NAVMAN

SiRF Binary Protocol Reference Manual

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SiRF

SiRF Binary Protocol Reference Manual

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Preface

The *SiRF Binary 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, 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.

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Protocol Layers 1

The SiRF binary protocol is the standard interface protocol used by all Navman 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. 0xYY denotes a hexadecimal byte 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 input messages.

Table 2-1 SiRF Messages - Input Message List

Hex	ASCII	Name	Description
0x55	85	Transmit Serial Message	User definable message
0x80	128	Initialize Data Source	Receiver initialization and associated parameters
0x81	129	Switch to NMEA Protocol	Enable NMEA messages, output rate and baud rate
0x82	130	Set Almanac (upload)	Sends an existing almanac file to the receiver
0x84	132	Poll Software Version	Polls for the loaded software version
0x85	133	DGPS Source Control	DGPS correction source and beacon receiver information
0x86	134	Set Main Serial Port	Baud rate, data bits, stop bits, and parity
0x87	135	Switch Protocol	Obsolete
0x88	136	Mode Control	Navigation mode configuration
0x89	137	DOP Mask Control	DOP mask selection and parameters
0x8A	138	DGPS Mode	DGPS mode selection and timeout value
0x8B	139	Elevation Mask	Elevation tracking and navigation masks
0x8C	140	Power Mask	Power tracking and navigation masks
0x8D	141	Editing Residual	Not implemented
0x8E	142	Steady-State Detection - Not Used	Not implemented
0x8F	143	Static Navigation	Configuration for static operation
0x90	144	Poll Clock Status	Polls the clock status
0x91	145	Set DGPS Serial Port	DGPS port baud rate, data bits, stop bits, and parity
0x92	146	Poll Almanac	Polls for almanac data
0x93	147	Poll Ephemeris	Polls for ephemeris data
0x94	148	Flash Update	On the fly software update

Table 2-1 SiRF Messages - Input Message List

Hex	ASCII	Name	Description
0x95	149	Set Ephemeris (upload)	Sends an existing ephemeris to the receiver
0x96	150	Switch Operating Mode	Test mode selection, SV ID, and period.
0x97	151	Set TricklePower Parameters	Push to fix mode, duty cycle, and on time
0x98	152	Poll Navigation Parameters	Polls for the current navigation parameters
0xA5	165	Set UART Configuration	Protocol selection, baud rate, data bits, stop bits, and parity
0xA6	166	Set Message Rate	SiRF Binary message output rate
0xA7	167	Low Power Acquisition Parameters	Low power configuration parameters
0xA8	168	Poll Command Parameters	Poll for parameters: 0x80 : Receiver initialization and associated parameters. 0x85 : DGPS correction source and beacon receiver information 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
0xAA	170	Set SBAS Parameters	SBAS configuration parameters
0xB6	182	Set UART Configuration	Obsolete

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

Table 2-2 Supported input messages

Message I.D.	SiRF Software Options		
	GSW2	SiRFXTrac	SiRFLoc
53	No	Yes	No
85	Yes	No	No
128	Yes	No	Yes
129	Yes	No	No
130	Yes	No	No
132	Yes	Yes	Yes
133	Yes	No	No
134	Yes	Yes	Yes
135	No	No	No

Table 2-2 Supported input messages

Message I.D.	SiRF Software Options		
	GSW2	SiRFXTrac	SiRFLoc
136	Yes	Yes	Yes
137	Yes	Yes	Yes
138	Yes	Yes	Yes
139	Yes	Yes	Yes
140	Yes	Yes	Yes
141	No	No	No
142	No	No	No
143	Yes	Yes	Yes
144	Yes	Yes	Yes
145	Yes	No	No
146	Yes	Yes	Yes
147	Yes	Yes	Yes
148	Yes	No	No
149	Yes	No	Yes
150	Yes	Yes	Yes
151	Yes	No	No
152	Yes	Yes	Yes
165	Yes	No	No
166	Yes	Yes	Yes
167	Yes	No	No
168	Yes	Yes	Yes
170	2.3 or above	No	No
182	No	No	No

Advanced Power Management– Message I.D. 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.

A0 A2 00 0C—Start Sequence and Payload Length

35 01 00 14 00 03 07 00 00 0A 01 00—Payload

00 5F B0 B3—Message Checksum and End Sequence

Payload Length: 12 bytes

Table 2-3 Advanced Power Management Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		0x35		decimal 53

Table 2-3 Advanced Power Management Parameters

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
APM Enabled	1		01		Enable or disable flag 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
Horizontal Error Maximum	1		03	Meters	Maximum requested horizontal error. See Table 2-4
Vertical Error Maximum	1		07	Meters	Maximum requested vertical error. See Table 2-4
Response Time Maximum	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.

1. A value of zero indicates that continuous APM cycles is requested.
2. It is bound from 10s to 180s.
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.

Payload Length: 12bytes

Table 2-4 Horizontal/Vertical Error

Value	Position Error (in meters)
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

Transmit Serial Message - Message I.D. 85

Message I.D. 85 is a user configurable SiRF Binary string with variable payload and variable payload length.

Example:

A0A2xxxx—Start Sequence and Payload Length

xxxxxxxx......—Payload

xxxxB0B3—Message Checksum and End Sequence

Table 2-5 Initialize Data Source

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		55		Decimal 85
User defined	Variable				User defined

Payload Length: variable length

Initialize Data Source - Message I.D. 128

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

Warm start the receiver 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)		Units	Description
		Scale	Example		
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 Config.	1		33		See Table 2-7

Payload Length: 25 bytes

Table 2-7 Reset Configuration Bitmap

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 start -- clears all memory including clock drift. Also clears almanac stored in flash memory
4	Enable raw track data (YES=1, NO=0)
5	Enable debug data for SiRF binary protocol (YES=1, NO=0)
6	Enable debug data for NMEA protocol (YES=1, NO=0)
7	Reserved (must be 0)

Note – If Nav Lib data is ENABLED then the resulting messages are enabled. Clock Status (MID 7), 50 BPS (MID 8), Raw DGPS (17), NL Measurement Data (MID 28), DGPS Data (MID 29), SV State Data (MID 30), and NL Initialize 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 I.D. 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.

Example:

A0 A2 00 18—Start Sequence and Payload Length

81 02 01 01 00 01 01 01 05 01 01 01 00 01 00 01 00 01 00 01 00 01 25 80—Payload

01 3A B0 B3—Message Checksum and End Sequence

Table 2-8 Switch To NMEA Protocol

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		81		Decimal 129
Mode	1		02		See
GGA Message[1]	1		01	sec	See NMEA Protocol Reference Manual for format.
Checksum[2]	1		01		
GLL Message	1		00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1		01		
GSA Message	1		01	sec	See NMEA Protocol Reference Manual for format.
Checksum	1		01		
GSV Message	1		05	sec	See NMEA Protocol Reference Manual for format..
Checksum	1		01		
RMC Message	1		01	sec	See NMEA Protocol Reference Manual for format.
Checksum:	1		01		
VTG Message	1		00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1		01		
MSS Message	1		00	sec	See NMEA Protocol Reference Manual for format.
Checksum	1		01		
Unused Field	1		00		
ZDA Message	1		01	sec	See NMEA Protocol Reference Manual for format.
Unused Field	1		00		
Unused Field	1		01		
Unused Field	1		00		
Unused Field	1		01		
Baud Rate	2		25 80		38400, 19200,9600,4800,2400

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 (i.e., to request a message to be sent every 5 seconds, request the message using a value of 0x05.) Maximum rate is 1/255s.
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).

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 Trickle Power 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 Trickle Power Update rate and the NMEA update rate (i.e. Trickle Power 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 protocol, you must send a SiRF NMEA message to revert to SiRF binary mode. (See NMEA-0183 Reference Manual for more information).

Set Almanac – Message I.D. 130

This command enables the user to upload an almanac file to the Evaluation 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)		Units	Description
		Scale	Example		
Message ID	1		82		ACSII 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 448 elements are partitioned as 32 x 14 elements where the 32 represents the satellite number minus 1 and the 14 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-2000 document. The ICD-GPS-2000 document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps

Poll Software Version – Message I.D. 132

Table 2-11 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 2-11 Software Version

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		84		ACSII 132
Control	1		00		Not used

Payload Length: 2 bytes

DGPS Source - Message I.D. 133

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

External RTCM Data (any serial port)

WAAS (subject to WAAS 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 2-12 DGPS Source Selection (Example 1)

Name	Bytes	Scale	Hex	Units	Decimal	Description
Message I.D.	1		85		133	Message Identification
DGPS Source	1		00		0	See Table 2-14. DGPS Source Selections
Internal Beacon Frequency	4		00000000	Hz	0	See Table 2-15. Internal Beacon Search Settings
Internal Beacon Bit Rate	1		0	BPS	0	See Table 2-15. Internal Beacon Search Settings

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 2-13 DGPS Source Selection (Example 2)

Name	Bytes	Scale	Hex	Units	Decimal	Description
Message I.D.	1		85		133	Message Identification.

Table 2-13 DGPS Source Selection (Example 2)

DGPS Source	1		03		3	See Table 2-14. DGPS Source Selections.
Internal Beacon Frequency	4		0004BAF0	Hz	310000	See Table 2-15. Internal Beacon Search Settings.
Internal Beacon Bit Rate	1		C8	BPS	200	See Table 2-15. Internal Beacon Search Settings.

Payload Length: 7 Bytes

Table 2-14 DGPS Source Selections

DGPS Source	Hex	Decimal	Description
None	00	0	DGPS corrections are not used (even if available).
WAAS	01	1	Uses WAAS 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 2-15 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	None zero	Auto scanning of all frequencies and specified bit rate are performed.
Full Bit Rate Scan	None 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 I.D. 134

Table 2-16 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 2-16 Set Main Serial Port

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		86		decimal 134
Baud	4		00002580		38400,19200,9600,4800,2400,1200
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

Switch Protocol - Message I.D. 135

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

Mode Control - Message I.D. 136

Table 2-17 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

880101010101000000002140501—Payload

00A9B0B3—Message Checksum and End Sequence

Table 2-17 Mode Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		88		Decimal 136
TBD	2		00 00		Reserved
Degraded Mode	1		01		See Table 2-18
TBD	2		00		Reserved
Altitude	2		0000	meters	User specified altitude, range -1,000 to +10,000
Alt Hold Mode	1		00		See Table 2-19
Alt Hold Source	1		02		0=Use last computed altitude, 1=Use user-input altitude
TBD	1				Reserved
Degraded Time Out	1		05	seconds	0=disable degraded mode, 1-120 seconds degraded mode time limit[1]

Table 2-17 Mode Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
DR Time Out	1		01	seconds	0=disable dead reckoning, 1-120 seconds dead reckoning mode time limit[2]
Track Smoothing	1		01		0=disable, 1=enable

Payload Length: 14 bytes

Table 2-18 Degraded Mode Byte Value

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)

s

Table 2-19 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 I.D. 137

Table 2-20 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 2-20 DOP Mask Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		89		Decimal 137
DOP Selection	1		00		See Table 2-21
GDOP Value	1		08		Range 1 to 50

Table 2-20 DOP Mask Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
PDOP Value	1		08		Range 1 to 50
HDOP Value	1		08		Range 1 to 50

Payload Length: 5 bytes

Table 2-21 DOP Selection

Byte Value	Description
0	Auto PDOP/HDOP
1	PDOP
2	HDOP
3	GDOP
4	Do Not Use

DGPS Control - Message I.D. 138

Table 2-22 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 2-22 DGPS Control

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8A		Decimal 138
DGPS Selection	1		01		See Table 2-23
DGPS Time Out:	1		1E	seconds	Range 0 to 255

Payload Length: 3 bytes

Table 2-23 DGPS Selection

Byte Value	Description
0	Auto
1	Exclusive
2	Never Use

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 used). 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 by the SBAS satellite (usually 18 seconds).

Elevation Mask – Message I.D. 139

Table 2-24 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 2-24 Elevation Mask

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
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

Power Mask - Message I.D. 140

Table 2-25 contains the input values for the following example:

Navigation mask to 33 dBHz (tracking default value of 28)

Example:

A0A20003—Start Sequence and Payload Length

8C1C21—Payload

00C9B0B3—Message Checksum and End Sequence

Table 2-25 Power Mask

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
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

Editing Residual– Message I.D. 141

This message is defined as Editing Residual but has not been implemented.

Steady State Detection - Message I.D. 142

This message is defined as Steady State Detection but has not been implemented.

Static Navigation– Message I.D. 143

This command allows the user to enable or disable static navigation to the Evaluation Receiver.

Example:

A0A20002 – Start Sequence and Payload Length

8F01 – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-26 Static Navigation

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		8F		ASCII 143
Static Navigation Flag	1		01		Decimal 1

Payload Length: 2 bytes

Table 2-27 Message ID 143 Description

Name	Description
Message ID	Message ID number.
Static Navigation Flag	Valid values: 1 – enable static navigation 0 – disable static navigation

Poll Clock Status – Message I.D. 144

Table 2-28 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 2-28 Clock Status

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		90		ASCII 144
Control	1		00		Not used

Payload Length: 2 bytes

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

Set DGPS Serial Port - Message I.D. 145

Table 2-29 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 2-29 Set DGPS Serial Port

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		91		Decimal 145
Baud	4		00002580		38400,19200,9600,4800,2400,1200
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 effect Com B only regardless of the port being used to communicate with the Evaluation Receiver.

Poll Almanac - Message I.D. 146

Table 2-30 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 2-30 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 Message I.D. 14. See “Almanac Data - Message I.D. 14” on page 3-23.

Poll Ephemeris - Message I.D. 147

Table 2-31 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 2-31 Ephemeris

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

Payload Length: 3 bytes

1. A value of 0 requests all available ephemeris records, otherwise the ephemeris of the Sv I.D. is requested.

Note – Returned message will be Message I.D. 15. See "Ephemeris Data (Response to Poll) – Message I.D. 15" on page 3-24.

Flash Update - Message I.D. 148

This command allows the user to command the Evaluation 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 2-32 Flash Update

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

Payload Length: 1 bytes

Set Ephemeris – Message I.D. 149

This command enables the user to upload an ephemeris file to the Evaluation Receiver.

Example:

A0A2005B – Start Sequence and Payload Length

95…………………. – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-33 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 3 represents three separate sub-frames. The data is actually packed and the exact format of this representation and packing method can be extracted from the ICD-GPS-2000 document. The ICD-GPS-2000 document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

Switch Operating Modes - Message I.D. 150

Table 2-34 contains the input values for the following example:

Sets the receiver to track a single satellite on all channels.

Example:

A0A20007—Start Sequence and Payload Length

961E510006001E—Payload

0129B0B3—Message Checksum and End Sequence

Table 2-34 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 I.D. 151

Table 2-35 contains the input values for the following example:

Sets the receiver into low power Modes.

Example: Set receiver into Trickle Power at 1 hz update and 200 msec On Time.

A0A20009—Start Sequence and Payload Length

97000000C8000000C8—Payload

0227B0B3—Message Checksum and End Sequence

Table 2-35 Set Trickle Power Parameters

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
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.
Milli Seconds On Time	4		000000C8	msec	range 200 - 900 msec
Payload Length:	9 bytes				

On-times of 700, 800, and 900 msec are 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:

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

Update rate = Off Time + On Time

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

Following are some examples of selections:

Table 2-36 Example of Selections for Trickle Power Mode of Operation

Mode	On Time (msec)	Duty Cycle (%)	Update Rate(1/Hz)
Continuous	1000	100	1
Trickle Power	200	20	1
Trickle Power	200	10	2
Trickle Power	300	10	3
Trickle Power	500	5	10

Table 2-37 TricklePower Supported Modes

	Update Rates (seconds)									
On Time (msec)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
200	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
400	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
500	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
600	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
700		✓	✓	✓	✓	✓	✓	✓	✓	✓
800		✓	✓	✓	✓	✓	✓	✓	✓	✓
900		✓	✓	✓	✓	✓	✓	✓	✓	✓

Push-to-Fix

In this mode the receiver will turn on every 30 minutes to perform a system update consisting of a 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 SnapStart in the event of an NMI. Ephemeris collection time in general takes 18 to 30 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:

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

The off period has a possible range between 10 and 7200 seconds. The default is 1800 seconds.

Poll Navigation Parameters - Message I.D. 152

Table 2-38 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 2-38 Poll Receiver for Navigation Parameters

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

Payload Length: 2 bytes

Note – Returned message will be Message I.D. 19. See “Navigation Parameters (Response to Poll) – Message I.D. 19” on page 3-28.

Set UART Configuration - Message I.D. 165

Table 2-39 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

A50001010000258008010000000100000000E1000801000000FF0505000000000000 0000000FF05050000000000000000000—Payload

0452B0B3—Message Checksum and End Sequence

Table 2-39 Set UART Configuration

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

Table 2-39 Set UART Configuration *(Continued)*

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
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. 0 = SiRF Binary, 1 = NMEA, 2 = ASCII, 3 = RTCM, 4 = User1, 5 = No Protocol.
2. Valid values are 1200, 2400, 4800, 9600, 19200, 38400, and 57600.
3. Valid values are 7 and 8.
4. Valid values are 1 and 2.
5. 0 = None, 1 = Odd, 2 = Even.

Set Message Rate - Message I.D. 166

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

Set message ID 2 to output every 5 seconds starting immediately.

Example:

A0A20008—Start Sequence and Payload Length

A601020500000000—Payload

00AEB0B3—Message Checksum and End Sequence

Table 2-40 Set Message Rate

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		A6		decimal 166
Send Now[1]	1		01		Poll message
MID to be set	1		02		
Update Rate	1		05	sec	Range = 1 - 30
Reserved	1		00		Not used
Reserved	1		00		No used
Reserved	1		00		Not used
Reserved	1		00		Not used

Payload Length: 8 bytes

1. 0 = No, 1 = Yes, if no update rate the message will be polled.

Set Low Power Acquisition Parameters - Message I.D. 167

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

Set maximum off and search times for re-acquisition while receiver is in low power and using Adaptive TricklePower.

Example:

A0A2000F—Start Sequence and Payload Length

A7000075300001D4C00000003C0001—Payload

031EB0B3—Message Checksum and End Sequence

Table 2-41 Set Low Power Acquisition Parameters

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
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 I.D. 168

Table 2-42 contains the input values for the following example:

Queries the receiver to send specific response messages for one of the following messages: 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, and 0x97 (see Table 2-1).

Example:

A0A20002–Start Sequence and Payload Length

A897-Payload

013FB0B3-Message Checksum and End Sequence

Table 2-42 Poll Command Parameters

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		A8		Decimal 168
Poll Msg ID	1		97		Requesting Msg ID 0x97

Payload Length: 2 bytes

Set SBAS Parameters– Message I.D. 170

This command allows the user to set the SBAS parameters.

Table 2-43 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 2-43 Set SBAS Parameters

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
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 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.

Table 2-43 Set SBAS Parameters

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Flag Bit	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

Set UART Configuration - Message I.D. 182

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

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 lists the message list for the SiRF output messages.

Table 3-1 SiRF Messages - Output Message List

Hex	ASCII	Name	Description
0 x 01	1	Reference Navigation Data	Not Implemented
0 x 02	2	Measured Navigation Data	Position, velocity, and time
0 x 03	3	True Tracker Data	Not Implemented
0 x 04	4	Measured Tracking Data	Satellite and C/No information
0 x 05	5	Raw Track Data	Not supported by SiRFstarII
0 x 06	6	SW Version	Receiver software
0 x 07	7	Clock Status	Current clock status
0 x 08	8	50 BPS Subframe Data	Standard ICD format
0 x 09	9	Throughput	Navigation complete data
0 x 0A	10	Error ID	Error coding for message failure
0 x 0B	11	Command Acknowledgment	Successful request
0 x 0C	12	Command NAcknowledgment	Unsuccessful request
0 x 0D	13	Visible List	Auto Output
0 x 0E	14	Almanac Data	Response to Poll
0 x 0F	15	Ephemeris Data	Response to Poll
0 x 10	16	Test Mode 1	For use with SiRFtest (Test Mode 1)
0 x 11	17	Differential Corrections	Received from DGPS broadcast
0 x 12	18	OkToSend	CPU ON / OFF (Trickle Power)
0 x 13	19	Navigation Parameters	Response to Poll
0 x 14	20	Test Mode 2/3/4	Test Mode 2, 3, or 4 test data
0 x 1C	28	Nav. Lib. Measurement Data	Measurement Data
0 x 1D	29	Nav. Lib. DGPS Data	Differential GPS Data
0 x 1E	30	Nav. Lib. SV State Data	Satellite State Data
0 x 1F	31	Nav. Lib. Initialization Data	Initialization Data
0 x 29	41	Geodetic Navigation Data	Geodetic navigation information including error estimates
0 x 2E	46	Test Mode 3	Additional test data (Test Mode 3)
0 x 30	48	Test Mode Raw Measurement Data	Raw GPS measurement data

Table 3-1 SiRF Messages - Output Message List

Hex	ASCII	Name	Description
0 x 31	49	Test Mode Raw Tracking Loop Data	Raw tracking loop data
0 x 32	50	SBAS Parameters	SBAS operating parameters
0 x 34	52	PPS Time Message	Time Message for PPS
0 x FF	255	Development Data	Various status messages

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

Table 3-2 Supported output messages

Message I.D.	SiRF Software Options		
	GSW2	SiRFXTrac	SiRFLoc
1	Yes	No	No
2	Yes	Yes	Yes
3	No	No	No
4	Yes	Yes	Yes
5	No	No	No
6	Yes	Yes	Yes
7	Yes	Yes	Yes
8	Yes	Yes	Yes
9	Yes	Yes	Yes
10	Yes	Yes	Yes
11	Yes	Yes	Yes
12	Yes	Yes	Yes
13	Yes	Yes	Yes
14	Yes	Yes	Yes
15	Yes	Yes	Yes
16	Yes	No	No
17	Yes	No	No
18	Yes	Yes	Yes
19	Yes	Yes	Yes
20	Test Mode 2 only	Test Mode 2/3/4	Test Mode 2/3/4
28	Yes	No	No
29	Yes	No	No
30	Yes	No	No
31	Yes	No	No
41	2.3 or above	No	No
46	Yes	No	No
48	No	Yes	Yes
49	No	Yes	Yes
50	2.3 or above	No	No
52	2.3.2 or above	No	No
255	Yes	Yes	Yes

Reference Navigation Data - Message I.D. 1

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

Measure Navigation Data Out - Message I.D. 2

Output Rate: 1 Hz

Table 3-3 lists the binary and ASCII message data format for the measured navigation data.

Example:

A0A20029—Start Sequence and Payload Length

02FFD6F78CFFBE536E003AC004000000003000104A00036B039780E3
0612190E160F04000000000000—Payload

09BBB0B3—Message Checksum and End Sequence

.

Table 3-3 Measured Navigation Data Out - Binary & ASCII 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
DOP[2]	1	*5	A		÷5	2.0
Mode 2	1		00	Bitmap[3]		0
GPS Week	2		036B			875
GPS TOW	4	*100	039780E3	seconds	÷100	602605.79
SVs in Fix	1		06			6
CH 1 PRN	1		12			18
CH 2 PRN	1		19			25
CH 3 PRN	1		0E			14
CH 4 PRN	1		16			22
CH 5 PRN	1		0F			15
CH 6 PRN	1		04			4
CH 7 PRN	1		00			0
CH 8 PRN	1		00			0
CH 9 PRN	1		00			0
CH 10 PRN	1		00			0
CH 11 PRN	1		00			0
CH 12 PRN	1		00			0

Payload Length: 41 bytes

1. For further information, go to Table 3-4.

2. Dilution of precision (DOP) field contains the HDOP value only.

3. For further information, go to Table 3-5.

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 $X_{vel} \div 8$).

Note – The PRNs listed with the 12 channel fields will only contain PRNs of satellites actually used in the solution.

Table 3-4 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 satellite solution
		2	2 satellite solution
		3	3 satellite solution
		4	>3 satellite solution
		5	2D point solution (Least square)
		6	3D point solution (Least square)
		7	Dead reckoning
TPMODE	Trickle power mode	0	Full power position
		1	Trickle power position
ALTMODE	Altitude mode	0	No altitude hold
		1	Altitude used from filter
		2	Altitude used from user
		3	Forced altitude (from user)
DOPMASK	DOP mask status	0	DOP mask not exceeded
		1	DOP mask exceeded
DGPS	DGPS status	0	No DGPS position
		1	DGPS position

Note – Mode 1 of Message I.D. 2 is used to define the Mode field of the Measure Navigation Message View. Mode 1 is used to define any TTFF values.

Table 3-5 Mode 2

Mode 2		
Hex	**ASCII**	**Description**
0 x 00	0	Solution not validated
0 x 01	1	DR Sensor Data (DR software versions only) 1=DR Valid, 0=Invalid, see bits 0x40 and 0x80
0 x 02	2	Validated (1)[1], Unvalidated (0)
0 x 04	4	If set, Dead Reckoning (Time Out)
0 x 08	8	If set, output edited by UI (i.e., DOP Mask exceeded)
0 x 10	16	Velocity is unvalidated
0 x 20	32	Altitude hold is disabled
0 x 40	64	Reason Sensor DR is invalid (bit 0x01 = 0) (DR software versions only) 00=GPS navigation only, 01=Calibrating DR sensors, 10=DR sensor error, 11=DR test mode
0 x 80	128	Reason Sensor DR is invalid (bit 0x01 = 0) (DR software versions only) 00=GPS navigation only, 01=Calibrating DR sensors, 10=DR sensor error, 11=DR test mode

1. From an unvalidated state, a 5 SV position solution must be achieved to become a validated position. If the receiver continues to navigate in a degraded mode (3D, 2D, 1SV, or DR), then the validated status will remain. If navigation is lost completely, an unvalidated status will result.

Note – Mode 2 of Message I.D. 2 is used to define the Fix field of the Measure 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 I.D. 3

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

Measured Tracker Data Out - Message I.D. 4

Output Rate: 1 Hz

Table 3-6 lists the binary and ASCII message data format for the measured tracker data.

Example:

A0A200BC—Start Sequence and Payload Length

04036C0000937F0C0EAB46003F1A1E1D1D191D1A1A1D1F1D59423F1A1A...—Payload

....B0B3—Message Checksum and End Sequence

Table 3-6 Measured Tracker Data Out

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04	None		4
GPS Week	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[1]		0 x 3F
C/No 1	1		1A			26
C/No 2	1		1E			30
C/No 3	1		1D			29
C/No 4	1		1D			29
C/No 5	1		19			25
C/No 6	1		1D			29
C/No 7	1		1A			26
C/No 8	1		1A			26
C/No 9	1		1D			29
C/No 10	1		1F			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[1]		63
C/No 1	1		1A			26
C/No 2	1		1A			63
SVid, Azimuth, Elevation, State, and C/No 1-10 values are repeated for each of the 12 channels						

Payload Length: 188 bytes

1. For further information, see Table 3-7 for state values for each channel.

Note – Message length is fixed to 188 bytes with nontracking channels reporting zero values.

Table 3-7 State Values for Each Channel

Bit	Description when bit is set to 1
0x0001	Acquisition and 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 I.D. 5

This message is not supported by the SiRFstarII architecture.

Software Version String (Response to Poll) - Message I.D. 6

Output Rate: Response to polling message

Example:

A0A20015—Start Sequence and Payload Length

0606312E322E30444B495431313920534D0000000000—Payload

0382B0B3—Message Checksum and End Sequence

Table 3-8 Software Version String

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		06			6
Character	20		[1]			[2]

Payload Length: 21 bytes

1. 06312E322E30444B495431313920534D0000000000
2. 1.2.0DKit119 SM

Note – Convert to symbol to assemble message (i.e., 0 x 4E is ‘N’). These are low priority task and are not necessarily output at constant intervals.

Response: Clock Status Data - Message I.D. 7

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD021549240800012231000472814D4DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table 3-9 Clock Status Data Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		07			7
GPS Week	2		03BD			957
GPS TOW	4	*100	02154924	sec	÷100	349494.12
Svs	1		08			8
Clock Drift	4		00012231	Hz		74289
Clock Bias	4		0004728	nano sec		128743715
Estimated GPS Time	4		14D4DAEF	milli sec		349493999

Payload Length: 20 bytes

50 BPS Data – Message I.D. 8

Output Rate: As available (12.5 minute download time)

Example:

A0A2002B—Start Sequence and Payload Length

08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFF A80365A867FC67708BEB5860F4—Payload

15AAB0B3—Message Checksum and End Sequence

Table 3-10 50 BPS Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		08			8
Channel	1		00			0
Sv I.D	1		19			25
Word[10]	40					

Payload Length: 43 bytes per subframe (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 in bits 31 and 30, respectively, from the previous navigation message word.

CPU Throughput – Message I.D. 9

Output Rate:1 Hz

Example:

A0A20009—Start Sequence and Payload Length

09003B0011001601E5—Payload

0151B0B3—Message Checksum and End Sequence

Table 3-11 CPU Throughput

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		09			9
SegStatMax	2	*186	003B	milli sec	÷186	.3172
SegStatLat	2	*186	0011	milli sec	÷186	.0914
AveTrkTime	2	*186	0016	milli sec	÷186	.1183
Last MS	2		01E5	milli sec		485

Payload Length: 9 bytes

Error ID Data – Message I.D. 10

Output Rate: Every measurement cycle (Full Power / Continuous: 1Hz)

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 3-12 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

Table 3-12 Error ID 2 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Satellite ID	4		00000001			1
Subframe No	4		00000002			2

Payload Length: 13 bytes

Table 3-13 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 or Space Vehicle (SV) I.D. number or 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 3-14 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 3-15 Error ID 9 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).

Table 3-15 Error ID 9 Message Description

Name	Description
Count	Number of 32 bit data in message.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or 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 3-16 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
Pseudo Range	4		00001234			4660

Payload Length: 9 bytes

Table 3-17 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.
Pseudo Range	Pseudo Range

Error ID: 11

Code Define Name: ErrId_RXM_TDOPOverflow

Error ID Description: Convert pseudo range rate to doppler frequency exceeds limit.

Example:

A0A20009 – Start Sequence and Payload Length

0A000B0001xxxxxxxx – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-18 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 3-19 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 3-20 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 3-21 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 or Space Vehicle (SV) I.D. number or 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 3-22 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 3-23 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 or 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 3-24 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 3-25 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 or 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 3-26 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 3-27 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 or 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 3-28 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 Compute Clock Offset Checksum	4 4		cccccccc xxxxxxxx			cccc xxxx
Battery-Backed Clock Offset Checksum	4		aaaaaaaa			aaaa
Battery-Backed Clock Offset Computed Position Time Checksum	4 4		bbbbbbbb xxxxxxxx			bbbb xxxx
Battery-Backed Position Time Checksum	4		aaaaaaaa			aaaa

Payload Length: 21, 17, or 11 bytes

Table 3-29 Error ID 4104 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count Computed Receiver Control Checksum	Number of 32 bit data in message. 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 Compute Clock Offset Checksum	Battery-backed receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are 0-12. Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.
Battery-Backed Clock Offset Checksum	Battery-backed clock offset checksum of SRAM.Data.DataBuffer.clkChkSum.
Battery-Backed Clock Offset Computed Position Time Checksum	Battery-backed clock offset value stored in SRAM.Data.DataBuffer,clkOffset. 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 or 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 3-30 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 3-31 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 or 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 3-32 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 3-33 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 or 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 3-34 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 3-35 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 or 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 3-36 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 3-37 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 or 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 3-38 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 3-39 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 or 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 3-40 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 3-41 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 I.D. 11

Output Rate: Response to successful input message

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

A0A20002—Start Sequence and Payload Length

0B92—Payload

009DB0B3—Message Checksum and End Sequence

Table 3-42 Command Acknowledgment

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0B			11
Ack. I.D.	1		92			146

Payload Length: 2 bytes

Command NAcknowledgment – Message I.D. 12

Output Rate: Response to rejected input message

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

A0A20002—Start Sequence and Payload Length

0C92—Payload

009EB0B3—Message Checksum and End Sequence

Table 3-43 Command NAcknowledgment

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0C			12
NAck. I.D.	1		92			146

Payload Length: 2 bytes

Visible List – Message I.D. 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 3-44).

Example:

A0A2002A—Start Sequence and Payload Length

0D081D002A00320F009C0032....—Payload

....B0B3—Message Checksum and End Sequence

Table 3-44 Visible List

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0D			13
Visible Svs	1		08			8
CH 1 - Sv I.D.	1		10			16
CH 1 - Sv Azimuth	2		002A	degrees		42
CH 1 - Sv Elevation	2		0032	degrees		50
CH 2 - Sv I.D.	1		0F			15
CH 2 - Sv Azimuth	2		009C	degrees		156
CH 2 - Sv Elevation	2		0032	degrees		50
.....						

Payload Length: Variable

Almanac Data - Message I.D. 14

Output Rate: Response to poll

Example:

A0A2001E—Start Sequence and Payload Length

0E0111014128FF630D51FD5900A10CC111B454B909098C6CE7

14..............—Payload

09E5B0B3—Message Checksum and End Sequence

Table 3-45 Almanac Data

Name	Bytes	Binary (Hex) Scale	Example	Notes
Message I.D.	1		0E	
SV I.D.	1		01	Satellite PRN Number[1]
Almanac Week & Status	2		1101	First 10 bits is the Almanac week. Next 5 bits have a zero value. Last bit is 1.
Almanac Data	24		....	This information is taken from the 50BPS navigation message broadcast by the satellite. This information is the last 8 words in the 5th subframe but with the parity removed.[2]
Package Checksum	2		4CA1	This is the checksum of the preceding data in the payload. It is calculated by arranging the previous 26 bytes as 13 half-words and then summing them.[3]

1. Each satellite almanac entry is output in a single message.
2. There are 25 possible pages in subframe 5. Pages 1 through 24 contain satellite specific almanac information which is output as part of the almanac data. Page 25 contains health status flags and the almanac week number.
3. This checksum is not used for serial I/O data integrity. It is used internally for ensuring that almanac information is valid.

Payload Length: 30 bytes

The data is actually packed and the exact format of this representation and packing method can be extracted from the ICD-GPS-2000 document. The ICD-GPS-2000 document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

Ephemeris Data (Response to Poll) – Message I.D. 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

Example:

A0 A2 00 5C —Start Sequence and Payload Length

0F 1A 00 1A 00 8B D3 A5 3A 11 01 3B 15 B8 8A 99 FC 88 D4 40 31 3B F2 DD 69 78 00 FF 9E 38 F6 B6 00 1A 00 8B D4 29 DD FB 5C 31 0E F1 79 A6 4D FC 1F 07 AB F1 29 00 F7 A1 0D 12 7F 69 78 7D 00 1A 00 8B D2 2E 00 37 CB F8 C1 D1 00 7F 27 ED E1 D9 2F 2D 16 5A DB D8 FF A2 0C DD F6 F9 —Payload

2A 55 B0 B3—Message Checksum and End Sequence

Table 3-46 Ephemeris Data

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Notes
Message I.D.	1		0F	Message I.D.
Satellite I.D.	1		1A	Satellite PRN Number[1]
Data	90		…	UINT16 [3] [15] array with subframes 1 to 3 data. See description below.

1. Each satellite almanac entry is output in a single message.

Payload Length: 92 bytes

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 satellite ID. The remaining words in the row will contain the data from the navigation message subframe, with row [0] containing subframe 1, row [1] containing subframe 2, and row [2] containing subframe 3. Data from the subframe 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 subframe, the TLM or telemetry word, does not contain any data needed by the receiver, it is not saved. Thus, there are 9 remaining words, with 3 bytes each, in each subframe. This total of 27 bytes is stored in 14 16-bit words. The second word of the subframe, the HOW or Handoff Word, has its most significant byte (MSB) stored as the least significant byte (LSB) of the first of the 16-bit words. Each following byte is stored in the next available byte of the array. Table 3-47 shows where each byte of the subframe is stored in the row of 16-bit words.

Table 3-47 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array	
Word	**Byte**	**Word**	**Byte**
2 (HOW)	MSB	[] [1]	LSB
2	Middle	[] [2]	MSB
2	LSB	[] [2]	LSB
3	MSB	[] [3]	MSB
3	Middle	[] [3]	LSB
3	LSB	[] [4]	MSB
4	MSB	[] [4]	LSB
4	Middle	[] [5]	MSB
4	LSB	[] [5]	LSB
5	MSB	[] [6]	MSB
5	Middle	[] [6]	LSB
5	LSB	[] [7]	MSB
6	MSB	[] [7]	LSB
6	Middle	[] [8]	MSB
6	LSB	[] [8]	LSB
7	MSB	[] [9]	MSB
7	Middle	[] [9]	LSB
7	LSB	[] [10]	MSB
8	MSB	[] [10]	LSB
8	Middle	[] [11]	MSB

Table 3-47 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array	
Word	**Byte**	**Word**	**Byte**
8	LSB	[] [11]	LSB
9	MSB	[] [12]	MSB
9	Middle	[] [12]	LSB
9	LSB	[] [13]	MSB
10	MSB	[] [13]	LSB
10	Middle	[] [14]	MSB
10	LSB	[] [14]	LSB

Note – Message ID 149 uses the same format, except the Satellite ID (the second byte in Message ID 15) is omitted. Message ID 149 is thus a 91-byte message. The satellite ID is still embedded in elements [0][0], [1][0] and [2][0] of the data array.

Test Mode 1 - Message I.D. 16

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

Example:

A0A20011—Start Sequence and Payload Length

100015001E000588B800C81B5800040001—Payload

02D8B0B3—Message Checksum and End Sequence

Table 3-48 Test Mode 1 Data

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	ASCII (Decimal) Scale	ASCII (Decimal) 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 3-49 Detailed Description of Test Mode 1 Data

Name	Description
Message I.D.	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 causes a VCO lost lock.

Differential Corrections - Message I.D. 17

Message I.D. 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. For more information see *RTCM Recommended Standards for Differential GNSS* by the Radio *Technical Commission for Maritime Services*.

OkToSend - Message I.D. 18

Output Rate: Trickle Power CPU on/off indicator

Example:

A0A20002—Start Sequence and Payload Length

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table 3-50 Almanac Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		12			12
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

Navigation Parameters (Response to Poll) – Message I.D. 19

Output Rate: 1 Response to Poll

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 3-51 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	1		00			
Altitude Hold Source	1		00			
Altitude Source Input	2		0000	meters		
Degraded Mode[2]	1		00			
Degraded Timeout	1		00	seconds		
DR Timeout	1		01	seconds		
Track Smooth Mode	1		1E			
Static Navigation	1		0F			
3SV Least Squares	1		01			
Reserved	4		00000000			
DOP Mask Mode[3]	1		04			
Navigation Elevation Mask	2		004B			

Table 3-51 Navigation Parameters *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Navigation Power Mask	1		1C			
Reserved	4		00000000			
DGPS Source	1		02			
DGPS Mode[4]	1		00			
DGPS Timeout	1		1E	seconds		
Reserved	4		00000000			
LP Push-to-Fix	1		00			
LP On-time	4		000003E8			
LP Interval	4		000003E8			
User Tasks Enabled[5]	1		00			
User Task Interval	4		00000000			
LP Power Cycling Enabled	1		00			
LP Max. Acq. Search Time	4		00000000	seconds		
LP Max. Off Time	4		00000000	seconds		
APM Enabled/Power Duty Cycle[6]	1		00			
Number of Fixes	2		0000			
Time Between Fixes	2		0000	seconds		
Horizontal/Vertical Error Max[7]	1		00	meters		
Response Time Max	1		00	seconds		
Time/Accuracy & Time/Duty Cycle Priority[8]	1		00			

Payload Length: 65 bytes

1. 00=GSW2 Definition, 01=SiRF Binary APM Definition, >02=Reserved
2. See Table 2-17.
3. See Table 2-20.
4. See Table 2-22.
5. User task enabled - scheduled from 100ms interrupt and the idle loop.
6. Bit7: APM Enabled, 1: Enabled, 0: Disabled, Bit 4-0: power duty cycle, Range: 1-20 scaled to 5%, 1: 5%, 2: 10% … 20:100%
7. See Table 3-52
8. Bit 3-2: Time accuracy, 0x00 = No priority imposed, 0x01 = RESP_TIME_MAX has higher priority, 0x02 = HORI_ERR_MAX has higher priority, Bit 1-0: time duty cycle, 0x01 = Time between two consecutive fixes has priority, 0x02 = Power Duty cycle has higher priority

Table 3-52 Horizontal/Vertical Error

Value	Position Error (in meters)
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

Test Mode 2/3/4 - Message I.D. 20

The definition of MID 20 is different depending on the version and type of software being used. For GSW2, MID 20 is defined as Test Mode 2 only. For SiRFLoc or SiRFXTrac, MID can be 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, 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

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A0000000000000000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-53 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	2	*10	1B0E	Hz	÷10	692.6
Clock Offset	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 3-54 Detailed Description of Test Mode 2 Message

Name	Description
Message I.D.	Message I.D. number.
SV ID	The number of the satellite being tracked.

Table 3-54 Detailed Description of Test Mode 2 Message

Name	Description
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	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.

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 3-55 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
Poor Status	2		001F			31
Good Status	2		0D29			3369

Table 3-55 Test Mode 3 Message *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
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	2	*10	1B0E	Hz	÷10	692.6
Clock Offset	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 3-56 Detailed Description of Test Mode 3 Message

Name	Description
Message I.D.	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	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.
Bad 1Khz Bit Count	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.

Table 3-56 Detailed Description of Test Mode 3 Message

Name	Description
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 3-57 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	2	*10	1B0E	Hz	÷10	692.6
Clock Offset	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 3-58 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 I.D. 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 3-59 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	milli-sec		135000
Satellite ID	1		15			20
GPS Software Time	8		F143F62C 4113F42F	milli-sec		2.4921113 696e+005
Pseudorange	8		417B235C F3FBE95E	m		2.1016756 638e+007
Carrier Frequency	4		468C6964	m/sec		1.6756767 578e+004
Carrier Phase	8		B8FBC582 415CF1C3	m		4.4345542 262e+004
Time in Track	2		7530	milli-sec		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	milli-sec		500
Extrapolation Time	2		0000	milli-sec		
Phase Error Count	1		00			0
Low Power Count	1		00			0

Payload Length: 56 bytes

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 3-60 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 3-61 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.
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 or Time of Week (TOW) estimated by the software in milliseconds.
Pseudo-range	This is the generated pseudo range measurement for a particular SV.
Carrier Frequency	This is can be interpreted in two ways: 1) The delta-pseudo range normalized by the reciprocal of the delta pseudo range measurement interval. 2) The frequency from the AFC loop. If, for example, the delta pseudo range interval computation for a particular channel is zero, then it can be the AFC measurement, otherwise it is a delta-pseudo range computation.
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

Table 3-61 Detailed Description of the Measurement Data *(Continued)*

Name	Description
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

Navigation Library DGPS Data - Message I.D. 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 3-62 Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1D			29
Satellite ID	2		000F			15
IOD	2		00B5			181
Source[1]	1		01			1
Pseudo-range Correction	4		BFC97C67	m		-1.574109
Pseudo-range rate Correction	4		3CAAAA AB	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 = Use WAAS channel, 2 = Use external source, 3 = Use Internal Beacon, 4 = Set DGPS Corrections

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 I.D. 30

The data in Message I.D. 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 3-63 SV State Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	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		

Table 3-63 SV State Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
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 into reverse order

Navigation Library Initialization Data - Message I.D. 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 3-64 Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	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
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

Table 3-64 Measurement Data *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Elevation Nav. Mask	2		000F			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					

Table 3-64 Measurement Data *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
GPS Week	2		0434			1076
Time Init. Source[7]	1		02			2
Drift	8					
Drift Init. Source[8]	1		02			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

Geodetic Navigation Data - Message I.D. 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 00 BB 00 00 01 38 00 00 00 00 00 00 6B 0A F8 61 00 00 00 00 00 1C 13 14 00 00 00 00 00 00 00 00 00 00 00 00 08 05 00—Payload

11 03 B0 B3—Message Checksum and End Sequence

Table 3-65 Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1					41
Nav Valid	2					
NAV Type	2					
Extended Week Number	2			week		
TOW	4			sec		
UTC Year	2			year		
UTC Month	1			month		
UTC Day	2			day		
UTC Hour	2			hr		
UTC Minute	2			min		
UTC Second	2			sec		

Table 3-65 Measurement Data *(Continued)*

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Satellite ID List	4					
Latitude	4			deg		
Longitude	4			deg		
Altitude from Ellipsoid	4			meters		
Altitude from MSL	4			meters		
Map Datum[1]	1					
Speed Over Ground (SOG)	2			m/sec		
Course Over Ground (COG, True)	2			deg		
Magnetic Variation	2			deg		
Climb Rate	2			m/sec		
Heading Rate	2			deg /sec		
Estimated Horizontal Position Error (EHPE)	4			meters		
Estimated Vertical Position Error (EVPE)	4			meters		
Estimated Time Error (ETE)	4			meters		
Estimated Horizontal Velocity Error (EHVE)	2			m/sec		
Clock Bias	4			meters		
Clock Bias Error	4			meters		
Clock Drift	4			m/sec		
Clock Drift Error	4			meters		
Distance Traveled since RESET	4			meters		
Distance Traveled error	2			meters		
Heading Error	2			deg		
Number of SVs in Fix	1					
HDOP	1					
Reserved	1					

Payload Length: 91 bytes

1. Map Datum indicates the datum to which latitude, longitude and altitude relate. 0 = WGS-84, by default. Other values will be defined as other datums are implemented.

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.

Table 3-66 Detailed Description of Geodetic Navigation Data Message

Name	Description
Message ID	Message I.D. number.
Nav Valid	Any bits not 0: Nav is Invalid Bit 0=1: Position fix not validated Bit 1=1: Reserved (EHPE limits exceeded) Bit 2=1: Reserved (EVPE limits exceeded) Bit 3=1: DR data Invalid Bit 4=1: DR Cal Invalid Bit 5=1: GPS-based Cal not Available Bit 6=1: DR Pos Invalid Bit 7=1: DR Heading Invalid Bit 8-15=1: Undefined
NAV Type	NAV Mode Bits definition: GPS Fix Type: bits 2-0: SVs Used 000 No Nav 001 1 SV solution 010 2 SV solution 011 3 SV solution (2D) 100 4 or More SV (3D) 101 Least Sq 2D fix 110 Least Sq 3D fix 111 DR solution (0 SV) bit 3 =1: Trickle Power On bits 5-4 Altitude hold 00 No Altitude Hold 01 Filter Altitude used 10 Use Altitude used 11 User Forced Altitude bit 6 = 1: SIRFDRIVE On bit 7 = 1: DGPS corrections bit 8 = 1: Sensor Based DR bit 9 = 1: Sol Validated bit 10 = 1: VEL DR Timeout bit 11 = 1: Edited by UI bit 12 = 1: Velocity Valid bit 13 = 1: Altitude hold is disabled bit 14-15 =1: Sensor DR status, 00=GPS only solution, 01=DR Calibration from GPS, 10=DR Sensor Error, 11=DR is in test
Extended Week Number	Range: 800 to 500
TOW	Range: 0 to 604800.00
UTC Year	Range: 1980 to 3000
UTC Month	Range: 1 to 12
UTC Day	Range: 1 to 31
UTC Hour	Range: 0 to 23

Table 3-66 Detailed Description of Geodetic Navigation Data Message

Name	Description
UTC Minute	Range: 0 to 60
UTC Second	Range: 0 to 60
Number of Satellites in Solution	Range: 0 -12
Latitude	Range: -90 to 90
Longitude	Range: -180 to 180
Altitude from Ellipsoid	Range: -2000 to 100000.0
Altitude from MSL	Range: -2000 to 100000.0
Map Datum	Range: 0-255
Speed Over Ground (SOG)	Range: 0-655
Course Over Ground (COG, True)	Range: 0 to 360
Magnetic Variation	Range: -90 to 90
Climb Rate	Range: -300 to 300
Heading Rate	Range: -300 to 300
Estimated Horizontal Position Error (EHPE)	Range: 0 to 6000000
Estimated Vertical Position Error (EVPE)	Range: 0 to 24000
Estimated Time Error (ETE)	Range: 0 to 6000000
Estimated Horizontal Velocity Error (EHVE)	Range: 0 to 655
Clock Bias	Range: -90000 to 90000
Clock Bias Error	Range: 0 to 6000000
Clock Drift	Range: -1000 to 1000
Clock Drift Error	Range: 0 to 1000
Distance Traveled since RESET	Range: 0 to 4294967295
Distance Traveled error	Range: 65535
Heading Error	Range: 0 to 180
Number of SVs in Fix	Count of satellites indicated by SVID list
HDOP	Horizontal Dilution of Precision
Reserved	Reserved

Test Mode 3/4 - Message I.D. 46

Note – This message is used in GSW2 software only. 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 3-67 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 3-67 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	2	*10	1B0E	Hz	÷10	692.6
Clock Offset	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 3-68 Detailed Description of Test Mode 3 Message

Name	Description
Message I.D.	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.

Table 3-68 Detailed Description of Test Mode 3 Message

Name	Description
Clock Drift	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.
Bad 1Khz Bit Count	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.
Abs Q1ms	Absolute value of the 1ms Q count over the duration of the test period.

Test Mode Raw Measurement Data - Message I.D. 48

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

Example:

?—Start Sequence and Payload Length

30010000000000015000660D0F3FBE95E417B235C468C6964—Payload

?—Message Checksum and End Sequence

Table 3-69 Test Mode Raw Measurement Data Message

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Units	Scale	Example
Message ID	1		30			48
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		15			20
Receiver Time Tag	4		000660D0	milli-sec		135000
Pseudo-range	4	*10	F3FBE95E4 17B235C	m		2.10167566 38e+007
Carrier Frequency	4	*100	468C6964	m/sec		1.67567675 78e+004

Payload Length: Variable

Table 3-70 Detailed Description of Test Mode Raw Measurement Data Message

Name	Description
Message ID	Message I.D. number.
nChannel	Number of channels reported
Reserved	Reserved
Channel	Receiver channel number for a given satellite being searched or tracked.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random noise (PRN) number.
Receiver Time Tag	This is the count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock.
Pseudo-range	This is the generated pseudo range measurement for a particular SV.

Table 3-70 Detailed Description of Test Mode Raw Measurement Data Message

Name	Description
Carrier Frequency	This can be interpreted in two ways: 1. The delta-pseudo range normalized by the reciprocal of the delta pseudo range 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.

Test Mode Raw Tracking Loop Data - Message I.D. 49

Output Rate: Every measurement cycle (full power / continuous: 8.33Hz)

Example:

?—Start Sequence and Payload Length

3101000000000015000660D0F3FBE95E417B235C—Payload

?—Message Checksum and End Sequence

Table 3-71 Test Mode Raw Tracking Loop Data Message

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Units	Scale	Example
Message ID	1		31			49
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		15			20
Receiver Time Tag	4		000660D0	milli-sec		135000
Carrier Doppler Rate	4	100000	F3FBE95E417B235C	Carrier Cycles/2ms/10ms	1048576	2.1016756638e+007
Carrier Doppler	4	100000	F3FBE95E417B235C	Carrier Cycles/2ms	1048576	2.1016756638e+007
Carrier Phase	4	400	468C6964	Carrier Cycles	1024	1.6756767578e+004
Code Offset	4	181000	00009783	Chip	1576960	38787

Payload Length: Variable

Table 3-72 Detailed Description of Test Mode Raw Tracking Loop Data Message

Name	Description
Message ID	Message I.D. number.
nChannel	Number of channels reported
Reserved	Reserved
Channel	Receiver channel number for a given satellite being searched or tracked.

Table 3-72 Detailed Description of Test Mode Raw Tracking Loop Data Message

Name	Description
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random noise (PRN) number.
Receiver Time Tag	This is the count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock.
Carrier Doppler Rate	The carrier doppler rate value from the Costas tracking loop for the satellite ID on channel 0.
Carrier Doppler	The frequency from the Costas loop for the satellite ID on channel 0.
Carrier Phase	The carrier phase value from the Costas tracking loop for the satellite ID on channel 0.
Code Offset	The code offset from the Code loop for the satellite ID on channel 0.

SBAS Parameters - Message I.D. 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 3-73 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
Spare	8		0000000000 000000			00000000

Payload Length: 13 bytes

Table 3-74 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.

Table 3-74 Detailed Description of SBAS Parameters

Name	Description
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 I.D. 52

Outputs the time associated with the 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 SiRF binary message ID 52 will report the time of the 1 PPS pulse in UTC any time 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: 1Hz (Synchronized to PPS)

Example:

A0A2000034.—Start Sequence and Payload Length

15122A0E0A07D3000D000000050700000000—Payload

0190B0B3—Message Checksum and End Sequence

Payload Length: 19 bytes

Table 3-75 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	8		0A			10
Year	2		07D3			2003
UTCOffsetInt	2		000D			13
UTCOffsetFrac	4	10^9	00000005	ns	10^9	5
Status	1		7			7
Reserved	4		00000000			00000000

Note – The status byte is bit-mapped with the following meaning:

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

Development Data – Message I.D. 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

Payload Length: Variable

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

Since August, 22, 1999, the GPS week roll from 1023 weeks to 0 weeks is in accordance with the ICD-GPS-200 specifications. To maintain roll over compliance, SiRF reports the ICD GPS week between 0 and 1023. If the user needs to have access to the Extended GPS week (ICD GPS week + 1024) this information is available through the Clock Status Message (007) under the Poll menu.

NMEA Protocol in TricklePower Mode

The NMEA standard is generally used in continuous update mode at some predefined rate. This mode is perfectly compatible with all SiRF TricklePower and Push-to-Fix modes of operations. There is *no* mechanism in NMEA that indicates to a host application when the receiver is on or in standby mode. If the receiver is in standby mode (chip set OFF, CPU in standby), then no serial communication is possible for output of NMEA data or receiving SiRF proprietary NMEA input commands. To establish reliable communication, the user must repower the receiver and send commands while the receiver is in full-power mode (during start-up) and prior to reverting to TricklePower operation. Alternatively, the host application could send commands (i.e., poll for position) repeatedly until the request has been completed. The capability to create communication synchronization messages in NMEA mode is available through the System Development Kit (SDK).

In Trickle-Power mode, the user is required to select an update rate (seconds between data output) and On Time (milli-seconds the chipset is on). When the user changes to NMEA mode, the option to set the output rate for each of the selected NMEA messages is also required. These values are multiplied by the TricklePower update rate value as shown in Table 4-1.

Table 4-1 NMEA Data Rates Under Trickle Power Operation

Power Mode	**Continuous**	**Trickle Power**	**Trickle Power**	**Trickle Power**
Update Rate	1 every second	1 every second	1 every 5 seconds	1 every 8 seconds
On Time	1000	200	400	600
NMEA Update Rate	1 every second	1 every 5 seconds	1 every 2 seconds	1 every 5 seconds
Message Output Rate	1 every second	1 every 5 seconds	1 every 10 seconds	1 every 40 seconds

Note – The On Time of the chip set has no effect on the output data rates.