



Operator's Manual

RTK Base

**Turf Pro™ Series Robotic Mowers and Range Pro™
Series Ball Pickers**

Model—Serial Range

30915—325000000 and Up
30912CAN, 30912EU, 30912JP, 30912US—324000000 and Up
30912ANZ—325000000 and Up



Disclaimers and Regulatory Information

This product complies with all relevant European directives; for details, please see the separate product specific Declaration of Conformity (DOC) sheet.

⚠ WARNING

CALIFORNIA Proposition 65

Use of this product may cause exposure to chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

Electromagnetic Compatibility Certification

Domestic: This device complies with FCC Rules Part 15. Operation is subject to the following two conditions: (1) This device may not cause harmful interference and (2) this device must accept any interference that may be received, including interference that may cause undesirable operation.

FCC ID: 2AC7Z-ESP32WROVER; 2AET4RUT241AF

IC: 21098-ESPS2WROVER; 26511-RUT241AF

This equipment has been tested and found to comply within the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to connect the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Australia



New Zealand

R-NZ

Electromagnetic Compatibility Certification (continued)

Japan

TELEC IDs:
  211-210111
018-230063
 D23-0004018

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Intended Use

This base station is intended to be used by professional, hired operators for autonomous, programmable lawn care. It is designed for sending and receiving geopositioning information that guides the Turf Pro and Range Pro autonomous robots. Using the autonomous robots, battery, charging station, and base station for purposes other than their intended use could endanger you and bystanders.

Read this information carefully to learn how to operate and maintain your product properly and to avoid injury and product damage. You are responsible for operating the product properly and safely.

Manual Conventions

This manual identifies potential hazards and has safety messages identified by the safety-alert symbol, which signals a hazard that may cause serious injury or death if you do not follow the recommended precautions.



This manual uses 2 words to highlight information. **Important** calls attention to special mechanical information and **Note** emphasizes general information worthy of special attention.

Safety Alert Classifications

The safety-alert symbol shown in this manual and on the machine identifies important safety messages that you must follow to prevent accidents.

Safety-alert symbol appears above information that alerts you to unsafe actions or situations and is followed by the word **DANGER**, **WARNING**, or **CAUTION**.



DANGER



Danger indicates an imminently hazardous situation which, if not avoided, *will* result in death or serious injury.

Safety Alert Classifications (continued)



WARNING



Warning indicates a potentially hazardous situation which, if not avoided, *could* result in death or serious injury.



CAUTION



Caution indicates a potentially hazardous situation which, if not avoided, *may* result in minor or moderate injury.

General Safety



Avoid contact with electricity and keep away from electrical power sources.



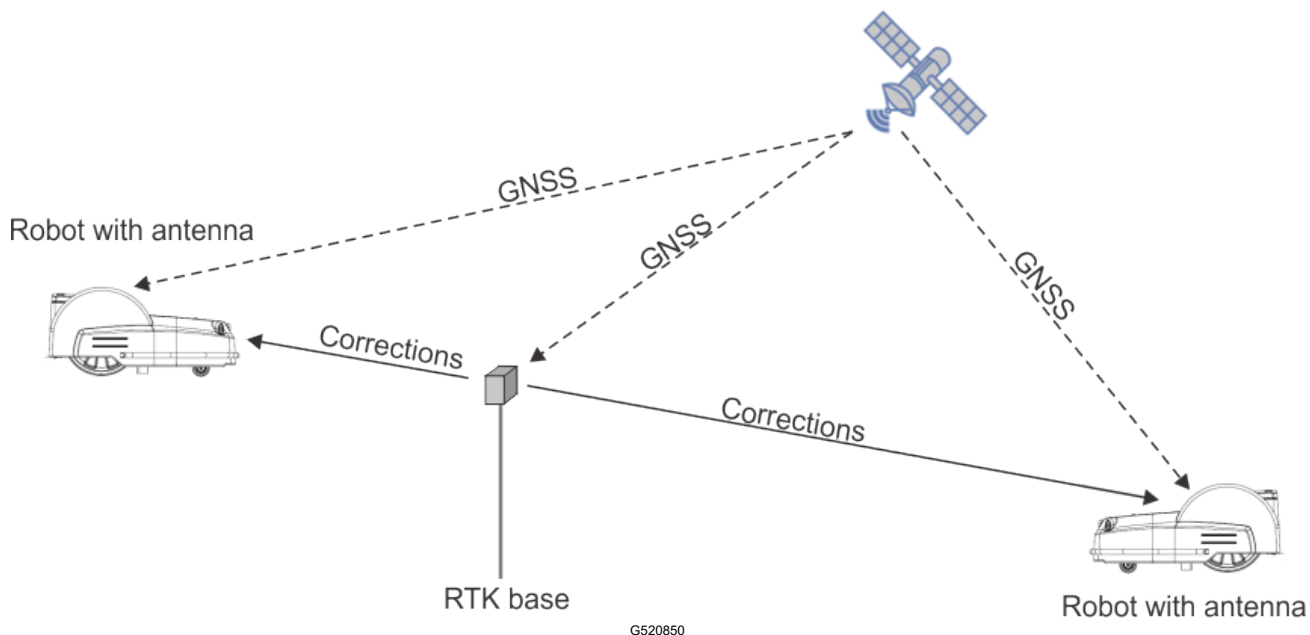
Read and understand the contents of this *Operator's Manual* before using this product.

About RTK GPS

- Standard GPS positioning data retrieved from satellites using GNSS (Global Navigation Satellite System) is accurate to between 5 m (16.4 ft) and 10 m (33 ft). This is because the signal received from a satellite is distorted due to atmospheric and environmental conditions. Higher precision positioning can be achieved by using an RTK (Real-Time Kinematic) technique.
- This technique involves the use of an RTK base placed in a fixed position, which receives GNSS signals from satellites. Since the base is fixed, the data it receives relates to its precise location.
- The robots are also fitted with antennas, which receive GNSS signals from satellites in order to determine their position. Both the RTK base and the robots receive the GNSS signals from satellites in different constellations (GPS, GLONASS, Galileo, BeiDou). Since the robots are moving however, the evaluation of their position is less precise than that of the fixed base.
- The RTK base computes correctional data for each of the satellites and sends these to the robot. The robot is then able to use these corrections to achieve a positional accuracy of between 2 cm and 3 cm (0.8 inch and 1.2 inches). With such accurate positioning, the robot is able to follow a defined pattern and cover the field in a series of straight lines.
- The RTK base, via a cloud server, computes its position from the satellite signals constantly, and there can be variations in its computed position. The position that is used as a reference for the robots is termed the "reference" position, which is determined during the survey-in process.
- There are two methods to transfer the positional corrections to the robots: using Wi-Fi or 4G. The decision to use Wi-Fi or 4G should be made according to the assessment of the site.

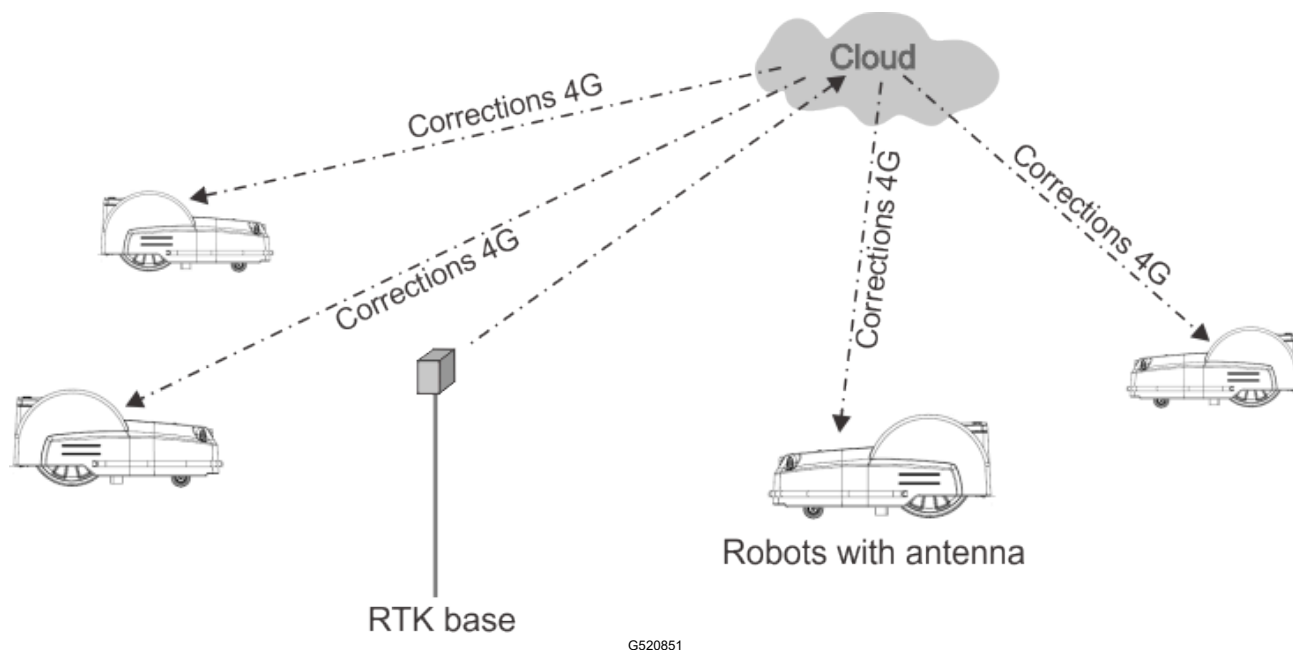
About RTK GPS (continued)

Corrections using Wi-Fi between the robot and the RTK base using Wi-Fi can be made over a distance of up to 200 m (219 yd) if there are no obstacles in the way. If greater distances are required, up to 2 Wi-Fi repeaters can be used. One base can communicate with up to 5 robots.



Corrections can also be made via the cloud using 4G cellular service. In this case, obstacles do not impede the transfer of correctional data and the base can connect to an unlimited number robots at distances of up to 15 km (9.3 mi).

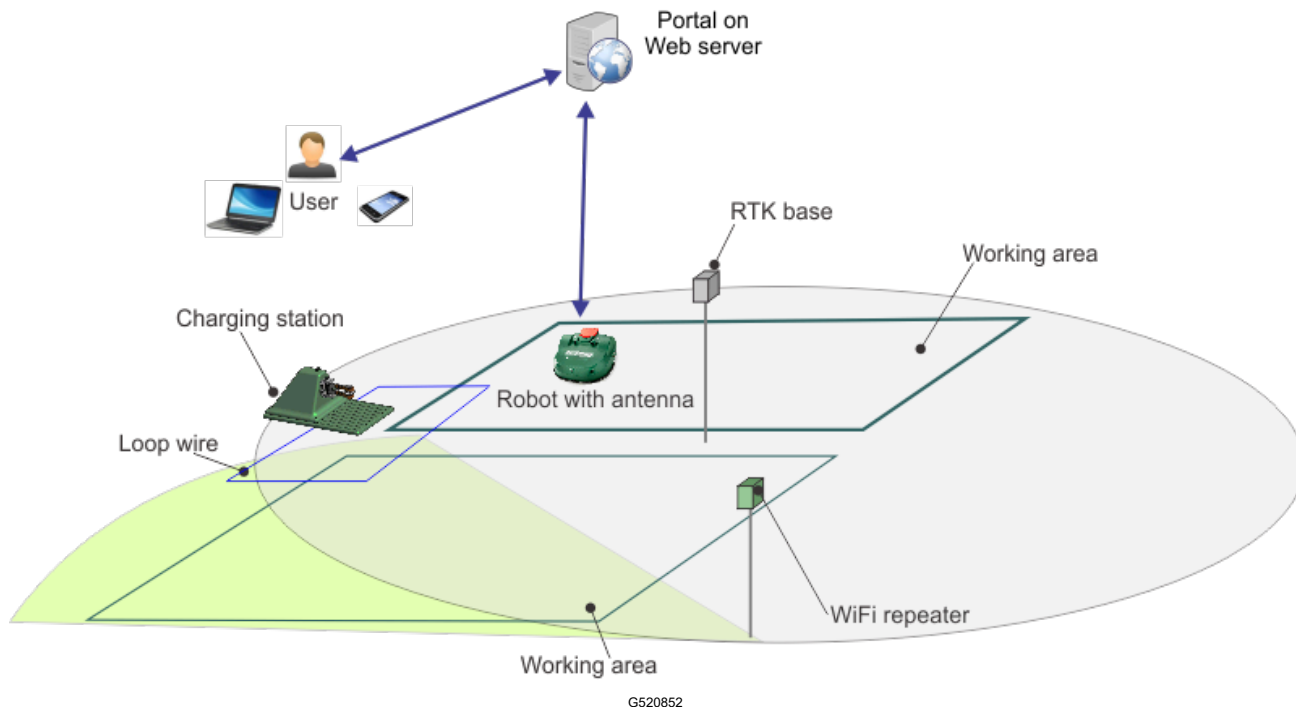
Transfer of corrections using 4G Cellular



One base station can feed corrections to multiple robots, but each robot must receive corrections from **only one base station** to keep corrections consistent.

About RTK GPS (continued)

Basic components of the RTK GPS mowing system



This topic describes the mechanical characteristics of the robot.

A user can exercise direct control over the robot using the User Interface. Once a robot is registered on the portal running on a web-server:

- The robot can send information to this server which can be seen by the user.
- The user can issue commands to the robot, assess its performance, and adjust the configuration.

Technical Specifications

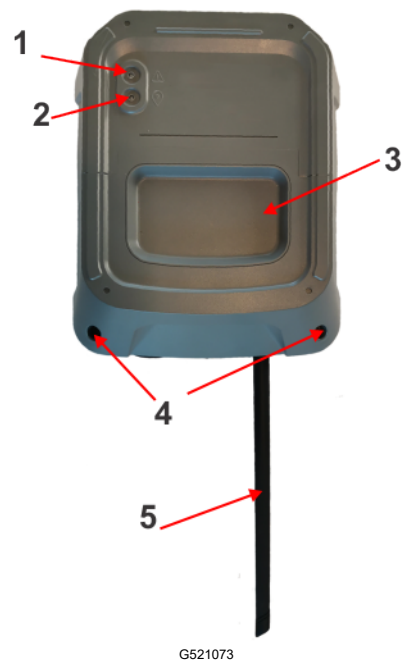
Note: Specifications and design are subject to change without notice.

	30912XX	30915
Power input	100-240V / 50-60Hz / 5W	
Operating temperature	-20°C / +80°C (-4°F / 176°F)	
Humidity	max 95%	
Weight	2 kg (4.4 lb)	
Dimensions (without Wi-Fi antenna)	240 mm (9.4 inches) (height) x 190 mm (7.5 inches) (width) x 90 mm (3.5 inches) (depth)	
Communication	4G	Wi-Fi

Field coverage	Max 15 km (9.3 mi) between the base and the robot.	Max 200 m (219 yd) between the base and the robot.
Enclosure	IP44 rated	

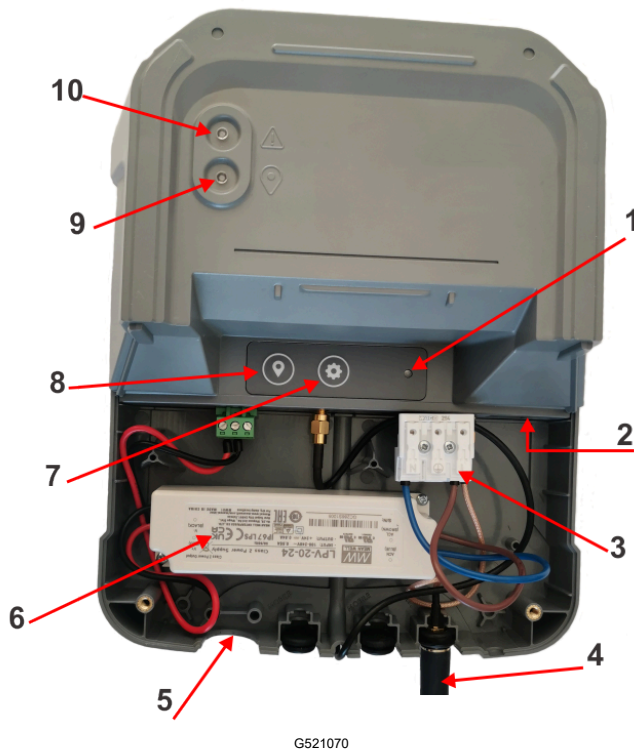
RTK Base Wi-Fi Product Overview

Note: This applies to model 30915 only.



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- ① Error LED
- ② Positional LED
- ③ Front cover (This can be removed to allow access to the interior components)
- ④ Screws to remove the front cover
- ⑤ Wi-Fi antenna

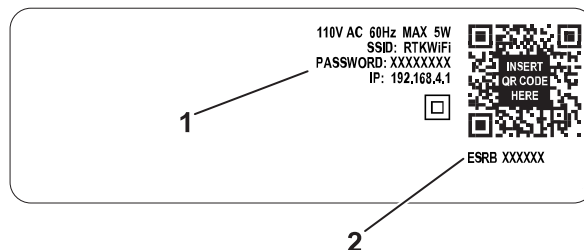


G521070

- ① Configuration LED
- ② Ethernet port
- ③ Power supply connector
- ④ Wi-Fi antenna

- ⑤ Power supply cable gland
- ⑥ AC/DC converter
- ⑦ Configuration button
- ⑧ Survey In button
- ⑨ Positioning status LED
- ⑩ Error LED

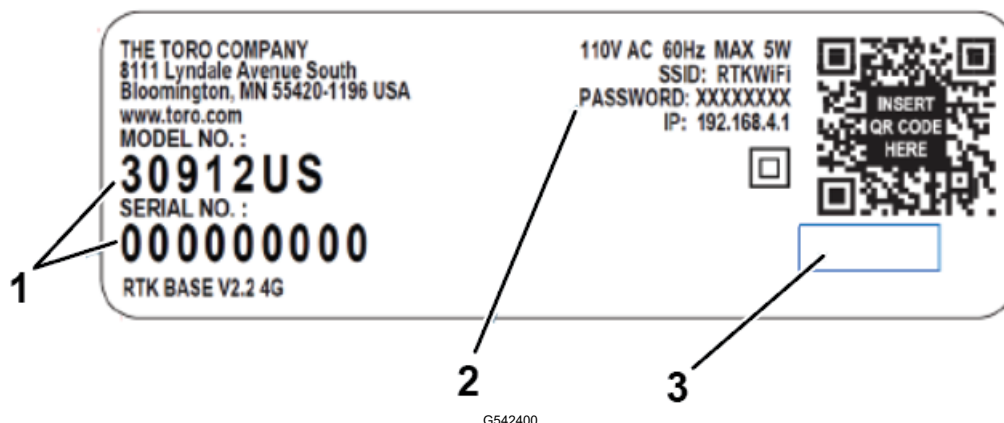
For serial numbers 324000000 through 324999999:



G539289

- ① The initial/default password for the base Wi-Fi
- ② The serial number of the base

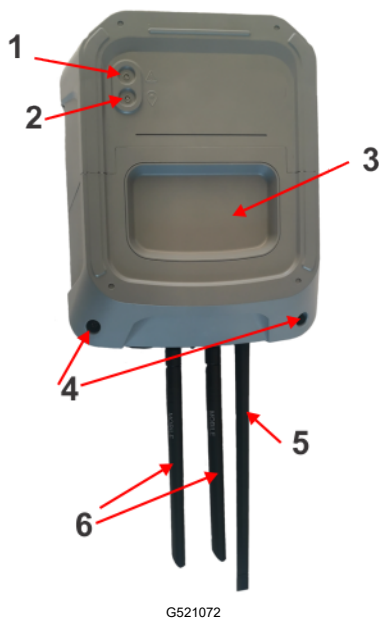
For serial numbers 325000000 and up:



G542400

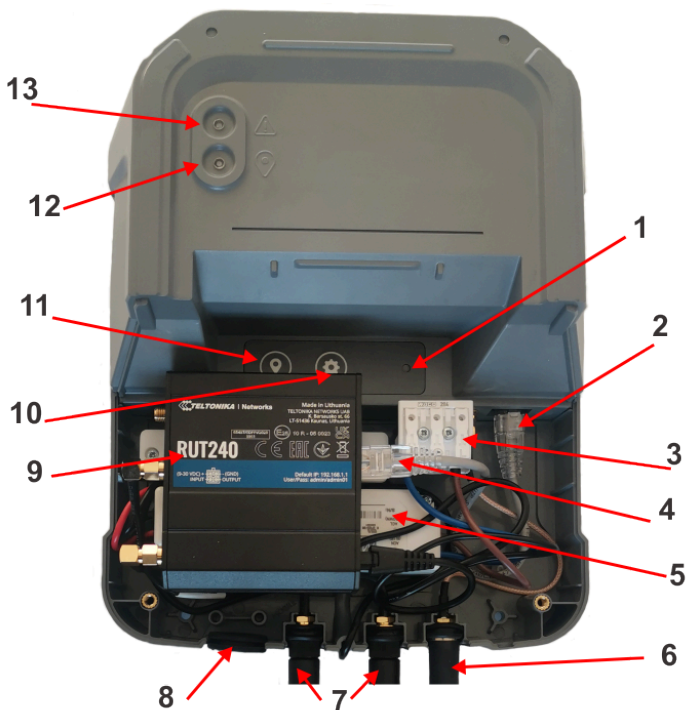
- ① Base ID serial number Model-Serial
- ② Initial/default password for the base ID
- ③ Area blank

RTK Base 4G Product Overview



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- | | |
|--|------------------------------------|
| ① Error LED | ④ Screws to remove the front cover |
| ② Positional LED | ⑤ Wi-Fi antenna |
| ③ Front cover (This can be removed to allow access to the interior components) | ⑥ 4G router antennas |



G521075

- | | |
|--------------------------|----------------------------|
| ① Configuration LED | ⑤ AC/DC converter |
| ② Base ethernet port | ⑥ Wi-Fi antenna |
| ③ Power supply connector | ⑦ Router antennas |
| ④ Router ethernet port | ⑧ Power supply cable gland |
| | ⑨ 4G router |

⑩ Configuration button

⑫ Positioning status LED

⑪ Survey In button

⑬ Error LED

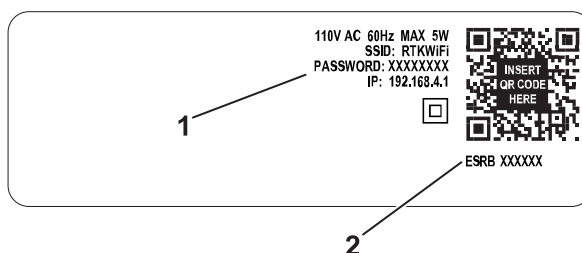
The 4G router supplied is the Teltonika RUT240, which is fitted into the base box. The mobile signal level can be viewed on the top side.



G520253.png

Note: The Ethernet cable needs to be connected to the LAN port of the 4G router.

For serial numbers 324000000 through 324999999:

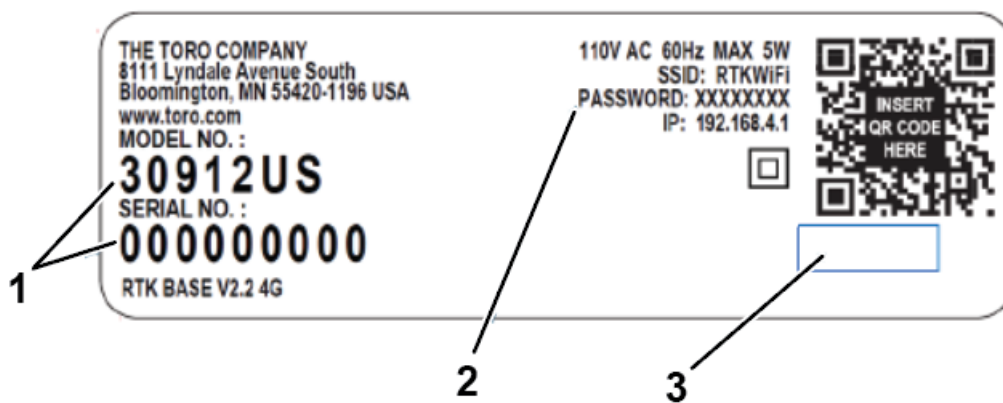


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① The initial/default password for the base Wi-Fi

② The serial number of the base

For serial numbers 325000000 and up:

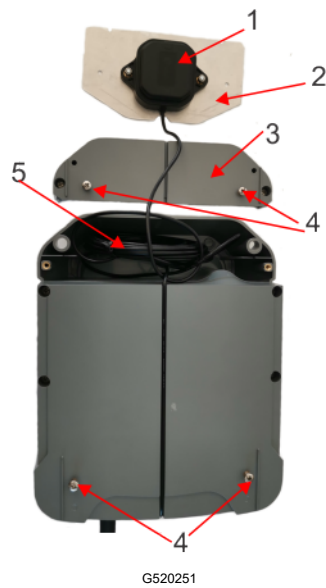


G542400

① Base ID serial number Model-Serial

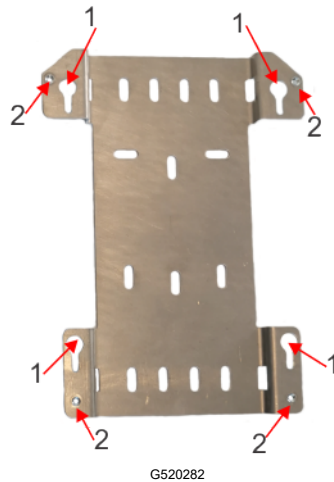
③ Area blank

② Initial/default password for the base ID



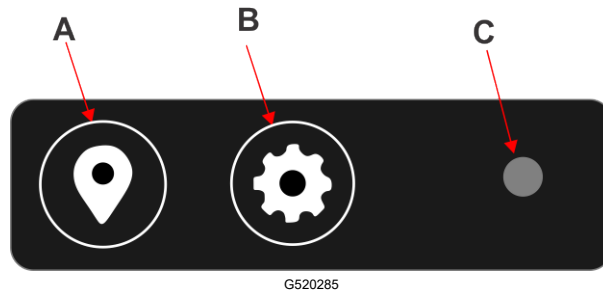
- | | |
|---|--|
| <ul style="list-style-type: none"> ① GNSS antenna ② Antenna base plate ③ Antenna cover. This can be removed so that the antenna can be positioned in a higher location to receive better satellite signals. The antenna must be flat mounted on its base plate | <ul style="list-style-type: none"> ④ Screws to locate the base on its support plate ⑤ Additional 5 m (16.4 ft) cable |
|---|--|

The support plate is provided to facilitate mounting the base on its chosen support.



- | | |
|---|---|
| <ul style="list-style-type: none"> ① Keyhole slots for sliding the base onto the plate | <ul style="list-style-type: none"> ② Threaded holes for fixing the base onto the support |
|---|---|

Operating the User Interface



A. Survey-in button

This starts a survey-in process where the base station reference position is established.

B. Configuration button

This performs different functions depending on the following factors:

- When a WiFi repeater is connected, a short press configures the repeater to operate with the base.
- When the error light is flashing, a short press provides information about the type of error through the color of the Configuration LED.
- When pressed for more than 10 seconds, it performs a factory reset.

C. Configuration LED

This displays different colors indicating the type of error.



RTK Base Functions

- Connect to GNSS satellites (Initialization state).
- Determine the RTK base station reference position (Survey-in state).
- Collect GNSS position data from all available satellites and compare this to the reference position of the RTK base station (Operational state).
- Calculate real time corrections on positional data for all available satellites (Operational state).
- Communicate the corrections to all connected robots using Wi-Fi or 4G (Operational state).
- Configure a Wi-Fi repeater to automatically pair with the RTK base station.
- Diagnose errors.
- Perform a factory reset.
- Update the software version.

Functional States

Figure 1 Functional State Wi-Fi (Model 30915 only)

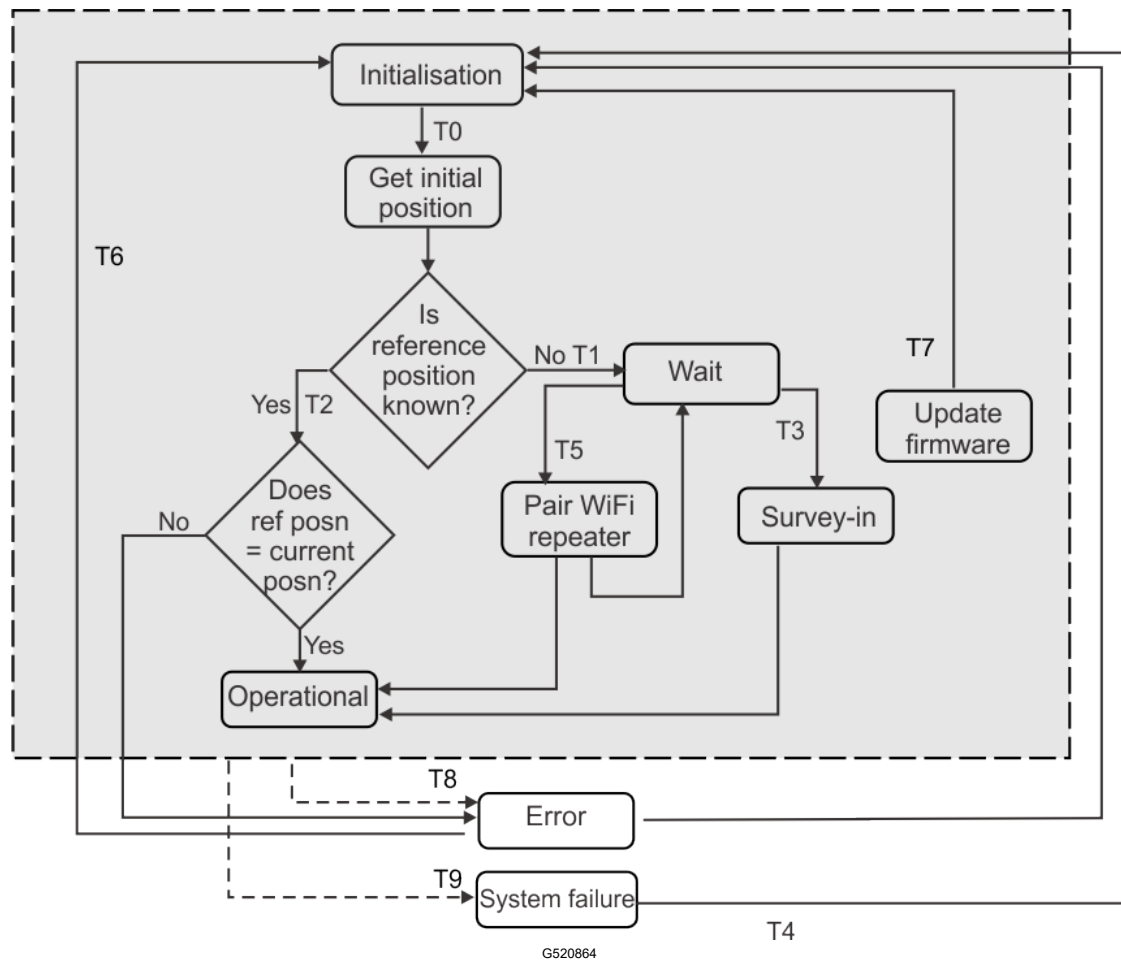
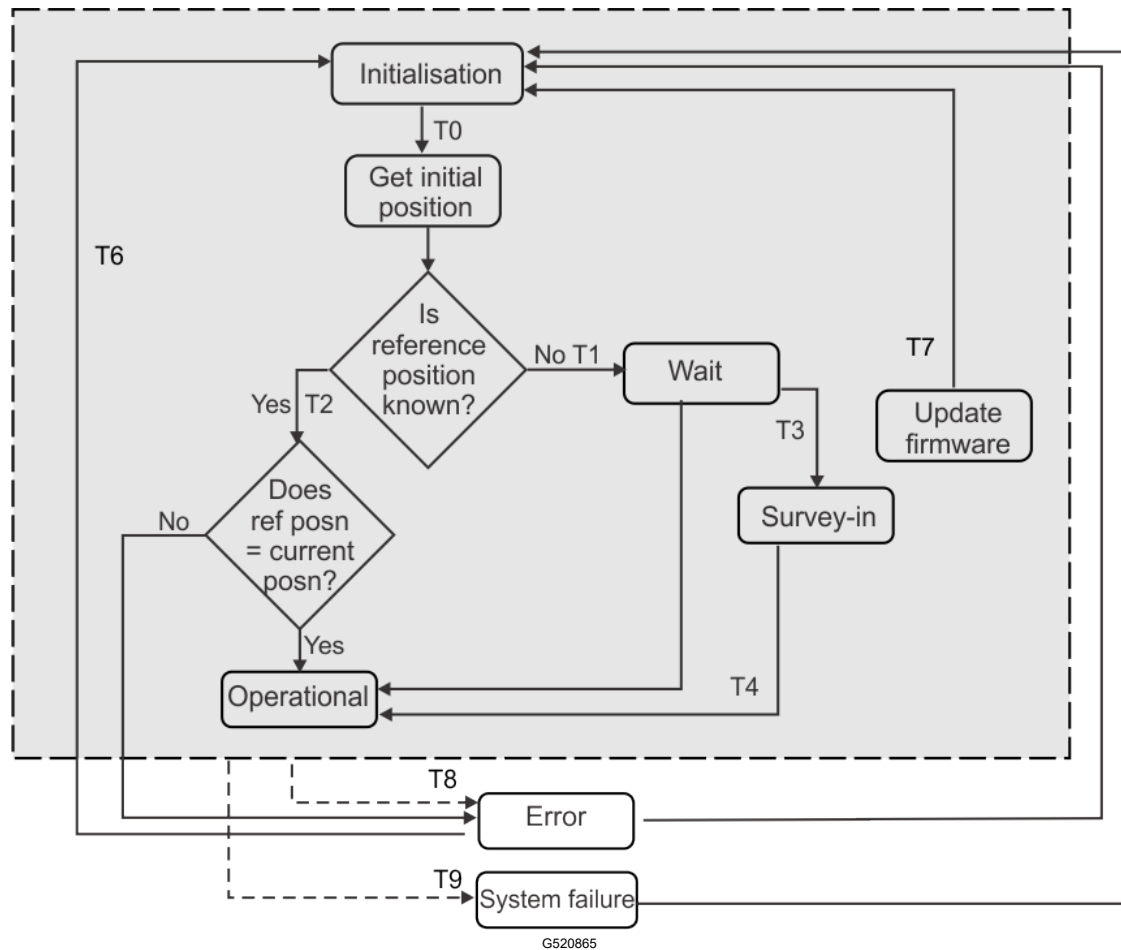


Figure 2 Functional State 4G



Three LEDs indicate the base station state:

- Positional
- Error
- Configuration

The status of the Configuration LED is not relevant in all of the functional states, and is only shown when relevant.

Initialization

This state is indicated by: the Positioning LED blinking green, then the Error LED blinking red.

Positioning LED



Blinking green 1Hz

Error LED



Blinking red 1Hz

This state is entered each time the RTK base station is powered on. This can be:

- During the initial installation

Initialization (continued)

- After a software update (T7)
- If the base is powered off then on following an error (T6)

During this state, the RTK base station is initializing all the electronic boards.

Maximum duration of state: 60 seconds. If this is not the case see Initialization state does not complete successfully after 60s.

Transition from this state: This happens automatically if the Initialization is successful and takes the base to the Get Initial Position state (T0).

Get Initial Position

This state is indicated by: the Positioning LED blinking green, while the Error LED is blinking red simultaneously.

Positioning LED



Blinking green 1Hz

Error LED



Blinking red 1Hz

This state is entered when the Initialization of the base has been successfully completed.

During this state:

- The RTK base station is searching for GNSS satellites.
- The RTK base station also compares its current position with the reference position (if known). If the distance between the current position and the reference position is greater than 7m the station will enter the Error state.

The Maximum duration of this state is 15 minutes.

Transition from this state:

- **Operational** state: if the reference position of the base is known and the difference between the reference and current positions is less than 7 m (T2) (23 ft)
- **Error** state: if the difference between the reference position used for the installation and current position is more than 7 m (23 ft).
- **Wait** state: if the reference position of the base is NOT known (T1).

Wait

This state is indicated by: the Positioning LED blinking green, the Error LED blinking red simultaneously AND the Configuration LED blinking green.

Wait (continued)

Positioning LED



Blinking green 1Hz

Error LED



Blinking red 1Hz

Configuration LED



Blinking green 1Hz

This state is entered automatically after the base station has successfully connected to GNSS satellites but has not yet determined its reference position (T1).

During this state: the base is waiting for user input to proceed

Transition from this state depends on the user input:

- **Survey-in state:** if the Survey-in button is pressed (T3).
- **Pair WiFi repeater state:** if the Configuration button is pressed while the Repeater is connected (T5).

Survey-in

This state is indicated by: the Positioning LED blinking green.

Positioning LED



Blinking green 2.5 Hz

This state is entered: by giving a short press on the Survey-in button.

During this state: the RTK base station is determining its own reference position.

Minimum duration of state: 5 minutes.

Maximum duration of state: 15 minutes.

The minimum and maximum durations can be modified using the diagnostic tool.

Transition from this state occurs automatically if the Survey-in process is successful and takes it to the Operational state (T4).

Operational

This state is indicated by: the Positioning LED blinking green.

Positioning LED



Blinking green 1Hz

This state is entered:

- Automatically when the Survey-in has been completed successfully (T4).

Operational (continued)

- Automatically from the **Get Initial Position** state if the reference position of the base is already known and the distance between the current and the reference positions is less than 7 m (23 ft) (T2).

During this state the RTK base station collects GNSS positional data from all available satellites and compares it to its reference position. It calculates real time correctional position data and communicates these to all connected robots.

Pair Wi-Fi Repeater

This state only occurs if Wi-Fi is being used for transmitting corrections.

This state is indicated by: no particular LED configuration. The LEDs will be indicating the state of the base when the Pair Wi-Fi state was initiated. This must be either the **Wait** state or the **Operational** state.

This state is entered: by pressing the Configuration button while the Wi-Fi repeater is connected to the base station over the ethernet port.

During this state: the RTK base station will pair the repeater to connect to this base station. While this is happening, the Configuration LED will blink blue at 1Hz. Once the repeater is paired the Configuration LED will blink green at 1Hz.

Transition from this state: the base will return to the state it was in before the pairing operation was started (i.e., the **Wait** or **Operational** state).

Update Software

This state is indicated by: both the Positional LED and the Error LED being off and the Configuration LED blinking white.

Positioning LED		Off
Error LED		Off
Configuration LED		Blinking white 1Hz

This state is entered: automatically after a valid software package has been sent to the base station.

During this state: the base station will update the software version. The base configuration parameters such as the survey-in position, and Wi-Fi or 4G are retained.

Transition from this state: the base will return to the **Initialization** state if the update is successful. A system error will occur if the update was not successful.

Error

This state is indicated by: the Error LED blinking red at 1Hz.

Positioning LED		Off
Error LED		Blinking red 1Hz
Configuration LED		Off

This state is entered: automatically if an error is detected on the base station.

System Failure

This state is indicated by: the Error LED blinking red rapidly at 2.5Hz.

Positioning LED		Off
Error LED		Blinking red 1Hz
Configuration LED		Off

This state is entered: automatically if an unrecoverable error is detected on the base station.

RTK Base Requirements When Using Wi-Fi

Note: These requirements apply to model 30915 only.

This topic sets out the installation requirements for the base, when Wi-Fi is being used to transfer the correctional data.

Common Requirements for the Base

- A power grid connection must be available. Electrical protection is required on the customer's side (e.g., panel breaker).
- There must be open sky vision between the satellites and the RTK base.
- There must be open sky vision between the satellites and the robots.
- Each robot on a single site should only be in communication with 1 RTK base.

Note: When using Wi-Fi, there is a maximum of 5 devices that can connect to the RTK base. This includes repeaters, robots, and smartphones.

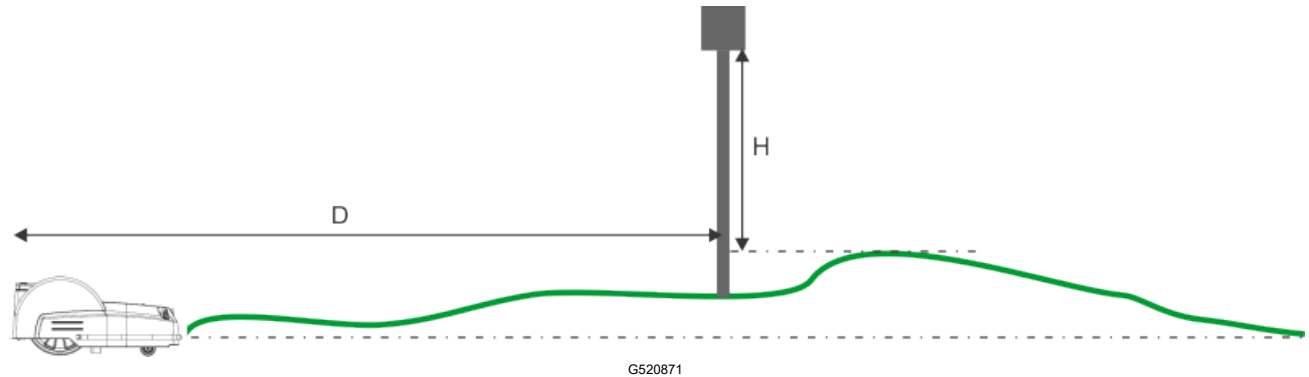
Height of the Base

The height of the base is important to ensure open sky vision for the base antenna to connect with the satellites.

Height Requirements for the Robots using Wi-Fi

Note: This applies if you are using Wi-Fi.

The height of the base depends on the highest point on the site and the furthest location (maximum distance) between the robot and the base.

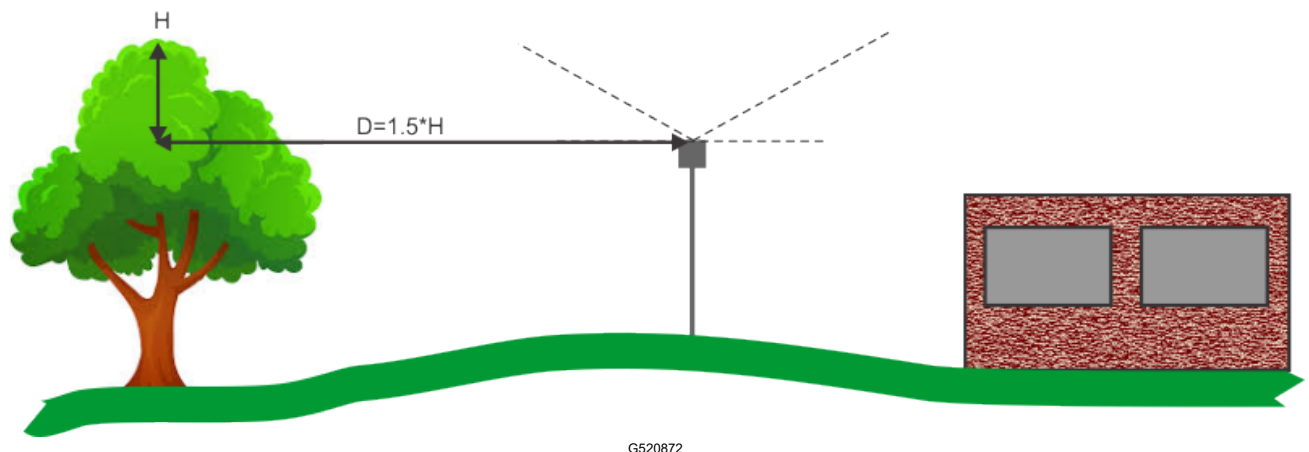


The minimum recommended height (H) is above the highest point on the site.

Maximum distance between robot and base (D)	Minimum recommended height (H)
<75 m (246 ft)	2.0 m (6.6 ft)
75 to 125 m (246 to 410 ft)	2.5 m (8.2 ft)
125 to 175 m (410 to 574 ft)	3.0 m (9.8 ft)
175 to 200 m (574 to 656 ft)	3.5 m (11.5 ft)

Height Requirements for the Satellites

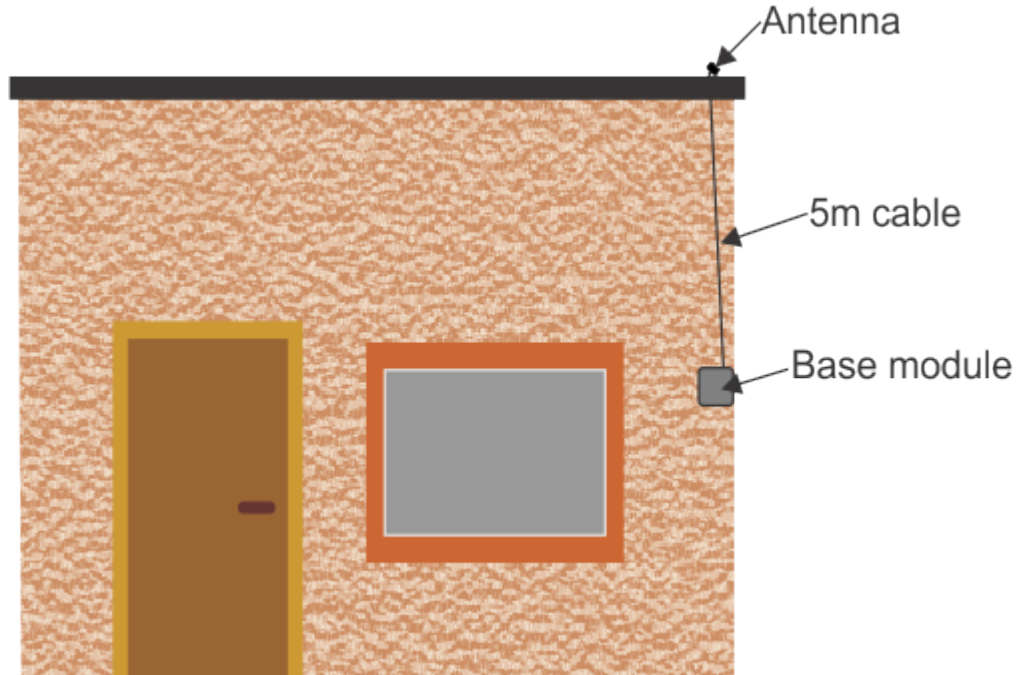
Permanent obstacles such as trees and buildings can obscure the open sky vision. If an obstacle is higher than the proposed height of the base, the base must be situated at a required distance from the obstacle as shown in the following figure.



Height of the Base (continued)

Height of the Antenna

The antenna can be mounted up to 5 m (16.4 ft) above the height of the base module.



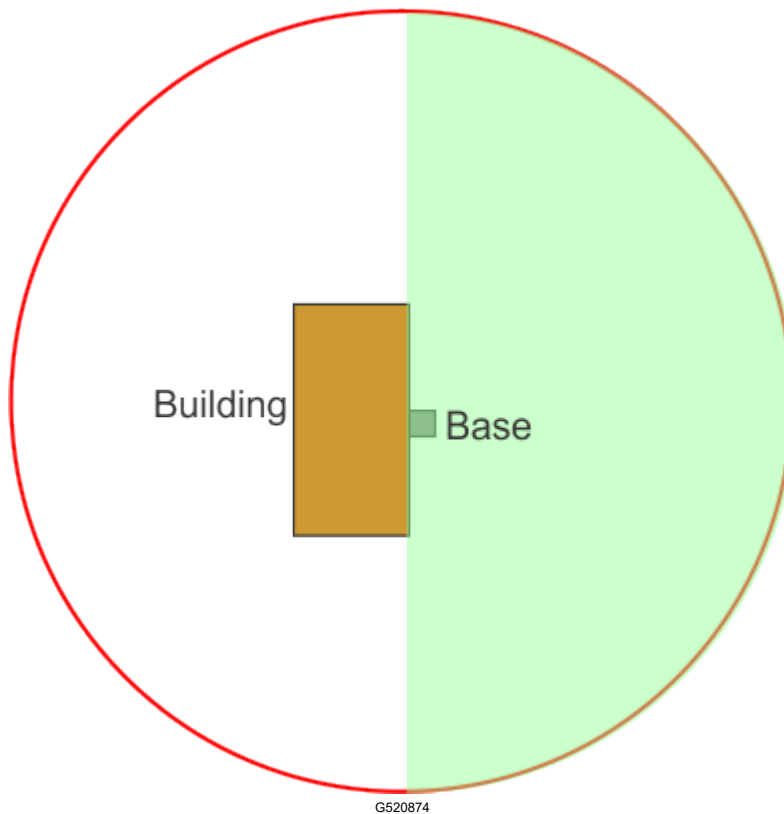
G520873

Note: If the antenna is mounted separately from the base module, then it must be installed horizontally on a metal plate that must be at least 100 mm x 100 mm (4.0 in x 4.0 in).

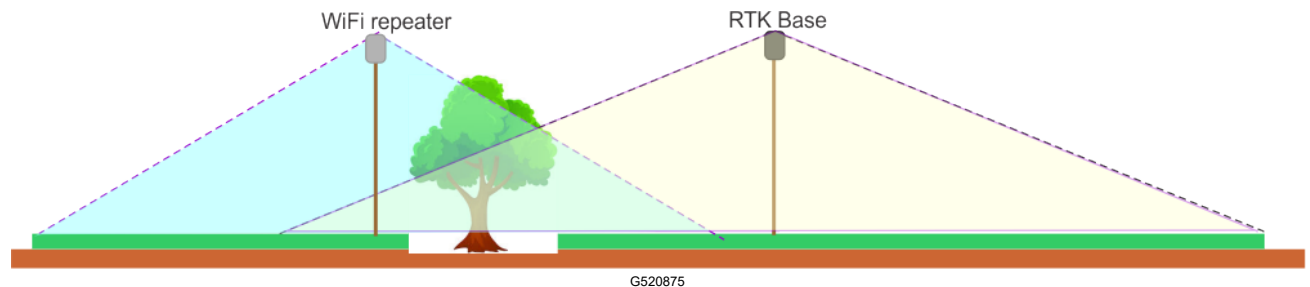
Wi-Fi Range of the RTK Base

The range of the base must cover as much of the working area as possible. The base must be set at a height to provide the necessary cover, which is a maximum of 200 m (219 yd) radius (see the table in the previous section). The range can only be achieved if the space between the edge of the working area and the base is unobstructed. Buildings will block the range of the base.

Wi-Fi Range of the RTK Base (continued)



If trees or buildings obscure the range of the base, the use of Wi-Fi repeaters will be necessary.



Note: There must be no obstruction between the RTK base and the Wi-Fi repeater.

The RTK base Wi-Fi should cover the location of the charging station. It is also possible that other Wi-Fi systems in the locality may affect the Wi-Fi connection between the base and the robot.

RTK Base Requirements When Using 4G

- A power grid connection must be available. Electrical protection is required on the customer's side (e.g., panel breaker).
- There must be open sky vision between the satellites and the RTK base GNSS antenna. If there are obstacles such as trees and buildings surrounding the site, the GNSS antenna of the base should be high enough to ensure these do not interfere with the signals.

- Position the base to ensure a sufficient 4G connection for data transfer. A minimum of 3 out of 5 bars signals strength is required. This can be checked using a mobile phone or on the top side of the 4G router.

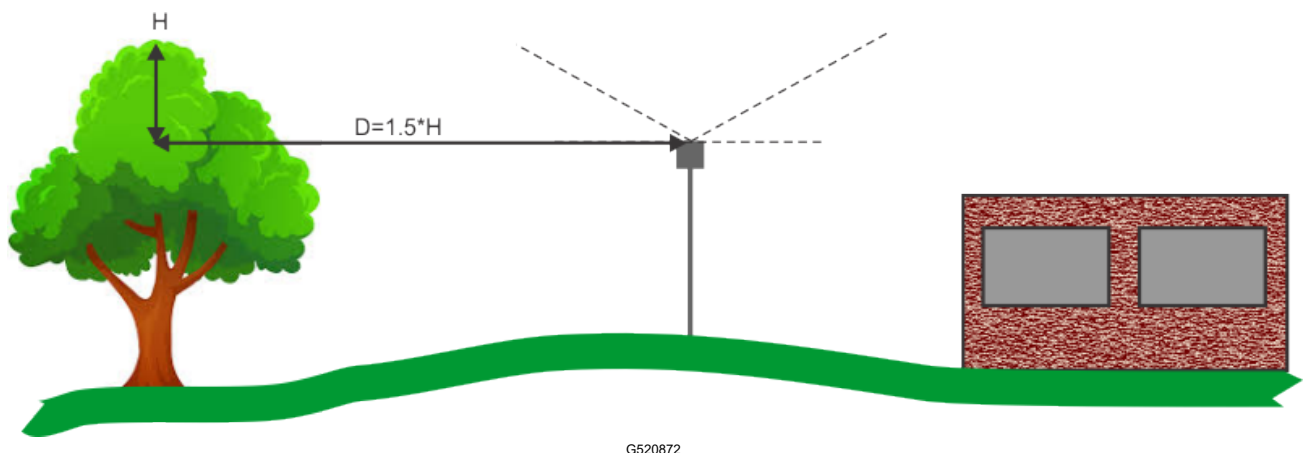
	>65dBm	Excellent
	-65dBm to -75dBm	Good
	-75dBm to -85dBm	Fair
	-85dBm to -95dBm	Poor
	<=-95dBm	Signal too low

- Each robot on a single site should be in communication with only one RTK base.
- There is no limit to the number of robots that can communicate with a single base station.
- Robots connected to the 4G base station must operate within a radius of 15 km (9.3 mi) from the base.
- Only one customer per base station is permitted.

Height of the Base

The height of the base is important to ensure open sky vision for the base antenna to connect with the satellites.

Permanent obstacles such as trees and buildings can obscure the open sky vision to the satellites. If an obstacle is higher than the proposed height of the base, the base must be situated at a required distance from the obstacle as shown in the figure below.



Height of the Base (continued)

Note: It is the height of the GNSS antenna that counts. This can be mounted up to 5 m (16.4 ft) above the height of the base module.

Range of the RTK Base Station

Robots must operate within a radius of 15 km (9.3 miles) from the 4G RTK base station in order to ensure sufficient GPS precision for pattern navigation.



Installing the RTK Base

Ensure that the following information is available before installing the RTK Base:

- The base location
- The height the base needs to be mounted
- If Wi-Fi repeaters are needed for a Wi-Fi installation (Model 30915 only)

Wire Installation of the Base

IMPORTANT

Installation must be performed by a qualified professional. Follow all national and regional codes.

IMPORTANT

When installing the base on any support, it is important that it is mounted the right way up,(i.e., with the Wi-Fi and 4G antennas at the bottom). This is to ensure that it remains water tight.

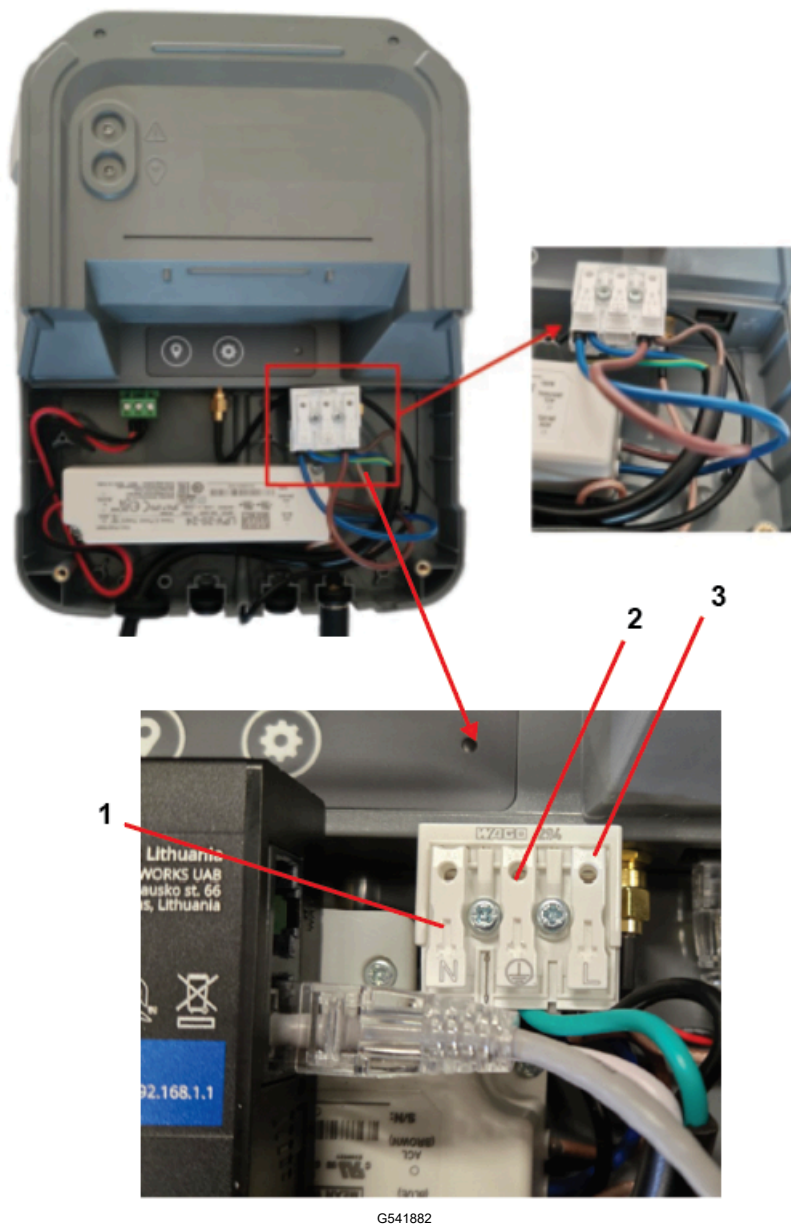
Note: If you are using a Wi-Fi repeater, it is recommended that you pair the base station with the repeater before you install the base in position.

1. Remove the 2 screws at the bottom of the base.



G540187

2. Run the 16 AWG power cord to the base location.
3. Connect the power cord to the terminal:
 - A. Push down on the lever.
 - B. Insert the wire.
 - C. Release the lever.
4. Insert the cable through the grommet and connect the wires to the power connectors in the base as shown in the figure below.

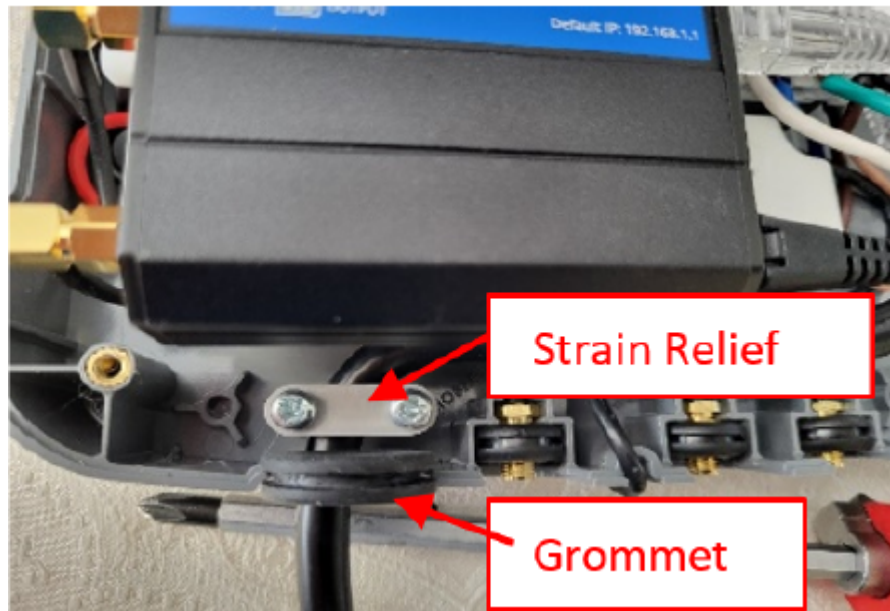


G541882

- ① Neutral
- ② Ground

- ③ Line/Hot

5. Route the cord and secure in the strain relief.



G540188

6. Place the grommet back in place.
7. Install the base cover.
8. Take a photo of the base station initial/default password sticker.

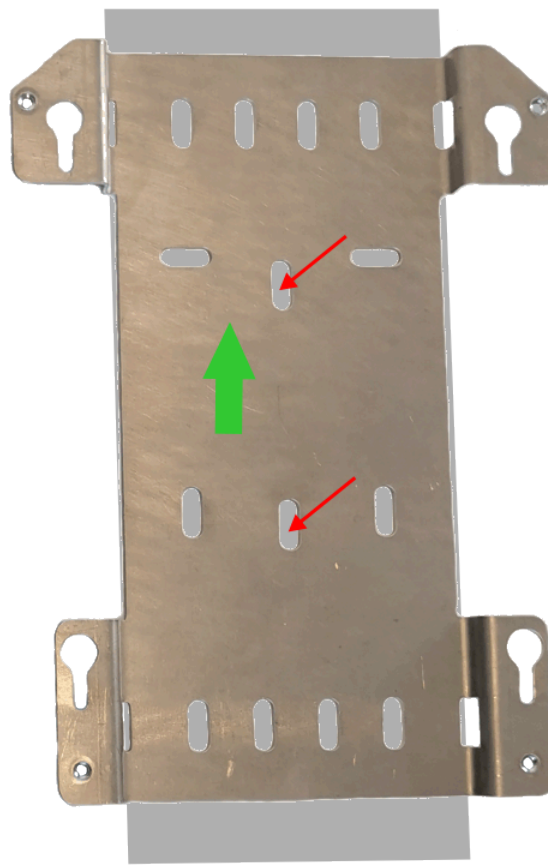
Mounting the Box

When determining the height at which the base must be installed, it is the height of the GNSS antenna that counts. The base box can be mounted at a lower height which is convenient for installation and maintenance. The GNSS antenna can be mounted up to 5 m (16.4 ft) higher on the support. In this case, the GNSS antenna must be mounted horizontally on the support on a metal base plate. This plate must have the dimensions of at least 100 mm x 100 mm (4 in x 4 in).

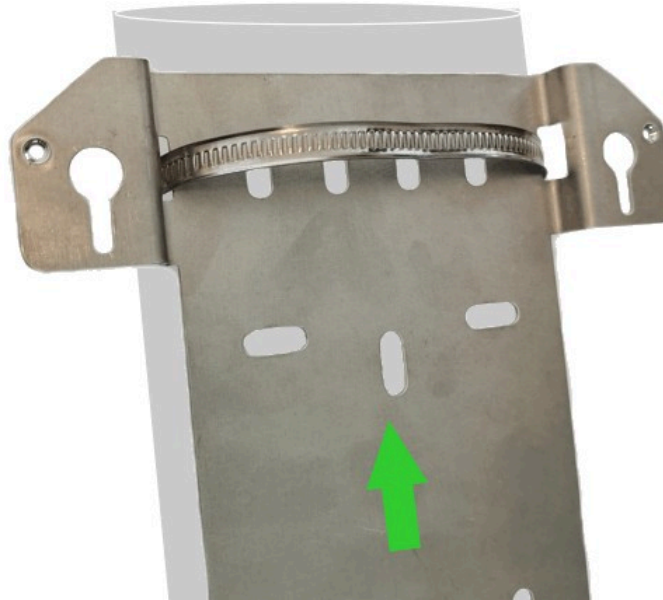
The RTK Base is supplied with a metal plate which can be attached to the support.

The plate contains a set of slots to its facilitate its fixation onto the support. Screws are supplied to fix it to a vertical surface and ring claps are provided to fix it to a pole.

It is important that the plate is attached to the support surface in the correct orientation, with the chamfered corners at the top as shown in the figure below.

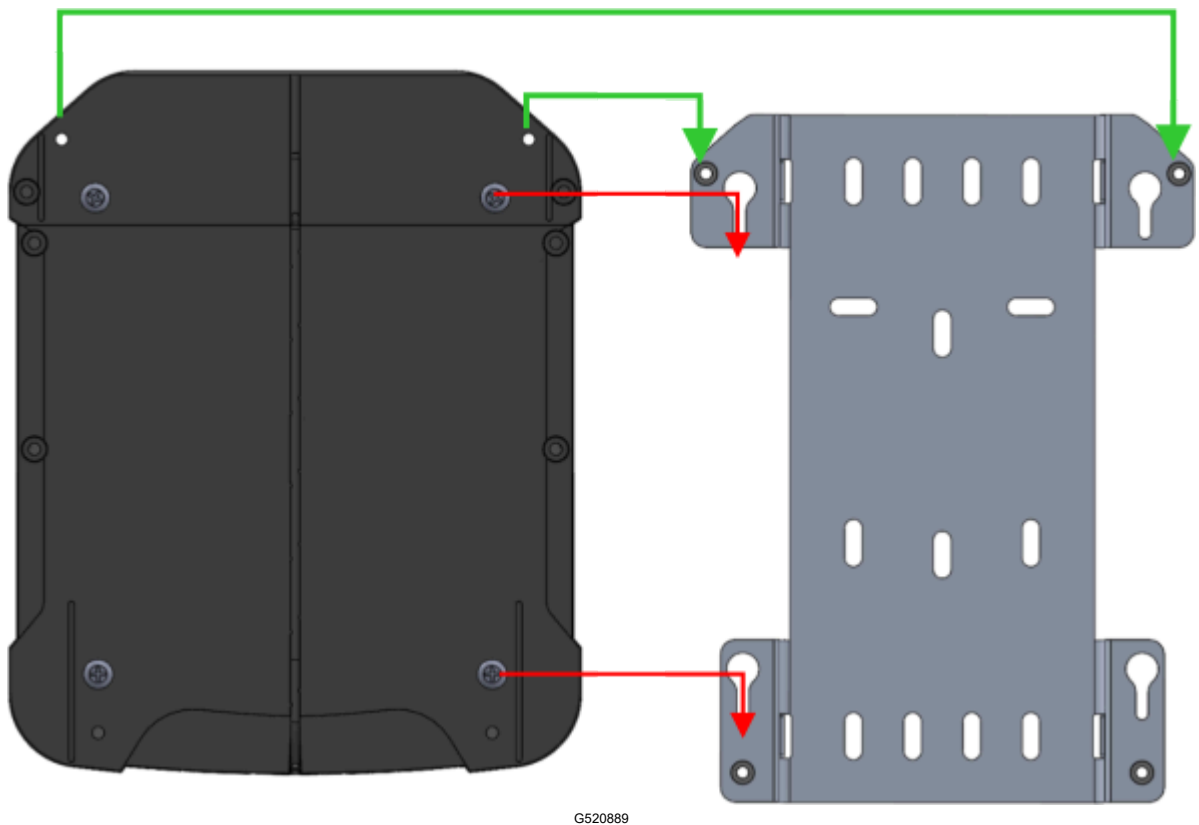


G520887



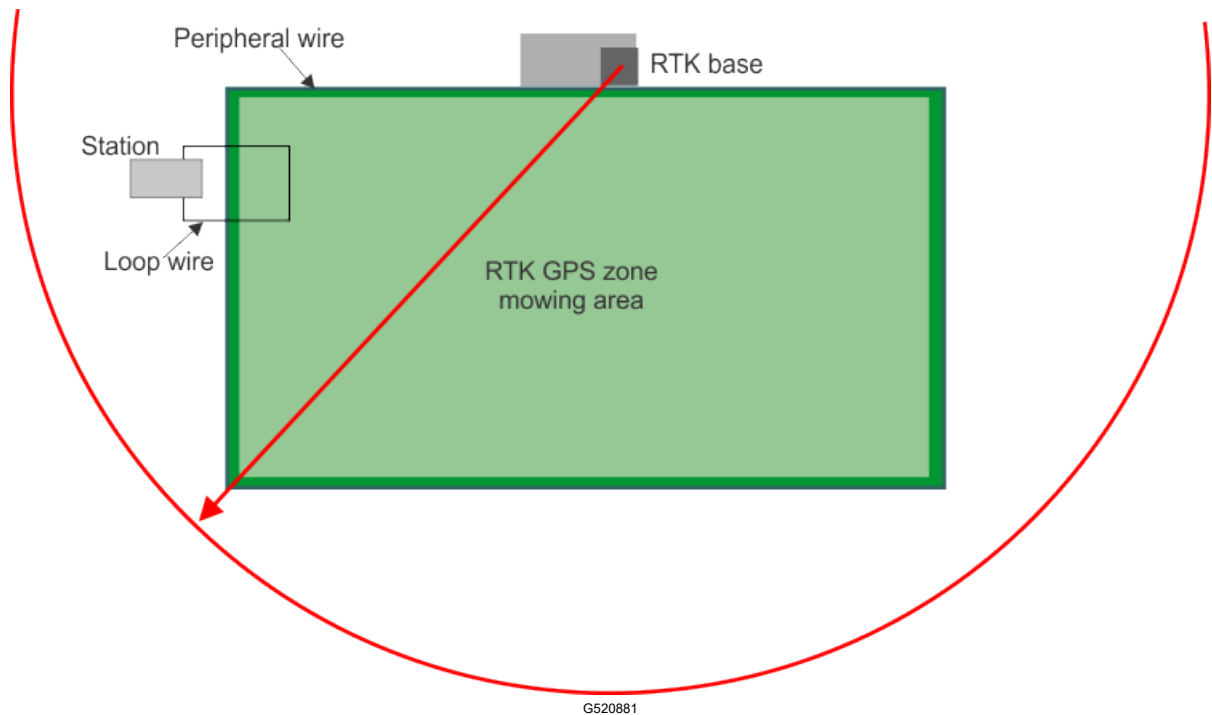
G520888

The base box can then be fitted on the plate by sliding the screws on the back of the base into the keyhole slots on the plate. The base should also be screwed into the 4 threaded holes in the plate as indicated by the green arrows in the figure below.



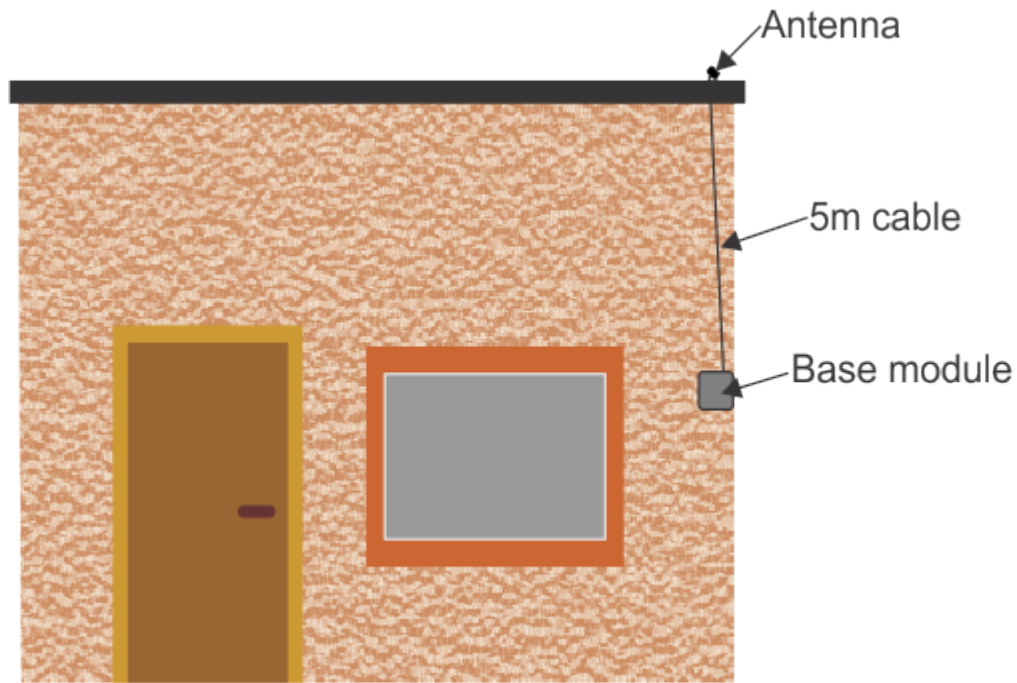
Mounting the Base on a Building

If you are using Wi-Fi for the data transfer, this is suitable if the working area(s) are on one side of the building, as illustrated by the figure below.



The building blocks the range of the base. If the working areas are on the other side of the building you may need to use a Wi-Fi repeater.

The base can be mounted at a convenient height and the GNSS antenna mounted up to 5 m (16.4 ft) higher on the roof.



G520873

In this case, the GNSS antenna must be mounted horizontally on the roof on a metal base plate. This plate must have the dimensions of at least 100 mm x 100 mm (4 in x 4 in).

IMPORTANT

If the base is mounted on any existing structure (including poles), ensure that the GNSS antenna is positioned on top of the structure or at least high enough to ensure clear sky vision.

Mounting the Base on a Pole

This enables you to position the base at the most convenient location and at a suitable height.

Two pairs of adjustable ring clamps are provided in the kit to enable you to attach the support plate to a pole. The base box can then be mounted on the plate as previously shown.



G520890

IMPORTANT

The pole needs to be firmly anchored in the ground.

Starting up the Base

1. Power on the base unit.
2. The green Positioning LED and red Error LED will alternate blinking until the initialization process is complete. During this phase, the base is initializing the electronic boards. This state should be completed within 60 seconds. If this does not occur see Initialization state if it does not complete successfully after 60 seconds.
3. When the Initialization phase has been completed successfully, the green Positioning LED and the red Error LED will both blink at 1Hz to indicate that the base has transitioned to the Get Initial Position state. During this phase, the base is searching for GNSS satellites. This phase should last a maximum of 15 minutes. If this is not the case, refer to the troubleshooting section.
4. Once the base has successfully located satellites, it will enter the Wait state (the Positioning LED will be blinking green, the Error LED blinking red simultaneously AND the Configuration LED blinking green).
5. Connect a phone or computer to the “RTKWifi” network. The default password is located on the sticker on the base enclosure. **You are required to change this later in the setup process.**
6. Open a web browser and go to <https://192.168.4.1>
7. In the browser, under **GPS**, change the **Choose survey-in duration** to **Recommended (1-3 hour)-minimum**.

Note: For Demo Only use a 15-45 minute survey period.

8. Click on **Start Survey-in**.
 - Survey mode: The 4G base will blink green quickly

- The 4G base will briefly blink simultaneously red and green
 - Survey complete: The 4G base will blink green slowly
9. The 4G base is now ready. Install Wi-Fi repeaters if required.

Difference Between the Current and the Reference Base Position

When using the RTK base installation software, version 3.0.0 or higher is required. This software has a function that checks if the current position of the RTK base station is within 7 m (23 ft) of its reference (survey-in) position. This constraint is necessary to guarantee safe operation of the robot without a peripheral wire.

The check is carried out at the start-up of the RTK base station or whenever the internal GPS module of the RTK base station is reset, which may occur randomly. If the initial reference position was not detected with sufficient accuracy, or if the current conditions are unfavorable for obtaining a high level of GPS signal, it may be that the base detects a difference greater than 7 m (23 ft) between the current and the reference position and goes into alarm: position error.

To ensure that the position is determined with a high degree of accuracy:

- Make sure you respect the requirements and installation rules for the RTK base station. Clear sky view and sufficient distance from tall obstacles are essential if the correct position of the RTK base is to be determined.
- Make use of smartphone apps to verify satellite view at the intended position of the RTK base station. The recommended app is GPS Test GNSS View.
- Make sure you do the installation in favorable weather conditions. Avoid finding the reference position on cloudy days.
- Setting a longer survey-in time will improve the accuracy of the reference position.
- Power the base on for a longer time before you perform the survey-in action.



RTK Base Diagnostic Tool

This tool can be used with bases that have software version 3.0 or higher. It provides information that can aid in resolving problems concerning the base.

Pre-requisites:

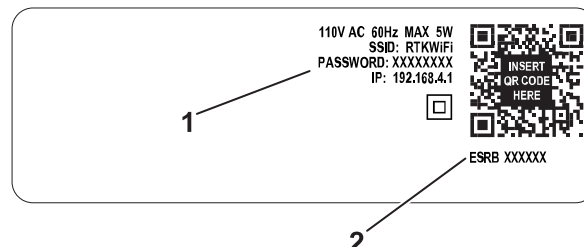
- A smartphone or laptop with Wi-Fi and an internet connection.
- You must be in close proximity to the base, since you need to connect to the Wi-Fi of the base.

Accessing the Diagnostic Tool

1. Power on the RTK base.
2. If you are using a smartphone, disable your mobile connection.
3. On the smartphone or laptop connect to the Wi-Fi of the base: RTKWi-Fi.
4. Enter the password for the Wi-Fi. The initial/default password is available from the label on the side of the base station. **You are required to change the password.**

Note: The password MUST consist of 8 characters.

For serial numbers 324000000 through 324999999:

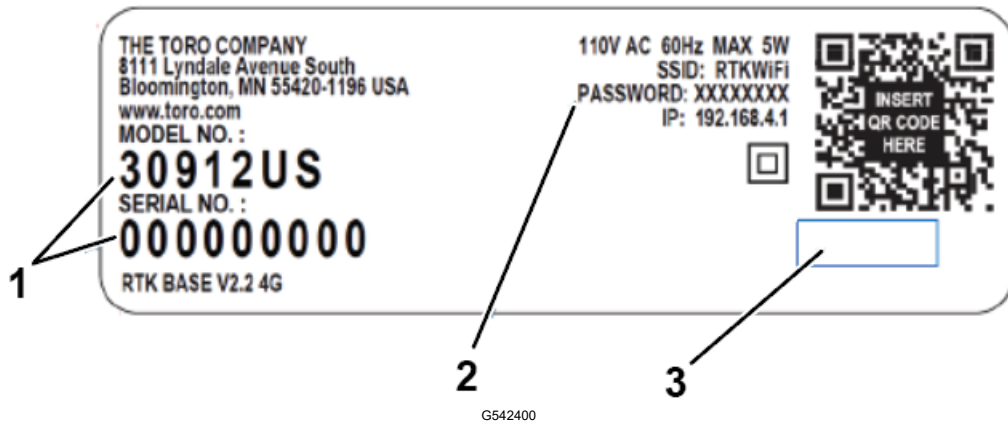


G539289

① The initial/default password for the base Wi-Fi

② The serial number of the base

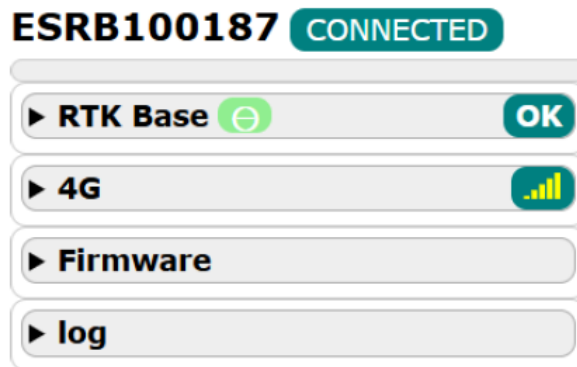
For serial numbers 325000000 and up:



- ① Base ID serial number Model-Serial
- ② Initial/default password for the base ID
- ③ Area blank

The initial/default password is highlighted in the figure above and consists of 8 characters. If you have changed the password, enter the new one.

- Open a web browser and go to page: <http://192.168.4.1>. The RTK base diagnostic page will open. The options presented depends on whether the base is using Wi-Fi or 4G.



Overview



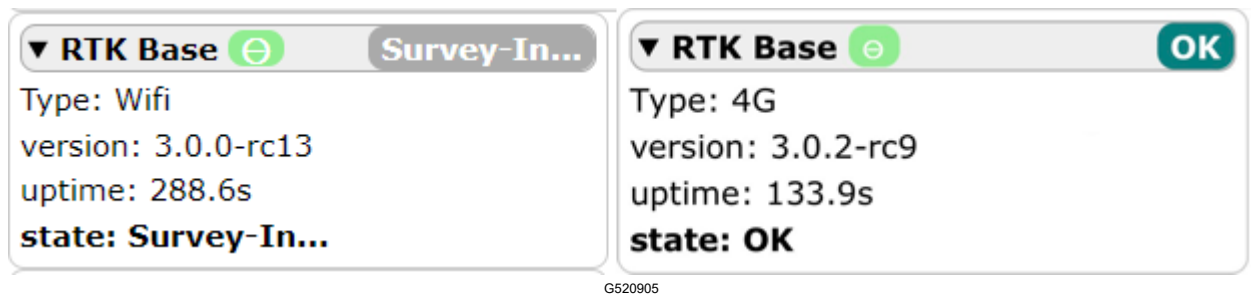
Base Serial Number

- The base serial number as shown on the label.

Connected Status

- This indicates whether the base is connected to the device you are using to access the diagnostic tool.

RTK Base



This page displays information about the current status of the base:

- Real time status LEDs
- Positioning (green) and Error (red) LEDs
- Base functional state

This shows the current functional state of the base. Possible values are:

- OK
- Initialization
- Get initial position
- Wait
- Survey-In
- Operational
- Error
- Pair repeater
- Update SW

Type

- The method used for transmitting the corrections. This can be Wi-Fi or 4G.

Version

- The current software version.

Uptime

- The number of seconds that the base has been operating since the last reset operation.

State

- The current functional state of the base.

If the current state is the error state, the type of error is displayed. Possible values are:

- Position error
- GNSS antenna error
- Survey-in error
- Network error (4G)
- System failure

GPS

This page displays information about the GPS performance and the base reference position. It enables you to determine the reference position. The details displayed on this page depends on the status of the base.

▼ GPS OK

time: 2/10/25, 5:08 PM

satellites: 32/42

Initial position

Delta to reference position: 2.476m

antenna accuracy: 2.7347m

Reference Position

mode: ☒ Survey-in ☐ Manual

Survey-in duration: 86402sec

Survey-in accuracy: 0.053m

Survey-in date: 10/19/24, 8:27 AM

Coordinate:

x: -259680.8676 m

y: -4521512.3819 m

z: 4476286.0713 m

Latitude: 44.8572562

Longitude: -93.2870177

Altitude: 44.9

Choose survey-in duration ▼

Start Survey-in

G539443

Status

- This corresponds to the overall status of the base.

Time

- The current date (mm/dd/yyyy) and time.

Satellites

- The number of satellites to which the base is connected / number of satellites available. The base should be connected to at least 10 satellites. If this is not the case, you need to move the antenna.

Initial position

- This field appears when a reference position has been determined. The initial position is the position detected when the base starts up.

Delta to reference position

- The value displayed here is the difference between the reference position and the initial position. This needs to be within 7 m (23 ft) of the reference position.

Antenna accuracy

- This is a factor describing the accuracy of the base in determining its position. This needs to be less than 1 m (3.2 ft) .

Reference Position

mode

- This sets the mode whereby the reference position is set. This can be either:
 - **Survey-in:** in this mode, the base will determine its own reference position.
 - **Manual:** in this mode, the reference position is defined by entering the coordinates that were previously determined.

Survey-in duration

- This field appears when the reference position has been determined. It is the time period used for the survey-in.

Survey-in accuracy

- This field appears when the reference position has been determined. It displays the accuracy at the termination of the survey-in process, which will be less than 7 m (23 ft).

Survey-in date

- Date on which the survey-in was performed.

Coordinates

- These fields are displayed once the reference position has been determined.
- **X, Y, Z**
The coordinates of the reference position expressed in terms of ECEF (Earth-Centered, Earth-Fixed coordinate system).
- **Latitude, longitude, Altitude**
The coordinates of the reference position expressed in terms of the GCS (Geographic Coordinate System).

Choose survey-in duration

These options allow you to choose the time that will be used for the survey-in process:

- Start Survey-in
- Starts the process whereby the base determines its reference position

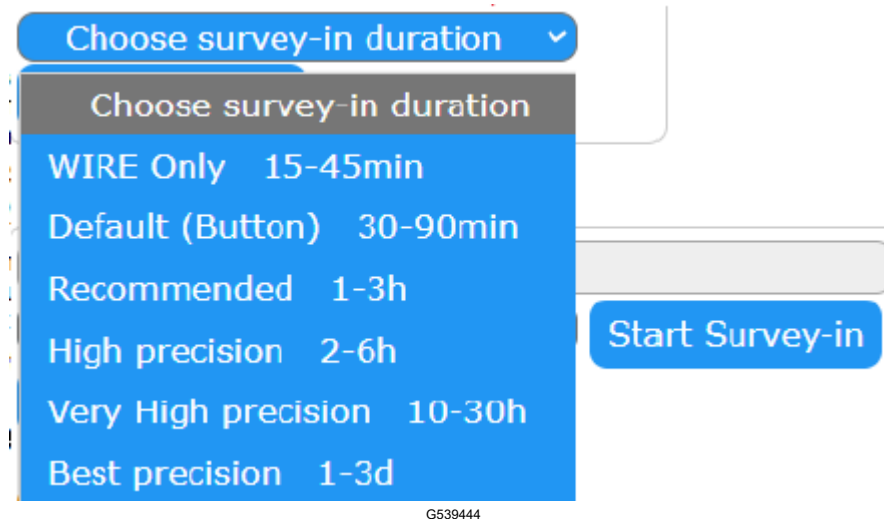
Determining the Base Reference Position

This process can be used if a new reference position is required.

1. Check the Survey-in mode option.

Determining the Base Reference Position (continued)

2. Choose the time to be used for the process. The longer the time, the more accurate the determination of the position will be. The shortest time available is **WIRE Only 15-45min** and can be used if the installation includes a peripheral wire.



3. Press **Start Survey-in**. The base will contact the satellites and determine its reference position. The current coordinates of the reference position will be shown in the Ongoing fields. The process will continue until the accuracy is less than 7 m (23 ft). When the minimum amount of time chosen has elapsed, an error will be generated and the process will continue for two more time periods after which another error will be generated. In this case, it will be necessary to move the base or its antenna.

Manually Setting the Reference Position for a 4G RTK Installation

This procedure enables you to retrieve the coordinates of the reference position that were determined during the discovery and verification process. The base reference position is regarded as having moved if the current coordinates differ by more than 7m from the coordinates that were used for the reference position. In the case of a 4G RTK installation, this difference is automatically detected on the robot, and the original coordinates can be retrieved from the robot. For an RTK installation using a peripheral wire, the difference is not automatically detected or communicated and the previous coordinates can be retrieved from the web portal. There is an advantage in retrieving the original reference coordinates because it means that the mapping the robot uses to calculate its working pattern do not have to be adjusted.

1. On the robot, select Technician's menu (9) > Infrastructure > Parcels > 4G RTK SUMMARY. This will show the message X RTK Base MOVED.
2. Click on **MOVED**.
3. Click on **4G RTK Base**.
4. In the diagnostic tool check the **Manual mode** option.
5. Copy the coordinates shown on the robot UI.
6. Press **Save**.

Manually Setting the Reference Position for a Wired RTK Installation

1. Go to the **turfpro.toro.com** web portal.
2. Select the robot you are interested in and click on **Parameters**.
3. Select the Robot Activity tab and click on **L** at the top of the page.
4. In the "Events" column, select the event type "RTKSVinChange". You will be presented with values for the previous and the new values of X, Y and Z.
5. Copy the previous values for X, Y and Z into the diagnostics tool.
6. Click **Save**.
7. Restart the robot.

Wi-Fi AP

This page provides information about the base Wi-Fi. It also enables you to change the Wi-Fi password and the channel used for the Wi-Fi communication.

▼ **WIFI AP** **1 connected**

bssid:

SSID:

Password:

channel:

Tx-Power:

clients

G539445

{X} Connected

- The number of clients (robots) connected to the Wi-Fi of the base.

bssid

- The BSSID of the base Wi-Fi.

SSID

- The SSID of the base.

Password

- This field will display the password if one has been set. If this field is empty, it means that no password has been defined. Details on changing the password are given in the following section. **You are required to set a new password.**

Channel

- This is the Wi-Fi frequency band used by the RTK base. The default is channel 1. If the robot is finding that the Wi-Fi coverage is not sufficient over the entire site, and is stopping working because the GPS signal is lost, this may be due to the presence of other Wi-Fi devices near the site which are interfering with the communication between the base and the robot. In this case, you can change the channel used to one that has more capacity than the current one. A recommended app to show the usage of the Wi-Fi channels in the vicinity of the base is Wi-Fi Analyzer.

If you change the channel, you need to re-pair the Wi-Fi repeater.

The remaining fields are used for technical purposes.

Changing the Wi-Fi Password

After changing the Wi-Fi password, the connection to the base Wi-Fi will be lost. You will need to re-connect to the base using the new password.

1. Click in the **Password** field.
2. Enter a new password. The background color will change to orange.

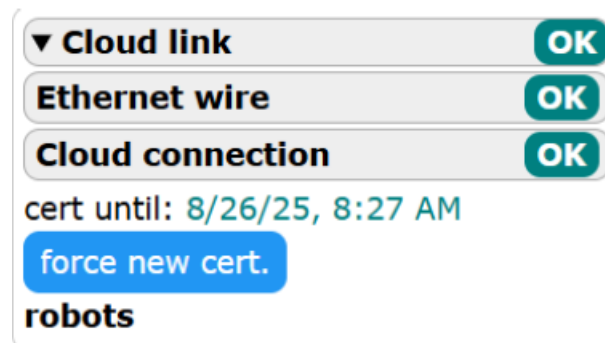
Note: This must contain at least 8 characters.

3. Press **Save**.

Note: It is recommended that you make a note of the password and keep it safe.

Cloud Link

Note: This page is only available if 4G is being used for data corrections.



G539446

This page provides information regarding connectivity of the base to the RTK base web server.

Cloud link

- The status value shown here depends on the status of the two fields shown below.

Ethernet wire

- The Ethernet wire needs to be properly connected.

Cloud connection

- Connection to RTK base web server.

Router

▼ router

uptime: 2700365s
serial: 6002135994
mac-addr: 20:97:27:32:49:79

AP

bssid: 20:97:27:32:49:7b
ssid: RUT241_62B2

G539448

Uptime

- The time in seconds since the router was started.

Serial

- The serial number of the router.

Mac-addr

- The MAC address of the router

AP

- The bssid and the ssid of the router

4G

Note: This page is only available if 4G is being used for data corrections.

▼ 4G 

IMEI: 863890055168827
SIM IMSI: 240075823315759
SIM ICCID: 89462038075012732461
data: connected
network: **Roaming**
connection type: LTE
operator: T-Mobile, Tele2 IoT
rssi: -24

Reboot Router

G539447

Signal level

- The strength of the 4G signal level.

Uptime

- Time in seconds since the last reboot of the router.

IMEI

- This information is displayed for technical purposes.

SIM IMSI

- This information is displayed for technical purposes.

SIM ICCID

- This information is displayed for technical purposes.

Network

- This information is displayed for technical purposes.

Connection type

- 2G, 3G, 4G, etc.

Operator

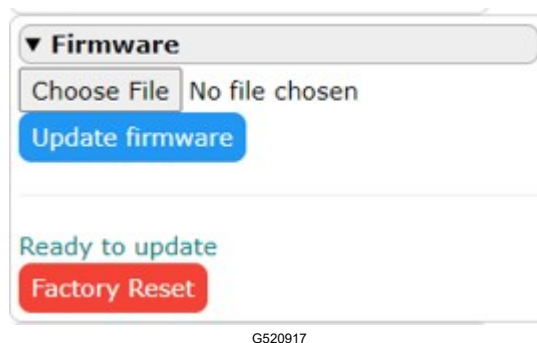
- Name of the operator.

Reboot Router

- Reboots the router.

Firmware

This page enables you to perform a software update using a binary file and a factory reset. The current software version can be seen on the RTK base page.



Choose file

- This enables you to perform a firmware update using a binary file. This option is not currently supported.

Update firmware

- Updates the base firmware.

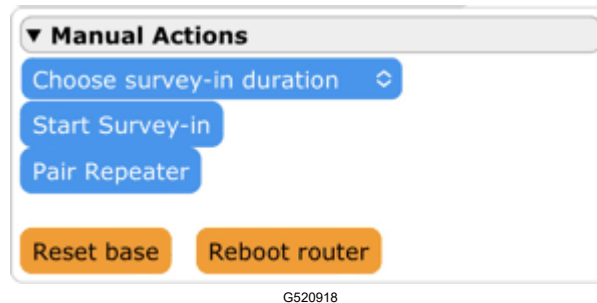
Factory reset

- Pressing this button will perform a factory reset. As a result of a factory reset:
 - All configuration parameters are lost
 - The reference (survey-in) position is lost
 - For a base delivered with firmware version 3.0, the password will be reset to the default one shown on the label

- For a base delivered with an firmware version lower than 3.0, the password will be cleared and the Wi-Fi will become open

Manual Actions

This page enables you to perform functions without the need for physical access to buttons in base.



Choose survey-in duration

This enables you to choose the length of time you want to use for the survey-in process. A list of options appears. The longer the duration chosen the higher the accuracy by which the reference position will be determined.

- "Wire Only 15-45min" can be used if the installation includes a peripheral wire.

Start Survey-in

- This starts Survey-in process to determine the reference position of the base. The base needs to be in Wait, Operational or Error states.

Pair Repeater

- This allows you to pair the base with a Wi-Fi Repeater. The base needs to be in Wait, Operational, or Error states.

Reset base

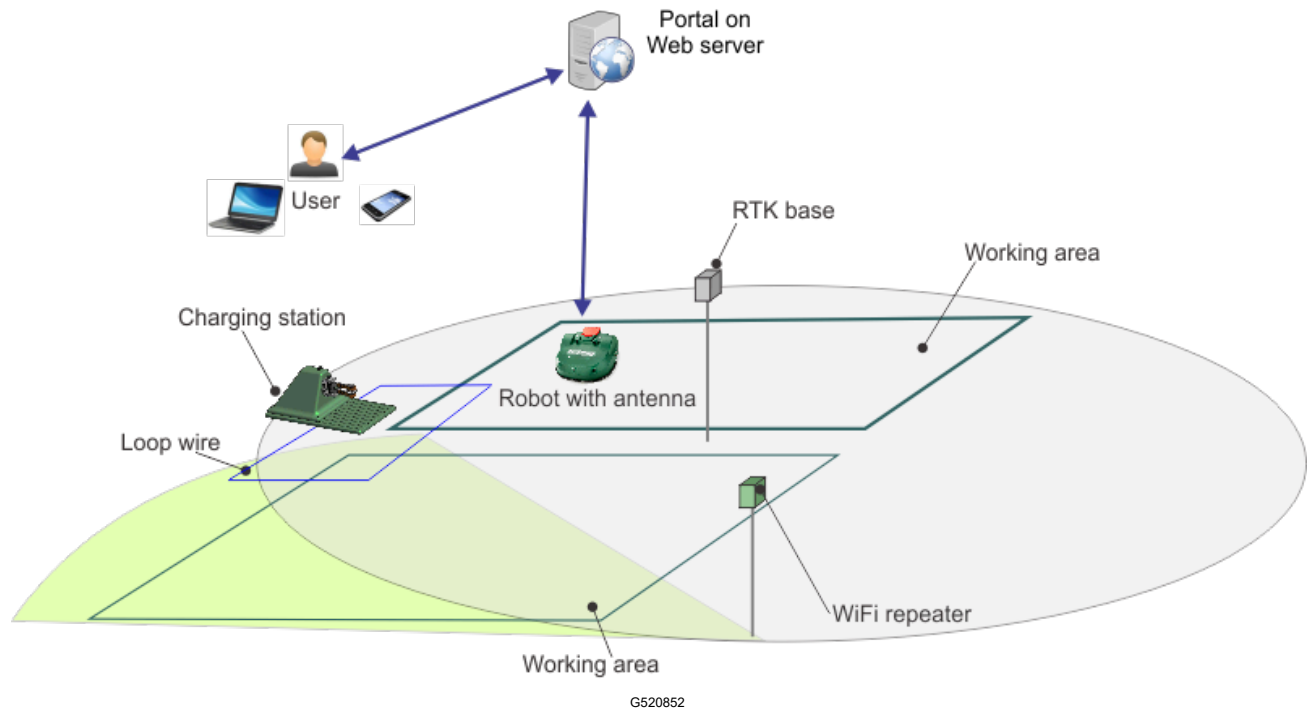
- This powers the base off, then on. All configuration parameters are retained.

Reboot router

- This powers the 4G router off, then on. All configuration parameters are retained. This operation is useful if it is blocked; no internet for example.

Using Wi-Fi Repeaters

Both the robots and the RTK base have antennas that enable communication between them using Wi-Fi. However if this communication is affected by distance or permanent obstacles, then it may be necessary to use one or more Wi-Fi repeaters which can boost the Wi-Fi signal.



Wi-Fi Repeater Description

The selected Wi-Fi repeater is TP-LINK CPE210, which is powered over Ethernet via LAN0.



G520919

Note: The repeater can be automatically paired with the base station before installation.

Note: The selected Wi-Fi repeater has an optimal beamwidth of 65° in the horizontal plane. This affects the orientation of the Wi-Fi repeater.





G520921

Note: In addition to the 10 m (33 ft) ethernet cable provided, additional cable can be used up to a maximum of 60 m (197 ft). This additional cable must be at least CAT6.

RTK Base and Wi-Fi Repeater Configurations

Note: A site can contain only 1 RTK base, which can connect to only 2 Wi-Fi repeaters. Two configurations are possible.

Configuration 1: RTK Base station + 1 Wi-Fi repeater.



G520922

The Wi-Fi repeater can be the standard kit or the recommended one with the protective box for outdoor use.

Configuration 2: RTK Base station + 2 repeaters.



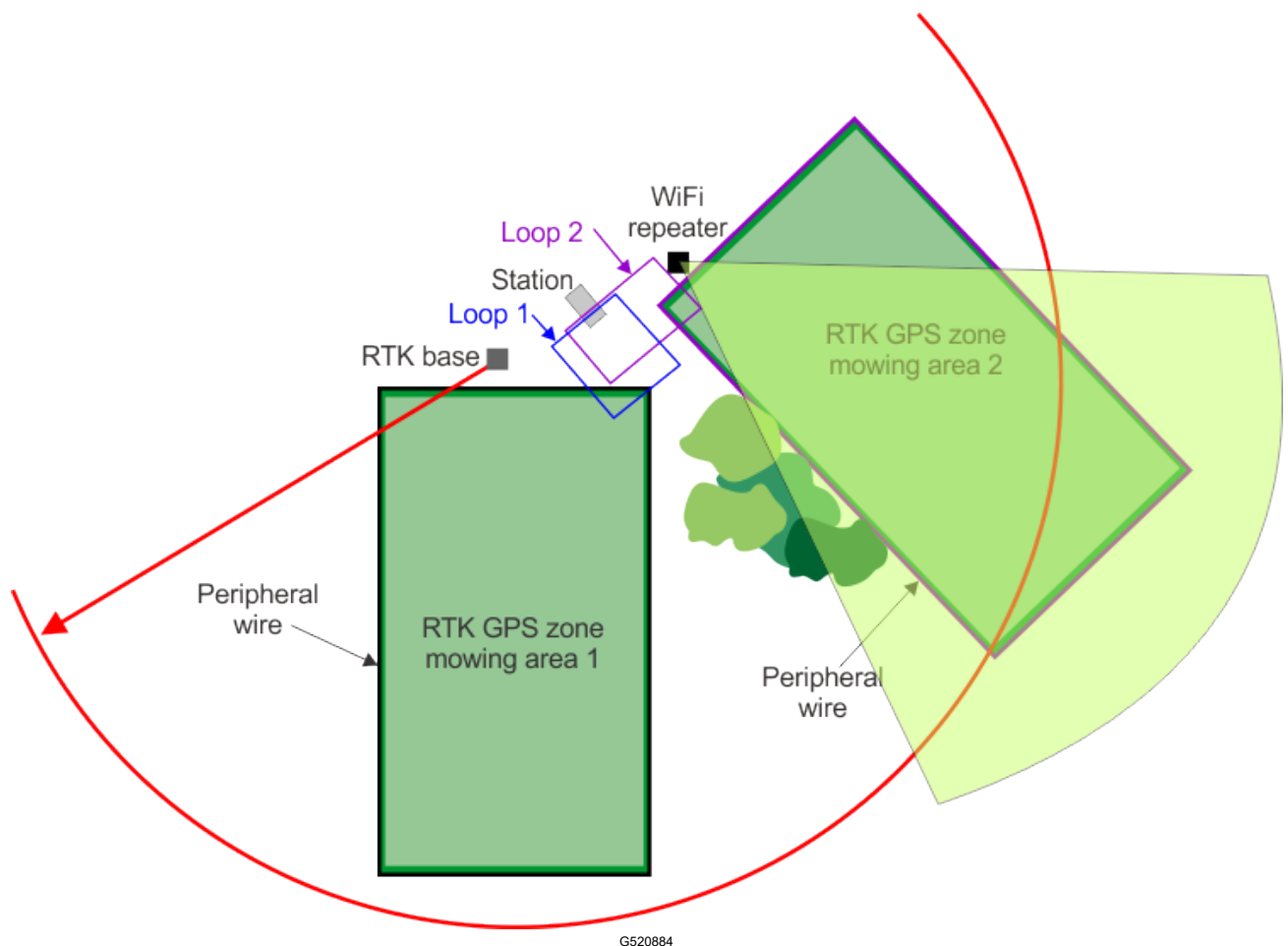
Each repeater must be paired with the base station.

If the RTK Base station is changed, the Wi-Fi repeaters need to be paired to connect to the new RTK base station.

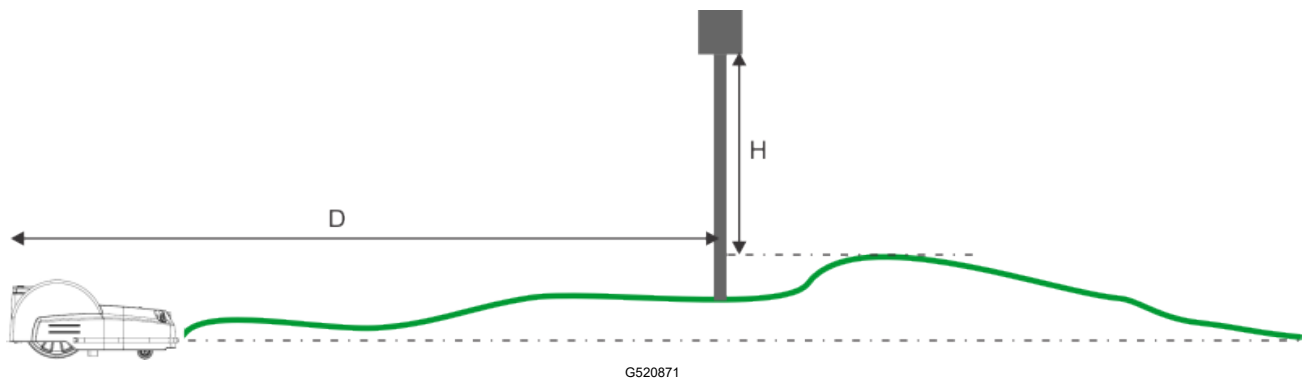
If a Wi-Fi repeater is changed, the new repeater needs to be paired to connect to the existing RTK base station.

Wi-Fi Repeater Requirements

A Wi-Fi repeater must be used in situations where the Wi-Fi coverage of the RTK base is not sufficient to cover all the working areas.



- The optimal performance of the repeater is within a beamwidth of 65°.
- There must be a direct line of sight between the base and the repeater for communication using Wi-Fi.
- There must be an unobstructed view between the robots and the Wi-Fi repeater.
- The minimum installation height of the Wi-Fi antenna is based on the unobstructed distance and field elevation **within the 65° beamwidth of the repeater.**



The minimum recommended height (H) is above the highest point on the site.

Maximum distance between robot and Wi-Fi repeater (D)	Minimum recommended height (H)
<75 m (246 ft)	2.0 m (6.6 ft)
75 - 125 m (246-410 ft)	2.5 m (8.2 ft)
125 - 175 m (410-574 ft)	3.0 m (9.8 ft)
175 - 200 m (574-656 ft)	3.5 m (11.5 ft)

Wi-Fi repeaters need to be powered with a specific Power over Ethernet (PoE) box. The PoE box is connected to the main power supply on one side, and to the Wi-Fi repeater via Ethernet on the other side.

The **maximum length** for the Ethernet power cable is 60 m (197 ft).

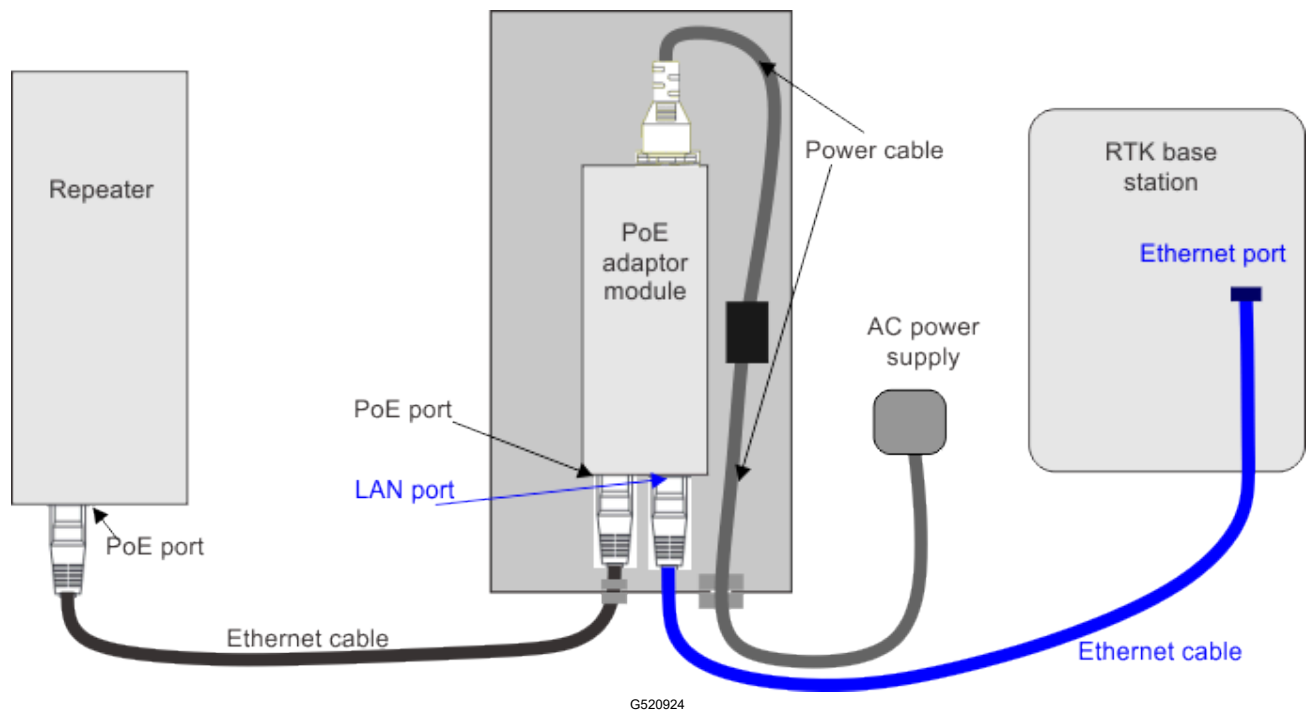
The **minimum quality** for the Ethernet cable is CAT6 (outdoor usage).

Automatically Pairing the Wi-Fi Repeater and Base Station

The RTK Base can be automatically configured to pair with one or two Wi-Fi repeaters. This procedure can be carried out before the base or the repeater are in their final position.

Note: If the password for the RTK base is changed, the pairing operation must be repeated. This operation can also be performed using the base diagnostic tool.

1. Power on RTK base station and wait until it is in:
 - The Wait state (Positioning LED blinking green, the Error LED blinking red simultaneously AND the Configuration LED blinking green,
 - The Operational state (Positioning LED blinking green at 1Hz).
 - The Error state.
2. Power on the Wi-Fi repeater using the PoE module.
3. Connect the LAN (data) port of PoE module from the Wi-Fi repeater to the Ethernet port in the base station using the ethernet cable.

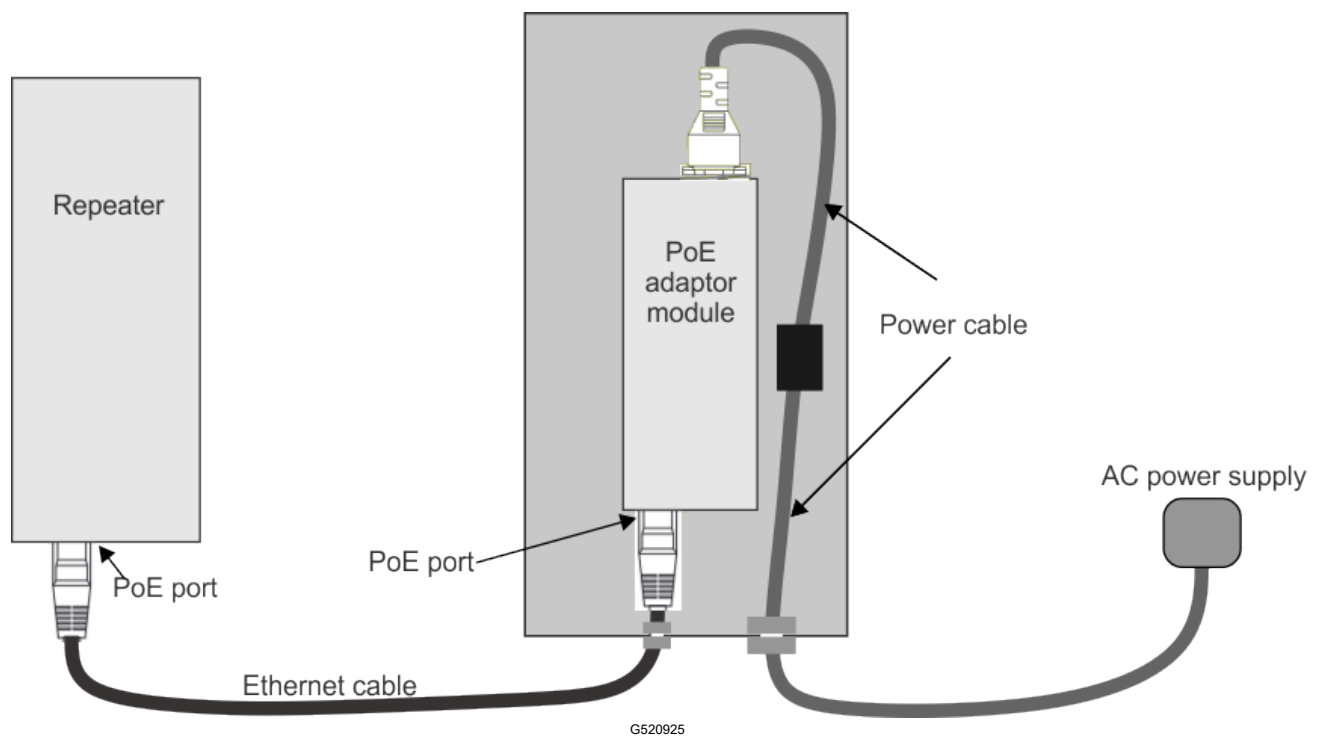


4. Press the **Configuration** button on the base station.
5. The base station will automatically configure the repeater.
 - During the configuration, the Configuration LED of the RTK base station will blink blue at 1Hz.
 - Once the repeater is configured the Configuration LED will blink green at 1Hz.
 - If an error should occur, the Configuration LED will blink red at 1Hz.
6. If the pairing is successful, disconnect the repeater from the base station and proceed to the installation step.
 If not successful, verify the Ethernet connection between the repeater and the base station and restart the procedure.

Installing the Wi-Fi Repeater

The installation of the Wi-Fi repeater can be done after the site has been assessed and the requirements satisfied. The repeater needs to be installed with a clear line of vision between the RTK base and the robots and at a suitable height. Mounting possibilities for the Wi-Fi repeater are the same as for the RTK base.

Note: It is recommended that you use the Wi-Fi repeater kit with the additional protective box, which enables you to install the PoE convertor module outdoors. A schematic outline of the wiring is shown below.



1. Connect one end of the Ethernet cable to the PoE port on the repeater.
2. Connect the other end of the Ethernet cable to the PoE port on the convertor.

Note: The maximum length of this cable is 60 m (197 ft).

3. Connect the power cable to the PoE adaptor module.
4. Connect the power cable to the connector inside the box.
5. Connect the power cable to the AC power supply.
6. Switch on the power.
7. Check the quality of the connection on the repeater.

The repeater is equipped with a set of LEDs. The upper four indicate the signal quality level.



For an adequate connection, you need at least 2 green LEDs. If this is not the case, you need to check if the repeater has a direct line of sight with the base, or whether it is too far from the base.

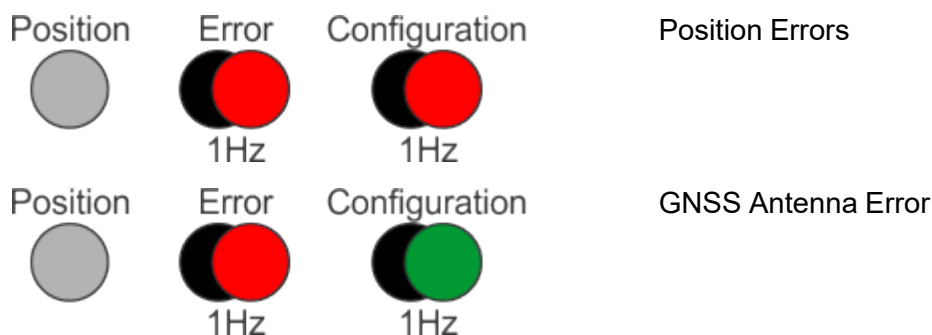
Initialization State Does Not Complete Successfully After 60 Seconds

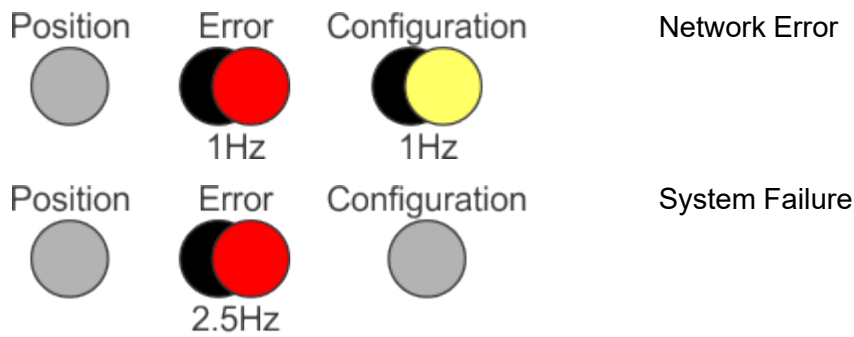
The base enters the Initialization state as soon as it is powered on. In this state, it is initializing the electronic boards. If this is not completed with 60 seconds an error has occurred, which will be indicated by the red Error LED blinking at 2.5Hz



Get Initial Position State Does Not Complete Successfully After 15 min

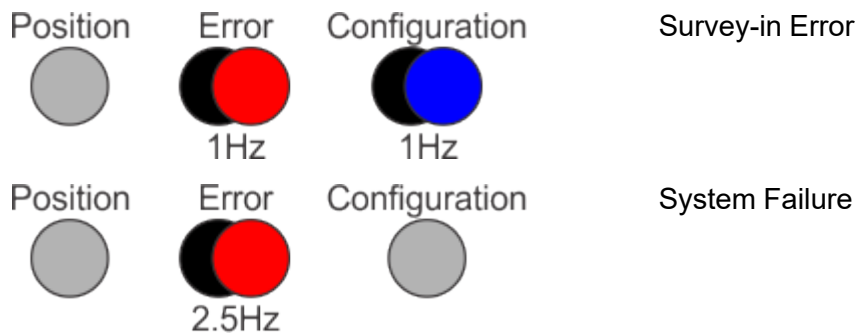
This state is entered when the Initialization state has been completed with 60 seconds. In this state, the base is using the satellite signals to establish its position. If this can not be completed within 15 minutes, an error has occurred, which will be indicated by the red error LED blinking at 1Hz. Further information about the error can be found after a short push on the Configuration button.





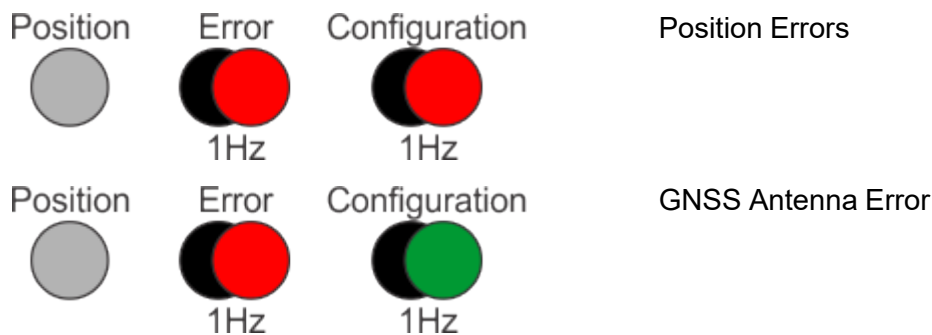
Survey-in State Does not Complete Successfully After 15 Minutes

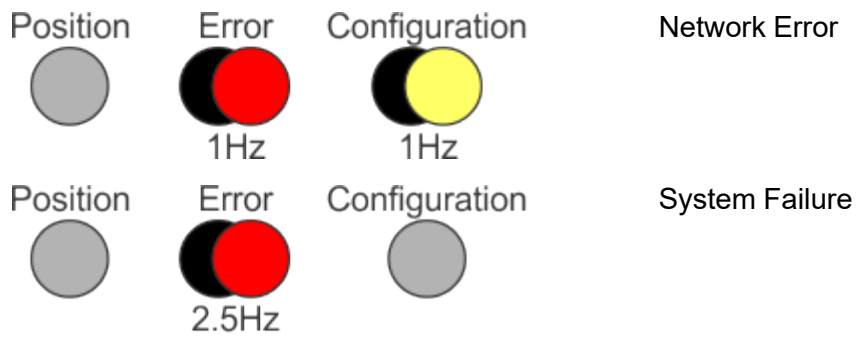
This state is entered after the **Get Initial Position** state has been successfully completed. If the Survey in can not be completed within 15 minutes, an error has occurred, which will be indicated by the red error LED blinking at 1Hz. Further information about the error can be found after a short push on the **Configuration** button.



Error During Operational State

The Operational state is indicated by the Position LED blinking green at 1Hz. If a problem occurs when the base is in this state, it will be indicated by the red Error LED blinking at 1Hz. Further information about the error can be found after a short push on the Configuration button.





LED Error Configurations

Different errors are indicated by the various LED configurations. In all cases, the Error LED will be blinking red at 1Hz. Further details can be obtained after a short push on the Configuration button. The type of error is indicated by the color of the configuration LED.

Position Errors

Possible Cause	Solution
Position Error Configuration  Poor open sky visibility for the GNSS antenna. This will occur if the RTK base is unable to connect to satellites and get an initial position after 5 minutes.	1. Power off the RTK base station. 2. Move the base station to a location with clear sky view. 3. Power on the base station.
The reference position saved in the RTK base is inconsistent with the current position.	The base checks if the current position is close to the reference position. If the difference is greater than 7 m (23 ft), a position error is generated. If the base has been physically moved: 1. Power off the RTK base station. 2. Wait for 2 min. 3. Power on the base station and wait for the Initialization to finish successfully. 4. Make a short press on the Survey-in button. 5. Retry for a maximum of 5 times. If not resolved contact your authorized Toro distributor. If the base station has not been physically moved: This may be due to the reference position being inaccurate, or the current position being too far away from the reference position. Whenever the RTK base is in operation, it will update its current position, even when this error is present. If the current position comes within 7 m (23 ft) of the reference position, it will resume normal operation. If the reference position was not sufficiently accurate, it is necessary to redo the survey- in process. If necessary, wait until current weather conditions are favorable for GPS. If the reference position was inaccurate, then you need to re-configure the entire installation (re-discover the borders).
Error in the transmission of the RTCM data corrections.	1. Power off the RTK base station. 2. Wait for 2 min. 3. Power on the base station and wait for Initialization to finish successfully. 4. Make a short press on the Survey-in button. 5. Retry for a maximum of 5 times.

Possible Cause	Solution
	- If this does not resolve the problem, press the configuration button for 10s. All the electronic boards will be reset (factory reset). Survey-in data will be lost. - Repeat the previous step for a maximum of 5 times. If the problem is still not resolved, contact your authorized Toro distributor.

GNSS Antenna Error

Possible Cause	Solution
Position Error Configuration  GNSS antenna is not connected or short-circuited.	- Power off the RTK base station. - Inspect the connection between the base station application board and the GNSS antenna. - Reconnect or replace the GNSS antenna. - Power on the base station.

Survey-In Error

Possible Cause	Solution
Position Error Configuration  Open sky visibility of the GNSS antenna is poor. The RTK base is unable to fix a reference position after 15 minutes.	- Power off the RTK base station. - Move the base station to a location with clear sky view. - Power on the base station.

Network Error

This may occur if 4G is being used for the correctional data.

Possible Cause	Solution
Position Error Configuration  No network connection is detected on the ethernet port.	1. Check the connection between the router ethernet port and the base ethernet port. 2. Verify that the 4G router has sufficient signal strength for mobile data: a minimum of 3 out of 5 bars signals strength is required. This can be seen on the top side of the 4G router in the base box. 3. Power off the RTK base station. 4. Move the base station to a location with sufficient 4G signal strength for mobile data. 5. Power on the base station.

System Failure

Possible Cause	Solution
Position Error Configuration  • Initialization of the RTK base station failed 20 times. • Software task is blocked.	1. Power off the RTK base station. 2. Wait for 2 min. 3. Power on the base station and wait for the Initialization to finish successfully. 4. Make a short press on the Survey-in button. 5. Retry for a maximum of 5 times. 6. If this does not resolve the problem, press the configuration button for 10s. All the electronic boards will be reset (factory reset). Survey in data will be lost. 7. Repeat the previous step for a maximum of 5 times. If the problem is still not resolved, contact your authorized Toro distributor.

Problems Related to Wi-Fi Coverage

Problems can arise with the operation of the robot if the Wi-Fi coverage is not sufficient over the entire field. This is especially important for 4G RTK installations where the Wi-Fi communication is critical, and if it is insufficient causes the robot to stop working. The warning message and event WaitPoselsTrusted – RTKBaseStationSignatureTimeout is displayed on the web portal, or the alarm Precise GPS position lost displayed on the robot.

This can be due to the presence of other Wi-Fi devices in the proximity of the RTK base, which can interfere with the signal of the RTK base station.

In this case, you should check the connection between the robot and the base station, and check that the location of the base ensures that there is a clear sky view and there are no tall obstacles impeding the transmission of the signal.

Use a smartphone app to check the presence of other Wi-Fi devices in the proximity of the RTK base. The recommended app is Wi-FiAnalyzer. Change the Wi-Fi signal channel of the RTK base station to a channel that has relatively low usage. This can be done using the RTK Base diagnostic tool.



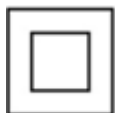
The product meets European standards.



The product should not be discarded as unsorted waste but must be sent to separate collection facilities for recovery and recycling.



The product is ensured by double insulation and does not require a safety connection to electrical earth (ground).



United Kingdom Conformity Assessed



IP44

Ingress Protection. The product is protected from solid particles that are over 1mm in size and from low velocity sprays of water from every direction.



California Proposition 65 Warning Information

What is this warning?

You may see a product for sale that has a warning label like the following:



WARNING: Cancer and Reproductive Harm—www.p65Warnings.ca.gov.

What is Prop 65?

Prop 65 applies to any company operating in California, selling products in California, or manufacturing products that may be sold in or brought into California. It mandates that the Governor of California maintain and publish a list of chemicals known to cause cancer, birth defects, and/or other reproductive harm. The list, which is updated annually, includes hundreds of chemicals found in many everyday items. The purpose of Prop 65 is to inform the public about exposure to these chemicals.

Prop 65 does not ban the sale of products containing these chemicals but instead requires warnings on any product, product packaging, or literature with the product. Moreover, a Prop 65 warning does not mean that a product is in violation of any product safety standards or requirements. In fact, the California government has clarified that a Prop 65 warning “is not the same as a regulatory decision that a product is ‘safe’ or ‘unsafe.’” Many of these chemicals have been used in everyday products for years without documented harm. For more information, go to <https://oag.ca.gov/prop65/faqs-view-all>.

A Prop 65 warning means that a company has either (1) evaluated the exposure and has concluded that it exceeds the “no significant risk level”; or (2) has chosen to provide a warning based on its understanding about the presence of a listed chemical without attempting to evaluate the exposure.

Does this law apply everywhere?

Prop 65 warnings are required under California law only. These warnings are seen throughout California in a wide range of settings, including but not limited to restaurants, grocery stores, hotels, schools, and hospitals, and on a wide variety of products. Additionally, some online and mail order retailers provide Prop 65 warnings on their websites or in catalogs.

How do the California warnings compare to federal limits?

Prop 65 standards are often more stringent than federal and international standards. There are various substances that require a Prop 65 warning at levels that are far lower than federal action limits. For example, the Prop 65 standard for warnings for lead is 0.5 µg/day, which is well below the federal and international standards.

Why don't all similar products carry the warning?

- Products sold in California require Prop 65 labelling while similar products sold elsewhere do not.
- A company involved in a Prop 65 lawsuit reaching a settlement may be required to use Prop 65 warnings for its products, but other companies making similar products may have no such requirement.
- The enforcement of Prop 65 is inconsistent.
- Companies may elect not to provide warnings because they conclude that they are not required to do so under Prop 65; a lack of warnings for a product does not mean that the product is free of listed chemicals at similar levels.

Why does Toro include this warning?

Toro has chosen to provide consumers with as much information as possible so that they can make informed decisions about the products they buy and use. Toro provides warnings in certain cases based on its knowledge of the presence of one or more listed chemicals without evaluating the level of exposure, as not all the listed chemicals provide exposure limit requirements. While the exposure from Toro products may be negligible or well within the “no significant risk” range, out of an abundance of caution, Toro has elected to provide the Prop 65 warnings. Moreover, if Toro does not provide these warnings, it could be sued by the State of California or by private parties seeking to enforce Prop 65 and subject to substantial penalties.



APN:	Access Point Name (GSM)
BMS:	Battery Management System
LFP:	Lithium Ferrous Phosphorous
UWB:	Ultra Wide Band
CPU:	Central Processing Unit
GPS:	Global Positioning System
AP:	Access Point (Wi-Fi)
RTK:	Real Time Kinematic
GNSS:	Global Navigation Satellite System
PoE:	Power over Ethernet
RTCM:	Radio Technical Commission for Maritime Services (a Real-Time GNSS Data Transmission Standard)

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