GPS Engine Board

TF Series

Embedded Solution Provider

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Reference Guideline to TF GPS Engine Board

About This Document

This document, originally from SiRF Technology, Inc., contains the guideline to usage of TF GPS Engine Board Series.

Reversion: 1.0

Sept 2000

Products Supported

This document describes the guideling to using OEM TF GPS Engine Boards Series:

- TF10

Contents

Tables

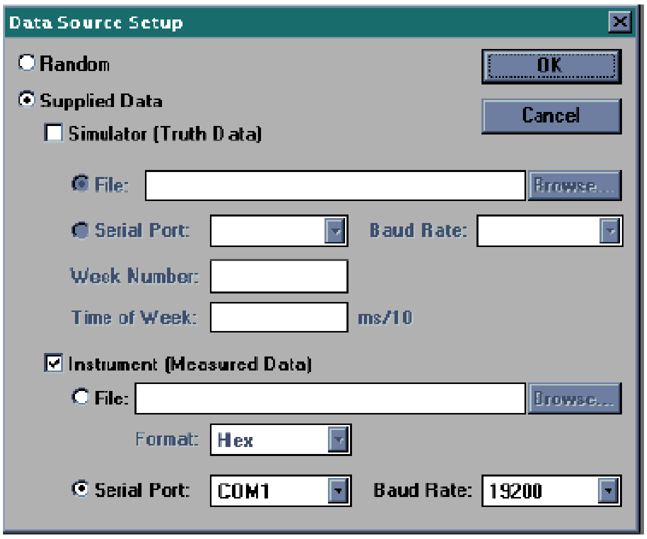
Chapter 1 Quickstart

This chapter describes how to run the SiRFdemo software.

Note – If you want to run the SiRFdemo, you only need to install the software. If you want a more detailed explanation on how to run the software, go to **Chapter 2, "Setup**."

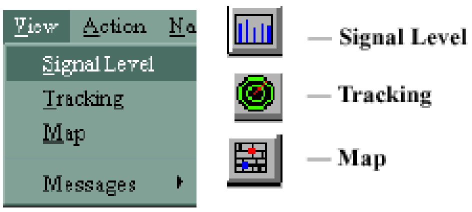
1. Double-click on the `SiRFdemo` icon. located in `\sirfstar(the folder name where the SiRFdemo is placed)`

The Data Source Setup screen is displayed.



Note – The Serial Port and Baud Rate apply to the host PC

2. Click OK.
3. Click on the Signal Level View button or choose Signal Level from the View menu.



The 12-Channel Signal Level View screen displays the satellite number, status, azimuth, elevation, C/No, and last five seconds of measured signal levels.

4. Click on the Tracking View button or choose Tracking from the View menu.

The Tracking View screen is displayed. This displays the satellites in a polar plot.

• Outer circle represents the horizon (Elevation=0 degrees)

• Inner circle represents 45 degrees

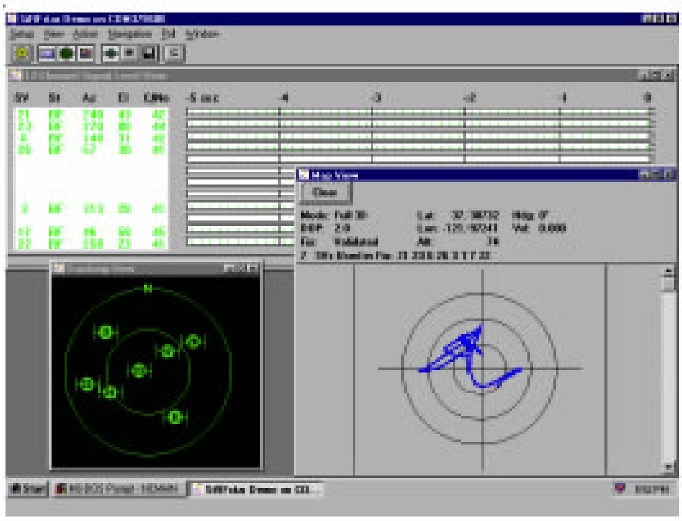
• Center point is directly overhead (Elevation=90 degrees)

5. Click on the Map View button.

The Map View screen displays the position of the ground tracking.

The red dot shows the last position solution. If you run Map View with a moving setup, the ground track is displayed in the Map View screen.

If no dot is shown, you must update the `ring90.smp` file for your location.



Note – To use the Map View track history portion of the screen, you must set up an appropriate SiRF Map Protocol file with a `*.smp` extension. Refer to Appendix B for more details.

6. Click the Connect/Disconnect button.

A prompt is displayed asking if you want to open a log file.

7. Click No.

If your receiver is properly connected (with antenna), the location and tracking status of the satellites are displayed on the Tracking View screen as follows:

• The Tracking View screen displays the location of the satellites, their relative location in azimuth and elevation.

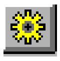
• The 12-Channel Signal Level View screen displays the SV PRN, status, azimuth, elevation, and C/No for each satellite.

• The colors for the satellites are as follows:
Green: Satellite with signal lock, used in navigation solution.
Blue: Satellite with signal lock, not used navigation solution.
Red: Satellite without signal lock.

Chapter 2 Setup

This chapter describes the SiRFdemo functions under the Setup menu:

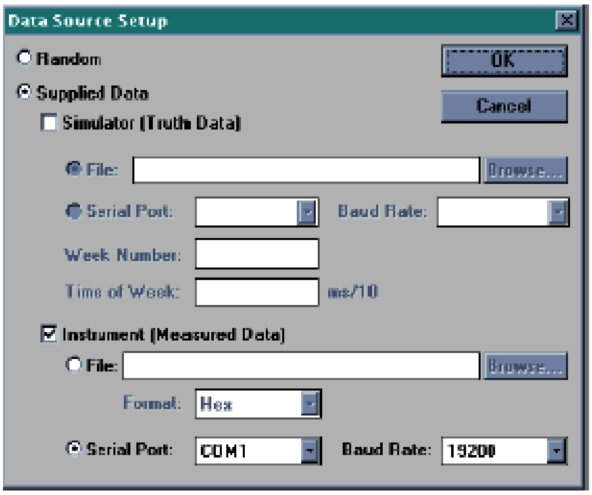
- “To Define the Data Source”
- “To Change Preferences”
- “To Display Information About the SiRFstar Demo”
- “To Exit the SiRFstar Demo”



— Data Source

To Define the Data Source

1. Click the Data Source button or choose Data Source from the Setup menu.
   The Data Source Setup screen is displayed.



Note – The Simulator (Truth Data) option is not yet implemented.

The Serial Port and Baud Rate apply to the host PC (The Evaluation Unit is set to a baud rate of 19200 during factory testing). To capture any information regarding your positions, the Evaluation Unit must be connected to the selected serial port on your PC.

Do not use the File radio button. This option is not implemented at this time.

2. Click on Supplied Data if you want to run the SiRFdemo.

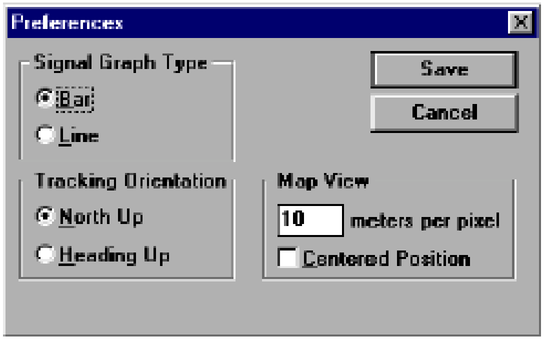
Option	**Description**
Random	Only uses randomly generated data. Use this option to verify that the SiRFdemo is running without the Evaluation Kit connected.
Supplied Data	Collects data on your positions.

3. Click on Instrument (Measured Data) if it is not already clicked on.
4. Select the comm port from the Serial Port pulldown menu to which the serial cable has been connected on your PC.
5. Select 4800 from the Baud Rate pulldown menu (default baud rate 4800 for NMEA output or 19200 for Binary output).
6. Click the OK button to continue.

To Change Preferences

Note – These are basic settings that apply to the 12-Channel Signal Level View Screen, Tracking View Screen, and Map View Screen.

1. Choose Preferences from the Setup pulldown menu.
   The Preferences screen is displayed.



2. Select the type of signal graph that you want to view on the 12-Channel Signal Level View screen.

Option	**Description**

Bar	Displays the data with vertical bars.
Line	Displays the data in a horizontal line.

3. Select the direction of the tracking orientation that you want to use in the Tracking View screen.

Option	**Description**
North Up	True north points to the top of the circle.
Heading Up	Used when driving. Current heading points to the top of the circle.

4. Type the meters per pixel that you want to display when viewing the map in Map View, this controls the scale of the map.
5. Click the check box if you want the Map View to be displayed with the current position at the map center.
6. Click the Save button to save the changes or the Cancel button to exit.

To Display Information About the SiRFstar Demo

1. Select About SiRFstar Demo from the Setup pulldown menu.
   This displays SiRFdemo software information.

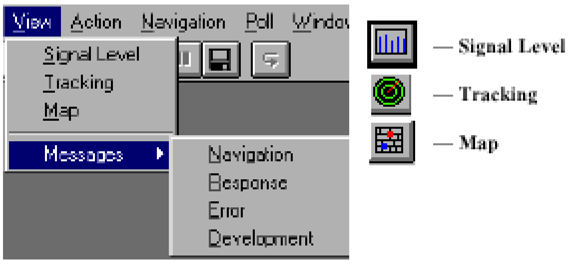
To Exit the SiRFstar Demo

1. Select Exit from the Setup pulldown menu.
   This closes SiRFdemo software.

Chapter 3   View

This chapter describes the SiRFdemo functions under the View menu:

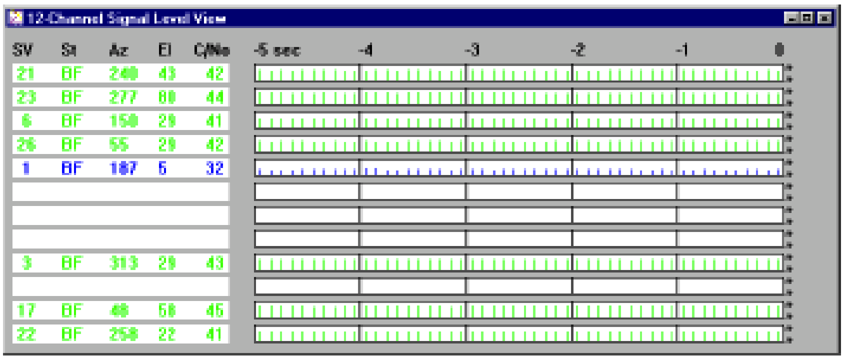
- "To Display the 12-Channel Signal Level View Screen"
- "To Display the Tracking View Screen"
- "To Display the Tracking View Configuration Screen"
- "To Display the Map View Screen"
- "To Change Preferences from the Map View"
- "To Display the Measured Navigation Message View Screen"
- "To Display the Response View Screen"
- "To Display the Error Message View Screen"
- "To Display the Development Data View Screen"



To Display the 12-Channel Signal Level View Screen

1. Click on the Signal Level View button or choose Signal Level from the View menu. The 12-Channel Signal Level View screen displays the satellite number, status, azimuth, elevation, C/No, and last five seconds of signal measured strength.
   Note – If you double-click on the 12-Channel Signal Level View screen, the Preferences screen is displayed, as described in "To Change Preferences"

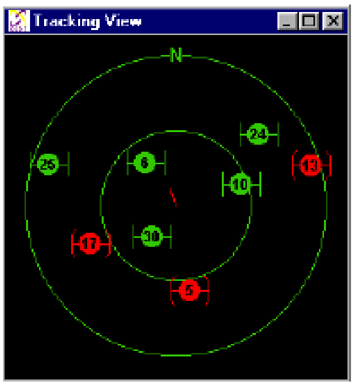
The Preferences screen enables you to modify the way information is displayed on the screen.



Information Displayed	**Description**
Satellite Number (SV)	GPS satellite PRN number
Status (St)	Satellite status (see Table A-31 for more information)
Azimuth (Az)	Satellite azimuth (in degrees)
Elevation (El)	Satellite elevation (in degrees)
C/No	Signal level (in dB-Hz)
Signal Level (-5 sec)	5-second history

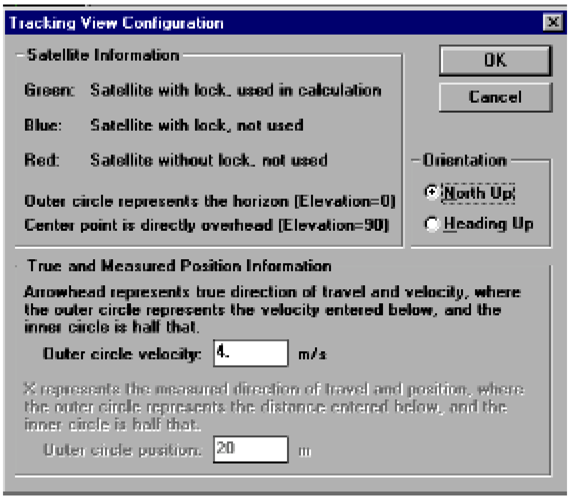
To Display the Tracking View Screen

1. Click on the Tracking View button or choose Tracking from the View menu. The Tracking View screen displays the satellites in a polar plot orientation.



To Display the Tracking View Configuration Screen

1. Double-click on the Tracking View screen to display the Tracking View



2.Select the direction of the tracking orientation that you want to use.

Option	**Description**
North Up	True north points to the top of the circle.
Heading Up	This option can be used when driving. Current heading points to the top of the circle.

3. Type the Outer circle velocity (in m/sec).

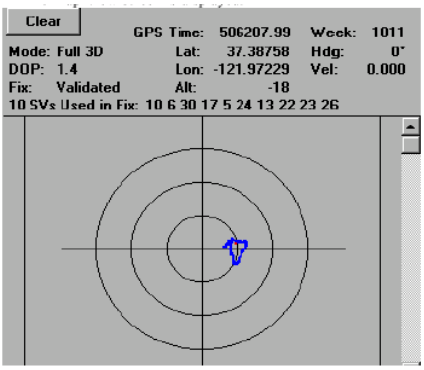
3. Click the OK button to save the changes or the Cancel button to exit.

To Display the Map View Screen

Note – To use the Map View track history screen, you must create a SiRF Map Protocol file (with a `*.smp` extension). Provided with your software is a sample `ring90.smp` file that includes data for SiRF Technology, Inc.'s location. You can modify this file for your location.

1. Click on the Map View button or choose Map from the View menu.

The Map View screen is displayed.

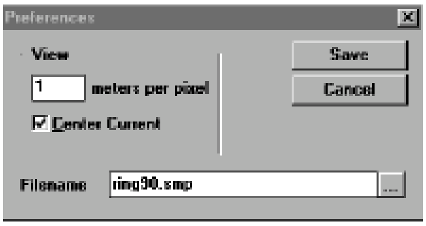


Note – The red dot shows the current position while the blue dots show the previous position.

Note – If you double-click on the Map View screen, the Preferences screen is displayed.

To Change Preferences from the Map View

1. Double-click on the Map View screen to set specific preferences on the Map View screen.



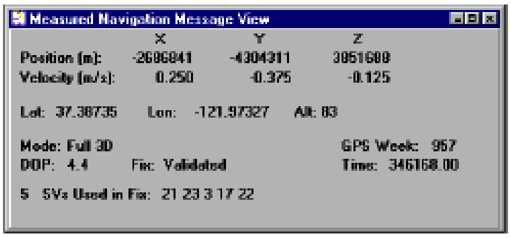
2. Type the meters per pixel that you want to display when viewing the map in Map View. This value controls the map scale.
4. Click the Center Current check box if you want the Map View to be displayed in the centered position.
4. Type the Filename or browse.
5. Click the Save button to save the changes or the Cancel button to exit.

Note – The Navigation, Response, Error, Development, and Messages options, are for viewing only. If you want to log data, choose Open a Log File from the Action menu. See "To Open a Log File"

To Display the Measured Navigation Message View Screen

1. Choose Messages Navigation from the View menu.

   The Measured Navigation Message View screen is displayed.



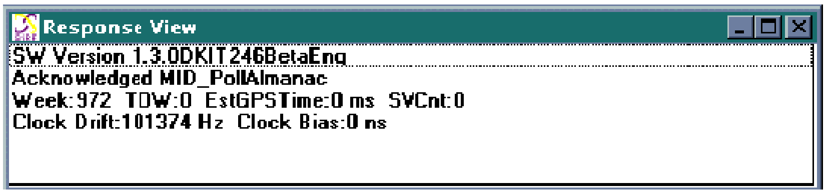
Information Displayed	**Description**
X, Y, Z positions	Coordinates of user's position in ECEF (meters)
Velocity	User's velocity in ECEF (m/s)
Latitude	User's latitude (decimal of degrees)
Longitude	User's longitude (decimal of degrees)
Altitude	User's altitude (meters)
Mode	Navigation solution type (see Table A-28 and Table A-29)
GPS Week	GPS week number
DOP	Dilution of Precision
Fix	Validated/unvalidated (see Table A-28 and Table A-29)
Time	Current GPS time (seconds)
Svs Used in Fix	Sv PRN used in solution

Note – ECEF XYZ is converted geodetic latitude, longitude, and altitude based on the WGS 84 ellipsoid parameters.

To Display the Response View Screen

Note – This option is used with the Poll menu. All responses to poll messages are displayed in the Response screen. See **Chapter 6, “Poll**.”

1. Choose Messages Response from the View menu.



To Display the Error Message View Screen

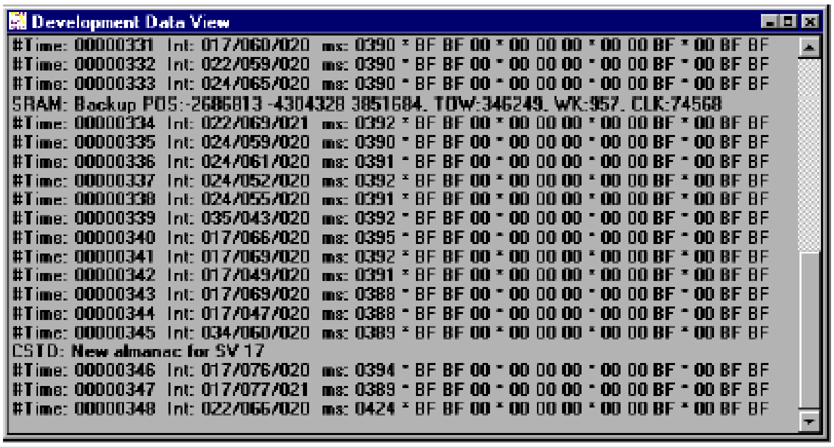
1. Choose Messages Error from the View menu.

Note – Error messages are generated automatically by the receiver under certain conditions. Many are caused by normal GPS operations (i.e., acquiring a low elevation satellite could result in a bad parity).

To Display the Development Data View Screen

The Development Data View screen displays additional information about the receiver operation. The data is generated automatically by the Evaluation Unit.

1. Choose Messages Development from the View menu.



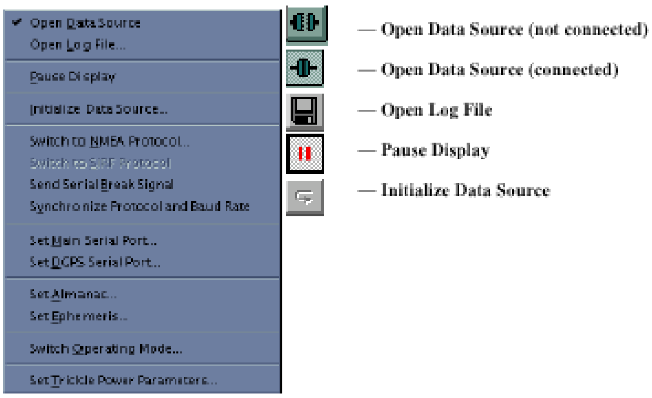
Note – To view incoming development data the Enable Development Data checkbox must be enabled on the Receiver Initialization screen. See “To Initialize Data Source”

Chapter 4   Action

This chapter describes the SiRFdemo functions under the Action menu:

- "To Open Data Source"
- "To Open a Log File"
- "To Pause the Display"
- "To Initialize Data Source"
- "To Switch to NMEA Protocol"
- "To Switch to SiRF Protocol (from NMEA Protocol)"
- "To Send Serial Break"
- "To Synchronize Protocol and Baud Rate"
- "To Set the Main Serial Port"
- "To Set the DGPS Serial Port Parameters"
- "To Set UART Configuration"
- "To Upload an Almanac to the Evaluation Unit"
- "To Upload an Ephemeris to the Evaluation Unit"
- "To Switch Operating Modes"
- "To Set Trickle Power Parameters"

Note – All values that appear in the dialogue boxes under this menu are **"RECEIVER DEFAULT VALUES."** To determine the current settings of all Navigation Parameters refer to the Poll Menu in Chapter 6.



To Open Data Source

1. Click the Connect/Disconnect button or select Open Data Source from the Action menu.

   A prompt is displayed asking if you want to open a log file.

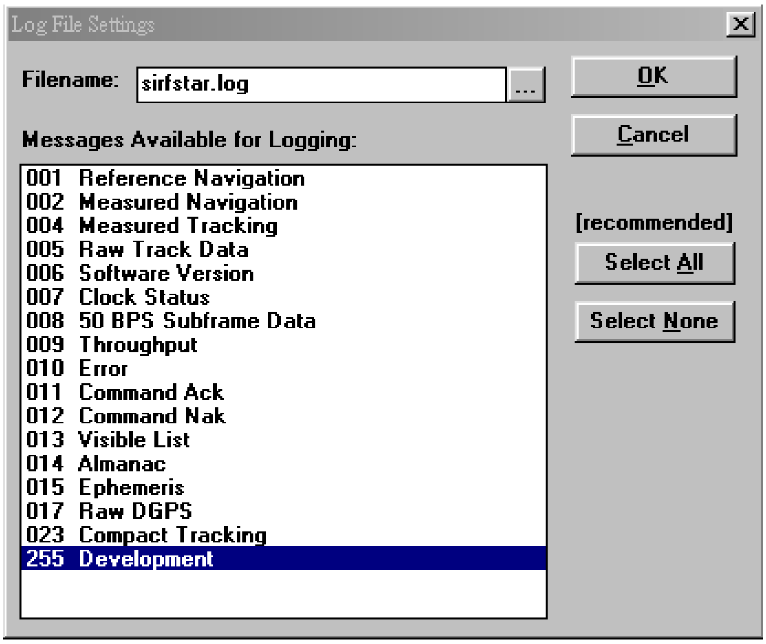
• Clicking the Yes button displays the Log File Settings screen (see "To Open a Log File" for more information).
• Clicking the No button will not open a log file.
• Clicking the Cancel button aborts the connection.

2. Click the Connect/Disconnect button again or select Open Data Source from the Action menu to disconnect communication to the Evaluation Unit.

To Open a Log File

1. Click the Log File Settings button or choose Open Log File from the Action menu.

   Note – `sirfstar.log` is the default filename. Click the button on the right side of the filename field to browse for a file.



Note – Message 001 and 023 are not currently supported.

Messages	**Description**
002 Measured Navigation	Time, position, velocity,...
004 Measured Tracking	Satellite status and C/No
005 Raw Track Data	Satellite raw data measurements
006 SW Version	Software version of the Evaluation Kit
007 Clock Status	Receiver clock performance
008 50 BPS Subframe Data	Satellite ephemeris and almanac data
009 Throughput	CPU throughput usage
010 Error	Various error messages
011 Cmd Ack	Acknowledgment of received commands
012 Cmd Nak	Input message failures
013 Visible List	Satellite visibility list (based on current almanac)
014 Almanac	Satellite almanac data
015 Ephemeris	Satellite ephemeris data
017 Raw DGPS Data	Differential GPS corrections in RTCM format
255 Development	Various development information

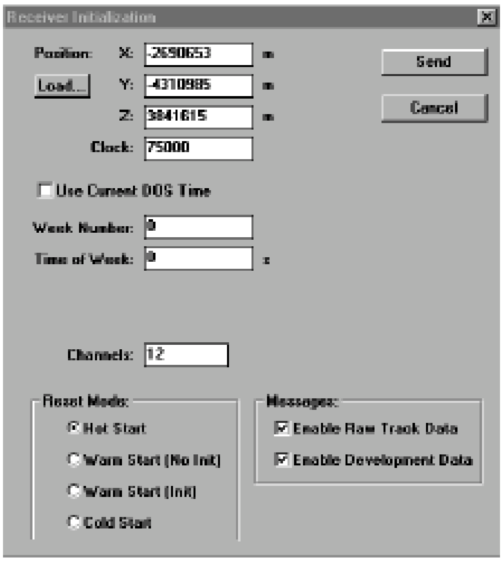
2. Type or select the file name in which you want to save the settings.
   Note – Only records that are selected are saved to file.
3. Click the OK button to begin logging the selected messages or the Cancel button to abort opening a file.

To Pause the Display

1. Click the Pause button or choose Pause Display from the Action menu.
   Note – No data is logged while the display is paused.

To Initialize Data Source

1. Click the reset button or choose Initialize Data Source from the Action menu. The Receiver Initialization Setup screen is displayed.



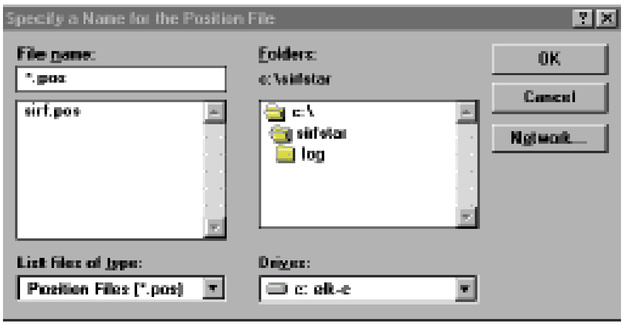
2. Select type of Reset Mode by clicking on the radio button.

Option	**Description**
Hot Start	The Evaluation Unit restarts by using the values stored in the internal memory of the Evaluation Unit.
Warm Start (No Init)	This option has the same functionality as Hot Start except that it clears the ephemeris data and retains all other data.
Warm Start (Init)	This option clears all initialization data in the Evaluation Unit and subsequently reloads the data that is currently displayed in the Receiver Initialization Setup screen. Almanac is retained but ephemeris is cleared. You can load a predefined file by selecting a *.pos file for more information on loading positions X, Y, and Z
Cold Start	This option clears all data that is currently stored in the internal memory of the Evaluation Unit including position, almanac, ephemeris, time, and clock drift.

Note – If Warm Start (Init) is selected the user must supply the X, Y, and Z coordinates and the clock data. (Refer to Step 3 through Step 10.) Otherwise go to Step 11.

Note – If Cold start is selected, all receiver settings will be reset to **FACTORY DEFAULTS**.

3. Type or Load the X, Y, and Z coordinates by clicking the Load button to display the Specify a Name for the Position File screen to browse for a position file.



4. Select the sample `Sirf.pos` configuration file.
5. Click the OK button to accept or the Cancel button to exit.
   The Receiver Initialization Setup screen is displayed again.
6. Type 96,000 in the Clock field (typical clock drift value of the crystal in the Evaluation Unit).

Note – If you type 0 in the Clock field, the Evaluation Unit uses its last stored value, or a default of 96,000 if no prior stored value is available.

7. Click on or off the Use current DOS time check box.
   The default value is set to the current time.

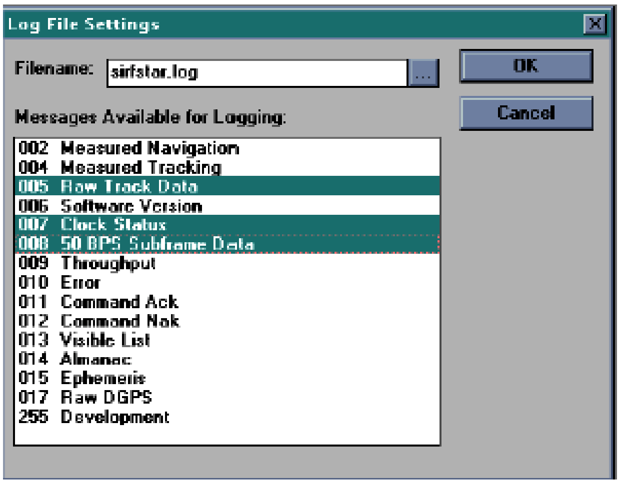
Note – It is recommended to use DOS time (it is assumed that the date and time on your computer are set correctly).

8. Type the number of the week in the Week Number field.
9. Type the time of the week in the Time of Week field.
10. Type number of channels in the Channel field.
    Not more than 12 and not less than 1.
11. Click on Enable Raw Track Data to Log Raw Track Data.

Note – To log the Raw Track Data (005) or the Development Data (255) the records must be enabled by clicking in the respective boxes.

Note – 005 [Raw Track] Data must also be high-lighted on the Log File Settings

Screen.



It is recommended to log records 007 [Clock Status] and 008 [50 BPS Subframe Data] with 005 [Raw Track Data] because they are enabled/disabled as a set of measurements.

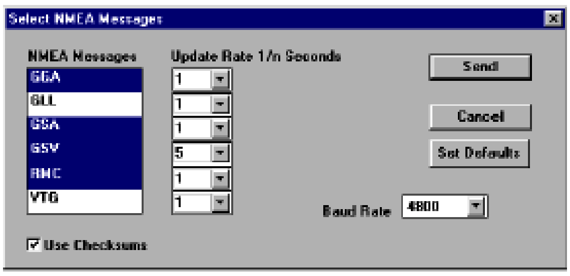
12. Click on Enable Development Data to turn on message 255 for Development Data View.
13. Click the Send button to initialize or the Cancel button to exit.

To Switch to NMEA Protocol

Note – Switching to NMEA Protocol causes the Evaluation Unit to reset and send NMEA Messages.

1. Choose Switch to NMEA Protocol from the Action menu.

   The Select NMEA Messages screen is displayed.



2.Select the NMEA Messages that you want to use:

Option	Description
GGA	Standard output message for detailed position information.
GLL	Older message for simple position information only.
GSA	List of satellites used in solution.
GSV	Detailed satellite information including signal strengths.
RMC	Combination message of position and velocity.
VTG	Standard output message for velocity.

3. Select the update rate for each NMEA message that you want to use from the Update Rate pulldown menu (1 record per second minimum to 1 record per 255 seconds maximum).
4. Select the baud rate that you want to use from the Baud Rate pulldown menu.
5. Click the OK button to save or the Cancel button to exit.

Note – NMEA is regarded as a message 255 and can be viewed in the Development Data screen. It can also be logged by using the same technique as a SiRF binary file. Select 255-Development in the Log File Settings screen and Enable Development Data must be checked on in the Messages field of the Receiver Initialization screen.

To Switch to SiRF Protocol (from NMEA Protocol)

1. Choose Switch to SiRF Protocol from the Action menu to return to SiRF binary protocol.

Note – For more detailed information see Appendix B, "NMEA Input/Output Messages."

To Send Serial Break

Note – Applies to previous software versions only (maintained for backwards compatibility).

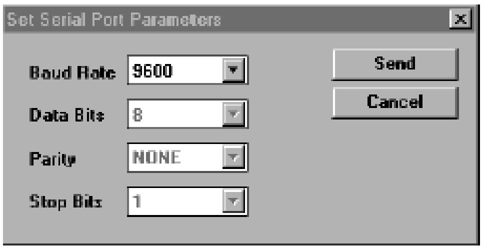
To Synchronize Protocol and Baud Rate

All receiver settings are preserved over power cycles in a battery backed SRAM. It can occur that the computer in use may change or communication parameters may change. Other users of the Evaluation Unit may not be aware of the last settings. This option will attempt to communicate with the evaluation unit using all possible baud rates and both NMEA and SiRF binary protocols. When communication is established with the unit it will be set to SiRF binary protocol at a baud rate of 19200.

Note – The RS232 settings (i.e. parity, stop bits....) are left at current settings

To Set the Main Serial Port

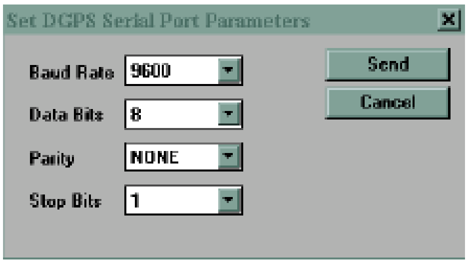
1. Choose Set Main Serial Port from the Action menu.
   The Set Serial Port Parameters screen is displayed.



2. Select the baud rate, data bits, parity, and stop bits that you want to use for the serial port parameters from each pulldown menu.
   Note – Only Baud Rate is changeable.
3. Click the Send button to accept or the Cancel button to exit.
   Clicking the Send button resets the Evaluation Unit and computer's serial port to Start communicating with the new parameters.

To Set the DGPS Serial Port Parameters

1. Choose Set DGPS Serial Port from the Action menu.
   The Set DGPS Serial Port Parameters screen is displayed.



2. Select the baud rate, data bits, parity, and stop bits that you want to use for the DGPS serial port parameters from each pulldown menu.
3. Click the Send button to accept or the Cancel button to exit.
   Clicking the Send button resets the Evaluation Unit and attempts to accept DGPS information from serial port B (RTCM input).
   Note – Differential correction data source must be configured separately.

To Set UART Configuration

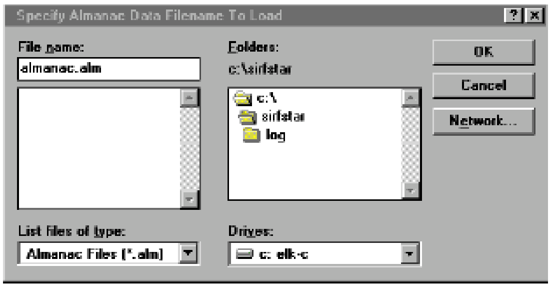
Current platform has the capability to output different protocols on the 4 supported UARTs with additional hardware modifications. However, it is not supported with our service now.

To Upload an Almanac to the Evaluation Unit

The Almanac file must be in the same format as polled from the Evaluation Unit.

1. Choose Set Almanac from the Action menu.

   The Specify Almanac Data Filename To Load screen is displayed.



2. Specify the file you want to use.
3. Click the OK button to accept or the Cancel button to exit.

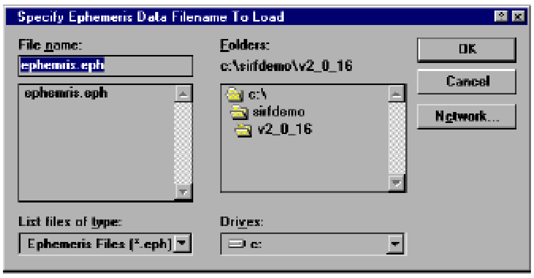
   Note – To download an Almanac from the Evaluation Unit see **Chapter 6, “Poll**.”

To Upload an Ephemeris to the Evaluation Unit

The Ephemeris file must be in the same format as polled from the Evaluation Unit.

1. Choose Set Ephemeris from the Action menu.

   The Specify Ephemeris Data Filename To Load screen is displayed.



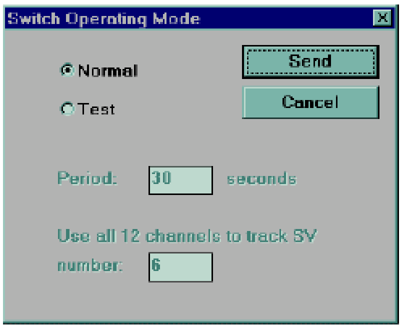
2. Specify the file you want to use.
3. Click the OK button to accept or the Cancel button to exit.

   Note – To download an Ephemeris from the Evaluation Unit see **Chapter 6, “Poll**.”

To Switch Operating Mode

1. Choose Switch Operating Mode the Action menu.

The Switch Operating Mode screen is displayed.



2. Select "Test" if you wish to track a specific satellite on all channels. Satellite and tracking period must be specified.
3. Select Normal (default) to track all available satellites.
5. Send the command to the Evaluation Unit.

To Switch Trickle Power Parameters

In release 1.3 or greater, functionality is added for low-power receiver operation. But the operation DOES NOT support the use of Differential GPS corrections. There are two modes of low-power operation:

- TricklePower — In TricklePower mode, the power to the SiRF chipset is cycled periodically, so that it operates only a fraction of the time.
- Push-to-Fix — In Push-to-Fix mode, the receiver is generally off, but turns on frequently enough to collect ephemeris maintain GSP1 real time clock calibration so that, upon user request, a position fix can be provided quickly after power-up.

TricklePower

In this mode, the power to the GRF1/LX chip is cycled regularly, according to two user-specified parameters: Update Rate and OnTime. During TricklePower operation, the GRF1/LX chip is powered on for OnTime (in milliseconds), then powered off for a specified number of milliseconds as determined by the update rate..This cycle repeats indefinitely.

The GSP1/LX chip is not explicitly powered down, but its primary operation is driven by the GPS clock generated by the GRF1/LX, so it draws very little power while the GRF1/LX is powered down. The real time clock (RTC) portion of the GSP1/LX continues operation at all times, and is used to generate the interrupt that turns everything back on.

The microprocessor on which the SiRF code executes is not explicitly powered down.

After the OnPeriod has elapsed, the processor continues operating long enough to complete its navigation tasks, then puts itself in sleep mode until it is reawakened by the RTC-generated interrupt.

For example, the parameters values are:

- OnPeriod = 200ms, Update Rate = 1 second

Note – In Release 131R144 or greater, there are SiRFdemo imposed Trickle Power limitations. See Table A-24 for supported/unsupported settings.

Push-to-Fix

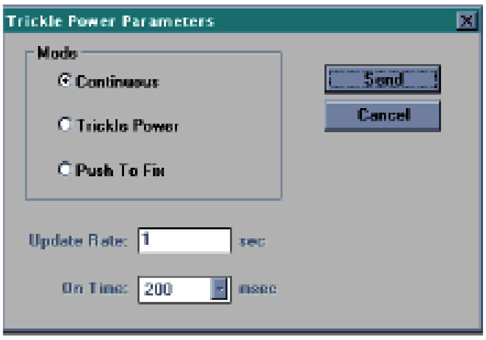
For applications where a position fix is required on demand (i.e., not continuous) then the Push-to-Fix mode is the most appropriate mode of operation for power sensitive situations. In this mode, the receiver turns on periodically (approximately every 30 minutes) to update ephemeris records and calibrate the clocks. When all internal updating tasks are complete, the unit powers itself off (except for RTC) and schedules the next wake up period. When the receiver is power cycled externally, a navigation solution will be available to the user in 3 seconds.

1. Select Set Trickle Power Parameters from the Action Menu

   The Trickle Power Parameters screen is displayed

2. Select low power mode.

Note – If you select Trickle Power you must also input the update rate (number of seconds between fixes, minimum is 1 second) and On Time (range 200-900 ms)



3. Click Send to activate selection.

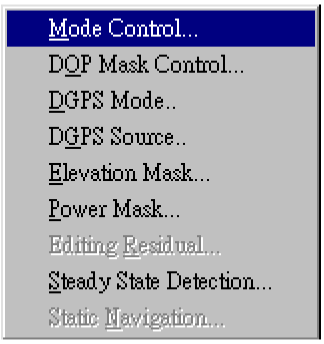
Chapter 5 Navigation

This chapter describes how to modify the operational parameters of the evaluation unit. The evaluation unit is shipped with a set of defaults that provide optimized operation over a variety of applications. However, your application may have specific requirements that need modification of the operation of the Evaluation Unit to provide improved performance. The navigation control parameters which can be adjusted via the serial port from the SiRFdemo and their effects are explained in this chapter. This chapter describes the SiRFdemo functions under the Navigation menu:

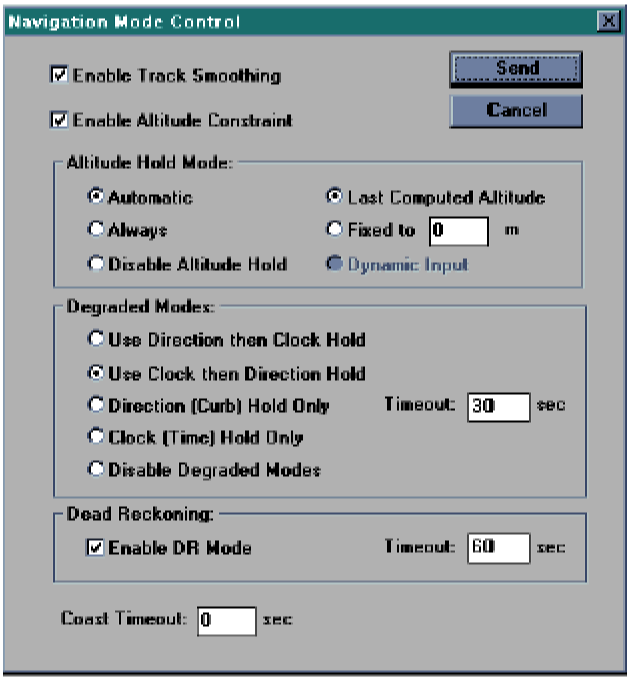
- "To Set Navigation Mode Control"
- "To Set the DOP Mask Control"
- "To Set the DGPS Source"
- "To Set the Elevation Mask"
- "To Set the Power Mask"
- "To Enable/Disable the Steady State Detection"

Note – All values that appear in the dialogue boxes under this menu are **"RECEIVER DEFAULT VALUES".** To determine the current settings of all Navigation Parameters refer to the Poll Menu in Chapter 6

To Set Navigation Mode Control



1. Choose Mode Control from the Navigation menu.
   The Navigation Mode Control screen is displayed.



Note – 3D mode is always enabled and cannot be changed.

2. Select the option(s) that you want to use.

Option	Description	Default
Enable Track Smoothing	Enables data smoothing	On
Enable Altitude Constraint	Clamp altitude variation to 10% of horizontal to create a smoother ground track	On
Altitude Hold Mode:		
Automatic	Switch automatically to 2D if only three satellites are used, 3D if four satellites or more are used.	On
Always	Stay in 2D regardless of number of satellites in solution.	Off
Disable Altitude Hold	Only do 3D, if less than four satellites, no navigation.	Off
Last Computed	In hold mode, use last computed altitude.	Off

Altitude		
Fixed to	In hold mode, use entered value (meters)	Off
Dynamic Input	User can input new value vie serial port. Not currently implemented.	Off

Degraded Modes:

Use Direction then Clock Hold	In two satellite mode use direction hold, one satellite is in clock hold.	Off
Use Clock then Direction Hold	In two satellite mode use clock hold, one satellite is in direction hold.	On
Direction (Curb) Hold Only	Never use clock hold, must have two satellites in direction hold.	Off
Clock (Time) Hold Only	Never use direction hold, must have two satellites in clock hold.	Off
Disable Degraded Modes	No output if less than three satellites.	Off
Timeout	Mode is disabled at timeout value.	

Dead Reckoning:

Enable Dead Reckoning Mode	Outputs position updated with last velocity for specified time period.	On
Timeout	Mode is disabled at timeout value.	
Coast Timeout	Delay mode switch by specified time. 0 sec	

8. Type the Timeout(s) that you want to use.
9. Click the Send button to accept or the Cancel button to exit.

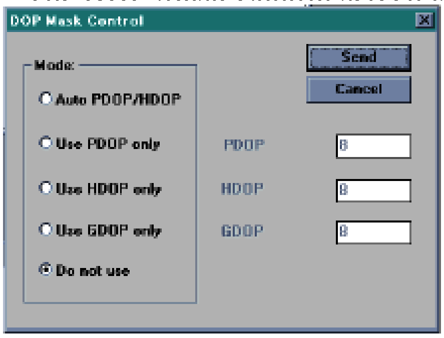
To Set the DOP Mask Control

This mask enables you to control the output of the receiver such that positions computed with a high DOP (dilution of precision) are not updated. When the DOP mask is exceeded, the position message status changes to “DOP mask exceeded” and the position does not update. You can select the modes and the associated values can be entered in the fields adjacent to the radio button for each mode.

Note – At this time, the mask is implemented based only on PDOP. The other options are not currently implemented.

1. Choose DOP Mask Control from the Navigation menu.

   The DOP Mask Control screen is displayed.



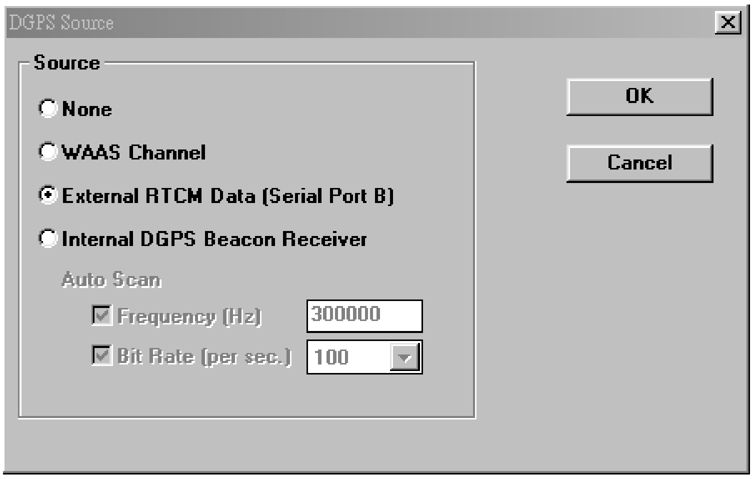
2. Select the Mode that you want to use.

Option	**Description**	**Default**
Auto PDOP/HDOP	PDOP in use if more than four satellites, HDOP if three satellites.	On
Use PDOP only	PDOP mask always in use.	Off (10)
Use HDOP only	HDOP mask always in use.	Off (8)
Use GDOP only	GDOP mask always in use.	Off (8)
Do not use	No mask in use, update regardless of DOP (default).	Off

3. Click the Send button to accept or the Cancel button to exit.

To Set the DGPS Source

1. Choose DGPS Source from the Navigation menu.

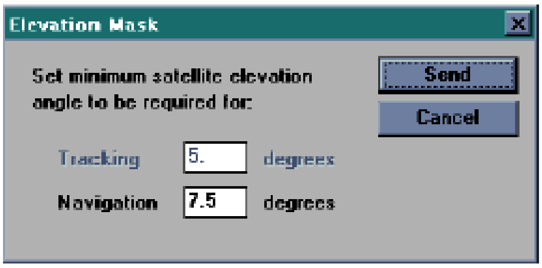


2.Select the Mode that you want to use.

Option	**Description**
None	No attempt to check for DGPS corrections Selection made here are reflected in the "DGPS Status" dialogue box.
WAAS Channel	Currently not supported
External RTCM data (Serial Port B)	Coast Guard Beacon(local coverage)
Internal DGPS Beacon Receiver	Coast Guard Beacon antenna required (currently not supported)

To Set the Elevation Mask

1. Choose Elevation Mask from the Navigation menu.
   The Elevation Mask screen is displayed.

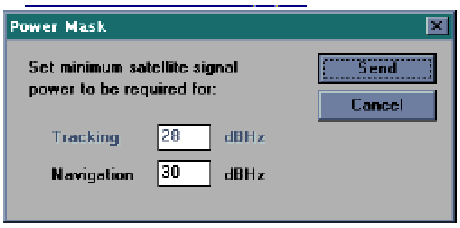


Note – Minimum satellite elevation angle for satellites to be tracked is not currently implemented (default is 5 degrees).

2. Type the minimum satellite elevation angle for satellites to be used in navigation solution. (The default is 7.5 degrees.)
3. Click the Send button to accept or the Cancel button to exit.

To Set the Power Mask

1. Choose Power Mask from the Navigation menu.
   The Power Mask screen is displayed.



Note – Minimum satellite signal power for satellites to be tracked is not currently implemented (default is 28 dBHz).

2. Type minimum satellite signal power for satellites to be used in navigation solution.
3. Click the Send button to accept or the Cancel button to exit.

To Enable/Disable the Steady State Detection

The steady state detection allows the navigating algorithms to decrease the noise in the in the position output when the acceleration is below the threshold. This reduces the position wander caused by Selective Availability (SA) and improved positions especially in stationary applications.

1. Choose Steady State Detection from the Navigation menu.

n is displayed.

2. Select the option that you want to use.
3. Type the Threshold if applicable.
4. Click the Send button to accept or the Cancel button to exit.

Chapter 6 Poll

This chapter describes how to request the following information. All responses are displayed in the Response View screen or saved in a file.
This chapter describes the SiRFdemo functions under the Poll menu:

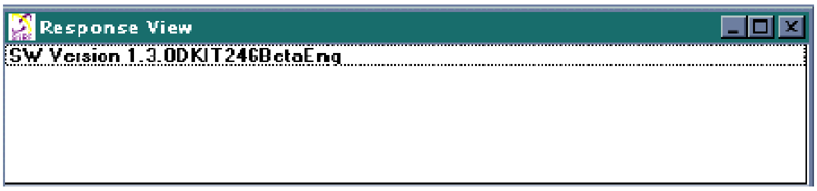
- "To Poll the Software Version"
- "To Poll the Clock Status"
- "To Poll Navigation Parameters"
- "To Download an Almanac"
- "To Download Ephemeris Data"

To Poll The Software Version

Note – The software version is composed of the software version number, a four-letter kit identifier, and a build number. This software version refers to the Evaluation Unit. Use this information when calling SiRF Technology technical support.

1. Choose SW Version from the Poll menu.

   The Response View screen is displayed with the software version.

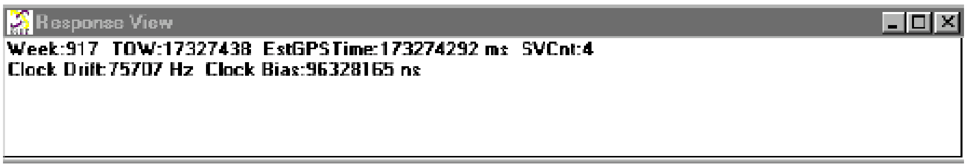


To Poll the Clock Status

The Clock Status displays the receiver clock performance.

1. Choose Clock Status from the Poll menu.

   The Response View screen is displayed with the clock status.

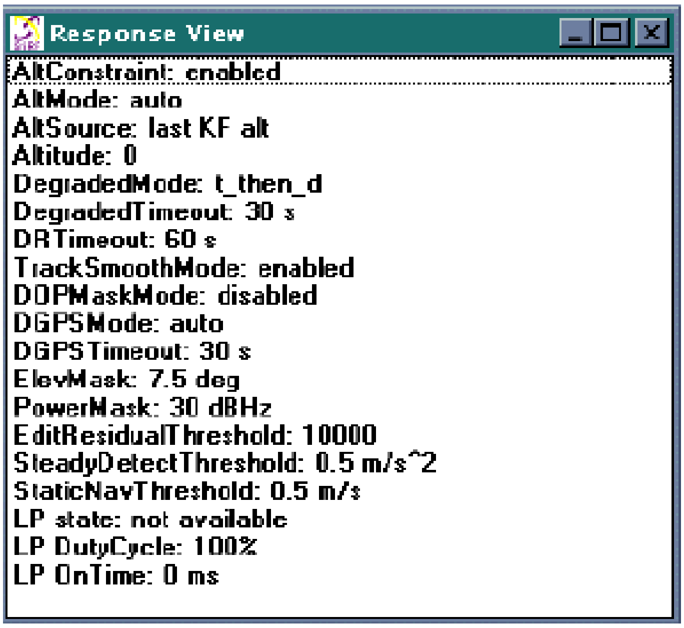


To Poll Navigation Parameters

All of the user settings under the Action and Navigation menus can be polled for their current status and settings.

1. Select Navigation Parameters from the Poll menu.

   The current settings will be displayed in the response view window.



To Download an Almanac

1. Choose Almanac from the Poll menu.

   The Specify Almanac Data Filename To Load screen is displayed.

   Note – To log the almanac see "To Open a Log File"

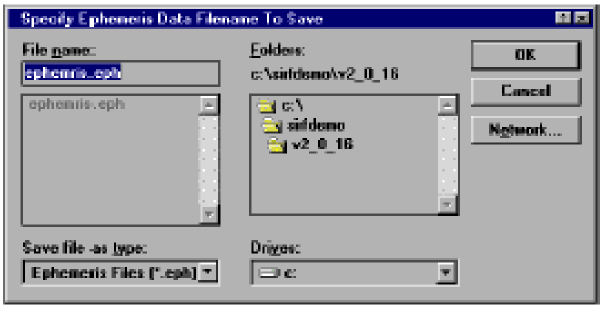
2. Specify the file name in which to save the almanac information.
3. Click the OK button to save or the Cancel button to exit.

   Note – Clicking the OK button saves the data to file when received. A message box is displayed to confirm completion.

To Download Ephemeris Data

1. Choose Ephemeris from the Poll menu.

   The Specify Ephemeris Data Filename To Load screen is displayed.



2. Specify the file name that you want to save the ephemeris information to.
3. Click the OK button to save or the Cancel button to exit.

   Note – Clicking the OK button saves the data to file when received. A message box is displayed to confirm completion.

Chapter 7 File Formats

This chapter describes the formats of files. It includes information on the following:

- "Modifying the Sample ring90.smp File"
- "Modifying the Sample Sirf.pos File"

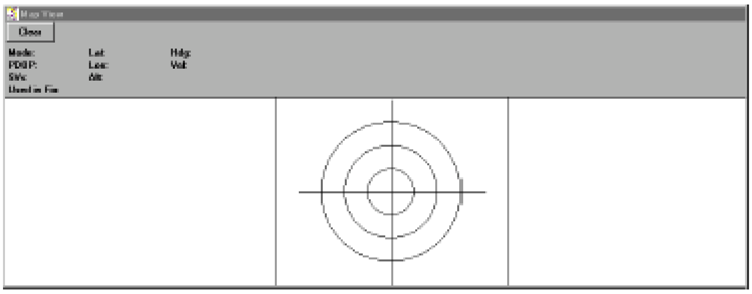
Modifying the Sample ring90.smp File

To modify the sample `ring90.smp` file:

1. Open the sample `ring90.smp` file in the SiRFdemo folder using a text editor.

```
; Current version
V,2,0
; SiRF in Santa Clara
O,37.37185,-121.99704
; Map extent (height, width) in meters
E,300,300
; Rings: 30, 60 and 90 radii in meters
C,0,0,30
C,0,0,60
C,0,0,90
; cross-hair lines
L,-120,0,120,0
L,0,-120,0,120
```

The Map View screen with the `ring90.smp` file loaded is displayed.

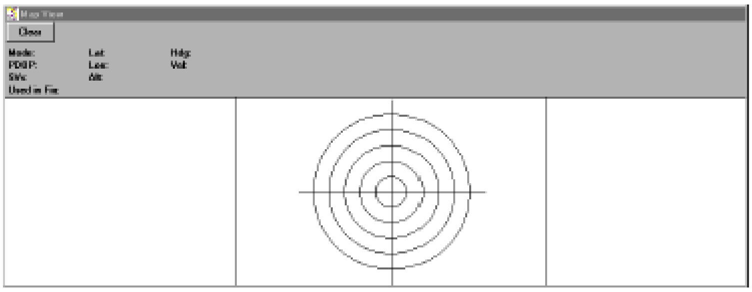


Note – The Map View screen shown in this chapter uses the default values set in the sample `ring90.smp` file. You can modify all of the configuration values in the sample ring90.smp file. You can modify the values for the Map View screen, as shown below.

```
; Current version
V,2,0
; SiRF in Santa Clara
O,37.3875113,-121.9723228
; Map extent (height, width)
E,400,400
; Rings: 20, 40 ... 100m radii
C,0,0,20
C,0,0,40
C,0,0,60
C,0,0,80
C,0,0,100
; cross-hair lines
L,-120,0,120,0
L,0,-120,0,120
```

The file is then saved as ring100.smp. The Map View screen changes are shown below.

The Map View screen with the ring100.smp file loaded is displayed.



Modifying the Sample Sirf.pos File

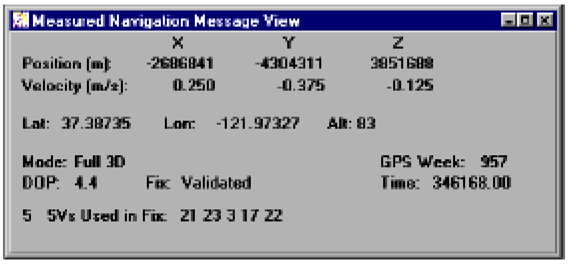
To modify the `Sirf.pos` file:

1. Open the sample `Sirf.pos` file in the SiRFdemo folder using a text editor.

   The sample X, Y, Z positions are displayed.

   ```
   -2690721
   -4310924
   3841682
   0
   ```

2. Use the configuration values displayed on the Measured Navigation Message View screen after communication has been connected to the Evaluation Unit as your new X, Y, and Z coordinates.



3. Modify the X, Y, Z positions in the `Sirf.pos` file with the new configuration values displayed on the Measured Navigation Message View screen.

   ```
   -2686718
   -4304272
   3851636
   0
   ```

APPENDIX A

SiRF Binary Protocol Specification

The serial communication protocol is designed to include:

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

Protocol Layers

Transport Message

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

1. 0xYY denotes a hexadecimal byte value. 0xA0 equals 160.

Transport

The transport layer of the protocol encapsulates a GPS message in two start characters and two stop characters. The values are chosen to be easily identifiable and such that they are unlikely to occur frequently in the data. In addition, the transport layer prefixes the message with a two-byte (15-bit) message length and a two-byte (15-bit) check sum. The values of the start and stop characters and the choice of a 15-bit values for length and check sum are designed such that both message length and check sum can not alias with either the stop or start code.

Message Validation

The validation layer is of part of the transport, but operates independently. The byte count refers to the payload byte length. Likewise, the check sum 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. Likewise, the SiRF receiving programs (e.g., SiRFdemo) may limit the actual size to something less than this maximum.

Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data may contain any 8-bit value. Where multi-byte values are in the payload data neither the alignment nor the byte order are defined as part of the transport although SiRF payloads will use the big-endian order.

Checksum

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

High Byte	Low Byte
< 0x7F	Any value

The check sum is 15-bit checksum of the bytes in the payload data. The following pseudo code defines the algorithm used.

Let message to be the array of bytes to be sent by the transport.

Let msgLen be the number of bytes in the message array to be transmitted.

Index = first

```
    checkSum = 0
while index < msgLen
    checkSum = checkSum + message[index]
    checkSum = checkSum AND (2^10 -1).
```

Input Messages for SiRF Binary Protocol

Note – All input messages are sent in **BINARY** format.
Table A-1 lists the message list for the SiRF input messages.

Table A-1 SiRF Messages - Input Message List

Hex	ASCII	Name
0 x 80	128	Initialize Data Source
0 x 81	129	Switch to NMEA Protocol
0 x 82	130	Set Almanac (upload)
0 x 84	132	Software Version (Poll)
0 x 85	133	Set DGPS Source
0 x 86	134	Set Main Serial Port
0 x 88	136	Mode Control
0 x 89	137	DOP Mask Control
0 x 8A	138	DGPS Control
0 x 8B	139	Elevation Mask
0 x 8C	140	Power Mask
0 x 8D	141	Editing Residual
0 x 8E	142	Steady-State Detection
0 x 8F	143	Static Navigation
0 x 90	144	Clock Status (Poll)
0 x 91	145	Set DGPS Serial Port
0 x 92	146	Almanac (Poll)
0 x 93	147	Ephemeris (Poll)
0 x 95	149	Set Ephemeris (upload)
0 x 96	150	Switch Operating Mode
0 x 97	151	Set Trickle Power Parameters
0 x 98	152	Navigation Parameters (Poll)

Initialize Data Source - Message I.D. 128

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

Warm start the receiver with the following initialization data: ECEF XYZ (-2686727 m, -4304282 m, 3851642 m), Clock Offset (75,000 Hz), Time of Week (86,400 s), Week Number (924), 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 A- 2 Initialize Data Source

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		80		ASCII 128
ECEF X	4		FFD700F	meters	
ECEF Y	4		FFBE5266	meters	
ECEF Z	4		003AC57A	meters	
Clock Offset	4		000124F8	Hz	
Time of Week	4	*100	0083D600	seconds	
Week Number	2		039C		
Channels	1		0C		Range 1-12
Reset Config.	1		33		See table Table C-3

Payload Length: 25 bytes

Table A- 3 Reset Configuration Bitmap

Bit	Description
0	Data valid flag—set warm/hot start
1	Clear ephemeris—set warm start
2	Clear memory—set cold start
3	Reserved (must be 0)
4	Enable raw track data (YES=1, NO=0)
5	Enable debug data (YES=1, NO=0)
6	Reserved (must be 0)
7	Reserved (must be 0)

Note – If Raw Track Data is ENABLED then the resulting messages are message I.D.0x05 (ASCII 5 – Raw Track Data), message I.D. 0x08 (ASCII 8 – 50 BPS data), and message I.D. 0x90 (ASCII 144 Clock Status). All messages are sent at 1 Hz.

Switch To NMEA Protocol - Message I.D. 129

Table A-4 contains the input values for the following example:

Request the following NMEA data at 4800 baud:

GGA – ON at 1 sec, GLL – OFF, GSA - ON at 5 sec,

GSV – ON at 5 sec, RMC-OFF, VTG-OFF

Example:

A0A20018—Start Sequence and Payload Length

810201010001050105010001000100010001000112C0—Payload

016AB0B3—Message Checksum and End Sequence

Table A-4 Switch To NMEA Protocol

Name	Bytes	Binary(Hex) Scale	Example	Units	Description
Message ID	1		81		ASCII 129
Mode	1		02		
GGA Message [1]	1		01	1/s	See Appendix D for format.
Checksum 2	1		01		
GLL Message	1		00	1/s	See Appendix D for format.
Checksum	1		01		
GSA Message	1		05	1/s	See Appendix D for format.
Checksum	1		01		
GSV Message	1		05	1/s	See Appendix D for format.
Checksum	1		01		
RMC Message	1		00	1/s	See Appendix D for format.
Checksum:	1		01		
VTG Message	1		00	1/s	See Appendix D for format.
Checksum	1		01		
Unused Field	1		00		Recommended value.
Unused Field	1		01		Recommended value.
Unused Field	1		00		Recommended value.
Unused Field	1		01		Recommended value.
Unused Field	1		00		Recommended value.
Unused Field	1		01		Recommended value.
Unused Field	1		00		Recommended value.
Unused Field	1		01		Recommended value.
Baud Rate	2		12C0		38400, 19200,9600,4800,2400

Payload Length: 24 bytes

1. A value of 0x00 implies NOT to send message, otherwise data is sent at 1 message every X seconds requested (i.e., to request a message to be sent every 5 seconds, request the message using a value of 0x05.) Maximum rate is 1/255s.

2. A value of 0x00 implies the checksum NOT transmitted with the message (not recommended). A value of 0x01 will have a checksum calculated and transmitted as part of the message (recommended).

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

Set Almanac – Message I.D. 130

This command enables the user to upload an almanac to the Evaluation Unit.

Note – This feature is not documented in this manual. For information on implementation contact SiRF Technology Inc.

Software Version – Message I.D. 132

Table A-5 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 A-5 Software Version

Name	Bytes	Binary (Hex) Scale	Binary (Hex) Example	Units	Description
Message ID	1		84		ACSII 132
TBD	1		00		Reserved

Payload Length: 2 bytes

Set DGPS Source – Message I.D. 133

Table A-44 contains the inpur values for the following example:

Set the DGPS source to "External RTCM Data"

Example:

A0A20007—Start Sequence and Payload Length

85020000000000—Payload

0087B0B3—Message Checksum and End Sequence

Tabl e A- 44 Set DGPS Source

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		85		decimal 133
DGPS Source	1		00		See Table A-45 – DGPS Source Selections
Internal Beacon Frequency	4		00000000	Hz	Internal Beacon Search Settings(not supported)
Internal Beacon Bit Rate	1		01	BPS	Internal Beacon Search Settings(not supported)

Payload Length: 7 bytes

Tabl e A- 45 Set DGPS Source Selections

Byte Value	Description
0	None - DGPS corrections will not be used (even if available)
1	WAAS - Uses WAAS Satellite (currently not supported)
2	External RTCM Data - External RTCM input source (i.e. Coast Guard Beacon)
3	Internal DGPS Beacon Receiver - Internal RTCM Coast Guard Beacon Receiver (currently not supported)

Set Main Serial Port - Message I.D. 134

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

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

Example:

A0A20009—Start Sequence and Payload Length

860000258008010000—Payload

0134B0B3—Message Checksum and End Sequence

Table A- 6 Set Main Serial Port

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		86		Decimal 134
Baud	4		00002580		38400,19200,9600,4800,2400, 1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved

Payload Length: 9 bytes

Mode Control - Message I.D. 136

Table A-7 contains the input values for the following example:
3D Mode = Always, Alt Constraining = Yes, Degraded Mode = clock then direction, TBD=1, DR Mode = Yes, Altitude = 0, Alt Hold Mode = Auto, Alt Source =Last Computed, Coast Time Out = 20, Degraded Time Out=5, DR Time Out = 2, Track Smoothing = Yes
Example:

A0A2000E—Start Sequence and Payload Length
880101010101000000002140501—Payload
00A9B0B3—Message Checksum and End Sequence

Table A-7 Mode Control

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		88		ASCII 136
3D Mode	1		01		1 (always true=1)
Alt Constraint	1		01		YES=1, NO=0
Degraded Mode	1		01		See Table A-8
TBD	1		01		Reserved
DR Mode	1		01		YES=1, NO=0
Altitude	2		0000	meters	range -1,000 to 10,000
Alt Hold Mode	1		00		Auto=0, Always=1,Disable=2
Alt Source	1		02		Last Computed=0,Fixed to=1
Coast Time Out	1		14	Seconds	0 to 120
Degraded Time Out	1		05	Seconds	0 to 120
DR Time Out	1		01	Seconds	0 to 120
Track Smoothing	1		01		YES=1, NO=0

Payload Length: 14 bytes

Table A-8 Degraded Mode Byte Value

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

DOP Mask Control - Message I.D. 137

Table A-9 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 A-9 DOP Mask Control

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		89		ASCII 137
DOP Selection	1		00		See Table C-10
GDOP Value	1		08		Range 1 to 50
PDOP Value	1		08		Range 1 to 50
HDOP Value	1		08		Range 1 to 50

Payload Length: 5 bytes

Table A-10 DOP Selection

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

DGPS Control - Message I.D. 138

Table A-11 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 A-11 DGPS Control

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		8A		ASCII 138
DGPS Selection	1		01		See Table A-12
DGPS Time Out	1		1E	seconds	Range 1 to 120

Payload Length: 3 bytes

Table A- 12 DGPS Selection

Byte Value	Description
0	Auto
1	Exclusive
2	Never Use

Set DGPS Serial Port - Message I.D. 145

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

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

Example:

A0A20009—Start Sequence and Payload Length

860000258008010000—Payload

0134B0B3—Message Checksum and End Sequence

Table A- 13 Set DGPS Serial Port

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		91		ASCII 145
Baud	4		00002580		38400,19200,9600,4800,2400, 1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved

Payload Length: 9 bytes

Elevation Mask – Message I.D. 139

Table A-14 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 A- 14 Elevation Mask

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		8B		ASCII 139
Tracking Mask	2	*10	0032	degrees	Not currently used
Navigation Mask	2	*10	009B	degrees	Range -20.0 to 90.0

Payload Length: 5 bytes

Power Mask - Message I.D. 140

Table A-15 contains the input values for the following example:

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

Example:

A0A20003—Start Sequence and Payload Length

8C1C21—Payload

00C9B0B3—Message Checksum and End Sequence

Table A- 15 Power Mask

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		8C		ASCII 140
Tracking Mask	1		1C	dBHz	Not currently implemented
Navigation Mask	1		21	dBHz	Range 28 to 50

Payload Length: 3 bytes

Editing Residual– Message I.D. 141

Note – Not currently implemented.

Steady State Detection - Message I.D. 142

Table A-16 contains the input values for the following example:

Set Stead State Threshold to 1.5 m/sec 2

Example:

A0A20002—Start Sequence and Payload Length

8E0F—Payload

009DB0B3—Message Checksum and End Sequence

Tabl e A- 16 Steady State Detection

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		8E		ASCII 142
Threshold	1	*10	0F	m/sec 2	Range 0.1 to 2.0

Payload Length: 2 bytes

Static Navigation– Message I.D. 143

Note – Not currently implemented.

Clock Status – Message I.D. 144

Table A-17 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

Tabl e A- 17 Clock Status

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		90		ACSII 144
TBD	1		00		Reserved

Payload Length: 2 bytes

Set DGPS Serial Port - Message I.D. 145

Table A-18 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

Tabl e A- 18 Set DGPS Serial Port

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		91		ASCII 145
Baud	4		00002580		38400,19200,9600,4800,2400,1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None=0, Odd=1, Even=2
Pad	1		00		Reserved

Payload Length: 9 bytes

Almanac - Message I.D. 146

Table A-19 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

Tabl e A- 19 Almanac

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		92		ASCII 146
TBD	1		00		Reserved

Payload Length: 2 bytes

Ephemeris - Message I.D. 147

Table A-20 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 A-20 Ephemeris Message I.D.

Name	Bytes	Binary (Hex)		Units	Description
		Scale	Example		
Message ID	1		93		ASCII 147
Sv I.D.[1]	1		00		Range 0 to 32
TBD	1		00		Reserved

Payload Length: 3 bytes

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

Switch To SiRF Protocol

Note – To switch to SiRF protocol you must send a SiRF NMEA message to revert to SiRF binary mode. (See Appendix B, "NMEA Input Messages" for more information.)

Switch Operating Modes - Message I.D. 150

Table A-21 contains the input values for the following example:
Sets the receiver to track a single satellite on all channels.
Example:
A0A20007—Start Sequence and Payload Length

961E510006001E—Payload

0129B0B3—Message Checksum and End Sequence

Table A-21 Switch Operating Mode I.D.150

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		96		ASCII 150
Mode	2		1E51		1E51=test, 0=normal
SvID	2		0006		Satellite to Track
Period	2		001E	Seconds	Duration of Track

Payload Length: 7 bytes

Set Trickle Power Parameters - Message I.D. 151

Table A-22 contains the input values for the following example:

Sets the receiver into low power Modes.

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

A0A20009—Start Sequence and Payload Length

97000000C8000000C8—Payload

0227B0B3—Message Checksum and End Sequence

Table A-22 Set Trickle Power Parameters I.D.151

Name	Bytes	Binary (Hex) Scale	Example	Units	Description
Message ID	1		97		ASCII 151
Push To Fix Mode	2		0000		ON = 1, OFF = 0
Duty Cycle	2	*10	00C8	%	% Time ON
Milli Seconds On Time	4		000000C8	ms	range 200 - 500 ms

Payload Length: 9 bytes

Note –The TricklePower mode of operation DOES NOT support the use Differential GPS corrections

Computation of Duty Cycle and On Time.

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

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

Update rate = Off Time + On Time

Note – On Time inputs of > 900 ms will default to 1000 ms

Following are some examples of selections:

Table A-23 Example of Selections for Trickle Power Mode of Operation

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

Note – To confirm the receiver is performing at the specified duty cycle and ms On Time, see"To Display the 12-Channel Signal Level View Screen" in **Chapter 3, "View**." The C/No data bins will be fully populated at 100% duty and only a single C/No data bin populated at 20% duty cycle. Your position should be updated at the computed update rate.

Table A-24 lists some supported/unsupported settings.

Table A-24 Trickle Power Mode Settings

On Time (ms)	Update Rate (sec)							
	1	2	3	4	5	6	7	8
200	Y [1]	Y	N [2]	N	N	N	N	N
300	Y	Y	Y	Y	Y	Y	N	N
400	Y	Y	Y	Y	Y	Y	Y	Y
500	Y	Y	Y	Y	Y	Y	Y	Y
600	Y	Y	Y	Y	Y	Y	Y	Y
700	Y	Y	Y	Y	Y	Y	Y	Y
800	Y	Y	Y	Y	Y	Y	Y	Y
900	Y	Y	Y	Y	Y	Y	Y	Y

1. Y = Yes (Mode supported) 2. N = No (Mode NOT supported)

Push-to-Fix

In this mode the receiver will turn on every 30 minutes to perform a system update consisting of a RTC calibration and satellite ephemeris data collection if required (i.e., a new satellite has become visible) as well as all software tasks to support SnapStart in the event of an NMI. Ephemeris collection time in general this takes 18 to 30 seconds.If ephemeris data is not required then the system will re-calibrate and shut down. In either case, the amount of time the receiver remains off will be in proportion to how long it stayed on:

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

Off Period is limited to 30 minutes. The duty cycle will not be less than approximately

On Period/1800, or about 1%. Push-to-Fix keeps the ephemeris for all visible satellites up to date so position/velocity fixes can generally be computed within SnapStart times (when requested by the user) on the order of 3 seconds.

Poll Navigation Parameters - Message I.D. 152

Table A-25 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 A-25 Poll Receiver for Navigation Parameters

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

Payload Length: 2 bytes

Output Messages for SiRF Binary Protocol

Note – All output messages are received in **BINARY** format. SiRFdemo interprets the binary data and saves it to the log file in **ASCII** format.

Table A-26 lists the message list for the SiRF output messages.

Table A-26 SiRF Messages - Output Message List

Hex	ASCII	Name	Description
0 x 02	2	Measured Navigation Data	Position, velocity, and time
0 x 03	3	True Tracker Data	Not Implemented
0 x 04	4	Measured Tracking Data	Satellite and C/No information
0 x 05	5	Raw Track Data	Raw measurement data
0 x 06	6	SW Version	Receiver software
0 x 07	7	Clock Status	Current clock status
0 x 08	8	50 BPS Subframe Data	Standard ICD format
0 x 09	9	Throughput	Navigation complete data
0 x 0A	10	Error ID	Error coding for message failure
0 x 0B	11	Command Acknowledgment	Successful request
0 x 0C	12	Command Nacknowledgment	Unsuccessful request
0 x 0D	13	Visible List	Auto Output
0 x 0E	14	Almanac Data	Response to Poll
0 x 0F	15	Ephemeris Data	Response to Poll
0 x 10	16	Test Mode Data	For use with SiRFtest [1]
0 x 11	17	Differential Corrections	Received from DGPS broadcast
0 x 12	18	OkToSend	CPU ON / OFF (Trickle Power)
0 x 13	19	Navigation Parameters	Response to Poll
0 x FF	255	Development Data	Various status messages

1. SiRFtest is product testing software tool.

Measure Navigation Data Out - Message I.D. 2

Output Rate: 1 Hz

Table A-27 lists the binary and ASCII message data format for the measured navigation data

Example:

A0A20029—Start Sequence and Payload Length

02FFD6F78CFFBE536E003AC00400030104A00036B039780E3

0612190E160F040000000000000—Payload

09BBB0B3—Message Checksum and End Sequence.

Table A- 27 Measured Navigation Data Out - Binary & ASCII Message Data Format

		Binary (Hex)			ASCII (Decimal)	
Name	Bytes	Scale	Example	Units	Scale	Example
Message ID	1		02			2
X-position	4		FFD6F78C	m		-2689140
Y-position	4		FFBE536E	m		-4304018
Z-position	4		003AC004	m		3850244
X-velocity	2	*8	00	m/s	Vx÷ 8	0
Y-velocity	2	*8	03	m/s	Vy÷ 8	0.375
Z-velocity	2	*8	01	m/s	Vz÷ 8	0.125
Mode 1	1		04	Bitmap [1]		4
DOP [2]	1	*5	A		÷ 5	2.0
Mode 2	1		00	Bitmap [3]		0
GPS Week	2		036B			875
GPS TOW	4	*100	039780E3	seconds	÷ 100	602605.79
SVs in Fix	1		06			6
CH 1	1		12			18
CH 2	1		19			25
CH 3	1		0E			14
CH 4	1		16			22
CH 5	1		0F			15
CH 6	1		04			4
CH 7	1		00			0
CH 8	1		00			0
CH 9	1		00			0
CH 10	1		00			0
CH 11	1		00			0
CH 12	1		00			0

Payload Length: 41 bytes

1. For further information, go to Table A-28..

2. Dilution of precision (DOP) field contains value of PDOP when position is obtained using 3D solution and HDOP in all other cases.

3. For further information, go to Table A-29.

Note – The measurement of GPS Week item is expressed with ICD GPS week format (between 0 and 1023)

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

Table A-28 Mode 1

Mode 1		Description
	ASCII	
0 x 00	0	No Navigation Solution
0 x 01	1	1 Satellite Solution
0 x 02	2	2 Satellite Solution
0 x 03	3	3 Satellite Solution (2D)
0 x 04	4	>4 Satellite Solution (3D)
0 x 05	5	2D Point Solution (Krause)
0 x 06	6	3D Point Solution (Krause)
0 x 07	7	Dead Reckoning
0 x 80	128	DGPS Position (as per lower nibble)

Example: A value of 0 x 84 (132) is a DGPS >4 Satellite Solution (3D)

Table A-29 Mode 2

Mode 2		Description
Hex	ASCII	
0 x 00	0	DR Sensor Data
0 x 01	1	Validated (1), Unvalidated (0)
0 x 02	2	If set, Dead Reckoning (Time Out)
0 x 03	3	If set, Output Edited by UI (i.e., DOP Mask exceeded)
0 x 04	4	Reserved
0 x 05	5	Reserved
0 x 06	6	Reserved
0 x 07	7	Reserved

Measured Tracker Data Out - Message I.D. 4

Output Rate: 1 Hz

Table A-30 lists the binary and ASCII message data format for the measured tracker data.

Example:

A0A200BC—Start Sequence and Payload Length

04036C0000937F0C0EAB46003F1A1E1D1D191D1A1A1D1F1D59423F1A1A...—Payload

****B0B3—Message Checksum and End Sequence

Table A-30 Measured Tracker Data Out

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04	None		4
GPS Week	2		036C			876
GPS TOW	4	s*100	0000937F	s	s÷ 100	37759
Chans	1		0C			12
1st SVid	1		0E			14
Azimuth	1	Az*[2/3]	AB	deg	÷ (2/3)	256.5
Elev	1	El*2	46	deg	÷ 2	35
State	2		003F	Bitmap 1		0 x BF
C/No 1	1		1A			26
C/No 2	1		1E			30
C/No 3	1		1D			29
C/No 4	1		1D			29
C/No 5	1		19			25
C/No 6	1		1D			29
C/No 7	1		1A			26
C/No 8	1		1A			26
C/No 9	1		1D			29
C/No 10	1		1F			31
2nd SVid	1		1D			29
Azimuth	1	Az*[2/3]	59	deg	÷ (2/3)	89
Elev	1	El*2	42	deg	÷ 2	66
State	2		3F	Bitmap 1		63
C/No 1	1		1A			26
C/No 2	1		1A			63

Payload Length: 188 bytes

1. For further information, go to Table A-31

Note – The measurement of GPS Week item is expressed with ICD GPS week format (between 0 and 1023)

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

Tabl e A- 31 TrktoNAVStruct.trk_status Field Definition

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

Note – When a channel is fully locked and all data is valid, the status shown is 0 x BF.

Raw Tracker Data Out - Message I.D. 5

GPS Pseudo-Range and Integrated Carrier Phase Computations Using SiRF Binary Protocol

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

SiRF Binary Data Messages

The SiRF GPS chip set provides a series of output messages as described in this Guide.

This is the raw data message required to compute the pseudo-range and carrier data.

The ephemeris data can be polled by the user or requested at specific intervals with customized software. Currently, there is no support for the automatic saving of the ephemeris when an update ephemeris is decoded. This will be included in future release version of the SiRFstarI/LX software.

Output Rate: 1 Hz

Table A-32 lists the binary and ASCII message data format for the raw tracker data.

Example:

A0A20033—Start Sequence and Payload Length

05000000070013003F00EA1BD4000D039200009783000DF45E

000105B5FF90F5C200002428272723272424272905000000070013003F—Payload

0B2DB0B3—Message Checksum and End Sequence

Note – The data that is sent from the SiRF GPS evaluation unit is in binary format, SiRFdemo converts the data to ASCII for the log file. Data is NOT output in ASCII format.

Table A- 32 Raw Tracker Data Out

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		05			5
Channel	4		00000007			7
SVID	2		0013			19
State	2		003F	bitmap 1		3F
Bit Number	4		00EA1BD4	bit		15342548
Millisecond Number	2		000D	ms		13
Chip Number	2		0392	chip		914
Code Phase	4	2 16	00009783	chip	÷ 2 16	38787
Carrier Doppler	4	2 10	000DF45E	radians/2ms	÷2 10	914526
Receiver Time Tag	4		000105B5	ms		66997
Delta Carrier 2	4	2 10	FF90F5C2	cycles	÷2 10	-7277118
Search Count	2		0000			0
C/No 1	1		24	dBHz		36
C/No 2	1		28	dBHz		40
C/No 3	1		27	dBHz		39
C/No 4	1		27	dBHz		39
C/No 5	1		23	dBHz		35
C/No 6	1		27	dBHz		39
C/No 7	1		24	dBHz		36
C/No 8	1		27	dBHz		36
C/No 9	1		29	dBHz		39
C/No 10	1		29	dBHz		41
Power Bad Count	1		05			5
Phase Bad Count	1		07			7
Accumulation Time	2		0013	ms		19
Track Loop Time	2		003F			63

Payload Length: 51 bytes

1. For further information, go to Table A-31. 2.Multiply by (1000 /4 π) 2^{16} to convert to Hz.

Note – The status is reflected by the value of all bits as the receiver goes through each stage of satellite acquisition. The status will have a 0xBF value when a channel is fully locked and all data is valid.

Message ID: Each SiRF binary message is defined based on the ID.

Channel: Receiver channel where data was measured (range 1-12).

SVID: PRN number of the satellite on current channel.

State: Current channel tracking state (see Table A-31).

Bit Number: Number of GPS bits transmitted since Sat-Sun midnight (in Greenwich) at a 50 bps rate.

Millisecond Number: Number of milliseconds of elapsed time since the last received bit (20 ms between bits).

Chip Number: Current C/A code symbol being transmitted (range 0 to 1023 chips; 1023 chips = 1 ms).

Code Phase: Fractional chip of the C/A code symbol at the time of sampling (scaled by 2^{-16}, = 1/65536).

Carrier Doppler: The current value of the carrier frequency as maintained by the tracking loops.

Note – The Bit Number, Millisecond Number, Chip Number, Code Phase, and Carrier Doppler are all sampled at the same receiver time.

Receiver Time Tag: This is the count of the millisecond interrupts from the start of the receiver (power on) until the measurement sample is taken. The ms interrupts are generated by the receiver clock.

Delta Carrier Phase: The difference between the carrier phase (current) and the carrier phase (previous). Units are in carrier cycles with the LSB = 0.00185 carrier cycles. The delta time for the accumulation must be known.

Note – Carrier phase measurements are not necessarily in sync with code phase measurement for each measurement epoch.

Search Count: This is the number of times the tracking software has completed full satellite signal searche.s

C/No: Ten measurements of carrier to noise ratio (C/No) values in dBHz at input to the receiver. Each value represents 100 ms of tracker data and its sampling time is not necessarily in sync with the code phase measurement.

Power Loss Count: The number of times the power detectors fell below the threshold between the present code phase sample and the previous code phase sample. This task is performed every 20 ms (max count is 50).

Phase Loss Count: The number of times the phase lock fell below the threshold between the present code phase sample and the previous code phase sample. This task is performed every 20 ms (max count is 50).

Integration Interval: The time in ms for carrier phase accumulation. This is the time difference (as calculated by the user clock) between the Carrier Phase (current) and the Carrier Phase (previous).

Track Loop Iteration: The tracking Loops are run at 2 ms and 10 ms intervals. Extrapolation values for each interval is 1 ms and 5 ms for range computations.

Calculation of Pseudo-Range Measurements

The pseudo-range measurement in meters can be determined from the raw track data by solving the following equation:

Pseudo-range (PR) = [Received Time (RT) – Transmit Time (TT)] * C

where C = speed of light

The following variables from the raw track data are required for each satellite:

Bit Number (BN) - 50 bits per second

Millisecond Number (MSN)

Chip Number (CN)

Code Phase (CP)

Receiver Time Tag (RTTag)

Delta Carrier Phase (DCP)

The following steps are taken to get the psr data and carrier data for each measurement epoch.

1. Computation of initial Receiver Time (RT) in seconds.

Note – Where the initial arbitrary value chosen at start up to make the PR reasonable (i.e., set equal to TT + 70 ms) and then incriminated by one second for each measurement epoch.

2. Computation of Transmit Time (TT) in seconds.

3. Calculate Pseudo-range at a common receiver time of the first channel of the measurement data set.

Note – All channel measurements are NOT taken at the same time. Therefore, all ranges must be extrapolated to a common measurement epoch. For simplicity, the first channel of each measurement set is used as the reference to which all other measurements are extrapolated.

4. Extrapolate the pseudo-range based on the correlation interval to improve precision.

5. Compute the delta range.

If the accumulation time of the Delta Carrier Phase is 1000 ms then the measurement is valid and can be added to the previous Delta Carrier Phase to get Accumulated Carrier Phase data. If the accumulation time of the Delta Carrier Phase is not equal to 1000 ms then the measurement is not valid and the accumulation time must be restarted to get Accumulated Carrier Phase data.

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

Output Rate: Response to polling message

Example:

A0A20015—Start Sequence and Payload Length

0606312E322E30444B495431313920534D0000000000—Payload

0382B0B3—Message Checksum and End Sequence

Table A- 33 Software Version String

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

Payload Length: 21 bytes

1. 06312E322E30444B495431313920534D0000000000

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

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

Output Rate: 1 Hz or response to polling message

Example:

A0A20014—Start Sequence and Payload Length

0703BD021549240822317923DAEF—Payload

0598B0B3—Message Checksum and End Sequence

Table A- 34 Clock Status Data Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		07			7
GPS Week	2		03BD			957
GPS TOW	4	*10	002154924	S	÷100	349494.12
Svs	1		08			8
Clock Drift	4		2231	Hz		74289
Clock Bias	4		7923	nano s		128743715
Estimated GPS Time	4		DAEF	milli s		349493999

Payload Length: 20 bytes

Note – The mersurement of GPS week item is with Extended GPS week (=ICD GPS week + 1024)

50 BPS Data – Message I.D. 8

Output Rate: As available (12.5 minute download time)

Example:

A0A2002B—Start Sequence and Payload Length

08********—Payload

****B0B3—Message Checksum and End Sequence

Table A- 35 50 BPS Data

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

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

Note – Data is logged in ICD format (available from `www.navcen.uscg.mil`). The ICD specification is 30-bit words. The above definition is 32-bit words; therefore, the user must strip the 2 MSB prior to decoding.

CPU Throughput – Message I.D. 9

Output Rate:1 Hz

Example:

A0A20009—Start Sequence and Payload Length

09003B0011001601E5—Payload

0151B0B3—Message Checksum and End Sequence

Table A- 36 CPU Throughput

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		09			9
SegStatMax	2	*186	003B	milli s	÷186	.3172
SegStatLat	2	*18	60011	milli s	÷186	.0914
AveTrkTime	2	*18	60016	milli s	÷186	.1183
Last MS	2		01E5	milli s		485

Payload Length: 9 bytes

Command Acknowledgment – Message I.D. 11

Output Rate: Response to successful input message

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

A0A20002—Start Sequence and Payload Length

0B92—Payload

009DB0B3—Message Checksum and End Sequence

Table A- 37 Command Acknowledgment

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

Payload Length: 2 bytes

Command NAcknowledgment – Message I.D. 12

Output Rate: Response to rejected input message

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

A0A20002—Start Sequence and Payload Length

0C92—Payload

009EB0B3—Message Checksum and End Sequence

Table A- 38 Command Nacknowledgment

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

Payload Length: 2 bytes

Visible List – Message I.D. 13

Output Rate: Updated approximately every 2 minutes

Note – This is a variable length message. Only the number of visible satellites are reported (as defined by Visible Svs in Table A-39). Maximum is 12 satellites.

Example:

A0A2002A—Start Sequence and Payload Length

0D080700290038090133002C*******************—Payload

****B0B3—Message Checksum and End Sequence

Table A- 39 Visible List

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0D			13
Visible Svs	1		08			8
CH 1 - Sv I.D.	1		07			7
CH 1 - Sv Azimuth	2		0029	degrees		41
CH 1 - Sv Elevation	2		0038	degrees		56
CH 2 - Sv I.D.	1		09			9
CH 2 - Sv Azimuth	2		0133	degrees		307
CH 2 - Sv Elevation	2		002C	degrees		44

Payload Length: 62 bytes (maximum)

Almanac Data - Message I.D. 14

Output Rate: Response to poll

Example:

A0A203A1—Start Sequence and Payload Length

0E01*************—Payload

****B0B3—Message Checksum and End Sequence

Table A- 40 Almanac Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		0E			14
Sv I.D. (1)	1		01			1
AlmanacData[14][2]	28					
....						
Sv I.D. (32)	1		20			32
AlmanacData[14][2]	28					

Payload Length: 929 bytes

Ephemeris Data (Response to Poll) – Message I.D. 15

The ephemeris data that is polled from the receiver is in a special SiRF format based on the ICD- GPS -200 format for ephemeris data.

Note – The source code provided is an example of the EPH decoding and GPS measurement calculations.

OkToSend - Message I.D. 18

Output Rate: Trickle Power CPU on/off indicator

Example:

A0A20002—Start Sequence and Payload Length

1200—Payload

0012B0B3—Message Checksum and End Sequence

Table A- 41 Ephemeris Data

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

Payload Length: 2 bytes

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

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

Output Rate:1 Response to Poll

Example:

A0A20018—Start Sequence and Payload Length

130100000000011E3C0104001E004B1E00000500016400C8—Payload

022DB0B3—Message Checksum and End Sequence

Table A- 42 Navigation Parameters

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		13			19
Altitude Constraint	1		01			1
Altitude Hold Mode	1		00			0
Altitude Hold Source	1		00			0
Altitude Source Input	2		0000	Meters		0
Degraded Mode [1]	1		01			1
Degraded Timeout	1		1E	Seconds		30
DR Timeout	1		3C	Seconds		60
Track Smooth Mode	1		01			1
DOP Mask Mode [2]	1		04			4
DGPS Mode [3]	1		00			0
DGPS Timeout	1		1E	Seconds		30
Elevation Mask	2	*10	004B	Degrees	÷10	7.5
Power Mask	1		1E	DBHz		30
Editing Residual	2		0000			0
Steady-State Detection	1	*10	05	m/s 2	÷10	0.5
Static Navigation	1	*10	00		÷10	0
Low Power Mode [4]	1		01			1
Low Power Duty Cycle	1		64	Percent		100
Low Power On-Time	2		00C8	Ms		200

Payload Length: 24 bytes

1. See Table A-7.

2.See Table A-9.

3.See Table A-11.

4.See Table A-22.

Development Data – Message I.D. 255

Output Rate: Receiver generated

Example:

A0A2****—Start Sequence and Payload Length

FF**************—Payload

****B0B3—Message Checksum and End Sequence

Table A- 43 Development Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		FF			255

Payload Length: Variable

Note – Messages are output to give the user information of receiver activity. Convert to symbol to assemble message (i.e., 0 x 4E is 'N'). These are low priority task and are not necessarily output at constant intervals.

APPENDIX B

NMEA Input/Output Messages

The Evaluation Unit may also output data in NMEA-0183 format as defined by the National Marine Electronics Association (NMEA), Standard For Interfacing Marine Electronic Devices, Version 2.20, January 1, 1997. Refer to Chapter 4 for detailed instructions.

NMEA Output Messages

The Evaluation Unit outputs the following messages as shown in Table B-1:

Table B- 1 NMEA-0183 Output Messages

NMEA Record	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

GGA —Global Positioning System Fixed Data

Table B-2 contains the values for the following example:

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

Table B-2 GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table D-3
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude [1]	9.0	meters	
Units	M	meters	
Geoid Separation [1]		meters	
Units	M	meters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

1. Values are WGS84 ellipsoid heights.

Table B-3 Position Fix Indicator

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3	GPS PPS Mode, fix valid

GLL—Geographic Position - Latitude/Longitude

Table B-4 contains the values for the following example:

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

Table B-4 GLL Data Format

Name	Example	Units	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
UTC Position	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Checksum	*2C		
<CR> <LF>			End of message termination

GSA—GNSS DOP and Active Satellites

Table B-5 contains the values for the following example:

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

Table B-5 GSA Data Format

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table B-6
Mode 2	3		See Table B-7
Satellite Used [1]	07		Sv on Channel 1
Satellite Used [1]	02		Sv on Channel 2
....			
Satellite Used [1]			Sv on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

1. Satellite used in solution.

Table B-6 Mode 1

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

Table B-7 Mode 2

Value	Description
1	Fix Not Available
2	2D
3	3D

GSV—GNSS Satellites in View

Table B-8 contains the values for the following example:
$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71
$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41

Table B-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages [1]	2		Range 1 to 3
Message Number [1]	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79	degrees	Channel 1 (Maximum 90)
Azimuth	048	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
....			
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	degrees	Channel 4 (Maximum 90)
Azimuth	138	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		
<CR> <LF>			End of message termination

1. Depending on the number of satellites tracked multiple messages of GSV data may be required.

RMC—Recommended Minimum Specific GNSS Data

Table B-9 contains the values for the following example:

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

Table B-9 RMC Data Format

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	degrees	True
Date	120598		Ddmmyy
Magnetic Variation [1]		degrees	E=east or W=west
Checksum *10			
<CR> <LF>			End of message termination

1. All “course over ground” data are geodetic WGS84 directions.

VTG—Course Over Ground and Ground Speed

Table B-10 contains the values for the following example:
$GPVTG,309.62,T, ,M,0.13,N,0.2,K*6E

Table B-10 VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic [1]
Speed	0.13	knots	Measured horizontal speed
Units	N	knots	
Speed	0.2	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Checksum	*6E		
<CR> <LF>			End of message termination

1. All "course over ground" data are geodetic WGS84 directions.

SiRF Proprietary NMEA Input Messages

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

Transport Message

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

1. Message Identifier consisting of three numeric characters. Input messages begin at MID 100.

2. Message specific data. Refer to a specific message section for <data>...<data> definition.

3. CKSUM is a two-hex character checksum as defined in the NMEA specification. Use of checksums is required on all input messages.

4. Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D 0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

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

SiRF NMEA Input Messages

Message	**MID** [1]	**Description**
Set Serial Port	100	Set PORT A parameters and protocol
Navigation Initialization	101	Parameters required for start using X/Y/Z
Set DGPS Port	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLA Navigation Initialization	104	Parameters required for start using Lat/Lon/Alt [2]
Development Data On/Off	105	Development Data messages On/Off

1. Message Identification (MID).

2. Input coordinates must be WGS84.

SetSerialPort

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

Table B-11 contains the input values for the following example:

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

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

Table B-11 Set Serial Port Data Format

Name	Example	Units	Description
Message ID	$PSRF100		PSRF100 protocol header
Protocol	0		0=SiRF Binary, 1=NMEA
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8,7 [1]
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*0C		
<CR> <LF>			End of message termination

1. Only valid for 8 data bits, 1stop bit, and no parity.

NaviagtionInitialization

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

Table B-12 contains the input values for the following example:

Start using known position and time.

$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*7F

Table B-12 Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	$PSRF101		PSRF101 protocol header
ECEF X	-2686700	meters	X coordinate position
ECEF Y	-4304200	meters	Y coordinate position
ECEF Z	3851624	meters	Z coordinate position
ClkOffset	96000	Hz	Clock Offset of the Evaluation Unit [1]
TimeOfWeek	497260	seconds	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See Table B-13
Checksum	*7F		
<CR> <LF>			End of message termination

1. Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 will be used.

Table B-13 Reset Configuration

Hex	Description
0x01	Data Valid—Warm/Hot Starts=1
0x02	Clear Ephemeris—Warm Start=1
0x04	Clear Memory—Cold Start=1

SetDGPSPort

This command is used to control Serial Port B which is an input-only serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. The default communication parameters for PORT B are 9600 baud, 8 data bits, stop bit, and no parity. If a DGPS receiver is used which has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery-backed SRAM and then the receiver restarts using the saved parameters.

Table B-14 contains the input values for the following example:

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

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

Table B-14 Set DGPS Port Data Format

Name	Example	Units	Description
Message ID	$PSRF102		PSRF102 protocol header
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8,7
StopBits	1		0,1
Parity	0		0=None, 1=Odd, 2=Even
Checksum	*12		
<CR> <LF>			End of message termination

Query/Rate Control

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

Table B-15 contains the input values for the following examples:

1. Query the GGA message with checksum enabled
   $PSRF103,00,01,00,01*25
2. Enable VTG message for a 1 Hz constant output with checksum enabled
   $PSRF103,05,00,01,01*20
3. Disable VTG message
   $PSRF103,05,00,00,01*21

Tabl e B- 15 Query/Rate Control Data Format (See example 1.)

Name	Example	Units	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See Table B-16
Mode	01		0=SetRate, 1=Query
Rate	00	seconds	Output—off=0, max=255
CksumEnabe	01		0=Disable Checksum, 1=Enable Checksum
Checksum	*25		
<CR> <LF>			End of message termination

Table B- 16 Messages

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG

Note – In Trickle Power mode, update rate is specified by the user. When you witch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the Trickle Power Update rate AND the NMEA update rate (i.e. Trickle Power update rate = 2 seconds, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10)).

LLANaviagtionInitialization

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

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

Start using known position and time.

$PSRF104,37.3875111,-121.97232,0,96000,237759,922,12,3*37

Table B- 17 LLA Navigation Initialization Data Format

Name	Example	Units	Description
Message ID	$PSRF104		PSRF104 protocol header
Lat	37.3875111	degrees	Latitude position (Range 90 to -90)
Lon	-121.97232	degrees	Longitude position (Range 180 to -180)
Alt	0	meters	Altitude position
ClkOffset	95000	Hz	Clock Offset of the Evaluation Unit [1]
TimeOfWeek	237759	seconds	GPS Time Of Week
WeekNo	922		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See Table B-18
Checksum	*37		
<CR> <LF>			End of message termination

1. Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 will be used.

Table B- 18 Reset Configuration

Hex	Description
0x01	Data Valid—Warm/Hot Starts=1
0x02	Clear Ephemeris—Warm Start=1
0x04	Clear Memory—Cold Start=1

Development Data On/Off

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

Table B-19 contains the input values for the following examples:

1. Debug On

   $PSRF105,1*3E

2. Debug Off

   $PSRF105,0*3F

Table B-19 Development Data On/Off Data Format

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

APPENDIX C

SPECIFICATIONS

This section list the specifications of TF GPS engine board series such as TF10

TF10

1. Electrical Characteristics

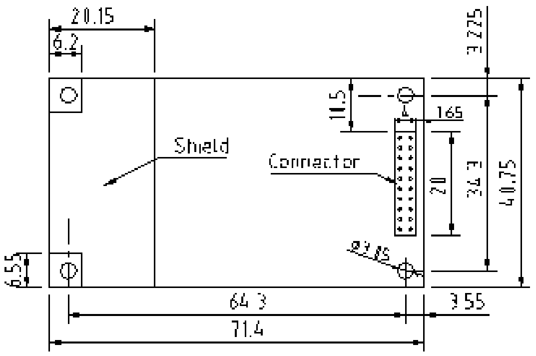
1.1 General	Frequency C/A code Channels	L1,1575.42MHz 1.023 MHz chip rate 12
1.2 Accuracy	Position Velocity Time	25 meters CEP without SA 0.1 meters/second, without SA 1 microsecond synchronized to GPS time
1.3 DGPS Accuracy	Position Velocity	1 to 5 meters, typical 0.05 meters/second, typical
1.4 Datum	WGS-84	
1.5 Acquisition Rate	Reacquisition Cold start Warm start Hot start	0.1 sec., average 48 sec., average 38 sec., average 8 sec., average
1.6 Dynamic Condition	Altitude Velocity Acceleration Jerk	18,000 meters (60,000 Feet) max. 515 meters/sec.(1000 Knots) max. 4 g., max. 20 meters/sec.^{3} max.
1.7 Power	Main Power Supply Current Backup Power Backup Current	+5Vdc±5% 180 mA typical +2.5V to 4.5V 10µA typical
1.8 External Reset	Active low input	
1.9 Serial Port	Electrical interface Protocol	Two full duplex serial communication Design-in binary and NMEA-0183, Version 2.2 0 with a baud rate selection
	NMEA output	GGA,GLL,GSA,GSV,RMC and VTG(on customer request) Default all 6 NMEA (Baud Rate :4800)
	DGPS protocol	RTCM SC-104, version 2.00, type1,2 and 9
1.10 Time-1PPS Pulse	Level Pulse duration Time reference Measurements	TTL 100 ms At the pulse positive edge Aligned to GPS second, ± 1µ sec.

2. Environmental Characteristics

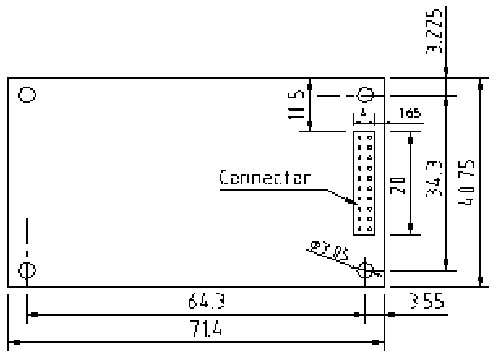
2.1Temperature	Operating range	- 40 ℃ to + 85 ℃

	Storage range	- 55 ℃ to +100 ℃
2.2 Physical characteristics	Length	72 mm
	Width	42 mm
	Height	12 mm
	Weight	23 gm
	Antenna connector	MCX type (see option on page 112)
	Interface connector	20-pin straight header, 2 mm(see option on page 112)
3. Antenna	Passive or Active Antenna	

TOP VIEW [Unit:mm]

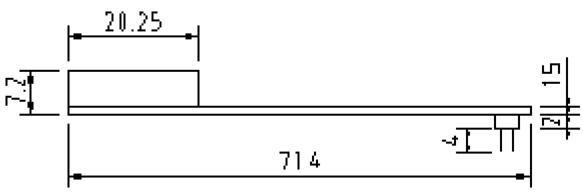


BUTTON VIEW [Unit:mm]



LATER VIEW [Unit.mm]

LATER VIEW [Unit.mm]

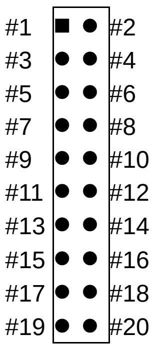


APPENDIX D

INTERFACE DESCRIPTION and OPTIONS

This section describes the pin definitions of the interface connector and flexible options of TF GPS engine board series.

Connector Layout with Top View



Pin Definition of the 20- pin Digital Interface Connector

TF10

Table D-1 Pin List of the 20- pin Digital Interface Connector of TF10

Pin Number	Name	Description
1	VANT	Antenna DC Voltage
2	VCC	+5V DC Power Input
3	BAT	Backup Battery
4	VDD	+3.3V DC Power Input
5	PBRES	Push Button Reset Input, Active Low
6	RESERVED	Reserved
7	RESERVED	Reserved
8	RESERVED	Reserved
9	RESERVED	Reserved
10	GND	Ground
11	TXA	Serial Data Output A
12	RXA	Serial Data Input A
13	GND	Ground
14	TXB	Serial Data Output B
15	RXB	Serial Data Input B
16	GND	Ground
17	RESERVED	Reserved
18	GND	Ground
19	TIMEMARK	1PPS Time Mark Output
20	RESERVED	Reserved

VCC_5V (+5V DC Power Input)

This is the main DC power supply for a +5V powered TMP board.

VCC_3V (+3.3V DC Power Input)

This is the main DC supply for a +3.3V powered TMP board (currently not used).

ANT_PWR

DC voltage for an active antenna is not required for operation with a passive antenna. The antenna power (+5V) may be supplied through the interface connector

GND

GND provides the ground for the TMP board. Connect all grounds.

Serial Data: RXA, RXB, TXA, and TXB

The TMP supports two full duplex serial channels. All four connections are at TTL Levels, all support variable baud rates, and all can be controlled from the appropriate screens in SiRFdemo ToolKit A TTL to RS232 conversion is necessary to directly communicate with a PC serial port.

RXA

This is the main receiver channel and is used to receive software commands to the TMP board from SiRFdemo software or from user written software.

RXB

This is the auxiliary receive channel and is used to input differential corrections to the TMP board to enable DGPS navigation.

TXA

This is the main transmit channel and is used to output navigation and measurement data to SiRFdemo or user written software.

TXB

For user's application ds(not currently used).

PBRES

This pin provides an active-low reset input to the TMP board. It causes the TMP board to reset and start searching for satellites. If not utilized, it may be tied high.

Timemark

This pin provides one pulse-per-second output from the TMP board, which is synchronized to GPS time. The output is a TTL negative level signal with negative logic.

Backup Battery (VBAT)

This is the battery backup input that powers the SRAM and RTC when main power is removed. Typical current draw is 10uA.

APPENDIX E

Using the TF GPS Engine Board Series

Customers may use the TF GPS engine board series
with user's defined interface board to allow easy performance evaluation of the board. We utilize PC interface data cable (modem cable) connected to the COM port (e.g. COM 1 port) of the Host PC and the supplied SiRFdemo software to evaluate the performance of GPS engine board. The GPS module is a credit card sized (72 mm x 42 mm x 12 mm) board, based on our receiver reference design, and mounted on the interface board.

The interface board with mounted-in GPS engine board consists of:

- Two RS232 port ("Port 1" and "Port 2") connectors
- Back- up supply
- 1 PPS timing signal output port

Under normal operating conditions, the total current consumption draws slightly more than 180mA (TF10 board) ; that is,
the external antenna current draws about 30mA. Differential GPS (DGPS) corrections in the RTCM-104 format may be accepted via the uni-directional Port 2 and are automatically applied (default) to the navigation solution. All other data I/O is performed via the bi-directional Port 1.