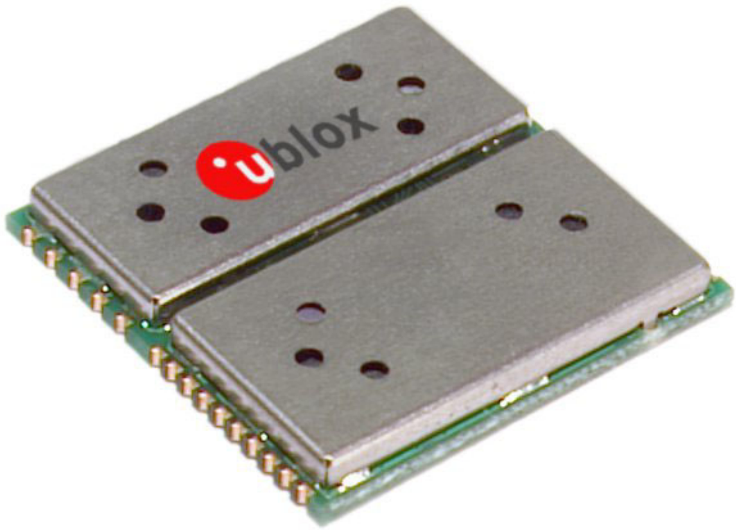
TIM
GPS Receiver Macro-Component

Protocol Specification



Abstract

This document lists up all protocol messages which are supported by the TIM modules, receiver boards, smart antennas and the TIM Evaluation Kit based on the SiRFstar™ II chip set.

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Protocol Specification

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Initial Version	10. Dec 01	GzB	First Release
A	08. Feb 02	GzB	See section 1.1
B	20. Mar 02	GzB	See section 1.1
C	17. May 02	GzB	See section 1.1
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E	19. Feb 03	GzB	See section 1.1
E1	11. Apr 03	GzB	See section 1.1

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Contents

1 Introduction

This application note describes the format of the available protocols of u-blox TIM GPS receivers. These receivers support the SiRF® binary and the standard NMEA protocol. In addition, the RTCM protocol is supported to feed differential GPS data to the GPS receiver to enhance accuracy.

1.1 Information on Document Revisions

1.1.1 Document Revision A

Revision A contains additional NMEA and SiRF® Binary Messages which access u-blox specific features. These features are augmentations of the Firmware Release provided by SiRF. These functions are available in the release "Firmware Release 2.1 UBX 1.0" or later.

1.1.2 Document Revision B

Title page and chapter 1 updated

Added OTS message (described in NMEA PSRF150, referenced NMEA 103 and SiRF® Binary 129)

Clarified tables on "Active Antenna Status" (Table 2-15, Table 3-69)

SiRF® Binary message I.D. 98: DOP mask information corrected

1.1.3 Document Revision C

Former appendix A.2 "Low Power Operation": All in-depth information on low power modes have been moved to a separate application note on low power modes [2].

Former appendix A.3 "Hardware Status State Machine": Info on active antenna supervisor has been moved to a separate application note on active antenna supervisor [6].

Former Chapter 4 "User Parameters Block" is transferred to user's manual of firmware update utility [7].

Current appendix A.2 (was A.3 in Rev. B) "Switching between NMEA and SiRF® Protocol": Minor correction in message number made in figure.

1.1.4 Document Revision D

The most recent firmware release (Firmware 2.1 UBX 2.2) contains data logging functionality. The new messages used to configure the data logger and carrying out downloads of logged data have been added. For more information on the data logger, please refer to the *TIM Data Logging Functionality - User's Manual* [9]. Minor correction made in example datas for SiRF message ID 28. Changed the picture on the frontpage to reduce filesize.

1.1.5 Document Revision E

SiRF® binary message . I.D: 28: Representation of floating point numbers has been corrected. They match with hexadecimal entries. In NMEA messages, the latitude format: dddmm.mmm has been corrected to ddmm.mmm. The NMEA ZDA message was erroneously referred as "ublox proprietary" and has been corrected.

Revision E1: Corrected error messages appearing the footers of nearly every page. Table 2.22: Added PSRF150 message. Explanation on “Magnetic declination” added in section 2.2.6.

2 NMEA Protocol

In default configuration the TIM GPS receiver outputs data in NMEA- 0183 format (Port A) as defined by the National Marine Electronics Association (NMEA), Standard For Interfacing Marine Electronic Devices, Version 2.20, January 1, 1997.

2.1 Protocol Layer

2.1.1 NMEA Checksum

All NMEA sentences have an optional checksum. The Checksum can be enabled/disabled when setting up the NMEA Protocol. The optional checksum field consists of a "*" and two hex digits representing the exclusive OR of all characters between, but not including, the "$" and "*".

The following pseudo code calculates a checksum of an array of characters " line". The first character in the array is " line[0]":

```
line = getline()
index = 1
checksum = 0

while line[ index] <> '*' do
checksum = checksum EXOR line[ index]
index = index+ 1

end while
```

2.1.2 Transport Message (NMEA Input)

Start Sequence	Payload	Checksum	End Sequence
$GPxxx $PSRF<MID>[1]	Data[2]	*CKSUM[3]	<CR> <LF>[4]

Table 2-1: Transport Message

1. Message Identifier consisting of three numeric characters. Input messages begin at MID 100.
2. Message specific data. Refer to a specific section for <data>...<data> definition.
3. CKSUM is a two-hex character checksum as defined in the chapter in the NMEA specification. Use of checksums is required on all input messages.
4. Each message is terminated using Carriage Return (CR = ASCII 13 = \r) Line Feed (LF = ASCII 10 = \n). Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

Important Notice

All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

2.2 NMEA Output messages

The following table lists each of the NMEA output messages supported by the TIM GPS Unit and a brief description.

A full description and definition of the listed NMEA messages are provided in the following sections of this chapter.

Option	Description
GGA	Time, position and fix type data.
GLL	Latitude, longitude, UTC time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution and DOP values.
GSV	The number of GPS satellites in view, satellite ID numbers, elevation, azimuth, and SNR values.
MSS	Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver.
RMC	Time, date, position, course and speed data.
VTG	Course and speed information relative to the ground
ZDA	Date and time
PSRF150	OK-to-send (used in Trickle power mode to indicate begin / end of active phase) (u-blox)
PSRF161	Hardware Status: Active antenna and Automatic Gain Control (AGC) (u-blox)

Table 2-2: NMEA Output Messages

Important Notice

The shaded fields in the table above relate to messages which are supported by u-blox firmware, but not by the original SiRF® firmware.

Important Notice

Some NMEA messages, such as GGA (Position Fix Indicator), GLL (Status) and RMC (Status) provide information on validity of position fix.

Position fix is valid if solution is validated if

(a) Solution validated ((Mode 1 byte ≠ 0) and (Mode 2 byte: Solution validated)

or

(b) (nav. mode = 3D fix and PDOP < 10) or (nav. mode = 2D fix and PDOP < 20)

Mode 1 byte is described in table Table 3-6. Mode 2 byte is described in Table 3-8.

The 'solution validated' should not be confused with a valid fix. if the receiver reports a fix validated (in SiRF® binary mode, or indirectly through the NMEA valid calculation), it has used more than 4 SVs for the fix, and therefore performed some consistency checks on the range measurements that succeeded.

2.2.1 NMEA Output message GGA, Global Positioning System Fixed Data

The following table contains the values for the following example:

```
$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , , ,0000*18
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPGGA		GGA protocol header
UTC Time	hhmmss.sss	161229.487		Current time
Latitude	ddmm.mmmm	3723.2475		Degrees + minutes
N/S Indicator	character	N		N=north or S=south
Longitude	dddmm.mmmm	12158.3416		Degrees + minutes
E/W indicator	character	W		E=east or W=west
Position Fix Indicator	1 digit	1		See Table 2-4.
Satellites Used	numeric	07		Range 0 to 12
HDOP	numeric	1.0		Horizontal Dilution of Precision
MSL Altitude[1]	numeric	9.0	meters	
Units	character	M		Stands for "meters"
Geoid Separation[1]	blank			Not used
Units	blank	M		stands for "meters
Age of Differential Corrections	numeric		second	Blank (Null) fields when DGPS is not used
Diff. Reference Station ID	numeric	0000		
Checksum	hexadecimal	*18		
<CR> <LF>				End of message

[1] u-blox ag does not support geodic corrections. Values are WGS-84 heights.

Table 2-3: GGA Data Format

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode. Fix Valid
2	Differential GPS. GPS SPS Mode. Fix Valid
3	GPS PPS Mode. Fix Valid

Table 2-4: GGA Position Fix Indicator

2.2.2 NMEA Output message GLL, Geographic Position, Latitude/Longitude

The following table contains the values for the following example:

```
$GPGLL,3723.2475,N,12158.3416,W,161229.487,A*2C
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPGLL		GLL protocol header
Latitude	ddmm.mmmm	3723.2475		Degrees + minutes
N/S Indicator	character	N		N=north or S=south
Longitude	dddmm.mmmm	12158.3416		Degrees + minutes
E/W indicator	character	W		E=east or W=west
UTC Time	hhmmss.sss	161229.487		Current time
Status	character	A		A=data valid or V=data invalid
Checksum	hexadecimal	*2C		
<CR> <LF>				End of message

Table 2-5: GLL Data Format

2.2.3 NMEA Output message GSA, GNSS DOP and Active Satellites

The following table contains the values for the following example:

`$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33`

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$GPGSA		GSA protocol header
Mode 1	character	A		See Table 2-7
Mode 2	1 digit	3		See Table 2-8
Satellites Used[1]	numeric	07		SV on Channel 1
Satellites Used[1]	numeric	02		SV on Channel 2
…				
Satellites Used[1]	numeric			SV on Channel 12
PDOP	numeric	1.8		Position Dilution of Precision
HDOP	numeric	1.0		Horizontal Dilution of Precision
VDOP	numeric	1.5		Vertical Dilution of Precision
Checksum	hexadecimal	*2C		
<CR> <LF>				End of message

[1] Satellite used in navigation solution.

Table 2-6: GSA Data Format

Value	Description
M	Manual – forced to operate in 2D or 3D mode
A	2D Automatic – allowed to automatically switch 2D/3D

Table 2-7: GSA Mode 1

Value	Description
1	Fix not available
2	2D position fix
3	3D position fix

Table 2-8: GSA Mode 2

2.2.4 NMEA Output message GSV, GNSS Satellites in View

The following table contains the values for the following example:

```
$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71
$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPGSV		GSV protocol header
Number of Messages	1 digit	2		Range 1 to 3
Message Number	1 digit	1		Range 1 to 3
Satellites in View	numeric	07		
Satellite ID	numeric	07		Channel 1 (Range 1 to 32)
Elevation	numeric	79	degree	Channel 1 (Maximum 90)
Azimuth	numeric	048	degree	Channel 1 (True, Range 0 to 359)
SNR (C/No)	numeric	42	dBHz	Range 0 to 99, null when not tracking
…				Channels 2, 3: Same format
Satellite ID	numeric	27		Channel 4 (Range 1 to 32)
Elevation	numeric	27	degree	Channel 4 (Maximum 90)
Azimuth	numeric	138	degree	Channel 4 (True, Range 0 to 359)
SNR (C/No)	numeric	42	dBHz	Range 0 to 99, null when not tracking
Checksum	hexadecimal	*71		
<CR> <LF>				End of message

Table 2-9: GSV Data Format

2.2.5 NMEA Output message MSS, MSK Receiver Signal

The following table contains the values for the following example:

`$GPMSS,55,27,318.0,100,*66`

Name	ASCII String Format	ASCII String Example	Units	Description
Message ID	string	$GPMSS		GSS protocol header
Signal Strength	numeric	55	dB	
Signal to Noise Ratio	numeric	27	dB	
Beacon Frequency	numeric	318.0	kHz	
Beacon Rate	numeric	100	bps	Bits per second
Checksum	hexadecimal	*66		
<CR> <LF>				End of message

Table 2-10: MSS Data Format

Important Notice

The MSS NMEA message can only be polled or scheduled using the MSK NMEA input message. See "MSK - MSK Receiver Interface" in section 2.3.10.

2.2.6 NMEA Output message RMC, Recommended Minimum Specific GNSS Data

The following table contains the values for the following example:

`$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10`

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPRMC		RMC protocol header
UTC Time	hhmmss.sss	161229.487		Current time
Status	character	A		A=data valid or V=data invalid
Latitude	ddmm.mmmm	3723.2475		Degrees + minutes
N/S Indicator	character	N		N=north or S=south
Longitude	ddmm.mmmm	12158.3416		Degrees + minutes
E/W indicator	character	W		E=east or W=west
Speed Over Ground	numeric	0.64	knots	
Course Over Ground	numeric	309.62	degrees	True
Date	ddmmyy	120598		Current date
Magnetic Variation[1]	blank		degrees	Not used
Checksum	hexadecimal	*10		
<CR> <LF>				End of message

[1] u-blox ag does not support magnetic declination. All 'Course Over Ground' data are geodetic WGS-84 directions. Note that this message generated by SiRFstar™ II based GPS receivers is not 100% compliant to NMEA protocol. According to NMEA standard, the field "Magnetic Reference" field must normally follow after "Magnetic Variation".

Table 2-11: RMC Data Format

2.2.7 NMEA Output message VTG, Course Over Ground and Ground Speed

The following table contains the values for the following example:

```
$GPVTG,309.62,T, ,M,0.13,N,0.2,K*6E
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPVTG		VTG protocol header
Course (True)	numeric	309.62	degrees	Measured heading
Reference	character	T		True
Course (Magnetic)	Blank			Measured heading
Reference	character	M		Magnetic[1]
Speed	numeric	0.13	knots	
Units	character	N		Knots
Speed	numeric	0.2	km/h	
Units	character	K		Kilometers per hour
Checksum	hexadecimal	*6E		
<CR> <LF>				End of message

[1] u-blox ag does not support magnetic declination. All 'Course Over Ground' data are geodetic WGS-84 directions.

Table 2-12: VTG Data Format

2.2.8 NMEA Output message ZDA, Date and Time

The following table contains the values for the following example:

```
Format:  $GPZDA,hhmmss.ss,dd,mm,yyyy,(-)xx,zz*CC<CR><LF>
Example: $GPZDA,201530.00,04,07,2002,00,00*6E<CR><LF>
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPZDA		ZDA Protocol header
UTC time: hours	hh	20	hour	00 … 23
UTC time: minutes	mm	15	minutes	00 … 59
UTC time: seconds [1]	ss.ss	30.00	seconds	00.00 … 59.99
UTC time: day	dd	04	day	01 … 31
UTC time: month	mm	07	month	01 … 12
UTC time: year	yyyy	2002	year	4 digit year
Local zone hours	xx or -xx	00		Not used (= 00)
Local zone minutes	zz	00		Not used (= 00)
Checksum	hexadecimal	*6E		
<CR><LF>				End of message

[1] The u-blox firmware issues seconds with two digits after decimal point. Please note that the NMEA standard also allows seconds to be given out without digits after decimal point.

Table 2-13: ZDA Data Format

2.2.9 NMEA Output message 150, OK-To-Send (u-blox)

Important Notice

This is a u-blox proprietary message.

In a power cycling mode (TricklePower™ or Push-To-Fix™ mode), the GPS receiver will only be fully active during time fragments where messages are transmitted or received. Outside these active phases, the TIM will neither transmit either data nor listen to incoming messages. In order to provide some orientation to an external host, this message indicates the beginnings and ends of the active phases.

- At the beginning, this message is issued with OK-to-Send indicator = 1
- At the end, this message is issued with OK-to-Send indicator = 0
- If a switchover to continuous is made, or during start-up, this message is sent once with OK-to-Send = 1 and Continuous = 1.

Output Rate: Depends on settings in Firmware User Parameters (see [7])

```
Format:  $PSRF150,o,c*CC<CR><LF>
Example: $PSRF150,1,0*6E<CR><LF>
```

	ASCII String			
Name	**Format**	**Example**	**Units**	**Description**
Message ID	string	$PSRF150		PSRF150 protocol header
OK-to-send Indicator	numeric digit	1		1= OK, 0 = No longer OK
Continuous Mode	numeric digit	0		1 = continuous 0 = TricklePower™ or Push-To-Fix™ mode.
Checksum	hexadecimal	*6E		
<CR><LF>				End of message

2.2.10 NMEA Output message 161, Hardware Status (u-blox)

Important Notice

This is a u-blox proprietary message.

The firmware provides a support for controlling and monitoring active antennas. Details on the active antenna supervisor is described a dedicated application note on active antenna supervisor [6].

Output Rate: Depends on settings in Firmware User Parameters (see [7])

```
Format:  $PSRF161,s,a*CC<CR><LF>
Example: $PSRF161,01,63*6E<CR><LF>
```

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$PSRF161		PSRF161 protocol header
Antenna status	numeric	01		See Table 2-15
AGC	numeric	63		Range: 0…63
Checksum	hexadecimal	*6E		
<CR><LF>				End of message

Table 2-14: Hardware Status

Byte Value	**Description** (See [6] for details)
0	Active antenna on and OK
1	Open circuit in antenna
2	Short circuit in antenna
3	Active antenna off
4	Passive antenna

Table 2-15: Active Antenna Status

2.3 NMEA Input Messages

NMEA input messages are provided to allow you to control the GPS receiver while in NMEA protocol mode. The GPS receiver may be put into NMEA mode by sending the SiRF® Binary protocol message "Switch To NMEA Protocol - Message I.D. 129" on page 103 using a user program or using the µ-center software and selecting Switch to NMEA Protocol from the Action menu. If the receiver is in SiRF® Binary mode, all NMEA input messages are ignored. Once the receiver is put into NMEA mode, the following messages may be used to command the module.

Option	Description
100	Set Serial Port A parameters and protocol
101	XYZ Navigation Initialization: WGS84 Parameters for start using X, Z and Z coordinates
102	Set DGPS Port: Set Port B parameters for DGPS input
103	Query Rate Control: Set or query output rates
104	LLA Navigation Initialization: Parameters for start using Latitude, Longitude and Altitude [2]
105	Development Data messages on/off
106	Set Datum (u-blox)
107	Configure TricklePower Mode™ (u-blox)
108	Enter download mode to allow updating flash (u-blox)
MSK	MSK receiver interface: Command messages for radio-beacon receiver

Table 2-16: NMEA Input Messages

Important Notice

NMEA input messages 100 to 105 are SiRF® proprietary NMEA messages. The MSK NMEA string is as defined by the NMEA 0183 standard.

The shaded fields in the table above relate to messages which are supported by u-blox firmware, but not by the original SiRF® firmware.

2.3.1 NMEA Input message 100, Set Serial Port

This command message is used to set the protocol (SiRF® Binary or NMEA) and/or the communication parameters (baud, data bits, stop bits, parity). Generally, this command is used to switch the module back to SiRF® Binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery-backed SRAM and then the GPS receiver restarts using the saved parameters.

The following table contains the input values for the following example:

Switch to SiRF® Binary protocol at 9600,8,N,1

`$PSRF100,0,9600,8,1,0*0C`

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$PSRF100		PSRF100 protocol header
Protocol	1 digit	0		0=SiRF® Binary, 1=NMEA
Baud	numeric	9600		4800, 9600, 19200, 38400
Data Bits	1 digit	8		7, 8
Stop Bits	1 digit	1		0, 1
Parity	1 digit	0		0=None, 1=Odd, 2=Even
Checksum	hexadecimal	*0C		
<CR> <LF>				End of message

[1] SiRF® Binary is only valid for 8 data bits, 1 stop bit and 0 parity.

Table 2-17: Set Serial Port Data Format

Important Notice

Only one protocol (e.g. SiRF® or NMEA) can be assigned to a single port. Before using this command, make sure, the GPS receiver is not running the protocol you wish to use on Port A, already on port B.

2.3.2 NMEA Input message 101, Navigation Initialisation

This command is used to initialize the GPS receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the GPS receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the GPS receiver to acquire signals quickly.

The following table contains the input values for the following example:

Start using known position and time.

```
$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*1C
```

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$PSRF101		PSRF101 protocol header
ECEF X	numeric	-2686700	meters	X coordinate position
ECEF Y	numeric	-4304200	meters	Y coordinate position
ECEF Z	numeric	3851624	meters	Z coordinate position
Clock Offset	numeric	96000	Hz	Clock Offset of GPS receiver[1]
Time Of Week	numeric	497260	Seconds	GPS time of week
Week No	numeric	921		GPS week number
Channel Count	numeric	12		Range 1 to 12[2]
Reset Configuration	numeric	3		See Table 2-19.
Checksum	hexadecimal	*1C		
<CR> <LF>				End of message

[1] Use 0 for last saved value if available. If this is unavailable, a default value of 96000 will be used.
[2] Use always 12 channels.

Table 2-18: Navigation Initialization Data Format

Number	Description
1	Hot Start – All data valid
2	Warm Start – Ephemeris cleared
3	Warm Start (with Init) – Ephemeris cleared, initialization data loaded
4	Cold Start – Clear all data in memory
8	Clear Memory – Clears all data in memory and resets GPS receiver back to factory defaults

Table 2-19: Reset Configuration

2.3.3 NMEA Input message 102, Set DGPS Port

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used which has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and then the receiver restarts using the saved parameters.

The following table contains the input values for the following example:

Set DGPS Port to be 9600,8,N,1.

```
$PSRF102,9600,8,1,0*12
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$PSRF102		PSRF102 protocol header
Baud	numeric	9600		4800,9600,19200,38400
Data bits	1 digit	8		7, 8
Stop bits	1 digit	1		0, 1
Parity	1 digit	0		0=None, 1=Odd, 2=Even
Checksum	hexadecimal	*12		
<CR> <LF>				End of message

Table 2-20: Set DGPS Port Data Format

2.3.4 NMEA Input message 103, Query Rate Control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or setup for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery-backed memory for each entry when the message is accepted.

The following table contains the input values for the following example:

1. Query the GGA message with checksum enabled

```
$PSRF103, 00,01,00,01*25
```

Other examples could be (Note the following examples are not show in a table form);

2. Enable VTG message for a 1 Hz constant output with checksum enabled

```
$PSRF103,05,00,01,01*20
```

3. Disable VTG message

```
$PSRF103,05,00,00,01*21
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$PSRF103		PSRF103 protocol header
code of message to configure	numeric	00		See Table 2-22.
Mode	numeric	01		0=SetRate, 1=Query
Rate	numeric	00	seconds	Output - off=0, max=255
Checksum Enable	numeric	01		0=Disable Checksum, 1=Enable Checksum
Checksum	hexadecimal	*25		
<CR> <LF>				End of message termination

Table 2-21: Query Rate Control Data Format

Value	Code	Description
0	GGA	Time, position and fix type data.
1	GLL	Latitude, longitude, UTC time of position fix and status.
2	GSA	GPS receiver operating mode, satellites used in the position solution and DOP values.
3	GSV	The number of GPS satellites in view, satellite ID numbers, elevation, azimuth, and SNR values.
4	RMC	Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver.
5	VTG	Time, date, position, course and speed data.
6	MSS	Course and speed information relative to the ground
7	ZDA	Date and time (u-blox)
8	PSRF150	OK-To-Send (used in Trickle power mode to indicate begin / end of active phase) (u-blox)
9	PSRF161	Hardware Status: Active antenna and Automatic Gain Control (AGC) (u-blox)

Table 2-22: Configurable Messages

Important Notice

In TricklePower™ mode, the update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the TricklePower™ Update rate and the NMEA update rate (i.e. TricklePower™ update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10)).

2.3.5 NMEA Input message 104, LLA Navigation Initialisation

This command is used to initialize the GPS receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

The following table contains the input values for the following example:

Start using known position and time.

```
$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1*07
```

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$PSRF104		PSRF104 protocol header
Latitude	numeric	37.3875111	degrees	Latitude position (Range –90 to +90)
Longitude	numeric	-121.97232	degrees	Longitude position (Range –180 to +180)
Altitude	numeric	0	meters	Altitude position
Clock Offset	numeric	96000	Hz	Clock Offset of GPS receiver[1]
Time Of Week	numeric	237759	seconds	GPS time of week
Week No	numeric	1946		Extended GPS week number (1024 added)
Channel Count	numeric	12		Range 1 to 12[2]
Reset Cfg	numeric	1		See Table 2-19.
Checksum	hexadecimal			
<CR> <LF>		*07		End of message

[1] Use 0 for last saved value if available. If this is unavailable, a default value of 96000 will be used.
[2] Use always 12 channels.

Table 2-23: LLA Navigation Initialization Data Format

2.3.6 NMEA Input message 105, Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.

The following table contains the input values for the following examples:

1. Debug On

```
$PSRF105,1*3E
```

2. Debug Off

```
$PSRF105,0*3F
```

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$PSRF105		PSRF105 protocol header
Debug	1 digit	0		0=Off, 1=On
Checksum	hexadecimal	*3E		
<CR> <LF>				End of message

Table 2-24: Development Data On/Off Data Format

2.3.7 NMEA Input message 106, Set Datum (u-blox)

Important Notice

This is a u-blox proprietary message.

This message is available to change map datum (geoid reference). The default initial value is WGS-84 (map datum code 216). Table B-1 lists up all geoidic references. Please note that selecting another map datum affects all navigation outputs given in latitude, longitude and altitude.

The following table contains the values for the following example:

```
Format:  $PSRF106,d*CC<CR><LF>
Example: $PSRF106,43*CB<CR><LF>
```

Name	ASCII String		Units	Description
	Format	**Example**		
Message ID	string	$PSRF106		PSRF106 Protocol header
Map Datum (Geoidic Reference). See table B-1.	numeric	43		43 = Cape_Canaveral_43_ Bahamas_Florida
Checksum	hexadecimal	*3F		Checksum
<CR><LF>				End of message

Table 2-25: Map Datum Selection

2.3.8 MEA Input message 107, TricklePower™ Mode (u-blox)

Important Notice

This is a u-blox proprietary message.

This message sets the GPS receiver into low power mode: TricklePower™ mode or Push-To-Fix™ mode. Details on configuring TricklePower™ and Push-To-Fix™ modes are in the application note on low power operation [2].

The following table contains the values for the following example:

```
Format:  $PSRF107,p,d,o*CC<CR><LF>
Example: $PSRF107,0,200,200*3E<CR><LF>
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$PSRF107		PSRF107 Protocol header
Push-To-Fix™ Mode	numeric (p)	0		ON = 1, OFF = 0
Duty Cycle	numeric (d)	200 (= 20 %)	% / 10	% Time ON. A duty cycle of 1000 (100%) means continuous operation.
Milli Seconds On Time	numeric (o)	200	ms	range 200 - 900 ms
Checksum	hexadecimal	*3E		Checksum
<CR><LF>				End of message

Table 2-26: TricklePower Mode™ Control

Important Notice

When TricklePower™ Mode is active, a high baud rate (min. 19200 baud) is required for transmission of NMEA messages due to limited time frames for transmission of navigation data.

2.3.9 NMEA Input message 108, Flash Update (u-blox)

Important Notice

This is a u-blox proprietary message.

This message will reset the GPS receiver and force it into download mode. New code can be downloaded to the target via serial port A.

The following table contains the values for the following example:

```
Format:  $PSRF108*2E<CR><LF>
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$PSRF108		PSRF108 Protocol header
(No payload data)				
Checksum	hexadecimal	*2E		
<CR><LF>				End of message

Table 2-27: Flash Update Control

2.3.10 NMEA Input message MSK, MSK Receiver Interface

The following table contains the values for the following example:

```
$GPMSK,318.0,A,100,M,2*45
```

Name	ASCII String		Units	Description
	Format	Example		
Message ID	string	$GPMSK		GPMSK protocol header
Beacon Frequency	numeric	318.0	KHz	Frequency to use
Auto/Manual Frequency[1]	character	A		A=Auto, M=Manual
Beacon Bit Rate	numeric	100		Bits per second
Auto/Manual Bit Rate[1]	character	M		A=Auto, M=Manual
Interval for Sending $--MSS[2]	numeric	2	seconds	Sending of MSS message for status
Checksum	hexadecimal	*45		
<CR> <LF>				End of message

[1] If Auto is specified, the previous field value is ignored.
[2] When status data is not to be transmitted, this field is null.

Table 2-28: MSK Data Format

Important Notice

The NMEA messages supported by the GPS receiver does not provide the ability to change the DGPS source. If you need to change the DGPS source to internal beacon, then this must be done using the SiRF® Binary protocol and then switched to NMEA.

3 SiRF® Binary protocol

The TIM GPS receivers can also be switched to SiRF® Binary protocol using a NMEA input message 100. SiRF® binary protocol is standard on port B of the TIM receivers.

The SiRF® Binary serial communication protocol is designed to include:

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

Using the SiRF® Binary protocol offers extensive control and output possibilities not offered in the NMEA protocol.

3.1 Protocol Layers

3.1.1 Transport Message

Start Sequence	Payload Length	Payload	Message Checksum	End Sequence
0xA0[1], 0xA2	Two-bytes (15-bits)	Up to 2^{10}-1 (<1023)	Two-bytes (15-bits)	0xB0, 0xB3

[1] OxYY denotes a hexadecimal byte value. 0xA0 equals 160.

Table 3-1: Transport Message

3.1.2 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.

3.1.3 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.

3.1.4 Payload Length

The payload length is transmitted high order byte first followed by the low byte.

High Byte	Low Byte
< 0x80	Any value

Table 3-2: Payload Length

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 receiving programs (e.g., µ-center) may limit the actual size to something less than this maximum.

3.1.5 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® Binary payloads will use the big-endian order.

3.1.6 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
< 0x80	Any value

Table 3-3: Checksum

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).
```

3.2 Output Messages for SiRF® Binary Protocol

Hex	ASCII	Name	Description	Page
0x02	2	Measured Navigation Data	Position, Velocity, and Time	31
0x04	4	Measured Tracking Data	Satellite and C/No Information	35
0x05	5	Raw Track Data - Not used	Obsolete, do not use anymore	36
0x06	6	Firmware Version	Receiver Firmware (Response to Poll from Message 132)	38
0x07	7	Clock Status	Current Clock Status	38
0x08	8	50 BPS Subframe Data	Standard ICD Format. See [1]	39
0x09	9	Throughput	Navigation Complete Data	40
0x0A	10	Error ID	Error coding for Message Failure	41
0x0B	11	Command Acknowledgement	Successful Request	52
0x0C	12	Command Not Acknowledgement	Unsuccessful Request	53
0x0D	13	Visible List	Auto Output	53
0x0E	14	Almanac Data	Response to Poll (from Message I.D. 146)	54
0x0F	15	Ephemeris Data	Response to Poll (from Message I.D. 147)	55
0x10	16	Test Mode 1	SiRF® Test information	56
0x11	17	Differential Corrections	Received from DGPS Broadcast	57
0x12	18	Ok to Send	CPU ON / OFF (TricklePower™ Mode)	57
0x13	19	Navigation Parameters	Response to Poll (from Message I.D. 152)	58
0x14	20	Test Mode 2	SiRF® Test information	60
0x1C	28	Navigation Library Measurement Data	Measurement Data	62
0x1D	29	Navigation Library DGPS Data	Differential GPS Data	64
0x1E	30	Navigation Library SV State Data	Satellite State Data	65
0x1F	31	Navigation Library Initialization Data	Initialization Data	66
0x62	98	Extended Measured Navigation Data (u-blox)	Position (Latitude / Longitude / Altitude), Velocity, and Time, DOPs	68
0x64	100	Hardware Status (u-blox)	Status information on AGC and active antenna	70
0x79	121	Log Data	Logged data payload	71
0x7A	122	Log Sector Info	Sector information	71
0x7B	123	Log Sector Erase End	Indicates the end of a sector erase	72
0x7C	124	Log Info	Contains information about flash architecture and logging space	72
0x7D	125	Log Config	Contains the general logging configuration	73
0x7E	126	Log Fix Config	Contains the position fix logging configuration	73
0x7F	127	Log GPIO Config	Contains the GPIO logging configuration	74
0xFF	255	Development Data	Various Status Messages	71

Table 3-4: Output Messages for SiRF® Binary

Important Notice

All output messages are received in BINARY format. Our evaluation software 'µ-Center' interprets the binary data.

The light shaded fields in the table above relate to messages which are supported by u-blox firmware, but not by the original SiRF® firmware.

The dark shaded fields in the table above relate to messages which are supported by u-blox firmware for data logging, but not by the original SiRF® firmware.

3.2.1 SiRF® Binary Output message I.D. 2, Measure Navigation Data

Output Rate: 1 Hz

The following table lists the binary and ASCII message data format for the measured navigation data.

Example:

`A0A2 0029` - Start Sequence and Payload Length
`02 FFD6F78C FFBE536E 003AC004 0000 0003 0001 04 A0 00`
`036B 039780E3 06 12190E160F04000000000000` - Payload
`09BB B0B3` - Message Checksum and End Sequence

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 (see Table 3-6)	1		04	Bitmap		4
HDOP	1	*5	A0		÷5	2.0
Mode 2 (See Table 3-8)	1		00	Bitmap		0
GPS Week	2		036B	week #		875
GPS TOW	4	*100	039780E3	seconds	÷100	602605.79
SV's in Fix	1		06			6
CH1 PRN	1		12			18
CH2 PRN	1		19			25
CH3 PRN	1		0E			14
CH4 PRN	1		16			22
CH5 PRN	1		0F			15
CH6 PRN	1		04			4
CH7 PRN	1		00			00
CH8 PRN	1		00			00
CH9 PRN	1		00			00
CH10 PRN	1		00			00
CH11 PRN	1		00			00
CH12 PRN	1		00			00

Payload length: 41 bytes

Table 3-5: Measured Navigation Data Out - Binary & ASCII Message Data Format

Important Notice

Binary units scaled to integer values need to be divided by the scale value to receive true decimal value (i.e., decimal X_{vel} = binary X_{vel} ÷ 8).

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

Table 3-6: Mode 1

Bit(s) Name	Name	Value	Description
PMODE	Position mode	0	No navigation solution
		1	1 satellite solution (altitude hold, direction hold, time hold)
		2	2 satellite solution (altitude hold and direction or time hold)
		3	3 satellite solution (altitude hold)
		4	≥4 satellite solution
		5	2D point solution (least square)
		6	3D point solution (least square)
		7	Dead reckoning
TPMODE	TricklePower™ mode	0	Full power mode
		1	TricklePower™ mode
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

Table 3-7: Interpretation of Mode 1

Mode 2		
Hex	ASCII	Description
0x00	0	Solution not validated
0x01	1	DR Sensor Data
0x02	2	Validated (1) [1], Invalidated (0)
0x04	4	If set, Dead Reckoning (Time Out)
0x08	8	If set, output edited by UI (i.e. DOP Mask exceeded)
0x10	16	Reserved
0x20	32	Reserved
0x40	64	Reserved
0x80	128	Reserved
Combinations of multiple values are possible, e.g. 3 = 1 + 2.		

[1] A validated fix is, if your receiver has 5 or more satellites that it uses to calculate the position fix. Since the navigation solution needs 4 or more satellites, the equations are overdetermined by 5 or more. This can be used to calculate some validation on the range measurements. If this has succeeded, the fix is considered validated. 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, a invalidated status will result. Consider 'Validated' as the best fix quality you can get.

Table 3-8: Mode 2

3.2.2 SiRF® Binary Output message I.D. 4, Measured Tracker Data

Output Rate: 1 Hz

The following table lists the binary and ASCII message data format for the measured tracker data.

Example:

`A0A2 00BC` - Start Sequence and Payload Length
`04 036C 0000937F 0C 0E AB 46 003F 1A1E1D1D191D1A1A1D1F 1D59423F1A1A...` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04			4
GPS Week	2		036C	week #		876
GPS TOW	4	s*100	0000937F	seconds	÷100	377.59 s
Channels	1		0C			12
1st SV ID	1		0E			14
Azimuth	1	Az*[2/3]	AB	deg	÷[2/3]	256.5
Elevation	1	El*2	46	deg	÷2	35
State (See Table 3-10)	2		003F	Bitmap		0x3F (hex)
C/No 1 (See [1])	1		1A	dBHz		26
C/No 2	1		1E	dBHz		30
C/No 3	1		1D	dBHz		29
C/No 4	1		1D	dBHz		29
C/No 5	1		19	dBHz		25
C/No 6	1		1D	dBHz		29
C/No 7	1		1A	dBHz		26
C/No 8	1		1A	dBHz		26
C/No 9	1		1D	dBHz		29
C/No 10	1		1F	dBHz		31
2nd SV ID	1		1D			29
Azimuth	1	Az*[2/3]	59	deg	÷[2/3]	89
Elevation	1	El*2	42	deg	÷2	66
State	2		003F	Bitmap [1]		63
C/No 1 (See [1])	1		1A	dBHz		26
C/No 2	1		1B	dBHz		27
etc. …						

[1] C/No 1 … C/No 10 represent C/No readings during every 1/10s time slice in a second

Payload length: 188 bytes

Table 3-9: Measured Tracker Data Out

Important Notice

Message length is fixed to 188 bytes with non-tracking channels reporting zero values.

Field Definition	Hex Value	Description
ACQ_SUCCESS	0x0001	Set, if acq/reacq is done successfully
DELTA_CARPHASE_VALID	0x0002	Set, Integrated carrier phase is valid
BIT_SYNC_DONE	0x0004	Set, Bit sync completed flag
SUBFRAME_SYNC_DONE	0x0008	Set, Subframe sync has been done
CARRIER_PULLIN_DONE	0x0010	Set, Carrier pullin done
CODE_LOCKED	0x0020	Set, Code locked
ACQ_FAILED	0x0040	Set, Failed to acquire S/V
GOT_EPHEMERIS	0x0080	Ephemeris data available

Table 3-10: TrktoNAVStruct.trk_status Tracking Status Field Definition.

	Achieved Tracking Stage							
Tracking Status (Hex)	**Acqui-sition Success**	**Delta-Phase Valid**	**Bit-Sync Done**	**Sub-Frame Sync. Done**	**Carrier Pull-in Done**	**Code Locked**	**Ephe-meris Data Available**	**Acqui-sition Failed**
00								
01	✓							
03	✓	✓						
21	✓					✓		
23	✓	✓				✓		
25	✓		✓			✓		
27	✓	✓	✓			✓		
2D	✓		✓	✓		✓		
33	✓	✓			✓	✓		
37	✓	✓	✓		✓	✓		
3F	✓	✓	✓	✓	✓	✓		
8D	✓		✓	✓			✓	
AD	✓		✓	✓		✓	✓	
AF	✓	✓	✓	✓		✓	✓	
BF	✓	✓	✓	✓	✓	✓	✓	
40								✓
CC			✓	✓			✓	✓
CD	✓		✓	✓			✓	✓

Table 3-11: Tracking Status Definitions

3.2.3 SiRF® Binary Output message I.D. 5, Raw Tracker Output

Important Notice

This Message is obsolete, even if it is still operational. Use of this message is strongly discouraged. Consider message I.D. 28 instead if raw tracker information is needed.

This section describes the necessary steps to compute the GPS pseudo-range, pseudo-range rate, and integrated carrier phase data that can be used for post processing applications such as alternative navigation filters. This data enables the use of third-party software to calculate and apply differential corrections based on the SiRF® binary protocol. Additionally, description and example code is supplied to calculate the measurement data and decode the broadcast ephemeris required for post processing applications. This is the raw data message required to compute the pseudo-range and carrier data.

Output Rate: 1Hz or less frequently if enabled

Example:

`A0A2 0033` - Start Sequence and Payload Length

`05 00000007 0013 003F 00EA1BD4 000D 0392 00009783 000DF45E 000105B5 FF90F5C2 0000 2428272723272424 2729 05 07 0013 003F` - Payload

`0B2D B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		05			5
Channel	4		0000007			7
SV ID	2		0013			19
State (See Table 3-10)	2		003F	bitmap		3F
Bit Number	4		00EA1BD4	bit		15342548
Millisecond Number	2		000D	ms		13
Chip Number	2		0392	chip		914
Code Phase	4	2^{16}	00009783	chip	2^{-16}	38787
Carrier Doppler	4	2^{10}	000DF45E	radians/2ms	2^{-10}	914526
Receiver Time Tag	4		000105B5	ms		66997
Delta Carrier (See [1])	4	2^{10}	FF90F5C2	cycles	2^{-10}	-7277118
Search Count	2		0000			0
C/No 1 (See [2])	1		24	dBHz		36
C/No 2	1		28	dBHz		40
C/No 3	1		27	dBHz		39
C/No 4	1		27	dBHz		39
C/No 5	1		23	dBHz		35
C/No 6	1		27	dBHz		39
C/No 7	1		24	dBHz		36
C/No 8	1		27	dBHz		36
C/No 9	1		29	dBHz		41
C/No 10	1		29	dBHz		41
Power Bad Count	1		05			5
Phase Bad Count	1		07			7
Accumulation Time	2		0013	ms		19
Track Loop Time	2		003F			63

[1] Multiply by $(1000 / 4\pi) \div 2^{16}$
[2] C/No 1 … C/No 10 represent C/No readings during every 1/10s time slice in a second

Payload length: 51 bytes

Table 3-12: Raw Tracker Data Out

3.2.4 SiRF® Binary Output message I.D. 6, Software Version String

Output Rate: Response to poll from message I.D. 132 (refer to page 80)

Example:

`A0A2 0015` - Start Sequence and Payload Length
`06 322E312E30523031323634204257204100000000` - Payload
`035E B0B3` - Message Checksum and End Sequence

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

[1] Hexadecimal: 06322E312E30523031323634204257204100000000
[2] ASCII string: 2.1.0R01264 BW A (Example data, a newer firmware version has a different code)

Payload length: 21 bytes

Table 3-13: Software Version String

Important Notice

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.

3.2.5 SiRF® Binary Output message I.D. 7, Clock Status Data

Output Rate: 1 Hz or response to poll from message I.D. 144 (refer to page 88)

Example:

`A0A2 0014` - Start Sequence and Payload Length
`07 03BD 02154924 08 00012231 00004728 14D4DAEF` - Payload
`0598 B0B3` - Message Checksum and End Sequence

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	s	÷ 100	349494.12
SVs	1		08			8
Clock Drift	4		00012231	Hz		74289
Clock Bias	4		00004728	ns		18216
Estimated GPS Time	4		14D4DAEF	ms		349493999

Payload length: 20 bytes

Table 3-14: Clock Status Data Message

3.2.6 SiRF® Binary Output message I.D. 8, 50 BPS Data

Output Rate: As available (6 seconds for every subframe. 12.5 minute full download time). In order to obtain these messages, the update rate of this message must be set to 1s using Message I.D. 166.

Example:

`A0A2 002B` - Start Sequence and Payload Length

`08 00 19`
`00C0342A9B688AB0113FDE2D714FA0A7FFFACC55`
`40157EFFEEDFFFA80365A867FC67708BEB5860F4` - Payload

`15AA B0B3` - Message Checksum and End Sequence

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					50bps data

Payload length: 43 bytes per subframe (5 subframes per page)

Table 3-15: CPU Throughput

Important Notice

Data is received in ICD format (available from www.navcen.uscg.mil, see also [1] and [5]). The ICD specification is 30-bit words. The output above has been stripped of parity to give a 240-bit frame instead of 300 bits.

Each Word in Message 8 is 32 bit wide and represents a 30 bit word of the 50 BPS data stream. The LSB of each 30 bit word of the 50 bps data stream is aligned to the LSB of a 32 bit Word in Msg 8. Unfortunately, the polarity of the data is not guaranteed. Both statements contain the same data:

Message 8 word: 00100010 11000000 00110010 00010000

Message 8 word: 11011101 00111111 11001101 11101111

50 bps data: 100010 11000000 00110010 00010000

The polarity can be identified by checking the most significant bits (e.g. bit 30) so the software can decide whether inverting the whole word is necessary to get the right data or not.

3.2.7 SiRF® Binary Output message I.D. 9, CPU Throughput

Output Rate: 1 Hz

Example:

`A0A2 0009` - Start Sequence and Payload Length
`09 003B 0011 0016 01E5` - Payload
0151 B0B3 - Message Checksum and End Sequence

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

[1] Duration of the last calculation of navigation solution

Payload length: 9 bytes

Table 3-16: CPU Throughput

3.2.8 SiRF® Binary Output message I.D. 10, Error ID

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

Error ID 2:

Code Define Name: ErrId_CS_SVParity

Error ID Description: Satellite subframe # failed parity check.

Example:

`A0A2 000D` - Start Sequence and Payload Length
`0A 0002 0002 00000001 00000002` - Payload
`0011 B0B3` - Message Checksum and End Sequence

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

Payload length: 13 bytes

Table 3-17: Error ID 2 Message

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.

Table 3-18: Error ID 2 Message Description

Error ID 9:

Code Define Name: ErrId_RMC_GettingPosition

Error ID Description: Failed to obtain a position for acquired satellite ID.

Example:

`A0A2 0009` - Start Sequence and Payload Length
`0A 0009 0002 00000001` - Payload
`0015 B0B3` - Message Checksum and End Sequence

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 3-19: Error ID 9 Message

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.

Table 3-20: Error ID 9 Message Description

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.

ON, 1 second time interval Example:

`A0A2 0009` - Start Sequence and Payload Length
`0A 000A 0001 00001234` - Payload
`005B B0B3` - Message Checksum and End Sequence

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 3-21: Error ID 10 Message

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

Table 3-22: Error ID 10 Message Description

Error ID 11:

Code Define Name: ErrId_RXM_TDOPOverflow

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

Example:

`A0A2 0009` - Start Sequence and Payload Length
`0A 000B 0001 xxxxxxxx` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

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 3-23: Error ID 11 Message

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

Table 3-24: Error ID 11 Message Description

Error ID 12:

Code Define Name: ErrId_RXM_ValidDurationExceeded

Error ID Description: Satellite's ephemeris age has exceeded 2 hours (7200 s).

Example:

`A0A2 000D` - Start Sequence and Payload Length
`0A 000C 0002 xxxxxxxx aaaaaaaa` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

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 3-25: Error ID 12 Message

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.

Table 3-26: Error ID 12 Message Description

Error ID 13:

Code Define Name: ErrId_STRTP_BadPostion

Error ID Description: SRAM position is bad during a cold start.

Example:

`A0A2 0011` - Start Sequence and Payload Length
`0A 000D 0003 xxxxxxxx yyyyyyyy zzzzzzzz` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

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		yyyyyyyy			yyyyyyyy
Z	4		zzzzzzzz			zzzzzzzz

Payload length: 17 bytes

Table 3-27: Error ID 13 Message

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.

Table 3-28: Error ID 13 Message Description

Error ID 4097 (or 0x1001):

Code Define Name: ErrId_MI_VCOClockLost
Error ID Description: VCO lost lock indicator.

Example:

`A0A2 0009` - Start Sequence and Payload Length
`0A 1001 0001 00000001` - Payload
`001D B0B3` - Message Checksum and End Sequence

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 3-29: Error ID 4097 Message

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.

Table 3-30: Error ID 4097 Message Description

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:

`A0A2 0009` - Start Sequence and Payload Length
`0A 1003 0001 00000001` - Payload
`001F B0B3` - Message Checksum and End Sequence

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 3-31: Error ID 4099 Message

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.

Table 3-32: Error ID 4099 Message Description

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:

`A0A2 xxxx` - Start Sequence and Payload Length
`0A 1008 0004 xxxxxxxx aaaaaaaa 00000000 cccccccc` - Payload
`[4 byte checksum] B0B3` - Message Checksum and End Sequence

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 Channel Control Count	4		cccccccc			cccc
Battery-Backed Receiver Compute Clock Offset Checksum	4		xxxxxxxx			xxxx
Battery-Backed Clock Offset Checksum	4		aaaaaaaa			aaaa
Battery-Backed Clock Offset	4		bbbbbbbb			bbbb
Computed Checksum	4		xxxxxxxx			xxxx
Battery-Backed Position Time Checksum	4		aaaaaaaa			aaaa

Payload length: 21, 17 or 11 bytes

Table 3-33: Error ID 4104 Message

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Computed Receiver Control Checksum	Computed receiver control checksum of SRAM.Data.Control structure
Battery-Backed Receiver Control Checksum	Battery-backed receiver control checksum stored in SRAM.Data.DataBuffer.CntrlChkSum.
Battery-Backed Receiver Control OpMode	Battery-backed receiver control checksum stored in SRAM.Data.Control.OpMode. Valid OpMode values are as follows: OP_MODE_NORMAL = 0, OP_MODE_TESTING = 0x1E51, OP_MODE_TESTING2 = 0x1E52, OP_MODE_TESTING3 = 0x1E53.
Battery-Backed Receiver Channel Control Count	Battery-backed receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are 0-12.
Compute Clock Offset Checksum	Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.
Battery-Backed Clock Offset Checksum	Battery-backed clock offset checksum of SRAM.Data.DataBuffer.clkChkSum.
Battery-Backed Clock Offset	Battery-backed clock offset value stored in SRAM.Data.DataBuffer,clkOffset.
Computed Position Time Checksum	Computed position time checksum of SRAM.Data.DataBuffer.postime[1].
Battery-Backed Position Time Checksum	Battery-backed position time checksum of SRAM.Data.DataBuffer.postimeChkSum[1].

Table 3-34: Error ID 4104 Message Description

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:

`A0A2 000D` - Start Sequence and Payload Length
`0A 1009 0002 xxxxxxx aaaaaaaa` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1009			4105
Count	2		0002			4 or 3 or 2
TOW	4		xxxxxxxx	seconds		xxxx
Week Number	4		aaaaaaaa			aaaa

Payload length: 13 bytes

Table 3-35: Error ID 4105 Message

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.

Table 3-36: Error ID 4105 Message Description

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:

`A0A2 0005` - Start Sequence and Payload Length
`0A 100A 0000` - Payload
`0024 B0B3` - Message Checksum and End Sequence

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 3-37: Error ID 4106 Message

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

Table 3-38: Error ID 4106 Message Description

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:

`A0A2 0005` - Start Sequence and Payload Length
`0A 100B 0000` - Payload
`0025 B0B3` - Message Checksum and End Sequence

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 3-39: Error ID 4107 Message

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

Table 3-40: Error ID 4107 Message Description

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:

`A0A2 0009` - Start Sequence and Payload Length
`0A 2001 0001 00000001` - Payload
`002D B0B3` - Message Checksum and End Sequence

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Units	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 3-41: Error ID 8193 Message

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.

Table 3-42: Error ID 8193 Message Description

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:

`A0A2 000D` - Start Sequence and Payload Length
`0A 2002 0002 00000001 00000064` - Payload
`0093 B0B3` - Message Checksum and End Sequence

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 3-43: Error ID 8194 Message

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.

Table 3-44: Error ID 8194 Message Description

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:

`A0A2 0005` - Start Sequence and Payload Length
`0A 2003 0000` - Payload
`002D B0B3` - Message Checksum and End Sequence

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 3-45: Error ID 8195 Message

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

Table 3-46: Error ID 8195 Message Description

3.2.9 SiRF® Binary Output message I.D. 11, Command Ack.

Output Rate: Response to successful input message

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

`A0A2 0002` - Start Sequence and Payload Length
`0B92` - Payload
`009DB0B3` - Message Checksum and End Sequence

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

Table 3-47: Command Acknowledgement

3.2.10 SiRF® Binary Output message I.D. 12, Command NAck.

Output Rate: Response to rejected input message (NAck = "negative acknowledgement")

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

`A0A2 0002` - Start Sequence and Payload Length
`0C 92` - Payload
`009E B0B3` - Message Checksum and End Sequence

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

Table 3-48: Command NAcknowledgement

3.2.11 SiRF® Binary Output message I.D. 13, Visible List

Output Rate: Updated approximately every 2 minutes

Important Notice

This is a variable length message. Only the number of visible satellites is reported.

Example:

`A0A2 002A` - Start Sequence and Payload Length
`0D 08 10 002A 0032 0F 009C 0032 ....` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0D			13
Visible SV's	1		08			8
CH1 - SV I.D.	1		10			16
CH1 - SV Azimuth	2		002A	degrees		42
CH1 - SV Elevation	2		0032	degrees		50
CH2 - SV I.D.	1		0F			15
CH2 - SV Azimuth	2		009C	degrees		156
CH2 - SV Elevation	2		0032	degrees		50
etc …						

Payload length: Variable (depends on number of visible SV's)

Table 3-49: Visible List

3.2.12 SiRF® Binary Output message I.D. 14, Almanac Data

Output Rate: Response to poll from message I.D. 146 (refer to page 89)

Example:

`A0A2 001E` - Start Sequence and Payload Length
`0E 01 1101 4128FF630D51FD5900A10CC111B454B909098C6CE714...........4AC1` - Payload
`09E5 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Notes
		Scale	Example	
Message ID	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]
Page Checksum	2		4AC1	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

Table 3-50: Almanac Data

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 [5] describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

3.2.13 SiRF® Binary Output message I.D. 15, Ephemeris Data

Output Rate: Response to poll from message I.D. 147 (refer to page 89)

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. Refer to GPS Standard Positioning Service Signal Specification [1] and ICD-GPS-200 [5] for further information.

The ephemeris data in the SiRF® binary format consists of 90 Bytes (or 45 16-bit) words. Word 1 to 15 represent subframe 1 of the 50 bit/s data stream, word 16 to 30 represent subframe 2 and word 31 to 45 subframe 3. The data is compressed by packing each subframe from 10 subframe words (32 bits/word) into 15 words (16 bits/word) with the TLM and parity words stripped off.

Example:

`A0A2005C` - Start Sequence and Payload Length
`0F 1E`
`001E 007D 0FA7 2010 0060 D855 23C4 BB8F BAE7 ADBD EE10 5EEC 0001 7539 6A3B`
`001E 007D 1029 1000 2C39 3F2F 5FBB 12FF E103 2F17 0B0E 0BA1 0CAD 955E EC7F`
`001E 007D 0E2C FFC2 32D6 813C FFF5 2666 9C14 1E48 369E 6CD5 FFA4 F010 F26C` - Payload
`2302 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0F			15
SV I.D.	1		01	Satellite PRN Number[1]		
Subframe 1 / Word 1	2		001E		All ephemeris data consist of signed 16-bit integers.	
:						
Subframe 1 / Word 15	2		6A3B			
Subframe 2 / Word 1	2		001E			
:						
Subfrme 2 / Word 15	2		EC7F			
Subframe 3 / Word 1	2		001E			
:						
Subfrme 3 / Word 15	2		F26C			

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

Payload length: 92 bytes

Table 3-51: Ephemeris Data

3.2.14 SiRF® Binary Output message I.D. 16, Test Mode 1

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

Example:

`A0A2 0011` - Start Sequence and Payload Length
`10 0015 001E 0005 88B8 00C8 1B58 0004 0001` - Payload
`02D8 B0B3` - Message Checksum and End Sequence

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

Payload length: 17 bytes

Table 3-52: Test Mode 1 Message

Name	Description
Message ID	Message ID number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20sec x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 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.
Last VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock.

Table 3-53: Detailed Description of Test Mode 1 Data

3.2.15 SiRF® Binary Output message I.D. 17, Differential Corrections

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.

3.2.16 SiRF® Binary Output message I.D. 18, OkToSend

Output Rate: TricklePower™ CPU on/off indicator

In a power cycling mode (TricklePower™ or Push-To-Fix™ mode), the GPS receiver will only be fully active during time fragments where messages are transmitted or received. Outside these active phases, the TIM will neither transmit either data nor listen to incoming messages. In order to provide some orientation to an external host, this message indicates the beginnings and ends of the active phases.

- At the beginning, this message is issued with OK-to-Send indicator = 1
- At the end, this message is issued with OK-to-Send indicator = 0

Example:

`A0A2 0002` - Start Sequence and Payload Length
`12 00` - Payload
`0012 B0B3` - Message Checksum and End Sequence

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

[1] 0 implies that CPU is about to go OFF, OkToSend==No, 1 implies CPU has just come ON, OkToSend==Yes

Payload length: 2 bytes

Table 3-54: OK-to-Send Message

3.2.17 SiRF® Binary Output message I.D. 19, Navigation Parameters

Output Rate: Response to Poll from message I.D. 152 (refer to page 93)

Important Notice

The SiRFstar™ I (used in u-blox 1st generation products like GPS-MS1(E) / PS1(E) modules) and SiRFstar™ II architectures (used in u-blox 2nd generation products like TIM modules) provide different message formats for binary message I.D. 19.

Example for SiRFstar™ I architecture (u-blox 1st generation products like GPS-MS1(E), GPS-PS1(E)):

`A0A2 0018` - Start Sequence and Payload Length
`13 01 00 00 0000 01 1E 3C 01 04 00 1E 004B 1E 2710 05 05 01 64 0000...` - Payload
`01A1 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		13			19
Altitude Constraint	1		01			1
Altitude Hold Mode (See [1])	1		00			0
Altitude Hold Source (See [1])	1		00			0
Altitude Source Input	2		0000	meters		0
Degraded Mode (See Table 3-91)	1		01			1
Degraded Timeout	1		1E	seconds		30
DR Timeout (See [1])	1		3C	seconds		60
Track Smoothing (See [1])	1		01			1
DOP Mask mode (See Table 3-93)	1		04			4
DGPS Mode (See Table 3-95)	1		00			0
DGPS Timeout	1		1E	seconds		30
Navigation Elevation Mask	2	*10	004B	deg	÷10	7.5 °
Navigation Power Mask	1		1E	dBHz		30
Editing Residual	2		2710			10000
Steady-State Navigation	1	*10	05	m/s^2	÷10	0.5
Static Navigation	1	*10	05		÷10	0.5
Low Power Mode	1		01			1
Low Power Duty Cycle	1		64	%		64%
Low Power On Time	2		0000	ms		0

[1] See corresponding entries in table Table 3-90, "Mode Control"

Payload length: 24 bytes

Table 3-55: Navigation Parameters (SiRFstar™ I architecture, applicable to GPS-MS1, but not TIM)

Example for SiRFstar™ II architecture (u-blox 2nd generation products like TIM):
`A0A2 0041` - Start Sequence and Payload Length
`13 01 00 00 … … …` - Payload
`022D B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		13			19
Reserved	4		01			-
Altitude Hold Mode (See [1])	1		00			0
Altitude Hold Source (See [1])	1		00			0
Altitude Source Input	2		0000	meters		0
Degraded Mode (See Table 3-91)	1		01			1
Degraded Timeout	1		1E	seconds		30
DR Timeout (See [1])	1		3C	seconds		60
Track Smoothing (See [1])	1		01			1
Static Navigation	1		04			4
3SV Least Squares	1		00			0
Reserved	4					-
DOP Mask mode (See Table 3-93)	1		04			4
Navigation Elevation Mask	2	*10	009B	deg	÷10	15.5 °
Navigation Power Mask	1		14	dBHz		20
Reserved	4					-
DGPS Source (See Table 3-86)	1		02			2
DGPS Mode (See Table 3-95)	1		00			0
DGPS Timeout	1		1E	seconds		30
Reserved	4					-
LP Push-to-Fix™ (See [3])	1		00			0
LP On-Time	4		000000C8	ms		200
LP Interval	4		000003E8	ms		1000
LP User Tasks Enabled (See [3])	1		00			0
LP User Task Interval	4		00000000	ms		0
LP Power Cycling Enabled (See [3])	1		00			0
LP Max. Acq. Search Time (See [2])	4		0001D4C0	ms		120000
LP Max. Off Time (See [2])	4		00007530	ms		30000
Reserved	4		00000000			-
Reserved	4		00000000			-

[1] See corresponding entries in table Table 3-90, "Mode Control"
[2] See corresponding entries in Table 3-113, "Set Low Power Acquisition Parameters"
[3] 0=Disabled 1=Enabled

Payload length: 65 bytes

Table 3-56: Navigation Parameters (SiRFstar™ II architecture, applicable to TIM)

3.2.18 SiRF® Binary Output message I.D. 20, Test Mode 2

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

Example:

`A0A2 0033` - Start Sequence and Payload Length
`14 0001 001E 0002 3F70 001F 0D29 0000 0000 0006 01C6 0005 1B0E 000EB41A`
`0000 00000000 00000000 00000000 00000000 00000000` - Payload
`0316 B0B3` - Message Checksum and End Sequence

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Units	Scale	Example
Message ID	1		14			20
SV ID	2		0001			1
Period	2		001E	seconds		30
Bit Sync Time	2		0002	seconds		2
Bit Count	2		3F70			13680
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Last VCO Count	2		0000			0
Frame Sync	2		0006			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 3-57: Test Mode 2 Message

Name	Description
Message ID	Message ID number.
SV ID	The number of the satellite being tracked.
Period Bit Sync Time Bit Count Poor Status Good Status Parity Error Count Last VCO Count	Same data structure as in Message 16 (0x10)
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.

Table 3-58: Detailed Description of Test Mode 2 Data

3.2.19 SiRF® Binary Output message I.D. 28, Navigation Library Measurement Data

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

Example:

`A0A2 0038` - Start Sequence and Payload Length
`1C 06 00045178 04 11989123411D0B32 6C0417CF417B1DD5 468FE814 A29D4F2741543299 7530 07 27272727262726262626 03E8 01F4 0000 00 00` - Payload
`0EE2 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1C			28
Channel	1		06			06
Time Tag	4		00045178	ms		283000
Satellite ID	1		04			4
GPS Software Time	8	(double)	11989123 411D0B32	ms		475852 .517184
Pseudo-Range	8	(double)	6C0417CF 417B1DD5	m		28433750 .750999
Carrier-Frequency	4	(float)	468FE814	m/sec		18420. 039063
Carrier-Phase	8	(double)	A29D4F27 41543299	m		5294694 .540851
Time in Track	2		7530	ms		30000
Sync Flags (See Table 3-60)	1		07	bitmap		7
C/No 1	1		27	dBHz		39
C/No 2	1		27	dBHz		39
C/No 3	1		27	dBHz		39
C/No 4	1		27	dBHz		39
C/No 5	1		26	dBHz		38
C/No 6	1		27	dBHz		39
C/No 7	1		26	dBHz		38
C/No 8	1		26	dBHz		38
C/No 9	1		26	dBHz		38
C/No 10	1		26	dBHz		38
Delta Range Interval	2		03E8	m		1000
Mean Delta Range Time	2		01F4	ms		500
Extrapolation Time	2		0000	ms		0
Phase Error Count	1		00			0
Low Power Count	1		00			0

Payload length: 56 bytes

Table 3-59: Measurement Data

Important Notice

The (double) fields are 8-byte doube-precision floating point values. The two 32-bit-blocks are sorted in Little Endian order, but the 4 bytes in every 32-bit block are sorted in Big Endian order. The single-precision (float) fields are always arranged in Big Endian order.

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 3-60: Sync Flag Fields

Name	Description
Message ID	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

C/No 1	This array of Carrier To Noise Ratios is the average signal power in dBHz for each of the 100-millisecond intervals in the previous second or last epoch for each particular SV being track in a channel. 1st 100 millisecond measurement
C/No 2 … C/No 10	2nd through 10th 100 millisecond measurements
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

Table 3-61: Detailed Description of Measurement Data

3.2.20 SiRF® Binary Output message I.D. 29, Navigation Library DGPS Data

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

Example:

`A0A2 001A` - Start Sequence and Payload Length
`1D 000F 00B5 01 BFC97C67 3CAAAAAB 3FBFFE12 40A00000 40A00000` - Payload
`0956 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1D			29
Satellite ID	2		000F			15
IOD (Issue of Data)	2		00B5			181
Source [1]	1		01			1
Pseudo-Range Correction	4		BFC97C67	m		3217652839
Pseudo-Range Rate Correction	4		3CAAAAAB	m/sec		1017817771
Correction Age	4		3FBFFE12	sec		1069547026
Reserved	4		40A00000			-
Reserved	4		40A00000			-

[1] Valid values: 0 = Use no corrections 1 = Use WAAS channel 2 = Use external source, 3 = Use Internal Beacon 4 = Set DGPS Corrections

Payload length: 26 bytes

Table 3-62: Navigation Library DGPS Data

3.2.21 SiRF® Binary Output message I.D. 30, Navigation Library SV State Data

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

Example:

`A0 A2 00 53` - Start Sequence and Payload Length

```
1E 11
05BE55CA411258BE DC1E7D7541740CD9 102603184160055A 1EB8E202416BB779
BF725276C09BE6FB C283C956406F9368 821A6AD740A2A0CD DCE33C2A3EF1E949
2CD3EFE6 01 00000000 00000000 4094F18C
```
- Payload

`2302B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1E			30
Satellite ID	1		11			17
GPS Time	8	(double)	05BE55CA 411258BE	sec		300591. 505609
X-Position	8	(double)	DC1E7D75 41740CD9	m		21024147. 757444
Y-Position	8	(double)	10260318 4160055A	m		8399569. 504640
Z-Position	8	(double)	1EB8E202 416BB779	m		14531528. 960069
X-Velocity	8	(double)	BF725276 C09BE6FB	m/s		-1785 .745847
Y-Velocity	8	(double)	C283C956 406F9368	m/s		252.606538
Z-Velocity	8	(double)	821A6AD7 40A2A0CD	m/s		2384.401383
Clock Bias	8	(double)	DCE33C2A 3EF1E949	sec		0.000017
Clock Drift	4	(float)	2CD3EFE6	sec/sec		0.000000
Ephemeris Flag [1]	1		01	Flags		1
Reserved	4		00000000			-
Reserved	4		00000000			-
Ionospheric Delay	4	(float)	4094F18C	m		4.654486

[1] Valid values: 0 = no valid SV state 1 = SV state calculated from ephemeris 2 = Satellite state calculated from almanac

Payload length: 83 bytes

Table 3-63: Navigation Library DGPS Data

Important Notice

The (double) fields are 8-byte doube-precision floating point values. The two 32-bit-blocks are sorted in Little Endian order, but the 4 bytes in every 32-bit block are sorted in Big Endian order. The single-precision (float) fields are always arranged in Big Endian order.

3.2.22 SiRF® Binary Output message I.D. 31, Navigation Library Initialisation Data

Output Rate: Appears once after initialisation, if tracking raw data is enabled. Output at fixed time intervals cannot be enabled.

Example:

`A0A2 0054` - Start Sequence and Payload Length
```
1F 89 00 00 00000000 01 001E 000F 0000 01 23 378A
0000 0000 00 0B83 004B 3FC3 7A 61A9 00 0000 00 0000
8000000041505A06 000000004123B428 C00000004151CA6D 01
000000004112781C 04B6 01 600000003F10494F 01
```
- Payload

0D3F B0B3 - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		1F			31
Reserved	1		89			-
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		0000			-
Track Smoothing Mode [3]	1		01	Flag		1
Reserved	1		23			-
Reserved	2		378A			-
Reserved	2		0000			-
Reserved	2		0000			-
DGPS Selection [4]	1		00	Flag		0
DGPS Timeout	2		0B83	sec		2947
Elevation Navigation Mask	2	*10	004B	degrees	÷10	7.5°
Reserved	2		3FC3			-
Reserved	1		7A			-
Reserved	2		61A9			-
Reserved	1		00			-
Reserved	2		0000			-
Static Navigation Mode [5]	1		00			0
Reserved	2		0000			-
Position X	8	(double)	80000000 41505A06	m		4286490 .000000
Position Y	8	(double)	00000000 4123B428	m		645652 .000000
Position Z	8	(double)	C0000000 4151CA6D	m		4663735 .000000
Position Init Source [6]	1		01			1
GPS Time	8	(double)	00000000			302599

			4112781C			.000000
GPS Week	2		04B6			1206
Time Init Source [7]	1		01			1
Drift	8	(double)	60000000 3F10494F			0.000062
Drift Init Source [8]	1		01	Flag		1

[1] 0 = Use last known 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 (Not supported)

[7] 0 = ROM time 1 = User time 2 = SRAM time 3 = RTC time 4 = Network assisted time (Not supported)

[8] 0 = ROM clock 1 = User clock 2 = SRAM clock 3 = Calibration clock 4 = Network assisted clock (Not supported)

Payload length: 84 bytes

Table 3-64: Navigation Library Initialization Data

Important Notice

The (double) fields are 8-byte doube-precision floating point values. The two 32-bit-blocks are sorted in Little Endian order, but the 4 bytes in every 32-bit block are sorted in Big Endian order.

3.2.23 SiRF® Binary Output message I.D. 98, Extended Measured Navigation (u-blox)

Important Notice

This is a u-blox proprietary message.

In contrast to the NMEA protocol, the original SiRF® Binary protocol outputs position in a Cartesian coordinate frame called Earth-Centered, Earth-Fixed (ECEF). For many applications, geodetic mapping coordinates of Latitude, Longitude and Altitude similar to NMEA are desired. In the SiRF® binary protocol, time is sent as GPS week number and Time of Week (TOW). But in many applications, the Universal Time Coordinated (UTC) is the best time format.

By default, the geodetic position is based on WGS-84 map datum. The datum can be modified with the "Set Datum" message 196 (0xC4), or, in NMEA format is activated, by NMEA $PSRF106.

Output Rate: 1 Hz

Example:

`A0A2 0027` - Start Sequence and Payload Length
`62 04EDBB4F 00E3C83E 0007C298 000000FA 00000066 07FB9FB9`
`64 07CF 09 1E 07 12 B0C2 0B 06 09 05 07` - Payload
`0C73 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		62			98
Latitude	4	$*10^8$	04EDBB4F	rad	$/10^8$	0x82688847
Longitude	4	$*10^8$	00E3C83E	rad	$/10^8$	0x14927934
Altitude	4	*1000	0007C298	m	/1000	508.568
Speed over Ground	4	*1000	000000FA	m/s	/1000	0.250
Climb Rate	4	*1000	00000066	m/s	/1000	0.102
Course over Ground	4	$*10^8$	07FB9FB9	rad	$/10^8$	1.33930937
Mode [1]	1		64	bit map [1]		100 [2]
UTC Year	2		07CF	years		1999
UTC Month	1		09	months		9
UTC Day	1		1E	days		30
UTC Hour	1		07	hours		7
UTC Minute	1		12	minutes		12
UTC Second	2	*1000	B0C2	seconds	/1000	45.250
GDOP (geometric DOP)	1	*5	0B		/5	2.2
HDOP (horizontal DOP)	1	*5	06		/5	1.2
PDOP (position DOP)	1	*5	09		/5	1.8
TDOP (time DOP)	1	*5	05		/5	1.0
VDOP (vertical DOP)	1	*5	07		/5	1.4

[1] See Table 3-66 and Table 3-67
[2] Example indicates L ≥ 4 satellite solution (3D), validated, UTC leap seconds corrected

Payload length: 39 bytes

Table 3-65: Extended Measured Navigation

Bit	7	6	5	4	3	2	1	0
Bit(s) Name	DGPS	LEAP-SEC	VALI-DATION	DOP-MASK	DRTMO	PMODE		

Table 3-66: Mode Byte

Bit(s) Name	Name	Value	Description
PMODE	Position mode	0	No navigation solution
		1	1 satellite solution (altitude hold, direction hold, time hold)
		2	2 satellite solution (altitude hold and direction or time hold)
		3	3 satellite solution (altitude hold)
		4	≥4 satellite solution
		5	2D point solution (least square)
		6	3D point solution (least square)
		7	Dead reckoning
DRTMO	Dead Reckoning timed out	0	No
		1	Yes
DOPMASK	DOP mask status	0	DOP mask not exceeded
		1	DOP mask exceeded
VALIDATION	Fix Quality	0	Unvalidated
		1	Validated
LEAPSEC	UTC Leap Seconds	0	Leap seconds not corrected
		1	Leap seconds corrected
DGPS	DGPS status	0	No DGPS position
		1	DGPS position

Table 3-67: Interpretation of Mode Byte

3.2.24 SiRF® Binary Output message I.D. 100, Hardware Status (u-blox)

Important Notice

This is a u-blox proprietary message.

The firmware provides a support for controlling and monitoring active antennas. Details on the active antenna supervisor is described a dedicated application note on active antenna supervisor [6].

Output Rate: Depends on settings in Firmware User Parameters (see [7])

Example:

`A0A2 0003` - Start Sequence and Payload Length
`64 01 3F` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		64			100
Antenna status	1		01			See table below
AGC	1		3F			63 Range: 0..63

Payload length: 3 bytes

Table 3-68: Hardware Status

Byte Value	**Description** (See [6] for details)
0	Active antenna on and OK
1	Open circuit in antenna
2	Short circuit in antenna
3	Active antenna off
4	Passive antenna

Table 3-69: Active Antenna Status

3.2.25 SiRF® Binary Output message I.D. 121, Log Data (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message is sent as a response to a LogRead message, I.D. 184 / 0xB8. (See page 96)

Example:

`A0A2....` - Start Sequence and Payload Length
`79 00010000....` - Payload
[2 byte checksum] `B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		79			121
Start address of 512 byte block	4		00010000	byte		
Payload data (256 x 16-bit)	512					

Payload length: 517 bytes

Table 3-70: Log Data

3.2.26 SiRF® Binary Output message I.D. 122, Log Sector Info (u-blox)

This message is sent as a response to a LogPollSectorInfo message, I.D. 186 / 0xBA. (See page 97)

Example:

`A0A2 0010` - Start Sequence and Payload Length
`7A 03 0000 00010000 40050000 00010000` - Payload
`00C4 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		7A			122
Flash EPROM Sector number	1		03			3
Flags (Reserved)	2		0000			-
Size of this sector	4		00010000	bytes		64 KB
Base: Start addr. of this sector To be used with LogRead	4		40050000	bytes		Addr 40050000
Free: Number of bytes available in this sector	4		00010000	bytes		64 KB avail.

Payload length: 16 bytes

Table 3-71: Log Sector Info

3.2.27 SiRF® Binary Output message I.D. 123, Log Sector Erase End (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message is sent as a response to a LogSectorErase message, I.D. 182 / 0xB6. (See page 96).

Example:

`A0A20002` - Start Sequence and Payload Length
`7B 02` - Payload
`007DB0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		7B			123
Flash EPROM Sector number	1		02			2

Payload length: 2 bytes

Table 3-72: Log Sector Erase End

3.2.28 SiRF® Binary Output message I.D. 124, Log Info (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message is sent as a response to a LogPollInfo message, I.D. 187 / 0xBB. (See page 97)

Example:

`A0A2 0013` - Start Sequence and Payload Length
`7C 03 07 40050000 4005FFFF 40058000 00008000` - Payload
`0453 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		7C			124
S_First -- Index of first sector of the available logging space (zero-based)	1		03			3
S_Last -- Index of last sector of the available logging space (zero-based)	1		07			7
A_First -- First address in the logging space.	4		40050000		bytes	Addr 40050000
A_Last -- Last address in the logging space.	4		4005FFFF		bytes	Addr 4005FFFF
A_Start -- Start address of the used logging space.	4		40058000		bytes	Addr 40058000
Size -- Size of the used logging space.	4		00008000		bytes	32 KB

Payload length: 19 bytes

Table 3-73: Log Info

3.2.29 SiRF® Binary Output message I.D. 125, Log Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message is sent as a response to a LogPollConfig message, I.D. 189 / 0xBD. (See page 98)

Example:

`A0A2 0002` - Start Sequence and Payload Length
`7D 00` - Payload
`007D B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		7D			125
Flags, see Table 3-119	2		00			None set

Payload length: 3 bytes

Table 3-74: Log Config

3.2.30 SiRF® Binary Output message I.D. 126, Log Fix Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message is sent as a response to a LogFixPollConfig message, I.D. 191 / 0xBF. (See page 100)

Example:

`A0A2 000F` - Start Sequence and Payload Length
`7E 0001 0002 0000 0003 0000 0000 0000` - Payload
`0084 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		7E			126
Flags			0001			Log fix enabled
T_min (Time difference filter)			0002	seconds		2 s
T_max (Time difference filter)			0000	seconds		disabled
D_min (Distance filter)			0003	m		3 m
D_max (Distance filter)			0000	m		disabled
V_min (Velocity filter)			0000	m/s		disabled
V_max (Velocity filter)			0000	m/s		disabled

Information on all entries: See table Table 3-121

Payload length: 15 bytes

Table 3-75: Log Fix Config

3.2.31 SiRF® Binary Output message I.D. 127, Log GPIO Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message is sent as a response to a LogGPIOPollConfig message, I.D. 193 / 0xC1. (See page 102)

Important Notice

The TIM GPS receiver supports GPIO 5, 6, 7 and 10 only. All other bits shall be ignored.

Example:
`A0A2 000F`- Start Sequence and Payload Length
`7F 0001 0002 0000 0020 0020 0040 0040` - Payload
`0142 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		7F			127
Flags			0001			log GPIO enabled*
T_min (Time difference filter)			0002	seconds		2 seconds
T_max (Time difference filter)			0000	seconds		disabled
Pin bit mask			0020			Port 5
Direction bit mask			0020			Port 5
Value bit mask			0040			Port 6
Check bit mask			0040			Port 6

Information on all entries: See table Table 3-124

Payload length: 15 bytes

Table 3-76: Log GPIO Config

3.2.32 SiRF® Binary Output message I.D. 255, Development Data

Output Rate: Receiver generated

Example:
`A0A2....` - Start Sequence and Payload Length
`FF....` - Payload
`....B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		FF			255
Payload of choice	Variable	…	…	…	…	…

Payload length: Variable

Table 3-77: Development Data

Important Notice

MID 255 is output when SiRF® Binary is selected and development data is enabled. The data output using MID 255 is essential for support.

3.3 Input Messages for SiRF® Binary Protocol.

The following table lists the message list for the SiRF® Binary input messages.

Hex	ASCII	Name	Description	Page
0x80	128	Initialize Data Source	ECEF and time information at start-up for warm start	76
0x81	129	Switch to NMEA Protocol	Enable NMEA messages, output rate and baud rate	78
0x82	130	Set Almanac	Sends an existing almanac file to the receiver	80
0x84	132	Poll Software Version	Software version replied with Message ID 6 (0x06)	80
0x85	133	DGPS Source Control	Select source for DGPS corrections	81
0x86	134	Set Main Serial Port	UART configuration like baud rate, stop bits, etc.	82
0x87	135	Switch Protocol	Switch to other protocol - obsolete	83
0x88	136	Mode control	Sets mode like 3D/2D, dead reckoning, etc.	84
0x89	137	DOP Mask Control	Sets DOP mask range to select satellites for navigation	85
0x8A	138	DGPS Control	Selects DGPS and timeout	86
0x8B	139	Elevation Mask	Elevation masks for tracking and navigation	86
0x8C	140	Power Mask	Power masks for qualifying satellites for navigation	87
0x8F	143	Static Navigation	Configuration for static operation	87
0x90	144	Poll Clock Status	Clock status is replied with Message ID 7 (0x07)	88
0x91	145	Set DGPS Serial Port	DGPS port baud rate, data bits, stop bits, and parity	88
0x92	146	Poll Almanac	Almanac is replied with Message ID 14 (0x0E)	89
0x93	147	Poll Ephemeris	Ephemeris is replied with Message ID 15 (0x0F)	89
0x94	148	Flash Update	Enters download mode to update Flash EPROM (u-blox)	90
0x95	149	Set Ephemeris	Upload Ephemeris File to receiver	90
0x96	150	Switch Operating Mode	Test mode or normal mode	91
0x97	151	Set TricklePower™ Mode	TricklePower™ and Push-to-Fix™	92
0x98	152	Poll Navigation Parameters	Navigation is replied with Message ID 19 (0x13)	93
0xA5	165	Set UART Configuration	Sets protocol, baud rates, etc. for all ports	94
0xA6	166	Set Message Rate	Set rate for individual SiRF® output messages	95
0xA7	167	Low Power Acquisition Parameters	Set max. off and search times for re-acquisition	95

Continued on next page.

Continued from previous page.

0xB6	182	Log Sector Erase	Erases all sectors or a specified sector in the Flash memory	96
0xB8	184	Log Read	Initiates data download from a specified address	96
0xBA	186	Log Poll Sector Info	Requests flash sector information	97
0xBB	187	Log Poll Info	Requests information about flash memory and logging space	97
0xBC	188	Log Set Config	Sets general logging configuration	98
0xBD	189	Log Poll Config	Requests general logging configuration	98
0xBE	190	Log Fix Set Config	Sets the position fix logging configuration	99
0xBF	191	Log Fix Poll Config	Requests the position fix logging configuration	100
0xC0	192	Log GPIO Set Config	Sets the GPIO logging configuration	101
0xC1	193	Log GPIO Poll Config	Requests the GPIO logging configuration	102
0xC4	196	Set Datum	Chooses a map datum as specified in table B-1 (u-blox)	103

Table 3-78: Output Messages for SiRF® Binary

Important Notice

All input messages are sent in BINARY format.

The light shaded fields in the table above relate to messages which are supported by u-blox firmware, but not by the original SiRF® firmware.

The dark shaded fields in the table above relate to messages which are supported by u-blox firmware for data logging, but not by the original SiRF® firmware.

3.3.1 SiRF® Binary Input message I.D. 128, Initialize Data Source

The following table 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 s),
Week Number (924),
Channels (12)
Raw track data enabled, Debug data enabled.

Example:

`A0A2 0019` - Start Sequence and Payload Length
`80 FFD700F9 FFBE5266 003AC57A 000124F8 0083D600 039C 0C 33` - Payload
`0A91 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		80			ASCII 128
ECEF X	4	See [1]	FFD700F9	meters		-2686727
ECEF Y	4	See [1]	FFBE5266	meters		-4304282
ECEF Z	4	See [1]	003AC57A	meters		3851642
Clock Offset	4		000124F8	Hz		75000
Time of Week	4	*100	0083D600	seconds	÷100	86400.00
Week Number	2		039C			924
Channels (Range 1…12)	1		0C			12
Reset Config. (See Table 3-80)	1		33			51

[1] 2's complement signed integer

Payload length: 25 bytes

Table 3-79: Initialize Data Source

Bit	Description
0	Data valid flag - set warm/hot start
1	Clear ephemeris - set warm start
2	Clear memory - set cold start
3	Factory Reset
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)

Table 3-80: Reset Configuration Bitmap

Important Notice

If "Raw Track Data" is enabled, then the following messages are enabled at update rate of 1 Hz and baud rate is automatically set to 38400 baud.

MID 7: Clock Status	**MID 8: 50 BPS Data**
MID 17: Raw DGPS	**MID 28: Navigation Library Measurement Data**
MID 28: DGPS Data	**MID 30: SV State Data**
MID 31: Navigation Library Initialization Data	

3.3.2 SiRF® Binary Input message I.D. 129, Switch To NMEA Protocol

The following table contains the input values for the following example:

Request the following NMEA data at 4800 baud:

GGA	-	ON, 1 second time interval
GLL	-	OFF
GSA	-	ON, 5 seconds time interval
GSV	-	ON, 5 seconds time interval
RMC	-	OFF
VTG	-	OFF
MSS	-	OFF
ZDA	-	ON, 1 second time interval
PSRF161	-	ON, 1 second time interval

Example:

`A0A2 0018` - Start Sequence and Payload Length
`81 02 01 01 00 01 05 01 05 01 00 01 00 01 00 01 01 01 00 01 05 01 12 C0` - Payload
`016A B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		81		ASCII 129
Mode	1		02		2 (Must always be 2!)
GGA Message [1]	1		01	sec	1
Checksum [2]	1		01		
GLL Message	1		00	sec	0 (no msg)
Checksum	1		01		
GSA Message	1		05	sec	5
Checksum	1		01		
GSV Message	1		05	sec	5
Checksum	1		01		
RMC Message	1		00	sec	0 (no message)
Checksum	1		01		
VTG Message	1		00	sec	0 (no message)
Checksum	1		01		
MSS Message	1		00	sec	0 (no message)
Checksum	1		01		
ZDA Message (u-blox)	1		01	sec	1
Checksum	1		01		
PSRF150 OK-to-Send (u-blox)	1		00	sec	0 (no message)
Checksum	1		01		
PSRF161 HW Status (u-blox)	1		05	sec	5
Checksum	1		01		
Baud rate [3]	2		12C0	baud	4800

[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).

[3] Valid values: 4800, 9600, 19200, 38400

Payload length: 24 bytes

Table 3-81: Switch to NMEA Protocol

Important Notice

In TricklePower™ mode, the update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the TricklePower™ Update rate and the NMEA update rate (i.e. TricklePower™ update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10)).

3.3.3 SiRF® Binary Input message I.D. 130, Set Almanac

This command enables the user to upload an almanac file from a host computer to the GPS unit.

Example:

`A0A2 0380` – Start Sequence and Payload Length
`82 ....` – Payload
`[2 byte checksum] B0B3` – Message Checksum and End Sequence

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

Payload length: 897 bytes

Table 3-82: Set Almanac

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.

3.3.4 SiRF® Binary Input message I.D. 132, Software Version

The following table contains the input values for the following example:

Poll the software version

Example:

`A0A2 0002` - Start Sequence and Payload Length
`84 00` - Payload
`0084 B0B3` - Message Checksum and End Sequence

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

Payload length: 2 bytes

Table 3-83: Software Version

Response: refer to page 38, section 3.2.4 SiRF® Binary Output message I.D. 6, Software Version String

3.3.5 SiRF® Binary Input message I.D. 133, DGPS Source

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

`A0A2 0007` - Start Sequence and Payload Length
`85 02 00000000 00` - Payload
`0087 B0B3` - Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		85		ASCII 133
DGPS Source	1		02		2 / See Table 3-86
Internal Beacon Frequency	4		00000000	Hz	See Table 3-87
Internal Beacon Bit Rate	1		00	Bps	See Table 3-87

Payload length: 7 bytes

Table 3-84: DGPS Source Selection (Example 1)

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

Search Frequency 310000, Bit Rate 200

`A0A2 0007` - Start Sequence and Payload Length
`85 03 0004BAF0 C8` - Payload
`02FE B0B3` - Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		85		ASCII 133
DGPS Source	1		03		3 / See Table 3-86
Internal Beacon Frequency	4		0004BAF0	Hz	31000 / See Table 3-87
Internal Beacon Bit Rate	1		C8	Bps	200 / See Table 3-87

Payload length: 7 bytes

Table 3-85: DGPS Source Selection (Example 2)

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 3-86: DGPS Source Selections

Search Type	Frequency [1]	Bit Rate [2]	Description
Auto Scan	zero	zero	Auto scanning of all frequencies and bit rates are performed.
Full Frequency Scan	zero	nonzero	Auto scanning of all frequencies and specified bit rate are performed.
Full Bit Rate Scan	nonzero	zero	Auto scanning of all bit rates and specified frequency are performed
Specific Search	nonzero	nonzero	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.

Table 3-87: Internal Beacon Settings

3.3.6 SiRF® Binary Input message I.D. 134, Set Main Serial Port

The following table contains the input values for the following example:

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

Example:

`A0A2 0009` - Start Sequence and Payload Length
`86 00002580 08 01 00 00` - Payload
`0134 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		86		ASCII 134
Baud rate [1]	4		00002580		9600 (example)
Data bits	1		08		8 (choice: 7 or 8)
Stop bit	1		01		1 (choice: 0 or 1)
Parity	1		00		0=None, 1=Odd, 2=Even
Reserved	1		00		-

[1] Valid values: 1200, 2400, 4800, 9600, 19200, 38400

Payload length: 9 bytes

Table 3-88: Set main Serial Port

3.3.7 SiRF® Binary Input message I.D. 135, Set Protocol

This is a simple message to change the protocol. Please note that the default or last baud rate setting configured for NMEA protocol is selected. This may result to a baud rate change.

Example:

`A0A2 0002` - Start Sequence and Payload Length
`87 01` - Payload
`0088 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		87		ASCII 134
Protocol (See [1])			01		NMEA

[1] 0 = SiRF® Binary, 1 = NMEA, 2 = ASCII, 3 = RTCM, 4 = User1

Payload length: 9 bytes

Table 3-89: Set Protocol

Important Notice

This Message is obsolete, even if it is still operational. Use of this message is strongly discouraged. Consider message I.D. 129 (Switch to NMEA Protocol) or message I.D. 165 (Change UART) instead. This message is subject to change without prior notice!

3.3.8 SiRF® Binary Input message I.D. 136, Mode Control

The following table 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:

`A0A2 000E` - Start Sequence and Payload Length
`88 01 01 01 01 01 0000 00 02 14 05 01` - Payload
`00A9 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		88		ASCII 136
3D Mode	1		01		1 (always true=1)
Alt Constraint	1		01		Not used
Degraded Mode	1		01		See Table 3-91
TBD	1		01		Reserved
DR Mode	1		01		YES=1, NO=0
Altitude	2		0000	meters	range -1,000 to 10,000
Altitude Hold Mode	1		00		Auto=0, Always=1, Disable=2
Altitude Source	1		02		Last Computed=0, Fixed to=1
Coast Time Out	1		14		Not Used
Degraded Time Out	1		05	seconds	0 to 120
DR Time Out	1		01	seconds	0 to 120
Track Smoothing	1		01		YES=1, NO=0

Payload length: 14 bytes

Table 3-90: Mode Control

Byte Value	Description
0	Use Direction then Clock Hold
1	Use Clock then Direction Hold
2	Direction (Curb) Hold Only
3	Clock (Time) Hold Only
4	Disable Degraded Modes

Table 3-91: Degraded Mode Byte Value

3.3.9 SiRF® Binary Input message I.D. 137, DOP Mask Control

The following table contains the input values for the following example:

Auto PDOP / HDOP,

GDOP =8 (default), Geometric (3 position coordinates plus clock offset in the solution)

PDOP =8, Position DOP (3 coordinates)

HDOP =8 Horizontal DOP

Example:

`A0A2 0005` - Start Sequence and Payload Length
`89 00 08 08 08` - Payload
`00A1 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		89		ASCII 137
DOP Selection	1		00		See Table 3-93
GDOP Value	1		08		Range 1 - 50
PDOP Value	1		08		Range 1 - 50
HDOP Value	1		08		Range 1 - 50

Payload length: 5 bytes

Table 3-92: DOP Mask Control

Byte Value	Description
0	Auto PDOP/HDOP
1	PDOP
2	HDOP
3	GDOP
4	Do not use

Table 3-93: DOP Selection

3.3.10 SiRF® Binary Input message I.D. 138, DGPS Control

The following table contains the input values for the following example:

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

Example:

`A0A2 0003` - Start Sequence and Payload Length
`8A 01 1E` - Payload
`00A9 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8A		ASCII 138
DGPS Selection	1		01		See Table 3-95
DGPS Timeout	1		1E	seconds	Range 0 = disabled, 1 – 255 [s]

Payload length: 3 bytes

Table 3-94: DGPS Control

Byte Value	Description
0	Auto
1	Exclusive
2	Never use

Table 3-95: DGPS Selection

Important Notice

Configuration of the DGPS mode using MID 138 only applies to RTCM corrections received from an external RTCM source or internal or external beacon. It does not apply to WAAS operation.

3.3.11 SiRF® Binary Input message I.D. 139, Elevation Mask

The following table contains the input values for the following example:

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

Example:

`A0A2 0005` - Start Sequence and Payload Length
`8B 0032 009B` - Payload
`0158 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8B		ASCII 139
Tracking Mask	2	*10	0032	degrees	Not implemented
Navigation Mask	2	*10	009B	degrees	Range -20…+90° (values -200 … +900)

Payload length: 5 bytes

Table 3-96: Elevation Mask

3.3.12 SiRF® Binary Input message I.D. 140, Power Mask

The following table contains the input values for the following example:

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

Example:

`A0A2 0003` - Start Sequence and Payload Length
`8C 1C 21` - Payload
`00C9 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		8C		ASCII 140
Tracking Mask	1		1C	dBHz	Not implemented
Navigation Mask	1		21	dBHz	Range 20…50

Payload length: 3 bytes

Table 3-97: Power Mask

3.3.13 SiRF® Binary Input message I.D. 143, Static Navigation

This command allows the user to enable or disable static navigation to the GPS receiver.

Example:

`A0A20002` – Start Sequence and Payload Length
`8F 01` – Payload
`[2 byte checksum] B0B3` – Message Checksum and End Sequence

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

Payload length: 2 bytes

Table 3-98: Static Navigation

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

Table 3-99: Message ID 143 Description

3.3.14 SiRF® Binary Input message I.D. 144, Poll Clock Status

The following table contains the input values for the following example:

Poll the clock status.

Example:

`A0A2 0002` - Start Sequence and Payload Length
`90 00` - Payload
`0090 B0B3` - Message Checksum and End Sequence

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

Payload length: 2 bytes

Table 3-100: Clock Status

Response: Refer to page 38, 3.2.5 SiRF® Binary Output message I.D. 7, Clock Status Data

3.3.15 SiRF® Binary Input message I.D. 145, Set DGPS Serial Port

The following table contains the input values for the following example:

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

Example:

`A0A2 0009` - Start Sequence and Payload Length
`91 00002580 08 01 0000` - Payload
`013F B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		91		ASCII 145
Baud rate [1]	4		00002580		9600 (example)
Data bits	1		08		8 (choice: 7 or 8)
Stop bit	1		01		1 (choice: 0 or 1)
Parity	1		00		0=None, 1=Odd, 2=Even
Reserved	1		00		-

[1] Valid values: 1200, 2400, 4800, 9600, 19200, 38400

Payload length: 9 bytes

Table 3-101: Set DGPS Serial Port

Important Notice

Setting the DGPS serial port using MID 145 will affect Com B only regardless of the port being used to communicate with the GPS receiver.

3.3.16 SiRF® Binary Input message I.D. 146, Poll Almanac

The following table contains the input values for the following example:

Poll for the Almanac.

Example:

`A0A2 0002` - Start Sequence and Payload Length
`92 00` - Payload
`0092 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		92		ASCII 146
Control	1		00		Not used

Payload length: 2 bytes

Table 3-102: Almanac

Response: refer to page 54, 3.2.12 SiRF® Binary Output message I.D. 14, Almanac Data

3.3.17 SiRF® Binary Input message I.D. 147, Poll Ephemeris

The following table contains the input values for the following example:

Poll for Ephemeris Data for all satellites.

Example:

`A0A2 0003` - Start Sequence and Payload Length
`93 00 00` - Payload
`0092 B0B3` - Message Checksum and End Sequence

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

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

Payload length: 3 bytes

Table 3-103: Ephemeris

Response: refer to page 55, 3.2.13 SiRF® Binary Output message I.D. 15, Ephemeris Data

3.3.18 SiRF® Binary Input message I.D. 148, Flash Update (u-blox)

Important Notice

This is a u-blox proprietary message. It only compatible to the u-blox Firmware Update Utility (Configuration Manager / Udownloader). For details, please refer to the user's manual for Firmware Update Utility [7].

This message will reset the GPS receiver and force it into download mode. New code can be downloaded to the target via serial port A. Serial port B is not needed.

Example:

`0A02 0001` – Start Sequence and Payload Length
`94` – Payload
`0094 B0B3` – Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		94		ASCII 149
No payload data	0				

Payload length: 1 byte

Table 3-104: Flash Update

3.3.19 SiRF® Binary Input message I.D. 149, Set Ephemeris

This command enables the user to upload an ephemeris file to the GPS receiver.

Example:

`A0A2 005B` – Start Sequence and Payload Length
`95....` – Payload
`[2 byte checksum] B0B3` – Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		95		ASCII 149
Ephemeris Data	90		00		Reserved

Payload length: 91 bytes

Table 3-105: Set Ephemeris

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.

3.3.20 SiRF® Binary Input message I.D. 150, Switch Operating Modes

The following table contains the input values for the following example:

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

Example:

`A0A2 0007` - Start Sequence and Payload Length
`96 1E51 0006 001E` - Payload
`0129 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		96		ASCII 150
Mode	2		1E51		0=normal, 1E51=Testmode1, 1E52=Testmode2, 1E53=Not Supported
SV I.D.	2		0006		Satellite to Track
Period	2		001E	seconds	Duration of Track

Payload length: 7 bytes

Table 3-106: Switch Operating Modes

3.3.21 SiRF® Binary Input message I.D. 151, Set TricklePower™ Mode

This message sets the GPS receiver into low power mode: TricklePower™ mode or Push-To-Fix™ mode. Details on configuring TricklePower™ and Push-To-Fix™ modes are in the application note on low power operation [2].

The following table contains the input values for the following example:

Example: Set GPS receiver into TricklePower™ at 1 hz update and 200 msec On Time.

`A0A2 0009` - Start Sequence and Payload Length
`97 0000 00C8 000000C8` - Payload
`0227 B0B3` - Message Checksum and End Sequence

If an update rate of 1 second is selected, then the on-time greater than 600ms is invalid.

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		97		ASCII 151
Push-To-Fix™ Mode	2		0000		ON = 1, OFF = 0
Duty Cycle	2	*10	00C8	%	20% Time ON. A duty cycle of 1000 (100%) means continuous operation.
Milliseconds On Time	4		000000C8	ms	200 (range: 200 - 900 msec)

Payload length: 9 bytes

Table 3-107: Set TricklePower™ Parameters

On-times of 700, 800, and 900 msec are invalid if an update rate of 1 second is selected.

3.3.21.1 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 ms). To calculate the TricklePower™ update rate as a function of Duty Cycle and On Time, use the following formula:

*Off_Time = (On_Time - (Duty_Cycle * On_Time)) / Duty_Cycle*

Update_Rate = Off_Time + On_Time

Important Notice

On Time inputs of > 900 ms will default to 1000 ms.

Following are some examples of selections:

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

Table 3-108: Example of Selections for TricklePower™ Mode of Operation

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

Table 3-109: TricklePower™ Mode Support

Important Notice

For "Update Intervals" of less than 2 seconds, the upper limit for "On Time" is 600 ms. Limiting the "On Time" to 500 ms and the "Update Interval" to 10 seconds is strongly recommended. Please refer to the low power application note [2] for further information.

3.3.21.2 Push-to-Fix™

In this mode the GPS 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:

*Off_Period = (On_Period * (1 - Duty_Cycle)) / Duty_Cycle*

Off Period is limited to 30 minutes. The duty cycle will not be less than approximately On Period/1800, or about 1%. Push-to-Fix™ keeps the ephemeris for all visible satellites up to date so position/velocity fixes can generally be computed within SnapStart™ times (when requested by the user) on the order of 3 seconds.

3.3.22 SiRF® Binary Input message I.D. 152, Poll Navigation Parameters

The following table 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

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

Payload length: 2 bytes

Table 3-110: Poll Receiver for Navigation Parameters

Response: refer to page 58, 3.2.17 SiRF® Binary Output message I.D. 19, Navigation Parameters

3.3.23 SiRF® Binary Input message I.D. 165, Set UART Configuration

The following table contains the input values for the following example:
Example: Set port A (UART 0) to NMEA with 9600 baud, 8 data bits, 1 stop bit, no parity. Set port B (UART 1) to SiRF® binary with 57600 baud, 8 data bits, 1 stop bit, no parity. Do not configure ports 2 and 3.

`A0A2 0031` - Start Sequence and Payload Length
`A5 00 01 01 ...` - Payload
`[2 byte checksum] B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A5		ASCII 165
Port: Identifies UART 0	1		00		For UART 0 (Port A)
UART 0: In Protocol [1]	1		01		"
UART 0: Out Protocol	1		01		"
UART 0: Baud Rate [2]	4		00002580		" (Here: 9600 baud)
UART 0: Data Bits	1		08		"; 8 (choose 7 or 8)
UART 0: Stop Bits	1		01		"; 1 (choose 0 or 1)
UART 0: Parity	1		00		"; 0=none,1=odd,2=even
UART 0: Reserved	1		00		" -
UART 0: Reserved	1		00		" -
Port: Identifies UART 1	1		01		For UART 1 (Port B)
UART 1: In Protocol [1]	1		03		"
UART 1: Out Protocol	1		03		"
UART 1: Baud Rate [2]	4		00002580		" (Here: 9600 baud)
UART 1: Data Bits	1		08		"; 8 (choose 7 or 8)
UART 1: Stop Bits	1		01		"; 1 (choose 0 or 1)
UART 1: Parity	1		00		"; 0=none,1=odd,2=even
UART 1: Reserved	1		00		" -
UART 1: Reserved	1		00		" -
Port: Identifies UART 2	1		FF		UART 2 kept inactive
UART 2: In Protocol [1]	1		05		No protocol
UART 2: Out Protocol	1		05		No protocol
UART 2: Baud Rate [2]	4		00000000		
UART 2: Data Bits	1		00		
UART 2: Stop Bits	1		00		
UART 2: Parity	1		00		
UART 2: Reserved	1		00		-
UART 2: Reserved	1		00		-
Port: Identifies UART 3	1		FF		UART 3 kept inactive
UART 3: In Protocol [1]	1		05		No protocol
UART 3: Out Protocol	1		05		No protocol
UART 3: Baud Rate [2]	4		00000000		
UART 3: Data Bits	1		00		
UART 3: Stop Bits	1		00		
UART 3: Parity	1		00		
UART 3: Reserved	1		00		-
UART 3: Reserved	1		00		-

[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.

Payload length: 49 bytes (4 x 12 + 1 for Message ID)

Table 3-111: Set UART Configuration

3.3.24 SiRF® Binary Input message I.D. 166, Set Message Rate

The following table contains the input values for the following example:

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

Example:

`A0A2 0008` - Start Sequence and Payload Length
`A6 01 02 05 00 00 00 00` - Payload
`00AE B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A6		ASCII 166
Send Now [1]	1		01		Poll message
MID to be set	1		02		Valid Message ID (0…127)
Update Rate	1		05	seconds	Range 1-30
Reserved	1		00		-
Reserved	1		00		-
Reserved	1		00		-
Reserved	1		00		-

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

Payload length: 8 bytes

Table 3-112: Set Message Rate

3.3.25 SiRF® Binary Input message I.D. 167, Low Power Acquisition Parameters

Table B-30 contains the input values for the following example:

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

Example:

`A0A2 000D` - Start Sequence and Payload Length
`A7 00007530 0001D4C0 0000003C` - Payload
`031D B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		A7		ASCII 167
Max Off Time	4		00007530	ms	Maximum time for sleep mode
Max Search Time	4		0001D4C0	ms	Max. satellite search time
Push-to-Fix™ Period	4		0000003C	seconds	Push-to-Fix™ cycle period

Payload length: 13 bytes

Table 3-113: Set Low Power Acquisition Parameters

3.3.26 SiRF® Binary Input message I.D. 182, Log Sector Erase (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message causes the receiver to erase a specific flash sector. The receiver disables flash writing. After erasing the receiver returns a message of type LogSectorEraseEnd (Message I.D. 123 / 0x7B). After erasing sectors you must reset the receiver. Send the Navigation Initialization Message (Message I.D. 128 / 0x80). There are two special sector numbers that erase all sectors in a row. If you send the message with 0xFF as Sector Number, the module will erase all used sectors, then it replies with the LogSectorEraseEnd Message and performs a reset. If you send the message with 0xFE as Sector Number, the module will erase all sectors regardless of the usage, then it replies with the LogSectorEraseEnd Message and performs a reset. Keep in mind that the erase command may take several seconds to complete. During this time no communication is possible.

Example:

`A0A2 0002` - Start Sequence and Payload Length
`B6 01` - Payload
`00B7 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		B6		ASCII 182
Flash EPROM Sector (8 bit unsigned)	1		00		Sector number

Payload length: 2 bytes

Table 3-114: LogSectorErase Message

3.3.27 SiRF® Binary Input message I.D. 184, Log Read (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message requests 512 bytes of stored and compressed log data. The module returns a message of type LogData (Message I.D. 121 / 0x79)

Example:

`A0A2 0005` - Start Sequence and Payload Length
`B8 00000100` - Payload
`00B9 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		B8		ASCII 184
Address (32 bit unsigned)	4		00000100		Address

Payload length: 5 bytes

Table 3-115: LogRead Message

3.3.28 SiRF® Binary Input message I.D. 186, Log Poll Sector Info (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message requests information on a specific sector of the flash memory. The receiver returns a message of type LogSectorInfo (Message I.D. 122 / 0x7A).

Example:

`A0A2 0002` - Start Sequence and Payload Length
`BA01` - Payload
`00BB B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		BA		ASCII 186
Sector (8 bit unsigned)	1		01		Sector number

Payload length: 2 bytes

Table 3-116: LogPollSectorInfo Message

3.3.29 SiRF® Binary Input message I.D. 187, Log Poll Info (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message requests information on flash memory and logging space. The receiver returns a message of type LogInfo (Message I.D. 124 / 0x7C).

`A0A2 0001` - Start Sequence and Payload Length
`BB` - Payload
`00BB B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		BB		ASCII 187

Payload length: 1 byte

Table 3-117: LogPollInfo Message

3.3.30 SiRF® Binary Input message I.D. 188, Log Set Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message sets the general logging configuration.

Example:

`A0A2 0003` - Start Sequence and Payload Length
`BC 0003` - Payload
`00BF B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		BC		ASCII 188
Flags, see Table 3-119	2		0003		Example for 0003: Logging enabled, incl. debug messages

Payload length: 3 bytes

Table 3-118: LogSetConfig Message

Byte Value	Description	Settings
Bit 0	Logging Control	0 = disabled, 1 = enabled
Bit 1	Logging Debug Messages	0 = disabled, 1 = enabled
Bit 2	Logging Diagnostics Strings (Escape strings)	0 = disabled, 1 = enabled
Bit 7	Flash 1PPS LED when logging	0 = disabled, 1 = enabled
All other bits are unused		

Table 3-119: LogSetConfig Flags

3.3.31 SiRF® Binary Input message I.D. 189, Log Poll Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message requests the general logging configuration. The receiver returns a message of type LogConfig (Message I.D. 125 / 0x7D).

Example:

`A0A2 0001` - Start Sequence and Payload Length
`BD` - Payload
`00BD B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		BD		ASCII 189

Payload length: 1 byte

Table 3-120: LogPollConfig Message

3.3.32 SiRF® Binary Input message I.D. 190, Log Fix Set Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message sets the position-fix logging configuration. The lower bounds (min) of the filter parameters are AND-ed and the higher bounds are OR-ed.

Example:

`A0A2 000F` - Start Sequence and Payload Length
`BE 0001 0002 0000 0003 0000 0000 0000` - Payload
`00C4 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		BE		ASCII 190
Flags, See Table 3-122	2		0001		Fix logging flags
T_min (Time difference filter)	2		0002	seconds	Sets min. time difference with which a record is stored. 0=disabled
T_max (Time difference filter)	2		0000	seconds	Sets max. time difference with which a record is stored regardless from the other parameters. 0=disabled
D_min (Distance filter)	2		0003	m	Sets min. distance with which a record may be stored. 0=disabled
D_max (Distance filter)	2		0000	m	Sets max. distance with which a record is stored regardless from the other parameters. 0=disabled
V_min (Velocity filter)	2		0000	m/s	Sets min. speed with which a record may be stored. 0=disabled
V_max (Velocity filter)	2		0000	m/s	Sets max. speed with which a record is stored regardless from the other parameters. 0=disabled

Payload length: 15 bytes

Table 3-121: LogFixSetConfig Message

Byte Value	Description	Settings
Bit 0	Position Fix Logging Control	0=Disabled 1=Enabled
Bit 2	Output Measured Navigation on Serial Port (SiRF Binary Message 2) while Logging	0=Output 1=Don't Output
Bit 3	Log Filter for 4SV Solution	1=Log only if 4 or more SV used 0=Log if valid navigation solution
Bit 6	Speed Format	0 = 3D speed 1 = 2D speed (speed over ground)
Bit 7	Store FULL records only (no compressed records)	0 = Compressed records allowed 1 = Full records only
All other bits are unused		

Table 3-122: LogFixSetConfig Flags

3.3.33 SiRF® Binary Input message I.D. 191, Log Fix Poll Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message requests the position fix logging configuration. The receiver returns a message of type LogFixConfig (Message I.D. 126 / 0x7E).

Example:

`A0A2 0001` - Start Sequence and Payload Length
`BF` - Payload
`00BF B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		BF		ASCII 191

Payload length: 1 byte

Table 3-123: LogFixPollConfig Flags

3.3.34 SiRF® Binary Input message I.D. 192, Log GPIO Set Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message sets the GPIO logging configuration. The lower bound (min) of the time filter is AND-ed with the GPIO filter, the higher bound is OR-ed.

Important Notice

The TIM GPS receiver supports GPIO 5, 6, 7 and 10 only. All other settings are ignored.

Example:

`A0A2 000F` - Start Sequence and Payload Length
`C0 0001 0002 0000 0020 0020 0040 0040` - Payload
`0183 B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		C0		ASCII 192
Flags, See Table 3-126	2		0001		GPIO logging flags
T_min (Time difference filter)	2		0002	seconds	Sets min. time difference with which a record is stored. 0=disabled
T_max (Time difference filter)	2		0000	seconds	Sets max. time difference with which a record is stored regardless from the GPIO filter parameters. 0=disabled
Pin bit mask See Table 3-125	2		0020		Any modification applies to the here masked pins only. (1 = change, 0 = leave)
Direction bit mask See Table 3-125	2		0020		1 = output, 0 = input
Value bit mask (if pin to be changed) See Table 3-125	2		0040		1 = high 0 = low
Check bit mask See Table 3-125	2		0040		1 = Log if signal changes 0 = Do not log changes

Payload length: 15 bytes

Table 3-124: LogGPIOSetConfig Message

Byte Value	Description	Settings
Bit 5	GPIO 5 / TIM module, pin 25	See Table 3-124
Bit 6	GPIO 6 / TIM module, pin 24	See Table 3-124
Bit 7	GPIO 7 / TIM module, pin 26	See Table 3-124
Bit 10	GPIO 10 / TIM module, pin 23	See Table 3-124
All other bits are unused		

Table 3-125: Supported GPIO Pins

Byte Value	Description	Settings
Bit 0	GPIO Logging Control	0=Disabled 1=Enabled
Bit 7	Store FULL records only (no compressed records)	0 = Compressed records allowed 1 = Full records only
All other bits are unused		

Table 3-126: LogFixSetConfig Flags

3.3.35 SiRF® Binary Input message I.D. 193, Log GPIO Poll Config (u-blox)

Important Notice

This is a u-blox proprietary message for data logger functionality.

This message requests the GPIO logging configuration. The receiver returns a message of type LogGPIOConfig (Message I.D. 127 / 0x7F).

Example:

`A0A2 0001` - Start Sequence and Payload Length
`C1` - Payload
`00BF B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		C1		ASCII 193

Payload length: 1 byte

Table 3-127: LogGPIOPollConfig Flags

3.3.36 SiRF® Binary Input message I.D. 196, Set Datum (u-blox)

Important Notice

This is a u-blox proprietary message.

This message is available to change map datum (geoid reference). The default initial value is WGS-84 (map datum code 216). Table B-1 lists up all geoidic references. Please note that selecting another map datum affects all navigation outputs given in latitude, longitude and altitude.

The following table contains the values for the following example:

Example:

`A0A2 0002` - Start Sequence and Payload Length
`C4 01` - Payload
`00EF B0B3` - Message Checksum and End Sequence

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		C4		ASCII 196
Map Datum code See table B-1	1		2B	ms	43 = Cape_Canaveral_ Bahamas_Florida

Payload length: 2 bytes

Table 3-128: Map Datum Control

A Additional Information

A.1 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, u-blox 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).

A.2 Switching between NMEA and SiRF® Protocol

To switch to the SiRF® Binary protocol, you must send a SiRF® NMEA message to revert to SiRF® Binary mode. A corresponding SiRF® Binary message exists to switch back to NMEA output.

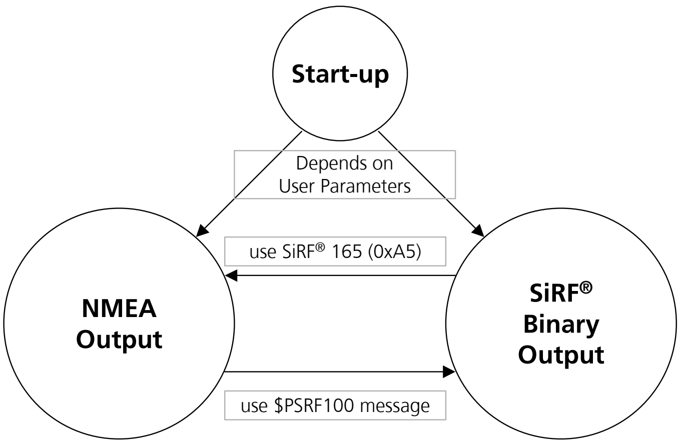

Figure A-1: Switchover between SiRF® Binary and NMEA Output

B Map Datums

Important Notice

This table of map data is supported by u-blox firmware, but not by the original SiRF® firmware.

The codes are used as parameters for SiRF® Binary message 196 (0xC4) and proprietary NMEA message $PSRF106. Changing the map datum will affect all measured navigation outputs in latitude, longitude and altitude, e.g. through SiRF® binary message 98 or NMEA GGA, GLL, etc. For more information about ellipsoids and datums, please refer to the u-blox book "GPS Basics" [8].

Code	Name	Reference Ellipsoid	dX	dY	dZ
0	Adindan_Burkina_Faso	Clarke_1880	-118	-14	218
1	Adindan_Ethiopia	Clarke_1880	-165	-11	206
2	Adindan_Ethiopia_Sudan	Clarke_1880	-166	-15	204
3	Adindan_Mali	Clarke_1880	-123	-20	220
4	Adindan_Regional_Mean	Clarke_1880	-166	-15	204
5	Adindan_Senegal	Clarke_1880	-128	-18	224
6	Adindan_Sudan	Clarke_1880	-161	-14	205
7	Adindan_Cameroon	Clarke_1880	-134	-2	210
8	Afgooye_Somalia	Krassovsky_1940	-43	-163	45
9	Ain_el_Abd_1970_Bahrain	International	-150	-251	-2
10	Ain_el_Abd_1970_Saudi_Arabia	International	-143	-236	7
11	American_Samoa_1962_Samoa_Islands	Clarke_1866	-115	118	426
12	Anna_1_Astro_1965_Cocos_Islands	Australian_National	-491	-22	435
13	Antigua_Island_Astro_1965_Leward_Islands	Clarke_1880	-270	13	62
14	Arc_1950_Botswana	Clarke_1880	-138	-105	-289
15	Arc_1950_Burundi	Clarke_1880	-153	-5	-292
16	Arc_1950_Lesotho	Clarke_1880	-125	-108	-295
17	Arc_1950_Malawi	Clarke_1880	-161	-73	-317
18	Arc_1950_Regional_Mean	Clarke_1880	-143	-90	-294
19	Arc_1950_Swaziland	Clarke_1880	-134	-105	-295
20	Arc_1950_Zaire	Clarke_1880	-169	-19	-278
21	Arc_1950_Zambia	Clarke_1880	-147	-74	-283
22	Arc_1950_Zimbabwe	Clarke_1880	-142	-96	-293
23	Arc_1960_Kenya	Clarke_1880	-157	-2	-299
24	Arc_1960_Kenya_Tanzania	Clarke_1880	-160	-6	-302
25	Arc_1960_Tanzania	Clarke_1880	-175	-23	-303
26	Ascension_Island_1958	International	-191	103	51
27	Astro_Beacon_E_1945_Iwo_Jima	International	145	75	-272
28	Astro_DOS_71_4_St_Helena_Island	International	-320	550	-494
29	Astro_Tern_Island_FRIG_1961	International	114	-116	-333
30	Astronomical_Station_1952_Marcus_Island	International	124	-234	-25
31	Australian_Geodetic_1966	Australian_National	-133	-48	148
32	Australian_Geodetic_1984	Australian_National	-134	-48	149
33	Ayabelle_Lighthouse_Djibouti	Clarke_1880	-79	-129	145

34	Bellevue_IGN	International	-127	-769	472
35	Bermuda_1957_Bermuda	Clarke_1866	-73	213	296
36	Bissau_Guinea_Bissu	International	-173	253	27
37	Bogota_Observatory_Colombia	International	307	304	-318
38	Bukit_Rimpah_Indonesia	Bessel_1841	-384	664	-48
39	Camp_Area_Astro_Antarctica	International	-104	-129	239
40	Campo_Inchauspe_Argentina	International	-148	136	90
41	Canton_Astro_1966_Phoenix_Islands	International	298	304	-375
42	Cap_South_Africa	Clarke_1880	-136	108	-292
43	Cape_Canaveral_Bahamas_Florida	Clarke_1866	-2	151	181
44	Carthage_Tunisia	Clarke_1880	-263	6	431
45	Chatham_Island_Astro_1971_New_Zealand	International	175	-38	113
46	Chua_Astro_Paraguay	International	-134	229	-29
47	Corrego_Alegre_Brazil	International	-206	172	-6
48	Dabola_Guinea	Clarke_1880	-83	37	124
49	Deception_Island_Deception_Island	Clarke_1880	260	12	-147
50	Djakarta_Batavia	Bessel_1841	-377	681	-50
51	DOS_1968_New_Georgia_Islands	International	230	-199	-752
52	Easter_Island_1967_Easter_Island	International	211	147	111
53	Estonia_Coordinate_System_1937	Bessel_1841	374	150	588
54	European_1950_Cyprus	International	-104	-101	-140
55	European_1950_Eastern_Regional_Mean	International	-87	-96	-120
56	European_1950_Egypt	International	-130	-117	-151
57	European_1950_Finland_Norway	International	-87	-95	-120
58	European_1950_Greece	International	-84	-95	-130
59	European_1950_Iran	International	-117	-132	-164
60	European_1950_Italy_Sardinia	International	-97	-103	-120
61	European_1950_Italy_Sicily	International	-97	-88	-135
62	European_1950_Malta	International	-107	-88	-149
63	European_1950_Northern_Regional_Mean	International	-86	-96	-120
64	European_1950_Portugal_Spain	International	-84	-107	-120
65	European_1950_Southern_Regional_Mean	International	-103	-106	-141
66	European_1950_Tunisia	International	-112	-77	-145
67	European_1950_Western_Regional_Mean	International	-87	-98	-121
68	European_1979_Central_Regional_Mean	International	-86	-98	-119
69	Fort_Thomas_1955_Nevis_St_Kitts	Clarke_1880	-7	215	225
70	Gan_1970_Republic_of_Maldives	International	-133	-321	50
71	Geodetic_Datum_1949_New_Zealand	International	84	-22	209
72	Graciosa_Base_SW_1948_Azores	International	-104	167	-38
73	Guam_1963_Guam	Clarke_1866	-100	-248	259
74	Gunung_Segara_Indonesia	Bessel_1841	-403	684	41
75	GUX_1_Astro_Guadalcanal_Island	International	252	-209	-751
76	Herat_North_Afganistan	International	-333	-222	114
77	Hermannskogel_Datum_Croatia_Serbia	Bessel_1841	653	-212	449
78	Hjorsey_1955_Iceland	International	-73	46	-86
79	Hong_Kong_1963_Hong_Kong	International	-156	-271	-189

80	Hu_Tsu_Shan_Taiwan	International	-637	-549	-203
81	Indian_Bangladesh	Everest_1830	282	726	254
82	Indian_India_Nepal	Everest_1956	295	736	257
83	Indian_Pakistan	Everest_1830 /* Everest_Pakistan*/	283	682	231 "
84	Indian_1954_Thailand_Vietnam	Everest_1830	218	816	297
85	Indian_1960	Everest_1830	198	881	317
86	Indian_1960_Vietnam_Con_Son_Islands	Everest_1830	182	915	344
87	Indian_1975_Thailand	Everest_1830	209	818	290
88	Indonesian_1974_Indonesia	International /*Indonesian_1974 */	-24	-15	5
89	Ireland_1965_Ireland	Airy_Modified	506	-122	611
90	ISTS_061_Astro_1968_South_Georgia_Islands	International	-794	119	-298
91	ISTS_073_Astro_1969_Diego_Garcia	International	208	-435	-229
92	Johnston_Island_1961_Johnston_Island	International	189	-79	-202
93	Kandawala_Sri_Lanka	Everest_1830	-97	787	86
94	Kerguelen_Island_1949	International	145	-187	103
95	Kertau_1948_West_Malaysia_And_Singapore	Everest_1948	-11	851	5
96	Korean_Geodetic_System_South_Korea	GRS_1980	0	0	0
97	Kusaie_Astro_1951_Caroline_Islands	International	647	1777	-1124
98	L_C_5_Astro_1961_Cayman_Brac_Islands	Clarke_1866	42	124	147
99	Legion_Ghana	Clarke_1880	-130	29	364
100	Liberia_1964_Liberia	Clarke_1880	-90	40	88
101	Luzon_Philippines	Clarke_1866	-133	-77	-51
102	Luzon_Philippines_Mindanao	Clarke_1866	-133	-79	-72
103	Mahe_1971_Mahe_Island	Clarke_1880	41	-220	-134
104	Massawa_Ethiopia_Eritrea	Bessel_1841	639	405	60
105	Merchich_Morocco	Clarke_1880	31	146	47
106	Midway_Astro_1961_Midway_Islands	International	912	-58	122
107	_7_Minna_Cameroon	Clarke_1880	-81	-84	115
108	Minna_Nigeria	Clarke_1880	-92	-93	122
109	Montserrat_Island_Astro_1958	Clarke_1880	174	359	365
110	M_Poraloko_Gabon	Clarke_1880	-74	-130	42
111	Nahrwan_Oman_Masirah_Island	Clarke_1880	-247	-148	369
112	Nahrwan_Saudi_Arabia	Clarke_1880	-243	-192	477
113	Nahrwan_United_Arab_Emirates	Clarke_1880	-249	-156	381
114	Naparima_BWI_Trinidad_And_Tobago	International	-10	375	165
115	North_American_1927_Alaska	Clarke_1866	-5	135	172
116	North_American_1927_Alaska_Aleutian_Islands_E	Clarke_1866	-2	152	149
117	North_American_1927_Alaska_Aleutian_Islands_W	Clarke_1866	2	204	105
118	North_American_1927_Bahamas	Clarke_1866	-4	154	178
119	North_American_1927_Bahamas_San_Salvador	Clarke_1866	1	140	165
120	North_American_1927_Canada_Yukon	Clarke_1866	-7	139	181
121	North_American_1927_Canal_Zone	Clarke_1866	0	125	201
122	North_American_1927_Central_America	Clarke_1866	0	125	194
123	North_American_1927_Central_Canada	Clarke_1866	-9	157	184

124	North_American_1927_Cuba	Clarke_1866	-9	152	178
125	North_American_1927_East_Canada	Clarke_1866	-22	160	190
126	North_American_1927_East_of_Mississippi	Clarke_1866	-9	161	179
127	North_American_1927_Greenland	Clarke_1866	11	114	195
128	North_American_1927_Gulf_of_Mexico	Clarke_1866	-3	142	183
129	North_American_1927_Mean_for_Canada	Clarke_1866	-10	158	187
130	North_American_1927_Mean_for_Conus	Clarke_1866	-8	160	176
131	North_American_1927_Mexico	Clarke_1866	-12	130	190
132	North_American_1927_Northwest_Canada	Clarke_1866	4	159	188
133	North_American_1927_West_Canada	Clarke_1866	-7	162	188
134	North_American_1927_West_of_Mississippi	Clarke_1866	-8	159	175
135	North_American_1983_Alaska_Canada_Conus	GRS_1980	0	0	0
136	North_American_1983_Aleutian_Islands	GRS_1980	-2	0	4
137	North_American_1983_Central_America_Mexico	GRS_1980	0	0	0
138	North_American_1983_Hawaii	GRS_1980	1	1	-1
139	North_Sahara_Algeria	Clarke_1880	-186	-93	310
140	Observatorio_Metereo_1939_Azores	International	-425	-169	81
141	Old_Egyptian_1907_Egypt	Helmert_1906	-130	110	-13
142	Old_Hawaiian_Hawaii	Clarke_1866	89	-279	-183
143	Old_Hawaiian_Kauai	Clarke_1866	45	-290	-172
144	Old_Hawaiian_Maui	Clarke_1866	65	-290	-190
145	Old_Hawaiian_Oahu	Clarke_1866	58	-283	-182
146	Old_Hawaiian_Regional_Mean	Clarke_1866	61	-285	-181
147	Oman_Oman	Clarke_1880	-346	-1	224
148	Ord_Survey_Great_Britain_1936_England	Airy	371	-112	434
149	Ord_Survey_Great_Britain_1936_Isle_of_Man	Airy	371	-111	434
150	Ord_Survey_Great_Britain_1936_Regional_Mean	Airy	375	-111	431
151	Ord_Survey_Great_Britain_1936_Scotland_Shetland	Airy	384	-111	425
152	Ord_Survey_Great_Britain_1936_Wales	Airy	370	-108	434
153	Pico_de_las_Nieves_Canary_Islands	International	-307	-92	127
154	Pitcairn_Astro_1967_Pitcairn_Island	International	185	165	42
155	Point_58_Mean_for_Burkina_Faso_And_Niger	Clarke_1880	-106	-129	165
156	Pointe_Noire_1948_Congo	Clarke_1880	-148	51	-291
157	Porto_Santo_1936_Maderia_Islands	International	-499	-249	314
158	Provisional_South_American_1956_Bolivia	International	-270	188	-388
159	Provisional_South_American_1956_Chile_Northern	International	-270	183	-390
160	Provisional_South_American_1956_Chile_Southern	International	-305	243	-442
161	Provisional_South_American_1956_Colombia	International	-282	169	-371
162	Provisional_South_American_1956_Ecuador	International	-278	171	-367
163	Provisional_South_American_1956_Guyana	International	-298	159	-369
164	Provisional_South_American_1956_Peru	International	-279	175	-379
165	Provisional_South_American_1956_Regional_Mean	International	-288	175	-376
166	Provisional_South_American_1956_Venezuela	International	-295	173	-371
167	Provisional_South_Chilean_1963_Chile	International	16	196	93
168	Puerto_Rico_Virgin_Islands	Clarke_1866	11	72	-101
169	Pulkovo_1942_Russia	Krassovsky_1940	28	-130	-95

170	Qatar_National_Qatar	International	-128	-283	22
171	Qornoq_Greenland_South	International	164	138	-189
172	Reunion_Mascarene_Islands	International	94	-948	-1262
173	Rome_1940_Italy_Sardinia	International	-225	-65	9
174	S_42_Pulkovo_1942_Albania	Krassovsky_1940	24	-130	-92
175	S_42_Pulkovo_1942_Czechoslovakia	Krassovsky_1940	26	-121	-78
176	S_42_Pulkovo_1942_Hungary	Krassovsky_1940	28	-121	-77
177	S_42_Pulkovo_1942_Kazakhstan	Krassovsky_1940	15	-130	-84
178	S_42_Pulkovo_1942_Latvia	Krassovsky_1940	24	-124	-82
179	S_42_Pulkovo_1942_Poland	Krassovsky_1940	23	-124	-82
180	S_42_Pulkovo_1942_Romania	Krassovsky_1940	28	-121	-77
181	Santo_DOS_1965_Espirito_Santo_Island	International	170	42	84
182	Sao_Braz_Azores	International	-203	141	53
183	Sapper_Hill_1943_East_Falkland_Island	International	-355	21	72
184	Schwarzeck_Namibia	Bessel_1841_Namibia	616	97	-251
185	Selvagem_Grande_Salvage_Islands	International	-289	-124	60
186	SGS_85_Soviet_Geodetic_system_1985	SGS_85	3	9	-9
187	Sierra_Leone_1960_Sierra_Leone	Clarke_1880	-88	4	101
188	S_JTSK_Czechoslovakia_prior_to_Jan_1993	Bessel_1841	589	76	480
189	South_American_1969_Argentina	South_American_1969	-62	-1	-37
190	South_American_1969_Bolivia	South_American_1969	-61	2	-48
191	South_American_1969_Brazil	South_American_1969	-60	-2	-41
192	South_American_1969_Chile	South_American_1969	-75	-1	-44
193	South_American_1969_Colombia	South_American_1969	-44	6	-36
194	South_American_1969_Ecuador	South_American_1969	-48	3	-44
195	South_American_1969_Ecuador_Baltra_Galapagos	South_American_1969	-47	27	-42
196	South_American_1969_Guyana	South_American_1969	-53	3	-47
197	South_American_1969_Paraguay	South_American_1969	-61	2	-33
198	South_American_1969_Peru	South_American_1969	-58	0	-44
199	South_American_1969_Regional_Mean	South_American_1969	-57	1	-41
200	South_American_1969_Trinidad_And_Tobago	South_American_1969	-45	12	-33
201	South_American_1969_Venezuela	South_American_1969	-45	8	-33
202	South_Asia_Singapore	Fischer_1960_Modified	7	-10	-26
203	Tananarive_Observatory_1925_Madagascar	International	-189	-242	-91
204	Timbalai_1948_Brunei_East_Malaysia	Everest_Sabah_And_Sarawak	-679	669	-48
205	Tokyo_Japan	Bessel_1841	-148	507	685
206	Tokyo_Korea	Bessel_1841	-146	507	687
207	Tokyo_Okinawa	Bessel_1841	-158	507	676
208	Tokyo_Regional_Mean	Bessel_1841	-148	507	685
209	Tokyo_South_Korea	Bessel_1841	-147	506	687
210	Tristan_Astro_1968_Tristan_da_Cunha	International	-632	438	-609
211	Viti_Levu_Fiji	Clarke_1880	51	391	-36
212	Voirol_1960_Algeria	Clarke_1880	-123	-206	219
213	Wake_Island_Astro_1952_Wake_Atoll	International	276	-57	149
214	Wake_Eniwetok_1960_Marshall_Islands	Hough	102	52	-38

215	WGS_1972_Global_Definition	WGS_72	0	0	0
216	**WGS_1984_Global_Definition (Default setting)**	**WGS_84**	**0**	**0**	**0**
217	Yacare_Uruguay	International	-155	171	37
218	Zanderij_Suriname	International	-265	120	-358

Table B-1: Geoidic References

Reference Ellipsoid	Semi major axis [m]	Inverse Flattening (1: ...)
Airy	6377563.396	299.324965
Airy_Modified	6377340.189	299.324965
Australian_National	6378160.000	298.250000
Bessel_1841	6377397.155	299.152813
Bessel_1841_Namibia	6377483.865	299.152813
Clarke_1866	6378206.400	294.978698
Clarke_1880	6378249.145	293.465000
Everest_Sabah_And_Sarawak	6377298.556	300.801700
Everest_1830	6377276.345	300.801700
Everest_1948	6377304.063	300.801700
Everest_1956	6377301.243	300.801700
Everest_1969	6377295.664	300.801700
Fischer_1960	6378166.000	298.300000
Fischer_1960_Modified	6378155.000	298.300000
Fischer_1968	6378150.000	298.300000
GRS_1980	6378137.000	298.257222
Helmert_1906	6378200.000	298.300000
Hough	6378270.000	297.000000
International	6378388.000	297.000000
Krassovsky_1940	6378245.000	298.300000
SGS_85	6378136.000	298.257000
South_American_1969	6378160.000	298.250000
WGS_60	6378165.000	298.300000
WGS_66	6378145.000	298.250000
WGS_72	6378135.000	298.260000
WGS_84	6378137.000	298.257224

Table B-2: Datum References

C Lists

C.1 List of Figures

C.2 List of Tables

D Glossary

Please refer to the GPS dictionary from u-blox [3].

E Related Documents

[1] Navstar GPS: GPS Standard Positioning Service Signal Specification, gpssps1.pdf

[2] TIM Low Power Modes - Application Note, GPS.G2-X-02003

[3] The GPS Dictionary, GPS-X-00001.pdf

[4] TIM Data Sheet, GPS.G2-MS2.01001

[5] ICD-GPS-200 - Interface Control Document, Arinc Research Corporation, gps/icd200c.pdf

[6] TIM Active Antenna Supervisor Application Note

[7] TIM Firmware Update Utility, User's Manual, GPS.G2-SW-02004

[8] GPS Basics - Introduction to the systems, GPS-X-02007

[9] TIM Data Logging Functionality, GPS.G2-SW-02015

All these documents are available on our homepage (http://www.u-blox.com).

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