

## 3 Software Interface

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This chapter describes the SVEEeight Plus GPS software interface, the start-up characteristics for the interface protocols, a description of the receiver operating modes, and a brief discussion of the interface protocols.

### 3.1 Start-up

When connected to an external GPS antenna, the SVEEeight Plus GPS receiver contains all the circuitry necessary to automatically acquire GPS satellite signals, track up to 8 GPS satellites, and compute location, speed, heading, and time. The receiver automatically begins to search for and track GPS satellite signals at power-up.

The performance of a GPS receiver at power-on is determined largely by the availability and accuracy of the satellite ephemeris data and the availability of a GPS system almanac. Refer to Chapter 4, Operation and Performance for additional information.

The first time the receiver is powered-up, it is searching for satellites from a cold start (no almanac). While the receiver begins to compute position solutions within the first two minutes, the receiver must continuously track satellites for approximately 15 minutes to download a complete almanac. This initialization process should not be interrupted. With a complete almanac and back-up power, the time to first fix can typically be shortened to less than 45 seconds. The receiver responds to commands almost immediately after power-up.

### 3.2 Software Tool Kits

The Software Developers Tool Kit that supports the TSIP and TAIP protocols can be downloaded from the Trimble FTP site:

```
ftp://ftp.trimble.com/pub/sct/embedded/bin
```

The Tool Kit contains a user-friendly program to communicate with the receiver and includes sample C source code and reusable routines to aid in developing applications. The following Appendices provide additional information:

- Appendix A, Trimble Standard Interface Protocol (TSIP)
- Appendix B, TSIP Toolkit User's Guide
- Appendix C, Trimble ASCII Interface Protocol
- Appendix D, GPSSK User's Guide (TAIP)
- Appendix E, NMEA 0183

### 3.3 Communicating with the SVEEeight Plus GPS

The SVEEeight Plus GPS receiver supports three message protocols: TSIP, TAIP, and NMEA. The protocols are discussed at the end of this chapter, and are explained in detail in Appendices A through E.

Communication with the SVEEeight Plus GPS receiver is through two RS-232 serial ports. The port characteristics can be changed to accommodate your application requirements. Port parameters are stored in a non-volatile, electrically erasable ROM (EEROM) that does not require backup power. The following tables list the default characteristics for each port.

**Table 3-1 Default Serial Port Characteristics for the -61 Receiver**

Port	Input Protocol	Default Setup	Output Language	Default Setup
1	RTCM	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control	NMEA	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control
2	TSIP	Baud Rate: 9600 Data Bits: 8 Parity: Odd Stop Bits: 1 No Flow Control	TSIP	Baud Rate: 9600 Data Bits: 8 Parity: Odd Stop Bits: 1 No Flow Control

**Table 3-2 Default Serial Port Characteristics for the -62 Receiver**

Port	Input Protocol	Default Setup	Output Language	Default Setup
1	RTCM	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control	NMEA	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control
2	TSIP	Baud Rate: 9600 Data Bits: 8 Parity: Odd Stop Bits: 1 No Flow Control	TSIP	Baud Rate: 9600 Data Bits: 8 Parity: Odd Stop Bits: 1 No Flow Control

**Table 3-3 Default Serial Port Characteristics for the -63 Receiver**

Port	Input Protocol	Default Setup	Output Language	Default Setup
1	RTCM	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control	NONE	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control
2	TAIP	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control	TAIP	Baud Rate: 4800 Data Bits: 8 Parity: None Stop Bits: 1 No Flow Control

Any standard serial communications program, such as Windows Terminal or PROCOMM, can be used with the TAIP or NMEA interface protocol. TSIP is a binary protocol and outputs raw binary serial data onto the screen which cannot be read. Trimble encourages the use of the TSIP Toolkit. The serial port drivers in the TSIPCHAT Toolkit match the SVeeEight Plus GPS serial port characteristics. The TSIPPRNT program converts binary data logged with the TSIPCHAT program into text that can be printed and displayed.




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**Warning** – When using the TSIP protocol to change port assignments or characteristics, confirm that your changes do not affect the ability to communicate with the receiver.

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## 3.4 Protocol Summary

The SVEEeight Plus GPS receiver is shipped from the factory with the configurations listed in the following tables.

**Table 3-4 -61 Receiver Protocol Summary**

Setting	Default
NMEA 0183 out/RTCM SC-104 V2.1 in.	Port 1: 4800 baud 8-none-1
TSIP bi-directional	Port 2: 9600 baud 8-odd-1

**Table 3-5 -62 Receiver Protocol Summary**

Setting	Default
NMEA output, RTCM input	Port 1: 4800 baud 8-none-1
TSIP bi-directional	Port 2: 9600 baud 8-odd-1

**Table 3-6 -63 Receiver Protocol Summary**

Setting	Default
RTCM input	Port 1: 4800 baud 8-none-1
TAIP bi-directional	Port 2: 4800 baud 8-none-1

### 3.4.1 TSIP Data Output

The Trimble Standard Interface Protocol (TSIP) is the native language for the SVEEeight Plus GPS receiver. TSIP is a binary language with a wide variety of commands and reports. TSIP reports can be output automatically, or they can be output as responses to queries. The format of the automatic reports can be easily configured. The receiver is factory configured for single precision Latitude-Longitude-Altitude. Report formats can be modified and position and velocity formats can be customized. Guidelines for making these modifications are provided in *Configuring the SVEEeight Plus GPS Protocols*, page 3-8, and Appendix A, *Trimble Standard Interface Protocol*.

The TSIPCHAT program permits using a computer keyboard to send the Request Packets to the GPS receiver. Responses are displayed on a DOS computer screen in ASCII format. C source code routines for TSIPCHAT are also provided. C source can be used as a software design guide by programmers who need to communicate system integration information with the SVEEeight Plus GPS receiver.

### 3.4.2 TAIP Data Output

The Trimble ASCII Interface Protocol (TAIP) is a Trimble-specified digital communication interface based on printable ASCII characters over a serial data link. TAIP interface provides the means to configure the SVeeEight Plus GPS receiver to output various sentences in response to query or on a scheduled basis. TAIP messages can be scheduled for output at a user specified rate starting on a given epoch from top of the hour. For communication robustness, the protocol optionally supports checksums on all messages. It also provides the user with the option of tagging all messages with the receiver's user specified identification number (ID). This greatly enhances the functional capability of the receiver in a network environment. This protocol is described in Appendix C, Trimble ASCII Interface Protocol (TAIP).

The receiver is factory configured by part number to the TAIP protocol, or it can be configured to TAIP with the TSIPCHAT program. (For detailed information on this program, refer to Configuring the SVeeEight Plus GPS Protocols, page 3-8.) The program stores these settings, along with all the other defaults, to non-volatile memory. The GPSSK program can now be used to control and re-configure the receiver.

Receiver configurations created in GPSSK can be stored in non-volatile memory using the RT command. As mentioned above, the receiver ports can also be set to TAIP through a TSIP port using TSIPCHAT and the TSIP command 0xBC.

### 3.4.3 NMEA 0183 Data Output

The National Marine Electronics Association (NMEA) protocol is an industry standard data protocol which was developed for the marine industry. Trimble has chosen to adhere stringently to the NMEA 0183 data specification as published by the NMEA.

NMEA data is output in standard ASCII sentence formats. Message identifiers signify what data is contained in each sentence. Data fields are separated by commas within the NMEA sentence. In the SVeeEight Plus GPS receiver, NMEA is an output only protocol. The protocol is described in detail in Appendix E, NMEA 0183.

The receiver is shipped with the NMEA protocol by part number from the factory. The NMEA setting can be changed using TSIPCHAT and command 0xBC. TSIP command 0x7A changes the NMEA output sentences and output rates. The new settings are saved to BBRAM or they can be saved to non-volatile memory using TSIP command 0x8E-26.



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**Note** – Although the SVeeEight Plus GPS receiver supports seven NMEA sentences that contain GPS information, the factory default setting for the receiver only outputs the GGA and VTG data strings. To change the output interval or sentence output, use TSIP Command Packet 7A.

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## 3.5 Timing Applications

The SVEEeight Plus GPS receiver is an excellent source for accurate system timing. Two examples of an application requiring accurate time are environmental data acquisition and synchronization of communications networks. The timing functions of the receiver are supported by the TSIP protocol. See Report Packet 0x41 - GPS Time, page A-33 for a description of the time function reports for TSIP.



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**Note** – Note that GPS time differs from UTC (Universal Coordinated Time) by a variable integer number of seconds:  $UTC = (GPS\ time) - (GPS\ UTC\ Offset)$

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As of January 1999, the GPS UTC offset was 13 seconds. The offset increases by 1 second approximately every 18 months. System designers should plan to read the offset value as a part of the timing interface to obtain UTC. The GPS week number is in reference to a base week (Week #0), starting January 6, 1980.

The current GPS UTC offset is contained within the almanac transmitted by the GPS system. The SVEEeight Plus GPS receiver must have a complete almanac before the offset data is valid.

### 3.5.1 Week Number Roll Over

The SVEEeight Plus GPS receiver has been designed to handle WNRO and there are no problems with either dates or the first fix after WNRO through the year 2015.



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**Note** – GPS Week Numbers system, as defined by the ICD200 GPS Specification, occupy a range from zero to 1023. The Week Number Roll Over (WNRO) occurs every 1024 weeks, or approximately every 19 years 8 months. August 1999 is the first roll-over for the GPS system since the beginning of GPS time on 06 January 1980.

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**Caution** – Trimble OEM GPS receivers have reported the true GPS Week Number in TSIP messages 0x41 and 0x8F-20 as a number between 0 and 1023. The SVEEeight Plus GPS receiver outputs the Extended GPS Week Number as the absolute number of weeks since the beginning of GPS time or 06 January 1980. If the true GPS Week Number is desired, the system developer should ignore the extra MSBs of the Extended GPS Week Number and use only the 10 LSBs.

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## 3.6 Differential GPS

The SVEEeight Plus GPS receiver can use differential corrections to compute a Differential GPS position (DGPS). DGPS can provide position accuracy of 2 meters (1 sigma).

RTCM SC-104, the industry standard format for differential corrections, is available from most DGPS reference stations, Coast Guard beacon transmissions, and commercial DGPS subscription services. The SVEEeight Plus GPS receiver is fully compatible with RTCM SC-104 Version 2.1. The receiver is factory configured to accept RTCM SC-104 correction data over Port 1 at 4800 baud, 8 data bits, 1 stop bit and no parity. The DGPS operating mode is set to Automatic which means that the receiver provides differential GPS solutions when valid correction data is available and outputs standard GPS solutions when no valid correction data is available.

No setup is required to use RTCM SC-104 differential corrections, however, you may need to reconfigure the serial port characteristics (baud rate, data bits, stop bits and parity) to match the characteristics of your RTCM SC-104 data source using the TSIP packet 0xBC. See Command Packet 0xBC - Protocol Configuration, page A-68 for more information. Table 3-1 summarizes the default characteristics for the SVEEeight Plus GPS serial ports.

Alternatively, you can use Trimble's TSIP packets 60h and 61h to apply differential corrections through the SVEEeight Plus GPS Port 2 (J4, pin 5). These packets can be interleaved with the TSIP command stream. Packets 60h and 61h are useful in applications which require the use of a single communications channel between the SVEEeight Plus GPS receiver and the system. Using these messages requires you to reformat the RTCM

SC-104 differential correction data into the 60h/61h message format. See Appendix A, Trimble Standard Interface Protocol for more information on these messages.

Similarly, you can use the TAIP DC and DD commands to input differential information through the TAIP primary port.

## 3.7 Configuring the SVEEeight Plus GPS Protocols

This procedure assumes Port 2 is initially configured to TSIP.

Store the SVEEeight Plus GPS receiver configuration in non-volatile memory (EEROM) rather than relying on battery-backed memory. This ensures the availability of the receiver configuration if back-up battery power is accidentally lost.

The configuration process has three steps:

1. Configure the receiver port PORT2 to TSIP input/output, as described in Reconfiguring PORT2, page 3-8.
2. Enter a series of configuration commands as described in Entering the Configuration, page 3-9.
3. Return the receiver port to the original setting (if necessary); and issue a save configuration command, as described in Saving the Configuration, page 3-11.

Detailed instructions follow.

### 3.7.1 Reconfiguring PORT2

If the PORT2 protocol is currently set to TSIP input/output, the port does not need to be reconfigured, and you can proceed to Entering the Configuration, page 3-9. Otherwise, reconfigure PORT2 as described.

Depending on the current receiver configuration, select from the following options to set the receiver PORT2 protocol to TSIP input/output.

1. If the PORT2 protocol is TSIP input but not TSIP output, reconfigure PORT2 to TSIP input/output using the TSIP 0xBC command.
2. If the PORT2 input protocol is TAIP, apply an >SPR... command to change the PORT2 protocol to TSIP input/output temporarily. This can be done with TSIPCHAT. Use the I keystroke and type in the following command at the prompt: >SPR;TSIP=TF;TAIP=FF;NMEA=FO;RTCM=FI<.



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**Note** – At least one of the ports must be configured to either the TSIP or the TAIP input protocol at all times.

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### 3.7.2 Entering the Configuration

The DOS program TSIPCHAT is used to configure the receiver to the desired settings. Table 3-7 lists the TSIPCHAT configuration commands. A complete description of these individual parameters is provided in Appendix A, Trimble Standard Interface Protocol.

Do the following to enter the configuration:

1. Start TSIPCHAT, with TSIPCHAT -c1 if attached to PC serial port COM1, or with TSIPCHAT -c2 if attached to PC serial port COM2.
2. If the PORT2 settings are not set to the TSIP default (9600 8-odd-1), use the keystroke ^i to set the PC serial port to match the PORT2 settings.
3. Send all desired configuration commands through PORT2, including the configuration for PORT1 (0xBC). If PORT2 is to be reconfigured to TAIP, or the baud rate, or parity are to change, send the 0xBC command for PORT2 as the last command of the sequence.
4. Change the PC serial port settings to match the PORT2 settings. A short period of time may be required for the serial port communication to be re-acquired, two seconds is sufficient.

**Table 3-7 TSIPCHAT Commands**

<b>TSIP Command ID</b>	<b>TSIPCHAT Keystroke</b>	<b>Description</b>	<b>TSIP Response ID</b>
0x35	O	TSIP input/output formatting Superpacket output (on/off) Position format (LLA and/or ECEF) Precision (double or single) Altitude format (MSL or HAE) Timetag format (GPS or UTC) SNR format (AMU or C/N <sub>0</sub> ) Automatic Pseudorange output	0x55
0x70	l	Position filter controls Position filter on/off Static filter on/off Altitude filter on/off	0x70
0x7A	q	NMEA message formats and schedule NMEA output messages NMEA output interval	0x7B
0xBB	p	GPS configuration parameters Operating dimension (2D, 3D, ...) DGPS mode Dynamics mode Elevation mask SNR mask DOP mask PDOP switch DGPS correction age	0xBB
0xBC	U	Serial port configuration Protocol: input, output Baud, data bits, parity, stop bits	0xBC
0x8E-15	= t	Output datum	0x8F-15
0x8E-19	= f	UTM output control	0x8F-19
0x8E-20	= g	Fixed point superfix control (default = on)	0x8F-20
0x8E-40	= t	TAIP configuration Report Mode Flags (command RM) Heartbeat message Heartbeat Top of Hour Offset Heartbeat Interval Vehicle ID Tag	0x8F-40

### 3.7.3 Saving the Configuration

Before writing the configuration to SEEPROM, verify that the receiver has been configured to the desired settings.



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**Warning** – Record the serial port settings. If forgotten, they are difficult to recover.

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1. If the PORT2 protocol is set to TAIP, send the TAIP command `SRTSAVE_CONFIG`. This can be done in TSIPCHAT using the keystroke | and typing the string `>SRTSAVE_CONFIG<` at the prompt.
2. If the PORT2 protocol is set to TSIP, use the TSIP command `0x8E-26` (TSIPCHAT = then s).  
  
Wait two seconds for the SEEPROM to be written.
3. Use a cold-start to verify that the procedure was successful. A cold-start is a power-cycle with no battery-backed memory. Use either the TSIP or TAIP protocol to initiate a cold-start and confirm that the receiver is initialized to the desired settings. In TSIP protocol, send the clear RAM and restart command, `0x1E-4B` (^k in TSIPCHAT). In TAIP protocol, send the TAIP cold-start command, `>SRTCOLD<`.

### 3.7.4 Returning to the Factory Settings

If your attempt to configure the receiver is unsuccessful, please contact your Trimble service representative who can assist you.

