

Operating
and
Programming
Guide

HP 59551A GPS Measurements
Synchronization Module
and
HP 58503A GPS Time and Frequency
Reference Receiver

Operating and Programming Guide

This guide describes how to operate the HP 59551A GPS Measurements Synchronization Module and the HP 58503A GPS Time and Frequency Reference Receiver via the RS-232C port(s). The information in this guide applies to instruments having the number prefix listed below, unless accompanied by a "Manual Updating Changes" package indicating otherwise.

SERIAL PREFIX NUMBER: **3542 and above (HP 59551A)**
 3542 and above (HP 58503A)

Instruments with serial numbers below 3542 may have earlier versions of firmware installed. There are no operator-specific differences in previous versions of firmware.

FIRMWARE REVISION: **3543 and above (HP 59551A)**
 3543 and above (HP 58503A)

Firmware revision can be identified by using a "*IDN?" command sent to the Receiver via RS-232C port. Refer to Chapter 2, "Serial Interface Capabilities," in this guide for instructions on connecting a computer or terminal to this product.

HP 59551A GPS Measurements
Synchronization Module
and
HP 58503A GPS Time and Frequency
Reference Receiver

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Printed: May 1996

Printed in USA

Manual part number
59551-90002

Certification and Warranty

Certification

Hewlett-Packard Company certifies that this product met its published specification at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For detailed warranty information, see back matter.

Safety Considerations

General

This product and related documentation must be reviewed for familiarization with this safety markings and instructions before operation.

Warning Symbols That May Be Used In This Book



Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicates hazardous voltages.



Indicates earth (ground) terminal.



or



Indicated terminal is connected to chassis when such connection is not apparent.



Indicates Alternating current.



Indicates Direct current.

Safety Considerations (contd)

WARNING

BODILY INJURY OR DEATH MAY RESULT FROM FAILURE TO HEED A WARNING. DO NOT PROCEED BEYOND A WARNING UNTIL THE INDICATED CONDITIONS ARE FULLY UNDERSTOOD AND MET.

CAUTION

Damage to equipment, or incorrect measurement data, may result from failure to heed a caution. Do not proceed beyond a CAUTION until the indicated conditions are fully understood and met.

Safety Earth Ground

An uninterruptible safety earth ground must be maintained from the mains power source to the product's ground circuitry.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE GROUNDING CONDUCTOR (INSIDE OR OUTSIDE THE PRODUCT'S CIRCUITRY) OR DISCONNECTING THE PROTECTIVE EARTH TERMINAL WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY. (GROUNDING ONE CONDUCTOR OF A TWO CONDUCTOR OUTLET IS NOT SUFFICIENT PROTECTION.) WHENEVER IT IS LIKELY THAT THE PROTECTION HAS BEEN IMPAIRED, THE PRODUCT MUST BE MADE INOPERATIVE AND BE SECURED AGAINST ANY UNINTENDED OPERATION.

For additional safety and acoustic noise information, see back matter.

Contents

In This Guide ix

1 Front and Rear Panels at a Glance

HP 59551A Front Panel at a Glance 1-2

HP 59551A Rear Panel at a Glance 1-3

HP 58503A Front Panel at a Glance 1-4

HP 58503A Rear Panel at a Glance 1-5

2 Serial Interface Capabilities

Chapter Contents 2-2

About the RS-232C Serial Port(s) 2-3

PORT 1 Rear-Panel 2-3

PORT 2 Front-Panel RS-232C Serial Port
(HP 59551A Only) 2-4

Connecting a Computer or Modem 2-5

To Connect the HP 59551A to a Palmtop Computer Via the
Front-Panel DB-9 Serial Port 2-5

To Connect the HP 59551A to a Palmtop Computer Via the
Rear-Panel DB-25 Serial Port 2-6

To Connect the HP GPS Receiver to a PC, Laptop, or Modem
Via the Rear-Panel DB-25 Serial Port 2-7

Connecting to the Personal Computer (PC) 2-7

Connecting to a Modem 2-7

To Connect the HP 59551A to a Laptop Computer Via the
Front-Panel DB-9 Serial Port 2-8

Configuring the RS-232C Port(s) 2-10

If You Need To Make Changes to the Serial Port
Settings 2-11

Configuring PORT 1 2-11

Configuring PORT 2 (HP 59551A Only) 2-12

If Changes Have Already Been Made to the Serial Port
Settings 2-12

3 Visual User Interface

Chapter Contents 3-2

Overview of the Visual User Interface 3-3

Setting Up the HP GPS Receiver 3-4

To Connect Antenna System to the Receiver 3-4

To Connect PC to the Receiver 3-4

To Configure Terminal Communications for
Windows-based PC 3-5

To Configure Terminal Communications for DOS-based
PC (No Windows) 3-6

To Power Up the Receiver 3-7

Accessing the Receiver Status Screen (the Visual User Interface) 3-8

Overview of the Visual User Interface 3-8

To Access the Manually Operated Receiver Status Screen 3-8

To Install the Automated HP SatStat Program for Continual
Status Updates 3-9

To Operate the Automated HP SatStat Program 3-10

Using and Reading the Receiver Status Screen 3-11

Tutorial on Using the Status Screen to Interface With the
Receiver 3-11

Demonstration of Holdover Operation 3-16

The Receiver Status Screen at a Glance 3-19

4 Command Quick Reference

Chapter Contents 4-2

An Introduction to HP GPS Receiver Commands 4-4

SCPI Conformance Information 4-4

Command Syntax Conventions 4-4

Command Presentation 4-4

GPS Satellite Acquisition 4-5

1 PPS Reference Synchronization 4-7

Operating Status 4-8

System Time 4-10

Programmable Pulse Output (HP 59551A Only) 4-11

Event Time Stamping (HP 59551A Only) 4-12
Serial Interface Communication 4-13
Receiver Initialization 4-14
Receiver Identification/Upgrade 4-15
**Receiver Commands at a Glance/Status Reporting System
at a Glance (foldout) 4-17**

5 Command Reference

Chapter Contents 5-2
Command Syntax Conventions 5-4
Description Format 5-5
 Commands and Returns 5-5
 Query-Specific Information 5-6
 Description of Response Formats (ASCII-encoded) 5-6
GPS Satellite Acquisition 5-7
 Facilitating Initial Tracking 5-9
 Establishing Position 5-12
 Selecting Satellites 5-17
 Compensating for Antenna Delay 5-22
 Monitoring Acquisition 5-24
1 PPS Reference Synchronization 5-27
 Monitoring 1 PPS Synchronization 5-28
 Assessing 1 PPS Quality 5-30
 Operating in Holdover 5-36
Operating Status 5-39
 Receiver Operation at a Glance 5-41
 Reading the Error Queue 5-42
 Reading the Diagnostic Log 5-44
 Monitoring Status/Alarm Conditions 5-48
 Assessing Receiver Health 5-70

System Time 5-73

Identifying Time of Next 1 PPS Reference Edge 5-74

Reading Current Time 5-76

Applying Local Time Zone Offset 5-78

Defining the 1 PPS Reference Edge
(HP 59551A Only) 5-79

Reading Leap Second Status 5-80

Programmable Pulse Output (HP 59551A Only) 5-84

Event Time Stamping (HP 59551A Only) 5-90

Defining the Time-stamped Edge 5-91

Clearing Time Stamp Memory 5-92

Reading Time Stamps 5-93

Processing Memory Overflows 5-98

Serial Interface Communication 5-101

Configuring I/O Ports 5-102

Recovering the Last Query Response 5-109

Receiver Initialization 5-110

Receiver Identification/Upgrade 5-114

Reading Product Identification 5-115

Installing Firmware via I/O Port 1 5-116

A Error Messages

Introduction A-2

Reading an Error A-2

Error Queue A-3

Error Types A-4

No Error A-4

Syntactic Error A-4

Semantic Error A-5

Hardware/Firmware Error A-5

Query Error A-6

General Error Behavior A-6

List of Errors A-7

B Command Syntax and Style

Appendix Contents B-2

Command Types, Format, and Elements B-3

Command Types B-3

Command Formats B-3

Common Command Format B-3

SCPI Command and Query Format B-3

Elements of SCPI Commands B-4

Common Command Syntax B-4

Subsystem Command Syntax B-4

Abbreviated Commands B-5

Keyword Separator B-5

Parameter Data Types B-6

Parameter Separator B-6

Query Parameters B-6

Suffixes B-7

Suffix Elements B-7

Suffix Multipliers B-7

Command Terminator B-8

Using Multiple Commands B-8

Program Messages B-8

Program Message Syntax B-8

Elements of Response Messages B-9

Response Messages B-9

Response Message Syntax B-10

Response Formats B-11

Reference Documentation B-13

C Receiver Firmware Installation

**Downloading New Firmware Using HP SatStat
Program C-2**

Command Index

General Index

In This Guide

Chapter 1, “**Front and Rear Panels at a Glance**,” provides overview of the Receiver’s indicators, inputs, and outputs.

Chapter 2, “**Serial Interface Capabilities**,” provides RS-232 serial interface port connection and configuration instructions.

Chapter 3, “**Visual User Interface**,” which is subtitled “Using the Receiver and Status Screen,” provides information on how to use the Receiver Status screen and the HP SatStat program. An illustrated foldout of the Receiver Status screen, which is a comprehensive summary of key operation conditions and settings, is provided at the end of this chapter.

Chapter 4, “**Command Quick Reference**,” is a quick reference that summarizes the Receiver commands. The commands are presented or grouped by their functions. A foldout sheet that presents all of the commands on one side (Receiver Commands at a Glance) and illustrates the status reporting system on the other side (Status Reporting System at a Glance) is provided at the end of this chapter.

Chapter 5, “**Command Reference**,” provides a description of each command that can be used to operate the HP GPS Receiver. The commands are grouped by functions. The functions are grouped and ordered the same as they are in Chapter 4, “Command Quick Reference,” and on the foldout “Receiver Commands at a Glance.” A comprehensive discussion on how you can monitor and control alarm conditions using the status registers is also provided in this chapter.

Appendix A, “**Error Messages**,” lists all error messages the Receiver could generate along with descriptions of possible causes for the errors.

Appendix B, “**Command Syntax and Style**,” provides an overview of the Standard Commands for Programming Instrument (SCPI) syntax and style to help you program the Receiver.

Appendix C, “**Receiver Firmware Installation**,” provides a procedure for downloading new firmware to the HP GPS Receiver.

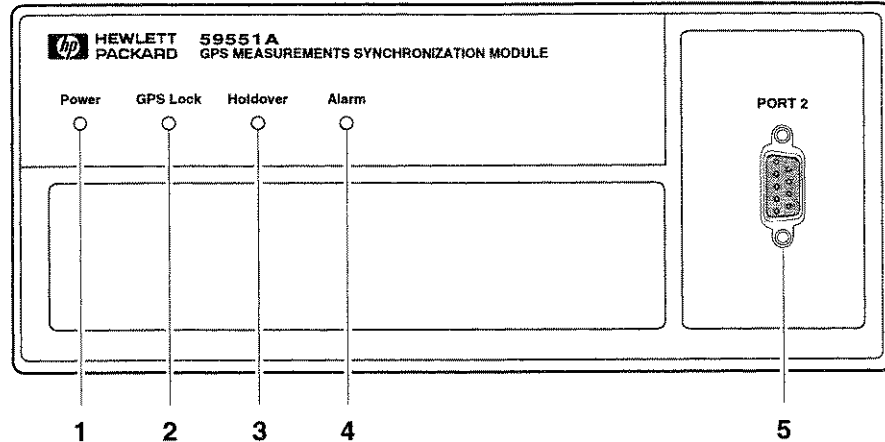
Command Index, lists all of the commands alphabetically and provides page references.

General Index

In this Guide

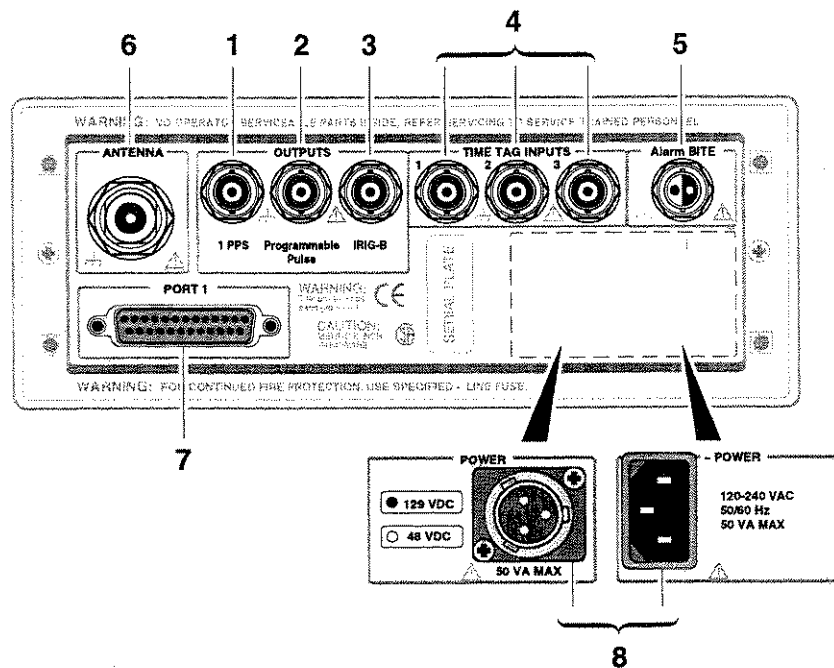
Front and Rear Panels at a Glance

HP 59551A Front Panel at a Glance



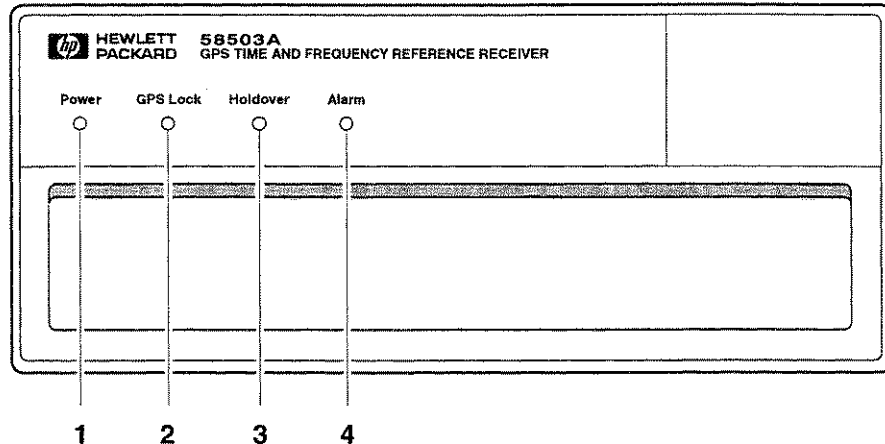
- 1 When the **Power** indicator is illuminated, it indicates that the proper input power is supplied to the Module.
- 2 When the **GPS Lock** indicator is illuminated, it indicates that the Module is tracking satellites and has phase-locked its internal reference to the reference provided by GPS.
- 3 When the **Holdover** indicator is illuminated, it indicates that the Module is not phase-locking its internal reference to the reference provided by GPS. Typically, this would happen due to loss of satellite tracking. The internal reference oscillator will determine the accuracy of the 1 PPS signal when the Module is operating in holdover. (See specification for Accuracy in Holdover in Chapter 3, "HP 59551A Specifications," in the Getting Started guide.)
- 4 When the **Alarm** indicator is illuminated, it indicates that the Module has detected a condition that requires attention.
- 5 **PORT 2** RS-232C serial interface port for local control, monitoring, and retrieving of the Module's memory data.

HP 59551A Rear Panel at a Glance



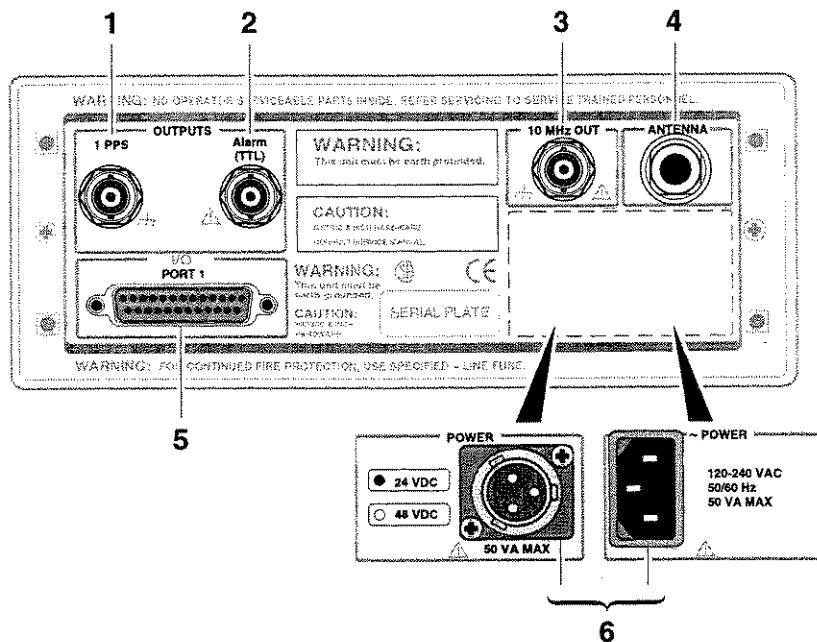
- 1** **1 PPS** connector for outputting a continuous 1 Pulse Per Second signal.
- 2** **Programmable Pulse** output connector for outputting pulses at user-specified time/period.
- 3** **IRIG-B** output for outputting formatted time-code signals. (This signal is used for general purpose time distribution and magnetic tape annotation applications requiring the time of year.)
- 4** **Time tag** input connectors for time stamping TTL conditioned signals.
- 5** **Alarm BITE** (Built-In Test Equipment) relay for external devices (such as red light, bell, or horn) to indicate that the Module has detected an internal condition that requires attention. The relay opens and closes with the **Alarm** indicator.
- 6** N-type (female) **ANTENNA** connector.
- 7** **PORT 1** RS-232C serial interface port for remote control, monitoring, and retrieving of the Module's memory data and upgrading Module software.
- 8** **Power** input jack.

HP 58503A Front Panel at a Glance



- 1** When the **Power** indicator is lit, it indicates that the proper input power is supplied to the Receiver.
- 2** When the **GPS Lock** indicator is lit, it indicates that the Receiver is tracking satellites and has phase-locked its internal reference to the reference provided by GPS.
- 3** When the **Holdover** indicator is lit, it indicates that the Receiver is not phase-locking its internal reference to the reference provided by GPS. Typically, this would happen due to loss of satellite tracking. The internal reference oscillator will determine the accuracy of the 1 PPS signal and the 10 MHz reference output when the Receiver is operating in holdover. (See specification for Accuracy in Holdover in Chapter 4, "HP 58503A Specifications," in the Getting Started guide.)
- 4** When the **Alarm** indicator is lit, it indicates that the Receiver has detected a condition that requires attention.

HP 58503A Rear Panel at a Glance



- 1 **1 PPS** connector for outputting a continuous 1 Pulse Per Second signal.
- 2 **Alarm** output for external devices (such as red light, bell, or horn) to indicate that the Receiver has detected an internal condition that requires attention. This output goes on and off with the **Alarm** indicator.
- 3 **10 MHz OUT** output for user-specific applications.
- 4 N-type (female) **ANTENNA** connector.
- 5 **PORT 1** RS-232C serial interface port for remote control, monitoring, and downloading of the Receiver's memory data and upgrading Receiver software.
- 6 **Power** input jack.

Front and Rear Panels at a Glance
HP 58503A Rear Panel at a Glance

Chapter Contents

This chapter describes how to operate the HP 59551A GPS Measurements Synchronization Module and the HP 58503A GPS Time and Frequency Reference Receiver via the RS-232C serial interface port. Hardware connections and configuration are discussed.

This chapter is organized as follows:

- About the RS-232C Serial Port(s) page 2-2
 - PORT 1 Rear-Panel RS-232C Serial Interface Port page 2-3
 - PORT 2 Front-Panel RS-232C Serial Interface Port (HP 59551A Only) page 2-4
- Connecting a Computer or Modem page 2-5
 - To Connect the HP 59551A to a Palmtop Computer Via the Front-Panel DB-9 Serial Port page 2-5
 - To Connect the HP 59551A to a Palmtop Computer Via the Rear-Panel DB-25 Serial Port page 2-6
 - To Connect the HP 59551A to a PC or Modem Via the Rear-Panel DB-25 Serial Port page 2-7
 - To Connect the HP 59551A to a Laptop Computer Via the Front-Panel DB-9 Serial Port page 2-8
- Configuring the RS-232C Port(s) page 2-10
 - If You Need To Make Changes to the Serial Port Settings page 2-11
 - If Changes Have Already Been Made to the Serial Port Settings page 2-12

About the RS-232C Serial Port(s)

The HP 59551A has separate rear-panel (**PORT 1**) and front-panel (**PORT 2**) RS-232C serial interface ports.

The HP 58503A has only a rear-panel (**PORT 1**) RS-232C serial interface port.

The rear-panel (**PORT 1**) RS-232C serial interface port is the only port which can be used to upgrade the Receiver firmware; therefore, it is referred to as the **PRIMARY** port. The HP 59551A's front-panel (**PORT 2**) RS-232C serial interface port is referred to as the **SECONDARY** port because it cannot be used to upgrade the Receiver firmware. The operation and configuration of these ports are described in the following paragraphs. More information is provided in the sections titled "Connecting a Computer or Modem" and "Configuring the RS-232C Port(s)" in this chapter on pages 2-5 and 2-10, respectively.

Either port allows you full communication with the Receiver. This can be done by connecting any computer with an RS-232C serial interface and suitable terminal emulation software, then sending the correct commands for transmitting or retrieving data.

PORT 1 Rear-Panel

This 25-pin female subminiature D (DB-25) connector (**PORT 1**) RS-232C Serial Interface Port, located on the rear panel.

The pins used for **PORT 1** RS-232C communication are described in Table 2-1.

NOTE

HP reserves the right to impose signals on other pins; therefore, your connection should be restricted to the pins described in Table 2-1.

Serial Interface Capabilities
About the RS-232C Serial Port(s)

Table 2-1. PORT 1 Rear-Panel RS-232C Serial Port Connections

*Pin Number	Input/Output	Description
2	Output	Transmit Data (TxD). GPS Receiver output.
3	Input	Receive Data (RxD). GPS Receiver input.
7	—	Signal Ground (SG)

Refer to the sections titled “Connecting a Computer or Modem” in this chapter, on page 2-5, for wiring diagrams and more information on the RS-232C interface cables.

PORT 2 Front-Panel RS-232C Serial Port (HP 59551A Only)

This 9-pin female subminiature D (DB-9) connector (**PORT 2**) RS-232C Serial Interface Port, located on the front panel.

The pins used for **PORT 2** RS-232C communication are described in Table 2-2.

NOTE

HP reserves the right to impose signals on other pins; therefore, your connection should be restricted to the pins described in Table 2-2.

Table 2-2. PORT 2 Front-Panel RS-232C Serial Port Connections (HP 59551A Only)

*Pin Number	Input/Output	Description
2	Input	Receive Data (RxD). GPS Receiver input.
3	Output	Transmit Data (TxD). GPS Receiver output.
5	—	Signal Ground (SG)

Refer to the sections titled “Connecting a Computer or Modem” in this chapter, on page 2-5, for wiring diagrams and more information on the RS-232C interface cables.

Connecting a Computer or Modem

To connect the HP GPS Receiver to a computer or modem, you must have the proper interface cable. Most computers are DTE (Data Terminal Equipment) devices. Since the Receiver is also a DTE device, you must use a DTE-to-DTE interface cable when connecting to a computer. These cables are also called “null-modem”, “modem-eliminator”, or “crossover” cables.

Most modems are DCE (Digital Communication Equipment) devices; thus, you must use a DTE-to-DCE interface cable.

The interface cable must also have the proper connector on each end and the internal wiring must be correct. Connectors typically have 9 pins (DB-9 connector) or 25 pins (DB-25 connector) with a “male” or “female” pin configuration. A male connector has pins inside the connector shell and a female connector has holes inside the connector shell.

To simplify interface cable selections, the following sections tells you which HP cables to use.

To Connect the HP 59551A to a Palmtop Computer Via the Front-Panel DB-9 Serial Port

Use the 9-pin (f) to miniature 10-pin (f) RS-232C interface cable, supplied for the HP 200LX Palmtop computer, and a “straight-through” type of 9-pin male-to-male adapter to connect the HP 59551A Module’s front-panel **PORT 2** DB-9 female connector to a palmtop computer as shown in Figure 2-1A. (Note: this cable is supplied in the HP F1021B Palmtop Connectivity Pack.)

CAUTION

DO NOT use the 9-pin male-to-male connector that is provided in the HP F1021B Palmtop Connectivity Pack as it will not work with the HP 59551A. Make sure you use a straight-through adapter.

The 9-pin male-to-male adapter should be wired as shown in Figure 2-5. Pins 2, 3, and 5 should be straight-through pin connections (no crossover pins).

Serial Interface Capabilities
Connecting a Computer or Modem

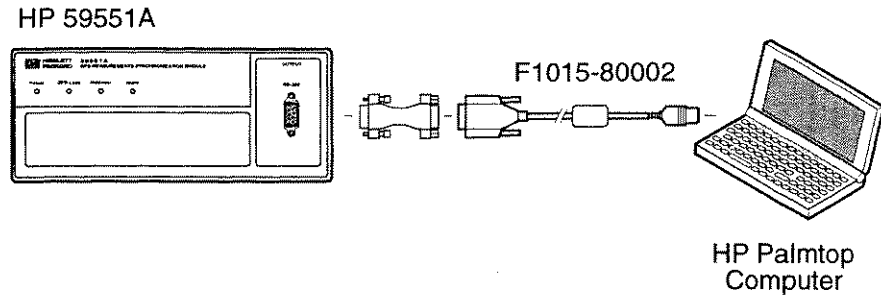


Figure 2-1A. Connecting the HP 59551A to a Palmtop Computer via the Front-Panel DB-9 Port

To Connect the HP 59551A to a Palmtop Computer Via the Rear-Panel DB-25 Serial Port

Use the interface cable (F1015-80002) and the 9-pin male to 25-pin male adapter (5181-6640) that are supplied in the HP F1021B Palmtop Connectivity Pack to connect the HP 59551A Module's rear-panel **PORT 1** DB-25 female connector to a palmtop computer as shown in Figure 2-1B.

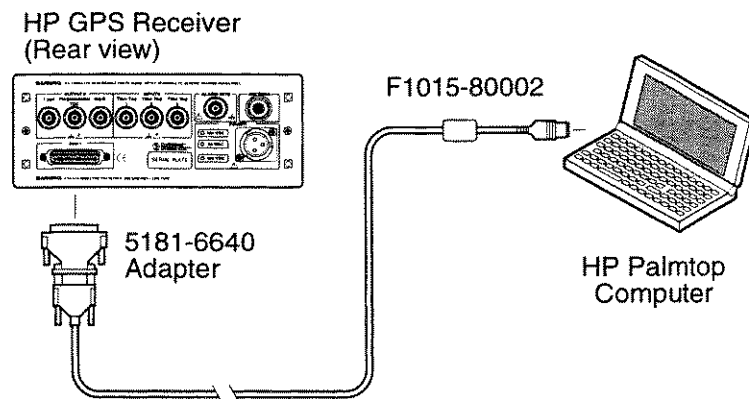


Figure 2-1B. Connecting the HP 59551A to a Palmtop Computer via the Rear-Panel DB-25 Port

Connecting a Computer or Modem

To Connect the HP GPS Receiver to a PC, Laptop, or Modem Via the Rear-Panel DB-25 Serial Port

Connecting to the Personal Computer (PC)

Use an HP 24542G interface cable to connect the Receiver's rear-panel **PORT 1** DB-25 female connector to a PC or laptop as shown in Figure 2-2.

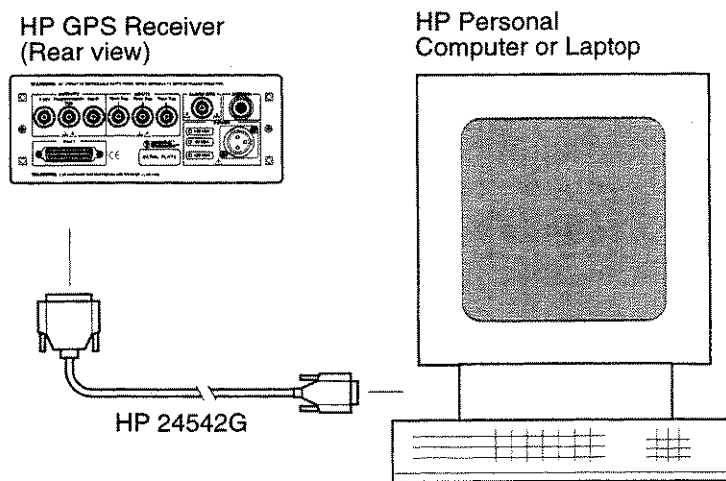


Figure 2-2. Connecting the HP GPS Receiver to a Computer

Connecting to a Modem

Use an HP 40242M interface cable to connect the Receiver's rear-panel **PORT 1** DB-25 female connector to a modem, which is a DCE (Digital Communication Equipment) device, as shown in Figure 2-3.

Serial Interface Capabilities
Connecting a Computer or Modem

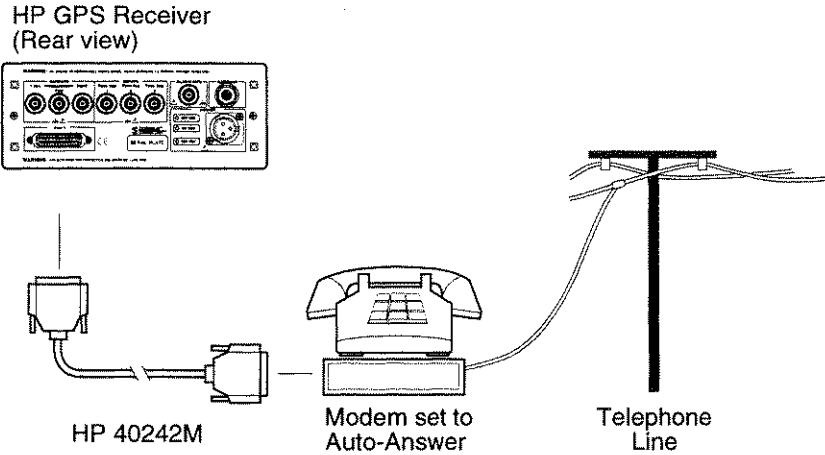


Figure 2-3. Connecting the HP GPS Receiver to a Modem

**To Connect the HP 59551A to a Laptop Computer Via
the Front-Panel DB-9 Serial Port**

Use the 9-pin (f) to miniature 9-pin (f) RS-232C interface cable supplied for the HP OmniBook 300 or Laptop computer, and a “straight-through” type of 9-pin male-to-male adapter to connect the HP 59551A Module’s front-panel **PORT 2** DB-9 female connector to a laptop computer as shown in Figure 2-4

CAUTION

DO NOT use the 9-pin male-to-male adapter that is provided in the HP F1021B Palmtop Connectivity Pack as it will not work with the HP 59551A. Make sure you use a straight-through adapter.

The 9-pin male-to-male adapter should be wired as shown in Figure 2-5. Pins 2, 3, and 5 should be straight-through pin connections (no crossover of pins).

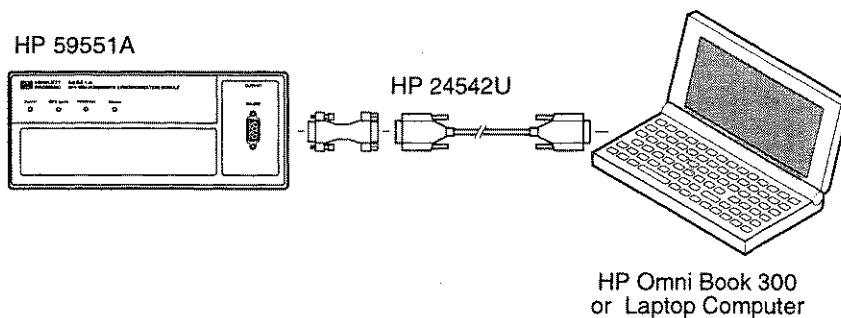


Figure 2-4. Connecting the HP 59551A to Laptop Computer

Serial Interface Capabilities
Connecting a Computer or Modem

If you choose to make your own cable, see figures 2-5 and 2-6.

Figures 2-5 and 2-6 illustrate the HP 24542U cable (9-pin female to 9-pin female connectors) and the HP 24542G cable (25-pin male to 9-pin female connectors), respectively. Each of these cables are null-modem cables. Note that pins 2 and 3 of the HP 24542G 25-pin (male) to 9-pin (female) cable, shown in Figure 2-6, DO NOT cross; nevertheless, this cable is a null-modem cable.

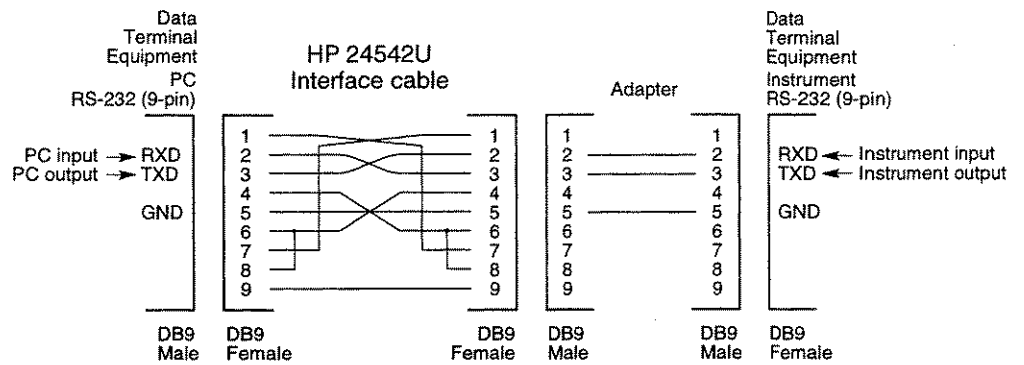


Figure 2-5. DB-9 to DB-9 Serial Connection

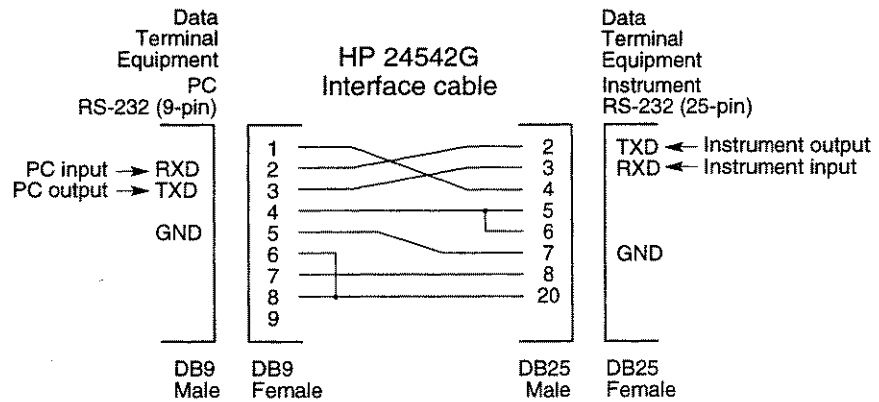


Figure 2-6. DB-25 to DB-9 Serial Connection

Configuring the RS-232C Port(s)

The HP 59551A has separate rear-panel (**PORT 1**) and front-panel (**PORT 2**) RS-232C serial interface ports.

The HP 58503A has one RS-232C serial interface port (**PORT 1**) on the rear panel.

Software pacing, baud rate, parity, data bits, and stop bits parameters for each port are user-selectable and independent of the configuration of the other.

Tables 2-3 and 2-4 list the configuration factory-default values for **PORT 1** and **PORT 2**, respectively.

Table 2-3. PORT 1 Configuration Factory-Default Values

Parameter	Default	Possible Choices
Software Pacing	NONE	XON or NONE
Baud Rate	9600	1200, 2400, 9600, or 19200
Parity	NONE	EVEN, ODD, or NONE
Data Bits	8	7 or 8
Stops Bits	1	1 or 2
Full Duplex	ON	ON or OFF

Table 2-4. PORT 2 Configuration Factory-Default Values (HP 59551A Only)

Parameter	Default	Possible Choices
Software Pacing	NONE	XON or NONE
Baud Rate	9600	1200, 2400, 9600, or 19200
Parity	NONE	EVEN, ODD, or NONE
Data Bits	8	Fixed at 7 when parity is even or odd. Fixed at 8 when parity is none.
Stops Bits	1	Fixed (no choices available)
Full Duplex	ON	ON or OFF

Serial Interface Capabilities
Configuring the RS-232C Port(s)

Procedures for configuring the RS-232C ports are provided in the following paragraphs.

If You Need To Make Changes to the Serial Port Settings

CAUTION

If you change the serial port settings, your changes will be stored in the Receiver. Cycling power will not reset to factory defaults. Therefore, if you make a change, it is recommended that you record the settings and keep the record with the Receiver.

If you need to change the serial port settings, for example, to set up for a different computer, use the guidelines given in this section.

Serial port settings are changed by issuing commands.

It is recommended that you issue a single compound command which simultaneously sets all the serial port parameters. Then connect the other computer and begin using the instrument with the new settings.

NOTE

If you choose to set parameters one at a time, you will make the procedure more difficult. That is, with each change, the instrument will be updated, but your computer will retain its original settings. At each step, you will have stopped serial communications and be forced to modify your PC settings to match the Receiver in order to continue. It is recommended that you make all changes in a single compound command, verify the changes, and record all parameters.

Configuring PORT 1

Complete configuration of **PORT 1** requires that you set *five* parameters. The command line sent in the following example would set the RS-232C port pacing to XON, baud rate to 2400, parity to EVEN, data bits to 7, and stop bits to 2. This command line must be transmitted on **PORT 1**.

```
SYST:COMM:SER:PACE XON; BAUD 2400; PARITY EVEN; BITS 7; SBITS 2
```

Serial Interface Capabilities

Configuring the RS-232C Port(s)

Configuring PORT 2 (HP 59551A Only)

Complete configuration of **PORT 2** requires that you set *three* parameters. The command line sent in the following example would set the RS-232C port pacing to XON, baud rate to 2400, and parity to EVEN. This command line must be transmitted on **PORT 2**.

```
SYST:COMM:SER2:PACE XON; BAUD 2400; PARITY EVEN
```

If Changes Have Already Been Made to the Serial Port Settings

If you connect your PC, press Return, and do not get a **scpi>** prompt back from the Receiver, your Receiver's serial communication settings may have been modified. You need to systematically step through the data communication settings on your PC until your PC matches the Receiver. The Receiver cannot communicate its settings until this process is complete.

Iterate until you are able to verify that settings on your PC match the Receiver.

When you are successful, you will have restored full RS-232C communications, enabling you to query the Receiver's communication settings. Once you establish communications with one serial port, you can query the Receiver for settings of either port.

Issue the following queries to either serial port to verify **PORT 1's** configuration.

```
SYST:COMM:SER:PACE?  
SYST:COMM:SER:BAUD?  
SYST:COMM:SER:PARITY?  
SYST:COMM:SER:BITS?  
SYST:COMM:SER:SBITS?
```

Issue the following queries to either serial port to verify **PORT 2's** configuration.

```
SYST:COMM:SER2:PACE?  
SYST:COMM:SER2:BAUD?  
SYST:COMM:SER2:PARITY?  
SYST:COMM:SER2:BITS?  
SYST:COMM:SER2:SBITS?
```

Visual User Interface

Using the Receiver and Status Screen

Chapter Contents

This chapter is organized as follows:

- Overview of the Visual User Interface page 3-8
- Setting Up the HP GPS Receiver page 3-4
 - To Connect Antenna System to the Receiver page 3-4
 - To Connect PC to the Receiver page 3-5
 - To Power Up the Receiver page 3-7
- Accessing the Receiver Status Screen (the Visual User Interface) page 3-8
 - To Access the Manually Operated Receiver Status Screen page 3-7
 - To Install the Automated HP SatStat Program for Continual Status Updates page 3-9
 - To Operate the Automated HP SatStat Program page 3-10
- Using and Reading the Receiver Status Screen page 3-11
 - Tutorial on Using the Status Screen to Interface With the Receiver page 3-11
 - Demonstration of Holdover Operation page 3-16
- The Receiver Status Screen at a Glance (foldout) page 3-19

Overview of the Visual User Interface

The combination of the PC and the HP GPS Receiver yields a visual user interface called the Receiver Status Screen that lets the user see what the Receiver is doing and how it is progressing towards tracking satellites to eventually lock to the GPS signal.

When connected to a properly configured PC, the Receiver Status Screen can be accessed. There are two ways to access and use the Receiver Status Screen:

- By installing a commercially available terminal emulation program, and manually sending the `:SYSTEM:STATUS?` query.
- By installing the HP SatStat program for continual status screen updates.

Setting Up the HP GPS Receiver

To Connect Antenna System to the Receiver

Connect the antenna system to the rear-panel **ANTENNA** Type-N connector of the Receiver as described in the instructions given in the subsection titled “To Assemble and Install the Antenna System” in Chapter 1 of the Getting Started guide.

NOTE

*Do not apply power to the Receiver unless a fully operational antenna system is connected to the rear-panel **ANTENNA** input connector. Power applied with no antenna input or a non-functioning antenna will initiate an extended search process that may increase time to reach GPS lock. You can halt the extended search by cycling the Receiver power (you may need to leave power off for greater than five seconds).*

To Connect PC to the Receiver

- 1 Although this isn't necessary for the Receiver to attain GPS lock, connect the HP GPS Receiver to the serial port of a PC via the Receiver's rear-panel **PORT 1** RS-232C port to observe the progress of the Receiver. Use an HP 24542G interface cable as shown in Figure 3-1.

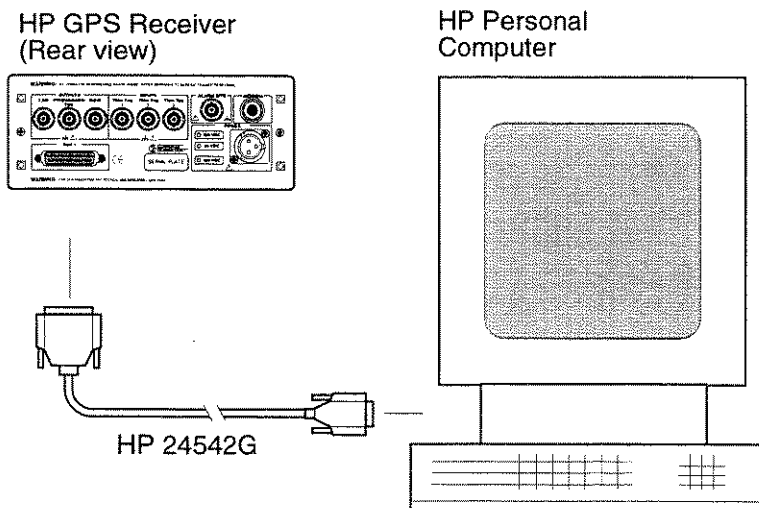


Figure 3-1. Connecting the HP GPS Receiver to a Computer

Visual User Interface
Setting Up the HP GPS Receiver

- 2 Turn the PC on.

You will need to run a terminal emulation or telecommunication program on your PC in order to communicate via the RS-232C serial port. Most PCs contain a terminal emulation program, especially PCs equipped with Windows. If your PC does not contain a telecommunication program, purchase one of the following programs: PROCOMM PLUS (DATASTORM Technologies, Inc.®), PROCOMM PLUS for Windows, Cross Talk (Hayes®), or any other terminal emulation program. (Note: HP is not endorsing any of these products.)

If you are using a Windows-based PC, perform procedure in the subsection titled "To Configure Terminal Communications for Windows-based PC" on page 3-5.

If you are using a DOS-based PC (no Windows application), perform procedure in the subsection titled "To Configure Terminal Communications for DOS-based PC (No Windows)" on page 3-6.

To Configure Terminal Communications for Windows-based PC

- 1 Select or double click on the Terminal icon (a picture of a PC with a telephone in front of it) in the Accessories window.
- 2 Select **Settings**, then choose **Communications**.
A dialog box is displayed that allows you to configure your PC.
- 3 Set the RS-232C port of your PC to match the following default values:

Pace: NONE

Baud Rate: 9600

Parity: NONE

Data Bits: 8

Stops Bits: 1

Setting Up the HP GPS Receiver

NOTE

The RS-232C port configurations of the Receiver and the PC must be the same for communications between the two. Thus, for this power-up procedure, set your PC to match the default values listed above if this Receiver is being powered up for the first time from the factory.

If the default values have been changed, as would be indicated by an error generation or no **scpi>** prompt displayed after pressing Return (or Enter) on your PC, then refer to the subsection titled "If Changes Have Already Been Made to the Serial Port Settings" in Chapter 2 of this guide for more information.

NOTE

Do not apply power to the Receiver unless a fully operational antenna system is connected to the rear-panel ANTENNA input connector. Power applied with no antenna input or a non-functioning antenna will initiate an extended search process that may increase time to reach GPS lock. You can halt the extended search by cycling the Receiver power (you may need to leave power off for greater than five seconds).

-
- 4 In the Communications dialog box, be sure to select the appropriate port or connector (COM2, for example).
 - 5 Next, perform the power-up procedure described in the subsections titled "To Power Up the Receiver."

To Configure Terminal Communications for DOS-based PC (No Windows)

- 1 Make sure you have a DOS telecommunication program such as PROCOMM PLUS and refer to a DOS reference guide for the proper command to send. *Hint:* send MODE COM2:9600, N,8,1 or MODE COM2:BAUD=9600, PARITY=NONE, DATA=8,STOP=1.
- 2 Next, perform the power-up procedure described in the following subsection.

Setting Up the HP GPS Receiver

To Power Up the Receiver

- 1 Apply the proper power source to the rear-panel **Power** input jack of the Receiver. (See the appropriate subsection titled “To Assemble the DC Power Connector” or “To Connect AC Power” in Chapter 1 of the Getting Started guide.

The following sequence of events occurs after power is applied to the Receiver.

- a. Only the front-panel **Power** indicator lights.
- b. After a moment, the Receiver runs through its self-test diagnostics as indicated by the flashing front-panel indicators.
- c. After the self test is completed, just the **Power** indicator remains illuminated, and the **scpi>** prompt is displayed on the screen of the PC. (There could also be an **E xxx>** prompt if a pre-existing error has occurred.)

If the **Alarm** indicator lights, a failure may have occurred during the self test. Refer to the section titled “Operating Status” in Chapter 5, “Command Reference,” of the Operating and Programming guide for a complete description of the Alarm capability.

- d. The Receiver begins to search the sky for all available satellites.

Accessing the Receiver Status Screen (the Visual User Interface)

Overview of the Visual User Interface

The combination of the PC and the HP GPS Receiver yields a visual user interface called the Receiver Status Screen that lets the user see what the Receiver is doing and how it is progressing towards tracking satellites to eventually lock to the GPS signal.

When connected to a properly configured PC, the Receiver Status Screen can be accessed. There are two ways to access and use the Receiver Status Screen:

- By installing a commercially available terminal emulation program, and manually sending the `:SYSTEM:STATUS?` query.
- By installing the HP SatStat Windows program for continual status screen updates.

To Access the Manually Operated Receiver Status Screen

- 1 From the computer keyboard, type
`:SYSTEM:STATUS?` and press Enter (or Return).

If no prompt or a corrupted prompt is displayed, then refer to the subsection titled "If Changes Have Already Been Made to the Serial Port Settings" in Chapter 2 of this guide for more information.

The computer displays the status screen as shown in the sample status screen in Figure 3-2.

(Note that you must re-enter the `SYSTEM:STATUS?` command each time you want an updated status screen.)

- 2 See the section titled "Using and Reading the Receiver Status Screen" on page 3-11 of this guide for a description of how to use and read the satellite acquisition information displayed in the status screen.

```

----- Receiver Status -----
SYNCHRONIZATION ..... [ Outputs Valid/Reduced Accuracy ]
SmartClock Mode _____ Reference Outputs _____
>> Locked to GPS: stabilizing frequency TFOM 6 FFOM 1
Recovery 1PPS TI +71 ns relative to GPS
Holdover HOLD THR 1.000 us
Power-up Holdover Uncertainty _____
Predict --

ACQUISITION ..... [GPS 1PPS Valid]
Satellite Status _____ Time _____
Tracking: 5 Not Tracking: 4 UTC 17:56:44 31 Jan 1996
PRN El Az SS PRN El Az GPS 1PPS Synchronized to UTC
2 70 337 134 9 11 292 ANT DLY 0 ns
7 46 188 117 16 24 243 Position _____
15 33 82 54 *26 Acq.. MODE Survey: 1.2% complete
19 28 113 29 31 -- --- AVG LAT N 37:19:34.746
22 65 91 128 AVG LON W 121:59:50.502
AVG HGT +34.14 m (MSL)
ELEV MASK 10 deg *attempting to track
HEALTH MONITOR ..... [ OK ]
Self Test: OK Int Pwr: OK Oven Pwr: OK OCXO: OK EFC: OK GPS Rcv: OK
    
```

Figure 3-2. Sample Status Screen

To Install the Automated HP SatStat Program for Continual Status Updates

This Windows program provides, among other things, continual status updates of the Receiver Status Screen. Your PC must have Windows installed to operate the program. The program is easy to install and operate.

- 1 Insert the HP SatStat disk in drive A.
- 2 From the File menu in either the Program Manager or File Manager, choose Run.
- 3 Type **a:setup**, and click **OK** or press Enter (Return). The SatStat Setup screen will appear, and installation will proceed.
- 4 Once the program is installed, you can start it by double-clicking the **HP SatStat** icon that was created during the installation.
- 5 You should establish communication with the HP GPS Receiver. This requires connection from a serial RS-232C port on your PC to the HP GPS Receiver's serial port (a 25-pin RS-232C connection). Assuming you've got the cable attached to make this connection, you may want to check the settings.

Accessing the Receiver Status Screen (the Visual User Interface)

- a. Select **CommPort**, then choose **Settings**.

The Communication Settings dialog box is displayed. Unless someone has reprogrammed the CommPort settings on the HP GPS Receiver, these settings are probably OK. *The one setting that is likely to need changing is the Com Port. The application defaults it to Com1, but the serial port on your PC may be assigned to a different Com Port. Select the appropriate setting. If you are unsure, Com1 will be your best bet (worst case, you can cycle through all of them until it works).*

- b. If you made any changes on this Settings form, select **OK**, otherwise you can just **Cancel**.

To Operate the Automated HP SatStat Program

- 1 Select **CommPort**, then choose **Port Open**.

The main form of the Receiver Status Screen is displayed. The program will send some commands to the HP GPS Receiver and then the main form should begin to periodically update every few seconds. If you are getting screen updates, proceed to the next step. Otherwise, something is wrong with your CommPort settings or perhaps the physical connection between your PC and the HP GPS Receiver.

If you need to control the Receiver or query for the status of a setting of the Receiver, use the "Control & Query" form. To activate this form, click anywhere on it. Select **Control** (or **Query**), then choose the type of control (or query) you want. This will pull down a list of control (or query) functions that you can choose from, and the corresponding command will be displayed. To send the command, click on **Send Cmd**. Hence, with the Control & Query form you can control the Receiver without knowing the command or query.

More information about the Windows program is provided in the "Getting Started" Help file.

- 2 Refer to the section titled "Using and Reading the Receiver Status Screen" on page 3-11 for a tutorial and demonstration of what to look for when viewing the status screen.

Using and Reading the Receiver Status Screen

As mentioned earlier in this chapter, the Receiver Status Screen can be accessed when the Receiver is connected to a properly configured PC. There are two ways to access and use the Receiver Status Screen:

- By installing a commercially available terminal emulation program, and manually sending the `:SYSTEM:STATUS?` query (see pages 3-8 and 3-9).
- By installing the HP SatStat program for continual status screen updates (see pages 3-9 and 3-10).

The following tutorial demonstrates how you can use the Receiver Status Screen to observe Receiver operation. The tutorial uses the manual (`:SYSTEM:STATUS?`) method.

Tutorial on Using the Status Screen to Interface With the Receiver

Type `:SYSTEM:STATUS?` at the `scpi>` prompt.

An initial power-up screen is displayed, which is similar to the demonstration screen shown in Figure 3-3. The first data that you should look at is in the SYNCHRONIZATION area of the screen. It is telling you that it is in the Power-up state as indicated by the `>>` marker. That is, the Receiver has just been put on line.

Visual User Interface

Using and Reading the Receiver Status Screen

```
----- Receiver Status -----
SYNCHRONIZATION ..... [ Outputs Invalid ]
SmartClock Mode _____ Reference Outputs _____
  Locked                      TFOM      9                FFOM      3
  Recovery                    1PPS TI  --
  Holdover                    HOLD THR 1.000 us
>> Power-up:GPS acquisition  Holdover Uncertainty _____
                               Predict   --

ACQUISITION ..... [GPS 1PPS Invalid]
Satellite Status _____ Time _____
Tracking: 0      Not Tracking: 6      UTC      12:00:00[?] 01 JAN 1996
                PRN  El  Az          GPS 1PPS Invalid:not tracking
                *1  --  ---          ANT DLY  0 ns
                *6  --  ---          Position _____
                *9  --  ---          MODE      Survey: 0% complete
                *14 --  ---          Suspended:Track <4 sats
                *22 --  ---          INIT LAT N  0:00:00.000
                *24 --  ---          INIT LON W  0:00:00.000
ELEV MASK 10 deg *attempting to track  INIT HGT      0 m (MSL)
HEALTH MONITOR ..... [ OK ]
Self Test: OK Int Pwr: OK Oven Pwr: OK  OCXO: OK  EFC: OK  GPS Rcv: OK
```

Figure 3-3. Receiver Status Screen at Powerup

The ACQUISITION area of the screen is telling you that no satellites have been tracked. The identification numbers of several satellites appear in the Not Tracking column. The asterisk next to the satellite identification number, or pseudorandom noise code (PRN), indicates the Receiver is attempting to track it.

The current time and date are shown in the Time quadrant of the ACQUISITION area. The default power-up setting, indicated by [?], is corrected when the first satellite is tracked. Since the Receiver is not tracking any satellites, the GPS 1 PPS reference signal is invalid.

An accurate position is necessary to derive precise time from GPS. The Position quadrant indicates that the Receiver is in survey mode, which uses GPS to determine the position of the GPS antenna. This process has not yet started, since position calculations can be performed only while tracking four or more satellites. INIT LAT, INIT LON, and INIT HGT are the initial estimate of the true position. These coordinates are refined by the survey process. The Receiver uses this position and the time-of-day to select satellites to track. Therefore, you can reduce satellite acquisition time by specifying an close approximation of position and time.

Visual User Interface

Using and Reading the Receiver Status Screen

Now, let's send the :SYSTEM:STATUS? query again to see what kind of progress the Receiver has made.

You can now see that the Receiver is tracking several satellites as shown in Figure 3-4. The process of acquiring and tracking satellites is described in the following paragraphs.

```
----- Receiver Status -----
SYNCHRONIZATION ..... [ Outputs Valid/Reduced Accuracy ]
SmartClock Mode _____ Reference Outputs _____
>> Locked to GPS: stabilizing frequency TFOM 6 FFOM 1
Recovery 1PPS TI +71 ns relative to GPS
Holdover HOLD THR 1.000 us
Power-up Holdover Uncertainty _____
Predict --

ACQUISITION ..... [GPS 1PPS Valid]
Satellite Status _____ Time _____
Tracking: 5 Not Tracking: 4 UTC 17:56:44 31 Jan 1996
PRN El Az SS PRN El Az GPS 1PPS Synchronized to UTC
2 70 337 134 9 11 292 ANT DLY 0 ns
7 46 188 117 16 24 243 Position _____
15 33 82 54 *26 Acq.. MODE Survey: 1.2% complete
19 28 113 29 31 -- ---
22 65 91 128
AVG LAT N 37:19:34.746
AVG LON W 121:59:50.502
ELEV MASK 10 deg *attempting to track AVG HGT +34.14 m (MSL)
HEALTH MONITOR ..... [ OK ]
Self Test: OK Int Pwr: OK Oven Pwr: OK OCXO: OK EFC: OK GPS Rcv: OK
```

Figure 3-4. Receiver Status Screen Displaying Initial Satellite Acquisition

An asterisk (*) next to the PRN of a satellite in the Not Tracking column indicates the Receiver is attempting to track it. The elevation (El) and azimuth (Az) angles of the satellite are indicated. Acq . or Acq .. tell you that the Receiver is attempting to track that satellite. One dot after the Acq indicator shows that the Receiver is attempting to acquire its signal, and two dots indicate impending lock. Eventually, you will see the satellite move from the Not Tracking column, which shows the satellite PRN, the elevation angle of the satellite in the sky (90° being zenith), the azimuth angle (number of degrees bearing from true north), and the signal strength (SS). A good signal strength is a number above 20, which would be efficient for the Receiver to operate. Numbers below 20, suggest intermittent tracking of the satellite or no tracking; check your antenna system should this be the case.

Using and Reading the Receiver Status Screen

As indicated by the demonstration screen in Figure 3-4, the Receiver is now surveying for position. It is tracking four satellites which is the minimum number that must be tracked to determine position. As you can see, the Position MODE line indicates survey is 1.2% complete. A complete survey would take two hours during which four satellites or more are continuously tracked.

Also, you can see the initial (estimated) position has been replaced with a computed position, which the Receiver continuously refines until it gets a very accurate position. The status screen indicates that a computed position is being used by displaying the averaged latitude, and longitude height (AVG LAT, AVG LON, and AVG HGT).

If the position were not precise, GPS timing information would be inaccurate by an amount corresponding to the error in the computed position. An error in the computed position of the antenna translates into an error in the derived time and will compromise the Receiver's ability to be a timing source.

Let's consider a case where four satellites are not visible at powerup because of a poor antenna location, such as an "urban canyon" (located between tall city buildings). If accurate position is known from a Geodetic survey of that site, it can be programmed with the position command, thereby bypassing the survey operation. This is useful when four satellites cannot be tracked for an extended period of time.

Let's send the :SYSTEM:STATUS? query again to observe the current status of the Receiver.

The updated demonstration status screen in Figure 3-5 indicates that the position survey is now 5.4% complete. Thus, the survey task is beginning to iterate toward an accurate position. In the Time quadrant, the UTC time is now correct. The date is correct, and the GPS reference signal is synchronized to UTC.

Using and Reading the Receiver Status Screen

```

----- Receiver Status -----
SYNCHRONIZATION.....[ Outputs Valid/Reduced Accuracy ]
SmartClock Mode _____ Reference Outputs _____
>> Locked to GPS: stabilizing frequency TFOM 4 FFOM 1
Recovery 1PPS TI +20 ns relative to GPS
Holdover HOLD THR 1.000 us
Power-up Holdrover Uncertainty _____
Predict 432.0 us/initial 24 hrs

ACQUISITION..... [GPS 1PPS Valid]
Satellite Status _____ Time _____
Tracking: 6 Not Tracking: 1 UTC 18:47:07 31 Jan 1996
PRN E1 Az SS PRN E1 Az GPS 1PPS Synchronized to UTC
2 70 301 82 16 13 258 ANT DLY 0 ns
7 35 186 71 Position
19 40 102 61 MODE Survey: 5.4% complete
22 71 60 84
26 19 317 54
31 16 41 52
ELEV MASK 10 deg AVG LAT N 37:19:34.937
HEALTH MONITOR..... [ OK ]
Self Test: OK Int Pwr: OK Oven Pwr: OK OCXO: OK EFC: OK GPS Rcv: OK
    
```

Figure 3-5. Receiver Status Screen Displaying Progress Towards Steady-State Operation

In the SYNCHRONIZATION area, the >> marker is pointed at the Locked to GPS line, indicating that the Receiver is locked to GPS and stabilizing the frequency of its oscillator. This means that the Receiver has phase-locked its oscillator to the 1 PPS reference signal provided by GPS, but it is not at its final, or most stable, state. The Receiver is locked and the front-panel **GPS Lock LED** is illuminated.

For users without the command interface (PC/Terminal emulator connected to the Receiver), the illuminated **GPS Lock LED** is probably the first indication that after powerup that the Receiver is moving towards a stable state.

With the command interface and status screen, you can get more detailed information. For example, you can read the reference outputs quality indicators in the Reference Outputs area of the status screen. These are the Time Figure of Merit (TFOM) and Frequency Figure of Merit (FFOM) indicators. As shown in Figure 3-5, the TFOM is 4 and the FFOM is 1. These values will eventually decrease towards the ultimate values that represent steady-state performance. Refer to the subsection titled “Reference Outputs,” in Chapter 2, “Features and Functions,” of the Getting Started guide for more information about TFOM and FFOM.

Also indicated is a prediction of the accuracy of the Receiver should it go into holdover operation.

Demonstration of Holdover Operation

CAUTION

The Receiver typically reaches stable state 24 hours after powerup, and it will learn best if its experiences no holdover in the first 24 hours. Therefore, the holdover demonstration in the following paragraphs will compromise the Receiver's ability to learn the characteristics of its internal reference oscillator. For the purpose of education only, you will be shown how to initiate a holdover.

A user should *never* initiate holdover during the first 24 hours while the Receiver is learning its internal oscillator characteristics. The Receiver should maintain GPS lock during this time because it is using the GPS signal to discipline the oscillator. It will learn what the oscillator drift characteristics are relative to the GPS signal. It will learn how the oscillator ages, and the software will learn how to compensate for that aging.

Thus, it is recommended that the Receiver is always kept locked to GPS during the first 24 hours.

For demonstration purposes, and since the Receiver has been powered up for a while, let's put the Receiver into holdover by simply removing the antenna connection. (*Note that holdover also can be manually initiated by sending the SYNCHRONIZATION:HOLDOVER:INITIATE command; however, for this demonstration, disconnect the antenna cable.*) The following will occur :

- The front-panel **Holdover** LED will illuminate, and
- after sending the :SYSTEM:STATUS? query again, a screen similar to Figure 3-6 should appear.

Let's send the :SYSTEM:STATUS? query. Figure 3-6 should appear.

Visual User Interface

Using and Reading the Receiver Status Screen

```
----- Receiver Status -----
SYNCHRONIZATION ..... [ Outputs Valid/Reduced Accuracy ]
SmartClock Mode _____ Reference Outputs _____
  Locked to GPS                TFOM      3                FFOM      2
  Recovery                      1PPS TI  --
>> Holdover: GPS 1PPS invalid   HOLD THR 1.000 us
  Power-up                      Holdover Uncertainty _____
                                Holdover Duration: 0m 14s
                                Predict 432.0 us/initial 24 hrs
                                Present 1.0 us
ACQUISITION ..... [GPS 1PPS Invalid]
Satellite Status _____ Time _____
Tracking: 0                Not Tracking: 7
                                PRN  E1  Az  PRN  E1  Az
                                *2   71 316 *31  12  29
                                *7   41 186
                                15  11  86
                                *19  35 107
                                *22  68  78
                                *26  23 314
                                *attempting to track
ELEV MASK 10 deg
HEALTH MONITOR ..... [ OK ]
Self Test: OK  Int Pwr: OK  Oven Pwr: OK  OCXO: OK  EFC: OK  GPS Rcv: OK
```

Figure 3-6. Receiver Status Screen Displaying Holdover Operation

In the SYNCHRONIZATION area, you can see that the Receiver has gone into holdover as indicated by >> marker that is pointing at the Holdover line. The status screen indicates that the reason the Receiver is in holdover is because the GPS 1 PPS reference signal is invalid.

You would expect this since the antenna has been disconnected.

The status screen shows, instantaneously, loss of the GPS signal. As you can see on the screen, all of the satellites in the Tracking column moved into the Not Tracking column.

The status screen in Figure 3-6 shows that the Receiver has been in holdover operation for 14 seconds.

If the Receiver HP SmartClock had had enough time to learn the internal oscillator characteristics (24 hours), the Receiver status screen would show that the Receiver went into holdover, and the Receiver's outputs were maintained during holdover by the HP SmartClock.

When the GPS antenna is re-connected and the GPS signal has been re-acquired, the Receiver has the ability to recover from holdover by itself. The SYNCHRONIZATION area of the screen will show the >> marker pointing at the Recovery line (and then eventually at the

Visual User Interface

Using and Reading the Receiver Status Screen

Locked to GPS line), the GPS Lock LED will illuminate, and the screen will look similar to Figure 3-7.

```
----- Receiver Status -----
SYNCHRONIZATION .....[ Outputs Valid/Reduced Accuracy ]
SmartClock Mode _____ Reference Outputs _____
>> Locked to GPS: Stabilizing frequency TFOM 3 FFOM 1
Recovery 1PPS TI +10.6 ns relative to GPS
Holdover HOLD THR 1.000 us
Power-up Holdover Uncertainty _____
Predict 432.0 us/initial 24 hrs

ACQUISITION ..... [GPS 1PPS Valid]
Satellite Status _____ Time _____
Tracking: 6 Not Tracking: 0 UTC 20:59:28 31 Jan 1996
PRN El Az SS GPS 1PPS Synchronized to UTC
2 71 317 80 ANT DLY 0 ns
7 34 185 73 Position _____
19 41 101 64 MODE Survey: 71.4% complete
22 67 80 87 LAT N 37:19:32.486
26 24 312 55 LON W 121:59:52.082
31 12 27 49 HGT +40.06 m (MSL)
ELEV MASK 10 deg HEALTH MONITOR ..... [ OK ]
Self Test: OK Int Pwr: OK Oven Pwr: OK OCXO: OK EFC: OK GPS Rcv: OK
```

Figure 3-7. Receiver Status Screen Following Recovery from Holdover Operation

You can see the Receiver has recovered from holdover almost immediately and it has returned to locked operation.

The Receiver Status Screen at a Glance

SYNCHRONIZATION

SYNCHRONIZATION profiles the process of synchronizing time and frequency reference signals with GPS.

HP SmartClock technology compares and adjusts (locks) the reference oscillator to GPS. In the absence of GPS, HP SmartClock operates in "holdover" mode, which maintains precise time and frequency over an extended duration by predicting and compensating for aging and temperature effects.

SmartClock Mode

Locked to GPS
Reference signals are synchronous with GPS. When stabilizing frequency is reported, short-term frequency errors limit the accuracy of the 10-MHz reference.

Recovery: ...
Adjusting the frequency and phase of the oscillator to correct errors accrued while in holdover operation. The phase difference between the GPS 1PPS reference and disciplined oscillator 1PPS signal is shown.

Holdover: ...
Reference outputs are not synchronous with GPS due to the reported condition. HP SmartClock maintains timing accuracy by applying learned oscillator characteristics.

GPS 1PPS invalid
Not tracking any satellites, or position is inaccurate
1PPS TI exceeds hold threshold
Phase difference between 1PPS signals exceeds a specified limit (**HOLD THR**)
manually initiated
User-initiated holdover.

Holdover Duration is the cumulative duration of holdover and recovery operations.

Power-up: ...
Warm-up/initial adjustment of the oscillator.

Reference Outputs

Measures of signal quality:

TFOM (Time Figure of Merit)

Accuracy of the 1PPS reference. A number between 0 (best) and 9 that denotes a timing error of 10^{TFOM-1} to 10^{TFOM} nanoseconds.

FFOM (Frequency Figure of Merit)

Frequency stability of the 10-MHz reference:

- 0 - Stable, signal within specification
- 1 - Stabilizing this signal
- 2 - Holdover mode: frequency will drift
- 3 - Signal is unusable.

1PPS TI (Time Interval)

Average phase difference between the GPS reference and oscillator 1PPS signals.

HOLD THR (Holdover Threshold)

1PPS phase difference that while exceeded forces holdover operation.

Receiver Status

```

SYNCHRONIZATION [ Outputs Valid/Reduced Accuracy ]
SmartClock Mode Reference Outputs
Locked TFOM 3 FFOM 2
>> Recovery: phase alignment [TI +1.296 us]
Holdover HOLD THR 1.000 us
Power-up Holdover Uncertainty
Predict 55.8 us/initial 24 hrs
Present 1.0 us

Holdover Duration: 1m 45s [ GPS 1PPS Valid ]

ACQUISITION
Tracking: 1 Not Tracking: 9
PRN E1 AZ SS PRN E1 AZ PRN E1 AZ
31 75 254 168 * 2 19 313 29 Not OK GPS 1PPS Synchronized to UTC
* 4 Acq * 5 Acq * 7 ---
* 9 35 140
* 15 Ignore
* 24 Acq
* 26 47 258
ELEV MASK 10 deg *attempting to track 60.52 m (MSL)

HEALTH MONITOR
Self Test: OK Int Pwr: OK Oven Pwr: OK OCXO: OK EFC: OK GPS Rcv: OK
    
```

ACQUISITION

ACQUISITION profiles the process of acquiring precise time from GPS. GPS provides time-of-day information and a 1PPS reference signal used to discipline the internal oscillator.

Time

Time of day:
UTC - Coordinated Universal Time
LOCAL - UTC with local time zone offset
GPS - GPS Time
LOCL GPS - GPS Time, with time zone offset
 [?] identifies a default power-up setting that is corrected when the first satellite is tracked.
 +1 (or -1) leap second pending is reported if a leap second correction to UTC is pending.

GPS 1PPS indicates the validity of the GPS 1PPS reference:

- 1PPS reference to UTC (or GPS Time)
- 1PPS reference is synchronous with GPS
- Questionable accuracy...

- 1PPS must be accurate for 35 seconds
- Inaccurate: not tracking
- Inaccurate: inacc position
- One or more satellites must be tracked

- Position must be known to derive time
- Inaccurate: Time RAIM err
- GPS timing integrity is suspect

ANT DLY offsets the GPS 1PPS reference to compensate for signal propagation delays introduced by the antenna system. (Time is referenced to the position of the antenna.)

Position

An accurate position is necessary to transfer time from GPS. Two position **MODES** are provided, hold and survey.

In **Hold** mode, a fixed position is used to derive time. This position may be specified if known, or determined by the survey process.

In **Survey** mode, position is determined from GPS. Four or more satellites must be tracked. Successive positional estimates (pseudoranges) are refined to obtain the true position, which is entered as the held position at the completion of this process.

Averaged (AVG) position coordinates and progress are reported while surveying. When surveying is suspended, an advisory message describes the reason:

- Suspended: track < 4 sats
- Four or more satellites must be tracked to determine position
- Suspended: poor geometry
- **DOP** (dilution of precision) is too large for an accurate pseudo-range measurement.

Specifying an approximate initial (**INIT**) position will reduce satellite acquisition time.

Tracking

Satellites currently tracked by the receiver. Four or more satellites must be tracked to determine position. Timing information is derived from all tracked satellites, and is considered accurate while tracking at least one satellite from a known position. The receiver selects satellites highest in the sky that are at or above the minimum elevation angle specified by **ELEV MASK**.

Not Tracking

Satellites considered for tracking. These satellites are predicted to be visible or are selected by the "sky search" algorithm. Visibility is predicted from the satellite almanac, current time and position.

Tracking and Not Tracking tables provide supplemental information about satellite position, signal strength and health:

- PRN** - Identification number (pseudorandom noise code) assigned to the satellite. Satellites are sorted by ascending PRNs.
- EI** - Elevation of the satellite (degrees) predicted by the almanac. "-" denotes it is unknown, such as when the satellite is not predicted to be visible but is selected for tracking by the sky search algorithm.
- AZ** - Azimuth of the satellite (degrees), referenced to true north, predicted by the almanac; "-" if unknown.
- SS** - Relative signal strength, proportional to the signal-to-noise ratio of the received signal. The maximum value is 255; 20 to 30 is the minimum range for stable tracking.
- Acq** - Locking code and carrier tracking loops to initially acquire the satellite signal.
- Acq** - Demodulating the satellite broadcast (NAV) message, and determining current time.
- Acq** - Reading the satellite ephemeris (orbital information) from the NAV message.
- Ignore** - The satellite is excluded from the selection process.
- Not OK** - GPS or Time RAIM reports the satellite is unhealthy.

HEALTH MONITOR

HEALTH MONITOR reports the operational status of key receiver components and internal signals. When **Err** is reported:

Self Test
Last diagnostic check of the microprocessor system, reference oscillator, satellite receiver and power supplies failed.

Int Pwr
Internal power supply voltage(s) exceeds tolerance.

Oven Pwr
Oscillator oven power supply voltage exceeds tolerance.

OCXO
Oscillator output failed.

EFC
Oscillator control voltage is at or near full-scale.

GPS Rcv
Satellite receiver communication failed, or GPS 1PPS reference is absent.

Holdover Uncertainty
Estimations of timing accuracy while in holdover mode, which reflect the extent to which HP SmartClock has learned the oscillator's characteristics.

Predict
Maximum timing error that can be expected over the initial 24 hours of holdover operation.

Present
Maximum timing error currently expected.

Chapter Contents

This chapter is a quick reference that summarizes the HP GPS Receiver commands which allow you to operate and program the Receiver.

This chapter is organized as follows:

- An Introduction to the HP GPS Receiver Commands page 4-4
 - SCPI Conformance Information page 4-4
 - Command Syntax Conventions page 4-4
 - Command Presentation page 4-4
- GPS Satellite Acquisition page 4-5
 - Facilitating Initial Tracking page 4-5
 - Establishing Position page 4-5
 - Selecting Satellites page 4-6
 - Compensating for Antenna Delay page 4-6
 - Monitoring Acquisition page 4-6
- 1 PPS Reference Synchronization page 4-7
 - Monitoring 1 PPS Synchronization page 4-7
 - Assessing 1 PPS Quality page 4-7
 - Operating in Holdover page 4-7
- Operating Status page 4-8
 - Receiver Operation at a Glance page 4-8
 - Reading the Error Queue page 4-8
 - Reading the Diagnostic Log page 4-8
 - Monitoring Status/Alarm Conditions page 4-8
 - Assessing Receiver Health page 4-9

Command Quick Reference

Chapter Contents

- System Time page 4-10
 - Identifying Time of Next 1 PPS Reference Edge page 4-10
 - Reading Current Time page 4-10
 - Applying Local Time Zone Offset page 4-10
 - Defining the 1 PPS Reference Edge (HP 59551A Only) page 4-10
 - Reading Leap Second Status page 4-10
- Programmable Pulse Output (HP 59551A Only) page 4-11
- Event Time Stamping (HP 59551A Only) page 4-12
 - Defining the Time-stamped Edge page 4-12
 - Clearing Time Stamp Memory page 4-12
 - Reading Time Stamps page 4-12
 - Processing Memory Overflows page 4-12
- Serial Interface Communication page 4-13
 - Configuring I/O Port 1 page 4-13
 - Configuring I/O Port 2 (HP 59551A Only) page 4-13
 - Recovering the Last Query Response page 4-13
- Receiver Initialization page 4-14
- Receiver Identification/Upgrade page 4-15
 - Reading Product Identification page 4-15
 - Installing Firmware via I/O Port 1 page 4-15
- Receiver Commands at a Glance/
Status Reporting System at a Glance (foldout) page 4-17

An Introduction to HP GPS Receiver Commands

SCPI Conformance Information

The SCPI commands used in the HP GPS Receiver are in conformance with the SCPI Standard Version 1994.0.

Details of all the HP GPS Receiver commands can be found in Chapter 5, "Command Reference," of this guide.

Information on the SCPI commands format, syntax, parameter, and response types is provided in Appendix B, "SCPI Syntax and Style," of this guide.

Command Syntax Conventions

POSition Means you **MUST** use either all the upper case letters or the entire word. The lower case letters are optional. For example, POS and POSITION are both valid. However, POSI is not valid. (Note POSITION is used here as an example, but this convention is true for all command keywords.) In other words, the short form of the keywords is shown in uppercase.

NOTE

When you see quotation marks in the command's parameter, you must send the quotation marks with the command.

Command Presentation

The shaded commands listed in the following sections are the "basic" (fundamental) or most commonly used commands. These commands are essential for operating the Receiver; thus, a brief description of each of these commands is included in this section. More complete descriptions are provided in Chapter 5, "Command Reference."

The non-shaded commands listed in this section are not fundamental or not commonly used. These commands are used for one-time setup, advanced, or specialized operation of the Receiver. Descriptions of these commands are provided in Chapter 5 only.



GPS Satellite Acquisition

The following commands are provided to facilitate initial GPS satellite tracking, to establish accurate GPS antenna position, to select or ignore satellites, to compensate for antenna cable delay, and to monitor the acquisition.

Facilitating Initial Tracking

:GPS:INITial:DATE <four-digit year>, <month>, <day>

:GPS:INITial:POSition N or S, <latitude degree>,
<latitude minute>,
<latitude second>,
E or W, <longitude degree>,
<longitude minute>,
<longitude second>,
<height above mean sea level, in meters>

:GPS:INITial:TIME <hour>, <minute>, <second>

Establishing Position

:GPS:POSition N or S, <latitude degree>,
<latitude minute>,
<latitude second>,
E or W, <longitude degree>,
<longitude minute>,
<longitude second>,
<height above mean sea level, in meters>

Specifies the position of the GPS antenna.

:GPS:POSition?

Returns the current average position of the GPS antenna.

:GPS:POSition:ACTual?

Returns the current instantaneous position of the GPS antenna.

:GPS:POSition LAST

:GPS:POSition SURVey

:GPS:POSition:HOLD:LAST?

:GPS:POSition:HOLD:STATe?

:GPS:POSition:SURVey:PROGress?

:GPS:POSition:SURVey:STATe ONCE

:GPS:POSition:SURVey:STATe?

:GPS:POSition:SURVey:STATe:POWerup ON or OFF

:GPS:POSition:SURVey:STATe:POWerup?

GPS Satellite Acquisition

Selecting Satellites

<select> = IGNore or INCLude

:GPS:SATellite:TRACking:EMANgle <degrees>

Sets the GPS elevation mask angle value.

:GPS:SATellite:TRACking:EMANgle?

Returns the GPS elevation mask angle value.

:GPS:SATellite:TRACking:IGNore <PRN>, ... , <PRN>

Sends list of satellites to ignore.

:GPS:SATellite:TRACking:IGNore?

Returns list of satellites to ignore.

:GPS:SATellite:TRACking:INCLude <PRN>, ... , <PRN>

:GPS:SATellite:TRACking:INCLude?

:GPS:SATellite:TRACking:<select>:ALL

:GPS:SATellite:TRACking:<select>:COUNT?

:GPS:SATellite:TRACking:<select>:NONE

:GPS:SATellite:TRACking:<select>:STATE? <PRN>

Compensating for Antenna Delay

:GPS:REFerence:ADELay <seconds>

Sets the GPS antenna delay value in seconds.

:GPS:REFerence:ADELay?

Returns the GPS antenna delay value in seconds.

Monitoring Acquisition

:GPS:REFerence:VALid?

Indicates whether the date and time are valid (1 = valid).

:GPS:SATellite:TRACking?

Returns a list of all satellites being tracked.

:GPS:SATellite:VISible:PREDicted?

Returns the list of satellites (PRN) that the almanac predicts should be visible, given date, time, and position.

:GPS:SATellite:TRACking:COUNT?

:GPS:SATellite:VISible:PREDicted:COUNT?



1 PPS Reference Synchronization

The following commands are provided to monitor the operating mode of the reference oscillator, to determine the accuracy and stability of the reference output signal(s), and to control the oscillator holdover process.

Monitoring 1 PPS Synchronization

:SYNChronization:STATE?

Returns the Receiver state.

:DIAGnostic:ROSCillator:EFControl:RELative?

:LED:GPSLock?

:LED:HOLDover?

Assessing 1 PPS Quality

:SYNChronization:FFOMerit?

Returns the Frequency Figure of Merit.

:SYNChronization:HOLDover:TUNCertainty:PREdicted?

Returns an estimate of the time error that can be expected for a one day holdover, given the current state of HP SmartClock learning in the Receiver.

:SYNChronization:HOLDover:TUNCertainty:PREsent?

Returns the current time interval error at any time during holdover operation, given the current state of HP SmartClock learning in the Receiver.

:SYNChronization:TFOMerit?

Returns the Time Figure of Merit.

:SYNChronization:TINTerval?

Returns the difference or timing shift between the HP SmartClock 1 PPS and the GPS 1 PPS signals.

:SYNChronization:HOLDover:DURation?

:SYNChronization:HOLDover:DURation:THReshold <seconds>

:SYNChronization:HOLDover:DURation:THReshold?

:SYNChronization:HOLDover:DURation:THReshold:EXCeeded?

Operating in Holdover

Initiating Manual Holdover

:SYNChronization:HOLDover:INITiate

Recovering from Holdover

:SYNChronization:HOLDover:WAITing?

Returns prioritized reason why the Receiver is waiting to recover.

:SYNChronization:HOLDover:RECover:INITiate

:SYNChronization:HOLDover:RECover:LIMit:IGNore

:SYNChronization:IMMediate



Operating Status

The following commands are provided to obtain Receiver status information. There are several ways to obtain Receiver status using commands. For example, you can send a command to display the Receiver Status screen, to read the error queue, and to read the diagnostic log. You can also send a sequence of commands to read and control the status registers for alarm generation.

Receiver Operation at a Glance

:SYSTEM:STATus?

Outputs a fully formatted status screen.

:SYSTEM:STATus:LENGth?

Reading the Error Queue

:SYSTEM:ERRor?

Returns the oldest error in the Error Queue and removes that error from the queue (first in, first out).

Reading the Diagnostic Log

:DIAGnostic:LOG:CLEar

Clears the diagnostic log.

:DIAGnostic:LOG:READ:ALL?

Returns all of the most recent diagnostic log entries.

:DIAGnostic:LOG:CLEar <current log size>

:DIAGnostic:LOG:COUNt?

:DIAGnostic:LOG:READ?

:DIAGnostic:LOG:READ? <entry number>

Monitoring Status/Alarm Conditions

Clearing and Presetting Alarms

***CLS**

Clears the event status registers and error queue.

:STATus:PRESet:ALARm

Reading and Qualifying Alarms

:LED:ALARm?

Returns status of front-panel Alarm LED.

***SRE <bit mask>**

***SRE?**

***STB?**

Operating Status

Reading and Qualifying Receiver Status

<register> = OPERATION <register> = QUESTIONABLE

<register> = OPERATION:HARDWARE

<register> = OPERATION:HOLDOVER

<register> = OPERATION:POWERUP

:STATUS:<register>:CONDITION?

Returns the Condition Status Register value.

:STATUS:<register>:EVENT?

Returns the Event Status Register value.

:STATUS:<register>:ENABLE <bit mask>

:STATUS:<register>:ENABLE?

:STATUS:<register>:NTRANSITION <bit mask>

:STATUS:<register>:NTRANSITION?

:STATUS:<register>:PTRANSITION <bit mask>

:STATUS:<register>:PTRANSITION?

Reading and Qualifying Command Error Status

*ESE <bit mask>

*ESE?

*ESR?

Reporting Questionable Status

:STATUS:QUESTIONABLE:CONDITION:USER SET or CLEAR

:STATUS:QUESTIONABLE:EVENT:USER PTR or NTR

Assessing Receiver Health

*TST?

Executes an internal selftest and reports the results.

:DIAGNOSTIC:LIFETIME:COUNT?

:DIAGNOSTIC:TEST? ALL or DISPLAY or PROCESSOR or RAM or EEPROM or UART or QSPI or FPGA or INTERPOLATOR or IREFERENCE or GPS or POWER

:DIAGNOSTIC:TEST:RESULT?



System Time

The following commands are provided to allow you to monitor and control the system date and time. These commands allow you access to a very accurate system clock that provides both date and time, to customize the clock for a local time zone, to identify the exact time, to identify the accumulated time difference (in seconds) between the GPS and UTC timelines, and to monitor leap second occurrences.

Identifying Time of Next 1 PPS Reference Edge

R :PTIME:TCODE?

Returns timecode message 980 to 20 ms prior to 1 PPS of indicated time.

Reading Current Time

:PTIME:DATE? or :SYSTEM:DATE?

:PTIME:TIME? or :SYSTEM:TIME?

:PTIME:TIME:STRing?

Applying Local Time Zone Offset

:PTIME:TZONE <hours>, <minutes>

Sets the time zone local time offset to provide an offset from UTC to serve as the basis for all reported time.

:PTIME:TZONE?

Returns the local time zone offset.

Defining the 1 PPS Reference Edge (HP 59551A Only)

:PTIME:PPS:EDGE RIsing or FALLing

Selects the polarity of the 1 PPS on-time edge.

:PTIME:PPS:EDGE?

Returns the polarity of the 1 PPS on-time edge.

Reading Leap Second Status

:PTIME:LEAPsecond:ACCumulated?

Returns the leap second difference accumulated between GPS time and UTC time since the beginning of GPS time. The time units are seconds.

:PTIME:LEAPsecond:DATE?

:PTIME:LEAPsecond:DURation?

:PTIME:LEAPsecond:STATe?

Basic command

R: Accessible via rear-panel PORT 1.



Programmable Pulse Output (HP 59551A Only)

The following commands are provided to allow you to operate and control the programmable pulse output of the HP 59551A GPS Receiver. The pulse output, which is programmable by the user, can either generate a stream of pulses at a specified start time and repetition interval, or can produce a single pulse at a specified time and then stop.

:PULSe:CONTInuous:PERiod <seconds>

Sets the interval between pulses in seconds.

:PULSe:CONTInuous:PERiod?

Returns the interval between pulses in seconds.

:PULSe:CONTInuous:STAtE ON or OFF

Selects whether the Programmable Pulse output will be just one pulse or a sequence of pulses.

:PULSe:CONTInuous:STAtE?

Identifies whether the Programmable Pulse output is set to output a single pulse or sequence of pulses.

:PULSe:REFerence:EDGE RIsing or FALLing

Selects the polarity of the Programmable Pulse on-time edge.

:PULSe:REFerence:EDGE?

Returns the polarity of the Programmable Pulse on-time edge.

:PULSe:STARt:DATE <four-digit year>, <month>, <day>

Sets the date when the individual pulse (or first pulse of the pulse sequence) is to be generated at the Programmable Pulse output.

:PULSe:STARt:DATE?

Returns the date when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.

:PULSe:STARt:TIME <hour>, <minute>, <second>

Sets the time when the individual pulse (or first pulse of the pulse sequence) is to be generated at the Programmable Pulse output.

:PULSe:STARt:TIME?

Returns the time when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.



Event Time Stamping (HP 59551A Only)

The following commands are provided to allow you to time-tag and record events such as power surges and power outages. The time tagging input feature allows you to use the Receiver with equipment which produce a TTL edge when some important event happens in the base station. The Receiver has three time tagging inputs which record the time of occurrence of TTL edge(s).

Defining the Time-stamped Edge

<channel> = 1 or 2 or 3

:SENSe:TSTamp<channel>:EDGE RISING or FALLING

Selects the polarity of the edges the Receiver will timestamp.

:SENSe:TSTamp<channel>:EDGE?

Returns the polarity of the edges the Receiver will timestamp.

Clearing Time Stamp Memory

:SENSe:DATA:CLEAr

Clears the data in the measurement buffer for all Time Tag inputs.

:SENSe:DATA:CLEAr "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

Reading Time Stamps

:SENSe:DATA? "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

Returns the data in the timestamp measurement buffer for the specified Time Tag input.

:FORMat:DATA ASCii or INTeger

:FORMat:DATA?

:SENSe:DATA:POINTs?

:SENSe:DATA:POINTs? "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

:SENSe:DATA:TSTamp? "TSTamp 1" or "TSTamp 2" or "TSTamp 3", <entry number>

Processing Memory Overflow

:SENSe:DATA:MEMory:OVERflow:COUNt?

:SENSe:DATA:MEMory:OVERflow:COUNt? "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

:SENSe:DATA:MEMory:SAVE FIRST or LAST

:SENSe:DATA:MEMory:SAVE?

Basic command



Serial Interface Communication

The following commands are provided to allow you to configure the serial interface port(s) for instrument communications.

Configuring I/O Port 1

R :SYSTem:COMMunicate?
R :SYSTem:COMMunicate:SERial1:BAUD 1200 *or* 2400 *or* 9600 *or* 19200
R,F :SYSTem:COMMunicate:SERial1:BAUD?
R :SYSTem:COMMunicate:SERial1:BITS 7 *or* 8
R,F :SYSTem:COMMunicate:SERial1:BITS?
R :SYSTem:COMMunicate:SERial1:FDUPlex ON *or* OFF
R,F :SYSTem:COMMunicate:SERial1:FDUPlex?
R :SYSTem:COMMunicate:SERial1:PACe XON *or* NONE
R,F :SYSTem:COMMunicate:SERial1:PACe?
R :SYSTem:COMMunicate:SERial1:PARity EVEN *or* ODD *or* NONE
R,F :SYSTem:COMMunicate:SERial1:PARity?
R :SYSTem:COMMunicate:SERial1:SBITS 1 *or* 2
R,F :SYSTem:COMMunicate:SERial1:SBITS?

Configuring I/O Port 2 (HP 59551A Only)

F :SYSTem:COMMunicate?
F :SYSTem:COMMunicate:SERial2:BAUD 1200 *or* 2400 *or* 9600 *or* 19200
R,F :SYSTem:COMMunicate:SERial2:BAUD?
R,F :SYSTem:COMMunicate:SERial2:BITS?
F :SYSTem:COMMunicate:SERial2:FDUPlex ON *or* OFF
R,F :SYSTem:COMMunicate:SERial2:FDUPlex?
F :SYSTem:COMMunicate:SERial2:PACe XON *or* NONE
R,F :SYSTem:COMMunicate:SERial2:PACe?
F :SYSTem:COMMunicate:SERial2:PARity EVEN *or* ODD *or* NONE *or* ONE
R,F :SYSTem:COMMunicate:SERial2:PARity?
R,F :SYSTem:COMMunicate:SERial2:SBITS?

Recovering the Last Query Response

:DIAGnostic:QUERy:RESPonse?

Basic command

R: Accessible via Rear-panel PORT 1.

F: Accessible via Front-panel PORT 2 of the HP 59551A



Receiver Initialization

The following commands are provided to allow you to initialize or preset the serial interface port(s) and the Receiver to their factory shipment values.

```
R :SYSTem:COMMunicate:SERial1:PRESet  
  :SYSTem:COMMunicate:SERial2:PRESet (HP 59551A Only)  
  :SYSTem:PRESet
```

Basic command

R: Accessible via Rear-panel PORT 1.



Receiver Identification/Upgrade

The commands provided in this section allow you to query the identification of the Receiver, and to perform firmware upgrades in the field after you obtain a new firmware disk.

Reading Product Identification

***IDN?**

Returns the Receiver identification.

Installing Firmware via I/O Port 1

R *CLS

R :DIAGnostic:DOWNload <Motorola S-record>

R :DIAGnostic:ERASe

R :DIAGnostic:ERASe?

R :SYSTem:ERRor?

R :SYSTem:LANGuage "INSTALL" or "PRIMARY"

R :SYSTem:LANGuage?

Basic command

R: Accessible via Rear-panel Port 1.

Command Quick Reference
Receiver Identification/Upgrade

Receiver Commands at a Glance



GPS Satellite Acquisition

Facilitating Initial Tracking
:GPS:INITIAt:DATE <year>, <month>, <day>
:GPS:INITIAt:POSITION <position> 1
:GPS:INITIAt:TIME <hour>, <minute>, <seconds>

Establishing Position

:GPS:POSITION <position> 1
:GPS:POSITION?
:GPS:POSITION:ACTUAL?
:GPS:POSITION LAST
:GPS:POSITION SURVEY
:GPS:POSITION:HOLD:LAST?
:GPS:POSITION:HOLD:STATE?
:GPS:POSITION:SURVEY:PROGRESS?
:GPS:POSITION:SURVEY:STATE ONCE
:GPS:POSITION:SURVEY:STATE?
:GPS:POSITION:SURVEY:STATE:POWERUP ON or OFF
:GPS:POSITION:SURVEY:STATE:POWERUP?

Selecting Satellites

<select> = IGNORE or INCLUDE
:GPS:SATellite:TRACKing:EMANgLE <degrees>
:GPS:SATellite:TRACKing:EMANgLE?
:GPS:SATellite:TRACKing:IGNore <PRN>, ..., <PRN>
:GPS:SATellite:TRACKing:IGNore?
:GPS:SATellite:TRACKing:INCLUDE <PRN>, ..., <PRN>
:GPS:SATellite:TRACKing:INCLUDE?
:GPS:SATellite:TRACKing:<select>:ALL
:GPS:SATellite:TRACKing:<select>:COUNT?
:GPS:SATellite:TRACKing:<select>:NONE
:GPS:SATellite:TRACKing:<select>:STATE? <PRN>

Compensating for Antenna Delay

:GPS:REFERENCE:ADELay <seconds>
:GPS:REFERENCE:ADELay?

Monitoring Acquisition

:GPS:REFERENCE:VALId?
:GPS:SATellite:TRACKing?
:GPS:SATellite:VISible:PREDICTed?
:GPS:SATellite:TRACKing:COUNT?
:GPS:SATellite:VISible:PREDICTed:COUNT?

1 PPS Reference Synchronization

Monitoring 1 PPS Synchronization
:SYNChronization:STATE?
:DIAGnostic:ROSCillator:EFFControl:RELAtive?
:LED:GPSLock?
:LED:HOLDover?

Assessing 1 PPS Quality

:SYNChronization:FFoMent?
:SYNChronization:HOLDover:TUNcertainly:PREDICTed?
:SYNChronization:HOLDover:TUNcertainly:PRESENT?
:SYNChronization:TFOMent?
:SYNChronization:TINTerval?
:SYNChronization:HOLDover:DURation?
:SYNChronization:HOLDover:DURation:THReshold <seconds>
:SYNChronization:HOLDover:DURation:THReshold?
:SYNChronization:HOLDover:DURation:THReshold:EXCEEDed?

Operating in Holdover

Initiating Manual Holdover
:SYNChronization:HOLDover:INITIate

Recovering from Holdover

:SYNChronization:HOLDover:WAITing?
:SYNChronization:HOLDover:RECOvery:INITIate
:SYNChronization:HOLDover:RECOvery:LIMit:IGNore
:SYNChronization:IMMediate



Operating Status

Receiver Operation at a Glance
:SYSTEM:STATUS?
:SYSTEM:STATUS:LENGth?

Reading the Error Queue

:SYSTEM:ERROR?
Reading the Diagnostic Log
:DIAGnostic:LOG:CLEAr
:DIAGnostic:LOG:READ:ALL?
:DIAGnostic:LOG:CLEAr <current log size>
:DIAGnostic:LOG:COUNT?
:DIAGnostic:LOG:READ?
:DIAGnostic:LOG:READ? <entry number>

Monitoring Status/Alarm Conditions

Clearing and Presetting Alarms
*CLS
Reading and Qualifying Alarms
:LED:ALARm?
*SRE <bit mask>
*SRE?
*STB?

Reading and Qualifying Receiver Status

<register> = OPERATION <register> = QUESTIONable
<register> = OPERATION:HARDWare
<register> = OPERATION:HOLDover
<register> = OPERATION:POWERup
:STATUS:<register>:CONDITion?
:STATUS:<register>:EVEnt?
:STATUS:<register>:ENABle <bit mask>
:STATUS:<register>:ENABle?
:STATUS:<register>:NTRAnsitioN <bit mask>
:STATUS:<register>:NTRAnsitioN?
:STATUS:<register>:PTRAnsitioN <bit mask>
:STATUS:<register>:PTRAnsitioN?

Reading and Qualifying Command Error Status

*ESE <bit mask>
*ESE?
*ESR?

Reporting Questionable Status

:STATUS:QUESTIONable:CONDITion:USER SET or CLEAR
:STATUS:QUESTIONable:EVEnt:USER PTRAnsitioN or NTRAnsitioN

Assessing Receiver Health

*TST?
:DIAGnostic:LIFetime:COUNT?
:DIAGnostic:TEST? ALL or <specific tests> 2
:DIAGnostic:TEST:RESult?

Command Quick Reference

Receiver Commands at a Glance



Serial Interface Communication

Configuring I/O Port 1 <port> = SERIAL1 or SERIAL
Configuring I/O Port 2 <port> = SERIAL2 (HP 59551A)
R,F :SYSTEM:COMMunicate?
R,F† :SYSTEM:COMMunicate:<port>:BAUD <rate> 4
R,F :SYSTEM:COMMunicate:<port>:BAUD?
R :SYSTEM:COMMunicate:SERIAL1:BITS 7 or 8
R,F :SYSTEM:COMMunicate:<port>:BITS?
R,F† :SYSTEM:COMMunicate:<port>:FDUPlex ON or OFF
R,F :SYSTEM:COMMunicate:<port>:PACE XON or NONE
R,F :SYSTEM:COMMunicate:<port>:PACE?
R :SYSTEM:COMMunicate:SERIAL1:PARity <parity> 5
R,F :SYSTEM:COMMunicate:SERIAL1:PARity <parity> 5 or ONE
R,F :SYSTEM:COMMunicate:SERIAL1:SBITS 1 or 2
R,F :SYSTEM:COMMunicate:<port>:SBITS?

Recovering the Last Query Response

:DIAGnostic:QUERY:RESPonse?



Receiver Initialization

R :SYSTEM:COMMunicate:SERIAL1:PRESet
:SYSTEM:COMMunicate:SERIAL2:PRESet
:SYSTEM:PRESet (HP 59551A)



Receiver Identification/Upgrade

Reading Product Identification

*IDN?

Installing Firmware via I/O Port 1

R *CLS
R :DIAGnostic:DOWNload <Motorola S-records>
R :DIAGnostic:ERASe
R :DIAGnostic:ERASe?
R :SYSTEM:ERRor?
R :SYSTEM:LANGUage "INSTALL" or "PRIMARY"
R :SYSTEM:LANGUage?



System Time

Identifying Time of Next 1 PPS Reference Edge
R :PTIME:TGODe?

Reading Current Time

:PTIME:DATE? or :SYSTEM:DATE?
:PTIME:TIME? or :SYSTEM:TIME?
:PTIME:TIME:STRing?

Applying Local Time Zone Offset

:PTIME:TZONE <hours>, <minutes>
:PTIME:TZONE?

Defining the 1 PPS Reference Edge

:PTIME:PPS:EDGE RISING or FALLING (HP 59551A)
:PTIME:PPS:EDGE?

Reading Leap Second Status

:PTIME:LEAPsecond:ACCumulated?
:PTIME:LEAPsecond:DATE?
:PTIME:LEAPsecond:DURation?
:PTIME:LEAPsecond:STATE?



Programmable Pulse Output

:PULSE:CONTinuous:PERIOD <seconds>
:PULSE:CONTinuous:PERIOD?
:PULSE:CONTinuous:STATE ON or OFF
:PULSE:REFerence:EDGE RISING or FALLING
:PULSE:REFerence:EDGE?
:PULSE:START:DATE <year>, <month>, <day>
:PULSE:START:DATE?
:PULSE:START:TIME <hour>, <minute>, <seconds>
:PULSE:START:TIME?



Event Time Stamping

(HP 59551A)

Defining the Time-stamped Edge

:SENSe:TSTamp:<channel>:EDGE RISING or FALLING
:SENSe:TSTamp:<channel>:EDGE?

Clearing Time Stamp Memory

:SENSe:DATA:CLEAr
:SENSe:DATA:CLEAr <data set> 3

Reading Time Stamps

:SENSe:DATA? <data set> 3
:FORMat:DATA ASCII or INTEGER
:FORMat:DATA?
:SENSe:DATA:POINts?
:SENSe:DATA:POINts? <data set> 3
:SENSe:DATA:TSTamp? <data set> 3, <data element number>

Processing Memory Overflows

:SENSe:DATA:MEMory:OVERflow:COUNT?
:SENSe:DATA:MEMory:OVERflow:COUNT? <data set> 3
:SENSe:DATA:MEMory:SAVE FIRSt or LAST
:SENSe:DATA:MEMory:SAVE?

Accessible via:

R: Rear-panel PORT 1.
F: Front-panel PORT 2 of the HP 59551A.
†Must be received via the specified I/O port.

Parameter Syntax:

- 1 <position> = N or S, <latitude degree>, <latitude minute>, <latitude seconds> E or W, <longitude degree>, <longitude minute>, <longitude seconds>, <height above mean sea level, in meters>
- 2 <specific tests> = DISPLAY or PROCESSOR or RAM or EEPROM or UART or QSPI or FPGA or INTERRUPT or IREFERENCE or GPS or POWER
- 3 <data set> = "TSTamp 1" or "TSTamp 2" or "TSTamp 3"
- 4 <rate> = 1200 or 2400 or 9600 or 19200
- 5 <parity> = EVEN or ODD or NONE

Shading identifies basic commands that access key receiver functions and settings.

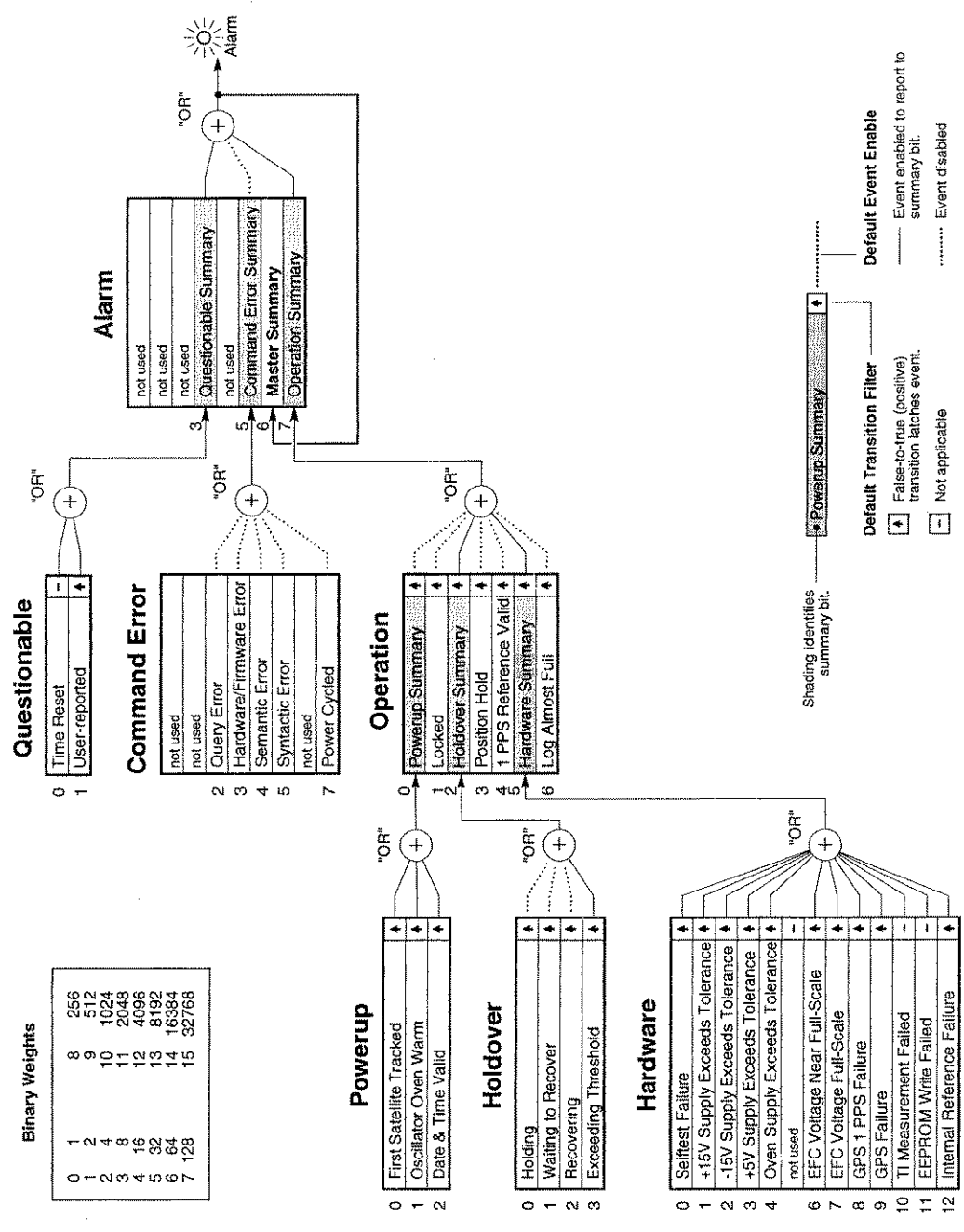
Parameter(s)

Literal parameters are enumerated settings that are represented by mnemonics (e.g., ON). Non-literal data types (or literal parameters requiring further explanation) are denoted by syntactic elements, which appear in *italic* type between angle brackets (<>).

Header

Long and short form mnemonics of headers and parameters are listed, with the short form portion shown in uppercase characters. Although mnemonics are not case-sensitive, only the exact long forms and exact short forms are recognized. Many commands have a corresponding query form. A query is a command header with a question mark (?) appended.

Status Reporting System at a Glance



Chapter Contents

This chapter provides a description of each command that can be used to operate the HP GPS Receiver. The commands are grouped by functions. The functions are grouped and ordered the same as they are in Chapter 4, “Command Quick Reference,” and on the foldout “Receiver Commands at a Glance.”

This chapter is organized as follows:

- Command Syntax Conventions page 5-4
- Description Format page 5-5
 - Commands and Returns page 5-5
 - Query-Specific Information page 5-6
- GPS Satellite Acquisition page 5-7
 - Facilitating Initial Tracking page 5-9
 - Establishing Position page 5-12
 - Selecting Satellites page 5-17
 - Compensating for Antenna Delay page 5-22
 - Monitoring Acquisition page 5-24
- 1 PPS Reference Synchronization page 5-27
 - Monitoring 1 PPS Synchronization page 5-28
 - Assessing 1 PPS Quality page 5-30
 - Operating in Holdover page 5-36
- Operating Status page 5-39
 - Receiver Operation at a Glance page 5-41
 - Reading the Error Queue page 5-42
 - Reading the Diagnostic Log page 5-44
 - Monitoring Status/Alarm Conditions page 5-48
 - Assessing Receiver Health page 5-70

Command Reference

Chapter Contents

- System Time page 5-73
 - Identifying Time of Next 1 PPS Reference Edge page 5-74
 - Reading Current Time page 5-76
 - Applying Local Time Zone Offset page 5-78
 - Defining the 1 PPS Reference Edge (HP 59551A Only) page 5-79
 - Reading Leap Second Status page 5-80
- Programmable Pulse Output (HP 59551A Only) page 5-84
- Event Time Stamping (HP 59551A Only) page 5-90
 - Defining the Time-stamped Edge page 5-91
 - Clearing Time Stamp Memory page 5-92
 - Reading Time Stamps page 5-93
 - Processing Memory Overflows page 5-98
- Serial Interface Communication page 5-101
 - Configuring I/O Ports page 5-102
 - Recovering the Last Query Response page 5-109
- Receiver Initialization page 5-110
- Receiver Identification/Upgrade page 5-114
 - Reading Product Identification page 5-115
 - Installing Firmware via I/O Port 1 page 5-116

See Appendix B, “Command Syntax and Style,” for details regarding command Expanded Syntax, parameter types, and query response types.

Command Syntax Conventions

- POSition** Means you **MUST** use either all the upper case letters or the entire word. The lower case letters are optional. For example, POS and POSITION are both valid. However, POSI is not valid. (Note POSition is used here as an example, but this convention is true for all command keywords.) In other words, the short form of the keywords is shown in uppercase.
- <n>** The notation <n> ending a command keyword indicates a numeric suffix, used to differentiate multiple instances of the same structure. The numeric suffix is applied to both the short and long forms. The valid range for the value n is specified from an enumerated list, for example [1 | 2 | 3], or from a range, for example [1..3] to indicate any of the integers from 1 to 3.
- "TSTamp 1"** When you see quotation marks in the command's parameter, you must send the quotation marks with the command.

Description Format

Commands and Returns

HP 59551A

Product Compatibility
(if not present, the command is supported by both products)

Default Setting
(commands only)

Scope
(commands only)

Command Index
Required characters are shown in bold type. "*" denotes one or more parameters; refer to **Expanded Syntax** for details.

Identifies a "basic" (fundamental) command.

Synopsis

Description

Command Mnemonic
Consult Appendix B: Command Syntax and Style for notational style.

Allowed Values, Range and Resolution

When the command may be issued

Secondary effects on other functions.

Concepts

Expanded Syntax
:PULSe:STARt:DATE <four-digit year>

Parameter
The <four-digit year> range is 1994 to 2000.
The <month> range is 1 to 12.
The <day> range is 1 to 31.

Context Dependencies
If you select a date and time which occur after the completion of powerup and first GPIB successfully find a start – and therefore after the Receiver has been set up to use a date and time, the parameters provided should be used.
:SYSTem:PRESet sets the date to January 1, 1994.

Side Effects

Theory

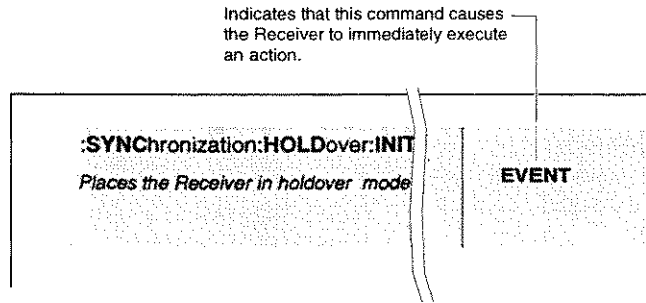
:SYSTem:PRESet
1994,1,1
NON-VOLATILE

indicates that you cautiously use the :SYSTem:COMMunicate:SERIAL commands to change the Receiver's serial interface parameters (i.e., BAUD, BITS, PACE, PARity, and SBITs) from their factory default values. It is recommended that you configure your PC's serial port settings to match the Receiver's factory default values instead. However, if you must change the parameters, be sure to write down or record all changes. Refer to Chapter 2, "Serial Interface Capabilities," in this guide for more information.

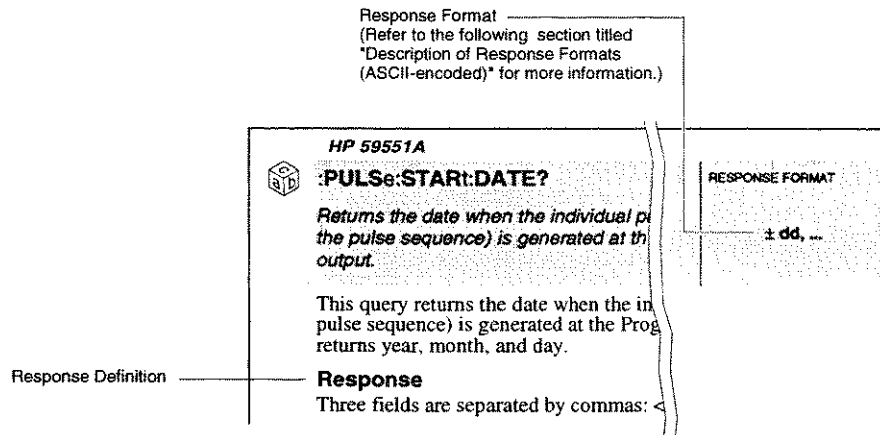
This command can be executed via the rear-panel PORT 1 only.

! :SYSTem:COMMunicate:SERial:BAUD ... :SYSTem:PRESet Not affected **R**
Sets the baud rate of PORT 1.

Command Reference
Description Format



Query-Specific Information



Description of Response Formats (ASCII-encoded)

The following legend provides the meaning of each type of response format. Refer to Table B-3 in Appendix B, "Command Syntax and Style," for details.

RESPONSE FORMAT	Example	Description
0 or 1	0	Single character, one or zero
± dd	+10	Integer
±d.d	+1.5	Fixed-point number
±d.dEe	+1.00000E-009	Floating-point number
XYZ	LOCK	Alphanumeric characters
" XYZ "	"19:49:51" or "No error"	Quoted string
± dd, ...	+14, +15, +18, +22, +29	Comma-separated list of integers
" XYZ", ...	"Log 001:19950101.00:00:00: Power on", "Log 002:19950101.00:10:00: Log cleared"	Comma-separated list of quoted strings



GPS Satellite Acquisition

The HP GPS Receiver is designed to acquire time transfer information (time, date, and position) from the GPS satellites, which is used by the Receiver's internal reference oscillator and HP SmartClock™ technology to lock to GPS. It acquires a precise *time* and *date* by tracking at least one satellite. By tracking at least four satellites, it precisely determines the *position* of the antenna. With this information, the Receiver can produce a precise 1 PPS signal that is exactly synchronous to Coordinated Universal Time (UTC) as determined by GPS.

The following commands are provided to facilitate initiate GPS satellite tracking, to establish accurate GPS antenna position, to select or ignore satellites, to compensate for antenna cable delay, and to monitor the acquisition.

■ Facilitating Initial Tracking

```
:GPS:INITial:DATE ...  
:GPS:INITial:POSition ...  
:GPS:INITial:TIME ...
```

■ Establishing Position

```
:GPS:POSition ...  
:GPS:POSition?  
:GPS:POSition:ACTual?  
:GPS:POSition:HOLD:LAST?  
:GPS:POSition:HOLD:STATe?  
:GPS:POSition:SURVey:PROGress?  
:GPS:POSition:SURVey:STATe ...  
:GPS:POSition:SURVey:STATe?  
:GPS:POSition:SURVey:STATe:POWerup ...  
:GPS:POSition:SURVey:STATe:POWerup?
```

■ Selecting Satellites

```
:GPS:SATellite:TRACking:EMANgle ...  
:GPS:SATellite:TRACking:EMANgle?  
:GPS:SATellite:TRACking:IGNore ...  
:GPS:SATellite:TRACking:IGNore?  
:GPS:SATellite:TRACking:INCLude ...  
:GPS:SATellite:TRACking:INCLude?  
:GPS:SATellite:TRACking:<select>:COUNT?  
:GPS:SATellite:TRACking:<select>:STATe? ...
```

Command Reference
GPS Satellite Acquisition

■ **Compensating for Antenna Dela**

:GPS:REFerence:ADELay ...
:GPS:REFerence:ADELay?

■ **Monitoring Acquisition**

:GPS:REFerence:VALid?
:GPS:SATellite:TRACking?
:GPS:SATellite:VISible:PREDicted?
:GPS:SATellite:TRACking:COUNT?
:GPS:SATellite:VISible:PREDicted:COUNT?



Facilitating Initial Tracking

:GPS:INITial:DATE ...

Sets an approximate date for faster initial GPS acquisition.

:SYSTem:PRESet

Not affected

VOLATILE

This command sets an approximate date for faster initial GPS acquisition. Following powerup, the Receiver obtains the current date from satellite data. This process occurs automatically. Providing an approximate date, however, reduces the time to initial GPS tracking by assisting the Receiver in finding satellites.

Expanded Syntax

:GPS:INITial:DATE <four-digit year>,<month>,<day>

Parameter

Range: the year, month, and day must be valid.

Context Dependencies

This command is valid prior to first satellite tracked (see bit 0 of the Operation Status Register). Sending this command after this time will generate **error -221**.

The initial date and time needs to be within 3 minutes of the actual date and time to be effective in enabling faster initial GPS acquisition.



Facilitating Initial Tracking _____ (continued)

:GPS:INITial:POSition . . . Sets an approximate position for faster initial GPS acquisition.	:SYSTEM:PRESet Not affected
	VOLATILE

This command sets an approximate position for faster initial GPS acquisition. Following powerup, the Receiver refines its position from the satellite data. This process occurs automatically. This command is most effective when the retained position differs significantly from the Receiver's true position.

Expanded Syntax

:GPS:INITial:POSition N or S, <latitude degree>,
 <latitude minute>,
 <latitude second>,
 E or W, <longitude degree>,
 <longitude minute>,
 <longitude second>,
 <height above mean sea level, in meters>

Parameter

This command requires three position coordinates: latitude, longitude, and height. Position must be specified with respect to the World Geodetic System 1984 (WGS-1984) datum absolute earth coordinates.

The latitude coordinate is preceded by either N or S, which denotes the northern or southern hemisphere, respectively. The longitude coordinate is preceded by either E or W, which denotes the eastern or western hemisphere, respectively.

The following table lists the allowed settings of other parameters:

Parameter	Range	Precision	Parameter	Range	Precision
<latitude degrees>	0 to 90	1	<longitude degrees>	0 to 180	1
<latitude minutes>	0 to 59	1	<longitude minutes>	0 to 59	1
<latitude seconds>	0 to 59.999	0.001	<longitude seconds>	0 to 59.999	0.001
<height, m>	-1000.00 to 18,000.00	0.01			

Context Dependencies

This command is valid while the Receiver is in survey mode prior to first computed position. Sending this command while the Receiver is not in survey mode will generate **error -221**.



Facilitating Initial Tracking _____ (continued)

:GPS:INITial:TIME . . . <i>Sets an approximate time for faster initial GPS acquisition.</i>	::SYSTEM:PRESet Not affected
	VOLATILE

This command sets an approximate time for faster initial GPS acquisition. Following powerup, the Receiver obtains the current time from satellite data. This process occurs automatically. Providing an approximate time, however, reduces the time to initial GPS tracking by assisting the Receiver in finding satellites.

Expanded Syntax

:GPS:INITial:TIME <hour>,<minute>,<second>

Parameter

Range: all parameters (hour, minutes, seconds) must be valid.

Context Dependencies

This command is valid prior to first satellite tracked (see bit 0 of the Operation Status Register). Sending this command after this time will generate **error -221**.

The initial date and time needs to be within 3 minutes of the actual date and time to be effective in enabling faster initial GPS acquisition.



Establishing Position



:GPS:POSition ...

Defines the position of the Receiver.

```

:SYSTEM:PRESet
latitude:  N 0:00:00.000
longitude:  E 0:00:00.000
height:    0 meters
NON-VOLATILE
    
```

This command defines the position of the Receiver. The Receiver uses this position to predict satellite visibility and to determine time. An accurate position is necessary for precise time transfer.

Expanded Syntax

```

:GPS:POSition  N or S, <latitude degree>,
                <latitude minute>,
                <latitude second>,
                E or W, <longitude degree>,
                <longitude minute>,
                <longitude second>,
                <height above mean sea level, in meters>

:GPS:POSition  LAST
:GPS:POSition  SURVey
    
```

Parameter

The numeric form of this command requires three position coordinates: latitude, longitude, and height. Position must be specified with respect to the World Geodetic System 1984 (WGS-1984) datum absolute earth coordinates.

The latitude coordinate is preceded by either N or S, which denotes the northern or southern hemisphere, respectively. The longitude coordinate is preceded by either E or W, which denotes the eastern or western hemisphere, respectively.

The following table lists the allowed settings of other parameters:

Parameter	Range	Precision	Parameter	Range	Precision
<latitude degrees>	0 to 90	1	<longitude degrees>	0 to 180	1
<latitude minutes>	0 to 59	1	<longitude minutes>	0 to 59	1
<latitude seconds>	0 to 59.999	0.001	<longitude seconds>	0 to 59.999	0.001
<height, m>	-1000.00 to 18,000.00	0.01			

Continued on next page ➡



Establishing Position _____ (continued)

LAST denotes the last specified position. This parameter is provided to cancel surveying (automatic position computation) and restore the last position setting.

SURVey directs the Receiver to stop surveying and use the computed position. This position is the average of individual position computations.

Context Dependencies

Error -221 is generated if this command is sent as SURV and no valid survey calculation has ever been computed.

Side Effects

This command stops position surveying. The computed position is retained and applied only when SURVey is specified.



:GPS:POSition?

Returns the current average position of the GPS antenna.

RESPONSE FORMAT

XYZ or
± dd or
± d.dEe,
...

This query returns the current average position of the Receiver.

Response

Returns a list of values defining the Receiver position:

N or S, <latitude degree>, <latitude minute>, <latitude second>,
E or W, <longitude degree>, <longitude minute>, <longitude second>,
<height above mean sea level, meters>

Context Dependencies

Error -230 is generated if in survey and first calculation has not occurred.



Establishing Position _____ (continued)



:GPS:POSition:ACTual? <i>Returns the current instantaneous position of the GPS antenna.</i>	RESPONSE FORMAT <i>XYZ or ± dd or ± d.dEe, ...</i>
---	--

This query returns the current instantaneous position of the GPS antenna.

Response

Returns a list of values defining the Receiver position:

N or S, <latitude degree>, <latitude minute>, <latitude second>,
E or W, <longitude degree>, <longitude minute>, <longitude second>,
<height above mean sea level, in meters>

Context Dependencies

Error -230 is generated if in survey and first calculation has not occurred.

:GPS:POSition:HOLD:LAST? <i>Returns the last position-hold setting.</i>	RESPONSE FORMAT <i>XYZ or ± dd or ± d.dEe, ...</i>
---	--

This query returns the last position-hold setting, which is restored when the :GPS:POSition LAST command is sent. Refer to the description of the :GPS:POSition command on page 5-13 for details.

Response

Returns a list of values defining the Receiver position:

N or S, <latitude degree>, <latitude minute>, <latitude second>,
E or W, <longitude degree>, <longitude minute>, <longitude second>,
<height above mean sea level, meters>

Context Dependencies

This query is always valid, but if the Receiver has not been in position-hold mode since it was preset (see :SYSTem:PRESet), the value returned will be the preset position.



Establishing Position _____ (continued)

:GPS:POSition:HOLD:STATe?	RESPONSE FORMAT
<i>Identifies whether the Receiver is in position-hold or survey mode.</i>	0 or 1

This query identifies whether the Receiver is in position-hold or survey mode. In survey mode, the Receiver continually refines its position. In position-hold mode, the position setting does not change.

Response

A value of 0 indicates not in position hold (in survey mode); a value of 1 indicates in position hold.

:GPS:POSition:SURVey:PROGress?	RESPONSE FORMAT
<i>Returns percent completed while in survey mode.</i>	± d.d

This query returns percent completed while in survey mode. Automatic transition to position-hold mode occurs following completion of survey mode (indicated by 100).

Response

The range is 0 to 100%. The units are percent.

Context Dependencies

This query is only valid while surveying for position (:GPS:POS:SURV:STATe? returns ONCE or status bit 3 = 0 in the Operation Status Register). If queried while not surveying, **error -221** is generated.

:GPS:POSition:SURVey:STATe . . .	:SYSTem:PRESet
<i>Initiates survey mode during which the Receiver determines its position from satellite data.</i>	ONCE

This command initiates survey mode during which the Receiver determines its position from satellite data. The Receiver refines successive positional estimates to obtain a final position, transitions from survey to position-hold mode.

Expanded Syntax

:GPS:POSition:SURVey:STATe ONCE



Establishing Position _____ (continued)

:GPS:POSition:SURVey:STATe?	RESPONSE FORMAT
<i>Identifies whether the Receiver is in survey or position-hold mode.</i>	XYZ or 0

This query identifies whether the Receiver is in survey or position-hold mode. In survey mode, the Receiver continually refines its position. In position-hold mode, the position does not change.

Response

A response of ONCE indicates that the Receiver is in survey mode. A response of 0 indicates the Receiver is in position-hold mode.

:GPS:POSition:SURVey:STATe:POWerup . . .	:SYSTem:PRESet
<i>Selects position mode to be used at powerup.</i>	ON
	NON-VOLATILE

This command specifies whether the Receiver always surveys at powerup or restores its last position at powerup.

Expanded Syntax

:GPS:POSition:SURVey:STATe:POWerup ON or OFF

Parameter

OFF sets the Receiver to powerup in the last valid position. ON sets the Receiver to survey on powerup.

:GPS:POSition:SURVey:STATe:POWerup?	RESPONSE FORMAT
<i>Returns the position mode to be used at powerup.</i>	0 or 1

This query returns the position mode to be used at powerup.

Response

A value of 0 indicates the Receiver is set to powerup in the last valid position. A value of 1 indicates the Receiver is set to survey on powerup.



Selecting Satellites



:GPS:SATellite:TRACking:EMANgle . . .

Sets the GPS elevation mask angle value (in degrees).

:SYSTem:PRESet

10

NON-VOLATILE

This command instructs the Receiver to allow tracking those satellites for which the elevation angle is greater than this elevation mask angle. Satellites below this elevation are visible, but will not be tracked.

Expanded Syntax

:GPS:SATellite:TRACking:EMANgle <degrees>

Parameter

<degrees> range is 0 degrees (horizon) to 89 degrees. The resolution is 1 degree.

The maximum recommended value while the position is being surveyed is 15 degrees, to allow tracking of four satellites needed for an accurate position determination.

Once the survey is complete, the elevation mask angle can be increased to avoid interference problems caused by buildings and trees and minimize effects of multipath, if necessary.

Values above 40 degrees severely limit GPS signal availability, and are not recommended.



:GPS:SATellite:TRACking:EMANgle?

Returns the GPS elevation mask angle value.

RESPONSE FORMAT

± dd

This query returns the GPS elevation mask angle value.

Response

The range is 0 degrees to 89 degrees.



Selecting Satellites (continued)



:GPS:SATellite:TRACking:IGNore . . .
Adds the specified satellites to the list that the Receiver ignores for tracking.

:SYSTem:PRESet

No satellites ignored

NON-VOLATILE

This command adds the specified satellites to the list that the Receiver ignores for tracking. Each satellite is identified by its pseudorandom noise code (PRN).

Expanded Syntax

:GPS:SATellite:TRACking:IGNore <PRN>, . . . , <PRN>

:GPS:SATellite:TRACking:IGNore:NONE

:GPS:SATellite:TRACking:IGNore:ALL

Parameter

<PRN> parameter is the pseudorandom noise code of the satellite(s) you want the Receiver to ignore. Each satellite has its own unique PRN.

Context Dependencies

This command is always valid. On send, if any item in the <PRN> list is invalid, the entire list will be rejected. **Error -222** will be generated.



:GPS:SATellite:TRACking:IGNore?
Returns list of satellites to ignore.

RESPONSE FORMAT

± dd, ...

This query returns a list of satellites to ignore for tracking. Each satellite is identified by its pseudorandom noise code (PRN). Zero (0) indicates no satellites being ignored.

Response

A value of 0 indicates no satellites being ignored. If any satellite is being ignored, the pseudorandom noise code (PRN) of the satellite is returned.

Context Dependencies

This query is always valid.



Selecting Satellites _____ (continued)

:GPS:SATellite:TRACking:INCLude . . . <i>Adds the specified satellites to the list that the Receiver considers for tracking..</i>	:SYSTEM:PRESet All satellites included <hr/> NON-VOLATILE
---	---

This command adds the specified satellites to the list that the Receiver considers for tracking. Actual satellite selection is based on satellite visibility, geometry, and health.

Expanded Syntax

```
:GPS:SATellite:TRACking:INCLude <PRN>, . . ., <PRN>
:GPS:SATellite:TRACking:INCLude:NONE
:GPS:SATellite:TRACking:INCLude:ALL
```

Parameter

<PRN> parameter is the pseudorandom noise code of the satellite(s) you want the Receiver to include. Each satellite has its own unique PRN.

Context Dependencies

This command is always valid. On send, if any item in the <PRN> list is invalid, the entire list will be rejected. **Error -222** will be generated.

:GPS:SATellite:TRACking:INCLude? <i>Returns a list of satellites to include.</i>	RESPONSE FORMAT ± dd, ...
--	------------------------------

This query returns a list of satellites to include for tracking. Each satellite is identified by its pseudorandom noise code (PRN). Zero (0) indicates no satellites being included (i.e., the satellites are still on the ignored list).

Context Dependencies

This query is always valid.



Selecting Satellites _____ (continued)

	RESPONSE FORMAT
:GPS:SATellite:TRACking:IGNore:COUNT? <i>Returns the number of satellites that are on the list to ignore for tracking.</i>	± dd
:GPS:SATellite:TRACking:INClude:COUNT? <i>Returns the number of satellites that are on the list to include for tracking.</i>	± dd

The query :GPS:SATellite:TRACking:IGNore:COUNT? returns the number of satellites that are on the list to ignore for tracking.

The query :GPS:SATellite:TRACking:INClude:COUNT? returns the number of satellites that are on the list to be included for tracking.

Response

There may be some delay between changes made to the list of satellites being ignored and their actual removal and inclusion in the tracking process.

At :SYSTEM:PRESet, all satellites are put on the list to include for tracking.



Selecting Satellites _____ (continued)

	RESPONSE FORMAT
:GPS:SATellite:TRACking:IGNore:STATe? ... <i>Returns the ignored status of individual satellites.</i>	0 or 1
:GPS:SATellite:TRACking:INClude:STATe? ... <i>Returns the include status of the specified satellite.</i>	0 or 1

The query `:GPS:SATellite:TRACking:IGNore:STATe?` returns the ignored status of the specified satellite. A satellite is specified by its pseudorandom noise code (PRN).

The query `:GPS:SATellite:TRACking:INClude:STATe?` returns the include status of the specified satellite. A satellite is specified by its pseudorandom noise code (PRN).

There may be some delay between changes made to the list of satellites being ignored and their actual removal and inclusion in the tracking process.

Expanded Syntax

```
:GPS:SATellite:TRACking:IGNore:STATe? <PRN>  
:GPS:SATellite:TRACking:INClude:STATe? <PRN>
```

Parameter

<PRN> parameter is the pseudorandom noise code of the satellite(s) you want the Receiver to ignore or include. Each satellite has its own unique PRN.

Response

A value of 0 indicates not on the selected list.

A value of 1 indicates on the selected list.

Context Dependencies

After a `:SYSTem:PRESet`, all satellites are removed from the list to ignore.



Compensating for Antenna Delay



:GPS:REFerence:ADELay ... Sets the GPS antenna delay value in seconds.	:SYSTEM:PRESet 0.0
	NON-VOLATILE

This command sets the GPS antenna delay value in seconds. It instructs the Receiver to output its 1 PPS output pulse earlier in time to compensate for antenna cable delay.

CAUTION

Using this command while the Receiver is in normal locked operation could cause the Receiver go into holdover.

Expanded Syntax

:GPS:REFerence:ADELay <numeric_value>

Parameter

Numeric_value range is 0 to 0 .000999999 seconds. The resolution is 1 nanosecond.

Zero cable delay is set for a zero-length antenna cable. Consult a cable data book for the delay per meter for the particular antenna cable used in order to compute the total cable delay needed for a particular installation.

See Also

:GPS:REFerence:ADELay?

The table below lists the delay values that you need to use with the :GPS:REFerence:ADELay command for the available cable assemblies.

Cable Model Number	Length	RG 213 or Beiden 8267 Antenna Delay Value
HP 58506A	50 ft (15.2 m)	77 nanoseconds
HP 58507A	100 ft (30.5 m)	154 nanoseconds
HP 58508A	175 ft (53.3 m)	270 nanoseconds
HP 58511A	200 ft (61 m)	308 nanoseconds

The nominal delay value is labeled on the HP 58506A/507A/508A/511A cable.



Compensating for Antenna Delay _____ (continued)



:GPS:REFerence:ADELay?

Returns the GPS antenna delay value in seconds.

RESPONSE FORMAT

±d.dEe

This query returns the GPS antenna delay value in seconds. This is the delay value set by the system installer (or the factory default). It is not a value measured by the Receiver.

Response

The time units are seconds.



Monitoring Acquisition



:GPS:REFerence:VALid?

Identifies whether date and time are valid.

RESPONSE FORMAT

0 or 1

This query identifies whether date and time are valid. Returns 0 or 1; 1 indicates date and time are valid. This is the same as bit 2 in the Powerup Status Register. This command makes it convenient to check whether the date and time are valid without checking the Powerup Status Register.

Response

A value of 1 indicates date and time are valid.

A value of 0 indicates date and time are not valid.



:GPS:SATellite:TRACking?

Returns a list of all satellites being tracked.

RESPONSE FORMAT

± dd, ...

This query returns a list of all satellites being tracked. Each satellite is identified by its pseudorandom noise code (PRN).

Response

A comma-separated list of satellite pseudorandom noise codes (<PRN>).

The range of each <PRN> is 1 to 32.

A response of 0 indicates no satellites being tracked.

Command Reference
GPS Satellite Acquisition



Monitoring Acquisition _____ (continued)



:GPS:SATellite:VISible:PREDicted?

Returns the list of satellites (PRN) that the almanac predicts should be visible, given date, time, and location.

RESPONSE FORMAT

± dd, ...

This query returns the list of satellites (PRN) that the almanac predicts should be visible, given date, time, and location (if any of these values are incorrect, the prediction will be incorrect). Each satellite is identified by its pseudorandom noise code (PRN).

Response

A comma-separated list of satellite pseudorandom noise codes (<PRN>).

The range of each <PRN> is 1 to 32.

A response of 0 indicates no satellites predicted visible.

Theory

Satellites must be in view to be tracked. At least four satellites must be in view, and tracked, to determine the position in position survey operation. Only one satellite must be in view, and tracked, to maintain operation of the reference oscillator locked to GPS when in position hold operation.

:GPS:SATellite:TRACking:COUNt?

Returns the number of satellites being tracked.

RESPONSE FORMAT

± dd

This query returns the number of satellites being tracked.

Response

If there are no satellites being tracked, this query returns a 0.

Command Reference
GPS Satellite Acquisition



Monitoring Acquisition _____ (continued)

:GPS:SATellite:VISible:PREdicted:COUNt?

Returns the number of satellites that the almanac predicts should be visible, given date, time, and location.

RESPONSE FORMAT

± dd

This query returns the number of satellites that the almanac predicts should be visible, given date, time, and location (if any of these are incorrect, the prediction will be incorrect).

Response

Number of satellites predicted visible.

Theory

Satellites must be in view to be tracked. At least four satellites must be in view, and tracked, to determine the position in position survey operation. Only one satellite must be in view, and tracked, to maintain operation of the reference oscillator locked to GPS when in position hold operation.



1 PPS Reference Synchronization

1 PPS and 10 MHz (HP 58503A only) output signals are generated by the Receiver's internal reference oscillator. This oscillator is synchronized (phased locked) to GPS while a sufficient number of satellites are tracked. When the GPS signal is interrupted or absent, the Receiver maintains timing and frequency accuracy through its oscillator "holdover" process. While in holdover, the frequency of the reference oscillator is adjusted as necessary to compensate for aging characteristics. The Receiver returns to "locked" operation through a "holdover recovery" process.

The following commands are provided to monitor the operating mode of the reference oscillator, to determine the accuracy and stability of the reference output signal(s), and to control the oscillator holdover process.

■ Monitoring 1 PPS Synchronization

```
:SYNChronization:STATe?
:DIAGnostic:ROSCillator:EFControl:RELative?
:LED:GPSLock?
:LED:HOLDover?
```

■ Assessing 1 PPS Quality

```
:SYNChronization:FFOMerit?
:SYNChronization:HOLDover:TUNCertainty:PREDicted?
:SYNChronization:HOLDover:TUNCertainty:PRESent?
:SYNChronization:TFOMerit?
:SYNChronization:TINTerval?
:SYNChronization:HOLDover:DURation?
:SYNChronization:HOLDover:DURation:THReshold ...
:SYNChronization:HOLDover:DURation:THReshold?
:SYNChronization:HOLDover:DURation:THReshold:EXCeeded?
```

■ Operating in Holdover

Initiating Manual Holdover

```
:SYNChronization:HOLDover:INITiate
```

Recovering from Holdover

```
:SYNChronization:HOLDover:WAITing?
:SYNChronization:HOLDover:RECOvery:INITiate
:SYNChronization:HOLDover:RECOvery:LIMit:IGNore
:SYNChronization:IMMEDIATE
```

1 PPS Reference Synchronization



Monitoring 1 PPS Synchronization



:SYNChronization:STATe?

Returns the Receiver state.

RESPONSE FORMAT

XYZ

This query returns the Receiver state.

Response

OFF, or HOLD, or WAIT, or REC, or LOCK, or POW.

OFF indicates in diagnostic mode or a temporary start-up mode; HOLD indicates in manual holdover; WAIT indicates waiting for external conditions to allow recovery from holdover; REC indicates actively recovering from holdover; LOCK indicates locked to GPS; POW indicates in powerup prior to first lock.

Context Dependencies

:SYSTEM:PRESet sets the state to POWERup.

:DIAGnostic:ROSCillator:EFControl:RELative?

Returns the Electronic Frequency Control (EFC) output value of the internal reference oscillator.

RESPONSE FORMAT

±d.dEe

This query returns the Electronic Frequency Control (EFC) output value of the internal reference oscillator. It returns a percentage value.

Response

Range is -100% to +100%.

1 PPS Reference Synchronization



Monitoring 1 PPS Synchronization _____ *(continued)*

:LED:GPSLock?

Returns the state of the front-panel GPS Lock LED.

RESPONSE FORMAT

0 or 1

This query returns the state of the front-panel GPS Lock LED. The Receiver sets this indicator during normal operation when it has locked the internal reference oscillator and 1 PPS output to GPS.

Response

A value of 0 indicates the LED is off.

A value of 1 indicates the LED is on.

:LED:HOLDover?

Returns the state of the front-panel Holdover LED.

RESPONSE FORMAT

0 or 1

This query returns the state of the front-panel Holdover LED. The Receiver sets this indicator when in holdover operation.

Response

A value of 0 indicates the LED is off.

A value of 1 indicates the LED is on.

1 PPS Reference Synchronization



Assessing 1 PPS Quality



:SYNChronization:FFOMerit?

Returns the Frequency Figure of Merit.

RESPONSE FORMAT

±dd

This query returns the Frequency Figure of Merit (FFOM). Use this query when you want to know the *stability* of the Receiver's 10 MHz output. The 10 MHz output is controlled by the HP SmartClock's Phase-Locked Loop (PLL). Thus, the FFOM value is determined by monitoring the status of the PLL.

Response

The following table lists and defines the FFOM values (0 thru 3) that could be returned.

FFOM Value	Definition
0	PLL stabilized — 10 MHz output within specification.
1	PLL stabilizing
2	PLL unlocked (holdover) — Initially the 10 MHz output will be within specifications. However, when in holdover, the 10 MHz output will eventually drift out of specification.
3	PLL unlocked (not in holdover) — Do not use the output.

1 PPS Reference Synchronization



Assessing 1 PPS Quality _____ (continued)



:SYNChronization:HOLDoVer:TUNCertainty:PREDIcted?

Returns an estimate of the time interval error that can be expected for a one day holdover, given the current state of HP SmartClock learning in the Receiver.

RESPONSE FORMAT

$\pm d.dEe$, 0 or 1

This query returns an estimate of the time interval error that can be expected for a one day holdover, given the current state of HP SmartClock learning in the Receiver.

Response

The first number in the response is the estimated time interval error. The units are seconds, the resolution is 100 nanoseconds.

The second number in the response identifies the holdover state. A value of 0 indicates the Receiver is not in holdover; a value of 1 indicates the Receiver is in holdover.

Context Dependencies

This query is not valid prior to first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTem:PRESet. Sending this query before first lock will generate error -230.



:SYNChronization:HOLDoVer:TUNCertainty:PRESEnt?

Returns the current time interval error during holdover operation, given the current state of HP SmartClock learning in the Receiver.

RESPONSE FORMAT

$\pm d.dEe$

This query returns the current time error during holdover operation, given the current state of HP SmartClock learning in the Receiver.

Response

The time error units are seconds.

Context Dependencies

This query is valid when the Receiver is in holdover. If not in holdover, error -230 is generated.

1 PPS Reference Synchronization



Assessing 1 PPS Quality _____ (continued)



:SYNChronization:TFOMerit?

Returns the Time Figure of Merit.

RESPONSE FORMAT

±dd

This query returns the Time Figure of Merit. Use this query when you want to know the accuracy of the Receiver's 1 PPS output. A low TFOM value indicates a more accurate output. A value of 3 indicates that the Time Error ranges from 100 to 1000 nanoseconds.

Response

The following table lists the TFOM values that could be returned and provides the corresponding Time Error.

TFOM Value	Time Error (In nanoseconds)	TFOM Value	Time Error (In nanoseconds)
*0	less than 1	5	10 ⁴ – 10 ⁵
*1	1 – 10	6	10 ⁵ – 10 ⁶
*2	10 – 100	7	10 ⁶ – 10 ⁷
3	100 – 1000	8	10 ⁷ – 10 ⁸
4	10 ³ – 10 ⁴	9	greater than 10 ⁸

* The TFOM values 0, 1, and 2 are not presently used in the HP 58503A and HP 59551A products. The HP 58503A and HP 59551A products will display TFOM values ranging from 9 to 3, which is consistent with the specified accuracies of each product.



:SYNChronization:TINterval?

Returns the difference or timing shift between the HP SmartClock 1 PPS and the GPS 1 PPS signals.

RESPONSE FORMAT

±d.dEe

This query returns the difference or timing shift between the HP SmartClock 1 PPS and the GPS 1 PPS signals. It generates an error when this interval is unavailable (That is, if no GPS 1 PPS).

Response

Time interval units are seconds.

Resolution is 1E-10 seconds.

1 PPS Reference Synchronization



Assessing 1 PPS Quality _____ (continued)

:SYNChronization:HOLDover:DURation?

Returns the duration of the present or most recent period of operation in the holdover and holdover processes.

RESPONSE FORMAT

$\pm d.dEe, 0$ or 1

This query returns the duration of the present or most recent period of operation in the holdover and holdover processes. This is the length of time the reference oscillator was not locked to GPS. The time units are seconds.

Response

The first number in the response is the holdover duration. The duration units are seconds, and the resolution is 1 second.

If the Receiver is in holdover, the response quantifies the current holdover duration. If the Receiver is not in holdover, the response quantifies the previous holdover.

The second number in the response identifies the holdover state. A value of 0 indicates the Receiver is not in holdover; a value of 1 indicates the Receiver is in holdover.

Context Dependencies

This query is always valid. If this query is sent before the first holdover has occurred, the response will be 0,0, indicating that the Receiver is currently not in holdover and last holdover duration was 0 seconds (user infers there has not been one yet).

Set to 0,0 after a :SYSTEM:PRESet. If there was a prior holdover, the duration will be lost.

1 PPS Reference Synchronization



Assessing 1 PPS Quality _____ (continued)

:SYNChronization:HOLDover:DURation:THReshold . . .	:SYSTern:PRESet
<i>Sets the duration (in seconds) to be used as a limit each time holdover begins.</i>	86400 (i.e., 1 day)
	NON-VOLATILE

This command sets the duration (in seconds) which represents a limit against which the elapsed time of holdover is compared. If the elapsed time in holdover (and associated processes) exceeds the limit, a flag is set. The flag indicating the limit is exceeded can be queried using the :SYNC:HOLD:DUR:THR:EXCeeded? query.

Expanded Syntax

:SYNChronization:HOLDover:DURation:THReshold <seconds>

Parameter

Resolution of the <seconds> parameter is 1 second.

:SYNChronization:HOLDover:DURation:THReshold?	RESPONSE FORMAT
<i>Returns the duration (in seconds) which represents a limit against which the elapsed time of holdover is compared.</i>	±dd

This query returns the duration (in seconds) which represents a limit against which the elapsed time of holdover is compared. If the elapsed time of holdover (and associated processes) exceeds the limit, a flag is set.

Expanded Syntax

:SYNChronization:HOLDover:DURation:THReshold?

Response

The threshold units are seconds.

The resolution is 1 second

1 PPS Reference Synchronization



Assessing 1 PPS Quality _____ (continued)

:SYNChronization:HOLDover:DURation:THReshold :EXCeeded?	RESPONSE FORMAT
<i>Identifies if the Receiver has been in holdover longer than the amount of time specified by the THReshold command.</i>	0 or 1

This query identifies if the Receiver has been in holdover longer than the amount of time specified by the THReshold command. If it has, 1 will be returned.

Response

A value of 1 indicates that the Receiver is in holdover, and has been operating in holdover for a duration that exceeds the specified duration.

The value 0 indicates either the Receiver is not in holdover, or it has been in holdover for less than the specified duration.

1 PPS Reference Synchronization



Operating in Holdover _____

Initiating Manual Holdover _____

:SYNChronization:HOLDover:INITiate <i>Places the Receiver in holdover mode.</i>	EVENT
---	--------------

This command places the Receiver in holdover mode. The Receiver will stay in holdover until you send :SYNC:HOLD:REC:INIT.

Context Dependencies

This command is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet. Sending this command before the first lock will generate **error -221**.

See Also

:SYNChronization:HOLDover:RECOvery:INITiate

1 PPS Reference Synchronization



Operating in Holdover _____ *(continued)*

Recovering from Holdover _____



:SYNChronization:HOLDover:WAITing?	RESPONSE FORMAT
<i>Returns prioritized reason for why the Receiver is waiting to recover.</i>	XYZ

This query returns prioritized reason for why the Receiver is waiting to recover.

Response

HARD indicates there is an internal hardware reason, GPS indicates there are no satellites, LIM indicates the time interval between GPS and internal oscillator is exceeding the limit, and NONE indicates the Receiver isn't waiting to recover.

Note that if holdover has been initiated by sending the :SYNC:HOLD:INIT command, the Receiver is not waiting to recover; the response is NONE.

This query is always valid. If not in holdover and waiting to recover, NONE will be the response.

:SYNChronization:HOLDover:RECOvery:INITiate	
<i>Initiates a recovery from manually initiated holdover.</i>	EVENT

This command initiates a recovery from manually initiated holdover. Use this command to take the Receiver out of a *manually selected holdover*. This command is not needed to initiate holdover recovery in any other situation.

See Also

:SYNChronization:HOLDover:INITiate

1 PPS Reference Synchronization



Operating in Holdover _____ (continued)

Recovering from Holdover (continued)

<p>:SYNChronization:HOLDover:RECOvery:LIMit:IGNore <i>Initiates recovery from holdover if recovery was inhibited by time intervals exceeding limit.</i></p>	<p>EVENT</p>
---	---------------------

This command initiates recovery from holdover if recovery was inhibited by time intervals exceeding limit.

The time interval used for this comparison is the time interval between the internal oscillator's 1 PPS edge and the GPS system's 1 PPS edge. When this time interval consistently exceeds the specified limit, the instrument enters the holdover state, "Waiting to Recover."

Recovery is initiated when the time intervals consistently fall within limits, or when the limit is ignored by issuing this command.

<p>:SYNChronization:IMMediate <i>Initiates a near-instantaneous alignment of the GPS 1 PPS and Receiver output 1 PPS if the command is issued during recovery from holdover.</i></p>	<p>EVENT</p>
--	---------------------

This command initiates a near-instantaneous alignment of the GPS 1 PPS and Receiver output 1 PPS if the command is issued during recovery from holdover.

Context Dependencies

This command is only valid when recovering from holdover. See bit 2 of the Holdover Status Register (if it is 1, this command is okay). Sending this command when the Receiver is not recovering will generate **error -221**.



Operating Status

This section describes the commands that can be used to obtain Receiver status information. There are several ways to obtain Receiver status using commands. For example, you can send a command to display the Receiver Status screen, to read the error queue, and to read the diagnostic log. You can also send a sequence of commands to read and control the status registers for alarm generation.

This section defines all of the commands used for status reporting. A comprehensive discussion on how you can monitor and control alarm conditions using the status registers is included.

■ Receiver Operation at a Glance

```
:SYSTem:STATus?
:SYSTem:STATus:LENGth?
```

■ Reading the Error Queue

```
:SYSTem:ERRor?
```

■ Reading the Diagnostic Log

```
:DIAGnostic:LOG:CLEar
:DIAGnostic:LOG:READ:ALL?
:DIAGnostic:LOG:CLEar ...
:DIAGnostic:LOG:COUNT?
:DIAGnostic:LOG:READ?
:DIAGnostic:LOG:READ? ...
```

■ Monitoring Status/Alarm Conditions

□ Clearing and Presetting Alarms

```
*CLS
:STATus:PRESet:ALARm
```

□ Reading and Qualifying Alarms

```
:LED:ALARm?
*SRE ...
*SRE?
*STB?
```


Command Reference
Operating Status



Receiver Operation at a Glance



:SYSTem:STATus?

Outputs a formatted status screen.

RESPONSE FORMAT

ASCII Data

This query outputs a formatted Receiver Status screen. Use this screen to monitor GPS acquisition, derivation of time and position, and synchronization of reference outputs to GPS.

Refer to Chapter 3, "Visual User Interface," for detailed information on the Receiver Status screen.

Response

Sending this command will display a status screen similar to the following figure.

```

----- Receiver Status -----
SYNCHRONIZATION..... [ Outputs Valid ]
SmartClock Mode _____ Reference Outputs _____
>> Locked to GPS          TFOM      3          FFOM      0
Recovery                 1PPS TI +7.2 ns relative to GPS
Holdover                 HOLD THR 1.000 us
Power-up                 Holdover Uncertainty _____
                          Predict  49.0 us/initial 24 hrs

ACQUISITION ..... [GPS 1PPS Valid]
Satellite Status _____ Time _____ +1 leap second pending
Tracking: 6             Not Tracking: 1      UTC      23:59:59   31 Dec 1995
PRN  El  Az  SS        PRN  El  Az        GPS 1PPS Synchronized to UTC
 2  49 243 168        14  11  82        ANT DELY 120 ns
16  24 282 125
18  38 154 132        Position _____
19  65  52 168        MODE      Survey: 17.5% complete
27  62 327 246        AVG LAT  N 37:19:32.264
31  34  61 133        AVG LON  W 121:59:52.112
ELEV MASK 10 deg      AVG HGT          +41.86 m (MSL)
HEALTH MONITOR ..... [ OK ]
Self Test: OK Int Pwr: OK Oven Pwr: OK OCXO: OK EFC: OK GPS Rcv: OK

```

:SYSTem:STATus:LENGth?

Returns the number of lines of formatted text that are in the Receiver Status screen.

RESPONSE FORMAT

±dd

This query returns the number of lines of formatted text that are in the Receiver Status screen.



Reading the Error Queue



:SYSTEM:ERRor?

Returns the oldest error in the Error Queue and removes that error from the queue (first in, first out).

RESPONSE FORMAT

±dd,"XYZ"

This query returns the oldest error in the Error Queue and removes that error from the queue (first in, first out).

See Appendix A, "Error Messages," in this guide for detailed error information.

Response

The error response format is: `<error_number>,"<error_description>"`, where

- The `<error_number>` is an integer transferred as ASCII bytes in `<NR1>` format (integer). The range is -32768 to 32767.
- Negative error numbers are defined by the SCPI standard.
- Positive error numbers are defined specifically for this Receiver.
- An error number value of zero indicates that the Error Queue is empty.
- The maximum length of the `<error_description>` is 255 characters.

Context Dependencies

`:SYSTEM:PRESet` clears the Error Queue.

The queue is cleared (emptied) on `*CLS`, power-on, or upon reading the last error from the queue.

If the Error Queue overflows, the last error in the queue is replaced with the error -350, "Queue overflow". Any time the queue overflows, the least recent errors remain in the queue and the most recent error is discarded. The maximum length of the Error Queue is 30.



Reading the Diagnostic Log _____

The Diagnostic Log is one way to obtain Receiver status.

The following activities and events are recorded in the diagnostic log:

- power-on sequence,
- automatic or manual transitions between locked, and holdover,
- automatic or manual transitions between position survey and position hold operation,
- alarm indications, and
- self-test failures.

Each entry is date-and-time tagged. The log entries are stored in non-volatile memory so all data remains valid even if power is lost. Access to the diagnostic log entries is through commands in the :DIAGnostic:LOG subtree. For example, to read the first diagnostic log entry, use the command

```
:DIAG:LOG:READ? 1
```

The possible log messages that can be displayed on your computer display are listed in the following table.

Diagnostic Log Messages

Log Message	Comments
Log cleared	Always becomes first log message when the log is cleared. See :DIAG:LOG:CLEAR.
Power on	Indicates Receiver has been powered on.
Re-boot	Indicates Receiver processor has re-booted.
Survey mode started	Indicates beginning of survey for position.
Position hold mode started	Indicates transition from survey to position hold.
GPS lock started	Indicates transition into locked operation.
GPS reference valid at yyymmdd.hh:mm:ss	indicates when GPS reference first become valid. Time in log is the present time from GPS.
Holdover started, manual	Indicates transition to holdover based on user request. See :SYNC:HOLD:INIT.
Holdover started, T1 error	Indicates transition to holdover due to problem detected with Receiver ability to properly measure interval between GPS 1 PPS and internal oscillator 1 PPS.
Holdover started, T1 limit exceeded	Indicates transition to holdover due to the interval from GPS 1 PPS to internal oscillator 1 PPS exceeding a limit threshold for numerous measurements.
Holdover started, not tracking GPS	Indicates transition to holdover since GPS is not tracking sufficient satellites.
Holdover started, GPS RAIM alarm	Indicates transition to holdover since time RAIM algorithm has detected GPS 1PPS timing inaccuracy.
Holdover started, GPS Alarm	Indicates transition to holdover due to GPS engine communication failure.

Reading the Diagnostic Log _____

(continued)



Diagnostic Log Messages (Continued)

Log Message	Comments
Holdover started, invalid GPS 1PPS	Indicates transition to holdover due to problem with the GPS 1PPS signal.
Holdover started, GPS	Indicates transition to holdover due to some other GPS problem.
Holdover started, HW error	Indicates transition to holdover due to internal hardware error.
Holdover started, temporary	Indicates temporary transition to holdover due to changing of certain settings.
Holdover started	Indicates transition to holdover for any reason not covered above.
Self-test failed	Indicates self-test failed on powerup.
System preset	Indicates that the Receiver has been preset to factory settings.
Hardware failure	Indicates that a hardware failure has been detected. See Hardware Status Register for details.
EEPROM save failed	Indicates that an attempt to save information to the EEPROM has failed.

The DIAGnostic commands for the log are described in the following text.



Reading the Diagnostic Log _____ (continued)



:DIAGnostic:LOG:CLEAr <i>Clears the diagnostic log.</i>	:SYSTEM:PRESet Log is cleared
	NON-VOLATILE

This command is an event that removes all previous diagnostic log entries, and effectively sets the number of diagnostic log entries to one.



:DIAGnostic:LOG:READ:ALL? <i>Returns all of the most recent diagnostic log entries.</i>	RESPONSE FORMAT "XYZ", ...
---	--------------------------------------

This query returns all of the most recent diagnostic log entries.

:DIAGnostic:LOG:CLEAr ... <i>Clears only the current diagnostic log.</i>	:SYSTEM:PRESet Log is cleared
	NON-VOLATILE

This command clears the diagnostic log. The optional log count parameter is provided to ensure that no log entries are unread at the time of the clear.

Expanded Syntax

:DIAGnostic:LOG:CLEAr <current log size>

Parameter

If the value sent for the optional log parameter does not match the current log entry count (use **:DIAG:LOG:COUN?** to obtain this number), the clear will not take place.

Context Dependencies

This command is always valid. If the optional log count parameter is sent, and the current and actual log count does not match log count value, the clear will not be performed and **error -222** will be generated.



Reading the Diagnostic Log _____ (continued)

:DIAGnostic:LOG:COUN?	RESPONSE FORMAT
<i>Identifies the number of entries in the diagnostic log.</i>	±dd

This query identifies the number of entries in the diagnostic log.

Response

Range is 1 to 222, maximum is subject to change.

:DIAGnostic:LOG:READ?	RESPONSE FORMAT
<i>Returns the most recent diagnostic log entry.</i>	"XYZ"

This query returns the most recent diagnostic log entry.

Response

The diagnostic log entry format is: "Log NNN: YYYYMMDD.HH:MM:SS: <log_message>", where:

Log indicates a diagnostic log entry, and NNN is the log entry number

YYYYMMDD.HH:MM:SS is the date and time of the diagnostic log entry:

The <log_message> is a sequence of up to 255 characters.



Reading the Diagnostic Log _____ (continued)

:DIAGnostic:LOG:READ? . . .

Returns the user-specified diagnostic log entry. Returns the most recent diagnostic log entry if no parameter is supplied.

RESPONSE FORMAT

"XYZ"

This query returns the user-specified diagnostic log entry.

Expanded Syntax

:DIAGnostic:LOG:READ? <entry number>

Parameter

Range is 1 to current log count.

Response

The diagnostic log entry format is: "Log NNN: YYYYMMDD.HH:MM:SS: <log_message>", where:

Log indicates a diagnostic log entry, and NNN is the log entry number

YYYYMMDD.HH:MM:SS is the date and time of the diagnostic log entry.

The <log_message> is a sequence of up to 255 characters.

Context Dependencies

This query is always valid. If no log message is associated with the requested log number, **error -222** is generated.



Monitoring Status/Alarm Conditions _____

The Receiver is at all times monitoring various operating conditions through a status/alarm reporting system. The Receiver is shipped from the factory with the status system set to generate an alarm under a default set of operating conditions.

The monitored operating conditions are organized by function into three major groups: Questionable status, Command Error status, and Operation status. The Operation status group has three functional subgroups: Powerup status, Holdover status, and Hardware status.

All of the operating conditions are summarized by the Alarm status.

Figure 5-1, on the next page, includes the identification of the default alarm conditions. Those conditions which are enabled to “feed” all the way through the system will generate an alarm in a Receiver configured with the factory defaults. (Note a diagram identical to Figure 5-1 is provided as part of the Receiver Commands at a Glance/Status Reporting System at a Glance foldout — pages 4-17 and 4-18, respectively.)

Command Reference
 Operating Status



Monitoring Status/Alarm Conditions _____ (continued)

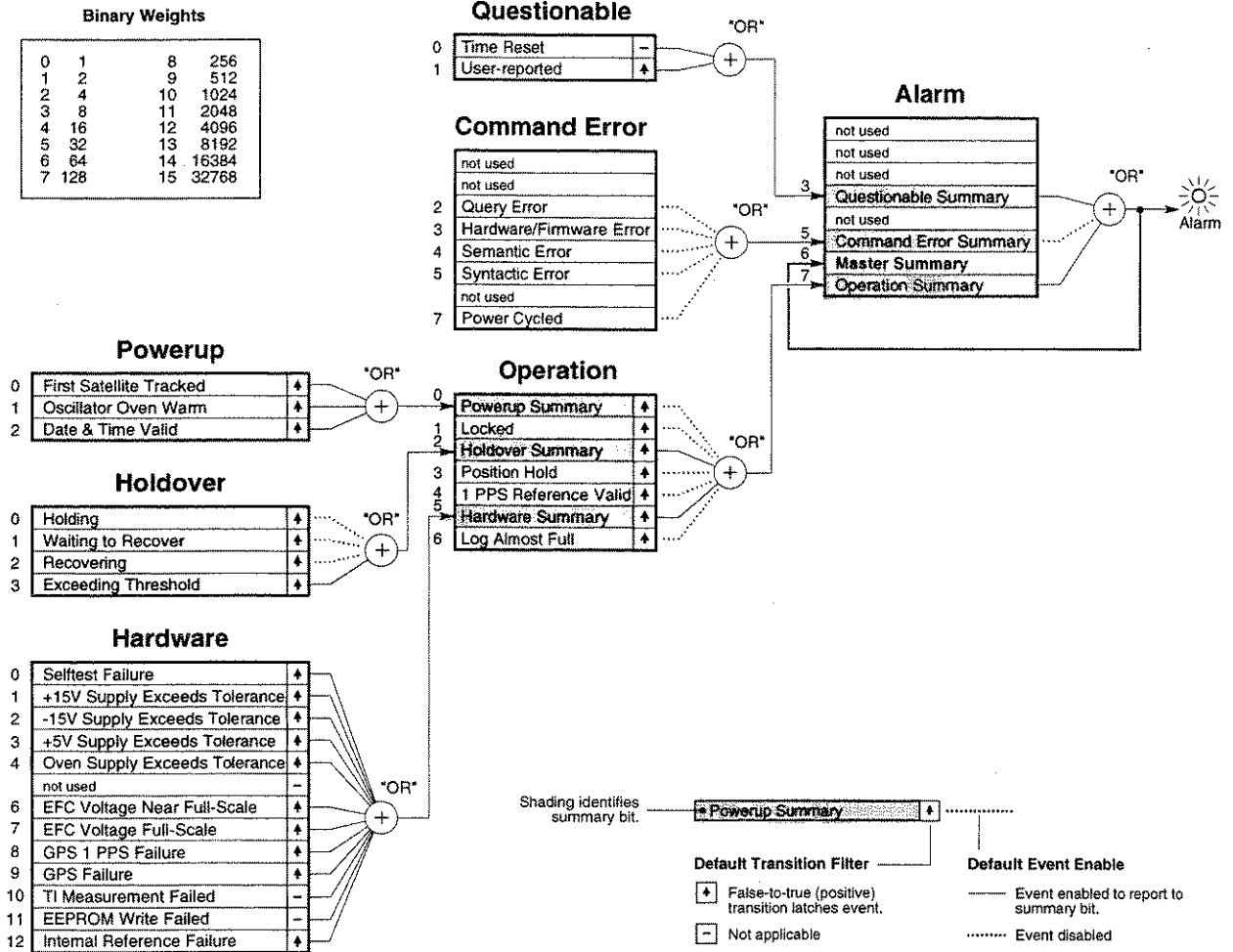


Figure 5-1. HP 59551A/58503A Status Reporting System Diagram

Operating Status



Monitoring Status/Alarm Conditions _____ (continued)

The following describes, for each functional group of operating status shown in Figure 5-1, each of the operating conditions that is monitored through the status/alarm system.

Each monitored condition bit is “set” (to one) when the named condition is true and “cleared” (to zero) when the named condition is false.

Each monitored event bit is set when the named event has occurred and cleared at powerup and when the user executes a command which reads or clears the event register.

All of the conditions and events are cleared at powerup and :SYSTem:PRESet.

Alarm Status

The Alarm Status summarizes condition changes from the three major functional status groups (Questionable, Command Error, and Operation).

- The Questionable Summary condition (bit 3) reflects one or more latched condition changes in the Questionable status group.
- The Command Error Summary condition (bit 5) reflects one or more latched condition changes in the Command Error status group.
- The Master Summary condition (bit 6) indicates that there was at least one reason for generating an Alarm.
- The Operation Summary condition (bit 7) reflects one or more latched condition changes in the Operation status group.

Operation Status

The Operation Status is comprised of the Operation subgroup (Powerup, Holdover, and Hardware) summaries, Locked, Position Hold, 1 PPS Reference Valid, and Log Almost Full status.

- The Powerup Summary condition (bit 0) reflects one or more latched condition changes in the Powerup status group.
- The Locked condition (bit 1) indicates whether or not the Receiver is locked to GPS.
- The Holdover Summary condition (bit 2) reflects one or more latched condition changes in the Holdover status group.

Operating Status



Monitoring Status/Alarm Conditions _____ *(continued)*

- The Position Hold condition (bit 3) indicates whether the Receiver is in position hold or survey mode.
- The 1 PPS Reference Valid condition (bit 4) indicates that the GPS 1 PPS signal is suitable to use as a locking reference.
- The Hardware Summary condition (bit 5) reflects one or more latched condition changes in the Hardware status group.
- The Log Almost Full condition (bit 6) indicates whether or not the diagnostic log is approaching the point where new entries will no longer be logged.

Hardware Status

This Operation subgroup comprises operating status that indicates the health of the Receiver hardware.

One or more of the condition changes from this group are summarized in the Operation Status group.

- The Selftest Failure condition (bit 0) indicates whether a failure was detected during the powerup or last user-initiated self test.
- The following conditions reflect the status of specific hardware that is continuously monitored by the Receiver:
 - +15V Supply Exceeds Tolerance condition (bit 1)
 - 15V Supply Exceeds Tolerance condition (bit 2)
 - +5V Supply Exceeds Tolerance condition (bit 3)
 - Oven Supply Exceeds Tolerance condition (bit 4)
 - EFC Voltage Near Full-Scale condition (bit 6)
 - EFC Voltage Full-Scale condition (bit 7)
 - GPS 1 PPS Failure condition (bit 8)
 - GPS Failure condition (bit 9)
 - Time Interval Measurement Failed event (bit 10)
 - Internal Reference Failure condition (bit 12)
- The EEPROM Write Failed event (bit 11) indicates that an attempt to write to the non-volatile memory failed.

Operating Status



Monitoring Status/Alarm Conditions _____ (continued)

Holdover Status

This Operation subgroup is comprised of operating status that occurs during holdover.

One or more of the condition changes from this group are summarized in the Operation Status group.

- The following conditions indicate that the Receiver is in holdover, and the specific holdover state:

Holding condition	(bit 0)
Waiting to Recover condition	(bit 1)
Recovering condition	(bit 2)

- The Exceeding User-Threshold condition (bit 3) indicates whether or not the user-specified holdover duration (:SYNC:HOLDover:DURation:THReshold) is being exceeded.

Powerup Status

This Operation subgroup is comprised of operating status that occurs at powerup.

One or more of the condition changes from this group are summarized in the Operation Status group.

- The First Satellite Tracked condition (bit 0) is cleared at powerup and set when the first satellite becomes tracked following powerup.
- The Oscillator Oven Warm condition (bit 1) is cleared at powerup and set when the internal oscillator has warmed up following powerup.
- The Date & Time Valid event (bit 2) is cleared at powerup and set when the date and time are set during the first lock is attained after powerup.

Questionable Status

The Time Reset status event (bit 0) indicates that the Receiver reset its time because the Receiver's time was found to be different from the time being reported by the satellites. This could occur after an extensive holdover period.

The User-reported condition (bit 1) indicates the setting reported by the user with the :STATus:QUESTionable:CONDition:USER or :STATus:QUESTionable:EVENT:USER command. This is the only condition in the status/alarm reporting that the user can directly affect.



Monitoring Status/Alarm Conditions _____ (continued)

Command Error Status

This group contains events which indicate a command error has occurred, and an event which indicates that the power has cycled. (See Figure 5-1.)

The following status events indicate that a command error occurred:

- The Query Error status event (bit 2). **Errors -400 through -499** are query errors.
- The Hardware/Firmware Error status event (bit 3). **Errors -300 through -399** are hardware/firmware errors.
- The Semantic Error status event (bit 4). **Errors -200 through -299** are semantic errors.
- The Syntactic Error status event (bit 5). **Errors -100 through -199** are syntactic errors.
- The Power Cycled status event (bit 7) is set at powerup.



Monitoring Status/Alarm Conditions _____ (continued)

□ Clearing and Presetting Alarms _____



***CLS**

Clears the current alarm and prepares the Receiver for the next alarm activation.

EVENT

When the *CLS command clears the event status registers and error queue, the Receiver's Alarm LED and Alarm BITE output will no longer indicate that there was a reason to alarm. Furthermore, the Receiver is then ready to detect a new alarm.

Context Dependencies

In the HP59551A, the error queue (and corresponding serial port prompt) of the I/O port which transmitted *CLS will be cleared.

Side Effects

The Alarm LED is extinguished.

The Alarm BITE output is set "inactive/off."

The prompt of the serial I/O port (which transmits *CLS) reflects error queue clearing.

The event status registers are cleared.

The error queue (and corresponding serial port prompt) of the I/O port which transmitted *CLS will be cleared.

Theory

The *CLS command clears the event status registers and error queue. (They are also cleared at power-up.)

Since the Alarm Condition register summarizes the event registers, it is cleared as a result of the clearing of all of the event registers.

The alarm remains active even after the condition that caused it has gone away.

If the condition that caused the alarm to occur is still set, a new alarm cannot be detected until the condition clears and resets.

This command has no effect on condition, enable, or transition filter registers.



Monitoring Status/Alarm Conditions _____ (continued)

Clearing and Presetting Alarms (continued)

:STATus:PRESet:ALARm

Presets the status/alarm reporting system to generate an alarm when a factory default set of operating conditions occurs.

EVENT

When the configurable portion of the status/alarm reporting system is preset, the Receiver is configured to generate an alarm under the factory default set of operating conditions.

Use this command to restore only the status/alarm reporting system to the factory (:SYSTem:PRESet) settings.

Theory

The configurable portion of the status/alarm reporting system consists of enable and transition filter registers. Figure 5-1 identifies the factory default enables and transitions.

The status/alarm reporting configuration is stored in non-volatile memory.

This command performs a subset of the :SYSTem:PRESet command in that it only presets the configuration associated with status/alarm reporting system.

This command does not affect condition or event registers.



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Alarms _____

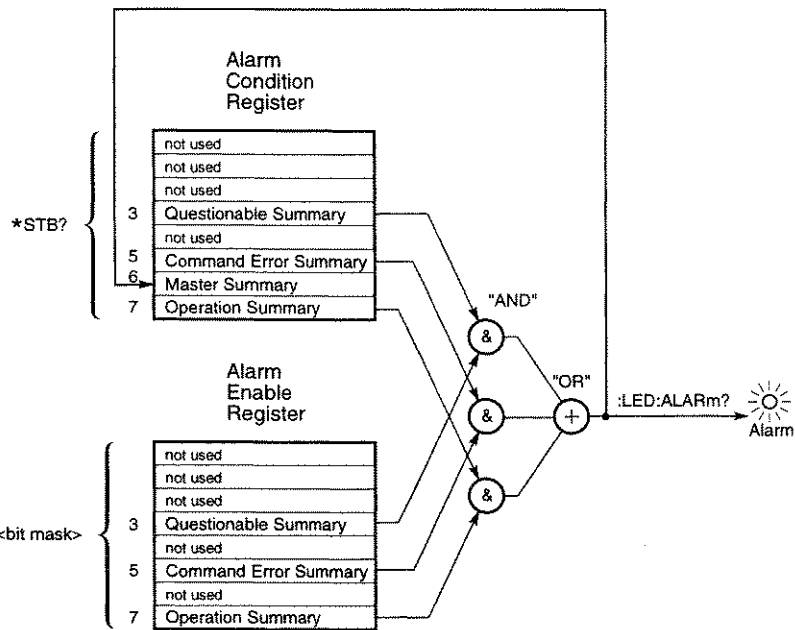


Figure 5-2. Alarm Condition and Enable Registers



:LED:ALARM?

Returns the status of the front-panel Alarm LED.

RESPONSE FORMAT

0 or 1

This query returns the status of the front-panel Alarm LED, which indicates that a change in operating conditions was recorded. The alarm remains active even after the condition that caused it has gone away.

Theory

This query essentially reads the Master Summary bit (bit 6) of the Alarm Condition Register.

At power-up, the alarm status is cleared.



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Alarms (continued)

*SRE . . . <i>Sets the Alarm Enable Register.</i>	SYSTEM:PRESet 136
	NON-VOLATILE

The setting of the Alarm Enable Register (Figure 5-2) selects which summary status from the Alarm Condition Register is enabled to generate an alarm.

Expanded Syntax

*SRE <bit mask>

Semantics

The <bit mask> has a range of 0 to 255.

The <bit mask> value represents the sum of the binary-weighted values of the register. Attempts to set unused bits in the register are ignored — the value of unused bits is zero.

*SRE? <i>Identifies the status conditions enabled to generate an alarm.</i>	RESPONSE FORMAT ±dd
---	-------------------------------

This query identifies the status conditions enabled to generate an alarm.

Reading the Alarm Enable Register identifies which summary status from the Alarm Condition Register is enabled to generate an alarm.

Response

The range is 0 to 255.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Theory

Reading/Querying the Alarm Enable Register does not change its contents.



Monitoring Status/Alarm Conditions _____ (continued)

Reading and Qualifying Alarms (continued)

***STB?**

Reads the Alarm Condition Register.

RESPONSE FORMAT

±dd

This query reads the Alarm Condition Register (Figure 5-2).

Response

The range is 0 to 255.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Theory

The Alarm Condition Register continuously monitors the summary status of the instrument.

The Alarm Condition Register bits are updated in real time — there is no latching or buffering.

Reading/Querying the Alarm Condition Register does not change its contents.

At powerup, the Alarm Condition Register is cleared.

Command Reference
Operating Status



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Receiver Status _____

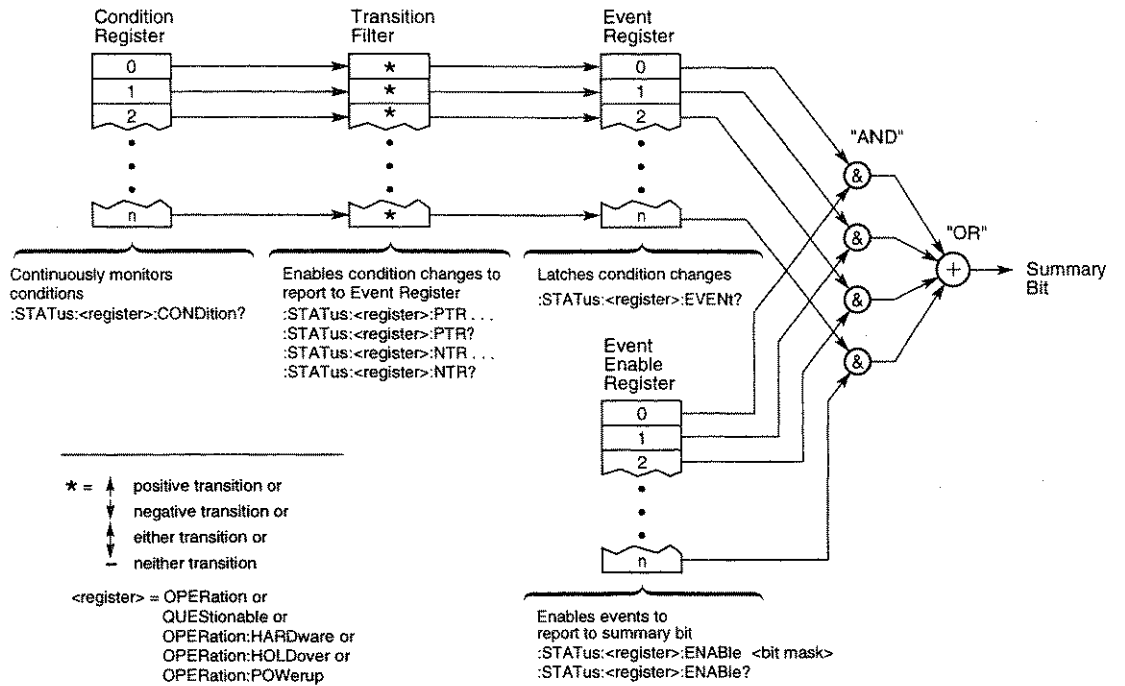


Figure 5-3. Condition, Transition Filter, Event Enable, and Event Registers



Monitoring Status/Alarm Conditions _____ (continued)

Reading and Qualifying Receiver Status (continued)



:STATus:<register>:CONDition?

Reads the specified condition register.

RESPONSE FORMAT

±dd

This query reads the specified condition register (figures 5-3 and 5-1).

Expanded Syntax

:STATus:OPERation:CONDition?

:STATus:QUESTionable:CONDition?

:STATus:OPERation:HARDware:CONDition?

:STATus:OPERation:HOLDover:CONDition?

:STATus:OPERation:POWerup:CONDition?

Response

The range is 0 to 65535.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Note that some bits, those which are “event-only”, have no corresponding conditions.

Theory

A condition register continuously monitors the hardware and firmware status (that is, the operating conditions) of the instrument.

Conditions register bits are updated in real time — there is no latching or buffering.

Reading/Querying a condition register does not change its contents.

At powerup, the conditions registers are cleared.



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Receiver Status (continued)



:STATus:<register>:EVENT? <i>Reads the specified event register.</i>	RESPONSE FORMAT ±dd
--	-----------------------------------

This query reads the specified event register (figures 5-3 and 5-1), retrieving information about what has happened to the instrument since it was last queried, or cleared by :SYSTem:PRESet or *CLS.

Expanded Syntax

- :STATus:OPERation:EVENT?
- :STATus:QUESTionable:EVENT?
- :STATus:OPERation:HARDware:EVENT?
- :STATus:OPERation:HOLDover:EVENT?
- :STATus:OPERation:POWerup:EVENT?

Response

The range is 0 to 65535.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Side Effects

Reading/Querying an event register clears it.

Theory

An event register captures changes in conditions. When a transition occurs, the corresponding bit in the event register is set TRUE. The instrument can be configured (using :STATus:<register>:NTRansition and :STATus:<register>:PTRansition), for each bit position, to capture the positive, the negative, either, or neither transition.

Event register bits, once set, are latched. That is, they remain set until they are read. When they are read, they are cleared.

At powerup, the event registers are cleared.

See Also

- :STATus:<register>:NTRansition . . .
- :STATus:<register>:PTRansition . . .



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Receiver Status (continued)

:STATus:<register>:ENABLE ... <i>Sets the specified enable register.</i>	:SYSTEM:PRESet See Figure 5-1 for Default Event Enable identification
	NON-VOLATILE

The setting of an enable register (figures 5-3 and 5-1) selects which events from the corresponding event register are enabled to report to the corresponding summary bit of the summarizing condition register.

Expanded Syntax

- :STATus:OPERation:ENABLE <bit mask>
- :STATus:QUESTionable:ENABLE <bit mask>
- :STATus:OPERation:HARDware:ENABLE <bit mask>
- :STATus:OPERation:HOLDover:ENABLE <bit mask>
- :STATus:OPERation:POWerup:ENABLE <bit mask>

Parameter

The <bit mask> has a range of 0 to 65535.

The <bit mask> value represents the sum of the binary-weighted values of the register. Attempts to set unused bits in an enable register are ignored — the value of unused bits is zero.



Monitoring Status/Alarm Conditions _____ (continued)

Reading and Qualifying Receiver Status (continued)

<p>:STATus:<register>:ENABLE? <i>Reads the specified enable register.</i></p>	<p>RESPONSE FORMAT ±dd</p>
---	---

Reading an enable register (figures 5-3 and 5-1) identifies which events from the corresponding event register are enabled to report to the corresponding summary bit of the summarizing condition register.

Expanded Syntax

- :STATus:OPERation:ENABLE?
- :STATus:QUESTionable:ENABLE?
- :STATus:OPERation:HARDware:ENABLE?
- :STATus:OPERation:HOLDover:ENABLE?
- :STATus:OPERation:POWerup:ENABLE?

Response

The range is 0 to 65535.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Theory

Reading/Querying an enable register does not change its contents.



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Receiver Status (continued)

<pre> :STATus:<register>:NTRansition ... :STATus:<register>:PTRansition ... </pre> <p><i>Sets the specified transition filter registers.</i></p>	<pre> :SYSTEM:PRESet See Figure 5-1 for Default Transition Filter Identification NON-VOLATILE </pre>
--	--

The setting of the transition filter registers selects which condition transitions (positive, negative, either, or neither) are enabled to report events.

Expanded Syntax

```

:STATus:OPERation:NTRansition <bit mask>
:STATus:QUESTionable:NTRansition <bit mask>
:STATus:OPERation:HARDware:NTRansition <bit mask>
:STATus:OPERation:HOLDover:NTRansition <bit mask>
:STATus:OPERation:POWerup:NTRansition <bit mask>

```

```

:STATus:OPERation:PTRansition <bit mask>
:STATus:QUESTionable:PTRansition <bit mask>
:STATus:OPERation:HARDware:PTRansition <bit mask>
:STATus:OPERation:HOLDover:PTRansition <bit mask>
:STATus:OPERation:POWerup:PTRansition <bit mask>

```

Parameter

The <bit mask> has a range of 0 to 65535.

The <bit mask> value represents the sum of the binary-weighted values of the register. Attempts to set unused bits in the transition filter are ignored — the value of unused bits is zero.

To enable negative (one to zero) transitions of specific conditions, set the corresponding bits to one in the <bit mask > for the NTRansition register command.

To enable positive (zero to one) transitions of specific conditions, set the corresponding bits to one in the <bit mask > for the PTRansition register command.

Note that some bits, those which are “event-only”, have no transition filter setting. Attempts to set these bits are ignored.



Monitoring Status/Alarm Conditions _____ (continued)

Reading and Qualifying Receiver Status (continued)

<pre>:STATus:<register>:NTRansition? :STATus:<register>:PTRansition?</pre>	<p>RESPONSE FORMAT</p>
<p><i>Reads the specified transition filter registers.</i></p>	<p>±dd</p>

Reading the transition filter registers identifies which condition transitions (positive, negative, either, or neither) are enabled to report events.

Expanded Syntax

```
:STATus:OPERation:NTRansition?
:STATus:QUESTionable:NTRansition?
:STATus:OPERation:HARDware:NTRansition?
:STATus:OPERation:HOLDover:NTRansition?
:STATus:OPERation:POWerup:NTRansition?
```

```
:STATus:OPERation:PTRansition?
:STATus:QUESTionable:PTRansition?
:STATus:OPERation:HARDware:PTRansition?
:STATus:OPERation:HOLDover:PTRansition?
:STATus:OPERation:POWerup:PTRansition?
```

Response

The range is 0 to 65535.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

The bits which are set to one in the <bit mask> of the NTRansition query response indicate the enabled negative transitions of corresponding conditions.

The bits which are set to one in the <bit mask> of the PTRansition query response indicate the enabled positive transitions of corresponding conditions.

Theory

Reading/Querying a transition filter register does not change its contents.



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Command Error Status _____

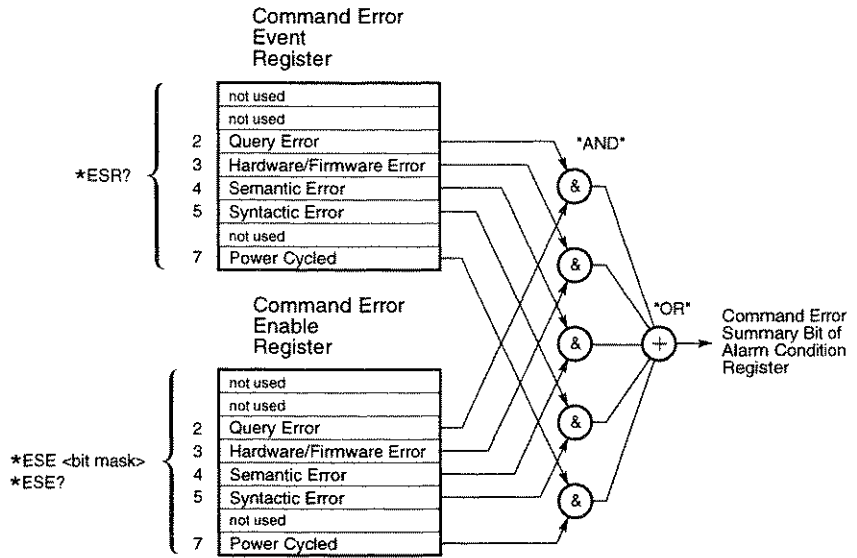


Figure 5-4. Command Error Event and Enable Registers

*ESE ... Sets the Command Error Enable Register.	:SYSTEM:PRESet 0 NON-VOLATILE
--	-------------------------------------

The setting of the Command Error Enable Register (Figure 5-4) selects which events from the Command Error Event Register are enabled to report to the Command Error Summary bit of the Alarm Condition Register.

Expanded Syntax

*ESE <bit mask>

Parameter

The <bit mask> has a range of 0 to 255.

The <bit mask> value represents the sum of the binary-weighted values of the register. Attempts to set unused bits in the register are ignored — the value of unused bits is zero.

Operating Status



Monitoring Status/Alarm Conditions _____ (continued)

□ Reading and Qualifying Command Error Status (continued)

*ESE? <i>Reads the Command Error Enable Register.</i>	RESPONSE FORMAT ±dd
---	-----------------------------------

This query identifies the status conditions enabled to generate an alarm.

Reading the Command Error Enable Register (Figure 5-4) identifies which events from the Command Error Event Register are enabled to report to the Command Error Summary bit of the Alarm Condition Register.

Response

The range is 0 to 255.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Theory

Reading/Querying the Command Error Enable Register does not change its contents.

*ESR? <i>Reads the Command Error Event Register.</i>	RESPONSE FORMAT ±dd
--	-----------------------------------

This query reads the Command Error Event Register, retrieving information about errors (or power cycles) that have occurred since the instrument was last queried, or cleared by SYSTEM:PRESet or *CLS.

Response

The range is 0 to 255.

The response value represents the sum of the binary-weighted values of the register. The value of unused bits is zero.

Operating Status



Monitoring Status/Alarm Conditions _____ (continued)

□ Reporting Questionable Status _____

:STATus:QUESTIONable:CONDition:USER . . .	SYSTem:PRESet
<i>Sets the User-reported bit of the Questionable Condition Register.</i>	Clear
	NON-VOLATILE

This command sets the User-reported bit of the Questionable Condition Register.

Expanded Syntax

:STATus:QUESTIONable:CONDition:USER SET or CLEAR

Parameter

SET will cause the User-reported bit of Questionable Condition Register to be set to 1.

CLEAR will cause the User-reported bit of Questionable Condition Register to be set to 0.

Side Effects

The User-reported bit of the Questionable Condition Register is set or cleared by this command.

Theory

A condition change (from SET to CLEAR, or CLEAR to SET) of the User-reported bit of the Questionable Condition Register, and the appropriate configuration of the Questionable Transition Filter is necessary to generate an event in the Questionable Event Register.

Furthermore, when the User-reported bit of Questionable Event Enable Register is enabled, and the Questionable Summary bit of the Alarm Enable Register is enabled, then a transition of the User-reported condition will generate an ALARM.



Monitoring Status/Alarm Conditions _____ (continued)

Reporting Questionable Status (continued)

<p>:STATus:QUESTIONable:EVENT:USER ... <i>Generates a transition of the User-reported bit of the Questionable Condition Register.</i></p>	<p>EVENT</p> <hr/> <p>NON-VOLATILE</p>
---	---

This command generates a transition of the User-reported bit of the Questionable Condition Register.

Expanded Syntax

:STATus:QUESTIONable:EVENT:USER PTRansition or NTRansition

Parameter

PTRansition will cause the User-reported bit of Questionable Condition Register to transition from a setting of 0 to a setting of 1.

NTRansition will cause the User-reported bit of Questionable Condition Register to transition from a setting of 1 to a setting of 0.

Context Dependencies

Issuing PTRansition, while the User-reported bit of the Questionable Positive Transition Register is enabled, sets the User-reported bit of the Questionable Event register.

Issuing NTRansition, while the User-reported bit of the Questionable Negative Transition Register is enabled, sets the User-reported bit of the Questionable Event register.

Side Effects

The user-reported bit of the Questionable Condition Register is set by the PTRansition parameter or cleared by the NTRansition parameter.

Theory

A positive or negative (PTRansition or NTRansition) of the User-reported bit of the Questionable Condition Register, and the appropriate configuration of the Questionable Transition Filter is necessary to generate an event in the Questionable Event Register.

Furthermore, when the User-reported bit of Questionable Event Enable Register is enabled, and the Questionable Summary bit of the Alarm Enable Register is enabled, then a User-reported event will generate an ALARM.



Assessing Receiver Health



*TST?

Executes an internal selftest and reports the results.

RESPONSE FORMAT

$\pm dd$

This query causes an internal selftest and the response indicates whether any errors were detected. This test takes about 40 seconds to complete.

Error -330, "Self test failed" is generated if the selftest fails.

NOTE

Manual operation of internal self-test diagnostics will affect normal Receiver operation, including disruption of any or all of the following: GPS satellite tracking, reference oscillator frequency, 1 PPS output timing, and Receiver status information. When invoked manually, any of these diagnostics should be considered to be destructive tests.

The following elements and functions are tested:

- CPU
- EPROM
- RAM
- EEPROM
- UART
- QSPI
- FPGA logic
- Interpolators
- GPS engine
- Power supply levels
- Reference oscillator

Response

A value of 0 indicates the tests passed, a non-zero value indicates the selftest was not completed or was completed with errors detected.



Assessing Receiver Health _____ *(continued)*

:DIAGnostic:LIFetime:COUNT?	RESPONSE FORMAT
<i>Returns the lifetime count, indicating the total powered-on time.</i>	±dd

This query returns the lifetime count, indicating the total powered-on time.

Response

Range of the integer is 0 to 4,294,967,296 with a resolution of 1. Each count represents three hours of operation.

:DIAGnostic:TEST? ...	RESPONSE FORMAT
<i>Returns information for user-specified test.</i>	±dd

This query returns information for user-specified test.

Expanded Syntax

:DIAGnostic:TEST? ALL *or* DISPlay *or* PROCessor *or* RAM *or* EEPRom *or* UART *or* QSPI *or* FPGA *or* INTerpolator *or* GPS *or* POWer.

Response

A value of 0 (zero) indicates test passed.

Parameter

ALL returns test information for all of the tests



Assessing Receiver Health _____ (continued)

:DIAGnostic:TEST:RESult?	RESPONSE FORMAT
<i>Returns the result of the last test and the type of test performed.</i>	±dd, XYZ

This query returns the result of the last test and the type of test performed. Use this query, for example, following powerup to check the outcome of the powerup selftest.

Response

A value of 0 indicates test passed. Non-zero value indicates test failed.

The literal or alphanumeric characters portion of the response identifies the specific test.



System Time

The HP GPS Receiver is designed to allow you access to a very accurate system clock that provides both date and time, to customize the clock for a local time zone, to identify the exact time, to identify the accumulated time difference (in seconds) between the GPS and UTC timelines, and to monitor and adjust for leap second occurrences.

The following commands are provided to allow you to monitor and control the system date and time.

■ Identifying Time of Next 1 PPS Reference Edge

:PTIME:TCODE?

■ Reading Current Time

:PTIME:DATE? *or* :SYSTEM:DATE?

:PTIME:TIME? *or* :SYSTEM:TIME?

:PTIME:TIME:STRING?

■ Applying Local Time Zone Offset

:PTIME:TZONE ...

:PTIME:TZONE?

■ Defining the 1 PPS Reference Edge (HP 59551A Only)

:PTIME:PPS:EDGE ...

:PTIME:PPS:EDGE?

■ Reading Leap Second Status

:PTIME:LEAPsecond:ACCumulated?

:PTIME:LEAPsecond:DATE?

:PTIME:LEAPsecond:DURation?

:PTIME:LEAPsecond:STATe?



Identifying Time of Next 1 PPS Reference Edge



:PTIME:TCODE?

Returns timecode message 980 to 20 ms prior to 1 PPS of indicated time.

RESPONSE FORMAT

R

ASCII Data

This query returns timecode message 980 to 20 ms prior to 1 PPS of indicated time. This special query provides not only accurate time but also provides the user the opportunity to correctly correlate this time with a corresponding 1 PPS edge.

Response

The query response provides the following type of information:

- date and time of next on-time edge,
- Time Figure of Merit,
- Frequency Figure of Merit,
- leap second indicator
- alarm indication, and
- service request.

An example response is:

T2199505112055233000049

The following text describes this response.



Identifying Time of Next 1 PPS Reference Edge _____

(continued)

The previous response example is in the
"T2YYYYMMDDHHMMSSMFLRVcc" format, where

T2	indicates a timecode message.
YYYYMMDD	is the calendar date at the next 1 PPS on-time edge.
HHMMSS	is the 24 hour time at the next 1 PPS on-time edge. Note that this value is influenced by the ptim:tzon setting.
M	is time figure of merit.
F	is frequency figure of merit.
L	is leapsecond indicator (- means a -1 leapsecond is pending, 0 means no leapsecond pending, + means a 1 leapsecond is pending).
R	is the request for service bit from the status system (0 = no service requested, 1 = service requested). An alarm will be generated when this byte transitions to 1.
V	is validity byte. 1 indicates that time-related information isn't valid, 0 indicates that it is valid.
cc	is the checksum of the prior bytes (two Hex bytes).

System Time



Reading Current Time

:PTIME:DATE? :SYSTEM:DATE? <i>Returns the current calendar date.</i>	RESPONSE FORMAT ±dd, ±dd, ±dd
--	---

This query returns the current calendar date. The local calendar date is always referenced to UTC time, offset by any local time zone value that has been provided by the user. The year, month, and day are returned.

Response

Three fields are separated by commas: <year>,<month>,<day>.

- The <year> range is 1994 to 2077.
- The <month> range is 1 to 12.
- The <day> range is 1 to 31.

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet. Sending this query before the first lock will generate **error -230**.

:PTIME:TIME? :SYSTEM:TIME? <i>Returns the current 24-hour time.</i>	RESPONSE FORMAT ±dd, ±dd, ±dd
---	---

This query returns the current 24-hour time. The local time is always referenced to UTC time, offset by any local time zone value that has been provided by the user. The hour, minute, and second is returned.

Response

Three fields are separated by commas: <hour>,<minute>,<second>.

- The <hour> range is 0 to 23.
- The <minute> range is 0 to 59.
- The <second> range is 0 to 60. The value of 60 only occurs as the UTC leapsecond.

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet. Sending this query before the first lock will generate **error -230**.

System Time



Reading Current Time _____ *(continued)*

:PTIME:TIME:STRing?

Returns the current 24-hour time suitable for display.

RESPONSE FORMAT

"XYZ"

This query returns the current 24-hour time suitable for display (for example, 15:23:06).

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTem:PRESet. Sending this query before the first lock will generate **error -230**.

System Time



Applying Local Time Zone Offset



:PTIME:TZONE ...

Sets the time zone local time offset to provide an offset from UTC to serve as the basis for all reported time.

.SYSTEM:PRESet

0,0

NON-VOLATILE

This command sets the time zone local time offset to provide an offset from Universal Coordinated Time (UTC) to serve as the basis for all reported time. The local 24-hour time and local calendar date depend on the present setting of the time zone parameter, which is used to indicate the offset from UTC. Typical application of this command is to account for time zone differences between the installed Receiver location and the prime meridian at Greenwich, which uses UTC uncorrected.

Expanded Syntax

:PTIME:TZONE <hour>, <minutes>

Parameter

- The <hour> range is -12 to +12, and is rounded to the nearest integer.
- The optionally supplied <minute> range -59 to +59, and is rounded to the nearest integer. The <minute> is defaulted to 0 if not supplied.

Context Dependencies

:SYSTEM:PRESet sets the time zone to zero (0,0).



:PTIME:TZONE?

Returns the local time zone offset.

RESPONSE FORMAT

±dd, ±dd

This query returns the local time zone offset.

Response

The first returned value is offset hours. The second returned value is offset minutes.

System Time



Defining the 1 PPS Reference Edge (HP 59551A Only) _____



HP 59551A

:PTIME:PPS:EDGE ...

Selects the polarity of the 1 PPS on-time edge.

:SYSTEM:PRESet

RISing

NON-VOLATILE

This command selects the polarity of the 1 PPS on-time edge.

Expanded Syntax

:PTIME:PPS:EDGE RISing or FALLing

Parameter

The RISing parameter sets the 1 PPS rising edge as the on-time edge.

The FALLing parameter sets the 1 PPS falling edge as the on-time edge.



HP 59551A

:PTIME:PPS:EDGE?

Returns the polarity of the 1 PPS on-time edge.

RESPONSE FORMAT

XYZ

This query returns the polarity of the 1 PPS on-time edge.

Response

RIS indicates that the 1 PPS on-time edge is the rising edge.

FALL indicates that the 1 PPS on-time edge is the falling edge.



Reading Leap Second Status _____



:PTIME:LEAPsecond:ACCumulated?

Returns the leap second difference accumulated between GPS time and UTC time since the beginning of GPS time. The time units are seconds.

RESPONSE FORMAT

±dd

This query returns the leap second difference accumulated between GPS time and UTC time since the beginning of GPS time. The time units are seconds.

Response

An example response is:

+10

which indicates that the accumulated leap second difference between the GPS time and UTC is 10 seconds.

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet. Sending this query before the first lock will generate **error - 230**.

Theory

The leap second value is initialized during the power-on sequence by evaluating :PTIME:LEAPsecond:ACC = GPS time - UTC time. In July 1994, the value was 10 seconds.

The value is automatically adjusted immediately following the occurrence of a leap second correction to the UTC time scale. When a 1 leap second addition is made to the UTC time scale, the extra second delays the arrival of midnight UTC causing :PTIME:LEAP:ACC? to increase by 1 second. When a 1 leap second subtraction is made to the UTC time scale, the missing second hastens the arrival of UTC midnight causing :PTIME:LEAP:ACC? to decrease by 1 second.



Reading Leap Second Status _____ (continued)

:PTIME:LEAPsecond:DATE? <i>Returns the UTC calendar date of next leap second.</i>	RESPONSE FORMAT ±dd, ±dd, ±dd
---	--

This query returns the UTC calendar date of next leap second. The year, month, and day are returned.

Response

Three fields are separated by commas: <year>,<month>,<day>.

- The <year> range is 1994 to 2077.
- The <month> range is 1 to 12.
- The <day> range is 1 to 31.

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet, or if no leap second is pending. Sending this query before the first lock or if no leap second is pending will generate **error – 230**.

System Time



Reading Leap Second Status _____ (continued)

:PTIME:LEAPsecond:DURation?	RESPONSE FORMAT
<i>Returns the duration of the minute corrected by the next leap second.</i>	±dd

This query identifies whether a leap second is pending, distinguishes between leap seconds which extend the minute, and leap seconds which shorten the minute. This query returns the duration of the minute corrected by the next leap second. The duration units are seconds.

Response

Returns a value of 59, 60 or 61:

- A value of 59 indicates subtraction of 1 second is pending.
- A value of 60 indicates no leap second pending.
- A value of 61 indicates addition of 1 second is pending.

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet, or if no leap second is pending. Sending this query before the first lock or if no leap second is pending will generate **error - 230**.



Reading Leap Second Status _____ (continued)

:PTIME:LEAPsecond:STATe? <i>Identifies if leap second is pending.</i>	RESPONSE FORMAT 0 or 1
---	---

This query identifies if a leap second is pending. This query looks ahead to indicate a pending leap second.

Response

A value of 0 indicates no leap second is pending.

A value of 1 indicates a leap second is pending. The leap second adjustment can be either the addition of a second or the subtraction of a second.

Context Dependencies

This query is not valid prior to the first lock following powerup (see bit 2 of the Powerup Status Register) or :SYSTEM:PRESet (but is valid if no leap second is pending). Sending this query before the first lock will generate **error - 230**.



Programmable Pulse Output (HP 59551A Only)

The Programmable Pulse output feature provides a means of using the HP GPS Receiver as a pulse generator. The pulse output, which is programmable by the user, can either generate a stream of pulses at a specified start time and repetition interval, or it can produce a single pulse at a specified time and then stop.


The following commands are provided to allow you to operate and control the programmable output of the HP 59551A GPS Receiver.

Note that the configuring of the Programmable Pulse output requires consideration of five settings: start date, start time, continuous on/off, pulse period, and pulse polarity. Changing any one of the settings will stop any previously configured pulse stream and reassert all five settings. If the start date has already passed when you modify the repetition interval, the pulse output will halt until you provide a new start date.

```
:PULSe:CONTInuous:PERiod ...  
:PULSe:CONTInuous:PERiod?  
:PULSe:CONTInuous:STATe ...  
:PULSe:CONTInuous:STATe?  
:PULSe:REFerence:EDGE ...  
:PULSe:REFerence:EDGE?  
:PULSe:STARt:DATE ...  
:PULSe:STARt:DATE?  
:PULSe:STARt:TIME ...  
:PULSe:STARt:TIME?
```

Command Reference

Programmable Pulse Output (HP 59551A Only)

 HP 59551A :PULSe:CONTInuous:PERiod ... <i>Sets the interval between pulses in seconds.</i>	:SYSTem:PRESet 1
	NON-VOLATILE

This command sets the interval between pulses in seconds.

Expanded Syntax


:PULSe:CONTInuous:PERiod <seconds>

Parameter

The <seconds> parameter range is 1 to 31536000, equivalent to one year. Resolution is 1.


Context Dependencies

The interval set by this command is only used if **:PULSe:CONTInuous:STATe** is ON.

 HP 59551A :PULSe:CONTInuous:PERiod? <i>Returns the interval between pulses in seconds.</i>	RESPONSE FORMAT ±dd

This query returns the interval between pulses in seconds.

Programmable Pulse Output (HP 59551A Only)

 HP 59551A :PULSe:CONTInuous:STATe . . . <i>Controls whether the Programmable Pulse output will be just one pulse or a sequence of pulses.</i>	:SYSTem:PRESet OFF
	NON-VOLATILE

This command controls whether the Programmable Pulse output will be just one pulse or a sequence of pulses.

Expanded Syntax


:PULSe:CONTInuous:STATe ON or OFF

Parameter

OFF selects one pulse. ON selects a sequence of pulses.

Context Dependencies

With either state (OFF or ON) the output commences at the time and date defined by :PULSe:STARt:DATE and :PULSe:STARt:TIME commands.

 HP 59551A :PULSe:CONTInuous:STATe? <i>Identifies whether the Programmable Pulse output is set to output a single pulse or a sequence of pulses.</i>	RESPONSE FORMAT 0 or 1
---	----------------------------------

This query identifies whether the Programmable Pulse output is set to output a single pulse or a sequence of pulses.

Response

- A value of 0 indicates the Receiver is set to output one pulse.
- A value of 1 indicates the Receiver is set to output a sequence of pulses.

Command Reference

Programmable Pulse Output (HP 59551A Only)



HP 59551A

:PULSe:REFerence:EDGE ...

Selects the polarity of the Programmable Pulse on-time edge.

:SYSTem:PRESet

RISing

NON-VOLATILE

This command selects the polarity of the Programmable Pulse on-time edge.

Expanded Syntax

:PULSe:REFerence:EDGE RISing or FALLing

Parameter

The RISing parameter sets the Programmable Pulse rising edge as the on-time edge.

The FALLing parameter sets the Programmable Pulse falling edge as the on-time edge.



HP 59551A

:PULSe:REFerence:EDGE?

Returns the polarity of the Programmable Pulse on-time edge.

RESPONSE FORMAT

XYZ

This query returns the the polarity of the Programmable Pulse on-time edge.

Response

RIS indicates that the Programmable Pulse on-time edge is the rising edge.

FALL indicates that the Programmable Pulse on-time edge is the falling edge.

Programmable Pulse Output (HP 59551A Only)



HP 59551A

:PULSe:STARt:DATE . . .

Identifies the date when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.

:SYSTem:PRESet

1994, 1, 1

NON-VOLATILE

This command identifies the date when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.

Expanded Syntax

:PULSe:STARt:DATE <four-digit year>,<month>,<day>

Parameter

- The <four-digit year> range is 1994 to 3000.
- The <month> range is 1 to 12.
- The <day> range is 1 to 31.

Context Dependencies

If you select a date and time which occurs prior to the current time or prior to the completion of powerup and first GPS lock, the Receiver will not successfully find a start — and therefore will produce no pulses.

If the Receiver has been set up to use a time zone offset to produce local date and time, the parameters provided should also be expressed as local date and time.



HP 59551A

:PULSe:STARt:DATE?

Returns the date when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.

RESPONSE FORMAT

±dd, ±dd, ±dd

This query returns the date when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output. This query returns year, month, and day.


Response

Three fields are separated by commas: <four-digit year>,<month>,<day>.

- The <four-digit year> range is 1994 to 3000.
- The <month> range is 1 to 12.
- The <day> range is 1 to 31.

Command Reference

Programmable Pulse Output (HP 59551A Only)

 HP 59551A :PULSe:STARt:TIME ... <i>Identifies the time when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.</i>	:SYSTem:PRESet 0,0,0
	NON-VOLATILE

This command identifies the time when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.

Expanded Syntax

:PULSe:STARt:TIME <hour>,<minute>,<second>

Parameter


Three fields are separated by commas: <hour>,<minute>,<second>.

- The <hour> range is 0 to 23.
- The <minute> range is 0 to 59.
- The <second> range is 0 to 59.

Context Dependencies

If you select a date and time which occurs prior to the current time or prior to the completion of powerup and first GPS lock, the Receiver will not successfully find a start — and therefore will produce no pulses.

If the Receiver has been set up to use a time zone offset to produce local date and time, the parameters provided should also be expressed as local date and time.

 HP 59551A :PULSe:STARt:TIME? <i>Returns the time when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.</i>	RESPONSE FORMAT ±dd,±dd,±dd
---	--

This query returns the time when the individual pulse (or first pulse of the pulse sequence) is generated at the Programmable Pulse output.

Response

Three fields are separated by commas: <hour>,<minute>,<second>.

- The <hour> range is 0 to 23.
- The <minute> range is 0 to 59.
- The <second> range is 0 to 59.



Event Time Stamping (HP 59551A Only)

The time stamping feature allows you to use the Receiver with equipment such as a fault analyzer or a surge detector that produces a TTL edge when some important event happens in the base station. The Receiver has three time tagging inputs (**Time Tag 1**, **Time Tag 2**, **Time Tag 3**) which record the time of occurrence of TTL edge(s).

The following commands are provided to allow you to tag and record events such as power surges and power outages.

■ Defining the Time-stamped Edge

```
:SENSe:TSTamp<channel>:EDGE ...  
:SENSe:TSTamp<channel>:EDGE?
```

■ Clearing Time Stamp Memory

```
:SENSe:DATA:CLEAr  
:SENSe:DATA:CLEAr ...
```

■ Reading Time Stamps

```
:SENSe:DATA? ...  
:FORMat:DATA ...  
:FORMat:DATA?  
:SENSe:DATA:POINts?  
:SENSe:DATA:POINts? ...  
:SENSe:DATA:TSTamp? ...
```

■ Processing Memory Overflow

```
:SENSe:DATA:MEMory:OVERflow:COUNT?  
:SENSe:DATA:MEMory:OVERflow:COUNT? ....  
:SENSe:DATA:MEMory:SAVE ...  
:SENSe:DATA:MEMory:SAVE?
```

Command Reference
Event Time Stamping (HP 59551A Only)



Defining the Time-stamped Edge _____



HP 59551A :SENSE:TSTamp<channel>:EDGE ... <i>Selects the polarity of the edges the Receiver will time stamp.</i>	:SYSTEM:PRESet RISing <hr/> NON-VOLATILE
--	---

This command selects the polarity of the edges the Receiver will time stamp.

Expanded Syntax

:SENSE:TSTamp1:EDGE RISing or FALLing
:SENSE:TSTamp2:EDGE RISing or FALLing
:SENSE:TSTamp3:EDGE RISing or FALLing

Parameter

- The RISing parameter sets the time-stamped edge as the rising edge.
- The FALLing parameter sets the time-stamped edge as the falling edge.



HP 59551A :SENSE:TSTamp<channel>:EDGE? <i>Returns the polarity of the edges the Receiver will time stamp.</i>	RESPONSE FORMAT XYZ
---	-------------------------------

This query returns the polarity of the edges the Receiver will time stamp.

Response

RIS indicates that the time-stamped edge is the rising edge.

FALL indicates that the time-stamped edge is the falling edge.



HP 59551A :SENSE:DATA:CLEar <i>Clears the data in the measurement buffer for all Time Tag inputs.</i>	EVENT
---	--------------

This command clears the data in the measurement buffer and clears the overflow counts for all Time Tag inputs.

Context Dependencies

:SYSTEM:PRESet clears the time stamp measurement buffers and overflow counts.



Clearing Time Stamp Memory

HP 59551A

:SENSe:DATA:CLEAr ...

Clears the data in the time stamp measurement buffer for the user-specified Time Tag input.

EVENT

This command clears the data in the time stamp measurement buffer for the user-specified Time Tag input. Use "TSTamp 1" or "TSTamp 2" or "TSTamp 3" to select one input.

Expanded Syntax

:SENSe:DATA:CLEAr "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

Parameter

"TSTamp 1" clears the data in **Time Tag 1** input buffer.

"TSTamp 2" clears the data in **Time Tag 2** input buffer.

"TSTamp 3" clears the data in **Time Tag 3** input buffer.

Context Dependencies

:SYSTem:PRESet clears the time stamp measurement buffers.



Reading Time Stamps



HP 59551A

:SENSe:DATA? ...

Outputs data from the one specified time stamp measurement buffer.

RESPONSE FORMAT

FORMAT = ASCII
±dd, ...

FORMAT = INTeger
BINARY Data

This query outputs data from the one specified time stamp measurement buffer (or Time Tag input). This query does not clear the buffer. Each time stamp provides the year, month, day, hours, minutes, seconds, milliseconds, microseconds, nanoseconds, and TFOM (Time Figure of Merit).

Expanded Syntax

:SENSe:DATA? "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

Response

If the format is ASCII (the default format), the response is a sequence of comma-separated integers.

If the format is INTeger, the response is BINARY Data (see Table B-3, in Appendix B, "SCPI Syntax and Style," in this guide for details).

To determine which format is selected, use query :FORMat:DATA?.

Parameter

Use "TSTamp 1" or "TSTamp 2" or "TSTamp 3" to select one input at a time:

- "TSTamp 1" outputs the data from **Time Tag 1** input buffer.
- "TSTamp 2" outputs the data from **Time Tag 2** input buffer.
- "TSTamp 3" outputs the data from **Time Tag 3** input buffer.

Context Dependencies

:SYSTem:PRESet clears the time stamp measurement buffers and overflow counts.

Time stamps are not collected until after the Receiver has completed its powerup, and has reached initial lock to GPS.

Time stamps are not collected while the user is reading/clearing or otherwise accessing the time stamp buffers.

Command Reference
Event Time Stamping (HP 59551A Only)



Reading Time Stamps _____ (continued)

HP 59551A

:FORMat:DATA ...

Selects output format for the time stamps.

:SYSTem:PRESet

ASCII

NON-VOLATILE

This command selects the output format for the time stamps.

Expanded Syntax

:FORMat:DATA ASCII or INTeger

Parameter

If the format is ASCII (the default format), the response is a sequence of comma-separated integers.

If the format is INTeger, the response to the :SENSe:DATA? query is BINARY Data (see Table B-3, in Appendix B, "Command Syntax and Style," in this guide for details).

When ASCII formatting is selected the output stream data is buffered. In general, INT mode will provide faster output than ASC, but will require special data-handling routines to interpret the BINARY Data.

HP 59551A

:FORMat:DATA?

Returns the output format for time stamp data.

RESPONSE FORMAT

XYZ

This query returns the output format for time stamp data.

Response

ASC or INT is returned.



Reading Time Stamps _____ (continued)

HP 59551A

:SENSE:DATA:POINts?

Returns the number of time stamps in each of the three Time Tag inputs.

RESPONSE FORMAT

±dd, ...

This query returns the number of time stamps in each of the three Time Tag inputs.

Response

Returns three comma-separated integers corresponding to the number of time stamps recorded for inputs 1, 2, and 3.

The numeric range for each integer is 0 to 256.

Context Dependencies

:SYSTEM:PRESet clears the time stamp measurement buffers and overflow counts.

Time stamps are not collected until after the Receiver has completed its powerup and has reached initial GPS lock.

HP 59551A

:SENSE:DATA:POINts? ...

Returns the number of time stamps recorded for the one specified Time Tag input.

RESPONSE FORMAT

±dd

This query returns the number of time stamps recorded for the one specified Time Tag input. Use "TSTamp 1", "TSTamp 2", or "TSTamp 3" to select one input.

Expanded Syntax

:SENSE:DATA:POINts? "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

Response

Returns an integer corresponding to the number of time stamps recorded for the specified input.

- Numeric range is 0 to 256.

Continued on next page ➡



Reading Time Stamps _____ (continued)

Parameter

"TSTamp 1" queries for the number of points in **Time Tag 1** input buffer.

"TSTamp 2" queries for the number of points in **Time Tag 2** input buffer.

"TSTamp 3" queries for the number of points in **Time Tag 3** input buffer.

Context Dependencies

:SYSTem:PRESet clears the time stamp measurement buffers and overflow counts.

Time stamps are not collected until after the Receiver has completed its powerup and has reached initial GPS lock.

HP 59551A

:SENSe:DATA:TSTamp? ...

Returns a single time stamp.

RESPONSE FORMAT

±dd, ...

This query returns a single time stamp. Use "TSTamp 1" or "TSTamp 2" or "TSTamp 3" to select an input channel. Use *<time stamp entry>* to select a single time stamp recorded on that input.

Expanded Syntax

:SENSe:DATA:TSTamp? "TSTamp 1" or "TSTamp 2" or "TSTamp 3",
<time stamp entry>

Response

The query response represents the single time stamp requested.

The query response is a sequence of ten comma-separated integers constituting a single time stamp. The time stamp provides the year, month, day, hours, minutes, seconds, milliseconds, microseconds, nanoseconds, and TFOM (Time Figure of Merit).

For example,

:SENSe:DATA:TSTamp? "TSTamp 2", 37

Selects the 37th time stamp recorded on Time Tag Input 2.

Continued on next page ➡

Command Reference
Event Time Stamping (HP 59551A Only)



Reading Time Stamps _____ (continued)

Parameter

<time tag input> parameter:

- "TSTamp 1" to select Time Tag 1 input buffer.
- "TSTamp 2" to select Time Tag 2 input buffer.
- "TSTamp 3" to select Time Tag 3 input buffer.

<time stamp entry> parameter range is 1 to 256

Context Dependencies

:SYSTEM:PRESet clears the time stamp measurement buffers and overflow counts.

Time stamps are not collected until after the Receiver has completed its powerup and has reached initial GPS lock.



Processing Memory Overflows

HP 59551A

:SENSe:DATA:MEMory:OVERflow:COUNT?

Returns an overflow count for each of the three Time Tag inputs.

RESPONSE FORMAT

±d.dEe, ...

This query returns an overflow count for each of the three Time Tag inputs. An “overflow count” occurs after 256 time stamps have been recorded. When any additional events are detected at the input, the overflow count increments.

If memory management protocol has been set to “FIRST,” the first 256 time stamps are recorded. The overflow count indicates the number of time stamps which followed the last recorded stamp, and which were discarded.

If memory management protocol has been set to “LAST,” the most recent 256 time stamps are recorded. The overflow count indicates the number of stamps which were collected prior to the first recorded stamp, and which were overwritten.

Response

Returns three comma-separated floating-point numbers corresponding to the overflow count of each of the three inputs: 1, 2, 3.

Context Dependencies

:SYSTem:PRESet clears the time stamp measurement buffers and overflow counts.

Time stamps are not collected until after the Receiver has completed its powerup and has reached initial GPS lock.

Command Reference
Event Time Stamping (HP 59551A Only)



Processing Memory Overflows _____ (continued)

HP 59551A

:SENSe:DATA:MEMory:OVERflow:COUNT? . . .	RESPONSE FORMAT
Returns an overflow count for the selected Time Tag input.	±d.dEe

This query returns an overflow count for the selected Time Tag input. Use "TSTamp 1", "TSTamp 2", or "TSTamp 3" to select or query one input at a time.

Expanded Syntax

:SENSe:DATA:MEMory:OVERflow:COUNT? "TSTamp 1" or "TSTamp 2" or "TSTamp 3"

Response

Returns one floating-point number corresponding to the overflow count of the selected Time Tag input.

Context Dependencies

:SYSTem:PRESet clears the time stamp measurement buffers and overflow counts.

Time stamps are not collected until after the Receiver has completed its powerup and has reached initial GPS lock.

HP 59551A

:SENSe:DATA:MEMory:SAVE . . .	:SYSTem:PRESet
Sets the Receiver's memory management protocol.	FIRSt
	NON-VOLATILE

This command sets the Receiver's memory management protocol.

Expanded Syntax

:SENSe:DATA:MEMory:SAVE FIRSt or LAST

Parameter

FIRSt retains time stamps for the first 256 events detected.

LAST retains time stamps of the last (most recent) 256 events detected.

Context Dependencies

:SYSTem:PRESet sets memory management protocol to retain time stamps for FIRSt 256 events.



Processing Memory Overflows _____ (continued)

HP 59551A

:SENSe:DATA:MEMory:SAVE?

Returns the state of the memory management protocol.

RESPONSE FORMAT

XYZ

This query returns the state of the memory management protocol.

Response

FIRS indicates that the memory retains time stamps for the first 256 events detected.

LAST indicates that the memory retains time stamps for the last (most recent) 256 events detected.



Serial Interface Communication

The HP 59551A and HP 58503A GPS Receivers provide a set of commands that allow you to configure the serial interface port(s) for instrument communications. A set of special commands is provided for the HP 59551A Receiver since it has two different serial ports (PORT 1, PORT 2).

Both Receivers have the rear-panel RS-232C serial interface port (PORT 1). The HP 59551A has an additional front-panel RS-232C serial interface port (PORT 2).

The commands following commands are provided to allow you to configure the ports are

■ **Configuring I/O Port 1** *<port>* = SERIAL1 or SERIAL **Configuring I/O Port 2** *<port>* = SERIAL2 (HP 59551A Only)

```
:SYSTem:COMMunicate?  
:SYSTem:COMMunicate:<port>:BAUD ...  
:SYSTem:COMMunicate:<port>:BAUD?  
:SYSTem:COMMunicate:SERial1:BITS ...  
:SYSTem:COMMunicate:<port>:BITS?  
:SYSTem:COMMunicate:<port>:FDUPlex ...  
:SYSTem:COMMunicate:<port>:FDUPlex?  
:SYSTem:COMMunicate:<port>:PACE ...  
:SYSTem:COMMunicate:<port>:PACE?  
:SYSTem:COMMunicate:<port>:PARity ...  
:SYSTem:COMMunicate:<port>:PARity?  
:SYSTem:COMMunicate:SERial1:SBITs ...  
:SYSTem:COMMunicate:<port>:SBITs?
```

■ **Recovering the Last Query Response**

```
:DIAGnostic:QUERy:RESPonse?
```



Configuring I/O Ports

:SYSTem:COMMunicate? <i>Identifies which serial port is being used.</i>	RESPONSE FORMAT XYZ
---	--

This query identifies which serial port is being used. Use this query when the Receiver is installed out of sight or at a remote location. The distinction between SERIAL1 and SERIAL2 is required in communication commands for setting parameters such as baud and parity.

Response

SER1 or SER2 is returned.



:SYSTem:COMMunicate:<port>:BAUD ... <i>Sets the baud rate of specified port.</i>	<table border="1"> <tr> <td data-bbox="1153 874 1364 978"> :SYSTem:PRESet Not affected </td> <td data-bbox="1364 874 1453 978"> R, F† </td> </tr> <tr> <td colspan="2" data-bbox="1153 978 1453 1017"> NON-VOLATILE </td> </tr> </table>	:SYSTem:PRESet Not affected	R, F†	NON-VOLATILE	
:SYSTem:PRESet Not affected	R, F†				
NON-VOLATILE					

This command sets the baud rate of the specified port.

Expanded Syntax

```
:SYSTem:COMMunicate:SERial1:BAUD 1200 or 2400 or 9600 or 19200
:SYSTem:COMMunicate:SERial2:BAUD 1200 or 2400 or 9600 or 19200
```

Parameter

The possible baud rate values that can be entered are 1200, 2400, 9600, or 19200.

Context Dependencies

The baud rate value is stored in non-volatile memory. It is unaffected by powerup and :SYSTem:PRESet.

:SYSTem:COMMunicate:<port>:PRESet sets the baud rate to 9600, which is the factory-default value.

† Must be received via the specified I/O port.

Command Reference
Serial Interface Communication



Configuring I/O Ports _____ (continued)

:SYSTem:COMMunicate:<port>:BAUD?

Returns the baud rate of specified port.

RESPONSE FORMAT **R, F**

±dd

This query returns the baud rate of specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:BAUD?

:SYSTem:COMMunicate:SERial2:BAUD?



:SYSTem:COMMunicate:SERial1:BITS ...

Sets the data bits value of PORT 1.

:SYSTem:PRESet **R**

Not affected.

NON-VOLATILE

This command sets the data bits of PORT 1.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:BITS 7 or 8

Parameter

The possible data bits values that can be entered are 7 or 8.

Context Dependencies

The data bits value is stored in non-volatile memory. It is unaffected by powerup and :SYSTem:PRESet.

:SYSTem:COMMunicate:SERial1:PRESet sets the data bits to 8, which is the factory-default value.



Configuring I/O Ports _____ (continued)

:SYSTem:COMMunicate:<port>:BITS? <i>Returns the data bits value of specified port.</i>	RESPONSE FORMAT R, F ±dd
--	--

This query returns the data bits value of the specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:BITS?
 :SYSTem:COMMunicate:SERial2:BITS?

:SYSTem:COMMunicate:<port>:FDUPlex ... <i>Sets the duplex state of specified port.</i>	:SYSTem:PRESet R, F† Not affected NON-VOLATILE
--	---

This command sets the duplex state of the specified port. Use this command when you cannot see on the computer screen the characters you are typing for your command.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:FDUPlex ON or OFF
 :SYSTem:COMMunicate:SERial2:FDUPlex ON or OFF

Parameter

ON enables echoing of the characters you type (i.e., when typing a command, the ON state allows you to see on the computer screen the characters you type).

OFF disables the echoing of the characters you type .

Context Dependencies

The duplex state is stored in non-volatile memory. It is unaffected by powerup and :SYSTem:PRESet.

SYSTem:COMMunicate:<port>:PRESet sets the duplex state to ON, which is the factory-default state.

† Must be received via the specified I/O port.



Configuring I/O Ports _____ (continued)

:SYSTem:COMMunicate:<port>:FDUPlex? <i>Returns the duplex state of the specified port.</i>	RESPONSE FORMAT	R, F
	0 or 1	

This query returns the duplex state of the specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:FDUPlex?
:SYSTem:COMMunicate:SERial2:FDUPlex?

Response

A value of 0 indicates echo is OFF.

A value of 1 indicates echo is ON.



:SYSTem:COMMunicate:<port>:PACE ... <i>Sets flow control of the specified port.</i>	.SYSTem:PRESet	R, F†
	Not affected	
	NON-VOLATILE	

This command sets flow control of the specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:PACE XON or NONE
:SYSTem:COMMunicate:SERial2:PACE XON or NONE

Parameter

The choices are XON or NONE.

Context Dependencies

The software pacing or flow control state is stored in non-volatile memory. It is unaffected by powerup and :SYSTem:PRESet.

:SYSTem:COMMunicate:<port>:PRESet sets the flow control to NONE, which is the factory-default state.

† Must be received via the specified I/O port.



Configuring I/O Ports _____ (continued)

:SYSTem:COMMunicate:<port>:PACE? <i>Returns flow control state of the specified port.</i>	RESPONSE FORMAT R, F XYZ
---	---

This query returns the flow control state of specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:PACE?
 :SYSTem:COMMunicate:SERial2:PACE?

Response

XON or NONE is returned.



:SYSTem:COMMunicate:<port>:PARity ... <i>Sets parity of the specified port.</i>	:SYSTem:PRESet R, F† Not affected NON-VOLATILE
---	---

This command sets parity of the specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:PARity: EVEN or ODD or NONE
 :SYSTem:COMMunicate:SERial2:PARity: EVEN or ODD or NONE or ONE

Parameter

The choices for SERIAL1 are EVEN, ODD, or NONE.

The choices for SERIAL2 are EVEN, ODD, NONE, or ONE.

Context Dependencies

The parity state is stored in non-volatile memory. It is unaffected by powerup and :SYSTem:PRESet.

:SYSTem:COMMunicate:<port>:PRESet sets the parity to NONE, which is the factory-default state.

If parity is enabled, the Receiver sends/receives 7 data bits plus 1 parity bit. If parity is disabled, the Receiver sends/receives 8 data bits.

† Must be received via the specified I/O port.

Command Reference
Serial Interface Communication



Configuring I/O Ports _____ (continued)

:SYSTem:COMMunicate:<port>:PARity? <i>Returns parity setting of the specified port.</i>	RESPONSE FORMAT R, F XYZ
---	---

This query returns the parity setting of the specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:PARity?
 :SYSTem:COMMunicate:SERial2:PARity?

Response

EVEN, ODD, NONE, or ONE is returned.



:SYSTem:COMMunicate:SERial1:SBITs ... <i>Sets the stop bits value of PORT 1.</i>	.SYSTem:PRESet R Not affected
	NON-VOLATILE

This command sets the stop bits value of PORT 1.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:SBITs 1 or 2

Parameter

The possible stop bits values that can be entered are 1 or 2.

Context Dependencies

The stop bits value is stored in non-volatile memory. It is unaffected by powerup and :SYSTem:PRESet.

:SYSTem:COMMunicate:SERial1:PRESet sets the stop bits value to 1, which is the factory-default value.



Configuring I/O Ports _____ (continued)

:SYSTem:COMMunicate:<port>:SBITs?

Returns the stop bits value of the specified port.

RESPONSE FORMAT R, F

±dd

This query returns the stop bits value of specified port.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:SBITs?

:SYSTem:COMMunicate:SERial2:SBITs?



Recovering the Last Query Response

:DIAGnostic:QUERy:RESPonse?

Returns the last response item issued through the Receiver's serial interface for use in an error recovery process.

RESPONSE FORMAT

Format depends on the last issued query.

This query returns the last response item issued through the Receiver's serial interface for use in an error recovery process.

In the case of a serial interface data transmission error, this query can be used to get the last response item which may otherwise be unavailable because of the side effects of the original command. For example, the :SYST:ERRor? query removes the oldest entry from the error queue, so to see the entry again following a data transmission error, use :DIAG:QUER:RESP? instead of repeating the original command.

Response

The format depends on the last issued query.



Receiver Initialization

The following commands are provided to allow you to initialize or preset the serial interface port(s) and the Receiver to their factory shipment values.

```
:SYSTem:COMMunicate:SERial1:PRESet  
:SYSTem:COMMunicate:SERial2:PRESet (HP 59551A Only)  
:SYSTem:PRESet
```

Command Reference
Receiver Initialization

:SYSTem:COMMunicate:<port>:PRESet <i>Sets the specified port configuration to its factory-default values.</i>	EVENT
---	--------------

This command is an event that sets specified port parameters to their factory-default values.

Expanded Syntax

:SYSTem:COMMunicate:SERial1:PRESet
 :SYSTem:COMMunicate:SERial2:PRESet

PORT 1 Configuration Factory-Default Values

Parameter	Default	Possible Choices
Software Pacing	NONE	XON or NONE
Baud Rate	9600	1200, 2400, 9600, or 19200
Parity	NONE	EVEN, ODD, or NONE
Data Bits	8	7 or 8
Stop Bits	1	1 or 2
Full Duplex	ON	ON or OFF

PORT 2 Configuration Factory-Default Values (HP 59551A Only)

Parameter	Default	Possible Choices
Software Pacing	NONE	XON or NONE
Baud Rate	9600	1200, 2400, 9600, or 19200
Parity	NONE	EVEN, ODD, NONE, or ONE
Data Bits	8	Fixed at 7 when parity is even or odd. Fixed at 8 when parity is none.
Stop Bits	1	Fixed (no choices available)
Full Duplex	ON	ON or OFF

Context Dependencies

The SERIAL1 preset command only is valid if transmitted on the rear-panel (PORT 1).

:SYSTem:PRESet <i>Restores the Receiver parameters settings to their factory-default values.</i>	EVENT
--	--------------

This command is an event that restores the Receiver parameters settings to their factory shipment or factory-default values (see the following Table 5-2).

NOTE

Issuing this command will result in disruption of all of the following: GPS satellite tracking, reference oscillator frequency, 1 PPS output timing, and Receiver status information.

Command Reference
Receiver Initialization

Table 5-2. System Preset (Factory Default) Parameter Settings Summary

Commands	:SYSTem:PRESet
ESE ...	0 (NV)
*SRE ...	136 (NV)
:DIAGnostic:LOG:CLEar	Log is cleared.
:DIAGnostic:LOG:COUNt?	2
:DIAGnostic:QUErY:RESPOse?	cleared.
:FORMat:DATA ...	ASCII (NV)
:GPS:POSition ...	N,0,0,0,E,0,0,0,0 (NV) LAST is also set to this position. (NV)
:GPS:POSition:HOLD:LAST?	N,0,0,0,E,0,0,0,0 (NV)
:GPS:POSition:HOLD:STATe?	0 (NV)
:GPS:POSition:SURVey:STATe ...	ONCE
:GPS:POSition:SURVey:STATe:POWerup ...	ON (NV)
:GPS:REFerence:ADELay ...	0.0 (NV)
:GPS:SATEllite:TRACking:EMANgle ...	10 (NV)
:GPS:SATEllite:TRACking:IGNore:STATe? ...	0 for every PRN.
:GPS:SATEllite:TRACking:IGNore ...	No satellites ignored (NV)
:GPS:SATEllite:TRACking:INCLude ...	All satellites included (NV)
:GPS:SATEllite:TRACking:INCLude:STATe? ...	1 for every PRN.
:PTIME:TZONE ...	0,0 (NV)
:PULSe:CONTInuous:PERiod ...	1 (NV)
:PULSe:CONTInuous:STATe ...	OFF (NV)
:PULSe:STARt:DATE ...	1994,1,1 (NV)
:PULSe:STARt:TIME ...	0,0,0 (NV)
:SENSe:DATA?	Data is cleared.
:SENSe:DATA:MEMory:OVERflow:COUNt?	All counts are cleared (V**).
:SENSe:DATA:MEMory:SAVE ...	FIRSt (NV)
:SENSe:DATA:POINts?	All responses become 0 (zero). (V)
:SENSe:DATA:TSTamp? ...	All timestamps cleared.

* NV stands for non-volatile memory.
**V stands for volatile memory.

Command Reference
Receiver Initialization

Table 5-2. System Preset (Factory Default) Parameter Settings Summary (Continued)

Commands	:SYSTem:PRESet
:STATus:OPERation:ENABle ...	36 (NV)
:STATus:OPERation:HARDware:ENABle ...	8191 (NV)
:STATus:OPERation:HARDware:NTRansition ...	0 (NV)
:STATus:OPERation:HARDware:PTRansition ...	5119 (NV)
:STATus:OPERation:HOLDover:ENABle ...	8 (NV)
:STATus:OPERation:HOLDover:NTRansition ...	0 (NV)
:STATus:OPERation:HOLDover:PTRansition ...	15 (NV)
:STATus:OPERation:NTRansition ...	0 (NV)
:STATus:OPERation:POWerup:ENABle ...	7 (NV)
:STATus:OPERation:POWerup:NTRansition ...	0 (NV)
:STATus:OPERation:POWerup:PTRansition ...	7 (NV)
:STATus:OPERation:PTRansition ...	127 (NV)
:STATus:QUEStionable:CONDition:USER ...	Cleared (NV)
:STATus:QUEStionable:ENABle ...	3 (NV)
:STATus:QUEStionable:NTRansition ...	0 (NV)
:STATus:QUEStionable:PTRansition ...	2 (NV)
:SYNChronization:HOLDover:DURation?	0,0 (Even if there was a prior holdover, its duration will be lost.)
:SYNChronization:HOLDover:DURation:THReshold ...	86400 (that is, 1 day), (NV)
:SYNChronization:STATE?	POWerup
:SYSTem:ERRor?	Error queue is cleared.
:SYSTem:LANGuage ...	"PRIMARY"

* NV stands for non-volatile memory.

**V stands for volatile memory.



Receiver Identification/Upgrade

The commands provided in this section allow you to query the identification of the Receiver, and to perform firmware upgrades in the field after you obtain a new firmware disk.

■ Reading Product Identification

*IDN?

■ Installing Firmware via I/O PORT 1

*CLS
:DIAGnostic:DOWNload ...
:DIAGnostic:ERASe
:DIAGnostic:ERASe?
:SYSTem:ERRor?
:SYSTem:LANGUage ...
:SYSTem:LANGUage?



Reading Product Identification _____



*IDN?

Returns the Receiver identification.

RESPONSE FORMAT

ASCII Data

This query returns the Receiver identification.

Response

- A sequence of ASCII-encoded bytes:

HEWLETT-PACKARD, 59551A, XXXXYZZZZZ, WWWW – V

where 59551A is the product model number, XXXXYZZZZZ is the product serial number, and WWWW is the product's firmware revision date code, and V is the hardware revision letter.

In the product serial number (XXXXYZZZZZ):

- XXXX is a four-digit prefix that identifies a series of instruments.
 - Y identifies the country in which the instrument was manufactured (e.g., the "A" in 3426A000123 stands for America).
 - ZZZZZ is a five-digit suffix that identifies a particular instrument within a series.
- For example,

HEWLETT-PACKARD, 59551A,3426A00123,3422 – A

This query should be the last query in a terminated program message; otherwise, error -440 is generated.

Context Dependencies

Preparatory to installation of new product firmware, the instrument is switched to the "INSTALL" language, available only on PORT 1. The "INSTALL" language includes an *IDN? query which returns the revision identification for the installation firmware. The response format is the same as described above for the instrument's "PRIMARY" language, but the identification code may be different.



Installing Firmware via I/O PORT 1 _____

The commands in this section represent the command set of the “INSTALL” language. The “INSTALL” language is part of a highly-specialized set of features used to erase the Receiver’s firmware, and to install a new firmware revision. It should be selected only when firmware installation is required.

The “INSTALL” language offers the limited number of commands and queries which are documented in this section. This set is designed to provide the Receiver status and control capability required during firmware upgrade.

NOTE

The HP SatStat program provides a Service menu which automates firmware installation.

*CLS <i>Clears errors.</i>	EVENT	R
--------------------------------------	--------------	----------

This command clears errors.

:DIAGnostic:DOWNload ... <i>Sends down a Motorola® S-record.</i>	EVENT	R
--	--------------	----------

This command sends down a Motorola® S-record.

Expanded Syntax

:DIAGnostic:DOWNload <Motorola S-record>



:DIAGnostic:ERASe <i>Erases the flash EEPROM.</i>	EVENT	R
---	--------------	----------

This command erases the flash EEPROM. It should ONLY be sent to the Receiver as a preparatory step during firmware upgrade. Erasing flash EEPROM will disable the instrument until flash EEPROM is reloaded with factory-supplied instrument firmware.



Installing Firmware via I/O Port 1 _____ (continued)

:DIAGnostic:ERASe? <i>Verifies flash EEPROM has been erased.</i>	RESPONSE FORMAT R 0 or 1
--	---------------------------------------

This query verifies the flash EEPROM has been erased.

Response

A value of 1 indicates that flash EEPROM has been erased.

This condition normally occurs when the instrument software in flash EEPROM is erased in preparation for installation of a more recent software revision. That is, after command :DIAG:ERASe has been issued and erase is complete, the :DIAG:ERASe? query response is "1".



:SYSTem:ERRor? <i>Returns the oldest error in the Error Queue and removes that error from the queue (first in, first out).</i>	RESPONSE FORMAT R ±dd, "XYZ"
--	---

This query returns the oldest error in the Error Queue and removes that error from the queue (first in, first out).

See Appendix A, "Error Messages," in this guide for detailed error information.

Response

The error response format is: <error_number>,"<error_description>", where

- The <error_number> is an integer transferred as ASCII bytes in <NR1>format (integer). The range is -32768 to 32767.
- Negative error numbers are defined by the SCPI standard.
- Positive error numbers are defined specifically for this Receiver.
- An error number value of zero indicates that the Error Queue is empty.
- The maximum length of the <error_description> is 255 characters.

Continued on next page ➡



Installing Firmware via I/O Port 1 _____ (continued)

Context Dependencies

:SYSTEM:PRESet clears the Error Queue.

The queue is cleared (emptied) on *CLS, power-on, or upon reading the last error from the queue.

If the Error Queue overflows, the last error in the queue is replaced with the error -350, "Queue overflow". Any time the queue overflows, the least recent errors remain in the queue and the most recent error is discarded. The maximum length of the Error Queue is 30.

:SYSTEM:LANGUage . . . Switches the operation mode (primary or install) of the Receiver.	:SYSTEM:PRESet R "PRIMARY" NON-VOLATILE
---	---

This command switches the operation mode (primary or install) of the Receiver.

Expanded Syntax

:SYSTEM:LANGUage "INSTALL" or "PRIMARY".

Parameter

The "INSTALL" language is part of a highly-specialized set of features used to erase the Receiver's firmware, and to install a new firmware revision. It should be selected only when firmware installation is required.

The "INSTALL" language offers the limited number of commands and queries which are documented in this section. This set is designed to provide the Receiver status and control capability required during firmware upgrade.

NOTE

The HP SatStat program provides a Service menu which automates firmware installation.

The "PRIMARY" language provides the capabilities required for normal Receiver operation. If the "INSTALL" language has been selected as part of the firmware upgrade, the "PRIMARY" language should be selected after the upgrade to restore normal operation.

Command Reference
Receiver Identification/Upgrade



Installing Firmware via I/O Port 1 _____ *(continued)*

:SYSTem:LANGuage?

Identifies the operation mode (primary or install) of the Receiver.

RESPONSE FORMAT

R

"XYZ"

This query identifies the operation mode (primary or install) of the Receiver.

Response

"INSTALL" or "PRIMARY" is returned.

Command Reference

Receiver Identification/Upgrade

A

Error Messages

Introduction

This appendix explains how to read any errors from the Receiver, discusses the error queue, types of errors and general error behavior, and provides a table of all of the Receiver's errors and their probable causes.

Reading an Error

Executing the :SYSTEM:ERROR? command reads the oldest error from the error queue and erases that error from the queue. The :SYST:ERR? response has the form:

<error number>, <error string>

An example response is:

**-113,"Undefined header"
scpi>**

Positive error numbers are specific to the Receiver. Negative error numbers are command language related and are discussed later in this appendix.

All errors set a corresponding bit in the Standard Event Status Register (see Figure 5-1).

Error Queue

As errors are detected, they are placed in an error queue. This queue is first in, first out. That is, if there has been more than one error, the first one in the queue is read out with :SYST:ERR?. Subsequent responses continue until the queue is empty.

If the error queue overflows, the last error in the queue is replaced with **error -350, "Queue overflow"**. Any time the queue overflows, the least recent errors remain in the queue, and the most recent error is discarded. The length of the Receiver's error queue is 30 (29 positions for the error messages, and 1 position for the "Queue overflow" error). Reading an error from the head of the queue removes that error from the queue, and opens a position at the tail of the queue for a new error, if one is subsequently detected.

When all errors have been read from the queue, further error queries return **+0, "No error"**.

The error queue is cleared when any of the following occur:

- Upon power-on.
- Upon receipt of a *CLS command.
- Upon reading the last item from the queue.

Error Types

Error numbers are categorized by type as shown in Table A-1. Each error is listed in Table A-2.

Table A-1. Error Types

Error Number	Error Type
+0	No Error
-100 to -199	Syntactic Errors
-200 to -299	Semantic Errors
-300 to -350	Hardware/Firmware Errors
-400 to -499	Query Errors

The first error described in each class (for example, -100, -200, -300, -400) is a "generic" error.

No Error

The :SYST:ERR? response **+0, "No error"** indicates that the Receiver has no errors. The error queue is empty when every error in the queue has been read (:SYST:ERR? query) or the queue was cleared by power-on or *CLS.

Syntactic Error

An <error number> in the range [-100 to -199] indicates that an IEEE 488.2 syntax error has been detected by the Receiver's parser. The occurrence of any error in this class causes the syntactic error bit (bit 5) in the Event Status Register to be set. One of the following events has occurred:

- An IEEE 488.2 syntax error has been detected by the parser. That is, a controller-to-Receiver message was received that is in violation of the IEEE 488.2 Standard. Possible violations include a data element that violates the Receiver listening formats or whose type is unacceptable to the Receiver.
- An unrecognized header was received. Unrecognized headers include incorrect Receiver-specific headers and incorrect or unimplemented IEEE 488.2 Common Commands.

Error Types

Events that generate syntactic errors do not generate semantic errors, hardware/firmware errors, or query errors.

Semantic Error

An <error number> in the range [-200 to -299] indicates that an error has been detected by the Receiver's execution control block. The occurrence of any error in this class causes the semantic error bit (bit 4) in the Event Status Register to be set. One of the following events has occurred:

- A <PROGRAM DATA> element following a header was evaluated by the Receiver as outside of its legal input range or is otherwise inconsistent with the Receiver's capabilities.
- A valid program message could not be properly executed due to some Receiver condition.

Semantic errors are reported by the Receiver after rounding and expression evaluation operations have been taken place. Rounding a numeric data element, for example, is not reported as a semantic error. Events that generate semantic errors do not generate syntactic errors, hardware/firmware errors, or query errors.

Hardware/Firmware Error

An <error number> in the range [-300 to -399] or [+1 to +32767] indicates that the Receiver has detected an error that is not a syntactic error, a query error, or a semantic error; some Receiver operations did not properly complete, possibly due to an abnormal hardware or firmware condition. These codes are also used for self-test response errors. The occurrence of any error in this class causes the hardware/firmware error bit (bit 3) in the Event Status Register to be set.

General Error Behavior

Query Error

An <error number> in the range [-400 to -499] indicates that the output queue control of the Receiver has detected a problem with the message exchange protocol. The occurrence of any error in this class should cause the query error bit (bit 2) in the Event Status Register to be set. One of the following is true:

- An attempt is being made to read data from the output queue when no output is either present or pending.
- Data in the output queue has been lost.

General Error Behavior

For Commands (i.e., non-query; doesn't provide a response):

- For any command that has numeric parameters, if the value is out of range (beyond either the min or max allowed settings), the value will be clipped to the appropriate limit and **error -222** will be generated (data out-of-range error) as an indication that the value wasn't set to the requested value.

There are some commands having numeric parameters where the clipping behavior described above doesn't make sense. These include the satellite include and ignore commands, and the status system mask commands. For these commands, an out-of-bounds value is ignored and **error -222** is generated. Also, a single out-of-bounds value may cause the entire command to be ignored. For example, GPS:SAT:TRAC:INCL 3,87,5 will be entirely ignored because 87 is out-of-range (i.e., 3 and 5 do not become included even though they are in-range).

- Commands with multiple numeric parameters can produce multiple errors. For example, if the initial date command is sent as GPS:INIT:TIME 25,66,-7, the actual programmed value will be 23:59:00 (23 is max hour, 59 is max minute, 0 is min second) and three out-of-range errors will be generated. As always, only a single prompt will be returned, but in this case three errors will be in the error queue (de-queued via SYST:ERR? or *CLS).

Error Messages

List of Errors

- Numeric parameters between in-range values are rounded to the closest value. For example, sending GPS:REF:ADEL 1.7 ns will set the antenna delay to 2 ns.

For Queries (response-generating commands)

- If the query produces an error, there will not be a response (other than the prompt that always occurs).
- If the query includes a numeric parameter, and that parameter is out of range, **error -222** will be generated and there won't be a response (this is consistent with the prior bullet). An example of this would be DIAG:LOG:READ? 25 when there are fewer than 25 messages in the log. Note that for this specific example, to get the most recent log entry, simply use DIAG:LOG:READ?.
- Another way you can view this: if you get a query response you can know that it is responding precisely to the question asked by the query.

List of Errors

Table A-2 lists and describes the error messages.

Error Messages

List of Errors

Table A-2. Error Messages

Number	Error String	Cause
+0	No error	The error queue is empty. Every error in the queue has been read (SYSTEM:ERRor? query) or the queue was cleared by power-on or *CLS.
-100	Command error	This is the generic syntax error used if the Receiver cannot detect more specific errors.
-101	Invalid character	A syntactic element contains a character that is invalid for that type.
-102	Syntax error	An unrecognized command or data type was encountered.
-103	Invalid separator	The parser was expecting a separator and encountered an illegal character.
-104	Data type error	The parser recognized a data element different than one allowed. For example, numeric or string data was expected, but block data was received.
-108	Parameter not allowed	More parameters were received than expected for the header.
-109	Missing parameter	Fewer parameters were received than required for the header.
-112	Program mnemonic too long	The header or character data element contains more than twelve characters.
-113	Undefined header	The header is undefined. For example, the command ":HELLO".
-120	Numeric data error	This error, as well as errors -121 through -129, is generated when parsing a data element which appears to be numeric. This particular error message is used when the Receiver cannot detect a more specific error.
-121	Invalid character in number	An invalid character for the data type being parsed was encountered. For example, a "9" in octal data.
-123	Exponent too large	Numeric overflow.
-124	Too many digits	The mantissa of a decimal numeric data element contained more than 255 digits excluding leading zeros.
-128	Numeric data not allowed	A legal numeric data element was received, but the Receiver does not accept one in this position for the header.
-131	Invalid suffix	The suffix does not follow the syntax described in IEEE 488.2 or the suffix is inappropriate for the Receiver.
-134	Suffix too long	The suffix contained more than 12 characters.
-138	Suffix not allowed	A suffix was encountered after a numeric element that does not allow a suffix.
-141	Invalid character data	The character data element contains an invalid character.
-148	Character data not allowed	A legal character data element was encountered where prohibited by the Receiver.
-150	String data error	This error can be generated when parsing a string data element. This particular error message is used if the Receiver cannot detect a more specific error.
-151	Invalid string data	A string data element was expected but was invalid for some reason.
-158	String data not allowed	A string data element was encountered but was not allowed by the Receiver at this point in parsing.
-170	Expression error	This error can be generated when parsing an expression data element. It is used if the Receiver cannot detect a more specific error.
-178	Expression data not allowed	Expression data was encountered but was not allowed by the Receiver at this point in parsing.

Error Messages

List of Errors

Table A-2. Error Messages (Continued)

Number	Error String	Cause
-200	Execution error	This is the generic syntax error if the Receiver cannot detect more specific errors.
-220	Parameter error	Indicates that a program data element error occurred. This error is used when the Receiver cannot detect more specific errors.
-221	Settings conflict	Indicates that a legal program data element was parsed but could not be executed due to the current Receiver state.
-222	Data out of range	Indicates that a legal program data element was parsed but could not be executed because the interpreted value is outside the legal range defined by the Receiver.
-223	Too much data	Indicates that a legal program data element of block, expression, or string type was received that contained more data than the Receiver could handle due to memory or related receiver-specific requirements.
-224	Illegal parameter value	Used where exact value, from a list of possible values, was expected (but not received).
-230	Data corrupt or stale	No valid data available.
-240	Hardware error	Indicates that a legal program command or query could not be executed because of a hardware problem in the Receiver.
-241	Hardware missing	Indicates that a legal program command or query could not be executed because of missing Receiver hardware.
-300	Device-specific error	This is the generic device-dependent error.
-310	System error	Indicates that a system error occurred.
-311	Memory error	Occurs on EEPROM write failure.
-315	Configuration memory lost	Could happen on powerup or preset if a nonvolatile memory problem is detected.
-321	Out of memory	Indicates that the Receiver has detected that insufficient memory is available.
-330	Self-test failed	Indicates at least one failure occurred when *TST? or :DIAG:TEST? was executed.
-350	Queue overflow	An error occurred but was not recorded because the error queue is full.
-360	Communication error	This is the generic communication error for devices that cannot detect the more specific errors described for errors -361 through -363.
-361	Parity error in program message	Parity bit not correct when data received for example, on a serial port.
-362	Framing error in program message	A stop bit was not detected when data was received. For example, on a serial port (for example, a baud rate mismatch).
-363	Input buffer overrun	Software or hardware input buffer on serial port overflows with data caused by improper or nonexistent pacing.
-440	Query UNTERMINATED after indefinite response	Indicates that a query was received in the same program message after a query requesting an indefinite response (e.g., *IDN? or :PTIM:TCOD? or :SYST:STAT?).

Error Messages
List of Errors

B

Command Syntax and Style

Appendix Contents

This appendix provides an overview of the Standard Commands for Programming Instrument (SCPI) syntax and style to help you program the Receiver. A section that lists SCPI reference documentation is also provided.

This appendix is organized as follows:

- Command Types, Formats, and Elements page B-3
 - Command Types page B-3
 - Command Formats page B-3
 - Elements of SCPI Commands page B-3
 - Using Multiple Commands page B-8
 - Elements of Response Messages page B-9
- Reference Documentation page B-13

Command Types, Format, and Elements

Command Types

There are two types of HP GPS Receiver programming commands: IEEE 488.2 Common Commands and Standard Commands for Programmable Instruments (SCPI). The IEEE 488.2 Common Commands control and manage communications between the Receiver and the controller, terminal, or personal computer. The SCPI commands control instrument functions. The format of each type of command is described in the following paragraphs.

Command Formats

Common Command Format

The IEEE 488.2 Standard defines the Common commands as commands that perform functions like reset, self-test, status byte query, and identification. Common commands always begin with the asterisk (*) character, and may include parameters. The command keyword is separated from the first parameter by a space character. Some examples of Common commands are as follows:

*IDN? *ESE 32

SCPI Command and Query Format

SCPI commands perform functions like instrument setup. A subsystem command has a hierarchical structure that usually consists of a top level (or root) keyword, one or more lower-level keywords, and parameters. The following example shows a command and its associated query:

```
:GPS:POSition:SURVey:STATe ONCE  
:GPS:POSition:SURVey:STATe?
```

GPS is a root-level keyword with POSition the second-level keyword, SURVey the third-level keyword, and STATe the fourth-level. ONCE is the command parameter.

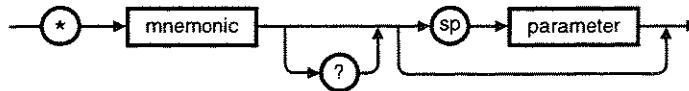
Elements of SCPI Commands

A program command or query is composed of functional elements that include a header (keywords with colon separators), program data, and terminators. These elements are sent to the Receiver over the serial interface as a sequence of ASCII characters. Examples of a typical Common Command and Subsystem Command are:

```
*CLS
:SYST:ERR?
```

Common Command Syntax

Figure B-1 shows the simplified syntax of a Common Command. You must use a space (SP) between the command mnemonic and the parameter in a Common Command.

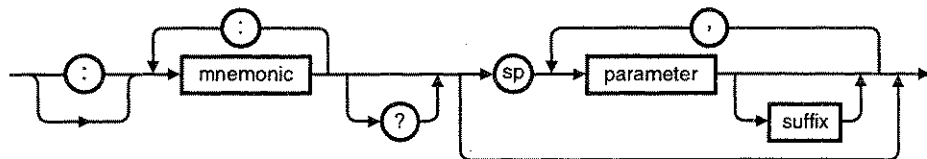


NOTE: sp = space. ASCII character decimal 32

Figure B-1. Simplified Common Command Syntax Diagram

Subsystem Command Syntax

Figure B-2 shows the simplified syntax of a Subsystem Command. You must use a space (SP) between the last command mnemonic and the first parameter in a Subsystem Command. Note that if you send more than one parameter with a single command, you must separate adjacent parameters with a comma.



NOTE: sp = space. ASCII character decimal 32

Figure B-2. Simplified Program Command Syntax Diagram

Command Syntax and Style

Command Types, Format, and Elements

Abbreviated Commands

The command syntax shows most keywords as a mixture of upper and lower case letters. Upper case letters indicate the abbreviated spelling for the command. For better program readability, you may send the entire keyword. The Receiver accepts either command form and is not case sensitive.

For example, if the command syntax shows SYNChronization, then SYNC and SYNCHRONIZATION are both acceptable forms. Other forms of SYNChronization, such as SYNCHR or SYNCHRONIZ will generate an error. You may use upper and/or lower case letters. Therefore, SYNCHRONIZATION, synchronization, SyNchRONizatioN, and SYnC are all acceptable.

Keyword Separator

A colon (:) always separates one keyword from the next lower-level keyword as shown below:

:SYST:ERR?

Parameter Data Types

Table B-1 contains explanations and examples of parameter types. Parameter types may be numeric value, Boolean, literal, NRf, string, or non-decimal numeric.

Table B-1. Command and Query Parameter Types

TYPE	EXPLANATIONS AND EXAMPLES
<numeric value>	Accepts all commonly used decimal representation of numbers including optional signs, decimal points, and scientific notation: 123, 123e2, -123, -1.23e2, .123, 1.23e-2, 1.23000E-01. Special cases include MINimum and MAXimum as follows: MINimum selects minimum value available. MAXimum selects maximum value available. Queries using MINimum or MAXimum return the associated numeric value.
<Boolean>	Represents a single binary condition that is either true or false: 1 or ON, 0 or OFF (Query response returns only 1 or 0.) An <NRf> is rounded to an integer. A non-zero value is interpreted as 1.
<literal>	Selects from a finite number of choices. These parameters use mnemonics to represent each valid setting. An example of a <literal> parameter is: GPS
<NRf>	Flexible numeric representation. Only positive integers are used for NRf parameters in the instrument.
<string>	A string parameter is delimited by either single quotes or double quotes. Within the quotes, any characters in the ASCII B-bit code may be specified.
<non-decimal numeric>	Format for specifying hexadecimal (#H1F), octal (#Q1077), and binary (#B10101011) numbers using ASCII characters. May be used in :STATus subsystem commands.

Parameter Separator

If you send more than one parameter with a single command, you must separate adjacent parameters with a comma.

Query Parameters

All selectable <numeric value> parameters can be queried to return the minimum or maximum values they are capable of being set to by sending a MINimum or MAXimum parameter after the “?” For example, consider the :GPS:REF:ADEL? query.

If you send the query without specifying a parameter (:GPS:REF:ADEL?), the present antenna delay value is returned. If you send the MIN parameter (using :GPS:REF:ADEL? MIN), the command returns the minimum value currently available. If you send the MAX parameter, the command returns the maximum value

Command Types, Format, and Elements

currently available. Be sure to place a space between the question mark and the parameter.

Suffixes

A suffix is the combination of suffix elements and multipliers that can be used to interpret the <numeric value> sent. If a suffix is not specified, the Receiver assumes that <numeric value> is unscaled (that is, Volts, seconds, etc.)

For example, the following two commands are equivalent:

```
:GPS:REF:ADELay 100 NS
:GPS:REF:ADELay 100E-9
```

Suffix Elements

Suffix elements, such as HZ (Hertz), S (seconds), V (Volts), OHM (Ohms), PCT (percent), and DEG (degrees) are allowed within this format.

Suffix Multipliers

Table B-2 lists the suffix multipliers that can be used with suffix elements (except PCT and DEG.).

Table B-2. Suffix Multipliers

DEFINITION	MNEMONIC	NAME
1E9	G	GIGA
1E6	MA (or M for OHM and HZ)*	MEGA
1E3	K	KILO
1E-3	M (except for OHM and HZ)*	MILLI
1E-6	U	MICRO
1E-9	N	NANO
1E-12	P	PICO

*The suffix units, MHZ and MOHM, are special cases that should not be confused with <suffix multiplier>HZ and <suffix multiplier>OHM.

Command Terminator

A command may be terminated with a line feed (ASCII LF character 10 decimal), a carriage return (ASCII CR character 13 decimal), or one followed immediately by the other in any order.

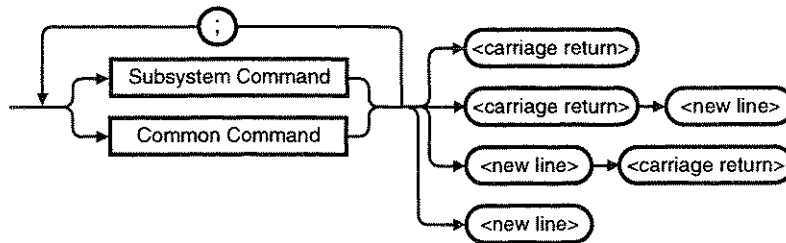
Using Multiple Commands

Program Messages

Program Messages are a combination of one or more properly formatted SCPI Commands. Program messages always go from the DTE to the Receiver. They are sent to the Receiver over the Receiver's serial interface as a sequence of ASCII characters.

Program Message Syntax

Figure B-3 shows the simplified syntax of a program message. You can see Common Commands and Subsystem Commands in the same program message. If you send more than one command in one message, you must separate adjacent commands with a semicolon.



NOTE:
<new line> = ASCII character decimal 10
<carriage return> = ASCII character decimal 13

Figure B-3. Simplified Program Message Syntax Diagram

When using IEEE 488.2 Common commands with SCPI Subsystem commands on the same line, use a semicolon between adjacent commands. For example:

```
*CLS;;SYST:ERR?
```

Command Types, Format, and Elements

When multiple SCPI Subsystem commands are sent in one program message, the first command is always referenced to the root node. Subsequent commands, separated by “;”, are referenced to the same level as the preceding command if no “:” is present immediately after the command separator (the semicolon).

For example, sending

```
:GPS:INIT:DATE 1994,7,4;TIME 12,34,56
```

is equivalent to sending:

```
:GPS:INIT:DATE 1994,7,4
```

```
:GPS:INIT:TIME 12,34,56
```

or

```
:GPS:INIT:DATE 1994,7,4;:GPS:INIT:TIME 12,34,56
```

The “:” must be present to distinguish another root level command.

For example:

```
:SYNC:HOLD:DUR?;:GPS:SAT:VIS:PRED?
```

is equivalent to sending:

```
:SYNC:HOLD:DUR?
```

```
:GPS:SAT:VIS:PRED?
```

If the “:”(which is following the “;” and is in front of GPS) is omitted, the Receiver assumes that the second command is

```
:SYNC:HOLD:GPS:SAT:VIS:PRED?
```

and generates a syntax error.

Elements of Response Messages

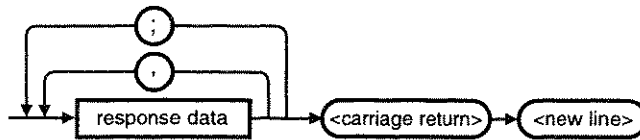
Response Messages

Response messages are data sent from the Receiver to the DTE in response to a query. (A query is a command followed by a question mark. Queries are used to find out how the Receiver is currently configured and to transfer data from the Receiver to the DTE.)

After receiving a query, the Receiver interrogates the requested configuration and issues its response message as soon as possible. The message is transmitted across the serial interface to the DTE.

Response Message Syntax

Figure B-4 shows the simplified syntax of a Response Message. Response messages may contain both commas and semicolon separators. When a single query command returns multiple values, a comma is used to separate each item. When multiple queries are sent in the same program message, the groups of data corresponding to each query are separated by a semicolon.



NOTE:

<new line> = ASCII character decimal 10

<carriage return> = ASCII character decimal 13

; = multiple response separator (ASCII character decimal 59)

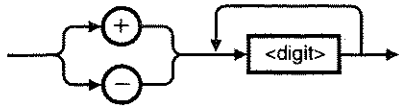
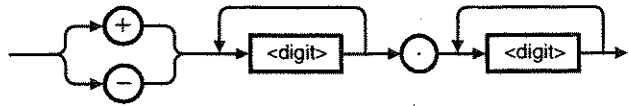
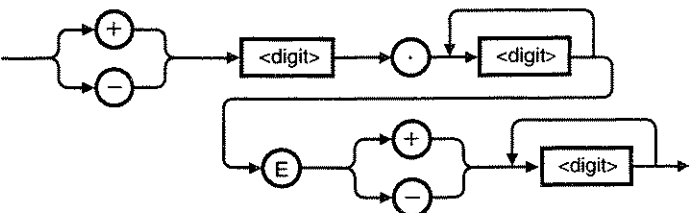
, = data separator within a response (ASCII character decimal 44)

Figure B-4. Simplified Response Message Syntax Diagram

Response Formats

Table B-3 contains explanations of response formats.

Table B-3. Response Formats

*Format	Description
$\pm dd$	<p>This numeric format represents an integer (e.g., +9).</p>  <p>The maximum number of characters in $\pm dd$ response data is 17 (maximum 16 digits, 1 sign).</p>
$\pm dd, \dots$	<p>This numeric format represents a comma-separated list of integers (e.g., +1,+2,+3).</p>
$\pm d.d$	<p>This numeric format represents a fixed (e.g., +10.5).</p> 
$\pm d.dEe$	<p>This numeric format represents a floating-point number (e.g., +1.00E+000).</p>  <p>The maximum number of characters in $\pm d.dEe$ response data is 13 (maximum 6 mantissa digits, 2 signs, 1 decimal point, 1 'E' character, 3 exponent digits).</p>
$\pm d.dEe, \dots$	<p>This numeric format represents comma-separated list of floating-numbers (e.g., +1.00000E-009, +2.00000E-009, +5.00000E-009).</p>
0 or 1	<p>A single ASCII-encoded byte, 0 or 1, is returned for the query of settings that use ON, OFF, 1, or 0 parameters.</p>

Command Syntax and Style
Command Types, Format, and Elements

Table B-3. Response Formats (Continued)

Format	Description
XYZ	<p>ASCII-encoded bytes corresponding to the literal used as the command parameter.</p> <div data-bbox="748 587 1117 725" style="text-align: center;"> </div> <p>An example of an alphanumeric response is: NONE</p>
" XYZ "	<p>A string response consists of ASCII characters enclosed by double quotes.</p> <p>For example, string data is used for the "<error description>" portion of :SYST:ERR? response.</p>
" XYZ", ...	<p>A list of string responses consist of comma-separated ASCII characters enclosed by double quotes.</p> <p>(e.g., "log 224:19951017.00:00:26:30: Holdover started, GPS", "log 225:19951017.00:00:29:02: GPS lock started")</p>
ASCII Data	<p>A sequence of ASCII-encoded bytes.</p>
Binary Data	<p>The syntax is a pound sign (#) followed by a non-zero digit representing the number of digits in the subsequent decimal integer. The decimal integer specifies the number of 8-bit data bytes being sent. This is followed by the actual data. The terminator is a line feed. For example, for transmitting 8 bytes of data, the format might be:</p> <div data-bbox="740 1351 1289 1523" style="text-align: center;"> </div> <p>The "2" indicates the number of digits that follow and the two digits "08" indicate the number of <i>data</i> bytes to be transmitted.</p> <p><carriage return> is defined as a single ASCII-encoded byte corresponding to 13 decimal.</p> <p><new line> is defined as a single ASCII-encoded byte corresponding to 10 decimal.</p>

Reference Documentation

This section contains a list of documentation related to the use of the Receiver's RS-232C serial port. Additional information that you may find useful can be found in the following publications:

1. **Beginner's Guide to SCPI (HP Part Number H2325-90001, July 1990 Edition).**
2. **Beginner's Guide to SCPI, Barry Eppler** (Hewlett-Packard Press, Addison-Wesley Publishing Co. 1991).
3. **Standard Commands for Programmable Instruments (SCPI), Version 1992.0.**

This standard is a guide for the selection of messages to be included in programmable instrumentation. It is primarily intended for instrument firmware engineers. However, you may find it useful if you are programming more than one instrument that claims conformance to the SCPI standard. You can verify the use of standard SCPI commands in different instruments.

To obtain a copy of this standard, contact:

SCPI Consortium
8380 Hercules, Suite P3
La Mesa, CA 91942
Phone: (619) 69B-8790
FAX: (619) 69B-5955

4. **The International Institute of Electrical Engineers and Electronic Engineers, IEEE Standard 488.2-1987, IEEE Standard Codes, Formats, Protocols, and Common Commands for Use with ANSI/IEEE Std 488.B-1987 Programmable Instrumentation.**

This standard defines the underlying message formats and data types used in SCPI. It is intended more for firmware engineers than for instrument users/programmers. However, it can be useful if you need to know the precise definition of specific message formats, data type, or common commands.

To obtain a copy of this standard, write to:

The Institute of Electrical and Electronic Engineers Inc.
345 East 47th Street
New York, NY 10017 USA

C

Receiver Firmware Installation

Downloading New Firmware Using HP SatStat Program

- 1 Copy the file of the updated firmware disk to a directory on your PC disk drive.

If you haven't already installed HP SatStat, you should install it now (follow instructions on the disk label or in the section titled "To Install the Automated HP SatStat Program for Continual Status Updates" in Chapter 3, "Visual User Interface," of this guide).

- 2 Start HP SatStat (easiest way is to double-click on the icon).
- 3 You should establish communication with the HP GPS Receiver. This requires connection from a serial RS-232 port on your PC to the HP GPS Receiver's serial port (a 25-pin RS-232 connection). Assuming you've got the cable attached to make this connection, you may want to check the settings.
 - a. Select **CommPort**, then choose **Settings**.

The Communication Settings dialog box is displayed. Unless someone has reprogrammed the CommPort settings on the HP GPS Receiver, these settings are probably OK. *The one setting that is likely to need changing is the Com Port. The application defaults it to Com1, but the serial port on your PC may be assigned to a different Com Port. Select the appropriate setting. If you are unsure, Com1 will be your best bet (worst case, you can cycle through all of them until it works).*

- b. If you made any changes on this form, select **OK**, otherwise you can just **Cancel**.

- 4 Select **CommPort**, then choose **Port Open**.

The main form of the Receiver Status screen is displayed. The application will send some commands to the HP GPS Receiver and then the main form should begin to periodically update every few seconds. If you are getting screen updates, proceed to the next step. Otherwise, something is wrong with your CommPort settings or perhaps the physical connection between your PC and the HP GPS Receiver.

NOTE

Prior to download, interrogate the product, record any custom configuration parameters. This step is necessary because downloading new instrument firmware will reset all parameters to system-preset defaults. Parameters typically recorded include:

- *antenna delay*
- *elevation mask angle*
- *timezone offset*

A table of all system-preset defaults is printed on page 5-125 in Chapter 5 of this guide; refer to it to identify additional parameters whose default values are inappropriate for your application. Record the settings you use prior to download.

-
- 5 Performing the download works best if the periodic updates are disabled. On the main form, select the **Function** menu and choose **Disable Updates**.
 - 6 Activate the form titled "Control & Query" by clicking anywhere on it. Select **Service**, then choose **Download Firmware**. This will bring up a form titled "Firmware Download".
 - 7 Now you need to select the file that you will download. Select the control labeled **File**.

This brings up a form for file selection. Download files for the HP GPS Receiver have a .s appended to the file name. This form is set to only find .s type files. In this case, you want to find and select the filename, for example **s_3503.s**. Depending on where you have placed this file, you may have to use this form to navigate for it. If it is on a different drive, use the Drives selection in the lower right. Once you've located **s_3503.s** select it (clicking on the name is probably the

Downloading New Firmware Using HP SatStat Program

easiest) and then select **OK**. The file, along with its path should now appear in the "File to Download" portion of the "Firmware Download" form.

- 8 The HP SatStat program (revision 5.0 and later) will offer to set up for the most efficient data transfer. By optimizing communication settings of both the instrument and the PC communication port, download time is reduced.

Prior to download, the program offers BAUD rate 19200, and echo off. If selected, these settings are maintained until after download is complete.

Following download, you should reconfigure the instrument and the PC comm port settings, restoring them to the choices appropriate to your installation.

- 9 You're now ready to perform the download. Select the control titled **Download** and an erase warning will appear. This is just a double-check to make sure you really want to do this. Assuming you do, select **Yes, Perform the Download**.

The program will switch the HP GPS Receiver to the "INSTALL" language, erase the flash memory, and begin downloading S-records. The S-records are the long character strings that appear in the lower part of the form as the downloading process proceeds. The total downloading time varies depending on the type of PC you have, but with communication settings optimized a typical time is about 7.5 minutes. Once the download is under way, an estimate of the time to complete the process is updated every 100 S-records.

- 10 When the downloading has completed, the "Minutes Until Finished" field will say "DONE". You can then select **Close** on the Firmware Download form.

There are a couple of ways to confirm that the new firmware has been installed; the easiest is to just power-cycle the unit. Once it has powered up, you can confirm that the new revision is in place by selecting **Query**, then choosing **Product ID** (from the "Control & Query" form) and selecting **Send Cmd**. The product ID will appear on the Control & Query form and should contain the new date code "3503", for example. An alternative way to check the download is to type SYST:LANG "PRIMARY" in the edit field on the "Control & Query" form and select **Send Cmd**. This will return the unit to normal operating mode without power-cycling. If you do this, you could then

Downloading New Firmware Using HP SatStat Program

check the product ID as described above. NOTE: it is expected that in early software revisions the alarm will come on the first time you power-cycle (or switch to “primary” using SYST:LANG “PRIMARY”). If you investigate the alarm, you will find it is the software safeguard — it has gone off because you have changed the instrument firmware. On subsequent power-ons the alarm will not come on.

After upgrading instrument firmware, you will need to restore the instrument settings recorded prior to the download, and restore the instrument and PC communications settings so that BAUD rate and echo are set according to the requirements of your installation.

Receiver Firmware Installation

Downloading New Firmware Using HP SatStat Program

Command Index

*CLS, 5-54, 5-116
*ESE, 5-66
*ESE?, 5-67
*ESR?, 5-67
*IDN?, 5-115
*SRE, 5-57
*SRE?, 5-57
*STB?, 5-58
*TST?, 5-70

:DIAGnostic:DOWNload, 5-116
:DIAGnostic:ERASe, 5-116
:DIAGnostic:ERASe?, 5-117
:DIAGnostic:LIFetime:COUNT?, 5-71

:DIAGnostic:LOG:CLEar, 5-45
:DIAGnostic:LOG:CLEar <current log size>, 5-45
:DIAGnostic:LOG:COUNT?, 5-46
:DIAGnostic:LOG:READ?, 5-46
:DIAGnostic:LOG:READ? <entry number>, 5-47
:DIAGnostic:LOG:READ:ALL?, 5-45

:DIAGnostic:QUERy:RESPonse?, 5-109
:DIAGnostic:ROSCillator:EFControl:RELative?, 5-28

:DIAGnostic:TEST?, 5-71
:DIAGnostic:TEST:RESult?, 5-72

:FORMat:DATA, 5-94
:FORMat:DATA?, 5-94

:GPS:INITial:DATE, 5-9
:GPS:INITial:POSition, 5-10
:GPS:INITial:TIME, 5-11

:GPS:POSition, 5-12
:GPS:POSition?, 5-13

:GPS:POSition:ACTual?, 5-14

:GPS:POSition:HOLD:LAST?, 5-14
:GPS:POSition:HOLD:STATe?, 5-15

:GPS:POSition:SURVey:PROGress?, 5-15
:GPS:POSition:SURVey:STATe, 5-15
:GPS:POSition:SURVey:STATe?, 5-16
:GPS:POSition:SURVey:STATe:POWerup, 5-16
:GPS:POSition:SURVey:STATe:POWerup?, 5-16

Command Index

:GPS:REFEreNce:ADELay, 5-22
:GPS:REFEreNce:ADELay?, 5-23

:GPS:REFEreNce:VALid?, 5-24

:GPS:SATEllite:TRACking?, 5-24
:GPS:SATEllite:TRACking:COUNt?, 5-25
:GPS:SATEllite:TRACking:EMANgle, 5-17
:GPS:SATEllite:TRACking:EMANgle?, 5-17

:GPS:SATEllite:TRACking:IGNore, 5-18
:GPS:SATEllite:TRACking:IGNore?, 5-18
:GPS:SATEllite:TRACking:IGNore:ALL, 5-18
:GPS:SATEllite:TRACking:IGNore:COUNt?, 5-20
:GPS:SATEllite:TRACking:IGNore:NONE, 5-18
:GPS:SATEllite:TRACking:IGNore:STATe?, 5-21

:GPS:SATEllite:TRACking:INCLude, 5-19
:GPS:SATEllite:TRACking:INCLude?, 5-19
:GPS:SATEllite:TRACking:INCLude:ALL, 5-19
:GPS:SATEllite:TRACking:INCLude:COUNt?, 5-20
:GPS:SATEllite:TRACking:INCLude:NONE, 5-19
:GPS:SATEllite:TRACking:INCLude:STATe?, 5-21

:GPS:SATEllite:VISible:PREDEcted?, 5-25
:GPS:SATEllite:VISible:PREDEcted:COUNt?, 5-26

:LED:ALARm?, 5-56
:LED:GPSLock?, 5-29
:LED:HOLDover?, 5-29

:PTIME:DATE?, 5-76
:PTIME:LEAPsecond:ACCumulated?, 5-80
:PTIME:LEAPsecond:DATE?, 5-81
:PTIME:LEAPsecond:DURation?, 5-82
:PTIME:LEAPsecond:STATe?, 5-83

:PTIME:PPS:EDGE, 5-79
:PTIME:PPS:EDGE?, 5-79

:PTIME:TCODE?, 5-74

:PTIME:TIME?, 5-76
:PTIME:TIME:STRing?, 5-77

:PTIME:TZONE, 5-78
:PTIME:TZONE?, 5-78

:PULSE:CONTInuous:PERiod, 5-85
:PULSE:CONTInuous:PERiod?, 5-85
:PULSE:CONTInuous:STATe, 5-86

Command Index

:PULSe:CONTInuous:STATe?, 5-86

:PULSe:REFerence:EDGE, 5-87
:PULSe:REFerenceEDGE?, 5-87

:PULSe:STARt:DATE, 5-88
:PULSe:STARt:DATE?, 5-88
:PULSe:STARt:TIME, 5-89
:PULSe:STARt:TIME?, 5-89

:SENSeDATA?, 5-93
:SENSe:DATA:CLEAr, 5-91
:SENSe:DATA:CLEAr <data set>, 5-92

:SENSe:DATA:MEMory:OVERflow:COUNT?, 5-98
:SENSe:DATA:MEMory:OVERflow:COUNT? <data set>, 5-99
:SENSe:DATA:MEMory:SAVE, 5-99
:SENSe:DATA:MEMory:SAVE?, 5-100

:SENSe:DATA:POINts?, 5-95
:SENSe:DATA:POINts? <data set>, 5-95
:SENSe:DATA:TSTamp?, 5-96

:SENSe:TSTamp <channel>:EDGE, 5-91
:SENSe:TSTamp <channel>:EDGE?, 5-91

:STATus:<register>:CONDition?, 5-60
:STATus:<register>:ENABle, 5-62
:STATus:<register>:ENABle?, 5-63
:STATus:<register>:EVENT?, 5-61

:STATus:<register>:NTRansition, 5-64
:STATus:<register>:NTRansition?, 5-65
:STATus:<register>:PTRansition, 5-64
:STATus:<register>:PTRansition?, 5-65

:STATus:PRESet:ALARm, 5-55

:STATus:QUEStionable:CONDition:USER, 5-68
:STATus:QUEStionable:EVENT:USER, 5-69

:SYNChronization:FFOMerit?, 5-30

:SYNChronization:HOLDover:DURation?, 5-33
:SYNChronization:HOLDover:DURation:THReshold, 5-34
:SYNChronization:HOLDover:DURation:THReshold?, 5-34
:SYNChronization:HOLDover:DURation:THReshold:EXCeeded?, 5-35

:SYNChronization:HOLDover:INITiate, 5-36

:SYNChronization:HOLDover:RECOvery:INITiate, 5-37
:SYNChronization:HOLDover:RECOvery:LIMit:IGNore, 5-38

Command Index

:SYNChronization:HOLDOVer:TUNCertainty:PREDicted?, 5-31
:SYNChronization:HOLDOVer:TUNCertainty:PRESent?, 5-31
:SYNChronization:HOLDOVer:WAITing?, 5-37

:SYNChronization:IMMediate, 5-38
:SYNChronization:STATe?, 5-28
:SYNChronization:TFOMerit?, 5-32
:SYNChronization:TINTerval?, 5-32

:SYSTem:COMMunicate?, 5-102
:SYSTem:COMMunicate:<port>:BAUD, 5-102
:SYSTem:COMMunicate:<port>:BAUD?, 5-103
:SYSTem:COMMunicate:<port>:BITS?, 5-104
:SYSTem:COMMunicate:<port>:FDUPlex, 5-104
:SYSTem:COMMunicate:<port>:FDUPlex?, 5-105
:SYSTem:COMMunicate:<port>:PACE, 5-105
:SYSTem:COMMunicate:<port>:PACE?, 5-106
:SYSTem:COMMunicate:<port>:PARity, 5-106
:SYSTem:COMMunicate:<port>:PARity?, 5-107
:SYSTem:COMMunicate:<port>:PRESet, 5-111
:SYSTem:COMMunicate:<port>:SBITS?, 5-108
:SYSTem:COMMunicate:SERial1:BITS, 5-103
:SYSTem:COMMunicate:SERial1:SBITS, 5-107

:SYSTem:DATE?, 5-76

:SYSTem:ERRor?, 5-42, 5-117

:SYSTem:LANGuage, 5-118
:SYSTem:LANGuage?, 5-119

:SYSTem:PRESet, 5-111

:SYSTem:STATus?, 5-41
:SYSTem:STATus:LENGth?, 5-41

:SYSTem:TIME?, 5-76

General Index

1PPS connector, HP 58503A, 1-5
1PPS connector, HP 59551A, 1-3
1PPS error estimation, 5-31
1PPS output, 1-3, 1-5, 5-27
1PPS output quality, 4-7, 4-10, 5-27,
5-28, 5-29, 5-30, 5-31, 5-32, 5-33,
5-34, 5-35
1PPS polarity, 4-10, 5-79
1PPS reference edge, 4-10
1PPS reference synchronization, 4-7
10MHz output, 5-27
10MHz output quality, 4-7, 4-10, 5-27,
5-28, 5-29, 5-30, 5-31, 5-32, 5-33,

A

abbreviated commands, B-5
ac power, 1-3, 1-5
acquisition of satellites, 4-5, 4-6, 5-7,
5-8
alarm analysis, 4-8, 5-39, 5-40, 5-48,
5-49, 5-50, 5-51, 5-52, 5-53, 5-54,
5-55, 5-56, 5-57, 5-58, 5-59, 5-60,
5-61, 5-62, 5-63, 5-64, 5-65, 5-66,
5-67, 5-68, 5-69
alarm BITE, 1-3, 4-8, 5-39, 5-48, 5-49,
5-50, 5-51, 5-52, 5-53, 5-54, 5-56,
5-57, 5-58, 5-59, 5-60, 5-61, 5-62,
5-63, 5-64, 5-65, 5-66, 5-67, 5-68,
5-69
alarm clear, 4-8, 5-39, 5-54, 5-55, 5-56,
5-57, 5-58
Alarm indicator, 1-2, 1-3, 1-4, 4-8,
5-39, 5-56
alarm relay, 1-3, 4-8, 5-39, 5-48, 5-49,
5-50, 5-51, 5-52, 5-53, 5-54, 5-55,
5-56, 5-57, 5-58, 5-59, 5-60, 5-61,
5-62, 5-63, 5-64, 5-65, 5-66, 5-67,
5-68, 5-69
alarm setup, 4-8, 5-39, 5-48, 5-49,
5-50, 5-51, 5-52, 5-53, 5-54, 5-56,
5-57, 5-58, 5-59, 5-60, 5-61, 5-62,
5-63, 5-64, 5-65, 5-66, 5-67, 5-68,
5-69
alarm status, 5-50

alarm test, 4-8, 5-39, 5-40, 5-68, 5-69,
5-70, 5-71, 5-72
Alarm, HP 58503A, 1-5
antenna connection, 1-3, 1-5, 3-4, 5-22
antenna delay compensation, 4-6, 5-8,
5-22
antenna delay values, 5-22
antenna input, 1-3, 1-5
antenna placement, 1-3, 1-5, 3-4, 4-6,
5-8, 5-22
antenna system, 3-4
application
 HPSatSat, 3-9
ASCII Data, B-12

B

baud, 2-10, 5-102, 5-103, 5-111
Belden 8267 cable, 5-22
BINARY Data, 5-94, B-12
BITE, alarm, 1-3
Boolean, B-6

C

cable delay compensation, 4-6, 5-8,
5-22
cables
 antenna, 5-22
 crossover, 2-5
 F1015-80002 interface, 2-6
 F1021B Palmtop Connectivity Pack,
 2-6
 HP 40242M interface, 2-7
 HP 24542G, 2-9
 HP 24542G interface, 2-7
 HP 24542U, 2-9
 modem-eliminator, 2-5
 null-modem, 2-5
clear, 5-91, 5-92
 alarm, 4-8, 5-39, 5-54
 errors, 4-8, 5-39, 5-42, 5-116
clear time stamp memory, 5-90
comma, B-4, B-6, B-10
command
 abbreviated, B-5
 common, B-3
 format, 5-5
 parameter, B-6
 SCPI, B-3
 syntax, B-2, B-5

General Index

- terminator, B-8
- terminators, B-4
- command error, 4-9, 5-40, 5-48, 5-53
- Command Error status, 5-48
- command syntax conventions, 4-4, 5-4
- commands
 - introduction, 4-4
- Commands at a Glance, 4-17
- common command
 - syntax, B-4
- Common Command Format, B-3
- common commands
 - description, B-3
- communication
 - serial interface port, 2-3, 2-45-101, 5-102, 5-104, 5-105, 5-106, 5-107
- compensating for antenna delay, 5-22
- configuration
 - PORT 1, 2-12, 5-101
 - PORT 2, 2-12, 5-101
- configuration factory-default values, 5-111
- configuring PORT 1, 2-11, 4-13
- configuring PORT 2, 2-12, 4-13
- configuring the RS-232C ports, 2-10
- configuring serial interface port(s), 5-101
- conformance information
 - SCPI, 4-4
- connecting a computer, 2-5
- connecting a laptop, 2-7, 2-8
- connecting a modem, 2-5, 2-7
- connecting a palmtop, 2-5, 2-6
- connecting a PC, 2-7, 3-4
- connecting antenna system, 1-3, 1-5, 3-4, 4-6, 5-8, 5-22
- connecting to a PC, 3-4
- Connectivity Pack, 2-6
- connectors
 - 1PPS, 1-3, 1-5
 - Alarm BITE, 1-3
 - Alarm, HP 58503A, 1-5
 - ANTENNA, 1-3, 1-5
 - IRIG-B, 1-3
 - Programmable Pulse, 1-3
 - Time Tag, 1-3
- conventions
 - command syntax, 4-4, 5-4
- Coordinated Universal Time, 5-7
- CPU, 5-70
- crossover cable, 2-5
- current time, 4-10

D

- d.dEe, B-11
- d.dEe, ..., B-11
- data, 5-93
- data bits, 2-10, 5-103, 5-104, 5-111
- date and time outputs, 4-6, 4-10, 5-8
- DB-25 connector, 2-5
- DB-9 connector, 2-5
- dc power, 1-3, 1-5
- DCE, 2-5
- dd, B-11
- dd, ..., B-11
- decimal point, B-6, B-11
- defaults, factory settings, 2-10, 3-5, 4-14, 5-110, 5-111
- delay values, antenna cables, 4-6, 5-8, 5-22
 - response formats (ASCII), 5-6
- diagnostic log, 4-8, 5-39, 5-43, 5-44, 5-45, 5-46, 5-47
- diagnostic log messages, 5-43
- diagnostic tests, 4-9, 5-40, 5-70, 5-71, 5-72
 - result, 5-72
- diagnostics
 - internal self-test, 5-70
- diagram
 - serial interface cable, 2-9
- documents
 - list, B-13
 - related, B-13
- download, 5-116
- downloading
 - Using HP SatStat, C-2
- downloading new firmware, C-2
- DTE, 2-5
- duplex state, 5-104, 5-105

E

- echoing of the characters you type, 5-104, 5-105, 5-111
- EEPROM, 5-70, 5-116
- EPROM, 5-70
- erasing
 - EEPROM, 5-117
- error
 - hardware/firmware error, A-5
 - query, A-6
 - semantic, A-5
 - syntactic, A-4
- error analysis, 4-8, 5-39, 5-40, 5-42, 5-117

General Index

error behavior, A-6
error log, 4-8, 5-39, 5-40, 5-42, 5-117
error messages, 4-8, 5-39, A-8
error queue, 4-8, 5-39, 5-42, 5-117, A-3
error recovery, serial port, 4-8, 4-13,
5-39, 5-109
error types, A-4
error, command, 5-48, 5-53
error, reading, A-2
external devices, 1-3

F

F1015-80002 interface cable, 2-6
F1021B Palmtop Connectivity Pack,
2-6
factory default settings, 2-10, 3-5,
4-14, 5-110, 5-111
failure protection, satellite loss, 4-7,
5-27, 5-33, 5-34, 5-35
FFOM, 4-7, 5-30
Figure
 antenna delay table, 5-22
 command list, 4-17
 factory instrument settings, 5-111,
 5-112, 5-113
 factory serial port settings, 5-111
 status reporting system, 5-49
figure of merit, 5-30, 5-32, 5-74
firmware error, A-5
firmware installation, 2-3, 4-15, 5-114,
5-116, 5-117, 5-118, 5-119
firmware revision code, 2-3, 4-15,
5-115
firmware upgrade, 2-3, 5-116
flash EEPROM, 5-116
flow control state, 5-105, 5-106
format
 ASCIi, 5-94
 INTeger, 5-94
FPGA logic, 5-70
front panel
 PORT 2, 2-4
full duplex, 2-10, 5-104, 5-111

G

GPS engine, 5-70
GPS lock, 4-5, 4-6, 5-7, 5-33, 5-34, 5-35
GPS Lock indicator, 1-2, 1-4, 4-7, 5-29
GPS position, 4-5, 5-7, 5-12, 5-13, 5-
14, 5-15
GPS satellite acquisition, 4-5, 4-6, 5-7,
5-33, 5-34, 5-35
GPS timeline, 5-73

GUI, 3-3, 3-9, 3-10, 3-11

H

Hardware status, 5-48, 5-51, 5-60,
5-61, 5-62, 5-63, 5-64, 5-65
hardware/firmware error, A-5
Holdover indicator, 1-2, 1-4, 4-7, 5-29
holdover
 loss of satellites, 4-7
 operation, 3-16
 process, 5-27
 recovery, 4-7, 5-27, 5-37
 status, 4-9, 5-48, 5-52
 tutorial, 3-16
HP 40242M interface cable, 2-7
HP 58506A/507A/508A cable, 5-22
HP 24542G cable, 2-9
HP 24542G interface cable, 2-7
HP 24542U cable, 2-9
HP 58503A indicators
 Alarm, 1-4
 GPS Lock, 1-4
 Holdover, 1-4
 Power, 1-4
HP 58503A inputs
 Antenna, 1-5
 Power, 1-5
HP 58503A interface port
 PORT 1, 1-5
HP 58503A outputs
 10 MHz OUT, 1-5
 1PPS, 1-5
 Alarm, 1-5
HP 59551A indicators
 Alarm, 1-2
 GPS Lock, 1-2
 Holdover, 1-2
 Power, 1-2
HP 59551A inputs
 Antenna, 1-3
 Power, 1-3
 Time Tag, 1-3
HP 59551A interface port
 PORT 1, 1-3
 PORT 2, 1-2
HP 59551A outputs
 1PPS, 1-3
 Alarm BITE, 1-3
 IRIG-B, 1-3
 Programmable Pulse, 1-3
HP SatStat, 3-3, 3-8, 3-9, 3-10, 3-11,
C-2

General Index

HP58506A antenna cable assembly, 5-22
HP58507A antenna cable assembly, 5-22
HP58508A antenna cable assembly, 5-22
HP58511A antenna cable assembly, 5-22

I

I/O Port 1, 4-13
identification of Receiver, 4-15, 5-115
IEEE Standard 488.2
 obtaining copy of standard, B-13
IEEE 488.2
 description, B-3
IEEE 488.2
 syntax, B-4
In This Guide, ix
indicators
 Alarm, 1-2, 1-4
 GPS Lock, 1-2, 1-4
 Holdover, 1-2, 1-4
 Power, 1-2, 1-4
initialization, 5-110
initializing the Receiver, 4-14
initiating manual Holdover, 5-27, 5-36
input
 antenna, 1-3, 1-5, 3-4, 4-6, 5-8, 5-22
 Time Tag, 1-3, 4-12
input power, 1-3, 1-5
install
 firmware, 2-3, 4-15, 5-114, 5-116
 HP SaStat, 3-9
 Receiver, 5-9, 5-17, 5-22
INSTALL language, 5-116
interface
 RS-232C, 2-3
interface port
 PORT 1, 1-3
 PORT 2, 1-2
internal reference oscillator, 5-7, 5-27
internal self-test diagnostics, 5-70
interpolators, 5-70
introduction
 commands, 4-4
IRIG-B output, 1-3
K
keyword
 separator, B-5

L

laptop, connection, 2-8
latitude, 4-5, 5-7, 5-12, 5-13, 5-14
leap second, 4-10
leap second status, 5-73
LED
 Alarm, 1-2, 1-4, 4-8, 5-39
 GPS Lock, 1-2, 1-4, 4-7
 Holdover, 1-2, 1-4, 4-7
 Power, 1-2, 1-4
lifetime count, 4-9, 5-71
list of
 commands, 4-17
 configuration factory-default values, 5-111
 error messages, A-8
 error types, A-4
 factory-default values, 5-111
 response format, B-11
 system preset, 5-112
literal, B-6
local time, 4-10
locking to GPS satellites, 4-5, 4-6, 5-7, 5-8, 5-9, 5-10, 5-11, 5-12, 5-13, 5-14, 5-15, 5-16, 5-17, 5-18, 5-19, 5-20, 5-21, 5-22, 5-23, 5-24, 5-25, 5-26, 5-33, 5-34, 5-35, 5-36, 5-37, 5-38, 5-39
log, diagnostic, 4-8, 5-39, 5-43, 5-44, 5-45, 5-46, 5-47
log, error, 4-8, 5-39, 5-40, 5-42, 5-117
longitude, 4-5, 5-7, 5-12, 5-13, 5-14

M

MAXimum, B-6
memory overflow, 4-12, 5-90
messages
 program, B-8
 response, B-9
messages, error, A-8
MINimum, B-6
modem-eliminator cable, 2-5
multipliers, B-7

N

new line, B-12
NRf, B-6
null-modem cable, 2-5

O

OHM, B-7
operating status, 5-39

General Index

- Operation status, 5-48, 5-50, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65
- output
 - 10MHz, 4-7, 4-10, 5-27, 5-28, 5-29, 5-30, 5-31, 5-32, 5-33, 5-34, 5-35
 - 1PPS, 1-3, 1-5, 4-7, 4-10, 5-27, 5-28, 5-29, 5-30, 5-31, 5-32, 5-33, 5-34, 5-35, 5-79
 - alarm, 4-7
 - Alarm BITE, 1-3
 - Alarm, HP 58503A, 1-5
 - IRIG-B, 1-3
 - Programmable Pulse, 1-3, 4-11, 5-84, 5-85, 5-86, 5-87, 5-88, 5-89
 - synchronization, 5-28, 5-29, 5-30, 5-31, 5-32, 5-33, 5-34, 5-35
- output pulse, 4-11, 5-84, 5-85, 5-86, 5-87, 5-88, 5-89
- output synchronization, 4-7
- overview
 - HP SatStat, 3-3
 - Receiver Status Screen, 3-3
- P**
- pace, 2-10, 5-105, 5-106, 5-111
- parameter separator, B-6
- parameter types, B-6
 - Boolean, B-6
 - literal, B-6
 - string, B-6
- parity, 2-10, 5-106, 5-107, 5-111
- pin assignment
 - PORT 1, 2-4
 - PORT 2, 2-4
- polarity of edges
 - 1PPS, 4-10, 5-79
 - programmable pulse, 4-11
 - time stamp, 4-12, 5-90, 5-91
- PORT 1, 1-3, 2-6, 2-7, 4-13, 5-101, 5-102, 5-103, 5-104, 5-105, 5-106, 5-107, 5-108, 5-111
- PORT 1,
 - factory-default values, 2-10
- PORT 1 configuration, 2-12
- PORT 1 rear panel, 2-3
- PORT 2, 1-2, 4-13, 5-101, 5-102, 5-103, 5-104, 5-105, 5-106, 5-107, 5-108, 5-111
 - factory-default values, 2-10
- PORT 2 configuration, 2-12
- PORT 2 front panel, 2-4
- position, 4-5, 5-7, 5-12, 5-13, 5-14, 5-15
- position at powerup, 5-16
- position hold, 5-15
- power
 - ac, 1-3, 1-5
 - dc, 1-3, 1-5
- Power indicator, 1-2, 1-4
- Power input, 1-3, 1-5
- power outages, 5-90
- Power supply levels, 5-70
- power surges, 5-90
- powering up the Receiver, 3-7
- Powerup status, 5-48, 5-52
- predicted visible satellites, 5-25
- preface, ix
- preset to factory defaults, 2-10, 4-14, 5-110, 5-111
- product identification, 4-15, 5-115
- program
 - HP SatSat, 3-9
- program messages
 - definition, B-8
 - syntax, B-8
- programmable pulse, 4-11, 5-84, 5-85, 5-86, 5-87, 5-88, 5-89
- Programmable Pulse connector, 1-3
- Programmable Pulse output, 1-3
- pulse generator, 4-11, 5-84, 5-85, 5-86, 5-87, 5-88, 5-89
- pulse output, 4-11, 5-84, 5-85, 5-86, 5-87, 5-88, 5-89
- pulse polarity, 4-11
- Q**
- QSPI, 5-70
- query, B-6, B-9
- query error, B-6
- query parameters
 - <numeric value>, B-6
 - MAXimum, B-6
 - MINimum, B-6
- querying instrument identification, 5-114
- Questionable status, 5-48, 5-52
- queue overflows, A-3
- queue, error, 4-8, 5-39, 5-117
- quick reference
 - command list, 4-17
 - factory instrument settings, 5-112
 - factory serial port settings, 5-111
 - status reporting system, 4-18
- R**
- RAM, 5-70

General Index

- rear panel
 - PORT 1, 2-3
- Receiver Commands at a Glance, 4-17
- Receiver identification, 4-15, 5-114, 5-115
- Receiver initialization, 4-14
- Receiver status screen, 5-41
- Receiver Status Screen at a Glance, 3-19
- recovering from holdover, 3-18, 4-7, 5-27, 5-37
- recovering the last query response, 4-13, 5-101
- Reference oscillator, 5-70
- related documentation, B-13
- relay, alarm, 1-3, 4-8, 5-39, 5-48, 5-49, 5-50, 5-51, 5-52, 5-53, 5-54, 5-55, 5-56, 5-57, 5-58, 5-59, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65, 5-66, 5-67, 5-68, 5-69
- removes error from error queue, 5-117
- reset to factory defaults, 2-10, 4-14, 5-110, 5-111
- response message syntax, B-10
- response messages, B-9
 - data types, B-11
- restore to factory defaults, 2-10, 4-14, 5-110, 5-111
- revision code, 4-15, 5-115
- RG-213 cable, 5-22
- RS-232 default values, 3-5
- RS-232C
 - PORT 1, 1-3
 - PORT 2, 1-2
- RS-232C interface, 4-13, 5-101
- RS-232C interface, 5-102, 5-103, 5-104, 5-105, 5-106, 5-107, 5-108
- RS-232C ports:, 2-3
- S**
- satellite acquisition, 4-5, 4-6, 5-7, 5-33, 5-34, 5-35
- satellite failure protection, 4-7, 5-27, 5-33, 5-34, 5-35
- satellite loss, 4-7, 5-33, 5-34, 5-35
- satellite management, 4-5, 4-6, 5-7, 5-9, 5-10, 5-11, 5-12, 5-13, 5-14, 5-15, 5-16, 5-17, 5-18, 5-19, 5-20, 5-21, 5-22, 5-23, 5-24, 5-25, 5-26, 5-33, 5-34, 5-35, 5-36, 5-37, 5-38, 5-39
- satellite reacquisition, 4-7
- satellite selection, 4-6, 5-7
- satellite tracking at installation, 4-5, 5-7, 5-9
- SatStat, 3-9, 3-10, 3-11
- SCPI, B-2
 - description, B-3
 - version, 4-4
- SCPI Command and Query Format, B-3
- SCPI conformance information, 4-4
- SCPI standard, B-13
- self test, 3-7, 4-9, 5-40, 5-70, 5-71, 5-72
- semantic error, A-5
- separator
 - keyword, B-5
 - parameter, B-6
- serial interface cable diagram, 2-9
- serial interface communication, 4-13
- serial interface port, 2-3, 2-4
 - PORT 1, 1-3
 - PORT 2, 1-2
 - preset, 5-110
- serial number, 5-115
- serial port error recovery, 4-8, 4-13, 5-39, 5-109
- serial port I/O, 4-13, 5-111
- serial port settings, 2-12
- setting up the Receiver, 3-4, 4-15, 5-9, 5-17
- settings, serial port, 2-12
- signal loss, 4-7, 5-27, 5-33, 5-34, 5-35, 5-36, 5-37, 5-38
- Software pacing, 2-10
- status
 - alarm, 5-50, 5-56
 - command error, 5-53, 5-66
 - hardware, 5-51, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65
 - holdover, 5-52, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65
 - operation, 5-50, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65
 - powerup, 5-52, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65
 - questionable, 5-52, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65, 5-68
- status information, 5-39
- status registers, 5-48
- status reporting, 4-8, 4-9, 5-39, 5-40, 5-48, 5-49, 5-50, 5-51, 5-52, 5-53, 5-54, 5-56, 5-57, 5-58, 5-59, 5-60, 5-61, 5-62, 5-63, 5-64, 5-65, 5-66, 5-67, 5-68, 5-69

General Index

- status reporting system, 5-48
 - Status Reporting System Diagram, 5-49
 - status screen, 3-9, 3-12, 4-8, 5-41
 - status/alarm reporting system, 5-48
 - stop bits, 2-10, 5-107, 5-108, 5-111
 - string, B-6
 - subsystem command
 - syntax, B-4
 - suffix
 - elements, B-7
 - multipliers, B-7
 - suffix, multiplier, B-7
 - suffixes, B-7
 - summary
 - commands, 4-17
 - survey mode, 5-15
 - synchronization of output signals, 4-7, 5-28, 5-29, 5-30, 5-31, 5-32, 5-33, 5-34, 5-35
 - synchronizing to reference, 4-7, 5-27
 - syntactic error, A-4
 - syntax, 4-4, 5-4
 - program messages, B-8
 - response messages, B-10
 - syntax, SCPI, B-2
 - system preset, 5-112
 - system time, 4-10, 5-73
- T**
- Table
 - antenna delay table, 5-22
 - command list, 4-17
 - factory instrument settings, 5-111, 5-112, 5-113
 - factory serial port settings, 5-111
 - status reporting system, 5-49
 - telecommunication, 3-6
 - terminal communications, 3-5, 3-6
 - terminal emulation program, 3-5
 - terminator
 - command, B-8
 - test result, 5-72
 - TFOM, 4-7, 5-32, 5-74
 - time and date outputs, 4-6, 4-10, 5-8, 5-24, 5-73, 5-74, 5-75, 5-76, 5-77
 - time of day outputs, 4-6, 4-10, 5-8, 5-24, 5-73, 5-74, 5-75, 5-76, 5-77
 - Time Stamp memory, 4-12
 - time stamp polarity, 4-12, 5-90, 5-91
 - time stamping, 1-3, 4-12, 5-90, 5-91, 5-92, 5-93, 5-94, 5-95, 5-96, 5-97, 5-98, 5-99, 5-100
 - time tag, 1-3, 4-12, 5-90, 5-91, 5-92, 5-93, 5-94, 5-95, 5-96, 5-97, 5-98, 5-99, 5-100
 - Time Tag inputs, 1-3, 4-12
 - time transfer information, 5-7
 - time zone setting, 4-10, 5-73, 5-78
 - Time-stamped Edge, 4-12, 5-91
 - timing outputs, 4-7, 5-28, 5-29, 5-30, 5-31, 5-32, 5-33, 5-34, 5-35
 - tutorial
 - using the Status Screen, 3-11
- U**
- UART, 5-70
 - units, B-7
 - upgrading firmware, 2-3, 4-15, 5-114
 - UTC, 5-7
 - UTC timeline, 5-73
- V**
- visible satellites, 5-25
- W**
- Windows program
 - Receiver Status Screen, 3-9, C-2
- X**
- XON, 5-105
 - XYZ, B-12



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Rev 1/96

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Warranty (contd)

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HP warrants that its software and firmware designed by HP for use with an instrument will execute its programming instructions when properly installed on that instrument. HP does not warrant that the operation of the instrument, or software, or firmware will be uninterrupted or error free.

Limitation of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

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For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

Safety Considerations (contd)

WARNING
INSTRUCTIONS FOR ADJUSTMENTS WHILE COVERS ARE REMOVED AND FOR SERVICING ARE FOR USE BY SERVICE-TRAINED PERSONNEL ONLY. TO AVOID DANGEROUS ELECTRIC SHOCK, DO NOT PERFORM SUCH ADJUSTMENTS OR SERVICING UNLESS QUALIFIED TO DO SO.

Acoustic Noise Emissions

LpA<47 dB at operator position, at normal operation, tested per EN 27779. All data are the results from type test.

GERAeUSCHEMISSION

LpA<47 dB am Arbeitsplatz, normaler Betrieb, geprüft nach EN 27779. Die Angaben beruhen auf Ergebnissen von Typprüfungen.

Supplemental Note

HP 59551A/58503A Performance Tests

Verifying Specifications

Introduction

Introduction

This note provides procedures to test the electrical performance of the HP 59551A and 58503A GPS Receivers specifications listed in Chapter 4, "HP 59551A Specifications," and Chapter 5, "HP 58503A Specifications," of the Getting Started Guide. Two types of testing are provided:

- Operational Verification, *starting on page 5*
- Complete Performance Tests, *starting on page 16*

Operational Verification

The Operational Verification test is an abbreviated series of checks that may be performed to give a high degree of confidence that the instrument is operating properly without performing the Complete Performance Tests. An operational verification is useful for incoming inspection, routine maintenance, and after instrument repair.

Complete Performance Tests

The Complete Performance Tests verify the specifications listed in Chapter 4, "HP 59551A Specifications" or Chapter 5, "HP 58503A Specifications" of the Getting Started Guide. All tests can be performed without access to the inside of the instrument.

Test Record

The results of the Operational Verification and Complete Performance Tests should be recorded on a copy of the appropriate (i.e., HP 59551A or HP 58503A) Performance Test Record, located at the end of this note.

Equipment Required

Equipment Required

Table 1. Recommended Test Equipment for Acceptance Test

Instrument	Required Characteristics	Recommended Model	Use*
Digitizing Oscilloscope	<ul style="list-style-type: none"> • 2 channels • 500 MHz bandwidth (repetitive) 	HP 54600B (or equivalent)	OV, P
Digital Multimeter (DMM)	Microvolt accuracy with leads	HP 34401A	OV, P
Terminal or computer	Communication Software, RS-232C connection	Any Model	OV, P
Universal Counter	Resolution: 300 ps or better in T.I. Mode	HP 53132A	P
Frequency Standard	1 PPS Source. Jitter: <1 ns rms pulse-to-pulse 10 MHz House Standard. Accuracy: 2×10^{-12} or better	HP 5071A	P
50Ω Feedthrough		HP 10100C	OV
50Ω Coaxial Cable with BNC connectors	BNC(m) to BNC(m), 48 inches	HP 10503A	P
GPS Antenna or Antenna Assembly		HP 58504A or HP 58513A	P
GPS Antenna Cable Assembly	RG-213 or LMR 400 cables with TNC (m)-to-N (m) connectors	HP 58518A, 58520A	P
Antenna Interconnect Cable Assembly	RG-213 or LMR 400 cables with N (m)-to-N (m) connectors	HP 58519A, HP 58521A	P
Barrel adapter	N (f)-to-N (f)	HP 1250-0777	P

*OV = Operational Verification

P = Performance Test

Before You Start

The time required to acquire lock as described in the following section can vary significantly depending on your local conditions. In general, HP strongly recommends that your antenna and cables be set up in accordance with the information provided in the HP documents listed below prior to performing any of the tests that follow, or the results cannot be assumed to be valid.

HP documents providing GPS Antenna System information are:

- *Designing Your GPS Antenna System Configuration Guide* (HP P/N 5964-9068E), which discusses the components of an HP GPS timing receiver system and how to custom design the configuration of your antenna system. *Contact your local HP Sales office for a copy of this guide.*
- Information Notes that provide installation procedures for the applicable HP GPS antenna and accessories that you purchase.

Acquiring lock does not mean that the unit is fully operational and meeting specifications. It just means that the GPS Receiver has detected enough satellites to start its survey mode to determine its precise location. An Internal measurement FFOM (Frequency Figure of Merit) becomes 0 when the internal loops reach their proper time constants, indicating that the output frequency and 1 PPS signals are now fully operational and meeting their specifications. Under the worst conditions, the GPS Receiver may take up to 24 hours to achieve FFOM = 0. FFOM can be monitored in the Reference Outputs quadrant of the Receiver Status screen (see Figure 3-2 in Chapter 3, "Visual User Interface," of the *HP 59551A and HP 58503A Operating and Programming Guide* or the Sample Status Screen figure in Chapter 1 of the *HP 59551A and HP 58503A Getting Started Guide* if needed). Also, using the appropriate SCPI query command will provide FFOM value (refer to the Operating and Programming Guide for specifics).

Operational Verification

Introduction

The HP 59551A and HP 58503A GPS Receivers are designed to automatically detect and acquire satellites in order to begin providing precise frequency and time information.

Until such acquisition is complete and the unit is locked with $FFOM = 0$, the signals produced on the rear panel are not precise. However, it is possible to verify that the Receiver has been received in good working condition by performing some simple operational verification tests upon receipt.

Except for two tests (Time Stamp Verification and Programmable Pulse Verification), all of the following operational verification tests do not require usage of the GPS antenna. These tests are designed to provide a high degree of confidence that the Receiver is functioning, but the tests will not verify the specified performance characteristics. Such testing requires more expensive equipment and very long test times (over 72 hours per unit). We recommend that full or complete Performance Testing be restricted to testing only after any repairs to the HP 59551A or HP 58503A.

The HP 59551A and HP 58503A require no calibration.

Record the results of the Operational Verification in the appropriate place on the appropriate (i.e., HP 59551A or HP 58503A) Performance Test Record, which is located at the end of this note.

Power-Up Procedure

NOTE

If you are using the HP 54600B Digitizing Oscilloscope, use the HP 10100C 50 Ω feedthrough on the input of the oscilloscope for the following tests.

- 1 Connect the Receiver to a suitable power source . The unit will perform a self-test of internal components. (If needed, refer to the subsection titled "To Connect DC Power" in Chapter 1 of the Getting Started Guide for assistance in connecting the Receiver to a power source.)

Operational Verification

- 2 Verify that after 15 seconds the **Power** indicator is on and the **Alarm** indicator is off. This ensures that all internal components and connections are functioning.

10 MHz Verification (HP 58503A Only)

- 1 Set the HP 54600B oscilloscope sweep rate to 100 ns/div, input amplitude to 0.2 Volts/div, and input coupling to ac.
- 2 Connect the oscilloscope to the rear-panel 10 MHz OUT output of the HP 58503A as shown in Figure 1.

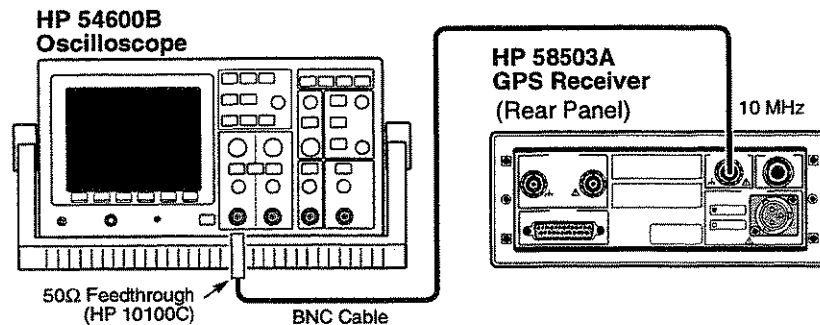


Figure 1. HP 58503A 10 MHz Operational Verification Setup

- 3 Verify that there is a 10 MHz sine wave present with approximately 1 Volt peak-to-peak into the 50 ohm load.
- 4 Mark Pass or Fail in Line 1 on the Operational Verification portion of the 58503A Performance Test Record, located at the end of this note.

1 PPS Verification

- 1 Set the oscilloscope sweep rate to 5 μs/div and amplitude to 5 Volts, and input coupling to dc.
- 2 Connect the oscilloscope to the rear-panel 1 PPS output of the Receiver as shown in Figure 2.

Operational Verification

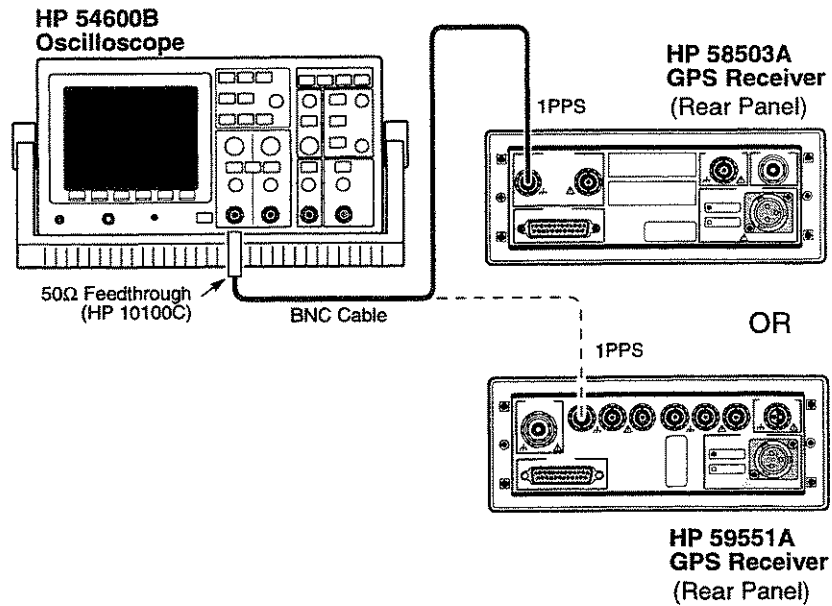


Figure 2. 1 PPS Operational Verification Setup

Verify the presence of a TTL level pulse with approximately 20 μ s pulse width.

- 3 Mark Pass or Fail in Line 2 on the Operational Verification portion of the appropriate (59551A or 58503A) Performance Test Record, located at the end of this note.

IRIG-B Verification (HP 59551A Only)

- 1 Set the oscilloscope sweep rate to 1 msec/div and input amplitude to 5 Volts/div, dc-coupled.
- 2 Connect the oscilloscope to the rear-panel IRIG-B output of the HP 59551A GPS Receiver as shown in Figure 3.

Verify that the display shows a sine wave with a period of 1 ms, changing in amplitude from 5 Volts peak-to-peak, to greater than 10 Volts peak-to-peak. This is the IRIG-B time code modulating a 1 kHz carrier.

- 3 Mark Pass or Fail in Line 3 on the Operational Verification portion of the HP 59551A Performance Test Record, located at the end of this note.

Operational Verification

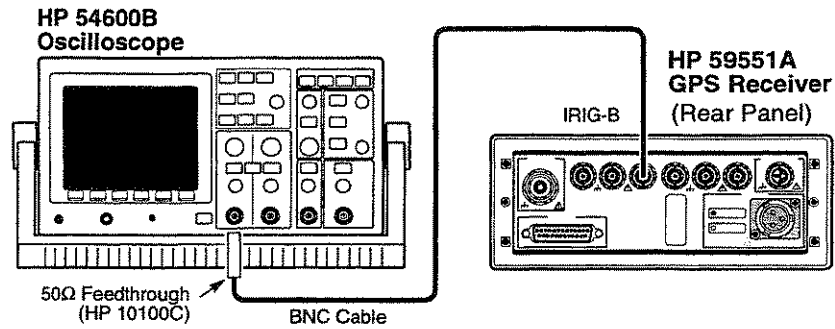


Figure 3. HP 59551A IRIG-B Operational Verification Setup

Time of Day and PORT 1 RS-232C Serial Interface Verification

- 1 Connect a terminal or computer (set to 9600 baud, 8 data bits, 1 stop bit, and no parity and no pace) to the rear-panel **PORT 1**. If you need assistance in setting the serial parameters, refer to the Getting Started guide.
- 2 Press the Return key on the terminal.

Verify that either a **SCPI >** or **E-xxx>** prompt is returned. The **xxx** can be any number for this test. If **E-xxx>** is returned, send the ***CLS** command to clear the error.

- 3 Type **:SYST:STAT?**, then press Enter (or Return) key.

The terminal screen displays the Receiver Status screen, which is a complete status report of the Receiver. Without a GPS antenna, most data will be blank or indicating that the instrument is in "Power-Up" mode. The **FFOM = 3** in the upper right corner indicates that the Receiver is in power-up mode and frequency outputs are invalid. At this point, the data at the bottom of the screen lists the results of all internal self-tests. The **HEALTH MONITOR, SelfTest, Int Pwr, Oven Pwr, OCXO, EFC, and GPS Rcv** should all show **OK**.

- 4 From the terminal keyboard, type

:PTIM:TCODE? and press Return.

An alphanumeric string which starts with a "T" should be displayed as shown in the following example:

T2199505112055233000049

Note that the value above will be different for each test, depending on the local date and time.

Operational Verification

- 5 Mark Pass or Fail in Line 4 on the Operational Verification portion of the appropriate (59551A or 58503A) Performance Test Record, located at the end of this note.

Antenna Power Verification

- 1 Set the DMM to read a range of 5 Volts dc.
- 2 Measure the dc voltage from the center pin of the antenna (Type N) connector with respect to the threaded connector shell.

Verify that the voltage is between 4.5 and 5.0 Volts dc.

- 3 Mark Pass or Fail in Line 5 on the Operational Verification portion of the appropriate (59551A or 58503A) Performance Test Record, located at the end of this note.
- 4 If you are testing the HP 58503A with Option 001 Front Panel and Keypad, perform the procedure in the following section titled "Front Panel Display/Keypad Verification (HP 58503A Option 001 Only)" on page 10.

If you are testing the standard HP 58503A, go to the section titled "Operational Verification Conclusion" on page 14 in this note.

If you are testing a HP 59551A, go to the section titled "Time Tagging (Stamping) Verification and Programmable Pulse Verification" on page 11.

Operational Verification

Front Panel Display/Keypad Verification (HP 58503A Option 001 Only)

This tests the operation of the Front Panel Display/Keypad option for the HP 58503A.

- 1 Disconnect and re-apply power to the HP 58503A.
- 2 While the letters "HP" are moving from right to left (about 2 seconds), press **Sat** key and then **Time** key to enter the TEST/DEMO mode.
- 3 The words **VFD DSP TEST** will momentarily appear.
The display should then show a test pattern that sequentially illuminates all 15 segments of all digits and punctuation marks in the display.
- 4 Verify that all segments illuminate.
- 5 When the segment illumination sequence is complete, the words **DEMO MODE** should then appear.
- 6 Press each key one at a time. Each keypress should:
 - illuminate the LED corresponding to that key, and
 - display a simulated response to the function.

NOTE

(1) The **Clear Alarm (Shift , Alt)** function will exit the test. (2) The values displayed are not related to the HP 58503A under test. They are displayed for demonstration only.

- 7 To exit the diagnostic, press **Shift** key, and then press **Alt** key.
- 8 The HP 58503A power-up sequence should then continue. No further tests are necessary.
- 9 Mark Pass or Fail in Line 5 on the Operational Verification portion of the HP 58503A Performance Test Record, located at the end of this note.
- 10 Proceed to the section titled "Operational Verification Conclusion" on page 14 to complete the operational verification.

Time Tagging (Stamping) Verification and Programmable Pulse Verification (HP 59551A Only)

NOTE

GPS ANTENNA REQUIRED. The steps below require that a GPS antenna be properly set up, and the HP 59551A is in GPS locked mode before proceeding. For information on how to make such a setup, refer to the reference information provided on page 4 in this note.

If you determine that these tests will not be performed for your facility, please proceed to the next section titled "Operation Verification Conclusion."

- 1 Connect a GPS Antenna and cable to the HP 59551A and allow the Receiver to indicate it is in "GPS Lock" mode as indicated by the illuminated **GPS Lock** indicator. Until GPS lock is attained, the following tests will not be valid. Your test setup should be similar to Figure 4.

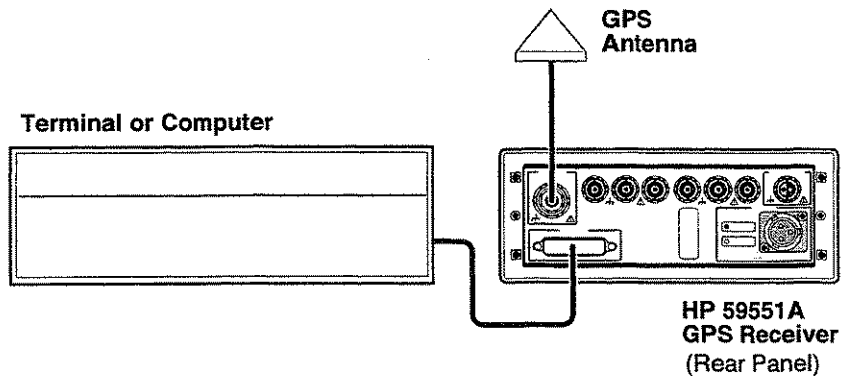


Figure 4. HP 59551A Time Tagging Operational Verification Setup

- 2 Enter the following commands from the terminal or computer to note the current date and time.

:PTIM:DATE?

:PTIM:TIME?

- 3 On the computer or terminal, type :SENS:DATA:CLE and press the Return key.

This clears the Time Tagging event registers of any data prior to the next step.

Operational Verification

- 4 On the computer or terminal, type: :FORM:DATA ASCII and press the Return key.

This sets the output format of the Time Tagging Data to an ASCII string for easier interpretation.

- 5 Refer to Chapter 2, "Features and Functions," in the Getting Started Guide to identify types of stimulus equipment that could be used for this test.

A suggested general-purpose device could be a pulse generator, set to output a TTL pulse.

- 6 Use this signal to send an event to each of the three Time Tagging inputs.

- 7 From the terminal or computer, send the following query commands to verify that an event was recorded in each of the Time Tagging event registers. Note that there is a space between the question mark (?) and the quotation mark (") in the following commands.

:SENS:DATA? "TSTAMP 1"

:SENS:DATA? "TSTAMP 2"

:SENS:DATA? "TSTAMP 3"

Note that the actual date and time of the record is not being tested.

- 8 Verify that each response is the following format:

yyyy,mm,dd,hh,mm,sssssss,xxxxxxxxxx

- 9 On the terminal, type: :SENS:DATA:CLE and press the Return key.

This again clears the Time Tagging event registers of any data from this test.

- 10 Mark Pass or Fail in Line 6 on the Operational Verification portion of the HP 59551A Performance Test Record, located at the end of this note.

- 11 Enter the following commands from the terminal or computer:

:PULS:CONT:PER 1

This sets the period to 1 second.

:PULS:CONT:STAT ON

This sets the programmable pulse output to provide a continuous stream of pulses.

Operational Verification

:PULS:STAR:DATE <four-digit year>, <month>, <day>

- a. Set the year, month, and day to the same values read in step 2 in the previous procedure "Time Tagging Verification."

Example:

:PULS:STAR:DATE 1995, 7, 25 is July 25, 1995.

:PULS:STAR:TIME <hours>, <minutes>, <seconds>

- b. Set the hours, minutes, and seconds to the same values observed in step 2 in the previous procedure "Time Tagging Verification."

Example:

:PULS:STAR:TIME 13, 1, 5 is 13:01:05 in 24-hour format.

NOTE

Setting the time to a value earlier than the present time will start the pulse stream immediately. If a time is input with a value some time in the future, the pulse stream will not start until that time is attained.

- 12 Set the oscilloscope sweep rate to 5 msec/div, input amplitude to 5 Volts/div, and input coupling to dc.
- 13 Connect the oscilloscope to the rear-panel **Programmable Pulse** output as shown in Figure 5.

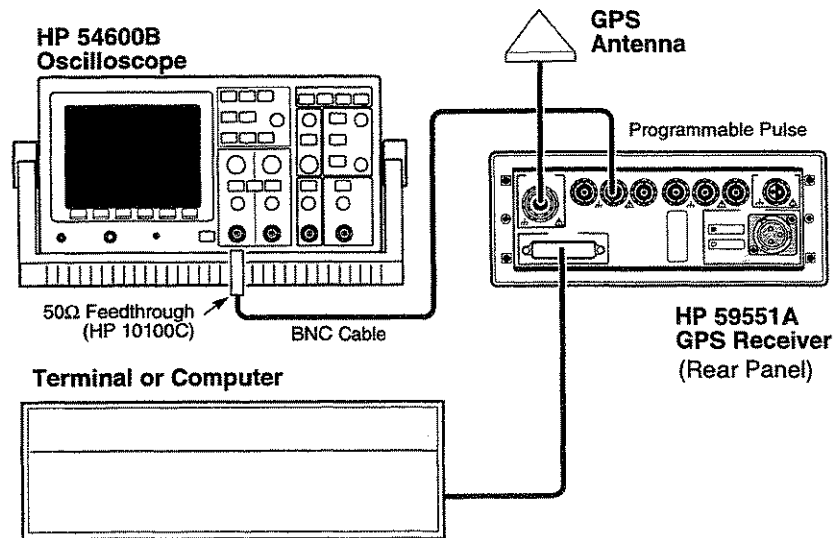


Figure 5. HP 59551A Programmable Pulse Operational Verification Setup

Operational Verification

- 14 Verify that a continuous stream of TTL-compatible pulses are occurring at a 1 second rate.
- 15 Mark Pass or Fail in Line 7 on the Operational Verification portion of the HP 59551A Performance Test Record, located at the end of this note.

Operational Verification Conclusion

NOTE

Perform the following step only if you wish to restore memory of the HP 58503A or HP 59551A Receiver to the factory default states. Doing this can change several parameters that have been stored by a previous user. If you have any questions or concerns, refer to the Getting Started Guide for information on the type of information that is stored.

On the terminal or computer, type:

:SYST:PRES and press the Return key.

This will ensure that your Receiver has been restored to the factory defaults as originally received.

This completes the operational verification.

In Case of Difficulty

In Case of Difficulty

If any of the above tests fail it should be re-checked before assuming that the unit is defective. Return any defective unit to the Hewlett-Packard office where it was purchased. State the nature of the problem and HP will repair it during the initial warranty period at no charge.

Complete Performance Tests

Complete Performance Tests

The specifications of the HP 59551A and HP 58503A can be verified by performing the Performance Tests provided in this section. Table 2 lists a summary of the HP 59551A/58503A Complete Performance Tests.

Table 2. The HP 59551A/58503A Complete Performance Tests

Page Number	Time and Frequency Output Tests
17	Preliminary Test Setup
18	Test 1: 10 MHz Frequency Accuracy and 1 PPS Jitter (Locked to GPS)
21	Test 2: 10 MHz Holdover Aging and 1 PPS Accumulated Time Error (Unlocked)
23	Test 3: 1 PPS Time Accuracy (Locked)
23	Test 4: 10 MHz Frequency Stability (Time Domain) and Phase Noise (Frequency Domain) Measurements

The following tests will ensure that the HP 59551A GPS Measurements Synchronization Module and HP 58503A GPS Time and Frequency Reference Receiver are meeting the published specifications. Some of these tests will require that the Receiver be operating continuously for at least 3 days, others require that the Receiver be disconnected from GPS, and others will require further investigation in order to produce a satisfactory setup and measurement.

The critical specifications to be tested are the 10 MHz Frequency Accuracy (1 day) and the 1 PPS Jitter (1 day) specifications. As long as the Receiver is locked, the proper performance of these two specifications will imply that the other specifications are in conformance.

The following tests do not test “typical” or “nominal” specifications, or “supplemental characteristics,” “supplemental information,” or “features.”

Record the results of the Performance Test in the appropriate place on the appropriate (i.e., HP 59551A or HP 58503A) Performance Test Record, which is located at the end of this note.

Complete Performance Tests

Preliminary Test Setup

If you have not connected the GPS antenna to the Receiver, perform the following preliminary procedure in this section.

If you have already connected the GPS antenna to Receiver, go to the next subsection titled “Test 1: 10 MHz Frequency Accuracy and 1 PPS Jitter (Locked to GPS).”

- 1 Connect the antenna system to the rear-panel **ANTENNA** Type-N connector of the Receiver as described in the instructions given in the subsection titled “To Assemble and Install the Antenna System” in Chapter 1, “Getting Started,” of the Getting Started Guide.

NOTE

Do not apply power to the Receiver unless a fully operational antenna system is connected to the ANTENNA input connector. Power applied with no antenna input or a non-functioning antenna will initiate an extended search process that may increase time to reach GPS lock. You can halt the extended search by disconnecting and reconnecting (cycling) the external supply voltage to the Receiver (you may need to leave power disconnected for greater than five seconds).

- 2 Connect the Receiver to a suitable power source. (If needed, refer to the subsection titled “To Connect DC Power” in Chapter 1 of the Getting Started Guide.
- 3 The Receiver will perform a self-test of internal components. Verify that after 15 seconds the **Power** indicator illuminates and the Alarm indicator is off. This ensures that all internal components and connections are functioning.

Complete Performance Tests**Test 1: 10 MHz Frequency Accuracy and 1 PPS Jitter
(Locked to GPS)**

This test measures the relative change in the 1 PPS pulses between the unit under test and a known accurate source. A time interval is measured and the data is stored to be compared with a second measurement, 24 hours later. The 1 PPS source is derived from the internal 10 MHz, and the relative accuracy of 1 PPS is directly related to the accuracy of the 10 MHz.

Specifications Tested

Frequency Accuracy (locked): Better than 1×10^{-12} for a one day average, 0 degrees to 50 degrees C.

1 PPS Jitter of leading edge: <750 ps with at least one satellite in view, Selective Availability on.

Procedure

- 1 Connect the terminal or computer to the Receiver using the cable recommended in the Getting Started Guide and ensure that they are both communicating.
- 2 Ensure that the Receiver is in "GPS Lock" mode as indicated by the illuminated **GPS Lock** indicator, and that FFOM = 0. The current value of FFOM and many other characteristics of the unit can be determined by typing :SYST:STAT? on the terminal.
- 3 Connect the 10 MHz reference output from the reference 1 PPS source (HP 5071A or another stable, traceable house standard) to the rear-panel **Ref In** of the Universal Counter, as shown in Figure 6, to provide an external timebase for the Counter.

HP 59551A/58503A Performance Tests
Complete Performance Tests

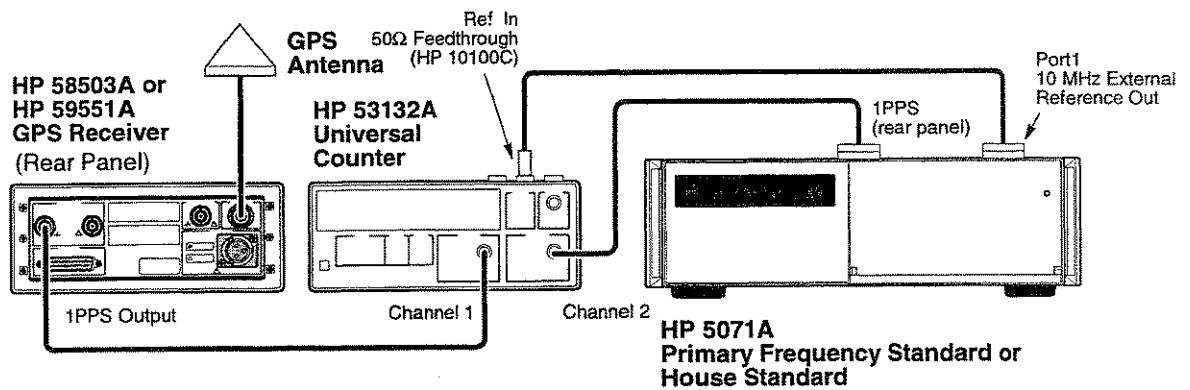


Figure 6. 10 MHz Frequency Accuracy and 1 PPS Jitter Test Setup (HP 58503A GPS Receiver shown)

- 4 Connect the rear-panel 1 PPS from Receiver under test to Channel 1 of the Universal Counter.
- 5 Connect the 1 PPS from the reference standard (HP 5071A) to Channel 2.
- 6 On the terminal or computer, enter the following command to clear all entries in the Diagnostic (status) Log:
:DIAG:LOG:CLE and press the Enter (or Return) key.
- 7 Set the Universal Counter function to take 100 samples of Time Interval and compute the Mean value. Ensure that the inputs are set to DC-coupled, 50 Ohms, and rising edge. Set the trigger level for both inputs to 1 Volt dc.
- 8 Record the average time interval for later comparison.
_____ seconds.
- 9 Disconnect the reference 1 PPS from input 2 and set the counter to "COMMON" mode so the 1 PPS from the Receiver is input to both channels. For this step, be sure the trigger levels are both set to 1 Volt dc.
- 10 Set the counter to compute the Standard Deviation for the same 100 samples.

This is the RMS Jitter of the 1 PPS.
- 11 Again, allow the counter to accumulate 100 samples of time interval.

Complete Performance Tests

12 Note the largest deviation (greater or less) from exactly 1 second.

This is the worst-case 1 PPS leading edge jitter.

13 Record the results of 1 PPS Jitter on Line 2 of Test 1 of the Performance Test Record.

14 Wait 24 hours to complete the Frequency Accuracy test.

15 On the terminal or computer, enter the following command:

:DIAG:LOG:READ:ALL? and press the Enter (or Return) key.

Observe the messages (if any) that appear and verify that none of the messages indicate that the HP 59551/58503A has entered holdover mode. If it has, the entire test must be re-started from step 2 above.

16 Repeat steps 2 through 8 above after the 24-hour period.

17 Compute the Frequency Accuracy using the following formula:

$$\frac{(t1 - t2) \text{ sec onds}}{\Delta t \text{ sec onds}} = \text{Accuracy (unitless)}$$

Where,

t1 is the average time interval first measured

t2 is the average time interval last measured

Δt is the time between measurements (86,400 seconds = 24 hours)

18 Record the results of Frequency Accuracy in Line 1 of Test 1 of the Performance Test Record.

Complete Performance Tests

**Test 2: 10 MHz Holdover Aging and 1 PPS
Accumulated Time Error (Unlocked)**

The following tests are identical to the previous tests, with the exception that during the actual test, the Receiver is not locked to the GPS. However, the test must adhere to the restrictions noted below with the specification in order for the results to be valid.

Specifications Tested

Holdover aging: $<1 \times 10^{-10}$ /day average frequency change in 24 hours unlocked after 3 days locked operation for any 10° C range between 10° C and 40° C.

Accumulated time error: <8.6 us accumulated in 24 hours unlocked after 3 days of locked operation with a fixed antenna location, any 10° C range between 10° C and 40° C.

Procedure

- 1 Ensure that the Receiver has been in GPS Lock mode for at least three (3) days without entering holdover mode by typing the following command on the terminal or computer:
DIAG:LOG:READ:ALL? and press the Enter (or Return) key.
Verify that there are no messages to indicate that holdover mode was started during the last 72 hours of operation.
- 2 Ensure that the temperature restrictions described above will be met for the next 24 hours.
- 3 Connect the 10 MHz reference output from the reference 1 PPS source (HP 5071A or another stable, traceable house standard) to the rear-panel **Ref In** of the Universal Counter, as shown in Figure 6, to provide an external timebase for the Counter.
- 4 Connect the rear-panel 1 PPS from Receiver under test to Channel 1 of the Universal Counter.
- 5 Connect the 1 PPS from the reference standard (HP 5071A) to Channel 2. Ensure that the inputs are set to DC-coupled, 50 Ohms, and rising edge. Set the trigger level for both inputs to 1 Volt dc.
- 6 Disconnect the antenna cable (N-type connector) at the rear of the Receiver to force it into Holdover Mode.

Complete Performance Tests

- 7 Ensure that the **Holdover** indicator is illuminated and the **GPS Lock** is not illuminated.
- 8 Note the time interval average for 100 samples, either positive or negative.

NOTE

Do not re-connect the antenna at this time. It must remain disconnected for the entire 24-hour period.

- 9 Wait 24 hours to complete the Holdover Aging test. During this 24-hour period, ensure that the temperature restrictions are maintained. If the temperature does exceed the range, the Receiver will have to be re-connected to the antenna, allowed to lock, run for at least 3 days, and re-tested with this procedure.
- 10 Repeat steps 3, 4, 5, and 8 above after the 24 hour period.
- 11 If desired, re-connect the antenna cable at this time.
- 12 Compute the Holdover Aging rate using the following formula:

$$\frac{(t1 - t2) \text{ sec onds}}{\Delta t \text{ sec onds}} = \text{Aging rate (unitless)}$$

Where,

t1 is the average time interval first measured

t2 is the average time interval last measured

Δt is the time between measurements (86,400 seconds = 24 hours)

- 13 Compute the Accumulated Time Error using the following formula:

$$(t1 - t2) \text{ seconds} = \text{Error (seconds)}$$

Where t1 and t2 are defined as in the previous step.

- 14 Record the results of Holdover Aging and 1 PPS Accumulated Time Error in the Test 2 row of the Performance Test Record.

Complete Performance Tests

Test 3: 1 PPS Time Accuracy (Locked)

This specification is a statistical probability that the Receiver will conform to the standard as described. This cannot be tested with any degree of confidence except at NIST or an equivalent National Standards Laboratory. Actual accuracy obtained depends on the exact knowledge of the geophysical location, characteristics and delay in the antenna, calibration of all measurement delays, and calibration of antenna cable delay. Calibration of both ionospheric and tropospheric delay use the standard algorithms provided in the GPS data messages. At the 95% confidence level, time errors associated with the Receiver, GPS system, and ionospheric and tropospheric effects will be less than 110 ns.

Hewlett-Packard Santa Clara Division Lab can perform the above test if you wish. Contact your local HP Sales Office for information about this special testing and to obtain information on where to ship your product.

Test 4: 10 MHz Frequency Stability (Time Domain) and Phase Noise (Frequency Domain Measurements)

NOTE

High accuracy precision measurements of both time and frequency domain stability are available through the National Institute of Standards and Technology (NIST) in the USA, and at other equivalent National Standards Laboratories. NIST can completely characterize and verify all major specifications of the HP 59551A or HP 58503A. For information regarding the various tests available, contact:

National Institute of Standards and Technology,
Measurements Services Office
325 Broadway, Boulder CO 80303-3328 USA,
Telephone: (303) 497-3753

Frequency Stability (Time Domain)

This is an engineering-level measurement requiring a special test setup. The test setup must be carefully designed to eliminate all sources of noise. For more information on how to make this measurement, see HP Application Note 358-12. Also, see NIST Technical Note 1337 (available from US Government Printing Office, Washington DC., USA). This is an excellent theoretical as well as technical reference for this measurement.

Phase Noise (Frequency Domain)

This measurement requires the HP 3048A Phase Noise Measurement System, a highly specialized test system. In order to perform properly,

Complete Performance Tests

this system must contain a reference oscillator with phase noise characteristics that are equal to or better than the HP 59551A or HP 58503A. Instructions for performing frequency domain stability tests can be found in the HP 3048A system documentation.

This completes the performance tests.

HP 59551A Performance Test Record

Hewlett-Packard Model 59551A GPS Measurements Synchronization Module

Serial Number: _____ Repair/Work Order No. _____

Test Performed By: _____ Temperature: _____

Date: _____ Relative Humidity: _____

Notes: _____

Line Number	Operational Verification	Test Results	
		Pass	Fail
1	10 MHz Verification	<input type="checkbox"/>	<input type="checkbox"/>
2	1 PPS Verification	<input type="checkbox"/>	<input type="checkbox"/>
3	IRIG-B Verification	<input type="checkbox"/>	<input type="checkbox"/>
4	Time of Day RS-232 Serial Interface Verification	<input type="checkbox"/>	<input type="checkbox"/>
5	Antenna Power Verification	<input type="checkbox"/>	<input type="checkbox"/>
6	Time Tagging (Stamping) Verification	<input type="checkbox"/>	<input type="checkbox"/>
7	Programmable Pulse Verification	<input type="checkbox"/>	<input type="checkbox"/>

HP 59551A Complete Performance Tests

Test Number	Test Description	Results	Limits
1	10 MHz Frequency Accuracy and 1 PPS Jitter (Locked to GPS)	1. _____ 2. _____	Better than 1×10^{-12} for a one day average, 0 degrees to 50 degrees C. <750 ps with at least one satellite in view, Selective Availability on.
2	10 MHz Holdover Aging and 1 PPS Accumulated Time Error (Unlocked)	1. _____ 2. _____	< 1×10^{-10} /day average frequency change in 24 hours unlocked after 3 days locked operation for any 10° C range between 10° C and 40° C. <8.6 μs accumulated in 24 hours unlocked after 3 days of locked operation with a fixed antenna location, any 10° C range between 10° C and 40° C.
3	1 PPS Time Accuracy (Locked)	_____	
4	10 MHz Frequency Stability (Time Domain) and Phase Noise (Frequency Domain) Measurements	_____	

HP 58503A Performance Test Record

Hewlett-Packard Model 58503A GPS Time and Frequency Reference Receiver

Serial Number: _____ Repair/Work Order No. _____

Test Performed By: _____ Temperature: _____

Date: _____ Relative Humidity: _____

Notes: _____

Line Number	Operational Verification	Test Results	
		Pass	Fail
1	10 MHz Verification	<input type="checkbox"/>	<input type="checkbox"/>
2	1 PPS Verification	<input type="checkbox"/>	<input type="checkbox"/>
3	Time of Day RS-232 Serial Interface Verification	<input type="checkbox"/>	<input type="checkbox"/>
4	Antenna Power Verification	<input type="checkbox"/>	<input type="checkbox"/>
5	Front Panel Display/Keypad Verification (Option 001 Only)	<input type="checkbox"/>	<input type="checkbox"/>

HP 58503A Complete Performance Tests

Test Number	Test Description	Results	Limits
1	10 MHz Frequency Accuracy and 1 PPS Jitter (Locked to GPS)	1. _____ 2. _____	Better than 1×10^{-12} for a one day average, 0 degrees to 50 degrees C. <750 ps with at least one satellite in view, Selective Availability on.
2	10 MHz Holdover Aging and 1 PPS Accumulated Time Error (Unlocked)	1. _____ 2. _____	< 1×10^{-10} /day average frequency change in 24 hours unlocked after 3 days locked operation for any 10° C range between 10° C and 40° C. <8.6 μs accumulated in 24 hours unlocked after 3 days of locked operation with a fixed antenna location, any 10° C range between 10° C and 40° C.
3	1 PPS Time Accuracy (Locked)	_____	
4	10 MHz Frequency Stability (Time Domain) and Phase Noise (Frequency Domain) Measurements	_____	

Supplemental
Guide

HP 58503A/Option 001
Front-Panel Display/Keypad

Supplemental Guide

This guide describes the HP 58503A/Option 001 GPS Time and Frequency Reference Receiver. The information in this guide applies to instruments with the front-panel display/keypad option having the number prefix listed below, unless accompanied by a "Manual Updating Changes" package indicating otherwise.

SERIAL PREFIX NUMBER: 3542 and above

HP 58503A/Option 001
Front-Panel Display/Keypad

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Printed: September 1996

Printed in USA

Manual part number
58503-90008

Certification and Warranty

Certification

Hewlett-Packard Company certifies that this product met its published specification at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by the Institute's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Hewlett-Packard instrument product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For detailed warranty information, see back matter.

Safety Considerations

General

This product and related documentation must be reviewed for familiarization with this safety markings and instructions before operation.

This product is a safety Class I instrument (provided with a protective earth terminal).

Before Applying Power

Verify that the product is set to match the available line voltage and the correct fuse is installed. Refer to instructions in Chapter 1 of the Manual.

Safety Earth Ground

An uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

Warning Symbols That May Be Used In This Book



Instruction manual symbol; the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual.



Indicates hazardous voltages.

Safety Considerations (contd)



Indicates earth (ground) terminal.



or



Indicated terminal is connected to chassis when such connection is not apparent.



Indicates Alternating current.



Indicates Direct current.

WARNING

BODILY INJURY OR DEATH MAY RESULT FROM FAILURE TO HEED A WARNING. DO NOT PROCEED BEYOND A WARNING SIGN UNTIL THE INDICATED CONDITIONS ARE FULLY UNDERSTOOD AND MET.

CAUTION

Damage to equipment, or incorrect measurement data, may result from failure to heed a caution. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

For additional safety and acoustic noise information, see back matter.

Contents

In This Guide v

1 Quick Start

Front-Panel Display/Keypad at a Glance 1-2

2 Functions and Capabilities

Chapter Contents 2-2

Overview 2-3

About the Display and Keypad 2-3

Product Compatibility 2-3

System Compatibility 2-3

Using the Display and Keypad 2-4

To Display Time 2-4

To Display Position 2-4

 Displaying Longitude 2-4

 Displaying Latitude 2-4

 Displaying Altitude 2-4

To Display Number of Satellites Being Tracked 2-4

To Display Serial Port Settings 2-4

To Display System Status 2-4

To Clear Instrument Alarm 2-5

Capabilities Under Special Circumstances 2-5

To Access the TEST MODE to Test the Front-Panel
Display 2-5

To Access the DEMO MODE to Demonstrate Front-Panel
Capabilities 2-5

To Check Serial Port Settings During Installation 2-6

Error Messages 2-7

Status Messages 2-10

3 Upgrade Installation

Chapter Contents 3-2

Introduction 3-3

Retrofitting Option 001 Front-Panel Display and Keypad 3-3

Option 001 Display/Keypad Upgrade Installation Kit (58503-67001) Contents 3-3

Tools Required 3-4

To Retrofit Option 001 3-4

Firmware Revision Identification 3-4

Hardware Installation 3-4

Downloading Firmware 3-6

In Case of Trouble 3-10

Final Checkout 3-11

Further Assistance 3-12

Index

In This Guide

This guide provides supplemental information for the Option 001 Front-Panel Display/Keypad of the HP 58503A GPS Time and Frequency Reference Receiver. Refer to the HP 59551A/58503A *Getting Started Guide* and *Operating and Programming Guide* for complete details on using the GPS Receiver.

The Option 001 Front-Panel Display/Keypad adds the following capabilities to the HP 58503A:

- front-panel display of Receiver's status
- front-panel keypad operation for retrieval of time, position, altitude, and serial port settings
- front-panel alarm clearing

This guide contains the following:

Table of Contents

In This Guide (this preface) introduces you to the Supplemental Guide.

Chapter 1, "**Quick Start**," introduces you to the Option 001 Front-Panel Display/Keypad with a visual and brief textual overview of it.

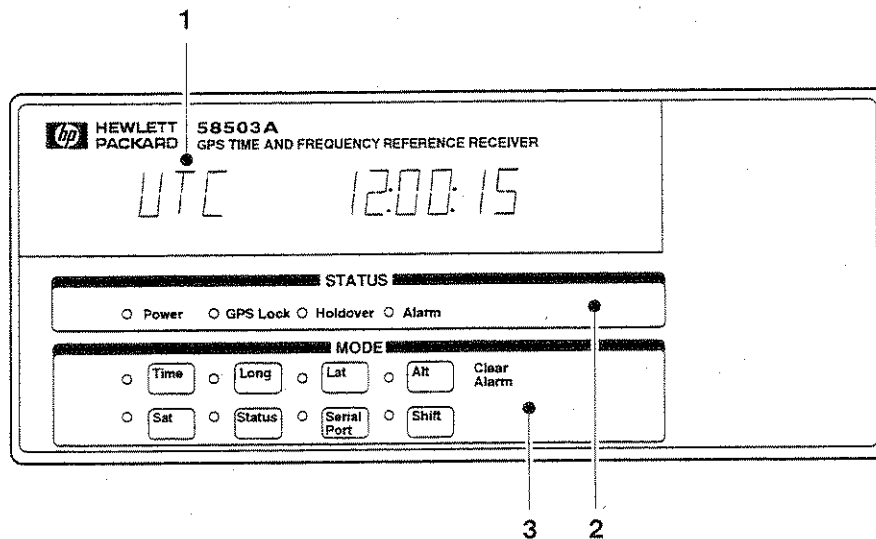
Chapter 2, "**Functions and Capabilities**," describes the Front-Panel Display/Keypad functions and capabilities. This chapter also instructs you on how to use the display and keypad to obtain Receiver status information. Tables of error and status messages are provided at the end of this chapter.

Chapter 3, "**Upgrade Installation**," provides a field-installation procedure that helps you install the Option 001 Front-Panel Display/Keypad into the Receiver.

Index

Quick Start

Front-Panel Display/Keypad at a Glance



1 An alphanumeric display for displaying time, position (i.e., longitude, latitude, and altitude), and Receiver status. The display is a highly visible twelve-character vacuum-fluorescent display.

2 Status LED indicators:

When the **Power** indicator is illuminated, it indicates that input power is supplied to the Receiver.

When the **GPS Lock** indicator is illuminated, it indicates that the Receiver is tracking satellites and has phase-locked its internal reference to the reference provided by GPS.

When the **Holdover** indicator is illuminated, it indicates that the Receiver is not phase-locking its internal reference to the reference provided by GPS. Typically, this would happen due to loss of satellite tracking.

When the **Alarm** indicator is illuminated, it indicates that the Module has detected a condition that requires attention.

3 Eight **MODE** keys with associated LEDs for front-panel access to time, position, and status information: **Time**, **Long** (longitude), **Lat** (latitude) **Alt** (altitude), **Sat** (number of satellites tracking), **Status** (Receiver or system status), and **Serial Port** (serial port settings). Each key selects a different display mode. Also, pressing **Shift** and **Alt** key in sequence clears instrument alarm.

Functions and Capabilities

Chapter Contents

The Option 001 front panel provides a keypad and a display for the HP 58503A GPS Time and Frequency Reference Receiver. This chapter presents more detailed information on the display and keypad, and is organized as follows:

- Overview page 2-3
 - About the Display and Keypad page 2-3
 - Product Compatibility page 2-3
 - System Compatibility page 2-3
- Using the Display and Keypad page 2-4
 - To Display Time page 2-4
 - To Display Position page 2-4
 - To Display Number of Satellites Being Tracked page 2-4
 - To Display Serial Port Settings page 2-4
 - To Display System Status page 2-4
 - To Clear Instrument Alarm page 2-5
- Capabilities Under Special Circumstances page 2-5
 - To Access the TEST MODE to Test the Front-Panel Display page 2-5
 - To Access the DEMO MODE to Demonstrate Front-Panel Capabilities page 2-5
 - To Check Serial Port Settings During Installation page 2-6
- Error Messages page 2-7
- Status Messages page 2-10

Overview

About the Display and Keypad

The front-panel display contains a twelve-character vacuum-flourescent display, four indicator LEDs, and eight elastomeric keys with associated mode LEDs. Each key selects a different display mode. In addition, there is one control capability (alarm clearing) available.

Product Compatibility

The Option 001 Front-Panel Display/Keypad is designed to be compatible with the HP 58503A GPS Time and Frequency Reference Receiver.

Retrofit of a previously-purchased HP 58503A with the display requires that the Option 001 front panel is swapped for the previously-installed front panel. New firmware (specific to the HP 58503A) is installed to support the display and keypad capabilities. Note that a firmware upgrade may add new capabilities, some unrelated to the front-panel display. Firmware upgrade also clears instrument non-volatile memory; if necessary, non-volatile settings should be recorded prior to sending the instrument for retrofit. Calibration settings (temperature coefficients) are not cleared by the firmware upgrade.

Display hardware and display-compatible firmware are designed at the factory to be backwards-compatible with all product hardware revisions, (serial prefix numbers 3542 and above for HP 58503A).

System Compatibility

Information displayed on the front panel corresponds with the same information available by other means.

Unit-to-unit correlation is good — two instruments which are synchronized and racked side-by-side will increment in unison. Similarly, the instrument display will increment in unison with a HP SatStat® display. Correlation with other time of day outputs is good: the display increments in unison with an IRIG decoder, and correlates with time of day outputs provided programmatically over the RS-232 interface.

Using the Display and Keypad

To Display Time

Press **Time** key to displays current time.

Under special circumstances, when UTC local time is selected for use throughout the instrument, the display shows the LOCAL time.

To Display Position

Displaying Longitude

Press **Long** key to display longitude.

Following powerup, the Receiver iteratively computes its position; the longitude display is updated as computation progresses.

Displaying Latitude

Press **Lat** key to display latitude.

Following power-up, the Receiver iteratively computes its position; the latitude display is updated as computation progresses.

Displaying Altitude

Press **Alt** key to display altitude.

Altitude is measured in meters above mean sea level. Following power-up, the instrument iteratively computes its position; the altitude display is updated as computation progresses.

To Display Number of Satellites Being Tracked

Press **Sat** key to display a count of the number of satellites currently tracked.

To Display Serial Port Settings

Press **Serial Port** key to display the Receiver's serial port settings.

To Display System Status

Press **Status** key to display system status.

To Clear Instrument Alarm

The Option 001 Front-Panel Display/Keypad allows you to clear instrument alarm.

Press and hold **Shift**, then press **Clear Alarm (Alt)** key to clear an alarm.

Capabilities Under Special Circumstances

To Access the TEST MODE to Test the Front-Panel Display

Access the product's installation TEST MODE using the following procedure.

- 1 Apply power to the HP 58503A. While the letters "HP" are moving from right to left, (about 2 seconds), press the **Sat** key followed by the **Time** key.

If necessary, you can remove and re-connect power to re-initiate the startup and try again. When you succeed, the product will enter its VFD DSP TEST (test of the vacuum-flourescent display).

The display should first show a test pattern that sequentially illumntates all 15 segments of all digits and punctuation marks on the display. When the segment illumination is complete, the words DEMO MODE appear, and the product enters the demo mode described below.

- 2 To exit, press the **Shift** key and then press the **Alt** key.

To Access the DEMO MODE to Demonstrate Front-Panel Capabilities

Access the product's DEMO MODE using the following procedure.

- 1 Apply power to the HP 58503A. While the letters "HP" are moving from right to left, (about 2 seconds), press the **Shift** key.

If necessary, you can remove and re-connect power to re-initiate the startup and try again. When you succeed, the product will enter its DEMO MODE. To exit the DEMO MODE, press the **Shift** key and then press the **Alt** key.

Capabilities Under Special Circumstances

The DEMO MODE does not require an antenna connection. DEMO MODE was designed to support the user during demonstrations, during installation, and during initial connection to a PC.

A special feature of the mode is to provide the HP 58503A's actual Serial Port Settings when the Serial Port key is pressed.

For other keys, the DEMO MODE responds to keypresses by displaying simulated data for UTC Time, Longitude, Latitude, Altitude, Satellite Count, and Status. These values are not related to the actual values, they are a simulation.

- 2 To exit the DEMO MODE, press the **Shift** key and then press the **Alt** key.

To Check Serial Port Settings During Installation

- 1 To display Serial Port settings during initial installation, press the **Serial Port** key during powerup or during DEMO MODE.
- 2 Access the product's DEMO MODE using the procedure described above. A special feature of the DEMO MODE is to provide the HP 58503A's actual Serial Port Settings when the **Serial Port** key is pressed. After having viewed the Serial Port settings, exit the DEMO MODE by pressing **Shift** key and then **Alt** key.

Error Messages

When the instrument status system within the HP 58503A detects an error condition, the front-panel display will identify the error to you. Table 2-1 lists an example of message format. Table 2-2 lists error messages.

Note that errors reported on the front panel are detected and reported in the instrument status system. Detailed information is available in the Operating and Programming Guide in Chapter 5 under the heading Monitoring Status/Alarm Conditions. The manual is Hewlett-Packard P/N 59551-90002. The treatment below is designed to be read in conjunction with the text and tables in Chapter 5, particularly Figure 5-1 on page 5-49 and the text following that Figure.

In addition to identifying the nature of the error detected, the front-panel display identifies which transition was detected. The status system can be configured to detect onset of conditions and/or abatement of conditions. The display identifies which has occurred. For example, the status system can be configured to detect the onset of holdover, exit from holdover, or both onset and exit. The display distinguishes these events by appending a minus (-) sign if the abatement of the condition is detected, (if a negative transition is detected). It presents a message with no appended sign if the onset of condition is detected. The holdover example in Table 2-1 describes this.

Table 2-1. Example Message Format

Message	Significance
HOLDING	Displayed when the instrument detects <i>entry</i> into Holdover. That is, the instrument detects a <i>positive transition</i> of the Holdover condition bit.
- HOLDING	Displayed when the instrument detects <i>exit</i> from Holdover. That is, the instrument detects a <i>negative transition</i> of the Holdover condition bit.
HOLDING ?	Displayed when the instrument detects <i>either entry into or exit from</i> Holdover. That is, the instrument detects status change, but is unable to identify whether the change is caused by either a <i>positive transition</i> or a <i>negative transition</i> of the Holdover condition bit.

Error Messages

Table 2-2. Error Messages[†]

Displayed Message	Meaning	Corresponding Status Register	Bit
1ST SAT AQ	first satellite has been tracked	Powerup	0
OXCO WARM	internal oscillator warmed up	Powerup	1
DT TM VALD	date and time have become valid	Powerup	2
HOLDING	user-initiated holdover entered	Holdover	0
RCOVR WAIT	instrument-initiated holdover entered, waiting to recover	Holdover	1
RECOVERING	recovering from holdover	Holdover	2
THRESH EXD	holdover duration exceeds threshold	Holdover	3
SLFTST ERR	selftest error	Hardware	0
POS 15V ER	+15-volt supply voltage exceeds tolerance	Hardware	1
NEG 15V ER	-15-volt supply voltage exceeds tolerance	Hardware	2
POS 5V ER	+5-volt supply voltage exceeds tolerance	Hardware	3
OVEN TOLER	Oven supply exceeds tolerance	Hardware	4
EFC NR LMT	EFC, (oscillator electronic frequency control voltage) near full-scale	Hardware	6
EFC LIMIT	EFC voltage at full-scale	Hardware	7
GPS PPS ER	Invalid GPS-engine 1PPS signal	Hardware	8
GPS FAILED	GPS engine not communicating	Hardware	9
TI MEAS ER	Measurement engine failed	Hardware	10
PROM WR ER	Failure during write to non-volatile memory hardware	Hardware	11
INT REF ER	Internal 1PPS reference failure	Hardware	12
QUERY ERR	Query error	Command Error	2
HW-FMW ERR	Hardware/Firmware Error	Command Error	3
SEMANT ERR	Semantic Error	Command Error	4
SYNTAX ERR	Syntactic Error	Command Error	5
PWR CYCLD	Power cycled. Set at powerup	Command Error	7

Error Messages

Table 2-2. Error Messages[†] (Continued)

Displayed Message	Meaning	Corresponding Status Register	Bit
PWERUP SUM	Power-up status summary bit	Operation	0
LOCKED	Locked to GPS	Operation	1
HLDOVR SUM	Holdover status summary bit	Operation	2
POS HOLD	Position Hold	Operation	3
PPS RF VLD	1PPS reference valid	Operation	4
HRDW SUM	Hardware status summary bit	Operation	5
LOG NR FUL	Diagnostic Log almost full	Operation	6
TIME RESET	Receiver reset its time	Questionable	0
USER EVENT	User sets this bit manually	Questionable	1
QUES SUM	Questionable register summary bit	Status Byte	3
CMD ER SUM	Command Err register summary bit	Status Byte	5
MSTR SUM	Master summary bit	Status Byte	6
OPER SUM	Operation register summary bit	Status Byte	7

[†] When the **Alarm** LED is illuminated by an error condition, the instrument display will show the cause of the alarm. Until the alarm is cleared, the displayed alarm (error) message will have priority over any other message on the display. For example, instead of displaying time, even if the **Time** key is pressed, the instrument will display the alarm (error) message.

Status Messages

Status Messages

The instrument provides several messages on the front-panel display which report routine operation. These are not messages originating from the Status/Alarm system. They are progress reports intended to provide a general indication of instrument state. The messages and their meanings are tabulated in Table 2-3.

Table 2-3. Status Messages

Displayed Message	When Message Appear	Meaning
TIME: **:**:**	Following powerup, before valid data is computed.	Time key pressed, data not yet valid.
LAT: **:**:**.*	Following powerup, before valid data is computed.	Latitude key pressed, data not yet valid.
LONG: **:**:**.*	Following powerup, before valid data is computed.	Longitude key pressed, data not yet valid.
ALT: +**.**m	Following powerup, before valid data is computed.	Altitude key pressed, data not yet valid.
UTC <numerics>	During normal operation, on keypress.	Current UTC time, uncorrected for local time zone offset.
LOCAL <numerics>	During normal operation, on keypress.	Current UTC time, corrected for local time zone offset.
<LAT numerics>	During normal operation, on keypress.	Latitude
<LONG numerics>	During normal operation, on keypress.	Longitude
<ALT numerics>	During normal operation, on keypress.	Altitude, meters above sea level
x TRACKED	During normal operation, on keypress.	Number of satellites currently being tracked
<baud>,<parity>,<data bits>,<stop bits>	During normal operation, on keypress.	Current serial port settings (displayed in order shown).
ALARM CLEARED	On keypress sequence: Shift followed by Alarm Clear	Instrument alarms have been cleared.
NO ALARM	On keypress sequence: Shift followed by Alarm Clear	Alarm clear was requested, no alarm condition was detected.

Chapter Contents

This chapter contains complete installation upgrade and firmware download procedures for retrofitting the Option 001 to the HP 58503A GPS Time and Frequency Reference Receiver.

This chapter is organized as follows:

- Introduction page 3-3
- Retrofitting Option 001 Front-Panel Display/Keypad page 3-3
 - Option 001 Display/Keypad Upgrade Installation Kit (58503-67001) Contents page 3-3
 - Tools Required page 3-4
 - To Retrofit Option 001 page 3-4
- Downloading Firmware page 3-6
- In Case of Trouble page 3-10
- Final Checkout page 3-11
- Further Assistance page 3-12

Status Messages

Table 2-3. Status Messages (Continued)

Displayed Message	When Message Appears	Meaning
HP 58503A	Powerup	Product identification. To enter demo mode, hit shift as this message scrolls.
OCXO WARM UP	Normal warmup	Oscillator warming up
SAT AQUIRD	Normal warmup	Number of satellites currently being tracked.
COARSE F ADJ	Normal warmup	Coarse frequency adjustment
FINE F ADJ	Normal warmup	Fine frequency adjustment
PHASE ALIGN	Normal warmup	Phase alignment
LEAPSEC CALC	Normal warmup	Leapsecond adjustment
OUTPUT VALID	Normal warmup	Outputs valid
STABILIZING	Normal operation	FFOM equal to 1
10MHZ STABLE	Normal operation	FFOM equal to 0
SURV <numeric> PCT	Normal warmup	Survey for position has progressed to stated percent completion.
<numeric> HLD USR	Holdover	Holdover has been manually initiated by the user. Holdover duration is specified <numeric>. Note if <numeric> exceeds 99:59, the label MAX appears.
<numeric> HLD LIM	Holdover	Holdover initiated when time error between internal and external 1PPS signals exceeded limit. Holdover duration is specified <numeric>. Note if <numeric> exceeds 99:59, the label MAX appears.
<numeric> HLD GPS	Holdover	Holdover initiated on loss of GPS satellites. Holdover duration is specified <numeric>. Note if <numeric> exceeds 99:59, the label MAX appears.
<numeric> HOLDOVER	Holdover	Holdover for reasons other than those identified above. Usually on transition out of user-initiated holdover.
HLD RECVR	Recovering from Holdover	Recovering from holdover
FINE F ADJ	Recovering from Holdover	Recovering from holdover, fine frequency adjustment.
PHASE ALIGN	Recovering from Holdover	Recovering from holdover, phase alignment.

Introduction

This chapter will assist you in upgrading your HP 58503A to include the Option 001 Front Panel Display/Keypad. The instructions below are limited to the mechanical and electrical changes to be made. Other note(s) included in the kit will further assist in the upgrade (if necessary) of the firmware to complete the process. Be sure all steps in this note are complete before proceeding to any other instructions. You will be directed when it is appropriate to refer to other documentation.

A copy of the HP 59551A/58503A Getting Started Guide is necessary to perform this upgrade. One copy is included with each HP 58503A shipped. If you do not have a copy, some of the steps will not be clear. Please retrieve your copy at this time. If you cannot locate one, contact your local HP Sales/Service facility to obtain another copy as HP Part Number 59551-90001 (English). If you wish, other language options are available as separate part numbers — your HP facility will assist you in determining the appropriate document.

Retrofitting Option 001 Front-Panel Display and Keypad

Option 001 Display/Keypad Upgrade Installation Kit (58503-67001) Contents

Item	HP Part No.	Qty.
HP 58503A Option 001 Front Panel Assembly	58503-60216	1
HP SatStat Software	59551-13401	1
HP 58503A Firmware Upgrade Disk	58503-13402	1
HP GPS Receivers Firmware Upgrade Procedure	59551-90013	1
HP 58503A Option 001 Supplemental Guide	58503-90008	1

Tools Required

- TORX® T-10 driver
- TORX® T-15 driver
- 1/4-inch flat-blade screwdriver
- 7 mm Nut Driver or Wire Cutter
- PC-compatible computer with Windows 3.1 installed

To Retrofit Option 001

NOTE

This procedure assumes that the HP 58503A is working properly prior to making these changes. Be sure to verify that the unit will correctly power up and lock to GPS satellites before proceeding.

Firmware Revision Identification

- 1 Make a note of the current version of firmware in your HP 58503A. Refer to the Getting Started Guide.
- 2 Keep this information available for the section titled "Downloading Firmware" on page 3-6 of this chapter.

Hardware Installation

- 1 Remove all power and connections to the HP 58503A.
- 2 Position the carrying (plastic) handle so that it is perpendicular with respect to the cover, facing upward.
- 3 Carefully spread the handle at the pivot points, and it will release from its mounting holes.
- 4 The front foot/trim frame is soft rubber, and can now be removed by prying them off with your fingers.
- 5 Loosen two TORX T-15 screws at the right and left edges of the rear panel to remove the rear foot/trim frame assembly.
- 6 Remove the TORX T-15 screw at the bottom rear of the cover and slide cover off toward the rear.

Retrofitting Option 001 Front-Panel Display and Keypad

- 7 Remove the two TORX T-15 screws, one on each side that are recessed in the plastic shell of the front bezel.

They are located between the handle pivot holes and the front of the unit.

- 8 Identify two metal extrusions visible within openings in the plastic, immediately above and below the screw just removed.

There will be two more on the other side of the unit as well. These extrusions hold the front bezel in place by engaging the openings in the plastic.

- 9 Insert a flat-blade screwdriver between the plastic bezel and the underlying chassis, immediately near one of the metal extrusions. Carefully and slightly pry and pull the bezel away so that the extrusion no longer completely engages the bezel.

- 10 Repeat step 9 for the other extrusion on the same side of the unit.

This will allow this side of the bezel to be pulled free of the metal extrusions. The other side of the bezel will fall free without using the screwdriver.

- 11 Disconnect the ribbon cable that connects the front panel to the Main Board.

- 12 Using the 7 mm nut driver, remove this ground wire (if present) connecting the existing front panel board to the chassis by disconnecting it from the mounting stud near the power supply, or if preferred, clip the wire very close to the mounting stud. This wire is no longer required.

CAUTION

There is more than one ground wire attached to this stud. Only remove/clip the wire that leads to the front panel.

- 13 Reverse the steps above to connect and install the Option 001 front panel assembly, cover, rear bezel, trim, and handle.

NOTE

Be sure to firmly seat the ribbon cable so that it snaps into the locking ears.

Downloading Firmware

It may now be necessary to upgrade the firmware in the HP 58503A to be compatible with the display/keypad.

Note that a firmware upgrade may add new capabilities, some unrelated to the front-panel display. Firmware upgrade also clears instrument non-volatile memory; if necessary, non-volatile settings should be recorded prior to sending the instrument for retrofit. Calibration settings (temperature coefficients) are not cleared by the firmware upgrade.

The firmware download procedure in this section is written so that any operator with access to a PC-compatible computer loaded with Windows® 3.1/Windows® 95 can update the firmware.

This process will require about 45 minutes to complete, and it will be necessary to take the HP 58503A off line for that period.

- 1 Locate the *HP 58503A Firmware Upgrade Disk* (HP Part Number 58503-13402) that is included in this kit.
- 2 Compare this revision to the firmware in your HP 58503A. If the revision on the disk is a higher number (newer version) proceed to step 3 below. Otherwise, it is not necessary to upgrade the firmware for your HP 58503A.

NOTE

A copy of HP SatStat software has been included with this kit (HP P/N 59551-13401) as a courtesy to facilitate the download process.

- 3 Connect the power to the HP 58503A.

NOTE

The following section assumes that HP SatStat software is installed on a PC with MS Windows®. If not, refer to the Getting Started Guide that was shipped with the HP 58503A for instructions on its installation.

HP SatStat is a Windows-based program that simplifies connection, control, query, and adjustment of the HP 58503A. A copy of this software is shipped with each HP 58503A on a 3.5-inch high-density floppy diskette. If you do not have a copy, one can be obtained from any HP Sales office by requesting HP Part Number 59551-13401.

Downloading Firmware

NOTE

It is highly recommended that no other programs are active in the background while performing the download. This is especially true for any communications software. The download process is very buffer-intensive and most errors encountered are due to process interruptions from other programs of the operator.

- 4 Double-click on the HP SatStat icon to start the program.
- 5 Select **Function** from the menu bar.
- 6 Choose the **Disable Updates** menu item so that a check mark appears.
- 7 Select **CommPort** from the menu bar.
- 8 Choose **Port Open** menu item to automatically initiate communication between the HP 58503A and PC.

NOTE

If necessary, use the **Settings** menu item under **CommPort** to match your PC and HP 58503A serial port parameters. Information for this procedure is also outlined in the Getting Started Guide.

- 9 Wait until a connection is established.
This will be indicated by a **Connected to Hpxxxx** message in the Title Bar.

NOTE

The **idle** on the screen indicates that no updates are being sent. This is normal.

- 10 Select Clear Cmd indicator at the screen bottom, just below the SatStat main window. This will open the **Control & Query** window.
- 11 Select **Service** in the menu bar.
- 12 Select the **Download Firmware** menu item.
- 13 Insert the supplied disk with the firmware file **XXXXXXXX.S**, or ensure that this file is already copied onto your PC hard disk in a known directory.

Downloading Firmware

- 14 Enter the path and filename in the edit box **File to Download ...** as shown in the examples below:

a:\XXXXXXXX.S,

or

c:\<path>\XXXXXXXX.S

NOTE

If necessary, select the **Files ...** button to search for the directory and filename.

- 15 When the path and filename are entered, select **Download**.

The **Erase Warning** window will appear, making sure you really want to change firmware.

CAUTION

During the following process, do not switch to another program or launch any other programs. The download is buffer-intensive, and although it will retry when interruptions occur, the process will be significantly slowed. In some extreme cases, the process can even abort.

- 16 Select the **Yes** button.

As the download progresses, **Lines Sent** and **Lines Retried** will give an indication of activity.

- 17 Wait 25 to 30 minutes until the word **Done** appears in the **Lines Sent** field.

This time will vary, depending on the speed of your PC's processor and baud rate selected.

- 18 Select the **Close** button in the **Firmware Download** window.

- 19 Remove any floppy disk with the firmware file and store it in a safe location.

- 20 Select the **Cmd: Edit** field and type the following command:

SYST:LANG "PRIMARY"

- 21 Select the **Send Cmd** button.

NOTE

Alternatively, you can simply remove power from the HP 58503A and re-connect. This will also initiate the internal Primary language.

NOTE

The **Alarm** indicator will be illuminated on the front panel. This is normal because the firmware has changed. It will disappear if power is removed or a command is sent to turn off the alarm.

- 22 Select **Query** from the menu bar.

- 23 Choose the **Product ID** menu item.

- 24 Select the **Send Cmd** button.

- 25 Verify that the serial number matches your product.

The firmware revision code should now be the same as that on the supplied floppy disk.

- 26 Refer to the Getting Started Guide to re-connect (or set up for the first time) your GPS antenna, cable, and other accessories.

Instructions contained in the guide will assist to determine when your HP 58503A has completed its lock process and is operating normally.

In Case of Trouble

The download process has built-in checking to ensure that all information is properly written to the Flash ROMs. However, there are situations (such as power failures) where the process can abort before completion. However, even without the firmware downloaded, there is still a “kernel” that remains untouched that ensures serial communication.

If a download had been aborted, simply repeat the download procedure from step 1.

The most common symptom can be seen using the *IDN? Query. If the firmware revision is not the same as the version you have attempted to download and also different from the original code, it is usually a revision name assigned to the “kernel” code. One example could be “PERU” instead of a four-digit date code.

Two messages below are typical of those encountered after an aborted download.

No Flash ROM

This may appear when attempting to establish communications with the product after a download problem.

Consecutive errors ...

This message appears if attempting to issue a Control or Query command, or when attempting to view the status screen.

NOTE

If a download has been aborted, simply repeat the download procedure from step 1.

Final Checkout

This is a simple procedure to ensure that the HP 58503A/Option 001 upgrade has been successfully performed.

NOTE

You will have about two seconds after applying power to perform step 2 below. If necessary, you can remove and re-connect power to re-initiate the startup sequence described in step 2 below.

- 1 Apply power to the HP 58503A.
- 2 While the letters "HP" are moving from right to left (about two seconds), press **SAT** key and then **Time** key to enter the Test/Demo mode.
The words **VFD DSP TEST** will momentarily appear on the display.
- 3 The display should then show a test pattern that sequentially illuminates all 15 segments of all digits and punctuation marks in the display.
- 4 When the segment illumination sequence is complete, the words **DEMO MODE** should then appear on the display.
- 5 Press each key one at a time.

Each keypress should:

- a. illuminate the LED corresponding to that key, and
- b. display a simulated response to the function.

NOTE

1. The "CLEAR ALARM" ("SHIFT", "ALT") function will not give a response in this mode, it will exit the test.
 2. The values displayed are not related to the HP 58503A under test. They are displayed for demonstration only.
-
- 6 To exit the diagnostic, press **Shift** key and then press **ALT** key.
The HP 58503A power-up sequence should then continue. No further tests are necessary.
 - 7 If the indications above do not appear, be sure to verify the following before contacting HP:

Further Assistance

- a. Did the firmware download properly (refer to the download procedure on page 3-6).
- b. Re-check the correct connection to antenna, power, and PC as described in the Getting Started Guide.
- c. If necessary, remove the cover and verify that the ribbon cable connection is correct and secure.

Further Assistance

Contact your local HP Sales or Service facility for assistance if the above steps do not resolve the problem. It may be necessary to ship the entire HP 58503A to an HP service center to verify the source of problem.

Index

A

alarm clearing, 2-5
Alarm LED, 1-2
altitude display, 2-4
antenna, operation without, 2-5, 2-6

B

BAUD-rate setting, 2-4, 2-6

C

clearing alarm, 2-5
compatibility, 2-3

D

demo mode, 2-5
downloading new firmware, 3-6

E

error messages, 2-7

F

firmware upgrade, 3-6

G

GPS Lock LED, 1-2

H

hardware installation, 3-3
help from HP, 3-3, 3-12
Holdover LED, 1-2

I

indicators
 Alarm, 1-2
 GPS Lock, 1-2
 Holdover, 1-2
 Power, 1-2
installation, 3-1
installation, final checkout, 3-11
installation of firmware, 3-6
installation of hardware, 3-3
installation tools, 3-4
installation, troubleshooting, 3-10
instrument state, 2-10

L

latitude display, 2-4
LED
 Alarm, 1-2
 GPS Lock, 1-2

 Holdover, 1-2
 Power, 1-2
longitude display, 2-4

P

Power LED, 1-2
power-up after installation, 3-11
power-up messages, 2-10
preface, vii

R

retrofit kit, 3-3

S

status display, 2-4
status messages, 2-10
status reference documentation, 2-7

T

test mode, 2-5
time display, 2-4
tools for installation, 3-4
troubleshooting installation, 3-10

