One Socket Protocol Interface Control Document

Including

SiRF Binary Protocol Reference Manual

from page 243 of the PDF

SiRF Technology, Inc.

217 Devcon Drive
San Jose, CA 95112
USA

Tel: +1-408-467-0410
Fax: +1-408-467-0420
www.sirf.com

Preface

The One Socket Protocol, OSP, is the binary protocol interface that enables customer device host software to access all CSR global positioning system chip products of the SiRFstar IV family and beyond. OSP also includes the SiRF Binary Protocol, or SSB, the binary protocol interface that enables customer device host software to access all SiRF global positioning system chip products of the SiRFStar III family and earlier. The first volume of this ICD describes the protocol message specification for the OSP extensions that can be used for SiRFStar IV products only. The second volume describes the SBB specifications slightly enhanced for SIRFStar IV but still fully backward compatible to earlier SiRF GPS products. At the beginning of Section 4, a summary message table is provided showing which messages have been part of SSB protocol, which belong to the SiRFStar IV OSP only and which ones are reserved for other uses not described in this document.

Document History

Revision	Date	History
1	29 JUL 09	Original publication of this document.
2	25 SEP 09	Updated issue, to include *SiRF Binary Protocol Reference Manual*. If you have any comments about this document, send an email to comments@csr.com, giving the document number, title and section with your feedback.

Trademarks, Patents and Licenses

One Socket Protocol (OSP) Interface Control Document

Revision 5.0
Sep 25, 2009

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 Overview

This document defines all SiRFLoc® messages in SiRF Binary format that have not yet been documented in the SiRF Binary Protocol Reference Manual [3]. Also not included are messages reserved for internal SiRF and future use, and the SiRFDRive® messages supporting mostly automotive applications.

2 References

Ref 1 *Aiding Independent Interoperability Interface*, Rev 2.2, 2008-03-26.

Ref 2 *SiRFLoc Client Interface Control Document*, Rev 2.1, 2007-08-156.

Ref 3 *SiRF Binary Protocol Reference Manual*, Revision 2.4.1, April 7, 2009. (this is an extended v2.4 November 2008, by adding GRF3i messages per Carl Carter)

3 Message Structure and Transport Mechanism

The transport mechanism defined in Ref 3 is used to transport the messages defined in this document.

3.1 Transport Message

Table 1: Generic Packet Format

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

3.2 NMEA Protocol Support

By default, the SiRF chip uses SSB only. NMEA protocol can be supported using one of the following three ways:

1. Reconstruct NMEA messages from OSP (LPL can do so).
2. Configure the SiRF chip in NMEA-only mode through a GPIO pin (TBD).
3. Use "Switch To NMEA Protocol" SiRF Binary message to switch the serial port from SSB to NMEA protocol.

OSP and NMEA protocols cannot be enabled at the same time; either OSP is output or NMEA, not both. If OSP protocol is chosen for output, LPL can reconstruct NMEA messages as per point 1 above.

3.3 Payload Structure

The payload always starts with a one byte long Message ID (MID) field. Depending on the MID value, a one byte Sub ID (SID) field may follow the MID field. Subsequently, and again depending on the value of the MID field on the value of the SID field if it exists, a variable number of message parameter fields follow. This ICD documents the name, the purpose of the value, the length, the type, the units of measurement, the value range and the scale of the value of each field.

In this document, the 'scale" of a parameter field specifies a multiplication factor to be applied before placing the parameter value into the message for subsequent transmission between the SLC and CP. For example, if the "duty cycle" parameter value range in the OSP message is a number between 1 – 20; the scale factor shown in the message field description here will be "*0.2", since this is the multiplication factor needed to represent the entire 0 – 100% actual value range as a number in the 1 – 20 range.

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

4 OSP Message Mappings

4.1 Access to OSP Messages and Their Documentation

OSP — Documented in this volume.

SSB — SiRFStar III messages; documented in the next volume.

SiRFNav Host Library Access Only — The message is a OSP-SSB message but it is currently documented only in the SiRFNav Host Programmer's Reference Manual. It is currently assumed that customers will invoke these OSP messages through the library functions only. (Table heading 1.)

Reserved for SDK Customer Use — These messages are documented separately from the OSP/SSB ICD and from the SiRFNav Host Programmer's Manual. (Table heading 2.)

Reserved for Future SiRF Use — These are Message IDs that either have not ever been assigned to any SiRF product use before, used only for internal SiRF development purposes or are obsolete but not reusable. Any Sub ID of any other Message ID in any of the above categories that have not yet been assigned in the documents and inventories listed above are also considered as "SiRF Reserved". If and when such a reserved MID or SID is assigned to an OSP function, the resulting message definition will also be entered in the OSP ICD in the appropriate OSP ICD message description format. (Table heading 3.)

Table 2: OSP Message Access

MID (hex)	MID (dec)	Definition	Sub ID (hex)	Sub ID (dec)	Definition	OSP	SSB	1	2	3
0x00	0	MID_LookInMessage								X
0x01	1	MID_TrueNavigation					X			
0x02	2	MID_MeasuredNavigation					X			
0x03	3	MID_TrueTracker					X			
0x04	4	MID_MeasuredTracker					X			
0x05	5	MID_RawTrkData					X			
0x06	6	MID_SWVersion					X			
0x07	7	MID_ClockStatus					X			

0x08	8	MID_50BPS					X			
0x09	9	MID_ThrPut					X			
0x0A	10	MID_Error					X			
0x0B	11	MID_Ack					X			
0x0C	12	MID_Nak					X			
0x0D	13	MID_VisList					X			
0x0E	14	MID_Almanac					X			
0x0F	15	MID_Ephemeris					X			
0x10	16	MID_TestModeData					X			
0x11	17	MID_RawDGPS					X			
0x12	18	MID_OkToSend					X			
0x13	19	MID_RxMgrParams					X			
0x14	20	MID_TestModeData2					X			
0x15	21	MID_NetAssistReq								X
0x16	22	MID_StopOutput								X
0x17	23	MID_CompactTracker								X
0x18	24	MID_DRCritSave								X
0x19	25	MID_DRStatus								X
0x1A	26	MID_DRHiRateNav								X
0x1B	27	MID_DGPSStatus					X			
0x1C	28	MID_NL_MeasData					X			
0x1D	29	MID_NL_DGPSData					X			
0x1E	30	MID_NL_SVStateData					X			
0x1F	31	MID_NL_InitData					X			
0x20	32	MID_MeasureData								X
0x21	33	MID_NavData								X
0x22	34	MID_SBASData								X
0x23	35	MID_TrkComplete								X
0x24	36	MID_TrkRollover								X
0x25	37	MID_TrkInit								X
0x26	38	MID_TrkCommand								X
0x27	39	MID_TrkReset								X
0x28	40	MID_TrkDownload								X
0x29	41	MID_GeodNavState					X			
0x2A	42	MID_TrkPPS								X
0x2B	43	MID_CMD_PARAM	0x80	128	SSB_QUEUE_CMD_NI		X			
			0x85	133	SSB_QUEUE_CMD_DGPS_SRC		X			
			0x88	136	SSB_QUEUE_CMD_SNM		X			
			0x89	137	SSB_AUEUE_CMD_SDM		X			
			0x8A	138	SSB_QUEUE_CMD_SDGPSM		X			
			0x8B	139	SSB_QUEUE_CMD_SEM		X			
			0x8C	140	SSB_QUEUE_CMD_SPM		X			

			0x8F	143	SSB_QUEUE_CMD_SSN		X			
			0x97	151	SSB_QUEUE_CMD_LP		X			
			0xAA	170	SSB_QUEUE_CMD_SSBAS		X			
0x2C	44	MID_LLA								X
0x2D	45	MID_TrkADCOdoGPIO					X			
0x2E	46	MID_TestModeData3					X			
0x2F	47	MID_NavComplete								X
0x30	48	MID_DrOut	0x01	1	SID_DrNavStatus		X			
			0x02	2	SID_DrNavState		X			
			0x03	3	SID_NavSubsys		X			
			0x04	4	SID_RawDr		X			
			0x05	5	SID_DrValid		X			
			0x06	6	SID_GyrFactCal		X			
			0x07	7	SID_DrSensParam		X			
			0x08	8	SID_DrDataBlk		X			
			0x09	9	SID_GenericSensorParam		X			
			0x0A	10	SID_GenericRawOutput	X				
			0x50	80	SID_MMFStatus	X				
0x31	49	MID_OemOut					X			
0x32	50	MID_SbasParam					X			
0x33	51	MID_SiRFNavNotification	0x01	1	SID_GPS_SIRFNAV_COMPLETE			X		
			0x02	2	SID_GPS_SIRFNAV_TIMING					X
			0x03	3	SID_GPS_DEMO_TIMING					X
			0x04	4	SID_GPS_SIRFNAV_TIME_TAGS			X		
			0x05	5	SID_GPS_NAV_IS801_PSEUDORANGE_DATA					X
			0x06	6	GPS_TRACKER_LOADER_STATE					X
				7	SSB_SIRFNAV_START					X
				8	SSB_SIRFNAV_STOP					X
			0x09	9	SSB_RESULT					X
			0x0A - 0x0F	10 - 15						X
			0x10	16	DEMO_TEST_STATUS					X
			0x11	17	DEMO_TEST_STATE					X
			0x12	18	DEMO_TEST_DATA					X
			0x13	19	DEMO_TEST_STATS					X
			0x14	20	DEMO_TEST_ERROR					X
0x34	52	MID_PPS_Time					X			
0x35	53									X
0X36	54	SSB_EVENT	0x01	1	SSB_STARTUP_INFO			X		
0x37	55	MID_TestModeTrackData					X			
0x38	56	SSB_EE	0x01	1	SSB_EE_GPS_TIME_INFO		X			
			0x02	2	SSB_EE_INTEGRITY		X			
			0x03	3	SSB_EE_STATE		X			

			0x04	4	SSB_EE_CLK_BIAS_ADJ		X			
			0x05	5	SSB_EE_X-CORR_FREE					X
			0x11	17	SSB_EE_EPHEMERIS_AGE			X		
			0x12	18				X		
			0x20	32	ECLM Ack/Nack	X				
			0x21	33	ECLM EE Age	X				
			0x22	34	ECLM SGEE Age	X				
			0xFF	255	SSB_EE_ACK		X			
0x39	57	MID_SYNEPHINT								X
0X3A	58	MID_GPIO_OUTPUT	0x01	1	SID_GPIOParam					X
			0x02	2	SID_GPIOStatus					X
0X3B	59	MID_BT_OUTPUT								X
0X3C	60	MID_AutoCorr								X
0X3D	61	MID_FAILURE_STATUS_RESPO NSE								X
0X3E	62	MID_ExceptionInfo								X
0X3F	63	MID_TESTMODE_OUTPUT	0x07	7	SSB_TEST_MODE_DATA_7		X			
0x40	64		0x00	0						X
0x40	64	MID_NL_AuxData	0x01	1	NL_AUX_INIT_DATA	X				
			0x02	2	NL_AUX_MEAS_DATA	X				
			0x03	3	NL_AUX_AID_DATA	X				
0x41	65	SSB_TRACKER_DATA _GPIO_STATE	0xC0	192			X			
0x42	66	SSB_DOP_VALUES				X				
0x43	67									X
0x44	68	MID_MEAS_ENG_OUT						X		
0x45	69	MID_POS_MEAS_RESP	0x01	1	POS_RESP	X				
			0x02	2	MEAS_RESP	X				
0x46	70	MID_STATUS_RESP	0x01	1	EPH_RESP	X				
			0x02	2	ALM_RESP	X				
			0x03	3	B_EPH_RESP	X				
			0X04	4	TIME_FREQ_APPROX_POS_RESP	X				
			0x05	5	CH_LOAD_RESP	X				
			0x06	6	CLIENT_STATUS_RESP	X				
			0x07	7	OSP_REV_RESP	X				
			0x08	8	SERIAL_SETTINGS_RESP	X				
			0x09	9	TX_BLANKING_RESP	X				
0x47	71	MID_HW_CONFIG_REQ				X				
0x48	72	MID_SensorData	0x01	1	SENSOR_READINGS	X				
			0x02	2	FACTORY_STORED_PARAMS	X				
			0x03	3	RECV_STATE	X				
0x49	73	MID_AIDING_REQ	0x01	1	APPROX_MS_POS_REQ	X				

			0x02	2	TIME_TX_REQ	X				
			0x03	3	FREQ_TX_REQ	X				
			0x04	4	NBA_REQ	X				
0x4A	74	MID_SESSION_CONTROL_RESP	0X01	1	SESSION_OPEN_RESP	X				
			0X02	2	SESSION_CLOSE_RESP	X				
0x4B	75	MID_MSG_ACK_OUT	0X01	1	ACK_NACK_ERROR	X				
			0X02	2	REJECT	X				
0x4C	76									X
0x4D	77	MID_LP_OUTPUT	0x01	1	MPM_ERR	X				
0x4E	78									X
0x4F	79									X
0x50	80									X
0x51	81	MID_QUERY_RESP	All (see ICD)			X				
0x52	82									X
0x53	83									X
0x54	84									X
0x55	85									X
0x56	86									X
0x57	87									X
0x58	88									X
0x59	89		0x01	1	Reserving for known need. Waiting for def'n.					X
0x5A	90	MID_PWR_MODE_RESP	0x00	0	ERR_RESP	X				
			0x01	1	APM_RESP	X				
			0x02	2	MPM_RESP	X				
			0x03	3	TP_RESP	X				
			0x04	4	PTF_RESP	X				
0x5B	91	MID_HW_CTRL_OUT	0x01	1	VCTCXO	X				
			0x02	2	ON_OFF_SIG_CONFIG	X				
0x5C	92	MID_CW_CONTROLLER_RESP	0x01	1	SCAN_RESULT	X				
			0x02	2	FILTER_CONDITIONS	X				
			0x03	3	MON_RESULTS					X
0x5D	93	MID_TCXO_LEARNING_OUT	0x00	0	Not Used					X
			0x01	1	CLOCK_MODEL_DATA_BASE_OUT	X				
			0x02	2	TEMPERATURE_TABLE	X				
			0x03	3	Not Used					X
			0x04	4	TEMP_RECORDER_MESSAGE	X				
			0x05	5	EARC	X				
			0x06	6	RTC_ALARM	X				
			0x07	7	RTC_CAL	X				
			0x08	8	MPM_ACQUIRED	X				
			0x09	9	MPM_SEARCHES	X				
			0x0A	10	MPM_PREPOS	X				

			0x0B	11	MICRO_NAV_MEASUREMENT	X				
			0x0C	12	TCXO UNCERTAINTY	X				
			0x0D	13	SYSTEM_TIME_STAMP	X				
0x5E	94	Reserved for Russ Thomas								X
0x5F	95									X
0x60	96	MID_Peek_Response								X
0x61	97	MID_UserOutputBegin								X
0x62	98	RESERVED for SDK User							X	
0x63	99	RESERVED for SDK User							X	
0x64	100	RESERVED for SDK User							X	
0x65	101	RESERVED for SDK User							X	
0x66	102	RESERVED for SDK User							X	
0x67	103	RESERVED for SDK User							X	
0x68	104	RESERVED for SDK User							X	
0x69	105	RESERVED for SDK User							X	
0X6A	106	RESERVED for SDK User							X	
0X6B	107	RESERVED for SDK User							X	
0X6C	108	RESERVED for SDK User							X	
0X6D	109	RESERVED for SDK User							X	
0X6E	110	RESERVED for SDK User							X	
0X6F	111	RESERVED for SDK User							X	
0x70	112	RESERVED for SDK User							X	
0x71	113	RESERVED for SDK User							X	
0x72	114	RESERVED for SDK User							X	
0x73	115	RESERVED for SDK User							X	
0x74	116	RESERVED for SDK User							X	
0x75	117	RESERVED for SDK User							X	
0x76	118	RESERVED for SDK User							X	
0x77	119	RESERVED for SDK User							X	
0x78	120	RESERVED for SDK User							X	
0x79	121	RESERVED for SDK User							X	
0x7A	122	RESERVED for SDK User							X	
0x7B	123	RESERVED for SDK User							X	
0x7C	124	RESERVED for SDK User							X	
0x7D	125	RESERVED for SDK User							X	
0x7E	126	RESERVED for SDK User							X	
0x7F	127	MID_UserOutputEnd								X
0x80	128	MID_NavigationInitialization					X			
0x81	129	MID_SetNMEAMode					X			
0x82	130	MID_SetAlmanac					X			
0x83	131	MID_FormattedDump					X			
0x84	132	MID_PollSWVersion					X			

0x85	133	MID_DGPSSourceControl					X			
0x86	134	MID_SetSerialPort					X			
0x87	135	MID_SetProtocol					X			
0x88	136	MID_SET_NAV_MODE					X			
0x89	137	MID_SET_DOP_MODE					X			
0x8A	138	MID_SET_DGPS_MODE					X			
0x8B	139	MID_SET_ELEV_MASK					X			
0x8C	140	MID_SET_POWER_MASK					X			
0x8D	141	MID_SET_EDITING_RES					X			
0x8E	142	MID_SET_SS_DETECTOR					X			
0x8F	143	MID_SET_STAT_NAV					X			
0x90	144	MID_PollClockStatus					X			
0x91	145	MID_SetDGPSPort					X			
0x92	146	MID_PollAlmanac					X			
0x93	147	MID_PollEphemeris					X			
0x94	148	MID_FlashUpdate					X			
0x95	149	MID_SetEphemeris					X			
0x96	150	MID_SwitchOpMode					X			
0x97	151	MID_LowPower					X			
0x98	152	MID_PollRxMgrParams					X			
0x99	153	MID_TOWSync								X
0x9A	154	MID_PollTOWSync								X
0x9B	155	MID_EnableTOWSyncInterrupt								X
0x9C	156	MID_TOWSyncPulseResult								X
0x9D	157	MID_DRSetup								X
0x9E	158	MID_DRData								X
0x9F	159	MID_DRCritLoad								X
0xA0	160	MID_HeadSync0								X
0xA1	161	MID_SSB_SIRFNAV_COMMAND	0x01	1	SSB_DEMO_SET_RESTART_MODE					X
			0x02	2	SSB_DEMO_TEST_CPU_STRESS					X
			0x03	3	SSB_DEMO_STOP_TEST_APP					X
				4	Nothing specified for SID 0x04.					X
			0x05	5	SSB_DEMO_START_GPS_ENGINE					X
			0x06	6	SSB_DEMO_STOP_GPS_ENGINE					X
			0x07	7	SSB_SIRFNAV_STORE_NOW	X				
			0x08	8	SSB_DEMO_START_NAV_ENGINE					X
			0x09	9	SSB_SET_IF_TESTPOINT					X
			0x0A - 0x0F	10 - 15						X
			0x10	16	SSB_DEMO_TEST_CFG_CONTINUOUS					X
			0x11	17	SSB_DEMO_TEST_CFG_RESTARTS					X
			0x12	18	SSB_DEMO_TEST_CFG_RF_ON_OFF					X
			0x13 - 0x1D	19 - 29						X

			0x1E	30	SSB_DEMO_TEST_CFG_DELETE					X
			0x1F	31	SSB_DEMO_TEST_CFG_POLL					X
			0x20	32	SSB_DEMO_TEST_START					X
			0x21	33	SSB_DEMO_TEST_STOP					X
			0x22 - 0x2F	34 - 47						X
			0x30	48	SSB_DEMO_TEST_POLL_STATUS					X
			0x31	49	SSB_DEMO_TEST_RF_ATTENUATION					X
			0x32 - 0x3F	50 - 63						X
			0x40	64	SSB_DEMO_TEST_REF_POSITION					X
			0x41	65	SSB_DEMO_TEST_PFC_CONTINUOUS					X
			0x42	66	SSB_DEMO_TEST_PFC_RESTARTS					X
0xA2	162	MID_HeadSync1								X
0xA3	163									X
0xA4	164									X
0xA5	165	MID_ChangeUartChnl					X			
0xA6	166	MID_SetMsgRate					X			
0xA7	167	MID_LPAcqParams					X			
0xA8	168	MID_POLL_CMD_PARAM					X			
0xA9	169	MID_SetDatum					X			
0xAA	170	MID_SetSbasParam					X			
0xAB	171	MID_AdvancedNavInit								X
0xAC	172	MID_DrIn	0x01	1	SID_SetDrNavInit		X			
			0x02	2	SID_SetDrNavMode		X			
			0x03	3	SID_SetGyrFactCal		X			
			0x04	4	SID_SetDrSensParam		X			
			0x05	5	SID_PollDrValid		X			
			0x06	6	SID_PollGyrFactCal		X			
			0x07	7	SID_PollDrSensParam		X			
			0x08	8	SID_ Jamie Colley ?					X
			0x09	9	SID_ InputCarBusData		X			
			0x0A	10	SID_CarBusEnabled		X			
			0x0B	11	SID_CarBusDisabled		X			
			0x0C	12	SID_SetGenericSensorParam					
			0x0D	13	SID_PollGenericSensorParam					
			0x0E	14	SID_InputCarBusData2		X			
			0x0F	15	SID_DR_Factory_Test_Calibration					X
			0x10	16	SID_DR_Initial_User_Information					X
			0x11	17	SID_DR_Output_Nav_Information					X
			0x12	18	SID_DR_Uncertainty_Information					X
			0x13	19	SID_DR_Debug_Information		X			
			0x50	80	SSB_MMF_DATA					
			0x51	81	SSB_MMF_SET_MODE					

0xAD	173	MID_OemPoll								X
0xAE	174	MID_OemIn								X
0xAF	175	MID_SendCommandString					X			
0xB0	176	MID_TailSync0								X
0xB1	177	GPS_NAV_LPL_CMDR	0x00	0	LPL_CMDR_POLL_STATUS					X
			0x01	1	LPL_CMDR_POLL_STATUS_RESP					X
			0x02	2	LPL_CMDR_SESSION_START					X
			0x03	3	LPL_CMDR_SESSION_START_RESP					X
			0x04	4	LPL_CMDR_SESSION_STOP					X
			0x05	5	LPL_CMDR_SESSION_IN_PROGRESS					X
			0x06	6	LPL_CMDR_SESSION_IN_PROGRESS_RESP					X
			0x07	7	LPL_CMDR_SESSION_STATUS					X
			0x08	8	LPL_CMDR_SET_PLATFORM_CONFIG					X
			0x09	9	LPL_CMDR_GET_PLATFORM_CONFIG_REQST					X
			0x0A	10	LPL_CMDR_GET_PLATFORM_CONFIG_RESP					X
			0x0B	11	LPL_CMDR_LOAD_NMR_FILE					X
			0x0C	12	LPL_CMDR_GET_NMR_FILE_STATUS					X
			0x0D	13	LPL_CMDR_START_LOGFILE					X
			0x0E	14	LPL_CMDR_STOP_LOGFILE					X
			0x0F	15	LPL_CMDR_GET_LOGFILE_STATUS_RE					X
			0x10	16	LPL_CMDR_GET_LOGFILE_STATUS_RESP					X
			0x11	17	LPL_CMDR_IS_EE_AVAILABLE_REQST					X
			0x12	18	LPL_CMDR_IS_EE_AVAILABLE_RESP					X
			0x13	19	LPL_CMDR_GET_EE_DATA					X
			0x14	20	LPL_CMDR_GET_EE_DATA_RESP					X
			0x15	21	LPL_CMDR_SET_POWER_MODE					X
			0x16	22	LPL_CMDR_GET_POWER_MODE_REQST					X
			0x17	23	LPL_CMDR_GET_POWER_MODE_RESP					X
0xB2	178	SIRF_MSG_SSB_TRACKER_IC	0x00	0	Reserved	X				
			0x01	1	SIRF_MSG_SSB_MEI_TO_CUSTOMIO	X				
			0x02	2	SIRF_MSG_SSB_TRKR_CONFIG	X				
			0x03	3	SIRF_MSG_SSB_TRKR_PEEKPOKE_CMD	X				
			0x04	4	SIRF_MSG_SSB_TRKR_PEEKPOKE_RSP	X				
			0x05	5	SIRF_MSG_SSB_TRKR_FLASHSTORE_RSP	X				
			0x06	6	SIRF_MSG_SSB_TRKR_FLASHERASE_RSP	X				
			0x07	7	SIRF_MSG_SSB_TRKR_HWCONFIG_RSP	X				
			0x08	8	SIRF_MSG_SSB_TRKR_CUSTOMIO_RSP	X				
0xB3	179	MID_TailSync1								X
0xB4	180	MID_UserInputEnd								X
0xB5	181	RESERVED for SDK User							X	
0xB6	182	RESERVED for SDK User							X	
0xB7	183	RESERVED for SDK User							X	

0xB8	184	RESERVED for SDK User							X	
0xB9	185	RESERVED for SDK User							X	
0xBA	186	RESERVED for SDK User							X	
0xBB	187	RESERVED for SDK User							X	
0xBC	188	RESERVED for SDK User							X	
0xBD	189	RESERVED for SDK User							X	
0xBE	190	RESERVED for SDK User							X	
0xBF	191	RESERVED for SDK User							X	
0xC0	192	RESERVED for SDK User							X	
0xC1	193	RESERVED for SDK User							X	
0xC2	194	RESERVED for SDK User							X	
0xC3	195	RESERVED for SDK User							X	
0xC4	196	RESERVED for SDK User							X	
0xC5	197	RESERVED for SDK User							X	
0xC6	198	RESERVED for SDK User							X	
0xC7	199	MID_UserInputEnd								X
0xC8	200	MID_GPIO_INPUT	0x01	1	SID_PollGPIOParam					X
			0x02	2	SID_SetGPIO					X
0xC9	201	MID_BT_INPUT								X
0xCA	202	MID_POLL_FAILURE_STATUS								X
0xCB	203	GPS_TRK_TESTMODE_COMMAND								X
0xCC	204	MID_MEAS_ENG_IN								X
0xCD	205	MID_SetGenericSWControl	0x10	16	SSB_SW_COMMANDED_OFF			X		
0xCE	206	MID_RF_Test_Point						X		
0xCF	207	MID_INT_CPUPause						X		
0xD0	208	MID_SiRFLoc								X
0xD1	209	MID_QUERY_REQ				X				
0xD2	210	MID_POS_REQ				X				
0xD3	211	MID_SET_AIDING	0x01	1	SET_IONO	X				
			0x02	2	SET_EPH_CLOCK	X				
			0x03	3	SET_ALM	X				
			0x04	4	SET_ACQ_ASSIST	X				
			0x05	5	SET_RT_INTEG	X				
			0x06	6	SET_UTC_MODEL	X				
			0x07	7	SET_GPS_TOW_ASSIST	X				
			0x08	8	SET_AUX_NAV	X				
			0x09	9	SET_AIDING_AVAIL	X				
0xD4	212	MID_STATUS_REQ	0x01	1	EPH_REQ	X				
			0x02	2	ALM_REQ	X				
			0x03	3	B_EPH_REQ	X				
			0X04	4	TIME_FREQ_APPROX_POS_REQ	X				

			0X05	5	CH_LOAD_REQ	X				
			0x06	6	CLIENT_STATUS_REQ	X				
			0x07	7	OSP_REV_REQ	X				
			0x08	8	SERIAL_SETTINGS_REQ	X				
			0x09	9	TX_BLANKING_REQ	X				
0xD5	213	MID_SESSION_CONTROL_REQ	0X01	1	SESSION_OPEN_REQ	X				
			0X02	2	SESSION_CLOSE_REQ	X				
0xD6	214	MID_HW_CONFIG_RESP				X				
0xD7	215	MID_AIDING_RESP	0x01	1	APPROX_MS_POS_RESP	X				
			0x02	2	TIME_TX_RESP	X				
			0x03	3	FREQ_TX_RESP	X				
			0x04	4	SET_NBA_SF1_2_3	X				
			0x05	5	SET_NBA_SF4_5	X				
0xD8	216	MID_MSG_ACK_IN	0X01	1	ACK_NACK_ERROR	X				
			0X02	2	REJECT	X				
0xD9	217		0x01	1	SENSOR_ON_OFF					X
0xDA	218	MID_PWR_MODE_REQ	0x00	0	FP_MODE_REQ	X				
			0x01	1	APM_REQ	X				
			0x02	2	MPM_REQ	X				
			0X03	3	TP_REQ	X				
			0X04	4	PTF_REQ	X				
0xDB	219	MID_HW_CTRL_IN	0x01	1	VCTCXO	X				
			0x02	2	ON_OFF_SIG_CONFIG	X				
0xDC	220	MID_CW_CONTROLLER_REQ	0x01	1	CONFIG	X				
			0x02	2	EVENT_REG					X
			0x03	3	COMMAND_SCAN					X
			0X04	4	CUSTOM_MON_CONFIG					X
			0X05	5	FFT_NOTCH_SETUP					X
0xDD	221	MID_TCXO_LEARNING_IN	0x00	0	OUTPUT_REQUEST	X				
			0x01	1	CLOCK_MODEL_DATA_BASE	X				
			0x02	2	TEMPERATURE_TABLE	X				
			0x03	3	TEST_MODE_CONTROL	X				
			0x04	4	Not Used					X
			0x05	5	Not Used					X
			0x06	6	Not Used					X
			0x07	7	Not Used					X
			0x08	8	Not Used					X
			0x09	9	Not Used					X
			0x0A	10	Not Used					X
			0x0B	11	Not Used					X
			0x0C	12	Not Used					X
0xDE	222	Reserved for Russ Thomas								X

0xDF	223									X
0xE0	224	MID_Peek_Poke_Command								X
0xE1	225	MID_SiRFOutput		6	STATISTICS	x	X			
0xE2	226	MID_UI_LOG								
0xE3	227	MID_NL_MeasResi								
0xE4	228	MID_SiRFInternal								
0xE5	229	MID_SysInfo								X
0xE6	230	MID_SysInfoOut								X
0xE7	231	MID_UserDebugMessage								X
0xE8	232	MID_EE_INPUT	0x01	1	SSB_EE_SEA_PROVIDE_EPH		X			
			0x02	2	SSB_EE_POLL_STATE		X			
			0x10	16	SSB_EE_FILE_DOWNLOAD					X
			0x11	17	SSB_EE_QUERY_AGE					X
			0x12	18	SSB_EE_FILE_PART					X
			0x13	19	SSB_EE_DOWNLOAD_TCP					X
			0x14	20	SSB_EE_SET_EPHEMERIS					X
			0x15	21	SSB_EE_FILE_STATUS					X
			0x16	22	ECLM Start Download	X				
			0x17	23	ECLM File Size	X				
			0x18	24	ECLM Packet Data	X				
			0x19	25	Get EE Age	X				
			0x1A	26	Get SGEE Age	X				
			0xFE	254	SSB_EE_DISABLE_EE_SECS					X
			0xFF	255	SSB_EE_DEBUG		X			
0xE9	233	MID_SetRFParams	0x01	1	SET_GRF3iPLUS_IF_BANDWIDTH		X			
			0x02	2	SET_GRF3iPLUS_POWER_MODE		X			
			0x0A	10	POLL_GRF3iPLUS_IF_BANDWIDTH		X			
			0x0B	11	POLL_GRF3iPLUS_POWER_MODE		X			
			0xA5	165	SET_GRF3iPLUS_IF_TESTPOINT_PARAM					
			0xA6	166	SET_GRF3iPLUS_AGC_MODE					
			0xFE	254	OUTPUT_GRF3iPLUS_POWER_MODE		X			
			0xFF	255	OUTPUT_GRF3iPLUS_IF_BANDWIDTH		X			
0xEA	234	MID_SensorControl	0x01	1	SENSOR_CONFIG	X				
			0x02	2	SENSOR_SWITCH	X				
0xEB	235	MID_WiFi_Tag				X				
0xEC	236									X
0xED	237									X
0xEE	238									X
0xEF	239									X
0xF0	240									X
0xF1	241									X
0xF2	242									X

0xF3	243									X
0xF4	244	MID_BufferFull								X
0xF5	245	MID_ParityError								X
0xF6	246	MID_RcvFullError								X
0xF7	247	MID_RcvOverrunError								X
0xF8	248	MID_FrameError								X
0xF9	249	MID_BreakInterrupt								X
0xFA	250	MID_BufferTerminated								X
0xFB	251	MID_TransportDataErr								X
0xFC	252	MID_CheckSumError								X
0xFD	253	MID_LengthError								X
0xFE	254	MID_MessageTypeError								X
0xFF	255	MID_ASCIIData				X				

4.2 Mapping between AI3 Messages and OSP Messages

Table 3: Mapping between AI3Messages and OSP Messages

AI3	OSP	Input or Output
AI3 Request	Position Request	I
	Set Ionospheric Model	I
	Set Satellite Ephemeris and Clock Corrections	I
	Set Almanac Assist Data	I
	Set Acquisition Assistance Data	I
	Set Real-Time Integrity	I
	Deleted ICD_REV_NUM, ALM_REQ_FLAG, IONO_FLAG	
	Move NEW_ENHANCE_TYPE to "Hardware Configuration Response" message	
	Don't support coarse location method anymore, deleted COARSE_POS_REF_LAT and COARSE_POS_REF_LON	
AI3 Response	Position Response	O
	Measurement Response	O
	Deleted fields from SUBALM_FLAG to SUBALM_TOA	
	Deleted fields from CP_VALID_FLAG to PR_ERR_TH	
ACK/NACK Message	ACK/NACK/Error Notification	I and O
SLC/CP Message ACK.NACK		
SLC Ephemeris Status Request	Ephemeris Status Request	I
Unsolicited SLC Ephemeris Status Response	Ephemeris Status Response	O
Solicited SLC Ephemeris Status Response		
Poll Almanac Request	Almanac Request	I
Poll Almanac Response	Almanac Response	O
Unsolicited SLC EE Integrity Warning	Replaced by the existing SSB message: "Extended Ephemeris Integrity – Message ID 56 (Sub ID 2)"	
Unsolicited SLC EE Clock Bias Adjustment	Replaced by the existing SSB message: "EE Provide Synthesized Ephemeris Clock Bias Adjustment Message – Message ID 56 (Sub ID 4)"	
CP Send Auxiliary NAV Message	Set UTC Model	I
	Set GPS TOW Assist	I
	Set Auxiliary Navigation Model Parameters	I
Aiding Request Message	Deleted since RRC/RRLP doesn't provide NAV subframe aiding	
NAV Subframe 1_2_3 Aiding Response Message	<AI – keep this message>	
NAV Subframe 4_5 Aiding Response Message	<AI – keep this message>	
Broadcast Ephemeris Request Message	Broadcast Ephemeris Request	I
Broadcast Ephemeris Response Message	Broadcast Ephemeris Response	O

4.3 Mapping between F Messages and OSP Messages

Table 4: Mapping between F Messages and OSP Messages

F	OSP	Input or Output
Session Open Request	Session Open Request	I
Session Open Notification	Session Open Notification	O
Error Notification	Replaced by "ACK/NACK/Error Notification" message	
SLC Status	SLC Status	O
Session Closing Request	Session Closing Request	I
Session Closing Notification	Session Closing Notification	O
Hardware Configuration Request	Hardware Configuration Request	O
Hardware Configuration Response	Hardware Configuration Response	I
Time Transfer Request	Time Transfer Request	O
Time Transfer Response	Time Transfer Response	I
Frequency Transfer Request	Frequency Transfer Request	O
Frequency Transfer Response	Frequency Transfer Response	I
Approximate MS Position Request	Approximate MS Position Request	O
Approximate MS Position Response	Approximate MS Position Response	I
Time_Frequency_ApproximatePosition Status Request	Time_Frequency_Approximate_Position Status Request	I
Time_Frequency_ApproximatePosition Status Response	Time_Frequency_Approximate_Position Status Response	O
Push Aiding Availability	Push Aiding Availability	I
ACK/NACK for Push Aiding Availability	ACK/NACK for Push Aiding Availability	O
Wireless Power Request	Deleted since we have not implemented this feature	
Wireless Power Response	Deleted since we have not implemented this feature	
Reject	Reject	O
Reset GPS Command	Replaced by the existing "Initialize Data Source – Message ID 128" message	
Software Version Request	Software Version Request	I
Software Version Response	Software Version Response	O
Set APM	"Power Mode Request" Msg ID 218 subsumes	I
Ack APM	"Power Mode Response" Msg ID 90 subsumes	O
Serial Port Setting Request	Serial Port Setting Request	I
Serial Port Setting Response	Serial Port Setting Response	O
Channel Open Request	Deleted since there is no logical channel anymore	
Channel Open Response	Deleted since there is no logical channel anymore	
Channel Close Request	Deleted since there is no logical channel anymore	
Channel Close Response	Deleted since there is no logical channel anymore	

F	OSP	Input or Output
Channel Priority Request	Deleted since there is no logical channel anymore	
Channel Priority Response	Deleted since there is no logical channel anymore	
Priority Query	Deleted since there is no logical channel anymore	
Priority Response	Deleted since there is no logical channel anymore	
Channel Load Query	Channel Load Query	I
Channel Load Response	Channel Load Response	O
Tx Blanking Request	Tx Blanking Request	I
Tx Blanking Response	Tx Blanking Response	O
Test Mode Configuration Request	Test Mode Configuration Request	I
Test Mode Configuration Response	Test Mode Configuration Response	O
ICD Version Request	Deleted since we cannot trace AI3 and F ICD version anymore	
ICD Version Response	Deleted since we cannot trace AI3 and F ICD version anymore	

5 Input Message Definitions

5.1 Position Request

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

Table 5: Position Request message

Field	Bytes	Scale	Unit
Message ID	1		
POS_REQ_ID	1		
NUM_FIXES	1		
TIME_BTW_FIXES	1	1	Seconds
HORI_ERROR_MAX	1		Meters
VERT_ERROR_MAX	1		
RESP_TIME_MAX	1	1	Seconds
TIME_ACC_PRIORITY	1		
LOCATION_METHOD	1		

POS_REQ_ID Position request identifier

This is a number in the range of 0 to 255 for the SLC to identify the position response (or measurements) with the associated request.

NUM_FIXES Number of requested MS position (fixes).

The CP shall set this field to the number of "MS Position" messages it requires the CP to send back.
If the number is set to 0, SLC shall send MS position continuously to CP.
If NUM_FIXES is 1, TIME_BTW_FIXES shall be ignored.

TIME_BTW_FIXES Time elapsed between fixes.

The CP shall set this field to the minimum time between two consecutive fixes of the NUM_FIXES sequence triggered by this request, in second units, in the range from 0 to 255 seconds. The number 0 is for one fix case. The time is minimized in the sense that if the tracking is temporary lost during the sequence of fixes, the time between two consecutive fixes can be larger than TIME_BET_FIXES to give time to the receiver to reacquire satellites and resume the position fixes delivery. The Advanced Power Management (APM) can also affect the actual time between fixes.

HORI_ERROR_MAX Maximum requested horizontal error.

The CP shall set this field to the maximum requested horizontal position error, in unit of 1 meter. The value of 0x00 indicates "No Maximum". The range of HORI_ERROR_MAX is from 1 meter to 255 meters. The SLC shall try to provide a position with horizontal error less than this specified value in more than 95% of the cases.

Table 6: Vertical Error

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

VERT_ERROR_MAX Maximum requested vertical error.

The CP shall set this field to the maximum requested vertical position error according to Table 6. The SLC shall try to provide a position with vertical error less than this specified value in more than 95% of the cases.

Note: The Position Request OSP message and the APM request message both specify QoS parameters and time between fixes. The APM request overrides the Position Request parameter values. When switching to and from APM to another mode, a previously issued multiple fix Position Request might be still in progress. The fixes overlapping the APM validity period will have the APM parameters; the ones outside of the APM validity period will have the Position Request parameters.

RESP_TIME_MAX Maximum response time

The CP shall set this field to the maximum requested response time, as an unsigned binary, in seconds. The value '0' is reserved "for no time limit"

TIME_ACC_PRIORITY Time/accuracy priority.

To indicate no time-limit for a fix, MAX_RESP_TIME shall be set to 0.
If RESP_TIME_MAX and HERRMAX/VERRMAX conditions are contradicting each other, this field determines which one should have the priority. This field shall be coded according to Table 7.

Table 7: Time/Accuracy Priority

TIME_ACC_PRIORITY	Description
0x00	No priority imposed
0x01	RESP_TIME_MAX has priority over HORI_ERROR_MAX/VERT_ERROR_MAX
0x02	HORI_ERROR_MAX/VERT_ERROR_MAX has priority over RESP_TIME_MAX
0x03 – 0xFF	Reserved

LOCATION_METHOD GPS Location Method

The CP shall set this field according to the requested location method (see Table 8).

Table 8: LOCATION_METHOD Definition

LOCATION_METHOD	Description
0x00	MS Assisted
0x01	MS Based
0x02	MS Based is preferred, but MS Assisted is allowed
0x03	MS Assisted is preferred, but MS Based is allowed
0x04	Simultaneous MS Based and MS Assisted
All others	Reserved

5.2 Set Ionospheric Model

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

Table 9: Set Ionospheric Model message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
ALPHA_0	8(1)	2^{-30}	Seconds
ALPHA_1	8(1)	2^{-27}	sec/semi-circles
ALPHA_2	8(1)	2^{-24}	sec/(semi-circles)^2
ALPHA_3	8(1)	2^{-24}	sec/(semi-circles)^3
BETA_0	8(1)	2^{11}	Seconds
BETA_1	8(1)	2^{14}	sec/semi-circles
BETA_2	8(1)	2^{16}	sec/(semi-circles)^2
BETA_3	8(1)	2^{16}	sec/(semi-circles)^3

ALPHA_0 Ionosphere correction parameter α_0 .

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

ALPHA_1 Ionosphere correction parameter α_1 .

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

ALPHA_2 Ionosphere correction parameter α_2.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

ALPHA_3 Ionosphere correction parameter α_3.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

BETA_0 Ionosphere correction parameter β_0.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

BETA_1 Ionosphere correction parameter β_1.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

BETA_2 Ionosphere correction parameter β_2.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

BETA_3 Ionosphere correction parameter β_3.

5.3 Set Satellite Ephemeris and Clock Corrections

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

Table 10: Set Satellite Ephemeris and Clock Corrections message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
NUM_SVS	1		
The structure of ephemeris parameters below shall repeat for the number of times indicated in the "NUM_SVS" field.			
EPH_FLAG	8	N/A	N/A
SV_PRN_NUM	8	N/A	N/A
URA_IND	8	N/A	N/A
IODE	8	N/A	N/A
C_RS	16(1)	2^{-5}	Meters

Field	Bytes	Scale	Unit
DELTA_N	16(1)	2^{-43}	semi-circles/sec
M0	32(1)	2^{-31}	semi-circles
C_UC	16(1)	2^{-29}	Radians
ECCENTRICITY	32	2^{-33}	N/A
C_US	16(1)	2^{-29}	Radians
A_SQRT	32	2^{-19}	$\sqrt{meters}$
TOE	16	2^{4}	Seconds
C_IC	16(1)	2^{-29}	Radians
OMEGA_0	32(1)	2^{-31}	semi-circles
C_IS	16(1)	2^{-29}	Radians
ANGLE_INCLINATION	32(1)	2^{-31}	semi-circles
C_RC	16(1)	2^{-5}	Meters
OMEGA	32(1)	2^{-31}	semi-circles
OMEGADOT	32(1)	2^{-43}	semi-circles/sec
IDOT	16(1)	2^{-43}	semi-circles/sec
TOC	16	2^{4}	Seconds
T_GD	8(1)	2^{-31}	Seconds
AF2	8(1)	2^{-55}	sec/sec^2
AF1	16(1)	2^{-43}	sec/sec
AF0	32(1)	2^{-31}	Seconds

NUM_SVS Number of satellites

This is the number of satellites for which satellite ephemeris and clock corrections are being given with this message.

EPH_FLAG Ephemeris parameter validity flag.

The CP shall set this field to 1 if the following fields from SV_PRN_NUM to AF0 are valid broadcast ephemeris parameters.
If those fields are not valid, The CP shall set this field and the following fields from SV_PRN_NUM to AF0 to 0. This field shall be set to 0 if ephemeris parameters are not present in this AI3 message. The client shall keep its internal ephemeris data in this case.
The CP shall set this field to 2 if the following fields from SV_PRN_NUM to AF0 are valid synthesized ephemeris parameters (ephemeris extension).
For an unhealthy SV ("SV health" is not equal to 0), a separate UNHEALTHY_SAT_FLAG section might be included.
Other values are interpreted as follows
Bit 5 (Bit 0 is LSB) represents the type of ephemeris extension (EE). The value of 0 represents server-based EE, and the value of 1 represents client-based EE.
Bit 0 to Bit 4 represents the age of EE.
The value of 2 represents valid ephemeris extension of age of 1-day.
The value of 3 represents valid ephemeris extension of age of 2-day.

The value of 4 represents valid ephemeris extension of age of 3-day.
The value of 5 represents valid ephemeris extension of age of 4-day.
The value of 6 represents valid ephemeris extension of age of 5-day.
The value of 7 represents valid ephemeris extension of age of 6-day.
The value of 8 represents valid ephemeris extension of age of 7-day.
For example: 0x22 represents a client-based ee of age 1, while 0x02 represents a server-based ee of age 1.

SV_PRN_NUM Satellite PRN number.

The CP shall set this field to the value of the PRN number for which the ephemeris is valid. It is represented as an unsigned binary value in the range from 1 to 32.

URA_IND User range accuracy index.

The CP shall set this field to the URA index of the SV. The URA index is an integer in the range of 0 through 15 and has the following relation to the URA of the SV.

Table 11: URA coding

URA Index	URA (meters)
0	$0.00 < URA \le 2.40$
1	$2.40 < URA \le 3.40$
2	$3.40 < URA \le 4.85$
3	$4.85 < URA \le 6.85$
4	$6.85 < URA \le 9.65$
5	$9.65 < URA \le 13.65$
6	$13.65 < URA \le 24.00$
7	$24.00 < URA \le 48.00$
8	$48.00 < URA \le 96.00$
9	$96.00 < URA \le 192.00$
10	$192.00 < URA \le 384.00$
11	$384.00 < URA \le 768.00$
12	$768.00 < URA \le 1536.00$
13	$1536.00 < URA \le 3072.00$
14	$3072.00 < URA \le 6144.00$
15	$6144.00 < URA$ (or no accuracy prediction is available)

IODE Issue of data.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

C_RS Amplitude of the sine harmonic correction term to the orbit radius.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

DELTA_N Mean motion difference from the computed value.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

M0 Mean anomaly at the reference time.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

C_UC Amplitude of the cosine harmonic correction term to the argument of latitude.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

ECCENTRICITY Eccentricity.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

C_US Amplitude of the sine harmonic correction term to the argument of latitude.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

A_SQRT Square root of the semi-major axis.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

TOE Ephemeris reference time.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.
The SLC shall accept the associated parameter if

1. The internal ephemeris has an TOE (let's call it int_TOE) that is in the past when compared to this TOE
2. int_TOE is in the future when compared to this TOE, and ((TOE * 16) mod 3600) != 0.

C_IC Amplitude of the cosine harmonic correction term to the angle of inclination.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

OMEGA_0 Longitude of ascending node of orbit plane at weekly epoch.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

C_IS Amplitude of the sine harmonic correction term to the angle of inclination.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

ANGLE_INCLINATION Inclination angle at reference time.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

C_RC Amplitude of the cosine harmonic correction term to the orbit radius.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

OMEGA Argument of perigee.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

OMEGADOT Rate of right ascension.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

IDOT Rate of inclination angle.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

TOC Clock data reference time.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

T_GD L1 and L2 correction term.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

AF2 Apparent satellite clock correction a_{f2}.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

AF1 Apparent satellite clock correction a_{f1}.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

AF0 Apparent satellite clock correction a_{f0}.

The CP shall set this field to the value contained in the associated parameter of the specified GPS ephemeris.

5.4 Set Almanac Assist Data

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

Table 12: Set Almanac Assist Data message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
ALM_WEEK_NUM	16	N/A	N/A
NUM_SVS	1		
The structure below of almanac parameters shall repeat a number of times indicated by the "NUM_SVS" field.			
ALM_VALID_FLAG	8	N/A	N/A
ALM_SV_PRN_NUM	8	N/A	N/A
ALM_ECCENTRICITY	16	2^{-21}	dimensionless
ALM_TOA	8	2^{12}	Seconds
ALM_DELTA_INCL	16(1)	2^{-19}	semi-circles
ALM_OMEGADOT	16(1)	2^{-38}	semi-circles/sec.
ALM_A_SQRT	24	2^{-11}	$meters^{1/2}$
ALM_OMEGA_0	24(1)	2^{-23}	semi-circles
ALM_OMEGA	24(1)	2^{-23}	semi-circles
ALM_M0	24(1)	2^{-23}	semi-circles
ALM_AF0	16 (1)	2^{-20}	Seconds
ALM_AF1	16 (1)	2^{-38}	sec/sec

ALM_WEEK_NUM The GPS week number of the almanac.

This field shall be equal to the 10 least significant bits of the GPS week number of the almanac. The range for this field is from 0 to 1024.

NUM_SVS Number of satellites
This is the number of satellites for which almanac assistance is being given with this message.

ALM_VALID_FLAG Almanac validity flag.

This field shall be set to 1 if the following fields from ALM_SV_PRN_NUM to ALM_AF1 are valid.

If those fields are not valid, The CP shall set this field and the following fields from ALM_SV_PRN_NUM to ALM_AF1 to 0. For a sub-almanac which is not present (i.e. not due to bad health of the SV, but due to the absence of aiding data), ALM_VALID_FLAG shall be set to 0 (0x00). In this case, the client shall preserve the sub-almanac it has in its memory without overwriting it with the sub-almanac data in this message.

ALM_SV_PRN_NUM The satellite PRN number.

This field shall set to the value of the SV PRN number for which the almanac is valid. It is represented as an unsigned value in the range from 1 to 32.

ALM_ECCENTRICITY Eccentricity

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_TOA The reference time of the almanac.

This field shall be set to specify the reference time of the almanac, its unit is 4096 seconds.. Its valid range is from 0 to 602,112 seconds.

ALM_DELTA_INCL Delta inclination

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_OMEGADOT Rate of right ascension.

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_A_SQRT Square root of the semi-major axis

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_OMEGA_0 Longitude of ascending node of orbit plane at weekly epoch

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_OMEGA Argument of perigee

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_M0 Mean anomaly at reference time

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

ALM_AF0 Apparent satellite clock correction a_{f0}

This field shall be set to the value contained in the associated parameter of the specified GPS almanac

ALM_AF1 Apparent satellite clock correction a_{f1}

This field shall be set to the value contained in the associated parameter of the specified GPS almanac.

5.5 Set Acquisition Assistance Data

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

Table 13: Set Acquisition Assistance Data message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
REFERENCE_TIME	32	0.001	Seconds
NUM_SVS	1		
The acquisition assistance parameters structure below shall repeat a number of times indicated by the NUM_SVS field.			
ACQ_ASSIST_VALID_FLAG	8	N/A	N/A
SV_PRN_NUM	8		
DOPPLER0	16[1]	2.5	Hz
DOPPLER1	8[1]	1/64	Hz/s
DOPPLER_UNCERTAINTY	8		(See Table 14)
SV_CODE_PHASE	16	1	Chips
SV_CODE_PHASE_INT	8	1	Milliseconds
GPS_BIT_NUM	8		
CODE_PHASE_UNCERTAINTY	16	1	Chips
AZIMUTH	16	1	Degrees
ELEVATION	8	1	Degrees

REFERENCE_TIME GPS Time Reference for Acquisition Assistance Data

The CP shall set this field to the GPS seconds since the beginning of the current GPS week at which the acquisition assistance data is valid, in binary format, in units of 1/1000 seconds, in the range from 0s to 604,799.999 seconds.

NUM_SVS Number of satellites
This is the number of satellites for which acquisition assistance data is being set with this message.

ACQ_ASSIST_VALID_FLAG Acquisition Assistance Data Validity Flag.

The CP shall set this field to 1 if the following fields from SV_PRN_NUM to ELEVATION are valid. If those fields are not valid, The CP shall set this field and the following fields from SV_PRN_NUM to ELEVATION to 0.

SV_PRN_NUM Satellite PRN Number

The CP shall set this field to the value of the PRN number for which acquisition assistance data is valid. It is represented as an unsigned binary value in the range from 1 to 32, where the binary value of the field conveys the satellite PRN number.

DOPPLER0 The 0^{th} Order Doppler

The CP shall set this field to the two's complement value of the 0^{th} order Doppler, in units of 2.5 Hz, in the range from –5,120 Hz to 5,120 Hz. The CP shall set this field to 0xF7FF (decimal -2049) if the 0^{th} order Doppler is unknown.

DOPPLER1 The 1^{st} Order Doppler

The CP shall set this field to the two's complement value of the1^{st} order Doppler, in units of 1/64 Hz/s. The valid value is from –1 Hz/s to +1 Hz/s. The CP shall set this field to 0xBF (decimal -65) if the 1^{st} order Doppler is unknown.

DOPPLER_UNCERTAINTY The Doppler Uncertainty

The CP shall set this field to represent the Doppler uncertainty as specified in Table 14.

Table 14: DOPPLER_UNCERTAINTY Field

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

SV_CODE_PHASE Code Phase

The CP shall set this field to the code phase in units of 1 C/A code chip. The valid range is from 0 to 1022 Chips.
The offset is specified in reference to the current millisecond boundary.

SV_CODE_PHASE_INT The Integer Number of C/A Code Periods That Have Elapsed Since The Latest GPS Bit Boundary

The CP shall set this field to the number of the C/A code periods that have elapsed since the latest GPS bit boundary, in units of C/A code period (1 ms). The valid range is from 0 to 19.

GPS_BIT_NUM The Two Least Significant Bits of The Bit Number (Within The GPS Frame) Being Currently Transmitted

The CP shall set this field to represent the two least significant bits of the bit number being received at REFERENCE_TIME. The valid range is from 0 to 3.

CODE_PHASE_UNCERTAINTY Code Phase Uncertainty

The CP shall set this field to the value of the code phase uncertainty, in units of 1 C/A code chip. The valid range is from 0 to 1023 chips.

AZIMUTH Azimuth Angle of the GPS Satellite

The CP shall set this field to the azimuth, in units of 1 degree. The valid value is from 0 to 359 degrees. The CP shall set this field to 0xFFFF if the azimuth angle is unknown.

ELEVATION Elevation Angle of the GPS Satellite

The CP shall set this field to the elevation angle, in units of 1 degree. The valid value is form -90 to 90 degrees. The CP shall set this field to 0xFF if the elevation angle is unknown

5.6 Set Real-Time Integrity

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

Table 15: Set Real-Time Integrity message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
UNHEALTHY_SAT_INFO	4		

UNHEALTHY_SAT_INFO Information on unhealthy satellite

This is a 32 bit field to indicate which satellite is unhealthy. Bit 0 corresponds to satellite PRN number 1, and Bit 31 corresponds to satellite PRN number 32. An unhealthy satellite is indicated by setting the corresponding bit to 1; if the bit is zero, the satellite is considered healthy by the aiding source.
If a satellite is considered unhealthy, the SLC shall not use it for search nor position computation.
For all position modes the SLC shall try to collect satellite health information on its own. SLC shall use the latest satellite health information (either from OSP messages or from self collection).
If this information is never received by the SLC during a session, SLC shall use its internal information.

5.7 OSP ACK/NACK/ERROR Notification

MID (Hex)	0xD8
MID (Dec)	216
Message Name in Code	MID_MSG_ACK_IN
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	ACK_NACK_ERROR

There were no existing messages for autonomous ACK/NACK input, therefore this message is intended for both autonomous and aided cases. For the autonomous case, certain fields are not applicable and will be zeroed out.

Table 16: ACK/NACK/ERROR NOTIFICATION message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
Echo Message ID	1		
Echo Message Sub ID	1		
ACK/NACK/ERROR	1		
Reserved	2		

Table 17: ACK/NACK/ERROR Field Description

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

5.8 Ephemeris Status Request

MID (Hex)	0xD4
MID (Dec)	212
Message Name in Code	MID_STATUS_REQ
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	EPH_REQ

Table 18: Ephemeris Status Request message

Field	Bytes	Scale Factor	Unit
Message ID	1		
Message Sub ID	1		

5.9 Almanac Request

MID (Hex)	0xD4
MID (Dec)	212
Message Name in Code	MID_STATUS_REQ
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	ALM_REQ

Table 19 Almanac Request message

Field	Bytes	Scale Factor	Unit
Message ID	1		
Message Sub ID	1		

5.10 Set UTC Model

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

Table 20: Set UTC Model message

Field	Bytes	Scale	Unit
Message ID			
Message Sub ID			
R_A0	32	2^{-30} (2)	seconds
R_A1	32(24) (1)	2^{-50} (2)	sec/sec
R_DELTA_TLS	8	1	seconds
R_T_OT	8	2^{12} (2)	seconds
R_WN_T	8	1	weeks
R_WN_LSF	8	1	weeks
R_DN	8	1	days
R_ DELTA_T_LSF	8	1	seconds

R_A0 Constant term of polynomial (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_A1 The first order term of polynomial (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_DELTA_TLS Delta time due to leap seconds (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_T_OT Reference time for UTC Data (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_WN_T UTC reference week number (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_WN_LSF Week number at which the scheduled future or recent past leap second becomes effective (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_DN Day number at the end of which the scheduled future or recent past leap second becomes effective (raw)
The CP shall set this field to the value contained in the associated parameter of the UTC data.

R_DELTA_T_LSF Delta time due to the scheduled future or recent past leap second (raw)
The GPS Data Center shall set this field to the value contained in the associated parameter of the UTC data.

5.11 Set GPS TOW Assist

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

Table 21: Set GPS TOW Assist message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
NUM_SVS	1		
The structure below of GPS TOW assistance parameters shall repeat a number of times indicated by the NUM_SVS field.			
TOW_ASSIST_SV_PRN_NUM	8	N/A	N/A
TLM_MSG	16(14)	N/A	N/A
TOW_ASSIST_INFO	8(1+1+2)	N/A	N/A (this field contains the "Anti-Spoof", "Alert" and the "TLM Reserved" parameters)

NUM_SVS Number of satellites
This is the number of satellites for which GPS TOW assistance data is being given with this message.

TOW_ASSIST_SV_PRN Satellite PRN Number
PRN number of the satellite that the GPS_TOW_ASSIST information belongs to. The value 0 indicates that the corresponding GPS_TOW_ASSIST parameters are not valid.

TLM_MSG Telemetry work
Telemetry word broadcast by the specified satellite.

TOW_ASSIST_INFO Additional TOW Assist Information
Bit 3 corresponds to the 1 bit "Anti-Spoof" parameter broadcast by the specified satellite.
Bit 2 corresponds to the 1 bit "Alert" parameter broadcast by the specified satellite.
Bit 1-0 (LSB) corresponds to the 2 bit "TLM Reserved" parameter broadcast by the specified satellite.

5.12 Set Auxiliary Navigation Model Parameters

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

Table 22: Set Auxiliary Navigation Model Parameters message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
NUM_SVS	1		
The structure of auxiliary navigation model parameters below shall repeat a number of times as indicated by the "NUM_SVS" field above.			
NAVMODEL_SV_PRN_NUM	1		
NAVMODEL_TOE	16	2^4 (2)	seconds
NAVMODEL_IODC	16(10) (1)	N/A	N/A
NAVMODEL_SF1_L2_INFO	8(2+1) (1)	N/A	N/A (this field contains the "C/A or P on L2" and the "L2 P Data Flag" parameters)
NAVMODEL_SF1_SV_HEALTH	8(6) (1)	N/A	N/A
NAVMODEL_SF1_RESERVED	88(87) (1)	N/A	N/A
NAVMODEL_SF2_AODO_FIT_INTERVAL	8(1+5)	N/A	N/A (this field contains the "AODO" and the "Fit Interval Flag" parameters)

(1) The number in parentheses indicates the actual number of bits of the parameter. If multiple parameters are included in a field, the number of bits for each parameter are connected by the "+" sign.
(2) The detailed description of each parameter can be found in ICD GPS 200C.

NUM_SVS Number of satellites
This is the number of satellites for which auxiliary navigation model parameters are being given with this message.

NAVMODEL_SV_PRN_NUM Satellite ID number for the NAVMODEL
PRN number of the satellite that the NAVMODEL belongs to. The value 0 indicates that the corresponding NAVMODEL parameters are not valid.

NAVMODEL_TOE Time of Ephemeris of the NAVMODEL
This is the TOE of the corresponding NAVMODEL.
The SLC shall accept the associated parameter if
- The internal NavModel parameters has an TOE (let's call it int_TOE) that is in the past when compared to this NAVMODEL_TOE
- int_TOE is in the future when compared to NAVMODEL_TOE, and ((TOE * 16) mod 3600) != 0.

NAVMODEL_IODC Issue of Data, Clock of the NAVMODEL
This is the 10 bit IODC that corresponds to the ephemeris of the specified satellite.

NAVMODEL_SF1_L2_INFO
Bits 2 and 1 correspond to the 2 bit "C/A or P on L2" found in bits 71 and 72 of subframe 1 of the specified satellite's navigation message.
Bit 0 (LSB) corresponds to the 1 bit "L2 P Data Flag" found in bit 91 of subframe 1 of the specified satellite's navigation message.

NAVMODEL_SF1_SV_HEALTH
Bits 5 to 0 (LSB) correspond to the 6 bit "SV Health" found in subframe 1 of the specified satellites' navigation message.

NAVMODEL_SF1_RESERVED
The LSB 7 bits of the first byte and the entire next 10 bytes correspond to the 87 reserved bits found in subframe 1 of the specified satellites' navigation message. The MSB valid bit in the first byte is transmitted from the satellite first.

NAVMODEL_SF2_AODO_FIT_INTERVAL
Bit 5 corresponds to the 1 bit "Fit Interval Flag" found subframe 2 of the specified satellite's navigation message.
Bits 4 to 0 (LSB) correspond to the 5 bit "AODO" found subframe 2 of the specified satellite's navigation message.

5.13 Broadcast Ephemeris Request

MID (Hex)	0xD4
MID (Dec)	212
Message Name in Code	MID_STATUS_REQ
SID (Hex)	0x03
SID (Dec)	3
SID Name in Code	B_EPH_REQ

Table 23: Broadcast Ephemeris Request message

Field	Bytes	Scale Factor	Unit
Message ID	1		
Message Sub ID	1		
EPH_RESP_TRIGGER	2	N/A	N/A
NUM_SVS	1		
The following fields are repeated a number of times as indicated by the value of the NUM_SVS field above.			
EPH_INFO_FLAG	1	N/A	N/A
SV_PRN_NUM	1	N/A	N/A
GPS_WEEK	2	N/A	N/A
TOE	2	16	Seconds

EPH_RESP_TRIGGER   Broadcast Ephemeris Response Message Trigger(s)

This field is designed to specify how the Broadcast Ephemeris Response Message(s) should be triggered with the following definition.

Bit 0 (LSB)   1 = output the available broadcast ephemeris once if the available broadcast ephemeris is newer than the one specified by valid GPS_WEEK and TOE (EPH_INFO_FLAG = 1). When GPS_WEEK and TOE are not valid (EPH_INFO_FLAG = 0), output the available broadcast ephemeris once

Bit 1   1 = output broadcast ephemeris according to rules specified in Bit 0, then output broadcast ephemeris only when the broadcast ephemeris is updated (not necessarily changed)

Bit 2 1 = output broadcast ephemeris according to rules specified in Bit 0, then output broadcast ephemeris only when the broadcast ephemeris is changed

Bit 3 to Bit 15 (MSB) Reserved

Only 1 out of the following three bits - Bit 0, Bit 1 and Bit 2 - may be set at one time.

NUM_SVS Number of satellites
This is the number of satellites for which broadcast ephemeris is being requested with this message.

EPH_INFO_FLAG Broadcast Ephemeris Information Validity Flag

This field should be set to 1 if the following fields from SV_PRN_NUM to TOE are valid. This field should be set to 0 if the following fields from SV_PRN_NUM to TOE are NOT valid.

SV_PRN_NUM Satellite PRN Number

This field should be set to the value of the PRN number for which the broadcast ephemeris information is valid. It is represented as an unsigned binary value in the range from 1 to 32. When EPH_INFO_FLAG is set to 0, this field should be set to 0.

GPS_WEEK Broadcast Ephemeris Reference Week

This field should be set to the value of GPS week number of the broadcast ephemeris. When EPH_INFO_FLAG is set to 0, this field should be set to 0.

TOE Broadcast Ephemeris Reference Time

This field should be set to the value of TOE of the broadcast ephemeris. When EPH_INFO_FLAG is set to 0, this field should be set to 0.

5.14 Session Opening Request

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

Table 24: Session Opening Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
SESSION_OPEN_REQ_INFO	1		

SESSION_OPEN_REQ_INFO: Session open request information.

This field shall be set to an appropriate value as specified in Table 25.

Table 25: SESSION_OPEN_REQ_INFO

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

5.15 Client Status Request

MID (Hex) 0xD4
MID (Dec) 212
Message Name in Code MID_STATUS_REQ
SID (Hex) 0x06
SID (Dec) 6
SID Name in Code CLIENT_STATUS_REQ

Table 26: Client Status Request message

Field	Bytes	Scale Factor	Unit
Message ID	1		
Message Sub ID	1		

5.16 Test Mode Configuration Request

This message already exists from SSB and is being kept as is. Since it is a previously existing message and is untouched by the conversion of SSB->OSP, it is not documented in this manual. Details of MID and SID are mentioned here for reference.

Table 27: Existing Test Mode Config Request MID and SID

MID (hex)	MID (dec)	MID Name	SID (hex)	SID (dec)	SID Name
0xE8	232	MID_SSB_EE_INPUT	0xFF	255	SSB_EE_DEBUG

Message details can be found in this document:
http://sirfcentral/sites/devops/SiRFLocServerAndLocationServicesPlatformDevelopment/Project%20SysEng/EASGEE_CLM_GPS_TOO_draft.doc

5.17 Tx Blanking Request

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

Table 28: Tx Blanking Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
COMMAND	1		
AIR_INTERFACE	1		
MODE	1		
Reserved	4		

COMMAND Message Command

The valid values are either "0" or "1". The value "0" represent a command to start Tx Blanking, the value "1" represents a command to stop Tx Blanking.

AIR_INTERFACE Air interface

This parameter indicates the air interface for which the SLC should perform the Tx blanking for. The value is "0", which represent the GSM air interface. All other values are currently invalid.

MODE Tx Blanking Mode

This parameter indicates Tx Blanking Mode the receiver should do.

Table 29: MODE Field Specification (for GSM)

Values	Description
0x00	1 Slot Blanking
0x01	2 Slot Blanking
0x02 to 0xFF	Reserved

5.18 Channel Load Query

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

Table 30: Channel Load Query message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
PORT	1		
MODE	1		

PORT Serial Port A or B

The CP shall set this field to the port number it wants to query the load. "0" represents the SiRF port A and "1" represents SiRF port B. Any other value has no meaning.

MODE Response Mode

The CP shall set this field according to Table 31. If the periodic mode is enabled, the Channel load response shall be output once per second.

Table 31: MODE Field Specification

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

[(1)]: No specific acknowledge nor further Channel Load Response message shall be sent after reception of this message.
[(2)]: periodic response is sent every second.

5.19 Serial Port Setting Request

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

This MID is from an existing SSB message which has been modified to include the superset of fields using from the previous analogous SSB and AI3 messages.

Table 32: Serial Port Setting Request Message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
BAUD_RATE	4		
DATA_BITS	1		
STOP_BIT	1		
PARITY	1		
PORT	1		
Reserved	1		

BAUD_RATE
The CP shall set this field to the desired baud rate. The current baud rates that are supported are 4800, 9600, 19200, 38400, 57600, and 115200. Any other value is illegal and is not supported. The Baud rate shall be coded as its equivalent binary value.

Example 1: "4800 bps" shall be coded as "000012C0" in hexadecimal equivalent.
Example 2: "115200bps" shall be coded "0001C200" in hexadecimal equivalent.

DATA_BITS
Represents how many data bits are used per character.

STOP_BIT
Stop bit length. For example, 1 = 1 stop bit.

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

PORT Serial Port A or B
The CP shall set this value to the port number that is being configured. "0" represents the port A and "1" represents the port B. Any other value has no meaning.

5.20 Software Version Request

MID (Hex) 0x84
MID (Dec) 132
Message Name in Code MID_PollSWVersion

Table 33: Software Version Request message

Field	Bytes	Scale	Unit
Message ID	U1		
Control	U1		

The 'Control' field has a value of 0 and it is not used. The only purpose of it is backward compatibility with the SSB "Poll Software Version" message.

5.21 Reject

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

Table 34: Reject message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
REJ_MESS_ID	1		
REJ_MESS_SUB_ID	1		
REJ_REASON	1		

REJ_MESS_ID Message ID of Rejected Message
REJ_MESS_ID Message Sub ID of Rejected Message
REJ_REASON Reject Reason

.

Table 35: "REJ_REASON" field Description

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

5.22 Time_Frequency_Approximate_Position Status Request

MID (Hex)	0xD4
MID (Dec)	212
Message Name in Code	MID_STATUS_REQ
SID (Hex)	0x04
SID (Dec)	4
SID Name in Code	TIME_FREQ_APPROX_POS_REQ

Table 36: Time_Frequency_Approximate_Position Status Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
REQ_MASK	1		

REQ_MASK Request mask

Bit 0 (LSB): {0,1} => {Time status not requested, Time (gps week number and tow) status requested)
Bit 1 (LSB): {0,1} => {Time accuracy status not requested, Time accuracy status requested)
Bit 2: {0,1} => {Frequency status not requested, Frequency status requested)
Bit 3: {0,1} => {ApproximatePosition status not requested, ApproximatePosition status requested)

5.23 Approximate MS Position Response

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

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

Table 37: Approximate MS Position Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
LAT	4		
LON	4		
ALT	2		
EST_HOR_ER	1		
EST_VER_ER	2		
USE_ALT_AIDING	1		

LAT Approximate MS Latitude

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

LON Approximate MS Longitude

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

ALT Approximate MS Altitude

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

ALT(in m)= Bx0.1-500

where B is the unsigned binary value of the "ALT" field from 0 to 65535.

"all zeros" represents –500m, "all ones" represents +6053.5m.

EST_HOR_ER Estimated Horizontal Error

The CP shall set this field using the estimated error in the Approximate MS location. The error shall correspond to radius of the maximum search domain the CP requires the SLC to search and shall be encoded according to Table 38.

Table 38: "EST_HOR_ER" field Description

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

EST_VER_ER Estimated Vertical Error

The CP shall set this field using the estimated vertical error in the Approximate MS location. The error shall correspond to the standard deviation of the error in MS altitude in units of 0.1 meters in the range of 0 meters to 6553.5 meters, in Unsigned Binary Offset coding**.** The formula to apply is:

EST_VER_ER (in m)= Vx0.1

where V is the unsigned binary value of the "EST_VER_ER" field from 0 to 65535.

"all zeros" represents 0m, "all ones" represents +6553.5m.

USE_ALT_AIDING Use Altitude Aiding

If the least significant bit of this byte is 1 then the altitude aiding is to be used, otherwise not.

5.24 Frequency Transfer Response

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

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

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

Table 39: Frequency Transfer Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
SCALED_FREQ_OFFSET	2		
REL_FREQ_ACC	1		
TIME_TAG	4		
REF_CLOCK_INFO	1		
NOMINAL_FREQ	5 This field is presented only if Bit 4 of REF_CLOCK_INFO is '1'		

SCALED_FREQ_OFFSET: SCALED_Frequency Offset (in Hz)

The CP shall set the bits in this field equal to the relative frequency difference between the theoretical and the real value of the CP clock, multiplied by the L1 frequency (1575.42 Mhz), in units of Hertz. If the theoretical value is higher than the real one, the value shall have a positive sign. The range of values shall be from -2^{14}Hz to $+2^{14}$-1Hz. The encoding shall be in two's complement.

Example: if the nominal CP clock is 10Mhz, and the real CP clock frequency is 9.999975Mhz , the relative frequency difference is +2.5ppm, and the value of the SCALED_FREQ_OFFSET field is: 2.5e-6.1575.42e6=3938.6Hz which shall be rounded to the closest integer number of Hz, and coded as 0x0F63.

REL_FREQ_ACC: Relative Frequency Offset Accuracy
The CP shall set this field based on the estimated accuracy of the frequency offset.
Note 1: the SLC only guarantees to search in a domain just large enough to encompass the search uncertainty engendered by the REL_FREQ_ACC field, but not beyond. It is CP's responsibility to choose this field value large enough.

Note 2: The REL_FREQ_ACC is one-sided: the SLC shall consider that the actual scaled frequency lies in the interval between "SCALED_FREQ_OFFSET – REL_FREQ_ACCxL1" and "SCALED_FREQ_OFFSET+ REL_FREQ_ACCxL1" where L1=1575.42 MHz.

The encoding shall be according to Table 40.

Table 40: "REL_FREQ_ACC" Field Description

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

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

- Set to 0xFFFFFFFE indicates that the contents of the message are valid from the time of reception forward and will not change until notified with another Frequency Response message. Note the CP must ensure that the clock is on and stable prior to sending the Frequency Transfer Response message with the TIME_TAG field set to 0xFFFFFFFE.
- Set to 0xFFFFFFFF to inform the SLC that this message is invalid.

Note: The rollover of the GPS_WEEK_NUM will be handled by SLC.

REF_CLOCK_INFO: Reference clock information for frequency transfer message
This is used to provide additional information about the clock used.

Table 41: REF_CLOCK_INFO Field Definition

Bits in REF_CLOCK_INFO	Description
Bit 1 (LSB)	Bit1 = 0 implies that this frequency transfer message is related to the reference clock input to the counter (and thus use of counter method) Bit1 = 1 implies that this frequency transfer message is related to the SLC clock
Bit 2	Valid only if the frequency transfer method is counter Bit 2 = 0: Reference clock is on Bit 2 = 1: Reference clock is off
Bit 3	Valid only if the frequency transfer method is counter Bit 3 = 0: Don't request to turn off reference clock Bit 3 = 1: Request to turn off reference clock
Bit 4	Bit 4 = 0: NOMINAL_FREQ field is not included in this message Bit 4 = 1: NOMINAL_FREQ field is included in this message
Bit 5 to Bit 8	Reserved

NOMINAL_FREQ Nominal CP Frequency

The CP shall set this field to the absolute frequency value of the clock derived from CP by division and delivered to the SLC for counter frequency measurement. The resolution is in 10^{-3} Hz. The format is unsigned binary over 40 bits. The range is from 0.001Hz to 1.0995GHz. Otherwise, the CP shall set this field to all '0's.

5.25 Time Transfer Response

MID (Hex) 0XD7
MID (Dec) 215
Message Name in Code MID_AIDING_RESP
SID (Hex) 0x02
SID (Dec) 2
SID Name in Code TIME_TX_RESP

The "Time Transfer Response" message is output in response to "Time Transfer Request" message.

Depending on the hardware configuration, this message can be returned along with a hardware timing pulse ("Precise Time Transfer" mode) or without hardware timing pulse ("Coarse Time Transfer" mode). The SLC will know which case is implemented by checking the "HW_CONFIG" field in the "Hardware Configuration Response" message.
Given the high resolution of the GPS_TIME field, the timing pulse can be sent any time convenient for the CP, provided the GPS_TIME is reported in the "Time Transfer Response" Message consistently.

Table 42: Time Transfer Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
TT_TYPE	1		
GPS_WEEK_NUM	2		
GPS_TIME	5		
DELTAT_UTC	3		
TIME_ACCURACY	1		

TT_TYPE Time Transfer Type
If the "Coarse Time Transfer" method is used, this field shall be set to all '0's.If the "Precise Time Transfer" method is used, this field shall be set to all '1's.
GPS_WEEK_NUM GPS Week Number
The GPS Week Number is the absolute Week number and not rolled over to Modulo 1024. The GPS shall set this field to the value of the current GPS Week Number
GPS_TIME: GPS Time
The SLC shall set this field to the time of the week in Units of 1 microsecond. This time shall be the GPS time valid at the preceding time pulse (for "Precise Time Transfer" mode), or at the time of the transmission of the message (for "Coarse Time Transfer" mode). The values range from 0 to 604800 seconds.
DELTAT_UTC GPS Time to UTC Time Correction
Correction in milliseconds to apply to the full GPS time (counted from GPS zero time point) to get UTC time from same zero time point. The formula to apply is: $T_{UTC}=T_{GPS}$-DELTAT_UTC. The format is in two's complement, in units of 1ms, in the range from –8388. 608 seconds to +8388.607 seconds .
TIME_ACCURACY Time Transfer Accuracy
The CP shall set this field equal to the estimated accuracy of the time in this message. This field will be used to set the maximum search domain the SLC will search.

Note 1: the SLC only guarantees to search in a domain just large enough to encompass the search uncertainty engendered by the TIME_ACCURACY field, but not beyond. It is CP's responsibility to choose this field value large enough.
Note 2: The TIME_ACCURACY is one-sided: the SLC shall consider that the actual GPS time lies in the interval between "GPS_TIME - TIME_ACCURACY" and "GPS_TIME + TIME_ACCURACY".

If the "Coarse Time Transfer" is used (see TT_TYPE field), this field shall be in units of 1 milliseconds and encoded as per Table 43.
If the "Precise Time Transfer" is used (see TT_TYPE field), this field shall be in units of 1 microsecond and encoded as per Table 44.

Table 43: "TIME_ACCURACY" field description-"Coarse Time Transfer" method

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

Table 44: "TIME_ACCURACY" field description-"Precise Time Transfer" method

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

5.26 Push Aiding Availability

MID (Hex) 0xD3
MID (Dec) 211
Message Name in Code MID_SET_AIDING
SID (Hex) 0x09
SID (Dec) 9
SID Name in Code SET_AIDING_AVAIL

Table 45: Push Aiding Availability message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
AIDING_AVAILABILITY_MASK	1		
FORCED_AIDING _REQ_MASK	1		
EST_HOR_ER	1		
EST_VER_ER	2		
REL_FREQ_ACC	1		
TIME_ACCURACY_SCALE	1		
TIME_ACCURACY	1		
SPARE	2		

AIDING_AVAILABILITY_MASK Mask to indicate the type of aiding available

Bit 0=1: Position aiding accuracy has improved, EST_HOR_ER and EST_VER_ER are valid;
Bit 0=0: Position aiding status has not changed
Bit 1=1: Frequency aiding available, REL_FREQ_ACC valid; Bit 1=0: Frequency aiding status has not changed
Bit 2=1: Time aiding available, TIME_ACCURACY valid; Bit 2=0: Time aiding status has not changed
The SLC may or may not request for aiding based on this availability mask. Once the aiding response is sent to the SLC, the SLC may not use the new aiding if the uncertainty level of the new aiding is not as good as SLC's internal information.

FORCED_AIDING_REQ_MASK Mask to indicate the type of aiding that the CP would like to force the SLC to re-request

Bit 0=1: Position aiding source has changed, SLC shall re-request for new aiding;
Bit 1=1: Frequency aiding source has changed, SLC shall re-request for new aiding;
Bit 2 = 1: SLC shall re-request for new time aiding

- This mask indicates the type(s) of aiding that the SLC shall request again. The SLC shall re-request regardless of the uncertainty level of the new aiding, but shall accept and use the aiding response only if the uncertainty is better than what the SLC has internally when the SLC is not navigating.

- When the SLC is navigation, the SLC may accept the aiding with better uncertainty. For example, if SLC is navigating with a 2D-position with no GPS week number, when a forced time and position aiding re-request comes in, the SLC shall request for time and position (using Time Transfer Request and Approximate MS Position Request). The SLC will only accept and use the GPS week number, and the height information in the new aiding. However, if the SLC is navigating with full knowledge of time, when a forced time aiding comes in, the SLC will request for time aiding, but it will not use the new time aiding.

EST_HOR_ER and EST_VER_ER
These parameters have the same definitions as the ones in Table 38.
REL_FREQ_ACC
This parameter has the same definition as the ones in Table 40.
TIME_ACCURACY_SCALE scale factor for the time accuracy
This represents the scale factor used to encode the time accuracy.
TIME_ACCURACY_SCALE =0 => time_scale = 1.0
TIME_ACCURACY_SCALE =1 => time_scale = 0.125
TIME_ACCURACY_SCALE =0xFF => time accuracy unknown
All other values are reserved.
TIME_ACCURACY time accuracy
This is the time accuracy of the aiding.
If time_scale (obtained from TIME_ACCURACY_SCALE) is 1.0, Table 43 shall be used to get the time accuracy.
If time_scale (obtained from TIME_ACCURACY_SCALE) is 0.125, Table 44 shall be used to get the time accuracy.
A value of 0xFF means "unknown accuracy"

5.27 Hardware Configuration Response

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

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

Table 46: Hardware Configuration Response message

Field	Bytes	Scale	Unit
Message ID	1		
HW_CONFIG	1		
NOMINAL_FREQ	5		
NW_ENHANCE_TYPE	1		

HW_CONFIG: Hardware configuration information.

This field shall be set to an appropriate value as specified in Table 47.

Table 47: HW_CONFIG Field Specification

Bits in HW_CONFIG	Value	CONFIGURATION
Bit 1(LSB)	0: No 1: Yes	Precise Time Transfer Availability(1)
Bit 2	0: CP ⟶ SLC 1: CP ⟷ SLC	Precise Time Transfer direction between CP and SLC
Bit 3	0: No 1: Yes	Frequency Transfer Availability
Bit 4	1: No Counter 0: Counter	Frequency Transfer Method
Bit 5	1: Yes 0: No	RTC Availability
Bit 6	1: Internal to GPS 0: External to GPS	RTC for GPS
Bit 7	0: No 1: Yes	Coarse Time Transfer Availability(1)
Bit 8	0: Reference clock is on 1: Reference clock is off	Valid only if Bit 4 is '0' Reference Clock Status for "Counter" type Frequency Transfer

(1) : Either "Precise Time Transfer" or "Coarse Time Transfer" can be available for a hardware configuration, but not both simultaneously.

NOMINAL_FREQ Nominal CP Frequency

If, in HW_CONFIG Bit 3 is set to '1' and Bit 4 is set to '0' (counter method), the CP shall set this field to the absolute frequency value of the clock derived from CP by division and delivered to the SLC for counter frequency measurement. The resolution is in 10^{-3} Hz. The format is unsigned binary over 40 bits. The range is from 0.001Hz to 1.0995GHz. Otherwise, the CP shall set this field to all '0's.

NW_ENHANCE_TYPE Network Enhancement Type

The CP shall use this field to inform the SLC which network enhanced features are available.

Table 48: NW_ENHANCE_TYPE Definition

NW_ENHANCE_TYPE	Description
Bit 0	Reserved
Bit 1	Reserved
Bit 2	0 = AUX_NAVMODEL Aiding is NOT supported 1 = AUX_NAVMODEL Aiding is supported
Bit 3	0 = NAVBit Subframe 1, 2, and 3 Aiding is NOT supported 1 = NAVBit Subframe 1, 2, and 3 Aiding is supported
Bit 4	0 = NavBit Subframe 4 and 5 Aiding is NOT supported 1 = NavBit Subframe 4 and 5 Aiding is supported
Bit 5	Reserved

NW_ENHANCE_TYPE	Description
Bit 6	Reserved
Bit 7	Reserved

Note: Network providers tend to support these enhancement types consistently in their coverage zone. Therefore, it is sufficient to specify the supported types at the initial configuration time here. When roaming into a different provider's network seamlessly in a single navigation session, the support configuration might change. If the new network does not support certain types that were originally declared as supported in the NW_ENHANCE_TYPE field here, the change becomes visible in the first position Navbit request response message if the SLC requested it.

5.28 Session Closing Request

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

Table 49: Session Closing Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
SESSION_CLOSE_REQ_INFO	1		

SESSION_CLOSE_REQ_INFO: Session closing request information.
This field shall be set to an appropriate value as specified in Table 50.

Table 50: SESSION_CLOSE_REQ_INFO

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

5.29 OSP Revision Request

MID (Hex) 0xD4
MID (Dec) 212
Message Name in Code MID_STATUS_REQ
SID (Hex) 0x07
SID (Dec) 7
SID Name in Code OSP_REV_REQ

Table 51: OSP Revision Request message

Field	Bytes	Scale Factor	Unit
Message ID	1		
Message Sub ID	1		

5.30 Nav Subframe 1_2_3 Aiding Response Message

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

This message is in response to the Nav Bit Aiding Request Message ("NBA_REQ").

Table 52: Nav Subframe 1_2_3 Aiding Response Fields

Field	Length (bits)	Units
Message ID	8	
Message Sub ID	8	
NUM_SVS	8	
The following fields are repeated a number of times as specified by the value in the NUM_SVS field above.		
SUBF_1_2_3_FLAG	8	NA
SAT_PRN_NUM	8	NA
SUBF_1_2_3	904	NA

NUM_SVS Number of satellites
This is the number of satellites for which ephemeris status parameters are given by this message.

SUBF_1_2_3_FLAG Subframe 1, 2, and 3 Flag

If set to "0x00", SAT_PRN_NUM and SUBFRAME_1_2_3 fields are invalid and must be set to zero. If set to "0x01", SAT_PRN_NUM and SUBFRAME_1_2_3 fields are valid.

SAT_PRN_NUM Satellite PRN number

This field contains satellite PRN number for which SUBF_1_2_3 is valid. It is represented as an unsigned binary value in the range from 1 to 32, where the binary value of the field conveys the satellite PRN number.

SUBF_1_2_3 Subframe 1, 2 and 3

This field contains subframe 1, 2 and 3 of the navigation message bits for the satellite specified by SV_PRN_NUM, in that order transmitted by the satellite. The most significant bit of the first byte shall contain the first bit of Subframe 1. There should be 900 valid bits. Therefore, the least significant 4 bit of the last byte shall be set to 0's.

5.31 Nav Subframe 4_5 Aiding Response Message

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

This message is in response to the Nav Bit Aiding Request Message ("NBA_REQ"). There could be one or two such messages in response to a single NBA_REQ message, which will always request SF45 data for all satellites. Generally, a single SF45_data set applies for all satellites and then, a single response message carries the SF45 data for all satellites. But, at least one day of the week, there are two versions of the Almanac are being broadcast, each of them applicable to two disjunctive sets of satellites. In these cases there are two response messages, and the SAT_LINK bitmaps in them should complement one another to cover all satellites.

Table 53: Nav Subframe 4_5 Aiding Response Fields

Field	Length (bits)	Units
Message ID	8	
Message Sub ID	8	
SAT_LIST	32	
The following fields are repeated 25 times.		
FRAME_NUM	8	NA
SUBF_4_5	600	NA

SAT_LIST Satellite List

This is a bitmap representing the satellites for which SUBF_4_5 are valid. If SUBF_4_5 are valid for the satellite represented by a bit of this field, CP shall set that bit to '1'. The LSB (Bit 0) of this field represents satellite PRN number 1. The MSB (Bit 31) of this field represents satellite PRN 32.
Note: SAT_LIST include all satellites for which SUBF_4_5 in this message are valid, whether they were specified in the NBA_REQ Navbit aiding request message or not.

FRAME_NUM Frame number

This field shall be set to the frame number for which the data in SUBF_4_5 is valid for. The frame number is the GPS frame number, within the 12.5 minute of the GPS superframe. The value range is 1 to 25 where the binary value of the field conveys the GPS frame number. The CP shall set this field to 0 if the data in SUBF_4_5 is invalid.

SUBF_4_5 Subframe 4 and 5

This field contains subframe 4 and 5 of the navigation message bits in the order transmitted by the satellite. The most significant bit of the first byte shall contain the first bit of the subframe 4. There should be 600 valid bits.

5.32 Power Mode Request

This message is a pair with the Power Mode Response message.

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

Table 54: Power Mode Request SIDs

0x00	0	FP_MODE_REQ
0x01	1	APM _REQ
0x02	2	MPM_REQ
0x03	3	TP_REQ
0x04	4	PTF_REQ

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

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

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

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

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

The message description for each SID follows.

SID 0x00 (0) FP_MODE_REQ

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		

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

SID 0x01 (1) APM REQ

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
NUM_FIXES	1		
TBF	1		sec
POWER_DUTY_CYCLE	1	*0.2	%
MAX_HOR_ERR	1		
MAX_VERT_ERR	1		
PRIORITY	1		
MAX_OFF_TIME	4		msec
MAX_SEARCH_TIME	4		msec
TIME_ACC_PRIORITY	1		
Reserved	1		

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

TBF Time between fixes
Requested time between fixes. 1 – 180sec. In SLC, if this value is equal or less than 10 sec, the POWER_DUTY_CYCLE parameter is disregarded and a trickle power mode is engaged where the TBF value also derives the "On Time" length, as shown in the table below:

Table 55: TBF Cycle Time Derived On Time Period Length

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

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

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

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

Table 56: Maximum Vertical Error

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

PRIORITY Specifies if time or power duty has priority
0x01 = Time between two consecutive fixes has priority
0x02 = Power duty has higher priority
Bits 2-7 reserved for expansion

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

MAX_SEARCH_TIME Maximum satellite search time
Default value is 120s. When the receiver is unable to reacquire at the start of a cycle, this parameter determines how long it will try to reacquire for. After this time expires, the unit returns to sleep mode for the value set in the MAX_OFF_TIME field. Entering a value of 0 for this field makes max search time disabled such that when the receiver attempts to reacquire continuously. When a value of 0 is entered for the MAX_SEARCH_TIME, the value entered in the MAX_OFF_TIME field is N/A and ignored.

TIME_ACC_PRIORITY Time/Accuracy Priority

0x00	No priority imposed (default)
0x01	MAX_SEARCH_TIME has higher priority
0x02	MAX_HOR_ERR has higher priority
0x03-0xFF	Reserved

Reserved Byte reserved for future use.

Note: The Position Request OSP message and the APM request message both specify QoS parameters and time between fixes. The APM request overrides the Position Request parameter values. When switching to and from APM to another mode, a previously issued multiple fix Position Request might be still in progress. The fixes overlapping the APM validity period will have the APM parameters; the ones outside of the APM validity period will have the Position Request parameters.

SID 0x02 (2) MPM REQ

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
Reserved	4		

Reserved Bytes reserved for future use

SID 0x03 (3) TP REQ

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
DUTY_CYCLE	2	*10	%
ON_TIME	4		msec
MAX_OFF_TIME	4		msec
MAX_SEARCH_TIME	4		msec

DUTY_CYCLE Percent time on
Desired time to be spent tracking with full power. A duty cycle of 1000 (100%) means continuous operation. When the duty cycle is set to 100% the on-time has no effect. The default value is 50%.

ON_TIME Actual time on
The value range is 100 – 900 msec. When the cycle time is 1 second, ON_TIME should be specified as less than 700 ms. For any other cycle times, the ON_TIME field value should be specified as less than or equal to 900 ms. The TBF time is derived from the values specified here in the ON_TIME and in the DUTY_CYCLE fields. If the resulting TBF value is too low and not supported, the request is rejected with an error message. When the specified ON_TIME and DUTY_CYCLE values can not be enforced to get a fix, power management reverts back to full power mode, until the signal conditions improve again to meet the specified ON_TIME and DUTY_CYCLE values.

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

MAX_SEARCH_TIME Maximum satellite search time
Default value is 120s. When the receiver is unable to reacquire at the start of a cycle, this parameter determines how long it will try to reacquire for. After this time expires, the unit returns to sleep mode for the value set in the MAX_OFF_TIME field. Entering a value of 0 for this field makes max search time disabled such that when the receiver attempts to reacquire continuously. When a value of 0 is entered for the MAX_SEARCH_TIME, the value entered in the MAX_OFF_TIME field is N/A and ignored.

Note: In trickle power mode, the parameters of this request may contradict with the similar parameters defined in the POS_REQ message. Therefore, the responses to the POS_REQ request may get suspended while in trickle power mode in which case only the MID 2 "Measure Navigation Data Out" SSB PVT messages are generated using TP mode.

SID 0x04 (4) PTF REQ

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
PTF_PERIOD	4		sec
MAX_SEARCH_TIME	4		msec
MAX_OFF_TIME	4		msec

PTF_PERIOD Push-To-Fix cycle time in seconds
Default value is 1800s. Value range: 10 – 7200 sec.

MAX_SEARCH_TIME Maximum satellite search time
Default value is 120s. When the receiver is unable to reacquire at the start of a cycle, this parameter determines how long it will try to reacquire for. After this time expires, the unit returns to sleep mode for the value set in the PTF_PERIOD field. Entering a value of 0 for this field makes max search time disabled such that when the receiver attempts to reacquire continuously.

MAX_OFF_TIME Maximum time for sleep mode
The longest period in msec for which the receiver will deactivate due to the MAX_SEARCH_TIME time-out. When the receiver is unable to acquire satellites for a cycle, it returns to sleep mode for this period of time before it tries again. Default value is 30000ms. Value range: 1000 – 180000 msec.

Note: In push-to-fix power mode, the parameters of this request may contradict with the similar parameters defined in the POS_REQ message. Therefore, the responses to the POS_REQ request may get suspended while in trickle power mode in which case only the MID 2 "Measure Navigation Data Out" SSB PVT messages are generated using TP mode.

5.33 Query Request

The intent of this message is to query the receiver to determine what modes/settings are active. The first implementation has the query messaging for low power and full power, with the intent that in the future this function could be expanded to other messages.

MID (Hex) 0xD1
MID (Dec) 209
Message Name in Code MID_QUERY_REQ

Table 57: Query Request message fields

Field	Bytes	Scale	Unit
Message ID	1		
QUERY_MID	1		
QUERY_SID	1		

QUERY_MID Message ID for query
Specifies which mode/setting is being queried.

QUERY_SID Sub ID for query
If a particular query requires that a SID be specified, it is in this field. Not all queries require a SID to be specified and therefore if a MID is sent where the SID does not matter, this field is ignored.

Query support is available only for the following MID/SIDs:

Table 58: Query message support

QUERY_MID	QUERY_SID	Description
218	Ignored	Determine if we are in a low power mode or full power.

5.34 Hardware Control Input

This message ID is reserved for future hardware control features, including VCTCXO and on/off signal configuration. Although two SIDs are specified in the master MID list, they are only placeholders to show which features would use this MID and there can be additions/subtractions to the

MID (Hex) 0xDB
MID (Dec) 219
Message Name in Code MID_HW_CTRL_IN
SID (Hex) TBD
SID (Dec) TBD
SID Name in Code TBD

Table 59: Hardware Control Input message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
Message details TBD			

5.35 CW Configuration

CW Configuration message allows for control (enable/disable) of specific hardware and software features of the CW Controller. Scanning can be disabled or set to run the automatic scan progression as specified in the system design. Filtering can be disabled, forced to just the 2MHz filter or the OFFT notch filter, or set to automatic.

Table 60: CW Configuration Message Definition

MID (Hex)	0xDC
MID (Dec)	220
Message Name in Code	MID_CW_INPUT
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	CW_CONFIG

Table 61: CW Configuration Field Definitions

Field	Bytes	Unit	Description
Message ID	U1		Message ID (0xDC)
Sub ID	U1		Sub ID (0x01)
Configuration Mode	U1		Enumeration of configuration modes: 0: Enable scan, enable filtering 1: Enable scan, use OFFT 2: Enable scan, use 2MHz 3: Enable scan, no filter 4: Disable scan, disable filtering 254: Factory Scan (not for 4t, reserved only) 255: Disable scan, disable filtering. Use only complex $8f_0$.

The SLC responds to this message with an ACK/NACK/ERROR 0x4B output message.

Note: The MID 150 "Switch Operating Modes" message always overrides these configuration settings. This CW configuration message is received and processed only if the SLC is in "normal" operating mode as defined in the "Mode" field of the MID 150 message.

5.36 TCXO Learning Input

Table 62: TCXO Learning Input

Message Name	TCXO_LEARNING
Input or Output	Input
MID (Hex)	DD
MID (Dec)	221
Message Name in Code	MID_TCXO_LEARNING_IN
SID (Hex)	See below
SID (Dec)	See below
SID Name in Code	See below

Table 63: TCXO Learning Input SID Descriptions

Field Being Described		
SID Field	Description	Inclusion in Builds
0x00	Clock Model Test Output Control.	All builds
0x01	Clock Model Data Base	All builds
0x02	Clock Model TCXO Temperature Table	Xo Test Builds Only
0x03	Clock Model Test Mode Control	Xo Test Builds Only

Messages marked as "Xo Test Builds Only" in the above table are missing in standard builds for products to be shipped to customers. These messages are present in special test builds only made for the purpose of testing the TCXO features.

5.36.1 TCXO Learning Clock Model Output Control

Table 64: Clock Model Output Definition

Message Name	TCXO_LEARNING
Input or Output	Input
MID (Hex)	DD
MID (Dec)	221
Message Name in Code	MID_TCXO_LEARNING_IN
SID (Hex)	0x00
SID (Dec)	0
SID Name in Code	CLOCK_MODEL OUTPUT CONTROL

Table 65: Clock Model Output Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					221	TCXO Learning In
Sub ID	U1					0	Clock Model Output Control
							The following fields are Bit Masks for message 0x5D output enabling. The bit position corresponds to the sID for 0x5D where bit 0 = sID 0 If the sID is not defined it is ignored. All output can be disabled by setting both lists to 0.
One Time SID List	U2						One Time sID List
Continuous SID List	U2						Continuous sID List
Output	U2						Requested control for Output

Request							sIDs. Bit 0: 0 = TRec Msg (0x5D,4) outputs current value only Bit 0: 1 = TRec Msg (0x5D,4) outputs all queued values
spare	U2						

5.36.2 TCXO Learning Clock Model Data Base Input

Table 66: Clock Model Data Base Input Message Definition

Message Name	TCXO_LEARNING
Input or Output	Input
MID (Hex)	DD
MID (Dec)	221
Message Name in Code	MID_TCXO_LEARNING_IN
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	CLOCK_MODEL_DATA_BASE

Table 67: Clock Model Data Base Input Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					221	TCXO Learning In
Sub ID	U1					1	Clock Model Data Base
Source	U1						Bit mask indicating source of the clock model. 0x0 = NOT_SET 0x1 = ROM 0x2 = DEFAULTS 0x4 = MFG 0x8 = TEST_MODE 0x10 = FIRST_NAV
Aging Rate Uncertainty	U1			Ppm /year	0.1	10	Aging rate of uncertainty
Initial Offset Uncertainty	U1			ppm	0.1	10	Initial Frequency offset of the TCXO
Spare1	U1						
Clock Drift	S4			ppb	1	60105	Clock drift
Temp Uncertainty	U2			ppm	0.01	50	Temperature uncertainty
Manufacturing Week Number	U2			GPS Week #	1	1465	TCXO Manufacturing week number in full GPS weeks
Spare2	U4						

5.36.3 TCXO Learning Temperature Table Input

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 68: TCXO Learning Temperature Table Input Definition

Message Name	TCXO_LEARNING
Input or Output	Input
MID (Hex)	DD
MID (Dec)	221
Message Name in Code	MID_TCXO_LEARNING_IN
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	TEMPERATURE_TABLE

Table 69: TCXO Learning Temperature Table Input Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					221	TCXO Learning In
Sub ID	U1					2	TCXO Temperature Table
Counter	U4						Counter updates by 1 for each output. Rolls over on overflow.
Offset	S2			ppb	1	-331	Frequency offset bias of the table from the CD default
Global Min	S2			ppb	1	-205	Minimum XO error observed
Global Max	S2			ppb	1	442	Maximum XO error observed
First Week	U2			GPS Week #	1	1480	Full GPS week of the first table update
Last Week	U2			GPS Week #	1	1506	Full GPS week of the last table update
LSB	U2			Ppb	1	4	Array LSB Scaling of Min[] and Max[]
Aging Bin	U1				1	37	Bin of last update
Aging Up Count	S1				1	4	Aging up or down count accumulator
Bin Count	U1						Count of bins filled
Spare2	U1						
Min []	1 * 64			Ppb * LSB			Min XO error at each temp scaled by LSB
Max[]	1 * 64			Ppb * LSB			Max XO error at each temp scaled by LSB

5.36.4 TCXO Learning Test Mode Control

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 70: Test Mode Control Message Definition

Message Name	TCXO_LEARNING
Input or Output	Input
MID (Hex)	DD
MID (Dec)	221
Message Name in Code	MID_TCXO_LEARNING_IN
SID (Hex)	0x03
SID (Dec)	3
SID Name in Code	TEST_MODE_CONTROL

Table 71: Test Mode Control Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					221	TCXO Learning In
Sub ID	U1					3	Clock Model Test Mode Control
TM Enable / Disable	U1				1	1	Bit Field for control of TCXO Test Mode. Bit 0: 0 = Rtc Cal will use Host updates 1 = Rtc Cal will ignore Host updates Bit 1: 0 = New TRec readings will update Temperature Table 1 = Ignore updates to the Temperature Table
spare1	U1						
spare2	U2						

5.37 WiFi Tag Message

The host sends a WiFi tag message whenever it discovers an active WiFi tower in range with a signal strength reaching a predefined threshold.

5.37.1 WiFi Tag Notification

Table 72: WiFi Tag Notification Message Definition

Message Name	WIFI_TAG
Input or Output	Input
MID (Hex)	0xEB
MID (Dec)	235
Message Name in Code	MID_WIFI_TAG
SID (Hex)	0x00
SID (Dec)	0
SID Name in Code	TAG_NOTIFICATION

Table 73: WiFi Tag Notification Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1						
Sub ID	U1						
Tower ID	U6						This is typically the Mac address of the WiFi tower
Signal Strength	S4			dBm			If zero, then the WiFi signal strength is unknown. If this value increases by a predefined threshold, a new WIFI_TAG message is sent to the engine with the new Signal Strength.

5.38 Sensor Control Input

The Location Manager software will be implemented on the Tracker and the Host processor as shown by a block diagram in Figure 1. below. MEMS sensor data acquisition, limited error checking and packaging of sensor data into a message will occur in the Measurement Engine (tracker). The rest of the sensor data processing will be completed on the host processor. A sensor configuration message will be sent from the host processor to the Measurement or Location Engine at the time of startup. This message will describe the sensor set connected to the sensor I2C port on the Measurement or Location Engine, and the process of initialization and data acquisition for each the sensors connected to the I2C port. This mechanism will enable the customer to select the sensor set to be attached to I2C port of Measurement or Location Engine chip. The data acquisition software in the Measurement Engine will conduct limited error checking and packaging of the sensor data into a message which would be sent back to the host.

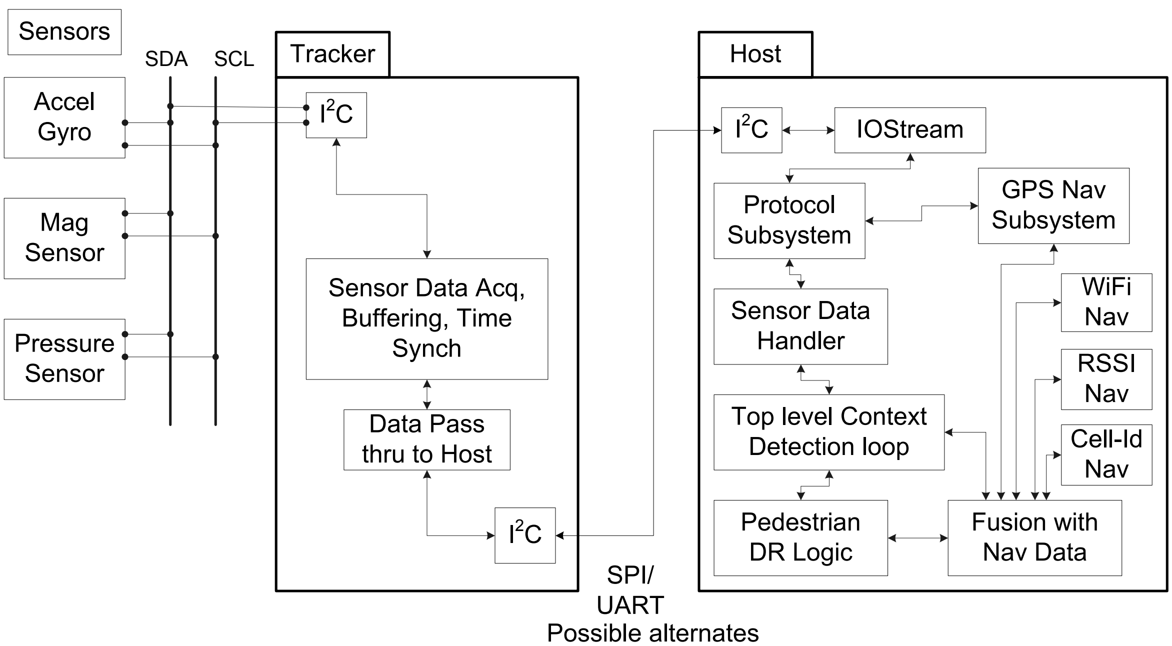


Figure 1. Sensor Control Architecture Block Diagram.

A sensor configuration message will be sent from the host processor to the Measurement or Location Engine at the time of startup. This message will describe the sensor set connected to the I2C port on the Measurement or Location Engine, the process of initialization and data acquisition for each the sensors connected to the tracker chip. This mechanism will enable the customer to select the sensor set to be attached to I2C port on in the Measurement or Location Engine.

Table 74: Sensor Control Input

Message Name	SENSOR_CONTROL
Input or Output	Input
MID (Hex)	0xEA
MID (Dec)	234
Message Name in Code	MID_SensorControl
SID (Hex)	Listed Below
SID (Dec)	Listed Below
SID Name in Code	Listed Below

Table 75: Sensor Control Input SID Descriptions

Field Being Described	
Bit Field	Description
0x01	SENSOR_CONFIG
0x02	SENSOR_SWITCH

Each sensor control input message sent by the Host is responded to by a MID_MSG_ACK_OUT, ACK_NACK_ERROR SID message.

Table 76: Sensor Configuration Message information

Message Name	SENSOR_CONTROL
Input or Output	Input
MID (Hex)	0xEA
MID (Dec)	234
Message Name in Code	MID_SensorControl
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	SENSOR_CONFIG

Sensor configuration message is generated on the Host and sent across to the Measurement or Location Engine in order to provide the configuration information to the sensor data acquisition logic for the sensor(s) attached to I2C DR port.. The sensor configuration information will be stored in a configuration file on the Host. This file will be read by the host application at startup, then a sensor configuration message (SSB) is formed and sent to the Nav thread running on the host. The Host application will create the sensor configuration MEI message which then will be sent to the Measurement Engine. The SSB message will contain additional information, such as zero point and scale factor for each sensor, which does not need to be sent to the Measurement Engine. This information will be extracted on the Host and stored on appropriate structures for use by the sensor data processing logic running on the Host.

Table 77: Sensor Configuration Message Fields Description

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1		0xEA			234	SENSOR_CONTROL
Sub ID	U1		0x01			1	SENSOR_CONFIG
NUM_SENS	U1						Number of sensors
I2C_SPEED_SET	U1						I2C bus speed setting
SDA_SENS1	U2						Slave Device Address for

		Binary (Hex)			ASCII (Dec)		
							Sensor 1
SENSR_TYPE_SEN1	U1						Sensor Type for sensor 1
SEN_INIT_TIME1	U1			microseconds	10		Sensor1 initialization period
NUM_BYTES_RES_SENS1	U1						Number of Bytes to be read from Register 1 and bit resolution in data read
SAMP_RATE1	U1						Sample Rate for Sensor 1
SND_RATE1	U1						Sending rate of sensor 1 data back to the Host
DECM_METHOD1	U1						Data decimation method setting
ACQ_TIME_DELAY1	U1			ms	10		Acquisition time delay for sensor1
NUM_SEN_READ_REG1	U1						Number of registers to read sensor data from
READ_OPR_REG1_SEN1	U1						Read operation method for register1 for sensor1
SENS_DATA_READ_ADD1	U1						Register 1 address from which to read sensor 1 data
…	…						
LO_PWR_REG_SEN1	U1						Register to put sensor 1 into Low Power mode
LO_PWR_MODE_SET1	U1						Setting for above register to effect Low Power Mode
NRML_PWR_MODE_SET1	U1						Setting for above register to effect normal power consumption mode
NUM_INIT_READ_REG_SEN1	U1						Number of registers to read sensor specific data from Sensor 1
INIT_READ_REG1	U1						Register 1 address to read at time of initialization
NUM_BYTES_REG1	U1						Nr of bytes to read from Register 1 at initialization
INIT_READ_REG2	U1						Register 2 address to read at time of initialization
NUM_BYTES_REG2	U1						Nr of bytes to read from Register 2 at initialization
NUM_CNTRL_REG_SEN1	U1						Nr of Control registers for sensor 1 to configure
REG_WRITE_DELAY1	U1			ms	1		Time delay between two consecutive register writes
CNTRL_REG1	U1						Control Register 1 address for sensor 1
CNTRL_REG1_SET	U1						Register 1 setting to be sent to sensor 1.

		Binary (Hex)			ASCII (Dec)		
CNTRL_REG 2	U1						Control Register 2 address for sensor 1
CNTRL_REG 1_SET	U1						Register 2 setting to be sent to sensor 1.
…							
SDA_SENS2	U1						Slave dev addr for sensor 2
SENSR_TYP E_SEN2	U1						Sensor Type of sensor 2
SEN_INIT_TI ME2	U1			ms	10		Sensor1 initialization period
…	…						
SEN_DATA_ PROC_RATE	U1			Hertz	1		Sensor data processing rate
ZERO_PT_SE N1	U2						Zero Point Value for sensor 1
SF_SEN1	U2						Scale Factor (sensitivity) for sensor 1
ZERO_PT_SE N2	U2						Zero Point Value for sensor 2
SF_SEN2	U2						Scale Factor (sensitivity) for sensor 2
…	…				…		
…	…				…		

NUM_SENS
Number of Sensor in the sensor set connected to DR sensor I2C port of GSD4t

I2C_SPEED_SET
I2C bus speed setting. The values for the bus speed setting are as follows:
0 - Low Speed,
1- Standard,
2 - Fast Mode,
3 - Fast mode Plus,
4- High speed.
Sensor with the lowest speed setting in the sensor set determines the speed mode for all sensors.

SDA_SENS1
Slave Device Address for Sensor 1. This supports 10 bit addressing.

SENSR_TYPE_SEN1
Sensor Type for sensor 1. The value for this setting is as follows:
1 - Accelerometer
2 – Magnetic sensor
3 – Pressure sensor
4 – Gyroscope
5 – Accelerometer + Gyroscope
6 – Accelerometer + Magnetic sensor
7 – Gyroscope + Magnetic sensor
8 = Accelerometer + Magnetic sensor + Gyro

SEN_INIT_TIME1
Sensor1 initialization period after power-up (milliseconds X 10). This is the amount of time which should be allowed before sensor is ready.

NUM_BYTES_RES_SENS1
Number of Bytes to be read from Register 1, sensor 1 (lower 4 bits). Resolution for each axis (upper 4 bits). This value can range from 9 through 16. Number of bytes would be 2, 4, 6 based on 1, 2 or 3 sensor axes

SAMP_RATE1
Sample Rate for Sensor 1 (Hertz). The values for this setting are as follows:
1 - 0.5Hz,
2 - 1Hz,
3 - 2Hz,
4 - 5Hz,
5 - 10 Hz,
6 - 25Hz,
7 - 50Hz,
8 through 15 – reserved

SND_RATE1
Rate (units Hertz) at which sensor 1 data is sent back to Host. The values for this setting are as follows:
1 - 0.5Hz,
2 - 1Hz,
3 - 2Hz,
4 - 5Hz,
5 - 10 Hz,
6 - 25Hz,
7 - 50Hz,
8 through 15 - reserved.
SND_RATE cannot be greater than SAMP_RATE.

DECM_METHOD1
Data decimation method setting. The values for this setting are as follows:
0 - raw,
1 - averaging,
2 - sliding median,
3 - reserved1,
4 - reserved2

ACQ_TIME_DELAY1
Acquisition time delay for sensor1 (microsecond X 10). Time period between triggering the sensor data acquisition and the sensor read operation.

NUM_SEN_READ_REG1
Number of registers to read sensor data from

READ_OPR_REG1_SEN1
Read operation method for register1 for sensor1.
0 - means read only from SENS_DATA_READ_ADD. Other values mean Write with repeated start read.

SENS_DATA_READ_ADD1
Register 1 address from which sensor 1 data will be read

SENS_DATA_READ_ADD2
Register 2 address from which sensor 1 data will be read
… … …

LO_PWR_REG_SEN1
Register to put sensor 1 into Low Power mode

LO_PWR_MODE_SET1
Setting for LO_PWR_REG_SEN1 to affect Low Power Mode for sensor 1

NRML_PWR_MODE_SET1
Setting for LO_PWR_REG_SEN1 to affect normal power consumption mode for sensor 1

NUM_INIT_READ_REG_SEN1
Number of registers to read sensor specific data from Sensor 1 at the time of initialization. If the value is set to 0, then no register addresses would be specified.

INIT_READ_REG1
Register 1 address to be read at time of initialization

NUM_BYTES_REG1
Number of bytes to read from Register 1 at initialization

INIT_READ_REG2
Register 2 address to be read at time of initialization

NUM_BYTES_REG2
Number of bytes to read from Register 2 at initialization

… … …

NUM_CNTRL_REG_SEN1
Number of Control registers for sensor 1 which need to be configured. Configuration of the control registers takes place at the time of initialization of sensors.

REG_WRITE_DELAY1
Time delay (milliseconds) between two consecutive register writes

CNTRL_REG1
Control Register 1 address for sensor 1

CNTRL_REG1_SET
Register 1 setting to be sent to sensor 1. If the setting is 0xFF then CNTRL_REG1 address is to be used as a write command only.

CNTRL_REG2
Control Register 2 address for sensor 1

CNTRL_REG1_SET
Register 2 setting to be sent to sensor 1. If the setting is 0xFF then CNTRL_REG2 address is to be used as a write command only.
… …

(This is the start of description of second sensor in the message)
SDA_SENS2
Slave Device Address for sensor 2

SENSR_TYPE_SEN2
Sensor Type:
1 - Accelerometer
2 – Magnetic sensor
3 – Pressure sensor
4 – Gyroscope
5 – Accelerometer + Gyroscope
6 – Accelerometer + Magnetic sensor
7 – Gyroscope + Magnetic sensor
8 = Accelerometer + Magnetic sensor + Gyro

SEN_INIT_TIME2
Sensor 2 initialization period after power-up (milliseconds X 10)
… … …

SEN_DATA_PROC_RATE
Sensor data processing rate (in Hertz). This is rate at which sensor data will be processed on Host. Range: 1 - 256 Hz. This value can not be higher than SND_RATE.

ZERO_PT_SEN1
Zero Point Value for sensor 1. This is the bias value which will be subtracted from the sensor data measurement (in ADC counts) for sensor 1

SF_SEN1
Scale Factor (sensitivity) for sensor 1. The expression used for converting the sensor measurement in ADC counts to Engineering units is
Sensor 1 measurement = (sensor 1 ADC counts – ZERO_PT_SEN1) / SF_SEN1

ZERO_PT_SEN2
Zero Point Value for sensor 2

SF_SEN2
Scale Factor (sensitivity) for sensor 2
… … …

Notes:
1. This is a variable length message. The message payload length will be contained in the header of the message.
2. SAMP_RATE: For the first release we plan on supporting 50 Hz as the highest sampling rate. The other samples rates which will be supported are 25 Hz, 10 Hz, 5 Hz, 2 Hz, 1 Hz, and 0.5 Hz.
3. SND_RATE: For the first implementation, the highest rate at which data can be sent from GSD4t to Host is 25 Hz. Also, SND_RATE cannot be higher than SAMP_RATE.

4. LO_PWR_MODE_SET1: If a sensor does not have the capability to switch to low power mode, then, LO_PWR_REG_SEN1, LO_PWR_MODE_SET1 and NRML_PWR_MODE_SET1 will contain 0x0.
5. The data acquisition software on GSD4t has following limitations for the maximum number of registers for each sensor :
   Maximum number of sensor data read registers NUM_SEN_READ_REG = 12
   Maximum number of initialization data registers NUM_INIT_READ_REG_SE = 12
   Maximum number of Control registers NUM_CNTRL_REG_SEN = 32
6. The maximum number of Bytes read from initialization data read register NUM_BYTES_REG = 20

Table 78**:** Information on messages to turn sensors on/off

Message Name	SENSOR_CONTROL
Input or Output	Input
MID (Hex)	0xEA
MID (Dec)	234
Message Name in Code	MID_SensorControl
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	SENSOR_SWITCH

This message sent from Host to the Measurement or Location Engine will turn the attached, entire sensor set OFF/ ON anytime after the configuration message has been sent. This message would be logged along with sensor data for post processing in NavOffline.

Table 79**:** Sensor Switch Message Fields Description

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1		0xEA			234	SENSOR_CONTROL
Sub ID	U1		0x02			2	SENSOR_SWITCH
STATE_SENSOR_SET	U1						Bit 0 – 0 - turn sensor set OFF 1 - turn sensor set ON Bit 1 – 0 - turn the receiver state change notifications OFF 1 - turn the receiver state change notifications ON Bits 2-7 – Reserved.

5.39 SirfDRive Input Messages

5.39.1 Msg-ID 0x2D (MID_TrkADCOdoGPIO)

MSG ID:

Number: 0x2D
Name: MID_TrkADCOdoGPIO
Purpose: Input Tracker to NAV – ADC/ODOMETER DATA

Message Length:

111 bytes @ 1Hz or 12 bytes @ 10Hz

Rate:

111 bytes @ 1Hz or 12 bytes @ 10Hz

Binary Message Definition:

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

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

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

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0x2D**	n/a
2 + (n-1)*11 (Note 0)	currentTime (Note 1)	UINT32	4	ms	0-4294967295	n/a
6 + (n-1)*11 (Note 0)	Gyro adc Avg (Note 2)	UINT16 Or INT16	2	n/a	0 to 4095 (GSP2eLP w/ DR option) Or -12000 to 28000 (GSP2t)	n/a
8 + (n-1)*11 (Note 0)	adc3Avg (Note 3)	UNIT16 Or INT16	2	n/a	0 (GSP2eLP w/ DR option) Or -12000 to 28000 (GSP2t)	n/a

10 + (n-1)*11 (Note 0)	odoCount (Note 4)	UINT16	2	n/a	0 to 65535	n/a
12 + (n-1)*11 (Note 0)	gpioStat (Note 5)	UINT8	1	Bit Map	bit 0 – if = 1: Reverse "ON" bits 1 to 7 Reserved	n/a

Note 0: n corresponds to either 1 or 1-10 depending on whether the message comes out a 10Hz (10 messages 1 data set) or 1Hz (1 message 10 data sets)
Note 1: Tracker Time, millisecond counts
Note 2: Averaged measurement from Gyro input. On the GSP2t, this is the ADC[2] input, on the GSP2eLP, this is the Maxim ADC input
Note 3: On a GSP2eLP system, there is currently only one ADC input so this field is always 0.
Note 4: Odometer counter measurement at the most recent 100mSec tracker interrupt. This field will rollover to 0 after 65535
Note 5: GPIO input states at the most recent 100mSec tracker interrupt

API:

```
#define NUM_OF_DR_RAW 10

typedef struct
{
   UINT32 currentTime;
   UINT16 adc2Avg;
   UINT16 adc3Avg;
   UINT16 odoCount;
   UINT8  gpioStat;
} tADCOdometer;

typedef struct
{
   struct
   {
      tADCOdometer  ADCOdometer[NUM_OF_DR_RAW];
   } DrRaw;

} tDrRawData, *tDrRawDataPtr;
```

5.39.2 Msg-ID 0xAC;Sub-ID 0x01 (SID_SetDrNavInit)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x01
Name: SID_SetDrNavInit
Purpose: DR NAV Initialization Input Message

Message Length:

28 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x01**	n/a
3-6	Latitude	INT32	4	deg	-90 to 90	10^{-7}
7-10	Longitude	INT32	4	deg	-180 to 180	10^{-7}
11-14	Altitude (from Ellipsoid)	INT32	4	meters	-2000 to 100000.0	.01
15-16	Heading (True)	UINT16	2	deg	0 to 360	.01
17-20	Clock Offset	INT32	4	Hz	25000 to 146000	n/a
21-24	Time Of Week	UINT32	4	secs	0 to 604800.00	.001
25-26	Week Number	UINT16	2	n/a	0 to 1023	n/a
27	Number of Channels	UINT8	1	n/a	1-12	n/a
28	Reset Configuration	UINT8	1	BitMap	Bit 0: Data valid flag (set warm/hot start) Bit 1: Clear ephemeris (set warm start) Bit 2: Clear memory (set cold start) Bit 3: Factory reset Bit 4: Enable raw track data Bit 5: Enable debug data for SiRF binary Bit 6: reserved Bit 7: reserved	n/a

API:

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

5.39.3 Msg-ID 0xAC;Sub-ID 0x02(SID_SetDrNavMode)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x02
Name: SID_SetDrNavMode
Purpose: DR NAV Mode Control Input Message

Message Length:

4 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x02**	n/a
3	DR NAV Mode Control	UINT8	1	Bit Map	Bit settings are exclusive Bit 0: 1 = GPS Nav Only Bit 1: 1 = DR Nav Ok (with Stored or Default Calibration) Bit 2: 1 = DR Nav Ok with Current GPS calibration Bit 3: 1 = DR NAV Only Bits 4-7 Reserved	n/a
4	Reserved	UINT8	1	n/a	undefined	n/a

API:

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

5.39.4 Msg-ID 0xAC;Sub-ID 0x03(SID_SetGyrFactCal)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x03
Name: SID_SetGyrFactCal
Purpose: Gyro Factory Calibration Control Input Message

Message Length:

4 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x03**	n/a
3	Gyro Factory Calibration Control **(Note 1)**	Bit Map	1	n/a	bit 0 = 1: Start Gyro Bias calibration bit 1 = 1: Start Gyro Scale Factor calibration **(Note 2)**	n/a
4	Reserved	UINT8	1	n/a	undefined	n/a

Note 1: The bit map of the Field variable controls the gyro factory calibration stages. The Gyro Factory Calibration procedure calls for the Gyro Bias Calibration to be done first while the gyro is stationary, and the Gyro Scale Factor Calibration to be done next while the gyro rotates smoothly through 360 degrees.

Note 2: The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the Least-Significant byte.

API:

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

5.39.5 Msg-ID 0xAC;Sub-ID 0x04(SID_SetDrSensParam)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x04
Name: SID_SetDrSensParam
Purpose: DR Sensor's Parameters Input Message

Message Length:

7 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x04**	n/a
3	Baseline Speed Scale Factor	UINT8	1	ticks/m	1 to 255 (default:4)	1
4-5	Baseline Gyro Bias	UNIT16	2	zero rate Volts	2.0 to 3.0 (default:2.5)	.0001
6-7	Baseline Gyro Scale Factor	UINT16	2	mV / (deg/sec)	1 to 65 (default: 22)	.001

API:

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

5.39.6 Msg-ID 0xAC;Sub-ID 0x05(SID_PollDrValid)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x05
Name: SID_PollDrValid
Purpose: Request Dr Valid to be outputted

Message Length:

10 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x05**	n/a
3 -6	Data Valid	UINT32	4	BitMap	bit 0: 1= invalid position bit 1: 1= invalid position error bit 2: 1= invalid heading bit 3: 1= invalid heading error bit 4: 1= invalid speed scale factor bit 5: 1= invalid speed scale factor error bit 6: 1= invalid gyro bias bit 7: 1= invalid gyro bias error bit 8: 1= invalid gyro scale factor bit 9: 1= invalid gyro scale factor error bit 10: 1= invalid baseline speed scale factor bit 11: 1= invalid baseline gyro bias bit 12: 1= invalid baseline gyro scale factor bit 13 - 31: ***reserved***	n/a
7-10	Reserved	UNIT32	4	n/a	undefined	n/a

API

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

5.39.7 Msg-ID 0xAC;Sub-ID 0x06(SID_PollGyrFactCal)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x06
Name: SID_PollGyrFactCal
Purpose: Request gyro calibration data to be outputted

Message Length:

4 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x06**	n/a
3	Calibration	UINT8	1	bitmap	bit 0: 1 = start gyro bias calibration bit 1: 1 = start gyro scale factor calibration	n/a
4	Reserved	UNIT8	1	n/a	undefined	n/a

API:

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

5.39.8 Msg-ID 0xAC;Sub-ID 0x07(SID_PollDrSensParam)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x07
Name: SID_PollDrSensParam
Purpose: Request gyro & odo scale factors be outputted

Message Length:

7 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x07**	n/a
3	Baseline Speed Scale Factor	UINT8	1	ticks/m	1 to 255 (default:4)	1
4-5	Baseline Gyro Bias	UNIT16	2	zero rate Volts	2.0 to 3.0 (default:2.5)	.0001
6-7	Baseline Gyro Scale Factor	UINT16	2	mV / (deg/sec)	1 to 65 (default: 22)	.001

API:

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

5.39.9 Msg-ID 0xAC;Sub-ID 0x09(SID_InputCarBusData)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x09
Name: SID_InputCarBusData
Purpose: Input Car Bus Data to NAV

Message Length:

22 to 182 bytes

Rate:

Input at 1Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	***5.39.9.1.1 0xAC***	N/A
2	Sub-ID	UINT8	1	N/A	**5.39.9.1.1.1 0x09**	N/A
3	Sensor Data Type (SDT)	UINT8	1	N/A	0-127 1: Gyro, Speed Data, and Reverse 2. 4 Wheel Pulses, and Reverse 3: 4 Wheel Speed, and Reverse 4: 4 Wheel Angular Speed, and Reverse 5: Gyro, Speed Data, NO Reverse 6: 4 Wheel Pulses, NO Reverse 7: 4 Wheel Speed, NO Reverse 8: 4 Wheel Angular Speed, NO Reverse 9: Gyro, Speed Data, Reverse, Steering Wheel Angle, Longitudinal Acceleration, Lateral Acceleration 10: Yaw Rate Gyro, Downward Acceleration (Z), Longitudinal Acceleration (X), Lateral Acceleration (Y) 10-127: Reserved	N/A
4	Number of Valid data sets	UINT8	1	N/A	0-11	N/A
5	Reverse Bit Map N/A for SDT = 10	UINT16	2	N/A	Bit-wise indication of REVERSE status corresponding to each sensor data set, i.e. bit 0 corresponds to the first data set, bit 1 corresponds to the second data set, etc.	N/A

Byte #	Field	Data Type	Bytes	Units	Range	Res
7+(N-1)* 16 (see Note 1)	Valid Sensor Indication	UINT8	1	N/A	Valid/Not Valid indication for each one of the 4 possible sensor inputs in a individual data set; when a particular bit is set to 1 the corresponding data is Valid, when the bit is set to 0 the corresponding data is NOT valid. Bit 0 corresponds to Data Set Time Tag Bit 1 corresponds to Odometer Speed Bit 2 corresponds to Data 1 Bit 3 corresponds to Data 2 Bit 4 corresponds to Data 3 Bit 5 corresponds to Data 4 Bits 6-7 : Reserved	N/A
8+(N-1)* 16 (see Note 1)	Data Set Time Tag	UINT32	4	msec	0-4294967295	1
12+ (N-1)*16 (see Note 1)	Odometer Speed (also known as VSS) N/A for SDT = 10	UINT16	2	m/sec	0 to 100	0.01
14+(N-1)* 16 (see Note 1)	**Data 1** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1,5, 9,10: Gyro Rate			Deg/sec	-120 to 120	0.01
	SDT = 2, 6: Right Front Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Right Front Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Right Front Wheel Angular Speed			rad/sec	-327.67 to 327.67	0.01
16+(N-1)* 16 (see Note 1)	**Data 2** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1: N/A			N/A	N/A	N/A
	SDT =2 , 6: Left Front Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Left Front Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Left Front Wheel Angular Speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9: Steering Wheel Angle			deg	-720 to 720	0.05
	SDT = 10: Downwards Acceleration			m/sec^2	-15 to 15	0.001

Byte #	Field	Data Type	Bytes	Units	Range	Res
18+(N-1)* 16 (see Note 1)	**Data 3** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: Right Rear Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Right Rear Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Right Rear Wheel Speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9,10:Longitudinal Acceleration			m/sec^2	-15 to 15	0.001
20+(N-1)* 16 (see Note 1)	**Data 4** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: Left Rear Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Left Rear Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Left Rear Wheel Speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9,10: Lateral Acceleration			m/sec^2	-15 to 15	0.001
22+(N-1)* 16 (see Note 1)	Reserved	UINT8	1	N/A	N/A	N/A
Note 1: N indicates the number of valid data sets in the message						

API:

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

typedef struct
{
        UINT8           SensorDataType;
        UINT8           NumValidDataSets;
        UINT16          ReverseBitMap;
```

```
      tCarSensorData  CarSensorData[11];
} tCarBusData;
```

5.39.10 Msg-ID 0xAC;Sub-ID 0x0A(SID_CarBusEnabled)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

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

Message Length:

6 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x0A**	n/a
3 - 6	Mode[1]	UINT8	4	n/a	undefined	n/a

API:

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

[1] For future use

5.39.11 Msg-ID 0xAC;Sub-ID 0x0B(SID_CarBusDisabled)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x0B
Name: SID_CarBusDisabled
Purpose: Indicates Car Bus is not enabled and not ready for function

Message Length:

6 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x0B**	n/a
3 - 6	Mode[2]	UINT32	4	n/a	undefined	n/a

API:

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

5.39.12 Msg-ID 0xAC;Sub-ID 0x0C(SID_SetGenericSensorParam)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x0C
Name: SID_SetGenericSensorParam
Purpose: DR set Sensor's Parameters Input Message

[2] For future use

Message Length:

30 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	**0xAC**	N/A
2	Sub-ID	UINT8	1	N/A	**0x0C**	N/A
3	Sensors[0].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
4 – 5	Sensors[0].ZeroRateVolts	UINT16	2	volts	0 to 5.0[3]	0.0001
6– 7	Sensors[0].MilliVoltsPer	UINT16	2	millivolts	0 to 1000[4]	0.0001
8 – 9	Sensors[0].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
10	Sensors[1].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
11 – 12	Sensors[1].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
13 – 14	Sensors[1].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
15 – 16	Sensors[1].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
17	Sensors[2].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
18 – 19	Sensors[2].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
20 – 21	Sensors[2].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
22 – 23	Sensors[2].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
24	Sensors[3].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
25 – 26	Sensors[3].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
27 – 28	Sensors[3].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
29 – 30	Sensors[3].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001

[3] To restore ROM defaults for ALL sensors enter the value 0xdeadabba here. You must still include the remainder of the message but these values will be ignored.
[4] For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

API:

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

}MI_SensorDescriptionType;

typedef struct
{

  MI_SensorDescriptionType Sensors[MAX_NUMBER_OF_SENSORS];

} MI_DR_SENS_PARAM;
```

5.39.13 Msg-ID 0xAC;Sub-ID 0x0D(SID_PollGenericSensorParam)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x0D
Name: SID_PollGenericSensorParam
Purpose: Request sensor scale factors be outputted

Message Length:

30 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	**0xAC**	N/A
2	Sub-ID	UINT8	1	N/A	**0x0D**	N/A
3	Sensors[0].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A

4 – 5	Sensors[0].ZeroRateVolts	UINT16	2	volts	0 to 5.0[5]	0.0001
6– 7	Sensors[0].MilliVoltsPer	UINT16	2	millivolts	0 to 1000[6]	0.0001
8 – 9	Sensors[0].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
10	Sensors[1].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
11 – 12	Sensors[1].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
13 – 14	Sensors[1].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
15 – 16	Sensors[1].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
17	Sensors[2].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
18 – 19	Sensors[2].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
20 – 21	Sensors[2].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
22 – 23	Sensors[2].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
24	Sensors[3].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
25 – 26	Sensors[3].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
27 – 28	Sensors[3].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
29 – 30	Sensors[3].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001

API:

```
#define MAX_NUMBER_OF_SENSORS 0x4

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

}MI_SensorDescriptionType;

typedef struct
{

  MI_SensorDescriptionType Sensors[MAX_NUMBER_OF_SENSORS];

} MI_DR_SENS_PARAM;
```

[5] To restore ROM defaults for ALL sensors enter the value 0xdeadabba here. You must still include the remainder of the message but these values will be ignored.
[6] For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

5.39.14 Msg-ID 0xAC;Sub-ID 0x50(SID_InputMMFData)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x50
Name: SID_InputMMFData
Purpose: Input MMF data into Nav

Message Length:

86 bytes

Rate:

Input at 1Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x50**	n/a
3 - 6	RefGpsTow	UINT32	4	sec	0 to 604800.00	.001
7	NumValidDataSets[7]	UINT8	1	n/a	0 to 3	n/a

[7] Current implementation considers one and only one MMF packet.

8	UseDataBitMap	UINT8	1	n/a	Bit 0 is LSB Bit 0 1 = Position **must** be updated if bit 3 = 1 0 = Position **may** be updated if bit 3 = 1 Bit 1 1 = Heading **must** be updated if bit 4 = 1 0 = Heading **may** be updated if bit 4 = 1 Bit 2 1 = Altitude **must** be updated if bit 5 = 1 0 = Altitude **may** be updated if bit 5 = 1 Bit 3 1 = Position provided is valid 0 = Position provided is **NOT** valid Bit 4 1 = Heading provided is valid 0 = Heading provided is **NOT** valid Bit 5 1 = Altitude provided is valid 0 = Altitude provided is **NOT** valid Bit 6 to 7: Reserved.	n/a
9 – 12	Latitude[0]	INT32	4	deg	-90 to 90	1e-7f
13 – 16	Longitude[0]	INT32	4	deg	-180 to 180	1e-7f
17-20	HorPosUncert[0]	UINT32	4	metres	0 to 0xffffffff	.01
21-24	Altitude[0]	INT32	4	metre	-2000 to 120000	.1
25-28	VerPosUncert[0]	UINT32	4	metre	122000	.1
29-30	Heading[0]	UINT16	2	deg	0 to 360	.01
31-32	HeadingUncert[0]	UINT16	2	deg	0 to 180	.01
33-34	Reserved[0]	UINT16	2	n/a	undefined	n/a
35-38	Latitude[1]	INT32	4	deg	-90 to 90	1e-7f
39-42	Longitude[1]	INT32	4	deg	-180 to 180	1e-7f
43-46	HorPosUncert[1]	UINT32	4	metres	0 to 0xffffffff	.01
47-50	Altitude[1]	INT32	4	metre	-2000 to 120000	.1
51-54	VerPosUncert[1]	UINT32	4	metre	122000	.1
55-56	Heading[1]	UINT16	2	deg	0 to 360	.01
57-58	HeadingUncert[1]	UINT16	2	deg	0 to 180	.01
59-60	Reserved[1]	UINT16	2	n/a	undefined	n/a
61-64	Latitude[2]	INT32	4	deg	-90 to 90	1e-7f
65-68	Longitude[2]	INT32	4	deg	-180 to 180	1e-7f
69-72	HorPosUncert[2]	UINT32	4	metres	0 to 0xffffffff	.01
73-76	Altitude[2]	INT32	4	metre	-2000 to 120000	.1
77-80	VerPosUncert[2]	UINT32	4	metre	122000	.1
81-82	Heading[2]	UINT16	2	deg	0 to 360	.01
83-84	HeadingUncert[2]	UINT16	2	deg	0 to 180	.01
85-86	Reserved[2]	UINT16	2	n/a	undefined	n/a

API:

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


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

5.39.15 Msg-ID 0xAC;Sub-ID 0x51(SID_SetMMFMode)8

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x51
Name: SID_SetMMFMode
Purpose: Enable or disable MMF feedback processing within NAV

Message Length:

3 bytes

Rate:

Input

Binary Message Definition

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x51**	n/a
3	Mode	UINT8	1	n/a	0 = disable 1 = enable	n/a

API:

static UINT32 MMFMode;

[8] Defined but not used by MMF

5.40 SGEE Download Input

These functions are needed to download the SGEE data into the SLC Flash and to get the SGEE and EE age from the SLC.

These SGEE file download input messages will use message id 232 (MID_EE_INPUT) and the output responses have message id 56 (SSB_EE). Different sub- message ids will be used to perform different actions.

Table 80: SGEE Download Input

MID (Hex)	0xE8
MID (Dec)	232
Message Name in Code	MID_EE_INPUT
SID (Hex)	As below
SID (Dec)	As below
SID Name in Code	As below

Table 81 shows the message IDs assigned to the input messages.

Table 81 : Input Messages Sub- IDs.

SNo.	Sub-Message ID	Message Name
1.	0x16	ECLM Start Download
2.	0x17	ECLM File Size
3.	0x18	ECLM Packet Data
4.	0x19	Get EE Age
5.	0x1A	Get SGEE Age

SID 0x16 (22) ECLM Start Download

This message is sent from Host EE Downloader to the SLC to indicate that the host EE downloader is initiating the SGEE download procedure.

Table 82: ECLM Start Download Message Fields

Field	Length (bytes)	Description
MID	1	0xE8
SID	1	0x16

Success/failure response upon completion of the command: MID 0x38, SID 0x20.

SID 0x17 (23) ECLM File Size

This message is sent from Host EE Downloader to the SLC to indicate that the host EE downloader is initiating the size of the SGEE file to be downloaded..

Table 83: ECLM File Size Message Fields

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		E8		Decimal 232
Sub Message ID	1U		17		23 : SID ECLM File Size
File Length	4U		00 00 28 59		Length of the SGEE File to be downloaded

Success/failure response upon completion of the command: MID 0x38, SID 0x20.

SID 0x18 (24) ECLM Packet Data

This message is used to send the SGEE data from host downloader to the GPS Receiver to be processed by CLM modules and saved in NVM.

Table 84: ECLM Packet Data Message Fields

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		E8		Decimal 232
Sub Message ID	1U		18		24: SGEE Packet Data SubMsgId
Packet Sequence Number	2U		00 01		Packet Sequence number of the current packet Starting from 1 .
Packet Length	2U		0020		Length of the sgee data in current packet
Packet Data	Packet Length		62 12 31 06 03 02 07 d9 07 07 00 00 39 6d 8f 12 00 00		SGEE Data of length indicated in Packet Length of the message.

			00 00 00 00 01 2d 9a e7 05 02 ff fe 28 05		

Payload length: 6+ Packet Length bytes.
Success/failure response upon completion of the command: MID 0x38, SID 0x20.

SID 0x19 (25) Get EE Age

This message is sent to GPS Receiver to get the age of extended ephemeris stored in GPS Receiver.

Table 85: Get EE Age Message Fields

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		E8		Decimal 232
Sub Message ID	1U		19		25: Get EE Age
Num Sat	1U		01		Number of satellites
prnNum;	1U		01		Prn Number
ephPosFlag	1U		00		
eePosAge	2U		0000		
cgeePosGPSWeek	2U		0000		
cgeePosTOE	2U		0000		
ephClkFlag	1U		00		
eeClkAge	2U		0000		

cgeeClkGPSWeek	2U		0000		
cgeeClkTOE	2U		0000		
Pad	1U		00		

Payload length: 19 bytes

Success response upon completion of the command is acknowledged with– SSB Message ID 56, Sub Msg ID 0x21 along with EE Age of the satellite(s).

Failure response upon completion of the command is acknowledged with "Nack" using Command Negative Acknowledgement - MID 0x38, SID 0x20.

SID 0x1A (26) Get SGEE Age

This message is sent to GPS Receiver to get the age of SGEE stored in GPS Receiver.

Table 86: Get SGEE Age Message Fields

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		E8		Decimal 232
Sub Message ID	1U		1A		26: Get SGEE Age
Sat ID	1U		01		Satellite ID for which SGEE Age is requested

Payload length: 3 bytes

Success response upon completion of the command is acknowledged using Command Acknowledgement Message ID 56, Sub Msg ID 0x22 along with SGEE Age of the satellite(s).

Failure response upon completion of the command is acknowledged with "Rejected: MID_ECLMAckNack" using Command Negative Acknowledgement - MID 0x38, SID 0x20.

5.41 SW Toolbox Input

(Remember, Input means User System to Host.) These messages allow the User System to access Tracker features via the Host. The Host will essentially map the SSB requests from the User System to MEI requests for the Tracker. The mapping is required since a direct pass-through is not always allowed. Some User System requests will require a corresponding change to the Host (for example, a change to the Tracker baud rate will necessitate a change at the Host or communication will be lost).

Table 87: SW Toolbox Input

MID (Hex)	0xB2
MID (Dec)	178
Message Name in Code	MID_TrackerIC (see PROTOCOL.H)
SID (Hex)	As below

SID (Dec) As below
SID Name in Code As below

SID 0x01 (1) SID_MeiToCustomIo

The format of this message is dependent upon the custom I/O, and the contents of this message set are not listed in this document. Instead, a separate ICD describing this message and the associated custom I/O will be distributed to each targeted customer under NDA.

Table 88: Tracker MEI to Custom I/O Command

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x01
Varies	n	Dependent upon the custom I/O

Response upon completion of the command: 0x0B (MID_ACK). Upon output of the SSB 0x0B (MID_ACK) response, the Host will send the appropriate MEI 0x1F (Select Custom I/O) command to the Tracker.

SID 0x02 (2) SID_TrackerConfig

Table 89: Tracker Configuration Command

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x02
Reference Clock Frequency	4	Value of attached TCXO in Hz. This parameter has no default.
Reference Start-up Delay	2	Tracker inserts the start-up delay on TCXO power-up. The units are RTC clock cycles, and start-up delay can range from 0 to 2 seconds. The Tracker default is 0x03FF or 31.2 ms.
Reference Initial Uncertainty	4	Initial TCXO uncertainty in ppb. The value 0xFFFFFFFF means initial uncertainty unknown, and the Tracker will use the default uncertainty.
Reference Initial Offset	4	Initial TCXO offset in Hz. Note this value is signed. The value 0x7FFFFFFF means the initial offset is unknown, and the Tracker will use the default offset.
LNA	1	0 = Use Internal LNA (Tracker default) 1 = Use External LNA
IO Pin Configuration Enable	1	0 = Disable (also means all IO pins are disabled) 1 = Enable (use IO Pin Configuration field) The default is one.
IO Pin Configuration	4	0 = TM and TSYNC are enabled Other values undefined. The default is zero.

Field	Length (bytes)	Description
UART Baud	4	The following is the list of valid bauds: 900, 1200, 1800, 2400, 3600, 4800, 7200, 9600, 14400, 19200, 28800, 38400, 57600, 76800, 115200, 153600, 230400, 307200, 460800, 614400, 921600, 1228800, and 1843200. The Tracker default is 115200.
UART Flow Control	1	0 = Disable hardware flow control (Tracker default) 1 = Enable hardware flow control
UART Wake Up Pattern	1	This byte is repeated in payload field of Tracker Wake Up Message.
UART Wake Up Count	1	This parameter defines the number of times to repeat the UART Wake Up Pattern in the Tracker Wake Up Message. In case of zero, the Tracker Wake Up Message is not generated. The default is zero.
I2C Master Address (user system)	2	Either a 7-bit or a 10-bit I2C address. If this 16-bit field begins with 0xF, then this is a flag indicating 10-bit I2C addressing is being used. For a 7-bit address, only the lower 7 bits are used. For a 10-bit address, only the lower 10-bits are used. The default address is 0x62. For a 7-bit I2C address, this field will range from 0x0008 through 0x007F. Values lower than 0x08 have special uses (see the I2C Bus Specification for a description). For a 10-bit I2C address, this field will range from 0xF000 through 0xF3FF.
I2C Slave Address (GSD4t)	2	Either a 7-bit or a 10-bit I2C address. If this 16-bit field begins with 0xF, then this is a flag indicating 10-bit I2C addressing is being used. For a 7-bit address, only the lower 7 bits are used. For a 10-bit address, only the lower 10-bits are used. The default address is 0x60. For a 7-bit I2C address, this field will range from 0x0008 through 0x007F. Values lower than 0x08 have special uses (see the I2C Bus Specification for a description). For a 10-bit I2C address, this field will range from 0xF000 through 0xF3FF.
I2C Mode	1	0 = Slave 1 = Multi-Master (default)
I2C Rate	1	0 = 100 Kbps 1 = 400 Kbps (default) 2 = 1 Mbps (not available on GSD4t) 3 = 3.4 Mbps (not available on GSD4t)
Power Supply Config Select	1	0 = Switching regulator 1 = Internal LDO 2 = External voltage 3 = Backup LDO

Response upon completion of the command: 0x0B (MID_ACK). Upon output of the SSB 0x0B (MID_ACK) response, the Host will send the appropriate MEI 0x0A (Tracker Configuration) command to the Tracker.

SID 0x03 (3) SID_PeekPoke

Tracker Peek and Poke Command (four-byte peek)

Table 90: Tracker Peek and Poke Command (four-byte peek)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x03
Type	1	enumeration 0 = Peek (always four bytes) 10 = eFUSE peek (4e and beyond only, 4 bytes)
Access	1	enumeration 1 = 8-bit access (byte access) 2 = 16-bit access (half-word access) 4 = 32-bit access (word access)
Address	4	unsigned integer
Data	4	ignored (usually filled with zero)

Response upon completion of the command: 0x0B (MID_ACK). Upon output of the SSB 0x0B (MID_ACK) response, the Host will send the appropriate MEI 0x1E (Peek and Poke Command) command to the Tracker.

Tracker Peek and Poke Command (four-byte poke)

Table 91: Tracker Peek and Poke Command (four-byte poke)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x03
Type	1	enumeration 1 = Poke (always four bytes)
Access	1	enumeration 1 = 8-bit access (byte access) 2 = 16-bit access (half-word access) 4 = 32-bit access (word access)
Address	4	unsigned integer
Data	4	

Response upon completion of the command: 0x0B (MID_ACK). Upon output of the SSB 0x0B (MID_ACK) response, the Host will send the appropriate MEI 0x1E (Peek and Poke Command) command to the Tracker.

Tracker Peek and Poke Command (n-byte peek)

Table 92: Tracker Peek and Poke Command (n-byte peek)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x03
Type	1	enumeration 2 = Multi-peek 12 = eFUSE multi-peek (4e and beyond only)
Access	1	enumeration 1 = 8-bit access (byte access) 2 = 16-bit access (half-word access) 4 = 32-bit access (word access)
Address	4	unsigned integer Beginning address
Number of Bytes	2	unsigned integer Range: 0 to 1000 If zero, no data is read

Response upon completion of the command: 0x0B (MID_ACK). Upon output of the SSB 0x0B (MID_ACK) response, the Host will send the appropriate MEI 0x1E (Peek and Poke Command) command to the Tracker.

Tracker Peek and Poke Command (n-byte poke)

Table 93: Tracker Peek and Poke Command (n-byte poke)

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

Response upon completion of the command: 0x0B (MID_ACK). Upon output of the SSB 0x0B (MID_ACK) response, the Host will send the appropriate MEI 0x1E (Peek and Poke Command) command to the Tracker.

5.42 SiRFNAV Command Messages

The host sends a command message to the SLC.

5.42.1 Store GPS Snapshot Information

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

Table 94: GPS Data Snapshot Saving Message Definition

Message Name	MID_SIRFNAV_COMMAND
Input or Output	Input
MID (Hex)	0xA1
MID (Dec)	161
Message Name in Code	MID_SSB_SIRFNAV_COMMAND
SID (Hex)	0x07
SID (Dec)	7
SID Name in Code	SSB_SIRFNAV_STORE_NOW

Table 95: GPS Data Snapshot Saving Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1		0xA1			161	
Sub ID	U1		0x07			7	
Reserved	U1						

6 Output Message Definition

6.1 Position Response

Table 96: Position Response Message Definition

MID (Hex)	0x45
MID (Dec)	69
Message Name in Code	MID_POS_MEAS_RESP
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	POS_RESP

Table 97: Position Response Message

Field		**Length(bits)**
Message ID		8
Message Sub ID		8
POS_REQ_ID		8 bits
POS_RESULTS_FLAG		8 bits
POSITION_ERROR_ STATUS		8 bits
POS_ACC_MET		8 bits
POSITION MAIN SECTION	POS_TYPE	8 bits
	DGPS_COR	8 bits
	MEAS_GPS_WEEK	16 bits
	MEAS_GPS_SECONDS	32 bits
	MEAS_LAT	32 bits
	MEAS_LONG	32 bits
	OTHER SECTIONS	8 bits
Following sections from Horizontal Error to Position Correction are always present, but their validity depends on the value of OTHER_SECTIONS		
HORIZONTAL ERROR SECTION	ER_EL_ANG	8 bits
	MAJ_STD_ER	8 bits
	MIN_STD_ER	8 bits
VERTICAL POSITION SECTION	HEIGHT	16 bits
	HEIGHT_STD_ER	8 bits
VELOCITY	HOR_VEL	16 bits

SECTION		
	HEADING	16 bits
	VER_VEL	8 bits
	VEL_ER_EL_ANG	8 bits
	VEL_MAJ_STD_ER	8 bits
	VEL_MIN_STD_ER	8 bits
	VER_VEL_STD_ER	8 bits
CLOCK CORRECTION SECTION	TIME_REF	8 bits
	CLK_BIAS	16 bits
	CLK_DRIFT	16 bits
	CLK_STD_ER	8 bits
	UTC_OFF	8 bits
POSITION CORRECTION SECTION	NB_SV	8 bits
	Two following fields are repeated 16 times, only the first "NB_SV" fields are valid.	
	SV_PRN	8 bits
	C_N0	8 bits
	INV_WEIGHTS	8 bits

POS_REQ_ID Position/measurement response identifier

This is the POS_REQ_ID (sent in a request) that the returned position/measurements are associated with.

POSITION_RESULTS_FLAG Position Results flag

If set to "0x00", all fields of the position result section from POSITION_ERROR_STATUS to INV_WEIGHTS are invalid and must be set to zero. No position information (even the "no position" information) is delivered.
If set to "0x01", some fields in the position result section are valid.

POSITION_ERROR_STATUS: Position Error Status

If set to 0x00, position information is delivered. POSITION MAIN SECTION is valid, plus other optional fields (see OTHER_SECTIONS field).

If set to any other value, the rest of the position results block is invalid and must be set to all zeros. The non-zero value provides information about the reason of the "no position delivered" information, according to the table below.

Table 97: POSITION_ERROR_STATUS field

Status	Value
Valid Position	0x00
Not Enough satellites tracked [(1)]	0x01
GPS Aiding data missing (not supported)	0x02
Need more time	0x03
No fix available after full search	0x04
Unused	0x05
Position Reporting Disabled	0x06
Rejected Position Reporting for QoP	0x07
Reserved	0x08-0xff

[(1)]: This case has been added to be compatible with the reporting capabilities defined in the GSM standard. From the document, there is no clear definition when this error case should be reported.

The following list details each situation:
Valid Position:
Position is available in the next fields.

Not Enough Satellites tracked:
SLC is tracking some satellites already, but not enough to compute a position.

GPS Aiding data missing:
Defined but not available aiding information to compute a position with satisfactory QoP.

Need more time:
No position was available within the RESP_TIME_MAX requested in the last data message.

No fix available after full search:
SLC went through all search strategy once and we could not compute a fix (all cases are covered here).

Position Reporting Disabled:

When the QoP specification in the originating POS_REQ can not be met any longer due to a low power transition request with conflicting QoP specification, POS_RESP messages are not generated while in the conflicting low power mode. This might occur after transitioning to trickle power or push-to-fix low power mode.

Rejected Position Reporting for QoP:

When the QoP specification in the originating POS_REQ could not be met due to an exisitng low power mode with conflicting QoP specification, the POS_REQ request is rejected and no POS_RESP messages are generated, even after transitioning out of the current low power mode.

POS_ACC_MET Position Accuracy Flag

If set to 1 (0) then horizontal error as well as vertical error in the position are estimated to be respectively less (more) than the maximum requested horizontal error and maximum requested vertical error with a confidence level of 95%.

POS_TYPE Position Type

The SLC shall set this field according to what is shown in Table 98 (x indicates a don't care bit).

Table 98: POS_TYPE Field Specification

POS_TYPE field value	Position Type
'xxxxxx00'	2D
'xxxxxx01'	3D
'xx0xxxxx'	Not a trickle power solution.
'xx10xxxx'	Trickle power solution (QoP ignored)
'x00000xx'	QoP guaranteed
'xxxxx1xx'	WiFi-tagged coarse solution
'xxxx1xxx'	Almanac derived coarse solution
'xx01xxxx'	Adjusted QoP APM solution
'x1xxxxxx'	Reverse EE candidate
All others'	(Reserved)

WiFi-tagged coarse solution:

Position was not calculated from GPS pseudo-ranges but copied from an earlier, valid GPS fix associated with the same WiFi tag value reported to the SLC engine.

Almanac derived coarse solution:

Position was calculated based on one or more of the SVs having their states derived from almanac parameters as opposed to ephemerides.

Adjusted QoP APM low power mode solution:

When the QoP specification in the originating POS_REQ can not be met any longer due to a low power transition request with conflicting QoP specification, POS_RESP messages are still generated while in the conflicting low power mode but the original POS_REQ QoP specification is overridden as specified for the new low power mode. This might happen after transitioning to APM low power mode.

Reverse EE candidate:

Reverse EE processing may be used for the data provided, which is populated in the measurement section and in the SV state section.

DGPS_COR DGPS correction type

The SLC shall set this field according to the following table.

Table 98: DGPS_COR Field Specification

DGPS_COR field Value	Correction Type
'00'	No DGPS correction
'01'	Local DGPS correction
'02'	WAAS correction
All others	Other Corrections (Reserved)

MEAS_GPS_WEEK Extended GPS week number

The SLC shall set this field to the extended number of GPS weeks since the beginning of the GPS reference, in binary format, in number of weeks.

Note 1: For the period from August 21st 1999 23:59.47, UTC time, to around midnight the night between April 7^{th} 2019/April 8^{th} 2019.

MEAS_GPS_WEEK=GPS_WEEK NUMBER+1024

Where GPS_WEEK NUMBER is the equivalent unsigned binary value of the ten most significant bits of the Z-count found in the GPS satellites broadcast message.
The UTC time of the next rollover is given only approximately, as we don't know today how many extra leap seconds will have been introduced between UTC time and TAI time (International Atomic Time).

Note 2: The leap seconds are defined as TAI-UTC.
TAI-UTC=32s at 08/21/1999.

Note 3: As of 11/19/2008:

TAI is ahead of UTC by 33 seconds.
TAI is ahead of GPS by 19 seconds.
GPS is ahead of UTC by 14 seconds.

MEAS_GPS_SECONDS GPS time in the week when the position was computed

The SLC shall set this field to the number of elapsed seconds since the beginning of the current GPS week, in binary format, in units of 1/1000 seconds, in the range from 0s to 604,799.999 seconds.

MEAS_LAT Measured Latitude

The SLC shall set this field to the two's complement value of the latitude, in units of $180/2^{32}$ degrees, in the range from -90 degrees to $+90x(1-2^{-31})$ degrees, referenced to the WGS84 reference ellipsoid, counting positive angles north of the equator, and negative angles south of the equator.

MEAS_LONG Measured Longitude

The SLC shall set this field to the two's complement value of the longitude, in units of $360/2^{32}$ degrees, in the range from -180 degrees to $+180x(1-2^{-31})$ degrees, referenced to the WGS84 reference ellipsoid, counting positive angles East of the Greenwich Meridian, and negative angles West of the Greenwich Meridian.

OTHER_SECTIONS Indicates the validity status of other sections

The SLC shall indicate what sections are valid in the message. All non valid sections are filled with zeros.

OTHER_SECTIONS consists of 8 bits; each of the bits represents one section. The mapping of the bits is listed in the following table. If a section is valid, the SLC shall set the corresponding bit to '1'; otherwise, the SLC shall set the corresponding bit to '0'. See table below for detailed specification.

Table 99: OTHER_SECTIONS Field Specification

Bits in OTHER_SECTIONS	**Value**	**SECTION**
Bit 0(LSB)	1: Valid 0: Not Valid	Horizontal Error Section
Bit 1	1: Valid 0: Not Valid	Vertical Position Section
Bit 2	1: Valid 0: Not Valid	Velocity Section
Bit 3	1: Valid 0: Not Valid	Clock Correction Section
Bit 4	1: Valid 0: Not Valid	Position Correction Section
Bit 5-7(MSB)	0	(Reserved)

ER_EL_ANG Error Ellipse Angle

The SLC shall set this field to the binary value of the Error Ellipse major axis angle with respect to True North in WGS84. The units shall be $180/2^8$degrees, with a range from 0 to $+180x(1-2^{-7})$ degrees, where 0 degrees is True North, and the angle is measured rotating toward the East.

MAJ_STD_ER Major Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation along the axis specified by the ER_EL_ANG field. The GPS shall set this field according to the following table.

Table 100: MAJ_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Horizontal Error (meters)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	2 ≤ I ≤ 253	0.125 (1 + Y/16) x 2^x	$f_{i-1} \leq \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680

MIN_STD_ER Minor Axis Standard Deviation Error
The SLC shall set this field to the Standard Deviation perpendicular to the axis specified by the ER_EL_ANG field according to the following table.

Table 101: MIN_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Horizontal Error (meters)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	2 ≤ I ≤ 253	0.125 (1 + Y/16) x 2^x	$f_{i-1} \leq \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680

HEIGHT Height

Units of 0.1 m in the range of –500 m to +6053.5 m with respect to WGS84 reference ellipsoid, in Unsigned Binary Offset coding. The formula to apply is:

HEIGHT(in m)= Bx0.1-500

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

HEIGHT_STD_ER Height Standard Deviation Error

The SLC shall set this field to the Vertical Error Standard Deviation as specified in the table below.

Table 102: HEIGHT_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Vertical Error (meters)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	2 ≤ I ≤ 253	$0.125 (1 + Y/16) x 2^x$	$f_{i-1} \leq \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680

HOR_VEL Horizontal Velocity

The SLC shall set this field to the horizontal velocity, in units of 0.0625 meters/second, in the range from 0 to 4095 m/s

HEADING Heading

The SLC shall this field to the velocity heading, in units of $360/2^{16}$ degrees, in the range from 0 to $360x(1\text{-}2\text{-}^{16})$ degrees. '0' degrees is True North, and the angle increases towards the East.

VER_VEL: Vertical Velocity

The SLC shall set this field to the two's complement value of Vertical Velocity, in units of 0.5m/s in the range from -64m/s to +63.5 m/s.

VEL_ER_EL_ANG Error Ellipse Angle

The SLC shall set this field to the binary value of the Error Ellipse major axis angle with respect to True North in WGS84. The units shall be 0.75 degrees, with a range from 0 to $+180x(1\text{-}2^{-7})$ degrees, where 0 degrees is True North, and the angle is measured rotating toward the East.

VEL_MAJ_STD_ER Major Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation along the axis specified by the ER_EL_ANG field. The SLC shall set this field according to the table below.

Table 103: VEL_MAJ_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Horizontal Velocity Error (meters/second)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	$2 \le I \le 253$	$0.125 (1 + Y/16) x 2^x$	$f_{i-1} \le \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680 or unknown

VEL_MIN_STD_ER Minor Axis Standard Deviation Error

The SLC shall set this field to the Standard Deviation perpendicular to the axis specified by the ER_EL_ANG field. The SLC shall set this field according to the following table.

Table 104: VEL_MIN_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Horizontal Velocity Error (meters/second)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	$2 \le I \le 253$	$0.125 (1 + Y/16) x 2^x$	$f_{i-1} \le \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680 or unknown

VER_VEL_STD_ER Height Standard Deviation Error

The SLC shall set this field to the Vertical Error Standard Deviation as specified in the table below.

Table 105: VER_VEL_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Vertical Velocity Error (meters/second)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	$2 \le I \le 253$	$0.125 (1 + Y/16) x 2^x$	$f_{i-1} \le \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680 or unknown

TIME_REF Time reference in clock computation

The SLC shall set this field to '0' to indicate the tie reference is the local clock. '1' value is reserved.

CLK_BIAS Clock Bias

The SLC shall set this field to the clock bias, in the range from –429.287 seconds to +429.287 seconds with a minimum non-zero value of 100ns. A "floating-point" representation is used where the most significant bit is the sign, the following 5 most significant bits constitute the exponent and the 10 least significant bits constitute the mantissa.

With

S being "0" or "1"

X being the binary value of the exponent field, ($0 \leq X \leq 31$)

Y being the binary value of the mantissa field, ($0 \leq Y \leq 1023$)

The CLOCK_BIAS parameter is given in units of 1 second by the formula:

$CLK\_BIAS=(-1)^S \, . \, 100 \, . \, 10^{-9} \, (1+Y/1024) \, . \, 2^X$ seconds

CLK_DRIFT Clock Drift

The SLC shall set this field to the clock drift in the range of –327.52ppm (or us/s) to +327.52 ppm, with a minimum non-zero value of 0.0025ppm. A "floating-point" representation is used where the most significant bit is the sign, the following 4 most significant represent the exponent, and the 11 least significant bits constitute the mantissa.

With

S being "0" or "1"

X being the binary value of the exponent field, ($0 \leq X \leq 15$)

Y being the binary value of the mantissa field, ($0 \leq Y \leq 2047$)

The CLOCK_BIAS parameter is given in units of 1 part-per-million (or us/s) by the formula:

$CLK\_DRIFT=(-1)^S \, . \, 5 \, . \, 10^{-3} \, (1+Y/2048) \, . \, 2^X$ ppm

CLK_STD_ER Estimated Time Accuracy.

The SLC shall set this field as defined in the table below.

Table 106: CLK_STD_ER Field Specification

Exponent X	Mantissa Y	Index value I= Y + 16 X	Floating Point Value f_i	Estimated Time Accuracy (Microseconds)
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	0.125 < σ < 0.1328125
X	Y	$2 \le I \le 253$	$0.125 (1 + Y/16) \times 2^x$	$f_{i-1} \le \sigma < f_i$
1111	1110	254	7680	7424 ≤ σ < 7680
1111	1111	255	Not Applicable	≥ 7680

UTC_OFF The offset between GPS time and UTC time in units of seconds.

The SLC shall set this field to the value of the offset between GPS time and UTC time at the time of location computation in units of seconds: range of 0-255 seconds.

NB_SV Number of Satellite Vehicles Currently Tracked

For MS-Based mode,

The SLC shall set this field to the number of GPS satellites currently tracked, in the range from 1 to 10, where the binary value of the field conveys the number of satellites.

SV_PRN Satellite PRN number

For MS-Based mode,

The SLC shall set this field to the value of the PRN signal number of the SV which is being tracked. It is represented as an unsigned value in the range from 1 to 32, where the binary value of the field conveys the satellite PRN number.

C_N0 Satellite C/N0

The SLC shall set this field to the C/N0 value in units of 1 dB-Hz in the range from 0 to 60, in Unsigned binary format.

INV_WEIGHTS Inverse of Weighting Factor in position computation

For MS-Based mode,

This field has a dual purpose:
-to report whether the satellite is used in the position fix,
-if it used in the fix, the value of the inverse weighting factor.

If the satellite is not used in the fix, INV_WEIGHTS shall be set to "0".

If the satellite is used in the fix, SLC shall set INV_WEIGHTS to the inverse of the weighting factor used for the satellite, in the range from 0.125 to 3968m. A "floating-point" representation is used where the 4 most significant bits constitute the exponent and the 4 least significant bits constitute the mantissa as specified in the table below.

Table 107: INV_WEIGHTS Field Specification

Exponent X	**Mantissa Y**	**Index value I= Y + 16 X**	**Floating Point Value f_i**	**Inverse Weighting Factor (meters)**
0000	0000	0	0.125	< 0.125
0000	0001	1	0.1328125	$0.125 < \sigma < 0.1328125$
X	Y	$2 \le I \le 253$	$0.125 (1 + Y/16) \times 2^x$	$f_{i-1} \le \sigma < f_i$
1111	1110	254	7680	$7424 \le \sigma < 7680$
1111	1111	255	Not Applicable	≥ 7680

6.2 Measurement Response

Table 108: Measurement Response Message Definition

MID (Hex)	0x45
MID (Dec)	69
Message Name in Code	MID_POS_MEAS_RESP
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	MEAS_RESP

Table 109: Measurement Response Message

Field		Length(bits)
Message ID		8
Message Sub ID		8
POS_REQ_ID		8 bits
MEASURE-MENT SECTION	GPS_MEAS_FLAG	8 bits
	MEAS_ERROR_STATUS	8 bits
	MEAS_GPS_WEEK	16 bits
	MEAS_GPS_SECONDS	32 bits
	TIME_ACCURACY	8 bits
	NUM_SVS	8 bits
	The following fields are repeated a number of times indicated by the value of the NUM_SVS field.	
	SV_PRN	8 bits
	C_N0	8 bits
	SV_DOPPLER	16 bits
	SV_CODE_PHASE_WH	16 bits
	SV_CODE_PHASE_FR	16 bits
	MULTIPATH_INDICATOR	8 bits
	PSEUDORANGE_RMS_ERROR	8 bits

POS_REQ_ID Position/measurement request identifier

This is the POS_REQ_ID (sent in a request) that the returned position/measurements are associated with.

GPS_MEAS_FLAG GPS Measurement Flag

If set to 0x00, all fields of the GPS measurement section from MEAS_ERROR_STATUS to PSEUDORANGE_RMS_ERROR are invalid and must be set to zero. No GPS measurement information is delivered. If set to 0x01, some fields in the GPS measurement section are valid.

MEAS_ERROR_STATUS GPS Measurement Error Status

If set to 0x00, GPS measurement information is delivered and the MEASUREMENT SECTION is valid. If set to any other value, the MEASUREMENT SECTION is invalid and must be set all zeros. The non zero value provides information about the reason of the "no GPS measurement delivered" information, according to the table below.

Table 110: MEAS_ERROR_STATUS Field

MEAS_ERROR_STATUS Value	Description
0x00	Valid GPS Measurements
0x01	No Enough Satellites Tracked
0x02	GPS Aiding Data Missing
0x03	Need More Time
0x04 – 0xFE	Reserved
0xFF	Requested Location Method Not Supported

TIME_ACCURACY Accuracy of GPS Measurement Time Tag

The SLC shall set this field to the estimated accuracy of GPS measurement time tag according to the table below.

Table 111: TIME_ACCURACY Field

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

NUM_SVS Number of Satellite Measurements

The SLC shall set this field to the number of valid GPS measurements included in MEASUREMENT SECTION. It is represented an unsigned value in the range from 1 to 32, where the binary value of the field conveys the number of measurements. The valid value is from 1 to 16.

SV_DOPPLER Satellite Doppler Measurement

The SLC shall set this field to the two's complement value of the measured Doppler, in units of 0.2 Hz, in the range from –6,553.6 Hz to +6,553.6 Hz.

SV_CODE_PHASE_WH Satellite Code Phase Measurement – Whole Chips

The SLC shall set this field to the satellite code phase measured as a number of C/A code chips, in units of 1 C/A code chip, in the range from 0 to 1022 chips.

SV_CODE_PHASE_FR Satellite Code Phase Measurement – Fractional Chips

The SLC shall set this field to the fractional value of the satellite code phase measurement, in units of 2^{-10} of C/A code chips, in the range from 0 to $(2^{-10}-1)/ 2^{-10}$ chips.

MULTIPATH_INDICATOR Multipath Indicator

The SLC shall set this field to the value shown in the table below.

Table 112: MULTIPATH_INDICATOR Field

MULTIPATH_INDICATOR Value	Description
'00000000'	Not Measured
'00000001'	Low, Multipath Error ≤ 5 meters
'00000010'	Medium, 5 <Multipath Error ≤ 43 meters
'00000011'	High, Multipath Error > 43 meters
'00000100' – '11111111'	Reserved

PSEUDORANGE_RMS_ERROR Pseudorange RMS Error

The SLC shall set this field to the pseudorange RMS error, in the range from 0.5m to 112m. A "floating-point" representation is used where the 3 least significant bits (Bit 0, 1, and 2) constitute the mantissa and Bit 3, 4, and 5 constitute the exponent as specified in the table below.

Table 113: Pseudorange RMS Error Representation

Exponent, X	Mantissa, Y	Index Value, i=Y+8X	Floating-Point Value, f_i	Pseudorange RMS Error, P (m)
'000'	'000'	0	0.5	P < 0.5
'000'	'001'	1	0.5625	0.5 ≤ P < 0.5625
X	Y	2 ≤ P ≤ 61	$0.5(1+Y/8)2^X$	$f_{i-1} \le P < f_i$
'111'	'110'	62	112	104 ≤ P < 112
'111'	111'	63	Not Applicable	112 ≤ P

6.3 Ephemeris Status Response

Table 114: Ephemeris Status Response Message Definition

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	EPH_RESP

The "Ephemeris Status Response" message is output in response to "Ephemeris Status Request" message. There is at least one solicited "Ephemeris Status Response" output message sent in response to a received "Ephemeris Status Request" input message. Optionally, several more unsolicited "Ephemeris Status Response" output messages can follow the solicited response message, while the current session is open.

Table 115: Ephemeris Status Response Message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
GPS_TIME_FLAG	1		
EXTD_GPS_WEEK	2		
GPS_TOW	4		
EPH_STATUS_TYPE	1		
GPS_T_TOE_LIMIT	1		
NUM_SVS	1		
The following structure should repeat a number of times as indicated by the value of the "NUM_SVS" field above.			
SATID	1		
SAT_INFO_FLAG	1		
GPS_WEEK	2		
GPS_TOE	2		
IODE	1		
AZIMUTH	2		
ELEVATION	1		

GPS_TIME_FLAG Flag for the GPS time section
Bit0 -> isExtdGPSWeekValid {0,1} = {FALSE, TRUE}
Bit1 -> isGPSTOWValid {0,1} = {FALSE, TRUE}

EXTD_GPS_WEEK Extended GPS week number
The SLC shall fill in the current GPS week. This field is only valid if isExtdGPSWeekValid (GPS_TIME_FLAG) is TRUE.

GPS_TOW GPS time of week
The SLC shall fill in the current GPS time of week in the unit of 0.1 seconds. This field is only valid if isGPSTOWValid (GPS_TIME_FLAG) is TRUE.

EPH_STATUS_TYPE The type of ephemeris status report
If set to 1 -> Aiding server shall make the decision on what to send. The SLC does not provide parameters from "GPS T-TOE Limit" to the "SatList" structure. The server can send all available in visible list, or all satellites that the server has.

If set to 3, "Status Report" -> The SLC shall fill parameters from "GPS T-TOE Limit" to the "SatList" structure with the current satellite states in SLC. The SLC may fill each SatList element partially or fully based on the information it has about the satellite:

- SATID=0 implies that the SLC has no ephemeris information about the satellite
- SATID only
- SATID with GPS_WEEK, GPS_TOE, IODE
- SATID with GPS_WEEK, GPS_TOE, IODE, AZIMUTH & ELEVATION
- SATID with AZIMUTH and ELEVATION

The CP or the server shall decide on what aiding to send based on this information.

All other values are invalid.

GPS_T_TOE_LIMIT Tolerance of the TOE age.
GPS time of ephemeris time tolerance, in unit of hours. The valid range is from 0 to 10. This parameter is currently set to 2.

NUM_SVS Number of satellites
This is the number of satellites for which ephemeris status parameters are given by this message.

SATLIST A structure that contains satellite ephemeris status information
This is a structure containing the following sub-elements
This structure can be repeated up to 32 times.

SATID The satellite ID (PRN number)
A value of zero means SATID is invalid.

SAT_INFO_FLAG The satellite info flag
If this flag is set to 0, the parameters from GPS_WEEK to ELEVATION are not valid.

If bit 0 of this flag is set to 1, the parameters from GPS_WEEK to IODE are valid.
If bit 1 of this flag is set to 1, the parameters from AZIMUTH to ELEVATION are valid.
Otherwise, the specified parameters are not valid.
If bit 2 (SLC_EPH_REQ) is set to 1, the corresponding satellite requires ephemeris aiding as determined by the SLC internal algorithm.

GPS_WEEK The GPS week number
The GPS week of the ephemeris in SLC for SATID. Value={0…1023}
For an invalid satellite, this value should be set to 0.

GPS_TOE The GPS time of ephemeris
GPS time of ephemeris in hours of the latest ephemeris set contained by the SLC for satellite SATID.
For an invalid satellite, this value should be set to 0.

IODE The issue of data of ephemeris
Issue of Data Ephemeris for SATID.
For an invalid satellite, this value should be set to 0.

AZIMUTH Azimuth angle of the GPS satellite
The SLC shall set this field to the azimuth, in units of 1 degree. The valid value is from 0 to 359 degrees. The CP shall set this field to 0xFFFF if the azimuth angle is unknown.

ELEVATION Elevation angle of the GPS satellite
The SLC shall set this field to the elevation angle, in units of 1 degree. The valid value is form -90 to 90 degrees. The CP shall set this field to 0xFF if the elevation angle is unknown

6.4 ACK/NACK/ERROR Notification

Table 116: ACK/NACK/ERROR Notification Message Definition

MID (Hex)	0x4B
MID (Dec)	75
Message Name in Code	MID_MSG_ACK_OUT
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	ACK_NACK_ERROR

Table 117: ACK/NACK/ERROR Notification Message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
Echo Message ID	1		
Echo Message Sub ID	1		
ACK/NACK/ERROR	1		
Reserved	2		

Table 118: ACK/NACK/ERROR Field Description

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

Note: At the time of releasing the 4t product, the support of this message for use by new 4t applications will coexist with the support of the SSB ACK (0x0B) and SSB NACK (0x0C) messages for use by legacy applications of earlier products.

6.5 Almanac Response

Table 119: Almanac Response Message Definition

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	ALM_RESP

The "Almanac Response" message is output in response to "Almanac Request" message.

Table 120: Almanac Response Fields

Field	Bytes	Scale Factor	Unit
Message ID	8		
Message Sub ID	8		
ALM_DATA_FLAG	8	N/A	N/A
EXTD_GPS_WEEK	16	N/A	weeks
GPS_TOW	32	0.1	seconds
NUM_SVS	1		
The structure of almanac parameters below shall repeat a number of times as indicated by the value of the NUM_SVS field above.			
ALM_VALID_FLAG	8	N/A	N/A
ALM_SV_PRN_NUM	8	N/A	N/A
ALM_WEEK_NUM	16	N/A	N/A
ALM_ECCENTRICITY	16	2^{-21}	dimensionless
ALM_TOA	8	2^{12}	Seconds
ALM_DELTA_INCL	16(1)	2^{-19}	semi-circles
ALM_OMEGADOT	16(1)	2^{-38}	semi-circles/sec.
ALM_A_SQRT	24	2^{-11}	$meters^{1/2}$
ALM_OMEGA_0	24(1)	2^{-23}	semi-circles
ALM_OMEGA	24(1)	2^{-23}	semi-circles
ALM_M0	24(1)	2^{-23}	semi-circles
ALM_AF0	16 (1)	2^{-20}	Seconds
ALM_AF1	16 (1)	2^{-38}	sec/sec

All parameters (from ALM_VALID_FLAG to ALM_AF1) have the same definition as the ones defined in Section 6.1 (AI3 Request) except that ALM_WEEK_NUM is the week number of the corresponding sub-almanac.

ALM_DATA_FLAG Flag for each data section

Bit 0 -> isAlmanacValid {0,1} = {No almanac data, at least one sub-almanac present in the message}
Bit1 -> isExtdGPSWeekValid {0,1} = {FALSE, TRUE}
Bit2 -> isGPSTOWValid {0,1} = {FALSE, TRUE}

EXTD_GPS_WEEK Extended GPS week number

The SLC shall fill in the current GPS week. This field is only valid if isExtdGPSWeekValid (ALM_DATA_FLAG) is TRUE.

GPS_TOW GPS time of week

The SLC shall fill in the current GPS time of week in the unit of 0.1 seconds. This field is only valid if isGPSTOWValid (ALM_DATA_FLAG) is TRUE.

NUM_SVS Number of satellites

This is the number of satellites for which almanac information is being given with this message.

6.6 Broadcast Ephemeris Response

Table 121: Broadcast Ephemeris Response Message Definition.

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x03
SID (Dec)	3
SID Name in Code	B_EPH_RESP

The "Broadcast Ephemeris Response" message is output in response to "Broadcast Ephemeris Request" message.

Table 122: Broadcast Ephemeris Response Message Fields

Field	Length (bits)	Scale Factor	Unit
Message ID			
Message Sub ID			
RESERVED	8	N/A	N/A
IONO_FLAG	8	N/A	N/A
ALPHA_0	8(1)	2^{-30}	Seconds
ALPHA_1	8(1)	2^{-27}	sec/semi-circles
ALPHA_2	8(1)	2^{-24}	sec/(semi-circles)^2
ALPHA_3	8(1)	2^{-24}	sec/(semi-circles)^3
BETA_0	8(1)	2^{11}	Seconds
BETA_1	8(1)	2^{14}	sec/semi-circles
BETA_2	8(1)	2^{16}	sec/(semi-circles)^2
BETA_3	8(1)	2^{16}	sec/(semi-circles)^3
TIME_FLAG	8	N/A	N/A
EXTD_GPS_WEEK	16	1	Week
GPS_TOW	32	0.1	Seconds
NUM_SVS	8		
The following fields are repeated a number of times indicated by the value of the NUM_SVS field above.			
EPH_FLAG	8	N/A	N/A
HEALTH	8	N/A	N/A
GPS_WEEK	16	N/A	N/A
SV_PRN_NUM	8	N/A	N/A
URA_IND	8	N/A	N/A
IODE	8	N/A	N/A
C_RS	16(1)	2^{-5}	Meters

DELTA_N	16(1)	2^{-43}	semi-circles/sec
M0	32(1)	2^{-31}	semi-circles
C_UC	16(1)	2^{-29}	Radians
ECCENTRICITY	32	2^{-33}	N/A
C_US	16(1)	2^{-29}	Radians
A_SQRT	32	2^{-19}	$\sqrt{meters}$
TOE	16	2^{4}	Seconds
C_IC	16(1)	2^{-29}	Radians
OMEGA_0	32(1)	2^{-31}	semi-circles
C_IS	16(1)	2^{-29}	Radians
ANGLE_INCLINATION	32(1)	2^{-31}	semi-circles
C_RC	16(1)	2^{-5}	Meters
OMEGA	32(1)	2^{-31}	semi-circles
OMEGADOT	32(1)	2^{-43}	semi-circles/sec
IDOT	16(1)	2^{-43}	semi-circles/sec
TOC	16	2^{4}	Seconds
T_GD	8(1)	2^{-31}	Seconds
AF2	8(1)	2^{-55}	sec/sec^2
AF1	16(1)	2^{-43}	sec/sec
AF0	32(1)	2^{-31}	Seconds

TIME_FLAG Time parameter validity flag.

The SLC shall set this field to 1 if the following fields from EXTD_GPS_WEEK to GPS_TOW are valid. If the fields are not valid, the SENDER shall set this field and the following fields from EXTD_GPS_WEEK to GPS_TOW to 0.

EXTD_GPS_WEEK Extended GPS week number

This is the extended GPS week number of the current time of the current time inside the SLC.

GPS_TOW GPS time of week

This is the time of week in unit of 0.1 seconds of the current time inside the SLC.

NUM_SVS Number of satellites
This is the number of satellites for which broadcast ephemeris is being given with this message. This needs to match the NUM_SVS field of the "Broadcast Ephemeris Request" message, for which this is the response pair.

Please see "AI3 Request" (Section 6.1) for description of all other fields.
HEALTH Broadcast Ephemeris Health
This field is used to indicate the health of the satellite. A value of 0 means the satellite is health, a value of 1 means the satellite is unhealthy.

6.7 Verified 50 bps Broadcast Ephemeris and Iono Data

Table 123: Verified 50 bps Broadcast Ephemeris Data Message Definition.

MID (Hex)	0x38
MID (Dec)	56
Message Name in Code	SSB_EE
SID (Hex)	0x05
SID (Dec)	5
SID Name in Code	SSB_EE_X-CORR_FREE

This message sends verified data containing broadcast ephemeris and iono parameters for Ephemeris Extension. The payload of this message is 42 bytes long, similarly to SiRF Binary Message 8, which contains 50 bps data in standard GPS ICD format. The payload here has the following sub-frames:

1) Sub-frames 1, 2 and 3 containing broadcast ephemeris data that is verified to be free from cross-correlation and verified to have broadcast ephemeris with good health. These sub-frames would be sent per SV each time when a new broadcast ephemeris is received and is verified to be free from cross-correlation and in good health.
2) Sub-frame 4 containing Klobucher inonspheric model parameters. This would be sent once only.
3) Sub-frame 5 will not be present.

Table 124: Verified 50 bps Broadcast Ephemeris Message Structure

Field	Bytes	Scale	Unit
Message ID	U1		
Message Sub ID	U1		
Channel	U1		
SV ID	U1		
Word[10]	U4		

6.8 Session Opening Response

Table 125: Session Open Message Definition

MID (Hex)	0x4A
MID (Dec)	74
Message Name in Code	MID_SESSION_CONTROL_RESP
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	SESSION_OPEN_RESP

The "Session Opening Notification" message is output in response to "Session Opening Request" message. Each time a "Session Opening Request" message is received, a "Session Opening Notification" message or a "Reject" message should be sent.

Table 126: Session Opening Notification

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
SESSION_OPEN_STATUS	1		

SESSION_OPEN_STATUS: Session Open Status
The field shall be set to an appropriate value as specified in the table below.

Table 127: SESSION_OPEN_STATUS Field Description

Value	Description
0x00	Session Opening succeeded.
0x01	Session Opening failed
0x02 to 0x7F	Reserved
0x80	Session Resume succeeded
0x81	Session Resume failed
0x82 to 0xFF	Reserved

6.9 Client Status Response

Table 128: Client Status Response

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x06
SID (Dec)	6
SID Name in Code	CLIENT_STATUS_RESP

Table 129: Client Status message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
STATUS	1		

STATUS Client Status
This field shall be set to the appropriate value as specified in the table below.

Table 130: STATUS Field Specification

Bits in STATUS	Description
Bit 7-1: STATUS BITS	'xxxxxx1'0x01:No fix available after full search 'xxxx10x': OK to send (SLC ready to receive message, e.g. wake-up from standby mode) 'xxxx01x': NOT OK to send (SLC not ready to receive message, e.g. in standby mode during trickle power).
Bit 8: EXTENSION BIT	'0': no byte extension '1': reserved

Bit 7-1: STATUS BITS
This field contains a bit pattern describing one of the SLC status events
Bit 8: EXTENSION BIT
In the future, this bit will be used as a condition reporting extension mechanism. For this version the only acceptable value is '0' (no extensions)

6.10 Session Closing Notification

Table 131: Session Close Notification Message Definition

MID (Hex)	0x4A
MID (Dec)	74
Message Name in Code	MID_SESSION_CONTROL_RESP
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	SESSION_CLOSE_RESP

The "Session Closing Notification" message is output in response to "Session Closing Request" message. Each time a "Session Closing Request" message is received, a "Session Closing Notification" message or a "Reject" message should be sent.

Table 132: Session Closing Notification message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
SESSION_CLOSE_STATUS	1		

SESSION_CLOSE_STATUS: Session closing status.
This field shall be set to an appropriate value as specified in the table below.

Table 133: SESSION_CLOSE_STATUS Field Specification

Value	Description
0x00	Session closed
0x01	Session closing failed
0x02 to 0x7F	Reserved
0x80	Session suspended
0x81	Session suspension failed
0x82 to 0xFF	Reserved

6.11 Hardware Configuration Request

Table 134: Hardware Configuration Message Definition

MID (Hex)	0x47
MID (Dec)	71
Message Name in Code	MID_HW_CONFIG_REQ

Table 135: Hardware Configuration Request message

Field	Bytes	Scale	Unit
Message ID	1		

6.12 Time Transfer Request

Table 136: Time Transfer Request Message Definition

MID (Hex)	0x49
MID (Dec)	73
Message Name in Code	MID_AIDING_REQ
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	TIME_TX_REQ

Request time transfer.

Table 137: Time Transfer Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		

6.13 Frequency Transfer Request

Table 138: Frequency Transfer Request Message Definition

MID (Hex)	0x49
MID (Dec)	73
Message Name in Code	MID_AIDING_REQ
SID (Hex)	0x03
SID (Dec)	3
SID Name in Code	FREQ_TX_REQ

Table 139: Frequency Transfer Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
FREQ_REQ_INFO	1		

FREQ_REQ_INFO Information field about frequency request

The SLC shall set this field according to the table below.

Table 140: "FREQ_REQ_INFO" field Description

Bits in FREQ_REQ_INFO	Value	Description
Bit 1(LSB)	"0": single request "1": multiple request	If "single request", only one response message is requested. Bit 2 is ignored If "multiple request", multiples responses are requested. Depending on Bit 2, this mode shall be turned ON or OFF
Bit 2	'1': "ON" "0":"OFF"	Valid only if Bit 1 is "1": If "ON", periodic "Frequency Transfer Response" mode is turned ON If "OFF", periodic "Frequency Transfer Response" mode is stopped
Bit 3	'0': don't turn off '1': turn off	'0' = Don't turn off reference clock '1' = Turn off reference clock
Bit 4 to 8	'0'	Reserved

6.14 Approximate MS Position Request

Table 141: Approximate MS Position Request Message Definition

MID (Hex)	0x49
MID (Dec)	73
Message Name in Code	MID_AIDING_REQ
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	APPROX_MS_POS_REQ

Request approximate MS position.

Table 142: Approximate MS Position Request message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		

6.15 Time_Frequency_Approximate_Position Status Response

Table 143: Time_Frequency_Approximate_Position Status Response Message Definition

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x04
SID (Dec)	4
SID Name in Code	TIME_FREQ_APPROX_POS_RESP

The "Time_Frequency_Approximate_Position Status Response" message is output in response to "Time_Frequency_Approximate_Position Status Request" message. Each time a "Time_Frequency_Approximate_Position Status Request" message is received, a "Time_Frequency_Approximate_Position Status Response" message or a "Reject" message should be sent.

Table 144: Time_Frequency_Approximate_Position Status Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
STATUS_RESP_MASK	1		
GPS_WEEK	2		
GPS_TOW	4		
STATUS_TIME_ACC_SCALE	1		
STATUS_TIME_ACCURACY	1		
STATUS_FREQ_ACC_SCALE	1		
STATUS_FREQ_ACCURACY	1		
STATUS_SCALED_FREQ_OFFSET	2		
STATUS_FREQ_TIME_TAG	4		
SLC_HOR_UNC	4		
SLC_VER_UNC	2		
SPARE	8		

STATUS_RESP_MASK status response mask

When Bit 0 (LSB) of this mask is set to 1, GPS_WEEK is valid; 0 otherwise.
When Bit 1 of this mask is set to 1, GPS_TOW is valid; 0 otherwise.
When Bit 2 of this mask is set to 1, STATUS_TIME_ACC_SCALE and STATUS_TIME_ACCURARY are valid; 0 otherwise.
When Bit 3 of this mask is set to 1, STATUS_FREQ_ACC_SCALE and STATUS_FREQ_ACCURARY are valid; 0 otherwise.
When Bit 4 of this mask is set to 1, SLC_HOR_UNC is valid; 0 otherwise.
When Bit 5 of this mask is set to 1, SLC_VER_UNC is valid; 0 otherwise.

GPS_WEEK extended GPS week

This is the internal extended GPS week number.

GPS_TOW

This is the internal GPS_TOW time of the receiver, rounded to the nearest second.

STATUS_TIME_ACC_SCALE scale factor for the time accuracy status

This represents the scale factor used to encode the internal time accuracy of the receiver.
STATUS_TIME_ACC_SCALE =0 => time_scale = 1.0
STATUS_TIME_ACC_SCALE=1 => time_scale = 0.125
STATUS_TIME_ACC_SCALE=0xFF => internal time accuracy unknown
All other values are reserved.

STATUS_TIME_ACCURACY time accuracy status

This is the internal time accuracy of the receiver.
If time_scale (obtained from STATUS_TIME_ACC_SCALE) is 1.0, Table 43 shall be used to get the time accuracy.
If time_scale (obtained from STATUS_TIME_ACC_SCALE) is 0.125, Table 43 shall be used to get the time accuracy.
A value of 0xFF means "unknown accuracy"

STATUS_FREQ_ACC_SCALE scale factor of the frequency accuracy

This represents the scale factor used to encode the internal frequency accuracy of the receiver.
STATUS_FREQ_ACC_SCALE =0 => frequency_scale = 0.00390625
STATUS_FREQ_ACC_SCALE=0xFF => internal frequency accuracy unknown
All other values are reserved.

STATUS_FREQ_ACCURACY frequency accuracy status

This is the internal frequency accuracy of the receiver.
If frequency_scale (obtained from STATUS_FREQ_ACC_SCALE) is 0.00390625, Table 40 shall be used to get the frequency accuracy.
A value of 0xFF means "unknown accuracy"

STATUS_SCALED_FREQ_OFFSET Scaled frequency offset

This parameter to the scaled frequency offset as measured by the receiver. The interpretation of this parameter is the same as SCALED_FREQ_OFFSET in Section 5.24.

STATUS_FREQ_TIME_TAG Time tag of the frequency status

This field shall be set to the time when the frequency status measurement is taken. The unit and encoding of this parameter is the same as TIME_TAG used in Section 5.24.

SLC_HOR_UNC
This field shall be set to the estimated horizontal uncertainty of the internal approximate position. The unit is 1 meter. A value of 0xFFFFFFFF means "unknown".

SLC_VER_UNC
This field shall be set to the estimated vertical uncertainty of the internal approximate MS location. The error shall correspond to the standard deviation of the error in MS altitude in units of 0.1 meters in the range of 0 meters to 6553.5 meters, in Unsigned Binary Offset coding. The formula to apply is:

EST_VER_ER (in m)= Vx0.1

where V is the unsigned binary value of the "EST_VER_ER" field from 0 to 65534.
0x0000 represents 0m, 0xFFFF represents "unknown".

6.16 ACK/NACK for Push Aiding Availability

Removed. There is no need for a separate ACK/NACK for this message. No additional information was proposed here from the ACK/NACK message in section 6.4.

6.17 Reject

Table 145: Reject Message Definition

MID (Hex)	0x4B
MID (Dec)	75
Message Name in Code	MID_MSG_ACK_OUT
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	REJECT

Table 146: Reject message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
REJ_MESS_ID	1		
REJ_MESS_SUB_ID	1		
REJ_REASON	1		

REJ_MESS_ID Message ID of Rejected Message

REJ_MESS_ID Message Sub ID of Rejected Message

REJ_REASON Reject Reason
The answering entity shall set this field to the reason of the reject according to the table below.

Table 147: "REJ_REASON" field Description

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

6.18 Software Version Response

Table 148: Software Version Response Message Definition

MID (Hex)	0x06
MID (Dec)	6
Message Name in Code	MID_SWVersion

Using pre-existing SSB message (MID 6). This message will need to be modified to include the SiRF customer fields as indicated below. The "AI3" format of this message was chosen to exist versus the existing response to poll message since it was a superset of customer and SiRF version IDs whereas the existing SSB message 6 was only SiRF version IDs.

The "Software Version Response" message is output in response to "Software Version Request" message. Each time a "Software Version Request" message is received, a "Software Version Response" message or a "Reject" message should be sent.

Table 149: Software Version Response message

Field	Bytes	Scale	Unit
Message ID	1		
SIRF_VERSION_ID	[0…80] (variable)		
LENGTH_SIRF_VERSION_ID	1		
LENGTH_CUSTOMER_VERSION_ID	1		
CUSTOMER_VERSION_ID	[0…80] (variable)		

SIRF_VERSION_ID SiRF Software Version ID
This field shall be set to the SiRF Software version ID. The ASCII representation of the character string, with the null terminator at the end, will be used. The number of characters (including the null terminator) should equal that set by "LENGTH_SIRF_VERSION_ID". For instance, the software version ID string denoted by A would be represented as "0100 0001 0000 0000" (including the null terminator)

LENGTH_SIRF_VERSION_ID Number of characters in SiRF Version ID
This field shall be set to the length equal to the number of characters in the SIRF_VERSION_ID (including the null terminator). The range shall be from 0 to 80. Any other value has no meaning. For instance, if the SIRF_VERSION_ID is the character string A, then including the null terminator this is 2 bytes long, and hence this field would be represented by "0000 0010" in binary.

LENGTH_CUSTOMER_VERSION_ID Number of characters in Customer Version ID
This field shall be set to the length equal to the number of characters in the CUSTOMER_VERSION_ID (including the null terminator). The range shall be from 0 to 80. Any other value has no meaning. For instance, if the CUSTOMER_VERSION_ID is the character string A, then including the null terminator this is 2 bytes long, and hence this field would be represented by "0000 0010" in binary.

SIRF_VERSION_ID SiRF Software Version ID
This field shall be set to the SiRF Software version ID. The ASCII representation of the character string, with the null terminator at the end, will be used. The number of characters (including the null terminator) should equal that set by "LENGTH_SIRF_VERSION_ID". For instance, the software version ID string denoted by A would be represented as "0100 0001 0000 0000" (including the null terminator)

CUSTOMER_VERSION_ID Customer Software Version ID
This field shall be set to the Customer Software version ID. The ASCII representation of the character string, with the null terminator at the end, will be used. The number of characters (including the null terminator) should equal that set by "LENGTH_CUSTOMER_VERSION_ID". For instance, the software version ID string denoted by A would be represented as "0100 0001 0000 0000" (including the null terminator)

6.19 Serial Port Settings Response

Table 150: Serial Port Settings Response

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x08
SID (Dec)	8
SID Name in Code	SERIAL_SETTINGS_RESP

The "Serial Port Settings Response" message is output in response to "Serial Port Settings Request" message. Each time a "Serial Port Settings Request" message is received, a "Serial Port Settings Response" message or a "Reject" message should be sent.

Table 151: Serial Port Settings Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
PORT	1		
BAUD_RATE	4		
ACK_NUMBER	1		

PORT Serial Port A or B

This field shall be set to the port number that has been configured. "0" represents the port A and "1" represents the port B. Any other value has no meaning.

BAUD_RATE Baud Rate

This field shall be set to the desired baud rate. The current baud rates that are supported are 4800, 9600, 19200, 38400, 57600, and 115200. Any other value is illegal and is not supported. The Baud rate shall be coded as its equivalent binary value.

Example 1: "4800 bps" shall be coded as "000012C0" in hexadecimal equivalent.

Example 2: "115200bps" shall be coded "0001C200" in hexadecimal equivalent.

ACK_NUMBER Acknowledge Number

This field can take 2 values only, "1" and "2". In the serial port settings protocol, two acknowledgements shall be sent, one at the old baud rate ("1"), and the second one at the new baud rate ("2"). This field allows to distinguish between both acknowledges.

6.20 Channel Load Response

Table 152: Channel Load Response

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x05
SID (Dec)	5
SID Name in Code	CH_LOAD_RESP

The "Channel Load Response" message is output in response to "Channel Load Request" message. Each time a "Channel Load Request" message is received, a "Channel Load Response" message, multiple "Channel Load Response" messages, a "Reject" message, or no message should be sent. The "Channel Load Response" messages will be reported at a rate depending on the value of the "MODE" field in the "Channel Load Request" message. The reported values shall be calculated as the average during one entire second preceding the message transmission. They will represent a percentage of the total theoretical limit of the port at the current baud rate.

Table 153: Channel Load Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
PORT	1		
TOTAL_LOAD	1		
NUMBER_OF_CHANNELS	1		
The following two fields should be repeated for "NUMBER_OF_CHANNELS" times			
CHANNEL_LOAD	1		

PORT Serial Port A or B

This field shall be set to the port number for which the load information has been requested. "0" represents the SiRF port A and "1" represents SiRF port B. Any other value has no meaning.

TOTAL_LOAD Total Load of the Port

This field shall be set to the percentage of the total port bandwidth of the currently opened channels. The value will range from 0 to 100.

NUMBER_OF_CHANNELS The number of channels with data in message

This field shall be set to the number of logical channels that have load data in the response message. All currently opened channels shall be reported.

CHANNEL_LOAD Total Load of the logical channel

This field shall be set to the load that the logical channel is using. The value will range from 0 to 100.

6.21 Tx Blanking Response

Table 154: Tx Blanking Response Message Definition

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x09
SID (Dec)	9
SID Name in Code	TX_BLANKING_RESP

The "Tx Blanking Response" message is output in response to "Tx Blanking Request" message. Each time a "Tx Blanking Request" message is received, a "Tx Blanking Response" message should be sent.

Table 155: Tx Blanking Response message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
ACK_NACK	1		
Reserved	1		

ACK_NACK Acknowledge or Non-Acknowledge

The value "0" represents ACK, and the value "1" represents NACK. NACK shall be sent if the requested Tx Blanking mode is not supported.

6.22 Test Mode Configuration Response

This message already exists from SSB and is being kept as is. Since it is a previously existing message and is untouched by the conversion of SSB->OSP, it is not documented in this manual. Details of MID and SID are mentioned here for reference.

Table 156: Existing Test Mode Config Response MID and SID

MID (hex)	MID (dec)	MID Name	SID (hex)	SID (dec)	SID Name
0x38	56	SSB_EE	0xFF	255	SSB_EE_ACK

Message details can be found in this document:
http://sirfcentral/sites/devops/SiRFLocServerAndLocationServicesPlatformDevelopment/Project%20SysEng/EASGEE_CLM_GPS_TOO_draft.doc

6.23 OSP Revision Response

Table 157: OSP Revision Response Message Definition

MID (Hex)	0x46
MID (Dec)	70
Message Name in Code	MID_STATUS_RESP
SID (Hex)	0x07
SID (Dec)	7
SID Name in Code	OSP_REV_RESP

Table 158: OSP Revision Response message

Field	Bytes	Scale Factor	Unit
Message ID	1		
Message Sub ID	1		
OSP Revision	1	* 10	unitless

The OSP Revision field has a valid range of 1.0 – 25.5. Since there is one byte allotted, the value in this field should be divided by 10 to get the revision number (ex. A value of 10 in this field translates to OSP rev 1.0).

6.24 Nav Bit Aiding (NBA) Request Message

Table 159: Nav Bit Aiding (NBA) Request Message Definition

MID (Hex)	0x49
MID (Dec)	73
Message Name in Code	MID_AIDING_REQ
SID (Hex)	0x04
SID (Dec)	4
SID Name in Code	NBA_REQ

This message is requesting the Nav Bit Aiding Response Messages (215 (MID_AIDING_RESP), 4 (SET_NBA_SF1_2_3)) and/or (215, (MID_AIDING_RESP), 5, (SET_NBA_SF4_5)), depending on the value of the NAVBIT_REQ_FLAG bit settings in the parameter block below. The message contains a SECTION_VALIDITY_FLAG field followed by request sections. Each request section has a "SECTION_SIZE" as the first byte to indicate the number of bytes in the associated section. The existence of "SECTION_SIZE", and proper handling of this field by SLC and CP supports forward compatibility.

Table 160: Nav Bit Aiding Request Fields

Field		Length (bits)	Description
SECTION_VALIDITY_FLAG		16	Bit0 • 0 = NAVBIT section is NOT valid • 1 = NAVBIT section is valid
NAVBIT SECTION	SECTION_SIZE	8	The size of this section in bytes, including "SECTION_SIZE" field. For this release, SECTION_SIZE should be set to 6.
	SAT_MASK_NAVBIT	32	This is a bitmap representing the satellites for which subframe 1, 2, and 3 NavBit aiding is requested . If SLC requests such NAV bit aiding for the satellite represented by a bit of this field, SLC shall set that bit to '1'. The LSB (Bit 0) of this field represents satellite PRN number 1. The MSB (Bit 31) of this field represents satellite PRN 32.
	NAVBIT_REQ_FLAG	8	Bit 0: • 0 => Subframe 1, 2, and 3 are NOT requested • 1 => Subframe 1, 2, and 3 are requested Bit 1: • 0 => Subframe 4 and 5 are NOT requested • 1 => Subframe 4 and 5 are requested Bit 2 – 7: Reserved

6.25 Hardware Control Output

This message ID is reserved for future hardware control features, including VCTCXO and on/off signal configuration. Although two SIDs are specified in the master MID list, they are only placeholders to show which features would use this MID and there can be additions/subtractions to the

Table 161: Hardware Control Output Message Definition

MID (Hex)	0x5B
MID (Dec)	91
Message Name in Code	MID_HW_CTRL_OUT
SID (Hex)	TBD
SID (Dec)	TBD
SID Name in Code	TBD

Table 162: Hardware Control Output message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
Message details TBD			

6.26 DOP

6.27 Values Output

This message provides all DOP information: GDOP, PDOP, HDOP, VDOP, and TDOP. This message is sent at 1 Hz rate. The DOP values validity is determined by the "DOP limit Exceeded" flag in the SSB_GEODETIC_NAVIGATION message. A value of 50 is used for any DOP of value 50 or more, and for invalid values.

Table 163: DOP Value Output Message Definition

MID (Hex)	0x42
MID (Dec)	66
Message Name in Code	SSB_DOP_VALUES

Table 164: DOP Value Output Fields

Field	Bytes	Scale	Unit	Data range (after de-scaling)	Description
Message ID	1				
gps_tow	4	0.001	sec	0 to 604799.999	GPS time of the week
gdop	2	0.1		0 to 50	Geometric DOP
pdop	2	0.1		0 to 50	Position DOP
hdop	2	0.1		0 to 50	Horizontal DOP
vdop	2	0.1		0 to 50	Vertical DOP
tdop	2	0.1		0 to 50	Time DOP

6.28 CW Controller Output

6.28.1 CW Interference Report

CW Interference message reports the presence of at most 8 interferences detected as a result of the most recent CW scan or monitor.

Table 165: CW Interference Report Message Definition

MID (Hex)	0x5C
MID (Dec)	92
Message Name in Code	MID_CW_OUTPUT
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	CW_DATA

Table 166: CW Interference Report Field Definitions

Field	Bytes	Unit	Scale	Description
Message ID	U1			Message ID (0x5C)
Sub ID	U1			Sub ID (0x01)
Frequency 0	U4	Hz		Frequency of peak 0
…				Repeat for each peak
Frequency 7	U4	Hz		Frequency of peak 7
C/No 0	U2	dB-Hz	0.01	Signal to Noise of peak 0
…				Repeat for each peak
C/No 7	U2	dB-Hz	0.01	Signal to Noise of peak 7

6.28.2 CW Mitigation Report

CW Mitigation message reports filtering employed to mitigate the effects of the interference.

Table 167: CW Mitigation Report Message Definition

MID (Hex)	0x5C
MID (Dec)	92
Message Name in Code	MID_CW_OUTPUT
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	CW_FILTER

Table 168: CW Mitigation Report Field Definitions

Field	Bytes	Unit	Description
Message ID	U1		Message ID (0x5C)
Sub ID	U1		Sub ID (0x02)
Sampling Mode	U1		Enumeration of sampling modes: 0: Use complex $8f_{0,}$ no filter 1: Use complex $2f_{0,}$ no filter 2: Use 2MHz filter 3: Use OFFT filter
A/D Mode	U1		Enumeration of A/D modes: 0: Use 2-bit A/D 1: Use 4-bit A/D
Center freq bin of freq 0	S1		Center frequency bin of the frequency 0. Range: -128 to 127 When the number of bins field (below) is 0, this field will be 0.
Number of bins for freq 0	U1		Number of bins excised on one side of the center frequency bin. Total number of bins excised = 2 x this number + 1. 0: no bin excised
…			Repeat these two fields above for each frequency.
Center freq bin of freq 7	S1		Center frequency bin of the frequency 7. Range: -128 to 127 When the number of bins field (below) is 0, this field will be 0.
Number of bins for freq 7	U1		Number of bins excised on one side of the center frequency bin. Total number of bins excised = 2 x this number + 1. 0: no bin excised

6.29 Power Mode Response

This message is output in response to the MID_PWR_MODE_REQ message. This response echoes back the low power mode which was set and it acknowledges either the completion of the transition to the requested power mode or the failure of the transition by remaining in the original power mode from where the MID_PWR_MODE_REQ request was issued.

Table 169: Power Mode Response Message Definition

MID (Hex)	0x5A
MID (Dec)	90
Message Name in Code	MID_PWR_MODE_RESP
SID (Hex)	Listed below
SID (Dec)	Listed below
SID Name in Code	Listed below

Table 170: SIDs for Power Mode Response message

0x00	0	FP_MODE_RESP
0x01	1	APM_RESP
0x02	2	MPM_RESP
0x03	3	ATP_RESP
0x04	4	PTF_RESP

The SID value is equal to the SID value in the requesting MID_PWR_MODE_REQ message in this response, wether the transition to this requested new mode was successful or not.

Table 171 Power Mode Response Message Fields

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
ERROR_CODE	1		

Table 172 Power Mode Response Error Code Values

Value	Condition
0x00	No error, requested transition performed successfully
0x01	Specified mode is same as current, no transition occurred
0x02	Specified power mode is not supported in current product
0x03	Unmet preconditions when transitioning to requested mode
0xXY	Invalid ATP_REQ, resulting TBF is too low, not supported
0xXZ	Tranzition to ATP suspended sequence of POS_RESP messages with conflicting QoP
0xXW	Tranzition to PTF suspended sequence of POS_RESP messages with conflicting QoP
0xXN	Tranzition to APM overriding a conflicting QoP specified in a POS_REQ being served
0x04-0xFF	Reserved

6.30 Query Response

This message is in response to the QUERY REQUEST message.

Table 173: Query Response Message Definition

MID (Hex)	0x51
MID (Dec)	81
Message Name in Code	MID_QUERY_RESP

Field	Bytes	Scale	Unit
Message ID	1		
QUERY_MID	1		
QUERY_SID	1		
ECHO_LENGTH	1		
MSG_ECHO	Variable		

QUERY_MID Message ID for query
Specifies which mode/setting is being queried. If the MID/SID combination sent

QUERY_SID Sub ID for query
If a particular query requires that a SID be specified, it is in this field. Not all queries require a SID to be specified and therefore if a MID is sent where the SID does not matter, this field is ignored.

ECHO_LENGTH Number of bytes in the QUERY_ECHO field.

QUERY_ECHO Echo of the MID and SID specified for the query.
Sends back the current settings as known by the client in the message format specified by the MID/SID.

Query support is available only for the following MID/SIDs:

Table 174: Query Response Supported Messages

QUERY_MID	QUERY_SID	Description
218	Ignored	Determine if we are in a low power mode or full power.

NOTE! For the response to be sent to the receiver, it must be awake. Any QUERY_REPSONSE messages sent while the receiver is in standby or hibernate will not be responded to. In this way, receiving a QUERY RESPONSE message indicates here that the receiver is not in a standby or hibernate low power mode.

6.31 Low Power Mode Output

This message currently only has one SID defined, though the intent is to have more output messages while in low power (LP) modes put under this MID in the future.

Micro Power Mode Error

This message is only output if there is a problem with going into or maintaining Micro Power Mode (MPM).

Table 175: Low Power Mode Output Message Definition

MID (Hex)	0x4D
MID (Dec)	77
Message Name in Code	MID_LP_OUTPUT
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	MPM_ERR

Table 176: MPM Power Mode Error Message

Field	Bytes	Scale	Unit
Message ID	1		
Message Sub ID	1		
ERR_REASON	1		
Reserved	4		

ERR_REASON Reason for exiting MPM mode

The exact details are TBD for this message but this byte will be a bit field which points to the reason MPM did not operate as anticipated. More input is needed from Kevin Powell, but these error conditions will include the following:

1) Error exceeds preset threshold values
2) No navigation

Reserved Reserved for future use/definition

6.32 Clock Modeling Output

6.32.1 TCXO Learning Output Request

Table 177: TCXO Learning Output

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	See below
SID (Dec)	See below
SID Name in Code	See below

Table 178: TCXO Learning Output SID Descriptions

Bit Field	Description	Inclusion
0x00	Not Used	
0x01	Clock model data base output	In all builds
0x02	Temperature table output	In all builds
0x03	Not Used	
0x04	Temp Recorder output	In Xo Test Builds Only
0x05	EARC output	In Xo Test Builds Only
0x06	RTC alarm output	In Xo Test Builds Only
0x07	RTC calibration output	In Xo Test Builds Only
0x08	Not Used	
0x09	MPM searches output	In Xo Test Builds Only
0x0A	MPM prepos output	In Xo Test Builds Only
0x0B	Micro Nav measurements output	In Xo Test Builds Only
0x0C	TCXO Uncertainty output	In Xo Test Builds Only
0x0D	System time stamps output	In Xo Test Builds Only

Messages marked as "Xo Test Builds Only" in the above table are missing in standard builds for products to be shipped to customers. These messages are present in special test builds only made for the purpose of testing the TCXO features.

6.32.2 TCXO Learning Clock Model Data Base

Table 179: Clock Model Data Base Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	CLOCK_MODEL_DATA_BASE_OUT

Table 180: Clock Model Data Base Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					1	Clock model data base output
Source	U1						Bit mask indicating source of the clock model. 0x0 = NOT_SET 0x1 = ROM 0x2 = DEFAULTS 0x4 = MFG 0x8 = TEST_MODE 0x10 = FIRST_NAV
Aging Rate Uncertainty	U1			Ppm /year	0.1	10	Aging rate of uncertainty
Initial offset Uncertainty	U1			ppm	0.1	10	Initial Frequency offset of the TCXO
spare	U1						
Clock Drift	S4			ppb	1	60105	Clock drift
Temp Uncertainty	U2			ppm	0.01	50	Temperature uncertainty
Manufacturing Week number	U2			GPS Week #	1	1465	TCXO Manufacturing week number in full GPS weeks
Spare	U4						

6.32.3 TCXO Learning Temperature Table

Table 181: Temperature Table Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	TEMPERATURE_TABLE

Table 182: Temperature Table Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	1					93	TCXO Learning Output
Sub ID	1					2	Temperature table output
Spare1	U4						
Offset	S2			ppb	1	-331	Frequency offset bias of the table from the CD default
Global Min	S2			ppb	1	-205	Minimum XO error observed
Global Max	S2			ppb	1	442	Maximum XO error observed
First Week	U2			GPS Week #	1	1480	Full GPS week of the first table update
Last Week	U2			GPS Week #	1	1506	Full GPS week of the last table update
LSB	U2			Ppb	1	4	Array LSB Scaling of Min[] and Max[]
Aging Bin	U1				1	37	Bin of last update
Aging Up Count	S1				1	4	Aging up / down count accumulator
Bin Count	U1						Count of bins filled
Spare2	U1						
Min []	1 * 64			Ppb * LSB			Min XO error at each temp scaled by LSB
Max[]	1 * 64			Ppb * LSB			Max XO error at each temp scaled by LSB

6.32.4 TCXO Learning Temperature Recorder

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 183: Temperature Recorder Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x04
SID (Dec)	4
SID Name in Code	TEMP_RECORDER_MESSAGE

Table 184: Temperature Recorder Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					4	Temp Recorder output
Current Time Count	U4			ms			Time since power on
RTC 1 sec time tag	U2			sec			RTC One Second Time of the TR value
TR value	U1			C	140/ 256 – 40C		Temperature Recorder value
N Count	U1						TR Queue rec count
Total Count	U1						TR Queue total count
Status	U1						Bit 1: 0 = New TRec readings will update Temperature Table 1 = Ignore updates to the Temperature Table
Seq number	U2						Sequence number counter. Set to 0 at startup, incremented for each output and rollover on overflow

6.32.5 TCXO Learning EARC

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 185: EARC Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x05
SID (Dec)	5
SID Name in Code	EARC

Table 186: EARC Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					5	EARC output
Current Time Count	U4			ms			Time since power on
Acqclk lsw	U4						EARC latched time
RTC Wclk Secs	U4						EARC latched RTC Wclk Secs
RTC Wclk Counter	U2			ms			EARC latched RTC Wclk Counter
EARC r0	U2						EARC r0
EARC r1	U2						EARC r1
spare	U2						

6.32.6 TCXO Learning RTC Alarm

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 187: RTC Alarm Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x06
SID (Dec)	6
SID Name in Code	RTC_ALARM

Table 188: RTC Alarm Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					6	RTC alarm output
Current Time Count	U4			ms			Time since power on
Acq Clock LSW	U4						Latched Acq clock least significant word
RTC Wclk Secs	U4						Latched RTC Wclk Secs
RTC Wclk Counter	U2						Latched RTC Wclk counter
spare	U2						

6.32.7 TCXO Learning RTC Cal

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 189: RTC Cal Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x07
SID (Dec)	7
SID Name in Code	RTC_CAL

Table 190: RTC Cal Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					7	RTC calibration output
Current Time Count	U4			ms			Time since power on
ACQ Clock LSW	U4			ns	60.99 ns		ACQ Clock LSW in 60.99 ns resolution
GPS Time Int	U4						Integer part of GPS Time
GPS Time Frac	U4			ns			Fractional part of GPS Time
RTC WClk Sec	U4			sec			RTC WClk Seconds
RTC WClk Ctr	U2			sec	1/ 32768		Rtc Wclk counter
RTC Freq Unc	U2			ppb	1e-3		RTC Freq Unc
RTC / Acq Drift Int	U4						Integer part of RTC Drift
RTC Drift Frac	U4						Fractional part of RTC Drift
RTC Time Unc	U4			sec	1e-6		RTC Time Unc
RTC / GPS Drift	I4			Hz	1/L1		RTC / GPS Drift
Xo Freq Offset	U4			Hz	1/L1		XO Frequency offset
GPS Week	U2						GPS Week
Spare	U2						

6.32.8 TCXO Learning TBD (Not Used)

Table 191: Not Used

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x08
SID (Dec)	8
SID Name in Code	Not Used

6.32.9 TCXO Learning MPM Searches

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 192: MPM Searches Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x09
SID (Dec)	9
SID Name in Code	MPM_SEARCHES

Table 193: MPM Searches Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					9	MPM searches output
Number of records	U1						Number of records
Spare1	U1						
Spare2	U2						
Current Time Count	U4			ms			Time since power on
Acqclk lsw	U4						
							following fields are based on number of records
Code Phase record [num]	U4						Code phase
Doppler [num]	I4						Frequency
Code Offset	U4						
Peak Mag	U4			dB-Hz			Peak Magnitude
Status[num]	U2						

		Binary (Hex)			ASCII (Dec)		
SVID [num]	U1						SVID searched
Spare [num]	U1						

6.32.10 TCXO Learning MPM Pre-Positioning

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 194: MPM Pre-positioning Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x0A
SID (Dec)	10
SID Name in Code	MPM_PREPOS

Table 195: MPM Pre-positioning Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					10	MPM prepos output
Number of records	U1						Number of records
Spare1	U1						
Spare2	U2						
Current Time Count	U4			ms			Time since power on
Acqclk lsw	U4						acqclk, lsw
							following fields are based on number of records
Pseudo Range [num]	U4			m			Pseudo Range of the SVID
Pseudo Range Rate [num]	U2			m/s			Pseudo Range Rate of the SVID
SVID [num]	U1						SVIDs searched in MPM search list
Spare [num]	U1						

6.32.11 TCXO Learning Micro-Nav Measurement

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 196: Micro-Nav Measurement Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x0B
SID (Dec)	11
SID Name in Code	MICRO_NAV_MEASUREMENT

Table 197: Micro-Nav Measurement Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					11	Micro Nav measurements output
Number of measurements	U1						Number of measurements in the message
Mode	U1						Operational mode
Spare	U2						
Current Time Count	U4			ms			Time since power on
Acqclk lsw	U4						acqclk, lsw
Time Corr	S4			ms	1e6		Time Correction
Time Corr Unc	U4			ms	1e6		Time Correction Uncertainty
Freq Corr	S2				1575.42 MHz		TCXO Oscillator Frequency Correction; Scale by L1
Freq Corr Unc	U2				1575.42 MHz		TCXO Oscillator Frequency Correction Uncertainty; Scale by L1
							following fields are based on number of measurements
Pseudo Range[num]	U4			m	10		PR
Pseudo Range Rate [num]	S2			m/s			PRR
C/No [num]	U2				10		C/No
SVID [num]	U1						SVID
Spare1[num]	U1						
Spare	U1						

6.32.12 TCXO Learning TCXO Uncertainty

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 198: TCXO Uncertainty Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x0C
SID (Dec)	12
SID Name in Code	TCXO_UNCERTAINTY

Table 199: TCXO Uncertainty Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					12	TCXO Uncertainty
Current Time Count	U4			Ms			Time since power on
Acqclk.lsw	U4						Acqclk.lsw
Frequency	U4			Hz			Clock Drift Frequency
Frequency Uncertainty Nominal	U2			ppb			Nominal Frequency uncertainty = A + T + M
Frequency Uncertainty Full	U2			Ppb			Full Frequency Uncertainty = A + T + M
Temperature Uncertainty Nominal	U2			Ppb			Temperature (T) uncertainty component, nominal
Temperature Uncertainty Full	U2			Ppb			Temperature (T) uncertainty component, full
Aging Uncertainty Nominal	U2			Ppb			Aging (A) uncertainty component, nominal
Measurement Uncertainty Nominal	U2			ppb			Measurement (M) uncertainty component, nominal
Measurement Uncertainty Full	U2			ppb			Measurement (M) uncertainty component, full
GPS Week #	U2			GPS Week #			Current GPS Week number of the uncertainty data
Temperature	U1			Deg C	140/ 256		Raw temperature in 0.549 degrees resolution

					- 40		
Spare	U1						
Spare	U4						

6.32.13 TCXO Learning System Time Stamp

This message is missing in standard builds for products to be shipped to customers, and present in special test builds only made for the purpose of testing the TCXO features.

Table 200: System Time Stamp Message Definition

Message Name	TCXO_LEARNING
Input or Output	Output
MID (Hex)	5D
MID (Dec)	93
Message Name in Code	MID_TCXO_LEARNING_OUT
SID (Hex)	0x0D
SID (Dec)	13
SID Name in Code	SYSTEM_TIME_STAMP

Table 201: System Time Stamp Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1					93	TCXO Learning Output
Sub ID	U1					13	System time stamps
Current Time Count	U4			Ms			Time since power on
ACQ Clk msw	U4			ns			Acq Clock Msw
ACQ Clk lsw	U4			ns			Acq Clock Lsw
TOW Int	U4			Sec			Integer part of TOW
TOW Frac Ns	U4			Nsec			Fractional part of TOW
RTC Seconds	U4			sec	1		RTC Seconds
RTC Counter	U2			us	1/ 32768		RTC Counter Value
Clock Bias	I4						Clock Bias, m
Clock Drift	I4						Clock Drift, m/s
Spare	U2						

6.33 SGEE Download Output

These functions are needed to respond to messages requesting download the SGEE data into the SLC Flash and to get the SGEE and EE age from the SLC.

These SGEE file download input messages used message id 232 (MID_EE_INPUT) and the output responses here have message id 56 ((SSB_EE). Different sub- message ids are used to perform different actions.

The table below shows the message IDs assigned to the output messages.

Table 202: SGEE Download Output

MID (Hex)	0x38
MID (Dec)	56
Message Name in Code	SSB_EE
SID (Hex)	As below
SID (Dec)	As below
SID Name in Code	As below

Table 203 : Output Messages Sub- IDs.

SNo.	Sub-Message ID	Message Name
1.	0x20	ECLM Ack/Nack
2.	0x21	ECLM EE Age
3.	0x22	ECLM SGEE Age

SID 0x20 (32) ECLM Ack / Nack

This is the response message to the Input Message ID 232, SubMsgID's 22, 23 , 24, 25 or 26.

. Table 204: ECLM Start Download Ack/Nack Message Field Definition

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		0x38		Decimal 56: SSB_EE
Sub Message ID	1U		0x20		ECLM Ack/Nack
Ack Msg Id	1U		0xE8		Ack Message Id 232
Ack Sub Id	1U		0x16		Ack Sub Id, ECLM Start Download 0x16
Ack/Nack	1U		00		0 = Ack
Ack Nack Reason	1U		00		**ECLM_SUCCESS** = 0, ECLM_SPACE_UNAVILABLE = 1 ECLM_PKT_LEN_INVALID = 2, ECLM_PKT_OUT_OF_SEQ = 3, ECLM_DOWNLOAD_SGEE_NONE WFILE = 4, ECLM_DOWNLOAD_CORRUPTFIL E_ERROR = 5, ECLM_DOWNLOAD_GENERIC_FAI

					LURE = 6, ECLM_API_GENERIC_FAILURE = 7

Payload length: 6 bytes

SID 0x21 (33) ECLM EE Age

This is the response message to the Input Message "ECLM Get EE Age" with Message ID 56, SubMsgID 25.

Table 205: Output ECLM Get EE Age Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		0x38		Decimal 56
Sub Message ID	1U		0x21		Response to ECLM Get EE Age
numSAT ID	U1		01		This field indicates the number of times following fields are present in the message
prnNum;	U1		02		PRN number of satellite for which age is indicated in other fields.
ephPosFlag	U1		02		Ephemeris flag to indicate the type of ephemeris available for the satellite:(Position Age) 0: Invalid ephemeris, not available, 1: BE, 2: SGEE, 3: CGEE
eePosAge	U2		00 00		Age of EE in 0.01 days (Position Age)
cgeePosGPS Week	U2		00 00		GPS week of BE used in the CGEE generation; 0 if ephPosFlag is not set to 3 or set to 0.(Position Age)
cgeePosTOE	U2		00 00		TOE of BE used in the CGEE generation; 0 if ephPosFlag is not set to 3.or set to 0 (Position Age)
ephClkFlag	U1		02		Ephemeris flag to indicate the type of ephemeris available for the satellite:(Clock Age)
eeClkAge	U2		00 00		Age of EE in 0.01 days(Clock Age)
cgeeClkGPS Week	U2		00 00		GPS week of BE used in the CGEE generation; 0 if ephClkFlag is not set to 3 or set to 0.(Clock Age)
cgeeClkTOE	U2		00 00		TOE of BE used in the CGEE generation; 0 if ephClkFlag is not set to 3.or set to 0(Clock Age)

Payload length: 19 bytes

SID 0x22 (34) ECLM SGEE Age

This is the response message to the Input Message "ECLM Get SGEE Age" with Message ID 232, SubMsgID 26

SGEE Age and Prediction Interval has 32 bit length.

Table 206: Output ECLM Get SGEE Age Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		0x38		Decimal 56
Sub Message ID	1U		0x22		Response to ECLM Get SGEE Age
SGEE Age	4U		00 00 80 ea		Age of the Satellite
Prediction Interval	4U		00 01 51 80		Prediction Interval

Payload length: 10 bytes

6.34 SW Toolbox Output

(Remember, Output means Host to User System.) These messages allow the User System to access Tracker features via the Host. The Host will essentially map the MEI responses from the Tracker to SSB responses for the User System. The mapping is required since a direct pass-through is not always allowed. Some Tracker responses will require a corresponding change to the Host (for example, a change to the Tracker baud rate will necessitate a change at the Host or communication will be lost).

MID (Hex)	0xB2
MID (Dec)	178
Message Name in Code	MID_TrackerIC (see PROTOCOL.H)
SID (Hex)	As below
SID (Dec)	As below
SID Name in Code	As below

SID 0x04 (4) SID_PeekPoke_Response

Tracker Peek Response (four-byte peek) (unsolicited)

Upon reception of the MEI 0xA0 (Peek Response) from the Tracker, the Host will generate this response for the User System.

Table 207: Tracker Peek Response (four-byte peek) (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x04
Type	1	enumeration 0 = Peek results 10 = eFUSE peek results (4e and beyond only)
Address	4	unsigned integer
Data	4	always four bytes

Tracker Poke Response (four-byte poke or n-byte poke) (unsolicited)

Upon reception of the MEI 0x81 (Acknowledge for poke) from the Tracker, the Host will generate this response for the User System.

Table 208: Tracker Poke Response (four-byte poke or n-byte poke) (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x04
Type	1	enumeration 1 = Poke command received

Tracker Peek Response (n-byte peek) (unsolicited)

Upon reception of the MEI 0xA0 (Peek Response) from the Tracker, the Host will generate this response for the user system.

Table 209: Tracker Peek Response (n-byte peek) (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x04
Type	1	enumeration 2 = Multi-peek response 12 = eFUSE multi-peek response (4e and beyond only)
Address	4	unsigned integer Beginning address
Number of Bytes	2	unsigned integer Range: 0 to 1000
Data	Number of Bytes	

SID 0x05 (5) SID_FlashStore_Response

Upon reception of the Bootloader ACK/NAK (for the FS command) from the Tracker, the Host will generate this response for the User System.

Table 210: Tracker Flash Store Response (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x05
Result	4	Zero = Flash write successful Non-zero = Flash write unsuccessful

SID 0x06 (6) SID_FlashErase_Response

Upon reception of the Bootloader ACK/NAK (for the FE command) from the Tracker, the Host will generate this response for the User System.

Table 211: Tracker Flash Erase Response (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x06
Result	4	Zero = Flash erase successful Non-zero = Flash erase unsuccessful

SID 0x07 (7) SID_TrackerConfig_Response

Upon reception of the MEI 0x81 (Acknowledge for MEI 0x0A) from the Tracker, the Host will generate this response for the User System.

Table 212: Tracker Configuration Response (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x07

SID 0x08 (8) SID_MeiToCustomIo_Response

Upon reception of the MEI 0x81 (Acknowledge for MEI 0x1F) from the Tracker, the Host will generate this response for the User System.

Table 213: Tracker Custom I/O Response (unsolicited)

Field	Length (bytes)	Description
MID	1	0xB2
SID	1	0x08

Once the custom I/O has been started, note a hard reset will ***NOT*** restore the Tracker to the MEI protocol. The custom I/O selection is remembered as long as BBRAM is maintained or, depending on the firmware loaded, external flash memory is used.

6.35 ASCII Data Output

Table 214: ASCII Data Output Message

Field	Type	Length (bytes)	Description
MID	U1	1	0xFF
msg_text	U256	256	ASCII string of the message. The actual text length is determined by message length parameter in the header. The msg_text string in this field is not null-terminated.

The ASCII text output can be enabled or disabled after restart using the restart flags of the initialization message MID 128.

6.36 Navigation Library (NL) Auxiliary Initialization Data

Table 215: General message information

Message Name	Navigation Library (NL) Auxiliary Initialization Data
Input or Output	Output
MID (Hex)	40
MID (Dec)	64
Message Name in Code	MID_NL_AuxData
SID (Hex)	01
SID (Dec)	1
SID Name in Code	NL_AUX_INIT_DATA

Table 216: Message Fields Description

Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
	Scale	Example		Scale	Example	
1 U		40			64	Message ID
1 U		01			1	Sub ID
4 U		00000155	usec		341	Uncertainty of the initial software time estimate.
2 U		0619			1561	Whole week number of recorded position if initializing from saved position, or zero otherwise.
4 U		000067AA	sec		26538	Time of week of recorded position if initializing from saved position, or zero otherwise.
2 U		0001	100m		1	Horizontal Position Uncertainty, 2dRMS, of the recorded position if initializing from saved

						position, or zero otherwise.
2 U		0004	m		4	Altitude uncertainty, 1σ, of the recorded position if initializing from saved position, or zero otherwise.
1 U		30			48	Software version of the Tracker.
1 U		16			22	ICD version
2 U		0038			56	HW ID
4 U		00F9C57C	Hz		16369020	Default clock rate of the Tracker's internal clock.
4 U		00017FCE	Hz		98254	Default frequency offset of the Tracker's internal clock.
4 U		00000006			6	Tracker System Status, see bit field definition.
4 U		0			0	Reserved

Table 217: Bit Field Description

Tracker Status		
Bit Number	Field	Description
[0]	Status	0=Good 1=Bad
[1]	Cache	0=Disabled 1=Enabled
[2]	RTC Status	0=Invalid 1=Valid
[3-31]	Reserved	Reserved

6.36.1 Navigation Library (NL) Auxiliary Measurement Data

Table 218: Navigation Library (NL) Auxiliary Measurement Data

Message Name	Navigation Library (NL) Auxiliary Measurement Data
Input or Output	Output
MID (Hex)	40
MID (Dec)	64
Message Name in Code	MID_NL_AuxData
SID (Hex)	02
SID (Dec)	2
SID Name in Code	NL_AUX_MEAS_DATA

Table 219: Navigation Library (NL) Auxiliary Measurement Data Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	1 U		40			64	Message ID
Sub ID	1 U		02			2	Sub ID
SV ID	1 U		0E			14	Satellite PRN number
Status	1 U		06			6	General Tracker Status, see bit field definition.
Extended Status	1 U		02			2	Tracker Channel Status, see bit field definition.
Bit Sync Quality	1 U		FF			255	Confidence metric for bit sync.
Time Tag	4 U		DAC9762E	acqclk		3670636078	Measurement time tag.
Code Phase	4 U		64BB16B9	2^{-11} chips		1689982649	Code Phase
Carrier Phase	4 S		230D018A	L1 cycles		588054922	Carrier Phase
Carrier Frequency	4 S		0C800F43	0.000476 Hz		209719107	Carrier Frequency
Carrier Acceleration	2 S		0000	0.1 m/s/s		0	Carrier Acceleration (Doppler Rate)
Millisecond number	2 U		0008			8	Millisecond number, range 0 to 19.
Bit number	4 U		0186B15E			25604446	Bit number, range 0 to 30239999.
Code corrections	4 S		0000002E	1 cycle		46	For code smoothing
Smoothed code	4 S		FFFFF769	2^{-10} cycles		-2199	For PR smoothing
Code offset	4 S		00001900	2^{-11} chips		6400	Code offset
Pseudorange Noise (Code Variance if soft tracking)	2 S		002E			46	Pseudorange noise estimate (one sigma). Normalized and left-shifted 16 bits.
Delta Range Quality (AFC Variance if soft tracking)	2 S		0077			119	Delta Range accuracy estimate (one sigma). Normalized and left-shifted 16 bits.
Phase Lock Quality (N/A if soft tracking)	2 S		FFDA			-38	Phase Lock accuracy estimate. Normalized and left-shifted 8 bits.

Milliseconds uncertainty	2 S		0000			0	Not implemented
Sum Abs I	2 U		DD8A			56714	Sum |I| for this measurement
Sum Abs Q	2 U		0532			1330	Sum |Q| for this measurement
SV Bit Number	4 S		0186B130			25604400	Bit number of last SV bit available.
Mpath LOS Det Value	2 S		0002			2	Multipath line-of-sight detection value
Mpath Only Det Value	2 S		FFFF			-1	Multipath-only line-of-sight detection value
Recovery Status	1 U		00			0	Tracker Recovery Status, see bit field definition.
SW Time Uncertainty	4 U		00000065	usec		101	SW Time Uncertainty

Table 220: Navigation Library (NL) Auxiliary Measurement Data Status Bit Field definitions

Status	
Bit Field	Description
[0]	1 = Trickle Power Active
[1]	1 = Scalable Tracking Loop (STL) Active 0 = HW Tracking Loop (HWTL) Active
[2]	1 = SCL_MEAS Active

Table 221: Navigation Library (NL) Auxiliary Measurement Data Extended Status Bit Field definitions

Extended Status	
Bit Field	Description
[0]	Not use
[1]	1 = Subframe sync verified
[2]	1 = Possible cycle slip
[3]	1 = Subframe sync lost
[4]	1 = Multipath detected
[5]	1 = Multipath-only detected
[6]	1 = Weak frame sync done
[7]	Not use

Table 222: Navigation Library (NL) Auxiliary Measurement Data Recovery Status Bit Field definitions

Recovery Status	
Bit Field	Description
[0]	1 = Weak Bit Sync (WBS) Active
[1]	1 = False Lock (not implemented)
[2]	1 = Bad PrePos, wrong Bit Sync
[3]	1 = Bad PrePos, wrong Frame Sync (not implemented)
[4]	1 = Bad PrePos, other
[5]	Not use
[6]	Not use
[7]	Not use

6.36.2 Navigation Library (NL) Aiding Initialization

Table 223: Navigation Library Aiding Initialization Message Definition

Message Name	Navigation Library (NL) Auxiliary Aiding Data
Input or Output	Output
MID (Hex)	40
MID (Dec)	64
Message Name in Code	MID_NL_AuxData
SID (Hex)	03
SID (Dec)	3
SID Name in Code	NL_AUX_AID_DATA

Table 224: Navigation Library Aiding Initialization Message Field Definitions

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	1 U		40			64	Message ID
Sub ID	1 U		03			3	Sub ID
Position X	4 S		FFD700F9	m		-2686727	User Position X in ECEF
Position Y	4 S		FFBE5266	m		-4304282	User Position Y in ECEF
Position Z	4 S		003AC57A	m		3851642	User Position Z in ECEF
Horz Pos Unc	4 U		00007200	m		29184	Horizontal Position Uncertainty, 2σ
Alt Unc	2 U		0064	m		100	Vertical Position Uncertainty
TOW	4 U		05265C00	msec		86400000	Software Time of Week

6.37 Sensor Data Output Messages

Table 225: Sensor Data Output

Message Name	SENSOR_DATA
Input or Output	Output
MID (Hex)	0x48
MID (Dec)	72
Message Name in Code	MID_SensorData
SID (Hex)	Listed Below
SID (Dec)	Listed Below
SID Name in Code	Listed Below

Table 226: Sensor Control Input SID Descriptions

Field Being Described	
Bit Field	Description
0x01	SENSOR_READINGS
0x02	FACTORY_STORED_PARAMETERS
0x03	RCVR_STATE

Table 227: Sensor Data Readings Output Message information

Message Name	SENSOR_DATA
Input or Output	Output
MID (Hex)	0x48
MID (Dec)	72
Message Name in Code	MID_SensorData
SID (Hex)	0x01
SID (Dec)	1
SID Name in Code	SENSOR_READINGS

The message which is sent from the Measurement Engine to host containing sensor data as described in the table below. This message will be logged such that the sensor data can be post processed in NavOffline.

Table 228: Sensor Data Readings Output Message Fields Description

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1		0x48			72	SENSOR_DATA
Sub ID	U1		0x01			1	SENSOR_READINGS
SENSOR_ID	U2						Identification for sensor
DATA_SET_LENGTH	U1						Number of Bytes per sensor data set
NUM_DATA_SET	U1						Number of data sets in the message
DATA_MOD	U1						0 - Raw,

E							1 - Average,
TIMESTMP1	U4						Time stamp for Data set 1
DATA_1_XS 1	U2						Data for Axis 1 for Set 1
…	U2						
DATA_1_XS _NXS	U2						Data for Axis (NUM_AXES) for Set 1
TIMESTMP2	U4						Time stamp for Data set 2
DATA_2_XS 1	U2						Data for Axis 1 for Set 2
…	U2						
DATA_2_AXI S_NXS	U2						Data for Axis (NUM_AXES) for Set 2
…	..						
TIMESTMP_ ND	U4						Time stamp for Data set ND
DATA_ND_X S1	U2						Data for Axis (NUM_AXES) for Set ND
…	U2						

SENSOR_ID
Identification for sensor. This can be the slave device address of the sensor. This field can support 10 bit addressing.

DATA_SET_LENGTH
Number of Bytes per sensor data set. Number of bytes would be 2, 4, or 6 based on 1,2, or 3 sensor axes

NUM_DATA_SET
Number of data sets in the message

DATA_MODE
Date Mode. Describes if the data is raw or averaged. Bit map is as follows:
0 - Raw,
1 - Average,
2- Sliding median,
3 through 15 – reserved,
16 through 32: Error codes

TIMESTMP1
Time stamp for Data set 1. Time stamp is 4 Bytes of AcqClkCount recorded at the time of sampling sensor data.

DATA_1_XS1
Data for Axis 1 for Set 1
… …

DATA_1_XS_NXS
Data for Axis (NUM_AXES) for Set 1

TIMESTMP2
Time stamp for Data set 2. Time stamp is 4 Bytes of AcqClkCount recorded at the time of sampling sensor data

DATA_2_XS1
Data for Axis 1 for Set 2
… 2 …

DATA_2_AXIS_NXS
Data for Axis (NUM_AXES) for Set 2
… .. …

TIMESTMP_ND
Time stamp for Data set ND. Time stamp is 4 Bytes of AcqClkCount recorded at the time of sampling sensor data

DATA_ND_XS1
Data for Axis 1 for Set ND
… 2 …

DATA_ND_AXIS_NXS
Data for Axis (NUM_AXES) for Set ND

Notes:

1. The sensor data message is being sent for each sensor separately.
2. This is a variable length message. The message payload length will be contained in the header of the message.
3. Only ADC counts for sensor measurements are being sent across. Conversion into appropriate units will be performed on the host. Host will have the configuration information with regards to each sensor identified with SENSOR_ID.
4. Time stamp is applied to the sensor data after the data has been read. For example, In case of reading 3-axes accelerometer, time-stamp will be applied to the acceleration data after all three axes have been read.
5. If the DATA_MODE is selected for averaging or sliding median, the applied time stamp would correspond to the time stamp for last sample collected.

Table 229: Sensor Data Readings Output Message information

Message Name	SENSOR_DATA
Input or Output	Output
MID (Hex)	0x48
MID (Dec)	72
Message Name in Code	MID_SensorData
SID (Hex)	0x02
SID (Dec)	2
SID Name in Code	FACTORY_STORED_PARAMTERS

This message will only be sent out after sensor initialization if any of the NUM_INIT_REG_READ_SEN_ is a non-zero value in the sensor configuration message received from the Host. This message will transfer a set of parameters that are stored in sensor EPROM at the time of factory testing. These parameters need to be read at the time of sensor module initialization and sent over to Host such that they can be used in subsequent calculations. These parameters also need to be logged such that they can be used in post processing in NavOffline.

Table 230: Sensor Data Readings Output Message Fields Description

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID			0x48			72	SENSOR_DATA
Sub ID	U1		0x02			2	FACTORY_STORED_PARAMETERS
SENSOR_ID	U2						Sensor ID
NUM_INIT_READ_REG_SEN	1						Number of registers to read from Sensor at the time of initialization
NUM_BYTES_REG1	1						Data read from Register 1 address at initialization
DATA_REG1	NUM_BYTES_REG1						Number of bytes read from Register 1 at initialization
NUM_BYTES_REG2	1						Data read from Register 2 address at time of initialization
DATA_REG2	NUM_BYTES_REG2						Number of bytes read from Register 2 at initialization
…							

SENSOR_ID
Identification for sensor. This identification is the unique slave device address of the sensor. This field can support 10 bit addressing.

NUM_INIT_READ_REG_SEN
Number of registers to read from Sensor at the time of initialization.

NUM_BYTES_REG1
Data read from Register 1 address at time of initialization

DATA_REG1 NUM_BYTES_REG1
Number of bytes read from Register 1 at initialization

NUM_BYTES_REG2
Data read from Register 2 address at time of initialization

DATA_REG2 NUM_BYTES_REG2
Number of bytes read from Register 2 at initialization

Table 231: Receiver State Output Message information

Message Name	SENSOR_DATA
Input or Output	Output
MID (Hex)	0x48
MID (Dec)	72
Message Name in Code	MID_SensorData
SID (Hex)	0x03
SID (Dec)	3
SID Name in Code	RCVR_STATE

This output message is sent each time the sensory logic perceives a signifying change in the state of the GPS receiver device. This is an unsolicited notification which can be enabled/disabled in the (MID_SensorControl, SENSOR_SWITCH) input message.

Table 232: Receiver State Output Message Field Description

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1		0x48			72	SENSOR_DATA
Sub ID	U1		0x03			3	RCVR_STATE
RCVR_PHYSICAL_STATE	U1		0x01			1	State of the Receiver: 0 – Unknown 1 – Stationary 2 – Moving 3 – Reserved 1 4 – Reserved 2 5 – Reserved 3

6.38 SirfDrive Output Messages

6.38.1 Msg-ID 0x29 (MID_GeodNavState)

MSG ID:

Number: 0x29
Name: MID_GeodNavState
Purpose: Geodetic Navigation State Output Message

Message Length:

91 bytes

Rate:

Output at 1Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1		**0x29**	1
2-3	Nav Validity	UINT16	2	Bitmap	*Any bits not 0: Nav is Invalid* *Bit 0=1: GPS Fix Invalid* Bit 1=1: EHPE exceeded (reserved) Bit 2=1: EVPE exceeded (reserved) Bit 3=1: DR data Invalid Bit 4=1: DR Cal Invalid Bit 5=1: GPS-based Cal not Available Bit 6=1: DR Pos Invalid Bit 7=1: DR Heading Invalid Bits 8-14: Reserved Bit 15 = 1: No Tracker Data	1
4-5	NAV Mode	UINT16	2	Bitmap	*NAV Mode Bits definition*[9]*:* *GPS Fix Type:* *bits 2-0: SVs Used* *000 No NAV* *001 1 SV solution* *010 2 SV solution* *011 3 SV solution (2D)* *100 4 or More SV (3D)* *101 Least Sq 2D fix* *110 Least Sq 3D fix* *111 DR solution (0 SV)* *bit 3 =1: Trickle Power On* *bits 5-4 Altitude hold* *00 No Altitude Hold* *01 Filter Altitude used* *10 Use Altitude used* *11 User Forced Altitude* bit 6 = 1: DOP exceeded bit 7 = 1: DGPS corrections bit 8 = 1: Sensor Based DR = 0: if bit 2-0=111, Velocity DR bit 9 = 1: Sol Validated bit 10 = 1: VEL DR Timeout bit 11 = 1: Edited by UI bit 12 = 1: Velocity Invalid bit 13 = 1: Altitude Hold disabled bits 15-14 – SiRFDrive DR status: 00 – GPS Only 01 – Calibrating 10 – DR sensor error 11 – DR Test mode	1
6-7	Extended Week Number	UINT16	2	week	0 to 65535	1
8-11	TOW	UINT32	4	sec	0 to 604800.00	0.001
12-13	UTC Year	UINT16	2	year	1980 to 3000	1
14	UTC Month	UINT8	1	month	1 to 12	1
15	UTC Day	UINT8	1	day	1 to 31	1
16	UTC Hour	UINT8	1	hr	0 to 23	1

[9] Bits 15-14 only have meaning when bit 8 is 0.

17	UTC Minute	UINT8	1	min	0 to 59	1
18-19	UTC Second	UINT16	2	sec	0 to 59	0.001
20-23	Satellites in Solution	UINT32	4	Bit Map	Bit 0 = 1: SV1 Bit 1 = 1: SV2 … Bit 31 = 1: SV32	
24-27	Latitude	INT32	4	deg	-90 to 90	10^{-7}
28-31	Longitude	INT32	4	deg	-180 to 180	10^{-7}
32-35	Altitude from Ellipsoid	INT32	4	meters	-2000 to 100000.0	.01
36-39	Altitude from MSL [10]	INT32	4	meters	-2000 to 100000.0	.01
40	Map Datum	UINT8	1		0-255	
41-42	Speed Over Ground (SOG)	UINT16	2	m/sec	0-655	.01
43-44	Course Over Ground (COG, True)[11]	UINT16	2	deg	0 to 360	.01
45-46	Magnetic Variation (RESERVED)	INT16	2	deg	-90 to 90	.01
47-48	Climb Rate	INT16	2	m/sec	-300 to 300	.01
49-50	Heading Rate	INT16	2	deg /sec	-300 to 300	.01
51-54	Expected Horizontal Position Error (EHPE)	UINT32	4	meters	0 to 6000000	.01
55-58	Expected Vertical Position Error (EVPE)	UINT32	4	meters	0 to 24000	.01
59-62	Expected Time Error (ETE)	UINT32	4	meters	0 to 6000000	.01
63-64	Expected Horizontal Velocity Error (EHVE)	UINT16	2	m/sec	0 to 655	.01
65-68	Clock Bias	INT32	4	meters	-21474837 to 21474837	.01
69-72	Clock Bias Error	UINT32	4	meters	0 to 6000000	.01
73-76	Clock Drift	INT32	4	m/sec	-21474837 to 21474837	.01
77-80	Clock Drift Error	UINT32	4	m/sec	0 to 1000	.01
81-84	Distance Traveled since RESET	UINT32	4	meters	0 to 4294967295	1
85-86	Distance Traveled error	UINT16	2	meters	65535	1
87-88	Heading Error	UINT16	2	deg	0 to 180	.01
89	Number of Satellites in Solution	UINT8	1	integer	0 –12	1
90	HDOP	UINT8	1	integer	0..51	0.2

[10] Altitude above MSL = Altitude from Ellipsoid – Geoidal Separation
[11] Also know as Heading(Hdg)

91	AdditionalModeInfo	UINT8	1	Bitmap	Bit 7: DR direction 0 = forward 1 = reverse Bits 6-3: reserved Bit 2: MMF usage 0 = used in solution 1 = not used in solution Bit 1: MMF received 0 = not received 1 = received Bit 0: MMF mode 0 = disabled 1 = enabled	1

API:

```
typedef struct
{
   UINT16 Valid
   UINT16 Mode
   UINT16 Week
   UINT32 TOW
   UINT16 UtcYr;
   UINT8  UtcMth;
   UINT8  UtcDay;
   UINT8  UtcHr;
   UINT8  UtcMin;
   UINT16 UtcSec;
   UINT32 SVIDList;
   INT32  Lat;
   INT32  Lon;
   INT32  AltE;
   INT32  AltM;
   UINT8  Datum;
   UINT16 Sog;
   UINT16 Hdg;
   INT16  MagVar;
   INT16  ClmbRte;
   INT16  HdRte
   UINT32 Ehpe;
   UINT32 Evpe;
   UINT32 Ete
   UINT16 Ehve;
   INT32  ClkBias
   UINT32 ClkBiasE
   INT32  ClkDrift
   UINT32 ClkDriftE
   UINT32 Trvled;
   UINT16 TrvledE
```

```
   UINT16 HdE;
   UINT8  SVIDCnt;
   UINT8  HDOP;
   UINT8  AdditionalModeInfo;
} MI_GEOD_NAV_STATE;
```

6.38.2 Msg-ID 0x2D (MID_TrkADCOdoGPIO)

MSG ID:

Number: 0x2D
Name: MID_TrkADCOdoGPIO
Purpose: Output Tracker to NAV – ADC/ODOMETER DATA

Message Length:

111 bytes @ 1Hz or 12 bytes @ 10Hz

Rate:

111 bytes @ 1Hz or 12 bytes @ 10Hz

Binary Message Definition:

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

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

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

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0x2D**	n/a
2 + (n-1)*11 (Note 0)	currentTime (Note 1)	UINT32	4	ms	0-4294967295	n/a
6 + (n-1)*11 (Note 0)	Gyro adc Avg (Note 2)	UINT16 Or INT16	2	n/a	0 to 4095 (GSP2eLP w/ DR option) Or -12000 to 28000 (GSP2t)	n/a
8 + (n-1)*11 (Note 0)	adc3Avg (Note 3)	UNIT16 Or INT16	2	n/a	0 (GSP2eLP w/ DR option) Or -12000 to 28000 (GSP2t)	n/a
10 + (n-1)*11 (Note 0)	odoCount (Note 4)	UINT16	2	n/a	0 to 65535	n/a
12 + (n-1)*11 (Note 0)	gpioStat (Note 5)	UINT8	1	Bit Map	bit 0 – if = 1: Reverse "ON" bits 1 to 7 Reserved	n/a

Note 0: n corresponds to either 1 or 1-10 depending on whether the message comes out a 10Hz (10 messages 1 data set) or 1Hz (1 message 10 data sets)
Note 1: Tracker Time, millisecond counts
Note 2: Averaged measurement from Gyro input. On the GSP2t, this is the ADC[2] input, on the GSP2eLP, this is the Maxim ADC input
Note 3: On a GSP2eLP system, there is currently only one ADC input so this field is always 0.
Note 4: Odometer counter measurement at the most recent 100mSec tracker interrupt. This field will rollover to 0 after 65535
Note 5: GPIO input states at the most recent 100mSec tracker interrupt

API:

```
#define NUM_OF_DR_RAW 10

typedef struct
{
   UINT32 currentTime;
   UINT16 adc2Avg;
   UINT16 adc3Avg;
   UINT16 odoCount;
   UINT8  gpioStat;
} tADCOdometer;

typedef struct
{
   struct
   {
      tADCOdometer  ADCOdometer[NUM_OF_DR_RAW];
   } DrRaw;

} tDrRawData, *tDrRawDataPtr;
```

6.38.3 Msg-ID 0x30;Sub-ID 0x01 (SID_DrNavStatus)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x01
Name: SID_DrNavStatus
Purpose: DR NAV Status Output Message

Message Length:

20 bytes

Rate:

Output at 1HZ

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1		**0x30**	1
2	Sub ID	UINT8	1		**0x01**	1
3.0 – 3.6	DR Navigation Valid **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: GPS Only Required Bit 1 = 1: Speed != 0 at startup Bit 2 = 1: DR Position Valid = False Bit 3 = 1: DR Heading Valid = False Bit 4 = 1: DR Calibration Valid = False Bit 5 = 1: DR Data Valid = False Bit 6 = 1: System has gone into Cold Start **(Note 2)**	N/A
3.7	Reserved					

4 -5	DR Data Valid **(Note 1)**	Bit Map	2	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Gyro Subsystem Operational = False Bit 1 = 1: DR Speed Subsystem Operational = False Bit 2 = 1: DR. Measurement Time < 0 Bit 3 = 1: Input serial DR message checksum Invalid Bit 4 = 1: No DR Data for > 2 seconds Bit 5 = 1: DR Data timestamp did not advance Bit 6 = 1: DR data bytes all 0x00 or all 0xFF Bit 7 = 1: Composite wheeltick count jumped by more than 400 between successive DR messages Bit 8 = 1: Input Gyro data bits (15) value of 0x0000 or 0x3FFF Bit 9 = 1: More than 10 DR messages in one second Bit 10 = 1: Delta Time <= 0 Bit 11-15: Reserved **(Note 2)**	N/A
6.0 – 6.3	DR Calibration Valid **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Gyro Bias Cal Valid = False Bit 1 = 1: DR Gyro Scale Factor Cal Valid = False Bit 2 = 1: DR Speed Scale Factor Cal Valid = False Bit 3 = 1; GPS Calibration is required and is not yet available **(Note 2)**	N/A
6.4 – 6.6	DR Gyro Bias Cal Valid **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: Zero-Speed Gyro Bias Calibration was Updated = False Bit 2 = 1: Heading Rate Scale Factor <= -1 **(Note 2)**	N/A
6.7	Reserved					
7.0 – 7.3	DR Gyro Scale Factor Cal Valid **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Heading Valid = False Bit 1 = 1: DR Data Valid = False Bit 2 = 1: DR Position Valid = False Bit 3 = 1: Heading Rate Scale Factor <= -1 **(Note 2)**	N/A
7.4 – 7.7	DR Speed Scale Factor Cal Valid **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: DR Position Valid = False Bit 2 = 1: GPS Velocity Valid For Dr = False Bit 3 = 1: DR Speed Scale Factor <= -1 **(Note 2)**	N/A
8.0 – 8.1	DR Nav Valid Across Reset **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Navigation Valid = False Bit 1 = 1: Speed > 0.1 m/sec **(Note 2)**	N/A
8.2	Reserved					

8.3 – 8.6	DR Position Valid **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: Speed != 0 at startup Bit 1 = 1: Valid GPS Position is Required and GPS Position Valid = False Bit 2 = 1: System has gone into Cold Start Bit 3 = 1: DR Data Valid = False **(Note 2)**	N/A
8.7	Reserved					
9.0 – 9.6	DR Heading Valid **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: Speed != 0 at startup Bit 1 = 1: Valid GPS Position is Required and GPS Position Valid = False Bit 2 = 1: Valid GPS Speed is Required and GPS Speed Valid = False Bit 3 = 1: GPS Updated Heading = False Bit 4 = 1: (Delta GPS Time <= 0.0) || (Delta GPS Time >= 2.0)) Bit 5 = 1: System has gone into Cold Start Bit 6 = 1: DR Data Valid = False **(Note 2)**	N/A
9.7	Reserved					
10.0 – 10.2	DR Gyro Subsystem Operational **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: High, Persistent Turn Rate Bit 1 = 1: Low, Persistent Turn Rate Bit 2 = 1: Gyro Turn Rate Residual is Too Large **(Note 2)**	N/A
10.3	Reserved					
10.4 – 10.6	DR Speed Subsystem Operational **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Speed Data = 0 when GPS Speed != 0 Bit 1 = 1: DR Speed Data != 0 when GPS Speed = 0 Bit 2 = 1: DR Speed Residual is Too Large **(Note 2)**	N/A
10.7	Reserved					
11.0 – 11.2	DR Nav State Integration Ran **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Position Valid = False Bit 1 = 1: DR Heading Valid = False Bit 2 = 1: DR Data Valid = False (Note 2)	N/A
11.3	Reserved					
11.4 – 11.6	Zero-Speed Gyro Bias Calibration was Updated **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: GPS Speed > 0.1 m/sec Bit 1 = 1: Zero Speed During Cycle = False Bit 2 = 1: Zero Speed Previous = False **(Note 2)**	N/A
11.7	Reserved					
12.0 – 12.3	DR Gyro Bias and Scale Factor Calibration was Updated **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: DR Position Valid = False Bit 2 = 1: GPS Velocity Valid For DR = False Bit 3 = 1: GPS Updated Heading = False **(Note 2)**	N/A

12.4 – 12.6	DR Speed Calibration was Updated **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Data Valid = False Bit 1 = 1: DR Position Valid = False Bit 2 = 1: GPS Velocity Valid For DR= False **(Note 2)**	N/A
12.7	DR Updated the Navigation State **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: DR Navigation Valid = False **(Note 2)**	N/A
13.0 – 13.7	GPS Updated Position **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: Update Mode != KALMAN Bit 1 = 1: EHE too large (i.e. EHE > 10.0) Bit 2 = 1: no previous GPS Kalman update < 4 sats Bit 3 = 1: GPS EHPE > DR EHPE Bit 4 = 1: DR EHPE < 10 even if GPS EHPE < DR EHPE Bit 5 = 1: Less than 4 satellites Bit 6 = 1: 0 satellites Bit 7 = 1: DR NAV Only Required **(Note 2)**	N/A
14.0 – 14.6	GPS Updated Heading **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: Update Mode != KALMAN Bit 1 = 1: GPS Speed <= 2.0 m/sec Bit 2 = 1: < 4 sats Bit 3 = 1: Horizontal Velocity Variance > 1.0 (m/sec)*(m/sec) Bit 4 = 1: GPS Heading Error >= DR Heading Error * 1.2 Bit 5 = 1: GPS Kalman Filter Updated = False Bit 6 = 1: Initial Speed Transient Complete = False (Note 2)	N/A
14.7	Reserved					
15.0 – 15.2	GPS Position Valid for DR **(Note 1)**	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: < 4 sats Bit 1 = 1: EHPE > 30 Bit 2 = 1: GPS Updated Position = False **(Note 2)**	N/A
15.3	Reserved					
15.4 – 15.7	GPS Velocity Valid for DR **(Note 1)**	Bit Map		N/A	All bits 0: True Any bits != 0 : False Bit 0 = 1: GPS Position Valid for DR = False Bit 1 = 1: EHVE > 3 Bit 2 = 1: GPS Speed < 2 m/sec Bit 3 = 1: GPS did not update the Heading **(Note 2)**	N/A
16.0 – 16.1	DWS Heading Rate Scale Factor Calibration Validity	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 : 1 = Heading Rate Scale Factor <= -1.0 Bits 1 – 7: = Reserved	N/A
16.2 – 16.7	Reserved					

17.0 – 17.6	DWS Heading Rate Scale Factor Calibration Was Update	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 : 1 = GPS Heading Rate is not valid Bit 1 : 1 = Absolute value of GPS Heading Rate < 5.0 Bit 2 : 1 = Absolute value of GPS Heading Rate >= 90.0 Bit 3 : 1 = Left Rear Speed SF Cal is not valid Bit 4 : 1 = Right Rear Speed SF Cal is not valid Bit 5 : 1 = Absolute value of prev Rear Axle Hd Rt <= 0.0 Bit 6 : 1 = (GPS Hd Rt * prev Rear Axle Hd Rt) <= 1.0 Bit 7 : = reserved	N/A
17.7	Reserved					
18.0 – 19.7	DWS Speed Scale Factor Calibration Validity	Bit Map	2	N/A	All bits 0: True Any bits != 0 : False Bit 0 : 1 = Right Rear Speed SF <= -1.0 Bit 1 : reserved for RR status Bit 2 : reserved for RR status Bit 3 : reserved for RR status Bit 4 : 1 = Left Rear Speed SF <= -1.0 Bit 5 : reserved for LR status Bit 6 : reserved for LR status Bit 7 : reserved for LR status Bit 8 : 1 = Right Front Speed SF <= -1.0 Bit 9 : reserved for RF status Bit 10: reserved for RF status Bit 11: reserved for RF status Bit 12: 1 = Left Front Speed SF <= -1.0 Bit 13: reserved for LF status Bit 14: reserved for LF status Bit 15: reserved for LF status	N/A
20.0 – 20.5	DWS Speed Scale Factor Cal was updated	Bit Map	1	N/A	All bits 0: True Any bits != 0 : False Bit 0 : 1 = GPS Speed is not valid for DR Bit 1 : 1 = GPS Heading Rate is not valid Bit 2 : 1 = Absolute value of GPS Hd Rate >= 0.23 Bit 3 : 1 = GPS Heading Rate Error >= 0.5 Bit 4 : 1 = Average GPS Speed <= 0.0 Bit 5 : 1 = DR Position is not valid Bits 6 – 7 : reserved	N/A
20.6 – 20.7	Reserved					

Note 1: The bit map of the Field variable reports the status. If all the bits in the bit map are zero (0), then the status of the variable = Valid. Otherwise, if any of the bits in the bit map are set = 1, then the status of the variable = Not Valid, and the individual bits give the reason why.

Note 2: The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the Least-Significant byte.

API:

```
typedef struct
{
   UINT8  Nav;
   UINT16 Data;
   UINT8  Cal_GbCal;
```

```
    UINT8   GsfCal_SsfCal;
    UINT8   NavAcrossReset_Pos ;
    UINT8   Hd;
    UINT8   GyrSubOp_SpdSubOp;
    UINT8   NavStIntRan_ZGbCalUpd;
    UINT8   GbsfCalUpd_SpdCalUpd_UpdNavSt;
    UINT8   GpsUpdPos;
    UINT8   GpsUpdHd;
    UINT8   GpsPos_GpsVel;
    UINT8   DWSHdRtSFCalValid;
    UINT8   DWSHdRtSFCalUpd;
    UINT16 DWSSpdSFCalValid;
    UINT8 DWSSpdSFCalUpd ;
} MI_DR_NAV_STATUS;
```

6.38.4 Msg-ID 0x30;Sub-ID 0x02 (SID_DrNavState)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x02
Name: SID_DrNavState
Purpose: DR NAV State Output Message

Message Length:

75 bytes

Rate:

Output at 1HZ

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0x30**	1
2	Sub-ID	UINT8	1	n/a	**0x02**	1
3 – 4	DR Speed	UINT16	2	m/sec	0 to 655	.01
5 – 6	DR Speed Error	UINT16	2	m/sec	0 to 655	.01
7 – 8	DR Speed Scale Factor **(Note 1)**	INT16	2	n/a	-1 to 3	.0001
9 – 10	DR Speed Scale Factor Error	UINT16	2	n/a	0 to 3	.0001
11 – 12	DR Heading Rate	INT16	2	deg/sec	-300 to 300	.01
13 – 14	DR Heading Rate Error	UINT16	2	deg/sec	0 to 300	.01
15 – 16	DR Gyro Bias	INT16	2	deg/sec	-300 to 300	.01

17 – 18	DR Gyro Bias Error	UINT16	2	deg/sec	0 to 300	.01
19 – 20	DR Gyro Scale Factor **(Note 1)**	INT16	2	n/a	-1 to 3	.0001
21 – 22	DR Gyro Scale Factor Error	UINT16	2	n/a	0 to 3	.0001
23 – 26	Total DR Position Error	UINT32	4	meters	0 to 6000000	.01
27 – 28	Total DR Heading Error	UINT16	2	deg	0 to 180	.01
29	DR Nav Mode Control	UINT8	1	Bitmap	bit 0 :1 = GPS-Only Navigation required (No DR NAV Allowed) bit 1: 1 = OK to do DR Nav with default or SRAM calibration bit 2: 1 = DR Nav OK if using current GPS calibration bit 3: 1 = DR Only Navigation	1
30	DR Direction	UINT8	1	boolean	0: forward 1: reverse	1
31 – 32	DR Heading	UINT16	2	deg/sec	0 to 360	.01
33	SensorPkg	UINT8	1	n/a	0 = Gyro and Odo 1 = Wheel Speed and Odo	1
34 – 35	Odometer Speed	UINT16	2	m/sec		0.01
36 – 37	Odometer Speed Scale Factor**(Note 1)**	INT16	2	n/a		0.0001
38 – 39	Odometer Speed Scale Factor Error	UINT16	2	n/a		0.0001
40 – 41	Left Front Wheel Speed Scale Factor**(Note 1)**	INT16	2	n/a		0.0001
42 - 43	Left Front Wheel Speed Scale Factor Error	UINT16	2	n/a		0.0001
44 - 45	Right Front Wheel Speed Scale Factor**(Note 1)**	INT16	2	n/a		0.0001
46 - 47	Right Front Wheel Speed Scale Factor Error	UINT16	2	n/a		0.0001
48 – 49	Left Rear Wheel Speed Scale Factor**(Note 1)**	INT16	2	n/a		0.0001
50 – 51	Left Rear Wheel Speed Scale Factor Error	UINT16	2	n/a		0.0001
52 – 53	Right Rear Wheel Speed Scale Factor**(Note 1)**	INT16	2	n/a		0.0001
54 – 55	Right Rear Wheel Speed Scale Factor Error	UINT16	2	n/a		0.0001
56 – 57	Rear Axle Speed Delta	INT16	2	m/sec		0.01
58 – 59	Rear Axle Average Speed	UINT16	2	m/sec		0.01
60 – 61	Rear Axle Speed Error	UINT16	2	m/sec		0.01
62 – 63	Rear Axle Heading Rate	INT16	2	deg/sec		0.01
64 – 65	Rear Axle Heading Rate Error	UINT16	2	deg/sec		0.01
66 – 67	Front Axle Speed Delta	INT16	2	m/sec		0.01
68 –	Front Axle Average Speed	UINT16	2	m/sec		0.01

69						
70 – 71	Front Axle Speed Error	UINT16	2	m/sec		0.01
72 – 73	Front Axle Heading Rate	INT16	2	deg/sec		0.01
74 - 75	Front Axle Heading Rate Error	UINT16	2	deg/sec		0.01
Note 1: Scale Factor is defined: True = Measured / (1 + Scale Factor)						

API:

```
typedef struct
{
   UINT16        Spd;
   UINT16        SpdE;
   INT16         Ssf;
   UINT16        SsfE;
   INT16         HdRte;
   UINT16        HdRteE;
   INT16         Gb;
   UINT16        GbE;
   INT16         Gsf;
   UINT16        GsfE;
   UINT32        TPE;
   UINT16        THE;
   UINT8         NavCtrl
   UINT8         Reverse;
   UINT16        Hd;
   UINT8         SensorPkg;
   UINT16        OdoSpd;
   INT16         OdoSpdSF;
   UINT16        OdoSpdSFErr
   INT16         LFWheelSpdSF
   UINT16        LFWheelSpdSFErr
   INT16         RFWheelSpdSF;
   UINT16        RFWheelSpdSFErr;
   INT16         LRWheelSpdSF;
   UINT16        LRWheelSpdSFErr;
   INT16         RRWheelSpdSF;
   UINT16        RRWheelSpdSFErr;
   INT16         RearAxleSpdDelta;
   UINT16        RearAxleAvgSpd;
   UINT16        RearAxleSpdErr;
   INT16         RearAxleHdRt;
   UINT16        RearAxleHdRtErr;
   INT16         FrontAxleSpdDelta;
   UINT16        FrontAxleAvgSpd;
   UINT16        FrontAxleSpdErr;
   INT16         FrontAxleHdRt
   UINT16        FrontAxleHdRtErr;
} MI_DR_NAV_STATE;
```

6.38.5 Msg-ID 0x30;Sub-ID 0x03 (SID_NavSubSys)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x03
Name: SID_NavSubSys
Purpose: NAV Subsystems Data Output Message

Message Length:

36 bytes

Rate:

Output at 1HZ

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**6.38.5.1.1** ***0x30***	n/a
2	Sub-ID	UINT8	1	n/a	**6.38.5.1.1.1**	n/a
3-4	GPS Heading Rate	INT16	2	deg/sec	-300 to 300	.01
5-6	GPS Heading Rate Error	UINT16	2	deg/sec	0 to 300	.01
7-8	GPS Heading (True)	UINT16	2	deg	0 to 360	.01
9-10	GPS Heading Error	UINT16	2	deg	0 to 180	.01
11-12	GPS Speed	UINT16	2	m/sec	0 to 655	.01
13-14	GPS Speed Error	UINT16	2	m/sec	0 to 655	.01
15-18	GPS Position Error	UINT32	4	meters	0 to 6000000	.01
19-20	DR Heading Rate	INT16	2	deg/sec	-300 to 300	.01
21-22	DR Heading Rate Error	UINT16	2	deg/sec	0 to 300	.01
23-24	DR Heading (True)	UINT16	2	deg	0 to 360	.01
25-26	DR Heading Error	UINT16	2	deg	0 to 180	.01
27-28	DR Speed	UINT16	2	m/sec	0 to 655	.01
29-30	DR Speed Error	UINT16	2	m/sec	0 to 655	.01
31-34	DR Position Error	UINT32	4	meters	0 to 6000000	.01
35-36	Reserved	UINT16	2	n/a	undefined	n/a

API:

```
typedef struct
{
   INT16  GpsHdRte;
   UINT16 GpsHdRteE;
```

```
   UINT16 GpsHd;
   UINT16 GpsHdE;
   UINT16 GpsSpd;
   UINT16 GpsSpdE;
   UINT32 GpsPosE;
   INT16  DrHdRte;
   UINT16 DrHdRteE;
   UINT16 DrHd;
   UINT16 DrHdE;
   UINT16 DrSpd;
   UINT16 DrSpdE;
   UINT32 DrPosE;
   UINT8  Reserved[2];
} MI_NAV_SUBSYS;
```

6.38.6 Msg-ID 0x30;Sub-ID 0x05 (SID_DrValid)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x05
Name: SID_DrValid
Purpose: Preserved DR Data Validity Output Message (RESERVED)

Message Length:

10 bytes

Rate:

Typically output at startup

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0x30**	n/a
2	Sub-ID	UINT8	1	n/a	**0x05**	n/a
3-6	Valid[12]	UINT32	4	bitmap	[13]bit 0: invalid position bit 1: invalid position error bit 2: invalid heading bit 3: invalid heading error bit 4: invalid speed scale factor bit 5: invalid speed scale factor error bit 6: invalid gyro bias bit 7: invalid gyro bias error bit 8: invalid gyro scale factor bit 9: invalid gyro scale factor error bit 10: invalid baseline speed scale factor bit 11: invalid baseline gyro bias bit 12: invalid baseline gyro scale factor bit 13 - 31: reserved	n/a
7-10	Reserved	UINT32	4	n/a	n/a	n/a

API:

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

[12] The bit map of the Field variable reports the status. If all the bits in the bit map are zero (0), then the status of the variable = Valid. Otherwise, if any of the bits in the bit map are set = 1, then the status of the variable = Not Valid, and the individual bits give the reason why.
[13] The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the Least-Significant byte.

6.38.7 Msg-ID 0x30;Sub-ID 0x06 (SID_GyrFactCal)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x06
Name: SID_GyrFactCal
Purpose: Gyro Factory Calibration Response Output Message

Message Length:

4 bytes

Rate:

Output after successful completion of each calibration stage; can be polled

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	**0x30**	N/A
2	Sub-ID	UINT8	1	N/A	**0x06**	N/A
3	Gyro Factory Calibration Progress **(Note 1)**	Bit Map	1	N/A	bit 0 = 1: Gyro Bias calibration completed bit 0 = 2: Gyro Scale Factor calibration completed[14] bits 3 –7: Reserved **(Note 2)**	N/A
4	Reserved		1	N/A	N/A	N/A

Note 1: The bit map of the Field variable reports the status of each calibration stage. All pertinent bits must be set to Valid before the calibration is considered successful.

Note 2: The individual bits are referenced by their offset from the start of the bit map, starting with offset 0 for the LSB of the Least-Significant byte.

API:

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

[14] Bit 0 can't equal 2??

6.38.8 Msg-ID 0x30;Sub-ID 0x07 (SID_DrSensParam)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x07
Name: SID_DrSensParam
Purpose: Output message of Sensor Package parameters

Message Length:

7 bytes

Rate:

Input

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0xAC**	n/a
2	Sub-ID	UINT8	1	n/a	**0x07**	n/a
3	Baseline Speed Scale Factor	UINT8	1	ticks/m	1 to 255 (default:4)	1
4-5	Baseline Gyro Bias	UNIT16	2	zero rate Volts	2.0 to 3.0 (default:2.5)	.0001
6-7	Baseline Gyro Scale Factor	UINT16	2	mV / (deg/sec)	1 to 65 (default: 22)	.001

API:

```
typedef struct
{
   UINT8  BaseSsf;  /* in ticks/m */
   UINT16 BaseGb;   /* in zero rate volts */
   UINT16 BaseGsf;  /* in mV / (deg/s) */
} MI_DR_SENS_PARAM;
```

6.38.9 Msg-ID 0x30;Sub-ID 0x08 (SID_DrDataBlk)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x08
Name: SID_DrDataBlk
Purpose: DR Data Block Output Message

Message Length:

86 bytes

Rate:

Output at 1 Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	**0x30**	N/A
2	Sub-ID	UINT8	1	N/A	**0x08**	N/A
3	Measurement Type (Note 3)	UINT8	1	N/A	*if = 0, Gyro and Odometer; if= 1, Differential Odometer;(RESERVED) if = 2, Compass and Odometer;(RESERVED)*	1
4	Valid measurements in block	UINT8	1	N/A	*1 to 10*	1
5-6	Backup Flags	UINT16	2	N/A	*bits 0 – 9:* if set = 1: Backup = True if set = 0: Backup = False (Note 4)	1
7 + (n-1)*8 (Note 1)	TimeTag	UINT32	4	msec	*0 to 4294967295*	1
11 + (n-1)*8 (Note 1)	DR Speed 1	UINT16	2	m/sec	0 to 655	.01
13 + (n-1)*8 (Note 1)	Gyro Heading Rate *or DR Speed 2 (RESERVED) or Magnetic Compass Heading (RESERVED)* (Note 3)	INT16 *or UINT16 (RESERVED) or UINT16 (RESERVED)*	2	deg /sec *or m/sec (RESERVED) or deg (RESERVED)*	-300 to 300 *or 0 to 655 (RESERVED) or 0 to 360 (RESERVED)*	.01 *or .01 (RESERVED) or .01 (RESERVED)*

Note 1: n = valid measurement sets in the block. Note 2: DR data validity is checked at 10 Hz, and if a particular data set contains invalid data, then the data is not outputted. Note 3: The type of data in the second DR measurement in each set is controlled by the Measurement Type value. Note 4: The bits index points to the corresponding data set; where the data set index goes from 0 to 9.

API:

```
typedef struct
{
   UINT32 Tag;
   UINT16 Data1;
   INT16  Data2;
} MI_DR_10HZ;

typedef struct
{
   UINT8      MeasType;
   UINT8      ValidCnt;
   UINT16     BkupFlgs;
   MI_DR_10HZ Blk[10];
} MI_DR_DATA_BLK;
```

6.38.10 Msg-ID 0x30;Sub-ID 0x09 (SID_GenericSensorParam)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

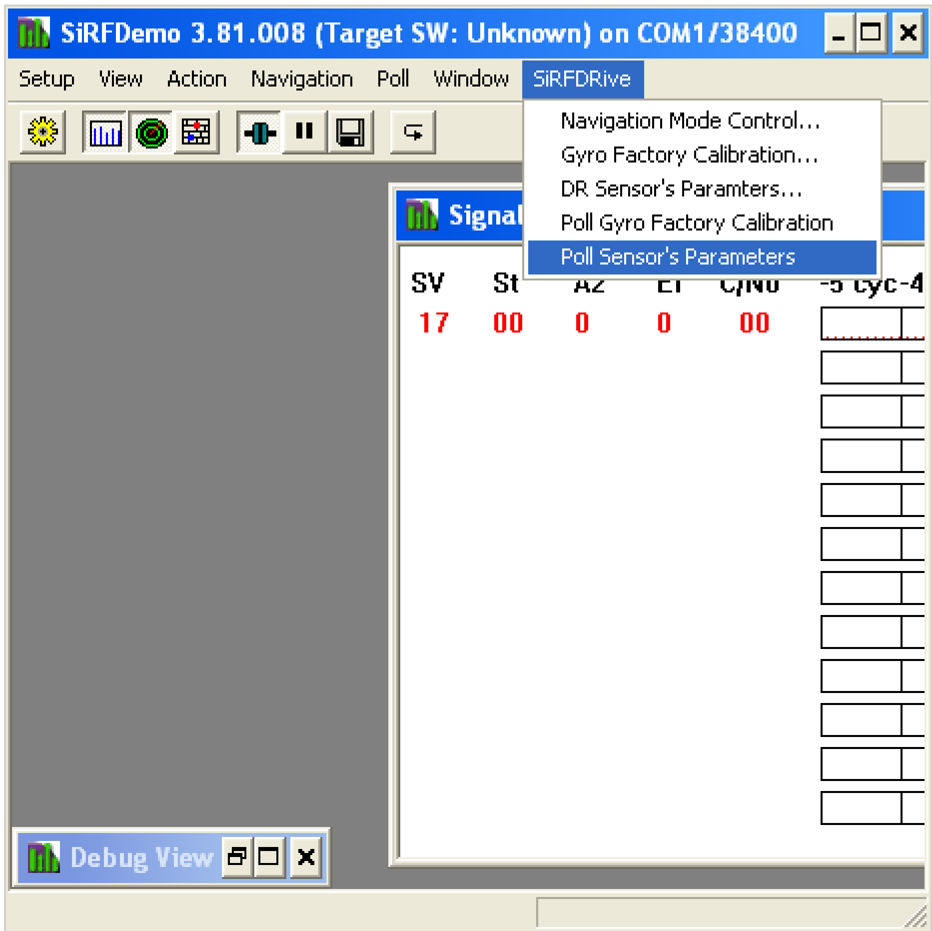
Number: 0x09
Name: SID_GenericSensorParam
Purpose: Output message of Sensor Package parameters

Message Length:

30 bytes

Rate:

The user can enable a one time transmission of this message via SirfDemo's Poll command for SirfDrive. In the "SirfDrive" menu item select the "Poll Sensor's Parameters" shown below:



Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	**0x30**	N/A
2	Sub-ID	UINT8	1	N/A	**0x09**	N/A
3	Sensors[0].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
4 – 5	Sensors[0].ZeroRateVolts	UINT16	2	volts	0 to 5.0[15]	0.0001
6– 7	Sensors[0].MilliVoltsPer	UINT16	2	millivolts	0 to 1000[16]	0.0001
8 – 9	Sensors[0].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001

[15] To restore ROM defaults for ALL sensors enter the value 0xdeadabba here. You must still include the remainder of the message but these values will be ignored.
[16] For gyro this is millivolts per degree per second. For the acceleration sensor it is millivolts per metre per second ^ 2

10	Sensors[1].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
11 – 12	Sensors[1].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
13 – 14	Sensors[1].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
15 – 16	Sensors[1].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
17	Sensors[2].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
18 – 19	Sensors[2].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
20 – 21	Sensors[2].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
22 – 23	Sensors[2].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001
24	Sensors[3].SensorType	UINT8	1	N/A	GYRO_SENSOR = 0x1 ACCELERATION_SENSOR = 0x2	N/A
25 – 26	Sensors[3].ZeroRateVolts	UINT16	2	volts	0 to 5.0	0.0001
27 – 28	Sensors[3].MilliVoltsPer	UINT16	2	millivolts	0 to 1000	0.0001
29 – 30	Sensors[3].ReferenceVoltage	UINT16	2	volts	0 to 5.0	0.0001

API:

```
#define MAX_NUMBER_OF_SENSORS 0x4

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

}MI_SensorDescriptionType;

typedef struct
{
  MI_SensorDescriptionType Sensors[MAX_NUMBER_OF_SENSORS];
} MI_DR_SENS_PARAM;
```

6.38.11 Msg-ID 0x30;Sub-ID 0x0A (SID_GenericRawOutput)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x0A
Name: SID_GenericRawOutput
Purpose: Output raw data from generic sensors

Message Length:

152 bytes @ 1Hz or 16bytes @ 10Hz

Rate:

152 bytes @ 1Hz or 16 bytes @ 10Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**6.38.11.1.1**	n/a
2	Sub-ID	UINT8	1	N/A	**0x0A**	N/A
3 – 6	[0].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
7 – 8	[0].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
9– 10	[0].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
11 -12	[0].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
13 – 14	[0].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
15 – 16	[0].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
17	[0].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
18- 21	[1].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
22 -23	[1].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
24 -25	[1].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
26 -27	[1].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
28 – 29	[1].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
30 -31	[1].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
32	[1].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
33 – 36	[2].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
37 – 38	[2].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
39 -40	[2].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
41 -42	[2].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
43 – 44	[2].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
45 -46	[2].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
47	[2].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
48- 51	[3].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
52 -53	[3].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
54 – 55	[3].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
56 – 57	[3].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
58 -59	[3].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
60 -61	[3].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
62	[3].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a

63 – 66	[4].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
67 – 68	[4].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
69 – 70	[4].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
71 – 72	[4].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
73 – 74	[4].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
75 – 76	[4].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
77	[4].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
78 – 81	[5].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
82 – 83	[5].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
84 – 85	[5].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
86 -87	[5].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
88 – 89	[5].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
90 – 91	[5].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
92	[5].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
93 – 96	[6].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
97 -98	[6].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
99 - 100	[6].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
101 - 102	[6].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
103 - 104	[6].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
105 – 106	[6].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
107	[6].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
108 – 111	[7].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
112 – 113	[7].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
114 – 115	[7].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
116 – 117	[7].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
118- 119	[7].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
120- 121	[7].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
122	[7].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a
123- 126	[8].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
127- 128	[8].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
129 – 130	[8].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
131 – 132	[8].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
133- 134	[8].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
135 – 136	[8].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
137	[8].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a

138 – 141	[9].CurrentTime	UINT32	4	millisecs	0 to 0xffffffff	n/a
142-143	[9].AdcAvg[0]	UINT16	2	raw count	0 to 0xffff	n/a
144-145	[9].AdcAvg[1]	UINT16	2	raw count	0 to 0xffff	n/a
146-147	[9].AdcAvg[2]	UINT16	2	raw count	0 to 0xffff	n/a
148-149	[9].AdcAvg[3]	UINT16	2	raw count	0 to 0xffff	n/a
150 – 151	[9].OdoCount	UINT16	2	raw count	0 to 0xffff	n/a
152	[9].GPIOStat	UINT8	1	n/a	0 to 0xff	n/a

API:

```
#define NUM_OF_DR_RAW 10
#define MAX_NUMBER_OF_SENSORS 0x4

typedef struct
{
   UINT32 currentTime;
   UINT16 adcAvg[MAX_NUMBER_OF_SENSORS];
   UINT16 odoCount;
   UINT8  gpioStat;
} tADCOdometer;

typedef struct
{
   struct
   {
     tADCOdometer  ADCOdometer[NUM_OF_DR_RAW];
   } DrRaw;

} tDrRawData, *tDrRawDataPtr;
```

6.38.12 Msg-ID 0x30;Sub-ID 0x50 (SID_MMFStatus)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x50
Name: SID_MMFStatus
Purpose: Map Matching Feedback State Output Message

Message Length:

42 bytes

Rate:

Output at 1 Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	***0x30***	N/A
2	Sub-ID	UINT8	1	N/A	***0x50***	N/A
3 -6	MMF_Status	UINT32	4	bitmap	See "*MMF_Status Bit Description*" below	0
7 -8	Heading	UINT16	2	deg	0 to 360	.01
9 -12	Latitude	INT32	4	deg	-90 to 90	10^{-7}
13 -16	Longitude	INT32	4	deg	-180 to 180	10^{-7}
17 -20	Altitude	INT32	4	metre	-2000 to 120000	0.1
21-24	TOW	UINT32	4	sec	0 to 604800.000	0.001
25-26	MMF_Heading	UINT16	2	deg	0 to 360	.01
27-30	MMF_Latitude	INT32	4	deg	-90 to 90	10^{-7}
31-34	MMF_Longitude	INT32	4	deg	-180 to 180	10^{-7}
35-38	MMF_Altitude	INT32	4	metre	-2000 to 120000	0.1
39-42	MMF_TOW	UINT32	4	sec	0 to 604800.000	0.001

MMF_Status Bit Description:

This represents what the MMF_Status ***was*** for the last received MMF packet.

Assuming Bit 0 is the Least Significant Bit:

Bit #	Name	Description
31	MMF_STATUS_MMF_ENABLED_MASK	Map matching is enabled

30	MMF_STATUS_MMF_CALIBRATION_ENABLED_MASK	Map matching calibration is enabled
29	MMF_STATUS_MMF_RETROLOOP_ENABLED_MASK	Map matching retroloop is enabled
28	MMF_STATUS_GOT_DATA_MASK	Received a MMF packet
27	MMF_STATUS_SYSTEM_ALTITUDE_VALID_MASK	Altitude updated with MMF data
26	MMF_STATUS_SYSTEM_HEADING_VALID_MASK	Heading updated with MMF data
25	MMF_STATUS_SYSTEM_POSITION_VALID_MASK	Position updated with MMF data
24	MMF_STATUS_INVALID_DATA_SIZE_MASK	Incorrect number of data sets inside MMF packet
23	MMF_STATUS_HEADING_OUT_OF_RANGE_MASK	Hdg must 0 to 360 degrees
22	MMF_STATUS_POSITION_DRIFT_MASK	MMF solution failed position drift logic
21	MMF_STATUS_DATA_OVERFLOW_MASK	New MMF packet arrived before prior one used
20	MMF_STATUS_DATA_TOO_OLD_MASK	MMF Data was too old for processing
19	MMF_STATUS_NAV_UPDATED_MASK	Nav was updated with MMF feedback
18	MMF_STATUS_NAV_VALID_MASK	Nav is valid
17	MMF_MI_MALFORMED_INPUT_DATA_MASK	MI_MMF_InputData() found error in data
16	MMF_STATUS_HEADING_ERROR_RATE_TOO_BIG_MASK	MMF packet failed Heading Error logic
15	MMF_STATUS_HEADING_TURN_RATE_TOO_BIG_MASK	MMF packet failed Heading Rate logic
14	MMF_STATUS_SPEED_TOO_LOW_MASK	MMF packet failed Speed logic
13 to 8	undefined	Reserved
7	MMF_BITMAP_RESERVED_TWO_MASK	Copy of MMF packet bitmap register
6	MMF_BITMAP_RESERVED_ONE_MASK	Copy of MMF packet bitmap register
5	MMF_BITMAP_ALTITUDE_VALID_MASK	Copy of MMF packet bitmap register
4	MMF_BITMAP_HEADING_VALID_MASK	Copy of MMF packet bitmap register
3	MMF_BITMAP_POSITION_VALID_MASK	Copy of MMF packet bitmap register
2	MMF_BITMAP_ALTITUDE_FORCED_MASK	Copy of MMF packet bitmap register
1	MMF_BITMAP_HEADING_FORCED_MASK	Copy of MMF packet bitmap register
0	MMF_BITMAP_POSITION_FORCED_MASK	Copy of MMF packet bitmap register

API:

```
typedef struct
{
  UINT32     MMF_Status[17];
  UINT16     Heading;
  INT32      Latitude;
  INT32      Longitude;
  INT32      Altitude;
  UINT32     TOW;
  UINT16     MMF_Heading;
  INT32      MMF_Latitude;
  INT32      MMF_Longitude;
  INT32      MMF_Altitude;
  UINT32     MMF_TOW;

} MI_MMF_State_Type;
```

6.38.13 Msg-ID 0x30;Sub-ID 0x64 (SID_GSA)

MSG ID:

Number: 0x30
Name: MID_DrOut

[17] See "*MMF_Status Bit Description*" above

SUB ID:

Number: 0x64
Name: SID_GSA
Purpose: Sirf Binary equivalent of NMEA GSA message.

Message Length:

32 bytes

Rate:

Output when Nav is complete.

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	integer	**0x30**	1
2	Sub-ID	UINT8	1	integer	**0x64**	1
3	mode1	UINT8	1	integer	1 = Manual-forced to operate in 2D or 3D mode 2 = 2D Automatic- allowed to automatically switch 2D/3D	1
4	mode2	UINT8	1	integer	1 = Fix not available 2 = 2D(<4 SVs used) 3 = 3D(> 3 SVs used)	1
5-8	satellite_used_0_31	UINT32	4	bitmap	Bit 0 = SV 0 Bit 1 = SV 1 .. .. Bit 31 = SV 31 If bit is set to 1 then SV was used in solution.	1
9-12	satellite_used_32_63	UINT32	4	bitmap	Bit 0 = SV 32 Bit 1 = SV 33 .. .. Bit 31 = SV 63 If bit is set to 1 then SV was used in solution.	1
13-16	GDOP	FLOAT32	4	metre	Geometric Dilution of Precision	1
17-20	HDOP	FLOAT32	4	metre	Horizontal Dilution of Precision	1
21-24	PDOP	FLOAT32	4	metre	Position Dilution of Precision	1
25-28	TDOP	FLOAT32	4	metre	Time Dilution of Precision	1
29-32	VDOP	FLOAT32	4	metre	Vertical Dilution of Precision	1

API:

```
typedef struct
{

  UINT32  satellite_used_0_31;
  UINT32  satellite_used_32_63;
  FLOAT32 GDOP;
  FLOAT32 HDOP;
  FLOAT32 PDOP;
```

```
  FLOAT32 TDOP;
  FLOAT32 VDOP;
  UINT8   mode1;
  UINT8   mode2;

} MI_GSA;
```

6.38.14 Msg-ID 0x30;Sub-ID 0x65 (SID_DR_NVM)

MSG ID:

Number: 0x30
Name: MID_DrOut

SUB ID:

Number: 0x65
Name: SID_DR_NVM
Purpose: Output contents of Sirfdrive NVM at boot. Used to seed offline test runs.

Message Length:

167 bytes

Rate:

Output once at start.

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	***0x30***	1
2	Sub-ID	UINT8	1	N/A	***0x65***	1
3-4	SeqNum	INT16	2	integer	2 to 32767	1
5-6	OkAcrossReset	BOOL16	2	boolean	0 = false, 1 = true	1
7-10	DRHeading	FLOAT32	4	degrees	0.0 to 360.0	1
11-14	DRHeadingError	FLOAT32	4	degrees	0.0 to 360.0	1
15-18	DRSpeedError	FLOAT32	4	m/sec	0.0 to 600.0[18]	1
19-22	DRPositionError	FLOAT32	4	metres	0.0 to 6.0e6f	1
23-26	SpeedSf	FLOAT32	4	dimensionless	+/- full res	1
27-30	OdoSpeedSf	FLOAT32	4	dimensionless	+/- full res	1
31-34	HeadingRateBias	FLOAT32	4	deg/sec	+/- full res	1
35-38	HeadingRateSf	FLOAT32	4	dimensionless	+/- full res	1
39-46	HeadingRateSf_SD	DOUBLE64	8	dimensionless	0.0 to +full res	1
47-50	LFSpeedSF	FLOAT32	4	dimensionless	+/- full res	1
51-54	RFSpeedSF	FLOAT32	4	dimensionless	+/- full res	1
55-58	LRSpeedSF	FLOAT32	4	dimensionless	+/- full res	1
59-62	RRSpeedSF	FLOAT32	4	dimensionless	+/- full res	1
63-66	AxleLength	FLOAT32	4	metres	0.0 to 10.0	1
67-70	AxleSep	FLOAT32	4	metres	0.0 to 50.0	1
71-74	AntennaDist	FLOAT32	4	metres	+/- 50.0	1
75-76	FirstHRSFDone	BOOL16	2	boolean	0 = false, 1 = true	1
77-78	DiffWheelSpdCalOK	BOOL16	2	boolean	0 = false, 1 = true	1

[18] COCOM speed limit

79-80	LFSpeedSFCalOk	BOOL16	2	boolean	0 = false, 1 = true	1
81-82	RFSpeedSFCalOk	BOOL16	2	boolean	0 = false, 1 = true	1
83-84	LRSpeedSFCalOk	BOOL16	2	boolean	0 = false, 1 = true	1
85-86	RRSpeedSFCalOk	BOOL16	2	boolean	0 = false, 1 = true	1
87-88	DrNavControl	INT16	2	bitmap	0x1 = GPS_ONLY_REQUIRED 0x2=DR_NAV_WITH_STORED_CAL_OK 0x4 = DR_NAV_REQUIRES_GPS_CAL 0x8 = DR_NAV_ONLY_REQUIRED	1
89-96	RawLonAccel	DOUBLE64	8	m/sec^2	+/- 50.0	1
97-104	RawLatAccel	DOUBLE64	8	m/sec^2	+/- 50.0	1
105-112	RawUpAccel	DOUBLE64	8	m/sec^2	+/- 50.0	1
113-120	YawAngle_rads	DOUBLE64	8	radians	0.0 to (2.0 * PI) ??	10^{-7}
121-128	YawAngleSD_rads	DOUBLE64	8	radians	0.0 to (2.0 * PI)??	10^{-7}
129-136	PitchAngle_rads	DOUBLE64	8	radians	0.0 to (2.0 * PI)??	10^{-7}
137-144	RollAngle_rads	DOUBLE64	8	radians	0.0 to (2.0 * PI)??	10^{-7}
145-146	Sensor2YawedDone	BOOL16	2	boolean	0 = false, 1 = true	1
147-148	YawAngleComputed	BOOL16	2	boolean	0 = false, 1 = true	1
149-150	UserResetWithData	BOOL16	2	boolean	1= User has issued Reset with Data for us to update DR with. 0= No data from user to update DR with.	1
151-152	ValidDrCal	BOOL16	2	boolean	0 = false, 1 = true	1
153 – 154	OdoSpeedSFCalOk	BOOL16	2	boolean	0 = false, 1 = true	1
155	SensorDataType	UINT8	1	Bus Type	0 = DIRECT_ODO_GYRO_REV 1= NETWORK_ODO_GYRO_REV 2= NETWORK_DIF_PULSES_REV 3=NETWORK_DIF_SPEEDS_REV 4=NETWORK_DIF_ANGLRT_REV 5=NETWORK_ODO_GYRO_NOREV 6 =NETWORK_DIF_PULSES_NOREV 7=NETWORK_DIF_SPEEDS_NOREV 8 =NETWORK_DIF_ANGLRT_NOREV	1

					9=NET_GYRO_ODO_STEER_ACCEL 12= NET_ONE_GYRO_THREE_ACCELS	
156-159	CheckSum	UINT32	4	CRC code	0x0 to 0xFFFFFFFF	1
160-163	Reserved1	UINT32	4	Undefined	Internal use	1
164-167	Reserved2	UINT32	4	undefined	Internal use	1

API:

```
typedef struct
{
INT16    SeqNum;
BOOL16   OkAcrossReset; // TRUE:  DR data can be used after a RESET
                        // FALSE: DR data cannot be used after a RESET

FLOAT32   DRHeading;          // deg
FLOAT32   DRHeadingError;     // deg, 1-sigma
FLOAT32   DRSpeedError;       // m/sec, 1-sigma
FLOAT32   DRPositionError;    // meters, 1-sigma

//
// Odometer data
//
FLOAT32   SpeedSf;            // dimensionless
FLOAT32   OdoSpeedSf;         // dimensionless

//
// Gyro Data
//
FLOAT32   HeadingRateBias;    // deg/sec
FLOAT32   HeadingRateSf;      // dimensionless
DOUBLE64  HeadingRateSf_SD;   // dimensionless


//
// Differential Wheel Speed Data
//
FLOAT32   LFSpeedSF; // Left Front Wheel Speed Scale Factor,
                     // dimensionless
FLOAT32   RFSpeedSF; // Right Front Wheel Speed Scale Factor,
                     // dimensionless
FLOAT32   LRSpeedSF; // Left Rear Wheel Speed Scale Factor,
                     // dimensionless
FLOAT32   RRSpeedSF; // Right Rear Wheel Speed Scale Factor,
                     // dimensionless
FLOAT32   AxleLength;// Length of rear axle, meters
FLOAT32   AxleSep;   // Distance from rear to front axle, meters
                     //  (positive forward)
FLOAT32   AntennaDist; // Distance from rear axle to GPS antenna,
                       //meters (positive forward)

BOOL16 FirstHRSFDone; // Indicates First Heading Rate Scale Factor
                      // estimate was done

BOOL16 DiffWheelSpdCalOK; // Indicates whether DWS calibration has been
                          // successful

BOOL16 LFSpeedSFCalOk; // Indicates whether individual speed has been
                       // calibrated
```

```
BOOL16 RFSpeedSFCalOk; // Indicates whether individual speed has been
                       // calibrated
BOOL16 LRSpeedSFCalOk; // Indicates whether individual speed has been
                       // calibrated
BOOL16 RRSpeedSFCalOk; // Indicates whether individual speed has been
                       // calibrated

INT16  DrNavControl;// GPS Only, DR with Stored Cal, or DR with GPS Cal
DOUBLE64 RawLonAccel;
DOUBLE64 RawLatAccel;
DOUBLE64 RawUpAccel;

DOUBLE64 YawAngle_rads ;   // radians
DOUBLE64 YawAngleSD_rads;  // radians

DOUBLE64 PitchAngle_rads;  // radians
DOUBLE64 RollAngle_rads;   // radians

BOOL16  Sensor2YawedDone;
BOOL16  YawAngleComputed;
BOOL16  UserResetWithData; //TRUE  = User has issued Reset with Data
                           //        for us to update DR with
                           //FALSE = No data from user to update DR
                           //        with

BOOL16   ValidDrCal;
BOOL16   OdoSpeedSFCalOk;
UINT8    SensorDataType; //Need to remember Bus Type Across reset
UINT32    CheckSum;

}  tDrRamData, *tDrRamDataPtr;
```

6.38.15 Msg-ID 0x41,Sub-ID 0x81 (MID_GPIO_State)

MSG ID:

Number: 0x41
Name: MID_DrIn

SUB ID:

Number: 0x81
Name: MID_GPIO_State

Message Length:

4 bytes

Rate:

Output at 1Hz.

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	n/a	**0x41**	1
2	Sub-ID	UINT8	1	n/a	**0x81**	1
3-4	gpio_state	UINT16	2	bitmap	Bit 0 is GPIO 0 Bit 1 is GPIO 1 .. .. Bit 15 is GPIO 15	1

API:

```
UINT16 gpio_state;
```

6.38.16 Msg-ID 0xAC;Sub-ID 0x09(SID_InputCarBusData)

MSG ID:

Number: 0xAC
Name: MID_DrIn

SUB ID:

Number: 0x09
Name: SID_InputCarBusData
Purpose: Output Car Bus Data to NAV

Message Length:

22 to 182 bytes

Rate:

Input at 1Hz

Binary Message Definition:

Byte #	Field	Data Type	Bytes	Units	Range	Res
1	Message ID	UINT8	1	N/A	*6.38.16.1.1 0xAC*	N/A
2	Sub-ID	UINT8	1	N/A	**6.38.16.1.1.1 0x09**	N/A
3	Sensor Data Type (SDT)	UINT8	1	N/A	0-127 1: Gyro, Speed Data, and Reverse 2. 4 Wheel Pulses, and Reverse 3: 4 Wheel Speed, and Reverse 4: 4 Wheel Angular Speed, and Reverse 5: Gyro, Speed Data, NO Reverse 6: 4 Wheel Pulses, NO Reverse 7: 4 Wheel Speed, NO Reverse 8: 4 Wheel Angular Speed, NO Reverse 9: Gyro, Speed Data, Reverse, Steering Wheel Angle, Longitudinal Acceleration, Lateral Acceleration 10: Yaw Rate Gyro, Downward Acceleration (Z), Longitudinal Acceleration (X), Lateral Acceleration (Y) 10-127: Reserved	N/A
4	Number of Valid data sets	UINT8	1	N/A	0-11	N/A
5	Reverse Bit Map N/A for SDT = 10	UINT16	2	N/A	Bit-wise indication of REVERSE status corresponding to each sensor data set, i.e. bit 0 corresponds to the first data set, bit 1 corresponds to the second data set, etc.	N/A
7+(N-1)* 16 (see Note 1)	Valid Sensor Indication	UINT8	1	N/A	Valid/Not Valid indication for each one of the 4 possible sensor inputs in a individual data set; when a particular bit is set to 1 the corresponding data is Valid, when the bit is set to 0 the corresponding data is NOT valid. Bit 0 corresponds to Data Set Time Tag Bit 1 corresponds to Odometer Speed Bit 2 corresponds to Data 1 Bit 3 corresponds to Data 2 Bit 4 corresponds to Data 3 Bit 5 corresponds to Data 4 Bits 6-7 : Reserved	N/A
8+(N-1)* 16 (see Note 1)	Data Set Time Tag	UINT32	4	msec	0-4294967295	1
12+ (N-1)*16 (see Note 1)	Odometer Speed (also known as VSS) N/A for SDT = 10	UINT16	2	m/sec	0 to 100	0.01

14+(N-1)* 16 (see Note 1)	**Data 1** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1,5, 9,10: Gyro Rate			Deg/sec	-120 to 120	0.01
	SDT = 2, 6: Right Front Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Right Front Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Right Front Wheel Angular Speed			rad/sec	-327.67 to 327.67	0.01
16+(N-1)* 16 (see Note 1)	**Data 2** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1: N/A			N/A	N/A	N/A
	SDT =2 , 6: Left Front Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Left Front Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Left Front Wheel Angular Speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9: Steering Wheel Angle			deg	-720 to 720	0.05
	SDT = 10: Downwards Acceleration			m/sec^2	-15 to 15	0.001
18+(N-1)* 16 (see Note 1)	**Data 3** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: Right Rear Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Right Rear Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Right Rear Wheel Speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9,10:Longitudinal Acceleration			m/sec^2	-15 to 15	0.001
20+(N-1)* 16 (see Note 1)	**Data 4** (Depends on SDT)	INT16	2	(Depends on (SDT))	(Depends on (SDT))	(Depends on (SDT))
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: Left Rear Wheel Pulses			N/A	4000	1
	SDT = 3, 7: Left Rear Wheel Speed			m/sec	0 to 100	0.01
	SDT = 4, 8: Left Rear Wheel Speed			rad/sec	-327.67 to 327.67	0.01

	SDT = 9,10: Lateral Acceleration			m/sec^2	-15 to 15	0.001
22+(N-1)* 16 (see Note 1)	Reserved	UINT8	1	N/A	N/A	N/A
Note 1: N indicates the number of valid data sets in the message						

API:

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

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

6.39 Measurement Engine Output Message

Table 233 : Measurement Engine Output Message

Message Name	MEAS_ENG_OUTPUT
Input or Output	Output
MID (Hex)	0x44
MID (Dec)	68
Message Name in Code	MID_MEAS_ENG_OUT
SID (Hex)	See below
SID (Dec)	See below
SID Name in Code	See below

This message wraps the content of another OSP message and outputs it to SiRFLive. The SID of this message equals to the MID of the message to be wrapped. The wrapped content includes the entire target message, comprising the start sequence, payload length, payload content, checksum and end sequence fields, as well.

Table 234: Measurement Engine Output SID Descriptions

SID		Description
Hex Value	Decimal Value	
0x04	4	MID_MeasuredTracker.
0xE1	225	MID_SiRFOutput
0xFF	255	MID_ASCIIData

Table 235: Message Fields Description

Name	Bytes	Binary (Hex)		Unit	ASCII (Dec)		Description
		Scale	Example		Scale	Example	
Message ID	U1						
Sub ID	U1		0xFF			255	The MID of the target message to be wrapped for output. The current value range is: 4, 225, 255.
Target Message	Variable						This is the entire target message including the message header and trailer.

6.40 Statistics Output Message

Table 236 : Statistics Output Message

Message Name	Statistics Output
Input or Output	Output
MID (Hex)	0xE1
MID (Dec)	225
Message Name in Code	MID_SiRFOutput
SID (Hex)	0x06
SID (Dec)	6
SID Name in Code	STATISTICS

This message generates quality of positioning data for collecting statistics. This message is sent once after system reset and it is fully documented in the SSB v2.4 manual document [3].

7 Message Processing Procedures

7.1 General Overview

7.1.1 Overview of Message Flow

7.1.1.1 Typical Message Flow in Stand-Alone Mode

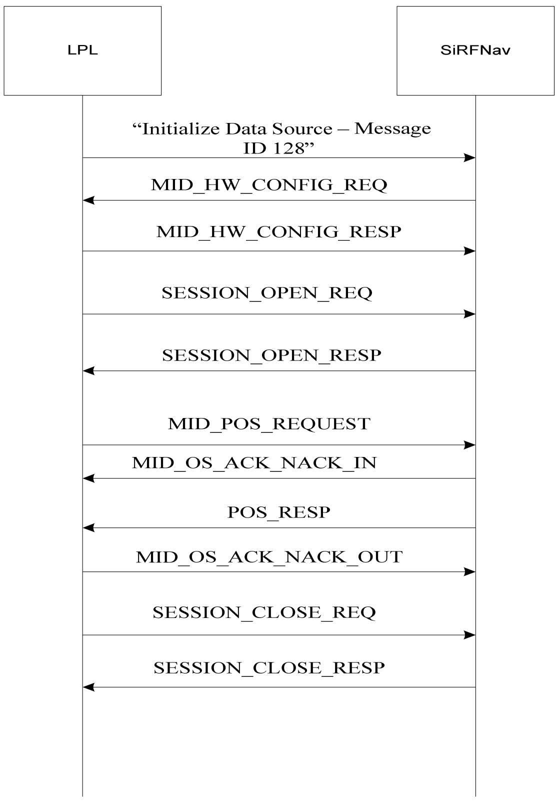


Figure 2 Example Stand-Alone Mode Message Flow

Figure 2 illustrates the message flow between a CP component, such as LPL and an SLC component, such as SiRFNav. This includes restarting the receiver with an "Initialize Data Source" message, exchanging HW configuration information, openin up a session, requesting position data and providing it, and finally, closing the session.

7.1.1.2 Typical Message Flow in Aided Mode

The overall message flow between CP and SLC interfaces during an aided GPS (AGPS) session is shown in Figure 3.

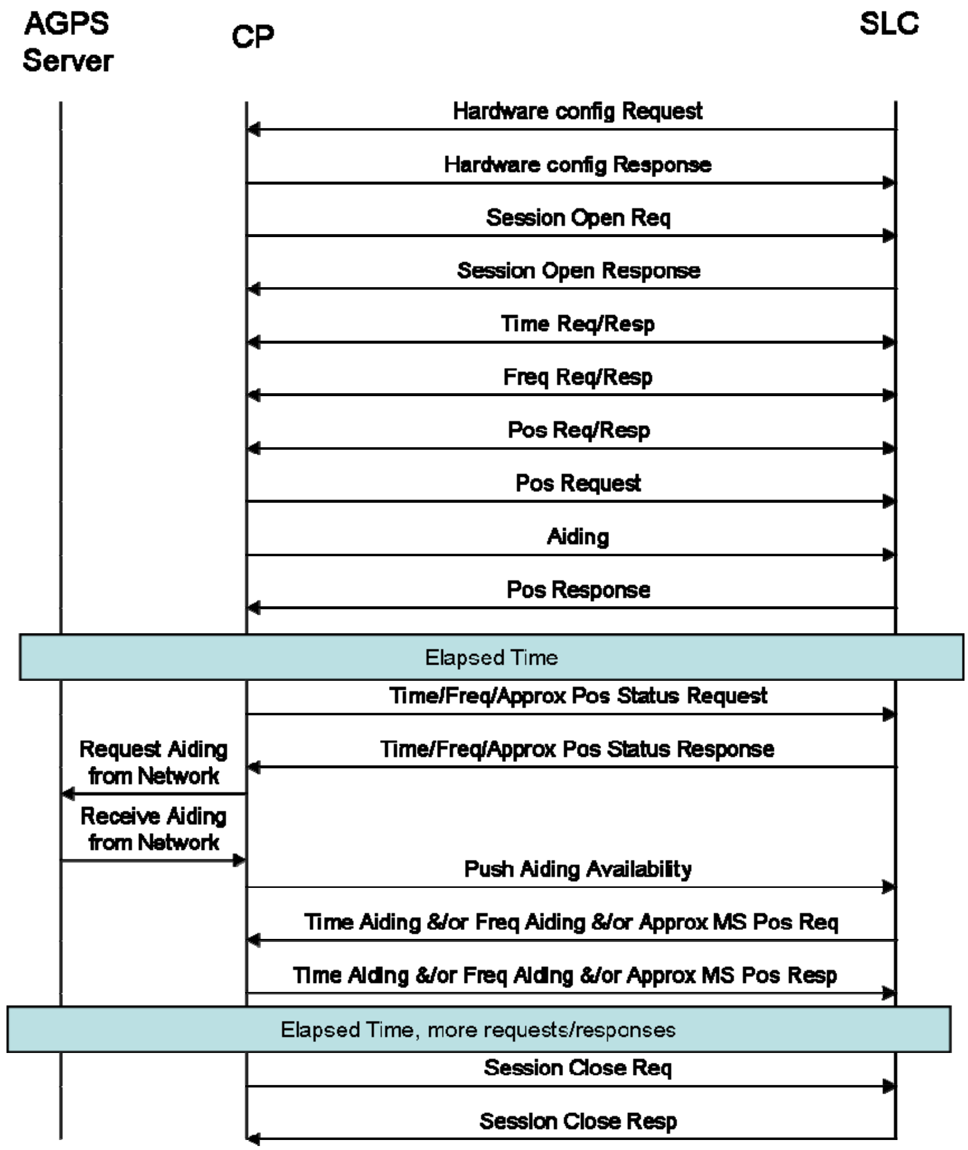


Figure 3 Example Aided GPS Message Flow

Similarly to the stand-alone mode, here a GPS session is also defined as the time between when the GPS receiver is started (e.g. power on) and when the GPS module is stopped (e.g. power off). A session is the time between "Session Open Request"/"Session Open Response" and "Session Close Request"/"Session Close Response". Figure 3 illustrates an example flow diagram from setting the hardware configur*ation* to closing the session.

Here, aiding is also part of the position request / response message tranzaction flow. In other scenarios, aiding can also be provided at any time while the session is open. For example, ephemeris can be pushed at any time while the session is open, even as the first step right after the session open is acknowledged.

Several other, alternative procedures such as the push-mode aiding procedure, and the time/frequency/approximate position status procedure are described further below in this section.

These two procedures provide the CP with more flexibility to give aiding to the SLC during a GPS session.

7.1.1.3 Typical Low Power Operation

Figure 4. below has a typical message sequence described for low power modes.

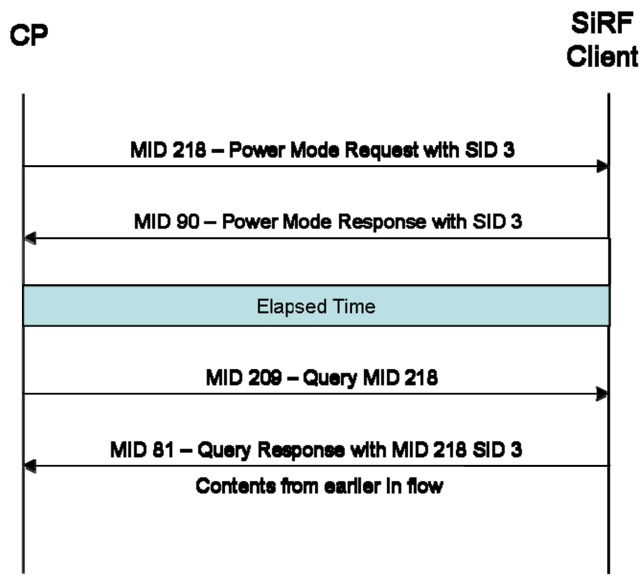


Figure 4. Typical low power messaging sequence

7.1.1.4 Push-Mode Aiding Procedure

Anytime after the first set of Time Transfer Request/Response, Frequency Transfer Request/Response, Approximate MS Position Request/Response (right after "Hardware Configuration Response") and before power down, the CP may push aiding information on the F interface under the following conditions:

1. When the CP obtains improved aiding accuracy:
The CP shall start the push-mode aiding procedure when new information about the accuracy of aiding information changes from the previous accuracy. The push-mode aiding procedure is triggered by a "Push Aiding Availability" with appropriate "AIDING_AVAILABILITY_MASK" from the CP.

The SLC shall compare the information in "Push Aiding Availability" with the internal information, and request for the aiding information which is more accurate on the CP side (using "Time Transfer Request", "Frequency Transfer Request", or 'MS Approximate Position Request"). If none of the newly available aiding is more accurate than the SLC's internal state, the SLC may not request for aiding from the CP. Special note: The CP should only send this information when accuracy has improved significantly.

2. When the CP detects change of aiding source:
If the position or frequency aiding sources have changed (e.g. base-station handover, a new network is entered), the CP may initiate a "forced aiding request" push-mode aiding procedure by sending a "Push Aiding Availability" with the appropriate "FORCED_AIDING_REQ_MASK". The SLC shall re-request aiding information indicated in the mask. If the SLC is not navigating, the SLC should use the new aiding information regardless of the uncertainty level of the new aiding. However, if SLC is navigating, the SLC will only use information which it currently does not have.

In terms of message handling:

Immediately after the reception of the "Push Aiding Availability" message, the SLC shall return a "Push_ACK_NACK" message before comparing the information in the message with its internal accuracy status. The SLC shall set the message to ACK if the SLC receives and understands the message properly. The SLC shall set the message to NACK if the SLC cannot properly understand the message (e.g. wrong parameter fields).

7.1.1.5 Time/Frequency/Approximate Position Status Procedure

At anytime after the "Hardware Configuration Response", the CP may query the internal status of the time, frequency and position accuracy from the SLC by sending the message "Time_Frequency_ApproximatePosition Request". The CP shall request the accuracy it wishes to query by setting the REQ_MASK of the message.

After the SLC receives the ""Time_Frequency_ApproximatePosition Request" message, the SLC shall immediately prepare the "Time_Frequency_ApproximatePosition Response" by filling the requested status (accordingly to REQ_MASK) with the current internal status. The STATUS_RESP_MASK in the response message shall match the REQ_MASK exactly. If a status is requested in the REQ_MASK, but the internal status is unknown, the SLC shall set the response status value(s) to "unknown", and keep the corresponding bit in STATUS_RESP_MASK as 1.

7.1.2 Message Organization

The Messages are organized by pairs of Request and Response (or Notification) messages. A Request Message can trigger the generation of a single or of a sequence of Response and/or Notification Messages. A requesting entity is allowed to have only one outstanding Request of a given type (specific MESS_ID) at any time. A Request is no longer outstanding as soon as any of the following events occurs:

- A Response or Notification of the corresponding type has been received.
- The elapsed time since the transmission of the request is larger than the current timeout value.

Every Response associated with a Request should be sent back to the requesting entity within the initial timeout delay. If the response did not arrive within the prescribed timeout delay to the requesting entity, the requesting entity can choose to send again the Request, or any other appropriate action.
If the requesting entity resends the same request, the timeout value will be doubled from the timeout value used during the previous attempt. At the end of the third attempt without any response received from the other end, no further attempt will be tried.
If the requested entity cannot send the response message within the timeout delay, it will retransmit a reject message instead.
No response message can be spontaneously sent without having previously received the associated Request for the other entity.

There are few exceptions to this general concept of associated Request/Responses pairs:

- Requests with no explicit response
  Reset GPS Command: As soon as the SLC receives this message, it shall reset itself. After noting a reset has occurred, the CP sees the hardware config request from the SLC and sends a hardware configuration response. No message has to be sent in reply to the Reset GPS Command.

- Unsolicited Information messages (no request)
  SLC Status message: SLC sends this message when one of the events described in the SLC Status event list has occurred. There is no obligation for the CP to act upon their reception.

Error Notification message: SLC sends this message to inform the CP of an error occurrence part of the list predefined for the error notification list. There is no obligation for the CP to act upon their reception.

Illustrating such message organization, Figure 5 and Figure 6 show how to the message request / response and notifications would detail a generic AGPS message flow depicted above in Figure 3.

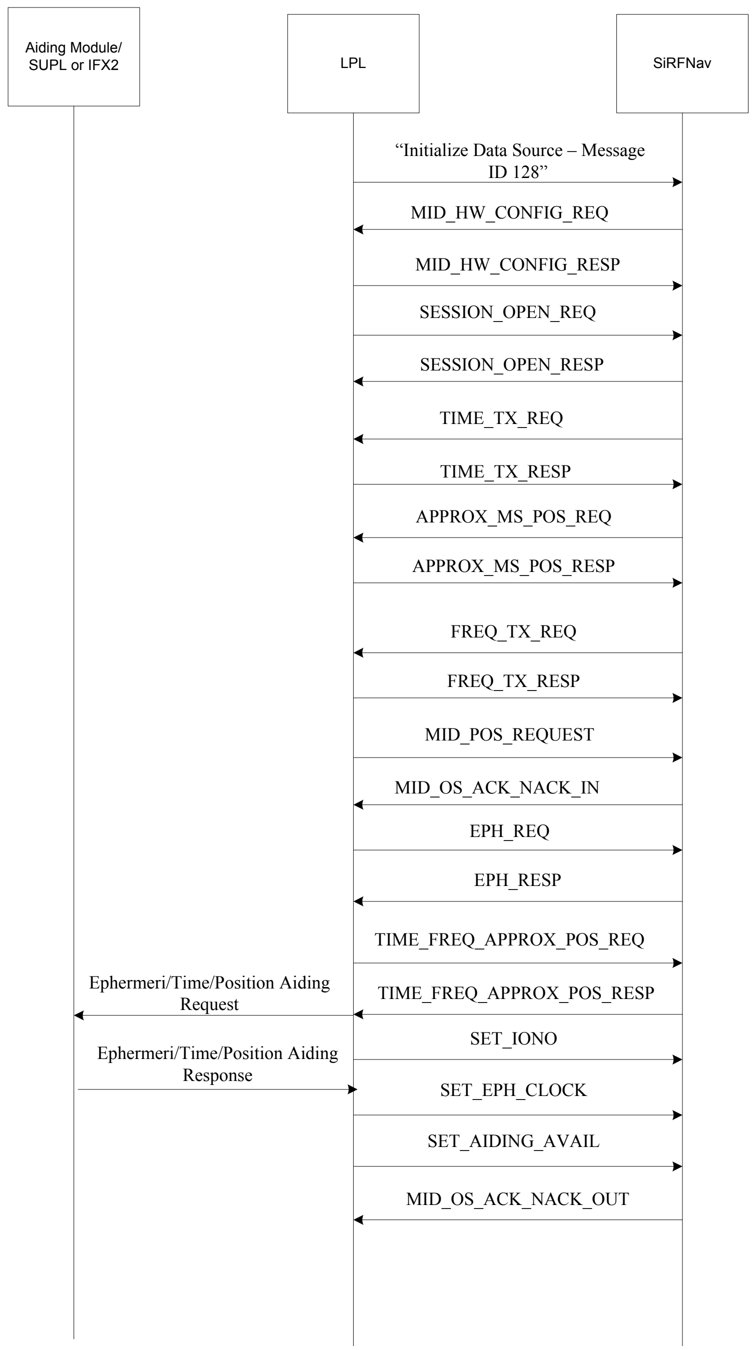


Figure 5. AGPS messaging sequence with response details. Session Part I.

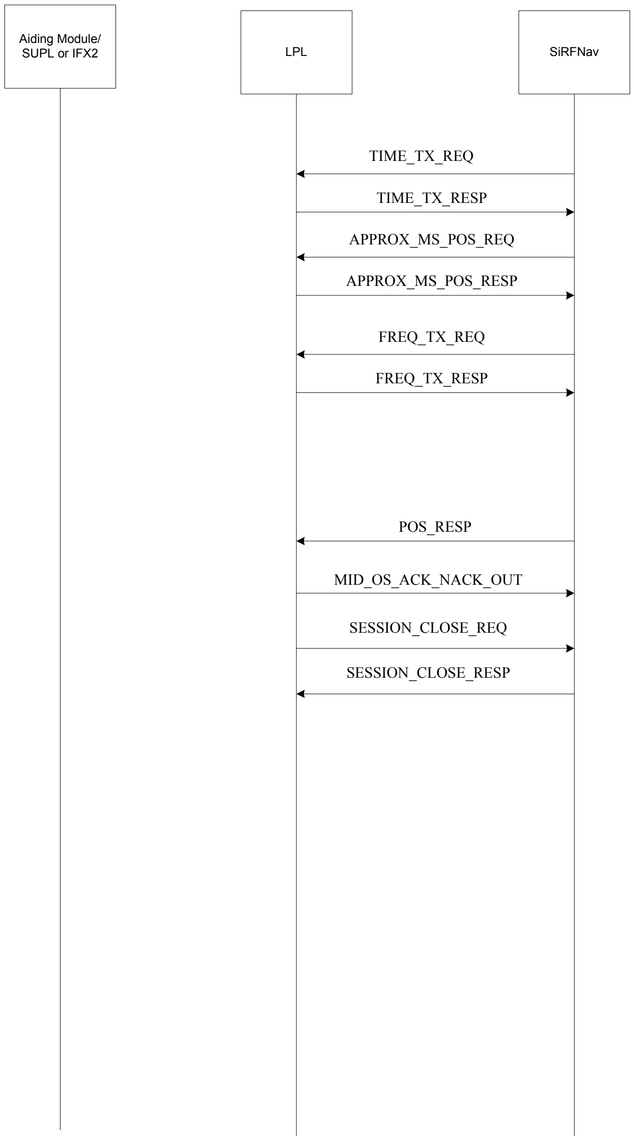


Figure 6. AGPS messaging sequence with response details. Session Part II.

General Error Handling Procedures on SLC side

-Upon receiving any request, if data is not immediately available, the SLC shall respond with a Reject Message with REJ_REASON set to "not ready". It will send a response message any time, as soon as the data becomes available.

-Upon receiving any request, if data will not be available and will not be available until the next power cycle, the SLC shall send a Reject message with REJ_REASON set "not available". No other Response shall be sent afterwards.

-Upon receiving a Reject message with REJ_REASON set to "not available", the SLC shall not expect any response for this request, and shall not request the same information later on.

-Upon receiving a Reject message with REJ_REASON set to "Wrongly formatted message", and a request of the rejected message is still pending, the SLC shall send the request once again instantly; otherwise the SLC will take no action.

-Upon receiving a Wrongly Formatted Message, the SLC shall send a "Reject" Message with "REJ_REASON" field set to "Wrongly formatted message" (see Glossary for definition of Wrongly Formatted Messages).
-Upon receiving a message with a reserved MESS_ID (see **Error! Reference source not found.**), the SLC shall send an error notification message with ERROR_REASON field set to "MESS_ID not recognized".
-Upon receiving an error notification message with ERROR_REASON field set to "MESS_ID not recognized", the SLC shall silently discard the message.

General Error Handling on CP side

- Upon receiving any request (except HW Configuration Request), if data is not immediately available, the CP shall respond with a Reject Message with REJ_REASON set to "not ready". It will send a response message any time, as soon as the data becomes available.
- Upon receiving any request (except HW configuration Request), if data will not be available and will not be available until the next power cycle, the CP shall send a Reject message with REJ_REASON set "not available". No other Response shall be sent afterwards.
- Upon receiving a Reject message with REJ_REASON set to "not available", the CP shall not expect any response for this request, and shall not Request the same information later on.
- Upon receiving a wrongly formatted query, the CP shall send a Reject message with REJ_REASON set to "Wrongly formatted message".
- Upon receiving a Reject message with REJ_REASON set to "Wrongly formatted message", and a request of the rejected message is still pending, the CP shall send the request once again instantly; otherwise the CP will take no action.
- Upon receiving a message with a reserved MESS_ID (see **Error! Reference source not found.**)), the CP shall send an error notification message with ERROR_REASON field set to "MESS_ID not recognized".
- Upon receiving an error notification message with ERROR_REASON field set to "MESS_ID not recognized", the CP shall silently discard the message.

7.1.3 "Reject message" vs. "Error Notification" Messages

There are two methods of error reporting:

- Either a Request cannot be fulfilled, and a "Reject" message is sent instead of the normal Reply message, with an code to identify the reason of the reject; this is a "solicited" error reporting. In this category falls "data not available" or trying to open a session when the session has already been opened.
- Or a condition, not associated to a request arose, and the SLC needs to report the problem to the CP for possible action. The Error Notification message has been introduced specifically for this ; this is an unsolicited error reporting. In this situation falls the incompatibility between Air-Interface revision numbers.

7.1.4 Error handling

The errors can be classified in three categories:

- The ones sent in a Reject Message, informing the requesting entity that the requested action has not been completed and giving the reason for the non completion. This category usually leads to a correction of the problem and repetition of the request by the requesting entity.
- The ones sent in an Error Notification message, informing the other entity that a change in the environment (but not triggered by a Request) occurred, and needs intervention. In this category falls the Air-interface OSP revision number incompatibility.

- The ones reported in an Error Notification message, informing that some error has occurred, but not destined to the other entity. The other entity will silently discard the message (i.e. do nothing), and will continue the processing. Those messages are meant to be captured by any message collection device connected between communicating entities, and meant to inform of a problem during the integration phase. Wrongly formatted messages fall into this category.

7.1.5 Message Time-out Procedures

- When the CP sends a "Reject" message with reason as "Data Not Ready", the SLC shall continuously send the request message every 4 seconds until the response message or the reject message with data not available is received.
- When a response message is not received, the sender of the request message shall re-try the sending of the message up to 3 times, starting after 6 seconds after the initial message, and doubling the time-out value at each retry.

7.2 Power ON/Power OFF

Power ON procedure:

When the CP needs to start a Geolocation Session, it turns ON the SLC's power. After Initialization and self-check, the SLC shall send the hardware config request message, which notifies the CP that the SLC is alive, and the message transfer can start. The Power ON sequence also directs the SLC to immediately start the GPS processing, with whatever aiding information is available at the SLC at that time.

Error Recovery on CP side:

If the hardware config request message is not received within (TBD at design phase on a case by case basis) seconds, the CP shall cycle the SLC's power OFF and ON again. It is to note that CP needs to allow enough time for the SLC to send the hardware config request after power ON (compatible with the TBD value), otherwise, the SLC will never start properly.

Error Recovery on SLC side:

The SLC shall wait (TIME_OUT at design phase on a case by case basis) seconds after outputting the hardware config request for the CP to send the Hardware Configuration Response message. If the Hardware configuration response never arrives at the SLC, then no session is opened and no aiding requests are sent. The SLC positions autonomously in this case.

Power OFF procedure:

To power OFF the SLC, after having sent a "Session Closing Request" with "SESSION_CLOSE_REQ_INFO" set to "Session Closing Requested", the CP shall wait for the "Session Closing Notification" with "SESSION_CLOSE_STATUS" field set to "Session Closed" before turning the power off. The Response message notifies the CP that all context has been saved in non-volatile memory, and that the SLC can be safely turned OFF at any time.

7.3 GPS Soft Reset

Aside from the power cycle, or the hard reset using HW pin, it is possible to reset the GPS function by sending a Reset GPS Command.

GPS Soft Reset Procedure

-When the CP wants to start a GPS session through software messaging only, it shall send a "Reset GPS Command" message and wait for (TBD) seconds to receive the hardware config request message.

-Upon receiving a "Reset GPS Command" message with

1)-"RESET TYPE" field set to "Hot Reset", the SLC shall execute a Software Reset without clearing non volatile memory.

2)-"RESET TYPE" field set to "Cold Reset", the SLC shall clear stored ephemeris , RTC Time and stored MS location from non volatile memory and then execute a Software Reset.

3)- "RESET TYPE" field set to "Factory Reset", the SLC shall clear entire non volatile memory and then execute a Software Reset.

In all of the previous cases, the SLC shall flush the message buffers before restart.

Error Handling

-If the CP does not receive a "Hardware Configuration Request" Message within the timeout, the CP shall cycle the power.

7.4 Advanced Power Management (APM)

As described in the message specification sections above, the SiRFstarIV power management also includes a Micropower Management (MPM) mode. This is a more advanced, improved version of the SiRFStarIII power management solution, the flow of which is summarized in this section, below.

The advanced Power Management is a sophisticated power control method applied between successive fixes, and between fixes requirements. It makes the assumption that the CP keeps the "Power ON" all the time on the SLC subassembly. After the CP enables it, it is under SLC's control.
The CP turns the APM mode "ON", by sending the "Set APM" message; the CP verifies that the command has been executed by checking the APM_STATE field in the "Ack APM" message.
In the simplest manner, the SLC can be put to Hibernate mode immediately by the following procedure:

1. An OSP session is open (i.e. Session Open Request/Notification have been exchanged)
2. The CP sends "Set APM" with APM_ENABLE to be "ON" (other parameters are "don't cares", and can be set to POWER_DUTY_CYCLE=1 and TIME_DUTY_PRIORITY=1, for example), and the CP receives "Ack APM"
3. The CP sends "Session Close Request", and receives "Session Close Notification".

After step 3, the SLC is in hibernate mode.

Alternatively, the APM can be turned "ON", either with priority to power reduction (the SLC shall try to keep the power duty cycle lower or equal to the prescribed value in the "POWER_DUTY_CYCLE" field, possibly by slowing down the fix update rate), or to performance (the SLC shall try to keep up with the periodicity between fixes, possibly by increasing the power consumption) using the "TIME_DUTY_PRIORITY" field.

APM enable procedure

-The CP shall send a "Set APM" message with APM_ENABLE field set to "1", POWER_DUTY_CYCLE field set to the desired power consumption (from 1 for 5% , to 20 for 100% of the total power), and TIME_DUTY_PRIORITY field set to "1" for priority to the performance and to "2" for priority for power reduction.
-The SLC shall send an "Ack APM" message with APM_STATE set to "1".

APM disable Procedure

-The CP shall send a "Set APM message with APM_ENABLE field set to "0". The others fields (POWER_DUTY_CYCLE and TIME_DUTY_PRIORITY) are not relevant.
-The SLC shall send an "Ack APM" message with APM_STATE set to "0".

Error handling

Fields out of range in the Set APM message:
-the SLC shall send a "Reject" message with REJ_REASON set to "Wrongly formatted message".

No APM available on this hardware platform
-The SLC has no means to find out if the hardware platform is "APM enabled". Upon reception of a "Set APM" message, the SLC shall return an "Ack APM" message with the APM_STATE field set to the APM_ENABLE field value in the "Set APM" message. However, the expected power reduction will not be achieved.

APM mode "ON", but no position can be computed
-If the SLC goes through the whole search domain without finding satellites or being able to compute a position, the SLC shall send a "no position" result message on the Air-Interface (Air-interface protocol-dependent, and only if this capability is defined). The SLC shall also send a "SLC Status" message on the F interface with STATUS field set to "no fix available after full search".
-Upon reception of this message, in order to save power, the CP may, either change the APM configuration, or shut down the SLC altogether.

CP wants to change the APM mode with APM already enabled
-Please see details in the APM document.

7.5 Hardware Configuration

As soon as the SLC is up and running it shall send a hardware config request message. The CP sends the hardware configuration response so that the software will know what the capabilities from the CP are, and won't try to access capabilities that are not present. It will also allow the dynamic change of the HW capabilities from one power cycle to another one.

The hardware config request needs to be the first messages sent from the host. In a tracker product, the hardware config request should be sent at part of the SiRFNav Start/Stop messages (see product's MEI documentation for details). When the product is a PVT, the hardware config request message is still sent from the SLC and should be ignored (i.e. no response sent). Without a hardware config response message received, the OSP will be backwards compatible to SSIII GSW and thus the SLC will operate autonomously.

In this category, there are:

1) Time transfer capabilities

The time can be sent by CP to SLC as a H/W signal time tagging a particular event, followed by a "Time Transfer Response" message, indicating what was the time of the H/W event. This is the "Precise Time Transfer" Mode.
If no H/W time transfer interface is present, the time can still be transmitted with a lower accuracy as an isolated "Time Transfer Response" message. This is the "Coarse Time Transfer" mode.
Whether some time transfer capability is present, and which one if any, is found in the "Hardware Configuration Response" Message. Please note that "Precise Time Transfer" and "Coarse Time Transfer" are exclusive of each other.

2) Frequency Transfer Capabilities

The Frequency can be either referred to the SLC clock or to the reference clock input to the counter. The HW_Config shall indicate whether the frequency transfer is counter method or not. Also the frequency transfer response now has a bit which identifies the relation of each frequency transfer message to either SLC clock or the reference clock to the counter. Whether some Frequency transfer capability is present, and which one if any, is found in the "HW_CONFIG" field of the "Hardware Configuration Response" Message. Please note that all Frequency transfer methods are exclusive of each other.

3)-Nominal Frequency aiding

If a "Counter" type frequency transfer is implemented, HW_CONFIG shall indicate whether the reference clock input to the counter is on or not. SLC shall NEVER read the counter when the reference clock is off. The "NOMINAL_FREQ" field in the "Hardware Configuration Response" Message gives the exact frequency (derived from the CP clock) applied to the counter input. This is necessary to determine the relative frequency error between CP clock and SLC clock from the absolute frequency difference measurement.

Procedure

- At the Power ON, the SLC shall send a hardware config request message.
- Upon receipt of the hardware config request the CP shall send a "Hardware Configuration Response" message describing the implemented hardware capabilities.
- Upon receiving a "Hardware Configuration Response" message, the SLC shall store the hardware capabilities only for the duration of the current power cycle. The subsequent request messages issued by the SLC will depend on HW configuration message. Most notably, time and frequency transfer requests will be issued depending on the contents of the HW configuration message.

Error recovery

- Check the Power ON/Power OFF error recovery section.

7.6 Serial Port management

Depending on the hardware configuration, the SLC has one or two serial ports available for communication. The ports are named "Port A", "Port B", up to the number of ports available.

- Only port A is available for all SiRFLoc communications.
- Port B is reserved for SiRF internal usage (NOTE – I don't think this is true?).
- The baud rate settings for port A or port B can be changed through the "Serial Port Settings Request/Response" pair, sent over port A only.
- The baud rate settings shall be stored in non-volatile memory.

Procedure for baud-rate change ON "port A" FROM port A:

Normal procedure

- CP sends a "Serial Port Settings Request" message with PORT field set to "0" , and BAUD_RATE field set to the "new" baud rate on port A. The message is transmitted at the "old" baud rate port A. It is the last message the CP shall transmit at the "old" baud rate on port A.
- Upon reception, the SLC shall flush the message buffer and then acknowledge by sending a "Serial Port Settings Response" message with PORT field set to '0', BAUD_RATE field set to the "new" baud rate, and ACK_NUMBER field set to '1'. This message is transmitted at the

"old" baud rate on port A. It is the last message sent at the "old" baud rate on the port A. Then the SLC waits one second during which it will transmit no message and accept no message.

- Upon reception of the first "Serial Port Setting Response" message, and within one second after reception, the CP will change the baud-rate settings on its Port. It shall transmit no message, but shall accept incoming messages at the "new" baud rate.
- After the one second delay, the SLC shall send a second "Serial Port Setting Response" message with PORT field set to '0', BAUD_RATE field set to the "new" baud-rate, and ACK_NUMBER set to '2', as an acknowledgement the baud rate has been effectively changed. This message shall be transmitted at the "new" baud rate on port A.
- Upon reception of the second "Serial Port Setting Response" message with ACK_NUMBER set to '2', CP shall resume the normal exchanges using port A at the "new" baud rate.

Error handling:

1) If the CP does not receive "Serial Port Setting Response" message with ACK_NUMBER set to '1' within 15 seconds after having sent "Serial Port Setting Request" message, the CP shall "hard reset" the SLC by HW pin, or "power cycle".
2) if CP does not receive "Serial Port Setting Response" message with ACK_NUMBER set to '2' within 2 seconds from the first "Serial Setting Response" message with ACK_NUMBER set to '1', the CP shall "hard reset" the SLC by HW pin, or power cycle. Then it shall try to communicate at "new" and then "old" baud rate.

Procedure for baud-rate change ON "port B" FROM "port A":

Normal procedure

- CP flushes the buffer for the outgoing messages on port B, so no more messages shall be transmitted on port B. CP sends a "Serial Port Settings Request" message with PORT field set to "1", and BAUD_RATE field set to the "new" baud rate on port B. The message is transmitted on port A at the baud rate in use on port A at that time.
- SLC flushes the message buffer on port B and then acknowledges by sending a "Serial Port Settings Response" message with PORT field set to '1', BAUD_RATE field set to the "new" baud rate, and ACK_NUMBER field set to '1'. This message is transmitted on port A, at the baud rate in use on port A at that time.
- Then the SLC waits one second during which it will transmit no message and accept no message on port B. The message traffic on port A is unaffected, though.
- After the one second delay, the SLC shall send a second "Serial Port Settings Response" message with PORT field set to '1', BAUD_RATE field set to the "new" baud-rate, and ACK_NUMBER set to '2', as an acknowledgement the baud rate has been effectively changed. This message shall be transmitted on port A, at the baud rate in use on port A at that time.
- Upon reception of the second "Serial Port Setting Response" message with ACK_NUMBER set to '2', CP shall resume the normal exchanges on port B, at the "new" baud rate.

Error handling:

1) If CP does not receive "Serial Port Settings Response" message with ACK_NUMBER set to '1' within 15 seconds after having sent "Serial Port Settings Request" message, the CP shall "hard reset" the SLC by HW pin, or "power cycle".
2) If CP does not receive "Serial Port Settings Response" message with ACK_NUMBER set to '2' within 2 seconds from the first "Serial Settings Response" message with ACK_NUMBER set to '1', the CP shall "hard reset" the SLC by HW pin, or power cycle.

7.7 Session Opening/Session Closing

After the SLC responded to an incoming HW_CONFIG_REQ message, it is ready to receive a "Session Opening Request" message. The latter message notifies the SLC that the connection with the SLS has been established and that air-interface messages can be exchanged. The SESSION_OPEN_REQ_INFO in the message allows the SLC to determine what "Geolocation Air-Interface protocol" to activate to dialog with the SLS. This allows the use of multi-mode MS's. A multi-mode MS supports several Geolocation air-interfaces which are determined at the opening of the Geolocation session.

The special case of "request for standalone solution" means that the position request actually comes from MS user whether the user is out of the cell phone coverage area.
The special case of "request without air-interface" means that the position request actually comes locally from the MS user but the cell phone can not obtain an air-interface connection, therefore no Geolocation aiding will be available from a remote SLS. The SLC will use all information available except Geolocation messages. The implicit aiding (time transfer, frequency transfer, approximate MS position) might be available, if the MS is in a wireless coverage area, and if the air-interface has the capability to provide the information. The Position Result will be obviously available only locally, and will be returned by a "Position Results" message to the CP (for local display to the MS user).

The "Session Closing Request" message with "SESSION_CLOSE_REQ_INFO" set to "Session Closed Requested" notifies the SLC that the Geolocation air-interface connection has been permanently broken. The SLC shall stop to send "Air-Interface" messages.

Session Opening procedure

When the CP is informed that an air-interface connection has been opened with the SLS or it has received an air-interface message from the SLS, it shall send a "Session Opening Request" message to the SLC, with the "SESSION_OPEN_REQ_INFO" field set to the appropriate air-interface identification.

Upon receiving a "Session Opening Request" message:

- If the SLC can open the session, it shall send a "Session Opening Notification" message with the "SESSION_OPEN_STATUS" field set to "Session Opening Succeeded". The SLC shall immediately start the "Air-Interface" protocol and messages process.
- If the SLC cannot open the session, it shall send a "Session Opening Notification" message with the "SESSION_OPEN_STATUS" field set to "Session Opening Failed".
- If the SLC cannot open the session within the timeout, it shall send a "Reject" message with "REJ_REASON" set to "Not ready".

  Session Opening Error Handling

  Upon receiving a Session Opening Request with SESSION_OPEN_REQ_INFO set to a valid opening mode, when the session is already open, the SLC shall send a Session Opening Notification message with SESSION_OPEN_STATUS set to "Session Opening Failed".

  Upon receiving a "Session Opening Notification" message with "SESSION_OPEN_STATUS" field set to "Session Opening Failed", the CP shall retry a "Session Opening Request" for at most three times, before declaring SLC failure.

Session Closing Procedure

When the CP is informed that the air-interface connection has been permanently closed, it shall send a "Session Closing Request" message, with the "SESSION_CLOSE_REQ_INFO" field set to "Session Closing Requested".

Upon receiving a "Session Closing Request" message:

- If the "SESSION_CLOSE_REQ_INFO" field is set to "Session Closing Requested", the SLC shall stop sending any air-interface message, and shall close the air-interface process. It shall store all information necessary to keep from session to session in the local non-volatile memory.

  If this action is safely done within the timeout period, the SLC shall send a "Session Closing Notification" Message with "SESSION_CLOSE_STATUS" field set to "Session Closed".

  If it is not done within the timeout, the SLC shall send a "Reject" message with "REJ_REASON" field set to "Not Ready".

  Session Closing Error Handling

  Upon receiving a Session Closing Request with SESSION_CLOSE_REQ_INFO set to "Session Closing requested", when no session is open, the SLC shall send a Session Closing Notification with SESSION_CLOSE_STATUS set to "Session closing failed".

7.8 Session Suspend/Session Resume

The CP might know about a transitory situation (like hand-over) where the air-interface connection is temporarily broken. The CP shall notify the SLC of such an occurrence by sending a special "Session Closing Request" message with "SESSION_CLOSE_REQ_INFO" field set to "Session Suspend Requested". Upon receiving such a message, the SLC will "freeze" the "geolocation air-interface protocol" (meaning that all timeout counters will be stopped).

When the CP knows about the reconnection, it shall send a special "Session Opening Request" with "SESSION_CLOSE_REQ_INFO" field set to "Session Resume Requested". Upon receiving such a message, the SLC will restart the "Geolocation Air-Interface protocol" where it left it after receiving the "Session Closing Request" Message with "Suspend" bit set.

Suspend Procedure

When the CP has been informed that an air-interface connection with the SLS has been temporarily closed, it shall send a "Session Closing Request" message with "SESSION_CLOSE_REQ_INFO" field set to "Session Suspend Requested".

> Note: In parallel with notifying the CP, we assume that the network will have sent a similar "suspend" notification to the MAS that will suspend air-interface activity in the SLS in a similar way.

Upon receiving a "Session Closing Request" message with "SESSION_CLOSE_REQ_INFO" field set to "Session Suspend Requested", the SLC shall "freeze" the air-interface process activity. In particular the timeout counters will be "frozen" at their current values. It shall send back a "Session Closing Notification" message with "SESSION_CLOSE_STATUS" field set to "Session Suspended". If the air-interface was already in a suspend state, the SLC shall still send a "Session Closing Notification" message with "SESSION_CLOSE_STATUS" set to "Session Suspended".

Error Handling

Upon receiving a Session Closing Request with SESSION_CLOSE_REQ_INFO set to "session Suspend requested", when no session is open, the SLC shall send a Session Closing notification with SESSION_CLOSE_STATUS set to "Session suspend failed".

Resume Procedure

When the CP has been informed that an air-interface connection with the SLS has been reestablished, it shall send a "Session Opening Request" message with "SESSION_OPEN_REQ_INFO" field set to "Session Resume Request".

> Note: In parallel with notifying the CP, we assume that the network will have sent a similar "Resume" notification to the MAS which will resume air-interface activity in the SLS in a similar way.

Upon receiving a "Session Opening Request" message with "SESSION_OPEN_REQ_INFO" field set to "Session Resume Request", the SLC shall "unfreeze" the air-interface process activity. In particular the timeout counters will be "reactivated". The SLC shall send a "Session Opening Notification" with the "SESSION_OPEN_STATUS" field set to "Session Resume Succeeded". If the air-interface was not in a suspend state, the SLC shall still send a normal "Session Opening Notification", with the "SESSION_OPEN_STATUS" field set to "Session Resume Succeeded".

7.9 Approximate MS Position Management

To speed up the position computation, The SLC can request from the network its approximate position by the "Approximate MS Position Request/Response" message pair.

The normal procedure is as follows:

- The SLC sends an "Approximate MS Position Request" message.
- The CP sends an "Approximate MS Position Response" message with the LAT, LON, ALT fields set to the best estimate of the MS location, and "EST_HOR_ERR" field set to the maximum radius of the position uncertainty around the given position.

Error handling:
- If the CP does not have the information available (and will not get it even later), it shall send a "Reject" message, with the "REJ_REASON" filed set to "Not Available".
- If the CP has no information ready (BUT could get the information eventually), it shall send a "Reject" message, with the "REJ_REASON" field set to "Not Ready"; if the information becomes available later, the CP shall immediately send an "Approximate MS Position Response" message, without waiting for a new request from the SLC.

7.10 Time Transfer

If some form of time transfer is available (as specified by the "Hardware Configuration Message"), the SLC may send "Time Transfer Request" Message. If the CP has access to the time, and depending on the HW_CONFIG word, it will:

- Either send a H/W pulse, then a "Time Transfer Response" Message in case the "Precise Time Transfer" mode has been activated.

- Send a "Time Transfer Response" Message in case the "Coarse Time Transfer" mode has been activated
- Send a Reject message.

All of these options must occur within a predetermined timeout period (defined at design time).

To assist in situations which could arise during the integration period, but should not occur in normal operation several special cases of "Reject" message have been added for situations where:

1) The Hardware Configuration Response has both bits "Precise Time Transfer" and "Coarse Time Transfer" asserted.
2) When a "Precise Time Transfer" mode has been declared in the "Hardware Configuration Response", a "Time Transfer Response" message is received with TT_TYPE field to all '0's (i.e. of "Coarse" type).
3) Conversely, whereas a "Coarse Time Transfer" mode has been declared in the "Hardware Configuration Response", a "Time Transfer Response" message is received with TT_TYPE field to all '1's (i.e. of "Precise" type).

In all preceding cases, the SLC shall send a "REJECT" message with REJ_REASON field set to "Wrongly formatted message".

Time transfer Procedure

Upon receiving a "Time transfer Request" Message:

1) If the CP is capable of generating a time pulse (as described in "Hardware Configuration" information), it shall send the time pulse within the timeout from the request message, then the "Time Transfer Response" message, within the timeout counted from the time pulse rising edge. The TT_TYPE field shall be set to "Precise Time Transfer". The "times" field in the "Time Transfer Response" message shall be set to the GPS time of the rising edge of the pulse; the "accuracy" field shall be set to the appropriate value according to the origin of the time information.
2) If the CP is not capable of generating a time pulse (as described in "Hardware Configuration" information), it shall send a "Time Transfer Response" message, within the timeout counted from the reception of the Request message. The TT_TYPE field shall be set to "Coarse Time Transfer". The "times" field in the "Time Transfer Response" message shall be set to the approximate GPS time at the time of message transmission; the "accuracy" field shall be set to the appropriate value according to the origin of the time information.

Error Handling

- If the CP either is not capable of giving time, or is not currently ready to give time, the CP shall send a "Reject" Message.
- If the time will not be accessible at all, the CP shall set the "REJ_REASON" field to "Not available".
- If the CP was not able to provide the information within the timeout, BUT it can eventually provide the information after a sufficient delay, the CP shall set the "REJ_REASON" field to "Not ready" bit.
- Upon receiving a "Time Transfer Response" Message in a "Precise Time Transfer" mode without receiving first a hardware time pulse, or receiving it before the message, the SLC shall send a "Reject" message with "REJ_REASON" field set to "No Time Pulse during Precise Time Transfer".

7.11 Frequency Transfer

If some form of frequency transfer is available (see "Hardware Configuration"), the SLC shall send "Frequency Transfer Request" Message to start frequency transfer.

If the information is available at the CP, the SLC may either require it once, or periodically from the CP. The periodicity depends on the quality of the CP clock, and will be determined at design time in agreement with SiRF technical team to ensure that the total frequency budget error stays within the limits. This frequency error refers to the error on the CP clock provided to the SLC. Each frequency error measurement from CP will be time tagged or set to FFFFFFFE if time tagging is not available. The relative frequency difference between CP and SLC is directly measured by SLC, or is "zero" in the case where the frequency transfer is referred to the SLC clock. It is important that the time transfer shall occur before the frequency transfer if time tagging is used.

Note 1: Applicable to the frequency counter method only: The SLC internal frequency measurement hardware is designed to measure the frequency of a clock signal derived from the CP clock, NOT the CP clock itself. The CP crystal clock frequency can be between 7MHz and 40MHz. To measure the relative frequency error between CP clock and SLC clock, the SLC needs to know the exact frequency it should receive on its internal frequency input when the CP clock is exactly at its nominal frequency. This nominal frequency value is found in the "NOMINAL_FREQ" field of the "Hardware Configuration Response" Message or the "NOMINAL_FREQ" field of the "Frequency Transfer Response" message.

Note 2: There are multiple situations to transfer CP frequency error from CP to SLC. Each one of them uses the SCALED_FREQ_OFFSET, REL_FREQ_ACC and TIME_TAG fields differently. Please refer to the technical application note on frequency transfer for specifics on how to fill out those fields appropriately.

Note 3: applicable to the frequency counter method only: SLC shall read the counter only when the reference clock is on and NEVER read the counter when the reference clock is off. Bit 8 of HW_CONFIG field in "Hardware Configuration Response" message and Bit2 of REF_CLOCK_INFO field in "Frequency Transfer Response" message indicate whether the reference clock input to the counter is on or off.

Single frequency transfer procedure

- The SLC shall send a "Frequency Transfer Request" Message to CP with Bit 1 in "FREQ_REQ_INFO" field set to "single request" or to "multiple request".
- The CP shall reply a single "Frequency Transfer Response" message, with SCALED_FREQ_OFFSET field set to the CP relative frequency difference multiplied by 1575.42MHz, in Hz, and REL_FREQ_ACC in ppm. If the frequency measurements are not reliable then the CP shall set this to 0xFF.
- The CP shall set the TIME_TAG field if time is available, else it will need to set this field to 0xFFFFFFFF to indicate that time transfer is not available
- The CP shall indicate in the CLOCK_REF of the "frequency transfer response" the relation between this frequency transfer message and the clock used. If the message is related to the SLC clock then Bit1 = 1 and if the message is related to the CP clock then Bit1 = 0

Multiple frequency transfers turn ON procedure

- By default, SLC always request multiple frequency transfers. But the actually mode (single vs. multiple) shall be decided with the handset design team.

- It is expected that in the multiple frequency transfer case, precise time transfer precedes the frequency transfer. Otherwise the CP shall set the TIME_TAG field of the "Frequency Transfer Response" message to either 0xFFFFFFFE or 0xFFFFFFFF.
- The SLC shall send a "Frequency Transfer Request" Message to CP with Bit 1 in "FREQ_REQ_INFO" field set to "multiple request", and Bit 2 set to "ON"
- If the frequency error is known, the CP shall periodically send a "Frequency Transfer Response" message, with the "SCALED_FREQ_OFFSET" field set to the frequency CP clock error between nominal and real value, in Hz scaled to GPS-L1 frequency. The periodicity of the message depends on the CP clock stability, and shall be determined at design time.
- Each of the frequency transfer message shall have a TIME_TAG field. The CP is responsible to time tag the frequency error measurements in terms of seconds elapsed since the beginning of the current GPS week. The SLC will be responsible for the rollover of the GPS_WEEK_NUM
- Each of the frequency transfer message shall also indicate in the REF_CLOCK_INFO the relation of this frequency transfer message and its relation to the clock. Bit1 = 1 implies that the message is related to the SLC clock and Bit1 = 0 implies that the message is related to the CP clock
- In APM, when the SLC is in full power mode and the reference clock input to the counter is on, the CP shall send "Frequency Transfer Response" message to restart the frequency transfer.

Reference clock turn OFF procedure (applicable to the frequency counter method only)

- If the CP wants to turn off the reference clock, the CP shall send a "Frequency Transfer Response" message with Bit 3 of REF_CLOCK_INFO field is '1'
- Upon receiving the "Frequency Transfer Response" message, the SLC shall stop reading frequency counter and send a "Frequency Transfer Request" message to allow turn off reference clock (Bit 3 of FREQ_REQ_INFO = 1). The SLC shall ALWAYS permit the CP to turn off the reference clock.
- The CP can turn off reference clock only if a "Frequency Transfer Request" message with Bit 3 of FREQ_REQ_INFO = 1 is received. When the reference clock is turned off, CP shall not send "Frequency Transfer Response" message anymore.

Reference clock turn ON procedure (applicable to the frequency counter method only)

The CP can turn on the reference clock at any time except when the SLC is in sleep mode and then send "Frequency Transfer Response" messages with Bit 2 of REF_CLOCK_INFO field is '0'.

Change reference clock procedure (applicable to the frequency counter method only)

- The CP shall send a "Frequency Transfer Response" message with Bit 3 of REF_CLOCK_INFO field is '1', which informs the SLC that the CP wants to turn off the reference clock.
- Upon receiving the "Frequency Transfer Response" message, the SLC shall stop reading frequency counter and send a "Frequency Transfer Request" message to allow turn off reference clock (Bit 3 of FREQ_REQ_INFO = 1).
- Upon receiving the "Frequency Transfer Request" message, the CP turns off reference clock.
- The CP then switches to another reference clock and shall send a "Frequency Transfer Response" message with FREQ_REQ_INFO set to

  Bit 2 = 0: reference clock is on
  Bit 4 = 1: NOMINAL_FREQ field is presented

and NOMINAL_FREQ field contains nominal frequency, which can be between 7 MHz to 40 MHz.

Multiple frequency transfers turn off procedure

Depending on the application, the SLC may send a request to disable the periodic frequency transfer. To disable the periodic frequency transfer from SLC, it shall send a "Frequency Transfer Request" Message to CP with Bit 1 in "FREQ_REQ_INFO" field set to "multiple request", and Bit 2 set to "OFF" the CP shall stop to send the periodic "Frequency Transfer Response" message.

General Error Handling

- If the frequency difference between Base Station master clock and CP clock is not known (and will not be known any time), the CP shall send a "Request Rejected" message with "REJ_REASON" field set to "Not available"
- If the frequency difference between Base Station master clock and CP clock is not known (and but can be known eventually), the CP shall send a "Reject" message with "REJ_REASON" field set to "Not Ready".

7.12 Interoperability between different Air-Interface ICD revision numbers

It can happen that a SLS and SLC with incompatible Air-Interface Revision numbers are put into communication. The way the Air-Interface is build, after SLS and SLC identify the problem by a simple message exchange common to all rev numbers, the Air-Interface message shall be stopped.

In such a case, the SLC must report back to the CP the problem, in order for the CP to take the appropriate action, which is to close the Air-Interface. An Error Notification message has been added to that effect.

Air Interface Revision Incompatibility Reporting Procedure

Upon detecting incompatibility between Air-Interface revision numbers, the SLC shall send an error notification message with the ERROR_REASON field set to "SLC does not support SLS's Air-Interface revision number". Upon receiving an error notification message with the ERROR_REASON field set to "SLC does not support SLS's Air-Interface revision number" (signaling the end of all message exchange over the air), the CP shall close the Air-Interface session.

7.13 Software Version ID

The CP can query the SLC to determine the software version ID that is currently being used. In such instances, the request/response format shall be as outlined in the Software Version Request/Response message descriptions.

A value of zero in the LENGTH_SIRF_VERSION_ID and/or LENGTH_CUSTOMER_VERSION_ID field is valid and indicates that there is no corresponding version name.

Error handling

Fields out of range in the Software Version message:

If the LENGTH_SIRF_VERSION_ID field and/or the LENGTH_CUSTOMER_VERSION_ID field in the Software Version Response has values outside the range of 0-80, then this value and corresponding SIRF_VERSION_ID and/or CUSTOMER_VERSION_ID shall be ignored. Fields do not match in the

Software Version message:

The LENGTH_SIRF_VERSION_ID field and/or the LENGTH_CUSTOMER_VERSION_ID field in the Software Version Response do not match the number of characters in the corresponding SIRF_VERSION_ID and/or CUSTOMER_VERSION_ID. In this case this value and corresponding SIRF_VERSION_ID and/or CUSTOMER_VERSION_ID shall be ignored.

SiRF Binary Protocol Reference Manual

SiRF Technology, Inc.
217 Devcon Drive
San Jose, CA 95112 U.S.A.
Phone: +1 (408) 467-0410
Fax: +1 (408) 467-0420
www.sirf.com

Part Number: CS-129291-DC2
September 2009

SiRF Binary Protocol Reference Manual

About This Document

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

Getting Help

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

phone +1 (408) 467-0410

e-mail support@sirf.com

Contents

Contents

Contents

Contents

Tables

Tables

Tables

Tables

Tables

Tables

Preface

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

Who Should Use This Guide

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

How This Guide Is Organized

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

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

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

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

Related Manuals

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

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

Troubleshooting/Contacting SiRF Technical Support

Address:

SiRF Technology Inc.
217 Devcon Drive
San Jose, CA 95112 U.S.A.

SiRF Technical Support:

Phone: +1 (408) 467-0410 (9 am to 5 pm Pacific Standard Time)
E-mail: support@sirf.com

General enquiries:

Phone: +1 (408) 467-0410 (9 am to 5 pm Pacific Standard Time)
E-mail: gps@sirf.com

Helpful Information When Contacting SiRF Technical Support

Receiver Serial Number: ____________________

Receiver Software Version: ________________

SiRFDemo Version: ________________________

Protocol Layers 1

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

This serial communication protocol is designed to provide:

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

Transport Message

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

1. Characters preceded by "0x" denotes a hexadecimal value. 0xA0 equals 160.

Transport

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

Message Validation

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

Payload Length

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

High Byte	Low Byte
≤ 0x7F	Any value

Even though the protocol has a maximum length of (2^{15}-1) bytes, practical considerations require the SiRF GPS module implementation to limit this value to a smaller number. The SiRF receiving programs, such as SiRFDemo, may limit the actual size to something less than this maximum.

Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data can contain any 8-bit value.

Where multi-byte values are in the payload data, neither the alignment nor the byte order are defined as part of the transport although SiRF payloads uses the big-endian order.

The Message ID tables in Chapter 2, "Input Messages" and Chapter 3, "Output Messages" describe the payload data, variable length and variable data type. The Bytes column contains:

- A number that specifies the number of bytes in each field of the message
- A letter that describes how to interpret the value

Table 1-1 lists the letters and their description.

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

Letter	Description
D	Discrete – The field consists of a bit mapped value, or subfields of groups of bits that are described in the Description field. Values should be considered unsigned.
S	Signed – The field contains a signed integer value in two's complement format
U	Unsigned – The field contains an unsigned integer value
Dbl	Double precision floating point – See the Note after Table 3-69 on page 34 for a detailed description of this data type
Sgl	Single precision floating point – See the Note after Table 3-69 on page 34 for a detailed description of this data type

Checksum

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

High Byte	Low Byte
≤ 0x7F	Any value

The checksum is a 15-bit checksum of the bytes in the payload data. The following pseudo code defines the algorithm used:

```
Let message be the array of bytes to be sent by the transport.

Let msgLen be the number of bytes in the message array to be
transmitted.

    Index = first

    checkSum = 0

    while index < msgLen

       checkSum = checkSum + message[index]

    checkSum = checkSum AND (2^15-1)

       increment index
```

Input Messages 2

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

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

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

Table 2-1 SiRF Messages – Input Message List

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

Table 2-1 SiRF Messages – Input Message List

Hex	Decimal	Name	Description
A5	165	Set UART Configuration	Protocol selection, bit rate, data bits, stop bits and parity
A6	166	Set Message Rate	SiRF Binary message output rate
A7	167	Set Low Power Acquisition Parameters	Low power configuration parameters
A8	168	Poll Command Parameters	Poll for parameters: 0x80: Receiver initialized and associated params 0x85: DGPS source and beacon receiver info 0x88: Navigation mode configuration 0x89: DOP mask selection and parameters 0x8A: DGPS mode selection and timeout values 0x8B: Elevation tracking and navigation masks 0x8C: Power tracking and navigation masks 0x8F: Static navigation configuration 0x97: Low power parameters
AA	170	Set SBAS Parameters	SBAS configuration parameters
AC	172	SiRF Dead Reckoning Class of Input Messages	The Message ID is partitioned into messages identified by Sub IDs. See Table 2-2.
AF	175	User Input Command	User settable input command string and parser.
B4-C7	180-199	MID_UserInputBegin – MID_UserInputEnd	Available for SDK user input messages only.
B4	180	Preset Software Configuration	Selection of the preset software configurations as defined in bits [3:2] of the GSC2xr chip configuration register
B6	182	Set UART Configuration	Obsolete
CD	205	Software Control	Generic software input message
E4	228	SiRF Internal Message	Reserved
E8	232	Extended Ephemeris Proprietary	Extended Ephemeris and debug flag
E9	233	GRF3I+ Interface Functions	GRF3I+ interface functions

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

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

1. Output message only at this time.

SiRF Binary protocol is a standard evolving with continued development of SiRF software and GPS solutions. Not all SiRF Binary messages are supported by all SiRF GPS solutions.

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

Table 2-3 Supported Input Messages

Message ID	SiRF Software Options							
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3 & GSWLT3	SiRF DiRect	GSD3tw	GSC3LPa
53	No	No	Yes	No	No	No	No	
128	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
129	Yes	Yes	Yes	No	Yes	Yes	Yes	
130	Yes	Yes	No	No	No	Yes	Yes	
131	No	No	No	No	Yes	Yes	No	
132	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
133	Yes	Yes	No	No	Yes	Yes	Yes	
134	Yes	Yes	Yes	Yes	Yes	Yes	No	
135	No	No	No	No	Yes	Yes	No	
136	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
137	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
138	Yes	Yes	Yes	Yes	Yes	No	Yes	
139	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
140	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
143	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
144	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
145	Yes	Yes	No	No	No	Yes	No	
146	Yes	Yes	No	Yes	Yes	Yes	Yes	
147	Yes	Yes	No	Yes	Yes	Yes	Yes	
148	Yes	Yes	Yes	No	Yes	Yes	No	
149	Yes	Yes	No	Yes	No	Yes	Yes	
150	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
151	Yes	Yes	Yes	No	Yes	Yes	Yes	
152	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
165	Yes	Yes	Yes	No	Yes	Yes	No	
166	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
167	Yes	Yes	Yes	No	Yes	Yes	Yes	
168	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
170	2.3 or above	Yes	No	No	Yes	No	Yes	
172	No	Yes[1]	No	No	No	Yes[1]	Yes	
175	No	No	No	No	Yes	Yes	No	
180[2]	Yes	No	No	No	No	No	No	
180-199	Yes	Yes	Yes	Yes	Yes	No	Yes	
205	No	No	No	No	3.2.5 or above	No	Yes	
228	No	No	No	No	Yes (reserved)	No	Yes	
232	2.5 or above	No	2.3 or above	No	3.2.0 or above	Yes	Yes	
233								

1. Not all Sub IDs supported
2. Only with GSC2xr chip

Advanced Power Management – Message ID 53

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

Example:

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

`A0A2000C`—Start Sequence and Payload Length

`350100140003070000000A0100`—Payload

`005FB0B3`—Message Checksum and End Sequence

Table 2-4 Advanced Power Management – Message ID 53

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

Payload length: 12 bytes

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

Table 2-5 Horizontal/Vertical Error

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

Initialize Data Source – Message ID 128

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

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

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

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

Example:

`A0A20019`—Start Sequence and Payload Length

`80FFD700F9FFBE5266003AC57A000124F80083D600039C0C33`—Payload

`0A91B0B3`—Message Checksum and End Sequence

Table 2-6 Initialize Data Source – Message ID 128

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		80		Decimal 128
ECEF X	4 S		FFD700F9	meters	
ECEF Y	4 S		FFBE5266	meters	
ECEF Z	4 S		003AC57A	meters	
Clock Drift	4 S		000124F8	Hz	
Time of Week	4 U	*100	0083D600	sec	
Week Number	2 U		51F		Extended week number (0 - no limit)
Channels	1 U		0C		Range 1 to 12
Reset Configuration Bit Map	1 D		33		See Table 2-7

Payload length: 25 bytes

Table 2-7 Reset Configuration Bit Map

Bit	Description
0	Data valid flag: 1 = Use data in ECEF X, Y, Z, Clock Offset, Time of Week and Week number to initialize the receiver; 0 = Ignore data fields
1	Clear Ephemeris from memory: blocks Snap or Hot Start from occurring
2	Clear all history (except clock drift) from memory: blocks Snap, Hot, and Warm Starts
3	Factory Reset: Clears all GPS memory including clock drift. Also clears almanac stored in flash memory[1]
4	Enable Nav Lib data (YES = 1, NO = 0)[2]
5	Enable debug data (YES = 1, NO = 0)
6	Factory reset including Xo model
7	Perform full system reset during "non-factory" system resets.

1. During a factory reset, if Bit 3= 1 and Bit 7 = 0, it requests a factory reset **without** clearing the almanac stored in flash memory. If Bit 3=1 and Bit 7=1, it requests a factory reset **and** clears the almanac stored in flash memory.
2. If Nav Lib data are enabled, the resulting messages are enabled: Clock Status (Message ID 7), 50BPS (Message ID 8), Raw DGPS (Message ID 17), NL Measurement Data (Message ID 28), DGPS Data (Message ID 29), SV State Data (Message ID 30), and NL Initialized Data (Message ID 31). All messages sent at 1 Hz. If SiRFDemo is used to enable Nav Lib data, the bit rate is automatically set to 57600 by SiRFDemo.

Switch To NMEA Protocol – Message ID 129

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

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

Request the following NMEA data at 9600 bits per second:
GGA – ON at 1 sec, GLL – OFF, GSA – ON at 1sec,
GSV – ON at 5 sec, RMC – ON at 1sec, VTG-OFF, MSS – OFF, ZDA-OFF.

Example:

`A0A20018`—Start Sequence and Payload Length

`810201010001010105010101000100010001000100012580`—Payload

`013AB0B3`—Message Checksum and End Sequence

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

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

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

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

Payload length: 24 bytes

1. A value of 0x00 implies not to send the message. Otherwise, data is sent at 1 message every X seconds requested (e.g., to request a message to be sent every 5 seconds, request the message using a value of 0x05). The maximum rate is 1/255 sec.
2. A value of 0x00 implies the checksum is not transmitted with the message (not recommended). A value of 0x01 has a checksum calculated and transmitted as part of the message (recommended).
3. In SiRFNavIII software, this field is reserved for SiRF's proprietary $PSRFEPE message. Otherwise it is unused.
4. These fields are available if additional messages have been implemented in the NMEA protocol.
5. Bit Rate changes are not supported in SiRFNavIII software.

Table 2-9 Mode Values

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

In TricklePower mode, the user specifies the update rate. When switching to NMEA protocol, the message update rate is also required. The resulting update rate is the product of the TricklePower update rate and the NMEA update rate (e.g., TricklePower update rate = 2 seconds, NMEA update rate = 5 seconds, the resulting update rate is every 10 seconds (2 X 5 = 10)).

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

Set Almanac – Message ID 130

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

Note – Some software versions do not support this command.

Example:

`A0A20381` – Start Sequence and Payload Length

82xx...................... – Payload

xxxxB0B3 – Message checksum and end sequence

Table 2-10 Set Almanac – Message ID 130

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

Payload length: 897 bytes

The almanac data is stored in the code as a 448-element array of INT16 values. These elements are partitioned as a 32 x 14 two-dimensional array where the row represents the satellite ID minus 1 and the column represents the number of INT16 values associated with this satellite. The data is actually packed and the exact format of this representation and packing method can be extracted from the *ICD-GPS-200* document. The *ICD-GPS-200* document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

Handle Formatted Dump Data – Message ID 131

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

Note – The buffer size limit is 912 bytes.

Table 2-11 contains the input values for the following example. This example shows how to output an array of elements. Each element structure appears as follows:

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

Example:

A0A2002B—Start Sequence and Payload Length

8303600010500501020101044865 6C6C6F00253264202532642025326420253264202 5313

02E316C660000—Payload

0867B0B3—Message Checksum and End Sequence

Table 2-11 Handle Formatted Dump Data – Message Parameters

Name	Bytes	Binary (Hex)	Unit	Description
		Example		
Message ID	1 U	83		Decimal 131
Elements	1 U	03		Number of elements in array to dump (minimum 1)
Data address	4 S	60000150		Address of the data to be dumped
Members	1 U	05		Number of items in the structure to be dumped
Member Size	Elements S	01 02 01 01 04	bytes	List of element sizes in the structure. See Table 2-12 for definition of member size (total of 5 for this example)
Header	string length + 1 S	"Hello"0		String to print out before data dump (total of 8 bytes in this example)
Format	string length + 1 S	"%2d %2d %2d %2d %10.1lf"0		Format string for one line of output (total of 26 bytes in this example) with 0 termination
Trailer	string length + 1 S	00		Not used

Payload length: Variable

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

Table 2-12 Member Size Data Type

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

Poll Software Version – Message ID 132

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

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

Poll the software version

Example:

A0A20002—Start Sequence and Payload Length

8400—Payload

0084B0B3—Message Checksum and End Sequence

Table 2-13 Software Version – Message ID 132

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

Payload length: 2 bytes

DGPS Source – Message ID 133

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

External RTCM SC-104 Data (any serial port)

Satellite Based Augmentation System (SBAS) – subject to SBAS satellite availability

Internal DGPS beacon receiver (supported only on specific GPS receiver hardware)

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

`A0A200007`—Start Sequence and Payload Length

`85020000000000`—Payload

`0087B0B3`—Checksum and End Sequence

Table 2-14 DGPS Source Selection (Example 1)

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

Payload length: 7 bytes

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

Search Frequency 310000, Bit Rate 200

`A0A200007`—Start Sequence and Payload Length

`85030004BAF0C802`—Payload

`02FEB0B3`—Checksum and End Sequence

Table 2-15 DGPS Source Selection (Example 2)

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

Payload length: 7 bytes

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

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

Table 2-16 DGPS Source Selections

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

Set Binary Serial Port – Message ID 134

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

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

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

Example:

`A0A20009`—Start Sequence and Payload Length

`860000258008010000`—Payload

`0134B0B3`—Message Checksum and End Sequence

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

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

Payload length: 9 bytes

Set Protocol – Message ID 135

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

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

Set protocol to NMEA

Example:

`A0A20002`—Start Sequence and Payload Length

`8702`—Payload

0089B0B3—Message checksum and end sequence.

Table 2-18 Set Protocol – Message ID 135

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

Payload length: 2 bytes

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

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

Mode Control – Message ID 136

Sets up the navigation operations. It controls use of fewer than 4 satellites, and enables or disables the track smoothing filter. Using fewer than 4 satellites results in what is commonly called a '2-D' fix. 4 or more satellites allow a '3-D' fix.

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

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

Example:

A0A2000E—Start Sequence and Payload Length

88000001000000000000000050201—Payload

0091B0B3—Message Checksum and End Sequence

Table 2-19 Mode Control – Message ID 136

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1 U		88		Decimal 136
Reserved	2 U		0000		Reserved
Degraded Mode[1]	1 U		01		Controls use of 2-SV and 1-SV solutions. See Table 2-20.
Reserved	2 U		0000		Reserved
Altitude	2 S		0000	meters	User specified altitude, range -1,000 to 10,000
Alt Hold Mode	1 U		00		Controls use of 3-SV solution. See Table 2-21.
Alt Hold Source	1 U		00		0 = Use last computed altitude 1 = Use user-input altitude
Reserved	1 U		00		Reserved

Table 2-19 Mode Control – Message ID 136

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

Payload length: 14 bytes

1. Degraded mode is not supported in GSW3.2.5 and later. This field should be set to 4 in these software versions.

Table 2-20 Degraded Mode

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

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

Table 2-21 Altitude Hold Mode

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

DOP Mask Control – Message ID 137

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

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

Example:

`A0A20005`—Start Sequence and Payload Length

`8900080808`—Payload

`00A1B0B3`—Message checksum and end sequence

Table 2-22 DOP Mask Control – Message ID 137

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description	tSIRF_MSG_SSB_SET_DOP_MODE Structure Member	Data Type
Message ID	1 U		89		Decimal 137		
DOP Selection	1 U		00		See Table 2-23	mode	tSIRF_UINT8
GDOP Value	1 U		08		Range 1 to 50	gdop_th	tSIRF_UINT8
PDOP Value	1 U		08		Range 1 to 50	pdop_th	tSIRF_UINT8
HDOP Value	1 U		08		Range 1 to 50	hdop_th	tSIRF_UINT8

Payload length: 5 bytes

Table 2-23 DOP Selection

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

DGPS Control – Message ID 138

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

Table 2-24 contains the input values for the following example:

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

Example:

`A0A20003`—Start Sequence and payload length

`8A011E`—Payload

`00A9B0B3`—Message checksum and end sequence

Table 2-24 DGPS Control – Message ID 138

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

Payload length: 3 bytes

Table 2-25 DGPS Selection

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

Note – DGPS Timeout interpretation varies with DGPS correction source. For an internal beacon receiver or RTCM SC-104 external source, a value of 0 means infinite timeout (use corrections until another one is available). A value of 1 to 255 means use the corrections for a maximum of this many seconds. For DGPS corrections from an SBAS source, the timeout value is ignored unless Message ID 170, Flag bit 0 is set to 1 (User Timeout). If Message ID 170 specifies User Timeout, a value of 1 to 255 here means that SBAS corrections can be used for the number of seconds specified. A value of 0 means to use the timeout specified in the SBAS satellite message (usually 18 seconds).

Elevation Mask – Message ID 139

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

Table 2-26 contains the input values for the following example:

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

Example:

`A0A20005`—Start Sequence and payload length

`8B0032009B`—Payload

`0158B0B3`—Message checksum and end sequence

Table 2-26 Elevation Mask – Message ID 139

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

Payload length: 5 bytes

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

Power Mask – Message ID 140

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

Table 2-27 contains the input values for the following example:

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

Example:

`A0A20003`—Start sequence and payload length

8C1C21—Payload

00C9B0B3—Message checksum and end sequence

Table 2-27 Power Mask – Message ID 140

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

Payload length: 3 bytes

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

Note – Satellites with received signal strength below the specified navigation mask signal level are used in the navigation solution.

Static Navigation – Message ID 143

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

Example:

A0A20002 – Start sequence and payload length

8F01 – Payload

0090B0B3 – Message checksum and end sequence

Table 2-28 Static Navigation – Message ID 143

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

Payload length: 2 bytes

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

Poll Clock Status – Message ID 144

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

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

Poll the clock status.

Example:

A0A20002—Start sequence and payload length

9000—Payload

0090B0B3—Message checksum and end sequence

Table 2-29 Clock Status – Message ID 144

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

Payload length: 2 bytes

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

Set DGPS Serial Port – Message ID 145

Sets the serial port settings associated with the RTCM SC-104 protocol. If the RTCM SC-104 protocol is currently assigned to a port, it also changes that port’s settings. The values entered are stored in battery-backed RAM (called NVRAM in this document) and are used whenever the RTCM protocol is assigned to a port. The settings control:

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

Table 2-30 contains the input values for the following example:

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

Example:

A0A20009—Start sequence and payload length

910000258008010000—Payload

013FB0B3—Message checksum and end sequence

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

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

Payload length: 9 bytes

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

Poll Almanac – Message ID 146

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

Note – Some software versions do not support this command.

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

Poll for the almanac.

Example:

`A0A20002`—Start Sequence and payload length

`9200`—Payload

`0092B0B3`—Message checksum and end sequence

Table 2-31 Almanac – Message ID 146

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

Payload length: 2 bytes

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

Poll Ephemeris – Message ID 147

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

Note – Some software versions do not support this command.

Table 2-32 contains the input values for the following example:

Poll for Ephemeris Data for all satellites.

Example:

A0A20003—Start Sequence and Payload Length

930000—Payload

0092B0B3—Message Checksum and End Sequence

Table 2-32 Poll Ephemeris – Message ID 147

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

Payload length: 3 bytes

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

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

Flash Update – Message ID 148

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

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

Example:

A0A20001 – Start Sequence and Payload Length

94 – Payload

0094B0B3 – Message Checksum and End Sequence

Table 2-33 Flash Update – Message ID 148

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

Payload length: 1 bytes

Note – Some software versions do not support this command

Set Ephemeris – Message ID 149

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

Example:

A0A2005B – Start Sequence and Payload Length

95………………….   – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 2-34 Set Ephemeris – Message ID 149

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

Payload length: 91 bytes

The ephemeris data for each satellite is stored as a two dimensional array of [3][15] UNIT16 elements. The row represents three separate sub-frames. See Message ID 15 (“Ephemeris Data (Response to Poll) – Message ID 15” on page 3-23) for a detailed description of this data format.

Note – Some software versions do not support this command.

Switch Operating Modes – Message ID 150

Ths command sets the receiver into production test or normal operating mode.

Table 2-35 contains the input values for the following example. This version of message 150 is supported by all prior to GSD3tw.

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

Example:

A0A20007 – Start Sequence and Payload Length

961E510006001E – Payload

0129B0B3 -   Message Checksum and End Sequence

Table 2-35 Switch Operating Modes – Message ID 150 (all software options prior to GSD3tw)

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		96		.Decimal 150
Mode	2		1E55		0=normal, IE51=Testmode1, 1E52=Testmode2, 1E53=Testmode3, 1E54=Testmode4
SVID	2		0006		Satellite to track
Period	2		001E	Seconds	Duration of track

Payload length: 7 bytes

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

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

Example:

A0A20007 – Start Sequence and Payload Length

961E510006001E – Payload

0129B0B3 - Message Checksum and End Sequence

Test mode 5:

Example:

A0A2000D – Start Sequence and Payload Length

961E550001601E001400140014 – Payload

01C4B0B3 - Message Checksum and End Sequence

Table 2-36 Switch Operating Modes – Message ID 150 (LT SLC version 3.3 or later)

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1		96		Decimal 150
Mode	2		1E55		0=normal, IE51=Testmode1, 1E52=Testmode2, 1E53=Testmode3, 1E54=Testmode4, 1E55=Testmode5
SVID	2		0006		Satellite to track
Period	2		001E	Seconds	Duration of Track. Minimum duration for track in testmode 5 shall be at least 15 seconds. Recommended value 20 seconds.
The following fields are only required for testmode 5					
Testmode4 Period	2		0014	Seconds	Testmode 4 period. Minimum recommended period at least 10 seconds
Testmode4 max Period	2		0014	Seconds	Maximum duration of testmode 4. maximum recommended value = 60 seconds
Attenuation Period	2		0014	Seconds	Dead time allowed for signal to drop. maximum recommended value = 20 seconds

Payload length: 13 bytes

Table 2-37 contains the input values for the following example:

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

Example:

A0A20008 – Start Sequence and Payload Length

961E510006001E00 – Payload

0129B0B3 - Message Checksum and End Sequence

Table 2-37 Switch Operating Modes – Message ID 150 (GSD3tw)

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		96		.Decimal 150
Mode	2		1E51		0 = normal, 1E51 = Testmode1, 1E52 = Testmode2, 1E53 = Testmode3, 1E54 = Testmode4, 1E55 = Testmode5, 1E56 = Testmode6, 1E57 = Testmode7
SVID	2		0006		Satellite to track
Period	2		001E	Seconds	Duration of track
Test Mode 5 Command	2 U		00		Test Mode 5 weak signal stage command. Not applicable in other test modes 0 = strong signal stage (test mode step 1) 1 = weak signal stage (test mode step 2)

Payload length: 8 bytes

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

Set TricklePower Parameters – Message ID 151

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

Table 2-38 contains the input values for the following example:

Sets the receiver to low power modes.

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

A0A20009—Start Sequence and Payload Length

97000000C8000000C8—Payload

0227B0B3—Message Checksum and End Sequence

Table 2-38 Set TricklePower Parameters – Message ID 151

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

Payload length: 9 bytes

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

Computation of Duty Cycle and On-Time

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

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

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

Following are some examples of selections:

Table 2-39 Example of Selections for TricklePower Mode of Operation

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

1. when the duty cycle is set to 100 %, the on time has no effect. However, the command parser might still test the value against the 200-600 ms limits permitted for a 1-second cycle time. Therefore, we recommend that you set the on-time value to 200 ms.
2. When the duty cycle is set to 100%, the value in this field has no effect. Thus, any legal value (100 to 900) may be used.

Table 2-40 Duty Cycles for Supported TricklePower Settings

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

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

Note – Values are in % times 10 as needed for the duty cycle field. For 1 second update rate, on-times greater than 600 ms are not allowed.

Push-to-Fix

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

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

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

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

Poll Navigation Parameters – Message ID 152

Requests the receiver to report its current navigation parameter settings. The receiver responds to this message with Message ID 19. Table 2-41 contains the input values for the following example:

Example: Poll receiver for current navigation parameters.

A0A20002—Start Sequence and Payload Length

9800—Payload

0098B0B3—Message Checksum and End Sequence

Table 2-41 Poll Receiver for Navigation Parameters – Message ID 152

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

Payload length: 2 bytes

Set UART Configuration – Message ID 165

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

Note – This message supports setting up to four UARTs.

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

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

Example:

A0A20031—Start Sequence and Payload Length

A50001010000258008010000000100000000E1000801000000FF050500000000000
0000000FF0505000000000000000000—Payload

0452B0B3—Message Checksum and End Sequence

Table 2-42 Set UART Configuration – Message ID 165

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

Table 2-42 Set UART Configuration – Message ID 165 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Reserved	1 U		00		For UART 0
Port	1 U		01		For UART 1
In Protocol	1 U		00		For UART 1
Out Protocol	1 U		00		For UART 1
Bit Rate	4 U		0000E100		For UART 1
Data Bits	1 U		08		For UART 1
Stop Bits	1 U		01		For UART 1
Parity	1 U		00		For UART 1
Reserved	1 U		00		For UART 1
Reserved	1 U		00		For UART 1
Port	1 U		FF		For UART 2
In Protocol	1 U		05		For UART 2
Out Protocol	1 U		05		For UART 2
Bit Rate	4 U		00000000		For UART 2
Data Bits	1 U		00		For UART 2
Stop Bits	1 U		00		For UART 2
Parity	1 U		00		For UART 2
Reserved	1 U		00		For UART 2
Reserved	1 U		00		For UART 2
Port	1 U		FF		For UART 3
In Protocol	1 U		05		For UART 3
Out Protocol	1 U		05		For UART 3
Bit Rate	4 U		00000000		For UART 3
Data Bits	1 U		00		For UART 3
Stop Bits	1 U		00		For UART 3
Parity	1 U		00		For UART 3
Reserved	1 U		00		For UART 3
Reserved	1 U		00		For UART 3

Payload length: 49 bytes

1. 0xFF means to ignore this port; otherwise, put the port number in this field (e.g., 0 or 1).
2. 0 = SiRF Binary, 1 = NMEA, 2 = ASCII, 3 = RTCM, 4 = User1, 5 = No Protocol. Any software version only supports some subset of these protocols. Selecting a protocol that is not supported by the software may cause unexpected results.
3. Valid values are 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200.
4. Valid values are 7 and 8.
5. Valid values are 1 and 2.
6. 0 = None, 1 = Odd, 2 = Even.

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

Set Message Rate – Message ID 166

Controls the output rate of binary messages. Table 2-43 contains the input values for the following example:

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

Example:

A0A20008—Start Sequence and Payload Length

A600020500000000—Payload

00ADB0B3—Message Checksum and End Sequence

Table 2-43 Set Message Rate – Message ID 166

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1 U		A6		decimal 166
Mode[1]	1 U		00		00: enable/disable one message 01: poll one message instantly 02: enable/disable all messages 03: enable/disable default navigation messages (Message ID 2 and 4) 04: enable/disable default debug messages (Message ID 9 and 255) 05: enable/disable navigation debug messages (Message ID 7, 28, 29, 30, and 31
Message ID to be set	1 U		02		
Update Rate[2]	1 U		05	sec	Range = 0 - 30
Reserved	1 U		00		Not used, set to zero
Reserved	1 U		00		No used, set to zero
Reserved	1 U		00		Not used, set to zero
Reserved	1 U		00		Not used, set to zero

Payload Length: 8 bytes

1. Values 02 - 05 are available for GSW3 and SLC3 software only.

2. A value of 0 means to stop sending the message. A value in the range of 1 - 30 specifies the cycle period.

Set Low Power Acquisition Parameters – Message ID 167

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

MaxOffTime: when the receiver is unable to acquire satellites for a TricklePower or Push-to-Fix cycle, it returns to sleep mode for this period of time before it tries again.

MaxSearchTime: in TricklePower and Push-to-Fix modes, when the receiver is unable to reacquire at the start of a cycle, this parameter sets how long it tries. After this time expires, the unit returns to sleep mode for MaxOffTime (if in TricklePower or ATP mode) or Push-to-Fix cycle time (in Push-to-Fix mode).

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

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

Example:

A0A2000F—Start Sequence and Payload Length

A7000075300001D4C00000003C0000—Payload

031DB0B3—Message Checksum and End Sequence

Table 2-44 Set Low Power Acquisition Parameters – Message ID 167

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

Payload length: 15 bytes

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

Poll Command Parameters – Message ID 168

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

Table 2-45 contains the input values for the following example:

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

Example:

A0A20002–Start Sequence and Payload Length

A897-Payload

013FB0B3-Message Checksum and End Sequence

Table 2-45 Poll Command Parameters – Message ID 168

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

Payload length: 2 bytes

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

Set SBAS Parameters – Message ID 170

Allows the user to set the SBAS parameters.

Table 2-46 contains the input values for the following example:

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

Example:

A0A20006—Start Sequence and Payload Length

AA020001027A —Payload Message

0129B0B3—Checksum and End Sequence

Table 2-46 Set SBAS Parameters – Message ID 170

Name	Bytes	Binary (Hex)		Unit
		Scale	Example	
Message ID	1 U		AA	
SBAS PRN or Region	1 U		02	
SBAS Mode	1 U		00	
Flag Bits[1]	1 D		01	
region[2]	1		02	
regionPrn	1		7A	

Payload length: 6 bytes

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

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

Table 2-47 Detailed Description

Name	Description
Message ID	Decimal 170
SBAS PRN or Region	Defines the SBAS to use. 0 = auto mode, the system chooses the best SBAS based upon its internal almanacs. 2-5: specifies a system to use. The receiver will select a PRN from among those designated as belonging to that system. 120-138: specifies a specific PRN to be used as first choice. If that PRN cannot be found, system will search using its defined search sequence starting at that PRN.
SBAS Mode	0 = Testing, 1 = Integrity Integrity mode rejects SBAS corrections if the SBAS satellite is transmitting in a test mode Testing mode accepts/uses SBAS corrections even if satellite is transmitting in a test mode
Flag Bits	If Bit 0 = 1, user-specified timeout from Message ID 138 is used. If Bit 0 = 0, timeout specified by the SBAS satellite is used (this is usually 18 seconds). If Bit 3 = 1, the SBAS PRN specified in the SBAS PRN field is used. If Bit 3 = 0, the system searches for any SBAS PRN.
region	Used to assign a PRN to a defined region. 0 means this feature is not being updated by this message. 2-5 designates one of the defined regions/systems.
regionPrn	When region field is non-zero, this field specifies the PRN to assign to the region designated in region field.

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

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

Table 2-48 Navigation Initialization Parameters

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

Table 2-48 Navigation Initialization Parameters *(Continued)*

Name	Bytes	Scale	Unit	Description

Payload length: 28 bytes

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

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

Sets the GPS/DR navigation mode control parameters.

Table 2-49 GPS/DR Navigation Mode Control Parameters – Message ID 172 (Sub ID 2)

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

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

Sets DR gyro factory calibration parameters.

Table 2-50 DR Gyro Factory Calibration Parameters – Message ID 172 (Message Sub ID 3)

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

Payload length: 4 bytes

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

Sets DR sensors parameters.

Table 2-51 DR Sensors Parameters – Message ID 172 (Message Sub ID 4)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0xAC
Message Sub ID	1			= 0x04
Base speed scale factor	1		ticks/m	
Base gyro bias	2	10^4	mV	
Base gyro scale factor	2	10^3	mV/deg/s	

Payload length: 7 bytes

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

Polls the DR gyro factory calibration status.

Table 2-52 DR Gyro Factory Calibration Status – Message ID 172 (Message Sub ID 6)

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

Payload length: 2 bytes

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

Message 172 Sub IDs apply to SiRFDiRect only

Polls the DR sensors parameters.

Table 2-53 DR Sensors Parameters – Message ID 172 (Message Sub ID 7)

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

Payload length: 2 bytes

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

Sensor data output converted into engineering units.

Table 2-54 Input Car Bus Data – Message ID 172 (Message Sub ID 9)

Byte	Field	Data Type	Bytes	Unit	Range	Res
1	Message ID	UINT8	1	N/A	0xAC	N/A
2	Message Sub-ID	UINT8	1	N/A	0x09	N/A
3	Sensor Data Type (depends on sensor)	UINT8	1	N/A	0-127 1: Gyro, Speed Data, and Reverse 2. 4 Wheel Pulses, and Reverse 3: 4 Wheel Speed, and Reverse 4: 4 Wheel Angular Speed, and Reverse 5: Gyro, Speed Data, NO Reverse 6: 4 Wheel Pulses, NO Reverse 7: 4 Wheel Speed, NO Reverse 8: 4 Wheel Angular Speed, NO Reverse 9: Gyro, Speed Data, Reverse, Steering Wheel Angle, Longitudinal Acceleration, Lateral Acceleration 10: Yaw Rate Gyro, Vertical Acceleration (Up)(Z), Longitudinal Acceleration (Front)(X), Lateral Acceleration (Left)(Y) 11-127: Reserved	N/A
4	Number of Valid data sets	UINT8	1	N/A	0-11	N/A
5	Reverse Bit Map N/A for SDT = 10	UINT16	2	N/A	Bit-mapped indication of REVERSE status corresponding to each sensor data set, i.e. bit 0 corresponds to the first data set, bit 1 corresponds to the second data set, etc.	N/A

Table 2-54 Input Car Bus Data – Message ID 172 (Message Sub ID 9) *(Continued)*

Byte	Field	Data Type	Bytes	Unit	Range	Res
7+(N-1)* 16[1]	Valid Sensor Indication	UINT8	1	N/A	Valid/Not Valid indication for each one of the four possible sensor inputs in a individual data set; when a particular bit is set to 1 the corresponding data is Valid, when the bit is set to 0 the corresponding data is NOT valid. Bit 0 corresponds to Data Set Time Tag Bit 1 corresponds to Odometer Speed Bit 2 corresponds to Data 1 Bit 3 corresponds to Data 2 Bit 4 corresponds to Data 3 Bit 5 corresponds to Data 4 Bits 6-7 : Reserved	N/A
8+(N-1)* 16[1]	Data Set Time Tag	UINT32	4	msec	0-4294967295	1
12+ (N-1)*16[1]	Odometer Speed (also known as VSS) N/A for SDT = 10	UINT16	2	m/sec	0 to 100	0.01
14+(N-1)* 16[1]	**Data 1** Depends on SDT	INT16	2	Depends on SDT	Depends on SDT	Depends on SDT
	SDT = 1, 5, 9, 10: gyro rate			Deg/sec	-120 to 120	0.01
	SDT = 2, 6: right front wheel pulses			N/A	4000	1
	SDT = 3, 7: right front wheel speed			m/sec	0 to 100	0.01
	SDT = 4, 8: right front wheel angular speed			rad/sec	-327.67 to 327.67	0.01
16+(N-1)* 16[1]	**Data 2** Depends on SDT	INT16	2	Depends on SDT	Depends on SDT	Depends on SDT
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: left front wheel pulses			N/A	4000	1
	SDT = 3, 7: left front wheel speed			m/sec	0 to 100	0.01
	SDT = 4, 8: left front wheel angular speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9: steering wheel angle			deg	-720 to 720	0.05
	SDT = 10: downward acceleration			m/sec^2	-15 to 15	0.001
18+(N-1)* 16[1]	**Data 3** Depends on SDT	INT16	2	Depends on SDT	Depends on SDT	Depends on SDT
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: right rear wheel pulses			N/A	4000	1
	SDT = 3, 7: right rear wheel speed			m/sec	0 to 100	0.01
	SDT = 4, 8: right rear wheel speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9, 10: longitudinal acceleration			m/sec^2	-15 to 15	0.001
20+(N-1)* 16[1]	**Data 4** Depends on SDT	INT16	2	Depends on SDT	Depends on SDT	Depends on SDT
	SDT = 1: N/A			N/A	N/A	N/A
	SDT = 2, 6: left rear wheel pulses			N/A	4000	1
	SDT = 3, 7: left rear wheel speed			m/sec	0 to 100	0.01
	SDT = 4, 8: left rear wheel speed			rad/sec	-327.67 to 327.67	0.01
	SDT = 9, 10: lateral acceleration			m/sec^2	-15 to 15	0.001
22+(N-1)* 16[1]	Reserved	UINT8	1	N/A	N/A	N/A

Payload length: 22 to 182 bytes

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

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

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

Table 2-55 Bus Enabled – Message ID 172 (Message Sub ID 10)

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

Payload length: 6 bytes

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

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

Table 2-56 Bus Disabled – Message ID 172 (Message Sub ID 11)

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

Payload length: 6 bytes

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

Message applies to SiRFDiRect only

Sensor data output converted into engineering units.

Table 2-57 Binary Message Definition – Message ID 172 (Message Sub ID 14)

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

Table 2-57 Binary Message Definition – Message ID 172 (Message Sub ID 14) *(Continued)*

Byte	Field	Data Type	Bytes	Unit	Range	Resolution
23	ValidSensorIndication[1]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
25	DataSetTimeTag[1]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
29	Heading Gyro[1]	INT16	2	deg/sec	±60 degrees per second	1/1e2
31	Z-Axis[1]	INT16	2	M/sec^2	±2 Gs	1/1668.0
33	X-Axis[1]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
35	Y-Axis[1]	INT16	2	M/sec^2	±2 Gs	1/1668.0
37	Pitch Gyro[1]	INT16	2	deg/sec	±60 degrees per second	1/1e2
39	Reserved[1]	UINT8	1	N/A	0 to 0xff	1
40	ValidSensorIndication[2]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
42	DataSetTimeTag[2]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
46	Heading Gyro[2]	INT16	2	deg/sec	±60 degrees per second	1/1e2
48	Z-Axis[2]	INT16	2	M/sec^2	±2 Gs	1/1668.0
50	X-Axis[2]	INT16	2	M/sec^2	±2 Gs	1/1668.0
52	Y-Axis[2]	INT16	2	M/sec^2	±2 Gs	1/1668.0
54	Pitch Gyro[2]	INT16	2	deg/sec	±60 degrees per second	1/1e2
56	Reserved[2]	UINT8	1	N/A	0 to 0xff	1
57	ValidSensorIndication[3]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
59	DataSetTimeTag[3]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
63	Heading Gyro[3]	INT16	2	deg/sec	±60 degrees per second	1/1e2
65	Z-Axis[3]	INT16	2	M/sec^2	±2 Gs	1/1668.0
67	X-Axis[3]	INT16	2	M/sec^2	±2 Gs	1/1668.0
69	Y-Axis[3]	INT16	2	M/sec^2	±2 Gs	1/1668.0
71	Pitch Gyro[3]	INT16	2	deg/sec	±60 degrees per second	1/1e2
73	Reserved[3]	UINT8	1	N/A	0 to 0xff	1
74	ValidSensorIndication[4]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
76	DataSetTimeTag[4]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
80	Heading Gyro[4]	INT16	2	deg/sec	±60 degrees per second	1/1e2
82	Z-Axis[4]	INT16	2	M/sec^2	±2 Gs	1/1668.0
84	X-Axis[4]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
86	Y-Axis[4]	INT16	2	M/sec^2	±2 Gs	1/1668.0

Table 2-57 Binary Message Definition – Message ID 172 (Message Sub ID 14) *(Continued)*

Byte	Field	Data Type	Bytes	Unit	Range	Resolution
88	Pitch Gyro[4]	INT16	2	deg/sec	±60 degrees per second	1/1e2
90	Reserved[4]	UINT8	1	N/A	0 to 0xff	1
91	ValidSensorIndication[5]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
93	DataSetTimeTag[5]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
97	Heading Gyro[5]	INT16	2	deg/sec	±60 degrees per second	1/1e2
99	Z-Axis[5]	INT16	2	M/sec^2	±2 Gs	1/1668.0
101	X-Axis[5]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
103	Y-Axis[5]	INT16	2	M/sec^2	±2 Gs	1/1668.0
105	Pitch Gyro[5]	INT16	2	deg/sec	±60 degrees per second	1/1e2
107	Reserved[5]	UINT8	1	N/A	0 to 0xff	1
108	ValidSensorIndication[6]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
110	DataSetTimeTag[6]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
114	Heading Gyro[6]	INT16	2	deg/sec	±60 degrees per second	1/1e2
116	Z-Axis[6]	INT16	2	M/sec^2	±2 Gs	1/1668.0
118	X-Axis[6]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
120	Y-Axis[6]	INT16	2	M/sec^2	±2 Gs	1/1668.0
122	Pitch Gyro[6]	INT16	2	deg/sec	±60 degrees per second	1/1e2
124	Reserved[6]	UINT8	1	N/A	0 to 0xff	1
125	ValidSensorIndication[7]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
127	DataSetTimeTag[7]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
131	Heading Gyro[7]	INT16	2	deg/sec	±60 degrees per second	1/1e2
133	Z-Axis[7]	INT16	2	M/sec^2	±2 Gs	1/1668.0
135	X-Axis[7]]	INT16	2	M/sec^2	±2 Gs	1/1668.0
137	Y-Axis[7]	INT16	2	M/sec^2	±2 Gs	1/1668.0
139	Pitch Gyro[7]	INT16	2	deg/sec	±60 degrees per second	1/1e2
141	Reserved[7]	UINT8	1	N/A	0 to 0xff	1
142	ValidSensorIndication[8]	UINT16	2	N/A	Bit 0x1: Time tag valid Bit 0x2: Reserved Bit 0x4: Data[0] valid Bit 0x8: Data[1] valid Bit 0x10: Data[2] valid Bit 0x20: Data[3] valid Bit 0x40: Data[4] valid	N/A
144	DataSetTimeTag[8]	UINT32	4	N/A	0 to 0xFFFFFFFF	N/A
148	Heading Gyro[8]	INT16	2	deg/sec	±60 degrees per second	1/1e2
150	Z-Axis[8]	INT16	2	M/sec^2	±2 Gs	1/1668.0

Table 2-57 Binary Message Definition – Message ID 172 (Message Sub ID 14) *(Continued)*

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

Payload length: 175 bytes

User Set Command – Message ID 175

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

Table 2-58 describes the message content.

Table 2-58 User Set Command – Message ID 175

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

Payload length: Variable bytes

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

Preset Operating Configuration – Message ID 180

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

Overrides the Preset Operating Configuration as defined in bits [3:2] of the GSC2xr chip configuration register. The valid input values mapped to the Preset Operating Configuration are described in Table 2-59.

Table 2-59 Valid Input Values

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

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

Table 2-60 contains the input values for the following example:

Set receiver to Standard GSW2 Default Configuration.

Example:

A0A20002—Start Sequence and Payload Length

B404—Payload

00B8B0B3—Message Checksum and End Sequence

Table 2-60 GSC2xr Preset Operating Configuration – Message ID 180

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

Payload length: 2bytes

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

Table 2-61 GSC2xr Preset Operating Configurations

New Config	**Nav Status**	**Config 4**	**Config 3**	**Config 2**	**Config 1**
UARTA		NMEA v2.2	NMEA v2.2	SiRF Binary	NMEA v2.2
UARTB		RTCM	RTCM	NMEA v2.2	SiRF Binary
Build		GSWx2.4.0 and greater	GSWx2.4.0 and greater	GSWx2.4.0 and greater	GSWx2.4.0 and greater, Adaptive TricklePower @ 300,1
UARTA bit rate		4800 n, 8, 1	19200 n, 8, 1	57600 n, 8, 1	4800 n, 8, 1
UARTB bit rate		9600 n, 8, 1	9600 n, 8, 1	115200 n, 8, 1	38400 n, 8, 1
SiRF Binary Output Messages[1]		2, 4, 9, 13, 18, 27, 41, 52	2, 4, 9, 13, 18, 27, 41, 52	2, 4, 9, 13, 18, 27, 41, 52	2, 4, 9, 13, 18, 27, 41, 52

Table 2-61 GSC2xr Preset Operating Configurations *(Continued)*

New Config	Nav Status	Config 4	Config 3	Config 2	Config 1
NMEA Messages		RMC, GGA, VTG, GSA (GSV@ 1/5 Hz), ZDA	GGA, GLL, GSA, GSV, RMC, VTG, ZDA	GGA, GLL, GSA, GSV, RMC, VTG, ZDA	GGA, GLL, GSA, GSV, RMC, VTG, ZDA
GPIO A (GPIO 1)	No Nav	On	On	On	On
	Nav	100 ms on, 1 Hz	100 ms on, 1 Hz	100 ms on, 1 Hz	100 ms on, 1 Hz
GPIO B (GPIO 3)	No Nav	Off	Off	Off	Off
	Nav	100 ms on, 1 Hz	100 ms on, 1 Hz	100 ms on, 1 Hz	100 ms on, 1 Hz
GPIO C (GPIO 13)	No Nav	On	On	On	On
	Nav	1s on, 1s off	1s on, 1s off	1s on, 1s off	1s on, 1s off
GPIO D (GPIO 2)	No Nav	Off	Off	Off	Off
	Nav	On	On	On	On
Static Filter		Off	Off	Off	Off
Track Smoothing		On	On	On	On
WAAS		Disabled	Enabled	Enabled	Disabled
DR		Off	Off	Off	Off

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

Software Control – Message ID 205

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

Table 2-62 Software Control – Message ID 205

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

Payload length: Variable

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

Shuts down the chip.

Table 2-63 Software Commanded Off – Message ID 205 (Message Sub ID 16)

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

Payload length: 0 bytes

Reserved – Message ID 228

SiRF proprietary

Extended Ephemeris – Message ID 232

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

Table 2-64 Extended Ephemeris – Message ID 232

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

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

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

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

Example:

A0A201F6—Start Sequence and Payload Length

Table 2-65 Extended Ephemeris – Message ID 232 (Message Sub ID 1)

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

Payload length: variable

Format – Message ID 232 (Sub ID 2)

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

Table 2-66 Format – Message ID 232 (Message Sub ID 2)

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

Payload length: 6 bytes

1. SVID Mask is a 32-bit value with a 1 set in each location for which ephemeris status is requested. Bit 0 represents PRN 1, …, Bit 31 represents PRN 32. If more than 12 bits are set, the response message responds with data on only the 12 lowest PRNs requested.

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

Example:

A0A20006—Start Sequence and Payload Length

E8FF01000000 – Payload

01E8B0B3—Message Checksum and End Sequence

Table 2-67 Extended Ephemeris – Message ID 232 (Message Sub ID 255)

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

Payload length: 6 bytes

Set GRF3i+ IF BW Mode - Msg ID 233, SubMsgID 0x01

This message allows the user to set the IF bandwidth for GRF3i+. The SubMsgID for this message is fixed to 0x01.

Table 2-68 contains the input values for the following example:

Sub Message ID = 0x1, GRF3i+ Bandwidth Mode Selection = 0x1

Example:

A0A20003— Start Sequence and Payload Length

E90101 — Payload

00EBB0B3 — Message Checksum and End Sequence

Table 2-68 Set GRF3i+ IF Bandwidth

Name	Bytes	Binary (Hex) Scale	Example	Unit	Description
Message ID	1U		E9		Decimal 233
Sub Message ID	1U		01		01: Set GRF3i+ IF Bandwidth Mode
GRF3i+ IF Bandwidth Mode Selection	1U		01		0 = Wideband Mode 1 = Narrowband Mode [default]

Payload length: 3 bytes

Payload length: 3 bytes

Note – GRF3i+ IF Bandwidth Mode would be internally saved to NVM.
This message would be acknowledged to indicate SUCCESS/FAILURE.

SUCCESS: would be acknowledged with “Ack: MID_GRF3iPlusParams” using Command Acknowledgment – SSB Message ID 11.

FAILURE: would be acknowledged with “Rejected: MID_GRF3iPlusParams” using Command Negative Acknowledgment – SSB Message ID 12.

Set GRF3i+ Normal/Low Power RF Mode - Msg ID 233, Sub ID 0x02

This message allows user to set the RF power mode to normal or low. The Sub ID for this message is fixed to 0x02.

Table 2-69 contains the input values for the following example:

Sub Message ID = 0x2, GRF3i+ power mode =0x1

Example:

A0A20003— Start Sequence and Payload Length

E90201 — Payload

00ECB0B3— Message Checksum and End Sequence

Table 2-69 Set GRF3i+ Power Mode

Name	Bytes	Binary (Hex) Scale	Example	Unit	Description
Message ID	1U		E9		Decimal 233
Sub Message ID	1U		02		02: Set GRF3i+ power mode
GRF3i+ power mode	1U		01		0 = Normal power [default] 1 = Low power

Payload length: 3 bytes

Note – GRF3i+ power mode would be internally saved to NVM.

This message would be acknowledged to indicate SUCCESS/FAILURE.

SUCCESS: would be acknowledged with “Ack: MID_GRF3iPlusParams” using Command Acknowledgment – SSB Message ID 11.

FAILURE: would be acknowledged with “Rejected: MID_GRF3iPlusParams” using Command Negative Acknowledgment – SSB Message ID 12.Poll GRF3i+ IF

Bandwidth Mode - Msg ID 233, SubMsgID 0x0A

This message allows user to poll the IF bandwidth mode for GRF3i+.

The SubMsgID for this message is fixed to 0x0A.

Table 2-70 contains the input values for the following example:

Sub Message ID = 0xA

Example:

A0A20002— Start Sequence and Payload Length

E90A — Payload

Table 2-70 Set GRF3i+ IF Bandwidth Mode

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1U		E9		Decimal 233
Sub Message ID	1U		0A		0A: Poll GRF3i+ IF bandwidth mode

Payload length: 2 bytes

Note – This message would be acknowledged to indicate SUCCESS/FAILURE.

SUCCESS: would be acknowledged with “Ack: MID_GRF3iPlusParams” using Command Acknowledgment – SSB Message ID 11.

FAILURE: would be acknowledged with “Rejected: MID_GRF3iPlusParams” using Command Negative Acknowledgment – SSB Message ID 12.

A corresponding output message (Message ID: 233 with SubMsgID 0xFF) with parameters status would also be sent as a response to this query message.

Poll GRF3i+ Normal/Low Power mode - Msg ID 233, SubMsgID 0x0B

This message allows user to poll whether the GRF3i+ is currently in normal or low power mode. The SubMsgID for this message is fixed to 0x0B.

Table 2-71 contains the input values for the following example:

Sub Message ID = 0xB

Example:

A0A20002— Start Sequence and Payload Length

E90B — Payload

00F4B0B3— Message Checksum and End Sequence

Table 2-71 Poll GRF3i+ Normal/Low Power Mode

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	Description
Message ID	1U		E9		Decimal 233
Sub Message ID	1U		0B		0B: Poll GRF3i+ power mode

Payload length: 2 bytes

Note – This message would be acknowledged to indicate SUCCESS/FAILURE.

SUCCESS: would be acknowledged with “Ack: MID_GRF3iPlusParams” using Command Acknowledgment – SSB Message ID 11.

FAILURE: would be acknowledged with “Rejected: MID_GRF3iPlusParams” using Command Negative Acknowledgment – SSB Message ID 12.

A corresponding output message (Message ID: 233 with SubMsgID 0xFE) with parameters status would also be sent as a response to this query message.

Output Messages 3

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

Table 3-1 SiRF Binary Messages – Output Message List

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

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

Hex	Decimal	Name	Description
30	48	SiRF Dead Reckoning Class of Output Messages	The Message ID is partitioned into messages identified by Message Sub IDs, refer to Table 3-2
31	49	Test Mode 4 for SiRFLoc v2.x only	Additional test data (Test Mode 4)
32	50	SBAS Parameters	SBAS operating parameters
34	52	1 PPS Time Message	Time message for 1 PPS
37	55	Test Mode 4	Track Data
38	56	Extended Ephemeris Data	Extended Ephemeris Mask & Integrity Information
3F	63	Test Mode Output	Outputs frequency spike for Test Mode 7
41	65	SiRF Tracker Messages	Messages between tracker and SiRFNav. Refer to Table 3-3 for Sub IDs.
61 - 7F	97 - 127	MID_UserOutputBegin – MID_UserOutputEnd	Available for SDK user output messages only.
DF	223	GRF3i+ Messages	
E1	225	SiRF internal message	Reserved
FF	255	Development Data	Various status messages

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

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

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

Table 3-3 Message Sub IDs for Tracker Messages - Message ID 65 (0x41)

Sub ID	Message ID	SiRFstarIII
192 (0xC0)	GPIO state	

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

Table 3-4 identifies the supported output messages for each SiRF architecture.

Table 3-4 Supported Output Messages

Message ID	SiRF Software Options						
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3 & GSWLT3	SiRFDiRect	GSD3tw
1	No	No	No	No	No	No	No
2	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	No	No	No	No	No	No	No
4	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	No	No	No	No	No	No	Yes
6	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Yes	Yes	Yes	Yes	Yes	No	Yes
9	Yes	Yes	Yes	Yes	Yes GSW3; No GSWLT3	No	Yes
10	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13	Yes	Yes	Yes	Yes	Yes	No	Yes
14	Yes	Yes	No	Yes	Yes	Yes	Yes
15	Yes	Yes	No	Yes	Yes	Yes	Yes
16	Yes	Yes	No	No	No	No	No
17	Yes	Yes	No	No	No	No	Yes
18	Yes	Yes	Yes	Yes	Yes	Yes	Yes
19	Yes	Yes	Yes	Yes	Yes	Yes	Yes
20	Test Mode 2 only	Test Mode 2 only	Test Modes 2/3/4	Test Mode 4 (2.x only)	No	No	Yes
27	Yes	Yes	No	No	Yes	No	Yes
28	Yes	Yes	No	No	Yes	Yes	Yes
29	Yes	Yes	No	No	No	No	Yes
30	Yes	Yes	No	No	Yes	Yes	Yes
31	Yes	Yes	No	No	Yes	Yes	Yes
41	2.3 & above	Yes	2.0 & above	No	Yes	Yes	Yes
43	No	No	No	No	Yes	Yes	Yes
45	No	Yes	No	No	No	No	Yes
46	Yes	Yes	No	3.x & above	Yes	Yes	Yes
48[1] (Test Mode 4)	No	No	No	2.x only	No	No	No
48 (DR)	No	Yes[2]	No	No	No	Yes[2]	Yes[2]
49	No	No	No	2.x only	No	No	No
50	2.3 & above	Yes	No	No	3.2.5 & above	No	Yes
52	2.3.2 & above	No	No	No	No	No	No
55	No	No	No	3.x & above	Yes	Yes	No
56	2.5 & above	No	2.3 & above	No	3.2.5 & above	No	No
56 (Sub ID 4)	No	Yes	No	No	3.2.5 & above	No	Yes

Table 3-4 Supported Output Messages *(Continued)*

Message ID	SiRF Software Options						
	GSW2	SiRFDRive	SiRFXTrac	SiRFLoc	GSW3 & GSWLT3	SiRFDiRect	GSD3tw
63	No	No	No	No	No	No	Yes
225	No	No	No	No	Yes (reserved)	No	Yes
232	No	No	No	No	Yes	Yes	Yes
255	Yes	Yes	Yes	Yes	Yes	No	Yes

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

2. Not all Message Sub IDs supported.

Reference Navigation Data – Message ID 1

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

Measure Navigation Data Out – Message ID 2

Output Rate: 1 Hz

Table 3-5 lists the message data format for the measured navigation data.

Example:

A0A20029—Start Sequence and Payload Length

02FFD6F78CFFBE536E003AC004000000030001040A00036B039780E3
0612190E160F04000000000000—Payload

09BBB0B3—Message Checksum and End Sequence

Table 3-5 Measured Navigation Data Out – Message ID 2

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		02			2
X-position	4 S		FFD6F78C	m		-2689140
Y-position	4 S		FFBE536E	m		-4304018
Z-position	4 S		003AC004	m		3850244
X-velocity	2 S	*8	0000	m/sec	Vx÷8	0
Y-velocity	2 S	*8	0003	m/sec	Vy÷8	0.375
Z-velocity	2 S	*8	0001	m/sec	Vz÷8	0.125
Mode 1	1 D		04	Bitmap[1]		4
HDOP[2]	1 U	*5	0A		³5	2.0
Mode 2	1 D		00	Bitmap[3]		0
GPS Week[4]	2 U		036B			875
GPS TOW	4 U	*100	039780E3	sec	÷100	602605.79
SVs in Fix	1 U		06			6
CH 1 PRN[5]	1 U		12			18
CH 2 PRN[5]	1 U		19			25
CH 3 PRN[5]	1 U		0E			14
CH 4 PRN[5]	1 U		16			22
CH 5 PRN[5]	1 U		0F			15

Table 3-5 Measured Navigation Data Out – Message ID 2

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
CH 6 PRN[5]	1 U		04			4
CH 7 PRN[5]	1 U		00			0
CH 8 PRN[5]	1 U		00			0
CH 9 PRN[5]	1 U		00			0
CH 10 PRN[5]	1 U		00			0
CH 11 PRN[5]	1 U		00			0
CH 12 PRN[5]	1 U		00			0

Payload length: 41 bytes

1. For further information see Table 3-6 and Table 3-7. Note that the Degraded Mode positioning mode is not supported in GSW3.2.5 and newer
2. HDOP value reported has a maximum value of 50.
3. For further information see Table 3-8.
4. GPS week reports only the ten LSBs of the actual week number.
5. PRN values are reported only for satellites used in the navigation solution.

Note – Binary units scaled to integer values must be divided by the scale value to receive true decimal value (i.e., decimal X_{vel} = binary $X_{vel} \div 8$).

Mode 1 of Message ID 2 is a bit-mapped byte with five sub-values. Table 3-6 shows the location of the sub-values and Table 3-7 shows the interpretation of each sub-value.

Table 3-6 Mode 1

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

Table 3-7 Mode 1 Bitmap Information

Bit(s) Name	Name	Value	Description
PMODE	Position mode	0	No navigation solution
		1	1-SV solution (Kalman filter)
		2	2-SV solution (Kalman filter)
		3	3-SV solution (Kalman filter)
		4	> 3-SV solution (Kalman filter)
		5	2-D point solution (least squares)
		6	3-D point solution (least squares)
		7	Dead-Reckoning[1] solution (no satellites)
TPMODE	TricklePower mode	0	Full power position
		1	TricklePower position
ALTMODE	Altitude mode	0	No altitude hold applied
		1	Holding of altitude from KF
		2	Holding of altitude from user input
		3	Always hold altitude (from user input)
DOPMASK	DOP mask status	0	DOP mask not exceeded
		1	DOP mask exceeded
DGPS	DGPS status	0	No differential corrections applied
		1	Differential corrections applied

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

Mode 2 of Message ID bit-mapped byte information is described in Table 3-8.

Table 3-8 Mode 2 Bitmap

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

1. Bit 0 is controlled by the acquisition hardware. The rest of the bits are controlled by the tracking hardware, except that in SiRFstarIII receivers, bit 2 is also controlled by the acquisition hardware.
2. Bit 1 set means that the phase relationship between the I and Q samples is being tracked.
3. From an unvalidated state, a 5-SV fix must be achieved to become a validated position. If the receiver continues to navigate in a degraded mode (less than 4 SVs), the validated status remains. If navigation is lost completely, an unvalidated status results.
4. Bit 4 set means that the Doppler corrections have been made so that the phase between the I and Q samples is stable.
5. Generally, bit 6 cannot be set at the same time other bits are set. However, some firmware versions use the special case of setting

Note – Mode 2 of Message ID 2 is used to define the Fix field of the Measured Navigation Message View. It should be used only as an indication of the current fix status of the navigation solution and not as a measurement of TTFF.

True Tracker Data – Message ID 3

Defined as True Tracker data, but not yet implemented.

Measured Tracker Data Out – Message ID 4

Output Rate: 1 Hz

Table 3-9 lists the message data format for the measured tracker data.

Example:

A0A200BC—Start Sequence and Payload Length

04036C0000937F0C0EAB46003F1A1E1D1D191D1A1A1D1F1D59423F1A1A...—Payload

....B0B3—Message Checksum and End Sequence

Table 3-9 Measured Tracker Data Out – Message ID 4

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U		04			4
GPS Week[1]	2 S		036C			876

Table 3-9 Measured Tracker Data Out – Message ID 4 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	**Example**		**Scale**	**Example**
GPS TOW	4 U	s*100	0000937F	sec	s÷100	37759
Chans	1 U		0C			12
1st SVid	1 U		0E			14
Azimuth	1 U	Az*[2/3]	AB	deg	^{3}[2/3]	256.5
Elev	1 U	El*2	46	deg	^{3}2	35
State	2 D		003F	Bitmap[2]		63
C/N0 1	1 U		1A	dB-Hz		26
C/N0 2	1 U		1E	dB-Hz		30
C/N0 3	1 U		1D	dB-Hz		29
C/N0 4	1 U		1D	dB-Hz		29
C/N0 5	1 U		19	dB-Hz		25
C/N0 6	1 U		1D	dB-Hz		29
C/N0 7	1 U		1A	dB-Hz		26
C/N0 8	1 U		1A	dB-Hz		26
C/N0 9	1 U		1D	dB-Hz		29
C/N0 10	1 U		1F	dB-Hz		31
2nd SVid	1 U		1D			29
Azimuth	1 U	Az*[2/3]	59	deg	^{3}[2/3]	89
Elev	1 U	El*2	42	deg	^{3}2	66
State	2 D		003F	Bitmap[2]		63
C/N0 1	1 U		1A	dB-Hz		26
C/N0 2	1 U		1A	dB-Hz		63
...						
SVid, Azimuth, Elevation, State, and C/N0 1-10 values are repeated for each of the 12 channels						

Payload length: 188 bytes

1. GPS week number is reported modulo 1024 (ten LSBs only).
2. For further information, see Table 3-10 for state values for each channel.

Table 3-10 State Values for Each Channel

Bit	Description When Bit is Set to 1
0[1]	Acquisition/re-acquisition has been completed successfully
1[2]	The integrated carrier phase is valid – delta range in Message ID 28 is also valid
2	Bit synchronization has been completed
3	Subframe synchronization has been completed
4[3]	Carrier pullin has been completed (Costas lock)
5	Code has been locked
6[4,5]	Multiple uses. See footnotes.
7	Ephemeris data is available
8-15	Reserved

1. Bit 0 is controlled by the acquisition hardware. The rest of the bits are controlled by the tracking hardware except in SiRFstarIII receivers, where bit 2 is also controlled by the acquisition hardware.
2. Bit 1 set means that the phase relationship between the I and Q samples is being tracked. When this bit is cleared, the carrier phase measurements on this channel are invalid.
3. Bit 4 set means that the Doppler corrections have been made so that the phase between the I and Q samples is stable.
4. Most code versions use this bit to designate that a track has been lost. Generally, bit 6 cannot be set at the same time other bits are set. However, some firmware versions use the special case of setting all bits 0-7 to 1 (0xFF) to indicate that this channel is being used to test the indicated PRN for an auto or cross correlation. When used in this way, only 1 or 2 channels will report state 0xFF at any one time.
5. In some code versions, this bit is used to denote the presence of scalable tracking loops. In those versions, every track will have this bit set. When that is the case, there will be no reports for tracks being tested for auto- and cross-correlation testing as it will be done in another part of the code and not reported in this field.

Raw Tracker Data Out – Message ID 5

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

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

This message has a variable length from 1 to 81 bytes.

Output Rate: Response to polling message

Example:

A0A2001F—Start Sequence and Payload Length

06322E332E322D475358322D322E30352E3032342D4331464C4558312E32 —Payload

0631B0B3—Message Checksum and End Sequence

Table 3-11 Software Version String – Message ID 6

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

Payload Length:1-81 bytes

1. Payload example is shown above.
2. 2.3.2-GSW2-2.05.024-C1FLEX1.2

Note – Convert ASCII to symbol to assemble message (i.e., 0x4E is 'N'). Effective with version GSW 2.3.2, message length was increased from 21 to 81 bytes to allow for up to an 80-character version string.

Response: Clock Status Data – Message ID 7

This message is output as part of each navigation solution. It tells the actual time of the measurement (in GPS time), and gives the computed clock bias and drift information computed by the navigation software.

Control of this message is unique. In addition to being able to control it using the message rate commands, it also acts as part of the "Navigation Library" messages controlled by bit 4 of the Reset Configuration Bit Map field of message ID 128. When navigation library messages are enabled or disabled, this message is enabled or disabled. It is also enabled by default whenever a system reset occurs.

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD021549240800012231000472814D4DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table 3-12 Clock Status Data – Message ID 7

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

Payload length: 20 bytes

Table 3-13 Detailed Description of Message ID 7 Fields

Field	Description
Extended GPS Week	GPS week number is reported by the satellites with only 10 bits. The receiver extends that number with any higher bits and reports the full resolved week number in this message.
GPS TOW	Seconds into the current week, accounting for clock bias, when the current measurement was made. This is the true GPS time of the solution.
SVs	Total number of satellites used to compute this solution.
Clock Drift[1]	Rate of change of the Clock Bias. Clock Drift is a direct result of the GPS crystal frequency, so it is reported in Hz.
Clock Bias	This is the difference in nanoseconds between GPS time and the receiver's internal clock. In different SiRF receivers this value has different ranges, and as the computed bias approaches the limit of the range, the next measurement interval will be adjusted to be longer or shorter so that the bias remains in the selected range.
Estimated GPS Time[2]	This is the GPS time of the measurement, estimated before the navigation solution is computed. Due to variations in clock drift and other factors, this will normally not equal GPS TOW, which is the true GPS time of measurement computed as part of the navigation solution.

1. Clock Drift in SiRF receivers is directly related to the frequency of the GPS clock, derived from the GPS crystal. From the reported frequency, you can compute the GPS clock frequency, and you can predict the next clock bias. Clock drift also appears as a Doppler bias in Carrier Frequency reported in Message ID 28.
2. Estimated GPS time is the time estimated when the measurements were made. Once the measurements were made, the GPS navigation solution was computed, and true GPS time was computed. Variations in clock drift and measurement intervals generally make the estimate slightly wrong, which is why GPS TOW and Estimated GPS time typically disagree at the microsecond level.

For detailed information about computing GPS clock frequency, see "Computing GPS Clock Frequency" in Chapter 4.

50 BPS Data – Message ID 8

Output Rate: Approximately every six seconds for each channel

Example:

A0A2002B—Start Sequence and Payload Length

08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFFA
80365A867FC67708BEB5860F4—Payload

15AAB0B3—Message Checksum and End Sequence

Table 3-14 50 BPS Data – Message ID 8

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

Payload length: 43 bytes

CPU Throughput – Message ID 9

Output Rate: 1 Hz

Example:

A0A20009—Start Sequence and Payload Length

09003B0011001601E5—Payload

0151B0B3—Message Checksum and End Sequence

Table 3-15 CPU Throughput – Message ID 9

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

Payload length: 9 bytes

Error ID Data – Message ID 10

Output Rate: As errors occur

Message ID 10 messages have a different format from other messages. Rather than one fixed format, there are several formats, each designated by an error ID. However, the format is standardized as indicated in Table 3-16. The specific format of each error ID message follows

Table 3-16 Message ID 10 Overall Format

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

Error ID: 2

Code Define Name:ErrId_CS_SVParity

Error ID Description:Satellite subframe # failed parity check.

Example:

A0A2000D – Start Sequence and Payload Length

0A0002000200000001000000002 – Payload

0011B0B3 – Message Checksum and End Sequence

Table 3-17 Error ID

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

Payload Length: 13 bytes

Table 3-18 Error ID 2 Message Description

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

Error ID: 9

Code Define Name:ErrId_RMC_GettingPosition

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

Example:

A0A20009 – Start Sequence and Payload Length

0A0009000100000001 – Payload

0015B0B3 – Message Checksum and End Sequence

Table 3-19 Error ID 9 Message

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

Payload Length: 9 bytes

Table 3-20 Error ID 9 Message Description

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

Error ID: 10

Code Define Name:ErrId_RXM_TimeExceeded

Error ID Description:Conversion of Nav Pseudo Range to Time of Week (TOW) for tracker exceeds limits: Nav Pseudo Range > 6.912e5 (1 week in seconds) || Nav Pseudo Range < -8.64e4.

Example:

A0A20009 – Start Sequence and Payload Length

0A000A000100001234 – Payload

005BB0B3 – Message Checksum and End Sequence

Table 3-21 Error ID 10 Message

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

Payload length: 9 bytes

Table 3-22 Error ID 10 Message Description

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

Error ID: 11

Code Define Name:ErrId_RXM_TDOPOverflow

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

Example:

A0A20009 – Start Sequence and Payload Length

0A000B0001xxxxxxxx – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-23 Error ID 11 Message

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

Payload length: 9 bytes

Table 3-24 Error ID 11 Message Description

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

Error ID: 12

Code Define Name:ErrId_RXM_ValidDurationExceeded

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

Example:

A0A2000D – Start Sequence and Payload Length

0A000C0002xxxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-25 Error ID 12 Message

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

Payload Length: 13 bytes

Table 3-26 Error ID 12 Message Description

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

Error ID: 13

Code Define Name:ErrId_STRTP_BadPostion

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

Example:

A0A20011 – Start Sequence and Payload Length

0A000D0003xxxxxxxxaaaaaaaabbbbbbbb – Payload

xxxxB0B3 – Message Checksum and End Sequence0

Table 3-27 Error ID 13 Message

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

Payload length: 17 bytes

Table 3-28 Error ID 13 Message Description

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

Error ID: 4097 (0x1001)

Code Define Name:ErrId_MI_VCOClockLost

Error ID Description:VCO lost lock indicator.

Example:

A0A20009 – Start Sequence and Payload Length

0A1001000100000001 – Payload

001DB0B3 – Message Checksum and End Sequence

Table 3-29 Error ID 4097 Message

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

Payload length: 9 bytes

Table 3-30 Error ID 4097 Message Description

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

Error ID: 4099 (0x1003)

Code Define Name:ErrId_MI_FalseAcqReceiverReset

Error ID Description:Nav detect false acquisition, reset receiver by calling NavForceReset routine.

Example:

A0A20009 – Start Sequence and Payload Length

0A1003000100000001 – Payload

001FB0B3 – Message Checksum and End Sequence

Table 3-31 Error ID 4099 Message

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

Payload Length: 9 bytes

Table 3-32 Error ID 4099 Message Description

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

Error ID: 4104 (0x1008)

Code Define Name:ErrId_STRTP_SRAMCksum

Error ID Description:Failed SRAM checksum during startup.

- Four field message indicates receiver control flags had checksum failures.
- Three field message indicates clock offset checksum failure or clock offset value is out of range.
- Two field message indicates position and time checksum failure forces a cold start.

Example:

A0A2xxxx – Start Sequence and Payload Length

0A10080004xxxxxxxxaaaaaaaa00000000cccccccc – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-33 Error ID 4104 Message

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

Payload length: 21, 17, or 11 bytes

Table 3-34 Error ID 4104 Message Description

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

Table 3-34 Error ID 4104 Message Description *(Continued)*

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

Error ID: 4105 (0x1009)

Code Define Name:ErrId_STRTP_RTCTimeInvalid

Error ID Description:Failed RTC SRAM checksum during startup. If one of the double buffered SRAM.Data.LastRTC elements is valid and RTC days is not 255 days, the GPS time and week number computed from the RTC is valid. If not, this RTC time is invalid.

Example:

A0A2000D – Start Sequence and Payload Length

0A10090002xxxxxxxxaaaaaaaa – Payload

xxxxB0B3 – Message Checksum and End Sequence

Table 3-35 Error ID 4105 Message

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

Payload length: 13 bytes

Table 3-36 Error ID 4105 Message Description

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

Error ID: 4106 (0x100A)

Code Define Name:ErrId_KFC_BackupFailed_Velocity

Error ID Description: Failed saving position to NVRAM because the ECEF velocity sum was greater than 3600.

Example:

A0A20005 – Start Sequence and Payload Length

0A100A0000 – Payload

0024B0B3 – Message Checksum and End Sequence

Table 3-37 Error ID 4106 Message

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

Payload length: 5 bytes

Table 3-38 Error ID 4106 Message Description

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

Error ID: 4107 (0x100B)

Code Define Name:ErrId_KFC_BackupFailed_NumSV

Error ID Description: Failed saving position to NVRAM because current navigation mode is not KFNav and not LSQFix.

Example:

A0A20005 – Start Sequence and Payload Length

0A100B0000 – Payload

0025B0B3 – Message Checksum and End Sequence

Table 3-39 Error ID 4107 Message

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

Payload length: 5 bytes

Table 3-40 Error ID 4107 Message Description

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

Error ID: 8193 (0x2001)

Code Define Name:ErrId_MI_BufferAllocFailure

Error ID Description:Buffer allocation error occurred. Does not appear to be active because uartAllocError variable never gets set to a non-zero value in the code.

Example:

A0A20009 – Start Sequence and Payload Length

0A2001000100000001 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-41 Error ID 8193 Message

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

Payload length: 9 bytes

Table 3-42 Error ID 8193 Message Description

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

Error ID: 8194 (0x2002)

Code Define Name:ErrId_MI_UpdateTimeFailure

Error ID Description:PROCESS_1SEC task was unable to complete upon entry. Overruns are occurring.

Example:

A0A2000D – Start Sequence and Payload Length

0A200200020000000100000064 – Payload

0093B0B3 – Message Checksum and End Sequence

Table 3-43 Error ID 8194 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		0A			10
Error ID	2 U		2002			8194

Table 3-43 Error ID 8194 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Count	2 U		0002			2
Number of in process errors.	4 U		00000001			1
Millisecond errors	4 U		00000064			100

Payload length: 13 bytes

Table 3-44 Error ID 8194 Message Description

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

Error ID: 8195 (0x2003)

Code Define Name:ErrId_MI_MemoryTestFailed

Error ID Description:Failure of hardware memory test.

Example:

A0A20005 – Start Sequence and Payload Length

0A20030000 – Payload

002DB0B3 – Message Checksum and End Sequence

Table 3-45 Error ID 8195 Message

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

Payload length: 5 bytes

Table 3-46 Error ID 8195 Message Description

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

Command Acknowledgment – Message ID 11

This reply is sent in response to messages accepted by the receiver. If the message being acknowledged requests data from the receiver, the data is sent first, then this acknowledgment.

Output Rate: Response to successful input message

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

A0A20002—Start Sequence and Payload Length

0B92—Payload

009DB0B3—Message Checksum and End Sequence

Table 3-47 Command Acknowledgment – Message ID 11

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

Payload length: 2 bytes

Command Negative Acknowledgment – Message ID 12

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

Output Rate: Response to rejected input message

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

A0A20002—Start Sequence and Payload Length

0C92—Payload

009EB0B3—Message Checksum and End Sequence

Table 3-48 Command Negative Acknowledgment – Message ID 12

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

Payload length: 2 bytes

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

Visible List – Message ID 13

This message reports the satellites that are currently above the local horizon. Generally there are from 6 to 13 satellites visible at any one time.

Output Rate: Updated approximately every 2 minutes

Note – This is a variable length message. Only the number of visible satellites are reported (as defined by Visible SVs in Table 3-49).

Example:

A0A2002A—Start Sequence and Payload Length

0D081D002A00320F009C0032....—Payload

....B0B3—Message Checksum and End Sequence

Table 3-49 Visible List – Message ID 13

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

Payload length: variable (2 + 5 times number of visible SVs).

Almanac Data – Message ID 14

This message is sent in response to the Poll Almanac command, Message ID 146. When Message ID 146 is sent, the receiver responds with 32 individual Message ID 14 messages, one for each of the possible satellite PRNs. If no almanac exists for a given PRN, the data in that message is all zeros.

Output Rate: Response to poll

Table 3-50 Contents of Message ID 14

Name	Bytes	Description
Message ID	1 U	Hex 0x0E (decimal 14)
SV ID	1 U	SV PRN code, hex 0x01..0x02, decimal 1..32
Almanac Week & Status	2 S	10-bit week number in 10 MSBs, status in 6 LSBs (1 = good; 0 = bad)
Data[1] [2][12]	2 S	UINT16[12] array with sub-frame data
Checksum	2 S	

Payload length: 30 bytes

1. The data area consists of an array of 12 16-bit words consisting of the data bytes from the navigation message sub-frame. Table 3-51 shows how the actual bytes in the navigation message correspond to the bytes in this data array. Note that these are the raw navigation message data bits with any inversion removed and the parity bits removed.

2. For a complete description of almanac and Ephemeris data representation for Data[12], see Appendix A.

Table 3-51 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array		Navigation Message		Data Array	
Word	Byte	Word	Byte	Word	Byte	Word	Byte
3	MSB	[0]	LSB	7	MSB	[6]	MSB
3	Middle	[0]	MSB	7	Middle	[6]	LSB
3	LSB	[1]	LSB	7	LSB	[7]	MSB
4	MSB	[1]	MSB	8	MSB	[7]	LSB
4	Middle	[2]	LSB	8	Middle	[8]	MSB
4	LSB	[2]	MSB	8	LSB	[8]	LSB
5	MSB	[3]	LSB	9	MSB	[9]	MSB

Table 3-51 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array		Navigation Message		Data Array	
Word	Byte	Word	Byte	Word	Byte	Word	Byte
5	Middle	[3]	MSB	9	Middle	[9]	LSB
5	LSB	[4]	LSB	9	LSB	[10]	MSB
6	MSB	[4]	MSB	10	MSB	[10]	LSB
6	Middle	[5]	LSB	10	Middle	[11]	MSB
6	LSB	[5]	MSB	10	LSB	[11]	LSB

Note – Message ID 130 uses a similar format, but sends an array of 14 16-bit words for each SV and a total of 32 SVs in the message (almanac for SVs 1..32, in ascending order). For that message, a total of 448 words constitutes the data area. For each of 32 SVs, that corresponds to 14 words per SV. Those 14 words consist of one word containing the week number and status bit (described in Table 3-50 above as Almanac Week & Status), 12 words of the same data as described for the data area above, then a single 16-bit checksum of the previous 13 words. The SV PRN code is not included in the message 130 because the SV ID is inferred from the location in the array.

Ephemeris Data (Response to Poll) – Message ID 15

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

The ephemeris data that is polled from the receiver is in a special SiRF format based on the ICD-GPS-200 format for ephemeris data.

Output Rate: Response to poll

Table 3-52 Contents of Message ID 15

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

Payload length: 92 bytes

1. The data area consists of a 3x15 array of unsigned integers, 16 bits long. The first word of each row in the array ([0][0], [1][0], and [2][0]) contain the SV ID. The remaining words in the row contain the data from the navigation message sub-frame, with row [0] containing sub-frame 1, row [1] containing sub-frame 2, and row [2] containing sub-frame 3. Data from the sub-frame is stored in a packed format, meaning that the 6 parity bits of each 30-bit navigation message word have been removed, and the remaining 3 bytes are stored in 1.5 16-bit words. Since the first word of the sub-frame, the telemetry word (TLM), does not contain any data needed by the receiver, it is not saved. Thus, there are 9 remaining words, with 3 bytes in each sub-frame. This total of 27 bytes is stored in 14 16-bit words. The second word of the sub-frame, the handover word (HOW), has its high byte (MSB) stored as the low byte (LSB) of the first of the 16-bit words. Each following byte is stored in the next available byte of the array. Table 3-53 shows where each byte of the sub-frame is stored in the row of 16-bit words.
2. For a complete description of almanac and Ephemeris data representation for Data[45], see Appendix A.

Table 3-53 Byte Positions Between Navigation Message and Data Array

Navigation Message		Data Array		Navigation Message		Data Array	
Word	**Byte**	**Word**	**Byte**	**Word**	**Byte**	**Word**	**Byte**
2 (HOW)	MSB	[][1]	LSB	7	MSB	[][9]	MSB
2	Middle	[][2]	MSB	7	Middle	[][9]	LSB
2	LSB	[][2]	LSB	7	LSB	[][10]	MSB
3	MSB	[][3]	MSB	8	MSB	[][10]	LSB
3	Middle	[][3]	LSB	8	Middle	[][11]	MSB
3	LSB	[][4]	MSB	8	LSB	[][11]	LSB
4	MSB	[][4]	LSB	9	MSB	[][12]	MSB
4	Middle	[][5]	MSB	9	Middle	[][12]	LSB
4	LSB	[][5]	LSB	9	LSB	[][13]	MSB
5	MSB	[][6]	MSB	10	MSB	[][13]	LSB
5	Middle	[][6]	LSB	10	Middle	[][14]	MSB
5	LSB	[][7]	MSB	10	LSB	[][14]	LSB
6	MSB	[][7]	LSB				
6	Middle	[][8]	MSB				
6	LSB	[][8]	LSB				

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

Test Mode 1 – Message ID 16

This message is output when the receiver is in test mode 1. It is sent at the end of each test period as set by Message ID 150.

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

Example:

A0A20011—Start Sequence and Payload Length

100015001E000588B800C81B5800040001—Payload

02D8B0B3—Message Checksum and End Sequence

Table 3-54 Test Mode 1 Data – Message ID 16

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

Payload length: 17 bytes

Table 3-55 Detailed Description of Test Mode 1 Data

Name	Description
Message ID	Message ID number
SV ID	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20sec x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 / sec).
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the parity of the transmitted word does not match the receiver's computed parity.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and/or phase causes a VCO lost lock.

Differential Corrections – Message ID 17

Message ID 17 provides the RTCM data received from a DGPS source. The data is sent as a SiRF Binary message and is based on the RTCM SC-104 format. To interpret the data, see *RTCM Recommended Standards for Differential GNSS* by the Radio Technical Commission for Maritime Services. Data length and message output rate vary based on received data.

Table 3-56 RTCM message – Message ID 17

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

Payload length: variable

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

OkToSend – Message ID 18

The OkToSend message is sent by a receiver that is in power-saving mode such as TricklePower or Push-to-Fix. It is sent immediately upon powering up, with an argument indicating it is OK to send messages to the receiver, and it is sent just before turning off power with an argument that indicates no more messages should be sent.

Output Rate: Two messages per power-saving cycle

Example:

A0A20002—Start Sequence and Payload Length

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table 3-57 Almanac Data – Message ID 18

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

Payload length: 2 bytes

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

Navigation Parameters (Response to Poll) – Message ID 19

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

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

Example:

A0 A2 00 41 —Start Sequence and Payload Length

13 00 00 00 00 00 00 00 00 01 1E 0F 01 00 01 00 00 00 00 04 00 4B 1C 00 00 00 00 02 00 1E 00 00 00 00 00 00 00 03 E8 00 00 03 E8 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00—Payload

02 A4 B0 B3—Message Checksum and End Sequence

Table 3-58 Navigation Parameters – Message ID 19

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

Table 3-58 Navigation Parameters – Message ID 19 *(Continued)*

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

Payload length: 65 bytes

1. 00 = GSW2 definition; 01 = SiRF Binary APM definition; other values reserved.
2. These values are set by Message ID 136. See description of values in Table 2-19. Note that Degraded Mode is not supported in GSW3.2.5 and newer.
3. These values are set by Message ID 143. See description of values in Table 2-28.
4. These parameters are set in the software and are not modifiable via the User Interface.
5. These values are set by Message ID 137. See description of values in Table 2-22.
6. These values are set by Message ID 139. See description of values in Table 2-26.
7. These values are set by Message ID 140. See description of values in Table 2-27.
8. These values are set by Message ID 133. See description of values in Table 2-14.
9. These values are set by Message ID 138. See description of values in Table 2-24.
10. These values are set by Message ID 151. See description of values in Table 2-38.
11. This setting is derived from the LP on-time and LP interval.
12. These values are set by Message ID 167. See description of values in Table 2-44.
13. Bit 7: APM Enabled, 1 = enabled, 0 = disabled; Bits 0-4: Power Duty Cycle, range: 1-20 scaled to 5%, 1 = 5%, 2 = 10%
14. Only used in SiRFLoc software.
15. These values are set by Message ID 53. See description of values in Table 2-4
16. Bits 2-3: Time Accuracy, 0x00 = no priority imposed, 0x01 = RESP_TIME_MAX has higher priority, 0x02 = HORI_ERR_MAX has higher priority, Bits 0-1: Time Duty Cycle, 0x00 = no priority imposed, 0x01 = time between two consecutive fixes has priority, 0x02 = power duty cycle has higher priority.

Table 3-59 Horizontal/Vertical Error

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

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

Table 3-60 describes the SiRF software and test mode 2/3/4 with respect to their respective Message ID.

Table 3-60 SiRF Software and Test Mode in Relation with – Message ID 20, 46, 48, 49, and 55

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

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

Refer to each specific Message ID for more details.

Test Mode 2/3/4 – Message ID 20

Test Mode 2

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

The definition of Message ID 20 is different depending on the version and type of software being used.

Example:

A0A20033—Start Sequence and Payload Length

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A0000000000000 000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-61 Test Mode 2 – Message ID 20

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		14			20
SV ID	2 U		0001			1
Period	2 U		001E	sec		30
Bit Sync Time	2 U		0002	sec		2
Bit Count	2 U		3F70			13680
Poor Status	2 U		001F			31
Good Status	2 U		0D29			3369
Parity Error Count	2 U		0000			0

Table 3-61 Test Mode 2 – Message *(Continued)*ID 20 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Lost VCO Count	2 U		0000			0
Frame Sync Time	2 U		0006	sec		6
C/N0 Mean	2 S	*10	01C6		÷10	45.4
C/N0 Sigma	2 S	*10	0005		÷10	0.5
Clock Drift Change	2 S	*10	1B0E	Hz	÷10	692.6
Clock Drift	4 S	*10	000EB41A	Hz	÷10	96361.0
Reserved	2 S		0000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			
Reserved	4 S		00000000			

Payload length: 51 bytes

Table 3-62 Detailed Description of Test Mode 2 Message ID 20

Name	Description
Message ID	Message ID number
SV ID	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20 sec x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/N0 Mean	Calculated average of reported C/N0 by all 12 channels during the test period.
C/N0 Sigma	Calculated sigma of reported C/N0 by all 12 channels during the test period.
Clock Drift Change	Difference in clock frequency from start and end of the test period.
Clock Drift	Rate of change in clock bias.

Test Mode 3

This is supported by SiRFXTrac only as Message ID 20. Test Mode 3 requires approximately 10 seconds of measurement data collection before sufficient summary information is available.

Example:

A0A20033—Start Sequence and Payload Length

140001001E00023F70001F0D2900000000000601C600051B0E000EB41A000000000000000
000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-63 Test Mode 3 – Message ID 20

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		14			20
SV ID	2 U		0001			1
Period	2 U		001E	sec		30
Bit Sync Time	2 U		0002	sec		2
Bit Count	2 U		3F70			13680
Poor Status	2 U		001F			31
Good Status	2 U		0D29			3369
Parity Error Count	2 U		0000			0
Lost VCO Count	2 U		0000			0
Frame Sync Time	2 U		0006	sec		6
C/N0 Mean	2 S	*10	01C6		÷10	45.4
C/N0 Sigma	2 S	*10	0005		÷10	0.5
Clock Drift Change	2 S	*10	1B0E	Hz	÷10	692.6
Clock Drift	4 S	*10	000EB41A	Hz	÷10	96361.0
Bad 1 kHz Bit Count	2 S		0000			
Abs I20 ms	4 S		00000000			
Abs Q1 ms	4 S		00000000			
Reserved	4 S		00000000			
Reserved[1]	4 S		00000000			
Reserved	4 S		00000000			

Payload length: 51 bytes

1. In some later versions of GSW3 (3.2.4 or later) this field is split into two new fields: RTC Frequency 2 U (in Hz) and Reserved 2 U.

Table 3-64 Detailed Description of Test Mode 3 Message ID 20

Name	Description
Message ID	Message ID number
SV ID	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20sec x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check.

Table 3-64 Detailed Description of Test Mode 3 Message ID 20 *(Continued)*

Name	Description
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/N0 Mean	Calculated average of reported C/N0 by all 12 channels during the test period
C/N0 Sigma	Calculated sigma of reported C/N0 by all 12 channels during the test period
Clock Drift Change	Difference in clock frequency from start and end of the test period
Clock Drift	Rate of change of clock bias
Bad 1 kHz Bit Count	Errors in 1 ms post correlation I count values
Abs I20 ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period
Abs Q20 ms	Absolute value of the 20 ms Q count over the duration of the test period
RTC Frequency	The measured frequency of the RTC crystal oscillator, reported in Hertz

Test Mode 4

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

Table 3-65 Test Mode 4 – Message ID 20

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U		14			20
Test Mode	1 U		04			4
Message Variant	1 U		01			1
SV ID	2 U		0001			1
Period	2 U		001E	sec		30
Bit Sync Time	2 U		0002	sec		2
C/N0 Mean	2 S	*10	01C6		÷10	45.4
C/N0 Sigma	2 S	*10	0005		÷10	0.5
Clock Drift Change	2 S	*10	1B0E	Hz	÷10	692.6
Clock Drift	4 S	*10	000EB41A	Hz	÷10	96361.0
I Count Errors	2 S		0003			3
Abs I20ms	4 S		0003AB88			240520
Abs Q1ms	4 S		0000AFF0			45040

Payload length: 29 bytes

Table 3-66 Detailed Description of Test Mode 4 Message ID 20

Name	Description
Message ID	Message ID number
Test Mode	3 = Testmode 3, 4 = Testmode 4
Message Variant	The variant # of the message (variant change indicates possible change in number of fields or field description)
SV ID	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
C/N0 Mean	Calculated average of reported C/N0 by all 12 channels during the test period
C/N0 Sigma	Calculated sigma of reported C/N0 by all 12 channels during the test period
Clock Drift Change	Difference in clock frequency from start and end of the test period

Table 3-66 Detailed Description of Test Mode 4 Message ID 20

Name	Description
Clock Drift	The internal clock offset
I Count Errors	Errors in 1 ms post correlation I count values
Abs I20 ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period
Abs Q 1 ms	Absolute value of the 1 ms Q count over the duration of the test period

DGPS Status Format – Message ID 27

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

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

Example (with SBAS):

A0A20034—Start Sequence and Payload Length

1B1444444444007252864A2EC .... —Payload

1533B0B3—Message Checksum and End Sequence

The above example looks as follows in ASCII format:

27, 1, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 0, 0, 7, 594, 8, 100, 10, 748

Table 3-67 DGPS Status Format – Message ID 27

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

Table 3-67 DGPS Status Format – Message ID 27 *(Continued)*

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Signal Strength	2 S			dB		
SNR	2 S			dB		
If the DGPS source is not Beacon, next 14 bytes are interpreted as follows:						
Correction Age[2] [12]	1 x 12		4	sec		4
Reserved	2					
Remainder of the table applies to all messages, and reports on available corrections						
Satellite PRN Code	1 U		18			SV = 24
DGPS Correction	2 S		24E	meters	100	5.90
The above 3 bytes are repeated a total of 12 times. If less than 12 satellite corrections are available, the unused entries have values of 0.						
Payload length: 52 bytes						

1. Possible values for this field are given in Table 3-68. If the GSPS source is set to none, three messages are being sent and then the message is disabled.

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

Table 3-68 DGPS Correction Types

DGPS Correction Types	Value	Description
None	0	No DGPS correction type have been selected
SBAS	1	SBAS
Serial Port	2	RTCM corrections
Internal Beacon	3	Beacon corrections (available only for GSW2 software)
Software	4	Software Application Program Interface (API) corrections

Note – This message differs from others in that it has multiple formats. Further, not all SiRF software versions implement all of the features. All versions implement the first 2 bytes and the last 3 x 12 bytes (3 bytes per satellite times 12 satellites) the same. The 14 bytes in between these two sections vary depending on the source of the DGPS information. If the source is an internal beacon, the 14 bytes are used to display information about the beacon itself (frequency, bit rate, etc.). If the source is something other than an internal beacon, some software versions display the age of the corrections while other versions only fill this area with zeroes.

Navigation Library Measurement Data – Message ID 28

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

Example:

A0A20038—Start Sequence and Payload Length

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

1533B0B3—Message Checksum and End Sequence

Table 3-69 Navigation Library Measurement Data – Message ID 28

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		1C			28
Channel	1 U		00			0
Time Tag[1]	4 U		000660D0	ms		135000
Satellite ID	1 U		15			20
GPS Software Time[2]	8 Dbl		41740B0B48353F7D	sec		2.4921113696e+005
Pseudorange[3]	8 Dbl		7D3F354A0B0B7441	m		2.1016756638e+007
Carrier Frequency	4 Sgl		89E98246	m/s		1.6756767578e+004
Carrier Phase[4]	8 Dbl		A4703D4A0B0B7441	m		2.1016756640e+007
Time in Track	2 U		7530	ms		10600
Sync Flags[5]	1 D		17			23
C/N0 1	1 U		34	dB-Hz		43
C/N0 2	1 U			dB-Hz		43
C/N0 3	1 U			dB-Hz		43
C/N0 4	1 U			dB-Hz		43
C/N0 5	1 U			dB-Hz		43
C/N0 6	1 U			dB-Hz		43
C/N0 7	1 U			dB-Hz		43
C/N0 8	1 U			dB-Hz		43
C/N0 9	1 U			dB-Hz		43
C/N0 10	1 U			dB-Hz		43
Delta Range Interval	2 U		03E801F4	ms		1000
Mean Delta Range Time	2 U		01F4	ms		500
Extrapolation Time[6]	2 S		0000	ms		
Phase Error Count	1 U		00			0
Low Power Count	1 U		00			0

Payload length: 56 bytes

1. Internal time for relative measure only.
2. GPS software time minus clock bias = GPS time of measurement.
3. Pseudorange does not contain ionospheric, tropospheric or clock corrections
4. GSW3 and GSWLT3 software does not report the Carrier Phase.
5. In GSW2 software this is sync flags, see Table 3-70. In GSW3 code this field is a duplicate of the State field from Message ID 4. See Table 3-10.
6. Reserved for SiRF use with GSW3, GSWLT3, GSW3.0 and above.

Note – For GPS Software Time, Pseudorange, Carrier Frequency, and Carrier Phase, the fields are floating point (4-byte fields) or double-precision floating point (8-byte fields), per IEEE-754 format. The byte order may have to be changed to be properly interpreted on some computers. Also, GSW3.x and GSWLT3 use the same byte ordering method as the GSW 2.2.0. Therefore, GSW 2.2.0 (and older) and GSW 3.0 (and newer) use the original byte ordering method; GSW 2.3.0 through 2.9.9 use an alternate byte ordering method.

To convert the data to be properly interpreted on a PC-compatible computer, do the following: For double-precision (8-byte) values: Assume the bytes are transmitted in the order of B0, B1, ... , B7. For version 2.2.0 and earlier software, rearrange them to B3, B2, B1, B0, B7, B6, B5, B4. For version 2.3.0 and later software, rearrange them to B7, B6, B5, ... , B0. For single-precision (4-byte) values: Assume bytes are transmitted in the order of B0, B1, B2, B3. Rearrange them to B3, B2, B1, B0 (that is, byte B3 goes into the lowest memory address, B0 into the highest).

With these remappings, the values should be correct. To verify, compare the same field from several satellites tracked at the same time. The reported exponent should be similar (within 1 power of 10) among all satellites. The reported Time of Measurement, Pseudorange and Carrier Phase are all uncorrected values.

Message ID 7 contains the clock bias that must be considered. Adjust the GPS Software time by subtracting clock bias, adjust pseudorange by subtracting clock bias times the speed of light, and adjust carrier phase by subtracting clock bias times speed of light/GPS L1 frequency. To adjust the reported carrier frequency do the following: Corrected Carrier Frequency (m/s) = Reported Carrier Frequency (m/s) – Clock Drift (Hz)*C / 1575420000 Hz. For a nominal clock drift value of 96.25 kHz (equal to a GPS Clock frequency of 24.5535 MHz), the correction value is 18315.766 m/s.

Note – GPS Software Time – Clock Bias = Time of Receipt = GPS Time. GPS Software Time – Pseudorange (sec) = Time of Transmission = GPS Time. Adjust SV position in Message ID 30 by (GPS Time $_{MID\ 30}$ – Time of Transmission) * V_{sat}.

Table 3-70 Sync Flag Fields (for GSW2 software ONLY)

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

Table 3-71 Detailed Description of the Measurement Data

Name	Description
Message ID	Message ID number
Channel	Receiver channel number for a given satellite being searched or tracked. Range of 0-11 for channels 1-12, respectively
Time Tag	This is the Time Tag in milliseconds of the measurement block in the receiver software time. Time tag is an internal millisecond counter which has no direct relationship to GPS time, but is started as the receiver is turned on or reset.
Satellite ID	Pseudo-Random Noise (PRN) number.
GPS Software Time	This is GPS Time of Week (TOW) estimated by the software in millisecond
Pseudorange	This is the generated pseudorange measurement for a particular SV. When carrier phase is locked, this data is smoothed by carrier phase.

Table 3-71 Detailed Description of the Measurement Data *(Continued)*

Name	Description
Carrier Frequency	This can be interpreted in two ways: 1. The delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval. 2. The frequency from the AFC loop. If, for example, the delta pseudorange interval computation for a particular channel is zero, it can be the AFC measurement, otherwise it is a delta pseudorange computation.[1]
Carrier Phase	For GSW2 software, the integrated carrier phase (meters), which initially is made equal to pseudorange, is integrated as long as carrier lock is retained. Discontinuity in this value generally means a cycle slip and renormalization to pseudorange.
Time in Track	The Time in Track counts how long a particular SV has been in track. For any count greater than zero (0), a generated pseudorange is present for a particular channel. The length of time in track is a measure of how large the pull-in error may be.
Sync Flags	For GSW2, this byte contains two 2-bit fields and one 1-bit field that describe the Autocorrelation Detection State, Synch State and Coherent Integration Time. Refer to Table 3-70 for more details. For GSW3, this field contains a duplicate of the state field of Message ID 4. See Table 3-10 for details. In builds with Scalable Tracking Loops, including SiRFNav that supports GSD3tw hardware, note that some bits are given additional duties or definitions. See specifically bits 1 and 6.
C/N0 1	This array of Carrier To Noise Ratios is the average signal power in dB-Hz for each of the 100-millisecond intervals in the previous second or last epoch for each particular SV being track in a channel. First 100 millisecond measurement
C/N0 2	Second 100 millisecond measurement
C/N0 3	Third 100 millisecond measurement
C/N0 4	Fourth 100 millisecond measurement
C/N0 5	Fifth 100 millisecond measurement
C/N0 6	Sixth 100 millisecond measurement
C/N0 7	Seventh 100 millisecond measurement
C/N0 8	Eighth 100 millisecond measurement
C/N0 9	Ninth 100 millisecond measurement
C/N0 10	Tenth 100 millisecond measurement
Delta Range Interval	This is the delta-pseudorange measurement interval for the preceding second. A value of zero indicated that the receiver has an AFC measurement or no measurement in the Carrier Frequency field for a particular channel When carrier phase measurement is impossible, some software versions will report the low-power count threshold in dB-Hz in this field. See Low Power Counts field description for details.
Mean Delta Range Time	When carrier phase is locked, the delta-range interval is measured for a period of time before the measurement time. By subtracting the time in this field, reported in milliseconds, from the reported measurement time (Time Tag or GPS Software Time) the middle of the measurement interval will be computed. The duration of the measurement interval is double the value in this field. In SiRFstarIII receivers, this value is always 500 since the measurement interval is always 1 second. Because of this fact, the two LSBs have been given new uses in some code versions starting with SiRFNav for GSD3tw. The LSB, bit 0, will be set to 1 whenever a measurement was made in a TricklePower period. Since TricklePower measurements may be made in either of 2 methods, bit 1 will be used to indicate the measurement type. A 1 in bit 1 means the TricklePower measurement was made using Tracking Algorithm, while a 0 means that the measurement was made using the Acquisition/Reacquisition Interpolation Algorithm. These bits are useful only to SiRF and may be ignored by other users.
Extrapolation Time	In GSW2, this is the pseudorange extrapolation time, in milliseconds, to reach the common Time tag value. Reserved for SiRF use in GSW3 and GSWLT3.

Table 3-71 Detailed Description of the Measurement Data *(Continued)*

Name	Description
Phase Error Count	This is the count of the phase errors greater than 60 degrees measured in the preceding second as defined for a particular channel
Low Power Count	Whenever low power counts occur in a measurement interval, this field will record how many of the 20 ms measurements reported low power. The range of this field is 0 to 50. In SiRFstarIII receivers the low-power threshold is not well defined, but varies under various software versions. For that reason, later versions of software, beginning with SiRFNav for GSD3tw may report the threshold for low power in dB-Hz. In software implementing this feature, it is necessary to examine bit 1 of the Sync Flags field. When that bit is set, low power counts should not occur. When it is clear, carrier phase tracking is impossible, and the threshold for low power counts will be reported in the Delta Range Interval field. Field Delta Range Interval, Description, add at the end: "In SiRFstarIII later software versions, starting with SiRFNav for the GSD3tw, this field may have a secondary use. When bit 1 of the Sync Flags (or State) field is set to 0, carrier phase tracking is not possible. This field becomes unnecessary and can be used for the second purpose. Since the threshold for declaring a measurement as a low power measurement varies, this field can be used to report that threshold, in dB-Hz. This field reports low-power threshold only when bit 1 of the Sync Flags field is 0.

1. Carrier frequency may be interpreted as the measured Doppler on the received signal. The value is reported in metres per second but can be converted to hertz using the Doppler equation:

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

   Note that the computed Doppler frequency contains a bias equal to the current clock drift as reported in Message ID 7. This bias, nominally 96.250 kHz, is equivalent to over 18 km/s.

Navigation Library DGPS Data – Message ID 29

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

Example:

A0A2001A—Start Sequence and Payload Length

1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000—Payload

0956B0B3—Message Checksum and End Sequence

Table 3-72 Navigation Library DGPS Data – Message ID 29

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

Payload length: 26 bytes

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

Note – The fields Pseudorange Correction, Pseudorange Rate Correction, and Correction Age are floating point values per IEEE-754. To properly interpret these in a computer, the bytes must be rearranged in reverse order.

Navigation Library SV State Data – Message ID 30

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

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

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

Example:

A0A20053—Start Sequence and Payload Length

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

2360B0B3—Message Checksum and End Sequence

Table 3-73 Navigation Library SV State Data – Message ID 30

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1 U		1E			30
Satellite ID	1 U		15			21
GPS Time	8 Dbl			sec		
Position X	8 Dbl			m		
Position Y	8 Dbl			m		
Position Z	8 Dbl			m		
Velocity X	8 Dbl			m/sec		
Velocity Y	8 Dbl			m/sec		
Velocity Z	8 Dbl			m/sec		
Clock Bias	8 Dbl			sec		
Clock Drift	4 Sgl		2C64E99D	s/s		744810909
Ephemeris Flag (see details in Table 3-74)	1 D		01			1
Reserved	4 Sgl					
Reserved	4 Sgl					
Ionospheric Delay	4 Sgl		408906C8	m		1082721992

Payload length: 83 bytes

Note – Each of the 8-byte fields as well as Clock Drift and Ionospheric Delay fields are floating point values per IEEE-754. To properly interpret these in a computer, the bytes must be rearranged. See Note in “Navigation Library Measurement Data – Message ID 28” on page 33 for byte orders.

Table 3-74 Ephemeris Flag Definition

Ephemeris Flag Value	Definition
0x00	No Valid SV state
0x01	SV state calculated from broadcast ephemeris
0x02	SV state calculated from almanac at least 0.5 week old
0x03	Assist data used to calculate SV state
0x04	SV state calculated from almanac less than 0.5 weeks old
0x11	SV state calculated from server-based synthesized ephemeris with age of 1 day
0x12	SV state calculated from server-based synthesized ephemeris with age of 2 day
0x13	SV state calculated from server-based synthesized ephemeris with age of 3 day
0x14	SV state calculated from server-based synthesized ephemeris with age of 4 day
0x15	SV state calculated from server-based synthesized ephemeris with age of 5 day
0x16	SV state calculated from server-based synthesized ephemeris with age of 6 day
0x17	SV state calculated from server-based synthesized ephemeris with age of 7 day
0x21	SV state calculated from client-based synthesized ephemeris with age of 1 day
0x22	SV state calculated from client-based synthesized ephemeris with age of 2 day
0x23	SV state calculated from client-based synthesized ephemeris with age of 3 day
0x24	SV state calculated from client-based synthesized ephemeris with age of 4 day
0x25	SV state calculated from client-based synthesized ephemeris with age of 5 day
0x26	SV state calculated from client-based synthesized ephemeris with age of 6 day
0x27	SV state calculated from client-based synthesized ephemeris with age of 7 day

Navigation Library Initialization Data – Message ID 31

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

Example:

A0A20054—Start Sequence and Payload Length

1F....000000000000001001E000F....00....000000000F....00....02....043402....

....02—Payload

0E27B0B3—Message Checksum and End Sequence

Table 3-75 Navigation Library Initialization Data – Message ID 31

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		1F			31
Reserved	1 U					
Altitude Mode[1]	1 U		00			0
Altitude Source	1 U		00			0
Altitude	4 Sgl		00000000	m		0
Degraded Mode[2]	1 U		01			1
Degraded Timeout	2 S		001E	sec		30
Dead-reckoning Timeout	2 S		000F	sec		15
Reserved	2 S					
Track Smoothing Mode[3]	1 U		00			0
Reserved	1 U					
Reserved	2 S					
Reserved	2 S					

Table 3-75 Navigation Library Initialization Data – Message ID 31 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Reserved	2 S					
DGPS Selection[4]	1 U		00			0
DGPS Timeout	2 S		0000	sec		0
Elevation Nav. Mask	2 S	2	000F	deg		15
Reserved	2 S					
Reserved	1 U					
Reserved	2 S					
Reserved	1 U					
Reserved	2 S					
Static Nav. Mode[5]	1 U		00			0
Reserved	2 S					
Position X	8 Dbl			m		
Position Y	8 Dbl			m		
Position Z	8 Dbl			m		
Position Init. Source[6]	1 U		02			2
GPS Time	8 Dbl			sec		
GPS Week	2 S		0434			1076
Time Init. Source[7]	1 U		02	sec		2
Drift	8 Dbl			Hz		
Drift Init. Source[8]	1 U		02	sec		2

Payload length: 84 bytes

1. 0 = Use last know altitude, 1 = Use user input altitude, 2 = Use dynamic input from external source
2. 0 = Use direction hold and then time hold, 1 = Use time hold and then direction hold, 2 = Only use direction hold, 3 = Only use time hold, 4 = Degraded mode is disabled. Note that Degraded Mode is not supported in GSW3.2.5 and newer.
3. 0 = True, 1 = False
4. 0 = Use DGPS if available, 1 = Only navigate if DGPS corrections are available, 2 = Never use DGPS corrections
5. 0 = True, 1 = False
6. 0 = ROM position, 1 = User position, 2 = SRAM position, 3 = Network assisted position
7. 0 = ROM time, 1 = User time, 2 = SRAM time, 3 = RTC time, 4 = Network assisted time
8. 0 = ROM clock, 1 = User clock, 2 = SRAM clock, 3 = Calibration clock, 4 = Network assisted clock

Note – Altitude is a single-precision floating point value while position XYZ, GPS time, and drift are double-precision floating point values per IEEE-754. To properly interpret these values in a computer, the bytes must be rearranged. See note in Message ID 28 for byte orders.

Geodetic Navigation Data – Message ID 41

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

Example:

A0 A2 00 5B—Start Sequence and Payload Length

29 00 00 02 04 04 E8 1D 97 A7 62 07 D4 02 06 11 36 61 DA 1A 80 01 58 16 47 03 DF B7 55 48 8F FF FF FA C8 00 00 04 C6 15 00 00 00 00 00 00 00 00 00 00 00 00 00 BB 00 00 01 38 00 00 00 00 00 00 6B 0A F8 61 00 00 00 00 00 1C 13 14 00 00 00 00 00 00 00 00 00 00 00 00 08 05 00—Payload

11 03 B0 B3—Message Checksum and End Sequence

Table 3-76 Geodetic Navigation Data – Message ID 41

Name	Bytes	Description
Message ID	1 U	Hex 0x29 (decimal 41)
Nav Valid	2 D	0x0000 = valid navigation (any bit set implies navigation solution is not optimal); Bit 0 ON: solution not yet overdetermined[1] (< 5 SVs), OFF: solution overdetermined[1] (> = 5 SV) Bits 1 – 2 : Reserved Bits 8 – 14 : Reserved (The following are for SiRFDRive only) Bit 3 ON : invalid DR sensor data Bit 4 ON : invalid DR calibration Bit 5 ON : unavailable DR GPS-based calibration Bit 6 ON : invalid DR position fix Bit 7 ON : invalid heading (The following is for SiRFNav only) Bit 15 ON : no tracker data available
NAV Type	2 D	Bits 2 – 0 : GPS position fix type 000 = no navigation fix 001 = 1-SV KF solution 010 = 2-SV KF solution 011 = 3-SV KF solution 100 = 4 or more SV KF solution 101 = 2-D least-squares solution 110 = 3-D least-squares solution 111 = DR solution (see bits 8, 14-15) Bit 3 : TricklePower in use Bits 5 – 4 : altitude hold status 00 = no altitude hold applied 01 = holding of altitude from KF 10 = holding of altitude from user input 11 = always hold altitude (from user input) Bit 6 ON : DOP limits exceeded Bit 7 ON : DGPS corrections applied Bit 8 : Sensor DR solution type (SiRFDRive only) 1 = sensor DR 0 = velocity DR[2] if Bits 0 – 2 = 111; else check Bits 14-15 for DR error status Bit 9 ON : navigation solution overdetermined[1] Bit 10 ON : velocity DR[2] timeout exceeded Bit 11 ON : fix has been edited by MI functions Bit 12 ON : invalid velocity Bit 13 ON : altitude hold disabled Bits 15 – 14 : sensor DR error status (SiRFDRive only) 00 = GPS-only navigation 01 = DR calibration from GPS 10 = DR sensor error 11 = DR in test
Extended Week Number	2 U	GPS week number; week 0 started January 6 1980. This value is extended beyond the 10-bit value reported by the SVs.
TOW	4 U	GPS time of week in seconds x 10^3
UTC Year	2 U	UTC time and date. Seconds reported as integer milliseconds only
UTC Month	1 U	
UTC Day	1 U	
UTC Hour	1 U	
UTC Minute	1 U	
UTC Second	2 U	

Table 3-76 Geodetic Navigation Data – Message ID 41

Name	Bytes	Description
Satellite ID List	4 D	Bit map of SVs used in solution. Bit 0 = SV 1, Bit 31 = SV 32. A bit set ON means the corresponding SV was used in the solution
Latitude	4 S	In degrees (+ = North) x 10^7
Longitude	4 S	In degrees (+ = East) x 10^7
Altitude from Ellipsoid	4 S	In meters x 10^2
Altitude from MSL	4 S	In meters x 10^2
Map Datum[3]	1 S	See footnote
Speed Over Ground (SOG)	2 U	In m/s x 10^2
Course Over Ground (COG, True)	2 U	In degrees clockwise from true north x 10^2
Magnetic Variation	2 S	Not implemented
Climb Rate	2 S	In m/s x 10^2
Heading Rate	2 S	deg/s x 10^2 (SiRFDRive only)
Estimated Horizontal Position Error	4 U	EHPE in meters x 10^2
Estimated Vertical Position Error	4 U	EVPE in meters x 10^2
Estimated Time Error	4 U	ETE in seconds x 10^2 (SiRFDRive only)
Estimated Horizontal Velocity Error	2 U	EHVE in m/s x 10^2 (SiRFDRive only)
Clock Bias	4 S	In m x 10^2
Clock Bias Error	4 U	In meters x 10^2 (SiRFDRive only)
Clock Drift[4]	4 S	In m/s x 10^2
Clock Drift Error	4 U	In m/s x 10^2 (SiRFDRive only)
Distance	4 U	Distance traveled since reset in meters (SiRFDRive only)
Distance error	2 U	In meters (SiRFDRive only)
Heading Error	2 U	In degrees x 10^2 (SiRFDRive only)
Number of SVs in Fix	1 U	Count of SVs indicated by SV ID list
HDOP	1 U	Horizontal Dilution of Precision x 5 (0.2 resolution)
AdditionalModeInfo	1 D	Additional mode information: Bit 0: Map matching mode for Map Matching only 0 = Map matching feedback input is disabled 1 = Map matching feedback input is enabled Bit 1: Map matching feedback received for Map Matching only 0 = Map matching feedback was not received 1 = Map matching feedback was received Bit 2: Map matching in use for Map Matching only 0 = Map matching feedback was not used to calculate position 1 = Map matching feedback was used to calculate position Bit 7: DR direction for SiRFDRive only 0 = Forward 1 = Reserve

Payload length: 91 bytes

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

2. Velocity Dead Reckoning (DR) is a method by which the last solution computed from satellite measurements is updated using the last computed velocity and time elapsed to project the position forward in time. It assumes heading and speed are unchanged, and is thus reliable for only a limited time. Sensor DR is a position update method based on external sensors (e.g., rate gyroscope, vehicle speed pulses, accelerometers) to supplement the GPS measurements. Sensor DR is only applicable to SiRFDRive products.

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

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

Note – Values are transmitted as integer values. When scaling is indicated in the description, the decimal value has been multiplied by the indicated amount and then converted to an integer. Example: Value transmitted: 2345; indicated scaling: 10^2; actual value: 23.45.

Queue Command Parameters – Message ID 43

This message is output in response to Message ID 168, Poll Command Parameters. The response message will contain the requested parameters in the form of the requested message. In the example shown below, in response to a request to poll the static navigation parameters, this message has been sent with the payload of Message ID 143 (0x8F) contained in it. Since the payload of Message ID 143 is two bytes long, this message is sent with a payload 3 bytes long (Message ID 43, then the 2-byte payload of message 143).

Output Rate: Response to poll

This message outputs Packet/Send command parameters under SiRF Binary Protocol.

Example with MID_SET_STAT_NAV message:

A0A20003—Start Sequence and Payload Length

438F00—Payload

00D2B0B3—Message Checksum and End Sequence

Table 3-77 Queue Command Parameters – Message ID 43

Name	Bytes	Scale	Unit	Description
Message ID	1 U			= 0x2B
Polled Msg ID[1]	1 U			= 0x8F (example)
Data[2]	Variable[3]			Depends on the polled Message ID length

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

1. Valid Message IDs are 0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, 0x97, and 0xAA.
2. The data area is the payload of the message whose Message ID is listed in the Polled Msg ID field. For the specific details of the possible payloads, see the description of that message in Chapter 2
3. Data type follows the type defined for the Polled Message ID. For example, if the Polled Message ID is 128, see Message ID 128 payload definition in Table 2-6 on page 5 in Chapter 2, "Input Messages".

DR Raw Data – Message ID 45

Table 3-78 1-Hz DR Raw Data from ADC (Output After Collection of Data) – Message ID 45

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

Payload length: 111 bytes

Test Mode 3/4/5/6 – Message ID 46

Message ID 46 is used by GSW2, SiRFDRive, SiRFLoc v3.x, GSW3, GSWLT3, and SLCLT3 software.

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

Example for GSW2, SiRFDRive, SiRFLoc v3.x, and GSW3 software output:

A0A20033—Start Sequence and Payload Length

2E0001001E00023F70001F0D29000000000000601C600051B0E000EB41A0000000
000000000000000000000000000000000000—Payload

0316B0B3—Message Checksum and End Sequence

Example for GSWLT3 and SLCLT3 software output:

A0A20033—Start Sequence and Payload Length

2E0001001E00023F70001F0D29000000000000601C600051B0E000EB41A0000000
00000000000000000000800000002F000000—Payload

0316B0B3—Message Checksum and End Sequence

Table 3-79 Test Mode 3/4 – Message ID 46

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		2E			46
SV ID	2 U		0001			1
Period	2 U		001E	sec		30
Bit Sync Time[1]	2 U		0002	sec		2
Bit Count[1]	2 U		3F70			16420
Poor Status[1]	2 U		001F			31
Good Status[1]	2 U		0D29			3369
Parity Error Count[1]	2 U		0000			0
Lost VCO Count[1]	2 U		0000			0
Frame Sync Time[1]	2 U		0006	sec		6
C/N0 Mean	2 S	*10	01C6	dB/Hz	÷10	45.4
C/N0 Sigma	2 S	*10	0005	dB/Hz	÷10	0.5
Δ Clock Drift	2 S	*10	1B0E	Hz	÷10	692.6
Clock Drift	4 S	*10	000EB41A	Hz	÷10	96361.0
Bad 1 kHz Bit Count[1]	2 S		0000			0
Abs I20 ms[2]	4 S		000202D5	Counts		131797
Abs Q20 ms[2]	4 S		000049E1	Counts		18913
Phase Lock Indicator[3]	4 S		00000000		0.001	0
RTC Frequency[4]	2 S		8000	Hz		32768
ECLK Ratio[3]	2 S		0000		3*Value/ 65535	0 (no ECLK input)
Timer Synch input[3] (bit 7) AGC[3] (bit 0 - 6)	1 D		2F	Timer Synch = True/False AGC = ~0.8 dB per step		TS 0 = no activity and 47 for AGC
Reserved	3 U					

Payload length: 51 bytes

1. Field not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
2. Phase error = (Q20 ms)/(I20 ms).
3. A value of 0.9 to 1.0 generally indicates phase lock
4. Only for GSWLT3 and SLCLT3 software

Table 3-80 Detailed Description of Test Mode 3/4 Message ID 46

Name	Description
Message ID	Message ID number
SV ID	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 0x37. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50 bps x 20 sec x 12 channels). This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.

Table 3-80 Detailed Description of Test Mode 3/4 Message ID 46 *(Continued)*

Name	Description
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 100-ms intervals). This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 msec of phase lock equates to 1 good status count. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Lost VCO Count	The number of 1 msec VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Frame Sync	The time it takes for channel 0 to reach a 0x3F status. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
C/N0 Mean	Calculated average of reported C/N0 by all 12 channels during the test period.
C/N0 Sigma	Calculated sigma of reported C/N0 by all 12 channels during the test period.
Clock Drift Change	Difference in clock drift from start and end of the test period.
Clock Drift	The measured internal clock drift.
Bad 1 kHz Bit Count	Errors in 1 ms post correlation I count values. This field is not filled for GSW3 and GSWLT3 software in Test Mode 3/4.
Abs I20 ms	Absolute value of the 20 ms coherent sums of the I count over the duration of the test period.
Abs Q20 ms	Absolute value of the 20 ms Q count over the duration of the test period.
Phase Lock Indicator	Quality of the received signal with 1 being perfect and decreasing as noise level increases. A value of 0.9 to 1.0 generally indicates phase lock.
RTC Frequency[1]	F(RTC counts/CLCKACQ counts over test interval). 16-bit unsigned integer value of RTC frequency in Hz. Value = 0, no RTC Value = 1 to 65534, 32678±1 = good RTC frequency Value = 65535, RTC frequency = 65535 Hz of higher
ECLK Ratio[1]	F(ECLK counts/CLCKACQ counts over test interval). 16-bit unsigned integer value of scaled value of ratio. Value = 0, no ECLK input 0< Value <3, Ratio = 3*Value/65535 Value >3, Ratio = 65535
Timer Synch[1]	Timer Synch input activity bit Value = 0, no Timer Synch input activity Value = 1, activity
AGC[1]	Automatic Gain Control value Value = 0, gain set to maximum saturated 1< Value > 62, active gain range Value = 63, gain set to minimum saturated

1. Supported only by GSWLT3 and SLCLT3 software. When test mode command is issued, test report interval time value and PRN are specified. Reports every interval whether SV signals or not and data is accumulated every interval period. Continuous output until software is reset or unit is restarted.

Test Mode 4 – Message ID 48 (SiRFLoc v2.x only)

SiRFLoc results from Test Mode 4 are output by Message IDs 48 and 49. Message ID 48 for Test Mode 4 used by SiRFLoc version 2.x only is not to be confused with SiRFDRive Message ID 48.

Table 3-81 Test Mode 4 – Message ID 48

		Binary (Hex)			ASCII (Decimal)	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1		30			48
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		18			24
Receiver Time Tag	4		000660D0	ms		30995
Pseudo-range	4	A	0	m	10	0
Carrier Frequency	4	64	174ADC	m/sec	100	1526492

Payload length: 20 bytes

Table 3-82 Detailed Description of Test Mode 4 Message ID 48

Name	Description
Message ID	Message ID number
nChannel	Number of channels reporting
Reserved	Reserved
Channel	Receiver channel number for a given satellite being searched or tracked
Satellite ID	Satellite or Space Vehicle (SV ID number or Pseudo-Random Noise (PRN) number
Receiver Time Tag	Count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock
Pseudorange	Generated pseudorange measurement for a particular SV
Carrier Frequency	Can be interpreted in two ways: 1. Delta pseudorange normalized by the reciprocal of the delta pseudorange measurement interval 2. Frequency from the AFC loop. If, for example, the delta pseudorange interval computation for a particular channel is zero, it can be the AFC measurement, otherwise it is a delta pseudorange computation

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

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

Table 3-83 DR Navigation Status – Message ID 48 (Sub ID 1)

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

Table 3-83 DR Navigation Status – Message ID 48 (Sub ID 1) *(Continued)*

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

Table 3-83 DR Navigation Status – Message ID 48 (Sub ID 1) *(Continued)*

Name	Bytes	Description
DR gyro subsystem and DR speed subsystem	1	Bits 0 - 3 : 0000 = updated DR gyro bias and scale factor calibration; else Bit 0 ON : invalid DR data Bit 1 ON : invalid DR position Bit 2 ON : invalid GPS velocity for DR Bit 3 ON : GPS did not update heading Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 : 0 = updated DR navigation state
DR Nav state integration ran and zero-speed gyro bias calibration updated	1	Bits 0 - 7 : 00000000 = GPS updated position; else Bit 0 ON : update mode != KF Bit 1 ON : EHPE > 50 Bit 2 ON : no previous GPS KF update Bit 3 ON : GPS EHPE < DR EHPE Bit 4 ON : DR EHPE < 50 Bit 5 ON : less than 4 SVs in GPS navigation Bit 6 ON : no SVs in GPS navigation Bit 7 ON : DR-only navigation required
Updated DR gyro bias/scale factor calibration, updated DR speed calibration, and updated DR Nav state	1	Bits 0 - 3 : 0000 = updated DR gyro bias and scale factor calibration; else Bit 0 ON : invalid DR data Bit 1 ON : invalid DR position Bit 2 ON : invalid GPS velocity for DR Bit 3 ON : GPS did not update heading Bits 4 - 6 : 000 = updated DR speed calibration; else Bit 4 ON : invalid DR data Bit 5 ON : invalid DR position Bit 6 ON : invalid GPS velocity for DR Bit 7 : 0 = updated DR navigation state
GPS updated position	1	Bits 0 - 7 : 00000000 = GPS updated position; else Bit 0 ON : update mode != KF Bit 1 ON : EHPE > 50 Bit 2 ON : no previous GPS KF update Bit 3 ON : GPS EHPE < DR EHPE Bit 4 ON : DR EHPE < 50 Bit 5 ON : less than four SVs in GPS navigation Bit 6 ON : no SVs in GPS navigation Bit 7 ON : DR-only navigation required
GPS updated heading	1	Bits 0 - 6 : 0000000 = GPS updated heading; else Bit 0 ON : update mode != KF Bit 1 ON : GPS speed < = 5 m/s Bit 2 ON : less than 4 SVs in GPS navigation Bit 3 ON : horizontal velocity variance > 1 m^2/s^2 Bit 4 ON : GPS heading error > = DR heading error Bit 5 ON : GPS KF not updated Bit 6 ON : incomplete initial speed transient Bit 7 : Reserved

Table 3-83 DR Navigation Status – Message ID 48 (Sub ID 1) *(Continued)*

Name	Bytes	Description
GPS position & GPS velocity	1	Bits 0 - 2 : 000 = valid GPS position for DR; else Bit 0 ON : less than 4 SVs in GPS navigation Bit 1 ON : EHPE > 30 Bit 2 ON : GPS KF not updated Bit 3 : Reserved Bits 4 - 7 : 0000 = valid GPS velocity for DR; else Bit 4 ON : invalid GPS position for DR Bit 5 ON : EHVE > 3 Bit 6 ON : GPS speed < 2 m/s Bit 7 ON : GPS did not update heading.
Reserved	2	Reserved

Payload length: 17 bytes

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

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

Table 3-84 DR Navigation State – Message ID 48 (Sub ID 2)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x30
Message Sub ID	1			= 0x02
DR speed	2	10^2	m/s	
DR speed error	2	10^4	m/s	
DR speed scale factor	2	10^4		
DR speed scale factor error	2	10^4		
DR heading rate	2	10^2	deg/s	
DR heading rate error	2	10^2	deg/s	
DR gyro bias	2	10^2	deg/s	
DR gyro bias error	2	10^2	deg/s	
DR gyro scale factor	2	10^4		
DR gyro scale factor error	2	10^4		
Total DR position error	4	10^2	m	
Total DR heading error	2	10^2	deg	
DR Nav mode control	1			1 = GPS-only nav required (no DR nav allowed) 2 = GPS + DR nav using default/stored calibration 3 = GPS + DR nav using current GPS calibration 4 = DR-only nav (no GPS nav allowed)
Reverse	1			DR direction: 0 = forward; 1 = reverse.
DR heading	2	10^2	deg/s	

Payload length: 32 bytes

Navigation Subsystem – Message ID 48 (Sub ID 3)

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

Table 3-85 Navigation Subsystem – Message ID 48 (Sub ID 3)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x30
Message Sub ID	1			= 0x03
GPS heading rate	2	10^2	deg/s	
GPS heading rate error	2	10^2	deg/s	
GPS heading	2	10^2	deg	
GPS heading error	2	10^2	deg	
GPS speed	2	10^2	m/s	
GPS speed error	2	10^2	m/s	
GPS position error	4	10^2	m	
DR heading rate	2	10^2	deg/s	
DR heading rate error	2	10^2	deg/s	
DR heading	2	10^2	deg	
DR heading error	2	10^2	deg	
DR speed	2	10^2	m/s	
DR speed error	2	10^2	m/s	
DR position error	4	10^2	m	
Reserved	2			

Payload length: 36 bytes

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

DR gyro factory calibration parameters (response to poll).

Table 3-86 DR Gyro Factory Calibration – Message ID 48 (Sub ID 6)

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

Payload length: 4 bytes

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

DR sensors parameters (response to poll).

Table 3-87 DR Sensors Parameters – Message ID 48 (Sub ID 7)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x30
Message Sub ID	1			= 0x07

Table 3-87 DR Sensors Parameters – Message ID 48 (Sub ID 7)

Name	Bytes	Scale	Unit	Description
Base speed scale factor	1		ticks/m	
Base gyro bias	2	10^4	mV	
Base gyro scale factor	2	10^3	mV/deg/s	

Payload length: 7 bytes

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

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

Table 3-88 DR Data Block – Message ID 48 (Sub ID 8)

Name	Bytes	Scale	Unit	Description
Message ID	1			= 0x30
Message Sub ID	1			= 0x08
Measurement type	1			0 = odometer and gyroscope (always); 1 .. 255 = Reserved
Valid count	1			Count (1 .. 10) of valid DR measurements
Reverse indicator	2			Bits 0 .. 9, each bit: ON = reverse, OFF = forward
1st 100-ms time-tag	4		ms	
1st 100-ms DR speed	2	10^2	m/s	
1st 100-ms gyro heading rate	2	10^2	deg/s	
2nd 100-ms time-tag	4		ms	
2nd 100-ms DR speed	2	10^2	m/s	
2nd 100-ms gyro heading rate	2	10^2	deg/s	
...				
10th 100-ms time-tag	4		ms	
10th 100-ms DR speed	2	10^2	m/s	
10th 100-ms gyro heading rate	2	10^2	deg/s	

Payload length: 86 bytes

SID_GenericSensorParam – Message ID 48 (Sub ID 9)

Output message of Sensor Package parameters

Note – This message is not Supported by SiRFDemoPPC

The user can enable a one time transmission of this message via the SiRFDemo Poll command for SiRFDRive. In the SiRFDRive menu, select *Poll Sensors Parameters*.

Table 3-89 DR Package Sensor Parameters – Message ID 48 (Sub ID 9)

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

Table 3-89 DR Package Sensor Parameters – Message ID 48 (Sub ID 9) *(Continued)*

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

Payload length: 54 bytes

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

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

Test Mode 4 – Message ID 49

SiRFLoc results from Test Mode 4 are output by Message IDs 48 and 49. Message ID 48 for Test Mode 4 used by SiRFLoc version 2.x only is not to be confused with SiRFDRive Message ID 48.

Table 3-90 Test Mode 4 – Message ID 49

		Binary (Hex)			**ASCII (Decimal)**	
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID	1		31			49
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		18			24
Receiver Time Tag	4		000660D0	ms		31085
Carrier Doppler Rate	4	100000	796D	carrier cycles/2 ms/10 ms	1048576	271

Table 3-90 Test Mode 4 – Message ID 49 *(Continued)*

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Unit	ASCII (Decimal) Scale	ASCII (Decimal) Example
Carrier Doppler	4	100000	10F	carrier cycles/2 ms	1048576	168229578
Carrier Phase	4	400		carrier cycles	1024	94319770
Code Offset	4	181000	FFFFFFFFFFF C925C	chip	1576960	-224676

Payload length: 28 bytes

Table 3-91 Detailed Description of Test Mode 4 Message ID 49

Name	Description
Message ID	Message ID number
nChannel	Number of channels reporting
Channel	Receiver channel number for a given satellite being searched or tracked
Satellite ID	Satellite or Space Vehicle (SV ID number or Pseudo-Random Noise (PRN) number
Receiver Time Tag	Count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock
Carrier Doppler Rate	Carrier Doppler Rate value from the Costas tracking loop for the satellite ID on channel 0
Carrier Doppler	Frequency from the Costas tracking loop for the satellite ID on channel 0
Carrier Phase	Carrier phase value from the Costas tracking loop for the satellite ID on channel 0
Code Offset	Code offset from the Code tracking loop for the satellite ID on channel 0

SBAS Parameters – Message ID 50

Outputs SBAS operating parameter information including SBAS PRN, mode, timeout, timeout source, and SBAS health status.

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

Example:

A0A2000D—Start Sequence and Payload Length

327A00120800000000000000000—Payload

00C6B0B3—Message Checksum and End Sequence

Table 3-92 SBAS Parameters – Message ID 50

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

Payload length: 13 bytes

Table 3-93 Detailed Description of SBAS Parameters

Name	Description
Message ID	Message ID number
SBAS PRN	This is the PRN code of the SBAS either selected by the user, the default PRN, or that currently in use 0 = Auto mod SBAS PRN 120-138 = Exclusive (set by user)
SBAS Mode	0 = Testing, 1 = Integrity Integrity mode does not accept SBAS corrections if the SBAS satellite is transmitting in a test mode Testing mode accepts and use SBAS corrections even if the SBAS satellite is transmitting in a test mode
DGPS Timeout	Range 0-255 seconds. 0 returns to default timeout. 1-255 is value set by user. The default value is initially 18 seconds. However, the SBAS data messages may specify a different value. The last received corrections continue to be applied to the navigation solution for the timeout period. If the timeout period is exceeded before a new correction is received, no corrections are applied.
Flag bits	Bit 0: Timeout; 0 = Default 1 = User Bit 1: Health; 0 = SBAS is healthy 1 = SBAS reported unhealthy and can't be used Bit 2: Correction; 0 = Corrections are being received and used 1 = Corrections are not being used because: the SBAS is unhealthy, they have not yet been received, or SBAS is currently disabled in the receiver Bit 3: SBAS PRN; 0 = Default 1 = User Note: Bits 1 and 2 are only implemented in GSW3 and GSWLT3, versions 3.3 and later
Spare	These bytes are currently unused and should be ignored

1 PPS Time – Message ID 52

Output time associated with current 1 PPS pulse. Each message is output within a few hundred ms after the 1 PPS pulse is output and tells the time of the pulse that just occurred. The Message ID 52 reports the UTC time of the 1 PPS pulse when it has a current status message from the satellites. If it does not have a valid status message, it reports time in GPS time, and so indicates by means of the status field.

This message may not be supported by all SiRF Evaluation receivers

Output Rate: 1 Hz (Synchronized to PPS)

Example:

A0A20013—Start Sequence and Payload Length

3415122A0E0A07D3000D000000050700000000—Payload

0190B0B3—Message Checksum and End Sequence

Table 3-94 Timing Message Data – Message ID 52

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

Table 3-94 Timing Message Data – Message ID 52 *(Continued)*

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Month	1 U		0A			10
Year	2 U		07D3			2003
UTCOffsetInt[1]	2 S		000D			13
UTCOffsetFrac[1]	4 U	10^9	00000005	sec	10^9	0.000000005
Status (see Table 3-95)	1 D		7			7
Reserved	4 U		00000000			00000000

Payload length: 19 bytes

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

Table 3-95 Status Byte Field in Timing Message

Bit Fields	Meaning
0	When set, bit indicates that time is valid
1	When set, bit indicates that UTC time is reported in this message. Otherwise, GPS time
2	When set, bit indicates that UTC to GPS time information is current, (i.e., IONO/UTC time is less than 2 weeks old)
3-7	Reserved

Test Mode 4 Track Data – Message ID 55

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

Table 3-96 Test Mode 4 – Message ID 55

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		37			55
SV ID	2 U		0001			1
Acqclk Lsq	4 U		12345678			12345678
Code Phase	4 U	2^{-11}	0000	Chips		0
Carrier Phase	4 S	2^{-32}	0000	Cycles		0
Carrier Frequency	4 S	0.000476	0000	Hz	0.000476	0
Carrier Acceleration	2 S	0.476	0000	Hz/sec	0.476	0
Code Corrections	4 S		0000			0
Code Offset	4 S	2^{-11}	0000	Chips	2^{-11}	0
MSec Number[1]	2 S	ms	0006	ms	0.001	0.006
Bit Number[1]	4 S	20 ms	01C6	20 ms	0.02	9.08
Reserved	4 U		0000			
Reserved	4 U		0000			
Reserved	4 U		0000			
Reserved	4 U		0000			

Payload length: 51 bytes

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

Extended Ephemeris Data – Message ID 56

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

Table 3-97 Extended Ephemeris – Message ID 56

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

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

GPS Data and Ephemeris Mask – Message ID 56 (Sub ID 1)

Output Rate: Six seconds until extended ephemeris is received

Example:

A0A2000D—Start Sequence and Payload Length

380101091E00000E7402000001 – Payload (Message ID, Message Sub ID, time valid; GPS week = 2334; GPS TOW = 37000 seconds; request flag for satellite 30 and 1)

00E6B0B3—Message Checksum and End Sequence

Table 3-98 GPS Data and Ephemeris Mask – Message ID 56 (Message Sub ID 1)

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

Payload length: 13 bytes

Table 3-99 Detailed Description of GPS Data and Ephemeris Mask Parameters

Name	Description
Message ID	Message ID number
Message Sub ID	Message Sub ID number
GPS_TIME_VALID_FLAG	LSB bit 0 = 1, GPS week is valid LSB bit 0 = 0, GPS week is not valid LSB bit 1 = 1, GPS TOW is valid LSB bit 1 = 0, GPS TOW is not valid
GPS Week	Extended week number. Range from 0 to no limit
GPS TOW	GPS Time Of Week. Multiply by 10 to get the time in seconds. Range 0 to 604800 seconds.
EPH_REQ_MASK	Mask to indicate the satellites for which new ephemeris is needed MSB is used for satellite 32, and LSB is for satellite 1

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

Output Rate: Upon host's request

Example:

A0A2000E—Start Sequence and Payload Length

380200000040000000400000000040 – Payload (Message ID, Message Sub ID, invalid position and clocks for SVID 7, and unhealthy bit for SVID 7)

00FAB0B3—Message Checksum and End Sequence

*Table 3-100*Extended Ephemeris Integrity Parameters – Message 56 (Message Sub ID 2)

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

Payload length: 14 bytes

Table 3-101 Detailed Description of Extended Ephemeris Integrity Parameters

Name	Description
Message ID	Message ID number
Message Sub ID	Message Sub ID number
SAT_POS_VALIDITY_FLAG	1 = invalid position found, 0 = valid position SVID 1 validity flag is in LSB and subsequent bits have validity flags for SVIDs in increasing order up to SVID 32 whose validity flag are in MSB
SAT_CLK_VALIDITY_FLAG	1 = invalid clock found, 0 = valid clock SVID 1 validity flag is in LSB and subsequent bits have validity flags for SVIDs in increasing order up to SVID 32 whose validity flag are in MSB
SAT_HEALTH_FLAG	1 = unhealthy satellite, 0 = healthy satellite SVID 1 health flag is in the LSB and subsequent bits have health flags for SVIDs in increasing order up to SVID 32 whose validity flag are in MSB

Extended Ephemeris Integrity – Message ID 56 (Sub ID 3)

This is the ephemeris status response message. It is output in response to Poll Ephemeris Status message, Message ID 232, Message Sub ID 2.

Table 3-102 Contents of Message ID 56 Message (Message Sub ID 3)

Name	Bytes	Description
Message ID	1	Hex 0x38, Decimal 56
Message Sub ID	1	Message Sub ID, 3
The following data are repeated 12 times:		
SVID	1	Satellite PRN, range 0-32
Source	1	Source for this ephemeris[1]
Week #	2	Week number for ephemeris

Table 3-102 Contents of Message ID 56 Message (Message Sub ID 3) *(Continued)*

Time of ephemeris	2	toe: effective time of week for ephemeris (seconds / 16, range 0 to 37800)
Integrity	1	Not used
Age	1	Age of ephemeris (days). Bit 0 to 3 contain the age of the ephemeris. Bit 4 and bit 5 are bit-mapped to indicate the source of ephemeris. * When bit 4 is set, the source is server-generated. * When bit 5 is set, the source is client-generated.

Payload length: 98 bytes

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

The Poll Ephemeris Status input message includes a satellite ID mask that specifies the satellite PRN codes to output. This message reports on the ephemeris of the requested satellites, up to a maximum of 12. If more than 12 PRN codes are requested, this message reports on the 12 with the lowest PRN codes. If the receiver does not have data for a requested PRN, the corresponding fields are set to 0. If fewer than 12 satellites are requested, the unused fields in the message are set to 0.

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

Output Rate: Variable

Example:

A0A20056 – Start Sequence and Payload Length

3804 0170801E000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 00000000000000 (Payload, message id, sub-id, sv_id, se_TOE and clock_bias_adjust for 12 satellites).

3992B0B3 – Message Checksum and End Sequence

Table 3-103 EE Provide Synthesized Ephemeris Clock Bias Adjustment Message – Message 56 (Message Sub ID 4)

		Binary (Hex)			**ASCII (Decimal)**
Name	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**
Message ID	1		38		Decimal 56
Message Sub-ID	1		04		Message Sub-ID for the Ephemeris Extension Message
The following 3 fields are repeated 12 times					
SV_ID	1	1		Dimensionless	SV_ID = 0 means fields SE_TOE and Clock_Bias_Adjust are invalid
SE_TOE	2	2^4		Seconds	The TOE of the Synthesized Ephemeris for which the clock bias adjustment is being reported
Clock_Bias_Adjust	4	2^-31		Second	Clock bias adjustment (for af0)

Payload length: 84 bytes

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

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

Table 3-104 General Structure for the Ephemeris Extension Messages – Message ID 56 (Message Sub ID 38)

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

Payload length: 2 + EE Payload

Extended Ephemeris ACK – Message ID 56 (Sub ID 255)

Output Rate: Variable.

This message is returned when input Message ID 232 Message Sub ID 255 is received. See to Chapter 2, "Input Messages" for more details on Message ID 232.

Example:

A0A20004—Start Sequence and Payload Length

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

03CEB0B3—Message Checksum and End Sequence

Table 3-105 Extended Ephemeris Ack – Message 56 (Message Sub ID 255)

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1 U		E8			232
Message Sub ID	1 U		FF			255
ACK ID	1 U		E8			232
ACK Sub ID	1 U		FF			255

Payload length: 4 bytes

Table 3-106 Detailed Description of Extended Ephemeris Ack Parameters

Name	Description
Message ID	Message ID number
Message Sub ID	Message Sub ID number
ACK ID	Message ID of the message to ACK
ACK Sub ID	Message Sub ID of the message to ACK

Test Mode Output – Message 63 (Sub ID 7)

SSB MID 63 (0x3f), sub ID 7 has been defined to output suspected CW spurs. This message contains information on four CW spurs, C/N0 estimate and frequency.

This message will be output under two circumstances:

1. Four CW spurs have been detected. This would completely fill one MID 63. Then, MID 63 is output with the test status set to test in progress.
2. When Test Mode 7 has completed. Then, MID 63 is output with the test status indicating test completed. Any remaining CW spurs not yet output will also be included in this message.

Example:

A0A2001B – Start Sequence and Payload Length

3F07 01 5DF52B05 012C 5DF52D95 0125 00000000 0000 00000000 0000 (Payload, message id, sub-id, test_status, spur1_frequency, . . .).

0430B0B3 – Message Checksum and End Sequence

Table 3-107 Message ID

Value	Macro
63 (0x3f, 0x07)	SIRF_MSG_SSB_TEST_MODE_DATA_7

Table 3-108 Message Structure

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
test_status	1 U	1	01	n/a		1
spur1_frequency	4 U	1	5DF52B05	Hz		1576348421
spur1_sig_to_noise	2 U	0.1	012C	dB·Hz		30.0
spur2_frequency	4 U	1	5DF52D95	Hz		1576349077
spur2_sig_to_noise	2 U	0.1	0125	dB·Hz		29.3
spur3_frequency	4 U	1	00000000	Hz		0
spur3_sig_to_noise	2 U	0.1	0000	dB·Hz		0
spur4_frequency	4 U	1	00000000	Hz		0
spur4_sig_to_noise	2 U	0.1	0000	dB·Hz		0

Payload length: 27 bytes.

Table 3-109 Detailed Description

Name	Description
test_status	Test Status. See below for details
spur1_frequency	Frequency of detected spur. 0 if not detected. See below for details.
spur1_sig_to_noise	Signal to noise of detected spur. 0 if not detected
spur2_frequency	Frequency of detected spur. 0 if not detected
spur2_sig_to_noise	Signal to noise of detected spur. 0 if not detected

Table 3-109 Detailed Description *(Continued)*

Name	Description
spur3_frequency	Frequency of detected spur. 0 if not detected.
spur3_sig_to_noise	Signal to noise of detected spur. 0 if not detected.
spur4_frequency	Frequency of detected spur. 0 if not detected.
spur4_sig_to_noise	Signal to noise of detected spur. 0 if not detected.

Test_status

Table 3-110 Test Status

Value	Description
0	Test in progress
1	Test complete

Spur Frequency

The spur frequency will be the full frequency value. For example, if a CW is detected 100 kHz below L1, the spur frequency will be reported as (1575.42 MHz – 100 kHz) = 1,575,320,000 Hz.

Message ID 65, Sub ID 192

Example:

A0A2XXXX – Start Sequence and Payload Length

XXXXB0B3 – Message Checksum and End Sequence

Table 3-111 Message Structure

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Unit	Scale	Example
Message ID	1 U	1	41	n/a		65
Sub ID	1U	1	C0			192
gpio_state	2D			Bitmap		

Payload length: 4 bytes

Table 3-112 Detailed Description

Name	Description
Message ID	65
Sub ID	192
gpio_state	State of each GPIO, where bit 0 = GPIO 0, bit 1 = GPIO 1, etc.

Output GRF3i+ IF Bandwidth Mode - Msg ID 233, SubMsgID 0xFF

This is the response message to the Input Message "Poll GRF3i+ IF Bandwidth Mode" with Message ID 233, SubMsgID 0x0A

*Table 3-113*Output GRF3i+ IF Bandwidth Mode

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		E9		Decimal 233
Sub Message ID	1U		FF		OxFF: Output Message for Message ID 233 with SubMsgID 0x02
Band Mode Status	1U		01		0 = Indicates Wideband 1 = Indicates Narrowband

Payload length: 3 bytes

Output GRF3i+ Normal/Low Power Mode - Msg ID 233, SubMsgID 0xFE

This is the response message to the Input Message “Output GRF3i+ Normal/Low Power Mode - Msg ID 233, SubMsgID 0xFE” with Message ID 233, SubMsgID 0x0B

*Table 3-114*Output GRF3i+ Normal/Low Power Mode

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	E.g.		
Message ID	1U		E9		Decimal 233
Sub Message ID	1U		FE		0xFE : Output Message for Message ID 233 with SubMsgID 0x0B
Power Mode Status	1U		01		0 = Normal power 1 = Low power

Payload length: 3 bytes

Reserved – Message ID 225

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

Statistics Channel – Message ID 225 (Sub ID 6)

The message is only used by GSW3, GSWLT3, and SiRFLoc v3.x software and outputs the TTFF, aiding accuracy information and navigation status.

Output Rate: Once after every reset.

Note – Message ID 225 (Message Sub ID 6) only comes out when the debug messages are enabled. The debug message feature is enabled by either setting the output rate of message 225 using Message ID 166 or by setting bit 5 (enable debug data bit) in the configuration bit map of Message ID 128.

Note – Message ID 225 (Message Sub ID 6) may not be output when the system is not able to compute a navigation solution. This message is not supported by APM.

Example:

A0A20027—Start Sequence and Payload Length

E106—Message ID and Message Sub ID

0100000000000000000000000000000000000000000000000000000010100000 00—Payload

0107B0B3—Message Checksum and End Sequence

Table 3-115 Statistic Channel – Message ID 225 (Message Sub ID 6)

			Binary (Hex)			ASCII (Decimal)	
Name	**Sub Field**	**Bytes**	**Scale**	**Example**	**Unit**	**Scale**	**Example**
Message ID		1 U		E1			225
Message Sub ID		1 U		06			6
TTFF	Since reset	2 U			sec	0.1	range from 0 .0 to 6553.5
	Since all aiding received[1]	2 U					0
	First nav since reset[1]	2 U					0
Position Aiding Error	North[1]	4 S					0
	East[1]	4 S					0
	Down[1]	4 S					0
Time Aiding Error[1]		4 S					0
Frequency Aiding Error[1]		2 S					0
Position Uncertainty	Horizontal[1]	1 U					0
	Vertical[1]	2 U					0
Time Uncertainty[1]		1 U					0
Frequency Uncertainty[1]		1 U					0
Number of Aided Ephemeris[1]		1 U					0
Number of Aided Acquisition Assistance[1]		1 U					0
Navigation and Position Status	Navigation Mode	1 D					see Table 3-116
	Position Mode	1 D					see Table 3-117
	Status	2 D					see Table 3-118 and Table 3-119
Start Mode		1 D					see Table 3-120
Reserved[1]		1 U					

Payload length: 39 bytes

1. Valid with SiRFLoc only

Table 3-116 Description of the Navigation Mode Parameters

Bit Fields	Description
0	No Nav
1	Approximate from SV records
2	Time transfer
3	Stationary mode

Table 3-116 Description of the Navigation Mode Parameters

Bit Fields	Description
4	LSQ fix
5	KF nav
6	SiRFDRive
7	DGPS base

*Table 3-117*Description of the Position Mode Parameters

Bit Fields	Description
0	Least Square (LSQ) mode 0 – no bit sync, approximate GPS time
1	LSQ mode 1 – no bit sync, accurate GPS time
2	LSQ mode 2 – bit sync, no frame sync, approximate GPS time
3	LSQ mode 3 – bit sync, no frame sync, accurate GPS time
4	LSQ mode 4 – bit and frame sync, user time (without aiding) See Table 3-118
5	KF mode – Kalman Filtering
6	No position
7	Not used

*Table 3-118*Description of the Status for Navigation LSQ Fix Mode

Value	Status
0x00	Good solution
0x01	Uncertainty exceeded maximum (UNCER_EXCEED)
0x02	Input information to navigation had error (INPUT_ERR)
0x04	Not sufficient information to have a fix position (UNDER_DETERM)
0x08	Matrix inversion failed (MATR_INVT)
0x010	LSQ iteration exceeds predefined maximum (ITER_OUT)
0x020	Altitude check failed (ALT_OUT)
0x040	GPS time check failed (TIME_OFF)
0x080	Failure found in measurements (FDI_FAIL)
0x100	DOP exceeded threshold (DOP_FAIL)
0x200	Velocity check failed (VEL_FAIL)

*Table 3-119*Description of the Status for Navigation KF Mode

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

*Table 3-120*Description of the Start Mode

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

Development Data – Message ID 255

Output Rate: Receiver generated.

Example:

A0A2....—Start Sequence and Payload Length

FF....—Payload

....B0B3—Message Checksum and End Sequence

Table 3-121 Development Data – Message ID 255

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

Payload length: variable

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

Note – Message ID 255 is output when SiRF Binary is selected and development data is enabled. It can also be enabled by setting its output rate to 1 using Message ID 166. The data output using Message ID 255 is essential for SiRF-assisted troubleshooting support.

Additional Information 4

TricklePower Operation in DGPS Mode

When in TricklePower mode, serial port DGPS corrections are supported if the firmware supports them in full-power mode. If the CPU can be awakened from sleep mode by the UART receiving data (this feature exists in SiRFstarII receivers, not in SiRFstarIII), then the incoming corrections awaken the receiver, and it stores the incoming data in a buffer and applies them when it awakens. If the receiver cannot be awakened by UART interrupts, messages should only be sent when the receiver has indicated OK to send, or they will be lost.

When in TricklePower mode, the use of SBAS corrections is not supported in any receiver.

GPS Week Reporting

The GPS week number represents the number of weeks that have elapsed since the week of January 6, 1980. Per ICD-GPS-200, the satellites only transmit the 10 LSBs of the week number. On August 22, 1999, the week number became 1024, which was reported by the satellites as week 0. SiRF receivers resolve the reported week number internally. When messages report the week number, that value is either truncated to the 10 LSBs or is called an extended week number (see messages 7 and 41 for examples).

Computing GPS Clock Frequency

To compute GPS clock frequency, you must know the receiver architecture. For receivers which use a GPS clock frequency of 16.369 MHz (newer SiRFstarII, most SiRFstarIII receivers), Crystal Factor in the below formula is 16. For receivers which use a GPS clock frequency of 24.5535 MHz (older SiRFstarII receivers such as those using GSP2e/LP), the Crystal Factor is 24. Refer to your receiver's data sheet to determine the GPS clock frequency for your receiver.

Clock Frequency = (GPS L1 Frequency + Clock Drift) * Crystal Factor / 1540

For example, in a SiRFstarIII receiver (Crystal Factor = 16), Clock Drift is reported to be 94.315 kHz. Clock Frequency is:

Clock Frequency = (1575.42 MHz + 94.315 kHz) * 16 / 1540 = 16.3689799 MHz

If this is used in a receiver where the GPS TCXO is nominally 16.369 MHz, then this frequency is the actual frequency of the crystal. If another frequency crystal is used, you must account for the frequency conversion factors in the synthesizer to compute the crystal frequency.

To predict clock bias, use the relationships between frequency and velocity. The reported clock drift value can be converted to a velocity using the Doppler formula, since in the SiRF architecture the clock drift value is a bias to the computed Doppler frequency:

Doppler Frequency / Carrier Frequency = Velocity / speed of light

Or:

Velocity = Doppler Frequency / Carrier Frequency * c

Next, the velocity can be converted to a time factor by dividing by the speed of light:

Change in Clock Bias = Velocity / c

Combining the above 2 formulae,

Change in Clock Bias = Doppler Frequency / Carrier Frequency

For a Clock Drift of 94.315 kHz as used above,

Change in Clock Bias = 94315 Hz / 1575.42 MHz = 59.867 μs

Note – Reported clock bias and clock bias computed using the above formula will likely agree only to within a few nanoseconds because the actual measurement interval may be slightly more or less than an exact second, and the clock drift is only reported to a (truncated) 1 Hz resolution.

Appendix A

Converting Sirf Message #14 (0x0E) and #15 (0x0F) into Engineering Units

Note – It is essential to consult with GPS-ICD documentation to become more familiar with conversions. For more information, see http://www.navcen.uscg.gov/pubs/gps/icd200/default.htm

Message # 14: Almanac Data

Message ID 14 is a packed field of the GPS navigation-message 50bps almanac data stream with the parity stripped out. Only the 24-bits of data are contained in message.

The data follows the format of the 50-bps message, subframe #5, pages 1-24.

"Data" is an array of 12-2byte integers: Data[12]

Only words 3 through 10 of the GPS-50bps Almanac data stream are stored.

The SiRF data aligns with the 24-data bits of the 50bps navigation message described in GPS ICD-200 as follows:

50-bps, 24-bit data word (See GPS ICD 200) Subframe 5 Words 3-10	X (24-bits)
SiRF Data structure per subframe, D[0] -> D[12], 2 byte words	X (16-bits)

W3	W4	W5	W6	W7	W8	W9	W10

D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]	D[8]	D[9]	D[10]	D[11]

S: is a signed integer, two's complement, sign bit is MSB.

U: is unsigned integer.

Scale factor (LSB) converts from Integer to scaled Engineering units.

Sign	Conversion	Scale / Units
U	DataID=(D[0]&0xC000)>>14	1
U	SVid = (D[0]&0x3F00)>>8	1
U	Ecc=((D[0]&0x00FF)<<8)||((D[1]&0xFF00)>>8)	2^-21
U	Toa = D[1]&0x00FF	2^+21 (sec)
S	deltaInc = D[2]	2^-19 (semiCirc)
S	OmegaDot = D[3]	2^-38 (semiCirc/s)
U	SV Health = (D[4]&0xFF00)>>8	1
U	SqrtA =((D[4]&0x00FF)<<16)|| D[5]	2^-11 (m^ (-1/2))
S	Omega0=(D[6]<<8)||((D[7]&0xFF00)>>8)	2^-23 (semiCirc)
S	Omega = ((D[7]&0x00FF)<<8)||D[8]	2^-23 (semiCirc)
S	Mo = (D[9]<<8)||((D[10]&0xFF00)>>8)	2^-23 (semiCirc)
S	Af0=((D[10]& 0x003F)<<5)||((D[11]&0xC000)>>11) || (D[11] & 0x0007)	2^ (-20)(seconds)
S	Af1 = ((D[11] & 0x3FF8) >> 3)	2^-38 (s/s)

Message # 15: Ephemeris Data

Message ID 15 is a packed field of the GPS navigation-message 50bps data stream, subframes 1,2,3 with the parity stripped out. Only the 24-bits of data are contained in message.

"Data" is an array of 45-2-byte integers, Data[45], or can be thought of as Data[3][15], with:

- Subframe 1 data: Data[0] -> Data[14] Or, Data[0][0] -> Data[0][14]
- Subframe 2 data: Data[15] -> Data[29] Or, Data[1][0] -> Data[1][14]
- Subframe 3 data: Data[30] -> Data[44] Or, Data[2][0] -> Data[0][14]

Only words 2 through 10 of the GPS-50bps data stream are stored.

The SiRF data aligns with the 24-data bits of the 50 bps navigation message described in GPS ICD-200 as follows:

50-bps, 24-bit data word (See GPS ICD 200) Subframe 1,2,3 Words 2-10	X (24-bits)
SiRF Data structure per subframe, D[0] -> D[14], 2 byte words	X (16-bits)

		W2	W3		W4	W5		W6	W7		W8	W9		W10
D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]	D[8]	D[9]	D[10]	D[11]	D[12]	D[13]	D[14]

S: is a signed integer, two's complement, sign bit is MSB.

U: is unsigned integer

Scale factor (LSB) converts from Integer to scaled Engineering units.

Subframe 1 = Data[0][0 -> 14] = D[0 -> 14 + i], i=0

Sign	Conversion	Scale / Units
U	SVId = D[i+0] & 0x00FF	1 (prn #)
U	Week# = (D[i+3] & 0xFFC0)>>6	1
U	L2Code = (D[i+3] & 0x0030)>>4	1
U	Health = (D[i+4] & 0xFC00)>>10	1
U	L2Pflag = (D[i+4] & 0x0080)>>7	1
S	TGD = (D[i+10] & 0xFF00)>>8	2^-31 (sec)
U	IODC = (D[i+10]&0x00FF)||(D[i+4]&0x0300)	1
U	ToC = D[i+11]	2^+4 (sec)
S	Af2 = (D[i+12]&0xFF00)>>8	2^-55 (sec/sec^2)
S	Af1 =((D[i+12]&0x00FF)<<8)||((D[i+13]&0xFF00)>>8)	2^-42 (sec/sec)
S	Af0=((D[i+13]&0x00FF)<<14)||((D[i+14]&0xFFFC)>>2)	2^-31 (sec)

Subframe 2 = Data[1][0 -> 14] = D[0 -> 14 + i] i=15

Sign	Conversion	Scale / Units
U	SVId = D[i+0] & 0x00FF	1 (prn #)
U	IODE = (D[i+3]&0xFF00)>>8	1
S	Crs =((D[i+3]&0x00FF)<<8)||((D[i+4]&0xFF00)>>8)	2^-5 (meters)
S	deltaN=((D[i+4]&0x00FF)<<8)||((D[i+5]&0xFF00)>>8)	2^-43 (semiCirc/s)
S	Mo=((D[i+5]&0x00FF)<<24)||(D[i+6]<<8)|| ((D[i+7]&0xFF00)>>8)	2^-31 (semiCirc)
S	Cuc =((D[i+7]&0x00FF)<<8)||((D[i+8]&0xFF00)>>8)	2^-29 (rads)
U	E=((D[i+8]&0x00FF)<<24) || (D[i+9]<<8) || ((D[i+10]&0xFF00)>>8)	1
S	Cuc =((D[i+10]&0x00FF)<<8)||((D[i+11]&0xFF00)>>8)	2^-29 (rads)
U	RootA=((D[i+11]&0x00FF)<<24) || (D[i+12]<<8) || ((D[i+13]&0xFF00)>>8)	2^-19 (meters)^-(1/2)
U	Toe=((D[i+13]&0x00FF)<<8)||((D[i+14]&0xFF00)>>8)	2^+4 (sec)
U	FitFlag = (D[i+14]&0x0080)>>7	1
U	AODO = (D[i+14]&0x007C)>>2	1

Subframe 3 = Data[1][0 -> 14] = D[0 -> 14 + i] i=30

Sign	Conversion	Scale / Units
U	SVId = D[i+0] & 0x00FF	1 (prn #)
S	Cic = D[i+3]	2^-29 (rads)
S	Omega0 = (D[i+4]<<16)||D[i+5]	2^-31(semiCirc)
S	Cis = D[i+6]	2^-29 (rads)
S	i0 = (D[i+7]<<16)||D[i+8]	2^-31(semiCirc)
S	Crc = D[i+9]	2^-5 (meters)
S	w = (D[i+10]<<16)||(D[i+11])	2^-31(semiCirc)
S	OmegaDot = (d[i+12]<<8)||((d[i+13]&0xFF00)>>8)	2^-43(semiCirc/s)
U	IODE = (D[i+13] & 0x00FF)	1
S	Idot = (D[i+14]&0xFFFC)>>22	2^-43(semiCirc/s)

Document References

Document	**Reference**
NMEA Protocol Reference Manual	CS-129435-MAP
ICD-GPS-200	

North America
Corporate HQ
(1) (408) 467-0410
Sales@sirf.com

Europe
United Kingdom
(44) (1344) 668390
SalesUK@sirf.com

Germany
(49) (81) 529932-90
SalesGermany@sirf.com

Asia Pacific
China
(86) (21) 5854-7127
SalesChina@sirf.com

Taiwan
(886) (2) 8174-8966
SalesTaiwan@sirf.com

Japan
(81) (44) 829-2186
SalesJapan@sirf.com

India
(91) (80) 41966000
SalesIndia@sirf.com

South Korea
(82) (2) 545-2562
SalesKorea@sirf.com

SiRF Binary Protocol Reference Manual

September 2009

Please
Recycle