SQ-SPT-0022

SITEPOINT™ SYSTEM

RTK-GNSS Base and Rover

SitePoint™ GNSS and SQ Survey iOS and Android app for data collection and device configuration.

DESCRIPTION

The SitePoint RTK-GNSS system employs dual frequency, multi constellation receivers, an active multipath rejecting antenna, a replaceable battery, and a Bluetooth® Low Energy radio integrated into an extremely rugged waterproof housing, greatly simplifying system architecture, and increasing overall reliability.

When used with the SQ Survey mobile app, the SitePoint system can be used as a handheld rover for data collection and mapping. It may also be configured as a fixed base station, broadcasting RTCM corrections to other SitePoint rovers and NorthPoint™ rovers.

Multiple SitePoint bases can be daisy chained together via Bluetooth to cover a wide area.

KEY FEATURES

- **Integrated Multi-Constellation, Multi-Frequency RTK-GNSS Receiver, Battery, Active Multipath Rejecting Antenna, and Long-Range Radio**
- **Configurable as Rover or Base via App or BLE**
- **RTCM Corrections over Bluetooth**
- **Bluetooth BLE, local aiding 1 km + range**
- **Wi-Fi for fixed base NTRIP casting**
- **Pole tilt compensation with auto calibration**

OUTPUTS

- **Position**
- **Device Status**
- **RTCM stream**

SPECIFICATIONS OVERVIEW

Parameter	Specification
Measurement axes	6 degrees of freedom (6DOF)
Relative position accuracy (local base)	0.7 cm (1-σ, horizontal) 1.4 cm (1-σ, vertical)
Dynamic orientation angle accuracy (pitch, roll, yaw)	0.1° 1-σ
Shock, acceleration, and vibration use conditions	▪ 1 *g*RMS random vibration 5 Hz to 500 Hz ▪ 1 *g* acceleration 1 second ▪ 20 *g* ½ sin 10 mSec ▪ 100 *g* ½ sin 0.1 mSec
Temperature range	-20 ° to 65 ° C
Battery	LiFePo4, 9 hour run time per charge
Protection	IP67

SYSTEM

SitePoint Handheld and NorthPoint Machine Mount

OUTPUT OPTIONS

Bluetooth BLE, Wi-Fi, LoRa, Cellular CAT-M1

DESIGNED FOR HEAVY VEHICLES

- Primary tier 1 supplier to more than half of the world's leading heavy vehicle OEMs
- Specifically designed, tested, and qualified to meet the unique environmental operating requirements of commercial, construction, military, agricultural, and mining vehicles.

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

TABLE OF CONTENTS

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

INTENDED USAGE

This sensor, a **Peripheral** in Bluetooth terminology, provides high accuracy and precision position measurements to a Bluetooth **Central** device connected to it using the Bluetooth Low Energy protocol.

The accuracy and precision are greatly improved when the **Central** provides RTCM aiding data to the sensor **Peripheral**, usually obtained by the **Central** from the internet using NTRIP.

It is expected that in most cases, the **Central** device connected over Bluetooth will provide RTCM aiding messages to the sensor.

COMMUNICATION PROTOCOL

More detail about the Bluetooth Low Energy protocol can be found in the freely available specification: https://www.bluetooth.com/specifications/bluetooth-core-specification/. All modern mobile devices and computers support this protocol.

The Bluetooth Low Energy protocol has a client/server architecture, and systems typically have a **Central** device and one or more **Peripheral** devices. In the system described here, a smartphone or PC is the **Central** and the sensor is a **Peripheral**.

Peripherals (or "servers") reply to requests from **Centrals** (or "clients") to perform a service.

Some key Bluetooth Low Energy protocol concepts include **Profiles**, **Services**, and **Characteristics**.

- A **Profile** contains 1 or more **Services**.
- A **Service** is a grouping of one or more **Attributes**, some of which are **Characteristics**.
- A **Service** groups together related **Attributes** that satisfy a specific function on a server.

Characteristics have:

- A Characteristic **Value.**
  - [A **Value** is one type of **Attribute**.]
- One or more **Properties:** represented by several bits which define how a Characteristic **Value** can be used.
  - Some examples include **Read**, **Write**, **Write Without Response**, **Notify**, and **Indicate**.
- Zero or more **Descriptors**
  - **Descriptors** contain related information about the characteristic Value. Some examples include **extended properties, user description**, fields used for subscribing to notifications and indications, and a field that defines the presentation of the value such as the format and the unit of the value.

This sensor implements a single **Profile,** with **1 Service**, which has several **Characteristics**.

The SitePoint sensor supports these **Characteristics**:

CHARACTERISTIC	CHARACTERISTIC VALUE	DESCRIPTION
Data Messaging	Message Characteristic	Used to receive Status and Location messages, and to send and receive Configuration messages using a frame-based protocol. Use the SitePoint SDK to translate messages to and from structured data objects for integration with your own mobile app.
RTCM Stream Input	RX Characteristic	Used to provide RTCM aiding to the GNSS for enhanced performance and precision.

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

COMMUNICATION PROTOCOL (CONTINUED)

Values are read from or written to the sensor by performing operations on a **Characteristic**. Each **Characteristic** reads or writes one or more **Values**.

Operations that transfer data from the sensor **Peripheral** to the **Central** are **Read**, **Notify** and **Indicate**.

Read is a 'Request' operation sent from the **Central** to the **Peripheral** and generates a **Read** 'Response' message back to the **Central**.

Notify response messages are generated when a **Value** changes (but only if notifications have been enabled). No response is required from the **Peripheral**.

Indicate response messages are generated when a **Value** changes (but only if notifications have been enabled). A response is required from the **Peripheral** to receive further **Indicate** messages.

Write operations that transfer data from the **Central** to the **Peripheral** come in 2 flavors: **Write** and **Write Without Response.**

These operations are performed using the Bluetooth Low Energy stack on the **Central**. Stacks provide APIs that provide methods to:

- Discover Bluetooth Low Energy devices
- Inquire about available Profiles, Services and Characteristics
- Perform Read, Write, Write Without Response, Notify, and Indicate operations

An abbreviated conceptual description with enough information to program the Bluetooth Low Energy stack on the **Central** is:

- This sensor **Peripheral** implements a single **Profile**
- The **Profile** contains a single **Service**
  - Service UUID 34ED-12EF-63F4-317792041D17
- The **Service** has several '**Characteristics**', which can be read or written (using Characteristic dependent data structures.)

Details of the Characteristics and message types implemented in this sensor are in the next section.

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

CHARACTERISTICS

DATA MESSAGING [MESSAGE CHARACTERISTIC]

- UUID Prefix 00000104 [Entire UUID 00000104-34ED-12EF-63F4-317792041D17]
- Sends and receives data in a frame-based protocol translated by the SitePoint SDK into structured data.
- Supports Read, Write, and Notify
- Variable Length

Data Messaging Layout

Data is sent and received across a frame-based protocol. Each message type (e.g., Location, Status, Configuration) is translated by the SitePoint SDK to and from a structured data object for easy integration into applications. The SDK makes the protocol transparent to developers, allowing them to focus on the implementation details.

Status Messages

The Status messages contain information about the device states, performance, and other information such as battery level. These messages are parsed by the SDK and return the following data structure:

PROPERTY	FORMAT	RANGE	NOTES		
.iTow	32-bit Unsigned Integer		GPS Time Of Week (mSec)		
.time	32-bit Unsigned Integer		Unix time, in seconds		
.mode	8-bit Unsigned Integer	0-7	0 = Offline		4 = RTK Float
			1 = Acquiring		5 = RTK Fixed
			2 = 2D		6 = Autosurveying
			3 = 3D		7 = Fixed Base
.satellites	8-bit Unsigned Integer		Number of satellites used to calculate location solution		
.battery	8-bit Unsigned Integer	0-100	Battery % remaining		
.charging	Boolean		True if connected to a charger		
.aidingQuality	Array of 8 Booleans		Individual status of the 8 latest RTCM messages being successfully used		

Location Messages

The Location messages contain information about the sensor position and accuracies. These messages are parsed by the SDK and return the following data structure:

PROPERTY	FORMAT	UNITS	NOTES
.iTow	32-bit Unsigned Integer	mSec	GPS Time Of Week
.latitude	Double	Degrees	Longitude (Negative is West)
.longitude	Double	Degrees	Latitude (Negative is South)
.height	Double	Meters	Height above Ellipsoid
.horizontalAccuracy	Double	Meters	Horizontal Accuracy Estimate
.verticalAccuracy	Double	Meters	Vertical Accuracy Estimate

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

RTCM INPUT STREAM **[RX CHARACTERISTIC]**

- UUID Prefix 00000102 [Entire UUID 00000102-34ED-12EF-63F4-317792041D17]
- Streaming input for RTCM data streams. Sent from **Central** device to sensor **Peripheral**.
- Stream is decoded internally; no framing required.
- (The use of Write Without Response is encouraged; the Sensor performs RTCM data integrity checking and framing recovery in the event of missing stream fragments.)
- Supports Write Without Response
- Variable length to 243 bytes, dependent upon **Central** operating system

NOTES ON RTCM AIDING

- RTCM messages are sent to the sensor in messages of 243 bytes or less.
- If an RTCM message doesn't fit within a single Bluetooth message, it is broken up into multiple 243-byte (or less) fragments and the fragments are sent one at a time until the entire RTCM message is sent.
- Messages can be combined. For instance, a short 20-byte message can be appended to a previous message of 64 bytes and sent as one Bluetooth message.
- The sensor treats all data sent on this Characteristic as an RTCM stream. No additional framing or handshaking is required.
- It is important to send RTCM messages immediately, as soon as possible. This provides the best aiding performance. Delays lead to less accurate location solutions.

RTCM Input Stream Layout

BYTE OFFSET	FORMAT	NOTES
0 *	8-bit Unsigned Integer	1st byte
1 *	8-bit Unsigned Integer	2nd byte
2 *	8-bit Unsigned Integer	3rd byte
… *	8-bit Unsigned Integer	…
… *	8-bit Unsigned Integer	…
… *	8-bit Unsigned Integer	Last byte

* No more than 247 characters per message total.
Fragmented messages are reassembled by the Sensor.

SITEPOINT IOS SDK, DOCUMENTATION, AND EXAMPLE APP

Note: The following contains links to private repositories and are shared upon request.

The SitePoint iOS SDK is available for immediate integration. The SDK includes SDK documentation and an example mobile app which demonstrates a basic integration.

Android and Flutter SDKs are available upon request.

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

LED STATUS INDICATOR (FIRMWARE 1.4.0 AND NEWER)

RED LED:

- Off: Unit is shutdown; battery is below 10%
- 1 blink every 5 seconds: Unit is shutdown; battery level is above 10%
- 2 short blinks every 2 seconds: Unit is charging
- 1 long blink every 2 seconds: Unit is connecting to application
- 1 blink every 1 second: Unit is active, but GNSS PPS signal is not found.
- Always on: Unit is active, battery level is below 10%

GREEN LED:

- Off: Unit is shutdown or GNSS PPS signal is not found.
- 1 blink every second: GNSS PPS signal had been found.

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

ABSOLUTE MAXIMUM RATINGS

PARAMETER	NOTES			MAX	UNITS
Supply voltage				5.5	VDC

ELECTRICAL CHARACTERISTICS

V+ = 5 to 5.25V, T_A = -20 to +65°C, unless otherwise specified.

PARAMETER	NOTES	MIN	TYP	MAX	UNITS
Supply voltage (V+)			5	5.25	VDC
Supply current (charging)	Up to 1.5A for 10 minutes from 0%			1.8	A
Run time (rover or base)			9		h
Idle time (disconnected)			240		h
Time to Charge (from 0%)				12	h
Time to Charge (from 15%)	Min time with 2.5A charger	3		9	h

DYNAMIC PERFORMANCE

SPECIFICATION	NOTES	MIN	TYP	MAX	UNITS
Output Data Rate		1	2	20*	Hz
Precision Horizontal Vertical	At TOV, 1σ, 10 sec		 0.2 0.4		 cm
Accuracy Horizontal Vertical	At TOV, 1σ, 9 hours		 0.7 1.8		 cm
Pitch and roll accuracy*	1σ		0.1		Degrees
Heading accuracy (dynamic)*	1σ		0.3		Degrees
Pole tilt compensation*	Additional horizontal error @ 45 degrees tilt		0.5		cm

*Available on some models

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

CONNECTOR DIAGRAM

Charging connector: Micro USB (charger shipped with sensor)

PIN DESCRIPTIONS

PIN	NAME	DESCRIPTION
1	Shield	Shield (Case)
2	V+	Supply Voltage
3	GND	Ground (Power Return)
4	No Connect	No Connect
5	No Connect	No Connect

MEASUREMENT DEFINITIONS

Measurement Axis is a vector pointing from the side of the device where the connectors are to the side opposite the connectors.

Body X Axis is the same as the *Measurement Axis.*
Body Y Axis is a vector perpendicular to the *Measurement Axis*, extending to the right when viewed from the connector side of the device, with the GNSS Antenna oriented upward.
Body Z Axis is a vector perpendicular to the X and Y Axes, pointing opposite the direction of the Antenna.

IMU Measurements (Acceleration and Angular Rate) are given for the three *Body Axes*, X, Y and Z.

Gravity is a vector pointing from the device to the center of the earth.

Horizontal is a plane that is perpendicular to *gravity*.

Elevation is the angle between the *measurement axis* and a plane that is *horizontal*. *Elevation* is 0° when the *measurement axis* is in a plane that is *horizontal*. *Elevation* increases when the *measurement axis* is tilted up, away from the surface of the earth.

Roll is right-handed rotation about the *measurement axis*. *Roll* is 0° when the *body Y axis* is *horizontal*, and the GNSS Antenna is within 90° of *gravity* and pointing away from the surface of the earth. Right-handed rotation means that roll increases when the sensor is rotated clockwise about the *measurement axis*, when the *measurement axis* is pointing away from the viewer.

Gimbal Lock occurs when elevation is at ±90° (also meaning that the *measurement axis* is parallel to gravity, pointing up or down). When the device is near the gimbal lock position, roll cannot be measured. The roll measurement may be stable, or it may drift about at random, but it cannot be relied upon in gimbal lock.

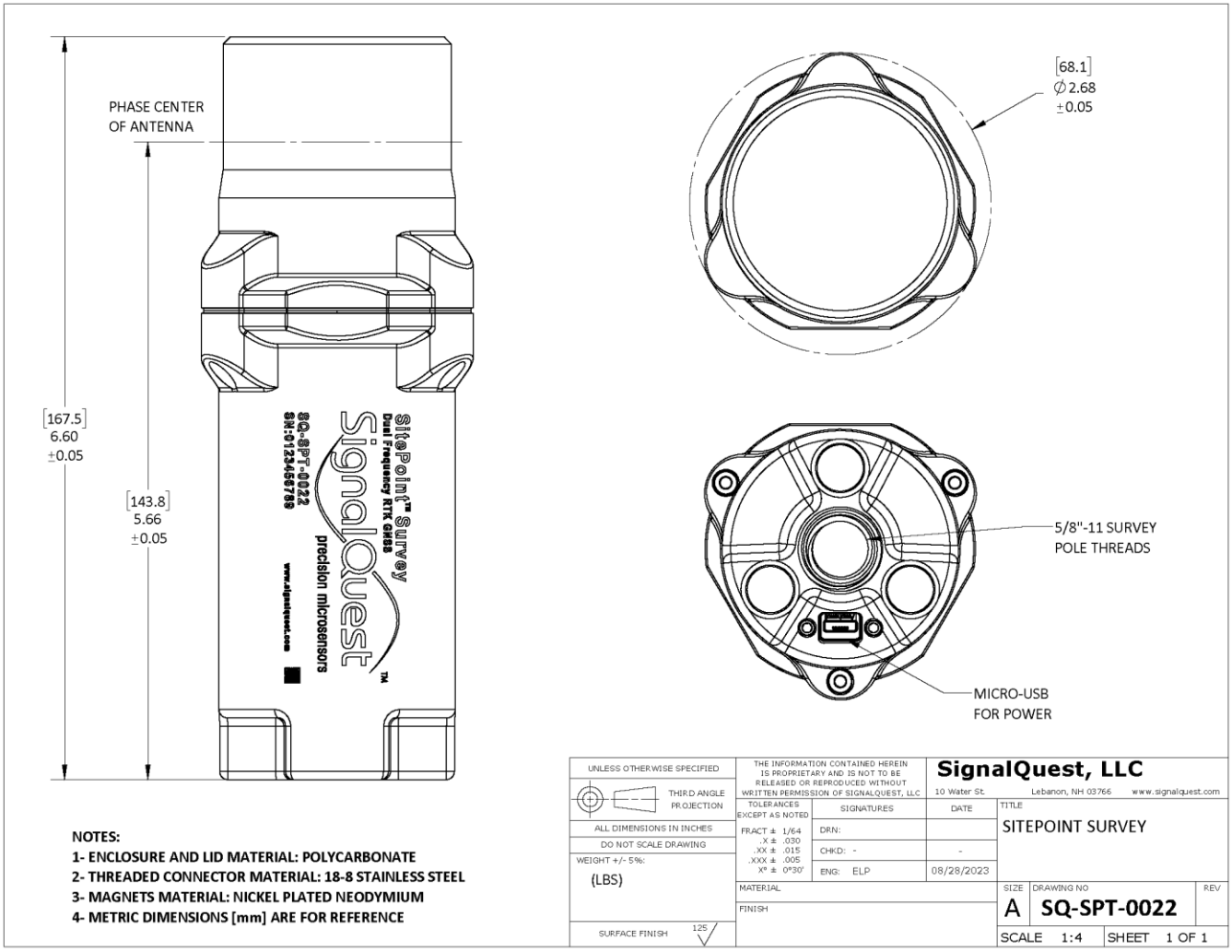
Relative Position applies when one sensor is aided by another sensor acting as a base. The relative position describes the offset, north, east and down from the base to this sensor.

Relative Base Line applies when one sensor is aided by another sensor acting as a base. This is the physical distance between the base and this sensor.

Relative Heading applies when one sensor is aided by another sensor acting as a base. This is the direction of the vector between the base and this sensor, projected onto a plane that is horizontal. It ranges from 0° to 360°, with 0° being north.

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

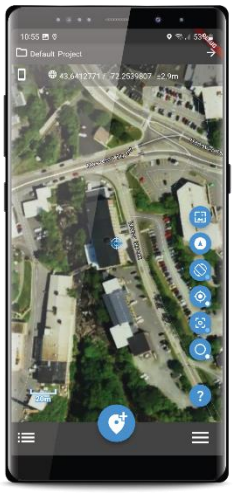
PACKAGE DIMENSIONS



INTERFACE SOFTWARE

INSTALLATION

Download the SitePoint iOS SDK with Developer Documentation and Example App, or get the SQ Survey app for iOS or Android (available upon request).



FEATURES

1. NTRIP aiding to SitePoint via Bluetooth
2. Device configuration
3. GNSS site survey, stakeout, and mapping
4. Data export and import

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com

LIMITATIONS AND WARNINGS

TESTING

The performance of each system is verified through build-time testing. Each system is tested before and after factory calibration to ensure reliable performance.

SYSTEM INTEGRATION TESTING

Thorough testing should be carried out prior to product release to ensure system integration has not introduced unforeseen problems. The system integrator assumes the ultimate responsibility for the safety of the target application.

NOTICE

Information furnished by SignalQuest, Inc is believed to be accurate and reliable. However, this document may contain ERRORS and OMISSIONS. Accordingly, the design engineer should use this document as a reference rather than a strict design guideline and should perform thorough testing of any product that incorporates this or any other SignalQuest product. No responsibility is assumed by SignalQuest, LLC for the use of this information, or for any infringements of patents or other rights of third parties that may result from its use. Specifications are subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of SignalQuest, LLC. Trademarks and registered trademarks are the property of their respective companies.

REVISION TABLE SQ-SPT-0022

Rev. #	Rev. Date	Revised By	Description	Lot Numbers
A	2023-08-25	CAS	Initial release	
B	2023-09-14	CAS	Page 1 consistency revisions	
C	2023-12-15	SER	Update LED behavior to match firmware 1.3.0 and newer	
D	2024-03-25	SER	Update LED behavior, battery performance, charging, idling, status messaging to match firmware 1.4.0 and newer, updated electrical specifications	

10 Water St.
Lebanon, NH 03766 USA
Tel: 603.448.6266
www.signalquest.com
info@signalquest.com