes to allow for up to 80-character version string.

Response: Clock Status Data - Message ID 7

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD0215492408000122310000472814D4DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table 3-10 Clock Status Data Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		07			7
Extended GPS Week[1]	2		03BD			957
GPS TOW	4	*100	02154924	sec	÷100	349494.12
SVs[2]	1		08			8
Clock Drift	4		00012231	Hz		74289
Clock Bias	4		00004728	ns		18216
Estimated GPS Time	4		14D4DAEF	ms		349493999
Payload length: 20 bytes						

1. GPS week has been resolved to the full week number (1024-week ambiguity has been resolved).
2. Number of satellites used in the solution for clock drift, clock bias, and estimated GPS time.

50 BPS Data - Message ID 8

Output Rate: Approximately every 6 seconds for each channel

Example:

A0A2002B—Start Sequence and Payload Length

08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFF A80365A867FC67708BEB5860F4—Payload

15AAB0B3—Message Checksum and End Sequence

Table 3-11 50 BPS Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		08			8
Channel	1		00			0
SV ID	1		19			25
Word[10]	40					
Payload length: 43 bytes per sub-frame (5 subframes per page)						

Note – Data is logged in ICD-GPS-200C format (available from www.navcen.uscg.mil). The 10 words together comprise a complete subframe of navigation message data. Within the word, the 30 bits of the navigation message word are right justified, complete with 24 data bits and 6 parity bits. Any inversion of the data has been removed. The 2 MSBs of the word contain parity bits 29 and 30 from the previous navigation message word.

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 3-12 CPU Throughput

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		09			9
SegStatMax	2	*186	003B	ms	÷186	0.3172
SegStatLat	2	*186	0011	ms	÷186	0.0914
AveTrkTime	2	*186	0016	ms	÷186	0.1183
Last Millisecond	2		01E5	ms		485
Payload length: 9 bytes						

Error ID Data - Message ID 10

Output Rate: As errors occur

MID 10 messages have a different format from other messages. Rather than one fixed format, there are serveral formats, each designated by an error ID. However, the format is standardize as indicated in Table 3-13. The specific format of each error ID message follows.

Table 3-13 Message ID 10 Overall Format

Name	Bytes	Description
Message ID	1	Message ID number - 10.
Error ID	2	Sub-message type.
Count	2	Count of number of 4-byte values that follow.
Data[n]	4 * n	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

0A0002000200000001000000002 – Payload

0011B0B3 – Message Checksum and End Sequence

Table 3-14 Error ID 2 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		0002			2
Count	2		0002			2
Satellite ID	4		00000001			1
Subframe No	4		00000002			2
Payload Length: 13 bytes						

Table 3-15 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 3-16 Error ID 9 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		0009			9
Count	2		0002			2
Satellite ID	4		00000001			1
Payload Length: 9 bytes						

Table 3-17 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 (PRN) 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 3-18 Error ID 10 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000A			10
Count	2		0001			1
Pseudorange	4		00001234			4660
Payload length: 9 bytes						

Table 3-19 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 3-20 Error ID 11 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000B			11
Count	2		0001			1
Doppler Frequency	4		xxxxxxxx			xxxxxxxx
Payload length: 9 bytes						

Table 3-21 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's ephemeris age has exceeded 2 hours (7200 s).

Example:

A0A2000D – Start Sequence and Payload Length

0A000C0002xxxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-22 Error ID 12 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000C			12
Count	2		0002			2
Satellite ID	4		xxxxxxxx			xxxxxxxx
Age Of Ephemeris	4		aaaaaaaa	seconds		aaaaaaaa
Payload Length: 13 bytes						

Table 3-23 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 (PRN) number
Age of Ephemeris	The Satellite's 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 Sequence

Table 3-24 Error ID 13 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000D			13
Count	2		0003			3
X	4		xxxxxxxx			xxxxxxxx
Y	4		aaaaaaaa			aaaaaaaa
Z	4		bbbbbbbb			bbbbbbbb
Payload length: 17 bytes						

Table 3-25 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 3-26 Error ID 4097 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1001			4097
Count	2		0001			1
VCOLost	4		00000001			1
Payload length: 9 bytes						

Table 3-27 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 3-28 Error ID 4099 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1003			4099
Count	2		0001			1
InTrkCount	4		00000001			1
Payload Length: 9 bytes						

Table 3-29 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's 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

0A10080004xxxxxxxxaaaaaaaa00000000cccccccc – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-30 Error ID 4104 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1008			4104
Count	2		0004 or 0003 or 0002			4 or 3 or 2
Computed Receiver Control Checksum	4		xxxxxxxx			xxxx
Battery-Backed Receiver Control Checksum	4		aaaaaaaa			aaaa
Battery-Backed Receiver Control OpMode	4		00000000			0
Battery-Backed Receiver Control Channel Count	4		cccccccc			cccc
Compute Clock Offset Checksum	4		xxxxxxxx			xxxx
Battery-Backed Clock Offset Checksum	4		aaaaaaaa			aaaa
Battery-Backed Clock Offset	4		bbbbbbbb			bbbb
Computed Position Time Checksum	4		xxxxxxxx			xxxx
Battery-Backed Position Time Checksum	4		aaaaaaaa			aaaa
Payload length: 21, 17, or 11 bytes						

Table 3-31 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.
Battery-Backed Receiver Control Checksum	Battery-backed receiver control checksum stored in SRAM.Data.DataBuffer. CntrlChkSum.
Battery-Backed Receiver Control OpMode	Battery-backed 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.
Battery-Backed Receiver Control Channel Count	Battery-backed receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are 0-12.
Compute Clock Offset Checksum	Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.
Battery-Backed Clock Offset Checksum	Battery-backed clock offset checksum of SRAM.Data.DataBuffer.clkChkSum.

Table 3-31 Error ID 4104 Message Description *(Continued)*

Name	Description
Battery-Backed Clock Offset	Battery-backed clock offset value stored in SRAM.Data.DataBuffer,clkOffset.
Computed Position Time Checksum	Computed position time checksum of SRAM.Data.DataBuffer.postime[1].
Battery-Backed Position Time Checksum	Battery-backed 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, then 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

0A10090002xxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-32 Error ID 4105 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1009			4105
Count	2		0002			2
TOW	4		xxxxxxxx	seconds		xxxx
Week Number	4		aaaaaaaa			aaaa
Payload length: 13 bytes						

Table 3-33 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 battery-backing position because of ECEF velocity sum was greater than equal to 3600.

Example:

A0A20005 – Start Sequence and Payload Length

0A100A0000 – Payload

0024B0B3 – Message Checksum and End Sequence

Table 3-34 Error ID 4106 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		100A			4106
Count	2		0000			0
Payload length: 5 bytes						

Table 3-35 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 battery-backing position 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 3-36 Error ID 4107 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		100B			4107
Count	2		0000			0
Payload length: 5 bytes						

Table 3-37 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 3-38 Error ID 8193 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2001			8193
Count	2		0001			1
uartAllocError	4		00000001			1
Payload length: 9 bytes						

Table 3-39 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 3-40 Error ID 8194 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2002			8194
Count	2		0002			2
Number of in process errors.	4		00000001			1
Millisecond errors	4		00000064			100
Payload length: 13 bytes						

Table 3-41 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. Does not appear to be active because MemStatus variable never gets set to a non-zero value in the code.

Example:

A0A20005 – Start Sequence and Payload Length

0A20030000 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-42 Error ID 8195 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2003			8195
Count	2		0000			0
Payload length: 5 bytes						

Table 3-43 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

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 3-44 Command Acknowledgment

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0x0B			11
ACK ID	1		0x92			146
Payload length: 2 bytes						

Command NAcknowledgment - Message ID 12

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 3-45 Command N'Acknowledgment

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0x0C			12
N'Ack ID	1		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

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 3-46).

Example:

A0A2002A—Start Sequence and Payload Length

0D081D002A00320F009C0032....—Payload

....B0B3—Message Checksum and End Sequence

Table 3-46 Visible List

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Units**	**Scale**	**Example**
Message ID	1		0D			13
Visible SVs	1		08			8
Ch 1 - SV ID	1		10			16
Ch 1 - SV Azimuth	2		002A	degrees		42
Ch 1 - SV Elevation	2		0032	degrees		50
Ch 2 - SV ID	1		0F			15
Ch 2 - SV Azimuth	2		009C	degrees		156
Ch 2 - SV Elevation	2		0032	degrees		50
...						
Payload length: variable (2 + 5 times number of visible SVs up to maximum of 62 bytes)						

Almanac Data - Message ID 14

Output Rate: Response to poll

Table 3-47 Contents of Message ID 14

Name	Bytes	Description
Message ID	1	Hex 0x0E (decimal 14)
SV ID	1	SV PRN code, hex 0x01..0x02, decimal 1..32
Almanac Week & Status	2	10-bit week number in 10 MSBs, status in 6 LSBs (1 = good; 0 = bad)
Data[1]	24	**UINT16**[12] array with sub-frame data.
Checksum	2	
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 3-48 shows how the actual bytes in the navigation message corresponds 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 3-48 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
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 3-47 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 since the SV ID is inferred from the location in the array.

Ephemeris Data (Response to Poll) – Message ID 15

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 3-49 Contents of Message ID 14

Name	Bytes	Description
Message ID	1	Hex 0x0E (decimal 14)
SV ID	1	SV PRN code, hex 0x01..0x02, decimal 1..32
Data[1]	90	**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]) will contain the SV ID. The remaining words in the row will 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 3-50 shows where each byte of the sub-frame is stored in the row of 16-bit words.

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**
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]	MSB				
6	Middle	[][8]	MSB				
6	LSB	[][8]	MSB				

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

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 3-51 Test Mode 1 Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
Message ID	1		10			16
SV ID	2		0015			21
Period	2		001E	sec		30
Bit Sync Time	2		0005	sec		5
Bit Count	2		88B8			35000
Poor Status	2		00C8			200
Good Status	2		1B58			7000
Parity Error Count	2		0004			4
Lost VCO Count	2		0001			1
Payload length: 17 bytes						

Table 3-52 Detailed Description of Test Mode 1 Data

Name	Description
Message ID	Message I.D. 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 100msec 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 100msec 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 *T*echnical Commission for Maritime Services. Data length and message output rate will vary based on received data.

Table 3-53 RTCM message

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

1. Data length and message output rate will vary based on received data.

OkToSend - Message ID 18

Output Rate: Two messages per power-saving cycle

Example:

A0A20002—Start Sequence and Payload Length

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table 3-54 Almanac Data

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

Note – This message is sent when the receiver is in a power-saving mode. One message is sent just before the receiver's power is turned off (with Send Indicator set to 0), and one is sent once the power has been restored (with Send Indicator set to 1).

Navigation Parameters (Response to Poll) - Message ID 19

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 00—Payload

02 A4 B0 B3—Message Checksum and End Sequence

Table 3-55 Navigation Parameters

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

Table 3-55 Navigation Parameters *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
DGPS Timeout[9]	1		1E	sec		
Reserved	4		00000000			
LP Push-to-Fix[10]	1		00			
LP On-time[10]	4		000003E8			
LP Interval[10]	4		000003E8			
User Tasks Enabled[4]	1		00			
User Task Interval[4]	4		00000000			
LP Power Cycling Enabled[11]	1		00			
LP Max. Acq. Search Time[12]	4		00000000	sec		
LP Max. Off Time[12]	4		00000000	sec		
APM Enabled/Power Duty Cycle[13,14]	1		00			
Number of Fixes[14]	2		0000			
Time Between Fixes[14]	2		0000	sec		
Horizontal/Vertical Error Max[15]	1		00	m		
Response Time Max[14]	1		00	sec		
Time/Accu & Time/Duty Cycle Priority[16]	1		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.
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 modifiabl e via the User Inteface.
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. See .
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 3-56 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

The definition of MID 20 is different depending on the version and type of software being used. For GSW2 or SiRFDRive, MID 20 is used for as Test Mode 2 only. For SiRFLoc or SiRFXTrac, MID is used for either Test Mode 2, Test Mode 3, or Test Mode 4. For GSW2 software, refer to MID 46 for Test Mode 3 and Test Mode 4 results.

Output Rate: variable - set by the period as defined in message ID 150

Test Mode 2

This is supported by either GSW2, SiRFDRive, SiRFLoc, or SiRFXTrac. Test Mode 2 requires approximately 1.5 minutes of data collection before sufficient data is available.

Example:

A0A20033—Start Sequence and Payload Length

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A0000000000000 000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-57 Test Mode 2 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
Bit Count	2		3F70			13680
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	sec		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Change	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
Reserved	2		0000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Payload length: 51 bytes						

Table 3-58 Detailed Description of Test Mode 2 Message

Name	Description
Message ID	Message I.D. 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 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 100msec 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 100msec 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 will cause a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No 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 SiRFLoc and SiRFXTrac only as MID 20. Test Mode 3 requires approximately 10 seconds of data collection before sufficient data is available.

Example:

A0A20033—Start Sequence and Payload Length

140001001E00023F70001F0D290000000000000601C600051B0E000EB41A0000000000000 000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-59 Test Mode 3 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
Bit Count	2		3F70			13680

Table 3-59 Test Mode 3 Message *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	sec		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Change	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
Bad 1Khz Bit Count	2		0000			
Abs I20ms	4		00000000			
Abs Q1ms	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Payload length: 51 bytes						

Table 3-60 Detailed Description of Test Mode 3 Message

Name	Description
Message ID	Message I.D. 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 100msec 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 100msec 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 will cause a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No 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 1Khz Bit Count	Errors in 1ms post correlation I count values.

Table 3-60 Detailed Description of Test Mode 3 Message *(Continued)*

Name	Description
Abs I20ms	Absolute value of the 20ms coherent sums of the I count over the duration of the test period.
Abs Q1ms	Absolute value of the 1ms Q count over the duration of the test period.

Test Mode 4

This is supported by SiRFLoc and SiRFXTrac only.

Table 3-61 Test Mode 4 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
Test Mode	1		04			4
Message Variant	1		01			1
SV ID	2		0001			1
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Change	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
I Count Errors	2		0003			3
Abs I20ms	4		0003AB88			240520
Abs Q1ms	4		0000AFF0			45040
Payload length: 29 bytes						

Table 3-62 Detailed Description of Test Mode 4 Message

Name	Description
Message I.D.	Message I.D. 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/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.
Clock Drift	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.
I Count Errors	Errors in 1ms post correlation I count values.
Abs I20ms	Absolute value of the 20ms coherent sums of the I count over the duration of the test period.
Q 1ms	Absolute value of the 1ms Q count over the duration of the test period.

Navigation Library Measurement Data - Message ID 28

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

Example:

A0A20038—Start Sequence and Payload Length

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

1533B0B3—Message Checksum and End Sequence

Table 3-63 Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1C			28
Channel	1		00			0
Time Tag	4		000660D0	ms		135000
Satellite ID	1		15			20
GPS Software Time	8		F143F62C4113F42F	ms		2.4921113696e+005
Pseudorange	8		417B235CF3FBE95E	m		2.1016756638e+007
Carrier Frequency	4		468C6964	m/s		1.6756767578e+004
Carrier Phase	8		Reserved	N/A		N/A
Time in Track	2		7530	ms		10600
Sync Flags	1		17			23
C/No 1	1		34	dB-Hz		43
C/No 2	1			dB-Hz		43
C/No 3	1			dB-Hz		43
C/No 4	1			dB-Hz		43
C/No 5	1			dB-Hz		43
C/No 6	1			dB-Hz		43
C/No 7	1			dB-Hz		43
C/No 8	1			dB-Hz		43
C/No 9	1			dB-Hz		43
C/No 10	1			dB-Hz		43
Delta Range Interval	2		03E801F4	m		1000
Mean Delta Range Time	2		01F4	ms		500
Extrapolation Time	2		0000	ms		
Phase Error Count	1		00			0
Low Power Count	1		00			0

Payload length: 56 bytes

Note – For GPS Software Time, Psuedorange, Carrier Frequency, and Carrier Phase, the fields are either 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 interpreted properly on some computers. Also, the byte order differs between GPS software versions 2.2.0 and earlier, and versions 2.3.0 and later. 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 Carrier Frequency contains a bias of the clock drift reported in MID 7. To adjust the reported carrier frequency do the following: Corrected Carrier Frequency (m/s) = Reported Carrier Frequency (m/s) - Clock Drift (Hz) / 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.

Table 3-64 Sync Flag Fields

Bit Fields	Description
[0]	Coherent Integration Time 0 = 2ms 1 = 10ms
[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 3-65 Detailed Description of the Measurement Data

Name	Description
Message I.D.	Message I.D. 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.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random Noise (PRN) number.
GPS Software Time	This is GPS Time of Week (TOW) estimated by the software in milliseconds.
Pseudorange	This is the generated pseudorange measurement for a particular SV.

Table 3-65 Detailed Description of the Measurement Data *(Continued)*

Name	Description
Carrier Frequency	This is 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, then it can be the AFC measurement, otherwise it is a delta pseudorange computation.[1]
Carrier Phase	This is the integrated carrier phase given in meters.
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 pseudo range is present for a particular channel. The length of time in track is a measure of how large the pull-in error may be.
Sync Flags	This byte contains two a two bit fields that report the integration interval and sync value achieved for a particular channel. **1) Bit 0:** Coherent Integration Interval (0 = 2 milliseconds, 1 = 10 milliseconds) **2) Bits:** (1 2) = Synchronization **3) Bit:** (2 1) Value: {0 0} Not Aligned Value: {0 1} Consistent Code Epoch Alignment Value: {1 0} Consistent Data Bit Alignment Value: {1 1} No Millisecond Errors
C/No 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/No 2	Second 100 millisecond measurement
C/No 3	Third 100 millisecond measurement
C/No 4	Fourth 100 millisecond measurement
C/No 5	Fifth 100 millisecond measurement
C/No 6	Sixth 100 millisecond measurement
C/No 7	Seventh 100 millisecond measurement
C/No 8	Eighth 100 millisecond measurement
C/No 9	Ninth 100 millisecond measurement
C/No 10	Tenth 100 millisecond measurement
Delta Range Interval	This is the delta-pseudo range 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-pseudo range interval in milliseconds measured from the end of the interval backwards
Extrapolation Time	This is the pseudo range extrapolation time in milliseconds, to reach the common Time tag value.
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

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 freq is in Hz; Carrier freq = 1,575,420,000 Hz; Velocity is in m/s; Speed of light = 299,792,458 m/s.

Note that the computed Doppler frequency will contain a bias equal to the current clock drift as reported in message 107. 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 : 1Hz)

Example:

A0A2001A—Start Sequence and Payload Length

1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000—Payload

0956B0B3—Message Checksum and End Sequence

Table 3-66 Measurement Data

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

Payload length: 26 bytes

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

Note – The fields Pseudorange Correction, Pseudorange Rate Correction, and Correction Age are floating point values per IEEE-754. To properly interpret these in a PC, the bytes need to be rearranged into 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.

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

Example:

A0A20053—Start Sequence and Payload Length

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

2360B0B3—Message Checksum and End Sequence

Table 3-67 SV State Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1E			30
Satellite ID	1		15			21
GPS Time	8			sec		
Position X	8			m		
Position Y	8			m		
Position Z	8			m		
Velocity X	8			m/sec		
Velocity Y	8			m/sec		
Velocity Z	8			m/sec		
Clock Bias	8			sec		
Clock Drift	4		2C64E99D	s/s		744810909
Ephemeris Flag[1]	1		01			1
Reserved	4					
Reserved	4					
Ionospheric Delay	4		408906C8	m		1082721992

Payload length: 83 bytes

1. 0 = no valid SV state, 1 = SV state calculated from ephemeris, 2 = Satellite state calculated from almanac

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 PC, the bytes need to be rearranged. See Note in MID 28 for byte orders.

Navigation Library Initialization Data - Message ID 31

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

Example:

A0A20054—Start Sequence and Payload Length

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

....02—Payload

0E27B0B3—Message Checksum and End Sequence

Table 3-68 Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1F			31
Reserved	1					
Altitude Mode[1]	1		00			0
Altitude Source	1		00			0
Altitude	4		00000000	m		0
Degraded Mode[2]	1		01			1

Table 3-68 Measurement Data *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Degraded Timeout	2		001E	sec		30
Dead-reckoning Timeout	2		000F	sec		15
Reserved	2					
Track Smoothing Mode[3]	1		00			0
Reserved	1					
Reserved	2					
Reserved	2					
Reserved	2					
DGPS Selection[4]	1		00			0
DGPS Timeout	2		0000	sec		0
Elevation Nav. Mask	2	2	000F	deg		15
Reserved	2					
Reserved	1					
Reserved	2					
Reserved	1					
Reserved	2					
Static Nav. Mode[5]	1		00			0
Reserved	2					
Position X	8			m		
Position Y	8			m		
Position Z	8			m		
Position Init. Source[6]	1		02			2
GPS Time	8			sec		
GPS Week	2		0434			1076
Time Init. Source[7]	1		02	sec		2
Drift	8			Hz		
Drift Init. Source[8]	1		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
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 PC, the bytes need to be rearranged. See Note in MID 28 for byte orders.

Geodetic Navigation Data - Message ID 41

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

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 BB 00 00 01 38 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 08 05 00—Payload

11 03 B0 B3—Message Checksum and End Sequence

Table 3-69 Geodetic Navigation Data

Name	Bytes	Description
Message ID	1	Hex 0x29 (decimal 41)
Nav Valid	2	0x0000 = valid navigation; else Bit 0 ON : invalid GPS position (< 5 SVs) Bits 1 - 2 : Reserved. Bits 8 - 14 : Reserved. (The following are for SiRFDRive only) Bit 3 ON : invalid DR data Bit 4 ON : invalid DR calibration Bit 5 ON : GPS-based calibration unavailable Bit 6 ON : invalid DR position fix Bit 7 ON : invalid DR heading. (The following is for SiRFNav only) Bit 15 ON : no tracker data available

Table 3-69 Geodetic Navigation Data *(Continued)*

Name	Bytes	Description
NAV Type	2	Bits 0 - 2 : GPS position fix type 000 = no navigation 001 = 1-SV KF solution 010 = 2-SV KF solution 011 = 3-SV KF solution 101 = 2-D least-squares solution 110 = 3-D least-squares solution 111 = DR solution (no SV) Bit 3 : Reserved Bits 4 - 5 : 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 exceeded Bit 7 ON : DGPS corrections applied Bit 8 : DR type 1 = sensor DR 0 = velocity DR if Bits 0 - 2 = 111; else check Bits 14-15 for DR error status Bit 9 ON : navigation solution validated Bit 10 ON : velocity DR timeout Bit 11 ON : solution edited by user input Bit 12 ON : invalid velocity Bit 13 ON : altitude hold disabled Bits 14 - 15 : sensor DR error status 00 = GPS-only navigation 01 = DR in calibration 10 = DR sensor errors 11 = DR in test
Extended Week Number	2	GPS week number; week 0 started 1980/01/06. This value is extended beyond the 10-bit value reported by the SVs.
TOW	4	GPS time of week in seconds x 10^3.
UTC Year	2	UTC time and date. Seconds reported as integer milliseconds only.
UTC Month	1	
UTC Day	2	
UTC Hour	2	
UTC Minute	2	
UTC Second	2	
Satellite ID List	4	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	In degrees (+ = North) x 10^7.
Longitude	4	In degrees (+ = East) x 10^7.
Altitude from Ellipsoid	4	In meters x 10^2.
Altitude from MSL	4	In meters x 10^2.
Map Datum[1]	1	See footnote.
Speed Over Ground (SOG)	2	In m/s x 10^2.
Course Over Ground (COG, True)	2	In degrees from true north x 10^2.
Magnetic Variation	2	Not implemented.

Table 3-69 Geodetic Navigation Data *(Continued)*

Name	Bytes	Description
Climb Rate	2	In m/s x 10^2.
Heading Rate	2	deg/s x 10^2 (SiRFDRive only).
Estimated Horizontal Position Error	4	EHPE in meters x 10^2 (SiRFDRive only).
Estimated Vertical Position Error	4	EVPE in meters x 10^2 (SiRFDRive only).
Estimated Time Error	4	ETE in seconds x 10^2 (SiRFDRive only).
Estimated Horizontal Velocity Error	2	EHVE in m/s x 10^2 (SiRFDRive only).
Clock Bias	4	In m/s x 10^2.
Clock Bias Error	4	In meters x 10^2 (SiRFDRive only).
Clock Drift	4	In m/s x 10^2.
Clock Drift Error	4	In m/s x 10^2 (SiRFDRive only).
Distance Traveled since Reset	4	In meters (SiRFDRive only).
Distance Traveled error	2	In meters (SiRFDRive only).
Heading Error	2	In degrees x 10^2 (SiRFDRive only).
Number of SVs in Fix	1	Count of SVs indicated by SV ID list.
HDOP	1	Horizontal Dilution of Precision x 5 (0.2 resolution).
Reserved	1	

Payload length: 91 bytes

1. Map Datum indicates the datum to which latitude, longitude, and altitude relate. 21 = WGS-84, by default. Other values will be defined as other datums are implemented. Available datums include: 21 = WGS-84, 178 = Tokyo Mean, 179 = Tokyo Japan, 180 = Tokyo Korea, 181 = Tokyo Okinawa.

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

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

Name	Bytes	Scale	Units	Description
MID	1			=0x2B
Polled Msg ID	1			=0x8F (example)
Data	Variable			Depends on the polled message ID length
Payload length: Variable length bytes (3 bytes in the example))				

DR Raw Data - Message ID 45

1-Hz DR raw data from ADC (output after collection of data).

Name	Bytes	Scale	Units	Description
MID	1			=0x30
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

Note – This message is used in GSW2, SiRFDRive, and GSW3 software. For SiRFLoc, and SiRFXTrac software, refer to MID 20.

Output Rate: Variable - set by the period as defined in message ID 150

Example:

A0A20033—Start Sequence and Payload Length

2E0001001E00023F70001F0D2900000000000601C600051B0E000EB41A0000000000000 000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-70 Test Mode 3 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		2E			46
SV ID	2		0001			1

Table 3-70 Test Mode 3 Message *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Period	2		001E	sec		30
Bit Sync Time	2		0002	sec		2
Bit Count	2		3F70			13680
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	sec		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift Rate	2	*10	1B0E	Hz	÷10	692.6
Clock Drift	4	*10	000EB41A	Hz	÷10	96361.0
Bad 1Khz Bit Count	2		0000			
Abs I20ms	4		00000000			
Abs Q1ms	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Payload length: 51 bytes						

Table 3-71 Detailed Description of Test Mode 3 Message

Name	Description
Message ID	Message I.D. number.
SV ID	The PRN code 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 state 0x37.
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 10 100-ms intervals)
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 navigation message word parity errors. This occurs when the transmitted parity word does not match the receiver's parity check.
Lost VCO Count	The number of 1 msec VCO lost lock detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and/or phase will cause a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach state 0x3F.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.

Table 3-71 Detailed Description of Test Mode 3 Message *(Continued)*

Name	Description
Clock Drift Rate	Difference in clock drift from start and end of the test period.
Clock Drift	The measured internal clock drift.
Bad 1Khz Bit Count	Errors in 1ms post correlation I count values.
Abs I20ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period.
Abs Q1ms	Absolute value of the 1ms Q count over the duration of the test period.

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

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

Name	Bytes	Description
MID	1	=0x30
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.
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 & 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 cal not updated Bit 6 ON : heading rate scale factor <= -1. Bit 7 : Reserved.

Name	Bytes	Description
DR gyro scale factor calibration & 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 & 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.
DR gyro subsystem & DR speed subsystem	1	Bits 0 - 3 : 0000 = updated DR gyro bias & 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 & 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.

Name	Bytes	Description
Updated DR gyro bias/scale factor calibration, updated DR speed calibration, & updated DR Nav state	1	Bits 0 - 3 : 0000 = updated DR gyro bias & 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 4 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.
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	
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).

Name	Bytes	Scale	Units	Description
MID	1			=0x30
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).

Name	Bytes	Scale	Units	Description
MID	1			=0x30
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	

Name	Bytes	Scale	Units	Description
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’s factory calibration parameters (response to poll).

Name	Bytes	Scale	Units	Description
MID	1			=0x30
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).

Name	Bytes	Scale	Units	Description
MID	1			=0x30
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).

Name	Bytes	Scale	Units	Description
MID	1			=0x30
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	1			Bits 0 .. 9, each bit: ON = reverse, OFF = forward.
1st 100-ms time-tag	1		ms	
1st 100-ms DR speed	1	10^2	m/s	
1st 100-ms gyro heading rate	1	10^2	deg/s	
2nd 100-ms time-tag	1		ms	
2nd 100-ms DR speed	1	10^2	m/s	
2nd 100-ms gyro heading rate	1	10^2	deg/s	
...				
10th 100-ms time-tag	1		ms	
10th 100-ms DR speed	1	10^2	m/s	
10th 100-ms gyro heading rate	1	10^2	deg/s	
Payload length: 86 bytes				

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

327A00120000000000000000000—Payload

BEBEB0B3—Message Checksum and End Sequence

Table 3-72 SBAS Parameters Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		32			50
SBAS PRN	1		7A			122
SBAS Mode	1		00			0
DGPS Timeout	1		12			18
Flag bits	1		00			0

Table 3-72 SBAS Parameters Message *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Spare	8		0000000000000000			00000000
Payload length: 13 bytes						

Table 3-73 Detailed Description of SBAS Parameters

Name	Description
Message ID	Message I.D. number.
SBAS PRN	0=Auto mode SBAS PRN 120-138= Exclusive
SBAS Mode	0=Testing, 1=Integrity Integrity mode will not accept SBAS corrections if the SBAS satellite is transmitting in a test mode. Testing mode will accept and use SBAS corrections even if the SBAS satellite is transmitting in a test mode.
DGPS Timeout	Range 1-250 seconds. 0 returns to default timeout. The last received corrections will 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 will be applied.
Flag bits	Bit 0: Timeout; 0=Default 1=User Bit 1: Health; Reserved Bit 2: Correction; Reserved Bit 3: SBAS PRN; 0=Default 1=User
Spare	Spare

PPS Time - Message ID 52

Output time associated with current 1 PPS pulse. Each message will be output within a few hundred ms after the 1 PPS pulse is output and will tell the time of the pulse that just occurred. The MID 52 will report 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 will report time in GPS time, and will so indicate by means of the status field.

Output Rate: 1 Hz (Synchronized to PPS)

Example:

A0A20013—Start Sequence and Payload Length

3415122A0E0A07D3000D000000050700000000—Payload

0190B0B3—Message Checksum and End Sequence

Table 3-74 Timing Message Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		34			52
Hour	1		15			21
Minute	1		12			18
Second	1		2A			42
Day	1		0E			15
Month	1		0A			10

Table 3-74 Timing Message Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Year	2		07D3			2003
UTCOffsetInt	2		000D			13
UTCOffsetFrac	4	10^9	00000005	sec	10^9	0.000000005
Status (see Table 3-75)	1		7			7
Reserved	4		00000000			00000000
Payload length: 19 bytes						

Table 3-75 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 it is 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

Reserved - Message ID 225

This output message is SiRF proprietary.

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 3-76 Development Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		FF			255
Data[1]	variable					
Payload length: variable						

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

Note – MID 255 is output when SiRF Binary is selected and development data is enabled. The data output using MID 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. The CPU goes into sleep mode but will wake up in response to any interrupt. This includes UARTs. Messages received during the TricklePower ‘off’ period are buffered and processed when the receiver awakens for the next TricklePower cycle.

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 th 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 will either be truncated to the 10 LSBs or will be called an extended week number (see messages 7 and 41 for examples).

ADDITIONAL AVAILABLE PRODUCT INFORMATION

Part Number	Description
1050-0042	**NMEA Reference Manual**
1050-0041	SiRF Binary Protocol Reference Manual
1065-0136	**Product Inserts**
1050-0056	SiRFstarIII System Development Kit User Guide
1050-0053	GSW3 Software System Development Kit Reference Manual
1050-0054	S3SDK Board System Development Kit Reference Manual
1050-0055	GSP3 Chip System Development Kit Reference Manual
1055-1034	GSP3f Data Sheet
1055-1035	GRF3w Data Sheet
	Available on the Developer Web Site
APNT3001	**SSIII System Guidelines and Considerations**
APNT3002	**PCB Design Guidelines for SSIII Implementations**
APNT3003	**Back-Up Power Operation for SSIII Architectures**
APNT3004	**Troubleshooting Notes for SSIII Board Development**
APNT3005	**Co-Location and Jamming Considerations for SSIII Integration**
APNT3006	**GPIO Pin Functionality for SSIII**
APNT3007	**I/O Message Definitions for SSIII**
APNT3008	**Implementing User Tasks in the SSIII Architecture**
APNT3009	**Effects of User Tasks on GPS Performance for SSIII**
APNT3010	**Advanced Power Management (APM) Considerations for SSIII**
APNT3011	**Multi-ICE Testing Issues for SSIII**
APNT3012	**Production Testing of SSIII Modules**
APNT3014	**Automotive Design Considerations for SSIII**

SiRF Technology Inc.
148 East Brokaw
San Jose, CA 95112
Tel: +1-408-467-0410
Fax: +1-408-467-0420
Email: gps@sirf.com
Website: http://www.sirf.com

SiRF France
Tel: +33-6-0717-7862
Fax: +44-1344-668157
Email: SalesFrance@sirf.com

SiRF Texas
Tel: +1-972-239-6988
Fax: +1-972-239-0372
Email: SalesAmericas@sirf.com

SiRF Germany
Tel: +49-81-529932-90
Fax: +49-81-529931-70
Email: SalesGermany@sirf.com

SiRF United Kingdom
Tel: +44-1344-668390
Fax: +44-1344-668157
Email: SalesUK@sirf.com

SiRF Taiwan
Tel: +886-2-2723-7853
Fax: +886-2-2723-7854
Email: SalesAsiaPacific@sirf.com

SiRF Japan
Tel: +81 44829-2186
Fax: +81 44829-2187
Email: SalesJapan@sirf.com

SiRF India
Tel: +91-120-251-0256
Fax: +91-120-251-0584
Email: SalesIndia@sirf.com

December 2004

Please
Recycle