GEOL-2600

Users Manual

About this User Guide

This prefix explains how to use this User Guide and includes the following topics:

Purpose and scope

This manual is intended to help you use the capabilities of the PNT-62xx Assured Position, Navigation, and Timing Reference.

This manual includes task-based instructions that describe how to configure, use, and troubleshoot the test capabilities available on your instrument assuming it is configured and optioned to support the capabilities.

Assumptions

This manual is intended for novice, intermediate, and experienced users who want to use their instrument effectively and efficiently. We are assuming that you have basic computer experience and are familiar with basic telecommunication concepts, terminology, and safety.

Related Information

This manual is application-oriented and contains information about using these instruments to test service carried on each of the listed networks. It includes an overview of testing features, instructions for using the instruments to generate and transmit traffic over a circuit, and detailed test result descriptions. This manual also provides contact information for VIAVI's Technical Assistance Center (TAC).

Conventions

This manual uses conventions and symbols, as described in the following tables.

Table 1 Text formatting and other typographical conventions

Item(s)	**Example(s)**
Buttons, keys, or switches that you press or flip on a physical device.	Press the **On** button. – Press the **Enter** key. – Flip the **Power** switch to the on position.
Buttons, links, menus, menu options, tabs, or fields on a PC-based or Web-based user interface that you click, select, or type information into.	Click **Start** – Click **File > Properties**. – Click the **Properties** tab. – Type the name of the probe in the **Probe Name** field.
Directory names, file names, and code and output messages that appear in a command line interface or in some graphical user interfaces (GUIs).	`$NANGT_DATA_DIR/results` (directory) – `test_products/users/defaultUser.xml` (file name) – `All results okay.` (output message)

Table 1 Text formatting and other typographical conventions (Continued)

Item(s)	Example(s)
Text you must type exactly as shown into a command line interface, text file, or a GUI text field.	– Restart the applications on the server using the following command: **`$BASEDIR/startup/npiu_init restart`** Type: **`a:\set.exe`** in the dialog box.
References to guides, books, and other publications appear in *this typeface*.	Refer to *Newton's Telecom Dictionary.*
Command line option separators.	`platform [a|b|e]`
Optional arguments (text variables in code).	`login [platform name]`
Required arguments (text variables in code).	<password>

Table 2 Symbol conventions

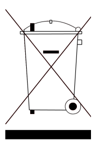
	This symbol indicates a note that includes important supplemental information or tips related to the main text.
	This symbol represents a general hazard. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents an alert. It indicates that there is an action that must be performed in order to protect equipment and data or to avoid software damage and service interruption.
	This symbol represents hazardous voltages. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents a risk of explosion. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message. See Table 3 for more information.
	This symbol represents a risk of a hot surface. It may be associated with either a DANGER, WARNING, CAUTION, or ALERT message. See Table 3 for more information.
	This symbol represents a risk associated with fiber optic lasers. It may be associated with either a DANGER, WARNING, CAUTION or ALERT message. See Table 3 for more information.
	This symbol, located on the equipment, battery, or the packaging indicates that the equipment or battery must not be disposed of in a land-fill site or as municipal waste, and should be disposed of according to your national regulations.

Table 3 Safety definitions

Term	Definition
DANGER	Indicates a potentially hazardous situation that, if not avoided, *will* result in death or serious injury. It may be associated with either a general hazard, high voltage, or other symbol. See Table 2 for more information.
WARNING	Indicates a potentially hazardous situation that, if not avoided, *could* result in death or serious injury. It may be associated with either a general hazard, high voltage, or other symbol. See Table 2 for more information.
CAUTION	Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury and/or damage to equipment. It may be associated with either a general hazard, high voltage, or risk of explosion symbol. See Table 2 for more information. When applied to software actions, indicates a situation that, if not avoided, could result in loss of data or a disruption of software operation.
ALERT	Indicates that there is an action that must be performed in order to protect equipment and data or to avoid software damage and service interruption.

Safety and compliance information

The following sections describe the safety and compliance information for the PNT-62xx.

California Proposition 65

California Proposition 65, officially known as the Safe Drinking Water and Toxic Enforcement Act of 1986, was enacted in November 1986 with the aim of protecting individuals in the state of California and the state's drinking water and environment from excessive exposure to chemicals known to the state to cause cancer, birth defects or other reproductive harm.

For the VIAVI position statement on the use of Proposition 65 chemicals in VIAVI products, see the Hazardous Substance Control section of the VIAVI Policies & Standards web page.

Federal Communications Commission (FCC)

The equipment was tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case you will be required to correct the interference at your own expense.

The authority to operate this equipment is conditioned by the requirements that no modifications be made to the equipment unless the changes or modifications are expressly approved by VIAVI.

Bands of Operation

The equipment operates on the following bands.

Table 4 Bands of operation

Receiver	Frequency Range
ASTS	1545 MHz - 1547 MHz

Product Environmental Compliance

VIAVI is committed to compliance with all applicable laws and regulations controlling the use of hazardous substances in its products, as well as the disposal of equipment (including batteries) and waste packaging. For details, see the VIAVI Policies & Standards web page or contact the VIAVI WEEE Program Management team at Global.WEEE@ViaviSolutions.com.

EU REACH

Article 33 of EU REACH regulation (EC) No 1907/2006 requires product suppliers to provide information when a substance included in the list of Substances of Very High Concern (SVHC) is present in an product above a certain threshold.

For information about the presence of REACH SVHC in VIAVI products, see the Hazardous Substance Control section of the VIAVI Policies & Standards web page.

Additional standards compliance

The equipment meets the following standards and requirements:

- Installation Category (Over Voltage Category) II under IEC 60664-1

- Pollution Degree 2 Category under IEC 62368-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

Technical assistance

If you require technical assistance, call 1-844-GO-VIAVI. For the latest TAC information, go to https://support.viavisolutions.com.

Table of Contents

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Introduction

This chapter discusses the following topics:

About the GEOL-2600

The GEOL-2600 is a precision satellite signal timing receiver that processes RF signals from GNSS satellites to generate highly accurate 1PPS (one pulse per second) and 10MHz timing signals. It uses a combination of VIAVI hardware/software and an embedded library to acquire, downconvert, and demodulate satellite signals, calculate timing corrections, and discipline its internal clock and 1PPS output relative to a reference GNSS time. The system can operate as a standalone timing device or be integrated into Positioning, Navigation, and Timing (PNT) solutions. Key performance parameters such as Carrier-to-Noise Ratio (C/N?), clock offset, clock drift, and signal convergence confidence are monitored in real time to ensure precise and reliable timing outputs.

General Safety Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design manufacture, and intended use of the instrument. VIAVI. assumes no liability for the customer’s failure to comply with these requirements.

Antenna lightning protector

WARNING

Always use a UL approved L-Band lightning protector Pasternack PE73SP1016 (VIAVI part number 22187702) or equivalent on the coaxial antenna feeds to prevent damage, injury, and/or death in the case of lightning strike.

Grounding

To avoid damaging the sensitive electronic components in the GEOL-2600 always make sure to discharge any built-up electrostatic charge to a good ground source, such as power supply ground. This should be done before handling the circuit board or anything connected to it, i.e. the L-band antennae.

Power Connections

Make sure to connect the DC power to the device following the polarity indicated in Section 2.2. Do not reverse the power pins as this will cause serious damage to the circuit board.

Environmental Conditions

This instrument is intended for indoor use. It is designed to operate at a maximum relative non-condensing humidity of 95% and at altitudes of up to 50,000 meters. Refer to the specifications tables for the DC voltage requirements and ambient operating temperature range, as well as the requirements for the optional external AC Wall Wart power supply.

Bands of Operation

Table 1 lists the bands of operation.

Table 1 Bands of operation

Receiver	Frequency Range
GEOL	1545 MHz - 1547 MHz

2

Quick-Start Instructions

The following topics are discussed in this chapter:

Overview

The following sections describe how to install the GEOL-2600.

Pre-installation

Ensure the following materials and resources are present before proceeding:

Delivered with module (refer to packing list):

- GEOL-2600 Receiver Module
- SMA to U.FL adapter cable

Optional accessories:

- Multi-connector power/comm harness (includes AC/DC adapter)
- ASTS L-Band Helical antenna
- 4-meter SMA antenna cable
- Micro-USB serial communication cable
- USB-to-TTL serial communication cable

Provided separately (by user):

- Windows PC (required to support firmware upgrades and monitoring/control)
- Frequency/time measurement equipment as required for evaluation
- RS232-to-TTL or USB-to-TTL serial adapter (if communicating to module UART from a PC)
- 50-ohm BNC interface cables for time/frequency signals (if measuring time/ frequency outputs, or supplying time/frequency reference inputs)

Powering the Unit

The following procedure describes how to power the unit.

To power the unit

1 Connect a 3.3V compatible antenna to U.FL (UMCC) connector J4.

> **NOTE**
> The antenna should have at least 25dB gain. The antenna can also be a combination-antenna that supplies GNSS signals and GEOL signals at the same time to the on-board GNSS receiver on the GEOL-2600 module. VIAVI recommends the ASTS L-Band Helical Antenna. The GEOL-2600 board will supply 3.3V power to the antenna.

2 Connect +3.3V (+/-0.15V) DC Power to J3 pins 2 and 4 on the unit, and ground to pin 1 and pin 5 of J3.

> **NOTE**
>
> The Samtec connector J3 indicator-notch indicates pin 20, not pin 1 by Samtec default. Pins 1 and 2 are marked in Silkscreen for reference on the bottom side of the PCB right next to connector J3.

The unit will consume up to 1.6W of power, or the equivalent of up to 510mA when operated at 3.15V.

3 Alternatively the unit can also be controlled and powered by connecting the Micro-USB serial port to a PC.

> **NOTE**
>
> Overall power consumption and heat generation is slightly higher when powering the unit only through the Micro-USB connector.

The unit will now lock to the GEOL signals (the Green LED D5 will blink every time an GEOL packet has been received and has been successfully processed). Combo bi-color LED D23 will indicate proper lock and no events pending when the Green LED lights up, and will blink Red whenever the board is generating a UTC(GEOL or GNSS as selected by the user with GEOL set as default) 1PPS output pulse. Once the green LED D23 is on, the unit will output 10MHz with significantly better than 1ppb frequency accuracy. Green LED D21 is connected to the 1PPS raw output of the on-board GNSS receiver and indicates whenever the GNSS receiver has achieved a 3D Fix.

Green LED D18 indicates when the unit is tracking an externally-supplied 10MHz signal by pulling J3 Pin 8 to ground. This is usually connected to, and driven by the BIST (BITE) output of an externally-connected CSAC oscillator and indicates when this CSAC oscillator has achieved atomic lock. Until atomic lock is achieved the internal TCXO will be controlled by the modules’ EFC DAC and loop software.

When tracking GEOL, it can take several minutes or in worst-case conditions tens of minutes to achieve a first 1PPS UTC output pulse as indicated by Red LED D23 - this is normal.

NOTE

If the reference oscillator frequency is unstable or reference CSAC oscillator is not locked yet, any large frequency jump may confuse the GEOL Kalman Filter and result in longer time to achieve first 1PPS UTC(GEOL) fix.

To avoid confusing the GEOL Kalman Filter, the J3 Pin 8 should not be pulled low until reference frequency is stable or delayed GEOL Kalman Filter processing can be configured with RECEiver:GEOL:KFPROCessing <ON|OFF|DELAYed> command.

NOTE

The GPS receiver establishes the internal antenna gain immediately after power-on. For proper operation the GPS antenna should always be connected prior to turning on the modules' power. Alternatively the internal GNSS receiver can be manually forced into reset and therefore to re-measure the antenna gain after the antenna has been connected with the RECEiver:GNSS:RESET <ONCE|HOLD|OFF> command.

Connect a terminal program (the latest version of TeraTerm is recommended as older versions of TeraTerm do not support baud rates higher than 115.2K) to the unit via the SCPI TTL serial connector pins 16 and 18 on connector J3, or to the Micro-USB serial port - both with 8 bit, 1 stop bit, no parity, and no flow-control. The default baud rate for USB serial port is 921,600, and the default baud rate for the SCPI TTL serial port is 115,200.

The unit can also be controlled, monitored, and performance-plotted via the free application program GPSCon available from the following website:

https://www.viavisolutions.com/en-us/software-download/gpscon-controller-software

The latest version of GPSCon now supports up to 921,600 baud. For more information about GPSCon and how to use it, please refer to Chapter 5.

WARNING

Do not connect RS-232 serial levels to connector J3. Doing so will damage the unit from RS-232 serial levels on connector J3, as the default configuration is TTL/LVCMOS levels only.

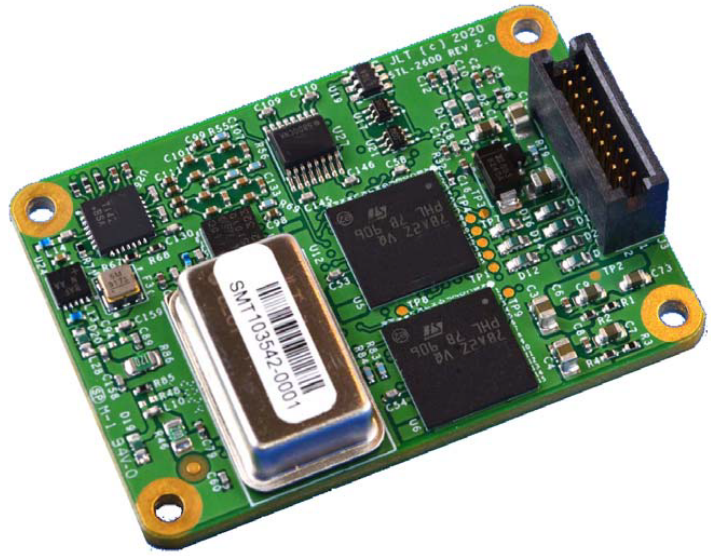
Both the TTL serial port J3 and the Micro-USB port operate orthogonally, so the user may send and receive commands to/from both ports at the same time. Try some of these SCPI commands:

- `HELP?`
- `SYSTem:STATus?`
- `RECEiver?`
- `SYNChronization?`
- `DIAG?`

PCB photos

The GEOL-2600 PCB is shown in Figure.

Figure 1 GEOL-2600 PCB



Mechanical drawings

The following drawings and table show the mechanical dimensions and the pinout of the GEOL-2600 PCB.

Figure 2 GEOL-2600 mechanical dimension top view

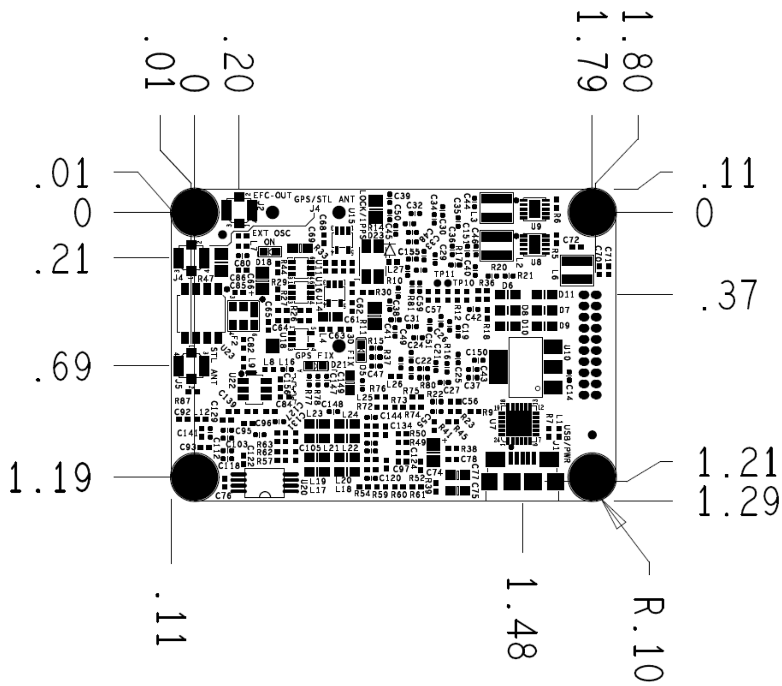


Figure 3 GEOL-2600 perspective mechanical drawings

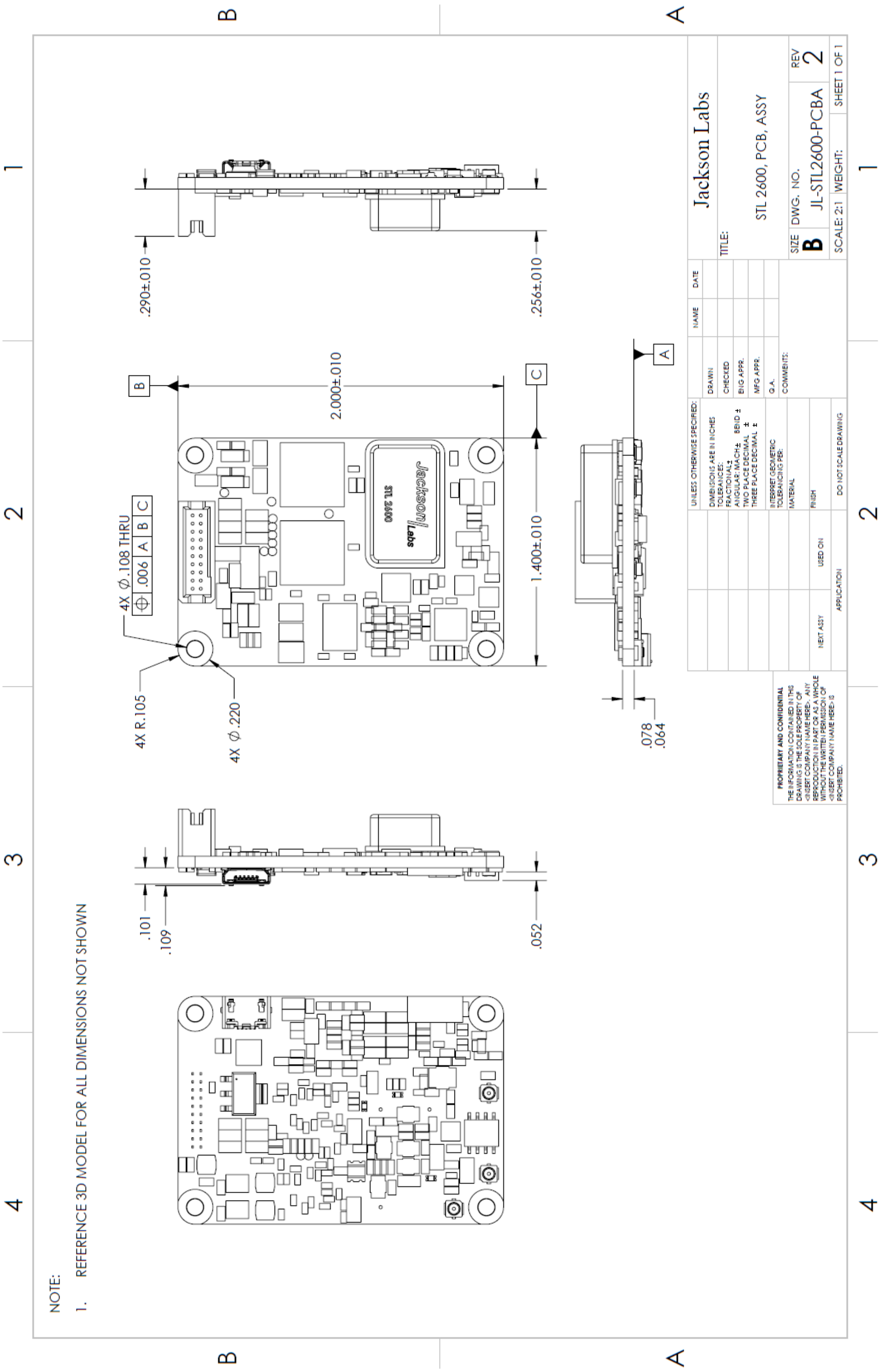


Table shows the GEOL-2600 revision 2.0 hardware pin descriptions.

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J3 Pin 1	Ground	Ground	Ground	Prime Power and 10MHz output Ground Return. All ground pins on connector J3 are connected together on the PCB, and can be used interchangeably
J3 Pin 2	3.3V Power In	+3.3V Prime Power Input A	3.3V +/- 0.15V, <0.55A	3.3V Prime Power Input, used to power the module if USB power is not available. Using the 3.3V Prime Power input will result in the overall lowest power consumption compared to USB power. **Note –** This pin will carry 3.15V on it if the unit is powered by the USB connector and will back-feed power into the user's PCB if the user-applied voltage is < 3.2V on the prime-power pins 2 and 4 of connector J3.
J3 Pin 3	10MHz OUT	10MHz LVCMOS output from internal TCXO	3.3V LVCMOS, <1ns Rise/Fall time typically, Internally buffered and series-terminated to 50 Ohms	10MHz LVCMOS output from internal TCXO with low phase-noise and jitter. Disciplined to UTC(GEOL/GNSS). While this signal can drive 50 ohms coax cables, do not end-terminate this signal with less than 1K Ohms

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J3 Pin 4	3.3V Power In	+3.3V Prime Power Input B	3.3V +/- 0.15V, <0.55A	3.3V Prime Power Input, used to power the module if USB power is not available. Using the 3.3V Prime Power input will result in the overall lowest power consumption compared to USB power. Pins 2 and 4 are internally connected to each other. Note – This pin will carry 3.15V on it if the unit is powered by the USB connector and will back-feed power into the users' PCB if the user-applied voltage is <3.2 on the prime-power pins 2 and 4 of connector J4.
J3 Pin 5	Ground	Ground	Ground	Prime Power and 10MHz output Return
J3 Pin 6	10MHz Input	Optional 10MHz LVCMOS Reference Input	10MHz input, 3.3V LVCMOS input with 5V compatibility <10ns rise/ fall time recommended. 0V to 5.0V min/max. 10MHz +/-5Hz lock-range	Used to connect an external CMOS 10MHz input signal from an oscillator that should be more stable and accurate than the internal 10MHz TCXO. The internal TCXO is phase-locked to this reference signal when Pin 8 (CSAC-LOCK#) is pulled to Ground. The module can discipline the external 10MHz oscillator either through serial commands on pins 12 and 14 of J3, or through an analog steering voltage on connector J2 to assure the externally-supplied 10MHz reference is accurate, stable, and UTC-disciplined

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J3 Pin 7	1PPS OUT	1PPS UTC(GEOL/ GNSS) Output	3.3V LVCMOS. <5mA	UTC-aligned 1PPS output generated by internal 10MHz oscillator signal, and aligned to UTC via either GEOL or GNSS received signals. This is the main 1PPS UTC output signal of the unit. This signal is generated during holdover by either the internal or the optional external 10MHz reference. This signal is also connected to the Red LED D23, and will not become active until a user-adjustable PFOM threshold is reached in GEOL reception mode.
J3 Pin 8	8 CSAC LOCK#	CSAC LOCK#	0V to 3.3V. Pulled internally to +3.3V via 4.7K resistor	A 0V signal on this pin enables the external 10MHz reference input to the module, and switches the internal TCXO to phase-lock to the external 10MHz reference signal rather than follow the internal DAC control voltage. The user must ensure that a stable and accurate 10MHz signal is applied to pin 6 of connector J3 prior to or simultaneously to pulling this pin low. This pin can be connected to Ground, be driven by a GPIO pin on the customers' PCB, or optimally be connected to the BITE/BIST output signal of externally connected CSAC or Rubidium oscillators. The latter case will allow the module to work from the internal 10MHz TCXO signal as long as the external CSAC/Rubidium has not achieved atomic lock or if the oscillator indicates a fault, and will automatically switch-over when the external CSAC achieves atomic lock as indicated by its BITE/BIST output signal. Leave floating or pull to 3.3V when no external 10MHz reference is to be used.

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J3 Pin 9	1PPS IN	Optional external 1PPS Input	3.3V LVCMOS, pulled to Ground via internal 4.7K resistor. Rising-edge aligned. <10ns rise-time recommended	Optional external 1PPS reference input. Internal oscillator can be locked to this reference input via SCPI-controlled disciplining algorithm
J3 Pin 10	GPS 1PPS OUT	Raw 1PPS Output from internal GNSS receiver	+3.3V LVCMOS, Rising-edge UTC(GNSS) aligned, <5mA	This UTC(GNSS) 1PPS output is directly connected to the internal uBlox GNSS receiver 1PPS output and Green LED D21. It is a rising-edge UTC(GNSS) aligned 3.3V signal that is gated by the GNSS receiver and indicates the GNSS receiver has achieved a 3D Fix
J3 Pin 11	LOCK_OK and NO_EVENT#	LOCK OK and EVENT#	0V or 3.3V CMOS	3.3V: Unit Locked to either GEOL, GPS, or external 1PPS reference input (selected via SCPI command) and no events are pending 0V: Event is pending (events can be queried via the SYNC:HEAlth? command) or units' phase/ frequency is out of bounds. Connected to Green LED D23 in parallel
J3 Pin 12	CSAC TX	TX Serial Input FROM optional external CSAC	0V to 3.3V TTL serial signal. Internally pulled to 3.3V via 4.7K resistor. Do not drive with 5V CMOS levels.	This is connected to the serial output from an externally connected CSAC or Rubidium oscillator. It is connected to the module processor's serial RX input
J3 Pin 13	ENTER_ISP	Enable ISP Mode	Pull to 3.3V during Reset to enter In System Programming (ISP) mode. Internally pulled to Ground via 4.7K resistor	Pull this signal to 3.3V during Reset or Power-On to enable the internal MCU to enter ISP mode manually for in-situ firmware upgrade programming.
J3 Pin 14	CSAC RX	Serial output to optional external CSAC RX pin	3.3V LVCMOS, <5ns rise-time	Connect this output signal to TTL level RX serial inputs on optional externally-connected CSAC or Rubidium oscillators. This signal is a driven output from the internal MCU and can drive <5mA

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J3 Pin 15	RESET#	External RESET# input	Pull to ground to Reset the module. Internally pulled to 3.3V via 100K resistor	Pull this pin to Ground via an open-collector output or a switch to reset the MCU on the module. Can also be used to force the module into ISP mode by pulling pin 13 of J3 to 3.3V while this reset pin is cycled to Ground. Leave open if not used.
J3 Pin 16	SCPI TX	SCPI TTL Serial OUTPUT	3.3V LVCMOS Output	Main SCPI TX control output from the MCU. Can also generate NMEA messages on this pin
J3 Pin 17	Ground	Ground	Ground	Ground
J3 Pin 18	SCPI RX	SCPI TTL Serial INPUT	0V to 3.3V max LVCMOS input. Do not drive with 5V levels.	Main SCPI RX serial input to the module. Accepts SCPI control commands
J3 Pin 19	Ground	Ground	Ground	Ground
J3 Pin 20	Ground	Ground	Ground	Ground

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J1	Micro-USB	Micro-USB power and serial port	3.6V to 5.5V Micro-USB Power and Control	The Micro-USB port allows power, SCPI serial control, and NMEA output from the module. Default baud-rate is 921,600 baud, 8N1. The modules' power consumption when using only USB connector J1 to power the board is slightly higher then when also applying 3.3V as the unit has an internal 5V to 3.15V LDO regulator that generates additional heat in this mode. This heat is not generated and the unit will not draw any current from the USB port if the board is also powered from an external 3.3V Prime Power on connector J3. The Micro-USB connector is diode-ored to prevent back-feeding of power into the Micro-USB cable. **Note –** The unit provides 3.15V to the prime power pins whenever USB power is applied and the user-supplied voltage on the prime power pins is <3.2V. Therefore, if the unit is powered through USB and plugged-into a users' PCB, that PCB will receive 3.15V power from pins 2 and 4 of connector J3. The module is not designed to power external circuitry when powered from the USB port, and care should be taken to avoid operating the unit with external circuitry connected to the 3.3V Prime Power pins when external power is not supplied to the Prime Power pins.

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J2	EFC OUT	EFC output voltage to OCXO	0V to 3.0V Frequency Steering output to external OCXO/TCXO. The input impedance of the external OCXO is recommended to be >40K. U.Fl (UMCC) connector type.	This pin supplies the EFC steering voltage to an externally-connected analog oscillator. It is driven by the modules' DAC output from a high-stability 3.0V reference. This output voltage controls the optional externally-connected analog oscillator frequency to steer the external OCXO onto UTC via the JLT software disciplining loops. Leave open if not used.
J4	GEOL/ GNSS Antenna IN	Combined GNSS and GEOL antenna input (default factory configuration) or GNSS-only antenna (custom factory option)	L1 RF input with 3.3 V antenna supply. Supplies up to 60mA at 2.7V to an external GEOL/GNSS antenna such as Tallysman PN: 2643A or 2600A or HC610. This is the default-configuration antenna input for both GEOL and GNSS signals. U.Fl (UMCC) connector type. GNSS-only antenna input as a factory configuration option.	L1 1574MHz to 1626MHz input. Antennae with >25dB RF gain and less than 1.5dB NF are recommended. This combined GEOL/GNSS antenna input is the factory-default setup, and the RF signal is internally split-up, amplified, and SAW-filtered for the two different L1 receivers on the module (GEOL and GNSS). This is the GNSS-only antenna input for boards configured in the default dual-antenna connector input mode at the factory.

Table 2 GEOL-2600 revision 2.0 hardware connectors

Ref	Name	Function	Specification	Description
J5	Optional GEOL-Only Antenna IN	Optional GEOL-Only antenna input connector. Requires custom factory-configured option.	L1 RF input with 3.3V antenna supply. Supplies up to 45mA at 2.7V to an external GEOL antenna. REMAINS UNUSED on factory-configured boards.	This is the optional external GEOL antenna input from the recommneded Tallysman PN: 2643A antenna if the unit is factory-configured to accept separate GNSS and GEOL antennae feeds for diversity-antenna function. 1620MHz to 1626MHz input. **REMAINS UNUSED ON BOARDS DELIVERED IN STANDARD FACTORY CONFIGURATION.** Antennae with >25dB RF gain and less than 1.5dB recommended. When the board is configured for dual GEOL/GNSS input on connector J4 (factory default) this connector is internally disconnected from the receivers, but is still useful to optionally ouput 3.3V power to an external antenna amplifier etc.

Prime connector J3

The 20-pin main connector J3 is a Samtec connector Part Number: TFM-110-11-H-D with a height of 0.29 inches above the PCB. See Figure 2.3 for more details.

The following parts are recommended to mount the module onto a users' PCB:

- 8pcs M2 Steel Washer, Flat, Digikey PN: H766-ND
- 4pcs Hex Nut, 0.157" M2, Digikey PN: H761-ND
- 4pcs8mm Hex Stand-Off, M2, Mouser PN: 710-971080244
- 4pcs M2 screw 5mm, Digikey PN: H738-ND
- Mating Female connector: Samtec SFM-110-02 series

A screw-retaining compound such as those typically manufactured by Loctite is recommended to secure the screws and nuts in place.

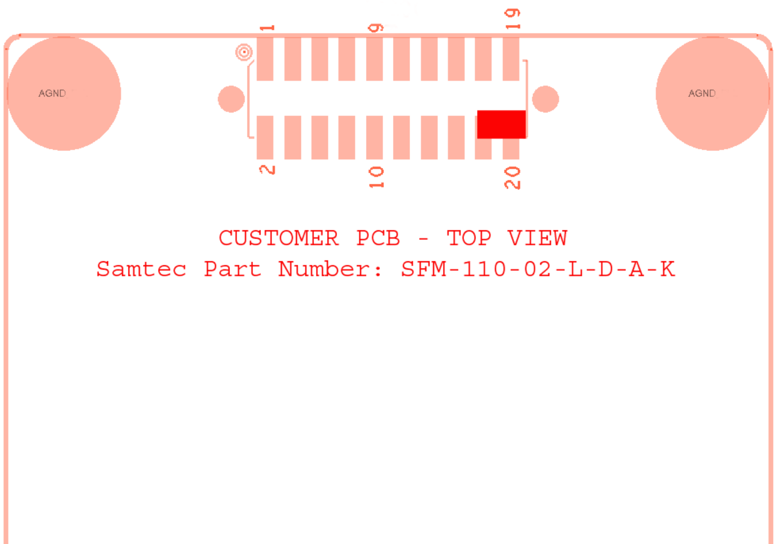
A suitable mating connector is Samtec Part Number: SFM-110-02-L-D-A-K.

> **NOTE**
>
> Tje same SAMTEC connector TFM and SFM series have a mechanical key indicator at Pin Location 20 and not PIN-1. This is non-standard and can lead to assembly of the connector onto a customer's PCB int he wrong direction.
>
> Pin 1, 2, and 19,20 are clearly marked in Figure which depicts how a customer PCB should be laid out when using the SFM-110-02 SMT type mating female connector (top view.)

Figure shows a customer PCB layout with SFM-110-02 connector.

> **NOTE**
>
> The large red square indicates the location of the keying notch in the SAMTEC connectors.

Figure 4 Customer PCB Mating (Female) Connector Layout. TOP VIEW



Notes on signal interfacing

The optional LOCK_OK signal on J3 pin 11 is a 3.3V LVCMOS output, and thus require a series resistor of typically 390 to 470 Ohms when used to drive an external LED.

The serial port RX and TX lines cannot be directly connected to a typical RS-232 level DB-9 connector as these are driven with TTL signal levels and doing so would damage the board. Connecting these pins to an RS-232 serial interface may seriously damage the board.

The SCPI and NMEA outputs can be sent to either the SCPI TTL or the USB serial ports, as both ports operate orthogonally to each other. The CSAC TX and RX lines are designed to directly connect to the CSAC RX and TX signals on the optional external CSAC or Rubidium oscillators. Drivers are available for optional Microchip, Teledyne, and Spectratime atomic clocks.

Connect an active or passive L1 ASTS L-Band Helical Antenna that is compatible to 2.5V to 3.3V antenna power to connector J4. Connect this antenna prior to turning-on the power to the board. Use a properly installed lightning arrestor on the antenna feed for safety and to prevent damage, injury, or death in case of a lightning strike.

For units that are optionally factory-modified to separate the L-Band and GNSS antennae to two separate antennae connectors: use J4 for the GNSS antenna and J5 for the L-band antenna. Use only active L-band antennae with at least 25dB antenna gain and 1.5dB NF or less.

Coaxial connectors

The RF antenna connectors and the EFC Analog OCXO steering output connector are U.FL (UMCC) types. Suitable coax U.FL to SMA connector adaptor cables are readily available from sources such as Digikey or Mouser etc. Taoglass cable PN: CAB.011 works well for example.

Power

Power can be provided by an external 3.3V DC power supply, the Micro-USB connector, or both at the same time. The unit is typically powered from a +3.3VDC source Prime Power with +/-0.15V allowable range. The current is typically less than 0.55A at 3.3V. Connect a clean +3.3V power supply to pin 2 and pin 4 of J3, and ground to any two of the ground pins on J3 as all ground pins are connected together on the PCB. Both USB power and external +3.3V power can be connected at the same time to the unit. Running with +3.3V applied at any time will result in lower power consumption compared to running only with USB 5V power. The current when running just from USB power is also about 0.55A max, hence since the USB voltage is higher the overall power consumption is higher when running from USB power only.

NOTE

The +3.3V power pins on connector J3 are diode-ored with a regulated +3.15V power supply derived from the USB connector 5V input. This means the unit will inject 3.15V into a users' PCB through the two power pins on connector J3 if USB power is applied, and the users' 3.3V power supply is turned-off. As the USB 3.15V power circuit is diode-protected, the USB power supply will be disabled as soon as the user applies greater than +3.2V to the prime power pins of connector J3, and thus no USB power is consumed when the unit is also powered by an external +3.3V power supply on pins 2 and 4 on connector J3. The unit is not designed to supply power from the USB connector to external circuitry through the 33V Prime Power pins, and may overheat if current is drawn this way.

The unit provides 3.3V via 10 Ohms series over-current protection resistors to the antenna connector J4 when running from external 3.3V power, and ~3.15V when running from USB power only.

Connecting GEO-L Antenna

See *GEO-L Antenna Installation Guide* (22188967) for information about connecting the GEO-L antenna.

Remote Serial Control

The unit is controlled via the SCPI TTL serial port at 115,200 baud or USB serial port at 921,600 baud, 8N1. Other Baud Rates can be set via SCPI commands.

Attach the GEOL-2600 unit to your PC's TeraTerm (recommended), or to the optional freeware GPSCon software package that can be downloaded from the support page on the VIAVI website. See Chapter 5 for more information.

Initial Operation

Perform the following procedure to start the GEOL-2600.

To start the GEOL-2600

> **NOTE**
> The antenna must be stationary and fixed at one location for GEOL-2600.

1 Configure the unit to receive the correct satellite signal:

   a Find the location where the GEOL-2600 is installed on the map in Figure 5 and determine the Satellite to be used. Table 3 lists the satellites, including frequency and symbol/bit rates.

Figure 5 Satellites and coverage

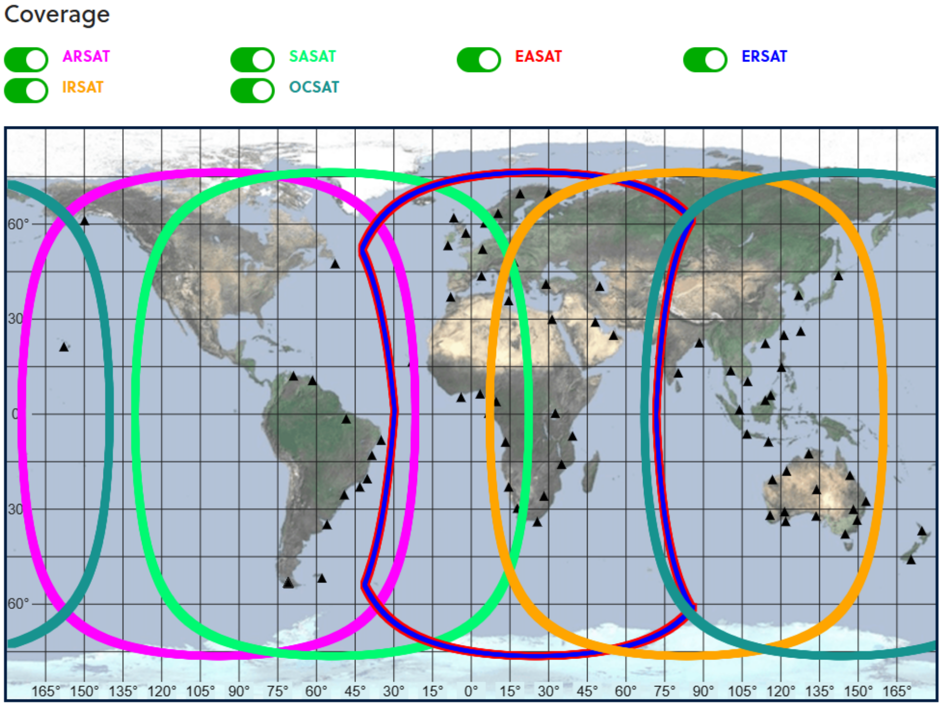


Table 3 Inmarsat satellites

Name (Lng) Link ID#	Carrier Frequency, Hz	Symbol/Bit Rate
ARSAT (98°W) Link ID #13	1545245000	4876 Hz 2400 bps
EASAT (25°E) Link ID #6	1546230000	2438 Hz 1200 bps
ERSAT (25°E) Link ID #20	1545950000	4876 Hz 2400 bps
IRSAT (83.5°E) Link ID #7	1546240000	2438 Hz 1200 bps
OCSAT (143.5°E) Link ID #18	1545875000	2438 Hz 1200 bps
SASAT (54°W) Link ID #4	1545815000	2438 Hz 1200 bps

b Configure the receiver to receive the correct frequency and symbol rate for the satellite used:

c Enter the following commands:

i `RECE:GEOL:FREQ` *`xxxxxxxxxx`*

ii `RECE:GEOL:SYMRATE` *`yyyy`*

Where *xxxxxxxxxx* is the frequency and *yyyy* is the symbol rate.

d Reset the receiver by entering the `SYST:CPURESET` command.

2 Configure the location of the antenna connected to the GEOL-2600 receiver:

a Using a nearby receiver or PNT-6250, determine the coordinates using the position reported in aNMEA GGA message from a GNSS receiver or by using the `GPS:POS?` command. The output is in Degree-Minute format.

b Convert the co-ordinates from Degree-Minute to Decimal format:

Minute / 60 + Degree value = decimal format

For example, using a latitude of N, 3911.2482: 11/60 + 39 = 39.1875

c Enter the coordinates using the `RECE:GEOL:HOLDPOS:LLH` command. For example, to enter the coordinates for the default antenna location, type:

```
RECE:GEOL:HOLDPOS:LLH 39.1875, -77.2627, 134.79
```

> **NOTE**
>
> For Decimal values, North and East are indicated by positive decimal values while South and West are indicated by negative decimal values.

3 Reset the receiver by entering the `SYST:CPURESET` command.

Operating With An External 10mhz Reference Or Oscillator

The GEOL-2600 module can accept an external asynchronous 10MHz reference signal or an external synchronous 10MHz oscillator signal that is being disciplined by the module via TTL serial signals or the analog EFC output signal on connector J2. Oscillator disciplining can be disabled whenever the user can provide a highly-stable and accurate 10MHz reference source to pin 6 of J3. The external 10MHz input is enabled by pulling the CSAC_LOCK# pin 8 of J3 to ground. This can be done through hard-wiring, or by connecting pin 8 to the CSAC/Rubidium oscillator BITE/BIST output pin for automatic switchover when the external oscillator achieves atomic lock. Pin 8 should only be pulled to ground when the external 10MHz signal is sufficiently stable and within +/-5Hz offset of true 10MHz to avoid jumping the internal TCXO frequency excessively and causing a processor crash.

Also note that if the reference oscillator frequency is unstable or reference CSAC oscillator is not locked yet, any large frequency jump may confuse the GEOL Kalman Filter and result in longer time to achieve first 1PPS UTC(GEOL) fix. To avoid confusing the GEOL Kalman Filter, the J3 Pin 8 should not be pulled low until reference frequency is stable or delayed GEOL Kalman Filter processing can be configured with RECEiver:GEOL:KFPROCessing <ON|OFF|DELAYed> command.

Once the CSAC_LOCK# pin is pulled low the module disconnects the internal DAC (that usually steers the internal TCXO frequency) from the TCXO, and connects the TCXO steering input to an analog Phase Locked Loop (PLL) with less than 20Hz loop bandwidth. The external 10MHz reference signal now “steers” the internal TCXO by phase-locking the TCXO to the 10MHz reference. This is useful for reducing the CSAC phase noise for example, as the internal TCXO has a much lower spur and phase noise levels compared to a typical CSAC 10MHz output. The low-phase-noise filtered CSAC-derived 10MHz signal is available on pin 3 of connector J3 and typically has ~90 degrees phase shift to the 10MHz reference input signal.

External reference oscillators can either be digitally steered via the CSAC TX/RX pins 12 and 14 on J3, or via the analog DAC steering output on U.FI connector J2. The EFC output voltage on J2 can range from 0V to 3V and can directly drive the EFC inputs of positive-slope analog DOCXO's that operate within the 0V to 3V EFC compliance range. It is recommended that a 220pF capacitor is connected between the EFC pin of the oscillator and Ground close to the OCXO EFC pin. SCPI commands are used to select analog or digital steering methods for the external oscillator, as well as the type of oscillator that is being connected (Microchip, Teledyne, Spectratime CSAC or Rubidium etc.). The externally connected oscillator is automatically phase- and frequency-steered by the proven JLT steering algorithms to UTC(GEOL) or UTC(GPS) or UTC(1PPS Ref-In) via SCPI user-selection as explained in Chapter 3.

Loop Parameter Adjustment

All loop parameters can be controlled via the USB or SCPI TTL serial port.

Loop parameters are optimized for the TCXO on the board, and changing the factory settings may result in the unit's performance to deteriorate. Loop time constants change automatically based on which 1PPS reference source is selected for disciplining (GEOL, GPS, or External). Since the GEOL signal is less stable than the typical GNSS signal, the time constants are extended when GEOL mode is selected.

Table 2.2 shows the recommended loop time constants for different 1PPS reference inputs in the GEOL-2600 board.

Table 4 Recommended loop settings for default on-board TCXO

Usage	GEOL 1PPS	GNSS 1PPS	EXT 1PPS
SERV:EFCS	0.5	2.0	6.0
SERV:PHASECO	40.0	40.0	400.0
SERV:EFCD	2	2	2
SYNC:TINT:THR	1000	300	300

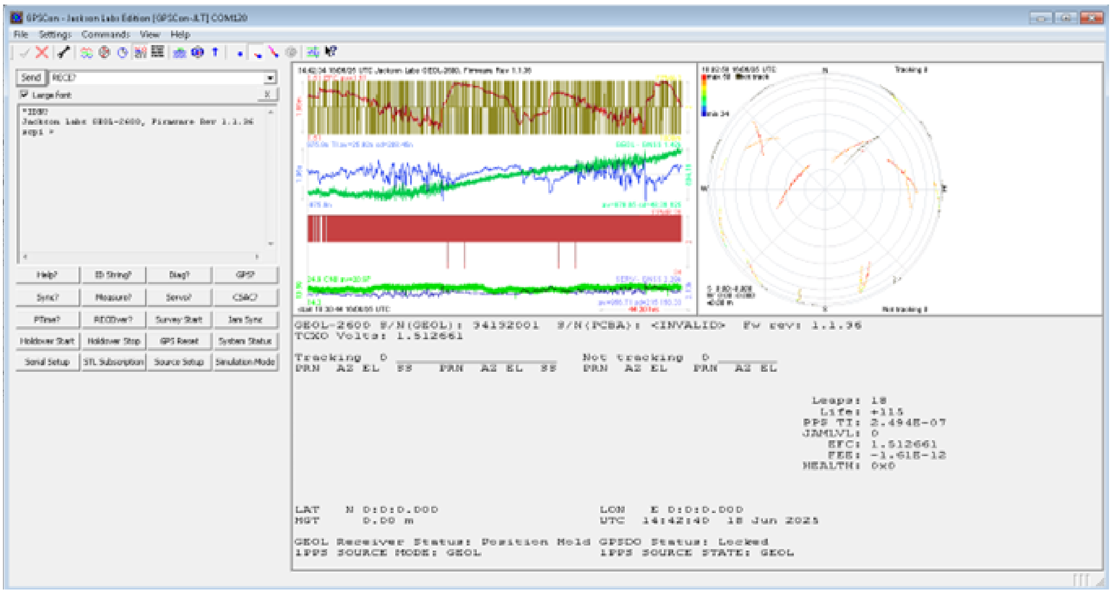
The commands to control the loop parameters are part of the SERVo? command. See also the SERVO Subsystem Section 3.10 . The individual commands are:

- **EFC Scale:** this is the proportional gain of the PI loop. Higher values will give quicker convergence, and faster locking of the GPS time (lower loop time constant), lower values give less noise. Typical values are 0.2 to 3.0 for different 1PPS reference inputs in the GEOL-2600 board.
- **EFC Damping:** overall IIR filter time constant. Higher values increase loop time constant. VIAVI. typically uses values between 2 to 20. Setting this value too high may cause loop instability.

- **Phase compensation:** this is the Integral part of the PID loop. This corrects phase offsets between the GEOL-2600 1PPS signal and the UTC 1PPS signal as generated by the GEOL/GNSS receiver. Set higher values for tighter phase-following at the expense of frequency stability. Typical values range from 4.0 - 40.0. Setting this value too high may cause loop instability.

A well-compensated unit will show performance similar to the plot shown in Figure 2.6 when experiencing small perturbations.

Figure 6 GEOL-2600 phase compensation plot



3

SCPI-Control Quick Start

The following topics are discussed in this chapter:

Introduction

The SCPI (Standard Commands for Programmable Instrumentation) subsystem is accessed via the SCPI TTL or USB serial interfaces and a terminal program. By default the terminal settings are 921,600 baud on USB port (115,200 on SCPI TTL port), 8N1, no flow-control.

There are a number of commands that can be used as listed below. Most of these are identical or similar to HP/Symmetricom 58503A commands. To get a listing of the available commands, send the HELP? query. This will return a list of all the available commands for the GEOL-2600 board.

Additional information regarding the SCPI protocol syntax can be found on the following web site:

http://www.ivifoundation.org/scpi/

A basic familiarity with the SCPI protocol is recommended when reading this chapter.

NOTE

The symbols “**<**“, “**>**”, “**[**“, “**]**”, “|”, and “**,**” in the parameter field listed in some commands of Chapter 3 are used for ranging or separating ONLY. Do not include these symbols when sending the SCPI commands to avoid a Command Error response.

NOTE

Only the upper-case letters have to be typed-in. Lowercase letters in the commands are optional.

General SCPI Commands

The following sections describe general SCPI commands.

Quick Start

For a quick start, try the following SCPI serial port commands:

- `HELP?`
- `SYSTem:STATus?`
- `RECEiver?`
- `SYNChronization?`
- `MEASure?`

*IDN?

This query outputs an identifying string. The response will show the following information:

`<company name> <model number>, <firmware revision>`

> **NOTE**
> The firmware revision reported by this command identifies the firmware revision number for the entire GEOL-2600 board and is different than the response of the `RECEiver:FWver?` command.

HELP?

This query returns a list of the commands available for the GEOL-2600 board. The list of commands may be increased or may change with future firmware releases, please consult the HELP? command for the latest command set available on the installed firmware.

RECEiver Subsystem

> **NOTE**
> The GEOL-2600 can display antenna height in MSL Meters or in GPS Meters on all commands that return antenna height, with GEOL height being GPS height and the GNSS receiver outputting MSL height. The NMEA position fixes are in the WGS84 coordinate system, while the X,Y, and Z velocity vectors are given in the ECEF coordinate system.

The RECEiver subsystem regroups all the commands related to the control and status of the GEOL/GNSS receiver. The list of the commands supported is the following:

- `RECEiver?`
- `RECEIVER:TYPE?`
- `RECEiver:GPGGA <int>  [0,255]`
- `RECEiver:GPRMC <int>  [0,255]`
- `RECEiver:GPZDA <int>  [0,255]`
- `RECEiver:PGEOLBEAM <ON | OFF>`
- `RECEiver:PGEOLFRAMe <ON | OFF>`
- `RECEiver:PGEOLPPS <int> [0,255]`
- `RECEiver:PGEOLSTAT <int> [0,255]`
- `RECEiver:PGEOLSUB  <ONCE|<int> [0,255]>`
- `RECEiver:NMEA?`
- `RECEiver:NMEA:OUTput <ON|OFF|USBON|USBOFF|SCPION|SCPIOFF>`

- RECEiver:NMEA:OUTput:ZEROPOSition <ON | OFF>
- RECEiver:NMEA:SCPI:GPGGA <int> [0,255]
- RECEiver:NMEA:SCPI:GPRMC <int> [0,255]
- RECEiver:NMEA:SCPI:GPZDA <int> [0,255]
- RECEiver:NMEA:SCPI:PGEOLBEAM <ON | OFF>
- RECEiver:NMEA:SCPI:PGEOLFRAMe <ON | OFF>
- RECEiver:NMEA:SCPI:PGEOLPPS <int> [0,255]
- RECEiver:NMEA:SCPI:PGEOLSTAT <int> [0,255]
- RECEiver:NMEA:SCPI:PGEOLSUB <ONCE | <int> [0,255]>
- RECEiver:POSition?
- RECEiver:POSition:ECEF?
- RECEiver:HEIGHT?
- RECEiver:INITial:DATE <yyyy,mm,dd>
- RECEiver:INITial:TIME <hour,min,sec>
- RECEiver:SYSMODE <GEOL|STL>
- RECEiver:GEOL:AGC <int> [400,3333]
- RECEiver:GEOL:AGC:MODE <AUTO|MANUAL>
- RECEiver:GEOL:DGAIN <int> [0,15]
- RECEiver:GEOL:CONFig?
- RECEiver:GEOL:FREQuency <double> [925000000.0,2175000000.0]
- RECEiver:GEOL:SYMRATE <float> <2438.0|4876.0>
- RECEiver:GEOL:HOLDPOSition:LLH <double> <ll.llllllll,lll.llllllll,h.hh>
- RECEiver:GEOL:HOLDPOSition:ECEF <double> <xxxxxxx.xxx,yyyyyyy.yyy,zzzzzzz.zzz>
- RECEiver:GEOL:SUBScription?
- RECEiver:GEOL:SUBScription:ASTSSN?
- RECEiver:GEOL:SUBScription:EXPDATE?
- RECEiver:GEOL:CNO?
- RECEiver:GEOL:PPSFilter:CONVergence <int> [0,100]
- RECEiver:GEOL:PPSFilter:WINDow <int> [0,2000]
- RECEiver:GEOL:PHASECOmpensation?
- RECEiver:GEOL:PHASECOmpensation:OFFSet <ns> [-1000000000.0,1000000000.0]
- RECEiver:GEOL:PHASECOmpensation:DEFAULT RESET
- RECEiver:GEOL:FPMAccepted?
- RECEiver:GEOL:FPMUpdated?
- RECEiver:GEOL:FPMReceived?
- RECEiver:GNSS:RESET <ONCE|HOLD|OFF>
- RECEiver:FWver?

RECEiver?

This query displays the configuration, position, speed, height and other relevant data of the GEOL or GNSS receiver in one convenient location.

RECEiver:TYPE?

This command queries the currently selected receiver type. The response is one of the following:

- `GEOL`

The default receiver type is GEOL.

NMEA Support

The following six commands allow the GEOL-2600 board to be used as an industry standard navigation GPS receiver. The GPGGA,GPRMC, PJLTPOS, PJLTPPS, PJLTSTAT, and PJLTVEL NMEA commands comprise all necessary information about the antenna position, height, velocity, direction, satellite info, fix info, time, date and other information that can be used by standard navigation applications via the GEOL-2600 serial interfaces.

Both SCPI TTL and USB serial ports are capable of transmitting NMEA output messages. Once enabled (valid command received on the SCPI TTL or USB serial receive pin), GEOL-2600 will send out information on the selected (SCPI TTL or USB) serial transmit pin automatically every N seconds. All incoming serial commands are still recognized by GEOL-2600 since the serial interface transmit and receive lines are completely independent of one another.

Please note that the position, direction, and speed data is delayed by one second from when the GEOL/GNSS receiver internally reported these to the GEOL-2600 Microprocessor, so the position is valid for the 1PPS pulse previous to the last 1PPS pulse at the time the data is sent (one second delay). The time and date are properly output with correct UTC synchronization to the 1PPS pulse immediately prior to the data being sent.

Once set for the selected serial port, the following six commands will be stored in NV memory, and generate output information even after power to the unit has been cycled.

RECEiver:GPGGA <int> [0,255]

This command will configure the NMEA output message for the currently selected serial port receiving this command. This command instructs the GEOL-2600 to send the NMEA standard string $GPGGA every N seconds, with N in the interval [0,255]. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:GPGGA <int> [0,255]
```

When operating from the GNSS receiver, the GPGGA sentence shows height in MSL Meters, this is different from traditional GPS receivers that display height in GPS Meters. When operating from the GEOL receiver height is indicated in GPS height. The difference between MSL and GPS height can be significant, 35m or more are common.

The following command will query the state of GPGGA output for the serial port receiving this command:

```
RECEiver:GPGGA?
```

RECEiver:GPRMC <int> [0,255]

This command will configure the NMEA output message for the currently selected serial port receiving this command. This command instructs the GEOL-2600 to send the NMEA standard string $GPRMC every N seconds, with N in the interval [0,255]. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:GPRMC <int> [0,255]
```

The following command will query the state of GPRMC output for the serial port receiving this command:

```
RECEiver:GPRMC?
```

RECEiver:GPZDA <int> [0,255]

This command will configure the NMEA output message for the currently selected serial port receiving this command. This command instructs the GEOL-2600 to send the NMEA standard string $GPZDA every N seconds, with N in the interval [0,255].

This command has the following format:

```
RECEiver:GPZDA <int> [0,255]
```

The following command will query the state of GPZDA output for the serial port receiving this command:

```
RECEiver:GPZDA?
```

RECEiver:NMEA?

This query will display results from the following commands:

- `RECEiver:NMEA:OUTput?`
- `RECEiver:GPGGA?`

- `RECEiver:GPRMC?`
- `RECEiver:GPZDA?`
- `RECEiver:PGEOLBEAM`
- `RECEiver:PGEOLFRAMe`
- `RECEiver:PGEOLPPS`
- `RECEiver:PGEOLSTAT`
- `RECEiver:PGEOLSUB`
- `RECEiver:NMEA:SCPI:GPGGA?`
- `RECEiver:NMEA:SCPI:GPRMC?`
- `RECEiver:NMEA:SCPI:GPZDA?`
- `RECEiver:NMEA:SCPI:PGEOLBEAM`
- `RECEiver:NMEA:SCPI:PGEOLFRAMe`
- `RECEiver:NMEA:SCPI:PGEOLPPS`
- `RECEiver:NMEA:SCPI:PGEOLSTAT`
- `RECEiver:NMEA:SCPI:PGEOLSUB`

RECEiver:NMEA:OUTput <ON|OFF|USBON|USBOFF|SCPION|SCPIOFF>

This command will control the output of all available NMEA messages on one or both of the USB and TTL SCPI serial ports. The following NMEA output messages are supported: GPGGA, GPRMC, GPZDA, PGEOLBEAM, PGEOLFRAMe, PGEOLPPS, PGEOLSTAT and PGEOLSUB. Sending the `RECE:NMEA:OUT USBON` command will turn on all NMEA outputs on the USB port. The USBOFF settings will turn off all NMEA outputs if any enabled on the USB port. The SCPION settings will turn on all NMEA outputs and the SCPIOFF settings will turn off all NMEA outputs if any enabled on the TTL SCPI port. The `RECE:NMEA:OUT ON` command will turn on all NMEA outputs on both USB and TTL SCPI ports. The `RECE:NMEA:OUT OFF` command will turn off all NMEA outputs if any enabled on both USB and TTL SCPI ports.

This command has the following format:

```
RECEiver:NMEA:OUTput <ON|OFF|USBON|USBOFF|SCPION|SCPIOFF>
```

The following command will query the state of this command and indicating if any NMEA output is enabled on USB or TTL SCPI ports:

```
RECEiver:NMEA:OUTput?
```

RECEiver:NMEA:OUTput:ZEROPOSition <ON|OFF>

This command will disable the output of $GPGGA and $GPRMC NMEA messages on both USB and TTL SCPI serial ports if the position of $GPGGA and/or $GPRMC messages become invalid due to loss of fix. The default settings is ON which will continue outputting $GPGGA and $GPRMC messages after losing fix.

When configuring OFF, the GEOL-2600 will stop outputting $GPGGA and $GPRMC messages containing zero latitude and/or longitude values to avoid jump in output position when lose fix, which may be useful for position plotting applications utilizing $GPGGA/GPRMC messages.

This command has the following format:

```
RECEiver:NMEA:OUTput:ZEROPOSition <ON|OFF>
```

The following command will query the settings of this command:

```
RECEiver:NMEA:OUTput:ZEROPOSition?
```

RECEiver:NMEA:SCPI:GPGGA <int> [0,255]

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the GEOL-2600 to send the NMEA standard string $GPGGA every N seconds, with N in the interval [0,255]. This message will be sent through the TTL SCPI port. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:NMEA:SCPI:GPGGA <int> [0,255]
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:GPGGA?
```

When operating from the GNSS receiver, the GPGGA sentence shows height in MSL Meters, this is different from traditional GPS receivers that display height in GPS Meters. When operating from the GEOL receiver height is indicated in GPS height. The difference between MSL and GPS height can be significant, with 35m or larger discrepancies being common.

RECEiver:NMEA:SCPI:GPRMC <int> [0,255]

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the GEOL-2600 to send the NMEA standard string $GPRMC every N seconds, with N in the interval [0,255]. This message will be sent through the TTL SCPI port. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:NMEA:SCPI:GPRMC <int> [0,255]
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:GPRMC?
```

RECEiver:NMEA:SCPI:GPZDA <int> [0,255]

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the GEOL-2600 to send the NMEA standard string $GPZDA every N seconds, with N in the interval [0,255]. This message will be sent through the TTL SCPI port.

This command has the following format:

```
RECEiver:NMEA:SCPI:GPZDA <int> [0,255]
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:GPZDA?
```

RECEiver:NMEA:SCPI:PGEOLBEAM <ON|OFF>

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the receiver to receive the proprietary NMEA messages $PGEOLBEAM. This message will be sent through the TTL SCPI port. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:NMEA:SCPI:PGEOLBEAM <ON|OFF>
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:PGEOLBEAM?
```

RECEiver:NMEA:SCPI:PGEOLFRAMe <ON | OFF>

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the receiver to recieve the proprietary NMEA messages $PGEOLFRAMe. This message will be received through the TTL SCPI port. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:NMEA:SCPI:PGEOLFRAMe <ON|OFF
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:PGEOLFRAMe?
```

RECEiver:NMEA:SCPI:PGEOLPPS <int> [0,255]

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the receiver to receive the proprietary NMEA messages $PGEOLPPS every N seconds, with N in the interval [0,255]. This message will be received through the TTL SCPI port. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:PGEOLPPS   <int> [0,255]
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:PGEOLPPS?
```

RECEiver:NMEA:SCPI:PGEOLSTAT <int> [0,255]

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the receiver to receive the proprietary NMEA messages $PGEOLSTAT every N seconds, with N in the interval [0,255]. This message will be received through the TTL SCPI port. The output message configured by this command is invalid until the receiver achieves a first fix.

This command has the following format:

```
RECEiver:PGEOLSTAT <int> [0,255]
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:PGEOLSTAT?
```

The PGEOLSTAT string has the following data format:

```
$PGEOLSTAT,v,ssssssssss,b,s*[checksum]
```

where

- `v` is the message version,
- `ssssssssss` is the GPS time (number of seconds since GPS epoch in 1980),
- `b` is the number of received bursts in last 60 seconds (bursts per minute, or BPM),
- `s` is the number of received strong (processed) bursts in last 60 seconds.

RECEiver:NMEA:SCPI:PGEOLSUB <int> [0,255]

This command will configure the NMEA output message for the TTL SCPI serial port. This command can be instantiated on either USB or TTL SCPI serial port. This command instructs the receiver to send the proprietary NMEA messages $PGEOLSUB every N seconds, with N in the interval [0,255]. This message will be received through the TTL SCPI port. The subscription status in the $PGEOLSUB output message will stay unknown until the GPS time is received.

This command has the following format:

```
RECEiver:NMEA:SCPI:PGEOLSUB <int> [0,255]
```

The following command will query the state of this command for the TTL SCPI serial port:

```
RECEiver:NMEA:SCPI:PGEOLSUB?
```

RECEiver:POSition?

This query will return position in latitude, longitude and altitude.

RECEiver:POSition:ECEF?

This query will return the earth-centered, earth-fixed (ECEF) X, Y, and Z coordinates as well as the position accuracy.

RECEiver:HEIGHT?

This command returns the current altitude of the GEOL receiver in GPS Meters or current altitude of the GNSS receiver in both MSL and GPS Meters.

RECEiver:INITial:DATE <yyyy,mm,dd>

This command allows setting the internal RTC DATE manually when operating the unit in GNSS denied environments.

This command has the following format:

```
RECEiver:INITial:DATE <yyyy,mm,dd>
```

The following command will query the state of this command:

```
RECEiver:INITial:DATE?
```

RECEiver:INITial:TIME <hour,min,sec>

This command allows setting the internal RTC TIME manually when operating the unit in GNSS denied environments. This command is compatible to the PTIMe:OUTput ON command available in other JLT products to allow automatic time and date synchronization of two units to each other.

For compatibility purpose, the GEOL-2600 also supports the GPS:INITial:DATE and GPS:INITial:TIME input messages from other JLT products. The internal RTC is driven by the highly stable oscillator 10MHz signal, and thus has very high time accuracy.

This command has the following format:

```
RECEiver:INITial:TIME <hour,min,sec>
```

The following command will query the state of this command:

```
RECEiver:INITial:TIME?
```

RECEiver:GEOL:SYSMODE <GEOL|STL>

This command sets the system mode to GEOL or STL.

The command has the following format:

```
RECEover:GEOL:SYSMODE <GEOL|STL>
```

RECEiver:GEOL:AGC <int> [400,3333]

This command will configure the manual RF Analog Gain Control (AGC) for the GEOL receiver.

Sending minimum value of 400 mV in this command results in maximum analog gain. The maximum value of 3333 mV results in minimum analog gain, with a nearly linear change of gain for intermediate values. Use this command to compensate for excessive cable losses or indoor reception with low signal levels, or non-amplified antennae. Observe the number of processed bursts per minute (BPM) in $PJLTSTAT message after changing the analog gain, and slowly adjust the value to achieve maximum number of processed BPM. A typical value when using the Tallysman 2643A amplified antenna with short antenna cabling is 1350 mV.

This command has the following format:

```
RECEiver:GEOL:AGC <int> [400,3333]
```

The following command will query the settings of this command:

```
RECEiver:GEOL:AGC?
```

RECEiver:GEOL:AGC:MODE <AUTO|MANUAL>

This command will determine the RF analog gain control mode for the GEOL receiver. Currently the AUTO mode is still work in progress and disabled until further notice.

The default and supported settings is MANUAL mode where the user can manually configure and determine the GEOL receiver’s analog gain control with RECEiver:GEOL:AGC <int> [400,3333] command.

This command has the following format:

```
RECEiver:GEOL:AGC:MODE <AUTO|MANUAL>
```

The following command will query the settings of this command:

```
RECEiver:GEOL:AGC:MODE?
```

RECEiver:GEOL:DGAIN <int> [0,15]

This command will configure the IF signal digital gain for the GEOL receiver. The default settings is 0 dB to avoid introducing extra noise into the GEOL receiver. JLT thus recommends configuring the RECEiver:GEOL:AGC <int> [400,3333] command before changing the settings of this command.

This command has the following format:

```
RECEiver:GEOL:DGAIN [0,15]
```

The following command will query the settings of this command:

```
RECEiver:GEOL:DGAIN?
```

RECEiver:GEOL:CONFig?

This command returns the symbol rate, PosLLH1, PosLLH2, phase offset, 1PPS Convergence Threshold, filter length, CNO minimum threshold, AGC, RF gain, ECEF[0,1,2].

RECEiver:GEOL:FREQuency <double> [925000000.0,2175000000.0]

This command will configure frequency. The system reset command `SYST:CPURESET` is required if Receiver Frequency is changed.

The command has the following format:

```
RECEiver:GEOL:FREQuency <double> [925000000.0,2175000000.0]
```

Example:

```
RECE:GEOL:FREQ 1545245000
```

The following query will return the current satellite frequency setting:

```
RECE:GEOL:FREQ?
```

RECEiver:GEOL:SUBScription?

This command returns licensing information, Serial Number and Expiration Date.

RECEiver:GEOL:SUBScription:ASTSSN?

This command will return compressed representation (32 bits) of VIAVI Board Serial Number.

RECEiver:GEOL:SUBS:ATTSBRDSN?

This command will return 14 bytes Board Serial Number digits.

RECEiver:GEOL:SUBS:ATTSMANID?

This command will return Manufacturing ID.

RECEiver:GEOL: SUBScription:EXPDATE?

This command will return the License Expiration date.

RECEiver:GEOL:CNO?

This query will return the carrier to noise (C/No) value of the last decoded burst that will be further processed by the GEOL receiver.

RECEiver:GEOL:PHASECOmpensation <ON|OFF>

This command configures the Phase Compensation feature on and off.

The command has the following format:

```
RECEiver:GEOL:PHASECOmpensation <ON|OFF>
```

The following command will return the Phase Compensation parameter:

```
RECEiver:GEOL:PHASECOmpensation?
```

RECEiver:GEOL:FPMAccepted?

This command will read the number of accepted (received when reported convergence factor is greater than configured convergence threshold) Update messages received during previous minute.

RECEiver:GEOL:FPMUpdated?

This command will read the number of received (regardless of current value of received reported convergence factor) Update messages received during previous minute.

RECEiver:GEOL:FPMReceived?

This command will read the number of Unique Word messages received during the previous minute.

RECEiver:GEOL:PHASECOmpensation:OFFSet <ns> [-1000000000.0,1000000000.0]

This command configures the offset parameter for Phase Compensation. The offset is the delay via the antenna and receiver data path.It can be configured between -1 second (-1000000000 ns) to +1 second (1000000000 s). The default value is 697750 ns.

The command has the following format:

```
RECEiver:GEOL:PHASECOmpensation:OFFSet <ns> [-
1000000000.0,1000000000.0]
```

The following command will return the Phase Compensation offset:

```
RECEiver:GEOL:PHASECOmpensationOFFSet?
```

RECEiver:GEOL:PHASECOmpensation:DEFAULT <RESET>

This command configures the Phase Compensation offset parameter to the default value. The default value is hard coded as 697750 ns.

The following command returns the default value:

```
RECEiver:GEOL:PHASECOmpensation:DEFAULT?
```

RECEiver:FWver?

This query will return the firmware version of the GEOL receiver or the GNSS receiver module.

> **NOTE**
> The response of this command is different than the firmware revision reported by the *IDN? command, which identifies the firmware revision number for the entire GEOL-2600 board.

PTIME Subsystem

The PTIME subsystem regroups all the commands related to the management of the internal RTC time.

> **NOTE**
> The GEOL-2600 does not contain a battery backup to maintain RTC time/date. As a result, the time/date is lost when power is removed or when the unit is reset.

The list of the commands supported is the following:

- `PTIME?`
- `PTIMe:DATE?`
- `PTIMe:TIME?`
- `PTIMe:TIME:STRing?`
- `PTIMe:TINTerval?`
- `PTIMe:OUTput <ON|OFF>`
- `PTIMe:OUTput:SCPI <ON|OFF>`
- `PTIMe:LEAPsecond?`
- `PTIMe:LEAPsecond:PENDing?`
- `PTIMe:LEAPsecond:ACCumulated?`

PTIMe:DATE?

This query returns the current calendar date referenced to UTC time. The year, month, and day are returned.

PTIMe:TIME?

This query returns the current 24-hour time referenced to UTC time. The hour, minute, and second are returned.

PTIMe:TIME:STRing?

This query returns the current 24-hour time suitable for display (for example, 13:24:56).

PTIMe:TINTerval?

This query is identical to the SYNChronization:TINTerval? query.

PTIMe:OUTput <ON|OFF>

This command adds support for auto-initialization of time and date between two VIAVI GPSDO units. This allows connecting two units together through the currently selected serial port with a serial cable, and having the master unit send time and date information to the slave unit. The slave unit's 1PPS reference input can also be driven by the master unit's 1PPS output signal, by setting the slave unit to external 1PPS sync mode using the SYNC:SOUR:MODE EXT command. This allows time synchronization within seconds at the nanosecond level between two units which can be useful when operating in GNSS denied environments.

This command has the following format:

```
PTIMe:OUTput <ON|OFF>
```

The following command returns the PTIME output settings for the serial port receiving this command:

```
PTIMe:OUTput?
```

Sending the following command will cause the unit to automatically generate GPS:INIT:DATE and GPS:INIT:TIME sentences described in "RECEiver:INITial:DATE <yyyy,mm,dd>" on page 37 and "RECEiver:INITial:TIME <hour,min,sec>" on page 38 on the selected serial port receiving this command once per second:

```
PTIMe:OUTput ON
```

PTIMe:OUTput:SCPI <ON|OFF>

This command will configure the PTIMe output messages for the TTL SCPI serial port. This command adds support for auto-initialization of time and date between two VIAVI. GPSDO units. This allows connecting two units together through the currently selected serial port with a serial cable, and having the master unit send time and date information to the slave unit. The slave unit's 1PPS reference input can also be driven by the master unit's 1PPS output signal, by setting the slave unit to external 1PPS sync mode using the SYNC:SOUR:MODE EXT command. This allows time synchronization within seconds at the nanosecond level between two units which can be useful when operating in GNSS denied environments.

This command has the following format:

```
PTIMe:OUTput:SCPI <ON|OFF>
```

The following command returns the PTIME output settings for the TTL SCPI serial port:

```
PTIMe:OUTput:SCPI?
```

Sending the following command will cause the unit to automatically generate GPS:INIT:DATE and GPS:INIT:TIME sentences described in "RECEiver:INITial:DATE <yyyy,mm,dd>" on page 37 and "RECEiver:INITial:TIME <hour,min,sec>" on page 38 on the TTL SCPI serial port once per second:

```
PTIMe:OUTput ON
```

PTIMe:LEAPsecond?

This command returns the leapseconds accrued between the GPS and UTC time systems.

PTIMe:LEAPsecond:PENDing?

This command returns 1 if the GPS almanac data contains a future pending leap second date or if the GEOL solution indicates an incoming leap second event and 0 if no future leap second is pending or almanac data or GEOL solution is not available. The internal GNSS receiver must have the GPS system enabled for the GPS almanac to be available when GNSS receiver is selected.

PTIMe:LEAPsecond:ACCumulated?

This command returns the internally applied leapsecond offset between GPS time and UTC time as stored in the EEPROM (GPS almanac not received or no GEOL solution yet) or as indicated by the GNSS receiver (GPS almanac is available) or the GEOL receiver.

PTIME?

This query returns at once the result of the following queries:

- `PTIMe:DATE?`
- `PTIMe:TIME?`
- `PTIMe:TINTerval?`
- `PTIMe:OUTput?`
- `PTIMe:LEAPsecond:ACCumulated?`

SYNChronization Subsystem

This subsystem regroups the commands related to the synchronization of the GEOL-2600 with the GEOL/GNSS receiver. The list of the commands supported for this subsystem is the following:

- `SYNChronization?`
- `SYNChronization:SOURce:MODE [GEOL|GPS|EXTernal]`
- `SYNChronization:SOURce:STATE?`
- `SYNChronization:HOLDover:DURation?`
- `SYNChronization:HOLDover:STATe?`
- `SYNChronization:TINTerval?`
- `SYNChronization:TINTerval:THReshold <int> [50,2000]`
- `SYNChronization:IMMEdiate`
- `SYNChronization:FEEstimate?`
- `SYNChronization:LOCKed?`
- `SYNChronization:LOCKed:LEDMODE <LOCK|BURST-LOCK>`
- `SYNChronization:OUTput:1PPS:RESET [ON|OFF]`
- `SYNChronization:OUTput:1PPS:HOLDover <int> <s> [0,604800]`
- `SYNChronization:OUTput:1PPS:DOMAin [GEOL|SERVo]`
- `SYNChronization:HEAlth?`

SYNChronization:SOURce:MODE [GEOL|GPS|EXTernal]

This command selects between the EXTernal, GNSS, and GEOL 1PPS sync modes. The EXTernal and GPS modes use the external or GNSS 1PPS reference input to synchronize precise timing and to discipline the oscillator.

The GEOL mode uses the GEOL 1PPS output to synchronize precise timing and discipline the oscillator when the GEOL 1PPS output is reported as valid. If GEOL mode is selected and the GEOL 1PPS output is no longer valid, the GEOL-2600 board will go into holdover mode.

Changing the settings of this command will also automatically configure the servo loop parameters described in “Loop Parameter Adjustment” on page 24 and settings in “SYNChronization:TINTerval:THReshold <int> [50,2000]” on page 46 suitable for oscillator disciplining with GEOL/GNSS/EXTernal 1PPS source.

The format of this command is:

```
SYNChronization:SOURce:MODE <GEOL|GPS|EXTernal>
```

The following command will query the settings of this command:

```
SYNChronization:SOURce:MODE?
```

SYNChronization:SOURce:STATE?

This command is implemented, but always reports the same state as the SYNC:SOUR:MODE command setting in the GEOL-2600 board.

SYNChronization:HOLDover:DURation?

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 UTC, and thus “coasting”. The time units are seconds. 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.

SYNChronization:HOLDover:STATe?

This query returns the current holdover state with possible responses being NONE, MANUAL, or ON. NONE indicates the holdover state is off. MANUAL indicates the holdover is manually enabled with the SYNC:HOLD:INIT command. ON indicates that holdover is enabled due to lack of GEOL/GNSS receiver 1PPS or valid GEOL/GNSS fix.

SYNChronization:TINTerval?

This query returns the difference or timing shift between the oscillator and the UTC (GEOL/GNSS) 1PPS reference signals. The resolution is 1E-10 seconds.

This value is essentially the phase offset from the unit’s 1PPS output to UTC and can be used to externally compensate for this phase offset. It is also pushed out in the SERVo:TRACe 1 command described in “SERVo:TRACe <int> [0,255]” on page 69.

> **NOTE**
> If the SERVo:LOOP? settings is OFF, the value returned by this query is unchanged and invalid since the oscillator disciplining is disabled with SERVo:LOOP OFF settings.

SYNChronization:TINTerval:THReshold <int> [50,2000]

This command selects the oscillator 1PPS phase-offset threshold as compared to the [EXT/GEOL/GNSS] reference 1PPS at which point the unit will initiate a counter-reset (jam-sync) aligning the TCXO oscillator-generated 1PPS with the reference 1PPS phase. The oscillator phase is slowly and continuously adjusted toward 0ns offset to the externally-supplied reference 1PPS phase as long as the phase difference is less than the THReshold phase limit. The oscillator generated 1PPS phase is allowed to drift up to this threshold before a jam-sync is initiated. The default setting is 300ns for GNSS/ EXT 1PPS and 1,000ns for GEOL 1PPS, allowing a drift of up to +/-1,000ns when in GEOL disciplining mode. Reaching this selected threshold will cause a jam-sync phase-normalization to be initiated, which will reset the counter phase that generates the internal 1PPS output, it will also cause the SYNC:HEAlth? Status to indicate 0x200, and the lock status to be “unlocked”. By selecting a larger phase window, the user can prevent these phase resets (jam-syncs) of the output 1PPS from happening too frequently in environments where airflow or thermal changes are expected or the satellite signals are very weak.

The format of this command is:

```
SYNChronization:TINTerval:THReshold <int> [50,2000]
```

The following command will query the settings of this command:

```
SYNChronization:TINTerval:THReshold?
```

SYNChronization:IMMEdiate

This command initiates a near-instantaneous alignment (jam-sync) of the [EXT/GNSS/ GEOL] 1PPS phase and Receiver output 1PPS phase. To be effective, this command has to be issued while not in holdover.

SYNChronization:FEEstimate?

This query returns the Frequency Error Estimate, similar to the Allan Variance using a 1,000s measurement interval and comparing the internal 1PPS to the [EXT/GNSS/ GEOL] 1PPS offset.

Values less than 1E-012 are below the noise floor, and are not significant.

> **NOTE**
> If the SERVo:LOOP? setting is OFF, the value returned by this query is unchanged and invalid since the oscillator disciplining is disabled with SERVo:LOOP settings.

SYNChronization:LOCKed?

This query returns the lock state (0=Not Locked, 1=Locked) of the PLL controlling the TCXO.

> **NOTE**
> If the SERVo:LOOP? setting is OFF, the value returned by this query is unchanged and invalid since the oscillator disciplining is disabled with SERVo:LOOP settings.

SYNChronization:LOCKed:LEDMODE <LOCK|BURST-LOCK>

This command selects the operation mode of Green LOCK LED D23 and Pin 11 of connector J3. The default settings is LOCK in which the LOCK LED will stay OFF until the unit is locked to the GEOL signals.

With BURST-LOCK settings, the Green LED D23 will behave the same as Green LED which will blink when GEOL packet has been received and has been successfully processed, until the unit is locked indicated by SYNChronization:LOCKed? query command. Once locked, the Green LED D23 will stay ON unless the unit becomes unlocked and start blinking for GEOL packet indication.

The format of this command is:

```
SYNChronization:LOCKed:LEDMODE <LOCK|BURST-LOCK>
```

This command will query the state of this command:

```
SYNChronization:LOCKed:LEDMODE?
```

SYNChronization:OUTput:1PPS:RESET [ON|OFF]

This command allows the generation of the 1PPS output pulse upon power-on without an external L1 Band antenna being connected to the unit. By default the unit does not generate a 1PPS pulse until the receiver has locked onto the Satellites. With the command SYNC:OUT:1PPS:RESET ON the unit can now be configured to generate an asynchronous 1PPS output after power-on even if an L1 Band antenna is not connected to the unit. Once the receiver locks and generates a first 3D Fix, the 1PPS pulse will align itself to UTC by stepping in 10 equally spaced steps toward UTC alignment. The default setting is OFF which means the 1PPS pulse is disabled until proper first 3D Fix is achieved.

The format of this command is:

```
SYNChronization:OUTput:1PPS:RESET <ON|OFF>
```

This command will query the state of this command:

```
SYNChronization:OUTput:1PPS:RESET?
```

SYNChronization:OUTput:1PPS:HOLDover <int> <s> [0,604800]

This command allows the user to specify the period in seconds that the holdover 1PPS output (pin 7 of J3 connector) should remain active after losing the reference 1PPS source from the GEOL/GNSS receiver.

The default holdover period is 0 indicated by "ON" response where the special settings of 0 will instruct the GEOL-2600 to output 1PPS signal indefinitely after first fix. The holdover period can be configured up to one week of holdover 1PPS output from the internal or externally-connected holdover oscillator.

This command has the following format:

```
SYNChronization:OUTput:1PPS:HOLDover [0,604800]
```

The following command will query the settings of this command:

```
SYNChronization:OUTput:1PPS:HOLDover?
```

SYNChronization:OUTput:1PPS:DOMAin [GEOL|SERVo]

This command will configure the 1PPS output domain to be generated in either GPSDO or receiver (GEOL/GNSS) mode. In GPSDO mode the 1PPS output is generated by the 10MHz reference oscillator phase, and has extremely high stability (picoseconds jitter), whereas in receiver mode the phase of the 1PPS signal jumps nanoseconds every second just like a typical GNSS receiver so as to align the 1PPS as close as possible to the UTC(GEOL) phase. The advantage of the receiver mode is that on average the phase offset to UTC(GEOL) is minimized at the expense of massive second to second jitter.

In GPSDO mode the unit drives (disciplines/steers) the phase of the 10MHz oscillator very slowly to adjust the 1PPS output phase as closely as possible to UTC(GEOL) phase. This steering can take many hours, and the phase offset can be queried with the SYNC:TINT? command and can thus be externally compensated for. The advantage of the GPSDO mode is that the second to second 1PPS jitter is extremely small, on the order of picoseconds, while it can take significant time to align the 1PPS output phase to UTC(GEOL) due to the very slow oscillator steering. A secondary effect in GPSDO mode is that if the phase threshold is exceeded (see also the "SYNChronization:TINTerval:THReshold <int> [50,2000]" on page 46 command) then the phase will be "jam-synced" to the correct UTC(GEOL) phase, meaning there can be an instantaneous jump of 100's of nanoseconds once the phase error threshold window is breached.

The GEOL 1PPS domain is used by default to minimize the overall 1PPS phase errors to UTC(GEOL) and thus the unit behaves like a typical GNSS receiver out of the box and when in GEOL mode.

The format for this command is:

```
SYNChronization:OUTput:1PPS:DOMAin [GEOL|SERVo]
```

The following command will query the settings of this command:

```
SYNChronization:OUTput:1PPS:DOMAin?
```

SYNChronization:HEAlth?

The SYNChronization:HEAlth? query returns a hexadecimal number indicating the system's health-status. Error flags are encoded in a binary fashion so that each flag occupies one single bit of the binary equivalent of the hexadecimal health-status flag.

The following system parameters are monitored and indicated through the health-status indicator. Individual parameters are 'ored' together which results in a single hexadecimal value encoding system status information as described in Table 5.

Table 5 SYNChrinization:HEAlth? status information

If...	Status
The TCXO coarse-DAC is maxed-out at 255	HEALTH STATUS |= 0x1;
The TCXO coarse-DAC is mined-out at 0	HEALTH STATUS |= 0x2;
The phase offset to UTC is greater than settings in "SYNChronization:TINTerval:THReshold <int> [50,2000]" on page 46	HEALTH STATUS |= 0x4;
The run-time with 1PPS reference is < 300 seconds	HEALTH STATUS |= 0x8;
The GEOL-2600 is in holdover > 60s	HEALTH STATUS |= 0x10;
The TCXO coarse-DAC is maxed-out at 255	HEALTH STATUS |= 0x1;
The Frequency Error Estimate is out of bounds	HEALTH STATUS |= 0x20;
The power supply or TCXO voltage is too high	HEALTH STATUS |= 0x40;
The power supply or TCXO voltage is too low	HEALTH STATUS |= 0x80;
The short-term-drift (ADEV @ 100s) > 500ns	HEALTH STATUS |= 0x100;
For the first 3 minutes after a phase-reset, or a coarsedac change	HEALTH STATUS |= 0x200;
The on-board GNSS receiver indicates a strong jamming signal of >=50 (range is 0 to 255)	HEALTH STATUS |= 0x800;

As an example, if the unit is waiting for 1PPS reference, and the Frequency error estimate is too high, and the time since phase reset is < 3 minutes then the following errors would be indicated:

- 1PPS reference count < 300 seconds: 0x8
- Frequency error estimate > 5E-9 for GEOL 1PPS with TCXO: 0x20
- Time since phase normalization < 3 minutes: 0x200

'Oring' these values together results in:

0x200 | 0x20 | 0x8 = 0x228

The unit would thus indicate: HEALTH STATUS: 0x228

A health status of 0x0 indicates a properly locked, and warmed-up unit that is completely healthy.

> **NOTE**
>
> A non 0x0 health status and the corresponding lock_ok output going low does not necessarily mean the unit is unlocked.
>
> **NOTE**
>
> If the SERVo:LOOP? settings is OFF, the health status flags related to oscillator frequency stability are invalid since the oscillator disciplining is disabled with SERVo:LOOP OFF settings.

SYNChronization?

This query returns the results of following queries:

- `SYNChronization:SOURce:MODE?`
- `SYNChronization:SOURce:STATE?`
- `SYNChronization:OUTput:1PPS:DOMAin?`
- `SYNChronization:OUTput:1PPS:RESET?`
- `SYNChronization:OUTput:1PPS:HOLDover?`
- `SYNChronization:LOCKed?`
- `SYNChronization:HOLDover:STATe?`
- `SYNChronization:HOLDover:DURation?`
- `SYNChronization:FEEstimate?`
- `SYNChronization:TINTerval?`
- `SYNChronization:TINTerval:THReshold?`
- `SYNChronization:HEAlth?`

DIAGnostic Subsystem

This subsystem regroups the queries related to the diagnostic of the TCXO steering system and lifetime of the GEOL-2600 firmware.The list of the commands supported for this subsystem is the following:

- `DIAGnostic:ROSCillator:EFControl:RELative?`
- `DIAGnostic:ROSCillator:EFControl:ABSolute?`
- `DIAGnostic:LIFetime:COUNt?`
- `DIAGnostic:LIFetime:SECond?`

DIAGnostic:ROSCillator:EFControl:RELative?

This query returns the Electronic Frequency Control (EFC) output value of the internal reference oscillator. This query returns a percentage value between -100% to +100%.

DIAGnostic:ROSCillator:EFControl:ABSolute?

This query returns the Electronic Frequency Control (EFC) output value of the internal reference oscillator. This query returns a value normalized to volts.

When an external Atomic oscillator is connected for disciplining, the steering value of the Atomic oscillator in units of parts-per-trillion (1E-12) is returned.

DIAGnostic:LIFetime:COUNt?

This command returns the number of hours the GEOL-2600 firmware has been running.

DIAGnostic:LIFetime:SECond?

This command returns the number of seconds the GEOL-2600 firmware has been running.

RFOUTput Subsystem

This subsystem regroups the commands related to the functionality of the external connected JLT Transcoder/CLAW Simulator option. The list of the commands supported for this subsystem is as follows:

- `RFOUTput <ON|OFF>`
- `RFOUTput:POWer <float> [-300.0, 300.0]`
- `RFOUTput:RESET ONCE`
- `RFOUTput:ISP ON`
- `RFOUTput:SIM:RESTART ONCE`
- `RFOUTput:SIM:RECONFIG ONCE`
- `RFOUTput:SCPI <scpi_cmd>`

RFOUTput <ON|OFF>

This command will enable or disable the transcoding RF output signal on the Transcoder/CLAW unit if properly connected to the GEOL-2600. Transcoding is enabled by default. If the Transcoder is not transcoding properly, try sending the

RFOUT ON command once. Sending RFOUT OFF command will stop the current simulation and RF output.

This command has the following format:

```
RFOUTput <ON|OFF>
```

This command will query the state of this command:

```
RFOUTput?
```

RFOUTput:POWer <float> [-300.0, 300.0]

This command sets the power level at the RF output jack of Transcoder/CLAW unit on an individual satellite basis if properly connected to the GEOL-2600.

The RFOUTput:POWer command sets the simulator's RF output power from the perspective of a single satellite, not the entire constellation. When N satellites are transmitting, the total RF output power will be approximately 10*log10N dB greater than specified.

The nominal output power of a live GPS satellite signal at the surface of the earth is typically about -125 dBm, but is often a few dB higher to allow for a reduction in power as the satellite ages.

Additionally, target GPS receivers often expect to be used with an amplified antenna, so the output power is typically set higher than -125 dBm for optimum performance of the target GPS receiver.

This command has the following format:

```
RFOUTput:POWer <float> [-300.0, 300.0]
```

This command will query the settings of this command:

```
RFOUTput:POWer?
```

RFOUTput:RESET ONCE

This command will issue a reset sequence to the Transcoder/CLAW unit once, if properly connected to the GEOL-2600.

RFOUTput:ISP ON

This command will send the Transcoder/CLAW unit into ISP mode for reprogramming, if properly connected to the GEOL-2600.

RFOUTput:SIM:RESTART ONCE

This command will stop the current simulation once and restart transcoding shortly for RF output of Transcoder/CLAW unit, if properly connected to the GEOL-2600.

RFOUTput:SIM:RECONFIG ONCE

This command will re-send initial configuration commands including output power settings to the Transcoder/CLAW unit, if properly connected to the GEOL-2600.

RFOUTput:SCPI <scpi_cmd>

This command will allow the user to send any ASCII command to the Transcoder/CLAW unit, if properly connected to the GEOL-2600. Note that the GEOL-2600 may overwrite the settings on next connection for settings changed with this command.

For example, sending the RFOUTput:SCPI OUT:POW -120 command will instruct the GEOL-2600 to send the command argument “OUT:POW -120” to the Transcoder/CLAW unit. However the GEOL-2600 will still send the output power settings configured in “RFOUTput:POWer <float> [-300.0, 300.0]” on page 53 on next connection or when RFOUTput:SIM:RECONFIG ONCE command is sent.

This command has the following format:

```
RFOUTput:SCPI <scpi_cmd>
```

MEASURE Subsystem

This subsystem regroups the queries related of some parameters that are measured on-board on the GEOL-2600. The list of the commands supported for this subsystem is the following:

- `MEASure:VOLTage?`
- `MEASure?`

MEASure:VOLTage?

This query is identical to the DIAGnostic:ROSCillator:EFControl:ABSolute? query.

MEASure?

This query returns the result of the following query:

```
MEASure:VOLTage?
```

SYSTEM Subsystem

This subsystem regroups the commands related to the general configuration of the GEOL-2600 board. The list of the commands supported for this subsystem is the following:

- `SYSTem:COMMunicate:SERial:ECHO <ON|OFF>`
- `SYSTem:COMMunicate:SERial:PROmpt <ON|OFF>`
- `SYSTem:COMMunicate:SERial:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>`
- `SYSTem:COMMunicate:SERial:MSGMASK <ON|OFF>`
- `SYSTem:COMMunicate:SERial:OUTput <USBOFF|SCPIOFF|ALLOFF>`
- `SYSTem:COMMunicate:USB:ECHO <ON|OFF>`
- `SYSTem:COMMunicate:USB:PROmpt <ON|OFF>`
- `SYSTem:COMMunicate:USB:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>`
- `SYSTem:COMMunicate:SCPI:PORT <ON|OFF>`
- `SYSTem:COMMunicate:SCPI:ECHO <ON|OFF>`
- `SYSTem:COMMunicate:SCPI:PROmpt <ON|OFF>`
- `SYSTem:COMMunicate:SCPI:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>`
- `SYSTem:COMMunicate:CSAC:MODE <OFF|QUERY|TRANScoder>`
- `SYSTem:COMMunicate:CSAC:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>`
- `SYSTem:SHOW?`
- `SYSTem:STATus?`
- `SYSTem:BUILD?`
- `SYSTem:OPERation:MODE <RECEiver|GEOL-3200>`
- `SYSTem:PWRSAVing:MODE [OFF|DUTY-CYCLE|RF-RECEIVER|SECOND-MCU|GNSS|ALL]`
- `SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>`
- `SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]`
- `SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]`
- `SYSTem:PWRSAVing:RFRECeiver <ON|OFF>`
- `SYSTem:PWRSAVing:SECONDMCU <ON|OFF>`
- `SYSTem:PWRSAVing:GNSS <ON|OFF>`
- `SYSTem:MASTERBRIDge`
- `SYSTem:MASTERBRIDge:TIMEOUT [5,300]`
- `SYSTem:SLAVECONfig <ON|OFF>`
- `SYSTem:SLAVESTATus?`
- `SYSTem:CPURESET`
- `SYSTem:ISP`
- `SYSTem:FACToryReset ONCE`

- `SYSTem:EEPROMUPDATE ONCE`

SYSTem:COMMunicate:SERial:ECHO <ON|OFF>

This command enables/disables echo on the currently selected serial port (USB/SCPI TTL) receiving this command. This command has the following format:

```
SYSTem:COMMunicate:SERial:ECHO <ON | OFF>
```

SYSTem:COMMunicate:SERial:PROmpt <ON|OFF>

This command enables/disables the prompt “scpi >” on the SCPI command lines of the currently selected serial port (USB/SCPI TTL) receiving this command. The prompt must be enabled when used with the GPSCon Utility. This command has the following format:

```
SYSTem:COMMunicate:SERial:PROmpt <ON | OFF>
```

SYSTem:COMMunicate:SERial:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>

This command sets the serial speed for the currently selected serial port (USB/SCPI TTL) receiving this command. The serial configuration is always 8 bit, 1 stop bit, no parity, no HW flow control. The default speed is set at 921600 bauds for USB serial port and 115200 bauds for SCPI TTL serial port.

This command has the following format:

```
SYSTem:COMMunicate:SERial:BAUD <9600 | 19200 | 38400 | 57600
| 115200 | 230400 | 460800 | 921600>
```

The following command will configure serial speed of 115200 baud for the USB serial port if this command is received at the RX pin of USB serial port or serial speed for the SCPI TLL serial port if this command is received at the RX pin (pin 18 of J3 connector) of SCPI TTL serial port:

```
SYST:COMM:SER:BAUD 115200
```

SYSTem:COMMunicate:SERial:MSGMASK <ON|OFF>

Sending this command with ON settings will activate the message mask and temporarily disable output of all periodic and NMEA messages on both USB and SCPI serial ports.

> **NOTE**
> The setting changed in the command are NOT stored in EERPOM.

This command is useful for querying SCPI command settings and responses, without having the responses interrupted by other messages. Issuing SYST:COMM:SER:MSGMASK OFF command or power cycling the GEOL-2600 will both clear this mask and resume output of configured periodic and/or NMEA messages.

This command has the following format:

```
SYSTem:COMMunicate:SERial:MSGMASK <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:SERial:MSGMASK?
```

SYSTem:COMMunicate:SERial:OUTput <USBOFF|SCPIOFF|ALLOFF>

This command allows the user to turn off and disable output of all currently configured periodic and NMEA messages on USB port, SCPI port, or both serial ports. Note that the settings changed in this command is stored in EEPROM.

The USBOFF settings will check for all configured periodic and NMEA messages on USB serial port such as RECEiver:GPGGA <int> [0,255] and RECEiver:PJLTSTAT <int> [0,255] messages and disable all these messages. Similarly the SCPIOFF settings will disable all configured periodic and NMEA messages on SCPI serial port and the ALLOFF settings will disable all configured periodic and NMEA messages on both USB and SCPI serial ports.

This command has the following format:

```
SYSTem:COMMunicate:SERial:OUTput <USBOFF|SCPIOFF|ALLOFF>
```

SYSTem:COMMunicate:USB:ECHO <ON|OFF>

This command enables/disables echo on the USB serial port.

This command has the following format:

```
SYSTem:COMMunicate:USB:ECHO <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:USB:ECHO?
```

SYSTem:COMMunicate:USB:PROmpt <ON|OFF>

This command enables/disables the prompt on the SCPI command lines of the USB serial port. The prompt must be enabled when used with the GPSCon Utility.

This command has the following format:

```
SYSTem:COMMunicate:USB:PROmpt <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:USB:PROmpt?
```

SYSTem:COMMunicate:USB:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>

This command sets the serial speed for the USB serial port. The serial configuration is always 8 bit, 1 stop bit, no parity, no flow control. The default speed is set at 921600 bauds for USB serial port.

This command has the following format:

```
SYSTem:COMMunicate:USB:BAUD
<9600|19200|38400|57600|115200|230400|460800|921600>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:USB:BAUD?
```

SYSTem:COMMunicate:SCPI:PORT <ON|OFF>

This command will enable or disable the SCPI TTL port (pins 16 and 18 of J3 connector) for serial communication. By default, the SCPI TTL port is enabled and should remain enabled for normal operation.

```
SYSTem:COMMunicate:SCPI:PORT <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:SCPI:PORT?
```

SYSTem:COMMunicate:SCPI:ECHO <ON|OFF>

This command enables/disables echo on the SCPI TTL serial port (pins 16 and 18 of J3 connector).

This command has the following format:

```
SYSTem:COMMunicate:SCPI:ECHO <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:SCPI:ECHO?
```

SYSTem:COMMunicate:SCPI:PROmpt <ON|OFF>

This command enables/disables the prompt on the SCPI command lines of the SCPI TTL serial port (pins 16 and 18 of J3 connector). The prompt must be enabled when used with the GPSCon Utility.

This command has the following format:

```
SYSTem:COMMunicate:SCPI:PROmpt <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:SCPI:PROmpt?
```

SYSTem:COMMunicate:SCPI:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>

This command sets the serial speed for the SCPI TTL serial port (pins 16 and 18 of J3 connector).

The serial configuration is always 8 bit, 1 stop bit, no parity, no flow control. The default speed is set at 115200 bauds for SCPI TTL serial port.

This command has the following format:

```
SYSTem:COMMunicate:SCPI:BAUD
<9600|19200|38400|57600|115200|230400|460800|921600>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:SCPI:BAUD?
```

SYSTem:COMMunicate:CSAC:MODE <OFF|QUERY|TRANScoder>

This command selects the mode for the CSAC TTL serial port (pins 12 and 14 of J3 connector) to support different target devices or applications. Currently couple Jackson Labs products are supported including varies JLT CSAC-based and Rubidium-based GPSDO products and JLT Transcoder/CLAW Simulator products. By default, the CSAC mode is OFF where input data on CSAC port is ignored and GEOL-2600 will assume no device is connected to the CSAC TTL serial port. The SCPI command support on CSAC serial port is in progress and will allow the user to send and configure SCPI settings for GEOL-2600.

With QUERY settings and proper connection between GEOL-2600 and JLT CSAC/ Rubidium GPSDO unit, the GEOL-2600 will periodically send the CSAC:STeer? query command and compute steering value for GEOL Kalman filter.

The TRANSCODER settings is designed for application with GEOL-2600 providing position and/or 1PPS output to JLT Transcoder/CLAW unit for transcoding. With TRANSCODER settings and proper connection between GEOL-2600 and JLT Transcoder/CLAW unit, the RF output from JLT Transcoder/CLAW unit can then be connected to target GPS/GNSS receiver with position and timing solution from GEOL-2600.

This command has the following format:

```
SYSTem:COMMunicate:CSAC:MODE <OFF|QUERY|TRANScoder>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:CSAC:MODE?
```

SYSTem:COMMunicate:CSAC:BAUD <9600|19200|38400|57600|115200|230400|460800|921600>

This command sets the serial speed for the CSAC TTL serial port (pins 12 and 14 of J3 connector).

The serial configuration is always 8 bit, 1 stop bit, no parity, no flow control. The default speed is set at 115200 bauds for CSAC TTL serial port.

This command has the following format:

```
SYSTem:COMMunicate:CSAC:BAUD
<9600|19200|38400|57600|115200|230400|460800|921600>
```

The following command will query the settings of this command:

```
SYSTem:COMMunicate:CSAC:BAUD?
```

SYSTem:SHOW?

This query will return current configuration of all available SCPI commands in ASCII format and separated by line feeds. The response of this query may be copied over to another GEOL-2600 unit to load the same configuration, with minor modifications.

This command is useful for debugging.

SYSTem:STATus?

This query returns a full page of GEOL/GNSS receiver status in ASCII format. The output is compatible with the GPSCon Utility.

This command is useful for debugging.

SYSTem:BUILD?

This query will return the information on GEOL-2600 firmware revision, build date and time.

SYSTem:OPERation:MODE <RECEiver|GEOL-3200>

This command allows the user to configure the operation mode of GEOL-2600 with currently supported RECEIVER and GEOL-3200 modes. The default operation mode is RECEIVER which the GEOL-2600 is configured as receiver with position and timing output solution.

The GEOL-3200 settings will configure the BURST-LOCK settings in "SYNChronization:LOCKed:LEDMODE <LOCK|BURST-LOCK>" on page 48 and TRANSCODER settings in Section 3.9.13 for proper operation of GEOL-2600 and JLT Micro-Transcoder installed inside the JLT GEOL-3200 module.

This command has the following format:

```
SYSTem:OPERation:MODE <RECEiver|GEOL-3200>
```

The following command will query the settings of this command:

```
SYSTem:OPERation:MODE?
```

SYSTem:PWRSAVing:MODE [OFF|DUTY-CYCLE|RF-RECEIVER|SECOND-MCU|GNSS|ALL]

This command allows the user to configure the power saving mode for the system which is recommended for battery-operated or other lower power applications. By enabling ALL power saving mode, power reduction of up to 550 mW may be achieved on GEOL-2600 with expense of reduced peak received and processed burst count down to ~100 bursts per minute.

The default settings is OFF for normal power mode. The ALL settings will enable (and OFF settings will disable) all following power saving options at the same time. Alternatively each individual option can be enabled/disabled separately.

- DUTY-CYCLE: The system periodically enters partial sleeping mode for the ON period of Duty Cycle and returns back to full power consumption for the OFF period of Duty Cycle. See "SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]" on page 62 for period and "SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]" on page 62 for ratio of duty cycle.
- RF-RECEIVER: The system turns off the analog front end RF receiver at any moment when the system is busy processing the bursts.
- SECOND-MCU: The system disables second MCU on the GEOL-2600 by keeping the second MCU in reset state.
- GNSS: The system disables the on-board GNSS receiver by keeping the GNSS receiver in reset state.

This command has the following format:

```
SYSTem:PWRSAVing:MODE <OFF|DUTY-CYCLE|RF-RECEIVER|SECOND-
MCU|GNSS|ALL>
```

The following example command will enable power saving mode for Duty Cycle, RF Receiver, and Second MCU:

```
SYSTem:PWRSAVing:MODE DUTY-CYCLE RF-RECEIVER SECOND-MCU
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:MODE?
```

SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>

This command configures the Duty Cycle power saving mode for the system. With ON settings, the system will periodically enter partial sleeping mode for the ON period of Duty Cycle and return back to normal operation mode for the OFF period of Duty Cycle. The default settings is OFF for normal power mode. Refer to settings configured in "SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]" on page 62 for period and "SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]" on page 62 for ratio of duty cycle.

For example, if period configured in "SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]" on page 62 is 10 seconds and ratio configured in "SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]" on page 62 is 60 for 60%, then system will enter partial sleeping mode for 6 seconds and return back to normal operation mode for 4 seconds.

This command has the following format:

```
SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:DUTYCYCle?
```

SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]

This command configures the duration in seconds for Duty Cycle power saving mode. The parameter is used only when Duty Cycle power saving mode is configured ON in "SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>" on page 62. The power saving period can be configured between 1 seconds and 255 seconds with default settings of 10 seconds. See "SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>" on page 62 for descriptions of Duty Cycle power saving mode and settings configured in "SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]" on page 62 for ratio of duty cycle.

This command has the following format:

```
SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:DUTYCYCle:PERIOD?
```

SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]

This command configures the ON / OFF ratio in percent of period for Duty Cycle power saving mode. The parameter is used only when Duty Cycle power saving mode is configured ON in “SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>” on page 62. The system is in periodic power saving mode during ON time of Duty Cycle.

The power saving duty cycle can be configured between 1% and 99%. The default value for this system parameter is 50%. See “SYSTem:PWRSAVing:DUTYCYCle <ON|OFF>” on page 62 for descriptions of Duty Cycle power saving mode and settings configured in “SYSTem:PWRSAVing:DUTYCYCle:PERIOD [1,255]” on page 62 for period of duty cycle.

This command has the following format:

```
SYSTem:PWRSAVing:DUTYCYCle:RATIO [1,99]
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:DUTYCYCle:RATIO?
```

SYSTem:PWRSAVing:RFRECeiver <ON|OFF>

This command configures the RF Receiver power saving mode for the system. With ON settings, the system will turn off the analog front end RF receiver at any moment when the system is busy processing the bursts. The default settings is OFF for normal power mode.

This command has the following format:

```
SYSTem:PWRSAVing:RFRECeiver <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:RFRECeiver?
```

SYSTem:PWRSAVing:SECONDMCU <ON|OFF>

This command configures the Second MCU power saving mode for the system. With ON settings, the system will disable second MCU on the GEOL-2600 by keeping the second MCU in reset state.

The default settings is OFF for normal power mode.

This command has the following format:

```
SYSTem:PWRSAVing:SECONDMCU <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:SECONDMCU?
```

SYSTem:PWRSAVing:GNSS <ON|OFF>

This command configures the GNSS Receiver power saving mode for the system. With ON settings, the system will disable the on-board GNSS receiver by keeping the GNSS receiver in reset state. The default settings is OFF for normal power mode.

This command has the following format:

```
SYSTem:PWRSAVing:GNSS <ON|OFF>
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:GNSS?
```

SYSTem:MASTERBRIDge

This command will activate the pass-thru serial bridge between Master and Second MCUs of GEOL-2600 and configure In System Programming (ISP) mode for programing the Second MCU.

> **WARNING**
>
> This command will stop normal receiver operation and configured current serial port receiving this command for Second MCU programming mode. See Chapter 5 for firmware upgrade instructions. After time-out of inactivity configured in "SYSTem:MASTERBRIDge:TIMEOUT [5,300]" on page 64, the GEOL-2600 will reset the firmware automatically and resume normal operation mode.

This command has the following format:

```
SYSTem:PWRSAVing:MASTERBRIDge
```

SYSTem:MASTERBRIDge:TIMEOUT [5,300]

This command configures the time-out in seconds for active pass-thru serial bridge between Master and Second MPUs of GEOL-2600. The default settings is 10 seconds.

If no activity is detected for time-out period configured in this command, then GEOL-2600 will reset the firmware automatically for normal operation mode. To apply changes, this command should be configured before activating the Master Bridge with SYSTem:MASTERBRIDge command.

This command has the following format:

```
SYSTem:PWRSAVing:MASTERBRIDge:TIMEOUT [5:300]
```

The following command will query the settings of this command:

```
SYSTem:PWRSAVing:MASTERBRIDge:TIMEOUT?
```

SYSTem:SLAVECONfig <ON|OFF>

This command allows the user to enable/disable Second (Slave) MCU of GEOL-2600. The default settings is ON in which the Second MCU is enabled for burst processing. The Second MCU can be disabled anytime with OFF settings (or enabled with ON settings) and will take effect immediately and the settings is stored in EEPROM.

When the Second MCU is enabled and active, the GEOL-2600 will automatically off load the burst processing task from Master MCU to Slave MCU to expand burst processing capability and maximize burst count. When the Second MCU is disabled or inactive, the Master MCU is responsible for all operations including burst detection and processing. The status of Second MCU can be queried with SYSTem:SLAVESTATus? command.

> **NOTE**
> The Second MCU will consume additional power when active. The Second MCU may be temporarily disabled by SECONDMCU power saving settings configured in "SYSTem:PWRSAVing:MODE [OFF|DUTY-CYCLE|RF-RECEIVER|SECOND-MCU|GNSS|ALL]" on page 61 or "SYSTem:PWRSAVing:SECONDMCU <ON|OFF>" on page 63

This command has the following format:

```
SYSTem:SLAVECONFig <ON|OFF >
```

The following command will query the settings of this command:

```
SYSTem:SLAVECONFig?
```

SYSTem:SLAVESTATus?

This query will return the status of Second (Slave) MCU of GEOL-2600.

Status of 1 indicates that the Second MCU is enabled and active for burst processing. Several factors may cause returned status of 0 including Second MCU being disabled in "SYSTem:SLAVECONfig <ON|OFF>" on page 65, Second MCU temporarily being disabled for power saving in "SYSTem:PWRSAVing:MODE [OFF|DUTY-CYCLE|RF-RECEIVER|SECOND-MCU|GNSS|ALL]" on page 61 or "SYSTem:PWRSAVing:SECONDMCU <ON|OFF>" on page 63, or communication/ hardware failure on the Second MCU.

SYSTem:CPURESET

This command causes the GEOL-2600 processor to reset.

SYSTem:ISP

This command causes the GEOL-2600 processor to reset into In System Programming (ISP) mode for firmware upgrades. Please see Chapter 5 for details on updating the firmware in ISP mode.

Initiating this command is equivalent to shorting the ISP# pin 13 of J3 connector to +3.3V. +3.3V can be found at the end of inductor D3 (between D3 and D4). Then, short pin 15 (RST_IN#) of J3 connector to Ground of the GEOL-2600 board during power-on.

Once the system is placed into ISP mode it will need to be power-cycled or an ISP-Reset command will need to be sent through the ISP programming interface commands to establish a normal operating mode.

SYSTem:FACToryReset ONCE

This command applies the Factory Reset setting to the EEPROM. WARNING: This operation resets all user parameters and clears factory calibration parameters. The GEOL-2600 will also initiate an AUTOMATIC FIRMWARE RESTART after the factory reset for proper re-initialization of the system.

Sending this command once results in a warning message being output. Sending the SYSTem:FACToryReset ONCE command a second time performs the factory reset.

ALERT

This command should not be used during normal field operation.

SYSTem:EEPROMUPDATE ONCE

This command applies the latest Factory default parameters embedded in the GEOL-2600 firmware to the EEPROM. WARNING: This operation overwrites all user parameters and clears factory calibration parameters. The GEOL-2600 will also initiate an AUTOMATIC FIRMWARE RESTART after the EEPROM update for proper re-initialization of the system.

Sending this command once results in a warning message being output. Sending the SYSTem:EEPROMUPDATE ONCE command a second time performs the EEPROM update.

In case of corrupted/non-functional EEPROM, this command is recommended over the SYSTem:FACToryReset ONCE command since this command allows the user to update the GEOL-2600 EEPROM with the latest default parameters.

ALERT

This command should not be used during normal field operation.

SERVO Subsystem

This subsystem regroups all the commands related to the adjustment of the servo loop:

- `SERVo:DACGain <float> [0.001,10000]`
- `SERVo:EFCScale <float> [0.0,500.0]`
- `SERVo:EFCDamping <int> [2,4000]`
- `SERVo:SLOPe <NEG|POS>`
- `SERVo:PHASECOrrection <float> [-500.0,500.0]`
- `SERVo:COARSedac <int> [0,255]`
- `SERVo:1PPSoffset <int> ns [-500000000,500000000]`
- `SERVo:TRACe <int> [0,255]`
- `SERVo:TRACe:SCPI <int> [0,255]`
- `SERVo:LOOP <ON|OFF>`
- `SERVo:CLOCK:STeer <ON|OFF>`
- `SERVo:CLOCK:STeer:INVerse <ON|OFF>`
- `SERVo?`

SERVo:DACGain <float> [0.001,10000]

This command is used for factory setup ONLY.

This command has the following format:

```
SERVo:DACGain [0.001,10000]
```

The following command will query the settings of this command:

```
SERVo:DACGain?
```

SERVo:EFCScale <float> [0.0,500.0]

This command controls the Proportional part of the PID loop. Typical values are 0.2 to 3.0 for different 1PPS reference inputs. Larger values increase the loop control at the expense of increased noise while locked. Setting this value too high can cause loop instabilities.

This command has the following format:

```
SERVo: EFCScale <float> [0.0,500.0]
```

The following command will query the settings of this command:

```
SERVo:EFCScale?
```

SERVo:EFCDamping <int> [2,4000]

This command adjusts the damping factor of the Low Pass filter in the DAC control loop. Values from 2.0 to 50 are typically used. Larger values result in less noise at the expense of phase delay. This command has the following format:

```
SERVo:EFCDamping <int> [2,4000]
```

The following command will query the settings of this command:

```
SERVo:EFCDamping?
```

SERVo:SLOPe <NEG|POS>

The parameter determines the sign of the slope between the EFC and the frequency variation of the TCXO. This parameter should be set to match the TCXO's EFC frequency slope which is typically set to POS. This command has the following format:

```
SERVo:SLOPe <NEG|POS>
```

The following command will query the settings of this command:

```
SERVo:SLOPe?
```

SERVo:PHASECOrrection <float> [-500.0,500.0]

This parameter sets the Integral part of the PID loop. Loop instability will result if the parameter is set too high. Typical values are 4.0 to 40.0 for different 1PPS reference inputs. This command has the following format:

```
SERVo:PHASECOrrection <float> [-500.0,500.0]
```

The following command will query the settings of this command:

```
SERVo:PHASECOrrection?
```

SERVo:COARSedac <int> [0,255]

This command sets the coarse DAC that controls the TCXO EFC. The GEOL-2600 control loop automatically adjusts this setting during disciplining and when the SERVo:LOOP? settings is ON.

The user should not have to change this value.

This command has the following format:

```
SERVo:COARSeDac <int> [0,255]
```

The following command will query the settings of this command:

```
SERVo:COARSeDac?
```

SERVo:1PPSoffset <int> ns [-500000000,500000000]

This command sets the GEOL-2600 1PPS signal's offset to UTC in 4.17ns steps. The default offset is 0 ns and maximum configurable 1PPS offset is +/- 500ms.

Using the SERV:1PPS command results in immediate phase change of the 1PPS output signal on pin 7 of J3 connector.

This command has the following format:

```
SERVo:1PPSoffset <int> ns [-500000000,500000000]
```

The following command will query the settings of this command:

```
SERVo:1PPSoffset?
```

SERVo:TRACe <int> [0,255]

This command sets the period in seconds for the debug trace for the currently selected serial port receiving this command. Debug trace data can be used with Ulrich Bangert's "Plotter" utility to show UTC tracking versus time etc.

This command has the following format:

```
SERVo:TRACe <int > [0,255]
```

The following command will query the settings of this command:

```
SERVo:TRACe?
```

An example trace output is described here:

```
Trace: 0 109578 41835.32 127 372.92 334.78 7.47E-10 0.0
0.0000000 2950.31 0.00000 0.00 0 0 1 375.00 0x0
```

```
Trace: [Current Loop][1PPS Count][Fine DAC][Coarse DAC][Raw
UTC offset ns][Filtered UTC offset ns][Frequency Error
Estimate][Reserved][Reserved][Reserved][Reserved][Reserved]
[Reserved][Reserved][Lock Status][Raw 1PPS reference
offset][Health Status]
```

Please see "SYNChronization?" on page 51 for detailed information on how to decode the health status indicator values.

SERVo:TRACe:SCPI <int> [0,255]

This command sets the period in seconds for the debug trace for the TTL SCPI serial port. Debug trace data can be used with Ulrich Bangert's "Plotter" utility to show UTC tracking versus time etc.

This command has the following format:

```
SERVo:TRACe:SCPI <int > [0,255]
```

The following command will query the settings of this command:

```
SERVo:TRACe:SCPI?
```

An example trace output is described here:

```
Trace: 0 109578 41835.32 127 372.92 334.78 7.47E-10 0.0
0.0000000 2950.31 0.00000 0.00 0 0 1 375.00 0x0
```

```
Trace: [Current Loop][1PPS Count][Fine DAC][Coarse DAC][Raw
UTC offset ns][Filtered UTC offset ns][Frequency Error
Estimate][Reserved][Reserved][Reserved][Reserved][Reserved]
[Reserved][Reserved][Lock Status][Raw 1PPS reference
offset][Health Status]
```

Please see "SYNChronization?" on page 51 for detailed information on how to decode the health status indicator values.

SERVo:LOOP <ON|OFF>

This command enables or disables the servo loop. With the loop disabled, no changes are made to the oscillator frequency control.

Disabling the loop is recommended when an external reference oscillator is connected without the capability to discipline this external oscillator. If accessible, the user can connect the EFC output signal at J2 connector to the EFC input pin of the external TCXO or OCXO. By doing so, the GEOL-2600 can discipline this oscillator (see "Initial Operation" on page 22 for more details). Adjustment of the loop time constants is recommended and please refer to "Loop Parameter Adjustment" on page 24 for more details.

Enabling the servo loop will allow for 1PPS disciplining of the internal TCXO or external oscillator with EFC signal connected.

This command has the following format:

```
SERVo:LOOP <ON|OFF>
```

The following command will query the settings of this command:

```
SERVo:LOOP?
```

SERVo:CLOCK:STeer <ON|OFF>

This command will enable or disable the capability to notify the GEOL Kalman filter whenever the internal TCXO is being steered. This command aims to mitigate the frequency feedback loop avoiding the GEOL Kalman filter attempting to re-adjust the clock drift due to the internal TCXO disciplining.

The default settings is ON and the user should not have to change this settings.

This command has the following format:

```
SERVo:CLOCK:STeer <ON|OFF>
```

The following command will query the settings of this command:

```
SERVo:CLOCK:STeer?
```

SERVo:CLOCK:STeer:INVerse <ON|OFF>

This command will enable or disable the inverse sign of steering value on the internal TCXO being reported to the GEOL Kalman filter.

The default settings is ON and the user should not have to change this settings. Please refer to the SERVo:CLOCK:STeer <ON|OFF> command for the capability of notifying the GEOL Kalman filter.

```
This command has the following format:
```

SERVo:CLOCK:STeer:INVerse <ON|OFF>

The following command will query the settings of this command:

```
SERVo:CLOCK:STeer:INVerse?
```

SERVo?

This command returns the result of the following queries:

- `SERVo:LOOP?`
- `SERVo:COARSeDac?`
- `SERVo:DACGain?`
- `SERVo:EFCScale?`
- `SERVo:PHASECOrrection?`
- `SERVo:EFCDamping?`
- `SERVo:SLOPe?`
- `SERVo:1PPSoffset?`
- `SERVo:TRACe?`

4

Firmware Upgrade

The following topics are discussed in this chapter:

Introduction

The following is a short tutorial on how to upgrade the GEOL-2600 firmware. Please follow the instructions in order to prevent accidentally corrupting the GEOL-2600 Flash, which may require reflashing at the factory.

With some practice, the entire Flash upgrade can be done in less than a couple of minutes, even though the following seems like a fairly long list of instructions.

ISP Flash Loader Utility installation

VIAVI recommends using the JLTerm application to upgrade the contents of Flash memory on the GEOL-2600. The JLTerm application can be downloaded for free from the support page at the link provided below. Alternatively, you can also use the STM32ISP utility to perform the same upgrade. The STM32ISP utility is available from JLT upon request.

The JLTerm application is available for download at:

https://www.viavisolutions.com/en-us/software-download/gpscon-controller-software

Putting the PCB into In-Circuit Programming (ISP) mode

Two methods are supported for enabling the GEOL-2600 in System Programming (ISP) mode. Issuing the SCPI command SYST:ISP discussed in Section 3.9.31 in JLTerm or another terminal program causes the board to reset into ISP mode from normal operation. This is automatically done by JLTerm if the “update device firmware...” button is pressed.

Although the JLTerm is recommended, the STM32ISP utility will be useful with hardware ISP entry if the GEOL-2600 has stopped communicating.

The board can also be put into ISP mode by first shorting-out the ISP# pin 13 of J3 to +3.3V. +3.3V can be found at the end of inductor D3 (between D3 and D4). Then, short pin 15 (RST_IN#) of J3 to Ground of the GEOL-2600 board during power-on..

Downloading the firmware

Request the latest version of GEOL-2600 firmware as well as downloading JLTerm from the VIAVI support page and store it in a place that will be remembered. The firmware file should be in .hex format. The unit needs to be connected to the computer’s USB serial port prior to firmware download. The GEOL-2600 is Micro-USB compatible. The firmware can also be upgraded via the SCPI TTL serial port when using JLTerm.

Using the JLTerm programming terminal

1. Download the JLTerm application from https://www.viavisolutions.com/en-us/software-download/gpscon-controller-software. Install and open the JLTerm application.
2. Select the COM port in JLTerm as needed on your PC.

   Once a successful connection is established, the connection icon becomes green, as shown in Figure 7. The PNT-62xx must be in normal operation with working SCPI communication prior to JLTerm connection.

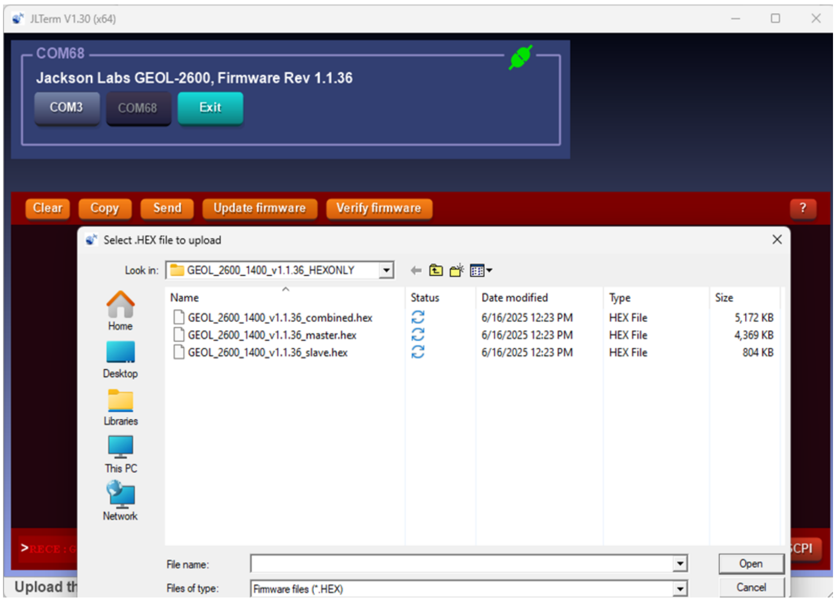
> **NOTE**
>
> If there is no valid response from the COM port, check for valid driver and port number for the COM port in the Device Manager on your computer. The COM poer number may be conflicting with another COM port device. Each device should have a different COM port. Ensure GPSCon is not running in the background and using the same COM port.

Figure 7 Successful connection

   If necessary, change the COM port number, install or update the driver, and unplug and reconnect the serial cable, then try to establish a connection again.

3. Once the device is connected in JLTerm, click the orange **Update device firmware...** button.
4. Choose the correct hex file to program the device and click **Open** in the pop-up, as shown in Figure 8. The firmware automatically downloads and the board is reset.

Figure 8 Open Hex file and download firmware



5 If an error occurs during the programming process:

a Check the USB cable connection.

b While the unit is still in ISP mode after the error occurred, follow the steps in “Using the STM32ISP programming utility” on page 76 and attempt to finish the firmware upgrade using the STM32ISP programming utility.

Figure 9 shows an error in programming.

Figure 9 Error in programming

Using the STM32ISP programming utility

The following procedures describe how to use the STM32ISP programming utility.

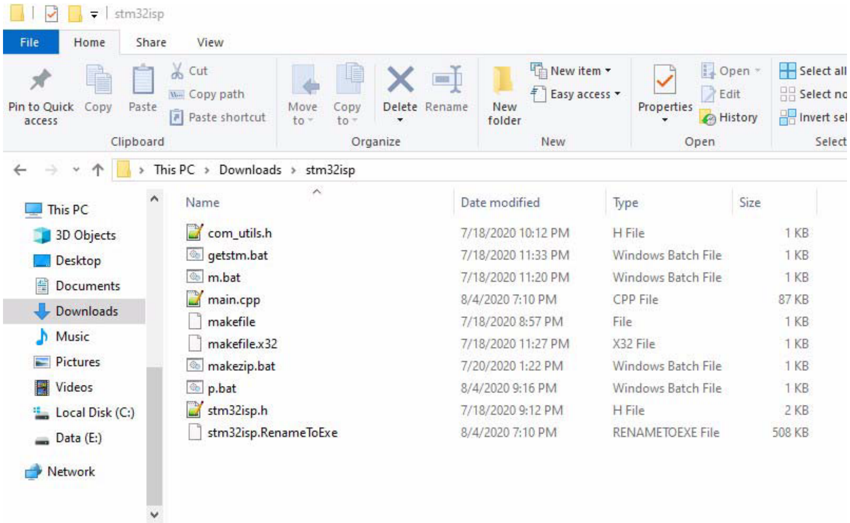
To prepare to use the STM32ISP programming utility

1 If:

- **a** The SCPI interface on GEOL-2600 board is not communicating properly, put the GEOL-2600 into ISP mode. See **LINK** for instructions to do so using the ISP and RESET# pins on connector J3.
- **b** The GEOL-2600 board can communicate and accept the SCPI command, send the SYST:ISP command on a terminal program with current baud rate

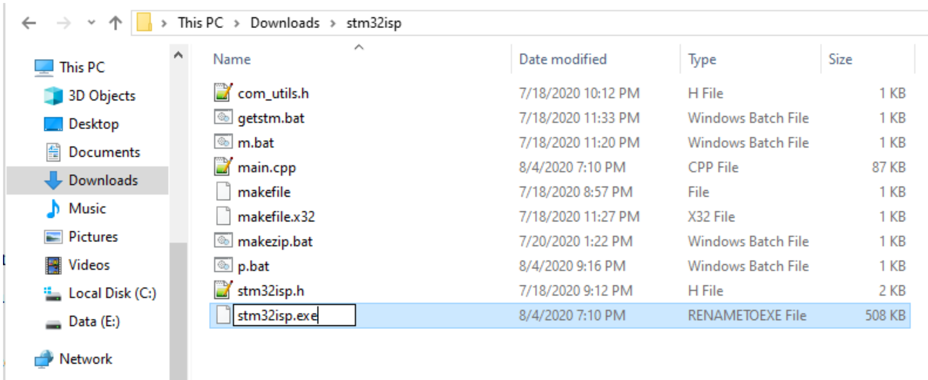
2 Request the latest STM32ISP utility and programming script from JLT. Install and open the STM32ISP utility folder as shown in Figure.

Figure 10 STM32ISP utility folder



3 Rename the file stm32isp.RenameToEXE to stm32isp.exe, as shown in Figure.

Figure 11 Rename stm32isp.RenameToExe file



4 Open the provided dual_mcu.bat file with a text editor.

> **NOTE**
> If the dual_mcu.bat file was not provided, create the file using a text editor to copy the contents of Figure.

5 Modify the file to point to correct path, file names, COM port, and baud rate to allow the utility to program the GEOL-2600. The command must have either of the following formats:

   a *`stm32isp, COM#, programming baud, write and/or verify, path of HEX file, and starting address after programming`*

   b *`stm32isp, COM#, connection baud, send, and SCPI command to be sent`*

   The following is an example command:

   `stm32isp_v3.22 COM29 921600 WRITEREAD`

   `C:\Downloads\GEOL_2600_1400_v4.053_combined.hex,master 0x08000000`

   Figure shows a command format for reference.

Figure 12 Example dual_mcu.bat file

```
C: > Users > JLT > STL-2600_Programming > dual_mcu.bat
@echo off

stm32isp_v3.22 COM29 921600 WRITE,NOPAUSE STL_2600_1400_v4.053_combined.hex,master 0x08000000 && ^
timeout 5 && ^
stm32isp_v3.22 COM29 921600 SEND,NOPAUSE "SYST:MASTERBRIDGE" && ^
timeout 3 && ^
stm32isp_v3.22 COM29 460800 WRITE,NOPAUSE STL_2600_1400_v4.053_combined.hex,slave 0x08000000
```

6 Save and close the dual_mcu.bat file.

7 Open the Windows Command Prompt :

   a In the Windows search bar, type **`cmd`.**

   b Select the Command Prompt application.

8 Navigate to the directory containing the stm32isp.exe utility by entering the cd command along with the file path for the stm32isp folder, as shown in figure.

Figure 13 Navigate the Windows command prompt

```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.19041.1165]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>cd ..\..\Users\JLT\STL-2600_Programming

C:\Users\JLT\STL-2600_Programming>
```

9 Type **dual_mcu.bat** in the Command Prompt application and press the **Enter** key.

   In the Command Prompt window, you will observe the firmware being downloaded to the processor with steps shown in Figure 4.8. Once the firmware has completed downloading press any key on your keyboard to continue.

Figure 14 Successful STN32ISP Dual_MCU download

```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.19042.1348]
(c) Microsoft Corporation. All rights reserved.

C:\Users\JLT\STL-2600_Programming>stm32isp_v3.22 COM29 921600 WRITE,NOPAUSE STL_2600_1400_v4.053_combined.hex,master 0x08000000

stm32isp version 3.22

   File: STL_2600_1400_v4.053_combined.hex (11/15/2021 7:12:12 PM)
Section: master
   Port: \\.\COM29
   Baud: 921600
 Bank 0: 819712 bytes at 0x08000000
 Bank 1: 751360 bytes at 0x08100000
  Start: 0x08000000

Synchronizing with device at COM29...
STM32 UART bootloader version = 3.1
STM32 device ID = 0x450
Preparing device memory for writing...
Erase in progress...
 Device memory successfully prepared for writing
Uploading bank 0 data...
  100% complete
Bank 0 data successfully uploaded
Uploading bank 1 data...
  100% complete
Bank 1 data successfully uploaded
Executing at 0x08000000...

C:\Users\JLT\STL-2600_Programming>stm32isp_v3.22 COM29 921600 SEND,NOPAUSE "SYST:MASTERBRIDGE"

stm32isp version 3.22
Transmitting: `SYST:MASTERBRIDGE`
Received:
scpi >
scpi > SYST:MASTERBRIDGE
Warning: This command stopped normal receiver operation and
configured current serial port for Slave CPU programming mode.
Follow instructions in user manual for firmware upgrade.
After timeout of inactivity, the system
Received:  will reset automatically
and resume normal operation mode.


C:\Users\JLT\STL-2600_Programming>stm32isp_v3.22 COM29 460800 WRITE,NOPAUSE STL_2600_1400_v4.053_combined.hex,slave

stm32isp version 3.22

   File: STL_2600_1400_v4.053_combined.hex (11/15/2021 7:12:12 PM)
Section: slave
   Port: \\.\COM29
   Baud: 460800
 Bank 0: 349696 bytes at 0x08000000
 Bank 1: 520192 bytes at 0x08100000

Synchronizing with device at COM29...
STM32 UART bootloader version = 3.1
STM32 device ID = 0x450
Preparing device memory for writing...
Erase in progress...
 Device memory successfully prepared for writing
Uploading bank 0 data...
  100% complete
Bank 0 data successfully uploaded
Uploading bank 1 data...
  100% complete
Bank 1 data successfully uploaded

C:\Users\JLT\STL-2600_Programming>
```

10 Verify the firmware update as described in **LINK.**

Verifying the firmware update

1 Power cycle the unit with the pin 13 of J3 (ISP) and pin 15 of J3 (RESET#) left floating.

2 During power on, the unit sends an ID string out of the USB serial port at 921600 Baud (115200 Baud for SCPI TTL serial port) by default. The firmware version can also be queried by sending the *IDN? command.

3 Verify that the firmware revision number that was downloaded.

> **NOTE**
>
> If errors occur repeatedly during the steps in "Using the JLTerm programming terminal" on page 75 and/or "Using the STM32ISP programming utility" on page 76, contact VIAVI support.

5

GPSCon Utility

The following topics are discussed in this chapter:

Description

GPSCon – VIAVI Edition is a free program for the monitoring and control of VIAVI GPSDO, Simulator, and Receiver products. It communicates with the receiver using the SCPI command set. This free version of the GPSCon utility is only compatible with VIAVI products, and is available for download from the following website:

https://www.viavisolutions.com/en-us/software-download/gpscon-controller-software

Installation

Extract the contents of the ZIP file downloaded from the VIAVI website and execute the MSI installer. Follow the on-screen instructions to complete the installation of GPSCon.

GEOL-2600 serial port config before using GPSCon

The GEOL-2600 baud rate of up to 921600 is now supported in latest version of GPSCon utility, however several settings are required for smooth connection with GPSCon including ON settings in SYSTem:COMMunicate:SERial:ECHO <ON|OFF> and SYSTem:COMMunicate:SERial:PROmpt <ON|OFF> commands, clean serial port with no periodic/NMEA output messages.

If current connected serial port is USB port and some periodic messages are still enabled, the SYSTem:COMMunicate:SERial:OUTput <USBOFF|SCPIOFF|ALLOFF> command with USBOFF settings can be used to disable all messages on USB port. Similarly, the SCPIOFF settings will disable all messages on SCPI port. Connect current selected serial port and correct COM port to a terminal program (TeraTerm is recommended), send necessary command(s) listed above to the GEOL-2600, then disconnect TeraTerm.

Start GPSCon using the correct COM port for GEOL-2600.

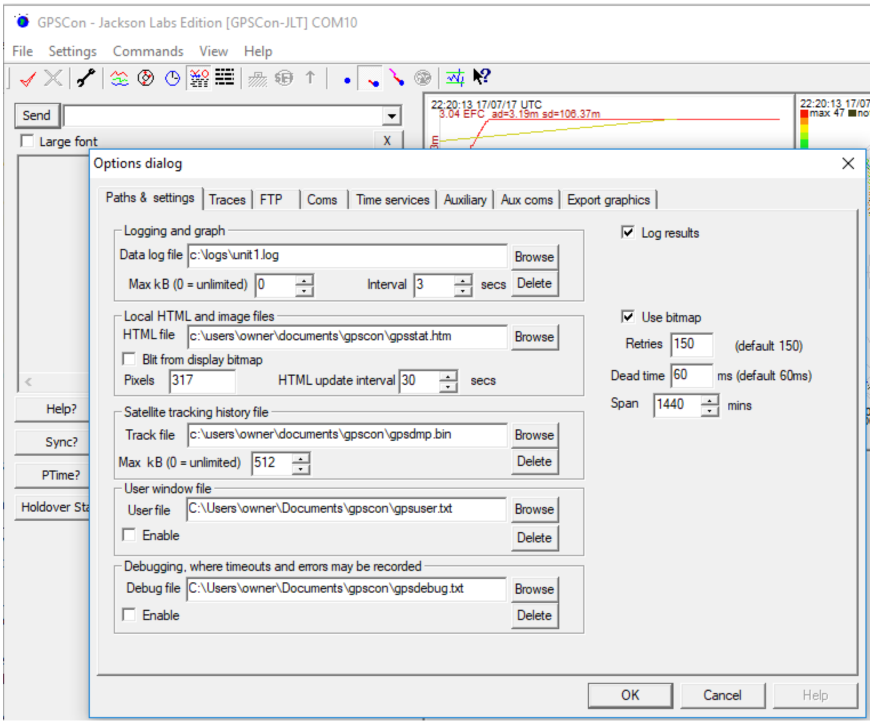
Using GSPCon

The GPSCon utility has a help file that should be consulted in order to get the full functionality of this utility. Only a few of the features and commands are mentioned in this appendix for convenience.

Setting options

To set up the options for your GPSCon session, press the wrench icon under the menu bar, or select Settings / Options on the menu. The window shown in Figure 15 will appear. You can select from the tabs which options you wish to set.

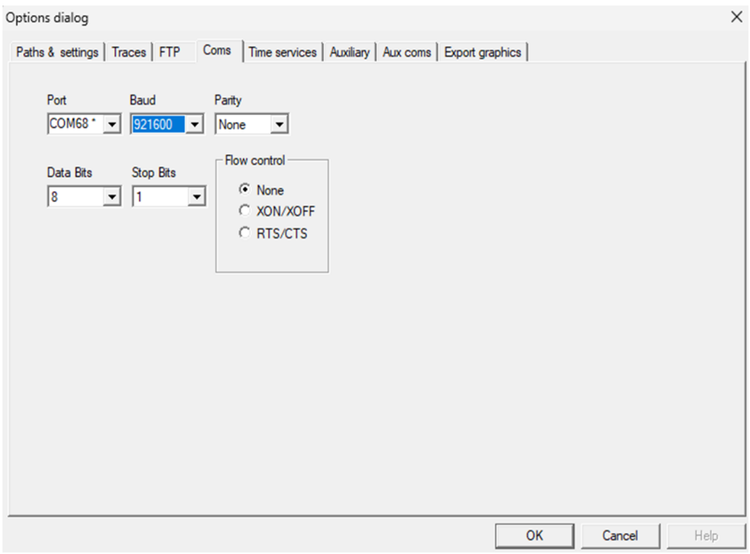
Figure 15 Options window



Communication parameters

Before you can use GPSCon, you must set the communication parameters for your system. Open the dialog box by pressing the wrench icon, then select the **Coms** tab. The Options window opens on the Coms tab, as shown in Figure 16.

Figure 16 Coms parameters tab

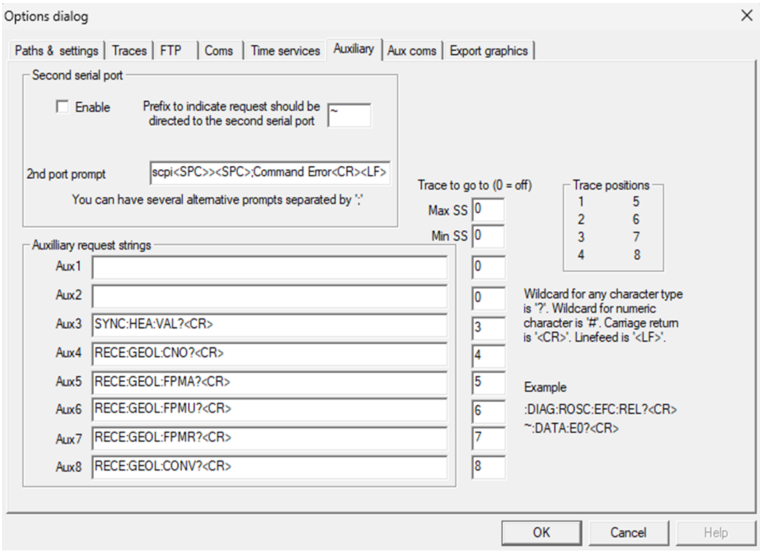


Available COM ports for your particular computer are indicated with a "*" symbol next to the COM port number in the drop-down menu. You can only select COM ports with this adjacent symbol. Select the correct COM port for your computer's serial port connection and set the baud rate to 115200, parity to None, Data Bits to 8 and Stop Bits to 1. Set Flow Control to “None”. Once you have configured the communication parameters, press the “OK” button to close the window.

Auxiliary parameters

After pressing the wrench icon , you can select the **Auxiliary** tab to configure auxiliary measurements. Figure 17 shows an example of an auxiliary measurement.

Figure 17 Auxiliary parameters tab

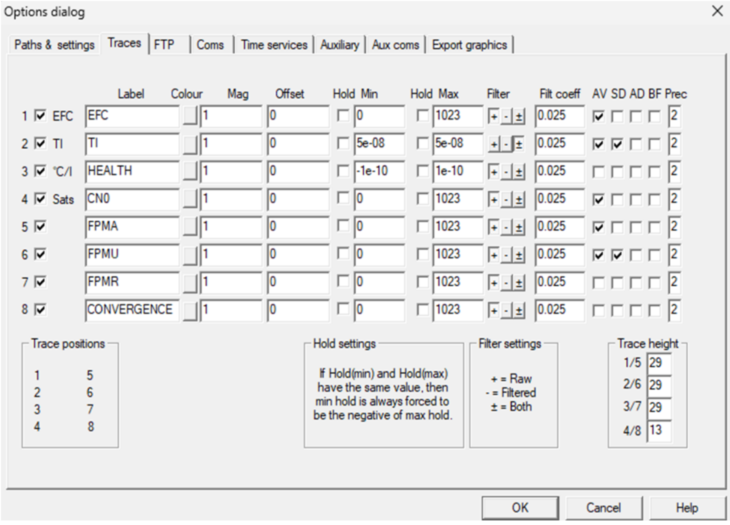


In the above example, the **Aux1** request string has been set to `GPS:GEOL:BPMP?<CR>` and the **Aux2** request string has been set to `GPS:GEOL:BPMR?<CR>`. The **Trace to go to** is set to trace positions 7 and 8 respectively. See the **Trace Position** diagram for the arrangement of the trace positions in the trace window. In this example, the bursts process and recevied obtained from the `GPS:GEOL:BPMP?` and `GPS:GEOL:BPMR?` queries will be plotted in trace position 7 and 8.

Traces parameters

After pressing the wrench icon , you can select the **Traces** tab and configure the trace labels and vertical plot ranges. Figure 18 shows an example of the trace parameter tab.

Figure 18 Traces parameters tab

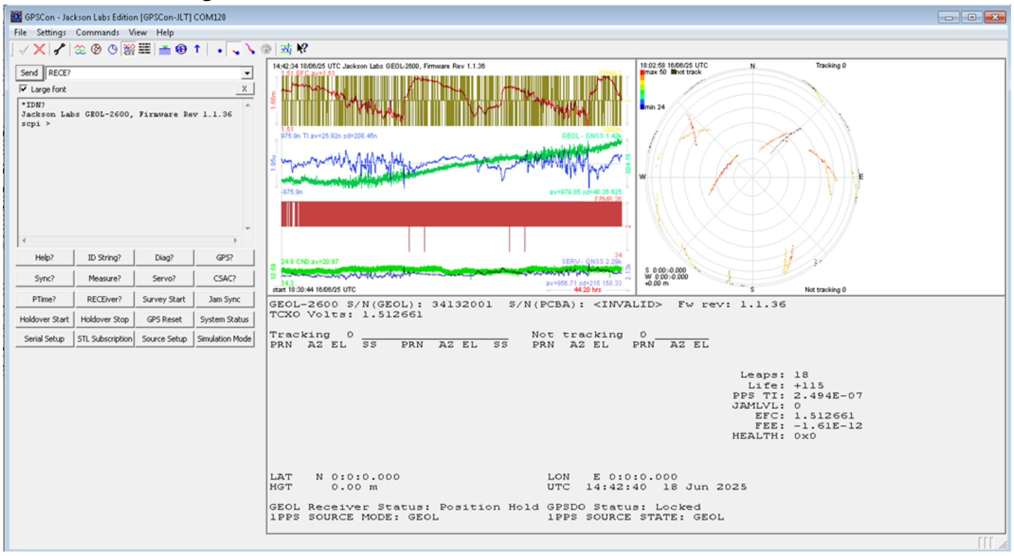


The labels and parameters are completed by default for traces 1 through 5. Any of the eight traces can be replaced by auxiliary traces as described in "Auxiliary parameters" on page 84. Press the **Help** button for a full description of each option in the Traces tab.

Sending manual commands to the receiver

You can send SCPI commands manually by using the drop-down box in the upper left of the main window, as shown in Figure 19.

Figure 19 Sending manual commands



Once a command is selected, press **Send** to send it to the GEOL-2600. You can also send common commands by clicking on the buttons below the message window. Hover over the buttons to see the exact command that is sent.

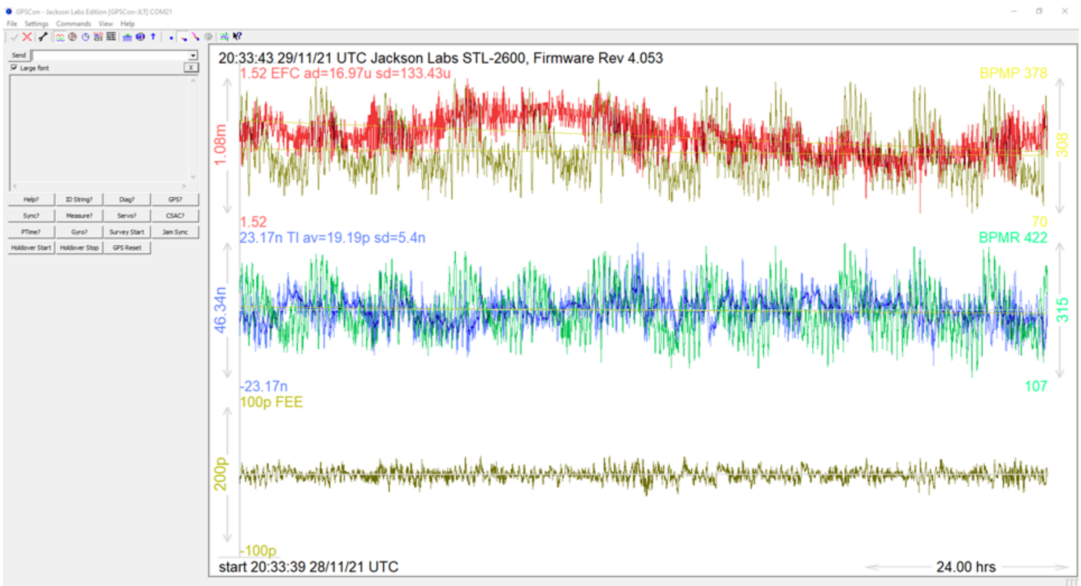
If the desired SCPI command is not listed in the drop-down box or command section, you can manually type the command in the text box and press the “Send” button.

> **NOTE**
> Ensure the selected command is supported by the GEOL-2600.

Using the mouse in the Graph display

Figure 20 shows the Graph display. The default view in GPSCon is **All**, which you can select with the **View/All** menu option. To see a larger view of the graph, select the View/ Graph menu option.

Figure 20 Graph display



You can set the horizontal range of the graph using the mouse. Perform the following steps to set the horizontal range.

1. Set the start time by clicking on the point that marks the left side of the curve to be magnified.
2. Set the stop time by right-clicking on the point that marks the right most portion of the magnified curve.

> **NOTE**
> The Set and Stop times can be removed by double-clicking anywhere on the graph.

3. Return to the “Fit to window” view by double left-clicking on the curve.

When you have locked the start and stop time using the mouse, you can scroll left or right through the data:

- To scroll to a later time, use Shift + Left click
- To scroll to an earlier time, use Shift + Right click

Exporting graphics

The settings which control the export function are contained in the “Export graphics” tab in the Options dialog.

Export allows you to create an image file of the graph and/or the satellite trails map. You can select which you want by specifying a file for the Graph path and/or Map path. If you export the graph, you have the option to export only that which is currently visible, or to export the graph which is a plot of the entire logfile contents. Use the checkbox “Export all graph data” to make this choice.

You may select a size of the exported images in X and Y. The file format may be .BMP, .JPG, .GIF, or .PNG. Your settings will be stored and will be the default next time you open this dialog.

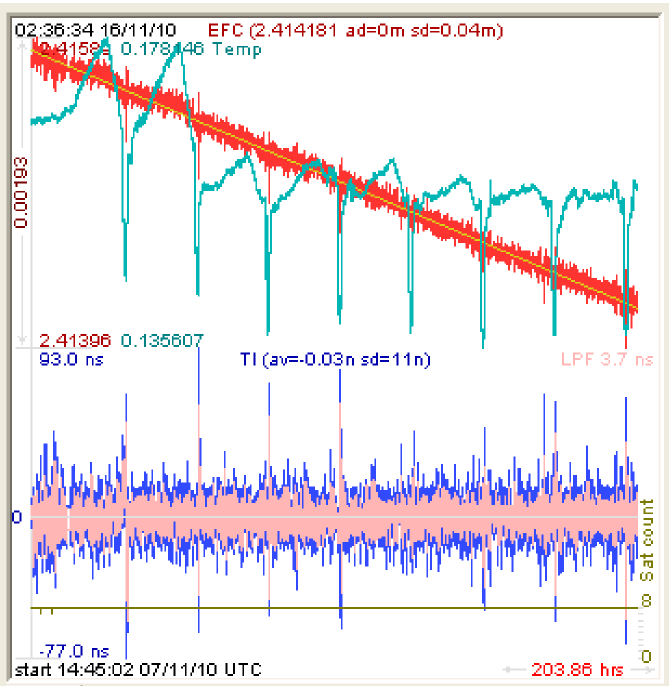
If you choose to export the graph, you can override the TI max setting in force on the screen display by entering a non-zero value into the 'Override TI' control. A value of zero causes the export to take the same setting if any as the screen display.

- To export automatically on a timed basis, enter a non-zero value in seconds to choose an export time interval.
- To manually export in accordance with the settings, press the 'Export' button.

Interpreting the Data

Figure shows an example of data acquired by a GPSDO unit over a period of time of more than 200 hours.

Figure 21 Captured data example



The red trace is EFC (crystal frequency control voltage). The crystal is aging (becoming faster in frequency over time). This requires the control voltage to be lowered to maintain precisely 10.0 MHz. A drift of ~2 mV is visible over 200 hours. On the left side of teh screen, the EFC range over this 200 hour plot is displayed vertically as 0.00193 V. This means the drift of the EFC voltage due to aging is ~88 mV per year. The EFC sensitivity of the crystal is about 8 Hz per volt, so the crystal ages at:

8Hz/V * 0.088V/Year = 0.704Hz/Year drift

At 10 MHz:

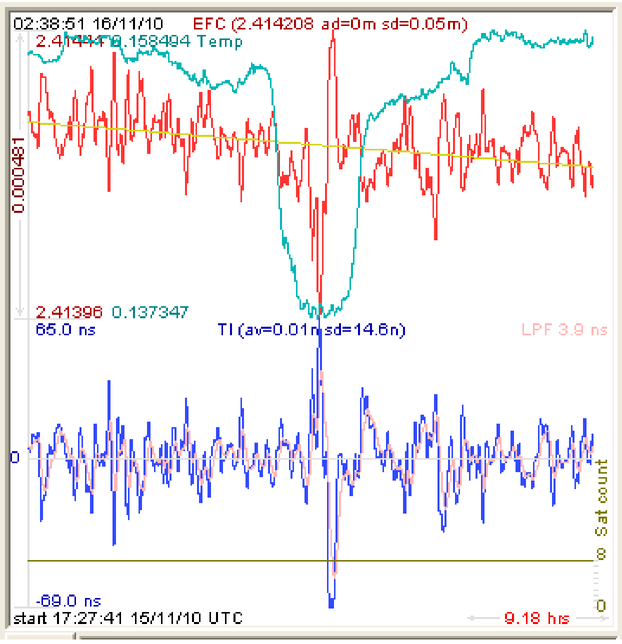
0.704Hz / 10MHz = 7.04E-08 aging rate per year

This is the same as 0.2ppb drift due to aging per day.This crystal aging is fully compensated by the firmware with and without GPS reception of course.

The board temperature is shown in tortoise. We can see it ranges from 0.135607A to 0.178146A. The OCXO current jumps lower every 24 hours because the unit is sitting next to a window, and the sun shines onto the OCXO in the evenings, heating it up, and thus making the unit use lower power during that event.

Figure 22 shows a zoom of the captured data.

Figure 22 Zoomed captured data example



The image shows a phase offset error of the internal OCXO to the UTC GPS reference. The maximum drift is -77 ns to +93 ns. The average is (TI_{av} = -0.03 ns). The standard deviation over the 200 hour plot is sd = 11 ns. This means the average error of the 10 MHz phase of this unit over 200 hours is only +/- -11 ns. Or, in other words, the average jitter (wander) over 200 hours is:

11ns / 200Hrs = 1.528E-014

The unit performs as well as a high quality Cesium Atomic reference clock over long periods of time. The unit disciplines its internal 10MHz reference to within less than +/-

80ns peak to peak of UTC at all times, which is less than one complete clock cycle at 10MHz.

22188644
R000, June 2025
English

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