



spire™

GNSS Receiver

USER MANUAL

Spire GNSS Receiver User Manual

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Cautions

⚠ CAUTION: This symbol indicates that failure to follow directions could result in serious injury, damage to equipment, or loss of information.



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CHAPTER 1

Introduction

1 Introduction

Spire is a precision GNSS receiver with sub-meter and centimeter accuracy options. It is small, lightweight, and easy to use. Take the Spire with you mounted on a pole, in a pack, or held in your hand to collect real-time GNSS data in extreme conditions, including heavy tree canopy and mountainous areas.

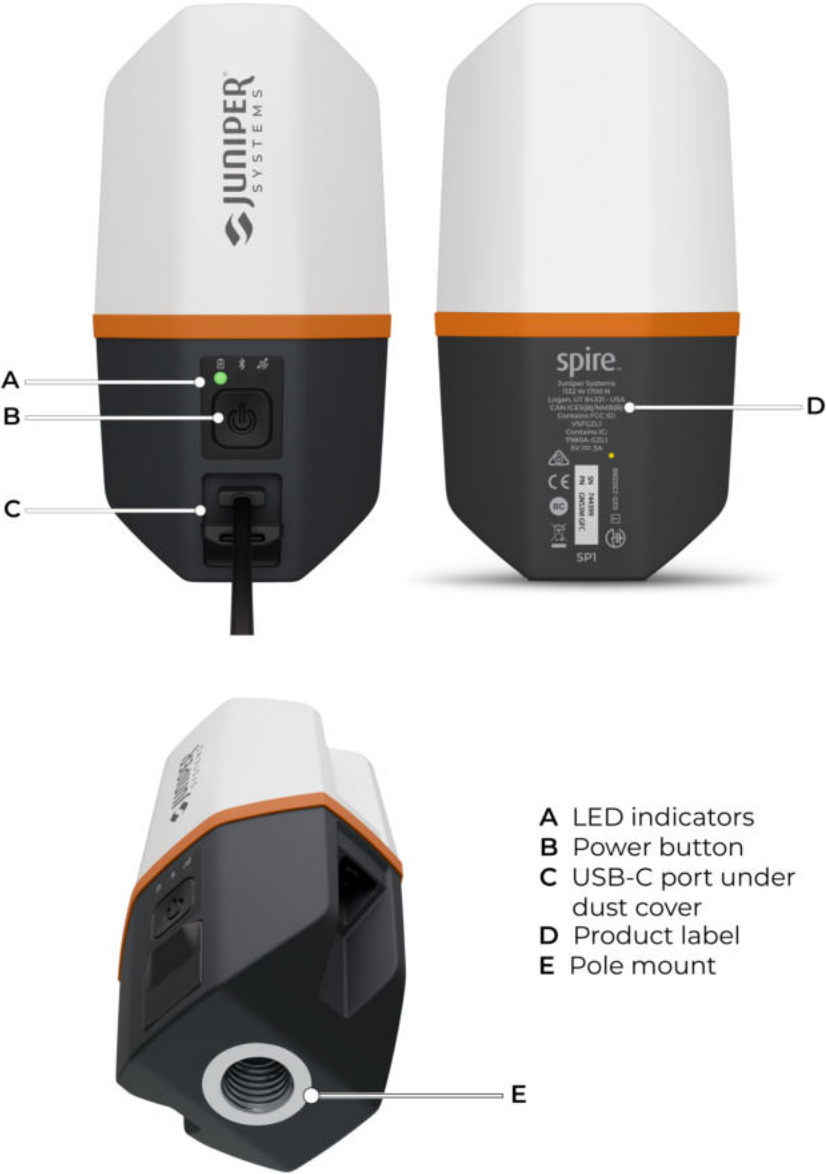
The Spire receiver works well with any of Juniper Systems' handhelds or with your own Android™, Apple® iOS™, or Windows® device. Spire uses correction services—including Network RTK and SBAS—and applies advanced smoothing algorithms and full-wave carrier phase tracking to deliver precision GNSS accuracy.

Note: GNSS accuracy is subject to observation conditions, multipath environment, number of satellites in view, satellite geometry, and ionospheric activity.

Juniper Rugged™

Like other Juniper Systems products, the Spire is waterproof, dustproof, and drop proof, providing reliable performance wherever you need to collect data. It features IP68-rated protection, meets or exceeds MIL-STD-810H (drop, vibration, temperature, ingress protection), and operates in extreme temperatures.

1.1 Anatomy of the Spire GNSS Receiver



1.2 LED Indicators and Sound Notifications

The Spire receiver uses LED indicators and sound to alert you to changes in operations.

LED Indicators

The Spire receiver has three LED indicators located above the Power button. Each LED uses a color and a blinking pattern to convey the receiver's status.



LED Indicator	 Battery	 Bluetooth	 Satellite
Power on			
Power on, low battery			
Charging			
Fully charged			
Power on & charging			

LED Indicator	 Battery	 Bluetooth	 Satellite
Power fault			
Bluetooth connected			
GNSS position (GNSS 3D position or RTK float)			
Correction applied			

Solid light =  ; Flashing light = 

Sound Notifications

The Spire receiver uses long (300 ms) and short (100 ms) beeps to alert you to changes in the receiver's operations.

Function	Audible Response	Pattern
Powered off	Long beep + short beep	 
GNSS solution (satellite fix)	1 short beep	
RTK fix	2 short beeps	 
RTK fix lost	1 short beep + 2 long beeps	  
Receiver reset	1 very long beep	

Short beep =  ; Long beep = 

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CHAPTER 2

Getting Started

2 Getting Started

The Spire GNSS receiver is ready to use out of the box. Simply charge the battery and connect the receiver to a handheld device. The Spire receiver may be used with most mapping apps that use industry-standard NMEA 0183 protocol or that access GNSS data through the operating system's location services.

2.1 Review Documentation

Before using your Spire receiver for the first time, review this user manual and other documents available at <http://www.junipersys.com/products/spire>. View, download, and print documents as desired.

2.2 Charge the Battery

The Spire receiver has an internal, non-removable battery. When the receiver arrives, the battery will have some charge. However, charge it completely before relying on it for a full day of work.

To charge the battery,

1. Remove the dust cover from the USB-C port on the Spire receiver and insert the USB-C cable.



2. Connect the USB-C cable to a charger and plug into a wall socket.
For charger specifications, see [Power Supply and Battery](#).
3. Charge the battery at room temperature (68°F or 20°C) for 6 hours.

While the battery is charging, the LED blinks red. When the receiver is fully charged and external power is applied, the LED is solid red. The LED turns off when the external power is removed.

2.3 Power On the Receiver

To power on the Spire receiver, press and release the Power button . The [battery LED](#) turns green.



Power Off the Receiver

To power off the receiver, press and hold the Power button  until the receiver beeps twice (after approximately 2 seconds), and then release the Power button.

2.4 Install Juniper Connect

Juniper Connect is a free communication utility, created by Juniper Systems, that allows you to quickly connect a mobile device to your Spire receiver. With Juniper Connect, you can

- Establish a connection to a mobile device.
- View GNSS data, such as position, altitude, estimated horizontal error, satellites in fix, and correction service status.
- Change the receiver settings.

Download Juniper Connect from the Google Play™ Store, Apple App Store®, or Juniper Systems website, and install it on your mobile device.

For more information on using Juniper Connect, refer to the [Juniper Connect User Manual](#).

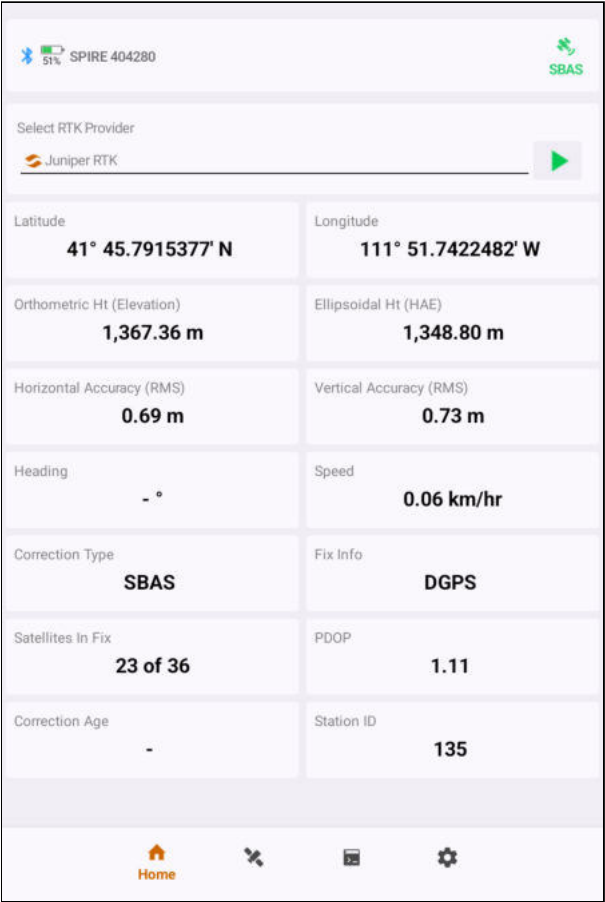
Note: Although Juniper Connect has some data capture and mapping features, it is not intended to replace your mapping or data-collection app. Juniper Systems has a full mapping software called [Uinta](#) that can be used with the Spire receiver.

2.5 Acquire Satellite Fix

With the Spire connected to your mobile device,

1. Go outdoors to an open area.
2. Open Juniper Connect on your mobile device.
3. The Spire will begin to acquire satellite signals. Once signals are detected and a position is determined, the Spire will beep once and the [satellite LED](#) will blink yellow. A solution requires a minimum of four satellites.
4. When a corrected solution is determined, the Spire will beep twice, and the satellite LED will change to solid yellow. The data fields on the Juniper Connect Home screen will

display correction information and position data.



2.6 Carrying Options

Spire can be carried in-hand, in a pack, or mounted on a pole, depending on your needs.

Pole Mount

The Spire receiver has a mounting hole in the bottom of the receiver compatible with survey poles, monopods, or tripods. A 5/8 x 11 to 1/4 x 20 thread adapter is included.

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CHAPTER 3

Standard Features

3 Maintenance

Properly maintaining your Spire's power supply, battery, and firmware will keep your Spire functioning well.

3.1 Manage Power Supply and Battery

Spire has an internal, non-removable battery that lasts up to 16 hours. It can be replaced only at an authorized Juniper Systems repair center.

Feature	Description
Battery	Internal, non-removable, lasts 16+ hrs
Charger	18 W, 100-240 V AC universal power supply. Power adapters for US, UK, EU, and AU/NZ are available from Juniper Systems.
Charging time	Up to 6 hours
Charging & data transfer cable	USB-C to USB-C

Note: The battery will not charge when outside the approved temperature range. See [Specifications](#).

3.1.1 Charging in the Field

To charge the Spire receiver in the field, use a USB-C cable and a vehicle USB adapter rated ± 5 V DC and a minimum of 0.5 A, or any adapter that supports USB-C power delivery.

Do not charge the Spire receiver from a battery powered PC or mobile device. Most of these devices while running on battery power do not have enough power to charge the Spire receiver. If Spire detects it is connected to a battery with insufficient power, it will not charge, and the red [battery LED](#) will blink rapidly.

Note: If you connect Spire to a device with a USB-C cable for data transfer, the red battery LED may blink rapidly to let you know that the battery isn't charging. This does not affect the data transfer.

3.1.2 Maximizing Battery Life

- Charge the batteries at room temperature.
- Don't leave the Spire receiver connected to a charger for extended periods.
- When not in daily use, charge the Spire receiver periodically to 50% power.
- If you do not plan to use the Spire receiver for more than a month, charge/discharge the battery to about 50% (the optimal charge level for storage).

⚠ CAUTION: Charge your Spire receiver periodically. If the battery drains completely, it may not recover, and your Spire will need to be sent to Juniper Systems for a battery replacement.

3.2 Update the Firmware

Using Juniper Connect, you can update the MCU, Bluetooth, and GNSS firmware for the Spire receiver as needed. Juniper Connect for Windows is the only version that includes the firmware installer. For instructions on updating the firmware, see the [Juniper Connect User Manual](#).

3.3 Reset the Receiver

You can reset the receiver to its default settings and clear the almanac.

1. Press and hold the Power button for at least 20 seconds.
2. When you hear a long beep tone, release the Power button.

The Spire receiver remains powered on.

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CHAPTER 4

GNSS Corrections Services

4 GNSS Correction Services

When selecting a GNSS correction service, it helps to understand how a GNSS receiver determines accuracy and precision and how it uses satellite signals to compute position.

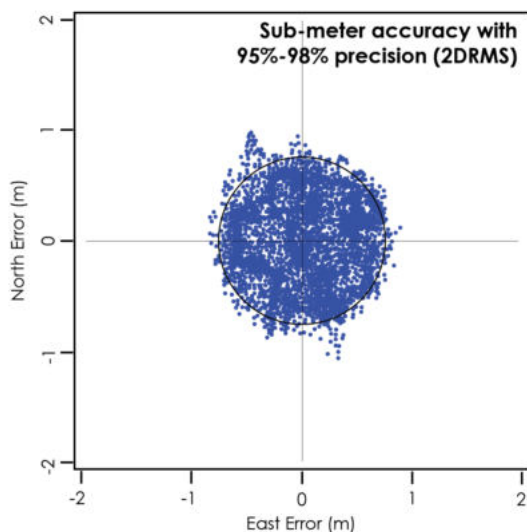
Accuracy and Precision

Accuracy and precision are related concepts, but they describe different aspects of GNSS performance. Understanding both helps you interpret GNSS data and select a correction service that achieves the desired level of performance.

Accuracy is how close a measured position is to the true location. Accuracy can be expressed as a radius around the true location: the smaller the radius, the higher the accuracy. For example, if the GNSS receiver reports a position that is 2 meters away from the true location, its accuracy is ± 2 meters. GNSS accuracy is subject to environmental and system conditions.

Precision is how consistently a receiver can report the same position under unchanged conditions. When a stationary GNSS receiver logs repeated positions, natural variation in satellite orbits, the surrounding environment, and ionospheric conditions can cause slight differences between measurements. A scatter plot of those measurements shows the distribution of points around the true location. Even though correction services reduce error sources, real-time accuracy depends on the receiver's ability to process those corrections.

Under ideal conditions, 95–98% of the points recorded by the Spire receiver fall within a sub-meter radius of the true location.



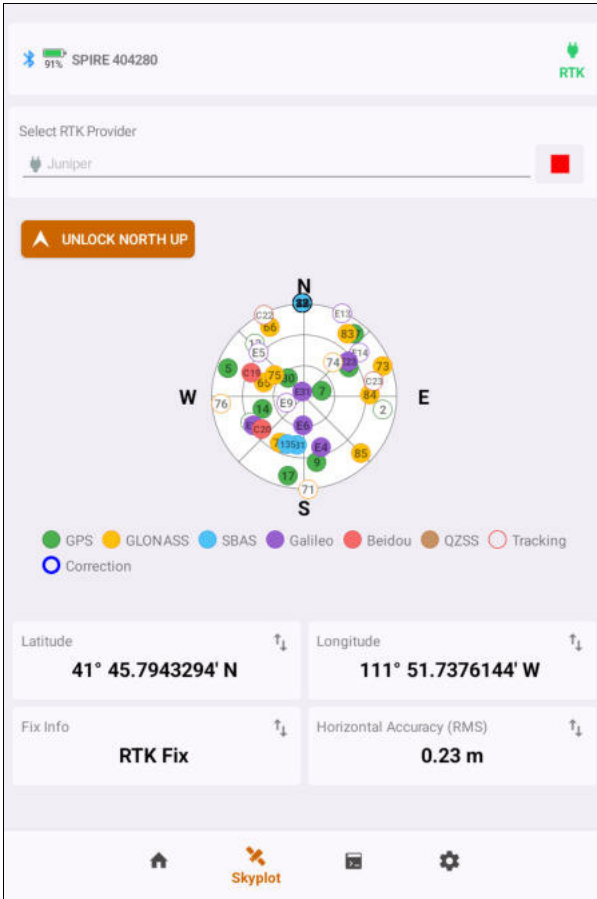
GNSS Satellite Systems

Global Navigation Satellite Systems (GNSS) are networks of satellite constellations maintained by various countries and unions, including:

- GPS (United States)
- GLONASS (Russia)
- Galileo (European Union)
- BeiDou (China)

Spire is a multi-frequency GNSS receiver that uses all available satellite constellations to achieve the highest possible positioning accuracy across diverse environments. To calculate an accurate position, the Spire requires a direct line of sight to at least four satellites. With fewer than four, the receiver must estimate altitude, which can change the horizontal accuracy by hundreds of meters.

The Skyplot screen in Juniper Connect shows the visible satellites at your location and identifies which ones are being used in the current positioning solution.



More information about the Skyplot screen is found in the [Juniper Connect User Manual](#).

4.4 GNSS Correction Services

GNSS receivers use signals from satellites to determine precise locations. However, as satellite signals travel through the Earth's atmosphere, it impacts the signals propagation, causing measurement errors.

Error sources include:

- Deviations in GNSS satellite orbits
- Inaccurate clocks on the GNSS satellites
- Ionospheric activity that changes daily and hourly
- Interference in satellite signal paths and signal reflection off other objects, buildings, and so on (multipath)

Spire is built to perform in all environments, no matter how challenging. As with all receivers, the Spire is more accurate under ideal conditions, but its ability to access and integrate data from various correction and satellite augmentation services provides real-time high accuracy positions in rugged environments.

Spire can use SBAS and Network RTK to achieve sub-meter and centimeter-level accuracy. These correction services are described in the following sections.

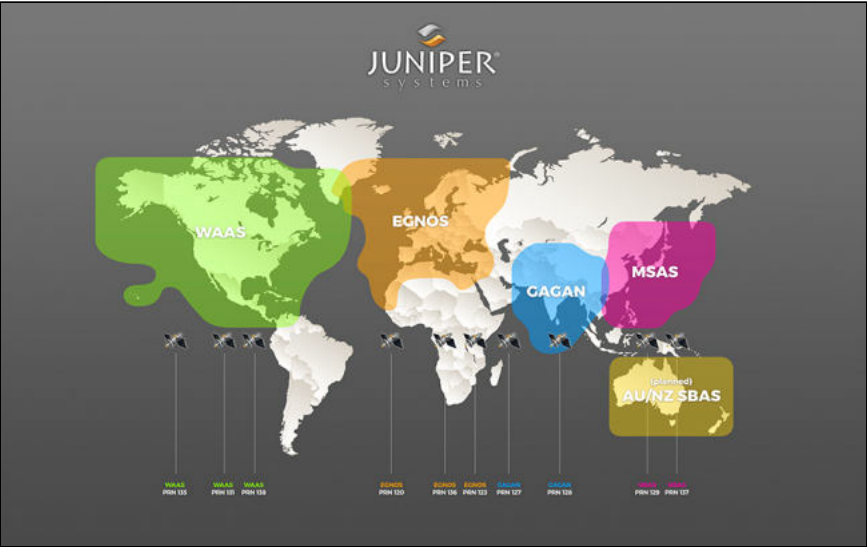
Manage your correction service through Juniper Connect. For instructions, refer to the [Juniper Connect User Manual](#).

4.4.1 SBAS Differential Correction

Satellite-Based Augmentation Systems (SBAS) improve the accuracy and reliability of GNSS signals by broadcasting correction data from geostationary satellites. These corrections are generated using a network of ground-based reference stations that monitor GNSS signals for errors caused by satellite orbit deviations, clock drift, and atmospheric interference. The correction data is then sent via SBAS satellites to compatible GNSS receivers, enabling enhanced position estimates without requiring additional hardware or paid subscriptions.

Standard GNSS positioning typically yields a horizontal accuracy of around 5 meters, but SBAS can reduce that to between 1 and 3 meters. Multiple countries throughout the world have created their own SBAS systems with a common global standard, ensuring a consistent and reliable level of service across regions.

SBAS is a free service.



SBAS Name	Region	Notes
WAAS	North America	US system
EGNOS	Europe	EU system
MSAS	Japan	Japanese system
GAGAN	India	Indian system
SDCM	Russia	Russian system
BDSBAS	China	Part of BeiDou system
SouthPan	Australia and New Zealand	Operated by Geoscience Australia and Land Information New Zealand

4.4.2 Network RTK

Network RTK is a high-precision positioning technique that uses a network of ground-based reference stations to provide real-time corrections to mobile receivers. NTRIP is a communication protocol to deliver those corrections over the internet. Because positioning accuracy depends on the proximity to a reference station, Network RTK with NTRIP can select the nearest station or use modeling to create a virtual reference station close the user's receiver.

Spire uses RTK corrections from ground stations (such as CORS) to calculate highly accurate positions in real time. Depending on the signal quality, RTK can produce either a Fix solution (centimeter-level accuracy) or a Float solution (decimeter-level accuracy).

Juniper RTK is a Network RTK correction service offered by Juniper Systems. Integrated into the Juniper Connect, it is a simple way to subscribe to and receive RTK corrections.

Network RTK requires a stable internet connection and, in most cases, a paid subscription to access correction services.