VersaPNT®

User Manual

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Warranty Information

For a copy of Spectracom's Limited Warranty policy, see the Spectracom website: http://spectracom.com/support/warranty-information.

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CHAPTER 1

Product Description

The Chapter presents an overview of the VersaPNT Position Time and Frequency Synchronization System, its capabilities, main technical features and specifications.

The following topics are included in this Chapter:

1.1 Getting Started

Figure 1-1: VersaPNT Rugged GPS Time & Frequency Reference

Welcome to the VersaPNT User Manual .

First steps:

- If you are not yet familiar with VersaPNT, you may want to start here: Product Overview.
- If you are ready to begin the installation process, see: "Initial Network Setup" on page 29
- If your unit is already up and running, and you would like to change specific settings, see ...
  - ... "Managing Location" on page 117
  - ... "Managing Time" on page 149, or
  - ... "System Administration" on page 215.

1.2 VersaPNT Overview

VersaPNT is a high-performance position, navigation, time, and frequency GPS master clock and network time server that delivers accurate, software-configurable time and position signals under all circumstances, including GNSS-denied environments. Its compact size and high level of ruggedization make VersaPNT suitable for mobile applications in harsh environments. VersaPNT's small footprint allows for easy integration of the time, position, and navigational functionality into systems architecture.

VersaPNTis equipped with a GPS-aided high-performance Inertial Navigation System (INS). This MEMS-based unit incorporates 3-axis accelerometers, gyros, magnetometer (all of which are 3-axis), as well as a barometric pressure sensor, a temperature sensor and two separate 50-channel L1 GPS receivers.

VersaPNT also includes all the timing functionality required in modern, network-centric applications:

- NTP/PTP precise time transfer over Ethernet, including security protocols that prevent network vulnerabilities
- Low phase noise 10 MHz frequency distribution
- Configurable pulse signals, including IRIG or HaveQuick timecodes
- Serial link Time Of Day (ToD) messages

GPS-Denied Environments

VersaPNT combines GNSS-aided inertial navigation with high-performance internal sensor to manage potential loss of GNSS.

VersaPNT also accommodates an OCXO oscillator, allowing the unit to maintain frequency and time accuracy for long periods of GPS/GNSS outage. In addition, it can be re-synchronized by an external reference.

Reliable, Versatile, and Configurable

VersaPNT physical inputs and outputs are software-configurable and can adapt to various application requirements. I/O pins can be configured as TTL, 10 V pulse, RS232, RS422, and RS485. This allows VersaPNT to provide a high number of outputs of the same type, while still fitting into a small form factor.

Due to its high level of ruggedization, VersaPNT provides very high intrinsic reliability. Strong status monitoring capability, either locally or remotely, allows quick fault diagnosis. Physical alarm (dry contact) and network alarms (SNMP traps) are raised in real time. An internal, exportable log can be accessed either locally or remotely. In addition to oscillator options (OCXO), VersaPNT is available with a C/A L1 GPS receiver or with an L1/L2 SAASM receiver. Pulse outputs are configurable through the web user interface ("Web UI"). An extension slot is available to accommodate additional timing interfaces.

Typical Applications

- **Airborne**: Observation payload (radars, optronics, electronic warfare), flying test bench, flight analysis
- **Ground**: Satcom On the Move (SOTM), anti-IED jamming systems, mobile radios and C3I, robotics
- **Marine**: Sensor support (radars, sonars, optronics, electronic warfare), communication networks, offshore/DSO platforms, buoys

1.3 Status LEDs

VersaPNT's front panel status LEDs provide a real-time status overview: Eight (8) LEDs indicate the unit's current operating state:

The LEDs can be disabled, see "Blackout Mode" on page 6.

1.3.1 Blinking Intervals

The status LEDs can communicate five different operating states:

- **"OFF"**
- **"ON"**
- **"FAST"**: blinking interval @ 8Hz
- **"SLOW"**: blinking interval @ 2Hz
- **"HEARTBEAT"**: sinus-shaped interval @ 1Hz

1.3.2 LED Lighting Patterns

The table below indicates LED status light patterns for common VersaPNT operating statuses.

Table 1-1: Common light patterns

Start-up	HEARTB.	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Acquiring fix	FAST	FAST	FAST	FAST	FAST	FAST	HEARTB.	FAST
Software upgrade	FAST	OFF	OFF	FAST	OFF	FAST	HEARTB.	OFF

1.3.3 Legend, individual LEDs

Table 1-2: Legend for Status LEDs

Icon	Light	Meaning
	OFF	No power
	HEARTBEAT	Booting
	ON	Powered
	OFF	No GNSS reception (0 satellites)
	HEARTBEAT	GNSS acquisition in process (≥ 1 satellite(s), or 1PPS OK, or Time OK
	SLOW	Jamming detected
	FAST	Antenna short circuit
	ON	GNSS is available as reference (1PPS and Time OK)
	OFF	Inputs not detected/all inputs are disabled
	FAST	1 or more input is missing, or invalid timing on 1 or more input detected
	ON	Inputs are enabled
	OFF	Unit is in Holdover (valid)
	ON	System Clock OK (valid)
	FAST	Invalid Time (Holdover period exceeded, or oscillator damaged)
	OFF	No output signal(s) detected/all outputs are disabled
	FAST	Malfunction detected (short circuit, or overload)
	ON	Outputs are enabled
	OFF	No network detected
	FAST	Network malfunction detected (e.g., no auto-negotiation)
	ON	Network OK, configuration OK
	OFF	Unit OK
	FAST	Unit requires attention; check other status LEDs, see Web UI
	HEARTBEAT	See table "LED Lighting Patterns" on the previous page
	OFF	Temperature OK
	FAST	High temperature detected

1.3.3.1 LED Patterns during Boot Sequence

For the first five seconds after power-up all LEDs will be OFF. Then the Power LED will be blinking before it will be lit permanently. If you have configured your unit to operate in Blackout Mode, this will take effect once the blinking cycle ends.

1.3.4 Blackout Mode

All LEDs can be turned off via the Web UI.

The LED brightness level can be set from 63 (as bright as possible) to 0 (not visable).

To disable all LED activity via the WebUI:

» Navigate to **MANAGEMENT > OTHER: LED Configuration**, and set the Brightness level to "0".

1.4 Interfaces Overview

All of VersaPNT's interfaces are integrated into the unit's connectors, which are located on the front panel:

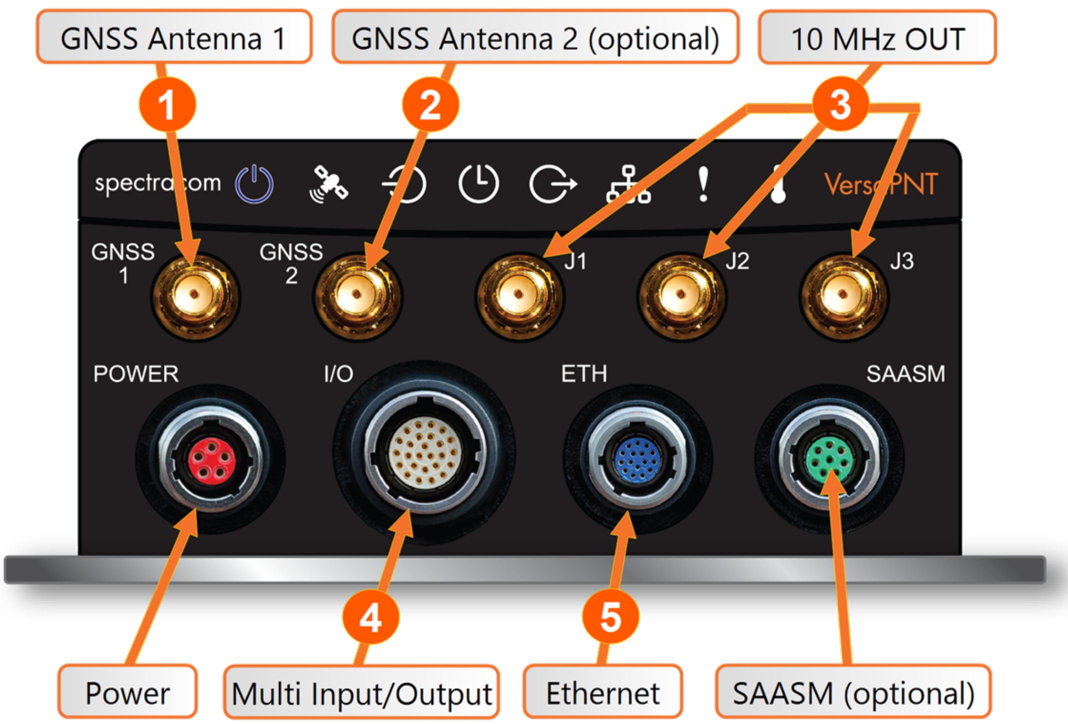


Figure 1-2: VersaPNT front panel connectors

Note: VersaPNT is highly configurable and the connections can be adjusted many different ways. Your interface configuration may vary based on options you selected during the ordering process.

The following interfaces are provided:

1.4.1 Input Timing Interfaces

Table 1-3: VersaPNT timing inputs

INPUT SIGNAL	Total available	DCLS		RS-232	RS-485	ETH	Connector No. (see Fig. above)
		TTL	10V				
1PPS	(1)	1					4
ASCII/HaveQuick/IRIG B	(1)				1		4
ASCII/NMEA	(1)			1			4
Network Interface (10/100/1000bT): NTP (Stratum 2), PTP	(2)					1	5

1.4.2 Output Timing Interfaces

Table 1-4: VersaPNT timing outputs

OUTPUT SIGNAL	Total available	DCLS		RS- 232	RS-485	ETH	Connector No. (see Fig. above)
		TTL	10V				
10 MHz	(1+3)	SMA					3
1PPS	(2)	1	1				4
ASCII/HaveQuick	(1)				1		4
ASCII/NMEA	(1)			1			4
NTP server, PTP v2 master	(1)					1	5

All **Multi I/O** interfaces (connector no. 4) are software-configurable, see "Assigning I/O Pins" on page 39.

1.4.3 Navigation Inputs & Outputs

The following VersaPNT options apply to the INS option board. The standard INS OUT connection will communicate your position and navigation information, while the Options 1-8 provide additional information via the multi I/O connector:

Table 1-5: Navigation input and output options

SIGNAL TYPE	Option Number/ Channel Position	DCLS	RS-232	RS-422 (n or p)	Connector No. (see Fig. above)
		TTL			
INS OUT	Channels 1, 4, & 6		1		4
PPS IN	Option & Channel 1	1			4
PPS OUT	Option & Channel 2	1			4
GPS IN	Option & Channel 3		1		4
GPS OUT	Option & Channel 4		1		4
IMU IN	Option & Channel 5			1 (p)	4
IMU IN	Option & Channel 6			1 (n)	4
IMU OUT	Option & Channel 7			1 (p)	4
IMU OUT	Option & Channel 8			1 (n)	4

For additional information on configuring pinouts, see "Connectors and their Pinouts" on the facing page and "Configuring I/O Settings" on page 43.

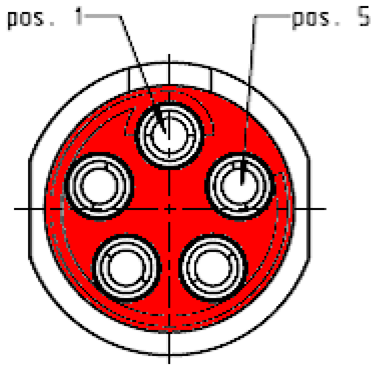
1.4.4 Other Interfaces

» USB serial equivalent: CLI interface (Connector 4)

1.5 Connectors and their Pinouts

All of VersaPNT's connectors are provided at the front panel of the unit, below the Status LEDs. The Advanced Military Connectors are keyed for foolproof connectivity and offer a push-pull locking mechanism.

1.5.1 Power Connector



Note: View in mating direction from front.

Table 1-6: Power connector pinout

Pin	Signal
1	V_{Main} (10 to 32 V)
2	V_{Main} (10 to 32 V)
3	V_{Batt} (10 to 32 V)
4	GND
5	GND

1.5.2 Input/Output Connector

VersaPNT has a 26-pin input/output connector that offers 8 software-configurable CHANNELS, plus one fixed DCLS channel, and a USB interface. To learn more about types of interfaces and signals, and how to configure them, see "Assigning I/O Pins" on page 39.

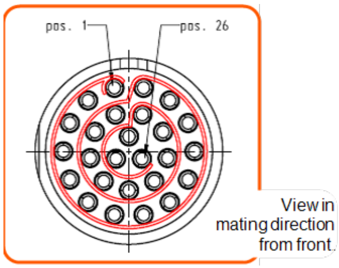
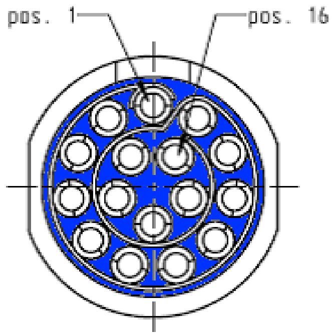


Table 1-7: Default I/O connector pinout

Pin	Channel	Signal	Pin	Channel	Signal
1	0	1PPS output (5V)	15	7	Have Quick output (RS-485 signal +)
2		GND	16		GND
3	1	Have Quick input (RS-485 signal +)	17	8	Have Quick output (RS-485 signal –)
4		GND	18		GND
5	2	Have Quick input (RS-485 signal –)	19	9 (USB dedicated)	GND
6		GND	20		GND
7	3	1PPS output (10 V)	21		Not connected
8		GND	22		GND
9	4	ASCII output (RS-232)	23		USB D–
10		GND	24		GND
11	5	1PPS input	25		USB D+
12		GND	26		GND
13	6	ASCII input (RS-232)			
14		GND			

1.5.3 Ethernet Connector



Note: View in mating direction from front.

Table 1-8: Ethernet connector pinout

Pin	Signal	Pin	Signal
1	Ethernet_1 A+	9	Ethernet_2 A+
2	Ethernet_1 A–	10	Ethernet_2 A–
3	Ethernet_1 B+	11	Ethernet_2 B+
4	Ethernet_1 B–	12	Ethernet_2 B–
5	Ethernet_1 C+	13	Ethernet_2 C+
6	Ethernet_1 C–	14	Ethernet_2 C–
7	Ethernet_1 D+	15	Ethernet_2 D+
8	Ethernet_1 D–	16	Ethernet_2 D–

1.5.4 Optional I/O Connector

The Optional I/O connector is used in conjunction with the Option Board that is available for VersaPNT. If the unit is not equipped with an Option Board, this connector is not used.

1.5.5 Coaxial Connectors

VersaPNT offers five (5) coaxial connectors, three (3) of which can be configured at the factory to accommodate requirements for e.g., IRIG AM signals or additional 10 MHz outputs. The minimum configuration includes the **GNSS antenna** and a **10 MHz sinewave** output.

Unless otherwise ordered at the factory, all coaxial connectors (aside from the GNSS connection) produce a 10MHz output that is not software configurable.

All coaxial connectors are **standard SMA connectors**.

Mating Connector Plugs

The table below lists the part numbers for the mating connectors. The connectors can be ordered through Spectracom or ODU-USA Inc. All connectors are circular ODU AMC® "mil-type" connectors.

Table 1-9: Connector Part Numbers

Ref	Description	VersaPNT Connector		Mating (Cable) Connector	
		Spectracom Part No.	ODU Part No.	Spectracom Part No.	ODU Part No.
POWER	Power connector, 5 pin	J240R-0051-002Q	GK1YBR-P05UJ00-000L	P240R-0051-002Q	S11YBR-P05XJG0-0000
I/O	I/O connector, 26 pin	J240R-0261-002F	GK2YAR-P26UC00-000L	P240R-0261-002F	S12YAR-P26XCD0-0000
ETH	Ethernet connector, 16 pin	J240R-0161-002F	GK1YCR-P16UC00-000L	P240R-0161-002F	S11YCR-P16XCD0-0000
SAASM	Optional I/O connector, 8 pin	J240R-0081-012F	GK1YDR-P08UF00-000L	P240R-0081-002F	S11YDR-P08XFG0-0000

1.5.5.1 ODU® ordering contact information (USA):

- ODU-USA Inc.
  4010 Adolfo Road
  Camarillo, CA 93012
  United States of America
  Phone: +1 (805) 484 0540
  Fax: +1 (805) 484 7458
  Email: sales@odu-usa.com

> **Note:** Building the mating cables requires special tools. Contact ODU for cable assemblies. Be advised that typical lead times are 12 to 16 weeks.

ETHERNET connector wiring:

- 1 through 8: A Ethernet Connect, 4 pairs, 1000bT
- 9 through 16: B Ethernet Connect, 4 pairs, 1000bT

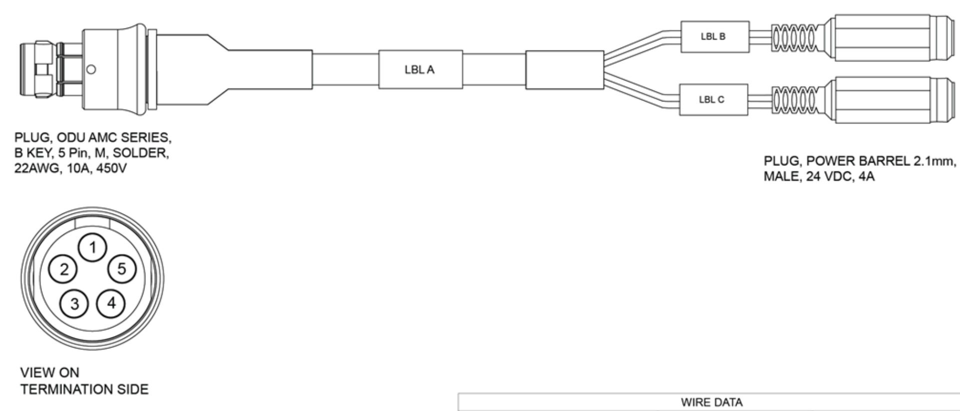
POWER connector pinout

- 1; 2: V_{Main}, 10 to 32 V_{DC}
- 3: V_{Batt}, 10 to 32 V_{DC} (Standby Power)
- 4; 5: Ground return

1.6 Included Cables

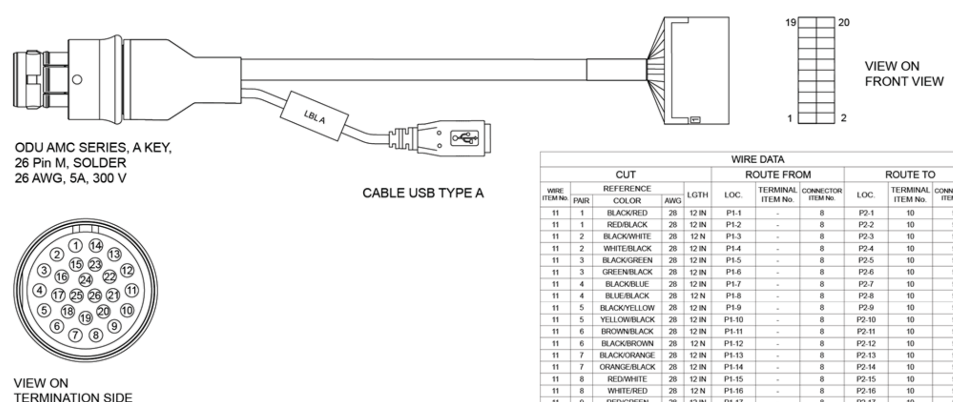
The VersaPNT Evaluation Kit contains the following cables (the antenna cable is not shown):

Power Cable



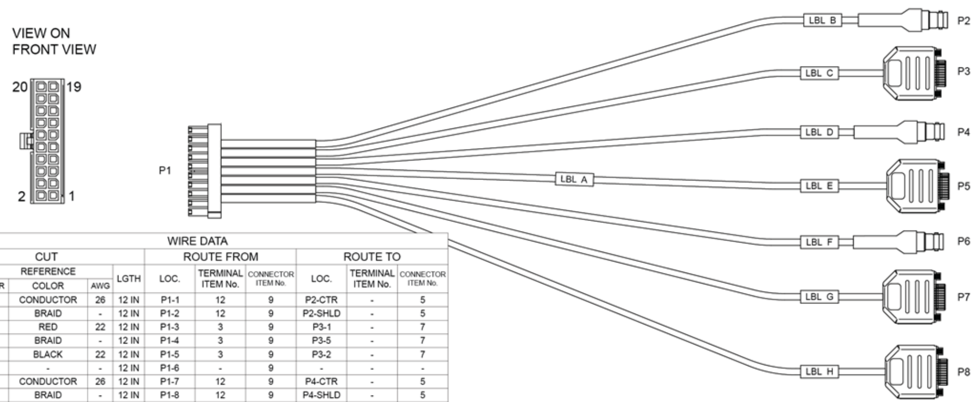
WIRE DATA										
CUT					ROUTE FROM			ROUTE TO		
WIRE ITEM No.	REFERENCE PAIR	REFERENCE COLOR	REFERENCE AWG	LGTH	LOC.	TERMINAL ITEM No.	CONNECTOR ITEM No.	LOC.	TERMINAL ITEM No.	CONNECTOR ITEM No.
10	1	WHITE	24	12 IN	P1-1	-	8	P2-PIN	-	9
10	1	BLACK	24	12 IN	P1-2	-	8	P2-SHELL	-	9
10	2	RED	24	12 IN	P1-3	-	8	P3-PIN	-	9
10	2	GREEN	24	12 IN	P1-5	-	8	P3-SHELL	-	9
10	-	DRAIN	24	12 IN	P1-SHELL	-	8	-	-	-

I/O Cable



WIRE DATA										
CUT					ROUTE FROM			ROUTE TO		
WIRE ITEM No.	REFERENCE PAIR	REFERENCE COLOR	REFERENCE AWG	LGTH	LOC.	TERMINAL ITEM No.	CONNECTOR ITEM No.	LOC.	TERMINAL ITEM No.	CONNECTOR ITEM No.
11	1	BLACK/RED	28	12 IN	P1-1	-	8	P2-1	10	9
11	1	RED/BLACK	28	12 IN	P1-2	-	8	P2-2	10	9
11	2	BLACK/WHITE	28	12 N	P1-3	-	8	P2-3	10	9
11	2	WHITE/BLACK	28	12 IN	P1-4	-	8	P2-4	10	9
11	3	BLACK/GREEN	28	12 IN	P1-5	-	8	P2-5	10	9
11	3	GREEN/BLACK	28	12 IN	P1-6	-	8	P2-6	10	9
11	4	BLACK/BLUE	28	12 IN	P1-7	-	8	P2-7	10	9
11	4	BLUE/BLACK	28	12 N	P1-8	-	8	P2-8	10	9
11	5	BLACK/YELLOW	28	12 IN	P1-9	-	8	P2-9	10	9
11	5	YELLOW/BLACK	28	12 IN	P1-10	-	8	P2-10	10	9
11	6	BROWN/BLACK	28	12 IN	P1-11	-	8	P2-11	10	9
11	6	BLACK/BROWN	28	12 N	P1-12	-	8	P2-12	10	9
11	7	BLACK/ORANGE	28	12 IN	P1-13	-	8	P2-13	10	9
11	7	ORANGE/BLACK	28	12 IN	P1-14	-	8	P2-14	10	9
11	8	RED/WHITE	28	12 IN	P1-15	-	8	P2-15	10	9
11	8	WHITE/RED	28	12 N	P1-16	-	8	P2-16	10	9
11	9	RED/GREEN	28	12 IN	P1-17	-	8	P2-17	10	9
11	9	GREEN/RED	28	12 IN	P1-18	-	8	P2-18	10	9
11	10	RED/BLUE	28	12 IN	P1-19		8	P2-19	10	9
11	10	BLUE/RED	28	12 IN	P1-20		8	P2-20	10	9
1	-	RED	-	-	P1-21		8	P3-1	-	1
-	-	-	-	-	P1-22		8	-	-	-
1	-	WHITE	28	3.5 IN	P1-23		8	P3-2	-	1
1	-	BLACK	28	3.5 IN	P1-24		8	P3-4	-	1
1	-	GREEN	28	3.5 IN	P1-25		8	P3-3	-	1
-	-	-	-	-	P1-26		8	-	-	-
11	-	SHIELD	-	12 IN	P1-SHELL		8	-	-	-
1	-	DRAIN	-	3.5 IN	P1-SHELL		8	P3-SHELL	-	1

I/O Breakout Cable



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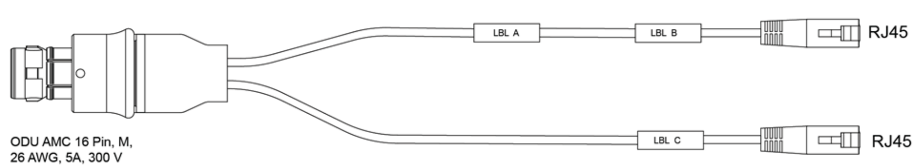
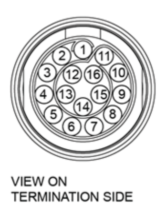
10	-	CONDUCTOR	26	12 IN	P1-1	12	9	P2-CTR	-	5
10	-	BRAID	-	12 IN	P1-2	12	9	P2-SHLD	-	5
11	1	RED	22	12 IN	P1-3	3	9	P3-1	-	7
11	-	BRAID	-	12 IN	P1-4	3	9	P3-5	-	7
11	1	BLACK	22	12 IN	P1-5	3	9	P3-2	-	7
-	-	-	-	12 IN	P1-6	-	9	-	-	-
10	-	CONDUCTOR	26	12 IN	P1-7	12	9	P4-CTR	-	5
10	-	BRAID	-	12 IN	P1-8	12	9	P4-SHLD	-	5
11	2	RED	22	12 IN	P1-9	3	9	P5-2	-	8
11	2	BLACK	22	12 IN	P1-10	3	9	P5-5	-	8
10	-	CONDUCTOR	26	12 IN	P1-11	12	9	P6-CTR	-	5
10	-	BRAID	-	12 IN	P1-12	12	9	P6-SHLD	-	5
11	3	RED	22	12 IN	P1-13	3	9	P7-2	-	7
11	3	BLACK	22	12 IN	P1-14	3	9	P7-5	-	7
11	4	RED	22	12 IN	P1-15	3	9	P8-1	-	8
11	-	BRAID	-	12 IN	P1-16	3	9	P8-5	-	8
11	4	BLACK	22	12 IN	P1-17	3	9	P8-2	-	8
-	-	-	-	-	P1-18	-	9	-	-	-
-	-	-	-	-	P1-19	-	9	-	-	-
-	-	-	-	-	P1-20	-	9	-	-	-

Ethernet Data Cable





WIRE DATA										
CUT					ROUTE FROM			ROUTE TO		
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1/P2	-	WHITE/ORANGE	26	15FT	P1-1	-	6	P2-1	-	1/P2
1/P2	-	ORANGE	26	15FT	P1-2	-	6	P2-2	-	1/P2
1/P2	-	WHITE/GREEN	26	15FT	P1-3	-	6	P2-3	-	1/P2
1/P2	-	BLUE	26	15FT	P1-5	-	6	P2-4	-	1/P2
1/P2	-	WHITE/BLUE	26	15FT	P1-6	-	6	P2-5	-	1/P2
1/P2	-	GREEN	26	15FT	P1-4	-	6	P2-6	-	1/P2
1/P2	-	WHITE/BROWN	26	15FT	P1-7	-	6	P2-7	-	1/P2
1/P2	-	BROWN	26	15FT	P1-8	-	6	P2-8	-	1/P2
1/P3	-	WHITE/ORANGE	26	15FT	P1-9	-	6	P3-1	-	1/P3
1/P3	-	ORANGE	26	15FT	P1-10	-	6	P3-2	-	1/P3
1/P3	-	WHITE/GREEN	26	15FT	P1-11	-	6	P3-3	-	1/P3
1/P3	-	BLUE	26	15FT	P1-13	-	6	P3-4	-	1/P3
1/P3	-	WHITE/BLUE	26	15FT	P1-14	-	6	P3-5	-	1/P3
1/P3	-	GREEN	26	15FT	P1-12	-	6	P3-6	-	1/P3
1/P3	-	WHITE/BROWN	26	15FT	P1-15	-	6	P3-7	-	1/P3
1/P3	-	BROWN	26	15FT	P1-16	-	6	P3-8	-	1/P3
1/P2	-	DRAIN	-	15FT	P1-SHELL	-	6	P2-SHELL	-	1/P2
1/P3	-	DRAIN	-	15FT	P1-SHELL	-	6	P3-SHELL	-	1/P3

1.7 VersaPNT Specifications

1.7.1 Supply Power

Operating Power and Standby Power: 10 to 32 V_{DC}

Power draw:

» **Operating**: 10 W typical

» **Standby**: 0.4 W

1.7.2 GNSS Receiver

VersaPNT has an integrated state-of-the-art GNSS receiver, suitable for concurrent dual-constellation reception.

Compatible signals:

» GPS L1 C/A (center frequency 1575.42 MHz)

» GLONASS L1 0F (center frequency 1602.0 MHz)

» Galileo E1 B/C (center frequency 1575.42 MHz)

» QZSS L1-SAIF (center frequency 1575.42 MHz)

» BeiDou B1 (center frequency 1561.098 MHz)

Satellites tracked: Up to 72 simultaneously

Update rate: up to 2Hz (concurrent)

Acquisition time: Typically < 27 seconds from cold start

Antenna requirements: Active antenna module, +5V, powered by VersaPNT, 16 dB gain minimum

Antenna connector: SMA

1.7.3 Mechanical & Environmental Specifications

1.7.3.1 Physical Specifications

» **Dimensions** (W x D x H): **147.3** x **127.5** x **63.0** mm (**5.8** x **5** x **2.5** in)

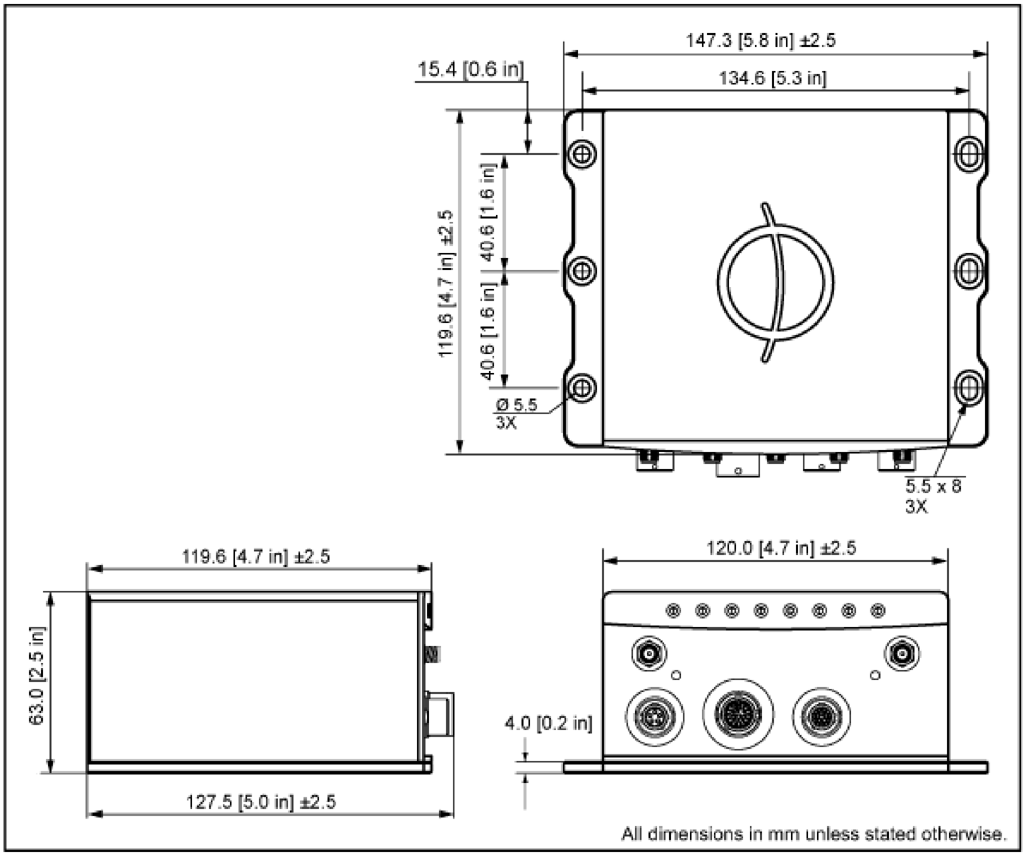


Figure 1-3: Mechanical dimensions

» **Mounting**: Bolted to a metal plate, using 6 through holes

» **Weight**: 0.91 kg (2.0 lbs)

1.7.3.2 Environmental Requirements

» **Temperature, in operation**: -40°C to +65°C

» **Temperature, in storage**: -45°C to +85°C

» **Humidity**: 95% RH, non condensing at 40°C

» **Altitude**: up to 45,000 ft

- **Protection**: IP 65
- **Vibration**:
    - 7.7 g rms, 20 to 1000 Hz (in accordance with MIL-STD 810G, Method 214.6 Category 24: Minimum Integrity and Helicopter Minimum Integrity, see graphs 514.7E-1 and 514.7E-2)
- **Shock**: 20 g, 11 ms (pulse sawtooth) in accordance with MIL-STD 810G, Method 516.7 Procedure 1

1.8 The VersaPNT Web UI

VersaPNT has an integrated web user interface (referred to as "Web UI" throughout this documentation) that can be accessed from a network-connected computer, using a standard web browser. The Web UI is used to configure and monitor the unit.

> **Note:** An integrated Command-Line Interpreter interface (CLI) allows the use of a subset of commands that are integrated into the Web UI.

The minimum browser requirements for the Web UI are: Internet Explorer® 9 or higher, Firefox®, or Chrome®.

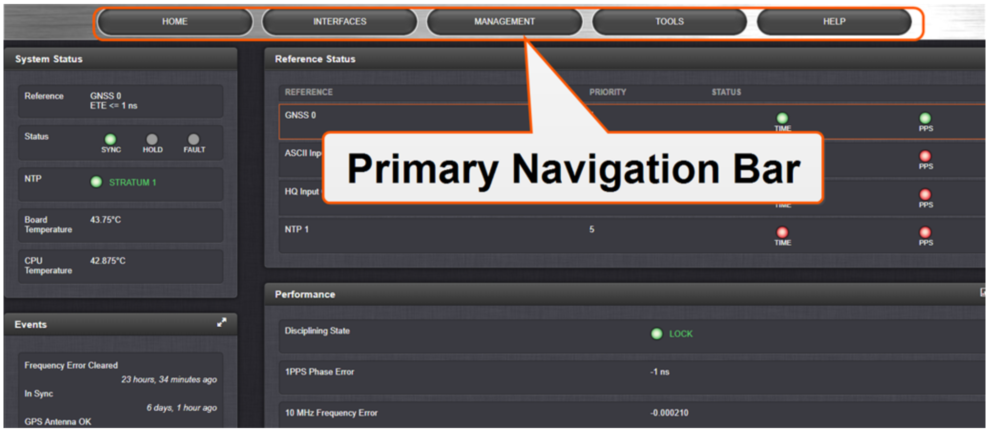
1.8.1 The Web UI HOME Screen

> **Note:** Screens displayed in this manual are for illustrative purposes. Actual screens may vary depending upon the configuration of your product.

The **HOME** screen of the VersaPNT web user interface ("Web UI") provides comprehensive status information at a glance, including:

- vital **system** information
- current status of the **references**
- key **performance**/accuracy data
- major **log events**.

The **HOME** screen can be accessed from anywhere in the Web UI, using the HOME button in the **Primary Navigation Bar**:



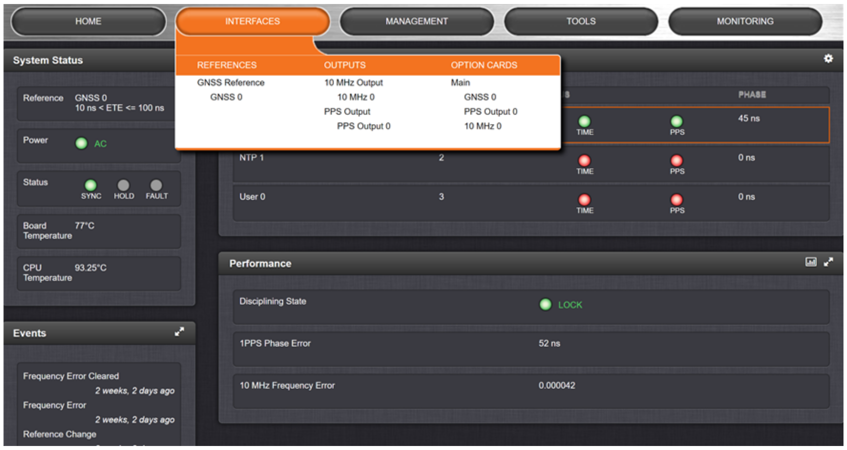
The **Primary Navigation Bar** provides access to all menus:

- **HOME**: Return to the HOME screen (see above)
- **INTERFACES**: Access the configuration pages for …
  - … references (e.g., GNSS, NTP)
  - … outputs (e.g. 10 MHz, PPS, NTP) and
  - … installed input/output option cards.
- **MANAGEMENT**: Access the NETWORK setup screens, and OTHER setup screens e.g., to configure Reference Priorities, System Time, and the Oscillator.
- **TOOLS**: Opens a drop-down menu for access to the system maintenance screens and system logs.
- **HELP**: Provides Spectracom Service Contact Information and high-level system configurations you may be required to furnish when contacting Spectracom Service.

1.8.2 The INTERFACES Menu

The **INTERFACES** menu on the Main screen provides access to VersaPNT's:

- External REFERENCES e.g., the GNSS reference input
- Detected OUTPUTS, such as 10 MHz and 1PPS
- Installed OPTIONS.



Clicking on any of the line items will open a status screen, providing real-time information on the selected interface e.g., availability, performance data and events history.

To configure settings for the selected interface, click the GEAR icons or buttons provided on most of the status screens. Icons like the INFO symbol provide access to more detailed status information and history data.

The headings of each of the INTERFACES drop-down menus (white on orange) open overview status screens for the respective menu items.

1.8.3 The Configuration MANAGEMENT Menu

The **MANAGEMENT** menu on the Web UI's Main screen provides access to VersaPNT's configuration screens and settings.

On the left side, under **NETWORK**, the following standard setup screens can be found:

- **Network** Setup
- **SSH** Setup
- **SNMP** Setup
- **NTP** Setup
- **PTP** Setup
- **INS** Setup
- **GPSD** Setup

Under **OTHER**, you can access non-network related screens:

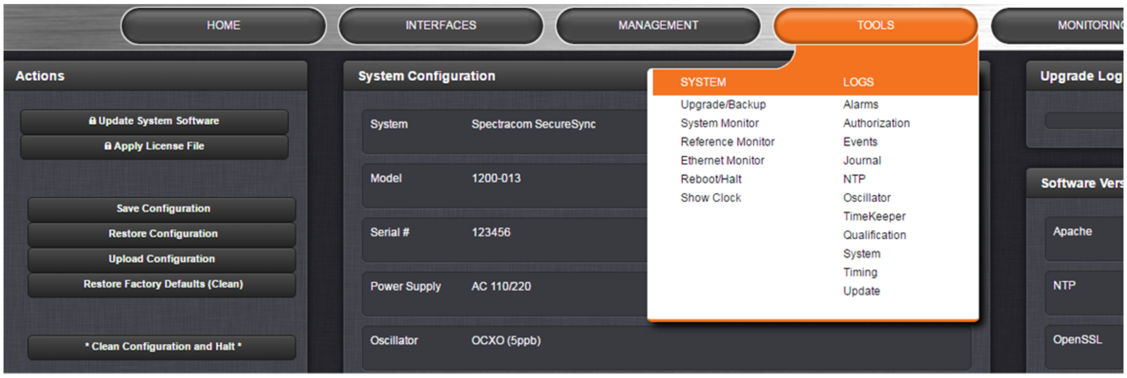
- **Authentication**: Manage user accounts, Security Policy, LDAP Setup, RADIUS setup, Login Preference and Remote Servers. Change My Password is also available.
- **Reference Priority**: Define the order of priority for timing inputs.
- **Notifications**: Configure the notifications triggered by VersaPNT’s events. A notification can be a combination of a mask alarm and/or SNMP Trap and/or email.

- **Time Management**: Manage the Local Clock, UTC Offset, DST Definition and Leap Second information.
- **System Time Message**: Configure a regularly delivered message of the system time.
- **Log Configuration**: Manage the system logs.
- **Disciplining**: Manage oscillator disciplining.
- **LED Configuration**: Change the LED brightness.
- **Change My Password**: Configure the admin password.

1.8.4 The TOOLS Menu

The **TOOLS** menu on the Web UI's Main screen provides access to:

- The System Upgrade screen
- System and network monitoring screens
- Miscellaneous system administration screens
- Log screens



SAFETY

Table 1-10: Safety symbols used on this product or in this document

Symbol	Signal word	Definition
	DANGER!	Potentially dangerous situation which may lead to personal injury or death! Follow the instructions closely.
	CAUTION!	Potential equipment damage or destruction! Follow the instructions closely.
	NOTE	Tips and other useful or important information.
	ESD	Risk of Electrostatic Discharge! Avoid potential equipment damage by following ESD Best Practices.
	CHASSIS GROUND	This symbol is used for identifying the functional ground of an I/O signal. It is always connected to the instrument chassis.
	Analog Ground	Shows where the protective ground terminal is connected inside the instrument. Never remove or loosen this screw!
	Recycle	Recycle the mentioned components at their end of life. Follow local laws.

1.9 SAFETY: Before You Begin Installation

This product may constitute a risk to the operator or installation/maintenance personnel, if used under conditions that must be deemed unsafe, or for purposes other than the product's designated use, which is described in the introductory technical chapters of this guide.

DANGER! If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Before you begin installing and configuring this product, carefully read the following important safety statements. Always ensure that you adhere to any and all applicable safety warnings, guidelines, or precautions during the installation, operation, and maintenance of your product.

DANGER! — INSTALLATION OF EQUIPMENT:

Installation of this product is to be done by authorized service personnel only. This product is not to be installed by users/operators without legal authorisation.

Installation of the equipment must comply with local and national electrical codes.

DANGER! — DO NOT OPEN EQUIPMENT, UNLESS AUTHORIZED:

The interior of this equipment does not have any user serviceable parts. Contact Spectracom Technical Support if this equipment needs to be serviced. Do not open the equipment. Follow Spectracom Safety Instructions, and observe all local electrical regulatory requirements.

Caution: Electronic equipment is sensitive to Electrostatic Discharge (ESD). Observe all ESD precautions and safeguards when handling Spectracom equipment.

1.10 SAFETY: User Responsibilities

- The equipment must only be used in technically perfect condition. Check components for damage prior to installation. Also check for loose or scorched cables on other nearby equipment.
- Make sure you possess the professional skills, and have received the training necessary for the type of work you are about to perform.
- Do not modify the equipment.
- Use only spare parts authorized by Spectracom.
- Always follow the instructions set out in this User Manual , or in other Spectracom documentation for this product.
- Observe generally applicable legal and other local mandatory regulations.

1.11 SAFETY: Other Tips

- Keep these instructions at hand, near the place of use.
- Keep your workplace tidy.
- Apply technical common sense: If you suspect that it is unsafe to use the product, do the following:
  - Disconnect the supply voltage from the unit.
  - Clearly mark the equipment to prevent its further operation.

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CHAPTER 2

SETUP

The following topics are included in this Chapter:

2.1 Installation Overview

The steps that need to be performed prior to putting VersaPNT into service include:

» Installation: Hardware setup, mechanical installation, physical connections.

» Setup: Establish basic access to the unit, so as to allow the use of the web user interface ("Web UI").

» Configuration: Access the Web UI, configure the network, input and output references, protocols (e.g., NTP), other settings.

Not all of the setup steps described in this manual may apply to you. Your unit installation relative to other connected devices, the cable selection and manufacturing, your chosen power source, your project-specific infrastructure, and your planned access to your unit (either WebUI or CLI), could all affect your setup needs.

2.1.1 Hardware Connections

During the procedure described below, you will connect the **Power** cable, the **Multi I/O** cable, and the **Ethernet** cable.

The step-by-step instructions below outline the VersaPNT installation and configuration process:

1. **Install VersaPNT** in the designated vehicle:
   » A location near the center of gravity of the vehicle is recommended.

   » It is recommended to orient the unit so that the back of the unit (facing away from the connections side) points in the direction of travel. Other orientations (including upside down) are possible, but will require Frame Rotation calculations (see ""Frame Rotation" Tab" on page 125).

   » Ground the unit by connecting the DC negative terminals to the chassis of the unit, and to the vehicle metallic structure.

   » The mounting plate should be in direct contact with the unit base plate, so as to conduct heat.

   » For more detail on mounting your unit, see "Mounting" on page 28.
2. **Install the GNSS antenna**(s). See ""Calibration" Tab/Antenna Installation" on page 121 for specifications.
3. **Wire the antenna cables and interface cables**. Most customers will require the Multi I/O and Ethernet cables for these connections, as well as a PC..

Requirement	Action	Evaluation kit cable
USB connection	Connect USB to the Multi I/O connector.	Connect the USB connector to a PC with a terminal emulator program (CA08R-CRUB-0002)

Requirement	Action	Evaluation kit cable
Network connection	Connect at least one of the two Ethernet connectors to a network.	Connect the RJ45 jack labeled ETH0 or ETH1 to a network hub/switch or directly to a PC (CA08R-CRET-0002)

- USB: Connect the **Multi I/O** connector to the VersaPNT unit. If you are using the Evaluation Kit, connect the Multi I/O USB output to a PC. Install a **terminal emulator** program on the PC (e.g., TeraTerm® or PuTTY®).
- Ethernet: Connect the **Ethernet** cable to the ETH port of the unit. If you are using the Evaluation Kit, connect at least one of the two I/O cable Ethernet ports (ETH0 or ETH1) to a network switch/hub, or to the PC mentioned above (using a standard Ethernet patch cable, or a crossover cable.)

For pinout tables, see "Connectors and their Pinouts" on page 9 and "Configuring Inputs/Outputs" on page 38.

4. **Connect the power supply**. The unit will power up, and the ON/OFF status LED will pulsate.

Requirement	Action	Evaluation kit cable
Power up	Connect 12 V_{DC} to the power connector.	Attach a cable and apply 12 V_{DC} to the plug labeled "Main" (CA08R-CRPB-0002)

5. **Establish a network connection** so as to allow access to the web user interface ("Web UI"). See "Initial Network Setup" on page 29 for information on the USB driver installation and network address configuration.

> Note: On a DHCP network, you can also use Zeroconf to access the Web UI (see "Zero Configuration Setup" on page 33).

6. Using the Web UI, **configure** the following:
   - Software-configurable I/O pins, see "Assigning I/O Pins" on page 39.
   - INS settings: see "INS Configuration" on page 118:
     - IMU data output settings (output format, position type, polling frequency)
     - Calibration settings: antenna offsets
     - Data log settings
     - FIR filter settings
     - Coning and sculling error compensation settings
     - Frame rotation configuration (if required).

   This list covers the standard configuration options. More complex configurations can be generated using the "INS Expert Mode" on page 147.

- Other VersaPNT INTERFACES settings and MANAGEMENT settings e.g., network settings, reference priorities (see "Configuring Network Settings" on page 57).

2.1.2 Mounting

2.1.2.1 Selecting a Mounting Location

The unit is to be mounted on a plate, using six (6) through holes. The mounting location must offer sufficient space to accommodate the unit and the cable connectors, and it must be within cable reach to other connected devices, such as the GNSS antenna. The best mounting position will align the unit to the unit such that the X-axis points out the front of the vehicle (bow), the Y-axis points out the right (starboard), and the Z-axis points down. (If your mounting position varies from this setup, you will need to adjust for the frame rotation.) The chosen environment must not fall below IP 65 ingress protection standards.

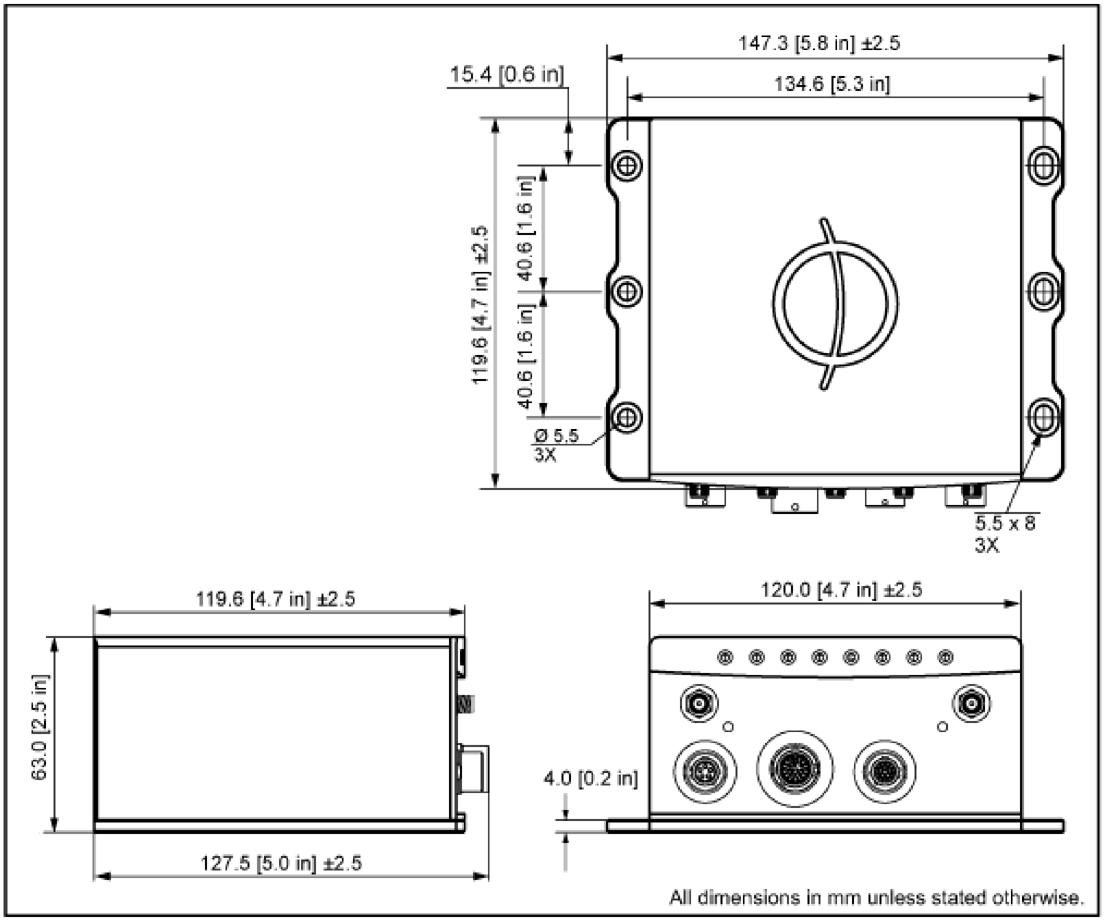


Figure 2-1: Mechanical dimensions

2.1.2.2 Heat Dissipation

The aluminum base plate of the unit acts as a heat drain, conducting heat away from VersaPNT's interior components. When considering a mounting location, it is crucial that:

» the operating temperature of the mounting surface does not exceed 65°C/149°F.

» the mounting surface is even and heat conductive. Do not use any insulator material e.g., rubber gaskets or similar.

» the ambient air temperature meets is within the specified range, i.e. -40°C to +65°C.

2.1.2.3 Fasteners

Spectracom recommends to observe the VITA 75 standard regarding mounting the unit, and fastener selection.

2.1.2.4 Grounding

The unit can be grounded in two different ways:

» By connecting the DC negative terminals to the chassis of the unit, and to the vehicle metallic structure. This option is the factory standard for VersaPNT.

» By isolating the DC negative terminals from the chassis of the unit ("airborne mode"). This option must be requested at the time of ordering your unit.

2.2 Initial Network Setup

After making the hardware connections outlined in the Installation Overview list, the following information will help you to establish a network connection.

VersaPNT has a **Command Line Interpreter** ("CLI"). Using the CLI connection, you can set up access to the **web user interface** ("Web UI") that is used to configure and monitor the unit. **You will need a terminal emulator program** installed on the PC that will be used to configure VersaPNT in order to communicate. See "Setting up a Terminal Emulator" on page 277 for more detailed instructions.

Default settings:

VersaPNT network settings default to DHCP: if the unit is connected to a DHCP server via ETH0 or ETH1, it will accept an assigned dynamic IP address.

In order to apply a static IP address, DHCP must be disabled. (See "Assigning a Static IP Address" on page 36).

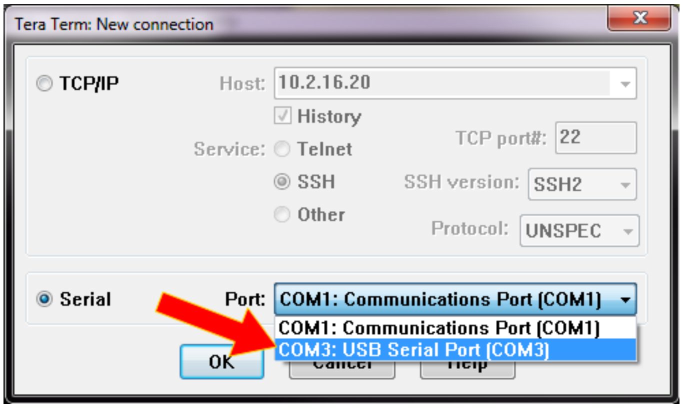
Note: VersaPNT supports zeroconf: If you have a DHCP enabled network, you can use zeroconf for initial setup. For more information, see "Zero Configuration Setup" on page 33. Otherwise follow the instructions below for conventional setup.

2.2.1 USB Driver

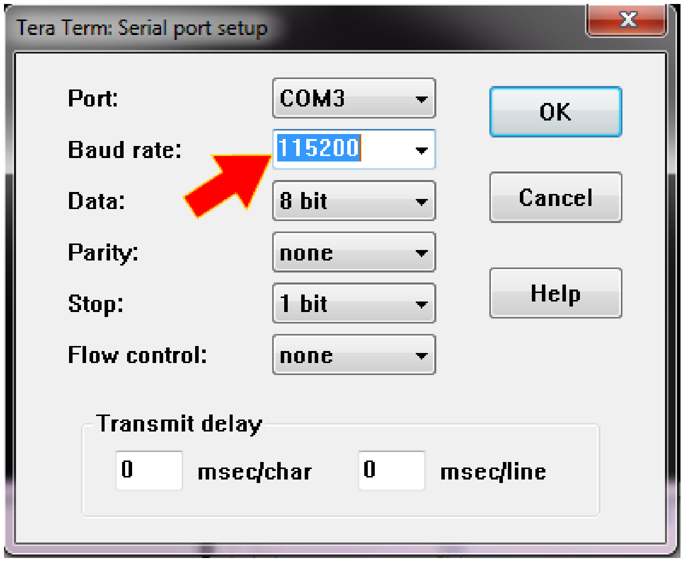
» On the PC connected to the unit, new hardware (the USB interface) will be detected. The correct driver should be installed automatically. If not, download the driver from www.ftdichip.com/Drivers/VCP.htm, and install it manually via the instructions for your operating system.

2.2.2 Network Address

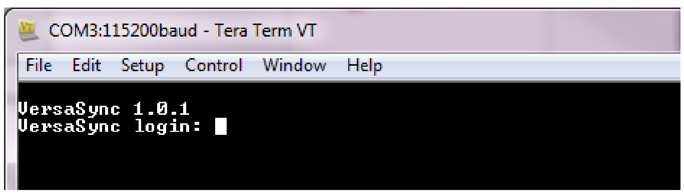
a. Start the terminal emulator program on the PC. Select the COM port that is assigned to the USB interface:



Access the CLI via ssh or telnet: The required port configuration is 115200 8N1:

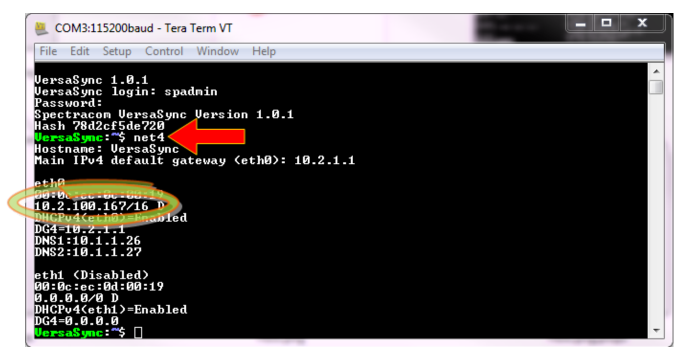


Press the **Return** key, and enter the login credentials:



> **Note:** The default login credentials are:
> **User name** = spadmin
> **Password** = admin123 (will not be displayed on the screen)

b. If you are on a DHCP-enabled network, retrieve the IP address assigned to VersaPNT by typing the `net4` command. The command should return the network settings, including the IP address assigned to the unit. Take note of the IP address.



You can use this IP address to login to the VersaPNT Web UI and then set a static IP address, subnet mask and gateway. (This can also be done via the CLI and a terminal emulator. See "Assigning a Static IP Address" on page 36).

Or, continue with the network configuration via the CLI, as described under Step c. below.

Note: For your reference, the command helpcli produces a list of available commands. Press the space key to display the next page, or the b key to display the previous page.

Note: Should it become necessary to leave the VI editor mode (indicated by a command line prompt ":"), press Q, or Ctrl C.

For more detailed information about setting a static IP address for your unit, see "Setting up an IP Address" on page 35

Next, proceed to "Accessing the Web UI" on page 34.

2.3 Zero Configuration Setup

As an alternative to the conventional network configuration, VersaPNT can also be set up using the zero-configuration networking technology ("zeroconf").

> **Note:** Zeroconf only works on DHCP-enabled networks.

When using zeroconf, a TCP/IP network will be created automatically, i.e. without the need for manual configuration: Once VersaPNT's ETH connector is connected to a hub, you can directly access the VersaPNT Web UI, using a standard web browser, without any configuration.

This is made possible because zeroconf utilizes these technologies:

- Automatic allocation of network addresses for all connected devices
- Automatic distribution and resolution of computer hostnames
- Automatic detection of all available network services.

For more information on zeroconf and the multicast Domain Name System, see https://en.wikipedia.org/wiki/Multicast_DNS.

Zeroconf Requirements

Prior to using zeroconf, ensure the following requirements are met:

- Your LAN network must have DHCP enabled.
- Your VersaPNT unit must have DHCP enabled for its ETH0 port (this is the factory default setting)

  > **Note:** Zeroconf is only supported on the ETH0 port.

- Check the serial number label on the side of the unit, and write down the last 6 digits of the MAC 0 address e.g., "0C 00 19"
- Windows 7/8 users should install Bonjour Print Services, otherwise access to `*.local` addresses will not be possible.
- Windows 10 already supports mDNS and DNS-SD, hence there is no need to install additional software.

2.3.1 Using Zeroconf

Connect to the Web UI of your VersaPNT unit in these 3 steps:

1. Connect VersaPNT to a router on your LAN via the ETH connector (see "Initial Network Setup" on page 29).
2. Connect the power supply to the VersaPNT unit.
3. On a connected computer, open your web browser and in the URL field type the following:

   versapnt-[xxxxxx].local/

   where [xxxxxx] are the last six digits of the MAC 0 address you copied from the serial number label on the unit.

   You should now be prompted for a username and password. The factory default credentials are:

   Username: **spadmin**

   Password: **admin123**

> **Note:** If you do not have physical access to the unit, you can obtain the MAC address also by accessing VersaPNT's CLI via the I/O connector USB port, using e.g., the `ifconfig` command.

Once you logged into the VersaPNT via zeroconf, you can retrieve the DHCP address for future use:

» Navigate to **MANAGEMENT: NETWORK > Network Setup**, and click **General Settings** in the **Actions** panel on the left. The IPV4 ADDRESS will be displayed for each port on the bottom of the window.

2.4 Accessing the Web UI

VersaPNT's Web UI is the recommended tool to interact with the device, since it provides access to nearly all configurable settings, and obtain comprehensive status information without having to use the Command Line Interpreter (CLI).

You can access the Web UI either by using the automatically assigned DHCP IP address, or by using a manually set static IP address (see "Assigning a Static IP Address" on page 36).

1. On a PC connected to VersaSync via ETH1 or ETH0, start a web browser.
2. Navigate to the IP address assigned in "Initial Network Setup" on page 29.
3. Log into the Web UI as an administrator. The factory-default administrator user name

and password are:

Username: `spadmin`

Password: `admin123`

> Note: For security reasons, it is advisable to change the default credentials, see: "Managing Passwords" on page 229.

4. Upon initial login, you will be asked to register your product. Spectracom recommends to register VersaPNT, so as to receive software updates and services notices. See also "Product Registration" on page 322.
5. To configure your INS settings, navigate to **MANAGEMENT** > **INS Setup**. For more information, see the chapter "Managing Location" on page 117.

2.5 Setting up an IP Address

In order for VersaPNT to be accessible via your network, you need to assign an IP address to VersaPNT, as well as a subnet mask and gateway, unless you are using an address assigned by a DHCP server.

> Note: Unless you are using DNS in conjunction with DHCP (with the client configured using VersaPNT's hostname instead of IP address), Spectracom recommends to disable DHCP, and instead use a static IP address. Failure to do this can result in a loss of time synchronization, should the DHCP server assign a new IP address to the unit.

Before you continue ...

... please obtain the following information from the system network administrator:

- **Available static IP address**
  - This is the unique address your network administrator will assign to your VersaPNT unit. Make sure the chosen address is outside of the DHCP range of your DHCP server.
- **Subnet mask (for the network)**
  - The subnet mask defines the number of bits taken from the IP address that are used in the network portion. The number of network bits used in the net mask can range from 8 to 30 bits.
- **Gateway address**
  - The gateway (default router) address is needed if communication to the VersaPNT is made outside of the local network. By default, the gateway is disabled.

2.5.1 Assigning a Static IP Address

There are two ways to setup a permanent static IP address, after connecting VersaPNT to a DHCP network:

Assigning a Static IP Address Using the CLI:

> **Note:** For your reference, the command helpcli produces a list of available commands. Press the space key to display the next page, or the b key to display the previous page. To leave the VI editor, press Q or Ctrl C.

Open the serial console (e.g., by using TeraTerm)

1. Disable DHCP – Command: `dhcp4set <x> off` **(where x is 0/1 for ETH0 and ETH1**, respectively).
2. Set the static IP address – Command: `ip4set <x>.<IP address>.<subnet mask>` Example: `ip4set 0 10.2.100.245 255.255.0.0`

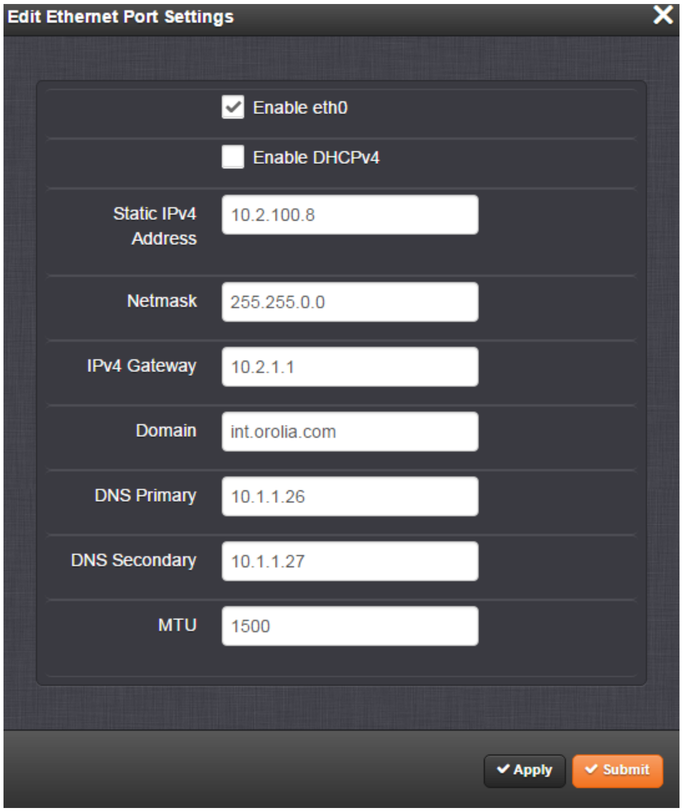
   If required, also set your gateway address: `gw4set <x> <gateway address>`
3. Verify that the address has been accepted – Command: `net`
4. If so required, turn DHCP back on – Command: `dhcp4set [x] on`

Assigning a Static IP Address Using the Web UI:

1. Enter the assigned dynamic IP address obtained during setup ("Initial Network Setup" on page 29) into the address field of your browser (on a computer connected to the VersaPNT network). If the network supports DNS, the hostname may also be entered instead (the default hostname is "Spectracom"). The start screen of the VersaPNT Web UI will be displayed.
2. Log into the Web UI as an administrator. The factory-default user name and password are:

   Username: `spadmin`
   Password: `admin123`
3. Disable DHCP by navigating to **MANAGEMENT > Network Setup**. In the **Ports** panel on the right, click the GEAR icon next to the Ethernet Port you are using. In the **Edit Ethernet Port Settings** window, uncheck the **Enable DHCPv4** field. Do NOT click Submit or Apply yet.
4. In the fields below the **Enable DHCPv4** checkbox, enter the desired Static IP address, Netmask, and Gateway address (if required). Click Submit.

   For subnet mask values, see "Subnet Mask Values" on the facing page.



5. To verify that the address has been accepted, enter the static IP address into the address field of the browser and log into the Web UI again.
6. If so required, turn DHCP back on (cf. Step 3), or continue with your configuration; see: "Configuring Network Settings" on page 57.

2.5.2 Subnet Mask Values

Table 2-1: Subnet mask values

Network Bits	Equivalent Netmask	Network Bits	Equivalent Netmask
30	255.255.255.252	18	255.255.192.0
29	255.255.255.248	17	255.255.128.0
28	255.255.255.240	16	255.255.0.0
27	255.255.255.224	15	255.254.0.0
26	255.255.255.192	14	255.252.0.0
25	255.255.255.128	13	255.248.0.0
24	255.255.255.0	12	255.240.0.0

Network Bits	Equivalent Netmask	Network Bits	Equivalent Netmask
23	255.255.254.0	11	255.224.0.0
22	255.255.252.0	10	255.192.0.0
21	255.255.248.0	9	255.128.0.0
20	255.255.240.0	8	255.0.0.0
19	255.255.224.0		

2.6 Configuring Inputs/Outputs

This Chapter covers the configuration of the inputs and outputs of the I/O connector.

When you configure an input our output via the I/O connector, you will need to adjust both the pin configuration ("Assigning I/O Pins" on the facing page) and (for some types) the settings for that input or output via the Web UI ("Configuring I/O Settings" on page 43).

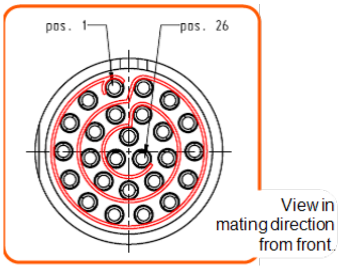


Figure 2-2: I/O connector

For more information on the I/O connector, see "Connectors and their Pinouts" on page 9.

2.6.1 Assigning I/O Pins

VersaPNT's I/O connector is software configurable, i.e. the pin interfaces and the signal modulations can be configured by the user via the VersaPNT Web UI.

The software-configurable 26-pin I/O connector comprises 9 user-configurable Channels, plus one fixed USB interface. Channels can be used for the following input or output interfaces:

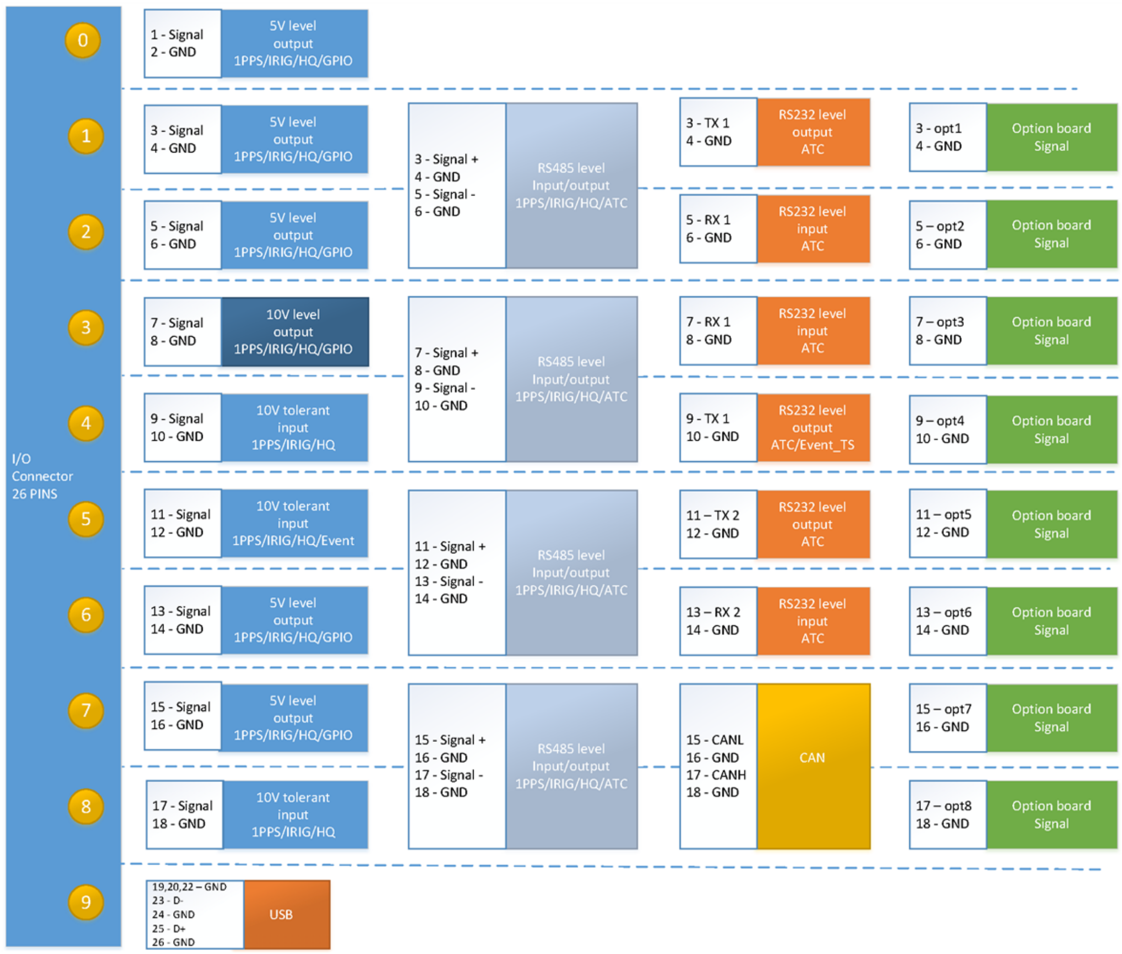


Figure 2-3: I/O configuration options

2.6.1.1 Signal Types

The table below shows the maximum number of available interfaces for each signal type. Note that you can assign only one signal for each pin pair, hence only four to nine input and output signals can be transmitted/received at any given time.

Table 2-2: Available signal types

	DCLS, TTL	DCLS, 10V	RS485	RS 485, 120 Ω	RS232
PPS	out (5), in (2)	out (1), in (1)	out (4), in (4)	in (4)	
IRIG	out (5), in (2)	out (1), in (1)	out (4), in (4)	in (4)	
HQ	out (5), in (2)	out (1), in (1)	out (4), in (4)	in (4)	
GPIO	out (5)	out (1)			
ASCII			out (4), in (4)	in (4)	out (3), in (3)
INS					out (3), in (3)

Note: ASCII Time Code is abbreviated in the UI as **ATC**.

DCLS Signal Lines

Up to six TTL (5V) or 10 V **DCLS** outputs and three DCLS inputs are available for e.g., 1PPS, xPPS, IRIG B 00x, HaveQuick, ASCII ToD signal transmission.

Single-ended Serial Lines

VersaPNT provides up to 3 RX and 3 TX **RS232** interfaces for e.g., ASCII ToD – NMEA 0183 (ICD-GPS-153).

Differential Serial Lines

Up to four differential serial lines are available. Each of them can be set in either **RS422** or **RS485** electrical standard, and used as input or output. One can be used in CAN mode. PPS or Time-of-Day messages will be available, as well as HaveQuick and ICD GPS-060. Note that this kind of interface uses two Channels.

Non-Configurable Pins

Channel # 0 provides a DCLS TTL output signal that is not user-configurable.

Also note that **pins # 19 through 26** are reserved for the USB command line interface.

2.6.1.2 I/O Signal Mapping Table

Each Channel (i.e., each pin pair e.g., "3&4" = Channel 1) can serve as only one interface, and not all combinations are possible due to the internal multiplexer architecture.

Spectracom provides an online interactive I/O switch matrix configurator that can be used to design a custom I/O configuration:
http://manuals.spectracom.com/VSS/Content/VSS/SETUP/IOpinConfiguration.htm.

The table below illustrates the signal combinations that can be assigned to the 18 configurable pins.

Table 2-3: I/O signal mapping to Channels

					Channel 0	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8	Channel 9
	Signal Message Type	I/O	Type Filter	Electr. Level	Pin Position 1 & 2	3 & 4	5 & 6	7 & 8	9 & 10	11 & 12	13 & 14	15 & 16	17 & 18	19-25
Time & Frequency	PPS	out	DCLS	TTL	Y	Y	Y				Y	Y		Occupied - USB
Time & Frequency	IRIG	out	DCLS	TTL	Y	Y	Y				Y	Y		
Time & Frequency	HQ	out	DCLS	TTL	Y	Y	Y				Y	Y		
Time & Frequency	GPIO	out	DCLS	TTL	Y	Y	Y				Y	Y		
Time & Frequency	ATC	out	RS232			Y			Y	Y				
Time & Frequency	PPS	out	RS485			Y		Y		Y		Y		
Time & Frequency	IRIG	out	RS485			Y		Y		Y		Y		
Time & Frequency	HQ	out	RS485			Y		Y		Y		Y		
Time & Frequency	ATC	out	RS485			Y		Y		Y		Y		
Time & Frequency	PPS	in	RS485			Y		Y		Y		Y		
Time & Frequency	PPS	in	RS485	Load		Y		Y		Y		Y		
Time & Frequency	IRIG	in	RS485			Y		Y		Y		Y		
Time & Frequency	IRIG	in	RS485	Load		Y		Y		Y		Y		
Time & Frequency	HQ	in	RS485			Y		Y		Y		Y		
Time & Frequency	HQ	in	RS485	Load		Y		Y		Y		Y		
Time & Frequency	ATC	in	RS485			Y		Y		Y		Y		
Time & Frequency	ATC	in	RS485	Load		Y		Y		Y		Y		
Time & Frequency	ATC	in	RS232				Y	Y			Y			
Time & Frequency	PPS	out	DCLS	10V				Y						
Time & Frequency	IRIG	out	DCLS	10V				Y						
Time & Frequency	HQ	out	DCLS	10V				Y						
Time & Frequency	GPIO	out	DCLS	10V				Y						
Time & Frequency	PPS	in	DCLS	10V					Y					
Time & Frequency	IRIG	in	DCLS	10V					Y					
Time & Frequency	HQ	in	DCLS	10V					Y					
Time & Frequency	PPS	in	DCLS	TTL						Y			Y	
Time & Frequency	IRIG	in	DCLS	TTL						Y			Y	
Time & Frequency	HQ	in	DCLS	TTL						Y			Y	
	CAN BUS	in/out										Y		
Navigation	INS	out	RS232			Y			Y	Y				
Navigation	INS	in	RS232			Y			Y	Y				
Navigation	OPT 1- PPS	in	DCLS	TTL		Y								
Navigation	OPT 2- PPS	out	DCLS	TTL			Y							
Navigation	OPT 3- GPS	in	RS232					Y						
Navigation	OPT 4- GPS	out	RS232						Y					
Navigation	OPT 5- IMU	in	RS422p							Y				
Navigation	OPT 6- IMU	in	RS422n								Y			
Navigation	OPT 7- IMU	out	RS422p									Y		
Navigation	OPT 8- IMU	out	RS422n										Y	

Notes:

Pins to Channels (e.g., pins 3 & 4= Channel 1)
green = Signal Message Type can be assigned to this Channel (RS485 requires two Channels)
red = This Signal Message type cannot be assigned to this Channel
ATC = ASCII Time Code

Configuring a new Input or Output

1. In the VersaPNT Web UI, navigate to **MANAGEMENT > NETWORK: Pin Layout**. The **Pin Layout** screen will be displayed.
2. Prior to assigning the new output, identify a pin pair in the pin **Layout** table that is not used (Signal = "None") or not needed. You can **Delete** it, but you may also simply assign the new PPS Output as described below, thus overwriting the existing Input or Output.
3. Add a pin configuration by clicking the PLUS icon in the top-right corner. The **Add Pin** window will display.

4. Start with the **Type Filter** drop-down menu (second line in the window) and select a signal type.
5. From the **Signal** drop-down menu, select a signal.
6. From the **Pins** drop-down menu in line 3, select the pin pair you chose in Step 2. (Note that you will need 4 pins if you selected a RS485 signal Type.)
7. Click **Submit**.
8. In the **Actions** panel, click **Apply Changes**.

Navigation Pinout Configuration

VersaPNT has navigation-specific options that can be configured through the multi I/O connector"I/O signal mapping to Channels" on the previous page

To configure INS IN or OUT via RS232, follow the steps for "Configuring a new Input or Output" on the previous page.

To configure any of the navigation options listed in the following chart(Options 1-8):

1. Navigate to **MANAGEMENT** > **NETWORK** > **Pin Layout** as above and click to PLUS sign in the top right corner..
2. Under **Signal**, select **OPTION**.
3. Select the correct **Pins** from the drop-down menu that correspond to the Option number.
4. You can then click Submit. Be sure to also **Apply Changes** in the Actions menu.

SIGNAL TYPE	Option Number/ Channel Position	Pins	DCLS	RS- 232	RS-422 (n or p)
			TTL		
INS OUT	Channels 1, 4, & 6	(3 &4), (9 & 10), or (11 & 12)		1	
PPS IN	Option 1 & Channel 1	3 & 4	1		
PPS OUT	Option 2 & Channel 2	5 & 6	1		
GPS IN	Option 3 & Channel 3	7 & 8		1	
GPS OUT	Option 4 & Channel 4	9 & 10		1	
IMU IN	Option 5 & Channel 5	11 & 12			1 (p)
IMU IN	Option 6 & Channel 6	13 & 14			1 (n)
IMU OUT	Option 7 & Channel 7	15 & 16			1 (p)
IMU OUT	Option 8 & Channel 8	17 & 18			1 (n)

Restoring the Default I/O Configuration

VersaPNT is shipped with a default I/O configuration that you can be customized. However, if required you can restore the default configuration at any time after applying changes.

To restore the default I/O pin configuration:

A. Navigate to the **MANAGEMENT: NETWORK > Pin Layout** screen.

B. In the **Actions** panel on the left, click **Restore Default Layout**.

Reloading the Current I/O Configuration

To reload the currently used I/O configuration after adding pin layout changes, but before clicking **Apply Changes**:

A. Navigate to the **MANAGEMENT: NETWORK > Pin Layout** screen.

B. In the **Actions** panel on the left, click **Reload Layout**.

2.6.2 Configuring I/O Settings

> **Note:** Illustrations shown below are examples; the windows displayed in your Web UI may look differently.

2.6.2.1 How to Configure an Input Reference

To access the user-editable settings of an Input Reference, choose one of these two methods:

Configuring the settings of an input reference, method 1:

1. Under **INTERFACES > REFERENCES**, click the desired reference.
2. The Status window for the specific reference you selected will be displayed. Click the Edit button in the bottom-left corner.
3. The settings window for the chosen reference will be displayed. Edit the field(s) as desired.

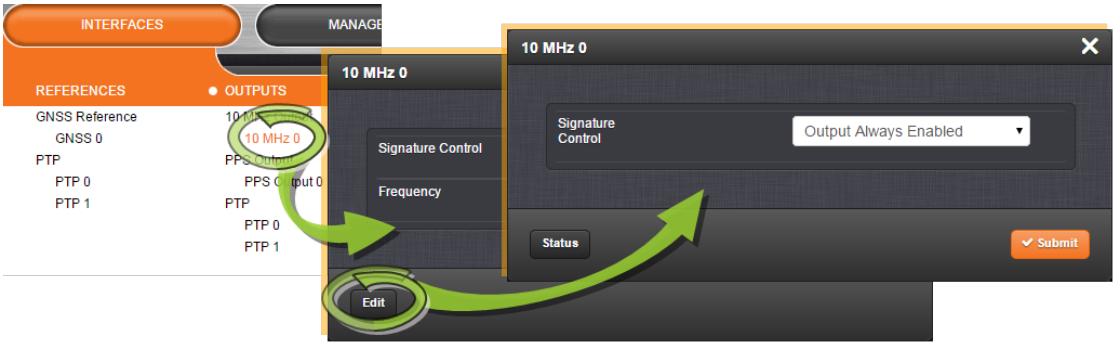
Configuring the settings of an input reference, method 2:

1. In the **INTERFACES > REFERENCES** drop-down menu, click **REFERENCES** (white on orange), or an input reference category (e.g., "GNSS reference").
2. In the Status window, click the GEAR button next to the desired input reference.
3. The settings window for the chosen reference will be displayed. Edit the field(s) as desired.

2.6.2.2 How to Configure an Output

To access the user-editable settings of an Output, choose one of these two methods:

Configuring the settings of an output, method 1:



1. Under **INTERFACES > OUTPUTS**, click the desired output.
2. The Status window for the specific reference you selected will be displayed. Click the **Edit** button in the bottom-left corner.
3. The settings window for the chosen output will be displayed. Edit the field(s) as desired.

Configuring the settings of an output, method 2:

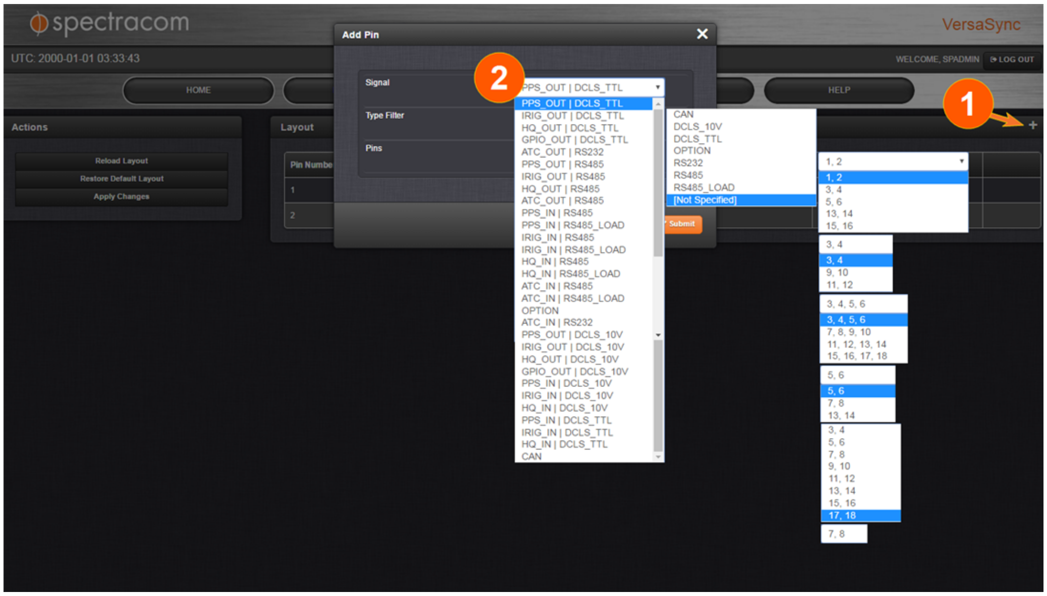
1. In the **INTERFACES > OUTPUTS** drop-down menu, click OUTPUTS, or one of the output categories (**not** indented to the right)
2. In the Status window, click the GEAR button next to the desired output.
3. The settings window for the chosen output will be displayed. Edit the field(s) as desired.

2.6.3 Example: Configuring a 20 PPS Output

The instructions below explain how to configure a 20 PPS output signal:

First, assign a GPIO output to an I/O pin pair:

1. In the Web UI, navigate to **MANAGEMENT > NETWORK: Pin Layout**. The **Pin Layout** screen will be displayed.



> **Note:** INS input/output not shown.

2. Prior to assigning the new output, identify a pin pair in the Pin Layout table that is not used (Signal = "None") or not needed. You can **Delete** it, but you may also simply assign the new PPS Output as described below, thus overwriting the existing Input or Output.
3. Add a pin configuration by clicking the PLUS icon in the top-right corner (1). The **Add Pin** window will display.
4. Start with the **Type Filter** drop-down menu (second line in the window) and select **DCLS_TTL**.
5. From the **Signal** drop-down menu, select **GPIO_OUT DCLS_TTL**.
6. From the **Pins** drop-down menu in line 3, select e.g., pins **1,2**.
7. Click **Submit**.
8. In the **Actions** panel, click **Apply Changes**.

Then, configure the settings for the newly created output:

9. Navigate to **INTERFACES > OUTPUTS > General Purpose Output/GP Output 0**. The **GP Output 0** status window will be displayed.
10. Click Edit. The **GP Output 0** configuration window will be displayed.

11. Under **General**, set the **Output Mode** to **Square Wave**, and check **Output Enabled**.
12. To configure e.g., a 20 PPS signal, set the **Pulse Width** to 1 000 000 ns, and the **Period** to 50 000 000 ns:

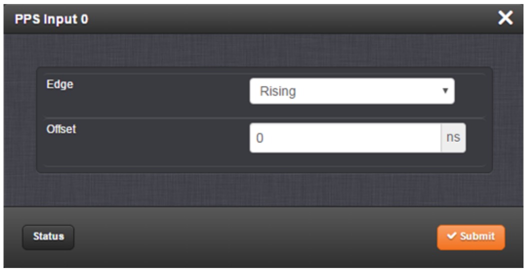
13. Click Submit.

2.6.4 Configurable I/Os

2.6.4.1 Configuring a 1PPS Input

To configure a 1PPS Input:

1. Navigate to **INTERFACES > REFERENCES: PPS Input 0** (or: **INTERFACES > OPTION CARDS: PPS Input 0**).
2. The PPS Input 0 Status window displays. Click Edit to open the configuration window:

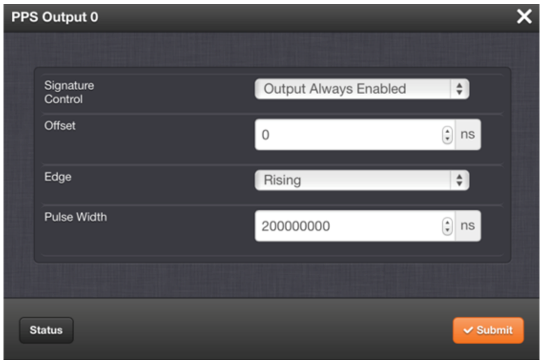


3. Apply your settings for:
    - **Edge**: [Rising, Falling] The on-time point of the 1PPS input can be configured to be either the rising or falling edge of the 1PPS signal (by default, the rising edge is the on-time point).
    - **Offset**: [-500000000 to 500000000 ns = ±0.5 s] Allows to offset the system's 1PPS on-time point, e.g. to compensate for cable delays and other latencies
4. Click Submit.

2.6.4.2 Configuring a 1PPS Output

To configure a 1PPS output:

1. Navigate to **INTERFACES: OUTPUTS**, or to **INTERFACES: OPTION CARDS** (white on orange).
2. In the panel on the right, click the GEAR button next to the **1PPS Output** you want to edit.
3. The **1PPS Output** Edit window will display, allowing the following items to be configured:



- **Signature Control**: Determines when the output is enabled. For more information, see "Signature Control" on page 55.
- **Offset** [ns]: Allows to offset the system's 1PPS on-time point, e.g. to compensate for cable delays and other latencies [range = –500000000 to 500000000 ns = ±0.5 s]
- **Edge**: Used to determine if the on-time point of the 1PPS output is the rising or the falling edge of the signal.

- » **Rising**
- » **Falling**

» **Pulse Width** [ns]: Configures the Pulse Width of the 1PPS output.

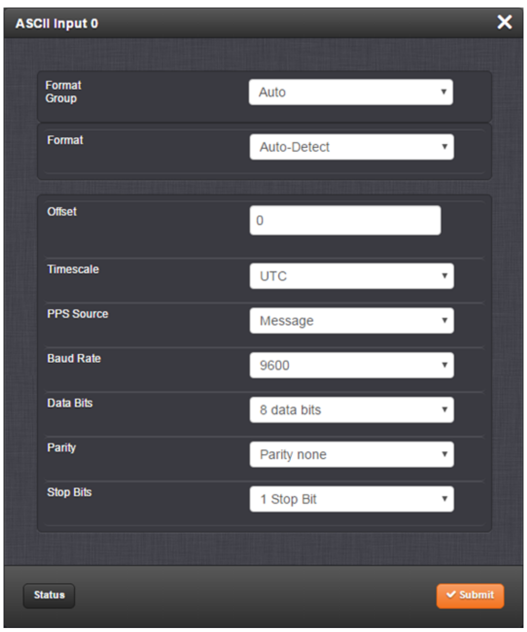
[range = 20 to 900000000 ns = 0.0 µs to 0.9 s]
[default = 200 ms]

4. Click Submit.

2.6.4.3 Configuring an ASCII Input

To configure an **ASCII Input** (ATC = ASCII Time Code):

1. Navigate to **INTERFACES > REFERENCES: ASCII Input 0** (or: **INTERFACES > OPTION CARDS: ASCII Input 0**). The status window will open, providing information on the current Reference ID, input Validity, ASCII Format, and if a pending Leap Second will be added to the UTC timescale at the end of the month. (See also "Local Clock(s), DST" on page 162.)
2. Click Edit to open the configuration window:



The following settings are editable:

» **Format Group**: Determines the time code message format category (see also "Time Code Data Formats" on page 283.) Choices are:

- » Auto
- » Spectracom
- » NMEA

- ICD-153
- EndRun

- **Format**: Once a **Format Group** has been selected, one or more **Format** fields may appear, allowing you to select one or more time code **Formats**. For detailed specifications and limitations on the supported time code formats, see "Time Code Data Formats" on page 283.

> **Note:** If Auto is chosen as the format group, the format will automatically be Auto-detect. VersaPNT will attempt to identify the format of the incoming ASCII message.

- **Offset**: Provides the ability to account for ASCII input cable delays or other latencies in the ASCII input. The Offset value is entered and displayed in nanoseconds (ns). The available Offset range is –500 to +500 ms.

- **Timescale**: Used to select the time base for the incoming ASCII time code data. The entered Timescale is used by the system to convert the time in the incoming ASCII data stream to UTC time for use by the System Time. The available choices are:
  - **UTC** : Coordinated Universal Time ("temps universel coordonné"), also referred to as ZULU time
  - **TAI**: Temps Atomique International
  - **GPS**: The raw GPS time as transmitted by the GNSS satellites (as of July, 2015, this is 17 seconds ahead of UTC time)
  - A **local clock** set up through the Time Management Page: This option will appear under the name of the local clock you have set up. Refer to "The Time Management Screen" on page 150 for more information on how to configure and read the System Time. Local timescale allows a Local Clock to apply a time offset for Time Zone and DST correction.
    The incoming input time information may be provided as local time, but System Time may be configured as UTC time, so internal computations need to be performed. With the Timescale field set to “Local”, select the name of a previously created Local Clock. See for more information on Local Clocks.

> **Note:** The Timescale of the ASCII input (as configured in the ASCII time source) must be set correctly, especially if other input references are enabled. Failure to configure the Timescale of the ASCII input correctly could result in time jumps occurring in the System Time when input reference changes occur. These time jumps could affect NTP and normal operation of the system.

- **PPS Source**: Choices are:
  - **Message**: The 1PPS on time point is extracted from the ASCII message received.
  - **1PPS Pin**: The origin of the 1PPS on-time-point is the 1PPS input connector.
- **Baud Rate**: Determines the speed at which the input port will operate.
- **Data Bits**: Defines the number of Data Bits for the input output.
- **Parity**: Configures the parity checking of the input port.
- **Stop Bits**: Defines the number of Stop Bits for the input port.

3. Click Submit.

2.6.4.4 Configuring an ASCII Output

About the ASCII Format Outputs

The ASCII outputs (ATC = ASCII Time Code) provide VersaPNT with the ability to output one, two or three back-to-back ASCII time code data streams that can be provided to peripheral devices which accept an ASCII RS-232 or RS-485 input data stream for either their external time synchronization or for data processing. See "Time Code Data Formats" on page 283 for a description of all supported time code formats.

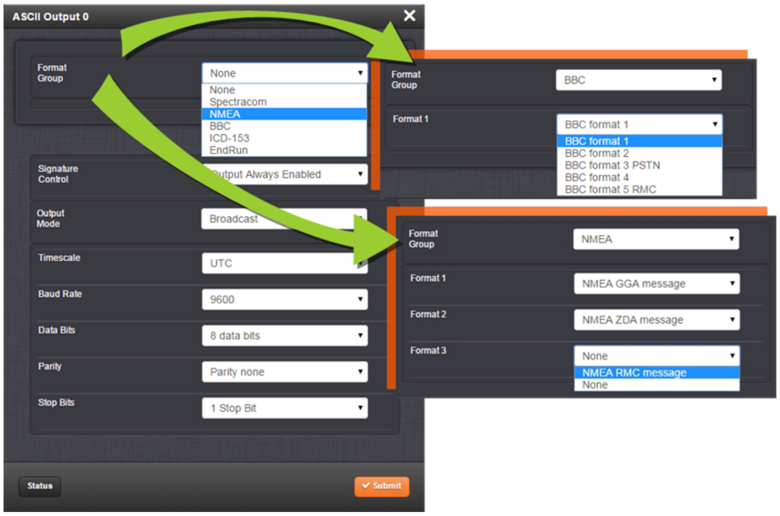
The **RX signal** on an output interface is used for triggering the output ASCII message output when a configured character is received from the peripheral device.

When VersaPNT is configured to output only one format message (the second and third formats configured as “None”), the one configured message will be available on the output port as either a broadcast message or only upon a request character being received. VersaPNT has the ability to output one or two additional data stream messages immediately following the first message. In this configuration, only the first message determines the on-time point for the entire output string. The on-time points for the second and third messages that are provided at the same time as the first message are discarded. This unique capability allows VersaPNT to be able to simultaneously provide multiple pieces of data from different selected format messages.

An example of selecting multiple formats is selecting “NMEA GGA” as the first format, “NMEA RMC” as the second format and “NMEA ZDA” as the third format. Depending on the setting of the “Mode” field (which determines if the data streams are available every second or upon a request character being received), at the next second or the receipt of the next request character, the output port will provide the GGA message followed immediately by the corresponding RMC message for that same second, followed immediately by the corresponding ZDA message for that same second. The first GGA message will provide the on-time point for the entire output data stream.

To configure an **ASCII Output**:

1. Navigate to **INTERFACES > OUTPUTS: ASCII Output 0**, or to **INTERFACES > OPTION CARDS: ASCII Output 0**. The status window will display, providing information on Signature Control and the message format (s).
2. Click the Edit button to open the configuration window:



The Edit window allows the configuration of the following settings:

- **Format Group**: configures the message format type. Choices are:
  - None (no message will be output)
  - Spectracom
  - NMEA
  - BBC
  - ICD-153
  - EndRun

  Once selected, the **Format Group** may offer a choice of **Formats**. For more information on supported **Formats**, see "Time Code Data Formats" on page 283.
  - **Format 1**: Selects either the first of up to three, or the only format message to be output.
  - **Format 2**: Selects the second consecutive format message to be outputted. Select “None” if only one output format is desired. “None” will be the only choice available if Format 1 is “None.”

- **Format 3**: Selects the third consecutive format message to be outputted. Select “None” if only one output format is desired. “None” will be the only choice available if Format 2 is “None.”

- **Signature Control**: Signature Control controls when the selected ASCII data output format will be present; see "Signature Control" on page 55.
- **Output Mode**: This field determines when the output data will be provided. The available Mode selections are as follows:
  - **Broadcast**: The format messages are automatically sent out on authorized condition (Signature control), every second a message is generated in sync with the 1PPS.
  - **Request (On-time)**: A format message is generated in sync with 1PPS after the configured request character has been received.
  - **Request (Immediate)**: A format message is generated as soon as the request character is received. As this selection does not correlate the output data to the on-time point for the message, in Data Formats that do not provide sub-second information (such as Formats 0 and 1 whereas Format 2 provides sub-second information), it should be noted that the output data can be provided immediately, but a time error could occur when using the on-time point of the message in addition to the data for timing applications.

  > **Note:** The choices available in this field are determined by the choices of Format Group and Format.

- **Timescale**: Used to select the time base for the incoming data. The entered Timescale is used by the system to convert the time in the incoming data stream to UTC time for use by the System Time. The available choices are:
  - **UTC**: Coordinated Universal Time ("temps universel coordonné"), also referred to as ZULU time
  - **TAI**: Temps Atomique International
  - **GPS**: The raw GPS time as transmitted by the GNSS satellites (as of August, 2018, this is currently 18 seconds ahead of UTC time).

  If GPS or TAI time is used, then the proper timescale offsets must be set on the **MANAGEMENT: OTHER > Time Management** page. (See "The Time Management Screen" on page 150 for more information on how to configure and read the System Time). Local timescale allows a Local Clock to apply a time offset for Time Zone and DST correction.
  - A **Local Clock** can be set up through the **Time Management** page: This option will appear under the name of the local clock you have set up. See for more information. Local timescale allows a Local Clock to apply a time offset for Time Zone and DST correction.

The incoming input time information may be provided as local time, but System Time may be configured as UTC time, so internal computations need to be performed. With the Timescale field set to “Local”, select the name of a previously created Local Clock.

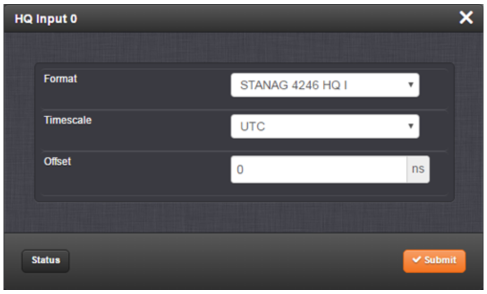
- **Baud Rate**: Determines the speed at which the output port will operate.
- **Data Bits**: Defines the number of Data Bits for the output port.
- **Parity**: Configures the parity checking of the output port.
- **Stop Bits**: Defines the number of Stop Bits for the output.

3. Click Submit.

2.6.4.5 Configuring a HaveQuick Input

To configure a HaveQuick input:

1. Navigate to **INTERFACES > REFERENCES: HQ Input 0** (or: **INTERFACES > OPTION CARDS: HQ Input 0**). The **Status** window will open, displaying information on the current Reference ID, input Validity, TOD Format, Time Scale, Offset, and TFOM. (For more information on TFOM, see "Time Figure of Merit (TFOM)" on page 210.)
2. Click **Edit** to open the **Configuration** window.



The following settings are configurable:

- **ToD Format**: The user-selectable format to be used. Available formats include:
  - STANAG 4246 HAVE QUICK I
  - STANAG 4246 HAVE QUICK II
  - STANAG 4372 HAVE QUICK IIA
  - STANAG 4430 Extended HAVE QUICK
  - STANAG 4430 Standard Time Message (STM)
  - ICD-GPS-060A BCD Time Code

   - ICD-GPS-060A HAVE QUICK
   - DOD-STD-1399 BCD Time Code
 - **Timescale**: Used to select the time base for the incoming time code data. The entered Timescale is used by the system to convert the time in the incoming data stream to UTC time for use by the System Time. The available choices are:
   - **UTC**: Coordinated Universal Time ("temps universel coordonné"), also referred to as ZULU time

     TAI: Temps Atomique International

     GPS: The raw GPS time as transmitted by the GNSS satellites (as of July, 2018, this is 18 seconds ahead of UTC time).

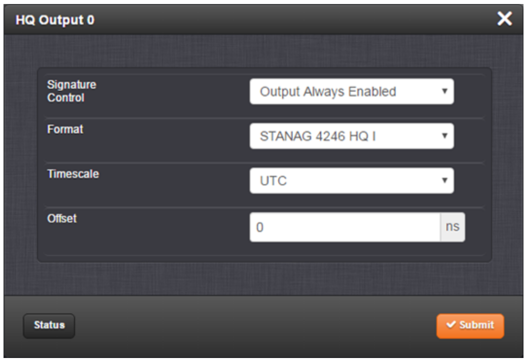
     A **local clock** can be set up through the Time Management Page; see "Local Clock(s), DST" on page 162. Local timescale allows a Local Clock to apply a time offset for Time Zone and DST correction.
 - **Offset**: Provides the ability to account for STANAG Line (TOD1 and TOD2 independently) cable delays or other latencies in the STANAG input. Available Offset range is –500 to +500 ms in 5ns steps.

3. Click Submit.

2.6.4.6 Configuring a HaveQuick Output

To configure a HaveQuick output:

1. Navigate to **INTERFACES > OUTPUTS: HQ Output 0**, or to **INTERFACES > OPTION CARDS: HQ Output 0**. The Status window will display, providing information on Signature Control, message Format, Timescale, and Offset.
2. Click Edit. The Configuration window will display.



The following settings are configurable:

- **Signature Control**: Used to control when the signal will be present. This function allows the modulation to stop under certain conditions, see also "Signature Control" below.
- **TOD Format**: The user-selectable format to be used. Available formats include:
  - STANAG 4246 HQI
  - STANAG 4246 HQII
  - STANAG 4372 HQIIA
  - STANAG 4430 STM
  - STANAG 4430 XHQ
  - ICD-GPS-060A BCD
  - ICD-GPS-060A HQ
  - DOD-STD-1399 BCD
- **Timescale**: Used to select the time base for the incoming time code data. The entered Timescale is used by the system to convert the time in the incoming data stream to UTC time for use by the System Time. The available choices are:
  - **UTC** — Coordinated Universal Time ("temps universel coordonné"), also referred to as ZULU time
  - **TAI**—Temps Atomique International
  - **GPS**—The raw GPS time as transmitted by the GNSS satellites (as of July, 2015, this is 17 seconds ahead of UTC time)
  - A **local clock** set up through the Time Management Page—Refer to "The Time Management Screen" on page 150 for more information on how to configure and read the System Time. Local timescale allows a Local Clock to apply a time offset for Time Zone and DST correction.
- **Offset (ns)**: Provides the ability to account for STANAG Line (TOD1 and TOD2 independently) cable delays or other latencies in the STANAG output. Available Offset range is –500 to +500 ms in 5ns steps.

3. Click Submit.

2.6.5 Signature Control

Signature Control is a user-set parameter that controls under which output states an output will be present. This feature allows you to determine how closely you want to link an output to the status of the active input reference e.g., by deactivating it after holdover expiration. It is also offers the capability to indirectly send an input-reference-lost-alarm to a downstream recipient via the presence of the signal.

EXAMPLES:

You can setup Signature Control such that VersaPNT's built in 1PPS output becomes disabled the moment its input reference is lost (e.g., if a valid GNSS signal is lost).

Or, you can setup your output signal such that remains valid while VersaPNT in holdover mode, but not in free run.

The available options are:

I. **Output Always Enabled**—The output is present, even if VersaPNT is not synchronized to its references (VersaPNT is free running).

II. **Output Enabled in Holdover**—The output is present unless VersaPNT is not synchronized to its references (VersaPNT is in Holdover mode).

III. **Output Disabled in Holdover**—The 1PPS output is present unless the VersaPNT references are considered not qualified and invalid (the output is NOT present while VersaPNT is in Holdover mode.)

IV. **Output Always Disabled**—The output is never present, even if VersaPNT references are present and valid.

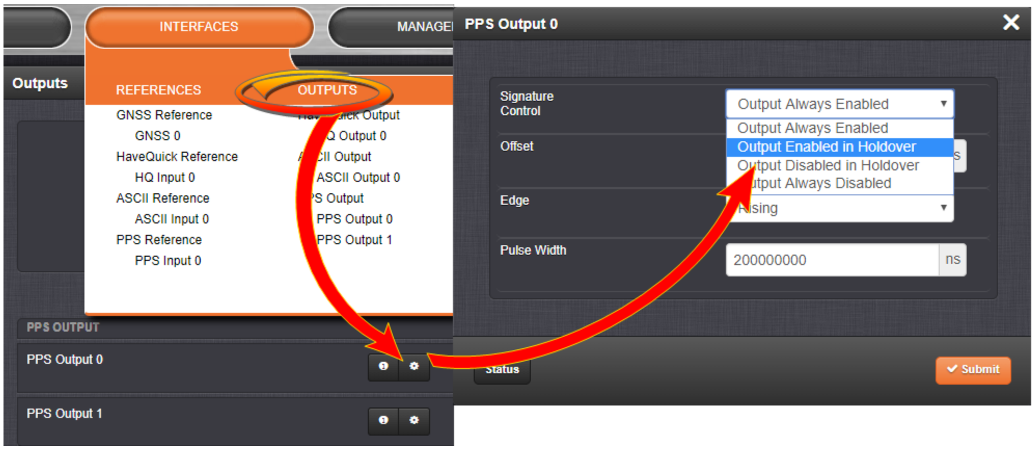
Table 2-4: Signature control output-presence states

Ref.	Out-of-sync, no holdover	In holdover	In-sync with external reference
I.	✓	✓	✓
II.	✗	✓	✓
III.	✗	✗	✓
IV.	✗	✗	✗

Configuring Signature Control for an Output

To review or configure the Signature Control setting for any output:

1. Navigate to **INTERFACES > OUTPUTS** and click the output you want to configure.



2. In the **Outputs** panel, click the GEAR button for the desired output. Ehe **Edit** window will open with the current Signature Control setting, and a drop-down list to change it.

2.7 Configuring Network Settings

Before configuring the network settings, you need to setup access to VersaPNT web user interface ("Web UI"). This can be done by assigning a static IP address, or using a DHCP address. For more information, see "Assigning a Static IP Address" on page 36.

Once you have assigned the IP address, login to the Web UI. For more information, see "Accessing the Web UI" on page 34.

To configure network settings, or monitor your network, navigate to VersaPNT's **Network Setup** screen.

To access the **Network Setup** screen:

» Navigate to **MANAGEMENT > Network Setup**. The **Network Setup** screen is divided into three panels:

The Actions panel provides:

- **General Settings**: Allows quick access to the primary network settings necessary to connect VersaPNT to a network. See "General Network Settings" below.
- **Web Interface Settings**:
  - Web interface **timeout**: Determines how long a user can stay logged on. For more information, see "Web UI Timeout" on page 233.
- **Access Control**: Allows the configuration of access restrictions from assigned networks/nodes.
- **Login Banner**: Allows the administrator to configure a custom banner message to be displayed on the VersaPNT Web UI login page and the CLI (Note: There is a 2000 character size limit).
- **SSH**: This button takes you to the **SSH Setup** window. For details on setting up SSH, see "SSH" on page 63.
- **System Time Message**: Setup a once-per-second time message to be sent to receivers via multicast. For details, see "System Time Message" on page 79.

The Network Services panel is used to enable (ON) and disable (OFF) network services, as well as the Web UI display mode, details see: "Network Services" on page 61.

The Ports panel not only displays STATUS information, but is used also to set up and manage VersaPNT's network ports via three buttons:

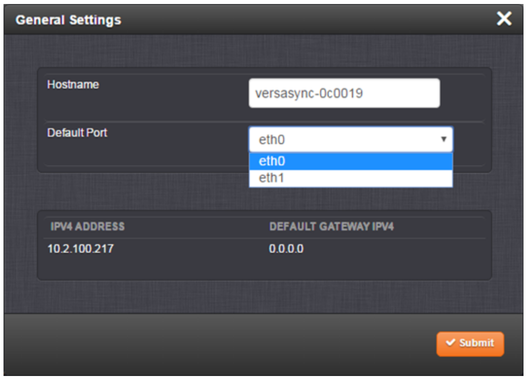
- **INFO** button: Displays the Ethernet port Status window for review purposes.
- **GEAR** button: Displays the Ethernet port settings window for editing purposes.

2.7.1 General Network Settings

To expedite network setup, VersaPNT provides the **General Settings** window, allowing quick access to the primary network settings.

To access the **General Settings** window:

1. Navigate to **MANAGEMENT > Network Setup**. In the **Actions Panel** on the left, click **General Settings**.



2. Populate the fields:
   - **Hostname**: This is the server's identity on the network or IP address.
   - **Default Port**: Unless you specify a specific Port to be used as Default Port, the factory default port **eth0** will be used as the gateway (default gateway).

   The **General Settings** window also displays the IPv4 Address and default IPv4 Gateway.

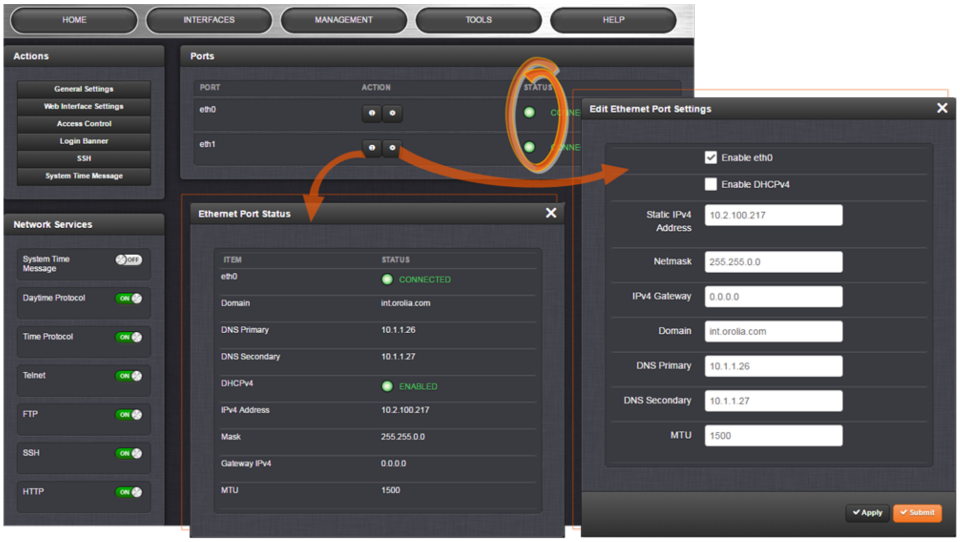
2.7.2 Network Ports

Ports act as communication endpoints in a network. The hardware configuration of your unit will determine which ports (e.g., Eth0, Eth1, ...) are available for use. Before using a port, it needs to be enabled and configured.

To enable & configure, or view a network port:

1. Navigate to **MANAGEMENT > NETWORK: Network Setup**.
2. The **Ports** panel on the right side of the screen lists the available Ethernet ports, and their connection STATUS:
   - Green: **CONNECTED** (showing the connection speed)
   - Yellow: **CABLE UNPLUGGED** (the port is enabled but there is no cable attached)
   - Red: **DISABLED**.

   Locate the port you want to configure and click the GEAR button to enable & configure the port, or the INFO button to view the port status.



3. If the port is not already enabled, in the **Edit Ethernet Ports Settings** window, click the **Enable** check box. The **Edit Ethernet Ports Settings** window will expand to show the options needed to complete the port setup.

   Fill in the fields as required:

   » **Enable eth0**: [Checkbox]

   » **Enable DHCPv4**: [Checkbox] Check this box to enable the delivery of IP addresses from a DHCP Server using the DHCPv4 protocol.

   » **Static IPv4 Address**: This is the unique address assigned by the network administrator.

   Table 2-5: Default IP addresses

ETH port	Default "static lease" IP address
ETH0	10.10.201.1
ETH1	10.10.201.2
ETH2	10.10.201.3
ETH3	10.10.201.4

   The default subnet is: 255.255.0.0

   » **Netmask**: This is the network subnet mask assigned by the network administrator. In the form “`xxx.xxx.xxx.xxx`.” See "Subnet Mask Values" on page 37 for a list of subnet mask values.

- **IPv4 Gateway**: The gateway (default router) address is needed if communication to the VersaPNT is made outside of the local network. By default, the gateway is disabled.
- **Domain**: This is the domain name to be associated with this port.
- **DNS Primary**: This is the primary DNS address to be used for this port. Depending on how your DHCP server is configured, this is set automatically once DHCP is enabled. Alternatively, you may configure your DHCP server to NOT use a DNS address. When DHCP is disabled, DNS Primary is set manually, using the format "#.#.#.#" with no leading zeroes or spaces, where each '#' is a decimal integer from the range [0,255].
- **DNS Secondary**: This is the secondary DNS address to be used for this port. Depending on how your DHCP server is configured, this is set automatically once DHCP is enabled, or your DHCP server may be configured NOT to set a DNS address. When DHCP is disabled, DNS Secondary is set manually, using the format "#.#.#.#" with no leading zeroes or spaces, where each '#' is a decimal integer from the range [0,255].
- **MTU**: Maximum Transmission Unit. Range (for Ethernet v2): Default: 1500 bytes. Smaller packages are recommended, if encapsulation is required e.g., to meet encryption needs, which would cause the maximum package size to be exceeded.

4. To apply your changes, click **Submit** (the window will close), or **Apply**.

2.7.3 Network Services

Several standard network services can be enabled or disabled via the easily accessible **Network Services** Panel under **MANAGEMENT** > **Network Setup**:

The **Network Services** panel has ON/OFF toggle switches for the following daemons and features:

- **Daytime Protocol, RFC-867**: A standard Internet service, featuring an ASCII daytime representation, often used for diagnostic purposes.
- **Time Protocol, RFC-868**: This protocol is used to provide a machine-readable, site-independent date and time.
- **Telnet**: Remote configuration
- **FTP** server: Access to logs
- **SSH**: Secure Shell cryptographic network protocol for secure data communication
- **HTTP**: Hypertext Transfer Protocol
- **tcpdump**: A LINUX program that can be used to monitor network traffic by inspecting tcp packets. Default = ON.
  If not needed, or wanted (out of concern for potential security risks), **tcpdump** can be disabled permanently: Once toggled to OFF, and after executing a page reload, **tcpdump**

will be deleted from the system: The toggle switch will be removed, and the function cannot be enabled again (even after a software upgrade).

2.7.4 Access Rules

Network access rules restrict access to only those assigned networks or nodes defined. If no access rules are defined, access will be granted to all networks and nodes.

> **Note:** In order to configure Access Rules, you need ADMINISTRATOR rights.

To configure a new, or delete an existing access rule:

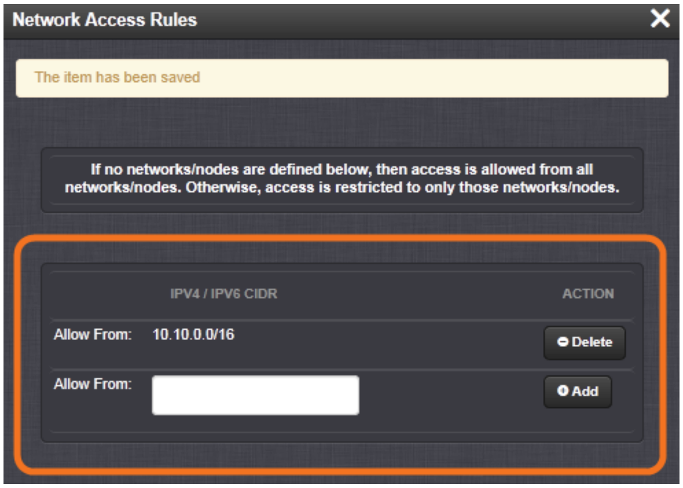
1. Navigate to the **MANAGEMENT > Network Setup** screen.
2. In the **Actions** panel on the left, click on **Access Control.**
3. The **Network Access Rules** window displays:

4. In the **Allow From** field, enter a valid IP address. It is not possible, however, to add direct IP addresses, but instead they must be input as blocks, i.e. you need to add `/32` at the end of an IP address to ensure that only that address is allowed. Example: `10.2.100.29/32` will allow only `10.2.100.29` access.

> **IP address nomenclature:**
>
> IPv4—`10.10.0.0/16`, where `10.10.0.0` is the IP address and `16` is the subnet mask in prefix form. See the table "Subnet Mask Values" on page 37 for a list of subnet mask values.
>
> IPv6—`2001:db8::/48`, representing `2001:db8:0:0:0:0:0:0` to `2001:db8:0:ffff:ffff:ffff:ffff:ffff`.

5. Click the **Add** button in the **Action** column to add the new rule.
6. The established rule appears in the **Network Access Rules** window.

Click the **Delete** button next to an existing rule, if you want to delete it.



2.7.5 SSH

The SSH, or Secure Shell, protocol is a cryptographic network protocol, allowing secure remote login by establishing a secure channel between an SSH client and an SSH server. SSH uses **host keys** to uniquely identify each SSH server. Host keys are used for server authentication and identification. A secure unit permits users to create or delete RSA or DSA keys for the SSH2 protocol.

Note: Only SSH2 is supported due to vulnerabilities in the SSH1 protocol.

The SSH tools supported by VersaPNT are:

- **SSH**: Secure Shell
- **SCP**: Secure Copy
- **SFTP**: Secure File Transfer Protocol

VersaPNT implements the server components of SSH, SCP, and SFTP.

For more information on OpenSSH, please refer to www.openssh.org.

To configure SSH:

1. Navigate to **MANAGEMENT** > **NETWORK: SSH Setup**. The **SSH Setup** window will display.

   The window contains two tabs:

   - **Host Keys**: SSH uses Host Keys to uniquely identify each SSH server. Host keys are used for server authentication and identification.

- **Public Key**: This is a text field interface that allows the user to edit the public key files `authorized_keys` file.

> **Note:** Should you exit the SSH Setup window (by clicking X in the top right corner of the window, or by clicking anywhere outside of the window), while filling out the Certificate Request Parameters form before clicking Submit, any information you entered will be lost. When switching between tabs within the SSH Setup window, however, the information you have entered will be retained.

Host Keys

You may choose to delete individual RSA or DSA host keys. Should you decide to delete the RSA or DSA key, the SSH will function, but that form of server authentication will not be available. Should you delete both the RSA and DSA keys, SSH will not function. In addition, if SSH host keys are being generated at the time of deletion, the key generation processes are stopped, any keys created will be deleted, and all key bit sizes are set to 0.

You may choose to delete existing keys and request the creation of new keys, but it is often simpler to make these requests separately.

You can create individual RSA and DSA Host Public/Private Key pairs. Host keys must first be deleted before new Host Keys can be created.

VersaPNT units have their initial host keys created at the factory. RSA host key sizes can vary between 768 and 4096 bits. The recommended key size is 1024. Though many key sizes are supported, it is recommended that users select key sizes that are powers of 2 or divisible by 2. The most popular sizes are 768, 1024, and 2048. Large key sizes of up to 4096 are supported, but may take 10 minutes or more to generate. DSA keys size support is limited to 1024 bits.

Host keys are generated in the background. Creating RSA and DSA keys, each with 1024 bits length, typically takes about 30 seconds. Keys are created in the order of RSA, DSA, RSA. When the keys are created, you can successfully make SSH client connections. If the unit is rebooted with host key creation in progress, or the unit is booted and no host keys exist, the key generation process is restarted. The key generation process uses either the previously specified key sizes or, if a key size is undefined, the default key bit length size used is 2048. A key with a zero length or blank key size field is not created.

The SSH client utilities SSH, SCP, and SFTP allow for several modes of user authentication. SSH allows you to remotely login or transfer files by identifying your account and the target machine's IP address. As a user you can authenticate yourself by using your account password, or by using a Public Private Key Pair.

It is advisable to keep your private key secret within your workstation or network user account, and provide the VersaPNT a copy of your public key. The modes of authentication supported include:

» Either Public Key with Passphrase or Login Account Password

» Login Account Password only

» Public Key with Passphrase only

SSH using public/private key authentication is the most secure authenticating method for SSH, SCP or SFTP sessions.

You are required to create private and public key pairs on your workstation or within a private area in your network account. These keys may be RSA or DSA and may be any key bit length as supported by the SSH client tool. These public keys are stored in a file in the `.ssh` directory named `authorized_keys`. The file is to be formatted such that the key is followed by the optional comment with only one key per line.

> **Note:** The file format, line terminations, and other EOL or EOF characters should correspond to UNIX conventions, not Windows.

Changing Key Length Values

You may change the key length of the RSA, DSA, ECDSA type host keys.

To change the key length of a host key:

1. Navigate to **MANAGEMENT > NETWORK: SSH Setup**. The **SSH Setup** window will open to the **Host Keys** tab by default.
2. Select the **Key Length** value for the key type you want to change.

   Key sizes that are powers of 2 or divisible by 2 are recommended. The most popular sizes are 768, 1024, and 2048. Large key sizes of up to 4096 are supported, but may take 10 minutes or more to generate. DSA keys size support is limited to 1024 bits. The key type ED25519 supports 256 bits.
3. Check the **Regenerate All Keys** box.
4. Click **Submit**. The new values will be saved.

> **Note:** Changing the values and submitting them in this manner DOES NOT generate new host public/private key pairs. See "Creating Host Public/Private Key Pairs" on the next page for information on how to create new host public/private key pairs.

Deleting Host Keys

You can delete individual host keys. To delete a key:

1. Navigate to **MANAGEMENT > NETWORK: SSH Setup**. The window will open to the **Host Keys** tab by default.
2. Select **Delete** in the field for the key you wish to delete, and click **Submit**.

Creating Host Public/Private Key Pairs

You may create individualHost Public/Private Key pairs. Host keys must first be deleted before new Host Keys can be created. To create a new set of host keys:

1. To access the SSH setup screen, navigate to **MANAGEMENT > NETWORK: SSH Setup**. The window will open to the **Host Keys** tab by default.
2. Should you want to change the key length of any host key, enter the desired length in the text field corresponding to the length you wish to change.
3. Check the **Regenerate All Keys** box.
4. Click **Submit**.
   The Key Type/Status/Action table will temporarily disappear while the VersaPNT regenerates the keys. The Host keys are generated in the background. Creating RSA and DSA keys, each with 1024 bits length, typically takes about 30 seconds. Keys are created in the order of RSA, DSA, ECDSA, ED25519. VersaPNT will generate all 4 host keys, RSA, DSA, ECDSA, and ED25519.
5. Delete any of the keys you do not want. See "Deleting Host Keys" on the previous page.

> **Note:** If the unit is rebooted with host key creation in progress, or the unit is booted and no host keys exist, the key generation process is restarted. The key generation process uses the previously specified key sizes.

> **Note:** If a key size is undefined, the default key bit length size used is 2048. A key with a zero length or blank key size field will not be created.

When you delete a host key and recreate a new one, SSH client sessions will warn you that the host key has changed for this particular IP address. You must then take one of the following actions:

1. Override the warning and accept the new Public Host Key and start a new connection. This is the default. This option allows users to login using either method. Whichever mode works is allowed for logging in. If the Public Key is not correct or the Passphrase is not valid the user is then prompted for the login account password.
2. Remove the old Host Public Key from their client system and accept the new Host Public Key. This option simply skips public/private key authentication and immediately prompts the user for password over a secure encrypted session avoiding sending passwords in the clear.

3. Load a public key into VersaPNT. This public key must match the private key found in the users account and be accessible to the SSH, SCP, or SFTP client program. The user must then enter the Passphrase after authentication of the keys to provide the second factor for 2-factor authentication.

Please consult your specific SSH client's software's documentation.

Public Keys: Viewing, Editing, Loading

The `authorized_keys` file can be viewed and edited, so as to enable adding and deleting Public Keys. The user may also retrieve the `authorized_keys` file from the .ssh directory Using FTP, SCP, or SFTP.

If you want to completely control the public keys used for authentication, a correctly formatted `authorized_keys` file formatted as indicated in the OpenSSH web site can be loaded onto VersaPNT. You can transfer a new public key file using the Web UI.

To view and edit the `authorized_keys` file:

1. Navigate to **MANAGEMENT > NETWORK: SSH Setup**. The **SSH Setup** window will open to the **Host Keys** tab by default.
2. Select the **Public Key** tab. The `authorized_keys` file appears in the **Public Keys File** window:

3. Edit the `authorized_keys` file as desired.
4. Click the **Submit** button or **Apply** button.

The file is to be formatted such that the key is followed by an optional comment, with only one key per line. The file format, line terminations, and other EOL or EOF characters should correspond to UNIX conventions, not Windows.

> **Note:** If you delete ALL Public Keys, Public/Private Key authentication is disabled. If you have selected SSH authentication using the Public Key with Passphrase option, login and file transfers will be forbidden. You must select a method allowing the use of account password authentication to enable login or file transfers using SCP or SFTP.

Editing the "authorized_key" File via CLI

Secure shell sessions using an SSH client can be performed using the admin or a user-defined account. The user may use Account Password or Public Key with Passphrase authentication. The OpenSSH tool SSH-KEYGEN may be used to create RSA and DSA keys used to identify and authenticate user login or file transfers.

The following command lines for OpenSSH SSH client tool are given as examples of how to create an SSH session.

Creating an SSH session with Password Authentication for the admin account

```
ssh spadmin@10.10.200.5
spadmin@10.10.200.5's password: admin123
```

You are now presented with boot up text and/or a ”>” prompt which allows the use of the Spectracom command line interface.

Creating an SSH session using Public Key with Passphrase Authentication for the admin account

You must first provide the secure Spectracom product a RSA public key found typically in the OpenSSH id_rsa.pub file. Then you may attempt to create an SSH session.

```
ssh -i ./id_rsa spadmin@10.10.200.5
Enter passphrase for key './id_rsa': mysecretpassphrase
```

Please consult the SSH client tool’s documentation for specifics on how to use the tool, select SSH protocols, and provide user private keys.

Secure File Transfer Using SCP and SFTP

VersaPNT provides secure file transfer capabilities using the SSH client tools SCP and SFTP. Authentication is performed using either Account Passwords or Public Key with Passphrase.

Example output from OpenSSH, SCP, and SFTP client commands are shown below.

Perform an SCP file transfer to the device using Account Password authentication

```
scp authorized_keys scp@10.10.200.5:.ssh
spadmin@10.10.200.135's password: admin123
publickeys                                                    100%
|***************************************************| 5 00:00
```

Perform an SCP file transfer to the device using Public Key with Passphrase authentication.

```
scp -i ./id_rsa spadmin@10.10.200.5:.ssh
Enter passphrase for key './id_rsa': mysecretpassphrase
```

```
publickeys 100%
|**************************************************| 5 00:00
```

Perform an SFTP file transfer to the device using Account Password authentication.

```
sftp spadmin@10.10.200.5
spadmin@10.10.200.135's password: admin123
```

You will be presented with the SFTP prompt allowing interactive file transfer and directory navigation.

Perform an SFTP file transfer to the device using Public Key with Passphrase authentication

```
sftp -i ./id_rsa spadmin@10.10.200.5
Enter passphrase for key './id_rsa': mysecretpassphrase
```

You will be presented with the SFTP prompt allowing interactive file transfer and directory navigation.

Recommended SSH Client Tools

Spectracom does not make any recommendations for specific SSH clients, SCP clients, or SFTP client tools. However, there are many SSH based tools available to the user at low cost or free.

Two good, free examples of SSH tool suites are the command line based tool OpenSSH running on a Linux or OpenBSD x86 platform and the SSH tool suite PuTTY.

The OpenSSH tool suite in source code form is freely available at www.openssh.org though you must also provide an OpenSSL library, which can be found at www.openssl.org.

PuTTY can be found at: http://www.chiark.greenend.org.uk/~sgtatham/putty/.

SSH Timeout

The keep-SSH alive timeout is hard-set to 7200 seconds. This value is not configurable.

2.7.6 SNMP

SNMP (Simple Network Management Protocol) is a widely used application-layer protocol for managing and monitoring network elements. It has been defined by the Internet Architecture Board under RFC-1157 for exchanging management information between network devices, and is part of the TCP/IP protocol.

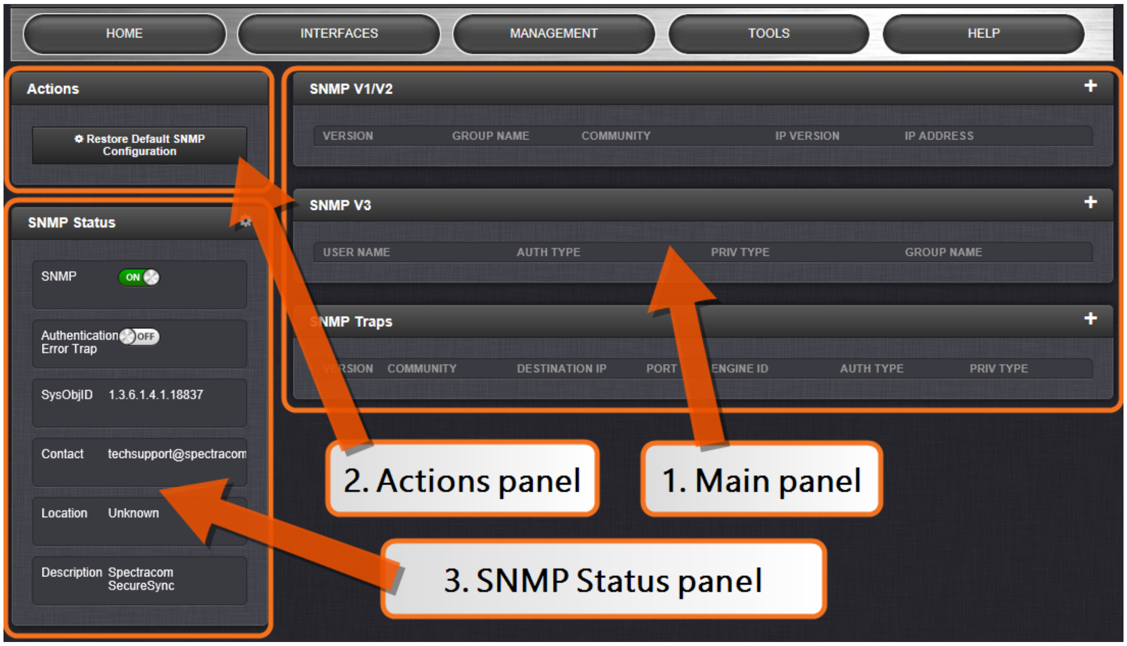
SNMP agents must be enabled and configured so that they can communicate with the network management system (NMS). The agent is also responsible for controlling the database of control variables defined in the Management Information Base (MIB).

VersaPNT's SNMP functionality supports SNMP versions V1, V2c and V3 (with SNMP Version 3 being a secure SNMP protocol).

Note: In order to configure SNMP, you need ADMINISTRATOR rights.

To access the **SNMP Setup** screen:

Navigate to **MANAGEMENT > NETWORK: SNMP Setup**. The **SNMP** screen will display:



The **SNMP** screen is divided into 3 panels:

1. The **Main panel**, which is subdivided into 3 displays:
   - **SNMP V1/V2**: This panel allows configuration of SNMP v1 and v2c communities (used to restrict or allow access to SNMP). This tab allows the configurations for SNMP v1 and v2c, including the protocols allowed, permissions and Community names as well as the ability to permit or deny access to portions of the network. Clicking on the "+" symbol in the top-right corner opens the SNMP V1/V2c Settings for Access Screen. See "SNMP V1/V2c" on page 73.
   - **SNMP V3**: This panel allows configuration of SNMP v3 functionality, including the user name, read/write permissions, authorization passwords as well as privilege Types and Passphrases. Clicking on the "+" symbol in the top-right corner opens the SNMP V3 Screen. See "SNMP V3" on page 75.
   - **SNMP Traps**: This panel allows you to define different SNMP Managers that SNMP traps can be sent to over the network. This allows for SNMP Managers in different geographical areas to receive the same SNMP traps that Managers in other areas also receive. Clicking the PLUS icon in the

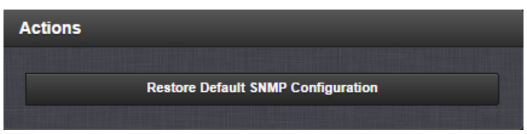
top-right corner opens the SNMP Traps Settings Screen. See also "SNMP Traps" on page 77 and "Setting Up SNMP Notifications" on page 222.

2. The **Actions panel**, which contains the **Restore Default SNMP Configuration** button.
3. The **SNMP Status panel**, which offers:
   - An **SNMP** ON/OFF switch.
   - An **Authentication Error Trap** ON/OFF switch.
   - **SysObjID**—The System Object ID number. This is editable in the SNMP Status panel (see "Configuring the SNMP Status" below).
   - **Contact Information**—The email to contact for service. This is editable in the SNMP Status panel (see "Configuring the SNMP Status" below).
   - **Location**—The system location. This is editable in the SNMP Status panel (see "Configuring the SNMP Status" below).
   - **Description**—A simple product description. This is not editable in the SNMP Status.

Restoring the Default SNMP Configuration

To restore the VersaPNT to its default SNMP configuration:

1. Navigate to the **MANAGEMENT > NETWORK: SNMP Setup** screen.
2. In the **Actions** panel, click the **Restore Default SNMP Configuration** button.

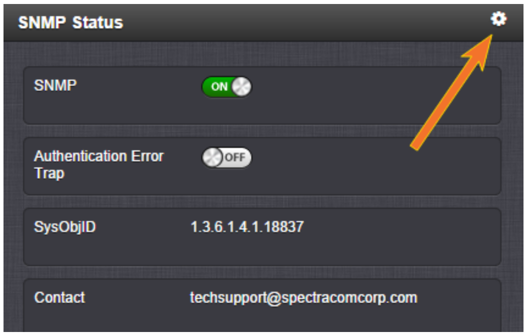


3. Confirm that you want to restore the default settings in the pop-up message.

Configuring the SNMP Status

The SNMP Status Settings are **sysObjectID**, **sysContact**, and **sysLocation**. To configure SNMP Status Settings:

1. Navigate to **MANAGEMENT > NETWORK: SNMP Setup**.
2. In the **SNMP Status** panel on the left, click the GEAR icon in the top-right corner of the panel.



3. The **SNMP Status** pop-up window will display:

The following settings can be configured in this window:

» In the **sysObjectID** field, enter the SNMP system object ID.

» In the **sysContact** field, enter the e-mail information for the system contact you wish to use.

» In the **sysLocation** field, enter the system location of your VersaPNT unit.

4. Click **Submit**, or cancel by clicking the **X**-icon in the top-right corner.

Accessing the SNMP Support MIB Files

Spectracom's private enterprise MIB files can be extracted via File Transfer Protocol (FTP) from VersaPNT, using an FTP client such as FileZilla or any other shareware/freeware FTP program.

To obtain the MIB files from VersaPNT via FTP/SFTP:

1. Using an FTP program, log in as an administrator.
2. Through the FTP program, locate the Spectracom MIB files in the `/home/spectracom/mibs` directory.
3. FTP the files to the desired location on your PC for later transfer to the SNMP Manager.
4. Compile the MIB files onto the SNMP Manager.

> **Note:** When compiling the MIB files, some SNMP Manager programs may require the MIB files to be named something other than the current names for the files. The MIB file names may be changed or edited as necessary to meet the requirements of the SNMP Manager. Refer to the SNMP Manager documentation for more information on these requirements.

> **Note:** In addition to the Spectracom MIB files, there are also some net-snmp MIB files provided. Net-snmp is the embedded SNMP agent that is used in the VersaPNT and it provides traps to notify the user when it starts, restarts, or shuts down. These MIB files may also be compiled into your SNMP manager, if they are not already present.

Spectracom's private enterprise MIB files can be requested and obtained from the Spectracom Customer Service department via email at techsupport@spectracom.com.

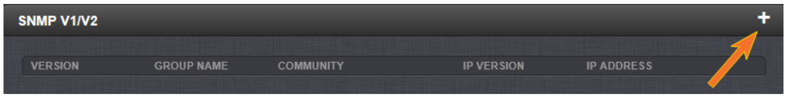
> **Note:** By default, techsupport@spectracom.com is the address in the sysContact field of the SNMP Status panel of the SNMP Setup page.

2.7.6.1 SNMP V1/V2c

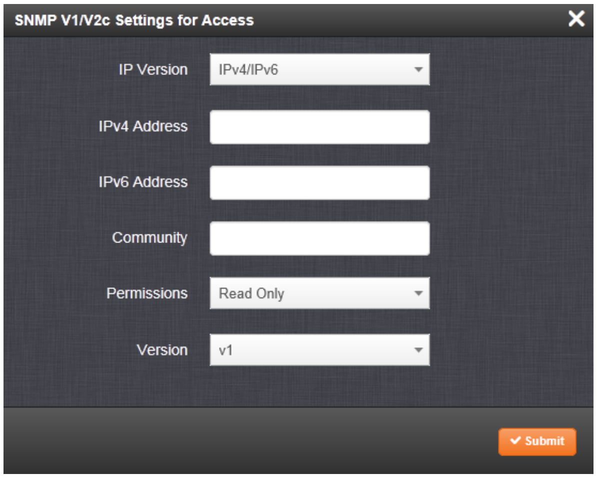
SNMP V1 is the first version of the SNMP protocol, as defined in the IETF (Internet Engineering Task Force) RFCs (Request for Comments) number 1155 and 1157. SNMP V2c is the revised protocol, but it also uses the V1 community based administration model.

Creating Communities

1. Navigate to **MANAGEMENT > NETWORK: SNMP Setup**.
2. In the **SNMP V1/V2** panel click the PLUS icon in the top-right corner.



3. The **SNMP V1/V2c Settings for Access** window will display:



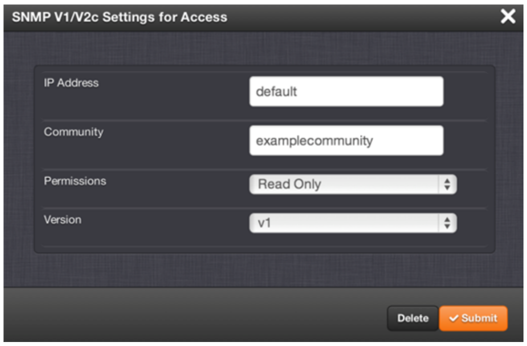
4. Enter the required information in the fields provided:
   - The **IP Version** field provides a choice of IPv4, IPV6 or both IPv4 and IPv6 (= default).
   - The choices offered below will change in context with the choice made in the **IP Version** field.
   - If no value is entered in the **IPv4** and/or **IPv6** field, VersaPNT uses the system default address.
   - SNMP **Community** names should be between 4 and 32 characters in length.
   - **Permissions** may be Read Only or Read/Write.
   - The **Version** field provides a choice of V1 or V2c.
5. Click **Submit**. The created communities will appear in the **SNMP V1/V2** panel:

Editing and Deleting Communities

To edit or delete a community you have created:

1. Navigate to **MANAGEMENT > NETWORK: SNMP Setup**.
2. Click the row of the **SNMP V1/V2** panel that displays the community you wish to edit or delete. The cursor will change from an arrow icon to a pointing finger to indicate that the entry is clickable.
3. The **SNMP V1/V2c Settings for Access** window will display.

> **Note:** The options available for editing in the SNMP V1/V2c Settings for Access window will vary contextually according to the information in the entry chosen.



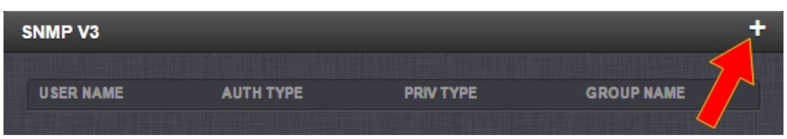
4. To edit the settings, enter the new details you want to edit and click **Submit**. OR: To delete the entry, click **Delete**.

2.7.6.2 SNMP V3

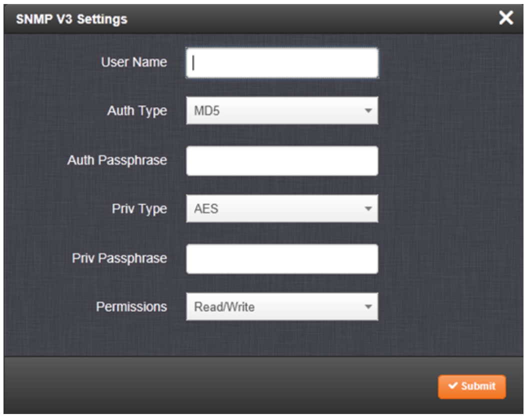
SNMP V3 utilizes a user-based security model which, among other things, offer enhanced security over SNMP V1 and V2.

Creating Users

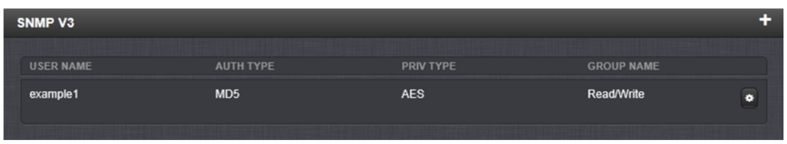
1. Navigate to **MANAGEMENT > NETWORK: SNMP Setup**.
2. In the **SNMP V3** panel, click the PLUS icon in the top-right corner.



3. The **SNMP V3 Settings** window will display.



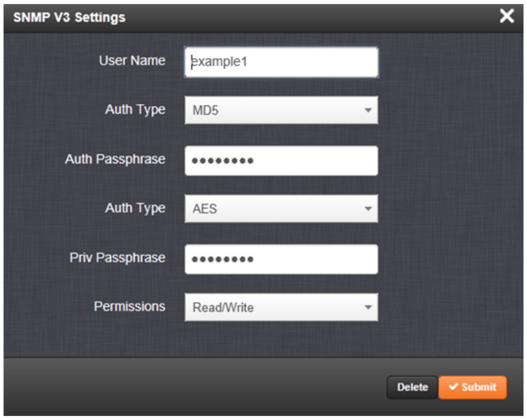
4. Enter the required information in the fields provided.
   - SNMP **User Names** and passwords are independent of users that are configured on the **Tools/Users** page.
     - User names are arbitrary. SNMP **User Names** should be between 1 and 31 characters in length.
     - The **User Name** must be the same on VersaPNT and on the management station.
   - The **Auth Type** field provides a choice between MD5 and SHA.
   - The **Auth Password** must be between 8 and 32 characters in length.
   - The **Priv Type** field provides a choice between AES and DES.
   - The **Priv Passphrase** must be between 8 and 32 characters in length.
   - The **Permissions** field provides a choice between Read/Write and Read Only.
5. Click **Submit**. The created user will appear in the **SNMP V3** panel:



Editing and Deleting Users

To edit or delete a user you have created:

1. Navigate to **MANAGEMENT > NETWORK: SNMP Setup**.
2. Click the row of the **SNMP V3** panel that displays the community you wish to edit or delete. The cursor will change from an arrow icon to a pointing finger to indicate that the entry is clickable.
3. The **SNMP V3 Settings** window will display:



4. Apply your changes and click **Submit**. OR: Click **Delete** to remove the User.

2.7.6.3 SNMP Traps

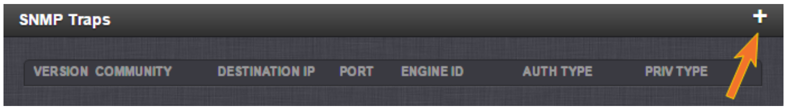
SNMP traps allow for automatic event notification, and as such are one way to remotely monitor VersaPNT's status.

SNMP traps indicate the status change that caused the trap to be sent and may also include one or more objects, referred to as variable-bindings, or **varbinds**. A varbind provides a current VersaPNT data object that is related to the specific trap that was sent. For example, when a Holdover trap is sent because VersaPNT either entered or exited the Holdover mode, the trap varbind will indicate that VersaPNT is either currently in Holdover mode or not currently in Holdover mode.

For testing purposes, a command line interface command is provided. This command, `testevent`, allows one, several, or all of the traps defined in the VersaPNT MIB to be generated. Refer to "CLI Commands" on page 278 for command details.

To define SNMP Traps (Notifications):

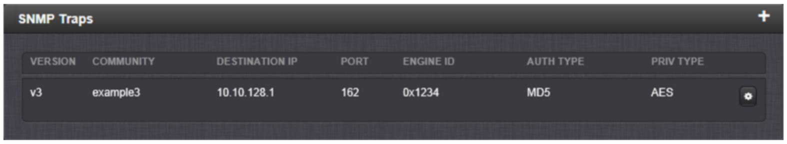
1. Navigate to **MANAGEMENT > NETWORK: SNMP Setup**.
2. In the **SNMP Traps** panel, click the PLUS icon in the top-right corner.



3. The **SNMP Traps Settings** window will display:

4. Enter the required information in the fields provided. (Note that the options will vary contextually according to your Version.)
5.
   - » The **Version** field provides a choice between v1, v2c, and v3 [= default]
   - » The **Community** field for the SNMP Community string. [v1, v2c]
   - » SNMP **User** names should be between 4 and 32 characters in length. [v3]
   - » **Destination IP Version** is a choice between IPv4 and IPv6. [v1, v2c, v3]
   - » **Destination IP** is destination address for the notification and password key to be sent. The default port is 162. [v1, v2c, v3]
   - » The UDP **Port** number used by SNMP Traps [default = 162]. [v1, v2c]
   - » **Engine Id** must be a hexadecimal number (such as 0x1234). The Id originates from the MIB Browser/SNMP Manager. [v3][1]
   - » **Auth Type** provides a choice between MD5 (the default) and SHA. [v3]
   - » The **Auth Password** must be between 8 and 32 characters in length. [v3]
   - » The **Priv Type** field provides a choice between AES and DES. [v3]
   - » The **Priv Passphrase** must be between 8 and 32 characters in length. [v3]
6. Click the **Submit** button at the bottom of the window. Cancel any changes by clicking the **X**-icon in the top-right corner (any information entered will be lost).
7. The SNMP trap you created will appear in the **SNMP Traps** panel:

[1] Should you require the Engine ID of your unit in order to decode traps sent to an NNMI, you can use an SNMPv3 "get" value of .1.3.6.1.3.10.2.1.1 to poll your Engine ID.



Each row of the **SNMP Traps** panel includes the version of the SNMP functionality, the User/Community name for the trap, the IP address/Hostname of the SNMP Manager and values applicable only to SNMP v3, which include the Engine ID, the Authorization Type, the Privilege Type.

You may define different SNMP Managers to whom SNMP traps can be sent over the network. This allows for SNMP Managers in different geographical areas to receive the same SNMP traps.

> **Note:** Spectracom has been assigned the enterprise identifier 18837 by the IANA (Internet Assigned Numbers Authority). Spectracom's product MIBs reside under the enterprise identifier @18837.3.

For detailed descriptions of the objects and traps supported by the VersaPNT, please refer to the Spectracom VersaPNT MIB files. See "Accessing the SNMP Support MIB Files" on page 72.

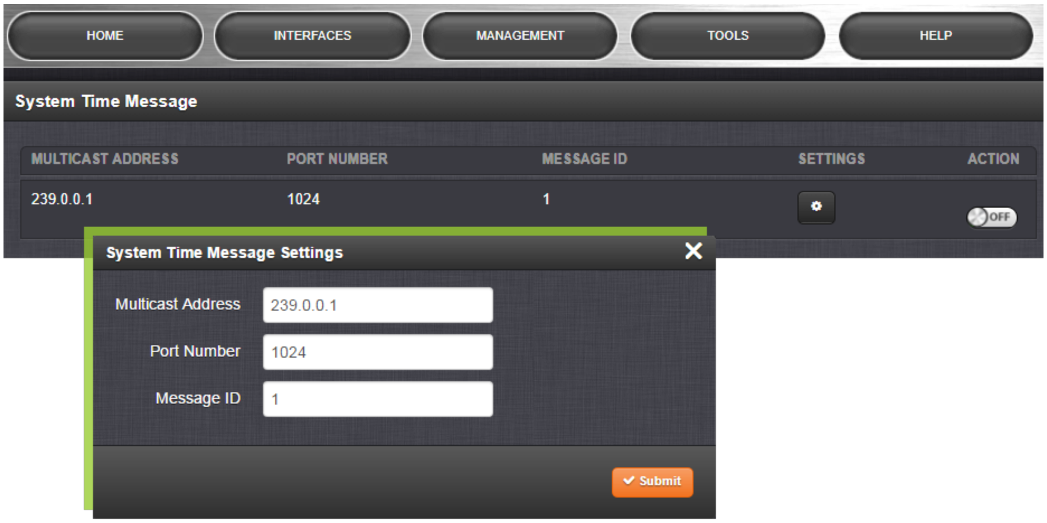
2.7.7 System Time Message

The **System Time Message** is a feature used for special applications that require a once-per-second time message to be sent out by VersaPNT via multicast. This time message will be transmitted before every 1PPS signal, and can be used to evaluate accuracy and jitter.

To set up and enable a **System Time Message**:

1. Navigate to **MANAGEMENT** > **OTHER** > **System Time Message**.
2. Populate the fields **Multicast Address**, **Port Number** and **Message ID**, and click **Submit**.

3. In the **Network Services** panel, enable **System Time Message**.



2.7.7.1 System Time Message Format

This message contains the time when the next 1PPS discrete will occur. It is sent once per second prior to the 1PPS discrete.

Table 2-6: System Time Message format

Word	Byte 3	Byte 2	Byte 1	Byte 0
1	Msg ID			
2	Msg Size			
3	Seconds			
4	nSec			
5	EOM			

Table 2-7: System Time Message field descriptions

Data Name	Data Description	Range	Resolution	Units
Message ID	UID of the message; programmable	Unsigned 32 bit integer	1	n/a
Message Size	Total message size in bytes	Unsigned 32 bit integer	1	Bytes
Seconds	Seconds since epoch (00:00:00 Jan 1, 1970 UTC)	Unsigned 32 bit integer	1	Seconds

Data Name	Data Description	Range	Resolution	Units
NSec	NSec within the current second	Unsigned 32 bit integer	1	nsec
EOM	End-of-message	-1	1	n/a

2.7.8 Configuring NTP

Network Time Protocol (NTP) and **Simple Network Time Protocol** (SNTP) are client-server protocols that are used to synchronize time on IP networks. NTP provides greater accuracy and better error checking capabilities than SNTP does, but requires more resources.

For many applications, it is not necessary to modify the NTP factory default configuration settings. It is possible, however, to change most of the settings in order to support specific NTP applications which may require a non-standard configuration:

These features include the ability to use either MD5 authentication or NTP Autokey, to block NTP access to parts of the network and to broadcast NTP data to the network's broadcast address. NTP and SNTP are used to synchronize time on any computer equipment compatible with the Network Time Protocol. This includes Cisco routers and switches, UNIX machines, and Windows machines with suitable clients. To synchronize a single workstation, several freeware or shareware NTP clients are available on the Internet. The software running on the PC determines whether NTP or SNTP is used.

When the NTP service is enabled, VersaPNT will "listen" for NTP request messages from NTP clients on the network. When an NTP request packet is received, VersaPNT will send an NTP response time packet to the requesting client. Under typical conditions, VersaPNT can service several thousand NTP requests per second without MD5 authentication enabled, and at a somewhat lower rate with MD5 authentication enabled.

You can either enable or completely disable the NTP Service. When NTP is disabled, no NTP time packets will be sent out to the network. When enabled, by default, the NTP Service operates in Unicast mode, i.e. the NTP Service responds to NTP requests only.

> Note: In order to configure NTP, you need to access the NTP Setup screen which requires ADMINISTRATOR rights.

2.7.8.1 Checklist NTP Configuration

The following is a list of configuration settings you may want to consider as you setup your NTP Service. (Not all items may apply to your application, or there may be other considerations not included in this list.)

1. Did you setup your NTP Service and have it use the right **Reference(s)**?

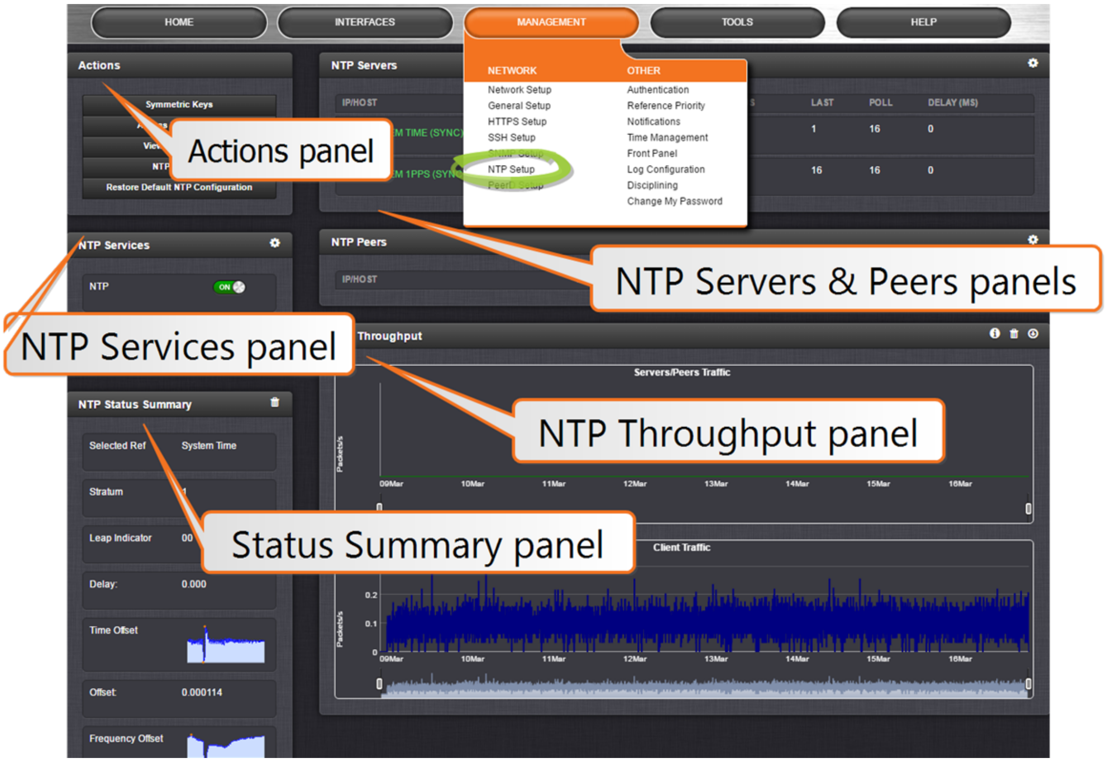
   » See "NTP Reference Configuration" on page 88.

2. Does your NTP Service use the right **Timescale**?
   » See "NTP Output Timescale" on page 86.
3. If required, have you setup other **NTP Servers and Peers** for fallback purposes?
   » See "NTP Peers: Adding, Configuring, Removing" on page 95.

2.7.8.2 The NTP Setup Screen

The NTP Setup screen provides access to all NTP configuration settings.

To open the **NTP Setup** screen, navigate to **MANAGEMENT > NTP Setup**. The **NTP Setup** screen is divided into 5 panels:



The NTP Servers and Peers panels

… are located on the right-hand side of the **NTP** screen:

» **NTP Servers**: In this display you can view the NTP Servers that VersaPNT detects in your network. It is through this display that you configure external NTP references. See "NTP Servers: Adding, Configuring, Removing" on page 93.

» **NTP Peers**: In this display you can view the NTP Peers that VersaPNT detects in your network. It is through this display that you configure NTP Peer reference inputs. See "NTP Peers: Adding, Configuring, Removing" on page 95.

For more information on NTP servers, clients, and Stratums see "NTP Servers and Peers" on page 90.

The NTP Throughput panel

… shows two graphs depicting the rate of NTP traffic from Clients and Server/Peers.

- The INFO icon opens a window showing the maximum per second traffic rate from each.
- The graphs maybe saved and downloaded (> ARROW icon), or deleted (> TRASH CAN icon).

The Actions panel

… is in the top left-hand corner of the **NTP** screen comprises the following buttons:

- **Symmetric Keys**: Click here to set up your symmetric keys for MD5 authentication. For more information on Symmetric Keys, see "Configuring NTP Symmetric Keys" on page 103.
- **Access Restrictions**: Click here to view, change or delete access restrictions to the NTP network. (See also "NTP Access Restrictions" on page 106.)
  Fields in the NTP Access Restrictions table include:
  - Type
  - IP Version
  - IP
  - IP Mask
  - Auth only
  - Enable Query
- **View NTP Clients**: Click here to reveal a table of all the clients your VersaPNT is servicing. (See also "Viewing NTP Clients" on page 85.)
  Information for each client includes:
  - Client IP
  - Received Packets
  - Mode
  - Version
  - Restriction Flags
  - Avg Interval
  - Last Interval
- **Restore Default NTP Configuration**: Click here to restore VersaPNT's NTP settings to the factory default. Any settings you have created previously will be lost. See "Restoring the Default NTP Configuration" on page 86.

The NTP Services panel

… is the second panel on the left-hand side of the NTP screen. It has two switches:

- **NTP ON/OFF**: This switch enables and disables NTP. See "Dis-/Enabling NTP" below.

  > Note: When applying any changes NTP will usually restart automatically. Use this switch only to force a restart.

- **Expert Mode**: Turning this switch ON enables direct access to the **NTP.conf** file, thus bypassing the VersaPNT Web UI. [Default =OFF] See "NTP Expert Mode" on page 107.

  > Note: Spectracom Tech Support does not support the editing of the NTP configuration files in Expert Mode. For additional information on editing the NTP.conf file, please refer to http://www.ntp.org.

Other **NTP Services** that can be configured via the **NTP Services** panel by clicking the GEAR icon are:

- Stratum 1 (see "NTP Reference Configuration" on page 88)

The NTP Status Summary panel

… provides a real-time overview of your key NTP network parameters. For more information, see "NTP Status Monitoring" on page 243.

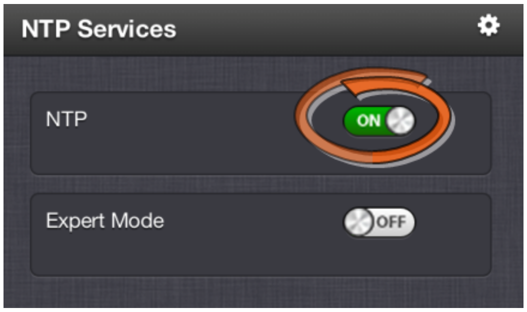
2.7.8.3 Dis-/Enabling NTP

If you applied NTP configuration changes e.g., added a new NTP Server, VersaPNT usually will stop and re-start the NTP Service automatically once you clicked Submit. Changes made to NTP configurations will also take effect after VersaPNT is either rebooted or power-cycled.

You can, however, also disable or enable the VersaPNT NTP Service manually, e.g. with NTP Autokey.

To disable and enable your NTP Service:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **NTP Services** panel, set the ON/OFF toggle switch to OFF.



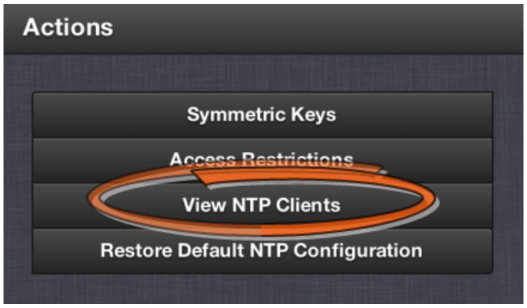
3. A notification window will confirm the status change.
4. In the **NTP Services** panel, set the ON/OFF toggle switch to ON again.

Changes made will now take effect and NTP operation will be restored shortly after this operation is performed.

2.7.8.4 Viewing NTP Clients

To view the NTP clients being served by VersaPNT:

1. Navigate to **MANAGEMENT> NETWORK: NTP Setup**.
2. In the **NTP Actions** panel, click **View NTP Clients**:



3. The **NTP Clients** window will display, showing a table of the clients that are synchronizing to VersaPNT via NTP:

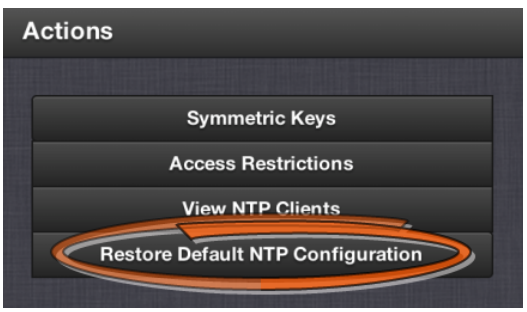
- You can search any of the fields for specific information in the Search field at the top of the window.
- A limit of 10 entries will appear on the screen at any one time. If you have more than 10 clients, you can move through the table using the **First**, **Previous**, **Next** and **Last** navigation buttons at the bottom of the screen.

2.7.8.5 Restoring the Default NTP Configuration

The VersaPNT default NTP configuration can be restored at any time. It comprises basic settings such as Stratum 1 operation with no other servers or peers, no broadcasting and no access restrictions. External queries or modifications are not permitted, while generally all IPv4 and IPv6 client connections are allowed.

To restore VersaPNT to its default NTP configuration:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **NTP Actions** panel, click **Restore Default NTP Configuration**.



3. In the dialog window that displays, click **OK**.

2.7.8.6 NTP Output Timescale

You can choose the timescale VersaPNT will use for the time stamps it sends out to its NTP clients and network nodes. This is done by setting VersaPNT **System Time** timescale. The options are UTC, TAI and GPS. Typically, UTC is used for network synchronization.

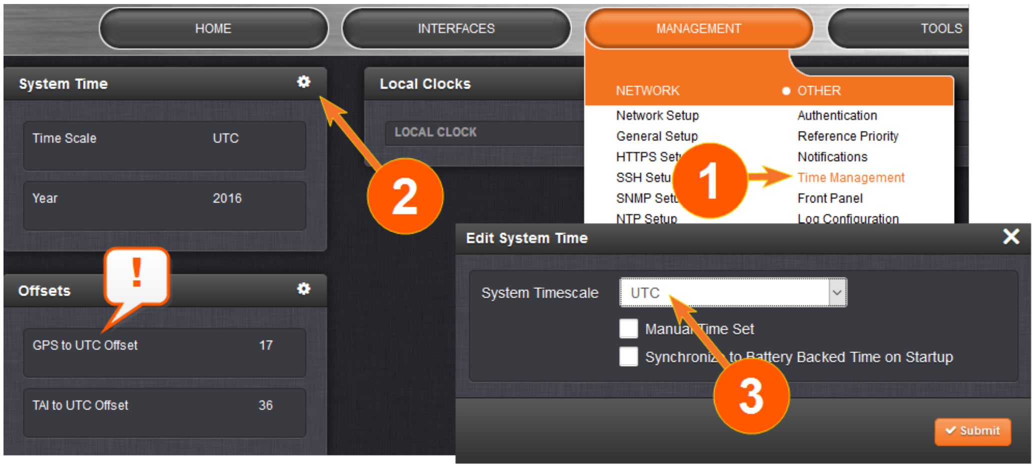
Note that the **System Time** affects not only NTP output, but also all other aspects of time management e.g., time distributed via channels other than NTP, logging, and time displayed in the Web UI.

If VersaPNT is operated as a Stratum 2 server, i.e. as a client to a Stratum 1 server (see "Configuring "NTP Stratum Synchronization"" on page 89), the other server will override VersaPNT's System Timescale, should it be different.

> Note: IMPORTANT: Make sure you select your desired timescale! Using the wrong timescale will inevitably result in an undesired time error in your NTP clients.

To change the system timescale VersaPNT will use for its NTP output (and other outputs):

1. Navigate to **MANAGEMENT > OTHER: Time Management**:



2. In the **System Time** panel, click the GEAR icon.
3. In the **Edit System Time** window, select the System Timescale VersaPNT will be in:
   - **UTC**: The network PCs will receive UTC time via NTP.
   - **TAI**: The network PCs will receive TAI time via NTP.
   - **GPS**: The network PCs will receive GPS time via NTP.

   > Note: When the Timescale is set to "GPS", the GPS to UTC Offset must be set correctly. As of July 2018, the offset between UTC and GPS is 18 seconds.

2.7.8.7 NTP Reference Configuration

VersaPNT's NTP Service needs to be setup such that it utilizes the time source ("input reference") you want it to use. There are two options for an NTP Server to derive its time from:

a. The NTP Service uses VersaPNT's System Time, i.e. typically the GNSS reference (or IRIG, ASCII data input, etc.), and distributes that time over the NTP network. This is called **Stratum 1 Operation**, because VersaPNT will be the Stratum 1 (or primary) server. This is the most common configuration.

b. It is, however, also possible for NTP to utilize the time provided by *another* NTP Server as a reference. In this case the other server would be Stratum 1, and VersaPNT would be **Stratum 2** (or higher). This operating mode can be referred to as **Stratum 2 operation**, **secondary server operation**, or **NTP Stratum Synchronization**.

With a GNSS-capable time server it is possible to combine these two configurations e.g., by assigning a higher reference priority to (a.), and a lower "fallback" priority to (b.). For more information on reference priority configuration, see "Configuring Input Reference Priorities" on page 167.

The NTP Stratum Model

The NTP Stratum model is a representation of the hierarchy of time servers in an NTP network, where the **Stratum level (0-15)** indicates the device's distance to the reference clock.

Stratum 0 means a device is directly connected to e.g., a GPS antenna. **Stratum 0** devices cannot distribute time over a network directly, though, hence they must be linked to a **Stratum 1** time server that will distribute time to **Stratum 2** servers or clients, and so on. The higher the Stratum number, the more the timing accuracy and stability degrades.

The NTP protocol does not allow clients to accept time from a **Stratum 15** device, hence **Stratum 15** is the lowest NTP Stratum.

A group of NTP servers at the same Stratum level (**Stratum 2**, for example) are considered NTP Peers to each other. NTP Servers at a *higher* Stratum level, on the other hand, are referred to as NTP Servers.

Note: Internet Time Servers should be configured as NTP Servers and not as NTP Peers.

If VersaPNT has no valid Timing System Reference, NTP Server or NTP Peers, the NTP Stratum value is automatically downgraded to **Stratum 15**. This ensures that its NTP clients will no longer use this VersaPNT unit as a time reference.

Configuring "NTP Stratum 1" Operation

When the Timing System references of your VersaPNT are normally available (rather than being unavailable most of the time e.g., in areas with poor GNSS reception), it is advisable to use the System Time as a reference to NTP, since this provides NTP with the most accurate references. This mode is called **Stratum 1** operation, since VersaPNT operates as a **Stratum 1** NTP server.

To configure **Stratum 1** operation for VersaPNT:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**:
2. Click the GEAR icon in the **NTP Services** panel.
3. The **Edit NTP Services** window will display. Click the **Stratum 1** tab.
4. Check <u>all of the three options</u>:
   - **Enable Stratum 1 Operation**
     Checking this option will cause the NTP Service to use the System Time provided by the Timing System input.
   - **Prefer Stratum 1**
     This option configures NTP to "weigh" the Timing System input heavier than input from other NTP servers for its selection (The Timing System inputs are normally more accurate than other NTP servers).

     However, if the Timing System inputs are not normally available (such as with intermittent GNSS reception or no other inputs are available), it may be desirable NOT to prefer the Timing System over an NTP reference, in which case this box should not be checked.
   - **Enable Stratum 1 1PPS**
     This option determines whether or not NTP uses the 1PPS input from the Timing System. The 1PPS input to NTP needs to correlate with its "Time" input. If the Time and PPS inputs are originating from the same source, they will be correlated. However, if the time is originating from another NTP server, but the 1PPS is being derived by the Timing System, the two inputs may not always correlate. Without this correlation, NTP performance will be degraded. In such a scenario, it is best NOT to use the System Time's 1PPS as a reference.
5. Click the **Submit** button.

Configuring "NTP Stratum Synchronization"

NTP Stratum Synchronization refers to the concept of using a different NTP Server or Peer as your primary reference (instead of e.g., GNSS). This will make the VersaPNT you are configuring a **Stratum 2** server, since the other server is Stratum 1.

To configure **Stratum 2** (or greater) operation for VersaPNT:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**:
2. Click the GEAR icon in the **NTP Services** panel.
3. The **Edit NTP Services** window will display. Click the **Stratum 1** tab.
4. Check the first of the three options, and uncheck the latter two:
   - **Enable Stratum 1 Operation**
     When the checkbox **Prefer Stratum 1** is unchecked, the input from a different NTP Server or Peer will normally be used at all times.

Spectracom, however, recommends to check this box, thus allowing the NTP Service to use VersaPNT's System Time during **Holdover**, i.e. if the external NTP reference has become unavailable.

» **Prefer Stratum 1**
Uncheck this option to prevent VersaPNT's NTP service from “weighing” the Timing System input heavier than input from other NTP servers. Thus, during normal operation, the time provided by the external Stratum 1 NTP server will be used (unless its quality is determined to be low).

> Note: If enabled, this function would give GPS additional “weight” for NTP to select the GNSS input over other NTP Servers.

» **Enable Stratum 1 1PPS**
Uncheck this option to prevent NTP from using the 1PPS input from the Timing System, but instead use the 1PPS signal from another NTP server. This will ensure the time signal and the 1PPS signal to correlate, which tends to result in better NTP performance.

5. Click the **Submit** button.

2.7.8.8 NTP Servers and Peers

VersaPNT can be configured to receive time from one or more available NTP Servers (VersaPNTs or different models). This allows for NTP Servers on a timing network to be configured as potential (fallback) input time references for VersaPNT System Time synchronization. In the event that a current reference becomes unavailable, VersaPNT can fallback to the other NTP Servers available on the network.

A group of NTP servers at the same Stratum level (Stratum 1 time servers, for example) are considered as NTP Peers to each other.

NTP Servers at a higher Stratum level, on the other hand, are called NTP Servers (Note that Internet Time Servers should be configured as NTP Servers and not as NTP Peers).

> Note: IMPORTANT: In order for other NTP servers to be a valid reference, you must enable “NTP” in the Reference Priority table (see "Configuring Input Reference Priorities" on page 167).

For mutual fallback purposes, it is recommended to use one or more NTP Peers. Each peer is normally configured to operate from one or more time sources including reference clocks or other higher stratum servers. If a peer loses all reference clocks or fails, the other peers continue to provide time to other clients on the network.

NTP Servers at the same Stratum level

If VersaPNT is configured to obtain time from other NTP Servers at the same Stratum level (i.e., NTP Peers) but is currently using a different input reference as its selected reference, VersaPNT will report to the network (via the NTP time stamps) that it is a **Stratum 1** time server. Should, however, all input references except the other NTP server(s) become unavailable, VersaPNT will then drop to a **Stratum 2** time server (with System Time being derived from the NTP time packets being received from the other NTP Peers.

NTP Servers at a higher Stratum level

If VersaPNT is configured to obtain time from another NTP Server at a higher Stratum level (i.e., NTP Servers), and it is using that NTP Server as its selected reference, VersaPNT will report to the network (via the NTP time stamps) that it is one less Stratum than its selected reference NTP Server.

> **EXAMPLE:**
>
> If VersaPNT is configured to receive time from one or more Stratum 1 NTP Servers, with no other higher priority input references available, VersaPNT will report to the network that it is a Stratum 2 Server.

In order for VersaPNT to use other NTP servers as a valid time reference to synchronize the System Time, the input Reference Priority Setup table must be configured to allow NTP as an available reference. For more information on the input Reference Priority table, refer to "Configuring Input Reference Priorities" on page 167.

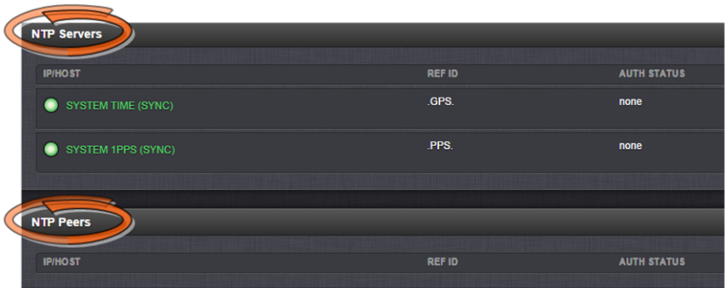
Holdover

If VersaPNT is synchronized to another NTP Server or reference, and that server or reference subsequently loses sync or becomes unavailable (with no other higher priority input references being present and valid), VersaPNT will then go into the Holdover mode. It will remain in Holdover mode until any enabled and valid input reference becomes available again, or until the Holdover period expires, whichever occurs first.

During Holdover mode, NTP will remain at the same Stratum level it was before entering the Holdover mode and can continue to be the reference to the network. However, if no input reference becomes available before the Holdover period expires, Time Sync will be lost and shortly thereafter, NTP will report to the network that it is now at Stratum 15. A status of Stratum 15 will cause the network to ignore VersaPNT as an NTP time reference.

For more information about Holdover, see "Holdover Mode" on page 203.

The NTP Servers and NTP Peers Panels



The **NTP Servers** and **NTP Peers** panels display which servers in the network are set up at higher or equal Stratums (Servers or Peers, respectively), and their configurations. These panels are also used to add, configure, or remove NTP Servers and Peers.

Note: For information on how to view NTP Clients, see "Viewing NTP Clients" on page 85.

The **NTP Servers** and **NTP Peers** panels are part of the **NTP Setup** screen (see "The NTP Setup Screen" on page 82), which can be accessed via **MANAGEMENT > NETWORK: NTP Setup**.

Information provided in the NTP Servers and NTP Peers panels

The following columns are used to break down the status information for recognized **NTP Servers** and **NTP Peers**.

Note: Servers will be displayed in the Status view only if they can be resolved. They will, however, always be displayed in the Setup view in order to reconfigure them, if necessary.

- **IP/HOST**: Name and real-time status (color-coded)
- **REF ID**: Identifies the type of Input REFerence e.g., **GPS** indicates the reference can use GPS for its synchronization. Below is a list of potential REF IDs reported by the VersaPNT Timing System (other NTP Servers and Peers may report different references):
  - **GPS**: GNSS reference
  - **IRIG**: IRIG reference
  - **HVQ**: HAVE QUICK reference
  - **FREQ**: Frequency reference
  - **PPS**: External 1PPS reference
  - **PTP**: PTP reference
  - **ATC**: ASCII time code reference

- » **USER**: User provided time
- » **LOCL**: Local reference (synced to itself)
- » **INIT**: NTP on server/peer is initializing
- » **STEP**: NTP on server/peer is performing initial synchronization step and restarting

» **AUTH STATUS**: Indicates if the selected reference is using MD5 authentication. “None” indicates authentication not being used.

» **LAST**: The number of seconds that have expired since this reference was last polled for its time.

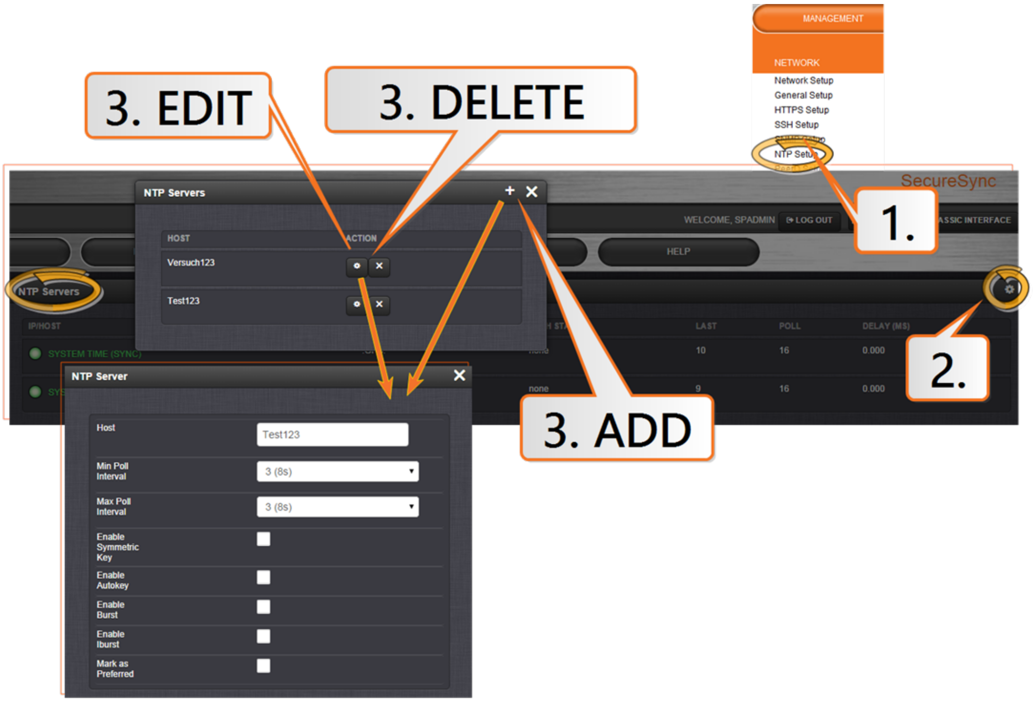
» **POLL**: The polling interval, i.e. how often VersaPNT is polling this NTP reference for its time.

» **DELAY (ms)**: The measured one-way delay between VersaPNT and its selected reference.

NTP Servers: Adding, Configuring, Removing

To add, configure, or remove an NTP Server:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.



2. The **NTP Setup** screen appears. The **NTP Servers** panel displays a list of recognized NTP servers. Click the GEAR icon in the upper right-hand corner of the **NTP Servers** panel.
3. The **NTP Servers** window opens. Should the list be empty, no servers have been added yet. In the event that added servers are not displayed in the NTP Setup screen/NTP

Servers panel, they could not be resolved. Verify the IP address. Note that System servers cannot be edited or deleted.

- To ADD a new server, click the PLUS icon in the upper right-hand corner, and proceed to the next step.

> Note: In order for other NTP Servers to be a valid reference, "NTP" must be enabled as both the Time and 1PPS references in the Reference Priority table. See "Configuring Input Reference Priorities" on page 167.

- To EDIT an existing server, click the corresponding ACTION GEAR button, and proceed to the next step.
- To REMOVE a server (and its associated configurations), click the X-button next to it, then confirm by clicking OK.

4. The **NTP Server** Edit window displays. Enter the required information:
   - **Host**: The IP address for the server to be used as host.
   - **Min Poll Interval**: Select a value from the drop down (the default is 3 (8s)).
   - **Max Poll Interval**: Select a value from the drop down (the default is 3 (8s)). For both NTP Peers, and NTP Servers the Minimum and Maximum Poll rate for NTP packets can be configured.

     Both NTP Peers and NTP Servers support either manually configured Symmetric Key-ID/Key string pairs or the use of Auto-Key. However, these choices are mutually exclusive and must be identically configured on both the VersaPNT and the NTP Peer or NTP Server. If the Symmetric Key-ID/Key string pair method is selected the Key-ID must be first defined on the Symmetric Key page.
   - **Enable Symmetric Key**: Click to enable Symmetric Key, and then select an option from the drop down menu that displays.

> Note: Before you can choose an option in the Key field, you must first set up symmetric keys through the Actions panel. See "Configuring NTP Symmetric Keys" on page 103. Conversely, you may check the Autokey box below the Key field.

   - **Enable Autokey**: Click here if you want to use Autokey with this server. See "NTP Autokey" on page 97.

> Note: When you configure NTP Autokey, you must first disable the NTP service in the NTP Services panel, and then re-enable it after the

Autokey configuration is completed.

- **Enable Burst**: This tells NTP to send a burst to the remote server when the server is reachable.
- **Enable Iburst**: The iburst function tells NTP to send a burst of queries instead of one when the remote server is not reachable for faster clock synchronization. This will occur if the connection was interrupted, or upon restart of the NTP daemon. For additional information, please refer to public NTP configuration documentation.
- **Mark as Preferred**: Click here to make this server the preferred server. For more information, see "Configuring "NTP Stratum 1" Operation" on page 88.

Note: It is not normally recommended to select more than one NTP Server in the NTP Servers table as being Preferred. Typically, only one NTP server should be selected as Preferred.

5. Click Submit, or press Enter.

NTP Peers: Adding, Configuring, Removing

To add, configure, or remove an NTP Peer:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. The **NTP Setup** screen appears. The **NTP Peers** panel displays a list of recognized NTP peers.

Note: Should the list be empty, no servers have been added yet. In the event that added peers are not displayed, they could not be resolved. Verify the IP address

- To EDIT the settings of an NTP Peer, click the GEAR button next to it, and proceed to Step 3 below.
- To ADD a new NTP Peer, click the PLUS icon in the top right corner of the **NTP Peers** panel.
- To REMOVE an NTP Peer (and its associated configurations), click the X-button next to it.

3. The **NTP Peers** edit window opens:

4. Enter the required information into the fields:
   - **Host**: The IP address for the server to be used as host.
   - **Min Poll Interval**: Select a value from the drop down (the default is 3 (8s).
   - **Max Poll Interval**: Select a value from the drop down (the default is 3 (8s).
     For both NTP Peers, and NTP Servers the Minimum and Maximum Poll rate for NTP packets can be configured. Both NTP Peers and NTP Servers support either manually configured Symmetric Key-ID/Key string pairs or the use of Auto-Key. However, these choices are mutually exclusive and must be identically configured on both the VersaPNT and the NTP Peer or NTP Server. If the Symmetric Key-ID/Key string pair method is selected the Key-ID must be first defined on the Symmetric Key page.
   - **Enable Symmetric Key**: Click the checkbox to enable/disable Symmetric Key. See also: "Configuring NTP Symmetric Keys" on page 103.

     > Note: Before you can edit the Key field, you must set up Symmetric Keys through the Actions Panel. See "NTP: Symmetric Keys (MD5) " on page 103. Conversely, you may check the Autokey box below the Key field.

   - **Enable Autokey**: Click the check box to enable/disable Autokey. See "NTP Autokey" on the facing page for more information on Autokey.

> **Note:** When you configure NTP Autokey, you must first disable the NTP service in the NTP Services panel, then re-enable it after Autokey configuration is completed.

» **Mark as Preferred**: Check this box to prefer this NTP Peer over other NTP Peers ("NTP Peer Preference"). This will result in VersaPNT synchronizing more frequently with this Peer. For additional information on NTP Preferences, see "Configuring "NTP Stratum 1" Operation" on page 88.

> **Note:** Please note that it is not advisable to mark more than one NTP Peer as Preferred, even though VersaPNT will not prevent you from doing so.

5. Click Submit, or press Enter.

2.7.8.9 NTP Authentication

Since NTP information is distributed across entire networks, NTP poses a security risk: Falsified NTP time stamps or other NTP-related information can be exploited by an attacker. NTP authentication keys are used to authenticate time synchronization, thus detecting a fake time source before it can do harm.

NTP Autokey

The NTP version installed on VersaPNT supports the Autokey Protocol. The Autokey Protocol uses the OpenSSL library which provides security capabilities including message digests, digital signatures and encryption schemes. The Autokey Protocol provides a means for NTP to authenticate and establish a chain of trusted NTP servers.

NTP Autokey: Support & Limitations

Currently, VersaPNT supports only the IFF (Identify Friend or Foe) Autokey Identity Scheme. The VersaPNT product web interface automates the configuration of the IFF using the MD5 digests and RSA keys and certificates. At this time the configuration of other key types or other digests is not supported.

> **Note:** When you configure NTP Autokey, you must disable the NTP service first, and then re-enable it after Autokey configuration is completed.

NTP Autokey: IFF Autokey Support

The IFF Autokey Support is demonstrated in the figure below. The IFF identity scheme is used with Multiple Stratum NTP Time Servers. The example below shows 3 Stratum layers. Stratum 1 NTP Servers are close to the physical time references. All Stratum 1 servers can be Trusted Hosts. One of them is the trusted route used to generate the IFF Group/Client Key. This defines the IFF Group.

All other group members generate Group Certificate and RSA public/private keys using MD5 digest. Each group member must share the common IFF Group/Client Key. Stratum 2 NTP servers are also members of the Group. All NTP Stratum 1 servers are Trusted Hosts. The NTP servers closest to the actual time reference (Stratum 1) should be designated trusted. A single Stratum 1 NTP server generates the IFF Group/Client Keys. There is NO group name feature supported. The Group can use the same passphrase (password) or different passphrases for each client.

An NTP Server Group member is configured by enabling Autokey and creating certificate and public/private key pair while not enabling the Client Only selection. A Client Only NTP server is configured by enabling Autokey and creating certificate and public/private key pair and enabling the Client Only selection.

Note: Passphrases can be identical for all group members and Client NTP Servers. Or passphrases can be the same for group members and a different passphrase shared between the Client Only NTP Servers.

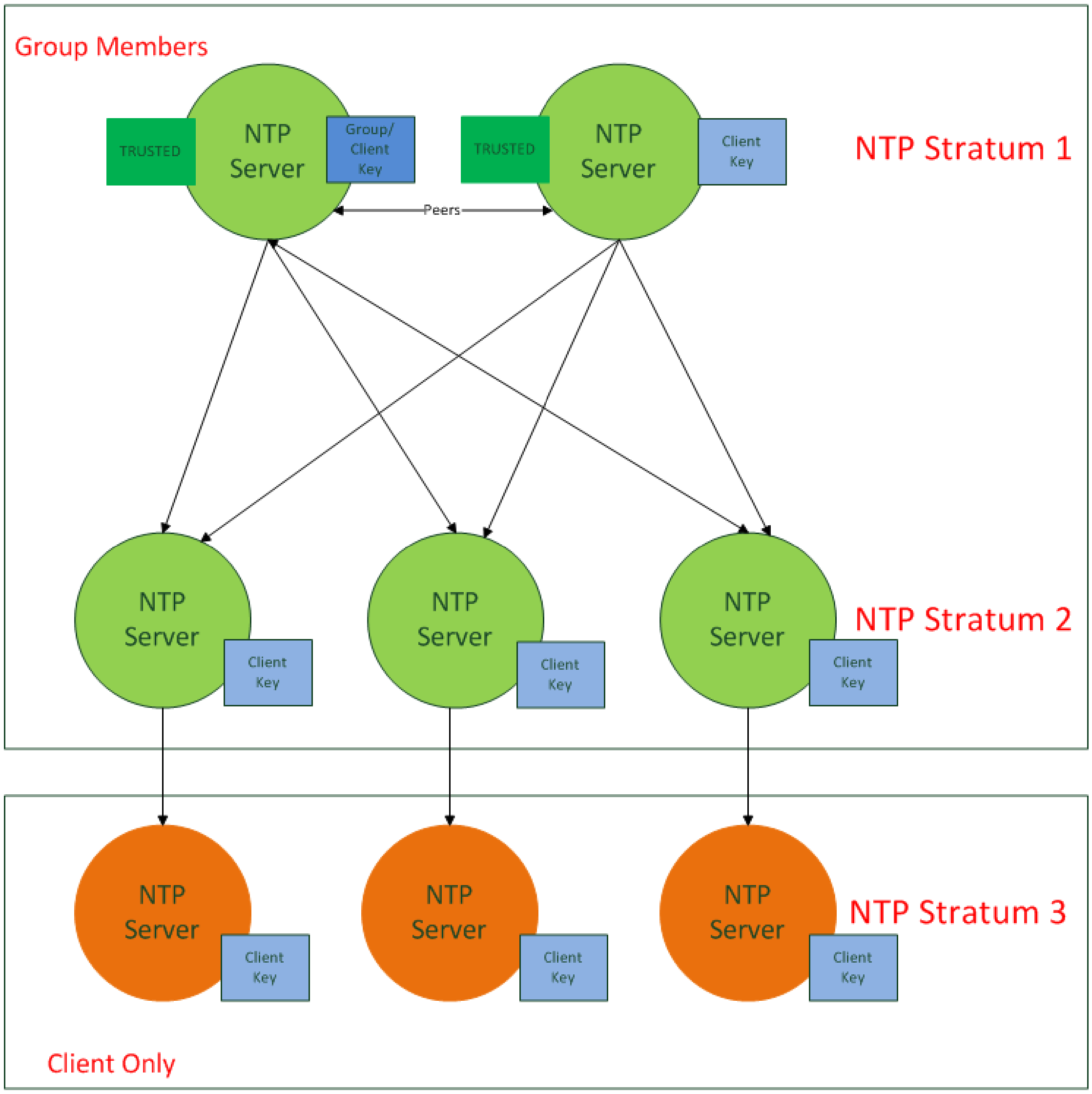


Figure 2-4: IFF Autokey configuration example

Configuring NTP Autokey

> **Note:** When you configure NTP Autokey, you must disable the NTP Service first, and then re-enable it after Autokey configuration is completed. See "Dis-/Enabling NTP" on page 84.

To configure NTP Autokey:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.

2. In the **NTP Services** panel, click the GEAR icon in the top-right corner.
3. The **Edit NTP Services** window will display.
4. Click the **Autokey** tab.
5. Check the **Autokey** box.
6. Fill in the **Passphrase** field by creating a passphrase (for a **Trusted** server—see **Certificate Type** below), or by using the existing passphrase of your trusted server (for **Server** and **Client** certificates).
7. Select the **Certificate Type** for your server, by clicking the appropriate radio button for **Server**, **Client**, or **Trusted**.

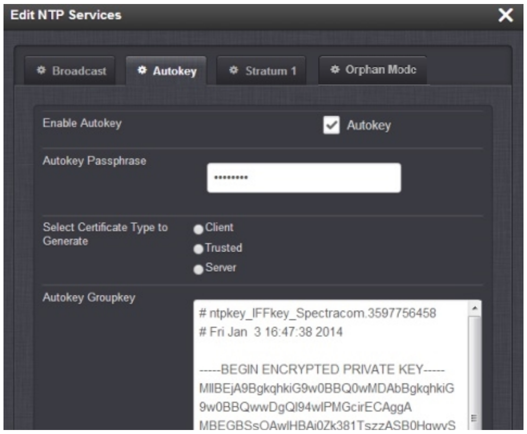
TRUSTED Server:

Before a server can be designated Client or Server status, one server must be designated as Trusted. When designating a server as Trusted:

1. Choose the Trusted radio button.

2. Click the Submit button.

A Groupkey is then generated for the network. This Groupkey will be pasted into the Groupkey box to designate another server on the network as Client or Server.



8. To designate a VersaPNT as **Trusted**, click the **Submit** button. This will generate a new **Groupkey**.
9. To designate a VersaPNT as a **Client** or a **Server**, paste the generated **Groupkey** into the **Groupkey** box, and click the **Submit** button.

Configuring a Stratum-1 Server as Trusted Host

To configure an NTP Stratum-1 Server as Trusted Host with IFF Group/Client key:

1. Define the Hostname of all NTP servers before proceeding. See "NTP Servers: Adding, Configuring, Removing" on page 93.
2. Disable NTP.
   » Ensure the time is accurate to a few seconds. Use NTP or manually set the clocks to set the system time.
3. Verify this VersaPNT is, in fact, NTP Stratum 1, and its Time, and 1PPS synchronization to GNSS are valid.
4. Under the **Autokey** tab of the **Edit NTP Services** window:
   » **Enable Autokey**—Check the box.
   » **Autokey Passphrase**—Enter your Group members NTP Autokey password.
   » **Select Certificate Type to Generate**—Do NOT enable **Client**.
   » Select **Trusted**.
   » Click **Submit**.
5. Observe the **IFF Group/Client Key** appearing.
   » This is the common **IFF Group/Client Key**. This key is shared between all Group members using this NTP Servers passphrase for ALL group members.
6. Configure NTP as requiring authentication.
7. Enable NTP in the **NTP Services** panel.
8. Verify that NTP reaches occur, and that NTP eventually reaches Stratum 1.

Creating a Stratum-1 Group Member Server

To configure an NTP Stratum-1 Server, which is a Group Member, using a Client key:

1. Define the **Hostname**, making sure it is unique, i.e. not the same as the trusted root server. See also "General Network Settings" on page 58.
2. Disable NTP if enabled.
3. Manually set the time or use NTP to set the system time.
4. Under the **Autokey** tab of the **Edit NTP Services** window, enable:
   - » **Enable Autokey**—Check the box.
   - » **Autokey Passphrase**—Enter your Group members NTP Autokey password.
   - » **Select Certificate Type to Generate**—Do NOT enable Server
5. Using the NTP Server containing the IFF Group/Common Key generate a Client Key using this NTP Server's passphrase.
6. Cut and paste the Client Key into the **Autokey Groupkey** text box.
7. For all NTP Stratum-2 servers and higher stratum numbers, disable the following items under the **Stratum-1** tab in the **Edit NTP Services** window:
   - » Prefer Stratum 1.
   - » Enable Stratum-1 1PPS.
8. In the **NTP Servers** panel of the main window, add an NTP server and enable the **Autokey** option box. See "NTP Servers: Adding, Configuring, Removing" on page 93.
9. Enable NTP in the **NTP Services** panel.
10. Wait for NTP to synchronize to the NTP References provided.

Creating a Stratum-1 Client Only Server

To create an NTP Stratum-1 'Client Only' Server with a Client key:

1. Define the Hostname, making sure that it is different from its trusted group server. See "NTP Servers: Adding, Configuring, Removing" on page 93.
2. Disable NTP if enabled.
3. Manually set the time or use NTP to set the system time.
4. Under the Autokey tab of the **Edit NTP Services** window, enable:
   - » **Enable Autokey**—Check the box.
   - » **Autokey Passphrase**—Enter your Group members NTP Autokey password.
   - » **Select Certificate Type to Generate**—Select **Client** to enable Client only.
5. Using the NTP Server containing the IFF Group/Client Key, copy the Group/Client key.
6. Paste this Group/Client key into the **Autokey Groupkey** text box.

7. For all NTP Stratum-2 servers and higher stratum numbers, under the **Stratum-1** tab in the **Edit NTP Services** window configure the NTP Stratum-1 references:
   - Disable Enable Stratum 1 Operation.
   - Disable Enable Stratum 1 1PPS.
8. In the **NTP Servers** panel of the main window, add an NTP server and enable the **Autokey** option box. See "NTP Servers: Adding, Configuring, Removing" on page 93.
9. Wait for NTP to synchronize to the NTP References provided.

NTP: Symmetric Keys (MD5)

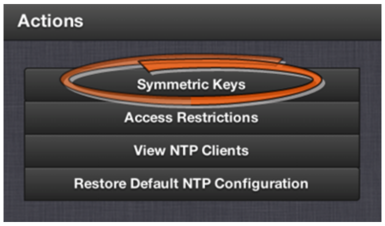
Symmetric Keys are an encryption means that can be used with NTP for authentication purposes.

VersaPNT supports authenticated NTP packets using an MD5 authenticator. This feature does not encrypt the time packets, but attaches an authenticator, which consists of a key identifier and an MD5 message digest, to the end of each packet. This can be used to guarantee that NTP packets came from a valid NTP client or server, and that they were not tampered with during transmission. The Symmetric Keys tab allows NTP to be configured to use MD5 authentication.

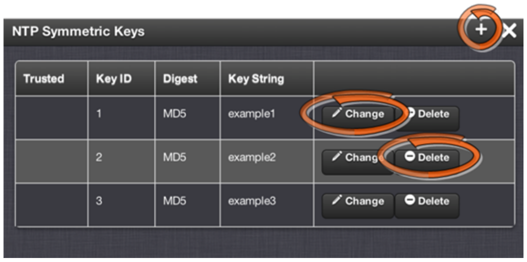
Configuring NTP Symmetric Keys

To create, edit, or delete Symmetric Keys (MD5 Authentication):

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **Actions** panel, click the **Symmetric Keys** button:



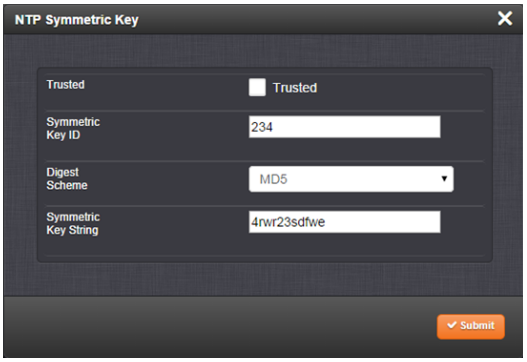
3. The **NTP Symmetric Keys** window will display:



   - To CREATE a **Symmetric Key**, click the PLUS icon in the top-right corner, and proceed to Step 4.

- To EDIT an existing key pair, click the corresponding Change button, and proceed to Step 4.
- To DELETE a key pair, click the corresponding Delete button, and click **OK** in the dialog box to confirm and complete the procedure.

4. The **NTP Symmetric Key** window will display:



Fill in, or edit the fields:

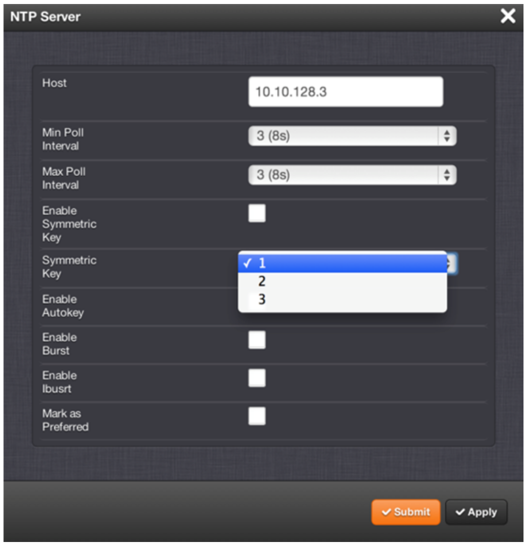
- **Trusted** (checkbox)—Check this box to use MD5 authentication with trusted key ID.

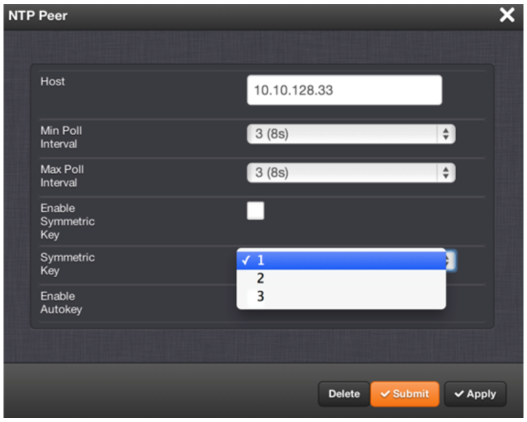
> Note: To use the MD5 authentication with trusted key ID, both the NTP client and the VersaPNT must contain the same key ID/key string pair, the client must be set to use one of these MD5 pairs, and the key must be trusted.

- **Key ID**—The key ID must be a number between 1 and 65532.
- **Digest Scheme**—Choose one of the options from the drop-down list. The available options are:
  - MD5 (the default)
  - SHA1
  - SHA
  - MDC2
  - MDC2
  - RIPEMD160
  - MD4
- **Key Str**—The key string must be readable ASCII and between 1 and 16 characters long.

5. Click the **Submit** button: The changes will be reflected in the table of the **NTP Symmetric Keys** window, which is displayed after clicking the **Submit** button.

6. The key(s) you have set up will now appear as options in the **Symmetric Key** field in both the **NTP Server** screen, and the **NTP Peer** screen.





NOTES:

Duplicate key IDs are not permitted. NTP requests received by that do not contain an authenticator containing a valid Key ID and MD5 message digest pair will be responded to, but no authentication will be performed. An NTP request with valid authenticators results in a valid NTP response with its own valid authenticator using the same Key ID provided in the NTP request.

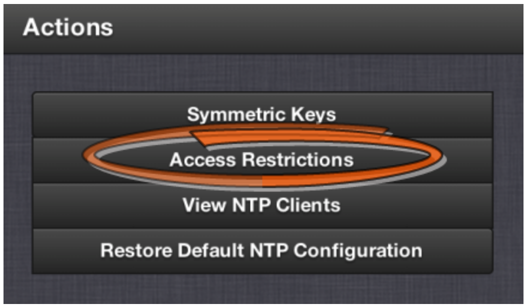
You may define the trusted Symmetric Keys that must be entered on both VersaPNT, and any network client with which VersaPNT is to communicate. Only those keys for which the "Trusted" box has been checked will appear in the dropdown menus on the **NTP References** screen.

2.7.8.10 NTP Access Restrictions

Next to encrypted authentication by means of Symmetric Keys, NTP supports a list-based means of access restriction, the use of which is also recommended to prevent fraudulent or inadvertent manipulation of a time server.

To configure NTP Access Restrictions:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **Actions** panel, click **Access Restrictions**:

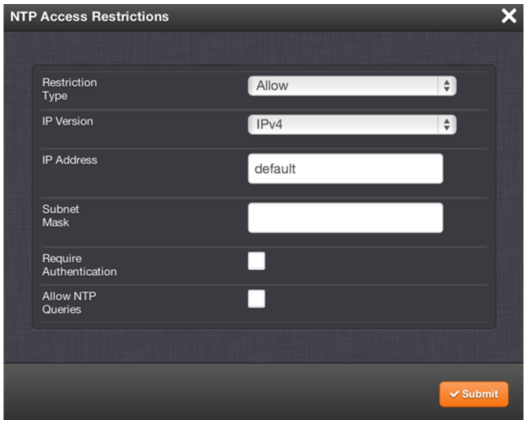


3. The **NTP Access Restrictions** Status window will display:

» To ADD or EDIT an access restriction, click the PLUS icon or the Change button, respectively, and proceed to Step 4. below.

» To DELETE an access restriction, click the corresponding Delete button, and confirm by clicking OK.

4. The **NTP Access Restrictions** window will display:



» Fill in the fields:

» **Restriction Type**—Choose either Allow or Deny.
If you select "Deny", the configured portion of the network will not have NTP access to VersaPNT, but the rest of the network will have access to VersaPNT. If you select "allow", the configured portion of the network will have NTP access to VersaPNT, but the rest of the network will not have access to VersaPNT. By default, VersaPNT allows all IPv4 and IPv6 connections.

» **IP Version**—Choose IPv4 or IPv6

» **IP Address**—Enter the appropriate hostname.

» **Subnet Mask**—Enter the appropriate IP mask.

» **Require Authentication** (checkbox)—Check this box if you want the additional security of authorized access. VersaPNT to accept only authenticated requests (MD5 or Autokey) from this user or network segment.

» **Allow NTP Queries** (checkbox)—Check this box if you want to allow external NTP queries into VersaPNT services.

5. Click the **Submit** button.

2.7.8.11 NTP Expert Mode

Advanced NTP configuration is possible via the NTP Expert Mode, which allows you to write directly into the `NTP.conf` file (the syntax is similar to the one used with CISCO routers).

> **Caution:** NTP Expert Mode should only be utilized by advanced users, as incorrectly altering the `NTP.conf` file can cause NTP to stop working (if NTP is configured as an input reference, VersaPNT could lose synchronization).

To access the NTP Expert Mode, navigate to **MANAGEMENT** > **NTP Setup**. The switch for the NTP Expert Mode is in the panel **NTP Services**.

Caution: Any configurations made in NTP Expert Mode will be lost as soon as NTP Expert Mode is disabled.

NTP utilizes the `NTP.conf` file for its configuration. Normally, configuration of this file is indirectly performed by a user via the integrated configuration pages of the VersaPNT Web UI. However, it may be desired in certain circumstances to edit this file directly, instead of using the web-based setup screens. When Expert Mode is enabled, the user has direct access to the `NTP.conf` file.

Caution: Spectracom Tech Support does not support the editing of the NTP configuration files while in the Expert Mode. For additional information on editing the `NTP.conf` file, please refer to http://www.ntp.org/.

Note: IMPORTANT: If an undesirable change is made to the `NTP.conf` file that affects the NTP operation, the `NTP.conf` file can be manually changed back as long as the previous configuration was known.

» The `NTP.conf` file can be reset back to the factory default values by either using the procedure to restore all of the VersaPNT factory default settings (see "Restoring the Default NTP Configuration" on page 86) or editing the file back to the original configuration as shown in the factory default configuration below.

Caution: If changes are made to the `NTP.conf` file while in the Expert mode, Expert mode should remain enabled from that point forward. Disabling Expert mode after changes being made to this file may result in loss of this configuration information.

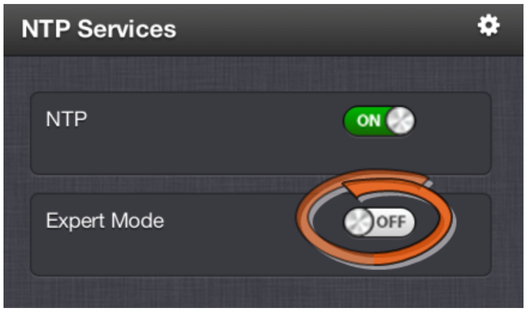
Factory default `NTP.conf` file:

```
restrict 127.0.0.1
restrict ::1
restrict default noquery nomodify
restrict -6 default noquery nomodify
keys /etc/ntp/keys/ntp.keys
controlkey 65533
requestkey 65534
trustedkey 65533 65534
server 127.127.45.0 prefer minpoll 4
server 127.127.22.0 minpoll 4
fudge 127.127.22.0 stratum 0
peer 10.10.128.35 minpoll 3 maxpoll 3 autokey
keysdir /etc/ntp/keys/
crypto pw admin123 randfile /dev/urandom
driftfile /etc/ntp/ntp.drift
logfile /home/spectracom/log/ntp.log
statsdir /home/spectracom/log/ntpstats/
statistics loopstats peerstats clockstats
filegen loopstats file loopstats type day enable
filegen peerstats file peerstats type day enable
filegen clockstats file clockstats type day enable
```

Prior to Expert mode being enabled, the **Network: NTP Setup** page will contain various tabs for configuring different options of the NTP Service. To prevent inadvertent changes from being made to a user-edited `NTP.conf` file via the web pages, these NTP configuration tabs are removed from the web browser view as long as the Expert mode remains enabled (only the **Expert Mode** tab is visible in Expert Mode; all other tabs will no longer be present). Disabling the Expert mode restores these tabs to the Edit NTP Services window.

To enable the Expert Mode, and edit the `NTP.conf` file:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **NTP Services** panel locate the **Expert Mode** switch:



When enabled, the NTP Service operates in Unicast mode. In Unicast mode, the NTP Service responds to NTP requests only. The NTP Service supports a broadcast mode in which it sends a NTP time packet to the network broadcast address.

3. Click the **Expert Mode** switch.
4. Confirm by clicking **OK** in the dialog box.
5. Click the GEAR icon.
6. In the **Edit NTP Services** window, edit the file as desired in the text box under the **Expert Mode** tab.
7. Click the Submit button to save any changes that were made.
8. Disable and then re-enable the NTP service using the **NTP ON/OFF** switch in the **NTP Services** panel. VersaPNT will now use the new NTP configuration per the manually edited file.

> **Caution:** Any configurations made in NTP Expert Mode will be lost as soon as NTP Expert Mode is disabled.

2.7.8.12 Spectracom Technical Support for NTP

Spectracom does not provide technical assistance for configuring and installing NTP on Unix-based applications. Please refer to www.ntp.org for NTP information and FAQs. Another helpful source is the Internet newsgroup at news://comp.protocols.time.ntp.

Spectracom can provide support for Microsoft® Windows-based time synchronization. See spectracom.com for additional information, or contact Spectracom Technical Support.

Spectracom also offers an alternate Windows NTP client software package called **PresenTense**. **PresenTense** software provides many features and capabilities not included with the limited functionality of the Windows W32Time program, including alert notification and audit trails for the PC's time.

For more information on **PresenTense**, please visit spectracom.com or contact your local Spectracom Sales Representative.

2.7.9 Configuring PTP

Precision Time Protocol (PTP) is a time protocol that can be used to synchronize computers on an Ethernet network. VersaPNT supports PTP Version 1 and 2, as specified in the IEEE 1588-2002 and IEEE 1588-2008 standard, via one (1) Ethernet port. **PTP is currently only available on eth1** in order to take advantage of the Spectracom Timestamper.

VersaPNT currently can be configured as a PTP Master Clock only.

Next to PTP specifications, this topic describes the PTP menu items and settings, and outlines how to set up VersaPNT as a PTP Master.

PTP Specifications

- **Inputs/Outputs**: (1) Ports
- **Signal Type**: Ethernet
- **Management**: Web UI
- **Network Speeds**: 100 Mb/s, 1Gb/s, or 10Gb/s
- **PTP Version** supported: PTP 1 IEEE (1588-2002) and 2 (IEEE 1588-2008)
- **PTP Profiles** supported: Default, Telecom, Enterprise
- **Transmission modes**: Unicast, Multicast (IPv4 and Ethernet), and Hybrid [default]

2.7.9.1 The PTP Screen

The PTP screen provides PTP status information, and provides access to all configurable PTP settings.

To access the PTP screen, navigate to **MANAGEMENT > NETWORK: PTP Setup**. The PTP screen will open:

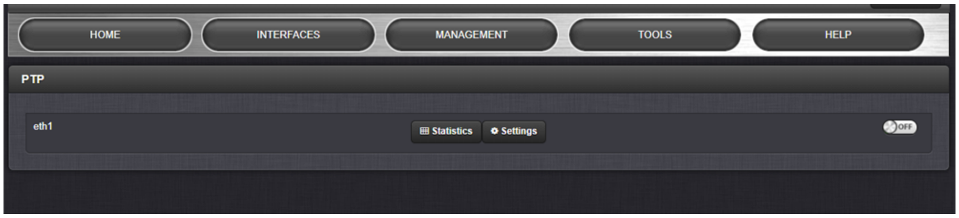


Figure 2-5: PTP setup screen

For each Ethernet port (eth1) you can toggle PTP functionality **ON** or **OFF**.

You can also access the "Settings" panel and the "Statistics" panel for each port (see below).

The PTP Settings Panel

The Settings Panel provides access to the configuration settings, divided into three tabs, which are described below. Each tab allows you to **Restore defaults**.

> **Note:** The Restore Defaults button in each PTP Settings panel will restore ALL the factory defaults for ALL Ethernet ports.

Settings changed by the user will be maintained when the PTP daemon is stopped and started, and between reboots and powercycles.

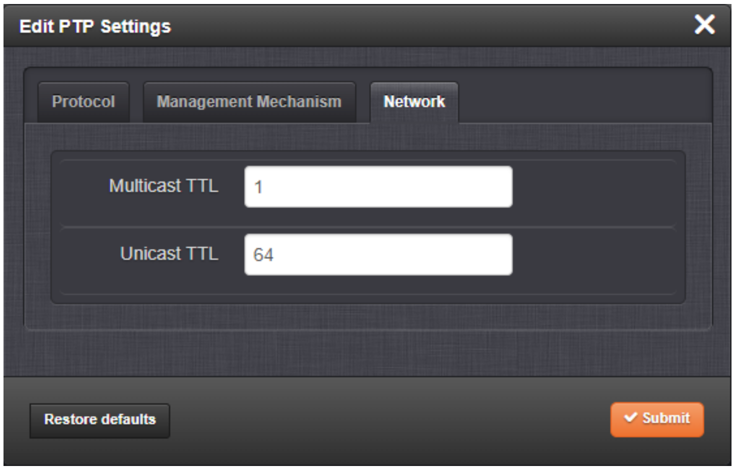


Figure 2-6: Edit PTP Settings panel

Protocol tab

- **PTP version**: [1, 2] Select Version 1 or Version 2.
- **Domain**: [1 through 127] Sets the current PTP Domain Number, as defined in IEEE Std 1588-2008 Section 7.1
- **Communication Mode**: Select multicast, hybrid, or unicast mode.

About…PTP Transmission Modes

The PTP Card is able to transmit the PTP packets in three transmission modes:

- **Multicast Mode**: PTP packets are transmitted to all PTP Clocks by means of Multicast IP addresses dedicated to the PTP protocol (224.0.1.129, 224.0.0.107). PTP packets received by the PTP Clocks are then filtered from the Domain Number, the Port Identity (Clock Identity + Port Number) of the transmitter. When the Master Clock is set in Multicast mode, this module will deny the requests from the Slaves Clocks to run in Unicast mode. When the Master Clock is set in Unicast mode, it doesn't transmit any PTP messages until a Slave has been granted to run in Unicast mode.

- **Unicast Mode**: This is a Point-to-Point transmission mode between two PTP Clocks by means of the unique IP address assigned to each PTP Clock.

- **Hybrid Mode**: [default] This mode uses Multicast messages for Sync, Follow-Up, and Announce packets from the Master. Slaves are expected to send Delay Request messages to the Master in Unicast, and the Master responds in Unicast. No Unicast Negotiation grants are necessary.

The Unicast mode is activated at the initiative of the Slaves. Each Slave, which wants to run in Unicast mode, shall first negotiate Unicast contracts with the Master.

» **Sync Rate**: The rate at which Sync messages are sent, in packets per second. [1 = 1 packet/sec.; 2 = 2 packets/sec.; 0.5 = 1 packet/2 sec.]

» **Announce Rate**: [see Sync Rate above] The rate at which Announce messages are sent, in packets per second.

» **Delay Req Rate**: Interval between request messages sent by the slave to the master.

» **Best Master Clock Algorithm**: [On or OFF] When set to ON, the Master will listen for traffic from other Masters and become passive if another master on the network has better credentials according to the Best Master Clock Algorithm (Section 9.3 of IEEE 1588-2008). A passive master will not transmit any protocol messages as long as another Master is active as the Best Master on the network.
When set to OFF, the Master will act as an active master no matter whether or not other masters are present. This may be required for certain PTP profiles.

» **Clock Priority 1**: [0 to 255] (0 is highest priority. Default is **128** for both priority values. This is usually the priority value that a Slave is set to.) See IEEE 1588-2008, Section 8.10.1, 8.10.2.

» **Clock Priority 2**: [0 to 255] (same as above).

» **Current UTC Offset**: to convert to civil time.

» **Network Transport**: [Ethernet, IPv4/UDP] Selects the transport protocol used for PTP packets.

Management Mechanism tab

» **Request Peer Information**: [ON/OFF] Enable/disable management requests.

» **Request Peer Information Rate**: [0.2 = one request every five seconds] Request rate in seconds for PTP Management messages.

» **Respond to Peer Information Requests**: [ON/OFF] Enable/disable management responses.

Network tab

» **Multicast Ttl**: [1 through 255] Time-to-live (packet lifespan) — Sets the TTL field for PTP packets except for Peer-to-Peer packets for which TTL is forced to 1 as specified in IEEE Std 1588-2008 Annex D.3.

» **Unicast Ttl**: [64] Time to live for Unicast packets.

The PTP Statistics Panel

This panel provides statistics for each Ethernet port. If the PTP is set to OFF for a specific port, this screen will not display any information.

All statistics shown are based on the traffic that is detectable by VersaPNT, i.e. in a Unicast environment, VersaPNT may only detect traffic that is addressed to it, based on switch configuration.

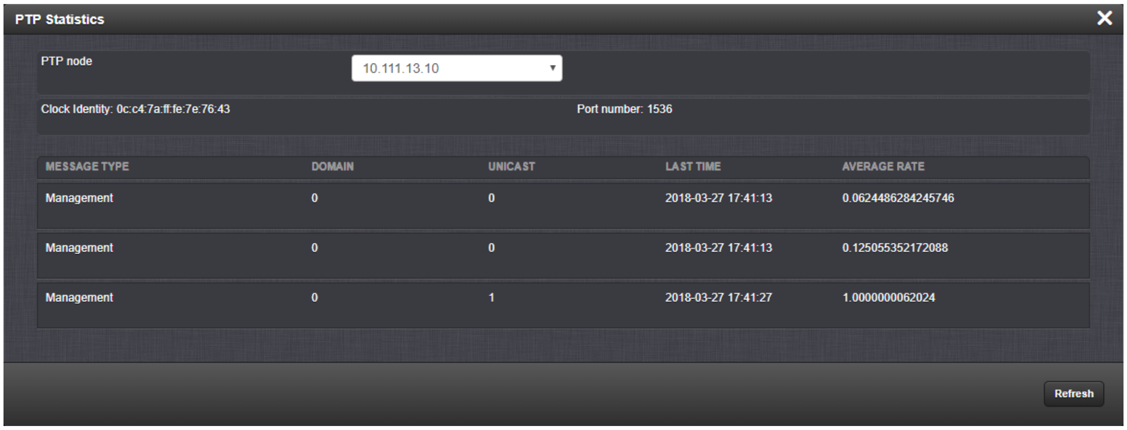


Figure 2-7: PTP Statistics Panel

» **PTP Node**: IP address of PTP node.

» **Clock Identity**: [e.g., "a0:36:9f:ff:fe:37:b9:5d"]

» **Domain**: Domain number of the selected PTP node.

» **Unicast**: [0,1] OFF or ON (1)

» **Last Time**: [e.g., "2016-08-12 18:19:15"] The last time a packet was received.

» **Average Rate**: [e.g., "0.0624986091344933"] Indicates how often the selected message has been detected (in seconds e.g., "1.0" would mean once every second).

2.7.9.2 Enabling/Disabling PTP

To enable or disable PTP:

1. Navigate to **MANAGEMENT > NETWORK: PTP Setup**.
2. In the **PTP** panel, slide the toggle switch to ON or OFF for the desired Ethernet port (eth1).

2.7.9.3 Configuration — General Steps

- Ensure that the Ethernet port used for PTP is connected to the network. Navigate to **MANAGEMENT > NETWORK: Network Setup**, and verify the STATUS in the **Ports** panel.
- Be sure that valid time and 1PPS references are currently selected: Navigate to **MANAGEMENT > OTHER: Reference Priority**, and confirm **Reference Priority** configuration, and **Reference Status**. Note that in order to operate properly as a Master Clock, VersaPNT must be synchronized to a non-PTP reference. The built-in GNSS reference provides all information needed with no user intervention. Should you, however, be using a different reference, ensure that it transmits the following information.
  - The proper TAI or UTC time (including the current year).
  - The current TAI to UTC offset (required even if the reference's time is in TAI).
  - Pending leap second information at least a day in advance.

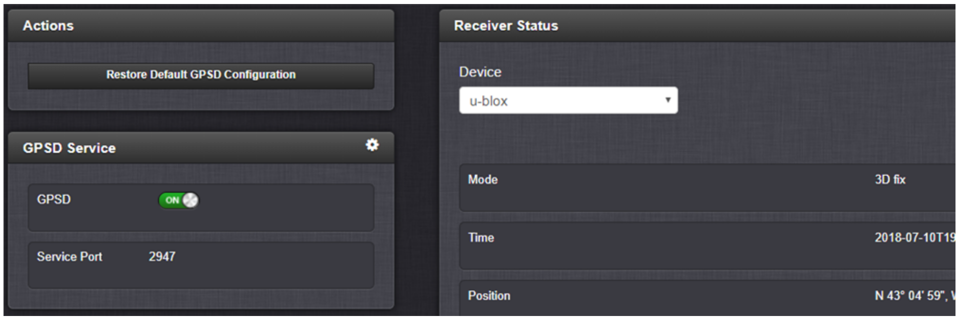
2.7.10 GPSD Setup

GPSD is a free, open-source package used worldwide to manage GNSS systems and devices. With GPSD support on a VersaPNT, users are able to:

- connect to the unit over a network via TCP at the specified port using any GPSD-compatable software
- receive position and timing information from the GNSS receiver in a consistent format, and
- use the WebUI (or CLI) to configure the GPSD service and view status information.

GPSD can only be configured to track the VersaPNT internal u-blox receiver (GDPS does not currently apply to the internal IMU or gyro for navigation purposes)..

To configure GPSD on the WebUI, navigate to **MANAGEMENT** > **NETWORK** > **GPSD Setup** to access the GSPD Setup Screen



The GPSD Setup Screen is divided into three panels:

1. The GPSD Service panel:
   - allows you to toggle the service ON or OFF
   - lists the Service Port

- the **Gear Icon** in the GPSD Service panel allows you to change the Service Port information. If your GPSD setup changes and needs to be reconfigured within your VersaPNT, this is where you can reset the service port.

2. The Actions panel provides an option to restore the **default configuration**.
3. The Receiver Status panel lists the information required by the GPSD service:
   - Device name
   - Mode, Time, Position, Track/Speed/Climb, Error Statistics, and Precision Statistics
   - All satellites in view and the PRN, Elevation, Azimuth, Signal Strength, and Usage for each satellite.

GPSD via CLI commands

The following CLI commands are used to control the behavior of GPSD via the VersaPNT CLI:

- `gpsdserviceportget` – Displays the GPSD service port
- `gpsdserviceportset` – Sets the GPSD service port

There are two GPSD utility programs already incorporated into VersaPNT; `GPSpipe` and `CGPS`. Both can be used as commands within the CLI to view information currently being sent via GPSD. Both commands use `CTL + C` to stop.

CHAPTER 3

Managing Location

This chapter explains the necessary settings required to configure location properly on your VersaPNT.

The following topics are included in this Chapter:

3.1 INS Configuration

VersaPNT is equipped with a GPS-aided high-performance Inertial Navigation System (INS). This MEMS-based unit incorporates 3-axis accelerometers, gyros, magnetometer (all of which 3-axis), as well as a barometric pressure sensor, a temperature sensor and two separate 50-channel L1 GPS receivers.

> **Note:** This section is designed to help you configure your INS. See INS Initialization once your unit is configured in order to finish setup.

To configure the INS:

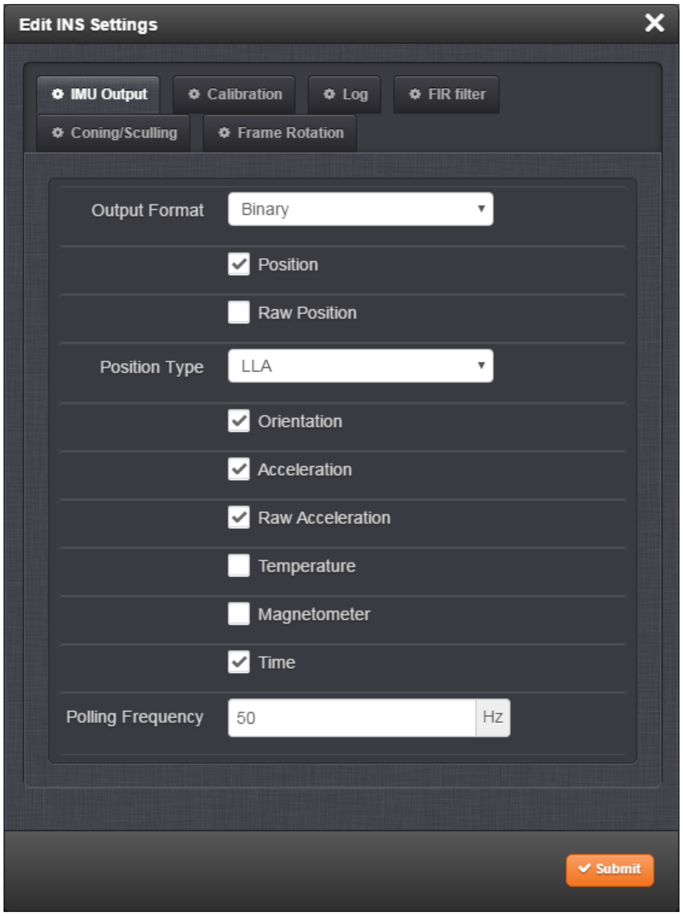
1. In the VersaPNT Web UI, navigate to **MANAGEMENT > NETWORK: INS Setup** (1). The INS screen will appear:

The INS screen has two panels:

- **Actions**:
  - Toggle ON/OFF **Expert Mode**, which allows you to write directly into the configuration file.
  - Toggle ON/OFF Panacea Support. To activate test services, contact your local sales representative.
  - **Restore the Default INS Configuration**

- **Status**: This panel lists INS configuration settings and status messages.
  - INS Model
  - HW Version
  - FW Version
  - INS Mode [aligned, aligning, none]: **The INS mode should read "aligned" for accurate navigation**.
  - GPS Fix [3D, 2D, no fix, time only]: For accurate positioning, the unit needs a 3D fix (at least 4 satellites).
  - Num Sats: The number of tracked satellites
  - Output format [Binary, NMEA]: user settings
  - Polling Rate: user settings
  - Initial Heading [Enabled/Disabled]: user settings

2. In the INS **Status** panel, click the GEAR icon (2). The **Edit INS Settings** window opens:



This window is used to configure the INS. **The window has six tabs which are described below**:

3.1.1 "IMU Output" Tab

VersaPNT provides two different means of obtaining measurements, using either human-readable ASCII messages in an NMEA format, or user-configurable custom binary output messages:

NMEA Output

Each different ASCII output message type has its own unique 5 character heading so that it can easily be distinguished in the data stream.

Output Format: [Binary/**NMEA**] Select NMEA to output the IMU data in an NMEA ASCII format.

ASCII Type: This register selection controls the type of data that will be asynchronously output. You can specify which data register will be automatically output once it is updated with a new reading. Select an ASCII output type from the drop-down list:

Table 3-1: ASCII output settings

Header	Output Type
VNOFF	Asynchronous output turned off
VNYPR	Yaw, Pitch, Roll
VNQTN	Quaternion
VNQMR	Quaternion, Magnetic, Acceleration and Angular Rates
VNDCM	Directional Cosine Orientation Matrix
VNMAG	Magnetic Measurements
VNACC	Acceleration Measurements
VNGYR	Angular Rate Measurements
VNMAR	Magnetic, Acceleration, and Angular Rate Measurements
VNYMR	Yaw, Pitch, Roll, Magnetic, Acceleration, and Angular Rate Measurements
VNYBA	Yaw, Pitch, Roll, Body True Acceleration, and Angular Rates
VNYIA	Yaw, Pitch, Roll, Inertial True Acceleration, and Angular Rates
VNIMU	IMU Measurements
VNGPS	GPS LLA
VNGPE	GPS ECEF
VNINS	INS LLA
VNINE	INS ECEF
VNISL	INS LLA 2

Header	Output Type
VNISE	INS ECEF 2
VNDTV	Delta theta and delta velocity
VNG2S	GPS2 LLA
VNG2E	GPS2 ECEF

To learn more about the settings listed above, see "ASCII Output Settings" on page 128 in the main user manual.

Polling Frequency: [Hz; default= 50] Select the frequency at which the NMEA output data described above will be sent out.

Binary Output

For high-rate data, or custom message outputs, VersaPNT supports the ability to construct your own binary output messages. This selected measurement subset will be packaged into a single compact binary packet provided at any rate from 1 to 400 times per second.

- **Output Format**: [**Binary**/NMEA] Select Binary to output the IMU data in binary format.
- **Position**: [checkbox] Select ON to output IMU position data.
  - **Raw Position**: [checkbox] Select ON to output raw sensor position data (i.e., unprocessed by Kalman filter), instead of processed position data.
- **Orientation**: [checkbox] Select ON to output orientation data.
- **Acceleration**: [checkbox] Select ON to output IMU acceleration data.
  - **Raw Acceleration**: [checkbox] Select ON to output raw sensor acceleration data (i.e., unprocessed by Kalman filter), instead of processed acceleration data.
- **Temperature**: [checkbox] Select ON to output temperature data.
- **Magnetometer**: [checkbox] Select ON to output magnetometer data.
  - **Raw Magnetometer**: [checkbox] Select ON to output raw (unprocessed) magnetometer data.
- **Time**: [checkbox] Select ON to output time data.
- **Polling Frequency**: [Hz; default=50; min.=1; max.=400]

3.1.2 "Calibration" Tab/Antenna Installation

VersaPNT can be connected to one or two GNSS antennas., depending on the model type. When selecting antenna installation locations, make sure that the following requirements are met:

- the view of the sky is unobstructed
- the antennas are located on opposite ends of the vehicle, as far away from the VersaPNT unit as possible, but the antenna cables are not longer than necessary.

Should only one GNSS antenna be used, the antenna can be installed at any location on the vehicle with an unobstructed view of the sky.

The X-Y-Z distances between the first antenna and the X-Y-Z etching on the lid of the VersaPNT unit, as well as the distance between the second antenna and the first antenna are referred to as offsets and need to be configured under the **Calibration** tab. The illustration below shows an example configuration:

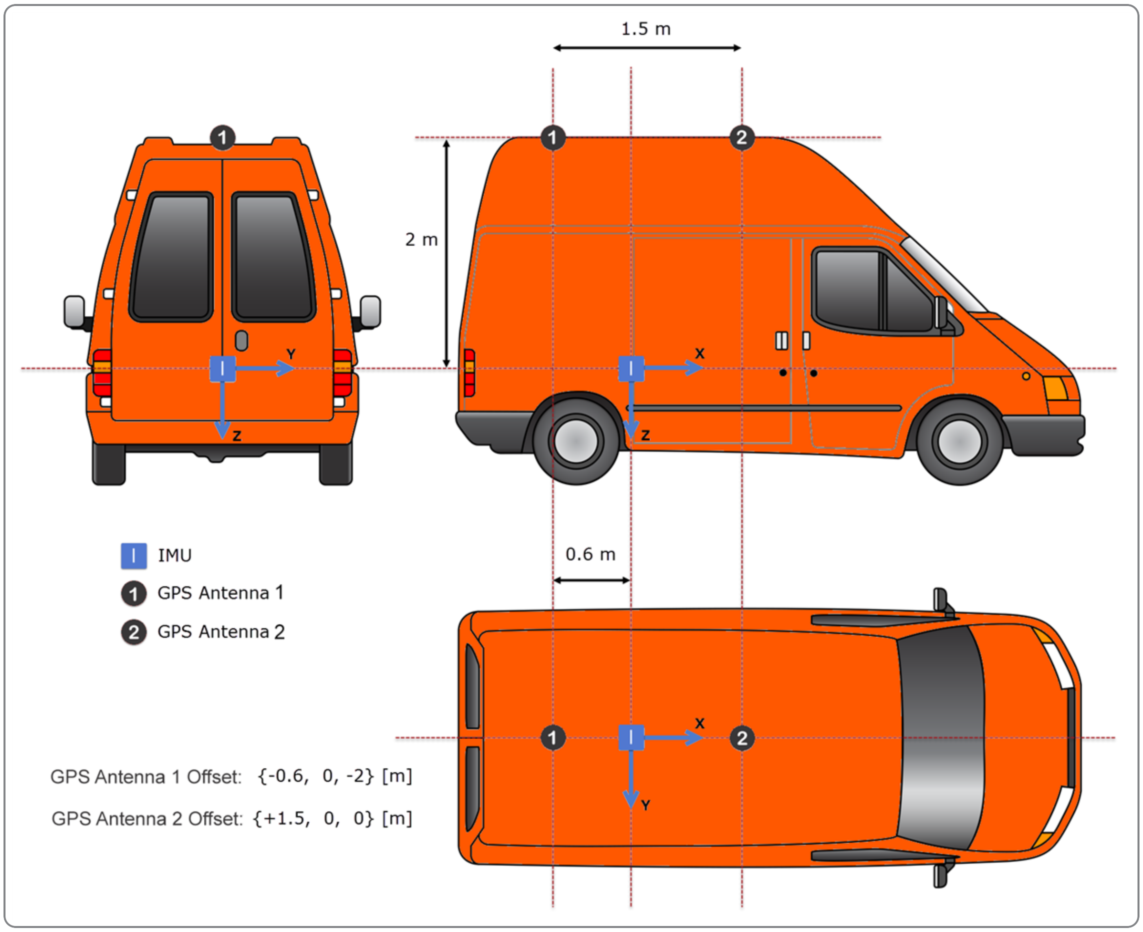


Figure 3-1: GPS antenna offset (Image source: VectorNav Technologies)

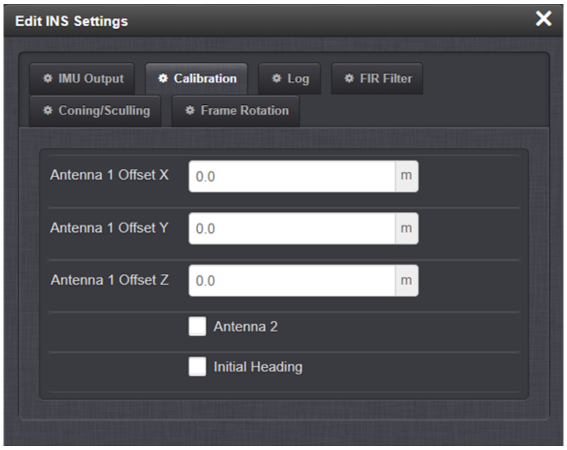
» **Antenna 1 Offset X**: [m] The X-offset from the X-Y-Z etching on the VersaPNT lid to the GNSS antenna number 1.

» **Antenna 1 Offset Y**: [m] The Y-offset from the X-Y-Z etching on the VersaPNT lid to the GNSS antenna number 1.

» **Antenna 1 Offset Z**: [m] The Z-offset from the X-Y-Z etching on the VersaPNT lid to the GNSS antenna number 1.

» **Antenna 2**: [checkbox] Select ON when using a second GNSS antenna. Note that the use of a second antenna is optional, but a second antenna is required for compassing functionality. Also note that the offset of antenna 2 is relative to antenna 1, not to the VersaPNT X-Y-Z etching (see illustration below).

- **Antenna 2 Offset X**: [m] The relative Y-offset from antenna 2 to antenna 1.
- **Antenna 2 Offset Y**: [m] The relative Y-offset from antenna 2 to antenna 1.
- **Antenna 2 Offset Z**: [m] The relative Y-offset from antenna 2 to antenna 1.
  The antenna 2 uncertainty settings indicate how accurate the actual distances could be measured.
- **Antenna 2 Uncert X**: [m; default=0.0254] The stated offset dimension is certain to be accurate within 2.54 cm.
- **Antenna 2 Uncert Y**: [m; default=0.0254] The stated offset dimension is certain to be accurate within 2.54 cm.
- **Antenna 2 Uncert Z**: [m; default=0.0254] The stated offset dimension is certain to be accurate within 2.54 cm.
- **Initial Heading**: [checkbox] Set to ON if each mission shall start with a pre-set initial compass heading.
  - **Initial Compass**: [Deg] Set the initial compass heading here.



3.1.3 "Log" Tab

You can configure your unit to stop logging events in this tab or to change the file name that your logs are stored in.

- **Log To CSV File**: [checkbox: OFF] Select ON to log to a comma-separated values file.
- **File Name**: Change the file name and the path to its location if a log file other than the default one shall be used.

3.1.4 "FIR Filter" Tab

Prior to sending the IMU sensor data to the INS Kalman filter it can be processed by a finite impulse response filter. To configure the FIR filter, use the following settings (for additional information, see the OEM documentation):

- **Mag Window Size** (default 400 Hz): Define the number of magnetometer samples at the IMU rate which will be averaged for each output measurement.
- **Accel Window Size** (default 400 Hz): Define the number of acceleration sensor samples at the IMU rate which will be averaged for each output measurement.
- **Gyro Window Size** (default 400 Hz): [Range:] Define the number of gyroscope samples at the IMU rate which will be averaged for each output measurement.
- **Temp Window Size** (default 400 Hz): [Range:] Define the number of temperature sensor samples at the IMU rate which will be averaged for each output measurement.
- **Pres Window Size** (default 400 Hz): [Range:] Define the number of pressure sensor samples at the IMU rate which will be averaged for each output measurement.

The **Filter Mode** parameters for each sensor select which output quantities the filtering should be applied to. Filtering can be applied to either the uncompensated IMU measurements, compensated (HSI and biases compensated by onboard filters, if applicable), or both.

- **Mag Filter Mode**: [**No Filtering**/Uncompensated/Compensated/(Uncompensated/Compensated)]
- **Accel Filter Mode**: [No Filtering/Uncompensated/Compensated/**(Uncompensated/Compensated)**]
- **Gyro Filter Mode**: [No Filtering/Uncompensated/Compensated/**(Uncompensated/Compensated)**]
- **Temp Filter Mode**: [No Filtering/Uncompensated/Compensated/**(Uncompensated/Compensated)**]
- **Pres Filter Mode**: [**No Filtering**/Uncompensated/Compensated/(Uncompensated/Compensated)]

3.1.5 "Coning/Sculling" Tab

The IMU's coning and sculling algorithms can be configured to operate in multiple frames and with different compensations applied. The IMU computes and accumulates the coning and sculling integrals which track the delta angle and delta velocity.

Integration Frame: [**Body Frame**/NED Frame/ECEF Frame] This setting selects the reference frame used for coning and sculling. Note that using any frame other than the body frame will rely on the onboard Kalman filter’s attitude estimate. The factory default state is to integrate in the sensor body frame.

Gyro Compensation: [checkbox: OFF] This setting selects the compensation to be applied to the angular rate measurements before integration. If set to ON, the Kalman filter’s real-time estimate of the gyro biases will be used to compensate the IMU measurements before integration. For additional information, see the OEM documentation.

To configure the compensation (if set to ON), the INS needs to be operated in Expert Mode.

Acceleration Compensation: [checkbox: OFF] This setting selects the compensation to be applied to the acceleration measurements before integration. If set to ON, the Kalman filter’s real-time estimate of the accel biases will be used to compensate the IMU measurements before integration.

3.1.6 "Frame Rotation" Tab

By default VersaPNT will output the heading, pitch, and roll with respect to the VersaPNT reference frame as it is shown on the etching on the lid of the unit. To ensure that the output is consistent with the attitude of the vehicle VersaPNT is used in, you will need to align the unit to the unit such that the X-axis points out the front of the vehicle (bow), the Y-axis points out the right (starboard), and the Z-axis points down. If it is not possible to orient VersaPNT in this configuration with respect to the vehicle, then you will need to use the Reference Frame Rotation to set the relative orientation of the unit with respect to the vehicle.

Please note: Some VersaPNT units were released with incorrect axis chassis markings. For the purpose of these instructions, the correct default X-Y-Z orientation at startup is:

- The X-axis pointing toward the back of the unit (along the cover, from the connections side to the back)
- The Y-axis pointing toward the right when looking at the connections face
- The z-axis pointing down.

This register can also optionally be used to take into account small known misalignment errors of VersaPNT with respect to the vehicle. The frame rotation provides the ability to apply a rigid body rotation to each of the sensor outputs. This can be used to transform the coordinate system of the onboard sensors into any other coordinate frame of your choice. Since this transformation is applied to the IMU measurements prior to their use in the onboard attitude estimation algorithms, applying a user reference frame rotation will not only change the output coordinates for the IMU measurements, it will also change the IMU body frame for all subsequent attitude estimation calculations.

The frame rotation matrix allows for the transformation of measured acceleration, magnetic, and angular rates from the VersaPNT body frame to any other arbitrary frame of reference. The frame rotation matrix allows for the sensor to be placed in any arbitrary orientation with respect to the user's desired body coordinate frame. This register can also be used to correct for any orientation errors due to mounting VersaPNT on the user's vehicle or platform.

$$\begin{Bmatrix} X \\ Y \\ Z \end{Bmatrix}_U = \begin{bmatrix} C00 & C01 & C02 \\ C10 & C11 & C12 \\ C20 & C21 & C22 \end{bmatrix} \cdot \begin{Bmatrix} X \\ Y \\ Z \end{Bmatrix}_B$$

The variables $\{X,Y,Z\}_{Body}$ are a measured parameter such as acceleration in the body reference frame with respect to the VersaPNT unit. The variables $\{X,Y,Z\}_U$ are a measured parameter such as acceleration in the user's frame of reference. The reference frame rotation register thus needs to be loaded with the transformation matrix that will transform measurements from the body reference frame of the VersaPNT unit to the desired user frame of reference.

> **Note:** The matrix C in the Reference Frame Rotation Register must be an orthonormal, right-handed matrix. The sensor will output an error if the tolerance is not within 1e-5. The sensor will also report an error if any of the parameters are greater than 1 or less than -1.

3.2 INS Initialization

VersaPNT needs a few orientation laps in order to fully orient itself after startup.

It is recommended that you maneuver in a known, repeating pattern for approximately five minutes in order to align with your surrounding satellites. (The length of time necessary for initialization may vary by location, size of route, time of day, etc.).

A figure-eight pattern is ideal in order to excite all possible axes.

There are three possible INS modes:

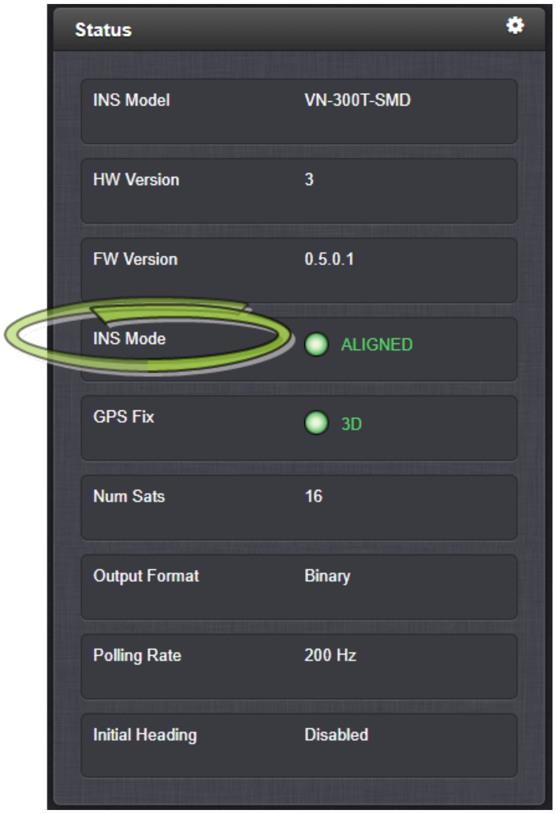
» **Aligned** indicates the solution is reliable and GNSS verified

» **Aligning** indicates either that the current solution is outside the range of validity, or that the INS is working to develop a solution

» **None** indicates that no INS solution is currently available. This message also occurs at startup.

The goal of initialization is to reach an **aligned** state before dependence on your solution.

To verify your INS status in the WebUI, navigate to **MANAGEMENT** > **INS Setup** > **Status**. In the Status panel, **INS Mode** will indicate your current alignment state.



3.3 INS Status Monitoring

In the event of a loss of GNSS alignment, VersaPNT will utilize the internal 3-axis accelerometers, gyroscopes, and magnetometer to maintain the best position and navigation possible.

However, drift does occur in any GNSS-denied environment. The most reliable navigation occurs when the INS status is **ALIGNED** and can decline following GNSS loss, at which point the status will switch to ALIGNING, depending on the integrity of the navigation solution.

It is therefore recommended that you monitor the INS status, to be aware of changes to GPS navigational integrity. Using the Web UI, navigate to **MANAGEMENT** > **NETWORK** > **INS Setup** to view your current **INS Mode** in the **Status** panel.

To monitor your INS status though the I/O connector, click the gear icon on the Status panel.. The "IMU Output" tab settings can be used to obtain INS status information, by either:

» using an NMEA output type that provides the **status** (VNINS and VNINE are both examples of such an output), OR,

» by using the Binary Output option and configuring your system-specific processing of the output data.

See ""IMU Output" Tab" on page 120 to configure the IMU Output tab.

See also "ASCII Output Settings" below for information on NMEA output types.

VersaPNT also issues alarms for loss of GNSS timing visibility. These alarms can be used to provide some indication of the relationship of the unit to local satellites but should not be seen as appropriate INS-status alarms as the processes used to verify timing differ from the processes used to verify navigation information.

See the OEM documentation for more discussion of loss of GNSS signals and accuracy.

3.4 ASCII Output Settings

3.4.1 VNYPR

Output Type: Yaw, Pitch, Roll

Register ID: 8

Async Header: YPR

Access: Read Only

Comment: Attitude solution as yaw, pitch, and roll in degrees. The yaw, pitch, and roll is given as a 3,2,1 Euler angle rotation sequence describing the orientation of the sensor with respect to the inertial North East Down (NED) frame.

Size (Bytes): 12

Example Response: $VNRRG, 8, +006.271,+000.031, -002.000*66

Table 3-2: VNYPR Settings

Offset	Name	Format	Unit	Description
0	Yaw	float	deg	Yaw angle.
4	Pitch	float	deg	Pitch angle.
8	Roll	float	deg	Roll angle.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNYPR header.

3.4.2 VNQTN

Output Type: Attitude Quarternion

Register ID: 9

Async Header: QTN

Access: Read Only

Comment: Attitude solution as a quaternion.

Size (Bytes): 16

Example Response: $VNRRG, 9, -0.017386, -0.000303, +0.055490, +0.998308*4F

Table 3-3: VNQTN Settings

Offset	Name	Format	Unit	Description
0	Quat[0]	float	–	Calculated attitude as quaternion.
4	Quat[1]	float	–	Calculated attitude as quaternion.
8	Quat[2]	float	–	Calculated attitude as quaternion.
12	Quat[3]	float	–	Calculated attitude as quaternion. Scalar component.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNQTN header.

3.4.3 VNQMR

Output Type: Quaternion, Magnetic, Acceleration and Angular Rates

Register ID: 15

Async Header: QMR

Access: Read Only

Comment: Attitude solution, magnetic, acceleration, and compensated angular rates.

Size (Bytes): 52

Example Response: $VNRRG, 15, -0.017057, -0.000767, +0.056534, +0.998255, +1.0670, -0.2568, +3.0696, -00.019, +00.320, -09.802, -0.002801, -0.001186, -0.001582*65

Table 3-4: VNQMR

Offset	Name	Format	Unit	Description
0	Quat[0]	float	–	Calculated attitude as quaternion.
4	Quat[1]	float	–	Calculated attitude as quaternion.
8	Quat[2]	float	–	Calculated attitude as quaternion.
12	Quat[3]	float	–	Calculated attitude as quaternion. Scalar component.
16	MagX	float	Gauss	Compensated magnetometer measurement in x-axis.
20	MagY	float	Gauss	Compensated magnetometer measurement in y-axis.
24	MagZ	float	Gauss	Compensated magnetometer measurement in z-axis.
28	AccelX	float	m/s^2	Compensated accelerometer measurement in x-axis.
32	AccelY	float	m/s^2	Compensated accelerometer measurement in y-axis.
36	AccelZ	float	m/s^2	Compensated accelerometer measurement in z-axis.
40	GyroX	float	rad/s	Compensated angular rate in x-axis.
44	GyroY	float	rad/s	Compensated angular rate in y-axis.
48	GyroZ	float	rad/s	Compensated angular rate in z-axis.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNQMR header.

3.4.4 VNMAG

Output Type: Magnetic Measurements

Register ID: 17

Async Header: MAG

Access: Read Only

Comment: Magnetometer measurements.

Size (Bytes): 12

Example Response: $VNRRG,17, +1.0647, -0.2498, +3.0628*66

Table 3-5: VNMAG Settings

Offset	Name	Format	Unit	Description
0	MagX	float	Gauss	Compensated magnetometer measurement in x-axis.
4	MagY	float	Gauss	Compensated magnetometer measurement in y-axis.
8	MagZ	float	Gauss	Compensated magnetometer measurement in z-axis.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNMAG header.

3.4.5 VNACC

Output Type: Acceleration Measurements

Register ID: 18

Async Header: ACC

Access: Read Only

Comment: Acceleration measurements.

Size (Bytes): 12

Example Response: $VNRRG,18, +00.013, +00.354, -09.801*65

Table 3-6: VNACC Settings

Offset	Name	Format	Unit	Description
0	AccelX	float	m/s^2	Compensated accelerometer measurement in x-axis.
4	AccelY	float	m/s^2	Compensated accelerometer measurement in y-axis.
8	AccelZ	float	m/s^2	Compensated accelerometer measurement in z-axis.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNACC header.

3.4.6 VNGYR

Output Type: Angular Rate Measurements

Register ID: 19

Async Header: GYR

Access: Read Only

Comment: Compensated angular rates.

Size (Bytes): 12

Example Response: $VNRRG, 19, +0.002112, -0.000362, -0.000876*6C

Table 3-7: VNGYR Settings

Offset	Name	Format	Unit	Description
0	GyroX	float	rad/s	Compensated angular rate in x-axis.

Offset	Name	Format	Unit	Description
4	GyroY	float	rad/s	Compensated angular rate in y-axis.
8	GyroZ	float	rad/s	Compensated angular rate in z-axis.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNGYR header.

3.4.7 VNMAR

Output Type: Magnetic, Acceleration and Angular Rates

Register ID: 20

Async Header: MAR

Access: Read Only

Comment: Magnetic, acceleration, and compensated angular rates.

Size (Bytes): 36

Example Response: $VNRRG,20, +1.0684, -0.2578, +3.0649, -00.005, +00.341, -09.780, -0.000963, +0.000840, -0.000466*64

Table 3-8: VNMAR Settings

Offset	Name	Format	Unit	Description
0	MagX	float	Gauss	Compensated magnetometer measurement in x-axis.
4	MagY	float	Gauss	Compensated magnetometer measurement in y-axis.
8	MagZ	float	Gauss	Compensated magnetometer measurement in z-axis.
12	AccelX	float	m/s^2	Compensated accelerometer measurement in x-axis.
16	AccelY	float	m/s^2	Compensated accelerometer measurement in y-axis.
20	AccelZ	float	m/s^2	Compensated accelerometer measurement in z-axis.
24	GyroX	float	rad/s	Compensated angular rate in x-axis.
28	GyroY	float	rad/s	Compensated angular rate in y-axis.
32	GyroZ	float	rad/s	Compensated angular rate in z-axis.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNMAR header.

3.4.8 VNYMR

Output Type: Yaw, Pitch, Roll, Magnetic, Acceleration, and Angular Rates

Register ID: 27

Async Header: YMR

Access: Read Only

Comment: Attitude solution, magnetic, acceleration, and compensated angular rates.

Size (Bytes): 48

Example Response: $VNRRG,27, +006.380, +000.023, -001.953, +1.0640, -0.2531, +3.0614, +00.005, +00.344, -09.758, -0.001222, -0.000450, -0.001218*4F

Table 3-9: VNYMR Settings

Offset	Name	Format	Unit	Description
0	Yaw	float	deg	Calculated attitude heading angle in degrees.
4	Pitch	float	deg	Calculated attitude pitch angle in degrees.
8	Roll	float	deg	Calculated attitude roll angle in degrees.
12	MagX	float	Gauss	Compensated magnetometer measurement in x-axis.
16	MagY	float	Gauss	Compensated magnetometer measurement in y-axis.
20	MagZ	float	Gauss	Compensated magnetometer measurement in z-axis.
24	AccelX	float	m/s^2	Compensated accelerometer measurement in x-axis.
28	AccelY	float	m/s^2	Compensated accelerometer measurement in y-axis.
32	AccelZ	float	m/s^2	Compensated accelerometer measurement in z-axis.
36	GyroX	float	rad/s	Compensated angular rate in x-axis.
40	GyroY	float	rad/s	Compensated angular rate in y-axis.
44	GyroZ	float	rad/s	Compensated angular rate in z-axis.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNYMR header.

3.4.9 VNYBA

Output Type: Yaw, Pitch, Roll, Body True Acceleration, and Angular Rates

Async Header: YBA

Table 3-10: VNYBA Settings

Offset	Name	Format	Unit	Description
0	Yaw	float	deg	Yaw angle.
4	Pitch	float	deg	Pitch angle.
8	Roll	float	deg	Roll angle.
12	AccelX	float	m/s^2	True acceleration. (X-axis)
16	AccelY	float	m/s^2	True acceleration. (Y-axis)
20	AccelZ	float	m/s^2	True acceleration. (Z-axis)
24	AngularRateX	float	rad/s	Angular rate. (X-axis)
28	AngularRateY	float	rad/s	Angular rate. (Y-axis)
32	AngularRateZ	float	rad/s	Angular rate. (Z-axis)

3.4.10 VNYIA

Output Type: Yaw, Pitch, Roll, Inertial True Acceleration, and Angular Rates

Async Header: YIA

Table 3-11: VNYIA Settings

Offset	Name	Format	Unit	Description
0	Yaw	float	deg	Yaw angle.
4	Pitch	float	deg	Pitch angle.
8	Roll	float	deg	Roll angle.
12	AccelX	float	m/s^2	Inertial true acceleration. (X-axis)
16	AccelY	float	m/s^2	Inertial true acceleration. (Y-axis)
20	AccelZ	float	m/s^2	Inertial true acceleration. (Z-axis)
24	AngularRateX	float	rad/s	Angular rate. (X-axis)
28	AngularRateY	float	rad/s	Angular rate. (Y-axis)
32	AngularRateZ	float	rad/s	Angular rate. (Z-axis)

3.4.11 VNIMU

Output Type: IMU Measurements

Register ID: 54

Async Header: IMU

Access: Read Only

Comment: Provides the calibrated IMU measurements including barometric pressure.

Size (Bytes): 44

Example Read Response: $VNRRG,54, -02.0841, +00.6045, +02.8911, +00.381, -00.154, -09.657, -00.005683, +00.000262, +00.001475, +21.6, +00099.761*5B

Table 3-12: VNIMU Settings

Offset	Name	Format	Unit	Description
0	MagX	float	Gauss	Uncompensated Magnetic X-axis.
4	MagY	float	Gauss	Uncompensated Magnetic Y-axis.
8	MagZ	float	Gauss	Uncompensated Magnetic Z-axis.
12	AccelX	float	m/s^2	Uncompensated Acceleration X-axis.
16	AccelY	float	m/s^2	Uncompensated Acceleration Y-axis.
20	AccelZ	float	m/s^2	Uncompensated Acceleration Z-axis.
24	GyroX	float	rad/s	Uncompensated Angular rate X-axis.
28	GyroY	float	rad/s	Uncompensated Angular rate Y-axis.
32	GyroZ	float	rad/s	Uncompensated Angular rate Z-axis.
36	Temp	float	C	IMU Temperature.
40	Pressure	float	kPa	Barometric pressure.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNIMU header.

3.4.12 VNGPS

Output Type: GPS Solution - LLA

Register ID: 58

Async Header: GPS

Access: Read Only

Size (Bytes): 72

Example Read Response: $VNRRG, 58, 333733.000159, 1694,3,05, +32.95622080, -096.71415970, +00169.457, - 000.850, - 000.580, - 002.860, +005.573, +003.644, +009.760, +003.320, 2.00E-08*0E

Table 3-13: VNGPS Settings

Offset	Name	Format	Unit	Description
0	Time	double	sec	GPS time of week in seconds.
8	Week	unit16	week	GPS week.

Offset	Name	Format	Unit	Description
10	GpsFix	uint8	–	GPS fix type. See table below.
11	NumSats	uint8	–	Number of GPS satellites used in solution.
12	–	–	–	– 4 PADDING BYTES –
16	Latitude	double	deg	Latitude in degrees.
24	Longitude	double	deg	Longitude in degrees.
32	Altitude	double	m	Altitude above ellipsoid. (WGS84)
40	NedVelX	float	m/s	Velocity measurement in north direction.
44	NedVelY	float	m/s	Velocity measurement in east direction.
48	NedVelZ	float	m/s	Velocity measurement in down direction.
52	NorthAcc	float	m	North position accuracy estimate. (North)
56	EastAcc	float	m	East position accuracy estimate. (East)
60	VertAcc	float	m	Vertical position accuracy estimate. (Down)
64	SpeedAcc	float	m/s	Speed accuracy estimate.
68	TimeAcc	float	sec	Time accuracy estimate.

Table 3-14: GPS Fix

Value	Description
0	No fix
1	Time only
2	2D
3	3D

This register provides the GPS PVT (position, velocity, & time) solution from GPS receiver A. This is the GPS receiver that is used by the INS (Inertial Navigation System) Kalman filter for position and velocity inputs.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNGPS header.

3.4.13 VNGPE

Output Type: GPS Solution - ECEF

Register ID: 59

Async Header: GPE

Access: Read Only

Comment: Available at 5Hz only.

Size (Bytes): 72

Example Read Response: $VNRRG, 59, 333752.800322, 1694, 3, 06, -0626351.600, -5320522.490, +3449975.910, - 000.810, -002.970, +000.850, +010.170, +010.170, +010.170, +002.740, 1.80E-08*35

Table 3-15: VNGPE Settings

Offset	Name	Format	Unit	Description
0	Tow	double	sec	GPS time of week.
8	Week	unit16	week	Current GPS week.
10	GpsFix	uint8	–	GPS fix type. See table below.
11	NumSats	uint8	–	Number of GPS satellites used in solution.
12	–	–	–	– 4 PADDING BYTES –
16	PositionX	double	m	ECEF X coordinate.
24	PositionY	double	m	ECEF Y coordinate.
32	PositionZ	double	m	ECEF Z coordinate.
40	VelocityX	float	m/s	ECEF X velocity.
44	VelocityY	float	m/s	ECEF Y velocity.
48	VelocityZ	float	m/s	ECEF Z velocity.
52	PosAccX	float	m	ECEF X position accuracy estimate.
56	PosAccY	float	m	ECEF Y position accuracy estimate.
60	PosAccZ	float	m	ECEF Z position accuracy estimate.
64	SpeedAcc	float	m/s	Speed accuracy estimate.
68	TimeAcc	float	sec	Time accuracy estimate.

Table 3-16: GPS Fix

Value	Description
0	No fix
1	Time only
2	2D
3	3D

This register provides the GPS PVT (position, velocity, & time) solution from GPS receiver A. This is the GPS receiver that is used by the INS (Inertial Navigation System) Kalman filter for position and velocity inputs.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNGPE header.

3.4.14 VNINS

Output Type: INS Solution – LLA

Register ID: 63

Async Header: INS

Access: Read Only

Size (Bytes): 72

Example Read Response:$VNRRG, 63, 333811.902862, 1694, 0004, +009.500, -004.754, -000.225, +32.95602815, -096.71424297, +00171.195, -000.840, -000.396, -000.109, 07.8, 01.6, 0.23*5F

Table 3-17: VNINS Settings

Offset	Name	Format	Unit	Description
0	Time	double	sec	GPS time of week in seconds
8	Week	uint16	week	GPS week.
10	Status	uint16	–	Status flags for INS filter. Hexadecimal format. See table below.
12	Yaw	float	deg	Yaw angle relative to true north.
16	Pitch	float	deg	Pitch angle relative to horizon.
20	Roll	float	deg	Roll angle relative to horizon.
24	Latitude	double	deg	INS solution position in geodetic latitude.
32	Longitude	double	deg	INS solution position in geodetic longitude.
40	Altitude	double	m	Height above ellipsoid. (WGS84)
48	NedVelX	float	m/s	INS solution velocity in NED frame. (North)
52	NedVelY	float	m/s	INS solution velocity in NED frame. (East)
56	NedVelZ	float	m/s	INS solution velocity in NED frame. (Down)
60	AttUncertainty	float	deg	Uncertainty in attitude estimate.
64	PosUncertainty	float	m	Uncertainty in position estimate.
68	VelUncertainty	float	m/s	Uncertainty in velocity estimate.

Table 3-18: INS Status

Name	Bit	Format	Description
Mode	0	2 bits	Indicates the current mode of the INS filter. 0 = Not tracking. GPS Compass is initializing. Output heading is based on magnetometer measurements. 1 = Aligning. INS Filter is dynamically aligning. For a stationary startup: GPS Compass has initialized and INS Filter is aligning from the magnetic heading to the GPS Compass heading. For a dynamic startup: INS Filter has initialized and is dynamically aligning to True North heading. In operation, if the INS Filter drops from INS Mode 2 back down to 1, the attitude undertainty has increased above 2 degrees. 2 = Tracking. The INS Filter is tracking and operating within specification. 3 = Loss of GPS. A GPS outage has lasted more than 45 seconds. The INS Filter will no longer update the position and velocity outputs, but the attitude remains valid.
GpsFix	2	1 bits	Indicates whether the GPS has a proper fix.
Error	3	4 bits	Sensor measurement error code. See table below. 0 = No errors detected.
Reserved	7	1 bit	Reserved for internal use. May toggle state during runtime and should be ignored.
GpsHeadingIns	8	1 bit	In stationary operation, if set the INS Filter has fully aligned to the GPS Compass solution. In dynamic operation, the GPS Compass solution is currently aiding the INS Filter heading solution.
GpsCompass	9	1 bit	Indicates if the GPS compass is operational and reporting a heading solution.
Reserved	10	8 bits	Reserved for internal use. These bits will toggle state and should be ignored.

Table 3-19: Error Bitfield

Name	Bit Offset	Format	Description
Reserved	0	1 bit	Reserved for future use and not currently used.
IMU Error	1	1 bit	High if IMU communication error is detected.
Mag/Pres Error	2	1 bit	High if Magnetometer or Pressure sensor error is detected.
GPS Error	3	1 bit	High if GPS communication error is detected.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNINS header.

3.4.15 VNINE

Output Type: INS Solution – ECEF

Register ID: 64

Async Header: INE

Access: Read Only

Size (Bytes): 72

Example Read Response: $VNRRG, 64, 333837.222917, 1694,0004, +009.315, -004.767, -000.193, -0626356.433, -5320530.947, +3449961.679, -000.224, -000.476, -000.564, 07.7, 01.5, 0.22*65

Table 3-20: VNINE Settings

Offset	Name	Format	Unit	Description
0	Time	double	sec	GPS time of week in seconds
8	Week	uint16	week	GPS week.
10	Status	uint16	–	Status flags for INS filter. Hexadecimal format. See table below.
12	Yaw	float	deg	Yaw angle relative to true north.
16	Pitch	float	deg	Pitch angle relative to horizon.
20	Roll	float	deg	Roll angle relative to horizon.
24	PositionX	double	m	INS solution position in ECEF. (X-axis)
32	PositionY	double	m	INS solution position in ECEF. (Y-axis)
40	PositionZ	double	m	INS solution position in ECEF. (Z-axis)
48	VelocityX	float	m/s	INS solution velocity in ECEF frame. (X-axis)
52	VelocityY	float	m/s	INS solution velocity in ECEF frame. (Y-axis)
56	VelocityZ	float	m/s	INS solution velocity in ECEF frame. (Z-axis)
60	AttUncertainty	float	deg	Expected uncertainty in estimated attitude.
64	PosUncertainty	float	m	Expected uncertainty in estimated position.
68	VelUncertainty	float	m/s	Expected uncertainty in estimated velocity.

Table 3-21: INS Status

Name	Bit	Format	Description
Mode	0	2 bits	Indicates the current mode of the INS filter. 0 = Not tracking. GPS Compass is initializing. Output heading is based on magnetometer measurements. 1 = Aligning. INS Filter is dynamically aligning. For a stationary startup: GPS Compass has initialized and INS Filter is aligning from the magnetic heading to the GPS Compass heading. For a dynamic startup: INS Filter has initialized and is dynamically aligning to True North heading. In operation, if the INS Filter drops from INS Mode 2 back down to 1, the attitude undertainty has increased above 2 degrees. 2 = Tracking. The INS Filter is tracking and operating within specification. 3 = Loss of GPS. A GPS outage has lasted more than 45 seconds. The INS Filter will no longer update the position and velocity outputs, but the attitude remains valid.

Name	Bit	Format	Description
GpsFix	2	1 bits	Indicates whether the GPS has a proper fix.
Error	3	4 bits	Sensor measurement error code. See table below. 0 = No errors detected.
Reserved	7	1 bit	Reserved for internal use. May toggle state during runtime and should be ignored.
GpsHeadingIns	8	1 bit	In stationary operation, if set the INS Filter has fully aligned to the GPS Compass solution. In dynamic operation, the GPS Compass solution is currently aiding the INS Filter heading solution.
GpsCompass	9	1 bit	Indicates if the GPS compass is operational and reporting a heading solution.
Reserved	10	8 bits	Reserved for internal use. These bits will toggle state and should be ignored.

Table 3-22: Error Bitfield

Name	Bit Offset	Format	Description
Reserved	0	1 bit	Reserved for future use and not currently used.
IMU Error	1	1 bit	High if IMU communication error is detected.
Mag/Pres Error	2	1 bit	High if Magnetometer or Pressure sensor error is detected.
GPS Error	3	1 bit	High if GPS communication error is detected.

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNINE header.

3.4.16 VNISL

Output Type: INS State - LLA

Register ID: 72

Async Header: ISL

Access: Read Only

Size (Bytes): 72

Example Read Response: $VNRRG, 72, +170.420, +001.398, +001.806, +00.000295, -00.000911, -00.000905, +32.95680804, -096.71414860, +00179.592, +000.181, -000.073, -000.050, +00.209, -00.322, -10.040*52

Table 3-23: VNISL Settings

Offset	Name	Format	Unit	Description
0	Yaw	float	deg	Yaw angle relative to true north.

Offset	Name	Format	Unit	Description
4	Pitch	float	deg	Pitch angle relative to horizon.
8	Roll	float	deg	Roll angle relative to horizon.
12	Latitude	double	deg	Estimated position in geodetic latitude.
20	Longitude	double	deg	Estimated position in geodetic longitude.
28	Altitude	double	m	Estimated height above ellipsoid. (WGS84)
36	VelocityX	float	m/s	Estimated velocity in NED frame. (North)
40	VelocityY	float	m/s	Estimated velocity in NED frame. (East)
44	VelocityZ	float	m/s	Estimated velocity in NED frame. (Down)
48	AccelX	float	m/s^2	Estimated acceleration in body frame. (X-axis)
52	AccelY	float	m/s^2	Estimated acceleration in body frame. (Y-axis)
56	AccelZ	float	m/s^2	Estimated acceleration in body frame. (Z-axis)
60	AngularRateX	float	rad/s	Estimated angular rate in body frame. (X-axis)
64	AngularRateY	float	rad/s	Estimated angular rate in body frame. (Y-axis)
68	AngularRateZ	float	rad/s	Estimated angular rate in body frame. (Z-axis)

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNISL header.

3.4.17 VNISE

Output Type: INS State - ECEF

Register ID: 73

Async Header: ISE

Access: Read Only

Size (Bytes): 72

Example Read Response: $VNRRG, 73, +170.558, +001.267, +001.762, +00.001502, -00.000403, +00.000394, -626343.88590823, -5320499.92650050, +3450022.606, +000.001, -000.010, +000.094, +00.255, -00.308, -10.060*50

Example Async Message: $VNISE, +170.558, +001.267, +001.762, +00.001502, -00.000403, +00.000394, -626343.88590823, -5320499.92650050, +3450022.606, +000.001, -000.010, +000.094, +00.255, -00.308, -10.060*XX

Table 3-24: VNISE Settings

Offset	Name	Format	Unit	Description
0	Yaw	float	deg	Yaw angle relative to true north.
4	Pitch	float	deg	Pitch angle relative to horizon.
8	Roll	float	deg	Roll angle relative to horizon.
12	PositionX	double	m	Estimated position in ECEF. (X-axis)
20	PositionY	double	m	Estimated position in ECEF. (Y-axis)
28	PositionZ	double	m	Estimated position in ECEF. (Z-axis)
36	VelocityX	float	m/s	Estimated velocity in ECEF frame. (X-axis)
40	VelocityY	float	m/s	Estimated velocity in ECEF frame. (Y-axis)
44	VelocityZ	float	m/s	Estimated velocity in ECEF frame. (Z-axis)
48	AccelX	float	m/s^2	Estimated acceleration in body frame. (X-axis)
52	AccelY	float	m/s^2	Estimated acceleration in body frame. (Y-axis)
56	AccelZ	float	m/s^2	Estimated acceleration in body frame. (Z-axis)
60	AngularRateX	float	rad/s	Estimated angular rate in body frame. (X-axis)
64	AngularRateY	float	rad/s	Estimated angular rate in body frame. (Y-axis)
68	AngularRateZ	float	rad/s	Estimated angular rate in body frame. (Z-axis)

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNISE header.

3.4.18 VNDTV

Output Type: Delta Theta and Delta Velocity

Register ID: 80

Async Header: DTV

Access: Read

Comment: This register contains the output values of the onboard coning and sculling algorithm.

Size (Bytes): 28

Example Read Response: $VNRRG, 80, +0.665016, -000.119, -000.409, -000.025, +000.011, -000.084, -006.702*6A

Table 3-25: VNDTV Settings

Offset	Name	Format	Unit	Description
0	DeltaTime	float	sec	Delta time for the integration interval.
8	DeltaThetaX	float	deg	Delta rotation vector component in the x-axis.
10	DeltaThetaY	float	deg	Delta rotation vector component in the y-axis.
12	DeltaThetaZ	float	deg	Delta rotation vector component in the z-axis.
16	DeltaVelocityX	float	m/s	Delta velocity vector component in the x-axis.
20	DeltaVelocityY	float	m/s	Delta velocity vector component in the y-axis.
24	DeltaVelocityZ	float	m/s	Delta velocity vector component in the z-axis.

The Delta Theta and Delta Velocity register contains the computed outputs from the onboard coning and sculling algorithm. The coning and sculling integrations are performed at the IMU sample rate (nominally at 400Hz) and reset when the register data is output. If polling this register, the values will represent the delta time, angles, and velocity since the register was last polled. If the Delta Theta/Velocity data is selected for asynchronous output via the Async Data Output Type register (Register 6, type 30), the integrals will be reset each time the data is asynchronously output at the configured rate.

The delta time output contains the length of the time interval over which the deltas were calculated. This can be used to check the interval time or to compute nonlinear "average" rates and accelerations from the integrated values.

The delta theta is output as a principal rotation vector, defined as the product of the unit vector of the principal rotation axis and the principal rotation angle in degrees. For small rotations, a typical use case for delta angles, the principal rotation vector elements may be treated individually as rotations in degrees about the individual sensor axes (in any Euler rotation sequence) with little error.

The delta velocity output provides the integration of the acceleration in the chosen frame, taking into account the coupling effects of any simultaneous rotation experienced.

The coning and sculling algorithm can be configured to operate in multiple frames and with a variety of compensations applied. See the Delta Theta and Delta Velocity Configuration Register in the IMU subsystem for further details

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured the data in this register will be sent out with the $VNDTV header.

3.4.19 VNG2S

Output Type: GPS2 Solution - LLA

Register ID: 103

Async Header: G2S

Access: Read Only

Comment: The calculated navigation solution of the Ant B receiver, expressed in the LLA/NED frames. Updates at the GPS rate (5Hz default).

Size (Bytes): 72

Example Read Response: $VNRRG, 103, 505020.999614, 1941, 3, 13, +32.89195540, -096.70376740, +00165.491, +000.000, -000.008, -000.025, +001.320, +001.303, +003.259, +000.098, 2.00E-09*35

Table 3-26: VNG2S Settings

Offset	Name	Format	Unit	Description
0	Time	double	sec	GPS time of week in seconds.
8	Week	uint16	week	GPS week.
10	GpsFix	uint8	–	GPS fix type. See table below.
11	NumSats	uint8	–	Number of GPS satellites used in solution.
12	–	–	–	– 4 PADDING BYTES –
16	Latitude	double	deg	Latitude in degrees.
24	Longitude	double	deg	Longitude in degrees.
32	Altitude	double	m	Altitude above ellipsoid. (WGS84)
40	NedVelX	float	m/s	Velocity measurement in north direction.
44	NedVelY	float	m/s	Velocity measurement in east direction.
48	NedVelZ	float	m/s	Velocity measurement in down direction.
52	NorthAcc	float	m	North position accuracy estimate. (North)
56	EastAcc	float	m	East position accuracy estimate. (East)
60	VertAcc	float	m	Vertical position accuracy estimate. (Down)
64	SpeedAcc	float	m/s	Speed accuracy estimate.
68	TimeAcc	float	sec	Time accuracy estimate.

Table 3-27: GPS Fix

Value	Description
0	No fix
1	Time only
2	2D
3	3D

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured, the data in this register will be sent out with the $VNG2S header.

3.4.20 VNG2E

Output Type: GPS2 Solution - ECEF

Register ID: 103

Async Header: G2E

Access: Read Only

Comment: The calculated navigation solution of the Ant B receiver, expressed in the ECEF frame. Updates at the GPS rate (5Hz default).

Size (Bytes): 72

Example Read Response: $VNRRG, 104, 505024.199617, 1941, 3, 13, -0625837.176, -5324476.241, +3443992.903, -000.001, -000.020, +000.007, +001.311, +001.298, +003.198, +000.098, 2.00E-09*03

Table 3-28: VNG2E Settings

Offset	Name	Format	Unit	Description
0	Time	double	sec	GPS time of week.
8	Week	uint16	week	Current GPS week.
10	GpsFix	uint8	–	GPS fix type. See table below.
11	NumSats	uint8	–	Number of GPS satellites used in solution.
12	–	–	–	– 4 PADDING BYTES –
16	PositionX	double	m	ECEF X coordinate.
24	PositionY	double	m	ECEF Y coordinate.
32	PositionZ	double	m	ECEF Z coordinate.
40	VelocityX	float	m/s	ECEF X velocity.
44	VelocityY	float	m/s	ECEF Y velocity.
48	VelocityZ	float	m/s	ECEF Z velocity.
52	PosAccX	float	m	ECEF X position accuracy estimate.
56	PosAccY	float	m	ECEF Y position accuracy estimate.
60	PosAccZ	float	m	ECEF Z position accuracy estimate.
64	SpeedAcc	float	m/s	Speed accuracy estimate.
68	TimeAcc	float	sec	Time accuracy estimate.

Table 3-29: GPS Fix

Value	Description
0	No fix
1	Time only
2	2D
3	3D

Note: You can configure the device to output this register at a fixed rate using the Async Data Output Type Register in the System subsystem. Once configured, the data in this register will be sent out with the $VNG2E header.

3.5 INS Expert Mode

Advanced INS configuration is possible via the INS Expert Mode, which allows you to write directly into the configuration file.

Caution: INS Expert Mode should only be utilized by advanced users, as incorrectly altering the configuration file can cause NTP to stop working (if NTP is configured as an input reference, VersaPNT could lose synchronization).

To access the INS Expert Mode, navigate to **MANAGEMENT** > **INS Setup**. The switch for the INS Expert Mode is in the **ACTIONS** panel.

Caution: Any configurations made in INS Expert Mode will be lost as soon as INS Expert Mode is disabled. If changes are made to the INS configuration file while in the Expert mode, Expert mode should remain enabled from that point forward.

Caution: Spectracom Tech Support does not support the editing of the INS configuration files while in the Expert Mode.

The INS configuration file can be reset back by clicking **Restore Default INS Configuration**.

To learn more about INS configuration, see the OEM documentation.

3.6 VICTORY Configuration

VersaPNT is equipped with an interface that complies with the VICTORY (Vehicular Integration for C4ISR/EW Interoperability) standard. The use of the VICTORY interface is optional. Prior to using it, however, the interface needs to be configured.

To configure the VICTORY interface, see the separate document "VICTORY Configuration".

CHAPTER 4

Managing Time

In this document, the notion of **Managing Time** refers not only to the concept of VersaPNT's System Time, but also to reference configuration, as well as distribution of time and frequency.

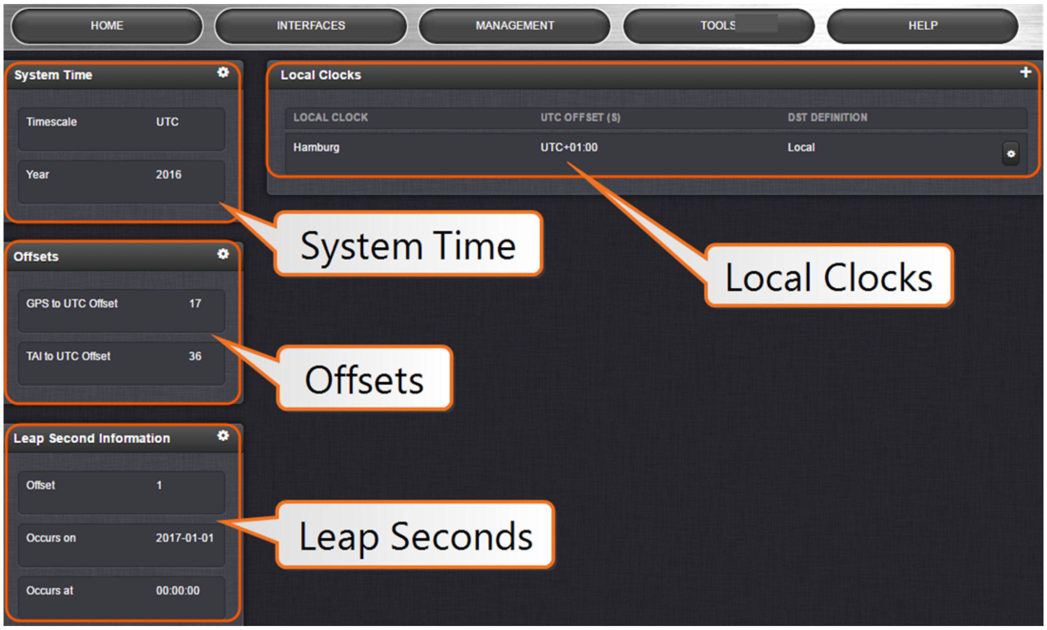
The following topics are included in this Chapter:

4.1 The Time Management Screen

The **Time Management** screen is the point of entry for all **System Time**-related settings that are user-configurable.

To access the **Time Management** screen:

1. Navigate to **MANAGEMENT > OTHER: Time Management**.
2. The **Time Management** screen opens. It is divided into 4 panels:



System Time panel

The System Time panel displays the time scale and the year, and allows access to the **Edit System Time** window via the GEAR icon in the top-right corner. This window is used to select the time scale, and to manually set a user- time, if so required.

See "System Time" on page 152.

Offsets panel

The Timescales **UTC**, **TAI**, and the **GPS**-supplied time are offset by several seconds, e.g. to accommodate leap seconds. The GPS offset may change over time, and can be managed via the GEAR icon in the top-right corner of this panel.

Leap Second Info panel

From time to time, a leap second is applied to UTC, in order to adjust UTC to the actual position of the sun. Via the **Leap Second Info** panel, leap second corrections can be applied to VersaPNT's time keeping. It is also possible to enter the exact day and time when the leap second is to be applied, and to delete a leap second.

See also: "Leap Seconds" on page 159

Local Clocks panel

You can create multiple different Local Clocks, as needed. The names of all Local Clocks that have already been created are displayed in the Local Clocks panel.

See also "Local Clock(s), DST" on page 162.

4.2 System Time

The time that VersaPNT maintains is referred to as the System Time. The System Time is used to supply time to all of the available time-of-day outputs (such as NTP time stamps, time stamps in the log entries, ASCII data outputs, etc.).

By default, the System Time is synchronized to VersaPNT's input references (such as GNSS, IRIG, ASCII data, NTP, PTP, etc.).

If a UTC-based time is not required, however, it is also possible to manually set the System Time to a desired time/date, or to use the unit's battery backed time (Real Time Clock) as System Time (with an external 1PPS reference).

The flow chart below illustrates how VersaPNT obtains the highest available and valid reference, depending on whether an external source is chosen as reference, or an internal (**User [x]**, or **Local System**).

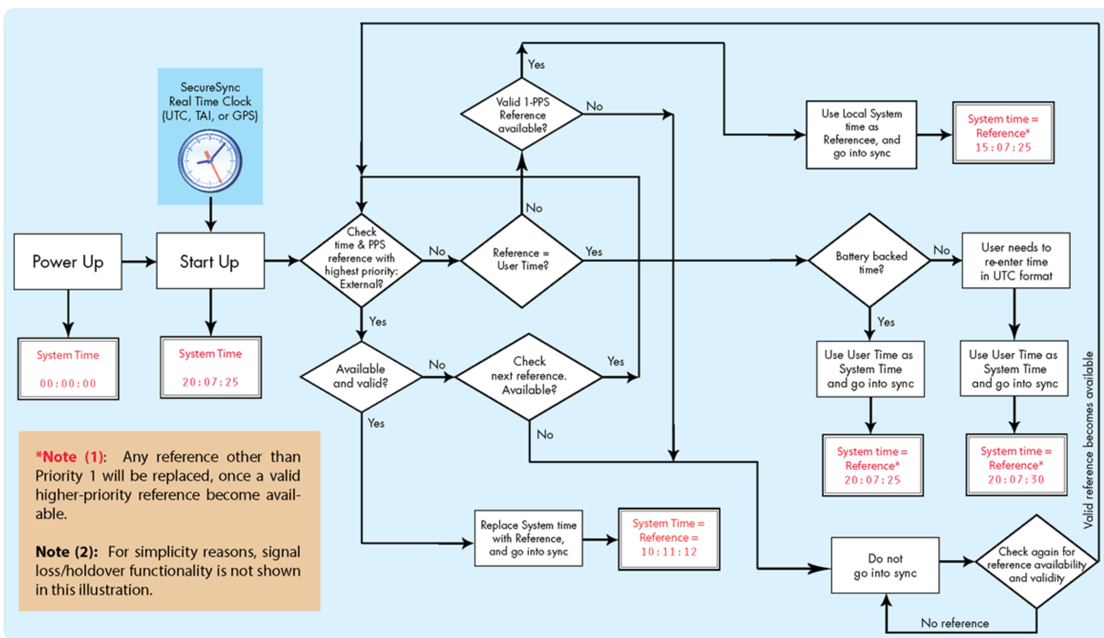


Figure 4-1: How the System Time is derived

Note: User hand-set times can only be set in UTC (not Local time).

4.2.1 System Time

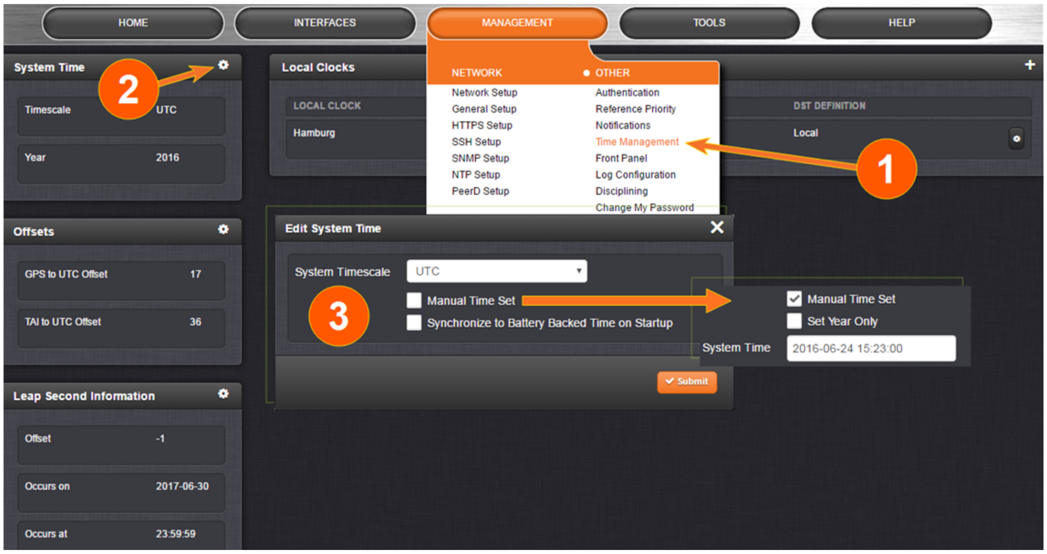
Several System Time parameters can be customized:

- The **System Timescale** can be changed.
- A **user-defined time** can be setup for e.g., for simulation purposes, or if no external reference is available.
- The **battery-backed** RTC time can be used as System Time, until an external reference become available.

4.2.1.1 Configuring the System Time

To configure the System Time:

1. Navigate to **MANAGEMENT > OTHER: Time Management**.



2. In the **System Time** panel located in the top-left corner of the **Time Management** screen, click the GEAR icon.
3. The **Edit System Time** pop-up window will display.
   - In the **System Timescale** field select a timescale from the drop-down list. The options are:
     - **UTC**: Coordinated Universal Time (Temps Universel Coordonné); your local time zone determines the difference between UTC and local time.

       Note that UTC is not a time zone, but a time standard, i.e. it is not used anywhere in the world as the official local time, whereas GMT (Greenwich Mean Time) is a time zone that is used in several European and African countries as the official local time.

- **TAI**: International Atomic Time (Temps Atomique International).

  The TAI time scale is based on the SI second and is not adjusted for leap seconds. As of August 2018, TAI is ahead of UTC by 37 seconds. TAI is always ahead of GPS by 19 seconds.

- **GPS**: The Global Positioning System time is the timescale maintained by the GPS satellites.

  Global Positioning System time is the time scale maintained by the GPS satellites. The time signal is provided by atomic clocks in the GPS ground control stations. The UTC–GPS offset as of August 2018 is 18 seconds.

For more information on Timescales, see "Timescales" below.

4. If you want to override the system time with a **manually set User Time**, check the **Manual Time Set** checkbox. For information, see "Manually Setting the Time" on the next page.
5. Click **Submit** to update the System Time and close the window.

4.2.1.2 Timescales

The System Time can be configured to operate in one of several **timescales**, such as UTC, GPS and TAI *(Temps Atomique International)*. These timescales are based on international time standards, and are offset from each other by varying numbers of seconds.

When configuring VersaPNT, in most cases, **UTC** will be the desired timescale to select.

> Note: UTC timescale is also referred to as "ZULU" time. GPS timescale is the raw GPS time as transmitted by the GNSS satellites (in 2018 the GPS time is currently 18 seconds ahead of UTC time. UTC timescale observes leap seconds while GPS timescale does not).

> Note: The TAI timescale also does not observe leap seconds. The TAI timescale is fixed to always be 19 seconds ahead of GPS time. As of August, 2018 TAI time is 37 seconds ahead of UTC.

VersaPNT's System timescale is configured via the **MANAGEMENT > OTHER: Time Management** screen, see "System Time" on the previous page.

Input timescales

Some of the inputs may not necessarily provide time to VersaPNT in the same timescale selected in the System Time's timescale field. These inputs have internal conversions that allow the timescale for the inputs to also be independently defined, so that they don't have to be provided in the same timescale. For example, the System timescale can be configured as "UTC", but the IRIG input data stream can provide VersaPNT with "local" time, with no time jumps occurring when the reference is selected.

If an output reference is using the GPS or TAI timescale, and the System Time is set to "UTC", then the GPS Offset box in the Edit GPS Offset window must be populated with the proper timescale offset value in order for the time on the output reference to be correct. Some references (like GNSS) provide the timescale offset to the system. In the event that the input reference being used does not provide this information, it must be set in through the **Offsets** panel of the **Time Management** page.

Since the GPS and TAI offsets have a fixed relationship, only the GPS offset can be set. If only the TAI offset is known, subtract 19 from it to get the GPS offset.

Note: If the System Time is set to the UTC timescale, and all output references either use the UTC or "local" timescale, then it is not necessary to set the GPS and TAI timescale Offsets.

Caution: It is imperative to configure any input reference's timescales appropriately. Otherwise, a System Time error may occur!

Output timescales

Some of the available VersaPNT outputs (such as the ASCII data module's outputs, etc.) won't necessarily output in the same timescale selected in the System Time's timescale field. These outputs have internal conversions that allow the timescale for the outputs to also be independently defined, so that they don't have to be provided in the same timescale.

Other VersaPNT outputs will be provided in the same timescale that is selected in the System timescale field. The NTP output for network synchronization and the time stamps included in all log entries will be in the same timescale as the configured System timescale. For example, if "GPS" is selected as the System timescale, the log entries and the time distributed to the network will all be in GPS time (time broadcasted directly from the GNSS constellation).

4.2.1.3 Manually Setting the Time

For some applications, it may not be necessary to synchronize VersaPNT to a UTC-based reference. Or, a GPS reference is not available yet (e.g., because the antenna is not yet installed), but the system has to be setup and tested.

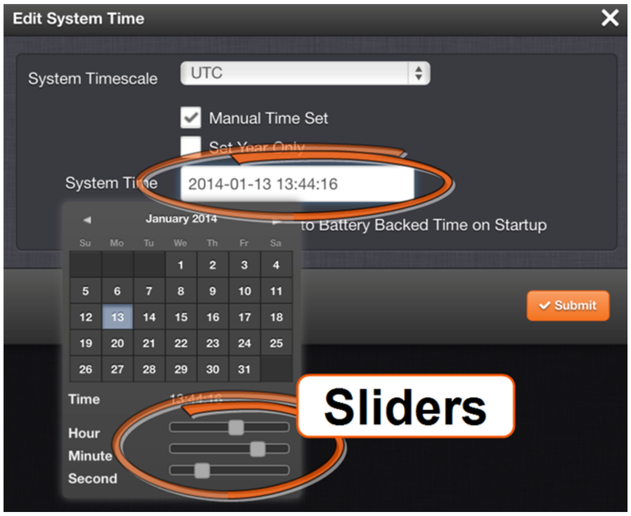
In such cases, the System Time can be hand-set, and then used as a **User [x]**-set System Time. For more information on when to use this functionality, see "The "User/User" Reference" on page 170.

> **Note:** If synchronization to UTC is NOT required, it is advisable to set a time in the past or future, so as to avoid users inadvertently considering the distributed time to be genuine.

> **Caution:** Note that this mode of operation is intended for special use cases e.g., autonomous systems, where legally traceable time is not required: This time will be inaccurate/not traceable, since it is not tied to any reference.

To hand-set the System Time, and configure this time to be a valid reference:

1. Navigate to **MANAGEMENT > OTHER: Time Management**.
2. In the **System Time** panel on the left, click the GEAR icon.
3. Select **Manual Time Set**. Set your time & date, as needed:
   - **System Time** [DATE; TIME]: If you do not select **Set Year Only**, this box will show the current time in the format: `Year-Month-Day Hour:Minute:Second`. To set the time manually, click anywhere in the **System Time** field. A drop-down calendar with time-setting sliders will appear:

     The time in the **System Time** field will default to the current date and time. To set the time, use the sliders. The time will display between the calendar and the sliders, and also next to the chosen date in the field directly above the calendar. To close the calendar, click anywhere in the **Edit System Time** window.

     NOTE: Except for testing purposes, you should not choose a date other than the current day.
   - **Set Year Only**: Some legacy time formats (e.g., IRIG) do not support years. Checking this box will open a data entry field to manually set the year. Spectracom

recommends not to utilize this feature, unless the IRIG format you are using does not provide a YEAR field.

- **Synchronize to Battery Backed Time on Startup**: See "Using Battery Backed Time on Startup" below.

4. Click Submit at the precise moment desired.
5. Navigate to **MANAGEMENT > OTHER: Reference Priority**.
6. In order for the **User** time to be a considered a valid reference, verify that the Reference Priority table includes an "Enabled" **User [x]** Time, and 1PPS reference ("**User/User**"). For more information, see "Input Reference Priorities" on page 165 and "The "User-/User" Reference" on page 170.
7. Move (drag & drop) the **User** time to the top of table, and disable all other references.
8. Let Holdover expire. (Set it to a very short duration, if desired:
   i. Navigate to **MANGAGEMENT > OTHER: Disciplining**.
   ii. In the **Status** panel, click the GEAR icon.
   iii. In the **Oscillator Settings** window, set the **Holdover Timeout**.)
9. Check on the **HOME** screen that **User 0** is displayed, with a green STATUS. Note that the **Disciplining State** will remain yellow, once **Holdover** has expired, since the system time is not synchronized to a reference.

> Note: Contrary to the User reference discussed above, the Local System reference can be used for Time, or 1PPS (but not both). For more information, see "The "Local System" Reference" on page 169.

4.2.1.4 Using Battery Backed Time on Startup

Upon system startup, by default VersaPNT will not declare synchronization until one of the external references becomes available and valid.

This functionality can be overridden by enabling the **Synchronize to Battery Backed Time on Startup**, thus allowing the battery backed time to be used as System Time upon system startup. The Battery Backed Time is also referred to as the time maintained by the integrated **Real Time Clock (RTC)**

This will result in VersaPNT providing a System Time before one of the external references becomes available and valid. This will happen automatically, i.e. without user intervention. As soon an external reference will become available, its time will take precedence over the battery backed time: The System Clock will adjust the System Time for any time difference.

> **Note:** The Battery Backed Time is also referred to as the time maintained by the integrated Real-Time Clock (RTC).

Use Cases

Using the Battery Backed Time on Startup is typically used in these cases:

a. If the synchronization state is to be reached as quickly as possible, even if this means the time distributed initially will most likely be less accurate than an external time reference.

b. A system is intended to operate autonomously (i.e. without any external references) and

   » the hand-set time entered manually during commissioning of the system is sufficiently accurate

   » the system needs to be able to completely recover from a temporary power loss, or similar, without human intervention.

c. A system is used for simulation or testing purposes, and UTC traceability is not required.

The Accuracy of the Battery Backed Time …

… depends on the accuracy of the hand-set time if the time is set manually in an autonomous system. In a non-autonomous system (i.e, when using external reference(s)) VersaPNT's System Clock will regularly update the battery-backed time.

Another factor impacting the accuracy of the battery-backed time is how long a VersaPNT unit is powered off: Any significant amount of time will cause the battery-backed RTC to drift, i.e. the battery-backed time will become increasingly inaccurate.

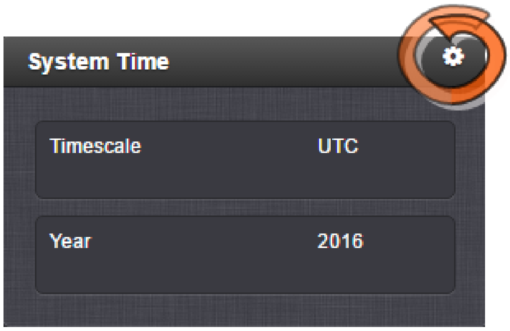
The battery used for the RTC is designed to last for the lifetime of the product.

Distributing battery-backed time over NTP

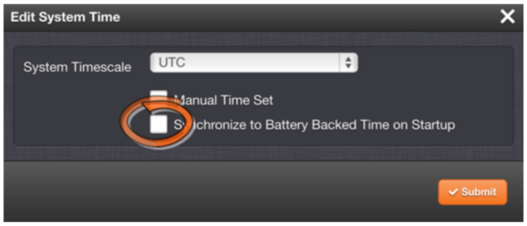
When distributing a hand-set, battery backed time via NTP, please set the time relatively close to UTC, so as to prevent NTP synchronization problems when transitioning from the hand-set time to a UTC-based external input reference. See also "Input Reference Priorities" on page 165.

To use the battery-backed time as the synchronized time at start-up:

1. Navigate to **MANAGEMENT > OTHER: Time Management**.
2. In the **System Time** panel click the GEAR icon.



3. The **Edit System Time** window will display. Select the checkbox **Synchronize to Battery Backed Time on Startup**:



4. Click the **Submit** button.

4.2.2 Timescale Offset(s)

Timescale offsets account for fixed differences between timescales, in seconds. Timescale offsets may change because of leap seconds, see "Leap Seconds" on the facing page.

4.2.2.1 Configuring a Timescale Offset

To configure a timescale offset to the System Time:

1. Navigate to **MANAGEMENT > OTHER: Time Management**.
2. In the **Offsets** panel on the left, click the GEAR icon in the top-right corner.
3. The **Edit GPS Offset** window will display. Enter the desired **GPS Offset** in seconds, and click Submit.

> **Note:** Since the GPS Offset and the TAI Offset have a fixed relationship, only the GPS Offset can be set. If only the TAI offset is known, subtract 19 from it, in order to obtain the GPS offset.

Note that the data stream of GPS and several other external references includes information about a pending Leap Second, and as such automatically corrects for a Leap Second. Nevertheless, it is advisable to perform some testing in advance to ensure all system components will adjust flawlessly. For more information, see "Leap Seconds" below.

4.2.3 Leap Seconds

4.2.3.1 Reasons for a Leap Second Correction

A Leap Second is an intercalary[1] one-second adjustment that keeps broadcast standards for time of day close to mean solar time. Leap Seconds are required to synchronize time standards with civil calendars, thus keeping UTC time in sync with the earth’s rotation.

Leap seconds can be introduced in UTC at the end of the months of December or June. The INTERNATIONAL EARTH ROTATION AND REFERENCE SYSTEMS SERVICE (IERS) publishes a bulletin every six months, either to announce a time step in UTC, or to confirm that there will be no time step at the next possible date. A Leap Second may be either added or removed, but in the past, the Leap Seconds have always been added because the earth’s rotation is slowing down.

Historically, Leap Seconds have been inserted about every 18 months. However, the Earth's rotation rate is unpredictable in the long term, so it is not possible to predict the need for them more than six months in advance.

> **Note:** Leap Seconds only apply to the UTC and Local timescales. Leap Seconds do NOT affect the GPS and TAI timescales. However, a Leap Second event will change the GPS to UTC, and TAI to UTC time offsets. When a Leap Second occurs, VersaPNT will automatically change these offsets by the proper amount, no matter which timescale is currently being used by the system.

As of 2018 the GPS to UTC Offset is 18 seconds. The last Leap Second occurred on December 31, 2016.

VersaPNT can be alerted of impending Leap Seconds by any of the following methods:

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[1] Intercalary: (of a day or a month) inserted in the calendar to harmonize it with the solar year, e.g., February 29 in leap years.

- **GNSS Receiver** (if available as an input reference): The GNSS satellite system transmits information regarding a Leap Second adjustment at a specific Time and Date an arbitrary number of months in advance.
- **Input references other than GNSS**: Some of the other available input references (e.g., IRIG, ASCII, NTP) can also contain pending Leap Second notification in their data streams (see chapter below).
- **Manual user input**: VersaPNT can be manually configured with the date/time of the next pending Leap Second. On this date/time, the System Time will automatically correct for the Leap Second (unless the System Time's timescale is configured as either GPS or TAI).

4.2.3.2 Leap Second Alert Notification

VersaPNT will announce a pending Leap Second adjustment by the following methods:

- ASCII Data Formats 2 and 7 (among other formats) from the **ASCII Data** option modules contain a Leap Second indicator. During the entire calendar month preceding a Leap Second adjustment, these Formats indicate that at the end of the current month a Leap Second Adjustment will be made by using the character 'L' rather than a '_ ' [space] in the data stream. Note that this does not indicate the direction of the adjustment as adding or removing seconds. These formats always assume that the Leap Second will be added, not removed.
- **NTP Packets** contain two Leap Indicator Bits. In the 24 hours preceding a Leap Second Adjustment, the Leap Indicator Bits (2 bits) which normally are 00b for sync are 01b (1) for Add a Leap Second and 10b (2) for Remove a Leap Second. The bit pattern 11b (3) indicates out of sync and in this condition NTP does NOT indicate Leap Seconds. The Sync state indicates Leap Seconds by indicating sync can be 00b, 01b, or 10b.
- **PTP Packets** provide leap indication with a 12-hour notification window.
- Some **IRIG formats** provide leap second notification indicators.

> **Note:** It is the responsibility of the client software utilizing either the Data Formats or NTP time stamps to correct for a Leap Second occurrence. VersaPNT will make the correction at the right time. However, because computers and other systems may not utilize the time every second, the Leap Second correction may be delayed until the next scheduled interval, unless the software properly handles the advance notice of a pending Leap Second and applies the correction at the right time.

4.2.3.3 Leap Second Correction Sequence

The following is the time sequence pattern in seconds that VersaPNT will output at UTC midnight on the scheduled day (Note: This is NOT local time midnight; the local time at which the adjustment is made will depend on which Time Zone you are located in).

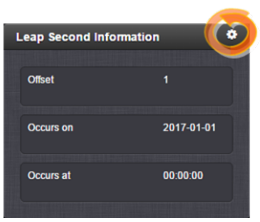
A. Sequence of seconds output when **adding a second** ("positive Leap Second"):
   - » 56, 57, 58, 59, **60**, 0, 1, 2, 3 ...

B. Sequence of seconds output when **subtracting a second** ("negative Leap Second"):
   - » 56, 57, **58, 0**, 1, 2, 3, 4 ...

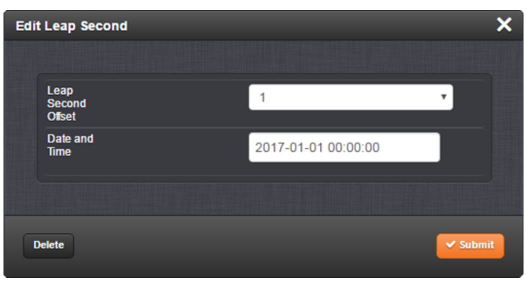
4.2.3.4 Configuring a Leap Second

To manually correct the System Time for a leap second:

1. Navigate to **MANAGEMENT> OTHER: Time Management**. The Time Management screen will be displayed. In the lower left-hand corner, the **Leap Second Information** panel will show if a leap second if pending. This panel will be empty, unless:
   a. A leap second is pending, and VersaPNT has obtained this information automatically from the GPS data stream.
   b. A leap second had been configured previously by a user via the **Edit Leap Second** window.
2. To access the **Edit Leap Second** information window, click the GEAR icon in the **Leap Second Information** panel.



3. The **Edit Leap Second** window will display:



4. In the **Leap Second Offset** field enter the desired GPS Offset.
5. In the **Date and Time** field, enter the date that the desired leap second should occur.
6. Click **Submit**.

To delete a leap second correction, click the Delete button.

> **Note:** The Delete button in the Edit Leap Second window will only be visible if a leap second has been set beforehand.

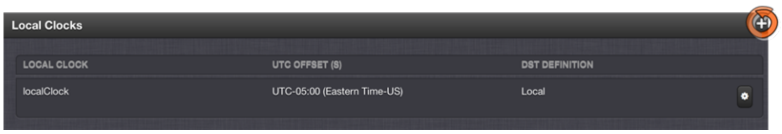
4.2.4 Local Clock(s), DST

The **Local Clock** feature allows for maintaining one or several local times. These times will reflect a time offset, thereby accounting for Time Zone, and DST (Daylight Savings Time) correction.

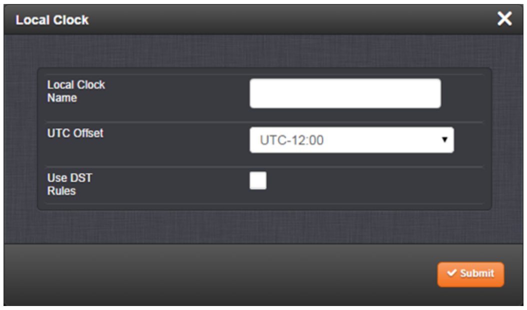
4.2.4.1 Adding a Local Clock

To add a Local Clock:

1. Navigate to **MANAGEMENT > OTHER: Time Management**.
2. Click the PLUS icon in the **Local Clocks** panel in the **Time Management** screen.



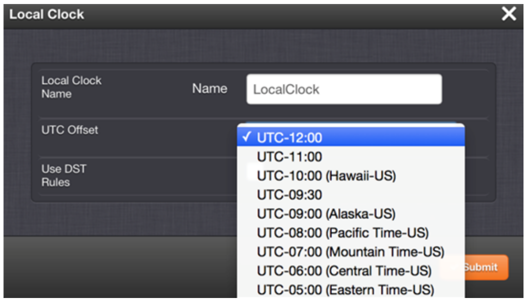
3. The **Local Clock** pop-up window will display.



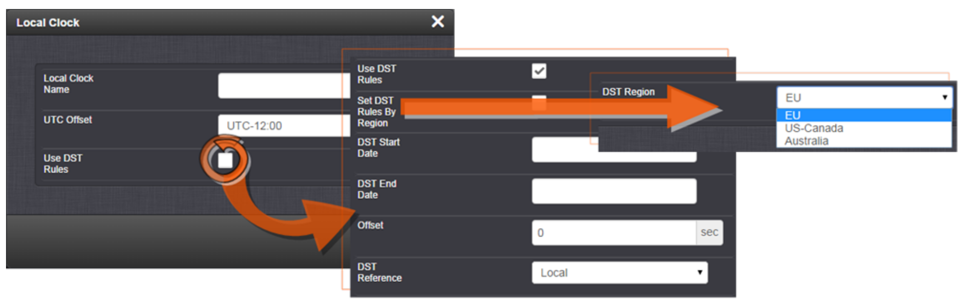
4. Enter a **Name** for your local clock.
   - The name must be between 1 and 64 characters long; spaces are allowed.
   - The name can be any meaningful name that helps you know your point of reference (for example: “NewYork”, “Paris” or “EasternHQ”, etc.).
   - This name will be used as cross-reference drop-down in the applicable Input or Output port configuration. Please note the following limitations apply to this option:

   > **Note:** Acceptable characters for the name include: A-Z, a-z, 0-9, (-+_) and space.

5. In the **UTC Offset** field, choose a **UTC Offset** from the drop-down list.



- » All of the **UTC Offset** drop-down selections are configured as UTC plus or minus a set number of hours.
- » Examples for the US: For **Eastern**, choose UTC–05:00; for **Central**, choose UTC-06:00; for **Mountain**, choose UTC-07:00; and for **Pacific**, choose UTC-08:00.
- » If you wish to use DST (Daylight Savings Time ["Summer Time"]) rules, click the **Use DST Rules** box. Otherwise the time for the local clock will always be standard time.
  DST options will appear in the **Local Clock** window:



6. **Set DST Rules by Region**: Check this box to apply regional DST rules. A regions drop-down menu with the following options will display:
   - » **EU** (Europe): For locations complying with the European DST Rule. This rule differs from all other rules because the DST changes occur based on UTC time, not local time (all time zones in Europe change for DST at precisely the same time relative to UTC, rather than offset by local time zone).
   - » **US-Canada**: For locations complying with the USA's DST Rule (as it was changed to back in 2006, where the "DST into" date is the Second Sunday of March and the "DST out" date is the first Sunday of November).
   - » **Australia**.

> **Note:** If a pre-configured rule DST rule happens to be changed in the future (like the change to the US DST rule in 2006), this option allows the DST rules to be edited without the need to perform a software upgrade for a new DST rule to be defined. Select this drop-down and enter the DST parameters for the new rule.

7. **DST Start Date** and **DST End Date**: This option is provided for locations that do not follow any of the pre-configured DST rules. Click anywhere in either field to open a calendar, allowing you to enter any custom day & time rule.
8. **Offset**: In seconds. Use this field to manually define your local clock's DST offset e.g., 3600 seconds for a one hour offset.
9. **DST Reference**: When configuring a Local Clock that is synchronized to an input reference (e.g., IRIG input), VersaPNT needs to know the timescale of the input time (Local Timescale, or UTC Timescale), in order to provide proper internal conversion from one Timescale to another.
   Select **Local** or **UTC**, depending on the Timescale of the Input reference this Local Clock is being used with.
   Additional Local Clocks may need to be created if multiple input Timescales are being submitted.
10. Click **Submit**. Your local clock will appear in the **Local Clocks** panel.

4.2.4.2 DST Examples

The following two examples illustrate the configuration of Daylight Savings Time (DST) for a Local Clock:

Example 1:

To create a Local Clock to UTC+1 with no DST rule:

1. Navigate to **MANAGEMENT > Time Management: Local Clocks > (+): Local Clock**.
2. In the **Local Clock Name** field, assign a meaningful name to the new Local Clock.
3. From the **UTC Offset** pull down menu, select "UTC +01:00".
4. Confirm that the **Use DST Rules** checkbox is not selected.
5. Review the changes made and click the **Submit** button.

The unit will display the status of the change.

Example 2:

To create a Local Clock for a VersaPNT installed in the Eastern Time Zone of the US, and desiring the Local Clock to automatically adjust for DST (using the post 2006 DST rules for the US).

1. In the **MANAGEMENT > Time Management: Local Clocks > (+): Local Clock** window:
2. Navigate to **MANAGEMENT > Time Management: Local Clocks > (+): Local Clock**.
3. From the **UTC Offset** pull-down menu, select "UTC -05:00".
4. Select the **Use DST Rules** checkbox.
5. Select the **Set DST Rules by Region** checkbox.
6. From the **DST Region** drop-down list, select "US-Canada."
7. Review the changes made and click the **Submit** button.

The unit will display the status of the change.

4.2.4.3 DST and UTC, GMT

Neither UTC, nor GMT ever change to Daylight Savings Time (DST). However, some of the countries that use GMT switch to a different time zone offset during their DST period. The United Kingdom is not on GMT all year, but uses British Summer Time (BST), which is one hour ahead of GMT, during the summer months.

Additional information about regional time zones and DST can be found on the following web sites: http://www.worldtimeserver.com/,
http://webexhibits.org/daylightsaving/b.html.

4.3 Managing References

4.3.1 Input Reference Priorities

VersaPNT can be synchronized to different time and frequency sources that are referred to as Input References, or just References.

References can be a GNSS receiver, or other sources delivered into your VersaPNT unit via dedicated (mostly optional) inputs. It is also possible to enter a system time manually, which VersaPNT then can synchronize to.

In order for VersaPNT to declare synchronization, it needs both a valid **1PPS**, and **Time** reference.

The concept of **Reference Priority** allows the ranking of multiple references for redundancy. This allows VersaPNT to gracefully fall back upon a lower ranking **1PPS** or **Time** reference without transitioning into Holdover, in case a reference becomes unavailable or invalid. The priority order you assign to your available references typically is a function of their accuracy and reliability.

Note: The References shown on your screen may look different from the ones in the illustration below, depending on your VersaPNT Position Time and Frequency Synchronization System model and hardware configuration.

Each available type of **Time** and **1PPS** input reference is assigned a human-readable name or "title" that is used in the **Reference Priority** table, indicating the type of reference. The reference titles are listed in the following table:

Table 4-1: Reference priority titles

Title	Reference
ASCII Timecode	ASCII serial timecode input
External 1PPS input	External 1PPS input
Frequency	External Frequency input
GNSS	GNSS input
PTP	PTP input
IRIG	IRIG timecode input
Local System	Built-in clock OR internal 1PPS generation
NTP	NTP input
User	Host (time is manually set by the user)
HAVEQUICK	HAVEQUICK input

The number displayed indicates the number of feature inputs of that type presently installed in the VersaPNT– starting with "0" representing the first feature input. For example:

- IRIG 0 = 1st IRIG input instance
- Frequency 1 = 2nd frequency input instance
- NTP 2 = 3rd NTP input instance

The columns of the **Reference Priority** table are defined as follows:

- **Priority**—Defines the order or priority for each index (row). The range is 1 to 16, with 1 being the highest priority and 16 being the lowest priority. The highest priority reference that is available and valid is the reference that is selected.
- **Time**—The reference selected to provide the necessary "Time" reference.
- **1PPS**—The reference selected to provide the necessary "1PPS" reference.

» **Enabled**—The reference is enabled.

» **Delete**—Removes the Index (row) from the Reference Priority table.

4.3.1.1 Configuring Input Reference Priorities

VersaPNT can use numerous external time sources, referred to as "references". As external time sources may be subject to different degrees of accuracy and reliability, you can determine in which order (= priority) VersaPNT calls upon its external time and 1PPS references.

For additional information, see also "Input Reference Priorities" on page 165.

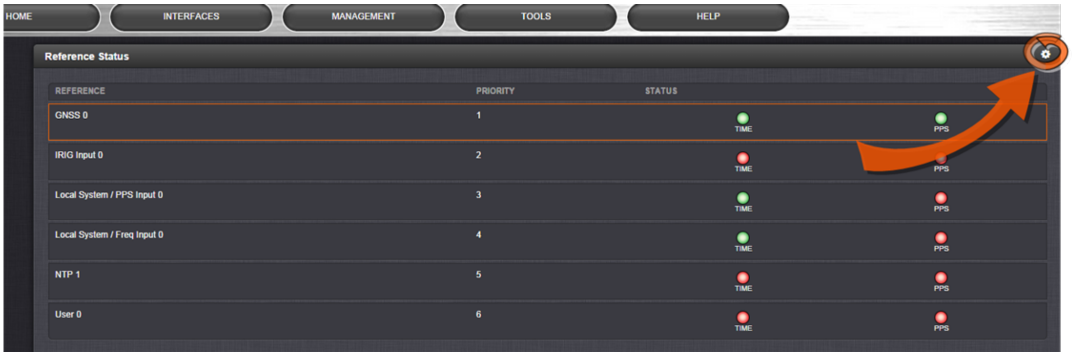
Accessing the Reference Priority Screen

To access the **Reference Priority Setup** screen:

1. Navigate to **MANAGEMENT > OTHER: Reference Priority**.

OR:

1. On the **HOME** screen, click the GEAR icon in the **Reference Status** panel:



2. The **Configure Reference Priorities** screen will display.

   The **Reference Priority** screen is divided into 3 areas:

   a. The **Actions** panel, which provides a single action:

      » Restore Factory Defaults

   b. The **Configure Reference Priorities** panel, which displays the priority of VersaPNT's references in a table form.
      In this panel you can:

      » Add and configure new references

      » Delete references

      » Enable/disable references

      » Reorder the priority of VersaPNT's references

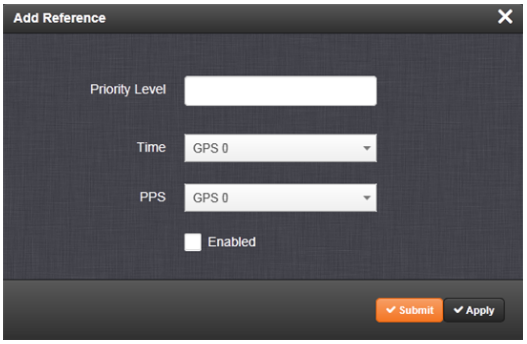
c. The **Reference Status** panel

» The **Reference Status** panel provides a real time indicator of the status of the VersaPNT's references. It is the same as the **Reference Status** panel on the **HOME** screen of the Web UI.

Adding an Entry to the Reference Status Table

To add a new entry to the **Reference Status** table:

1. Navigate to the **Configure Reference Priorities** screen via **MANAGEMENT > OTHER: Reference Priority**.
2. Click the PLUS icon in the top right-hand corner of the **Configure Reference Priorities** table.
3. The **Add Reference** window will display:



4. In the **Add Reference** window, enter:
   - » **Priority Level**: Assign a priority to the new reference.
   - » **Time**: Select the time reference.
   - » **PPS**: Select the PPS reference.
   - » **Enabled**: Check this box to enable the new reference.
5. Click **Apply** or **Submit**. (**Submit** will close the window.)

Deleting a Reference Entry

To delete an entry from the **Reference Status** table:

1. Navigate to the **Configure Reference Priorities** screen via **MANAGEMENT > OTHER: Reference Priority**.
2. In the **Configure Reference Priorities** table click the **Delete** button on the right-hand side of the entry you wish to delete.
3. In the pop-up window that opens click **OK** to confirm.

Reordering Reference Entries

To reorder the priority of a reference entry:

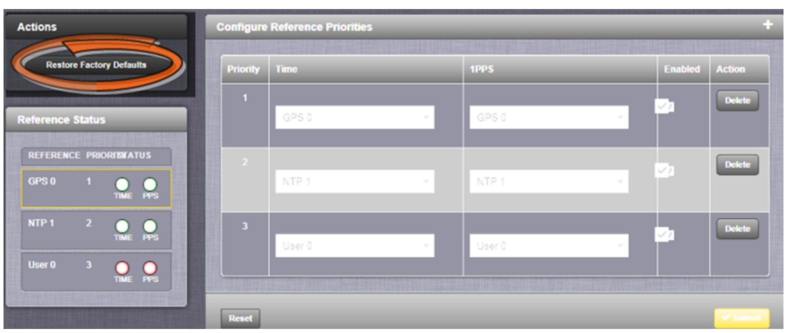
1. Navigate to the **Configure Reference Priorities** screen via **MANAGEMENT > OTHER: Reference Priority**.
2. Click and hold on the item whose priority you wish to reorder.
3. Drag the item up or down to the desired place.

4. Click **Submit.**

Resetting Reference Priorities to Factory Defaults

To reset all references in the **Reference Priority** table to their factory default priorities:

1. Navigate to the **Configure Reference Priorities** screen via **MANAGEMENT > OTHER: Reference Priority** menu.
2. In the **Actions** panel, click the **Restore Factory Defaults** button.



4.3.1.2 The "Local System" Reference

The **Local System** reference is a "Self" reference, i.e. VersaPNT uses itself as an input reference for Time, or as a 1PPS reference. The **Local System** is a unique input reference in that it can be used as either the Time reference, or the 1PPS reference, but never both.

Note: For VersaPNT to operate as a Local System reference, you must have either a valid external Time reference, or a valid external 1PPS reference.

- When the Time reference is configured as **Local System**, VersaPNT's System Time is considered a valid reference, as long as the external 1PPS input reference is valid.
- Vice versa, when the 1PPS reference is configured as **Local System**, VersaPNT's built-in oscillator is considered a valid reference, as long as the external Time reference is valid.

Use case "Local System Time"

The **Local System** reference when used for Time allows VersaPNT to operate using its current Time-of-Day (ToD) for Time, while synchronized to an external 1PPS reference.

While you may intentionally offset the time in this scenario, the second will be precisely aligned to the external 1PPS reference. Therefore, this use case qualifies as a legitimate, traceable time source.

Instead of an offset time, **Local System** can also be used as a backup Time reference (e.g., Priority "2"): Should the external Time reference become invalid, the **Local System** Time will become the valid backup reference, disciplined by the external 1PPS reference: VersaPNT will transition to the **Local System** Time, without going into Holdover.

Use case "Local System 1PPS"

The **Local System** reference can also be used for 1PPS: This allows VersaPNT to operate using an external ToD for time, while generating 1PPS from its own internal oscillator.

In this rare use case the 1PPS is NOT aligned to any standard, therefore the time may drift, and must be considered untraceable.

4.3.1.3 The "User/User" Reference

While it is normally not required, it is possible for you as the "User" to override the **System Time** (even if it is synchronized to a valid reference) with a manually set time, steered by an undisciplined oscillator, and use this manually set Time as an output reference. This concept is referred to as the **User/User** reference, because both the Time, and the 1PPS reference are not linked to any UTC-based external reference, but hand-set by you.

Caution: Since the User/User reference is not traceable to a valid reference, it does not qualify as a legitimate time source. Operating VersaPNT with a manually set User time bears the risk of inadvertently outputting an illegitimate System Time thought to be a valid reference time.

Use cases for the "User/User" reference

The **User/User** reference is provided for the following use cases:

a. No external references are available (yet), but you need a reference for testing or setup purposes. This may be the case e.g., while waiting for a GNSS antenna to be installed.

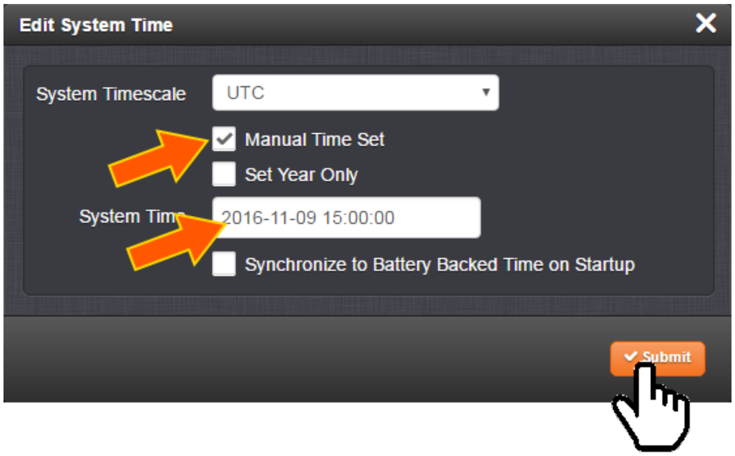
b. No external references are required e.g., if VersaPNT is used solely to synchronize computers on a network, with no need for traceable UTC-based timing.

c. To utilize a backup reference as soon as possible after a power cycle or reboot of VersaPNT, while waiting for the primary reference (e.g., GNSS) to become valid. To this end, in the **Edit System Time** window, the checkbox **Synchronize to Battery Backed Time on Startup** must be checked, AND the **User/User** reference is assigned a reference priority number other than "1". Note that a Time jump and/or 1PPS jump are likely to happen once the primary reference becomes valid.

Combining a **User** Time reference with a **non-User** 1PPS reference or vice versa is not a typical use case. Use the **Local System** reference instead, see "The "Local System" Reference" on page 169.

Built-in safety barrier

In order to "validate" (= **green** status lights) the **User/User** reference, the hand-set time must be manually submitted every time after VersaPNT reboots or resets, or after the Holdover period has expired: In the **Edit System Time** window, the checkbox **Manual Time Set** must be checked. The System Time displayed in the field below will become valid the moment the Submit button is clicked.



See also below, "How long will the User/User reference be valid?": The notion of limiting the validity of the User/User reference also serves as a safety feature.

How long will the User/User reference be valid?

Since the User/User reference does not qualify as a legitimate, traceable time, it becomes invalid once VersaPNT is reset, or power-cycles, or after the Holdover Time expires (whichever occurs first). It then needs to be set manually and submitted again (**Edit System Time** > **Manual Time Set**).

The only workaround for this is "Using Battery Backed Time on Startup" on page 156. This will allow VersaPNT to apply the **User/User** reference after a power-cycle without manual intervention.

How to setup the User/User Reference

See "Manually Setting the Time" on page 154.

Using the "User" Reference with Other References

If the **User/User** reference is used in conjunction with other, external references (such as GNSS or IRIG), the **System Time** should be set as accurately as possible:

Otherwise, the large time correction that needs to be bridged when switching from a lost reference to a valid reference, or from a valid reference to a higher-priority reference that has become available again, will cause NTP to exit synchronization. If the difference is under 1 second, NTP will remain in sync and will "slew" (over a period of time) to the new reference time.

4.3.1.4 Reference Priorities: EXAMPLES

Example 1 – GNSS as primary reference, IRIG as backup:

In this use case, the objective is to use:

- GNSS as the primary Time, and 1PPS reference
- IRIG as the backup Time, and 1PPS reference.

Step-by-step procedure:

1. Move the reference which has “GPS 0” in the **Time** column and “GPS 0” in the **1PPS** column to the top of the table, with a **Priority** value of 1. Click the **Enabled** checkbox.
2. Move the reference which has “GPS 0” in the **Time** column and “GPS 0” in the **1PPS** column to the top of the table, with a **Priority** value of 1. Click the **Enabled** checkbox.
3. Move the reference which has “GPS 0” in the **Time** column and “GPS 0” in the **1PPS** column to the top of the table, with a **Priority** value of 1. Click the **Enabled** checkbox.

Since both of these references are *default* references, no additional references need to be added to the **Reference Priority** table.

Example 2 – IRIG as primary reference, NTP input as backup

In this use case, the objective is to use:

- IRIG as the primary reference input
- Another NTP server as backup reference

Step-by-step procedure:

1. Move the reference which has “IRIG 0” in both the **Time** column and “IRIG 0” in the **1PPS** column to the top of the table, with a **Priority** value of 1. Click the **Enabled** checkbox.
2. Move the reference which has “NTP” in the **Time** column and “NTP” in the **1PPS** column to the second place in the table, with a **Priority** value of 2. Click the **Enabled** checkbox.
3. For all other references, uncheck the **Enabled** checkbox, so that they are all disabled.

Since both of these references are *default* references, no additional references need to be added to the **Reference Priority** table.

Example 3 – NTP input as the only available input (“NTP Stratum 2 operation”)

In this use case, the objective is to have NTP provided by another NTP server as the only available reference input, i.e. the unit to be configured is operated as a Stratum 2 server. For more information, see "Configuring "NTP Stratum Synchronization"" on page 89.

Step-by-step procedure:

1. Move the reference which has “NTP” in the **Time** column and “NTP” in the **1PPS** column to the top of the table, with a **Priority** value of 1. Click the **Enabled** checkbox.
2. For all other references, uncheck the **Enabled** checkbox, so that they are all disabled.
3. Configure the NTP Service as described under "Configuring "NTP Stratum Synchronization"" on page 89.

> **Note:** When selecting NTP as an input reference, do not select another reference (such as GNSS, IRIG, etc.) to work with NTP as a reference. NTP should always be selected as both the Time and 1PPS input when it is desired to use NTP as an input reference.

Example 4 – Time set manually by the User. Other references may or may not be available

> **Note:** In order for a manually set time to be considered valid and used to synchronize VersaPNT, a “User” needs to be created and enabled in the Reference Priority table. "The "User/User" Reference" on page 170.

In this use case, the objective is to use a hand-set time, in combination with VersaPNT's oscillator as a 1PPS source as valid references.

Step-by-step procedure:

1. If necessary (see NOTE above), create a “User.”
2. Move the reference which has “User 0” in the **Time** column and “User 0” in the **1PPS** column to the top of the table, with a **Priority** value of 1. Click the **Enabled** checkbox.
3. For all other references, uncheck the **Enabled** checkbox, so that they are all disabled.

If the objective is to use a manually set time as a *backup* to other references (such as GNSS or IRIG):

1. Move the "User/User" reference to a place in the table that has a priority lower than the references the "User/User" reference will be backing up. Make sure the **Enabled** checkbox is selected.
2. With “User/User” enabled, if no other higher priority references are enabled or available (or if the higher priority references have since been lost), you can now manually set the **System** time to the desired value (**MANAGEMENT > OTHER: Time Management > System Time > Manual Time Set**). See "System Time" on page 152 for more information. VersaPNT will go into synchronization using this set time once you click the Submit button.

> **Note:** You will need to repeat this procedure each time VersaPNT is power-cycled (with no other references available), unless you enabled the feature Synchronize to Battery Backed Time on Startup.

Example 5—Time at power-up ("Local System Time") to be considered "Valid". GNSS input to serve as 1PPS reference

The objective of this use case is to allow VersaPNT to use itself as a valid reference. This is referred to as “Local System” time.

In order for this to happen, VersaPNT requires an external Time, or 1PPS reference. In other words, "Local System" cannot be both Time, and 1PPS. This makes "Local System" a legitimate, traceable reference.

Therefore the "Local System" does not have to be manually set ("validated") by the User after VersaPNT was power cycled (as would be the case with a “User/User” reference).

Since “Local System” cannot be both **Time**, and **1PPS** input together, in this example the GNSS input will be set as the 1PPS reference (other use cases may require using different references, e.g. IRIG.)

As there is no default entry for “Local System” and “GPS”, a new entry needs to be added to the **Reference Priorities** table in order to use this combination of references.

Step-by-step procedure:

1. Add a reference to the Reference Priority by clicking the PLUS icon. Use the following settings, then click **Submit**:

- » In the **Priority Level** text box, enter **1**. This will give this reference the highest priority.
- » In the **Time** field, select "Local System".
- » In the **PPS** field, select "GPS".
- » Check the **Enabled** checkbox.

2. Confirm that the first reference in the **Reference Priority** table has "Local System" as the **Time** input and "GNSS" as the **1PPS** input.
3. After a power cycle or reboot, as soon as GNSS is declared valid, the System Time will automatically be used as-is, with no manual intervention required.

4.3.2 Reference Qualification and Validation

4.3.2.1 BroadShield

What is BroadShield?

BroadShield is an optional software module for VersaPNT that is capable of detecting the presence of GPS jamming or spoofing in real time.

How BroadShield Works

BroadShield monitors the GPS signal frequency band by applying proprietary error detection algorithms. If a threshold signal monitoring value level is exceeded, VersaPNT will emit a Major Alarm and – depending on your system configuration – invalidate the GPS reference causing VersaPNT to either transition into Holdover mode (see "Holdover Mode" on page 203), or go out of sync.

Even if you decide to turn off VersaPNT's **Auto Sync Control** feature, which allows BroadShield to disable the GNSS reference, BroadShield will still add value to your overall system capability by telling you (a) if your GNSS receiver is being spoofed, and (b) in the event of a signal loss due to jamming, *why* the signal is lost.

Also, if a normally strong GNSS signal becomes weakened, BroadShield's algorithms are capable of discerning a jamming event from natural events causing the signal to weaken.

> **Note:** For an effective jamming detection, and – to some extent – spoofing detection, a good antenna placement with optimal sky view resulting in a high signal-to-noise ratio is essential. A strong signal is required to discern between normal signal fluctuations and a non-natural divergence of signal strength.

BroadShield Requirements

In order for BroadShield to work on your VersaPNT system, the following requirements must be met:

1. The optional BroadShield software license needs to be enabled by applying the **OPT-BSH BroadShield** license key. For more information, contact your local Spectracom Sales Office. To determine if BroadShield has been activated on your VersaPNT unit, navigate to **TOOLS: SYSTEM > Upgrade/Backup**. The center panel **System Configuration** will list the **Options** installed in your unit.
2. BroadShield only works with a **u-blox M8T receiver**, not with Trimble receivers. To determine which receiver is installed in your unit, navigate to **TOOLS: SYSTEM > Upgrade/Backup**. The center panel **System Configuration** will list the **GNSS Receiver** installed in your unit.
3. System **Software 5.7.1** or higher must be installed in your unit. To determine which software is installed in your unit, follow the instructions above and locate the **System** line item in the **System Configuration** panel.

Activating the BroadShield License

If you have purchased the BroadShield license key and now want to activate it, please follow the instructions under "Applying a License File" on page 258.

To confirm that BroadShield has been activated on your VersaPNT unit, navigate to **TOOLS: SYSTEM > Upgrade/Backup**. The center panel **System Configuration** will list the **Options** installed in your unit.

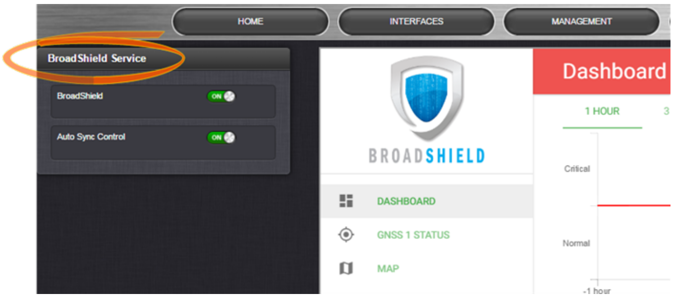
Enabling/Disabling the BroadShield Service

The Broadshield service can be run in two operating modes:

- **BroadShield only**: In the event jamming or spoofing is detected, VersaPNT will emit a Major Alarm, however it will continue to consider the GNSS reference as valid, i.e. it will NOT go out of sync.
- **Auto Sync Control**: In the event jamming or spoofing is detected, VersaPNT will emit a Major Alarm AND it will go into Holdover mode.

To configure these settings:

1. Navigate to **MONITORING > BroadShield**.
2. In the **BroadShield Service** panel on the left, configure the desired setting:



> **Note:** Turning BroadShield OFF and Auto Sync Control ON is an invalid setting and will cause a "Failed to connect to the unit..." error.

3. In the **BroadShield Web UI** on the right, navigate to **SETTINGS > ALGORITHMS**, and ensure that **Jamming** and/or **Spoofing** detection are enabled.

Configuring BroadShield

To configure BroadShield:

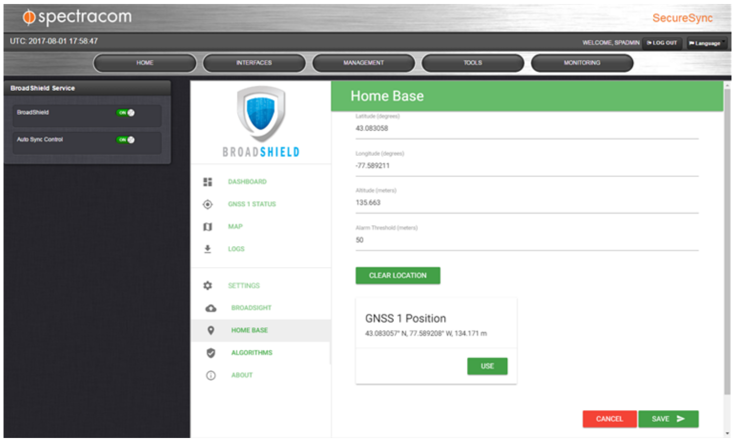
1. Navigate to **MONITORING > BroadShield**. (If you cannot see the **MONITORING** button in the Primary Navigation Bar of the **HOME** screen, this license is not present.) The embedded Broadshield Web UI will open.
2. Click **SETTINGS** to open the following sub-menus:

BROADSIGHT

BroadSight is a service that allows collection of data from multiple BroadShield units and provides a dashboard view of the data.

> **Note:** BroadSight for VersaPNT is currently not supported.

HOME BASE



By setting the HOME BASE position you allow BroadShield to use this location as a reference position for spoofing detection: Should BroadShield detect that the geographic position reported by VersaPNT's GPS receiver seems to move beyond the set **Alarm Threshold** (even though VersaPNT does not move), an alarm will be triggered.

The standard use case is to make your **GNSS 1 Position** your HOME BASE:

1. Should the position fields be populated (other than the **Alarm Threshold**), click CLEAR LOCATION (this will prevent BroadShield from issuing an alarm once you SAVEd the new position.)
2. Click USE in the **GNSS 1 Position** box to apply the settings.
3. The default **Alarm Threshold** is 50 m, i.e. any detected position shift beyond a 50-m circle around the HOME BASE position will cause an alarm. You can change this setting to adjust the sensitivity.
4. Click SAVE to accept the entered values.

A less common use case may be that you want to pre-set the unit's position for later use e.g., if the VersaPNT unit will be deployed in a different location: Set a position manually by entering **lat**/**long** (format: xx.xxxxxx degrees) and **alt**. Note, however, that this may cause a spoofing alarm, since BroadShield detects a difference between the HOME BASE position and the GNSS position.

ALGORITHMS

This menu option allows you to disaable/enable Jamming or Spoofing. **Spoofing** refers to impersonating the live-sky GNSS signal, thus "deceiving" the GNSS receiver, while **Jamming** refers to interference of the signal, i.e. making the live-sky GNSS signal unusable. Per default, both are Enabled.

ABOUT

The About menu displays Version and Build Date of the BroadShield software. Periodic updates are released with VersaPNT system software updates, as they become available.

Monitoring BroadShield

You can use the BroadShield Web UI to monitor the jamming/spoofing status, or the VersaPNT Web UI. In the latter case, you will be informed of a Major Alarm, as described below:

BroadShield Alarm

If BroadShield detects a jamming or spoofing event, VersaPNT will emit a *BroadShield Critical, Major Alarm* (see illustration below). VersaPNT will go into **Holdover** (yellow HOLD status light) and – depending on the **BroadShield Service** setting (see "Enabling/Disabling the BroadShield Service" on page 176) and your VersaPNT settings – will either remain in sync (green SYNC status light), i.e. it will continue to output time and frequency signals considered valid, or it will go out of sync (red SYNC light).

You can also configure a notification alarm, see "Enabling/Disabling the BroadShield Service" on page 176.

BroadShield Web UI Monitoring

The BroadShield Web UI will also display real time signal status information, or a map status.

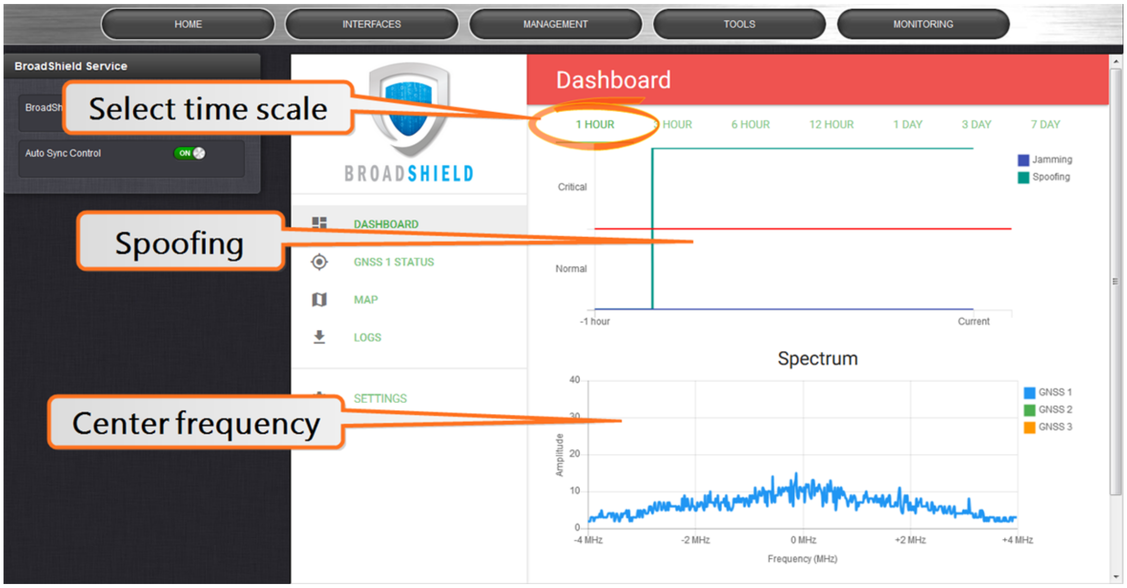
> **Note:** If at any time you receive an error message Failed to connect to the unit, the VersaPNT Web UI may have timed out (see "Web UI Timeout" on page 233). Refresh your browser page to log back in.

To open the BroadShield user interface:

1. Navigate to **MONITORING > BroadShield**. (If you cannot see the **MONITORING** button in the Primary Navigation Bar of the **HOME** screen, this license is not present.)
2. The embedded Broadshield Web UI will open, displaying the Dashboard and providing access to the following panels:

DASHBOARD

The Dashboard panel displays up to 7 days of history data, and a real-time amplitude frequency spectrum. The headline background color indicates the current jamming/spoofing status: red= jamming or spoofing detected; green = no alarms at this time



Top graph

The Dashboard top graph displays the past signal level over time, divided into a **Normal** and a **Critical** signal level (separated by a red line). A blue line in the **Critical** zone indicates a potential jamming incident, while a green line indicates that VersaPNT may be subject to a spoofing attack.

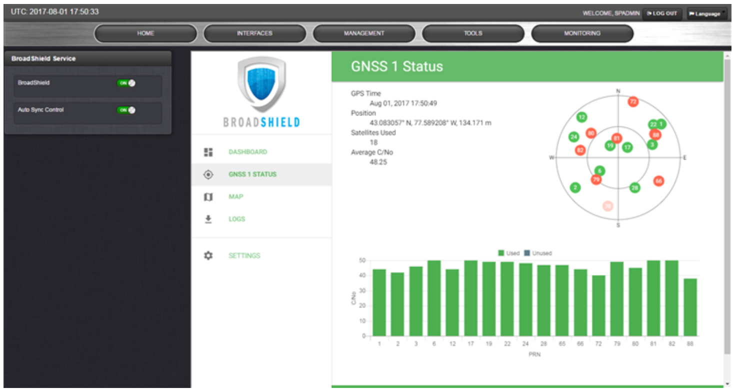
You can change the time scale by clicking on any of the labels between 1 HOUR and 7 DAY.

Note: A VersaPNT reboot will reset all history data (it can still be retrieved via LOGS.)

Bottom graph

The bottom graph labeled **Spectrum** visualizes the current signal over the GPS frequency band. Unusual amplitude spikes indicate a potential threat. If your system is equipped with more than one GNSS receivers, a green and an orange graph will indicate the signal level for additional receivers.

GNSS 1 Status



> **Note:** The BroadShield GNSS1 reference refers to the SecureSync GNSS 0 reference.

Status information

- **GPS Time**: Time and Day as provided by VersaPNT's GNSS receiver.
- **Position**: The position as determined by VersaPNT's GNSS receiver.
- **Satellites Used**: The number of satellites currently received by VersaPNT. This number includes all satellites currently received for all enabled constellations (see "Selecting GNSS Constellations" on page 200). Note that BroadShield uses only GPS signals for jamming/spoofing detection.
- **Average C/No**: Average signal to noise ratio. An average C/No value higher than 30 can be considered "good".

Skyplot graph

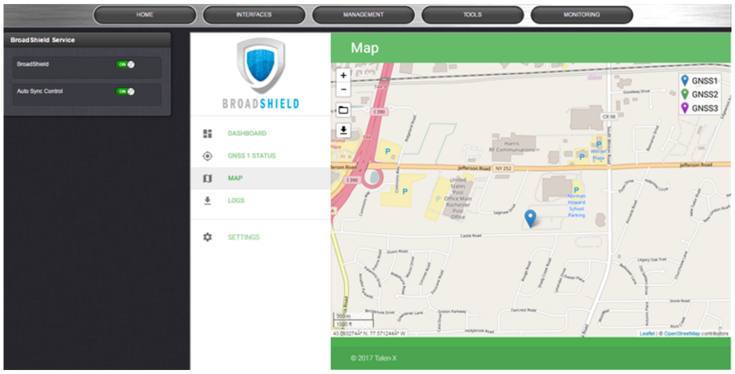
The center of the skyplot represents the antenna position. The skyplot shows all GPS satellites currently being tracked and – if enabled (under **INTERFACES: REFERENCES > GNSS Reference: GNSS 0 > Edit button > Selected Constellations**) – will also display all GLONASS satellites (numbered 65 and higher). Note, however, that GLONASS satellites will not be used by BroadShield. Galileo and Beidou satellites will not be displayed.

> **Note:** Even though VersaPNT may be configured to track multiple GNSS constellations (see "Selecting GNSS Constellations" on page 200), BroadShield only uses GPS.

Signal-to-noise bar graph

This graph visualizes the signal-to-noise ratio for up to 20 received satellites in real time. The satellites are numbered by their NMEA ID's (as in the skyplot mentioned above).

MAP



The map displays your current position, as reported by the GPS receiver. Should the displayed position differ from the actual antenna position, the GPS signal is likely spoofed.

Note that the map data is not part of the BroadShield software, but is downloaded from the Internet. Hence, this feature is only available if your VersaPNT unit is connected to the Internet.

LOGS

» To clear all current logs stored on VersaPNT, click **CLEAR LOGS**.

» To start a new log session, click **NEW LOG SESSION**.

» To download current logs, click **DOWNLOAD LOGS**.

Broadshield Notifications

You can setup Notifications to be sent if BroadShield detects or clears an alarm:

» Navigate to **MANAGEMENT: OTHER > Notifications**, and under the **GPS** tab, locate the two BroadShield line items. For further information on how to configure Notifications, see "Notifications" on page 217.

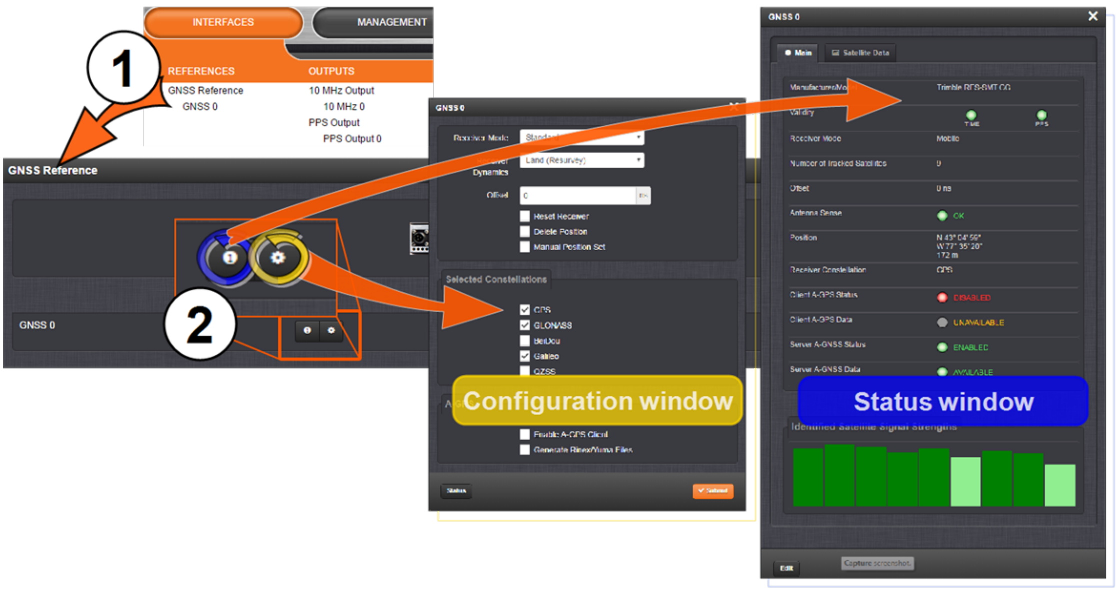
4.3.3 The GNSS Reference

With most applications, VersaPNT will be setup such that it utilizes a GNSS signal as the primary (if not the only) timing reference.

VersaPNT's GNSS receiver utilizes the signal provided by the GNSS antenna.

The GNSS receiver analyzes the incoming GNSS data stream and supplies the GNSS time and 1PPS (Pulse-Per-Second) signal to VersaPNT's timing system. The timing system uses the data to control the System Time and discipline the oscillator.

While VersaPNT's default GNSS receiver configuration will likely be adequate for most applic- ations, it is advisable that you review the options and change settings as needed, particularly if you are experiencing poor signal reception.



To access the GNSS Receiver settings:

1. Navigate to **INTERFACES > REFERENCES: GNSS 0**.

   Note: Typically, there will be only one GNSS reference, numbered "0".

2. The **GNSS 0** status window will open. To open the configuration window, click Edit in the bottom-left corner.

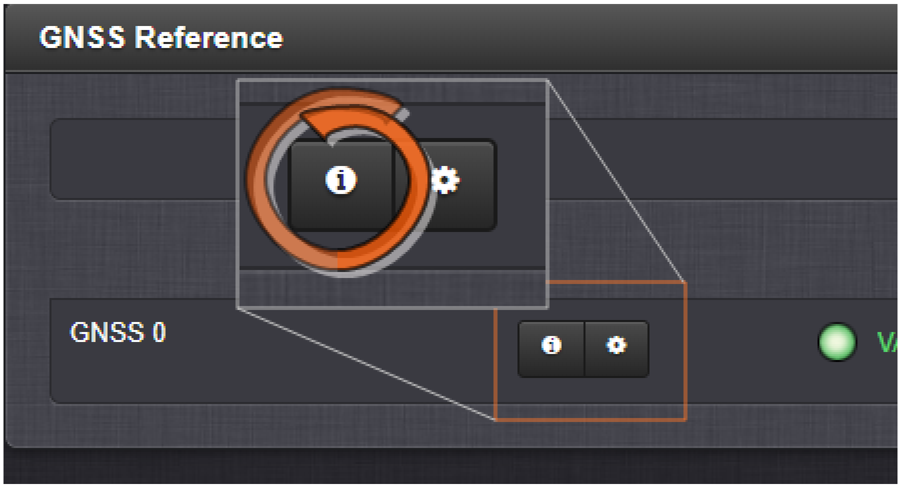
OR:

1. Navigate to **INTERFACES > REFERENCES: GNSS Reference**.
2. Click on the INFO button, or the GEAR button to configure the GNSS settings, or review GNSS reference status information.

4.3.3.1 Reviewing the GNSS Reference Status

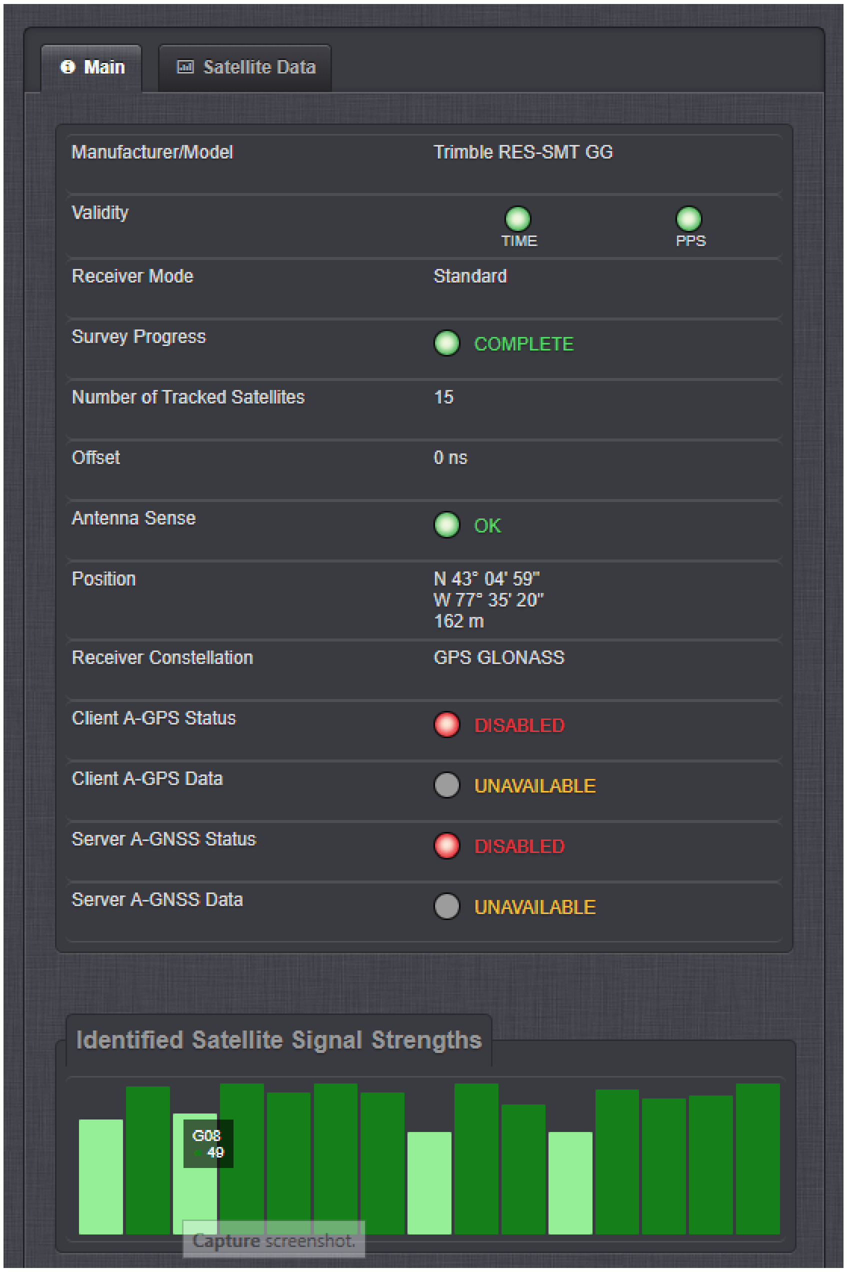
To view the current status of your GNSS reference:

1. Navigate to **INTERFACES** > **REFERENCES: GNSS Reference**.



2. Click the INFO button next to **GNSS 0**. The **GNSS 0** status window will display; it contains two tabs, explained in detail below: **Main** [= default], and **Satellite Data**.

The "Main" tab



Under the **Main** tab, the following information will display:

Note: Detailed information on the different parameters can be found in the subsequent GNSS topics.

- **Manufacturer/Model**: The manufacturer and/or model of the GNSS receiver in your VersaPNT unit.
- **Validity**: Status indicator lights for **TIME** and **1PPS** signals: “**On**” (green) indicates a valid signal, “**Off**” (red) indicates that no valid signal is available. A yellow **1PPS** light indicates that the monitored 1PPS value fell below a quality threshold and the unit is in flywheel mode.
- **Receiver Mode:**
  - **Single Satellite**: Used in areas with poor GNSS reception.
  - **Standard**: Default operating mode for the GNSS receiver.
  - **Mobile**: [default] For non-stationary applications.
- **Receiver Dynamics**: (u-blox receivers only); see "Setting GNSS Receiver Dynamics" on page 191.
- **Survey Progress**: Real-time status:
  - **ACQUIRING** (x Satellites)—red
  - **SURVEYING** (x %)—yellow; remains at 1% if no satellites are in view
  - **COMPLETE**—green
- **Number of Tracked Satellites**: The number of satellites currently being tracked.
- **Offset**: As set by the user, in nanoseconds.
- **Antenna Sense**:
  - **OK** (green)
  - **Open**: Check the antenna for the presence of an open.
  - **Short**: Check the antenna for the presence of a short circuit.
- **Position**: VersaPNT’s geographic position by:
  - **Latitude**: In degrees, minutes, seconds
  - **Longitude**: In degrees, minutes, seconds
  - **Altitude**: In meters MSL (Mean Sea Level)
- **Receiver Constellation**: GPS/GLONASS/Galileo/BeiDou/QZSS
- **Client A-GPS Status**: A-GPS is ENABLED and running, or DISABLED
- **Client A-GPS Data**: External A-GPS data is AVAILABLE, or UNAVAILABLE
- **Server A-GNSS Status**: The Rinex Server feature is ENABLED and running, or DISABLED
- **Server A-GNSS Data**: A-GPS data is AVAILABLE and can be downloaded by clients, or it is UNAVAILABLE
- **Identified Satellite Signal Strengths**: Bar graphs for all satellites detected. Color indicates signal strength.

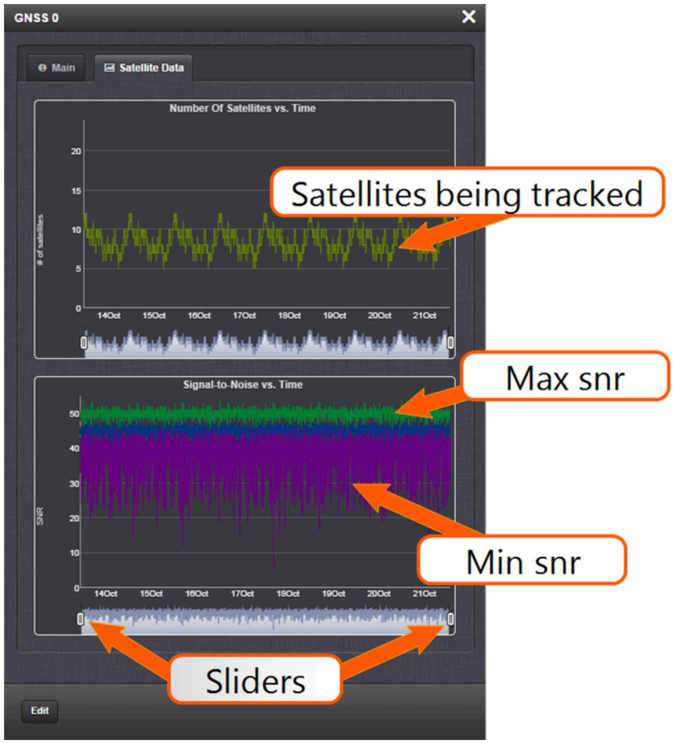
With your mouse pointer, hover over a bar graph to display tool tip information about satellite constellation, satellite number, and signal strength.

Letter Symbol	GNSS Constellation
G	GPS
R	GLONASS
E	Galileo
J	QZSS
C	BeiDou
I	IRNSS

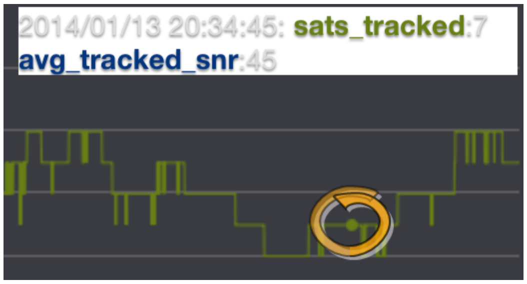
The "Satellite Data" tab

Under the **Satellite Data** tab, there are two graphs:

- **Number of Satellites over Time**: A graphical track of how many satellites were being tracked over time.
- **SNR over Time**: A graphical track of maximum SNR, and minimum SNR.



In both graphs, to see a legend of the graphical data, and time-specific status data, click inside the graph, choosing the desired point in time. If necessary, increase the time resolution by dragging the time sliders. A pop-up window will display the legend for that graph, and the status information for the selected time.

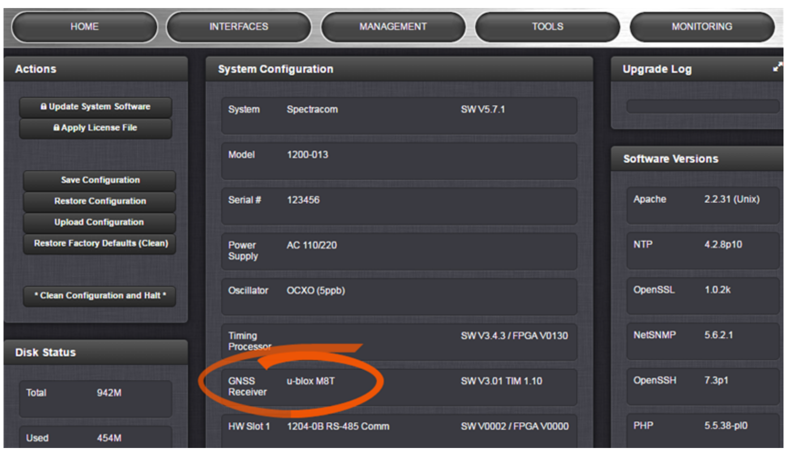


4.3.3.2 Determining Your GNSS Receiver Model

Note: All VersaPNT models are currently shipped with a u-blox M8T Receiver.

To determine which GNSS receiver model is installed in a VersaPNT unit:

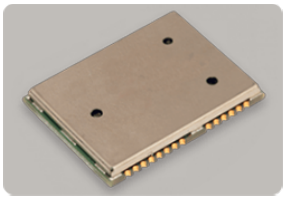
1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. In the **System Configuration** panel, locate the line item **GNSS Receiver**:



GNSS Receiver Models

Spectracom strives to equip VersaPNT with current technology. Depending on the production date of your VersaPNT unit, one of the following GNSS receiver models will be installed in your unit (if any):

u-blox® M8T



Production dates: Since 2016

Constellations: GPS, Galileo, GLONASS, BeiDou, QZSS

Other characteristics:

- **Client A-GPS** option: Yes
- **Server A-GNSS** option: Yes
- **Resurvey**: Automatic, after being moved and rebooted — can be changed, see "Setting GNSS Receiver Dynamics" on page 191.
- **Multi-GNSS** reception: Yes, within these permissible settings:

GPS	Galileo	GLONASS	Beidou
X	X	–	–
X	X	X	–
X	X	–	X
X	–	X	–
X	–	–	X
–	X	X	–
–	X	–	X
–	–	X	X

Note: The augmentation systems SBAS and QZSS can be enabled only if GPS operation is configured.

4.3.3.3 Selecting a GNSS Receiver Mode

When connected to a GNSS antenna that receives a GNSS signal, VersaPNT can use GNSS as an input reference. The factory default configuration allows GNSS satellites to be received/tracked with no additional user intervention required.

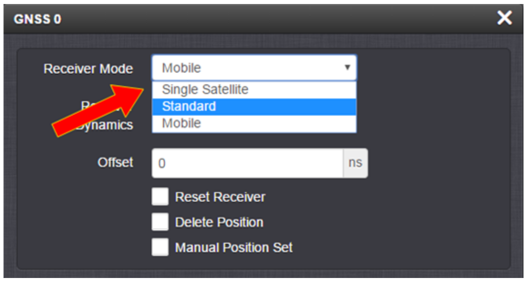
However, there are several user-configurable GNSS settings:

- The **Receiver Mode** function allows the GNSS receiver to operate in either a stationary mode ("**Standard**" or "**Single Satellite**" modes), or in a mobile mode environment e.g., in a vehicle, ship or aircraft.

- **Offset** [ns]: to account for antenna cable delays and other latencies
- **Receiver dynamics**: to optimize performance for land, sea or air operation
- The ability to **delete** the stored GNSS position information (latitude, longitude and antenna height).
- The option to determine when a **resurvey** is to be performed (supported only by newer GNSS receivers).

To configure the GNSS Receiver Mode for your VersaPNT unit:

1. Navigate to **INTERFACES > REFERENCES**: **GNSS 0**. The **GNSS 0** Status panel will open.
2. Select **Edit** in the bottom-left corner. The **GNSS 0** configuration window will open:



3. Select the desired Receiver Mode, and click **Submit**.

GNSS Receiver Modes

The receiver modes are:

- **Mobile Mode**: This is the default mode for VersaPNT. In Mobile Mode, GNSS surveys (see below) will NEVER be carried out since the position status is updated in near real-time. VersaPNT will go into synchronization shortly after beginning to track satellites.
- **Standard Mode**: While the Standard Mode tends to be the most accurate GNSS Receiver Mode, it can only be used for stationary applications, i.e. the VersaPNT unit must not be moved. In Standard Mode the so-called **GNSS survey** will be performed as soon as at least four GNSS satellites become available and no previously carried out survey was found. Upon completion of the survey the GNSS receiver will lock-in the calculated position and will enter Standard Mode. Once the survey is completed, less than four satellites will provide a valid Time and 1PPS signal.
- **Single Satellite Mode**: This mode is designed for stationary applications which cannot track at least four GNSS satellites for at least 33 minutes continuously in a 12-hour time window so as to complete the GNSS survey. This occurs frequently in areas with limited view of the sky (e.g., "urban canyons").

  In Single Satellite Mode, the GNSS receiver will be considered a valid input reference as long as:

» you have manually entered a valid position for your antenna location (instructions can be found under "Manually Setting the GNSS Position" on page 198 and "Determining Your Position" on page 199).

» the GNSS receiver continues to track at least one qualified satellite.

> **Note:** VersaPNT is designed to provide the most accurate time in Standard Mode. The Single Satellite Mode should only be used if the GNSS receiver could not complete a survey.

4.3.3.4 Setting GNSS Receiver Dynamics

Receiver Dynamics further refine the reception characteristics for the individual receiver modes and determine if the receiver will automatically resurvey after a reboot.

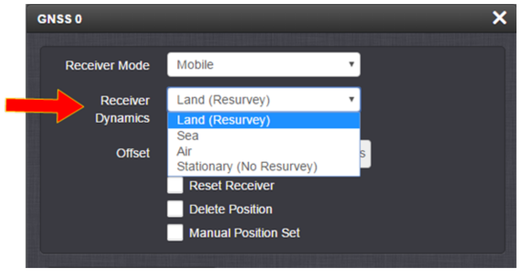
> **Caution:** If you select a setting that does NOT resurvey, and subsequently relocate your unit (antenna) by more than 100 m, u-blox M8T receivers will NOT detect the new position, and hence provide an incorrect time.

For more information about the **GNSS Survey**, see "Performing a GNSS Receiver Survey" on page 193.

For more information on **Receiver Modes**, see "Selecting a GNSS Receiver Mode" on page 189.

To change/review the GNSS Receiver Dynamics:

1. Navigate to **INTERFACES > REFERENCES: GNSS 0**.
2. Under the **Main** tab of the GNSS 0 status window, the line item **Receiver Dynamics** will indicate the current setting.
3. To change the setting, click Edit in the bottom-left corner. The GNSS 0 configuration window will display:



4. Select a setting and click Submit.

Available GNSS Receiver Dynamics Settings

Note: This option only applies to the M8T receiver in your device, not to SAASM GPS receivers (if equipped).

Caution: If you select a setting that does NOT resurvey, and subsequently relocate your unit (antenna) by more than 100 m, the receiver will NOT detect the new position, and hence provide an incorrect time.

The following Receiver Dynamics exist:

- **Land (Resurvey/No Resurvey)**:
  When used with the Mobile Receiver Mode, the receiver is adjusted for typical dynamic land-based applications.

  When used with the Standard Receiver Mode, this setting also will automatically initiate a resurvey after VersaPNT reboots, in order to account for a possible relocation.
- **Sea**: The receiver dynamics will be optimized for mobile motion patterns typical with marine applications, resulting in greater timing accuracy, and avoiding premature loss of synchronization.
- **Air**: The receiver dynamics will be optimized for acceleration forces typically experienced in civil aviation applications.
- **Stationary (No Resurvey)**: In Standard Mode, the receiver is set to a non-dynamic value for stationary applications; there will be no automatic resurvey after a reboot. Hence, should a unit be relocated, you need to delete its position, thus initiating a new survey.

The following table summarizes the different settings and their inter-dependencies:

Mode	Application	Survey?	(Re-)Survey – When?	Receiver Dynamics
Mobile	mobile	Never	Never	Land Air Sea

Mode	Application	Survey?	(Re-)Survey – When?	Receiver Dynamics
Standard	stationary only	Yes: needs ≥ 4 satellites for 33 minutes continuously in 12-hour window	(A) After any reboot, if the Dynamics setting is set to "Land – Resurvey". (B) If no previously carried out survey has been found after a reboot (C) When the unit detects it has been re- located (D): After "Delete Position" command was submitted	Land – Resurvey Stationary – No Resurvey
Single Satellite	stationary only	Manually set position	(A) On reboot, if no hand-set position is detected (B) After "Delete Position" command was submitted	Stationary

The following table illustrates the interdependence between Receiver Dynamics, Receiver Mode (see "Selecting a GNSS Receiver Mode" on page 189) and receiver type:

Table 4-2: Receiver dynamics, ~modes, ~ dynamics, ~ types

Receiver Mode	Receiver Dynamics			
	Land (Resurvey)	Sea	Air	Stationary (No Resurvey)
Single Satellite	irrelevant	irrelevant	irrelevant	irrelevant
Standard	✓	✗	✗	✓
Mobile (with u-blox receivers)	✓	✓	✓	✗

Notes:

- The **u-blox M8T** receiver now uses Land to indicate it will RESURVEY on reboot, and Stationary to indicate it will not resurvey after reboot.

4.3.3.5 Performing a GNSS Receiver Survey

Note: This topic only applies to stationary applications – in Mobile receiver mode NO surveys will be carried out since the position is updated continuously.

When VersaPNT's integrated GNSS receiver performs a survey, it tries to determine or verify its geographic position with high accuracy. An accurate geographic position is required to calculate a precise system time from the GNSS reference.

During a GNSS survey, the position will be iteratively recalculated while gradually increasing the position accuracy. A survey can take up to 33 minutes, but typically VersaPNT will synchronize earlier, i.e. offer a valid Time and 1PPS reference, once it has obtained a sufficiently accurate preliminary position.

> **Note:** If a system has been moved, in Standard receiver mode and Land Dynamics, receivers will automatically re-survey on reboot. In Standard mode and Stationary Dynamics, the unit will survey only once, and will not re-survey on reboot.

Initiating a GNSS Survey

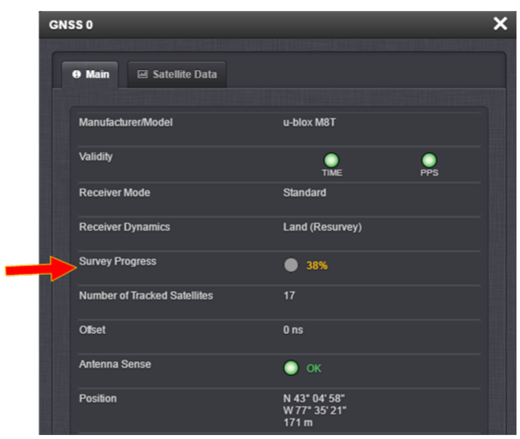
The standard behavior is that a power cycle or a reboot will automatically initiate a GNSS survey. To reboot your unit, navigate to **TOOLS > SYSTEM: Reboot/Halt**.

While it is crucially important to carry out a resurvey after a unit has been relocated (e.g., when commissioning a new unit), a resurvey is normally not required if a stationary unit is rebooted for other reasons. To turn off this functionality, see "Setting GNSS Receiver Dynamics" on page 191.

Verifying GNSS Survey Progress

To see if VersaPNT's GNSS receiver is performing a survey and if so, verify its progress:

1. Navigate to **INTERFACES > REFERENCES: GNSS 0**.
2. The survey status (ACQUIRING, COMPLETE, or progress in percent) is displayed under the line item Survey Progress.



Note: Once a survey has been initiated, the Survey Progress may not be displayed right away until the receiver has completed its initialization process.

4.3.3.6 GNSS Receiver Offset

The **Offset** setting in the GNSS configuration window (**INTERFACES** > **GNSS 0** > "**Edit**") allows you to enter an offset to the GNSS time and 1PPS reference in order to account for antenna cable delays or other latencies (entered and displayed in nanoseconds).

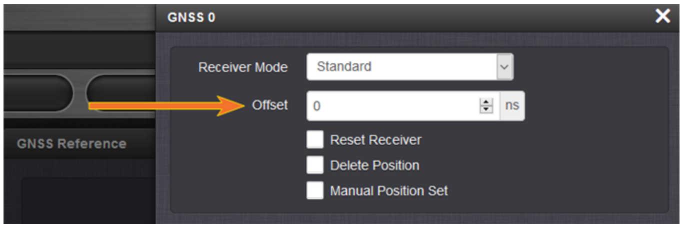
By setting the correct **Offset** value, you can offset the system's on-time point by the **Offset** value to compensate for the antenna and in-line amplifier delays. Under typical conditions, the expected cable and amplifier delays are negligible. You can calculate the delay based on the manufacture's specifications.

The offset range is ±½ seconds (i.e. ±500 ms, or ±500 000 000 ns). The default value is 0 nanoseconds, and the resolution is 1 nanosecond.

Configuring a GNSS receiver offset

To configure the GNSS receiver offset:

1. Navigate to **Interfaces > References: GNSS Reference**
2. Click on the GEAR button next to the GNSS Reference. The **GNSS 0** window will open:



3. Locate the **Offset** field, and enter the desired value.
4. Click Submit.

Calculating cable delay

The following formula can be used to calculate antenna cable delay:

```
D = (L * C) / V
```

Where:

D = Cable delay in nanoseconds

L = Cable length in feet

C = Constant derived from velocity of light: 1.016

V = Nominal velocity of propagation expressed as decimal, i.e. %66 = 0.66 Value is provided by cable manufacturer.

When using Spectracom **LMR-400** or equivalent coaxial cable, this formula equates to approximately 1.2 nanoseconds of delay per every foot of cable. To calculate the Offset value (cable delay), multiply the length of the entire cable run by “1.2” and then enter this value into the Offset field.

Examples of LMR-400 (or equivalent) coax cable delays:

100 feet of cable = 120 nanoseconds of cable delay

200 feet of cable = 240 nanoseconds of cable delay

300 feet of cable = 360 nanoseconds of cable delay

4.3.3.7 Resetting the GNSS Receiver

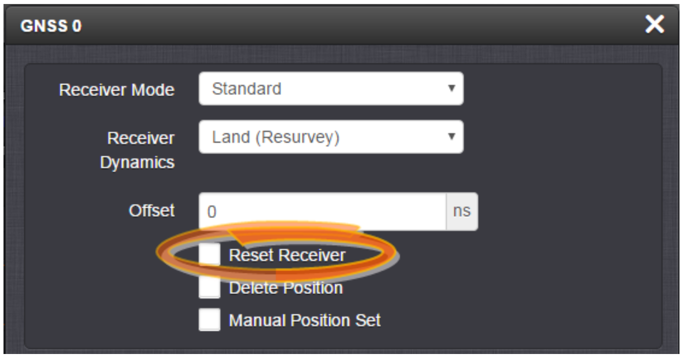
The **Reset Receiver** command causes the GNSS receiver to execute a cold start: All data will be erased from the volatile receiver memory. Only non-volatile memory is preserved.

Caution: Resetting the GNSS receiver may become necessary in the rare event of internal communication issues, and is typically ONLY required if Spectracom Technical Support advises you to execute this command.

Note that resetting the GNSS receiver is not the same as "Deleting the GNSS Receiver Position" on the facing page.

To reset the GNSS Receiver:

1. Navigate to **Interfaces > References: GNSS Reference**
2. Click on the GEAR button next to the GNSS Reference. The **GNSS 0** window opens:



3. Locate the **Reset Receiver** box, check it, and click Submit.

4.3.3.8 Deleting the GNSS Receiver Position

The VersaPNT timing system requires the exact geographic position in order to calculate the exact system time from the GNSS signal.

The **Delete Position** command deletes the GNSS antenna position data that is stored in the non-volatile memory of the GNSS receiver.

The deletion of the position data will automatically initiate a new **GNSS self survey**, provided:

» a GNSS antenna is connected to VersaPNT

» the GNSS receiver can track at least four satellites continuously

» and the GNSS receiver it is configured to operate in **Standard Mode**.

The objective of the **GNSS Survey** is to re-discover the current antenna position.

> **Note:** A self survey will take at least 2000 seconds (33 minutes).

Relocating VersaPNT

The **Delete Position** command may need to be used if a VersaPNT system is physically moved, and it did not self-initiate a new survey automatically. Note that neglecting to delete the old position data and discover the new position data will cause VersaPNT not to go into synchronization state.

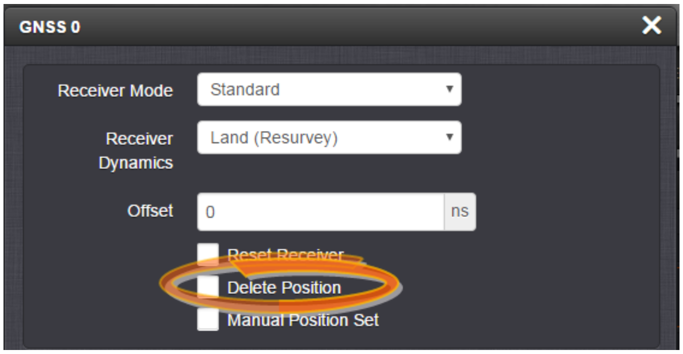
Sanitization

The **Delete Position** command must also be used when **sanitizing** a VersaPNT unit (ensuring that no trace of position data remains on the unit).

Deleting the GNSS position

To delete the GNSS position:

1. Disconnect the GNSS antenna from the VersaPNT unit (this is required **only when sanitizing** the unit).
2. Navigate to **Interfaces > References: GNSS Reference**.
3. Click on the GEAR button next to the GNSS Reference (typically, there is only one reference, numbered "0"). The **GNSS 0** window will open:



   Locate the **Delete Position** box, check it, and click Submit.
4. VersaPNT will initiate a GNSS self survey.

> **Note:** In Mobile Receiver Mode it is NOT possible to delete the position and start the GNSS survey. This feature is only available in Standard Mode and in Single Satellite Mode. In Single Satellite Mode a GNSS survey may take up to 24 hours.

4.3.3.9 Manually Setting the GNSS Position

> **Note:** This topic applies only to stationary applications, i.e. to Standard mode, or Single Satellite mode.

The exact geographic position (location and elevation) of the antenna your VersaPNT unit—and thus its onboard GNSS receiver—is a major factor for VersaPNT to calculate an accurate System Time from the GNSS reference.

> **Note:** The elevation (altitude) should be set in accordance with the World Geodetic System 1984 (WGS 84), not Mean Sea Level (MSL).

Normally, the onboard GNSS receiver will track and adjust the antenna position during the so-called GNSS **self survey**, which is performed during initial commissioning of a VersaPNT unit, or when rebooting a unit after it had been powered down for some time ("cold start").

Depending on where your GNSS antenna is installed and thus, how good the reception is, the self survey may be adequate for most applications.

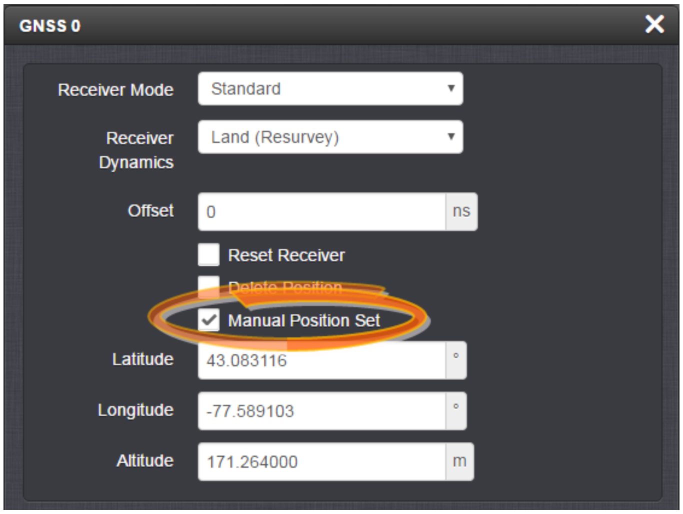
Setting a **Manual Position**, however, i.e. manually applying your current geographic position data (Latitude, Longitude, and Altitude) may be necessary if your GNSS receiver could not complete its survey due to poor reception.

In some cases, setting the position manually may also help to reduce the amount of time needed for the initial position "fix", i.e. for VersaPNT to synchronize with the satellites in view.

Note that this position will also be used if **Apply A-GPS Data** is checked.

To manually set your position:

1. Determine your geographic position. For more information, see "Determining Your Position" below.
2. Navigate to **INTERFACES > REFERENCES: GNSS 0**. In the **GNSS 0** status window, click **Edit** in the lower left corner. The **GNSS 0** window will open:



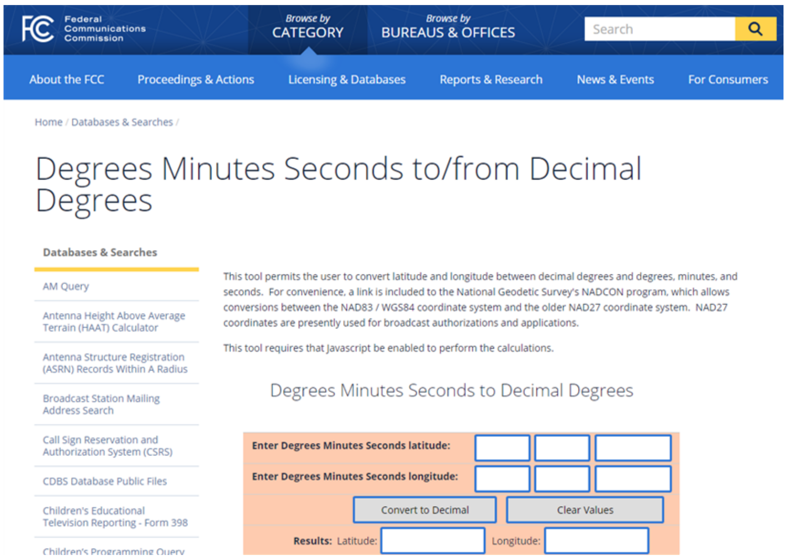
3. Under **Manual Position Set** accurately enter **latitude**, **longitude** (both in decimal degrees), and **altitude** (in meters [WGS 84]) of your GNSS antenna, VersaPNT can use this data during the satellite tracking/adjustment process, which typically leads to a quicker "fix". It is recommended to enter the position as accurately as possible.

Determining Your Position

To determine your GNSS position, using Google Maps™:

1. On your computer, open Google Maps.
2. In Google Maps, locate your building, and the location of your antenna.
3. Right-click on the location. Select **What's here?** At the bottom, you will see a card with the coordinates.
4. Take note of your **decimal** position (e.g., 43.083191, -77.589718).

> **Note:** Should you prefer to determine your position in a different way, and as a result, have your latitude & longitude data in degrees/minutes/seconds, you need to convert this data to the decimal format e.g., by using a conversion tool, such as Earth Point www.earthpoint.us , or https://www.fcc.gov/media/radio/dms-decimal:



5. Determine your **altitude**: To find the elevation of your location, search online for a *Google Maps elevation finder* tool. Do not forget to add the height above ground for your antenna.

If a more exact altitude is desired, the use of a topographical map is recommended. Applying the WGS 84 standard will likely yield the most accurate elevation.

4.3.3.10 GNSS Constellations

VersaPNT allows you to select which GNSS constellations can be tracked. For example, you can determine if you want GLONASS satellites to be tracked (besides GPS).

Selecting GNSS Constellations

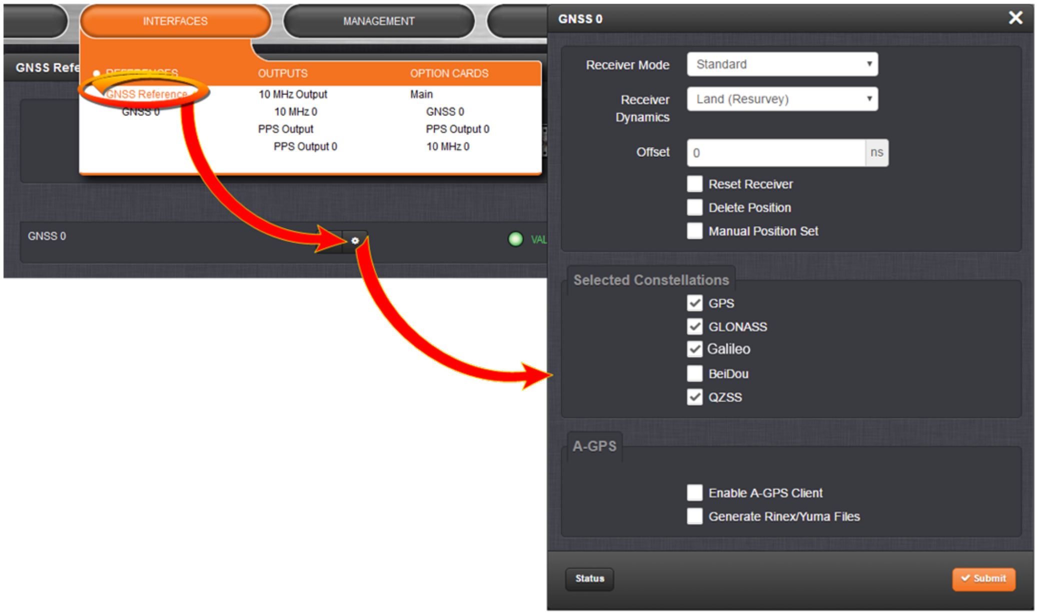
Your VersaPNT is capable of tracking multiple GNSS constellations simultaneously.

To verify if satellite signals for the selected GNSS constellations are currently received, see "Determining Which GNSS Satellites Are Received" on page 202.

Configuring GNSS Constellations

To configure which GNSS constellations VersaPNT's GNSS receiver shall track:

1. Navigate to **INTERFACES > REFERENCES: GNSS Reference**.
2. Click the GEAR button next to **GNSS 0**. The **GNSS 0** window will open:



3. Under **Selected Constellations**, review which constellations are currently tracked, and apply your changes. Note the following:

   » The **u-blox M8T** receiver is capable of receiving multiple GNSS constellations simultaneously; the table below shows which combinations are possible:

GPS	Galileo	GLONASS	BeiDou
X	X	–	–
X	X	X	–
X	X	–	X
X	–	X	–
X	–	–	X
–	X	X	–
–	X	–	X
–	–	X	X

> **Note:** The augmentation systems SBAS and QZSS can be enabled only if GPS operation is enabled.

> **Note:** Should you select more than 3 + QZSS constellations, you will receive a Constellation Error once you click Submit (ConstError).

About QZSS

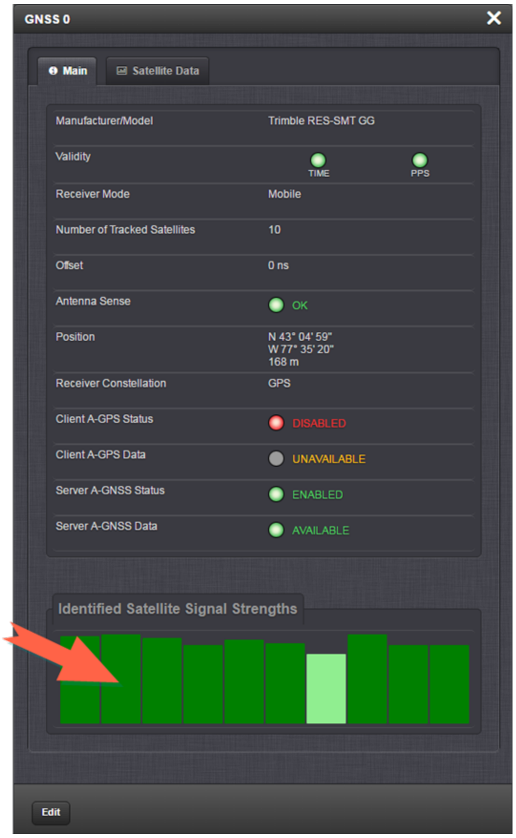
QZSS is disabled by default. In order to receive QZSS signals, you must either be located in the Japan region, or use a GNSS simulator (such as Spectracom GSG-5 or -6 Series).

QZSS is not considered a standalone constellation and while VersaPNT allows you to enable QZSS by itself, it is recommended to use it in combination with GPS.

Determining Which GNSS Satellites Are Received

To see which GNSS satellites your VersaPNT is currently receiving:

1. Navigate to **INTERFACES > REFERENCES: GNSS 0**.
2. The **GNSS 0** status window will open:

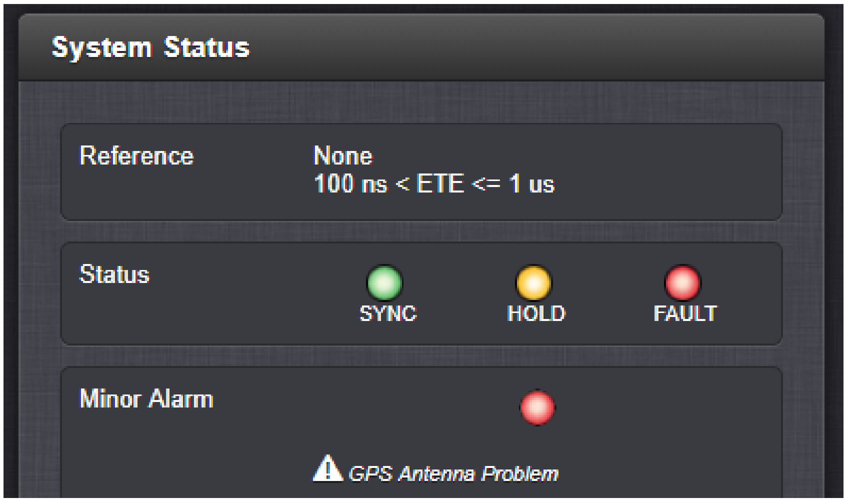


3. Under **Identified Satellite Signal Strengths** hover with your cursor over the bars: The letter in the tooltip window displayed for each signal bar indicates which constellation the satellite belongs to:

Letter symbol	GNSS Constellation
G	GPS
R	GLONASS
E	Galileo
J	QZSS
C	BeiDou
I	IRNSS

The number next to the letter indicates the satellite number. The number below indicates the signal strength (C/N_o).

4.3.4 Holdover Mode



When input references have been supplying input to VersaPNT and input from all the references has been lost, VersaPNT will not immediately declare loss of time synchronization, but first will go into Holdover mode. While the unit is in Holdover mode, the time outputs are derived from the internal 10 MHz oscillator incrementing the System Time, but the oscillator is not disciplined/steered by the external reference e.g., GNSS.

Because of the stability of the internal oscillator, accurate time can still be derived even after all the primary references are no longer valid or present. The more stable the oscillator is without an external reference, the longer this holdover period can be and have it still maintain very accurate outputs. The benefit of Holdover is that time synchronization and the availability of the time outputs is not immediately lost when input references are no longer available.

While VersaPNT is in Holdover, the only difference is the Holdover and associated Minor alarm are asserted. There are no changes to NTP or any of the other outputs, i.e. while in Holdover mode, NTP inside VersaPNT continues to be at the same Stratum level it was at before going into Holdover mode (such as Stratum 1 when synced to GPS). Should the Holdover period expire, however, or the unit is rebooted, the NTP Stratum will go to 16, preventing any clients from being able to sync with VersaPNT until GPS or another reference has been restored.

How long will the unit remain in Holdover mode?

VersaPNT will remain in Holdover mode until either:

a. Any enabled and valid input reference becomes available again: If one or more references return and are declared valid before the Holdover period has expired (even momentarily, i.e. for at least one second), VersaPNT exits the Holdover mode and returns to its fully synchronized state.

b. The Holdover Timeout period expires. In this case, VersaPNT will declare loss of synchronization.

Note that Holdover mode does not persist through reboots or power cycles. If a reboot or power cycle occurs while VersaPNT is in Holdover mode, it will power-up and remain in a "**not synchronized**" state until at least one valid Time and 1PPS input reference becomes available again. While in this state, NTP will be **Stratum 15** and outputs will not be usable. If the input references are restored and then lost or declared not valid again, VersaPNT will then go back into Holdover mode.

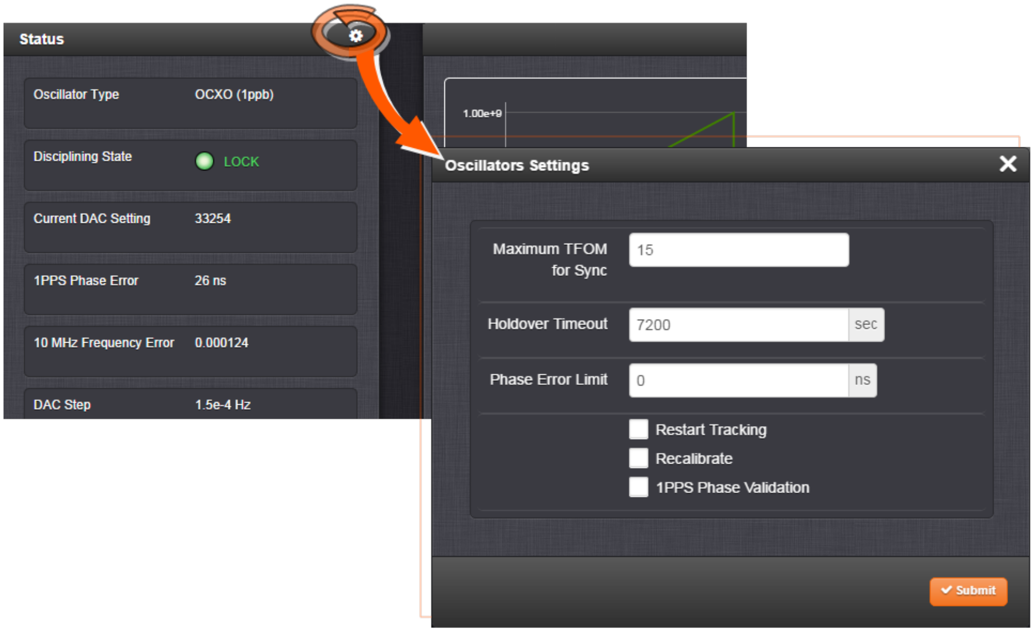
What is "Holdover Timeout"?

Holdover Timeout is the user-configurable allowable time period in which VersaPNT remains in Holdover mode before it declares loss of synchronization. Holdover Timeout can be adjusted according to application-specific requirements and preferences. See below for recommendations on how long (short) the Holdover Timeout should be.

How to configure Holdover Timeout

To set the Holdover Timeout value:

» Navigate to **MANAGEMENT > OTHER: Disciplining**, and click the GEAR icon in the **Status** panel:



For more information on the TFOM value and Phase Error Limit, see "Configuring the Oscillator" on page 208.

Note: Changes made to the Holdover Timeout always take effect immediately. If VersaPNT is in Holdover and the Holdover timeout is changed to a value that is less than the current time period that VersaPNT has been in Holdover Mode, the unit will immediately declare loss of synchronization.

What is the recommended setting for the Holdover Timeout period?

The factory **default** Holdover period is **2 hours (7200 seconds)**. The value can be increased to up to 5 years. During this time period, VersaPNT will be useable by its NTP clients (or other consumers) after GNSS reception has been lost.

The length of time is really based on the type of oscillator installed in a unit, and what the typical accuracy requirements are for the NTP clients. The longer it can run in Holdover mode before it expires, the longer it can continue being a central time source for all of its clients. But the longer VersaPNT runs in Holdover, the larger the offset to true UTC time will become, because the undisciplined oscillator will drift over time:

The better the type of oscillator installed, the more stable it is while in Holdover and therefore, the less its time will drift away from true UTC time. This results in more accurate timing, over extended durations upon the loss of GPS input. For instance, a Rubidium oscillator will maintain significantly better time over a longer Holdover duration than a TCXO oscillator (TCXOs are considerably less stable than a Rb oscillator).

Oscillator Phase Drift

The chart below provides typical stability performance for the oscillator types that can be found in VersaPNT units. These numbers are based on the oscillator being locked to a reference for two weeks, but then loses GPS reception for an extended period of time, while the ambient temperature remains stable.

This data can help you determine how long of a Holdover period can be tolerated, based on how much time drift may occur after GPS input is lost. The larger the time error that can be tolerated by VersaPNT clients, based on the oscillator installed, the larger the Holdover timeout period can be set to.

Table 4-3: Estimated Phase Drifts

1PPS Phase Drift in Holdover (no reference available)	OCXO	OCXO (high performance)	CSAC
- 4 hours	3 μs	2.8 μs	1μs
- 24 hours	40 μs	30 μs	7 μs
- 7 days	1.2 ms	0.6 ms	100 μs

To find out which type of oscillator is installed in your VersaPNT, navigate to **MANAGEMENT > OTHER: Disciplining**, and look for the line item **Oscillator Type** in the **Status** panel.

Typical Holdover lengths

The length of the allowed Holdover Timeout period is displayed and configured in seconds. The table below provides example conversions for typically desired Holdover periods.

Table 4-4: Typical Holdover lengths in seconds

Desired Holdover Length	Holdover Length (in seconds) to be entered
2 hours	7200 seconds (default value)
24 hours	86 400
7 days	604 800
30 days	2 419 200
1 year	29 030 400

Note: Due to Leap Seconds that are periodically inserted into the UTC and Local timescales, it is not normally recommended to exceed 30 days of Holdover without an external reference that can supply Leap Second information being applied (such as GNSS).

Configuring a Holdover value exceeding 30 days could result in a one-second time error in the UTC or Local timescales until an external reference (GNSS or IRIG input) is restored or a manually configured Leap Second is asserted by a user (leap seconds do not affect the GPS and TAI time scales).

If no external references (such as GNSS or IRIG) are available when a Leap Second is scheduled to occur, manual Leap Seconds can also be applied to the UTC or Local time base; see "Leap Seconds" on page 159.

If the Holdover Timeout has expired, do I need to reset the clock once GPS becomes available again?

No, the Holdover timer is automatically reset as soon as at least one reference has been restored/returned for at least one second. If GPS is restored and then lost again moments later, the Holdover timer starts again with its full value. If its set to one week in this case, it then gets another week of Holdover operation before NTP goes to Stratum 16 (if GPS remained unavailable for the entire week).

Holdover mode and the User/User reference

If the only available input reference is a manually set **User** time, and VersaPNT is subsequently rebooted or power cycled, time sync will be lost when VersaPNT powers back-up. The time will need to be set manually again in order for VersaPNT to return to its fully synchronized state. See "The "User/User" Reference" on page 170 and "Manually Setting the Time" on page 154 for more information.

4.4 Managing the Oscillator

The purpose of the built-in oscillator is to provide VersaPNT with an accurate and very stable internal frequency source. This allows VersaPNT to go into a holdover mode in the event that external time or frequency references are lost or become invalid. However, the oscillator can also be used as a legitimate 1PPS reference during normal operation, in conjunction with an external time reference (for more information, see "Configuring Input Reference Priorities" on page 167.)

VersaPNT's internal oscillator is normally disciplined to an input reference (such as GNSS, IRIG input, 1PPS input, etc.) in order to provide the highest degree of oscillator accuracy and to account for oscillator drift. While disciplining (with a 1PPS input reference input present and valid), the oscillator's output frequency is monitored and based on the measured frequency, the oscillator is steered to maintain a very accurate 10 MHz output. If no valid 1PPS input references are present (or input references are present but not considered valid), the oscillator will be in Freerun mode instead.

If no external input reference such as GNSS, IRIG, etc. is available (or is temporarily lost), VersaPNT may become an NTP Stratum 2 or higher reference. If so configured, VersaPNT can use a reference such as an NTP daemon, referred to as a **Host Reference**. If the Host Reference becomes active, it will automatically take over the disciplining of the oscillator. This built-in functionality is referred to as **Host Disciplining**.

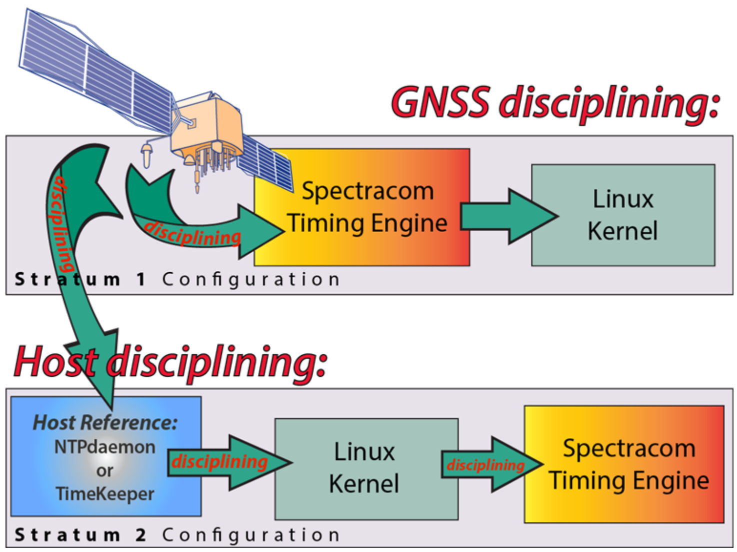


Figure 4-2: Host disciplining

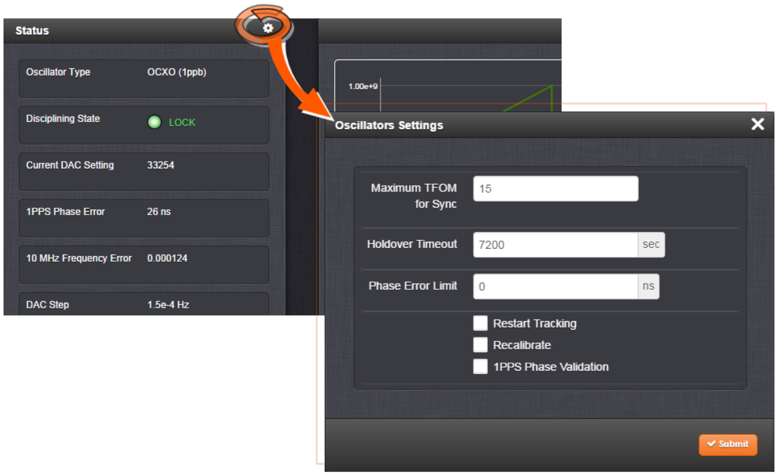
> **Note:** Host disciplining is NOT supported by VersaPNT units that are equipped with a Rubidium oscillator.

The Oscillators Settings page provides the user with some control of the disciplining process. This page is also used to configure the length of time VersaPNT is allowed to remain in the Holdover mode when all references are lost.

4.4.1 Configuring the Oscillator

VersaPNT is equipped with an internal oscillator. To configure the oscillator settings:

1. Navigate to **MANAGEMENT > OTHER: Disciplining**.
2. Click the GEAR icon at the top of the **Status** panel. The **Oscillators Settings** window will display:



3. Populate the fields:

   » **Maximum TFOM for Sync**: When TFOM (Time Figure of Merit, see also "Time Figure of Merit (TFOM)" on the next page) is greater than Max TFOM, disciplining will still be attempted against the selected reference to improve the TFOM. If the condition persists, the system will transition to holdover, and eventually out of sync. When disciplining is performed such that TFOM is no longer greater than max TFOM, the system will transition back into sync.

   » **Holdover Timeout(s)**: The default is 7200 s (= 2 hours).
   For more information on holdover timeouts, see "Typical Holdover lengths in seconds" on page 206. For additional information on holdover, see "What is "Holdover Timeout"?" on page 204.

   » **Phase Error Limit**: [Default=0 (disables this feature)]. Setting a Limit (valid for +/-) for the Phase Error between an external 1PPS reference and the System 1PPS will cause the disciplining tracking to restart automatically (after a few minutes delay) if that limit is exceeded. This will help to quickly re-align the System 1PPS with a reference.

   When using a Host Reference as a primary or backup reference, for improved performance it is recommended to set the phase error limit for NTP to a suggested value of 100000 ns (= 1 second). Adjust this value as needed, based on your accuracy requirements.

   » **Restart Tracking**: Check this box, and click Submit if you want to **manually** restart disciplining tracking.
   This option causes the disciplining algorithm to stop tracking the input reference and start over (as if it was just acquired). This can be useful if there is a large phase offset between reference 1PPS and system 1PPS, as it may occur when going back into sync to the external reference after a long holdover. A **Restart Tracking** will re-align the system 1PPS with the reference 1PPS very quickly, but may cause the 1PPS output to jump.

- **Recalibrate**: In rare cases, existing calibration data may no longer be suitable to calibrate the oscillator. This function will delete the existing calibration data, and begin a new calibration process (not applicable for low phase-noise Rubidium oscillators).

4. Click Submit.

4.4.1.1 Time Figure of Merit (TFOM)

The TFOM reflects the **estimated error** range values between the **reference 1PPS** (such as GPS 1PPS) and the **System 1PPS** which is being aligned to the 1PPS. The estimated error is referred to as the 1PPS Phase error. TFOM values are ranges of these phase errors. The larger the phase error estimate, the larger the TFOM value will be. For example, TFOM 3 is reported when the estimated phase error is any value between 10 ns to less than 100 ns of the offset between the selected 1PPS reference and the system's 1PPS.

TFOM is VersaPNT's estimation of how accurately it is synchronized with its time and 1PPS reference inputs, based on several factors, known as the **Estimated Time Error** or ETE. The larger the TFOM value, the less accurate VersaPNT believes it is aligned with its 1PPS input that is used to perform disciplining. If this estimated error is too large, it could adversely affect the performance of oscillator disciplining. The available TFOM range is 1 through 15. You may refer to the following for the TFOM to ETE conversions:

Table 4-5: TFOM to ETE conversion

Reported TFOM Value	Estimated Time Error (ETE)
1	<= 1 nsec
2	1 nsec < ETE <= 10 nsec
3	10 nsec < ETE <= 100 nsec
4	100 nsec < ETE <= 1 μsec
5	1 μsec < ETE <= 10 μsec
6	10 μsec < ETE <= 100 μsec
7	100 μsec < ETE <= 1 msec
8	1 msec < ETE <= 10 msec
9	10 msec < ETE <= 100 msec
10	100 msec < ETE <= 1 sec
11	1 sec < ETE <= 10 sec
12	10 sec < ETE <= 100 sec
13	100 sec < ETE <= 1000 sec
14	1000 sec < ETE <= 10000 sec
15	ETE > 10000 sec

Example

TFOM is a value between 1 and 15. TFOM can never exceed the default MaxTFOM value of 15.

Typically the MaxTFOM requires no adjustment, but in some instances it may be advisable to decrease MaxTFOM so that TFOM can potentially exceed it: For example, by lowering the MaxTFOM to “5” it is now possible for TFOM to be always higher than the MaxTFOM value:

Assuming the MaxTFOM is set to 5 and the TFOM happens to go to a 6, i.e. TFOM is now exceeding MaxTFOM. This condition will cause a **1PPS out of specification** alarm to be asserted and the oscillator disciplining will change in order to speed-up the alignment of the system 1PPS to the selected reference (causing it to take less time getting closer into alignment with the reference):

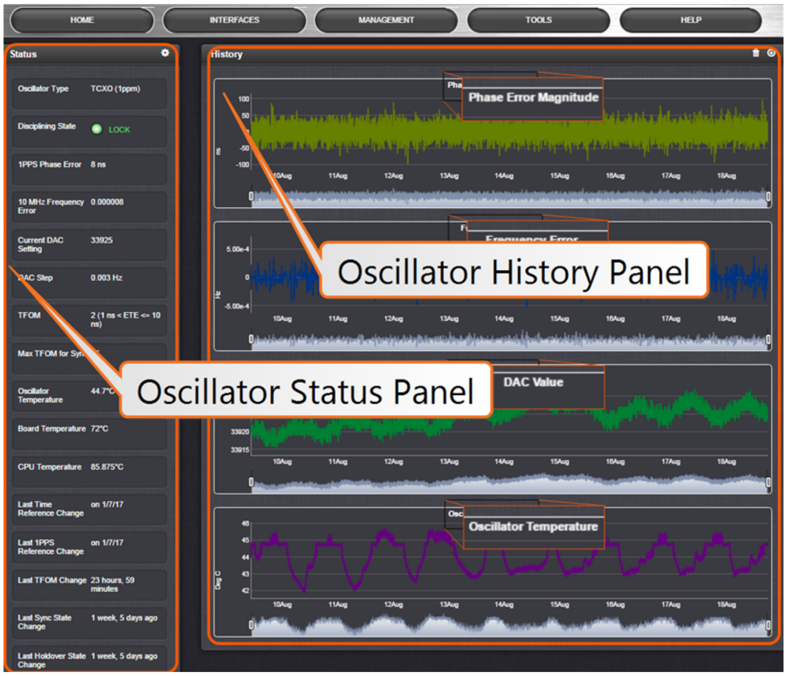
This will cause the TFOM to start to decrease faster. Once TFOM no longer exceeds MaxTFOM because the **System 1PPS** is now much closer to the **reference 1PPS**, the disciplining slows back down again as the system 1PPS continues to be brought into alignment with the selected 1PPS input.

4.4.2 Monitoring the Oscillator

The Oscillator Management screen provides current and history status information on disciplining state and accuracy.

To access the **Oscillator Management** screen:

1. Navigate to **MANAGEMENT > OTHER: Disciplining**.
2. The **Oscillator Management** screen will display. It consists of two panels:



The Oscillator Status Panel

This panel provides comprehensive information on the current status of VersaPNT's timing state.

» Oscillator Type: Type of oscillator installed in the unit.

» Disciplining State: State of oscillator control and disciplining; indicates whether or not the internal oscillator is currently being disciplined (steered to an input reference). The states are: "Warm up", "Calibration", "Tracking Setup", "Lock State", "Freerun", and "Fault".

» 1PPS Phase Error: A tracking measurement [scaled time, in ns, or ms] of the internal 1PPSs' phase error with respect to the selected input reference. Long holdover periods or an input reference with excessive jitter will cause the phase error to be high. The oscillator disciplining control will gradually reduce the phase error over time. Alternatively, restarting the tracking manually (see "Restart Tracking" under "Configuring the Oscillator" on page 208), or automatically via a pre-set Phase Error Limit, will quickly reduce the phase error.

» 10 MHz Frequency Error: An internal estimated calculation (in Hertz) of the internal oscillator's frequency error, based on the phase accuracy error at the beginning and end of a frequency measurement window (the length of this window will vary depending upon the type of oscillator installed and the oscillator adjustment algorithm).

» Current DAC Setting: Current DAC value, as determined by the oscillator disciplining system. The value is converted into a voltage that is used to discipline the oscillator. A stable value over time is desirable and suggests steady oscillator performance (see also the graph in the History Panel).

- DAC Step: Step size for adjustments to the internal oscillator, as determined by the oscillator disciplining system. Larger steps = quicker, but coarser adjustments. The step size is mainly determined by the type of oscillator.
- TFOM: The Time Figure of Merit is VersaPNT's estimation of how accurately the unit is synchronized with its time and 1PPS reference inputs, based on several factors, known as the Estimated Time Error or ETE. The larger the TFOM value, the less accurate VersaPNT believes it is aligned with its 1PPS input that is used to perform disciplining. If this estimated error is too large, it could adversely affect the performance of oscillator disciplining. The available TFOM range is 1 through 15.
- Max TFOM for Sync: Value, as set under "Configuring the Oscillator" on page 208
- Temperature(s): Three temperatures are displayed:
  - **Oscillator** temperature, which has an effect on oscillator accuracy, and therefore can be used to interpret oscillator performance.
  - **Board** temperature (measured on the main board, sometimes also referred to as 'System temperature')
  - **CPU** temperature

> **Note:** Oscillator temperature is plotted over time in the History panel on the right, while graphs for board and CPU temperature can be found under TOOLS > SYSTEM: System Monitor.

- Last Time Reference Change: [Timestamp: Last occurrence]
- Last 1PPS Reference Change: [Timestamp: Last occurrence]
- Last TFOM Change: [Timestamp: Last occurrence]
- Last Sync State Change: [Timestamp: Last occurrence]
- Last Holdover State Change: [Timestamp: Last occurrence]

The Oscillator History Panel

The **Oscillator History Panel** offers real-time graphical monitoring of VersaPNT's internal timing. The following graphs plot key oscillator-relevant data over time::

- **Phase Error Magnitude**: See 1PPS Phase Error
- **Frequency Error**: See 10_MHz_Frequency_Error
- **Scaled DAC Value**: See DAC Step
- **Oscillator Temperature**, which has an effect on oscillator accuracy, and therefore can be used to interpret oscillator performance.

You can **zoom** in on any of the graphs by grabbing the handles at either end and pulling them inwards. The graph will focus in on the time interval you choose in real time.

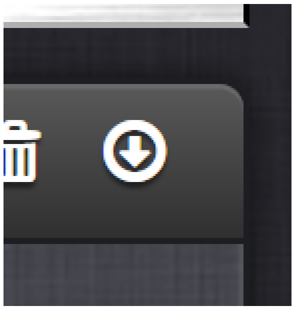
Clicking on the **Delete** icon in the top-right hand corner will erase all current oscillator log data.

Clicking on the **Download** arrow icon will download the latest oscillator log data as a `.csv` file.

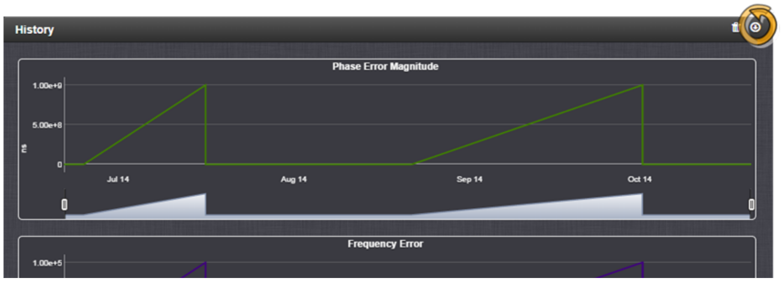
4.4.3 Oscillator Logs

To export, or delete the oscillator logs:

1. Navigate to **MANAGEMENT > OTHER: Disciplining**.
2. To download the log file: In the **History** panel, click the downwards pointing ARROW icon. in the top-right corner:



3. The log file will be downloaded onto your local computer. Its name is `oscil-latorStatusLog.csv`. Depending on the operating system you can open the file, or save it locally.
To delete the log file, click the TRASH CAN icon, and confirm.



CHAPTER 5

System Administration

The following topics are included in this Chapter:

5.1 Issuing the HALT Command Before Removing Power

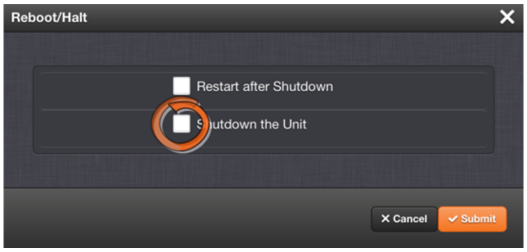
Gracefully shutting down VersaPNT by using the HALT command offers the following advantages over shutting the unit down by interrupting the power supply:

- The shutdown process will be logged
- The System Clock will update the Real Time Clock with the latest System Time.
- VersaPNT's file system will be synchronized, which under some circumstances will allow for faster startup next time the unit will be powered up again.

> **Note:** Wait 30 seconds after entering the HALT command before removing power.

Issuing a HALT Command via the Web UI

1. Navigate to **TOOLS > SYSTEM: Reboot/Halt**.
2. The **Reboot/Halt** window will display. Select the **Shutdown the Unit** checkbox.



3. Click **Submit**.
4. Wait 30 seconds after entering the HALT command before removing power from the unit.

Issuing a HALT Command via SerialPort/Telnet/SSH:

With a serial connection to the port, telnet connection or SSH connection, type `halt` <Enter> to halt the unit for shutdown. For more information on VersaPNT commands, see "CLI Commands" on page 278.

> **Note:** After issuing the HALT command wait 30 seconds before you remove power.

5.2 Rebooting the System

To reboot VersaPNT via the Web UI:

1. Navigate to **TOOLS > SYSTEM: Reboot/Halt**.
2. Select the **Restart after Shutdown** box in the **Reboot/Halt** window.

3. VersaPNT will now be rebooted and be accessible again shortly thereafter.

Rebooting via USB Port, Telnet, SSH, SNMP

With a serial connection to the USB port, telnet connection or SSH connection, type `reboot` <Enter> to reboot VersaPNT.

Reboot is also is available to be performed through an `snmpset` operation. For more information on VersaPNT commands, see "CLI Commands" on page 278.

5.3 Notifications

If an event occurs e.g., VersaPNT transitions into Holdover, or a short is detected in the GNSS antenna, VersaPNT can automatically notify users that a specific event has occurred.

In some situations, two events are generated. One event occurs in the transition to a specified state and then another event occurs when transitioning back to the original state. Examples of these are losing sync and then regaining sync, or going into Holdover mode and then going out of Holdover mode. Other situations may only consist of one event. An example of this situation is switching from one input reference to another.

Notifications of each event that may occur can be via alarms, via SNMP Traps being sent to one or more SNMP Managers, via an email being sent to a specified email recipient, or a combination of the three. The Notifications page allows a user to configure whether the occurrence of each event automatically triggers an alarm to be generated, an SNMP trap to be sent out, an email to be sent out, or a combination of the three.

Also, this page allows the desired email recipient’s address for that particular event to be specified. Each event can be configured with the desired email address that is specific to just that one event only. Note that only one email address can be specified in each Email Address field. If desired, the same email address can be used in all of the fields, or different addresses can be used for different events.

> **Note:** Whether or not notifications are enabled/disabled for a given event, the occurrence of the event is always logged.

All available VersaPNT events that can generate a notification to be sent are located under different tabs in the Notification Events panel: **Timing**, **GPS**, and **System**.

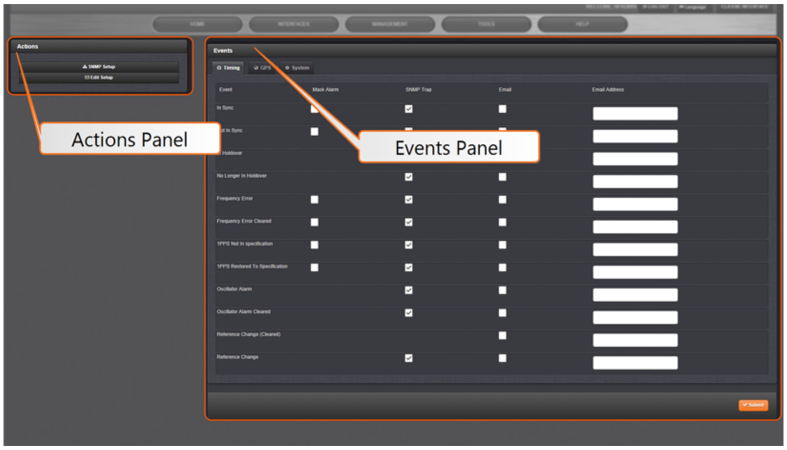
The VersaPNT Events that can automatically trigger a notification are listed in the **Event** column. It is possible to:

- Mask the alarm generation for specific events (prevent the alarm)
- Enable "SNMP" (to send out an SNMP trap)
- Send an email to the address specified in the corresponding "Email Address" column.

5.3.1 Configuring Notifications

To configure Notifications:

1. Navigate to **MANAGEMENT > OTHER: Notifications**. The **Notifications** screen will display:



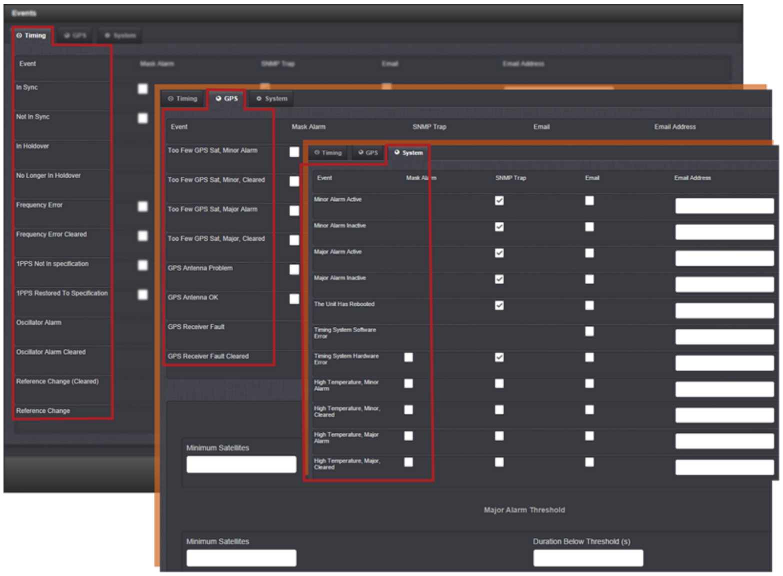
It is divided into two panels:

- The Actions panel, featuring:
  - The **SNMP Setup** button: See "SNMP" on page 69.
  - The **Email Setup** button: Configure VersaPNT's interface settings for Exchange email servers and Gmail.

    For more information on this subject, see the Spectracom Technical Note Email Notification Setup.
- The Events panel, offering three tabs:
  - **Timing**: Events for Sync Status and Holdover, Frequency error, Input references and the internal oscillator.

- » **GPS**: Events related to the GNSS receiver, including antenna cabling, tracking less than the minimum number of satellites and GNSS receiver faults.
- » **Systems**: Events related to the system operation, including minor and major alarms being asserted, reboot, timing system errors and option cards.

2. In the **Events** panel, choose the **Timing**, **GPS** or **System** tab. Configure your Notifications (see below), and click Submit.



The columns under each tab are:

- » **Event**—This is the event that will trigger the notification. The events under each tab will vary according to context.
- » **Mask Alarm**—Check here to enable an alarm mask. Enabling an alarm mask for a given notification will prevent that notification from generating an alarm condition. Other notifications for that event and logging of the event will still occur.
- » **SNMP Trap**—Check here to configure the event to trigger an SNMP Trap.
- » **Email**—Check here to configure the event to trigger an email notification.
- » **Email Address**—Enter the address to which the email should be sent when triggered by the event.

> **Note:** Each event can be configured with the desired email address that is specific to just that one event only. Note that only one email address can be specified in each Email Address field.

For each event choose the notification you want and an email address – if any – to which you want the notification to be sent. For more information, see "SNMP" on page 69 and "Setting Up Email Notifications" on page 223.

For each event, only the notification options available can be configured. For example, a mask alarm can be set for an In-Sync event, and a Not-in-Sync event, but not for an In-Holdover event.

5.3.2 Notification Event Types

The following types of events can be used to trigger notifications:

5.3.2.1 Timing Tab: Events

- In Sync
- Not In Sync
- In Holdover
- No Longer in Holdover
- Frequency Error
- Frequency Error Cleared
- 1PPS Not In Specification
- 1PPS Restored to Specification
- Oscillator Alarm
- Oscillator Alarm Cleared
- Reference Change (Cleared)
- Reference Change

5.3.2.2 GPS Tab: Events

- Too Few GPS Sat, Minor Alarm
- Too Few GPS Sat, Minor, Cleared
- Too Few GPS Sat, Major Alarm
- Too Few GPS Sat, Major, Cleared
- GPS Antenna Problem
- GPS Antenna OK
- GPS Receiver Fault
- GPS Receiver Fault Cleared

Under the **GPS Events** tab, you can also configure **Minor** and **Major Alarm Thresholds** for GNSS fault events; see "Configuring GPS Notification Alarm Thresholds" below.

5.3.2.3 System Tab: Events

- Minor Alarm Active
- Minor Alarm Inactive
- Major Alarm Active
- Major Alarm Inactive
- Unit Reboot
- Timing System Software Error
- Timing System Hardware Error
- High Temperature, Minor Alarm
- High Temperature, Minor, Cleared
- High Temperature, Major Alarm
- High Temperature, Major, Cleared

5.3.3 Configuring GPS Notification Alarm Thresholds

VersaPNT allows you to configure Minor and Major alarm thresholds for the GNSS receiver. This is done by setting the minimum number of satellites the receiver can track for a set time before an alarm is triggered. If both conditions are met, i.e. the reception quality falls below the set number of satellites for the set amount of time, an alarm is triggered.

The alarm notification feature described below allows you to be notified of a potential reception issue BEFORE the GNSS reference becomes invalid. This may be useful e.g., to notify system operators of a deteriorating signal reception before VersaPNT loses the GNSS reference.

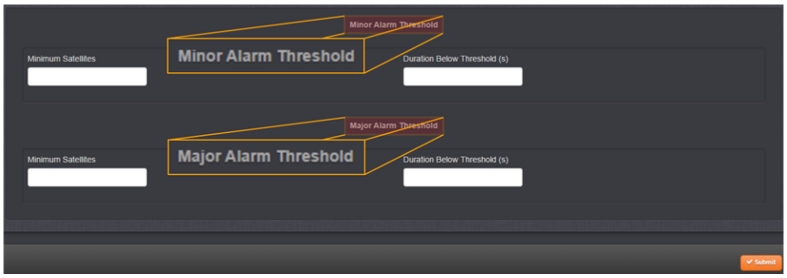
Note that VersaPNT itself has a pre-defined minimum number of satellites that must be tracked in order for GNSS to be considered a valid reference. The minimum number of satellites depends e.g., on your receiver mode, the GNSS signal reception in the area where your antenna is located, and the type of receiver in your unit. In Stationary mode, and for SAASM units, the minimum number of satellites is normally 4 (four). Hence, it would be prudent to set the Minor Alarm Threshold to 8, and the Major Alarm Threshold to 6.

> **Note:** While GPS Notification Alarms can be used in Mobile GNSS receiver mode, it is not advisable.

To determine **how many satellites** your VersaPNT unit is currently receiving, navigate to **INTERFACES > REFERENCES: GNSS 0**. See also "Reviewing the GNSS Reference Status" on page 184.

To **set** the GPS Alarm Thresholds:

1. Navigate to **MANAGEMENT > OTHER: Notifications**, and choose the **GPS** tab.
2. At the bottom of the window, locate the **ALARM THRESHOLD** panel:



3. In the **Minimum Satellites** fields enter the minimum number of satellites that must be available before the alarm is triggered. The alarm will be triggered when the number of satellites available is **BELOW** this number.
4. In the **Duration Below Threshold (s)** fields, enter the time **in seconds** that the system must be below the threshold set in the **Minimum Satellites** field before an alarm is triggered. The alarm will be triggered when this time is reached.
   By default, this timeout value is set to 0 seconds: As soon as the receiver drops below the minimum number of satellites, the associated alarm is triggered. A delay of e.g., 5 seconds, however, would not trigger an alarm if the number of received satellites drops below the specified number for only 3 seconds.

You can configure this event to cause either a Minor alarm, or a Major alarm, or both.

To learn more about Minor and Major alarms, see "Minor and Major Alarms" on page 270.

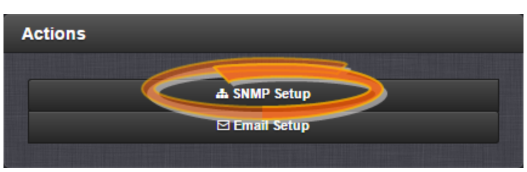
Note that the GNSS receiver must initially be tracking more than the configured number of satellites in order for this alarm to be triggered (the alarm is triggered when the receiver falls below the number of **Minimum Satellites** you specified above).

5.3.4 Setting Up SNMP Notifications

SNMP Notifications are SNMP traps that occur on a change of a monitored event.

To configure SNMP notifications:

1. Navigate to **MANAGEMENT > OTHER: Notifications**.
2. In the **Actions** panel, click **SNMP Setup**.



For more information on SNMP, see "SNMP" on page 69.

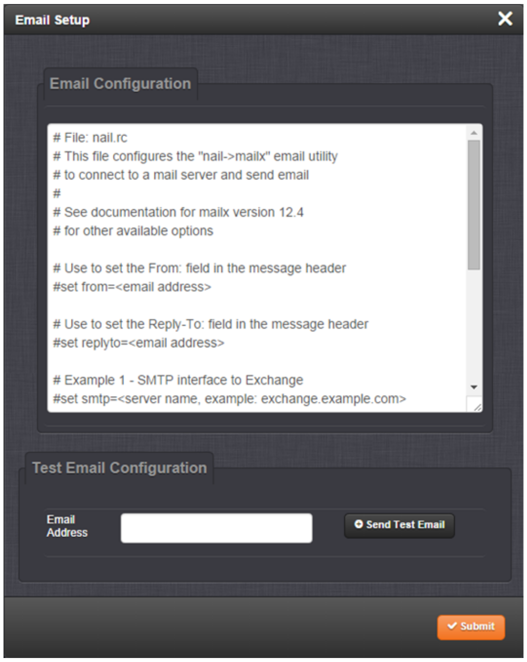
5.3.5 Setting Up Email Notifications

The **Email Setup** window provides a means to configure VersaPNT with the necessary settings to interface it with Exchange email servers and Gmail.

To set up Notification Emails:

1. Navigate to **MANAGEMENT> OTHER: Notifications**.
2. In the **Actions** panel of the **Notifications** screen, click 🖂 **Email Setup**.

3. The **Email Setup** window will display:



The **Email Configuration** box provides two example configuration files. One is for interfacing VersaPNT with an Email Exchange server; and the other is for sending emails via Gmail:

4. To configure the applicable example email configuration, delete the comments (“#”) from each line and replace the “<>” with the appropriate values for your particular email server (such as the user name and password for your Email server).

Example I: SMTP interface to MS Exchange

```
set smtp=outlook.office365.com
set smtp-auth-user=ryan.johnson@orolia.com>
set from="ryan.johnson@orolia.com"
set smtp-auth-password=PASSWORD
set smtp-auth=login
set ssl-verify=ignore
set smtp-use-starttls
```

Example II: SMTP interface to Gmail

```
set smtp=smtp.gmail.com:587
set smtp-use-starttls
set ssl-verify=ignore
set smtp-auth-user=<user name, example user_xyz123@gmail.com>
set smtp-auth-password=<password>
set smtp-auth=login
```

5. Click the **Submit** button at the bottom of the window.
6. To test your settings:
   - In the **Test Email Address** field, enter an email address.
   - Click the **Send Test Email** button.
   - A notification that your email has been sent will appear at the top of the window.

5.4 Managing Users and Security

5.4.1 Managing User Accounts

Users need to authenticate as the login to VersaPNT. The system administrator is responsible for maintaining a list of user accounts (user names, passwords etc.) via the **MANAGEMENT > OTHER: Authentication** screen of the VersaPNT Web UI (HTTP/HTTPS). Note that user accounts CANNOT be created or edited via CLI commands using telnet or SSH.

5.4.1.1 Types of Accounts

There are three types of accounts:

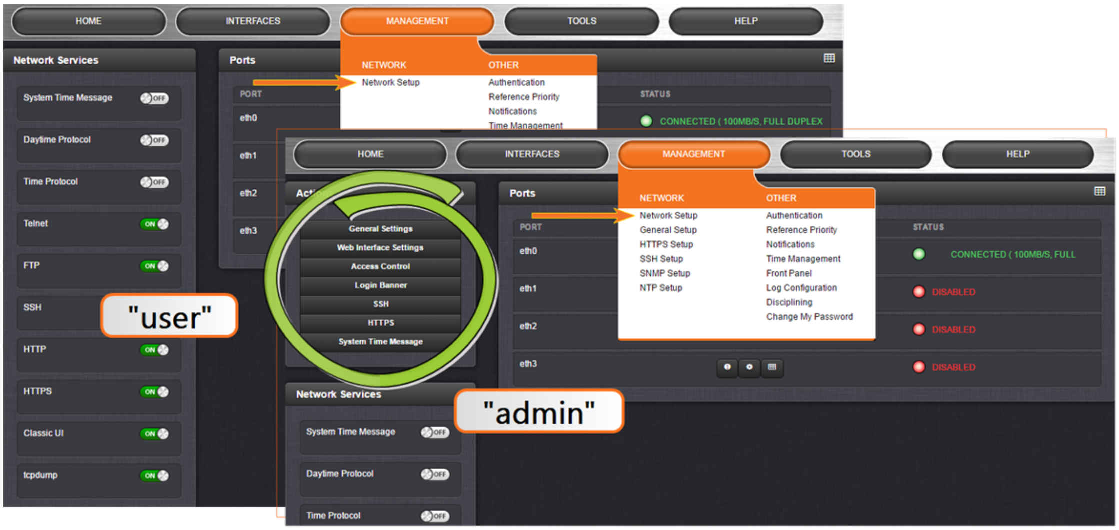
Account Type	Permissions
"user"	These accounts are intended for users only e.g., operators. These "user" accounts are read-only accounts, i.e. they do not allow any editing rights and are restricted to reviewing status-related information. The Web UI will not show (or gray-out) any editing functionality.
"admin"	Administrator accounts are intended to be used by system administrators. These accounts have writing access. You can add additional admin accounts to the pre-installed administrator account `spadmin`.
"factory"	The default factory account with the username `spfactory` is meant to provide access to Spectracom technical support personnel. You can delete this account, if you so prefer. Note, however, that executing the **Clean and Halt** command (see "Cleaning the Configuration Files and Halting the System" on page 265) will recreate the Factory account.

5.4.1.2 About "user" Account Permissions

As outlined above – unlike "administrator" accounts – "user" accounts are read-only accounts, i.e. they do not allow any editing rights and are restricted to reviewing status-related information. Otherwise, the privileges assigned to admin groups are exactly the same whether logging in via the Web UI, or connecting via SSH.

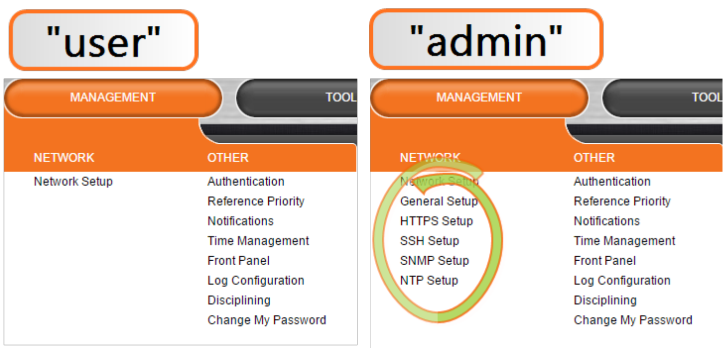
Account Differences, General

While most menus look the same to "admin" and "user" type accounts (except the MANAGEMENT menu, see below), the screens and panels located below the main menus will differ in such that the "user" UI will show fewer (if any) configuration options:



The status information presented, however, will be largely identical.

The most significant differences are visible in the MANAGEMENT menu, since most of the Setup menus are hidden from "user" accounts:



Account Differences, by Menu

INTERFACES Menu

"user" and "admin" accounts can view and modify all settings in these pages (can view/edit GNSS receiver, Outputs, and Option Cards).

MANAGEMENT Menu

Pin Layout: The "user" cannot see or manipulate these settings.

Network: While the toggle switches in the **Network Services** panel are displayed, "user" cannot modify any of the network-related configurations (such as telnet, FTP, SSH and HTTP/HTTPS). The switches can be moved, but an error message will be displayed shortly thereafter.

Authentication: "user" can access this page but can only change his/her own password. Users cannot create any new accounts and cannot modify any accounts.

Reference Priority: "user" can access this page and modify settings.

Notifications: "user" can access this page and modify settings.

Time Management: "user" can access this page and modify settings.

Front panel: "user" can access this page and modify settings.

Log Configuration: "user" can access this page and modify settings.

Disciplining: "user" can access this page and modify settings.

Change my password: "user" can access this page and change only their password.

TOOLS Menu

Logs: "user" can view only the listed logs

Upgrade/Backup: "user" cannot perform any updates.

Reboot/Halt: "user" cannot reboot/shutdown/halt the unit.

5.4.1.3 Rules for Usernames

- Length: Usernames can be between 3 and 32 characters long.
- Accepted characters:
  - All letters, including the first, must be lower-case.
  - Numbers, underscores and dashes are accepted.
  - Next to punctuation symbols, the following special characters are NOT accepted: ! @ # $ % ^ & * ( )

5.4.1.4 Adding/Deleting/Changing User Accounts

To access the **Users** list, and the **Password Security** panel:

1. Navigate to **MANAGEMENT > OTHER: Authentication**.
2. The **Users** panel on the right shows a list of all user accounts, including their **Username**, the **Group** to which that user account is assigned to, and any **Notes** about the user account:

VersaPNT units are shipped with two default accounts:

i. The "administrator" account (`spadmin`), and

ii. The "factory" service account (`spfactory`).

Additional accounts may be added and deleted as desired. The number of accounts that can be setup is virtually unlimited.

> **Note:** The password for the `spadmin` account can be changed (and it is recommended to do so for security reasons). However, the `spadmin` account name cannot be changed, and the account cannot be removed from VersaPNT.

> **Note:** The `spfactory` account is for use by Spectracom service personnel. While the `spfactory` account can be deleted by an administrator, it should be noted that this may potentially limit remotely provided technical support.

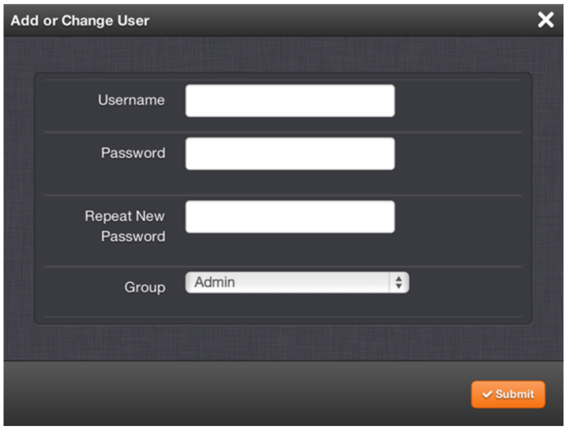
User accounts can be created to have either limited user or full administrator rights. Each user can be assigned his own login password.

» To ADD a user account, click the PLUS icon in the top-right corner of the **Users** screen.

» To DELETE a user account, click the Delete button in that account's entry on the **Users** screen.

» To APPLY CHANGES to a user account, click the Change button next to the desired user account.

When either the Change button or the PLUS icon is clicked, the **Add or Change User** window appears:



To add a user account:

1. Enter a **Username**. (For rules, see "Rules for Usernames" on the previous page.)

2. Enter a **Password**. The password requirements are configurable, see "Managing Passwords" below. By default a password can be any combination of upper- and lower-case characters. Minimum password length = 8 characters, maximum length = 32 characters.
3. Repeat the new **Password**.
4. In the **Group** field, choose the permission group to which you want the user to belong to: user or admin. The user permission level assigns permission to access and change all settings, with the following **exceptions** that are limited to the admin accounts:
    - Changing network settings
    - Adding and deleting user accounts
    - Web Interface Settings
    - Upgrading VersaPNT system software
    - Resetting the VersaPNT configuration
    - Clearing log files
    - Changing Disciplining Setup options
    - Changing configuration options for the following protocols or features:
        - NTP
        - HTTPS, SSH
        - LDAP/RADIUS
        - SNMP (with the exception of configuring SNMP notifications).

To change a user account:

1. In the **Add or Change User** window the **Username** field will be populated.
    a. To change it, type the new name.
    b. To change the user account's password, type the new password in the **Password** field and confirm it in the **Repeat New Password** field. Note that the password requirements are configurable, see "Managing Passwords" below.
    c. To change the user account's user permission group, select the group from the drop-down menu.

For more information, see also "Managing Passwords" below.

5.4.2 Managing Passwords

Caution: For security reasons, it is advisable to change the default credentials.

5.4.2.1 Configuring Password Policies

To configure password requirements e.g., rules for minimum password length and special characters:

1. Navigate to **MANAGEMENT > OTHER: Authentication**.
2. In the **Actions** panel, click **Security Policy**.

3. The **Password Security** window will display. Fill in the self-explanatory fields and click Submit.

5.4.2.2 The Administrator Password

The factory default administrator login password value of *admin123* can be changed from the default value to any desired value. If the current password is known, it can be changed using the VersaPNT Web UI.

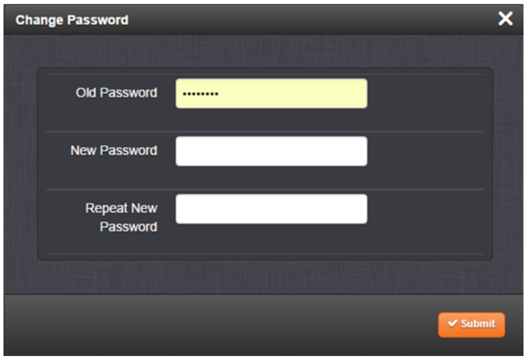
> **Note:** To follow this procedure, you must be logged in as the `spadmin` user. If you are unable to login as `spadmin`, follow the procedure outlined in "Lost Password" below.

If the password has already been changed from the default value, but the current value is no longer known, the administrator password can be reset back to the factory default value, see "Lost Password" below. Once reset, it can then be changed to a new desired value via the Web UI.

Changing the admin password

To change the admin password from a known value to another desired value:

1. Navigate to **MANAGEMENT > OTHER: Change My Password**.
2. The **Change Password** window will display.



3. In the **Old Password** field, type the current password.
4. In the **New Password** field, type the new password.

> **Note:** The new password can be from 8 to 32 characters in length.

5. In the **Repeat New Password** field, retype the new password.
6. Click **Submit**.

For more information, see also "Managing User Accounts" on page 225.

5.4.2.3 Lost Password

If the current *spadmin* account password has been changed from the default value and has been forgotten or lost, you can reset the *spadmin* password back to the factory default value of *admin123*.

Resetting the *spadmin* account password does not reset any user-created account passwords. This process only resets the *spadmin* account password.

Any user with administrator rights can reset the *spadmin* password through the **MANAGEMENT > OTHER: Authentication** window.

Changing the "spadmin" password via Web UI

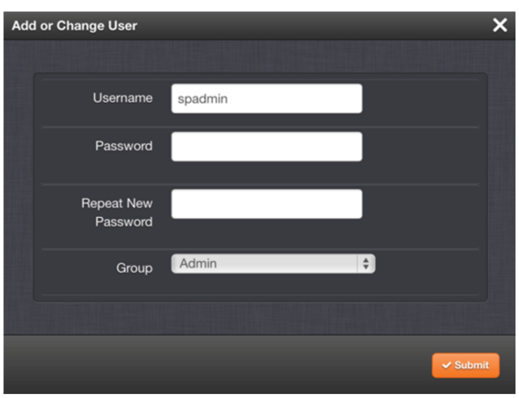
To change the spadmin password:

1. Navigate to the **MANAGEMENT > OTHER: Authentication** window.
2. Locate the *spadmin* entry in the **Users** table.

3. Click the **CHANGE** button.
4. In the **Add or Change User** window:
   1. Enter a new password.

      Note: The new password can be from 8 to 32 characters in length.

   2. Confirm the new password.

   3. Click **Submit**.

To reset the "spadmin" account password via the serial port, or SSH:

1. Connect a PC to the port, and log in using an account with admin group rights (such as the *spadmin* account).
2. Type: `resetpw` <Enter>. The *spadmin* account password is now reset.

After resetting the password follow the procedure above to change the *spadmin* password in the **MANAGEMENT > OTHER: Authentication** window.

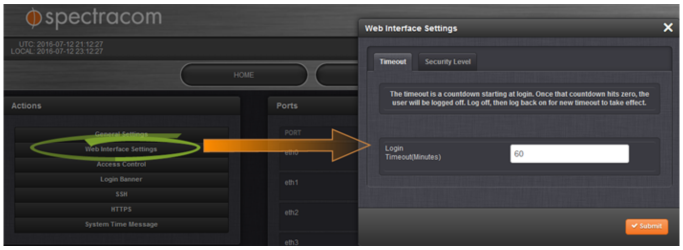
5.4.3 Web UI Timeout

For security reasons, the Web UI will automatically timeout after a set number of minutes, i.e. you will be logged out by the system, regardless of activity, and need to actively login again.

- **Minimum** timeout duration: 10 minutes
- **Maximum** timeout duration: 1440 minutes (24 hours)
- **Default** timeout duration: 60 minutes.

To change the time after which the Web UI will timeout:

1. Navigate to the **MANAGEMENT > Network Setup** screen.
2. In the **Actions** panel on the left, click on **Web Interface Settings**.



3. In the **Web Interface Settings** window, enter the desired value in minutes.

In order for a new setting to take effect, you need to log off, and then log back in again. This setting affects all users, not just the user changing the value.

5.5 Miscellanous Typical Configuration Tasks

5.5.1 REST API Configuration

REST (Representational State Transfer) API offers many benefits for customers who require additional configuration access. Any functionality that can be done manually through the Web UI can be scripted, creating machine-to-machine automation and communication.

Common tasks that would ordinarily require manual interaction with the Web UI can be scheduled and automated.

REST API is free available on any VersaPNT with Web UI communication.

For detailed instructions on REST API configuration and to obtain access, contact your local sales or service representative.

5.5.2 Creating a Login Banner

A login banner is a customizable banner message displayed on the login page of the VersaPNT Web UI. The login banner can be used, for example, to identify a unit.

Figure 5-1: Login banner (example)

To configure a login banner:

1. Navigate to the **MANAGEMENT > Network Setup** screen.
2. In the **Actions** panel on the left, click **Login Banner**.
3. The **Network Access Banner** window will display. Check the box **Enable Custom Banner**.
4. In the **Plain Text Banner** text box, type in your custom text.

   Note: The Plain Text Banner is used to create a message for all interactive login interfaces (Web UI, telnet, SSH, FTP, SFTP, serial, etc.). It is not required to include HTML tags.

5. Optionally, you may also use the Web Interface Banner text box.

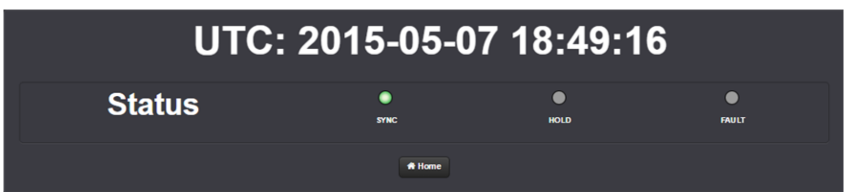
   Note: Enabling and using the Web Interface Banner text box will allow you to apply HTML formatting tags to your message (e.g., colors). Note that this

> functionality is limited to browser-based Web UI access.

6. To test your new banner, click **Apply** to see a preview at the bottom of the window. OR, click **Submit**, and log out of the Web UI, and back in so as to see the banner on the actual login page.

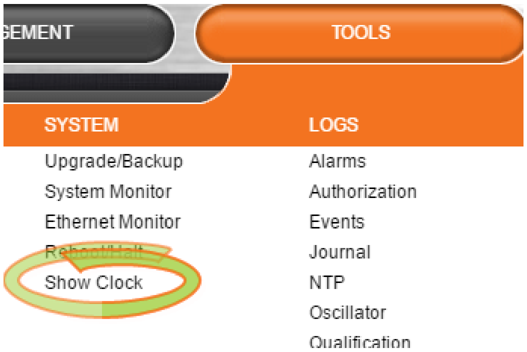
5.5.3 Show Clock

Instead of the Web UI, a large digital clock can be displayed on your computer screen. Next to the system status, the screen clock will display the UTC time, and the VersaPNT time.



To display the screen clock instead of the Web UI:

1. Navigate to **TOOLS** > **SYSTEM: Show Clock**:



2. To return to the standard Web UI, click **Home**.

5.5.4 Synchronizing Network PCs

Frequently, network PCs have to be synchronized to VersaPNT via the Ethernet port, using NTP (Network Time Protocol). A detailed description on how to synchronize Windows PCs can be found online in the Spectracom Technical Note Synchronizing Windows Computers on the Spectracom website. This document also contains information and details about using the Spectracom **PresenTense** NTP client software.

5.6 Quality Management

5.6.1 System Monitoring

5.6.1.1 Status Monitoring via the Web UI

status information can be accessed via the VersaPNT **Web UI**, such as:

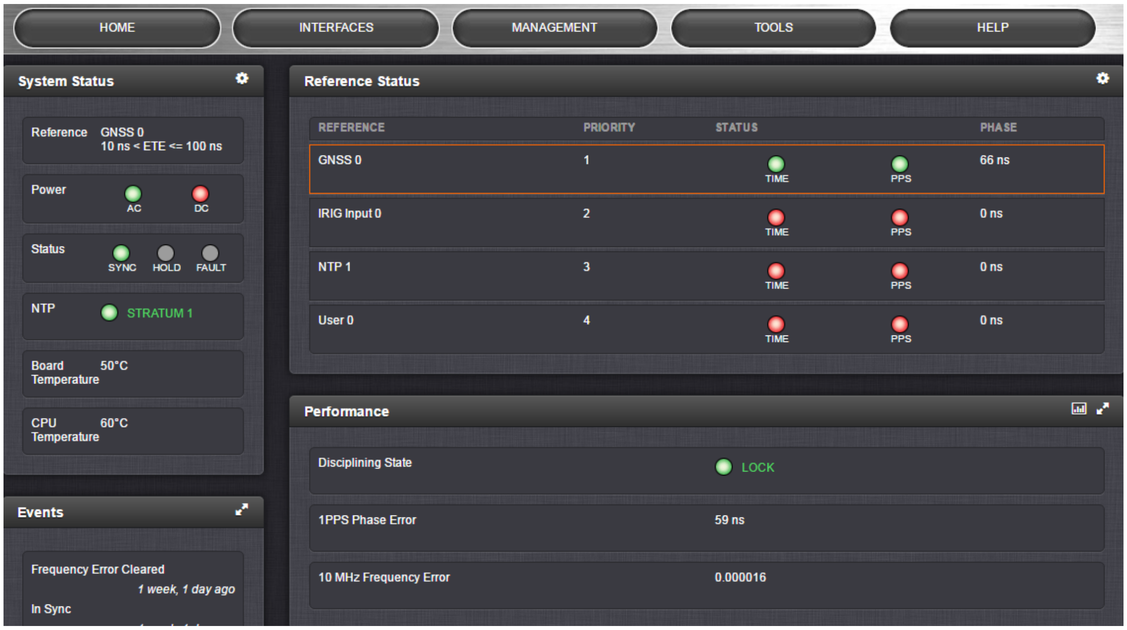
- Time synchronization status, including references
- GNSS satellites currently being tracked
- NTP sync status and current Stratum level
- Estimated time errors
- Oscillator disciplining
- Temperature monitoring

The **HOME** screen provides time server status information, while the **TOOLS** > **System Monitor** screen also displays hardware status data, e.g. temperature curves:

Status Monitoring via the HOME Screen

The **HOME** screen of the VersaPNT Web UI provides a system status overview (see also "The Web UI HOME Screen" on page 17).

The **HOME** screen is divided into four panels:



System Status panel

- **Reference**—Indicates the status of the current synchronizing reference, if any.
- **Power**—Indicates whether the power is on.
- **Status**—Indicates the status of the network's timing. There are three indicators in the Status field:
  - **Sync**—Indicates whether VersaPNT is synchronized to its selected input references.
    - **Green** indicates VersaPNT is currently synchronized to its references.
    - **Orange** indicates VersaPNT is not currently synchronized to its references.
  - **Hold**—When lit, VersaPNT is in Holdover mode.
  - **Fault**—Indicates a fault in the operation of the VersaPNT. See "Troubleshooting via Web UI Status Page" on page 272 for instructions for troubleshooting faults.
- **Alarm Status**: If a major or minor alarm is present, it will be displayed here.
- **NTP**—Current STRATUM status of this VersaPNT unit.
- **Temperature**—The current board temperature will be displayed here.

Reference Status panel

- **REFERENCE**: Indicates the name type of each reference. These are determined by the inputs set up for the VersaPNT
- **PRIORITY**: Indicates the priority of each reference. This number will be between 1 and 15. References in this panel appear in their order of priority. See "Configuring Input Reference Priorities" on page 167 for more information.
- **STATUS**: Indicates which available input reference is acting as the **Time** reference and which available input reference is acting as the **1PPS** reference.
  - **Green** indicates that the reference is present and has been declared valid.
  - **Orange** indicates the input reference is not currently present or is not currently valid.

Performance panel

- **Disciplining State**—Indicates whether or not the internal oscillator is currently being disciplined (steered to an input reference).
- **1PPS Phase Error**—An internal measurement (in nanoseconds) of the internal 1PPSs' phase error with respect to the selected input reference (if the input reference has excessive jitter, phase error will be higher)
- **10 MHz Frequency Error**—An internal estimated calculation (in Hertz) of the internal oscillator's frequency error, based on the phase accuracy error at the beginning and end of a frequency measurement window (the length of this window will vary depending upon the type of oscillator installed and the oscillator adjustment algorithm).

Events panel

The Events panel in the bottom-left corner of the **HOME** screen is a log of VersaPNT's recent activity. It updates in real time.

> **Note:** If you know the individual reference or output whose status you wish to see, you can access the Status window of that reference or output directly through the INTERFACES > REFERENCES or INTERFACES > OUTPUTS drop-down menu.

Status Monitoring via the System Monitor Screen

To display status information pertaining mainly to VersaPNT's current hardware status, navigate to **TOOLS > SYSTEM > System Monitor**.

The information provided on the **System Monitor** Screen is subdivided into three panels:

System Status panel

This is identical with the HOME screen "System Status panel" on the previous page.

Disk Status panel

This panel displays:

- Total: [MB]
- Used: [MB]
- Free: [MB]
- Percent: [%]

The last item refers to system storage. If you need to update the System Software, and this number is 70% or higher, it is recommended to clear logs and stats in order to free up memory space. (Navigate to **TOOLS > SYSTEM: Upgrade/Backup**, and click the corresponding buttons in the lower left-hand corner.)

System Monitor panel

Graphs are displayed for:

- Board Temperature
- CPU Temperature
- Memory Used
- CPU Used.

To delete the logged data used to generate the displayed graphs, click the TRASHCAN icon. (Note that re-populating the graphs with fresh data generated at a 1/min. rate will take several minutes.)

To download the logged data in `.csv` format, click the ARROW icon.

5.6.1.2 Ethernet Monitoring

To monitor Ethernet status and traffic:

1. Navigate to **TOOLS > SYSTEM: Ethernet Monitor**. The Ethernet monitoring screen opens:

The data displayed is linked to a specific Ethernet port e.g., ETH0. If you enable additional Ethernet ports, their throughput data will also be displayed.

In the **Traffic** pane on the right the traffic throughput in Bytes per second is displayed in two graphs. Drag the handles at the bottom of the graphs to zoom in on a particular time frame.

In the **Actions** panel on the left, you can clear or download monitoring data.

In the **Status** panel on the left, information pertaining to the given Ethernet port is displayed, including throughput statistics and error statistics. The Mode field indicates which transmission mode is being used for the given Ethernet port:

» **FULL** duplex, or

» **HALF** duplex.

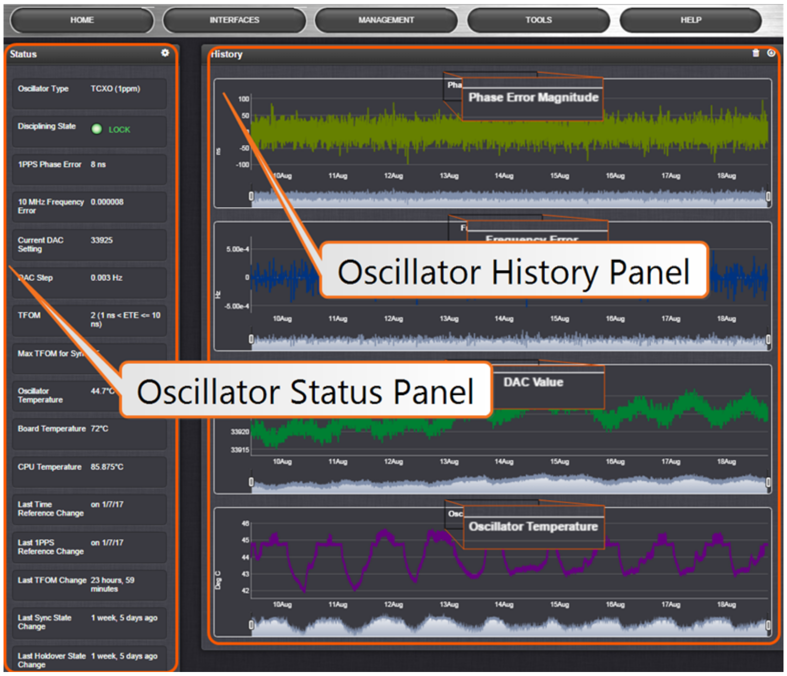
Note that the Mode is auto-negotiated by VersaPNT. It can be changed only via the switch VersaPNT is connected to, not by using the VersaPNT Web UI.

5.6.1.3 Monitoring the Oscillator

The Oscillator Management screen provides current and history status information on disciplining state and accuracy.

To access the **Oscillator Management** screen:

1. Navigate to **MANAGEMENT > OTHER: Disciplining**.
2. The **Oscillator Management** screen will display. It consists of two panels:



The Oscillator Status Panel

This panel provides comprehensive information on the current status of VersaPNT's timing state.

- Oscillator Type: Type of oscillator installed in the unit.
- Disciplining State: State of oscillator control and disciplining; indicates whether or not the internal oscillator is currently being disciplined (steered to an input reference). The states are: "Warm up", "Calibration", "Tracking Setup", "Lock State", "Freerun", and "Fault".
- 1PPS Phase Error: A tracking measurement [scaled time, in ns, or ms] of the internal 1PPSs' phase error with respect to the selected input reference. Long holdover periods or an input reference with excessive jitter will cause the phase error to be high. The oscillator disciplining control will gradually reduce the phase error over time. Alternatively, restarting the tracking manually (see "Restart Tracking" under "Configuring the Oscillator" on page 208), or automatically via a pre-set Phase Error Limit, will quickly reduce the phase error.
- 10 MHz Frequency Error: An internal estimated calculation (in Hertz) of the internal oscillator's frequency error, based on the phase accuracy error at the beginning and end of a frequency measurement window (the length of this window will vary depending upon the type of oscillator installed and the oscillator adjustment algorithm).
- Current DAC Setting: Current DAC value, as determined by the oscillator disciplining system. The value is converted into a voltage that is used to discipline the oscillator. A stable

value over time is desirable and suggests steady oscillator performance (see also the graph in the History Panel).

- DAC Step: Step size for adjustments to the internal oscillator, as determined by the oscillator disciplining system. Larger steps = quicker, but coarser adjustments. The step size is mainly determined by the type of oscillator.
- TFOM: The Time Figure of Merit is VersaPNT's estimation of how accurately the unit is synchronized with its time and 1PPS reference inputs, based on several factors, known as the Estimated Time Error or ETE. The larger the TFOM value, the less accurate VersaPNT believes it is aligned with its 1PPS input that is used to perform disciplining. If this estimated error is too large, it could adversely affect the performance of oscillator disciplining. The available TFOM range is 1 through 15.
- Max TFOM for Sync: Value, as set under "Configuring the Oscillator" on page 208
- Temperature(s): Three temperatures are displayed:
  - **Oscillator** temperature, which has an effect on oscillator accuracy, and therefore can be used to interpret oscillator performance.
  - **Board** temperature (measured on the main board, sometimes also referred to as 'System temperature')
  - **CPU** temperature

  > **Note:** Oscillator temperature is plotted over time in the History panel on the right, while graphs for board and CPU temperature can be found under TOOLS > SYSTEM: System Monitor.

- Last Time Reference Change: [Timestamp: Last occurrence]
- Last 1PPS Reference Change: [Timestamp: Last occurrence]
- Last TFOM Change: [Timestamp: Last occurrence]
- Last Sync State Change: [Timestamp: Last occurrence]
- Last Holdover State Change: [Timestamp: Last occurrence]

The Oscillator History Panel

The **Oscillator History Panel** offers real-time graphical monitoring of VersaPNT's internal timing. The following graphs plot key oscillator-relevant data over time::

- **Phase Error Magnitude**: See 1PPS Phase Error
- **Frequency Error**: See 10_MHz_Frequency_Error
- **Scaled DAC Value**: See DAC Step
- **Oscillator Temperature**, which has an effect on oscillator accuracy, and therefore can be used to interpret oscillator performance.

You can **zoom** in on any of the graphs by grabbing the handles at either end and pulling them inwards. The graph will focus in on the time interval you choose in real time.

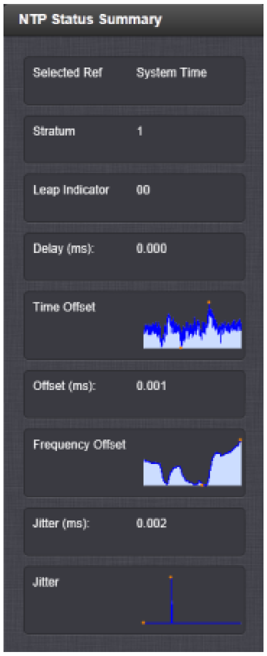
Clicking on the **Delete** icon in the top-right hand corner will erase all current oscillator log data.

Clicking on the **Download** arrow icon will download the latest oscillator log data as a `.csv` file.

5.6.1.4 NTP Status Monitoring

VersaPNT's **NTP Status Summary** provides a means to monitor NTP status and performance parameters relevant to your VersaPNT at a glance.

1. To access the **NTP Status Summary** panel, navigate to **MANAGEMENT > NETWORK: NTP Setup**.



2. The **NTP Status Summary** panel is at the lower left of the screen. The panel contains the following information:
   - » **Selected Ref**—The reference VersaPNT is currently using.
   - » **Stratum**—This is the stratum level at which VersaPNT is operating.
   - » **Leap Indicator**—The leap indicator bits (usually 00). See "Leap Second Alert Notification" on page 160.
   - » **Delay (ms)**—The measured one-way delay between VersaPNT and its selected reference.
   - » **Time Offset**—This is a graphical representation of the system time offset over time. Clicking on this graph in the NTP Status Summary panel will open a window in

the main panel containing a larger, more detailed view of the graph. See "The NTP Time Offset Performance Graph" below.

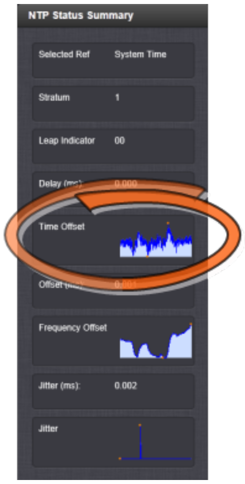
- **Offset (ms)**—Displays the configured 1PPS offset values.
- **Frequency Offset**—This is a graphical representation of the system frequency offset over time. Clicking on this graph in the NTP Status Summary panel will open a window in the main panel containing a larger, more detailed view of the graph. See "The NTP Frequency Offset Performance Graph" on the facing page.
- **Jitter (ms)**—Variance (in milliseconds) occurring in the reference input time (from one poll to the next).
- **Jitter**—This is a graphical representation of the system jitter over time. Clicking on this graph in the NTP Status Summary panel will open a window in the main panel containing a larger, more detailed view of the graph. See "The NTP Jitter Performance Graph" on page 246.

> **Note:** This panel is updated every 30 seconds, or upon clicking the browser refresh button.

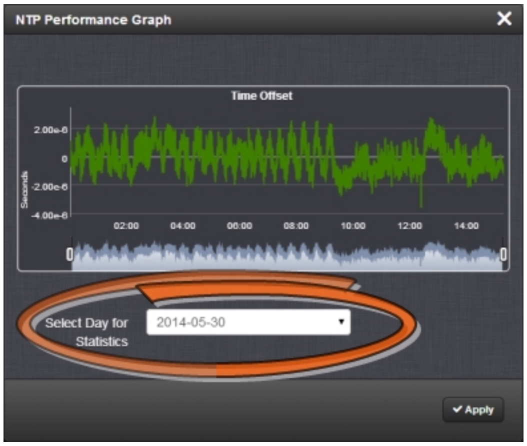
The NTP Time Offset Performance Graph

To view the NTP **Time Offset** performance graph:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **NTP Status Summary** panel locate the **Time Offset** graph.



3. Click the graph in the **NTP Status Summary** panel.
4. The **NTP Performance Graph** panel will appear.

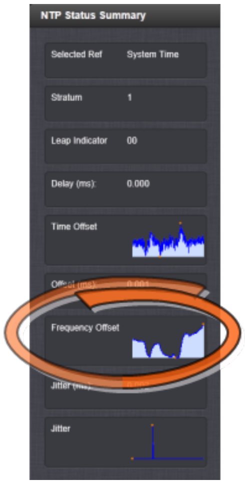


5. To select the statistics for a particular day, select a date from the drop-down list in the Select Day for Statistics field. The default date is the present date. Click **Apply**.
6. To display a higher resolution graph for a shorter time span, move one or both time sliders at the bottom of the graph inwards.

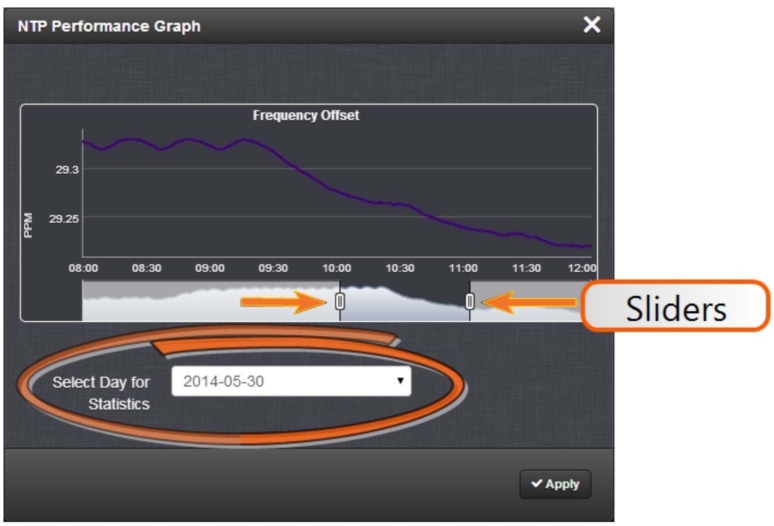
The NTP Frequency Offset Performance Graph

To view the NTP **Frequency Offset** performance graph:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup**.
2. In the **NTP Status Summary** panel locate the **Frequency Offset** graph.



3. Click the graph in the **NTP Status Summary** panel.
4. The **NTP Performance Graph** panel will appear (the data may be displayed with a delay). The X-axis represents time, the Y-axis shows the frequency offset in parts-per-million (PPM); e.g. 290 PPM is equivalent to .0290 percent.

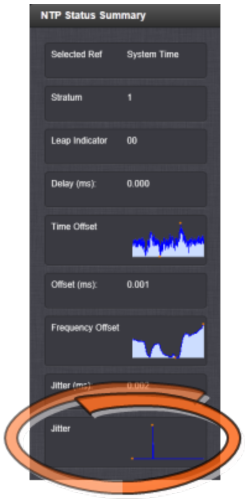


5. To select the statistics for a particular day, select a date from the drop-down list in the **Select Day for Statistics** field (highlighted in green in the illustration above). The default date is the present date. Click the **Apply** button.
   » To display a higher resolution graph of a shorter time frame, move one or both of the two sliders inwards.

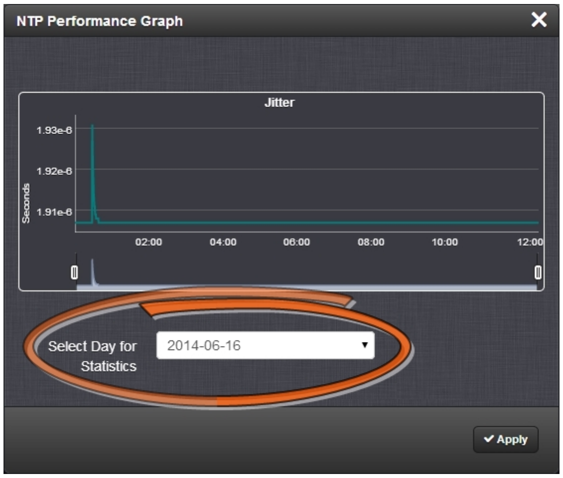
The NTP Jitter Performance Graph

To view the NTP **Jitter** performance graph:

1. Navigate to **MANAGEMENT > NETWORK: NTP Setup** screen.
2. In the **NTP Status Summary** panel locate the **Jitter** graph.



3. Click the graph in the **NTP Status Summary** panel.
4. The **NTP Performance Graph** panel will appear.



5. To select the statistics for a particular day, select a date from the drop-down list in the **Select Day for Statistics** field. The default date is the present date. Click the **Apply** button.

» To display a higher resolution graph for a shorter time span, move one or both time sliders at the bottom of the graph inwards.

5.6.2 Logs

VersaPNT maintains different types of event logs (see below) to allow for traceability, and for record keeping. Should you ever require technical support from Spectracom, you may be asked for a copy of your logs to facilitate remote diagnosis.

> Note: The logs that record **navigation** events and accuracy are in a separate file from all other logs. See "INS Configuration" on page 118 for INS log information.

Logs stored internally are being kept automatically, while the storage of log files in a remote location has to be set up by the user.

For each type of log, four 75 KB files are maintained internally on a revolving basis, i.e. the oldest file will be overwritten, as soon as all four files have filled up with event data. The life expectancy of a log file depends on the amount of data accumulating over time: Some types of logs will fill up within days, while others can take months until they have reached their maximum storage capacity.

You can delete logs at any time, see "Clearing All Logs" on page 256.

5.6.2.1 Types of Logs

VersaPNT generates log files for the following event categories:

Alarms Log

Displays log entries for the Timing System, for example:

- **The Unit has Rebooted**: VersaPNT was either rebooted or power cycled.
- **In Holdover**: Input references were available, but all input references have since been lost. If the references are not restored before the Holdover period expires, time sync will be lost.

- **No longer in Holdover**: Input references were lost at one point (or declared not valid), but have since been restored OR the Input references were not restored before the Holdover period expired (Time Sync alarm is asserted).
- **In Sync**: VersaPNT is synchronized to its selected Time and 1PPS reference inputs.
- **Not In Sync**: VersaPNT is not synchronized to its Time and 1PPS inputs and is not currently in Holdover. NTP will indicate to the network that it is Stratum 15 and so the time server likely be ignored as a time reference.
- **Frequency Error**: The oscillator's frequency was measured and the frequency error was too large. Or, the frequency couldn't be measured because a valid input reference was not available.
- **Reference change**: VersaPNT has selected a different Time and 1PPS input reference for synchronization. Either the previously selected input reference was declared not valid (or was lost), so a lower priority reference (as defined by the Reference Priority Setup table) is now selected for synchronization OR a valid reference with higher priority than the previous reference is now selected for synchronization.

> **EXAMPLE:**
>
> GNSS is the highest priority reference with IRIG input being a lower priority. VersaPNT is synced to GNSS and so GNSS is the selected reference. The GNSS antenna is disconnected and IRIG becomes the selected reference. The Reference change entry is added to this log.

Authentication Log

Displays log entries for authentication events (e.g., unsuccessful login attempts, an incorrectly entered password, etc.) that are made to VersaPNT's command line interfaces (such as telnet, SSH, FTP, etc.).

Events Log

Displays log entries related to GNSS reception status changes, Sync/Holdover state changes, SNMP traps being sent, etc. Examples include:

- **Reference Change**: VersaPNT has switched from one input reference to another (for example, IRIG was the selected input being used, but now GNSS is the selected reference).
- **GPS Antenna Problem**: The GPS Antenna Problem alarm indicates the GNSS receiver has detected an over-current or undercurrent condition (an open or short exists in the GNSS antenna cable, or the GNSS antenna is not connected to VersaPNT). The receiver will attempt to continue the normal acquisition and tracking process regardless of the antenna status. The current draw measurements that will indicate an antenna problem are:
  - Under-current indication < 8 mA
  - Over-current indication > 80 mA

> **Note:** This alarm condition will also be present if a GNSS antenna splitter that does not contain a load to simulate an antenna being present is being used.

- **GPS Antenna OK**: The antenna coax cable was just connected or an open or short in the antenna cable was being detected but is no longer being detected.
- **Frequency Error**: The oscillator's frequency was measured and the frequency error was too large. Or, the frequency couldn't be measured because a valid input reference was not available.
- **Frequency Error cleared**: The Frequency Error alarm was asserted but was then cleared.
- **In Holdover**: Input references were available, but all input references have since been lost. If the references are not restored before the Holdover period expires, time sync will be lost.
- **No longer in Holdover**: Input references were lost at one point (or declared not valid), but have since been restored OR the Input references were not restored before the Holdover period expired (Time Sync alarm is asserted).
- **In Sync**: VersaPNT is synchronized to its Time and 1PPS inputs.
- **Not In Sync**: VersaPNT is not synchronized to its Time and 1PPS inputs and is not currently in Holdover. NTP will indicate to the network that it is Stratum 15 and so the time server likely be ignored as a time reference.
- **Sending trap for event 1 (SNMPSAD)**: An SNMP trap was sent by the SNMP agent to the SNMP Manager. The event number in this entry indicates which SNMP trap was sent.
- **The Unit has Rebooted**: VersaPNT was either rebooted or power cycled.

Journal Log

Displays log entries created for all configuration changes that have occurred (such as creating a new user account, for example).

NTP Log

The NTP log displays operational information about the NTP daemon, as well as NTP throughput statistics (e.g., packets/sec.). Examples for entries in this log include indications for when NTP was synchronized to its configured references (e.g., it became a Stratum 1 time server), as well as stratum level of the NTP references.

The NTP throughput statistics data can be utilized to calculate mean values and the standard deviation.

Example log entries include:

- **Synchronized to (IP address), stratum=1**: NTP is synchronizing to another Stratum 1 NTP server.

- **ntp exiting on signal 15**: This log entry indicates NTP is now indicating to the network that it is a Stratum 15 time server because it is not synchronized to its selected reference.
- **Time reset xxxxx s**: These entries indicate time corrections (in seconds) applied to NTP.
- **No servers reachable**: NTP cannot locate any of its configured NTP servers.
- **Synchronized to PPS(0), stratum=0**: NTP is synchronized using the PPS reference clock driver (which provides more stable NTP synchronization).

Oscillator Log

Displays log entries related to oscillator disciplining. Provides the calculated frequency error periodically while synchronizing to a reference.

GPS Qualification Log

If VersaPNT is connected to a GNSS antenna and is tracking satellites, this log contains a running hourly count of the number of GNSS satellites tracked each hour. This history data can be used to determine if a GNSS reception problem exists and whether this is a continuous or intermittent reception issue.

GNSS reception may be displayed as cyclic in nature. A cyclic 12 hour pattern of decreased GNSS reception typically indicates that the GNSS antenna has an obstructed view of the horizon. The GNSS satellites are in a 12-hour orbit, so if part of the sky is blocked by large obstructions, at the same time every day (at approximately 12 hour intervals), the GNSS reception may be reduced or may vanish altogether. If this occurs, the antenna should be relocated to afford it an unobstructed view of the sky.

Every hour (displayed in the log as UTC time), VersaPNT counts the total number of satellites that were tracked during that hour. The GNSS qualification log shows the number of satellites that were tracked followed by the number of seconds that the particular number of satellites were tracked during the hour (3600 seconds indicates a full hour). The number to the left of the "=" sign indicates the number of satellites tracked and the number to the right of the "=" sign indicates the number of seconds (out of a total of 3600 seconds in an hour) that the unit was tracking that number of satellites. For example, "0=3600" indicates the unit was tracking 0 satellites for the entire hour, while "0=2700 1=900" indicates the unit was tracking one satellite for 900 seconds, but for the remaining portion of the hour it was tracking zero satellites.

Every hourly entry in the log also contains a quality value, represented by "Q= xxxx" (where x can be any number from 0000 through 3600). The Qualification log records how many satellites were tracked over a given hour. If for every second of the hour a tracked satellite was in view, the Quality value will equal 3600. For every second VersaPNT tracked less than the minimum number of satellites, the value will be less than 3600. The minimum requirement is one satellite at all times after the unit has completed the GNSS survey and indicates "Stationary". A minimum of four satellites are required in order for the GNSS survey to be initially completed.

If all entries in the qualification log are displayed as "0=3600", a constant GNSS reception problem exists, so the cause of the reception issue is continuous. If the unit occasionally shows 0=3600 but at other times shows that 1 through 12 have numbers of other than "0000", the reception is intermittent, so the cause of the reception issue is intermittent. If the Quality value normally equals 3600 but drops to lower than 3600 about every 12 hours, the issue is likely caused by the GNSS antenna having an obstructed view of the sky.

Example GPS Qualification Log Entry:

6 = 151 7 = 1894 8 = 480 9 = 534 10 = 433 12 = 108 Q = 3600

In this example, VersaPNT tracked no less that 6 satellites for the entire hour. Out of the entire hour, it was tracking 6 satellites for a cumulative total of 151 seconds (not necessarily in a row). For the duration of the hour, it was tracking, 7, 8, 9, 10 and 12 satellites for a period of time. Because it was tracking at least at least one satellite for the entire hour, this Quality value is Q=3600.

Note: If VersaPNT is not connected to a GNSS antenna, this log will remain empty.

System Log

Displays log entries related to the Timing System events and daemon events (such as the Alarms, Monitor, Notification, or SNMP daemons starting or stopping, etc.)

Timing Log

Displays log entries related to Input reference state changes (for example, IRIG input is not considered valid), antenna cable status. Examples include:

- **GRGR = GNSS Reference[1] antenna fault**: The GNSS Antenna Problem alarm indicates the GNSS receiver has detected an over-current or undercurrent condition (an open or short exists in the GNSS antenna cable, or the GNSS antenna is not connected to VersaPNT). The receiver will attempt to continue the normal acquisition and tracking process regardless of the antenna status.
- **GR antenna ok**: The antenna coax cable was connected at this time or an open or short in the antenna cabling was occurring but is no longer being detected.

Update Log

Displays log entries related to software updates that have been performed.

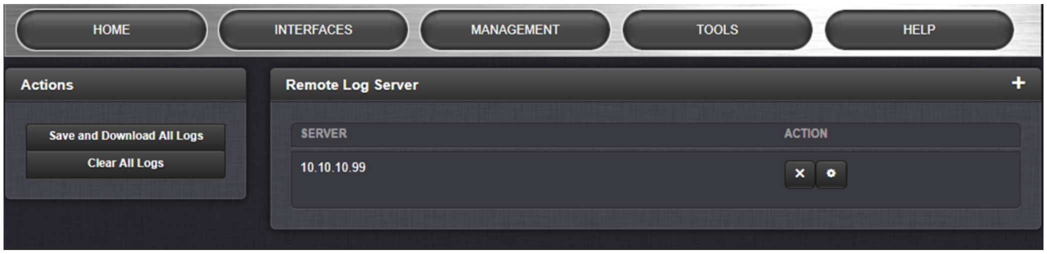
5.6.2.2 The Logs Screen

The **Logs** Screen provides access to settings that apply to all logs.

To access the Logs Screen:

[1] GR = GNSS Reference

1. Navigate to **MANAGEMENT** > **OTHER**: **Log Configuration.**
2. The **Logs** screen will appear. It is divided into two panels:



The Logs Actions panel

The **Actions** panel on the upper-left corner of the **Logs** screen allows you to perform batch actions on your logs:

» **Save and Download All Logs**—Save and download all the logs on VersaPNT.

» **Clear All Logs**—Clear all the logs on VersaPNT.

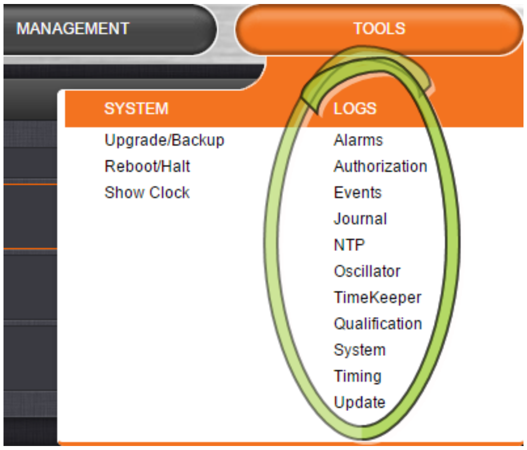
The Remote Log Server panel

The **Remote Log Server** panel, which is where you set up and manage logs on one or more remote locations. See also: "Setting up a Remote Log Server" on page 255.

5.6.2.3 Displaying Individual Logs

To access individual VersaPNT logs:

1. From the **TOOLS** drop-down menu, select the desired **Logs** category (for example, “Alarms”, or “Events”) from the right-hand column.

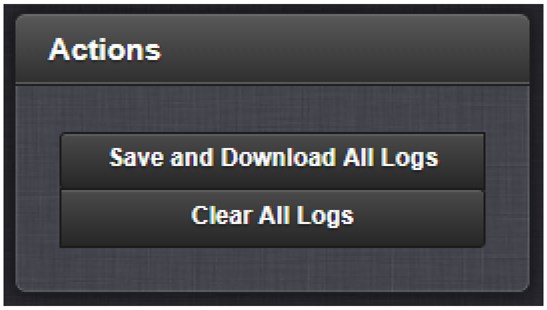


5.6.2.4 Saving and Downloading Logs

The VersaPNT Web UI offers a convenient way to save, bundle, and download all logs in one simple step. This feature may be useful when archiving logs, for example, or for troubleshooting technical problems: Spectracom Technical Support/Customer Service may ask you to send them the bundled logs to remotely investigate a technical concern.

To save, bundle, and download all logs:

1. Navigate to **MANAGEMENT > OTHER: Log Configuration**.
2. On the left side of the screen, in the **Actions** panel, click on the **Save and Download All Logs** button.



3. Select where to save the log bundle to. The default file name is `.log`.
4. If so asked by Spectracom Technical Support, attach the bundled log files (typically together with the oscillator status log, see: "Saving and Downloading the Oscillator Log" below) to your email addressed to Spectracom Technical Support.

Saving and Downloading the Oscillator Log

The oscillator status log captures oscillator performance data, such as frequency error and phase error. The data can be retrieved as a comma-separated .csv file that can be read and edited with a spreadsheet software, such as Microsoft Excel®. You may want to review and/or keep this data for your own records, or you may be asked by Spectracom Technical Support to download and send the oscillator status log in the event of technical problems.

To download the oscillator status log:

1. Navigate to **MANAGEMENT > OTHER: Disciplining**.

2. Click on the ARROW icon in the top-right corner of the screen. Save the .csv file to your computer.

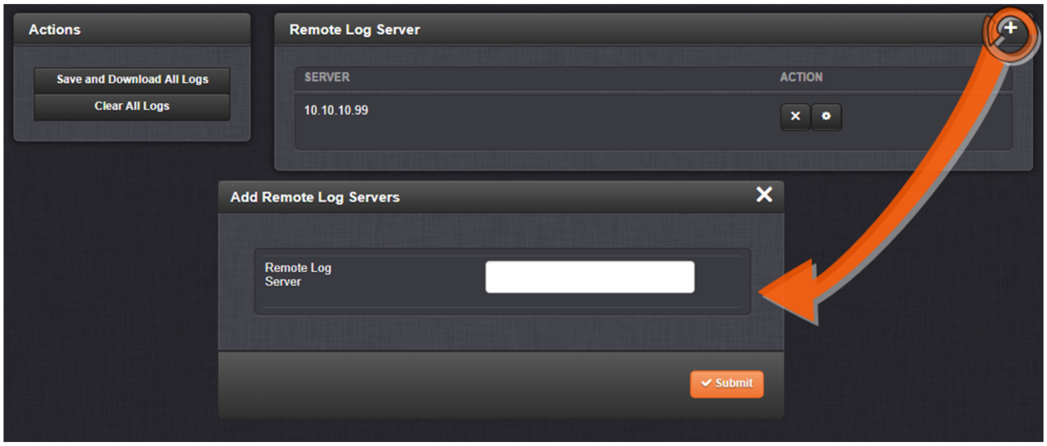
3. If so asked by Spectracom Technical Support, attach the oscillator status log file (typically together with the bundled VersaPNT log files, see: "Saving and Downloading Logs" on the previous page) to your email addressed to Spectracom Technical Support.

5.6.2.5 Setting up a Remote Log Server

Storing log files on a remote log server supports advanced logging functionality.

Adding a remote log server:

1. Navigate to **MANAGEMENT > OTHER: Log Configuration.**
2. In the **Remote Log Server** panel, click on the PLUS icon in the top-right corner of the panel. The **Add Remote Log Servers** window displays.



3. Enter the IP address or host server name (e.g., “MyDomain.com”) you want to use as a remote log server.
4. Click the **Submit** button.

5. Your remote log server will appear in the **Remote Log Server** panel.
6. This action will configure all logs to be sent to the remote server together.

Changing or deleting a remote log server:

1. Navigate to **MANAGEMENT > OTHER: Log Configuration**.
2. In the **Remote Log Server** panel locate the remote server you wish to change or delete.

3. Choose the MINUS button to delete the remote log server. Confirm by clicking OK in the message window.

—OR—

3. In the **Remote Log Server** panel, click the GEAR button to change the remote log server. Type in a new IP address or host domain server (e.g., MyDomain.com).

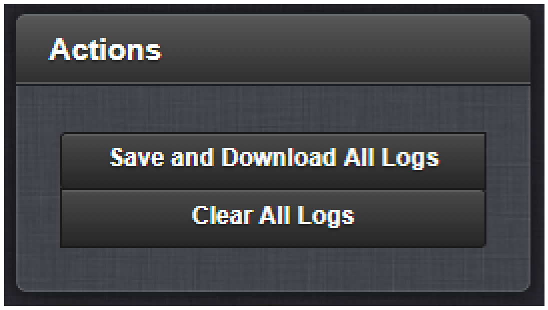
5.6.2.6 Clearing All Logs

> **Note:** Authentication logs and NTP logs cannot be cleared.

All local logs in the `home/spectracom` directory will be logged. Other logs e.g., located on Syslog Servers, must be maintained by the user.

To clear all locally stored log files:

1. Navigate to **MANAGEMENT > OTHER: Log Configuration**.
2. In the **Actions** panel, click **Clear All Logs**:



3. In the grey confirmation window, click **OK**.

5.7 Updates and Licenses

5.7.1 Software Updates

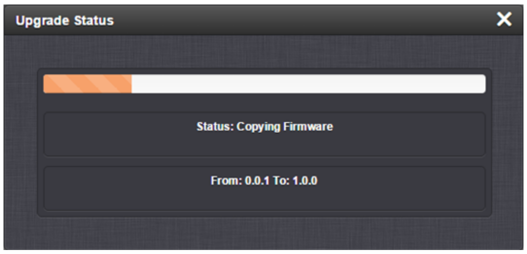
Spectracom periodically releases new versions of software for VersaPNT. These updates[1] are offered for free and made available for download from the Spectracom website. If you register your product, you will be notified of software updates.

To carry out a software update:

1. In the Web UI, navigate to **Tools** > **Upgrade/Backup**.
2. Determine your System software version in the System Configuration panel: Proceed to the next step if it is lower than the software version you plan on installing.
3. Free up disk space, if needed:
   Under **Tools** > **Upgrade/Backup** > **Disk Status**, check **Percent Used**: If the number is greater than 70%, free up disk space.
   (NOTE: If required, existing logs can be archived; for details see "Saving and Downloading Logs" on page 254.)
   To free up disk space:
   a. Delete old log files: **Tools** > **Upgrade/Backup** > **Disk Status** > **Clear All Logs**.
   b. Delete old statistics files: [~] > **Clear All Stats**.
   c. Delete previous Upgrade files: **Tools** > **Upgrade/Backup** > **Actions** > **Update System** > **Delete Upgrade File**(s). Note that **Delete Upgrade File** and **Update System** cannot be selected at the same time.
4. Download the latest upgrade software bundle from the Spectracom website onto your PC.

[1]The terms update and upgrade are both used throughout Spectracom technical literature, as software releases may include fixes and enhancements, as well as new features.

5. Perform the actual upgrade by navigating to **TOOLS** > **Upgrade/Backup** > **Actions**: **Update System Software**. Upload the upgrade software bundle previously downloaded onto your PC (`updateXYZ.tar.gz`).
   Once you have uploaded the software bundle, the following checkbox options will be presented:
   - **Remove software bundle**: Cancel the upgrade, and remove the uploaded software bundle from the system.
   - **Perform update**: Perform the software upgrade.
   - **Perform clean update**: Factory settings will be applied during the upgrade; any custom settings you may have applied previously will be overwritten! This also includes the unit's static IP address (if you applied one): it will be replaced by the default DHCP address (i.e., 0.0.0.0.) Also note that the browser session will terminate: After reconfiguring the unit's IP address, you will need to login to the Web UI in a new browser session.
6. Click **Submit** to carry out the update. A progress bar will provide real-time status information:



7. Verify that the update was successful: Navigate to **Tools** > **Upgrade/Backup**, and confirm the new SW version in the **System Configuration** panel.

> **Note:** Should you use DHCP, a new IP address may be assigned to your unit, and you may have to point your web browser to it.

> **Note:** In the event that the update failed, see "Troubleshooting Software Update" on page 276.

5.7.2 Applying a License File

Software options must be activated by applying a license file (OPT-xyz):

Typically, VersaPNT units are shipped with the license file pre-installed, reflecting the system configuration as ordered. If, however, a feature is to be activated after delivery of the VersaPNT unit, please contact your local Spectracom Sales Office first to have a license file generated. License files are archive files with a `tar.gz` extension. One license file may contain multiple licenses for multiple products.

To apply the license file, you need to upload it into your VersaPNT unit and install it:

1. Save the license file `license.tar.gz` to a location on your PC (which needs to be connected to the same network VersaPNT is.)
2. Open the VersaPNT Web UI, and navigate to **Tools** > **Upgrade/Backup**:

3. In the **Actions** panel, click **Apply License File**.
4. In the **Apply License File** window, click **Upload New File**.
5. In the **Upload File** window, click **Choose File**. Using the Explorer window, navigate to the location mentioned under the first step, select the license file, and monitor the installation progress in the **Status Upgrade** window until the application has rebooted.
6. Refresh the browser window, and login to the Web UI again. Re-navigate to **Tools** > **Upgrade/Backup**, and confirm that the newly installed Option is listed in the **System Configuration** panel.

5.8 Resetting the Unit to Factory Configuration

In certain situations, it may be desired to reset all VersaPNT configurations back to the factory default configuration. The GNSS location, any VersaPNT configurations and the locally stored log files can be cleared via the Web UI.

Caution: It is not possible to clear the Authentication logs and NTP logs.

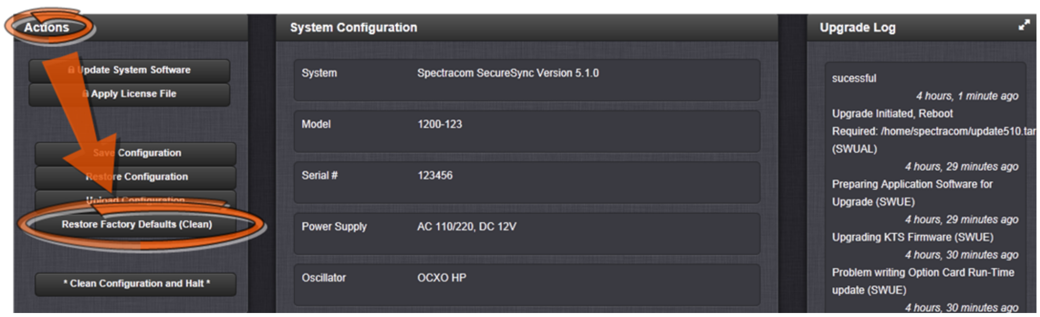
Note: Restoring configurations (reloading a saved configuration), erasing the stored GNSS location and clearing the log files are separate processes. You may restore one without restoring the others.

If VersaPNT was assigned a static IP address before cleaning the configurations, it will be reset to DHCP after the clean has been performed. If no DHCP server is available after the clean operation, the static IP address will need to be manually reconfigured.

5.8.1 Resetting All Configurations to their Factory Defaults

To restore the configuration files to their factory defaults:

1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. In the **Actions** panel, click the **Restore Factory Defaults (Clean)** button.



3. VersaPNT restores the configuration files to the factory settings, and then reboots in order to read the new configuration files. Once powered back up, VersaPNT will be configured with the previously stored files.

   Note: While the geographic GNSS position is stored and retained through power cycles, choosing Clean (Restore Factory Configuration) will erase the stored GNSS position.

   Erasing the position stored in your GNSS receiver means that the next time the GNSS antenna is connected and the GNSS receiver is able to continuously track at least four satellites, a new GNSS survey will be initiated, so the position can be recalculated and locked-in. A GNSS survey typically takes up to 33 minutes.

5.8.2 Backing-up and Restoring Configuration Files

Once VersaPNT has been configured, it may be desired to back up the configuration files to a PC for off-unit storage. If necessary in the future, the original configuration of the VersaPNT can then be restored into the same unit.

The capability to backup and restore configurations also adds the ability to "clone" multiple VersaPNT units with similar settings. Once one VersaPNT unit has been configured as desired, configurations that are not specific to each unit (such as NTP settings, log configs, etc.) can be backed up and loaded onto another VersaPNT unit for duplicate configurations.

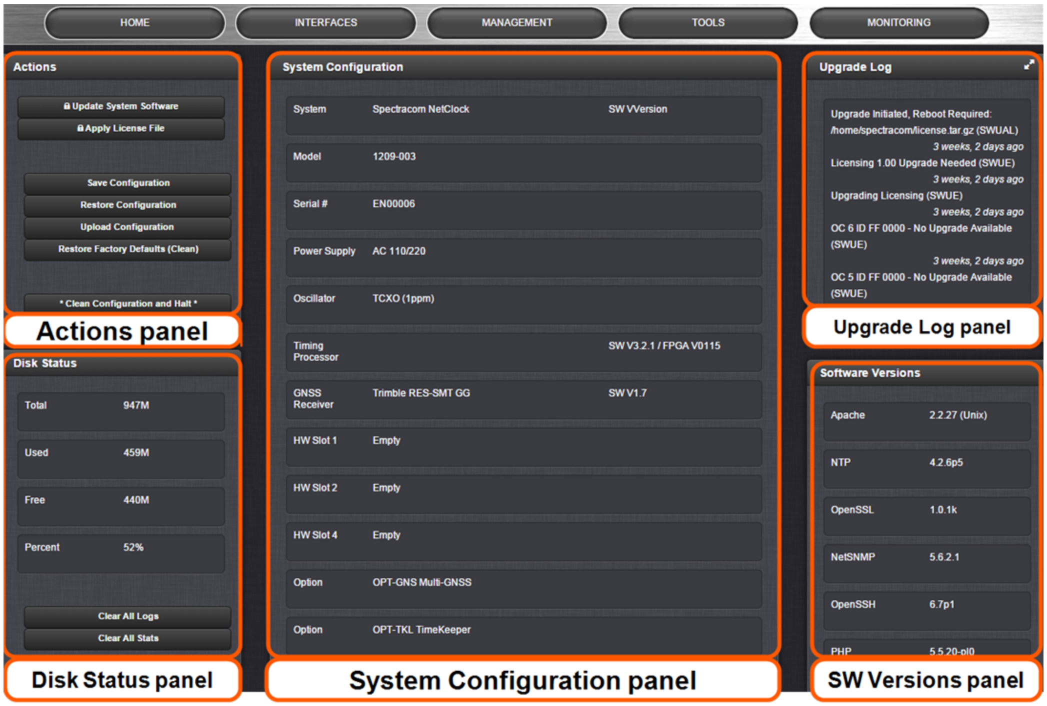
There are several configuration files that are bundled in one file for ease of handling.

> **Note:** For security reasons, configurations relating to security of the product, such as SSH/SSL certificates, cannot be backed up to a PC.

5.8.2.1 Accessing the System Configuration Screen

The System Configuration Screen provides comprehensive information about hardware and software status. To access the **System Configuration** screen:

1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. The **System Configuration** screen will display:



The **System Configuration** screen consists of 5 panels:

The Actions panel

The **Actions** panel is used for updating the system software, managing license files, saving and restoring the configuration files, and restoring the factory defaults.

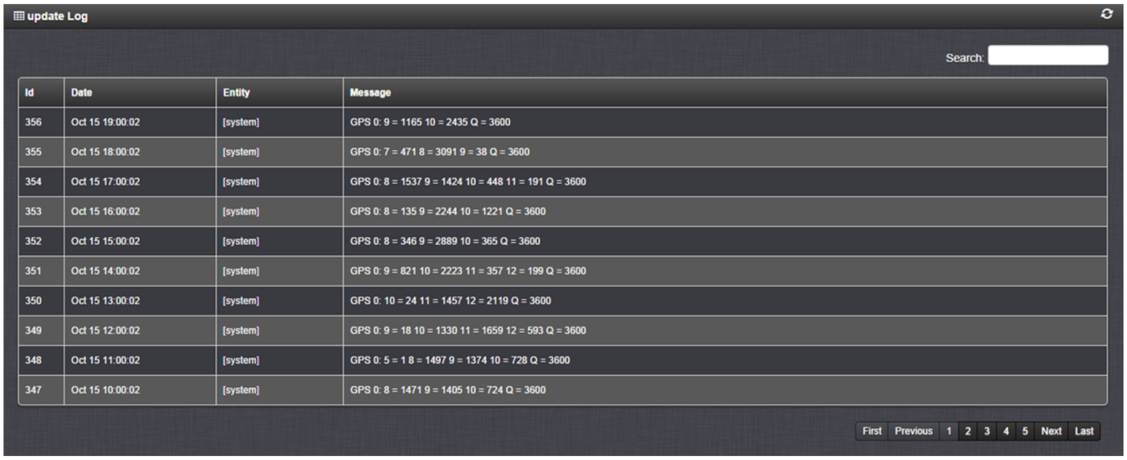
The System Configuration panel

The **System Configuration** panel provides the following information:

- **System**—The model name of this unit, and the software version currently installed.
- **Model**—The model number of this unit.
- **Serial Number**—The serial number of this unit.
- **Power Supply**—The type of power supply installed in this unit. This can be AC, DC or both.
- **Oscillator**—The type of internal timing oscillator installed in this unit.
- **Timing Processor**—The timing processor in use with this unit.
- **GNSS Receiver**—The GNSS receiver in use with this unit.
- **Option**—The optional features also included on this unit.

The Upgrade Log panel

The upgrade log is a running log of system upgrades, used for historical and troubleshooting purposes. It can be expanded by clicking on the DIAGONAL ARROWS icon in the top-right corner:



update Log

Search:

Id	Date	Entity	Message
356	Oct 15 19:00:02	[system]	GPS 0: 9 = 1165 10 = 2435 Q = 3600
355	Oct 15 18:00:02	[system]	GPS 0: 7 = 471 8 = 3091 9 = 38 Q = 3600
354	Oct 15 17:00:02	[system]	GPS 0: 8 = 1537 9 = 1424 10 = 448 11 = 191 Q = 3600
353	Oct 15 16:00:02	[system]	GPS 0: 8 = 135 9 = 2244 10 = 1221 Q = 3600
352	Oct 15 15:00:02	[system]	GPS 0: 8 = 346 9 = 2889 10 = 365 Q = 3600
351	Oct 15 14:00:02	[system]	GPS 0: 9 = 821 10 = 2223 11 = 357 12 = 199 Q = 3600
350	Oct 15 13:00:02	[system]	GPS 0: 10 = 24 11 = 1457 12 = 2119 Q = 3600
349	Oct 15 12:00:02	[system]	GPS 0: 9 = 18 10 = 1330 11 = 1659 12 = 593 Q = 3600
348	Oct 15 11:00:02	[system]	GPS 0: 5 = 1 8 = 1497 9 = 1374 10 = 728 Q = 3600
347	Oct 15 10:00:02	[system]	GPS 0: 8 = 1471 9 = 1405 10 = 724 Q = 3600

First Previous 1 2 3 4 5 Next Last

Each log entry is comprised of a unique ID, the date the entry was created, the originator of the entry, and the actual message. Refresh the log by clicking the CIRCLE ARROWS icon in the top-right corner. Go to the First, Last, or Previous entries by clicking the corresponding buttons in the bottom-right corner.

The Disk Status panel

The Disk Status panel provides information on the Compact Flash card memory usage. This information is relevant for troubleshooting purposes, and when preparing the system for a software update.

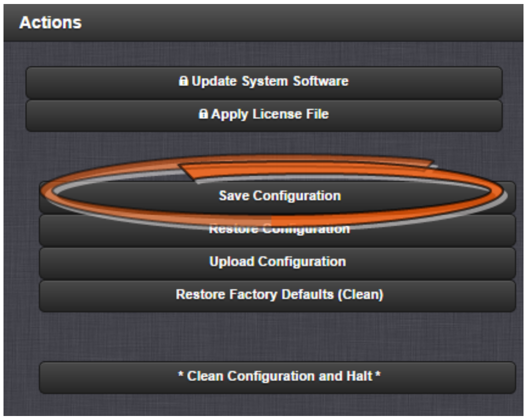
The Software Versions panel

This panel provides version information on the different SW components utilized by the system.

5.8.2.2 Saving the System Configuration Files

To save (back up) the system configuration files:

1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. In the **Actions** panel, click the **Save Configuration** button.

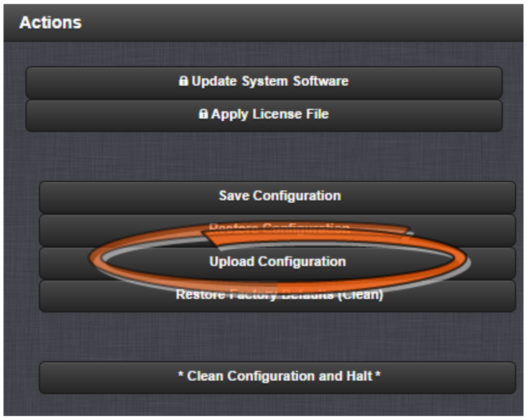


3. Click **OK** in the grey confirmation window that displays.
4. Save the configuration file to a directory where it will be safe. VersaPNT simultaneously saves a file at `/home/spectracom/xfer/config/`VersaPNT`.conf`.

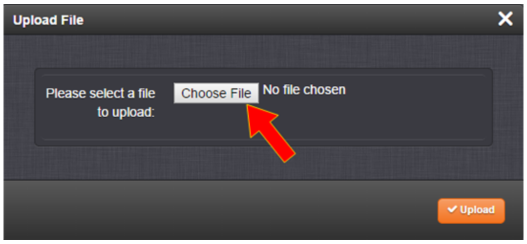
5.8.2.3 Uploading Configuration Files

To upload configuration files from a PC:

1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. In the **Actions** panel, click the **Upload Configuration** button.



3. Click **Choose File** in the window that displays, and navigate to the directory on your PC where the bundled file is stored.



4. Click the **Upload** button. VersaPNT saves the uploaded bundled file in the `/home/spectracom/xfer/config/` directory.

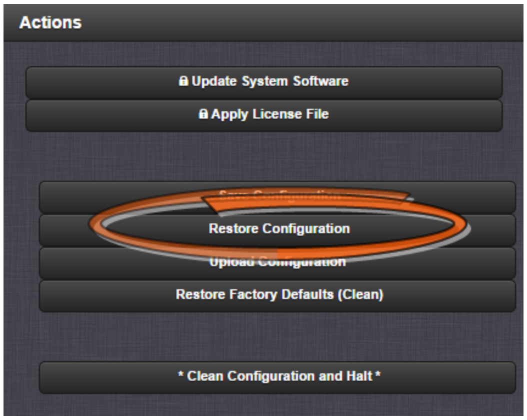
> **Note:** When uploading files remotely via long distances, or when uploading multiple files via several browser windows simultaneously, the upload process may fail to complete. In this case, cancel the upload by clicking X, and go back to Step 2.

5. To use the new configuration file for this VersaPNT, click the **Restore Configuration** button, and follow the procedure described under "Restoring the System Configuration" below.

5.8.2.4 Restoring the System Configuration

To restore the System Configuration:

1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. In the **Actions** panel, click **Restore Configuration**.



3. Click **OK** in the grey confirmation window. The system will restore the configuration using the bundled file stored at `/home/spectracom/xfer/config/`VersaPNT`.conf`, then reboot in order to read the new configuration file. Once powered back up, VersaPNT will be configured with the previously stored file.

5.8.2.5 Restoring the Factory Defaults

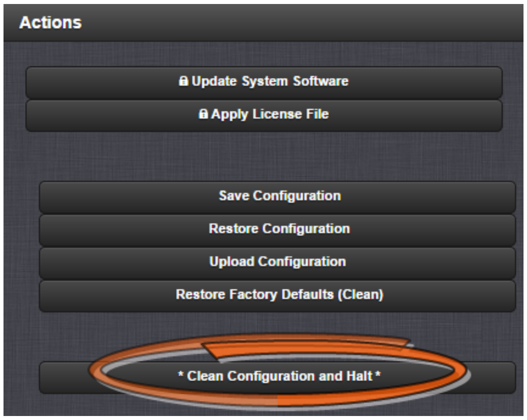
For instructions on how to restore the VersaPNT's configuration files to their factory default settings see "Resetting All Configurations to their Factory Defaults" on page 260.

5.8.3 Cleaning the Configuration Files and Halting the System

The "Clean and Halt" procedure restores the configuration files to their factory defaults and then immediately halts the system, so as to prevent any changes from being applied to the factory default condition.

To perform a "Clean and Halt":

1. Navigate to **TOOLS > SYSTEM: Upgrade/Backup**.
2. In the **Actions** panel, click *** Clean Configuration and Halt *** .



3. VersaPNT restores the configuration files to their factory default, and halts the system.

5.8.4 Default and Recommended Configurations

The factory default configuration settings were chosen for ease of initial setup. However, some of the default settings may deviate from best practices recommendations. The following table outlines the differences between factory default and recommended configuration settings for your consideration:

Table 5-1: Default and recommended configurations

Feature	Default Setting	Recommended Setting	Where to Configure
HTTP	Enabled	Disabled	Web UI or CLI
SNMP	Enabled	Disabled or Enabled (with SNMP v3 w/ encryption*)	Web UI
NTP	Enabled (with no MD5 values entered)	Enabled (use MD5 authentication with user-defined keys)	Web UI
Daytime Protocol	Disabled	Disabled	Web UI
Time Protocol	Disabled	Disabled	Web UI
Command Line Interface			
Telnet	Enabled	Disabled (use SSH instead)	Web UI
SSH	Enabled (default private keys provided)	Enabled	Web UI
File Transfer			
FTP	Enabled	Disabled (use SFTP or SCP)	Web UI
SCP	Available	Disabled (use SFTP or SCP)	Web UI
SFTP	Available	Disabled (use SFTP or SCP)	Web UI

* Spectracom recommends that secure clients use only SNMPv3 with authentication for secure installations.

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Appendix

The following topics are included in this Chapter:

6.1 Troubleshooting

The Web UI provide VersaPNT status information that can be used to help troubleshoot failure symptoms that may occur.

6.1.1 Minor and Major Alarms

Minor Alarm

There are several conditions that can cause the Web UI status lights to indicate a Minor alarm has been asserted. These conditions include:

- **Too few GPS satellites, 1st threshold**: The GNSS receiver has been tracking less than the minimum number of satellites for too long of a duration. Refer to "Troubleshooting GNSS Reception" on page 274 for information on troubleshooting GNSS reception issues.

Major Alarm

There are several conditions that can cause the Web UI status lights to indicate a Major alarm has been asserted. These conditions include:

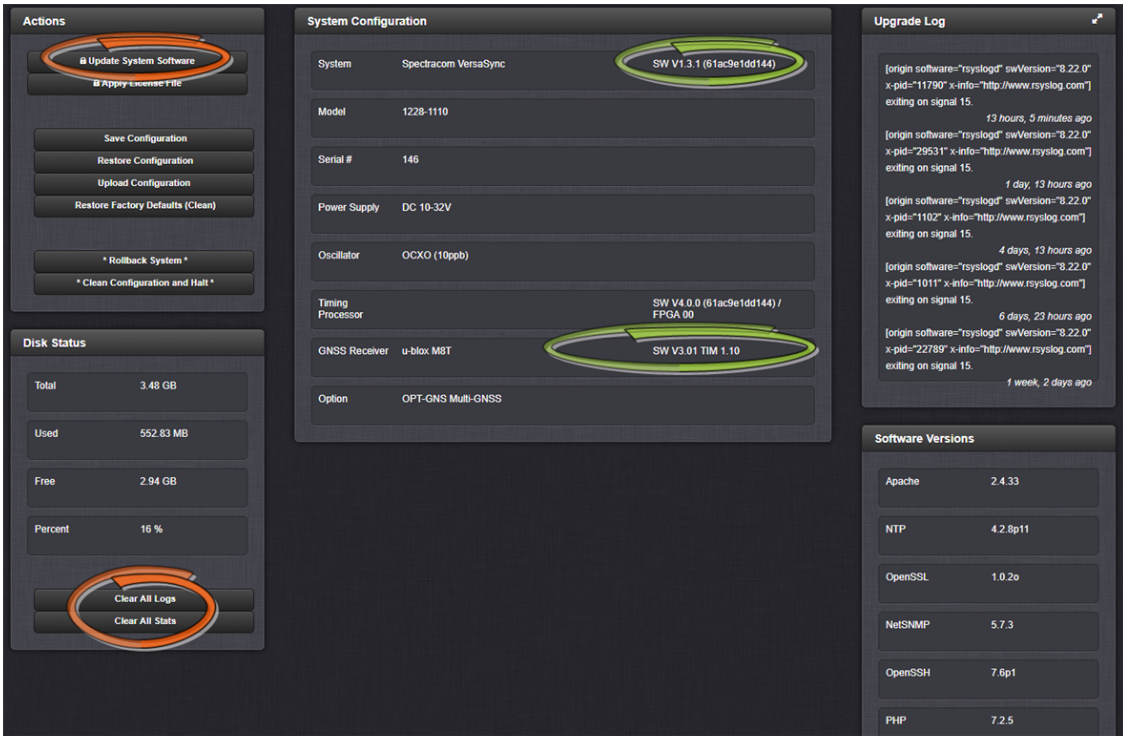
- **Frequency error**: Indicates a jump in the oscillator's output frequency has been detected. Contact Tech Support for additional information.
- **1PPS is not in specification**: The 1PPS input reference is either not present or is not qualified.
- **System Sync**: A Major alarm is asserted when the Timing System is not in sync (Input references are not available and the unit is not in Holdover). Examples of not being synced include:
  - When the Timing System has just booted-up and has not yet synced to a reference.
  - When all input references were lost and Holdover Mode has since expired.
- **Timing System Error**: A problem has occurred in the Timing System. Contact Spectracom technical support if the error continues.

6.1.2 Troubleshooting: System Configuration

One of the first tasks when troubleshooting a unit is to read out the current system configuration (you may also be asked for this when contacting Spectracom Technical Support.)

Select **TOOLS** > **Upgrade/Backup**: The screen displayed will provide information on:

- System configuration
- Disk status, memory status
- Software versions, and
- Recent log entries.



6.1.2.1 System Troubleshooting: Browser Support

Spectracom recommends using one of the following Web browsers to run the VersaPNTWeb UI on: Google Chrome, Mozilla Firefox, Internet Explorer > Ver. 8.

Using different or older browsers may lead to some incompatibility issues.

6.1.3 Troubleshooting – Unable to Open Web UI

With VersaPNT connected to either a stand-alone or networked PC and with the network configuration correct, it should be possible to connect to the Web UI.

Cable connectivity issue:

- Verify one end of standard network cable is connected to VersaPNT's Ethernet port and other end is connected to a hub/switch. Or a network cable is connected to VersaPNT and a stand-alone PC.
- Verify network settings of VersaPNT are valid for the network/PC it is connected with (IP address is on the same subnet as the other PC).

Communication issue:

- Disconnect VersaPNT's network cable and ping its assigned address to ensure no response (no duplicate IP addresses on the network).
- Try accessing VersaPNT from another PC on the same network.
- Network Routing/firewall issue. Try connecting directly with a PC and network cable.

6.1.4 Troubleshooting via Web UI Status Page

VersaPNT's Web UI includes pages that provide current "remote" status information about VersaPNT. The following table includes information that can be used as a troubleshooting guidance if status fault indications or conditions occur.

Web UI Page location	Current Status	Indication	Troubleshooting
HOME page, System Status panel, Status row	SYNC indicator is not "lit" (not Green).HOLD indicator is "lit" (Orange).—OR—FAULT indicator is "lit" (Red). Below the System Status panel there is an Out of Sync alarm statement	VersaPNT is in Holdover mode—OR—VersaPNT is now out of Time Sync	All available Input References have been lost. The Reference Status table on the HOME page will show the current status of all inputs (Green is valid and Red is invalid or not present). 1. Make sure the Input Reference Priority table still has the desired reference inputs Enabled, based on the desired priority. See "Configuring Input Reference Priorities" on page 167. 2. Make sure the desired input references are still connected to the correct input port of VersaPNT. 3. Verify GNSS antenna installation (if applicable). See "Troubleshooting GNSS Reception" on page 274.

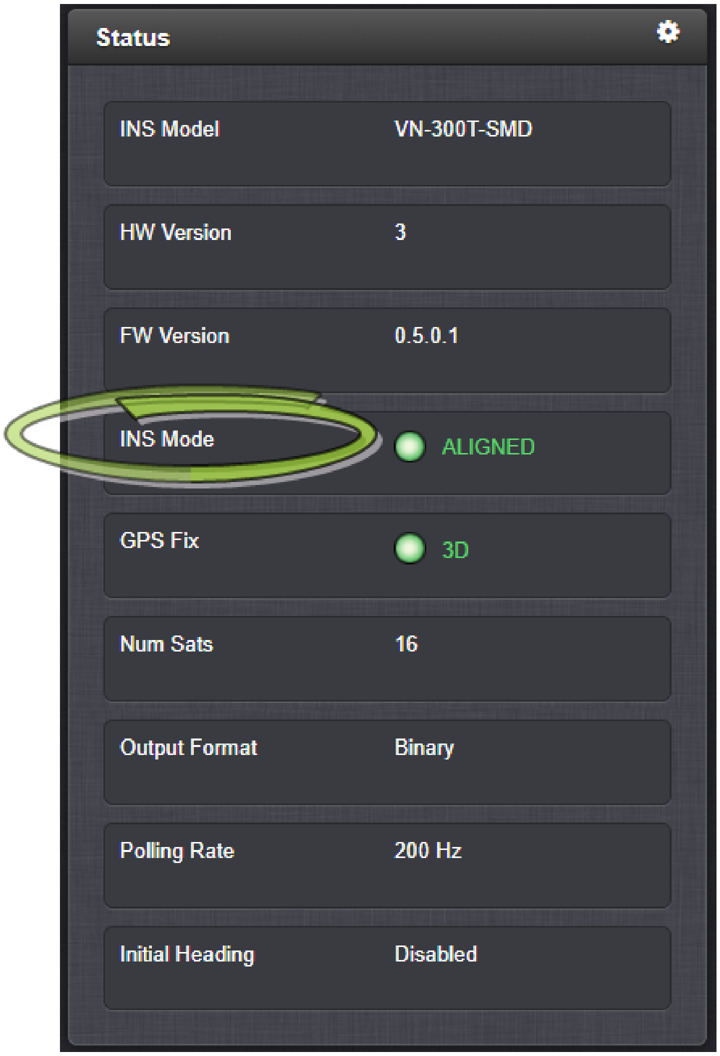
Web UI Page location	Current Status	Indication	Troubleshooting
MANAGEMENT/ NTP Setup page NTP Status Summary panel Stratum row	Stratum 15	NTP is not synchronized to its available input references (VersaPNT may have been in Holdover mode, but Holdover has since expired without the return of valid inputs)	Note: If VersaPNT was just recently powered-up or rebooted and input references are applied, no troubleshooting may be necessary. Allow at least 10-20 minutes for the input references to be declared valid and NTP to align to the System Time (allow an additional 35-40 minutes for a new install with GNSS input). 1. Verify in the Configure Reference Priorities table that all available references enabled. See "Configuring Input Reference Priorities" on page 167. 2. Verify that the Reference Status on the HOME page shows "OK" (Green) for all available references. 3. Verify NTP is enabled and configured correctly. See "NTP Reference Configuration" on page 88.
MANAGEMENT/ NETWORK page	Cannot login or access the Web UI.	The following error message is displayed: "Forbidden You don't have permission to access/ on this server"	This message is displayed when any value has been added to the Network Access Rules table and your PC is not listed in the table as an Allow From IP address.To restore access to the Web UI, either 1. Login from a PC that is listed as an Allow From in this table; or 2. If it is unknown what PCs have been listed in the Access table, perform an `unrestrict` command to remove all entries from the Network Access Rules table. This will allow all PCs to be able to access the Web UI.

Table 6-1: Troubleshooting using the Web UI Status indications

6.1.5 Troubleshooting – INS Status not Aligned

If your VersaPNT INS status isn't reaching an aligned state, or your solution results are inaccurate, it is recommended that you drive in a known, repeating pattern (ideally a figure-eight pattern) for approximately five minutes in order to align with your surrounding satellites.

To verify your INS status in the WebUI, navigate to **MANAGEMENT** > **INS Setup** > **Status**. In the Status panel, **INS Mode** will indicate your current alignment state.



See "INS Initialization" on page 126 and "INS Status Monitoring" on page 127 for more information.

6.1.6 Troubleshooting GNSS Reception

If VersaPNT reports Holdover and/or Time Sync Alarms caused by insufficient GNSS reception:

When a GNSS receiver is installed in VersaPNT, a GNSS antenna can be connected to the rear panel antenna connector via a coax cable to allow it to track several satellites in order for

GNSS to be an available input reference. Many factors can prevent the ability for the GNSS receiver to be able to track the minimum number of satellites.

With the GNSS antenna installed outdoors, with a good view of the sky (the view of the sky is not being blocked by obstructions), VersaPNT will typically track between 5-10 satellites (the maximum possible is 12 satellites). If the antenna's view of the sky is hindered, or if there is a problem with the GNSS antenna installation, the GNSS receiver may only be able to a few satellites or may not be able to track any satellites at all.

When GNSS is a configured time or 1PPS input reference, if the GNSS receiver is unable to continuously track at least four satellites (until the initial GNSS survey has been completed) or at least one satellite thereafter, the GNSS signal will not be considered valid. If no other inputs are enabled and available, VersaPNT may not initially be able to go into time sync. Or, if GNSS reception is subsequently lost after initially achieving time sync, VersaPNT will go into the Holdover mode. If GNSS reception is not restored before the Holdover period expires (and no other input references become available) VersaPNT will go out of sync. The GNSS reception issue needs to be troubleshot in order to regain time sync.

For additional information on troubleshooting GNSS reception issues with VersaPNT, please refer to the **GNSS Reception Troubleshooting Guide**, available here on the Spectracom website.

6.1.7 Troubleshooting – 1PPS, 10 MHz Outputs

If the 1PPS and/or the 10 MHz output(s) are not present, input power may not be applied. Or VersaPNT is not synchronized to its input references and Signature Control is enabled.

Web UI Page	Current Status	Indication	Troubleshooting
HOME page	Reference Status Table	One or more input references indicate "Not Valid" (red)	All available Input References have been lost. The Reference Status table on this same page will show the current status of all inputs (Green is valid and red is not valid, or not present). If Signature Control is enabled in this state, the output may be disabled. 1. Make sure the Input Reference Priority table still has the desired inputs enabled, based on desired priority. 2. Make sure desired input references are still connected to the correct input port of VersaPNT. 3. Verify GNSS antenna installation (if applicable).

Web UI Page	Current Status	Indication	Troubleshooting
Navigate to INTERFACES/OUTPUTS/ PPS Output page	Select the PPS Output screen.	Signature Control will show "Output Always Enabled", "Output Enabled in Holdover", "Output Disabled in Holdover" or "Output Always Disabled".	1. With "Output Always Enabled" selected, the selected output will be present no matter the current synchronization state.2. Any other configured value will cause the applicable output to be halted if VersaPNT is not fully synchronized with its input references.

Table 6-2: Troubleshooting 1PPS and/or 10 MHz outputs not being present

6.1.8 Troubleshooting – Network PCs Cannot Sync

In order for clients on the network to be able to sync to VersaPNT, several requirements must be met:

1. The PC(s) must be routable to VersaPNT. Make sure you can access VersaPNT Web UI from a PC that is not syncing. If the PC cannot access the Web UI, a network issue likely exists. Verify the network configuration.
2. The network clients have to be configured to synchronize to VersaPNT's address. For additional information on syncing Windows PC's, see https://spectracom.com/documents/synchronizing-windows-computers. The last section of this document also contains troubleshooting assistance for Windows synchronization. For UNIX/Linux computer synchronization, please visit http://www.ntp.org/.
3. If at least one PC can sync to VersaPNT, the issue is likely not with VersaPNT itself. The only VersaPNT configurations that can prevent certain PCs from syncing to the time server are the NTP Access table and MD5 authentication. See "Configuring NTP Symmetric Keys" on page 103. A network or PC issue likely exists. A firewall may be blocking Port 123 (NTP traffic), for example.
4. NTP in VersaPNT must be “in sync” and at a higher Stratum level than Stratum 15 (such as Stratum 1 or 2, for example). This requires VersaPNT to be either synced to its input references or in Holdover mode. Verify the current NTP stratum level and the sync status.

6.1.9 Troubleshooting Software Update

When experiencing slow data transmission rates, or other network issues, it may be possible that a system software update will be aborted due to a web server timeout during the transfer.

In such an event, the **Upload New File** window will disappear, and the **Upgrade System Software** window will be displayed again instead.

- Should this happen repeatedly, you can transfer the update file using a file transfer protocol such as scp, sftp or ftp, if security is not a concern. The update can then be initiated from the Web UI or Command Line.
- Disk Status: In the event of an aborted update process, under **Tools** > **Upgrade/Backup** > **Disk Status**, check **Percent Used**: If the number is greater than 70%, free up disk space, before starting another attempt to update the System Software.

6.2 Command-Line Interface

A terminal emulation program is used to emulate a video terminal, so as to access VersaPNT's CLI (Command-Line Interface) remotely via a serial cable. This may be required if no other means of remotely accessing VersaPNT are available, for example if Ethernet ports are used otherwise or have been disabled (e.g., for security reasons).

6.2.1 Setting up a Terminal Emulator

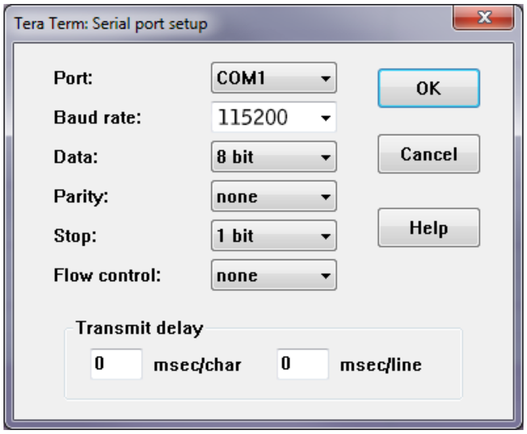
If no other means are available to access VersaPNT, a terminal emulation program can be used to carry out certain configuration changes by accessing VersaPNT's CLI (command-line interface) via a serial port connection. An application example for this scenario is to enable a network port so that the VersaPNT Web UI can be used. While it is also possible to retrieve selected logs, a terminal emulator does not replace the VersaPNT Web UI.

Spectracom does not distribute or support its own terminal emulator, and newer Microsoft operating systems no longer include HyperTerminal. However, there are several third-party open-source programs available, such as **TeraTerm®** or **PuTTY®**. The example below illustrates the use of TeraTerm. The setup procedure is similar when using other terminal emulation programs.

Procedure:

1. Connect the personal computer to the USB interface.
2. Configure your terminal emulation program, using the following settings:
   - **Port**: COM1
   - **Bits per second**: 115200
   - **Data bits**: 8
   - **Parity**: None

- **Stop bits**: 1
- **Flow control**: None



3. Depending on which network protocol you are using (SSH, Telnet), you will need to enter authentication upon establishment of the connection either in a separate authentication window, or the Terminal window: The default user name is `spadmin`, and the password `admin123`.
4. Using the Terminal window, you can now submit commands.

6.2.2 CLI Commands

VersaPNT features a suite of command-line interface (CLI) commands that can be used to configure parameters and retrieve status information or log files via a remote connection, using the `telnet` or `ssh` (if enabled) protocol.

This section includes a list of some of the supported commands.

Notes:

a. The command "`helpcli`" will provide a list of all available commands and their syntax (**Note**: Typing "`help`" will output bash shell help only and will not provide useful information).

b. You can scroll up or scroll down through the output by using the Page Up/Page down keys, or the arrow keys.

c. Type "`q`" (lower-case) to quit.

d. Pressing the up/down keys scrolls through previously typed commands.

e. Commands need to be typed in all lower-case letters.

f. Where `eth0` is the base network port and `eth1` (and higher) are used with the optional Gigabit Ethernet module for multiple network interfaces.

g. User accounts with "user" group permissions can perform "`get`" commands but cannot perform any "`set`" commands or change/reset passwords. Only user accounts with "admin" group permissions can perform "`set`" commands or change/reset password. Refer to "Adding/Deleting/Changing User Accounts" on page 227 for user account setup information.

Command	Description
clean	Restores VersaPNT configuration to factory defaults and reboots
cleanhalt	Restores VersaPNT configuration to factory defaults and halts
clearlogs	Clears all logs
clearstats	Clears all statistical data (NTP, and oscillator/disciplining)
dateget	Displays current date (for example, 15 APR 2015)
dateset	Used to set the current date
defcert	Used to create a new Spectracom self-signed SSL certificate for HTTPS in case of expiration of the original certificate
dhcp4get	Displays whether DHCP is enabled
dhcp4set	Used to enable or disable DHCP
dns4get	Displays the configured DNS servers
dns4set	Used to configure the DNS servers
dhcp6get	Displays whether DHCPv6 is enabled
dhcp6set	Used to enable or disable DHCPv6
doyget	Used to obtain the current Day of Year
doyset	Used to set the current Day of Year
gpsdop	Displays GNSS receiver positional accuracy estimates
gpsdserviceportget	Displays the GPSD service port
gpsdserviceportset	Sets the GPSD service port
gpsinfo	Applicable to SAASM-equipped VersaPNT units only
gpsloc	Displays GNSS latitude, longitude and antenna height
gpsmdl	Displays the GNSS Manufacturer and Model

Command	Description
gpssat	Displays GNSS satellites tracked and maximum signal strength being received
gw4get	Displays configured IPv4 gateway addresses
gw4set	Used to configure the IPv4 gateway addresses
gw6get	Displays configured IPv6 gateway address
gw6set	Used to configure the IPv6 gateway address
halt	Used to Halt the system for shutdown
helpcli	Provides list of available commands and syntax
hostget	Displays the DNS hostname
hostset	Sets the DNS hostname
hotstart	Initiate a hot start operation on the SAASM GPS receiver
ip4get	Displays IPv4 Ethernet port settings information (IP address net mask and gateway)
ip4set	Used to set IPv4 Ethernet port settings information (IP address net mask and gateway)
ip6add	Used to add IPv6 Ethernet port settings information (IP address net mask and gateway)
ip6del	Used to delete IPv6 IP address
ip6get	Used to obtain the IPv6 IP address
iptables	See for more information.
licenses	Displays configured licenses installed (if any)
list	Outputs a list of commands
loadconf	Restore a saved configuration and reboot
localget	Used to obtain the configured local clock
locallist	Used to display local clocks
localset	Used to configure local clocks
model	Displays the Serial Number of the unit
net	Displays network status
netnum	Displays the number of general-purpose network interfaces
net4	Displays IPv4 network status
net6	Displays IPv6 network status
options	Displays configured options installed (if any)

Command	Description
oscget	Displays the installed system oscillator
portget	Display whether network port is enabled (for example, "portget ETH2")
portset	Enable or disable a network port: "portset x on" where "x" is the port number (for example, "ETH2") "portset X off" [NOTE: Available since Web UI Revision no. 5.1.2]
portstate	Display the current state for a network port
ppsctrl	Enable/disable individual 1PPS output signals
priorset	Sets the priority of an entry in the reference priority table
radius setretry	<value> Sets how many radius login retries will be attempted
radius getretry	<value> Gets the number of radius login retry attempts
radius server list	Lists radius servers
radius server add	<host> <port> <key> <timeout> Adds radius server
radius server del	<id> Deletes radius server number <id>
reboot	Used to warm-boot the unit without having to disconnect or reconnect power
reftable	Displays reference priority table
release4	Used with DHCP to release the IPv4 address
release6	Used with DHCPv6 to release the IPv6 address
renew4	Used with DHCP to renew the assigned IPv4 address
renew6	Used with DHCPv6 to renew the assigned IPv6 address
resetpw	Resets the administrator account (spadmin) password back to the default value “admin123”
routes4	Displays the current IPv4 routing table(s)
routes6	Displays the current IPv6 routing table(s)
rt4add	Adds an IPv4 static route
rt4del	Deletes an IPv4 static route
rt4get	Displays the configured IPv4 static routes
rt6add	Adds an IPv6 static route
rt6del	Deletes an IPv6 static route

Command	Description
rt6get	Displays the configured IPv6 static routes
saveconf	Generate archive of current configuration
savelog	Generate archive of all log files
scaleget	Displays configured system timescale
scaleset	Used to configure the system timescale
services	Displays the state of services (enabled/disabled)
servget	Displays the state of individual services
servset	Enable or disable specific services
slaacget	Displays whether SLAAC is enabled
slaacset	Used to enable or disable SLAAC
stateset	Enable or disable an entry in the reference priority table. index = 0…15. state = 0 (disable), 1 (enable)
status	Displays information about the oscillator disciplining
syncstate	Display timing system synchronization state
sysupgrade	Performs system upgrade using the update bundle provided
testevent	Generates SNMP events in the enterprise MIB
tfomget	Displays current estimated system time error (TFOM – Time Figure of Merit)
timeget	Displays current system time (time is displayed in the configured timescale – See `scaleget` command to retrieve the configured timescale)
timeset	Used to manually set the current time (hours, minutes in seconds); time is entered based on the configured timescale – See `scaleget` command to retrieve the configured timescale
unrestrict	Used for clearing access control restrictions to VersaPNT
version	Displays the installed main VersaPNT and timing system software versions
yearget	Displays the current year
yearset	Used to set the current year
zeroize	Applicable to SAASM-equipped VersaPNT units only

6.3 Time Code Data Formats

This section describes the different time code data format selections available for use with VersaPNT option cards that accept ASCII data streams as inputs or outputs via their RS-485 and RS-232 interfaces.

Supported are formats like NMEA, BBC, Spectracom, GSSIP, and Endrun.

6.3.1 NMEA GGA Message

The GGA Format provides essential fix data which includes 3D location and accuracy data.

Example message:

$GPGGA,123519.00,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47

NOTE: The GGA format does not support precision timing and 1PPS functionality; the Web UI may permit the selection of **Message** or **PPS Pin** as **PPS Source**, but the NMEA GGA Message will not use either. If this data is required for your application, use the ZDA Message format instead (see "NMEA ZDA Message" on the next page).

Where:

GGA	Global Positioning System Fix Data
123519.00	Fix taken at 12:35:19 UTC
4807.038,N	Latitude 48 deg 07.038' N
01131.000, E	Longitude 11 deg 31.000' E
1	Fix quality: 0 = Invalid 1 = GNSS fix (SPS) 2 = DGPS fix 3 = PPS fix 4 = Real Time Kinematic 6 = estimated (dead reckoning) (2.3 feature) 7 = Manual input mode 8 = Simulation mode
08	Number of satellites being tracked
0.9	Horizontal dilution of position
545.4,M	Altitude, Meters, above mean sea level
46.9,M	Height of geoid (mean sea level) above WGS84 ellipsoid

(empty field)	Time in seconds since last DGPS update
(empty field)	DGPS station ID number
*47	Checksum data, always begins with *

6.3.2 NMEA RMC Message

NMEA Message Format RMC, (Recommended Minimum) provides fix information, speed over ground and Magnetic Variance information.

Example message:

$GPRMC,123519.00,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A

Where:

RMC	Recommended Minimum Sentence C
123519.00	Fix taken at 12:35:19 UTC
A	Status A=active or V=Void.
4807.038,N	Latitude 48 deg 07.038' N
01131.000,E	Longitude 11 deg 31.000' E
022.4	Speed over the ground in knots
084.4	Track angle in degrees True
230394	Date - 23rd of March 1994
003.1,W	Magnetic Variation
*6A	Checksum data, always begins with *

6.3.3 NMEA ZDA Message

The Format ZDA Data message provides Date and Time information.

Example message:

$GPZDA,HHMMSS.00,DD,MM,YYYY,XX,YY*CC

Where:

HHMMSS.00	HrMinSec(UTC)
DD,MM,YYYY	Day, Month, Year
XX	Local zone hours -13...13
YY	Local zone minutes 0...59
*CC	Checksum

6.3.4 Spectracom Format 0

Format 0 includes a time synchronization status character, day of year, time reflecting Time Zone Offset and DST corrections when enabled. Format 0 also includes the DST/Standard Time indicator, and the Time Zone Offset value. Format 0 data structure is shown below:

Example message:

CR LF I ^ ^ DDD ^ HH:MM:SS ^ DTZ=XX CR LF

Where:

CR	Carriage Return
LF	Line Feed
I	Time Sync Status (space, ?, *)
^	Space separator
DDD	Day of Year (001-366)
HH	Hours (00-23)
:	Colon separator
MM	Minutes (00-59)
SS	Seconds (00- 60)
D	Daylight Saving Time indicator (S,I,D,O)
TZ	Time Zone
XX	Time Zone offset (00-23)

The leading edge of the first character (`CR`) marks the on-time point of the data stream.

The time synchronization status character (`I`) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

The Daylight Saving Time indicator (D) is defined as:

S	During periods of Standard time for the selected DST schedule.
I	During the 24-hour period preceding the change into DST.
D	During periods of Daylight Saving Time for the selected DST schedule.
O	During the 24-hour period preceding the change out of DST.

Example:

271 12:45:36 DTZ=08

The example data stream provides the following information:

Sync Status	Time synchronized to GNSS
Date	Day 271
Time	12:45:36 Pacific Daylight Time
D	DST, Time Zone 08 = Pacific Time

6.3.5 Spectracom Format 1

Format 1 converts the received day of year data (001-366) to a date consisting of day of week, month, and day of the month. Format 1 also contains a time synchronization status character, year, and time reflecting time zone offset and DST correction when enabled.

Available Formats 1 and 1S are very similar to each other. Most external systems utilizing Data Format 1 will look for a single-digit day of the month for day 1 through day 9, with a space in front of each digit (^1, ^2, ^3 … 10, 11…), whereas other systems need to see a two digit day of the month for all days 1 through 9 with a leading 0 instead of a space (01, 02, 03… 10, 11…).

- If your device requires the two digit day of the month for days 1 through 9 (i.e. 01, 02 etc.), select Format 1.
- If your device requires the single digit day of the month for days 1 through 9 (i.e. ^1, ^2, etc.), select Format 1S instead. Refer to "Spectracom Format 1S" on page 288 for information on Format 1S.

Format 1 data structure:

CR LF I ^ WWW ^ DDMMMYY ^ HH:MM:SS CR LF

Where:

CR	Carriage Return
LF	Line Feed
I	Time Sync Status (space, ?, *)
^	Space separator
WWW	Day of Week (SUN, MON, TUE, WED, THU, FRI, SAT)
DD	Numerical Day of Month (01-31)
MMM	Month (JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC)
YY	Year without century (99, 00, 01, etc.)
HH	Hours (00-23)
:	Colon separator
MM	Minutes (00-59)
SS	Seconds (00-60)

The leading edge of the first character (`CR`) marks the on-time point of the data stream.

The time synchronization status character (`I`) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

Example:

FRI 20APR01 12:45:36

The example data stream provides the following information:

Sync Status	The clock is not time synchronized to GNSS. Time is derived from the battery backed clock or set manually
Date	Friday, April 23, 2015
Time	12:45:36

6.3.6 Spectracom Format 1S

Format 1S (Space) is very similar to Format 1, with the exception of a space being the first character of Days 1 through 9 of each month (instead of the leading "0" which is present in Format 1).

Most external systems utilizing Data Format 1 will look for a single digit day of the month for day 1 through day 9, with a space in front of each digit (^1, ^2, ^3 ... 10, 11...) whereas other systems need to see a two digit day of the month for all days 1 through 9 with a leading 0 instead of a space (01, 02, 03... 10, 11...).

» If your device requires the single digit day of the month for days 1 through 9 (i.e. 1, 2, etc.), select Format 1S.

» If your device requires the two digit day of the month for days 1 through 9 (i.e. 01, 02, etc.), select Format 1 instead. Refer to "Spectracom Format 1" on page 286 for information on Format 1.

Example message:

CR LF I ^ WWW ^ DDMMMYY ^ HH:MM:SS CR LF

Where:

CR	Carriage Return
LF	Line Feed
I	Time Sync Status (space, ?, *)
^	Space separator
WWW	Day of Week (SUN, MON, TUE, WED, THU, FRI, SAT)
DD	Numerical Day of Month (1-31)
MMM	Month (JAN, FEB, MAR, APR, MAY, JUN, JUL, AUG, SEP, OCT, NOV, DEC)
YY	Year without century (99, 00, 01, etc.)
HH	Hours (00-23)
:	Colon separator
MM	Minutes (00-59)
SS	Seconds (00-60)

The leading edge of the first character (`CR`) marks the on-time point of the data stream.

The time synchronization status character (`I`) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

Example:

FRI 20APR15 12:45:36

The example data stream provides the following information:

Sync Status	The clock is not time synchronized to GNSS. Time is derived from the battery backed clock or set manually.
Date	Friday April, 23, 2015
Time	12:45:36

6.3.7 Spectracom Format 2

This format provides a time data stream with millisecond resolution. The Format 2 data stream consists of indicators for time synchronization status, time quality, leap second and Daylight Saving Time. Time data reflects UTC time and is in the 24-hour format. Format 2 data structure is shown below:

Note: Format 2 cannot be configured for a Time Zone Offset or with automatic Daylight Saving Time adjustment. Attempting to configure a Local clock using Data Format 2 with either a Time Zone Offset or automatic DST rule will result in an error message.

Example message:

CR LF IQYY ^ DDD ^ HH:MM:SS.SSS ^ LD

Where:

CR	Carriage Return
LF	Line Feed
I	Time Sync Status (space, ?, *)

Q	Quality Indicator (space, A, B, C, D)
YY	Year without century (99, 00, 01, etc.)
^	Space separator
DDD	Day of Year (001-366)
HH	Hours (00-23 UTC time)
:	Colon separator
MM	Minutes (00-59)
:	Colon separator
SS	(00-60)
.	Decimal separator
SSS	Milliseconds (000-999)
L	Leap Second indicator (space, L)
D	Daylight Saving Time Indicator (S,I,D,O)

The leading edge of the first character (`CR`) marks the on-time point of the data stream.

The time synchronization status character (`I`) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

The quality indicator (`Q`) provides an inaccuracy estimate of the output data stream. When the receiver is unable to track any GNSS satellites, a timer is started. "Quality indicators" on the facing page lists the quality indicators and the corresponding error estimates based upon the GNSS receiver 1PPS stability, and the time elapsed tracking no satellites. The Tracking Zero Satellites timer and the quality indicator reset when the receiver reacquires a satellite.

Quality	Time (hours)	TXCO Error (milliseconds)	OCXO Error (milliseconds)	Rubidium Error (microseconds)
Space	Lock	<1	<0.01	<0.3
A	<10	<10	<0.72	<1.8
B	<100	<100	<7.2	<18
C	<500	<500	<36	<90
D	>500	>500	>36	>90

Table 6-3: Quality indicators

The leap second indicator (L) is defined as:

(Space)	When a leap second correction is not scheduled for the end of the month.
L	When a leap second correction is scheduled for the end of the month.

The Daylight Saving Time indicator (D) is defined as:

S	During periods of Standard time for the selected DST schedule.
I	During the 24-hour period preceding the change into DST.
D	During periods of Daylight Saving Time for the selected DST schedule.
O	During the 24-hour period preceding the change out of DST.

Example:

?A15 271 12:45:36.123 S

The example data stream provides the following information:

Sync Status	The clock has lost GNSS time sync. The inaccuracy code of "A" indicates the expected time error is <10 milliseconds.
Date	Day 271 of year 2015.
Time	12:45:36 UTC time, Standard time is in effect.

6.3.8 Spectracom Format 3

Format 3 provides a format identifier, time synchronization status character, year, month, day, time with time zone and DST corrections, time difference from UTC, Standard time/DST indicator, leap second indicator and on-time marker. The Format 3 data structure is shown below:

Example message:

FFFFI^YYYYMMDD^HHMMSS±HHMMD L # CR LF

Where:

FFFF	Format Identifier (0003)
I	Time Sync Status (Space, ?, *)

^	Space separator
YYYY	Year (1999, 2000, 2001, etc.)
MM	Month Number (01-12)
DD	Day of the Month (01-31)
HH	Hours (00-23)
MM	Minutes (00-59)
SS	Seconds (00-60)
±	Positive or Negative UTC offset (+,-) Time Difference from UTC
HHMM	UTC Time Difference Hours Minutes (00:00-23:00)
D	Daylight Saving Time Indicator (S,I,D,O)
L	Leap Second Indicator (space, L)
#	On time point
CR	Carriage Return
LF	Line Feed

The time synchronization status character (I) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

The time difference from UTC, ±HHMM, is selected when the Serial Com or Remote port is configured. A time difference of -0500 represents Eastern Time. UTC is represented by +0000.

The Daylight Saving Time indicator (D) is defined as:

S	During periods of Standard time for the selected DST schedule.
I	During the 24-hour period preceding the change into DST.
D	During periods of Daylight Saving Time for the selected DST schedule.
O	During the 24-hour period preceding the change out of DST.

The leap second indicator (L) is defined as:

(Space)	When a leap second correction is not scheduled for the end of the month.
L	When a leap second correction is scheduled for the end of the month.

Example:

0003 20150415 124536-0500D #

The example data stream provides the following information:

Data Format	3
Sync Status	Day 271 of year 2015.
Date	April 15, 2015.
Time	12:45:36 EDT (Eastern Daylight Time). The time difference is 5 hours behind UTC.
Leap Second	No leap second is scheduled for this month.

6.3.9 Spectracom Format 4

Format 4 provides a format indicator, time synchronization status character, modified Julian date, time reflecting UTC with 0.1 millisecond resolution and a leap second indicator. Format 4 data structure is shown below:

Example:

FFFFIMJDXX^HHMMSS.SSSS^L CR LF

Where:

FFFF	Format Identifier (0004)
I	Time Sync Status (Space, ?, *)
MJDXX	Modified Julian Date
^	Space separator
HH	Hours (00-23 UTC time)
MM	Minutes (00-59)
SS.SSSS	Seconds (00.0000-60.0000)
L	Leap Second Indicator (space, L)
CR	Carriage Return
LF	Line Feed

The start bit of the first character marks the on-time point of the data stream.

The time synchronization status character (`I`) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

The leap second indicator (`L`) is defined as:

(Space)	When a leap second correction is not scheduled for the end of the month.
L	When a leap second correction is scheduled for the end of the month.

Example:

0004 50085 124536.1942 L

The example data stream provides the following information:

Data format	4
Sync Status	Time synchronized to GNSS.
Modified Julian Date	50085
Time	12:45:36.1942 UTC
Leap Second	A leap second is scheduled at the end of the month.

6.3.10 Spectracom Format 7

This format provides a time data stream with millisecond resolution. The Format 7 data stream consists of indicators for time synchronization status, leap second and Daylight Saving Time. Time data reflects UTC time and is in the 24-hour format. Format 7 data structure is shown below:

Note: Format 7 cannot be configured for a Time Zone Offset or with automatic Daylight Saving Time adjustment. Attempting to configure a Local clock using Data Format 7 with either a Time Zone Offset or automatic DST rule will result in an error message.

Example message:

CR LF I^YY^DDD^HH:MM:SS.SSSL^D CR LF

Where:

CR	Carriage Return
LF	Line Feed
I	Time Sync Status (space, ?, *)
YY	Year without century (99, 00, 01, etc.)
^	Space separator
DDD	Day of Year (001-366)
HH	Hours (00-23 UTC time)
:	Colon separator
MM	Minutes (00-59)
SS	Seconds (00-60)
.	Decimal Separator
SSS	Milliseconds (000-999)
L	Leap Second Indicator (space, L)
D	Daylight Saving Time Indicator (S,I,D,O)

The leading edge of the first character (`CR`) marks the on-time point of the data stream.

The time synchronization status character (`I`) is defined as described below:

?	When the receiver is unable to track any satellites and the time synchronization lamp is red.
*	When the receiver time is derived from the battery backed clock or set manually through the Setup Port Interface.

The leap second indicator (`L`) is defined as:

(Space)	When a leap second correction is not scheduled for the end of the month.
L	When a leap second correction is scheduled for the end of the month.

The Daylight Saving Time indicator (D) is defined as:

S	During periods of Standard time for the selected DST schedule.
I	During the 24-hour period preceding the change into DST.
D	During periods of Daylight Saving Time for the selected DST schedule.
O	During the 24-hour period preceding the change out of DST.

> **Example:**
>
> ? 15 271 12:45:36.123 S

The example data stream provides the following information:

Sync Status	The clock has lost GNSS time sync.
Date	Day 271 of year 2015.
Time	12:45:36 UTC time, Standard time is in effect.

6.3.11 Spectracom Format 8

Format 8 includes a time synchronization status character, the four digit year, day of year, time reflecting Time Zone Offset and DST corrections when enabled. Format 8 also includes the DST/Standard Time indicator, and the Time Zone Offset value. Format 8 data structure is shown below:

> **Example:**
>
> CR LF I ^ ^YYYY^ DDD ^ HH:MM:SS ^ D+XX CR LF
> or
> CR LF I ^ ^YYYY^ DDD ^ HH:MM:SS ^ D-XX CR LF

Where:

CR	Carriage Return
LF	Line Feed
I	Time Sync Status (space, ?, *)
YYYY	Four digit year indication
^	Space separator
DDD	Day of Year (001-366)
HH	Hours (00-23)
:	Colon separator
MM	Minutes (00-59)
SS	Seconds (00-60)
D	Daylight Saving Time indicator (S,I,D,O)
XX	Time Zone Switch Setting (±00…12)

The leading edge of the first character (`CR`) marks the on-time point of the data stream. Time sync status character (`I`) is described below:

(Space)	When VersaPNT is synchronized to UTC source.
*	When VersaPNT time is set manually.
?	When VersaPNT has not achieved or has lost synchronization to UTC source.

The time and date can be set to either local time or UTC time, depending upon the configuration of the output port.

6.3.12 Spectracom Format 9

Format 9 provides Day-of-Year and Time information.

Example message:

<SOH>DDD:HH:MM:SSQ<CR><LF>

Where:

SOH	Start of header (ASCII Character 1)
DDD	Day of Year (001-366)
:	Colon Separator
HH	Hours (00-23)
MM	Minutes (00-59)
SS	Seconds (00-59) (00-60 for leap second)
Q	Time Sync Status [as INPUT] space = SYNC '.' = SYNC '*'=NOT IN SYNC '#' = NOT IN SYNC "?" = NOT IN SYNC
Q	Time Sync Status [as OUTPUT] space = Time error is less than time quality flag 1's threshold (TFOM < or = 3) "." = Time error has exceeded time quality flag 1's threshold (TFOM = 4) "*" = Time error has exceeded time quality flag 2's threshold (TFOM = 5) "#" = Time error has exceeded time quality flag 3's threshold (TFOM = 6) "?" = Time error has exceeded time quality flag 4's threshold OR a reference source is unavailable (TFOM >=7)

CR	Carriage Return (ASCII Character 13)
LF	Line Feed (ASCII Character 10)

The leading edge of the first character (`CR`) marks the on-time point of the data stream.

6.3.12.1 Format 9S

Format 9S is a variation of ASCII Format 9 that uses Sysplex compatible fields indicating sychronization status:

FL_SYNC_SYS_REF_NONE ('X')	Never been in sync
FL_SYNC_SYS_REF_YES (' ')	In sync with a reference
FL_SYNC_SYS_REF_LOST ('F')	Out of sync, lost reference

6.3.13 Spectracom Epsilon Formats

6.3.13.1 Spectracom Epsilon TOD 1

This message corresponds to the TOD 1 format provided by EPSILON 2S/3S Series products on RS232/422 ports.

The structure of this format is as follows:

» <space>DD/MM/YYYY<space>HH:MM:SST(CR)(LF)

Length=23 bytes

Where:

<space>	separator
DD	2-digit Day of month
</>	separator
MM	2-digit Month
</>	separator
YYYY	4-digit Year
<space>	separator
HH	2-digit Hour

:	separator
MM	2-digit Minutes
:	separator
SS	2-digit Seconds
T	1-digit Timescale ('N' None, 'G' GPS, 'U' UTC, 'A' TAI, 'L' Local, 'M' Manual)
(CR)	Carriage Return (ASCII Character 13 0x0D)
(LF)	Line Feed (ASCII Character 10 0x0A)

6.3.13.2 Spectracom Epsilon TOD 3

This message corresponds to the TOD 3 format provided by EPSILON 2S/3S Series products on RS232/422 ports.

The structure of this format is as follows:

» <space>DOY/YYYY<space>HH:MM:SS<space>T(CR)(LF)

Length=22 bytes

Where:

<space>	separator
DOY	3-digit Day of year
</>	separator
YYYY	4-digit Year
</>	separator
YYYY	4-digit Year
<space>	separator
HH	2-digit Hour
:	separator
MM	2-digit Minutes
:	separator
SS	2-digit Seconds
T	1-digit Timescale ('N' None, 'G' GPS, 'U' UTC, 'A' TAI, 'L' Local, 'M' Manual)
(CR)	Carriage Return (ASCII Character 13 0x0D)
(LF)	Line Feed (ASCII Character 10 0x0A)

6.3.14 BBC Message Formats

6.3.14.1 Format BBC-01

This format is based on string ASCII characters, and is sent once per second. It provides year, month, day, day of week, day of month, hours, minutes, and seconds.

Number of characters: 24 (including CRLF and '.')

Example message:

T:ye:mo:da:dw:ho:mi:sc

Where:

T	Indicates the synchronous moment for the time setting.
ye	Year (00-99)
mo	Month (01-12)
da	Day of month (01-31)
dw	Day of week (01=Monday to 7=Sunday)
ho	Hours (00-23)
mi	Minutes (00-59)
sc	Seconds (00-59)

6.3.14.2 Format BBC-02

This is a hexadecimal frame/message sent twice per second. The message should be sent such that the final “99” occurs at 0 msec and 500 msec.

Number of bytes: 26

Format:

START		Year		Month	Day	Hour	Min	Sec.
AA	AA	07	DA	06	16	13	59	01

Millisecond		Time Zone		Daylight	Leap-second Sign	Leap-second Month	Leap-second Zone	GPS Week	
02	BA	80	00	00	00	00	00	1A	2A

GPS Second			GPS to UTC Offset	Check-sum	END	
09	3A	7E	12	FE	99	99

Where:

Leap Second Sign:

- 01=Positive
- FF=Negative
- 00=No leap second

Leap Second Month:

- 00=None scheduled
- 03=March
- 06=June
- 09=September
- 0C=December

Leap Second Zone:

- 0=Out of zone
- 1=Within zone
- Zone is 15 minutes before to 15 minutes after a leap second.

GPS Week:

- Up to FFFF

GPS Second:

- Second of week 000000 up to 093A7F (604799 decimal)

GPS to UTC offset:

- 2's complement binary signed integer, seconds

Checksum:

- Sum of all bytes up to and including the checksum (sum includes the AAAA start identifier but excludes the 9999 end identifier)

6.3.14.3 Format BBC-03 PSTN

The third format is a string ASCII characters and is sent on a received character.

The message should be advanced by an appropriate number such that the stop bit of each <CR> occurs at the start of the next second. For example, at 300 baud, 8 data bits, 1 stop bit, and no parity, each byte takes 10/300 s=33 ms, so the <CR> byte should be advanced by 33 ms in order for the <CR>'s stop bit to line up with the start of the next second.

Time information is available in UTC format or UK TOD format.

't' command

Input format: `t<CR>`

Output format:

Current Second	Second + 1	Second + 2	Second + 3
`<CR>`	`HHMMSS<CR>`	`HHMMSS<CR>`	`HHMMSS<CR>`

Number of characters: 7 (including CR)

Each `HHMMSS` filed refers to the time at the start of the next second. The data transmitted by VersaPNT is timed so that the stop bit of each <CR> ends at the start of the next second.

'd' command

VersaPNT transmits the date on request.

Input format: `d<CR>`

Output format: `YYMMDD<CR>`

Number of output characters: 7 (including CR)

's' command

VersaPNT transmits the status information on request.

Input format: `s<CR>`

Output Format: `status`

Number of output characters: 1

Where returned, values for `status` are:

- `G` = System Good
- `D` = Failure of VersaPNT internal diagnostics
- `T` = VersaPNT does not have correct time

‘l’ command

The loopback command will cause VersaPNTto echo the next character received back to the caller. This may be used by a caller’s equipment to calculate the round trip delay across the PSTN connection in order to apply a correction to the received time data.

Input format: `l<CR>`

Output format: (Next character received)

‘hu’ command

The hang up command will cause VersaPNT to drop the line immediately and terminate the call.

Input format: `hu<CR>`

6.3.14.4 Format BBC-04

This format is a string of ASCII characters and is sent once per second.

Number of characters: 18 (including CRLF)

Example message:

T:ho:mi:sc:dw:da:mo:ye:lp:cs<CR><LF>

Where:

T	Indicates the synchronous moment for the time setting.
ho	Hours (00-23)
mi	Minutes (00-59)
sc	Seconds (00-59)
dw	Day of week (01=Monday to 7=Sunday)

da	Day of month (01-31)
mo	Month (01-12)
ye	Year (00-99)
lp	0 (for 60s, no leap) or 1 (for 61s, leap)
cs	Checksum. This is calculated from the start of the message, including start identifier and excluding CRLF. It is created by adding all the 1s. If the sum is even, 0 is returned. If the sum is odd, 1 is returned. This is mathematically the same as sequentially running an XOR on each bit of each byte.

Standard Serial configuration is:

- RS-232 format
- 9600 baud
- 8 data bits
- 1 stop bit
- No parity

6.3.14.5 Format BBC-05 (NMEA RMC Message)

The NMEA Message Format RMC, (Recommended Minimum) provides fix information, speed over ground and Magnetic Variance information. Note that this RMC Message is not 100% identical to the official NMEA RMC MESSAGE (that corresponds to the 3.01 NMEA 0183 standard and is another time code format supported by VersaPNT.)

The BBC RMC message (BBC-05) corresponds to Version 2 of the NMEA 0183 standard, following the description below:

Example message:

$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A

Where:

RMC	Recommended Minimum sentence C
123519	Fix taken at 12:35:19 UTC
A	Status: A=active or V=Void.

4807.038,N	Latitude 48 deg 07.038' N
01131.000,E	Longitude 11 deg 31.000' E
22.4	Speed over the ground in knots
84.4	Track angle in degrees True
230394	Date—23rd of March 1994
003.1,W	Magnetic Variation
*6A	The checksum data, always begins with *

6.3.15 GSSIP Message Format

The GSSIP[1] format includes 3 ICD-GPS-153C messages which are used to support emulation of a SAASM GPS used in a SINCGARS interface. The messages are the Buffer Box (253), Time Transfer (5101), and the Current Status (5040).

The ICD-GPS-153C protocol defines the format of these messages. The Current Status and Time Transfer are sent once per second (1Hz). The Buffer Box is sent once every 6 seconds (1/6 Hz).

The purpose of these three messages is to emulate a SINCGARS interface connection to a SAASM GPS. VersaPNT generates these messages emulating the Time and 1PPS transfer behavior of the SINCGARS interface. An external device compatible with the SINCGARS interface can attach to an ASCII Output from VersaPNT and receive time and 1PPS as if communicating with and ICD-GPS-153C compatible SAASM GPS.

These commands are emulated only and contain only time information; position and velocity information is zeroed out. No controlled data is included in the messages, hence no SAASM GPS receiver is required.

The ASCII Output supports two configurations for supporting SINCGARS:

A configuration of Time Transfer as Message Format1 and Current Status as Format2 causes the SINCGARS protocol to be emulated and the machine state to be initializated.

- **Format1**: Time Transfer (5101)
- **Format2**: Current Status (5040)
- **Format3**: Buffer Box (253)

A configuration of Current Status as Message Format1 and Time Transfer as Format2 results in broadcasting of the messages Current Status (1Hz), Time Transfer (1Hz), and Buffer Box (1/6Hz) at their default rates.

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[1]GSSIP = GPS STANDARD SERIAL INTERFACE PROTOCOL

- **Format1**: Current Status (5040)
- **Format2**: Time Transfer (5101)
- **Format3**: Buffer Box (253)

6.3.16 EndRun Formats

The following formats provide compatibility with **EndRun** technology.

6.3.16.1 EndRun Time Format

Example message:

T YYYY DDD HH:MM:SS zZZ m<CR><LF>

Where:

T	Time Figure of Merit character (TFOM), limited to the range 6 to 9: 9 indicates error >±10 milliseconds, or unsynchronized condition 8 indicates error <±10 milliseconds 7 indicates error <±1 millisecond 6 indicates error <±100 microseconds
YYYY	Year
DDD	Day of Year (001-366)
HH	Hour of the day (00-23)
:	Colon Separator
MM	Minutes of the hour
SS	Seconds (00-59), (00-60 for leap second)
z	The sign of the offset to UTC, + implies time is ahead of UTC
ZZ	The magnitude of the offset to UTC in units of half-hours. If ZZ = 0, then z = +
m	Time mode character, is one of: G = GPS L = Local U = UTC T = TAI
CR	Carriage Return
LF	Line Feed

6.3.16.2 EndRunX (Extended) Time Format

The **EndRunX** format is identical to the **EndRun** format, with the addition of two fields: the current leap second settings and the future leap second settings.

> The following example message string is sent once each second:
>
> T YYYY DDD HH:MM:SS zZZ m CC FF<CR><LF>

Where:

T	Time Figure of Merit character (TFOM), limited to the range 6 to 9: 9 indicates error >±10 milliseconds, or unsynchronized condition 8 indicates error <±10 milliseconds 7 indicates error <±1 millisecond 6 indicates error <±100 microseconds
YYYY	Year
DDD	Day of Year (001-366)
HH	Hour of the day (00-23)
:	Colon Separator
MM	Minutes of the hour
SS	Seconds (00-59), (00-60 for leap second)
z	The sign of the offset to UTC, + implies time is ahead of UTC
ZZ	The magnitude of the offset to UTC in units of half-hours. If ZZ = 0, then z = +
m	Time mode character, is one of: G = GPS L = Local U = UTC T = TAI
CC	The current leap seconds
FF	The future leap seconds, which will show a leap second pending 24 hours in advance
CR	Carriage Return
LF	Line Feed

6.3.17 Event Broadcast Time Code Formats

The following ASCII-based time code formats are available:

6.3.17.1 Event Broadcast Format 0

Example message:

SSSSSSSSSS.XXXXXXXXX<CR><LF>

Where:

SSSSSSSSSS	10-digit Seconds Time (references from January 1st, 1970)
.	Decimal Point Separator
XXXXXXXXX	9-digit Sub-Seconds Time (5 ns resolution)
CR	Carriage Return
LF	Line Feed

6.3.17.2 Event Broadcast Format 1

Example message

YYYY DDD HH:MM:SS.XXXXXXXXX<CR><LF>

Where:

YYYY	Year
	Space Separator
DDD	Day of Year (001-366)
	Space Separator
HH	Hour of the Day (00-23)
:	Colon Separator
MM	Minutes of the Hour (00-59)
:	Colon Separator

SS	Seconds (00-59), (00-60 for leap second)
.	Period Separator
XXXXXXXXX	9-digit Sub-Seconds Time (5 ns resolution)
CR	Carriage Return
LF	Line Feed

6.4 IRIG Standards and Specifications

6.4.1 About the IRIG Output Resolution

The IRIG output signals are generated from VersaPNT's System Time, which can be synced to one or more external input references (such as GPS, IRIG, PTP, etc). The accuracy of the System time to true UTC time is dependent upon what the selected external reference is (with GPS typically being the most accurate reference for the system to sync with).

As for the four available IRIG outputs of the 1204-15 Option Card, outputting an IRIG DCLS (Phase Modulation) signal provides much better and more accurate synchronization of another device than does an IRIG AM (Amplitude Modulation) signal. This is due to the faster rise-time with the DCLS signal being able to provide a more “crisp” on-time point (more distinct, with less jitter) than the slower rise-time of an AM modulated signal.

IRIG AM synchronization of a device to its IRIG source is typically measured in the tens of microseconds, while synchronization using a IRIG DCLS signal can typically provide around 100 nanoseconds or so (plus the cable delays between VersaPNT and the other device, as well as the processing delays of the other system itself).

Note that each of the four IRIG outputs of the Model 1204-15 card has its own available ‘offset’ capability, which is configurable via VersaPNT’s Web UI, to help account for cabling and processing delays of the device each output is connected with.

6.4.2 IRIG Carrier Frequencies

Each IRIG code specifies a carrier frequency that is modulated to encode date and time, as well as control bits to time-stamp events. Initially, IRIG applications were primarily military and government associated. Today, IRIG is commonly used to synchronize voice loggers, recall recorders, and sequential event loggers found in emergency dispatch centers and power utilities.

Table 6-4: Available IRIG output signals

Format	Encoding	Modulation	Carrier	Coded Expressions	Bit rate	Time Frame Interval
IRIG-A						
IRIG-A	A000	DCLS	N/A	BCD_{TOY}, CF and SBS	1000 pps	0.1 sec
IRIG-A	A001	DCLS	N/A	BCD_{TOY}, CF	1000 pps	0.1 sec
IRIG-A	A002	DCLS	N/A	BCD_{TOY}	1000 pps	0.1 sec
IRIG-A	A003	DCLS	N/A	BCD_{TOY}, SBS	1000 pps	0.1 sec
IRIG-A	A004	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}, CF and SBS	1000 pps	0.1 sec
IRIG-A	A005	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}, and CF	1000 pps	0.1 sec
IRIG-A	A006	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}	1000 pps	0.1 sec
IRIG-A	A007	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}, and SBS	1000 pps	0.1 sec
IRIG-A	A130	AM	10 kHz	BCD_{TOY}, CF and SBS	1000 pps	0.1 sec
IRIG-A	A131	AM	10 kHz	BCD_{TOY}, CF	1000 pps	0.1 sec
IRIG-A	A132	AM	10 kHz	BCD_{TOY}	1000 pps	0.1 sec
IRIG-A	A133	AM	10 kHz	BCD_{TOY}, SBS	1000 pps	0.1 sec
IRIG-A	A134	AM	10 kHz	BCD_{TOY}, BCD_{YEAR}, CF and SBS	1000 pps	0.1 sec
IRIG-A	A135	AM	10 kHz	BCD_{TOY}, BCD_{YEAR}, and CF	1000 pps	0.1 sec
IRIG-A	A136	AM	10 kHz	BCD_{TOY}, BCD_{YEAR}	1000 pps	0.1 sec
IRIG-A	A137	AM	10 kHz	BCD_{TOY}, BCD_{YEAR}, and SBS	1000 pps	0.1 sec
IRIG-B						
IRIG-B	B000	DCLS	N/A	BCD_{TOY}, CF and SBS	100 pps	1 sec
IRIG-B	B001	DCLS	N/A	BCD_{TOY}, CF	100 pps	1 sec
IRIG-B	B002	DCLS	N/A	BCD_{TOY}	100 pps	1 sec
IRIG-B	B003	DCLS	N/A	BCD_{TOY}, SBS	100 pps	1 sec
IRIG-B	B004	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}, CF and SBS	100 pps	1 sec
IRIG-B	B005	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}, and CF	100 pps	1 sec
IRIG-B	B006	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}	100 pps	1 sec

Format	Encoding	Modulation	Carrier	Coded Expressions	Bit rate	Time Frame Inter-val
IRIG-B	B007	DCLS	N/A	BCD$_{TOY}$, BCD$_{YEAR}$, and SBS	100 pps	1 sec
IRIG-B	B120	AM	1 kHz	BCD$_{TOY}$, CF and SBS	100 pps	1 sec
IRIG-B	B121	AM	1 kHz	BCD$_{TOY}$, CF	100 pps	1 sec
IRIG-B	B122	AM	1 kHz	BCD$_{TOY}$	100 pps	1 sec
IRIG-B	B123	AM	1 kHz	BCD$_{TOY}$, SBS	100 pps	1 sec
IRIG-B	B124	AM	1 kHz	BCD$_{TOY}$, BCD$_{YEAR}$, CF and SBS	100 pps	1 sec
IRIG-B	B125	AM	1 kHz	BCD$_{TOY}$, BCD$_{YEAR}$, and CF	100 pps	1 sec
IRIG-B	B126	AM	1 kHz	BCD$_{TOY}$, BCD$_{YEAR}$	100 pps	1 sec
IRIG-B	B127	AM	1 kHz	BCD$_{TOY}$, BCD$_{YEAR}$, and SBS	100 pps	1 sec
IRIG-E						
IRIG-E	E000	DCLS	N/A	BCD$_{TOY}$, CF and SBS	10 pps	1 sec
IRIG-E	E001	DCLS	N/A	BCD$_{TOY}$, CF	10 pps	1 sec
IRIG-E	E002	DCLS	N/A	BCD$_{TOY}$	10 pps	1 sec
IRIG-E	E003	DCLS	N/A	BCD$_{TOY}$, SBS	10 pps	1 sec
IRIG-E	E004	DCLS	N/A	BCD$_{TOY}$, BCD$_{YEAR}$, CF and SBS	10 pps	1 sec
IRIG-E	E005	DCLS	N/A	BCD$_{TOY}$, BCD$_{YEAR}$, and CF	10 pps	1 sec
IRIG-E	E006	DCLS	N/A	BCD$_{TOY}$, BCD$_{YEAR}$	10 pps	1 sec
IRIG-E	E007	DCLS	N/A	BCD$_{TOY}$, BCD$_{YEAR}$, and SBS	10 pps	1 sec
IRIG-E	E110	AM	100 Hz	BCD$_{TOY}$, CF and SBS	10 pps	1 sec
IRIG-E	E111	AM	100 Hz	BCD$_{TOY}$, CF	10 pps	1 sec
IRIG-E	E112	AM	100 Hz	BCD$_{TOY}$	10 pps	1 sec
IRIG-E	E113	AM	100 Hz	BCD$_{TOY}$, SBS	10 pps	1 sec
IRIG-E	E114	AM	100 Hz	BCD$_{TOY}$, BCD$_{YEAR}$, CF and SBS	10 pps	1 sec
IRIG-E	E115	AM	100 Hz	BCD$_{TOY}$, BCD$_{YEAR}$, and CF	10 pps	1 sec
IRIG-E	E116	AM	100 Hz	BCD$_{TOY}$, BCD$_{YEAR}$	10 pps	1 sec

Format	Encoding	Modulation	Carrier	Coded Expressions	Bit rate	Time Frame Interval
IRIG-E	E117	AM	100 Hz	BCD_{TOY}, BCD_{YEAR}, and SBS	10 pps	1 sec
IRIG-E	E120	AM	100 Hz	BCD_{TOY}, CF and SBS	10 pps	1 sec
IRIG-E	E121	AM	1kHz	BCD_{TOY}, CF	10 pps	10 sec
IRIG-E	E122	AM	1kHz	BCD_{TOY}	10 pps	10 sec
IRIG-E	E123	AM	1kHz	BCD_{TOY}, SBS	10 pps	10 sec
IRIG-E	E124	AM	1kHz	BCD_{TOY}, BCD_{YEAR}, CF and SBS	10 pps	10 sec
IRIG-E	E125	AM	1kHz	BCD_{TOY}, BCD_{YEAR}, and CF	10 pps	10 sec
IRIG-E	E126	AM	1kHz	BCD_{TOY}, BCD_{YEAR}	10 pps	10 sec
IRIG-E	E127	AM	1kHz	BCD_{TOY}, BCD_{YEAR}, and SBS	10 pps	10 sec
IRIG-G						
IRIG-G	G001	DCLS	N/A	BCD_{TOY}, CF	10000 pps	10 msec
IRIG-G	G002	DCLS	N/A	BCD_{TOY}	10000 pps	10 msec
IRIG-G	G005	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}, and CF	10000 pps	10 msec
IRIG-G	G006	DCLS	N/A	BCD_{TOY}, BCD_{YEAR}	10000 pps	10 msec
IRIG-G	G141	AM	100 kHz	BCD_{TOY}, CF	10000 pps	10 msec
IRIG-G	G142	AM	100 kHz	BCD_{TOY}	10000 pps	10 msec
IRIG-G	G145	AM	100 kHz	BCD_{TOY}, BCD_{YEAR}, and CF	10000 pps	10 msec
IRIG-G	G146	AM	100 kHz	BCD_{TOY}, BCD_{YEAR}	10000 pps	10 msec
NASA-36	N/A	AM	1msec	UNKNOWN	100 pps	1 sec
NASA-36	N/A	DCLS	10 msec	UNKNOWN	100 pps	1 sec

The Spectracom IRIG formats use the control functions for BCD year information and a Time Sync Status bit and in format E the control functions are used for straight binary seconds (SBS).

Refer to individual IRIG Time Code description figures and text. IRIG Standard 200-98 format B had 27 control bits and format E had 45 bits for control functions. These control bits could be used for any use and there was no defined function. Spectracom used the control function element at index count 55 as the TIME SYNC STATUS and the sub-frame after position identifiers P6 and P7 as the year info and for format E the sub-frame after P8 and P9 for the straight binary seconds (SBS). The position of the BCD year information does not conform to the newer IRIG Standard 200-04. IRIG Standard 200-04 incorporated the year information after P5 and reduced the allocated control bits to 18 for format B and 36 for format E.

Note: DCLS is DC Level Shifted output, pulse width modulated with a position identifier having a positive pulse width equal to 0.8 of the reciprocal of the bit rate, a binary one (1) having a positive pulse width equal to 0.5 of the reciprocal of the bit rate and a binary zero (0) having a positive pulse width equal to 0.2 of the reciprocal of the bite rate.

VersaPNT can provide IRIG A, IRIG B, IRIG E and IRIG G code in amplitude modulated (AM) or pulse width coded (TTL) formats. A signature control feature may be enabled for any IRIG output. Signature control removes the modulation code when a Time Sync Alarm is asserted.

6.4.3 IRIG B Output

The IRIG B Time Code description follows.

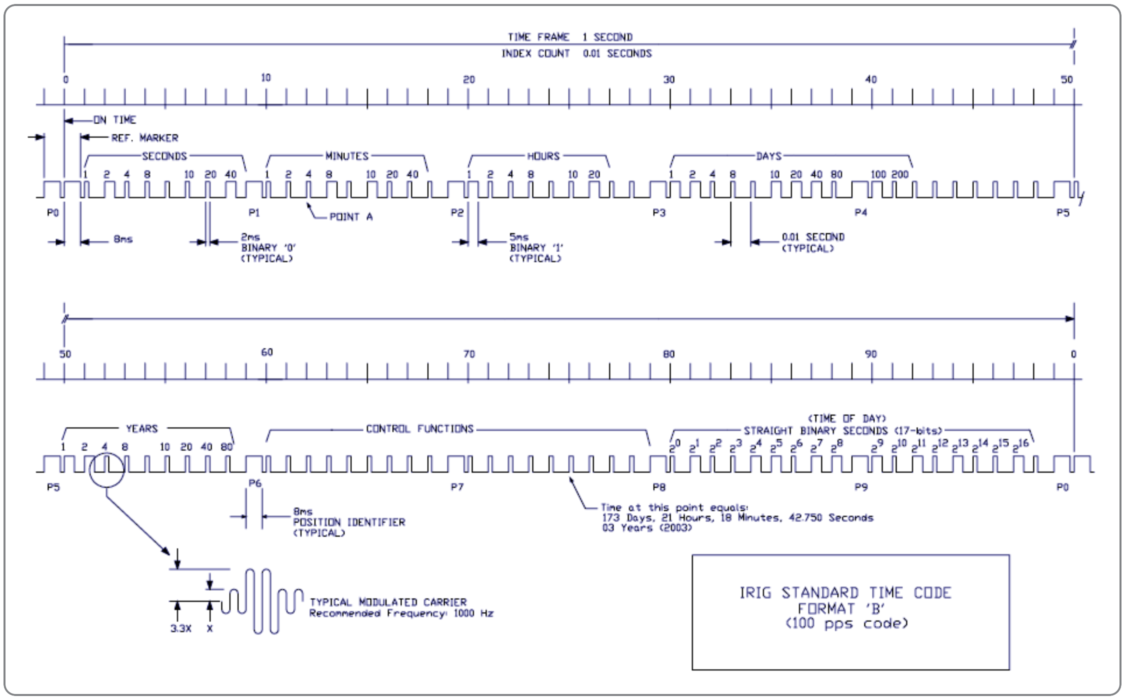

Figure 6-1: IRIG B time code description

The IRIG B code contains the Binary Coded Decimal (BCD) time of year, Control Function (CF) field and the Straight Binary Seconds time of day. The following figure illustrates the IRIG B data structure. The BCD time of year provides the day of the year, 1-366, and the time of day including seconds. The hour of the day is expressed in 24 hour format. The SBS time is the number of seconds elapsed since midnight. The Control Function field contains year information and a time synchronization status bit.

1. Time frame: 1.0 seconds.
2. Code digit weighting:
   A. Binary Coded Decimal time-of-year.
   - Code word - 30 binary digits.
   - Seconds, minutes hours, and days.
   - Recycles yearly.

   B. Straight Binary Seconds time-of-day.

- Code word - 17 binary digits.
- Seconds only, recycles daily.

3. Code word structure:
    - **BCD**: Word seconds digits begin at index count 1. Binary coded elements occur between position identifier elements P0 and P5 (7 for seconds, 7 for minutes, 6 for hours, and 10 for days) until the code word is complete. An index marker occurs between decimal digits in each group to provide separation for visual resolution. Least significant digit occurs first.
    - **CF**: IRIG formats reserve a set of elements known as Control Functions (CF) for the encoding of various control, identification, or other special purpose functions. IRIG B has 27 Control Functions located between elements 50 and 78. The VersaPNT uses the Control Functions to encode year information and time synchronization status.

The table below lists the **Control Function Field** and the function of each element.

- Element 55 is the time synchronization status bit. Element 55 is a Binary 1 when the unit is in sync, and a Binary 0 when it is not.
- Year information consists of the last two digits of the current year (i.e. 97, 98, 99 etc.). Elements 60 through 63 contain the binary equivalent of year units. Elements 65 through 68 contain the binary equivalent of tens of years. In keeping with IRIG formats, the least significant bit occurs first. All unused Control Functions are filled with a space (Binary 0).
- **SBS**: Word begins at index count 80. Seventeen Straight Binary Coded elements occur with a position identifier between the 9th and 10th binary coded elements. Least significant digit occurs first.
- Pulse rates:
    - Element rate: 100 per second.
    - Position identifier rate: 10 per second.
    - Reference marker rate: 1 per second.
- Element identification: The "on time" reference point for all elements is the pulse leading edge.
    - Index marker (Binary 0 or uncoded element): 2 millisecond duration.
    - Code digit (Binary 1): 5 millisecond duration.
    - Position identifier: 8 millisecond duration.

- Reference marker, 1 per second. The reference marker appears as two consecutive position identifiers. The second position identifier marks the on-time point for the succeeding code word.
- Resolution:
  - Pulse width coded signal: 10 milliseconds.
  - Amplitude modulated signal: 1 millisecond.
- Carrier frequency: 1kHz when modulated.

Table 6-5: IRIG B control function field

C.F. Element #	Digit #	Function
50	1	Space
51	2	Space
52	3	Space
53	4	Space
54	5	Space
55	6	Time Sync Status
56	7	Space
57	8	Space
58	9	Space
59	PID P6	Position Identifier
60	10	Years Units Y1
61	11	Years Units Y2
62	12	Years Units Y4
63	13	Years Units Y8
64	14	Space
65	15	Years Tens Y10
66	16	Years Tens Y20
67	17	Years Tens Y40
68	18	Years Tens Y80
69	PID P7	Position Identifier

C.F. Element #	Digit #	Function
70	19	Space
71	20	Space
72	21	Space
73	22	Space
74	23	Space
75	24	Space
76	25	Space
77	26	Space
78	27	Space

6.4.4 IRIG E Output

The **IRIG E** code contains the Binary Coded Decimal (BCD) time of year and Control Functions. The figure IRIG E Time Code Description illustrates the IRIG E data structure. The BCD time of year provides the day of year, 1-366, and time of day to tens of seconds. The hour of the day is expressed in 24 hour format. The Control Function field includes a time synchronization status bit, year information and SBS time of day.

- **Time frame**: 10 seconds.
- **Code Digit Weighting**:
  - Binary Coded Decimal time of year.
  - Code world - 26 binary digits.
  - Tens of seconds, minutes, hours, and days.
  - Recycles yearly.

- **Code Word Structure**: BCD word tens of seconds digits begin at index count 6. Binary coded elements occur between position identifier elements P0 and P5 (3 for seconds, 7 for minutes, 6 for hours, and 10 for days) until the code word is complete. An index marker occurs between decimal digits in each group to provide separation for visual resolution. Least significant digit occurs first.
- **Control Functions**: IRIG formats reserve a set of elements known as Control Functions (CF) for the encoding of various control, identification, or other special purpose functions. IRIG E has 45 Control Functions located between elements 50 and 98. The VersaPNT

uses the Control Function field to encode year data, time synchronization status, and SBS time data. Table B-2 lists the Control Function Field and each element's function.

Element 55 is the time synchronization status bit. Element 55 is a Binary 1 when the front panel time synchronization lamp is green, and a Binary 0 when the lamp is red.

Year information consists of the last two digits of the current year (i.e. 98, 99, etc.). Elements 60 through 63 contain the binary equivalent of year units. Elements 65 through 68 contain the binary equivalent of tens of years. In keeping with IRIG formats, the least significant bit occurs first.

Elements 80 through 97 are encoded with the Straight Binary Seconds (SBS) time data. The SBS time data is incremented in 10-second steps and recycles every 24 hours.

- Pulse rates:
  - Element rate: 10 per second.
  - Position identifier rate: 1 per second.
  - Reference marker rate: 1 per 10 seconds.
- Element identification: The "on time" reference point for all elements is the pulse leading edge.
- Index marker (Binary 0 or uncoded element): 20 millisecond duration.
- Code digit (Binary 1): 50 millisecond duration.
- Position identifier: 80 millisecond duration.
- Reference marker: 80 millisecond duration, 1 per 10 seconds. The reference marker appears as two consecutive position identifiers. The second position identifier or reference marker is the on-time point for the succeeding code word.

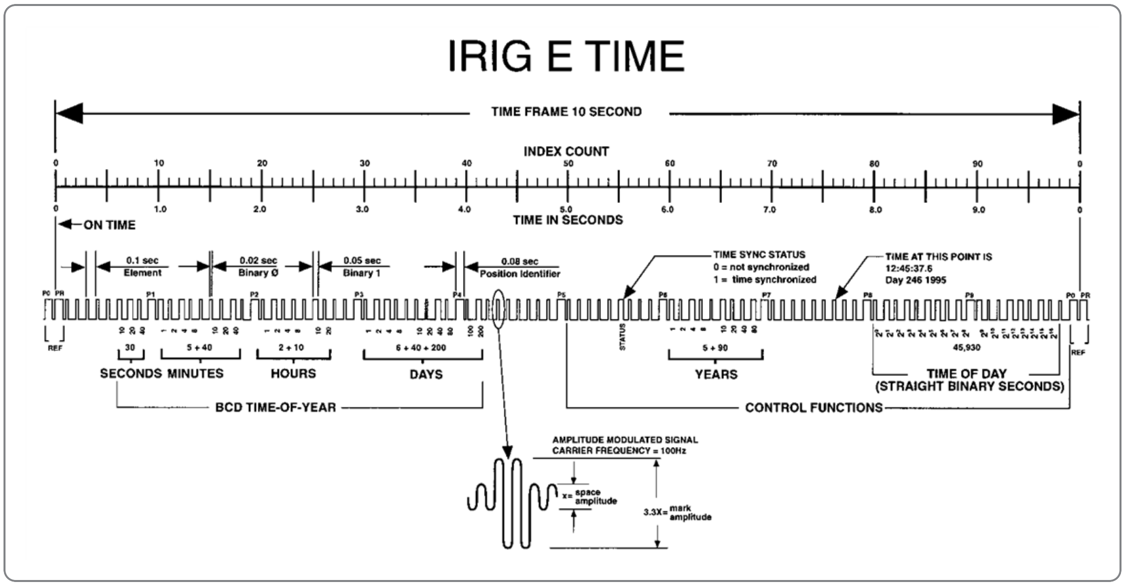

Figure 6-2: IRIG E time code description

Additional information

The beginning of each 10 second time frame is identified by two consecutive 80 ms elements (P_0 and P_R). The leading edge of the second 80 ms element (P_R) is the "on time" reference point for the succeeding time code. 1PPS position identifiers P_0, P_1 … P_9 (80 ms duration) occur 0.1 s before 1PPS "on time" and refer to the leading edge of the succeeding element.

The time code word and the control functions presented during the time frame are pulse-width coded. The binary "zero" and index markers have a duration of 20 ms, and the binary "one" has a duration of 50 ms. The leading edge is the 10 pps "on time" reference point for all elements.

The binary coded decimal (BCD) time-of-year code word consists of 26 digits beginning at index count 6. The binary coded subword elements occur between position identifiers P_0 and P_5 (3 for seconds; 7 for minutes; 6 for hours; 10 for days) until the code word is complete. An index marker occurs between the decimal digits in each subword to provide separation for visual resolution. The least significant digit occurs first. The BCD code recycles yearly.

Forty-five control functions occur between position identifiers P_5 and P_0. Any control function element for combination of control function elements can be programmed to read a binary "one" during any specified number of time frames. Each control element is identified on the Control Function Field Table.

Table 6-6: IRIG E control function field

BIT No.	CF ELEMENT No.	FUNCTION
50	1	SPACE
51	2	SPACE
52	3	SPACE
53	4	SPACE
54	5	SPACE
55	6	TIME SYNC_STATUS
56	7	SPACE
57	8	SPACE
58	9	SPACE
59	PID P6	POSITION IDENTIFIER
60	10	YEAR UNITS Y1
61	11	YEAR UNITS Y2
62	12	YEAR UNITS Y4
63	13	YEAR UNITS Y8
64	14	SPACE
65	15	YEAR TENS Y10
66	16	YEAR TENS Y20
67	17	YEAR TENS Y40
68	18	YEAR TENS Y80
69	PID P7	POSITION IDENTIFIER
70	19	SPACE
71	20	SPACE
72	21	SPACE
73	22	SPACE
74	23	SPACE
75	24	SPACE
76	25	SPACE

BIT No.	CF ELEMENT No.	FUNCTION
77	26	SPACE
78	27	SPACE
79	PID P8	POSITION IDENTIFIER
80	28	SBS 20
81	29	SBS 21
82	30	SBS 22
83	31	SBS 23
84	32	SBS 24
85	33	SBS 25
86	34	SBS 26
87	35	SBS 27
88	36	SBS 28
89	PID P9	POSITION IDENTIFIER
90	37	SBS 29
91	38	SBS 210
92	39	SBS 211
93	40	SBS 212
94	41	SBS 213
95	42	SBS 214
96	43	SBS 215
97	44	SBS 216
98	45	SPACE
99	PID P0	POSITION IDENTIFIER

6.4.5 IRIG Output Accuracy Specifications

The IRIG outputs of the Spectracom Option Cards 1204-15, -1E, -22, and 1204-05, -27 deliver signals with the following 1PPS accuracy:

IRIC DCLS

Signal Category	Measured Accuracy
IRIG A	30 ns
IRIG B	30 ns
IRIG G	30 ns
IRIG NASA	30 ns
IRIG E	30 ns

IRIG AM

Signal Category	Measured Accuracy
IRIG A	200 ns
IRIG B	800 ns
IRIG G	200 ns
IRIG NASA	800 ns
IRIG E	1.5 μs

6.5 Product Registration

Spectracom recommends that you register your VersaPNT so as to allow our Customer Service and Technical Support to notify you of important software updates, or send you service bulletins, if required.

Upon initial start of the VersaPNT Web UI, you will be prompted to register your new product. It is also possible to register at a later time via the HELP menu item, or directly on the **Spectracom website**: register.spectracom.com

6.6 Technical Support

To request technical support for your VersaPNT unit, please go to the "Support" page of the Spectracom Corporate website, where you can not only submit a support request, but also find additional technical documentation.

Phone support is available during regular office hours under the telephone numbers listed below.

To speed up the diagnosis of your VersaPNT, please send us:

- the current **product configuration**,and
- the **events log**.

Thank you for your cooperation.

6.6.1 Regional Contact

Spectracom operates globally and has offices in several locations around the world. Our main offices are listed below:

Country	Location	Phone
China	Beijing	+86-10-8231 9601
France	Les Ulis, Cedex	+33 (0)1 6453 3980
USA	Rochester, NY	+1.585.321.5800

Table 6-7: Spectracom contact information

Additional regional contact information can be found on the Contact Us page of the Spectracom corporate website.

6.7 Return Shipments

Please contact Spectracom Technical Support before returning any equipment to Spectracom. Technical Support must provide you with a Return Material Authorization Number (RMA#) prior to shipment.

When contacting Technical Support, please be prepared to provide your equipment serial number(s) and a description of the failure symptoms or issues you would like resolved.

Freight to Spectracom is to be prepaid by the customer.

Note: Should there be a need to return equipment to Spectracom, it must be shipped in its original packing material. Save all packaging material for this purpose.

6.8 License Notices

6.8.1 NTPv4.2.6p5

****

The following individuals contributed in part to the Network Time Protocol Distribution Version 4 and are acknowledged as authors of this work.

1. Takao Abe <takao_abe(at)xurb.jp> Clock driver for JJY receivers
2. Mark Andrews <mark_andrews(at)isc.org> Leitch atomic clock controller
3. Bernd Altmeier <altmeier(at)atlsoft.de> hopf Elektronik serial line and PCI-bus devices
4. Viraj Bais <vbais(at)mailman1.intel.com> and Clayton Kirkwood <kirkwood(at)strider-fm.intel.com> port to WindowsNT 3.5
5. Michael Barone <michael,barone(at)lmco.com> GPSVME fixes
6. Karl Berry <karl(at)owl.HQ.ileaf.com> syslog to file option
7. Greg Brackley <greg.brackley(at)bigfoot.com> Major rework of WINNT port. Clean up recvbuf and iosignal code into separate modules.
8. Marc Brett <Marc.Brett(at)westgeo.com> Magnavox GPS clock driver
9. Piete Brooks <Piete.Brooks(at)cl.cam.ac.uk> MSF clock driver, Trimble PARSE support
10. Nelson B Bolyard <nelson(at)bolyard.me> update and complete broadcast and crypto features in sntp

11. Jean-Francois Boudreault <Jean-Francois.Boudreault(at)viagenie.qc.ca> IPv6 support
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13. Steve Clift <clift(at)ml.csiro.au> OMEGA clock driver
14. Casey Crellin <casey(at)csc.co.za> vxWorks (Tornado) port and help with target configuration
15. Sven Dietrich <sven_dietrich(at)trimble.com> Palisade reference clock driver, NT adj. residuals, integrated Greg's Winnt port.
16. John A. Dundas III <dundas(at)salt.jpl.nasa.gov> Apple A/UX port
17. Torsten Duwe <duwe(at)immd4.informatik.uni-erlangen.de> Linux port
18. Dennis Ferguson <dennis(at)mrbill.canet.ca> foundation code for NTP Version 2 as specified in RFC-1119
19. John Hay <jhay(at)icomtek.csir.co.za> IPv6 support and testing
20. Dave Hart <davehart(at)davehart.com> General maintenance, Windows port interpolation rewrite
21. Claas Hilbrecht <neoclock4x(at)linum.com> NeoClock4X clock driver
22. Glenn Hollinger <glenn(at)herald.usask.ca> GOES clock driver
23. Mike Iglesias <iglesias(at)uci.edu> DEC Alpha port
24. Jim Jagielski <jim(at)jagubox.gsfc.nasa.gov> A/UX port
25. Jeff Johnson <jbj(at)chatham.usdesign.com> massive prototyping overhaul
26. Hans Lambermont <Hans.Lambermont(at)nl.origin-it.com> or <H.Lambermont (at)chello.nl> ntpsweep
27. Poul-Henning Kamp <phk(at)FreeBSD.ORG> Oncore driver (Original author)
28. Frank Kardel <kardel (at) ntp (dot) org> PARSE <GENERIC> (driver 14 reference clocks), STREAMS modules for PARSE, support scripts, syslog cleanup, dynamic interface handling
29. Johannes Maximilian Kuehn <kuehn(at)ntp.org> Rewrote sntp to comply with NTPv4 specification, ntpq saveconfig
30. William L. Jones <jones(at)hermes.chpc.utexas.edu> RS/6000 AIX modifications, HPUX modifications
31. Dave Katz <dkatz(at)cisco.com> RS/6000 AIX port
32. Craig Leres <leres(at)ee.lbl.gov> 4.4BSD port, ppsclock, Magnavox GPS clock driver
33. George Lindholm <lindholm(at)ucs.ubc.ca> SunOS 5.1 port

34. Louis A. Mamakos <louie(at)ni.umd.edu> MD5-based authentication
35. Lars H. Mathiesen <thorinn(at)diku.dk> adaptation of foundation code for Version 3 as specified in RFC-1305
36. Danny Mayer <mayer(at)ntp.org>Network I/O, Windows Port, Code Maintenance
37. David L. Mills <mills(at)udel.edu> Version 4 foundation, precision kernel; clock drivers: 1, 3, 4, 6, 7, 11, 13, 18, 19, 22, 36
38. Wolfgang Moeller <moeller(at)gwdgv1.dnet.gwdg.de> VMS port
39. Jeffrey Mogul <mogul(at)pa.dec.com> ntptrace utility
40. Tom Moore <tmoore(at)fievel.daytonoh.ncr.com> i386 svr4 port
41. Kamal A Mostafa <kamal(at)whence.com> SCO OpenServer port
42. Derek Mulcahy <derek(at)toybox.demon.co.uk> and Damon Hart-Davis <d(at)hd.org> ARCRON MSF clock driver
43. Rob Neal <neal(at)ntp.org> Bancomm refclock and config/parse code maintenance
44. Rainer Pruy <Rainer.Pruy(at)informatik.uni-erlangen.de> monitoring/trap scripts, statistics file handling
45. Dirce Richards <dirce(at)zk3.dec.com> Digital UNIX V4.0 port
46. Wilfredo Sánchez <wsanchez(at)apple.com> added support for NetInfo
47. Nick Sayer <mrapple(at)quack.kfu.com> SunOS streams modules
48. Jack Sasportas <jack(at)innovativeinternet.com> Saved a Lot of space on the stuff in the html/pic/ subdirectory
49. Ray Schnitzler <schnitz(at)unipress.com> Unixware1 port
50. Michael Shields <shields(at)tembel.org> USNO clock driver
51. Jeff Steinman <jss(at)pebbles.jpl.nasa.gov> Datum PTS clock driver
52. Harlan Stenn <harlan(at)pfcs.com> GNU automake/autoconfigure makeover, various other bits (see the ChangeLog)
53. Kenneth Stone <ken(at)sdd.hp.com> HP-UX port
54. Ajit Thyagarajan <ajit(at)ee.udel.edu>IP multicast/anycast support
55. Tomoaki TSURUOKA <tsuruoka(at)nc.fukuoka-u.ac.jp>TRAK clock driver
56. Brian Utterback <brian.utterback(at)oracle.com> General codebase, Solaris issues
57. Loganaden Velvindron <loganaden(at)gmail.com> Sandboxing (libseccomp) support

58. Paul A Vixie <vixie(at)vix.com> TrueTime GPS driver, generic TrueTime clock driver
59. Ulrich Windl <Ulrich.Windl(at)rz.uni-regensburg.de> corrected and validated HTML documents according to the HTML DTD

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6.9 List of Tables

6.10 List of Images

6.11 Document Revision History

Rev	ECO	Description	Date
1	DOC-213	First-generation VersaPNT User Manual.	Septmeber 2018

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