INSTALLATION MANUAL

Emlid Base Station Setup

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Release Notice: This is the February 2024 release of the Base Station Setup Manual.

It is assumed that users of the products described herein have either system integration or technical experience. This manual is not meant to replace Emlid user manuals, but is supplemental to Emlid documentation in order to highlight recommended settings for a typical farm setup.

In this manual, the Emlid Reach RS2/RS2+ may be referred to simply as the RS2.

Please check: https://docs.Emlid.com/reachrs2 for Emlid documentation!

Disclaimer

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DO NOT USE THE BASE STATION IF YOU DISAGREE WITH THE DISCLAIMER.

Important Safety Information

Read this manual and the machine operation & safety instructions carefully before installing the Emlid Reach RS2.

- Follow all safety information presented within this manual.

- Follow all safety labels affixed to the system components. Be sure to keep safety labels in good condition and replace any missing or damaged labels. To obtain replacements for missing or damaged safety labels, contact Agra-GPS.

When operating the machine after installing the CRG and the Emlid Reach RS2, observe the following safety measures:

- Be alert and aware of surroundings.

- Do not operate the CRG system while impaired.

- Always remain in the operator's position in the machine when the CRG system is engaged.

- Determine and maintain a safe working distance away from other individuals. The operator is responsible for disabling the CRG system when a safe working distance has been diminished.

- Ensure the CRG is disabled prior to starting any maintenance work on the machine or parts of the CRG system.

- Follow all safety instructions.

- The CRG must only be used in the field, never on public roads.

Electrical Safety

- Always verify that the power leads are connected to the correct polarity as marked. Reversing the power leads could cause severe damage to the equipment.

- Verify that all cables and connectors are not in contact with sharp edges or anything that could cause chafing, as this could result in power shorts and/or other malfunctions.

Introduction

Congratulations on your purchase of the CRG and the Emlid Reach RS2/RS2+!

The CRG contains an RTK-capable GPS receiver + a full steering controller capable of steering different brands of machines with a John Deere display! The CRG can also be used in John Deere machines, and in that configuration the steering controller within the CRG is simply disabled (automatically).

In order to utilize the CRG RTK capabilities, a RTCM correction must be supplied to the CRG. When you are reading Emlid documentation the moving vehicle is also named "rover", which in this case is the CRG on your machine.

RTCM correction may be supplied to the CRG from many different sources e.g. local government base stations, subscription services for RTCM from private companies, or maybe even from a neighbour's base station providing RTCM corrections.

The RS2 is your base station providing RTCM corrections.

In this manual we are explaining the setup of an RS2 base station for sending RTCM corrections over NTRIP (internet setup) to the CRG, and we also explain how to set up the CRG to receive them.

Refer to the diagram on the last page for an overview of a typical RTK correction setup.

NOTICE

This manual is not intended to replace the manuals for the RS2. Please refer to Emlid's documentation at https://docs.Emlid.com/reachrs2 for additional help.

Components

The base station kit contains the following items:

1.   Emlid Reach RS2/RS2+

2.   CBL101: for connecting power to the RS2

It is assumed that you have a CRG on your machine. Since the CRG must have access to the NTRIP server over the internet, the CRG must be equipped with a modem and valid data SIM card or must be used with a Bluetooth connection and an NTRIP application on your smartphone. More details on these two options will be shown in the following pages.

Step 1: Install the Emlid Reach RS2

Location

The RS2 may be setup with a number of different configurations. We assume that the majority of your farm land is within 10 km of the base station and that you have an internet service at that base station location.

It is also assumed that you have good cell phone service in your area.

Should you have land more than 10 km from the base station, your accuracy will diminish, but as long as you have good cell phone coverage you can continue to use the base station.

A rule of thumb for accuracy is losing about 1 cm/10 km distance. Assuming we start with 2 cm accuracy, you still get 6 cm accuracy at a distance of 40 km from the base (2 cm + 4 x 1cm).

The RS2 may also be used on a tripod in combination with a sim card (which must have a fixed IP!) or a radio transmitter. These options are beyond the scope of this manual.

Placement: The RS2 must have an unobstructed view of the sky in all directions! While tall structures such as grain elevators may appear to be the perfect location, these structures have too much movement, especially on windy days. Better suited are shorter buildings with a solid foundation but with a free view of the sky.

You will also need a permanent power source to provide between 6V to 40 V (DC, 10 watts minimum).

The CBL101 cable provided has open ends as typically a much longer cable from the roof to a suitable power source is required.

Front view
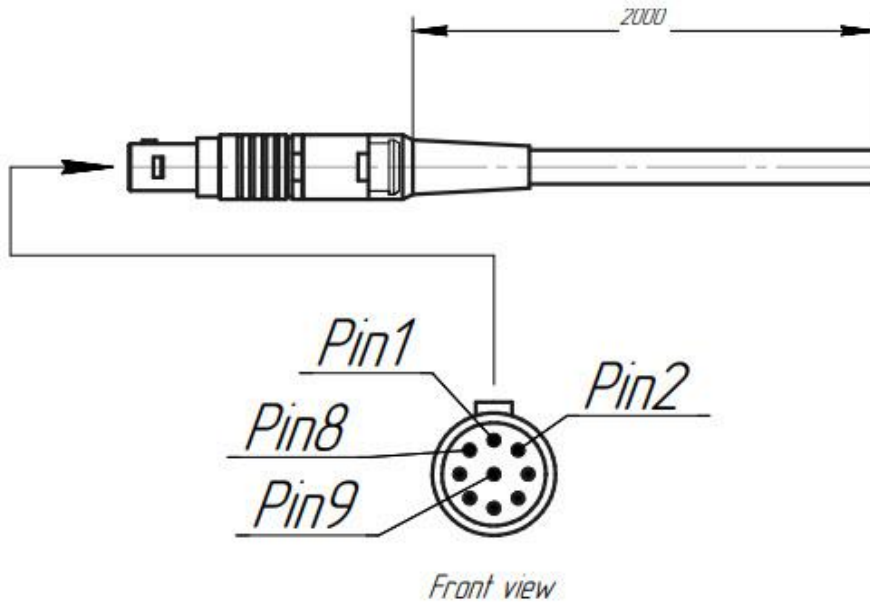
Pin	Pin name	Wire
1	GND	red
2	GND	black
3	GND	green
4	Event	blue
5	PPS	yellow
6	RX	orange
7	TX	brown
8	5V 1A output	gray
9	5-40V Input	violet

Use pins 1,2,3 for ground and pin 9 for the positive power supply. Ensure you use a DC power supply!

Last, your location must have access to a wireless router connected to the internet. If that is not available, you may use a SIM card (with a fixed IP) installed in the RS2.

Step 2: Configure Emlid Reach

The RS2 can be configured using a Smartphone and the "Emlid Flow" app. For Android phones, use the Google Play Store and search for the "emlid flow" app. Similarly, it is also available on the App Store for iPhones.
https://emlid.com/wp-content/uploads/2023/06/Emlid_Flow_User_Documentation.pdf

To power up the RS2, first plug in a USB charger capable of supplying 5V and 2A. You do not have to wait for the battery to charge to continue (fully charging can take hours). Hold the main button for a few seconds to start it.

When the RS2 is first powered up, it creates a wireless host (if your wi-fi network is password protected), so you can connect your phone to the RS2. You then use the ReachView app to configure the RS2 for your wireless network on the farm. NOTE: when the network icon on the RS2 is lit <u>white</u>, it is acting as a wireless *host* and is NOT connected to your wi-fi network; but when it is <u>blue</u>, it is acting as a normal *client* device connected to your wi-fi network. (When acting as a host, the RS2 defaults to 192.168.42.1)

When the wi-fi indicator shows white, it will create a new wireless network with the name Reach:xx:xx. You will likely need to go to wi-fi settings on your phone to connect to this network. The default password is: "emlidreach".

Now you can start the ReachView application and the Reach RS2 device should be visible. Select it to continue the configuration.

You will need to go to Settings, the Wi-Fi to connect to your own wireless network. Select your own network and enter in your own wi-fi password (which is stored within the RS2). The RS2 then switches off host mode and connects to your network as a client, and the light turns blue.
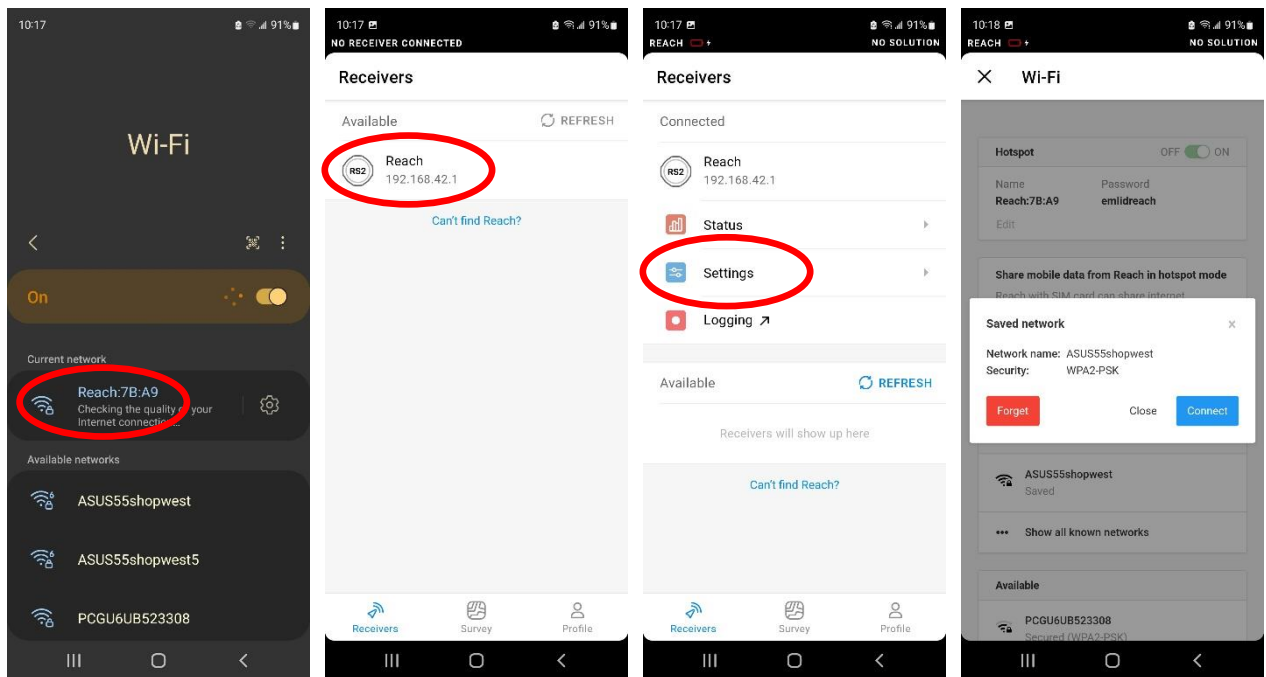
Now that the RS2 network LED is blue, it has been given an IP address in YOUR network. In our network the IP address given to the RS2 base station shows as 192.168.15.141; however, this address is assigned by your local network's router and is different for every setup, and may also change over time (there is also a way to configure your wireless router so the IP address stays fixed, or "static", but this is beyond the scope of this document).

Now you have a choice: you may use the ReachView app to continue configuring the RS2, or you can switch to your computer. If using ReachView, start at the beginning and refresh the "Receivers" screen, and you should see your RS2.

You can also reach your base station from your local network and configure it using a computer with a standard browser like Google Chrome or Microsoft Edge. Simply type the IP address into the address bar (circled).   In our example: 192.168.15.141.
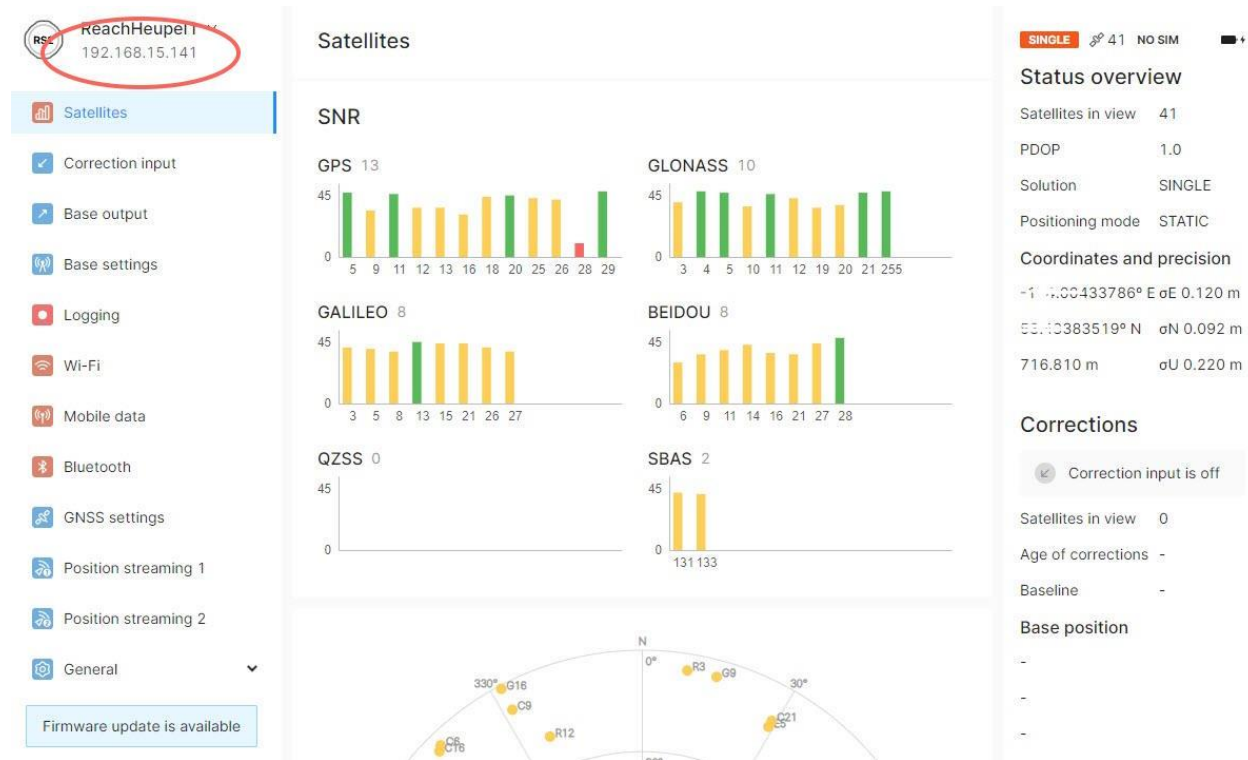
You should be directed to the status page. The first time starting the RS2+ won't show as much information as you see here.

For the following steps, your Emlid base station should already be installed in its fixed position and not be moved again!

Refer to the image below.

Correction Input

Using Correction Input is optional. If you have access to a local RTCM correction service even just for a short period of time, you can use its service to set the base station's position very accurately. Enter the correction service access data here.

If a correction input is not available, there are several other options to get a good position for your base station. The simplest approach is to let the Emlid use an average position. Another option is to get a latitude/longitude position from your smartphone and enter it in manually.

RTK Settings

Once a base station position is obtained, go to "Base settings".

Configure the base station to "Manual", and check GPS, GLONASS and GALILEO for best performance. We chose 0.5 Hz as the update rate to reduce data usage as there is little to no advantage to send corrections any faster.
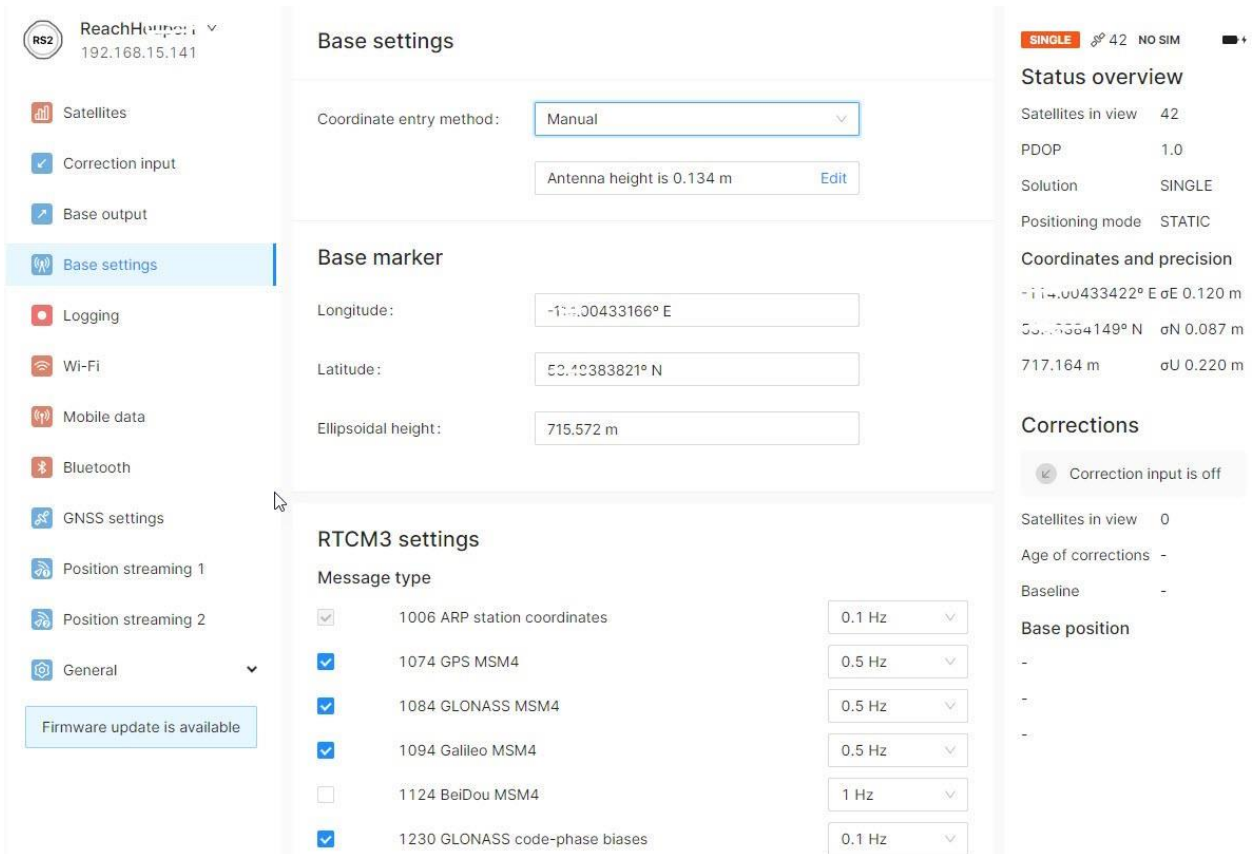
For working with the CRG please enable the following RTCM3 messages:
1006, 1074, 1084, 1094, 1230, 1008 (that is done in Base settings)

Enable these messages at the rate as shown. 0.5 Hz means 1 message every 2 seconds, and 0.1 Hz means 1 message every 10 seconds. Any more frequent for the CRG is overkill; it's important to realize that the CRG has an internal position tracking system (the Inertial Reference System), and can maintain an RTK quality position for several minutes without receiving RTK messages or even loss of satellite signal.

For the Base coordinates, select "Manual" and make sure your latitude, longitude and height settings are entered correctly (use the number of decimal points as shown). This is your base station location and it should never change! Make a note (or take a picture) of these settings! All your RTCM correction data is sent in reference to this position, so if this position is changed (due to a new base station setup etc.) all your field points may shift with the change. In order to use boundaries and field positions created by RTK you always want the same reference point. A surveyed position point is clearly best; however, it is more important that this reference point does not change.

Base Mode

(https://docs.emlid.com/reachrs2/reference/settings-overview/#base-mode)

As mentioned in the introduction of this manual, we are going to use the cell phone network to deliver RTCM correction data to the CRG. For this purpose, we will need an NTRIP caster, and with the purchase of an Emlid Reach RS2 a free NTRIP caster is provided. **You will need to signup here:** https://Emlid.com/ntrip-caster
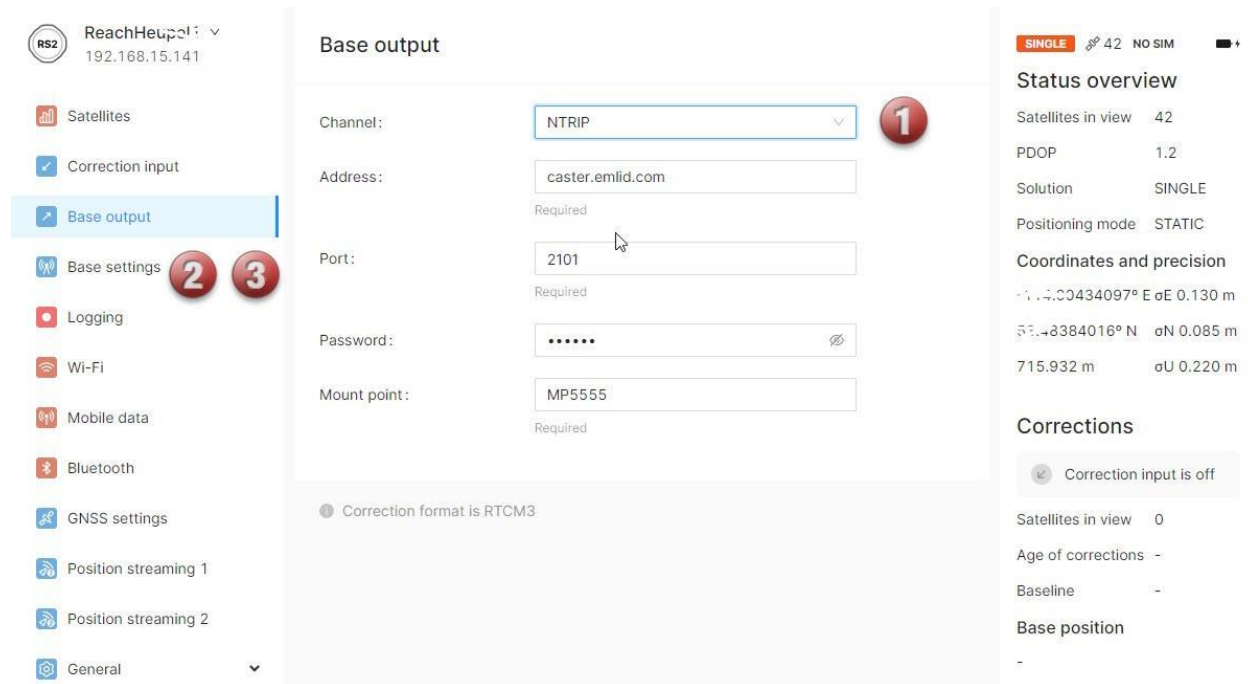
Once signed up, enter the data in section 1 (Corrections output). Select NTRIP and turn this service ON.

NOTE: The free Emlid caster is limited to 10 rovers which should be more than sufficient for the average farmer setup, however if you run more than 10 CRGs at any given time or share your Emlid base station with a number of neighbours you may hit the limit of 10 rovers.

OPTIONAL: IGNORE this if you use the caster.emlid.com!

A free **alternative** without the 10 rover limit is rtk2go.com.

The setup with the rtk2go caster is very similar to the Emlid caster. You must register with rtk2go and your e-mail address will become the username in the NTRIP client setup.

Check the status of your NTRIP output on rtk2go with:
http://monitor.use-snip.com/?hostUrl=www.rtk2go.com&port=2101

This concludes the base station setup! Your status screen should now show similar to this:
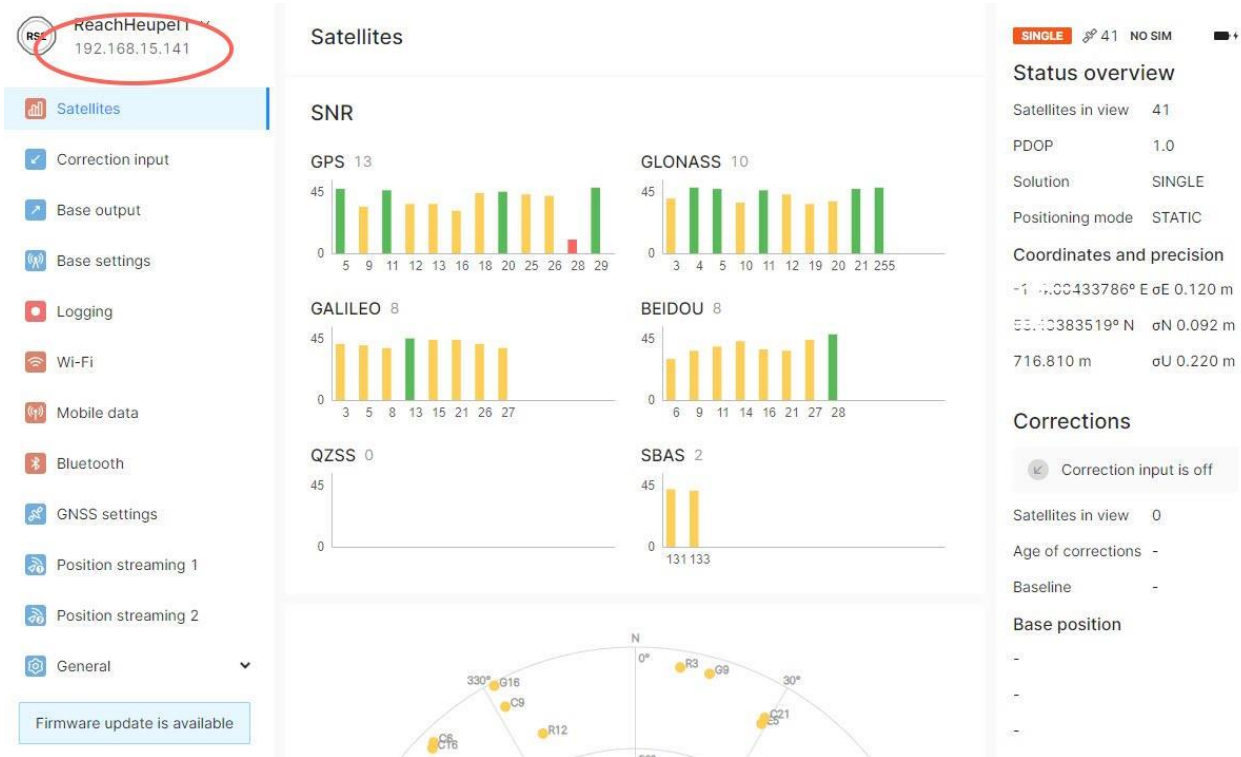
Verify Your Setup

If you are using the Emlid caster, check that the NTRIP service is working by logging in to caster.emlid.com.

After logging in, you should be able to see that your base station is "ONLINE" (1) and see the access data required for your CRG NTRIP configuration (2).

The NTRIP credentials (2) are entered either in your NTRIP app on the smartphone (if using Bluetooth) or in the JD monitor in the AgraGPS CRG ISO app screen, under NTRIP Settings (if using the CRG's internal cellular modem).

At the bottom of the page, the settings for your "rover" (The rover is your CRG setup on the tractor). You will need this data to complete the setup on the CRG.

Step 3: Configure CRG ISO App

Refer to CRG User Manual for details on accessing the CRG ISO app.

The main screen of the CRG-Receiver app is the "CRG Info" page, as shown.

This document will focus on the NTRIP settings. For more information on other CRG settings, please refer to the CRG Installation Manual.

Select the "Settings" page.

Select the type of internal cellular modem you have installed in the CRG (typically Microhard).

If you do not have an internal modem, you can select "Bluetooth" as your modem, which requires you to use your mobile phone to stream the RTK correction data (RTCM). If using Bluetooth, all NTRIP settings are entered in your phone's Agra-GPS app (skip to the Bluetooth setup section in this manual).

If using an internal modem, after modem type is selected, the CRG will begin automatic configuration of the modem. The CRG may be supplied with a data-only SIM. If not, please refer to the CRG Modem Guide for help with installing your own SIM card. The first time a modem connects with the network may take a few minutes. Please be patient.

Press the Modem Settings button to make sure the modem is working. The APN may automatically appear, or you may have to enter it in manually depending on your cellular service provider. You may also have to enter in other information like a PIN.

Pressing "Reset Modem" will cause the modem to start the process over, trying to contact the cellular network and retreiving the APN.
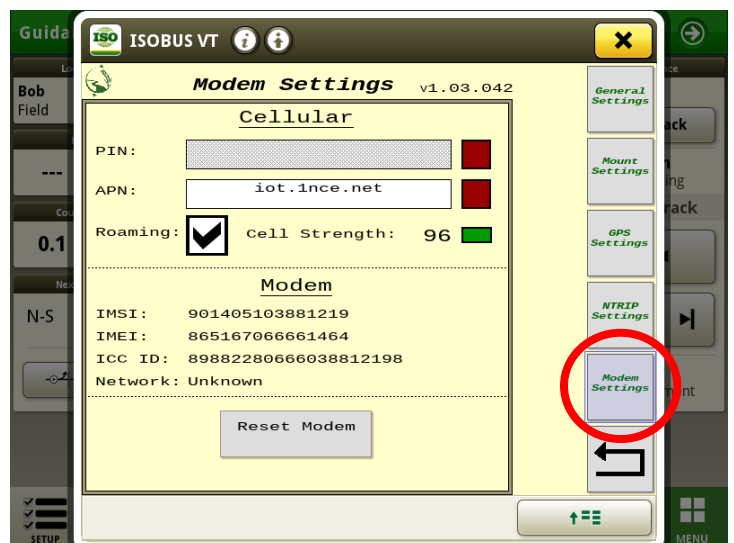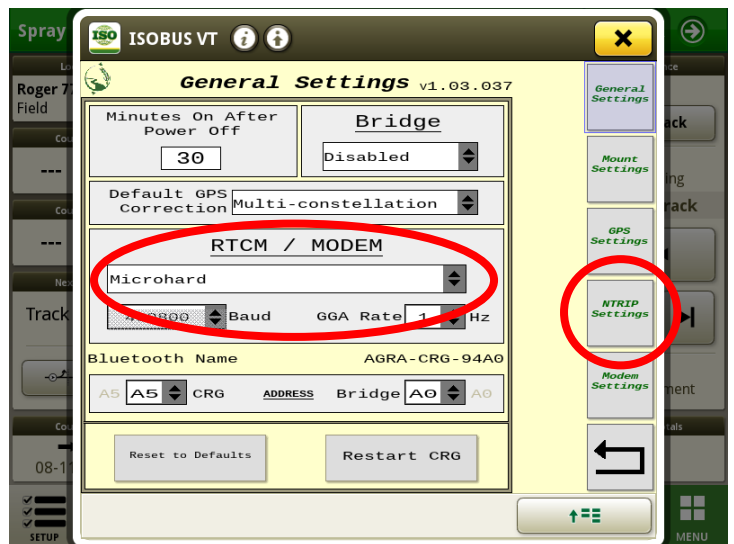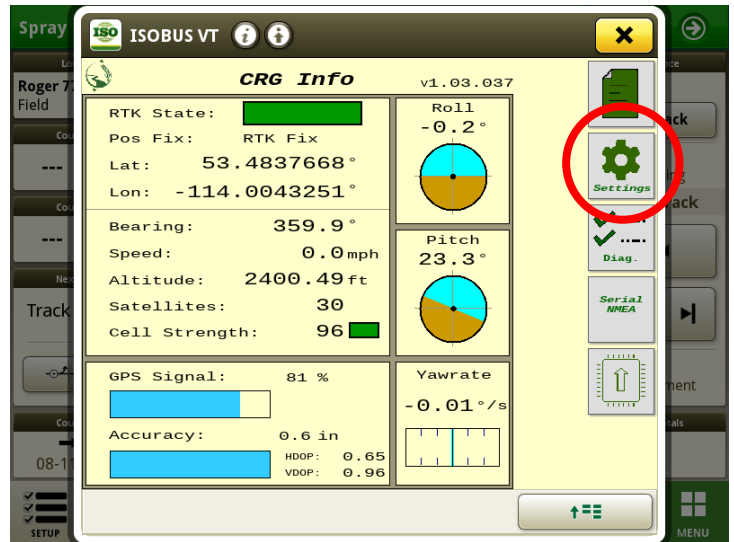
NTRIP Settings

The NTRIP settings allow you to connect to RTCM correction data via Internet connection. Refer to the diagram on the last page of this manual for an overview of a typical RTK correction setup. The CRG also works without RTCM correction data; however, accuracy is not nearly as good as with an RTCM correction source.

Fill in your NTRIP profile(s). Different profiles may be required for different physical locations, since the base station providing RTCM corrections should be located within 35 km (22 miles) of the CRG location for best results. RTK Fix may be achieved with further distances, but bear in mind that accuracy will decrease as distance from the base station increases.

a) <u>Profile</u>: First, select the profile number.

If the profile information has been filled in previously, the connection process will begin immediately. Different profiles represent different "mount point" locations, which are essentially different base stations from which the correction data is obtained. Select the profile for which the base station is closest to your physical work location. The distance to the base station is displayed on the Diagnostics page, once streaming has started.

b) <u>Edit</u>: Press this button to change the NTRIP Settings.

c) <u>Address and Port number</u>: Fill these in. Emlid provides a free NTRIP caster service at "caster.emlid.com", port 2101. However, other casters may be used, but the Emlid must have matching settings (as shown in Step 2)

d) <u>Mount Point</u>: type in the name of your mount point (it must match the setting within the base station). **Optional**: Press the "Load Mount Points" button. This populates the adjacent drop-down list. 100 different possible mount points may be listed, but typically casters such as caster.emlid.com or rtk2go.com have too many mount points to load, so in these cases is best to type in the Mount Point manually.

e) <u>User name and Password</u>: as supplied in Step 2: "My Rovers"
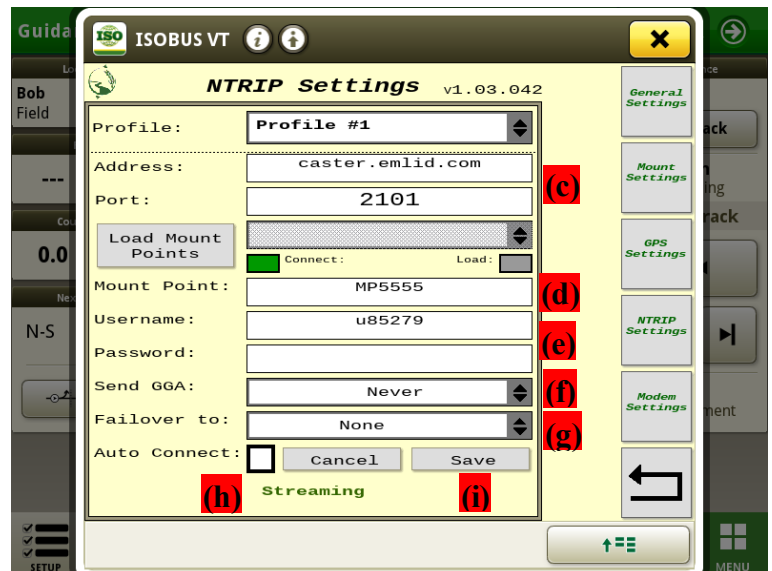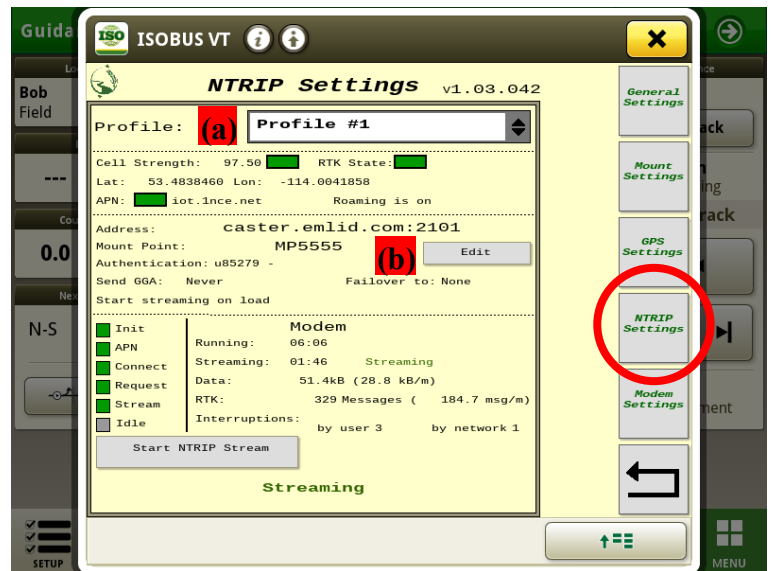
f) <u>Send GGA</u>: this is the rate at which the CRG sends its position back to the caster. The caster may use this to determine if the rover (CRG) is in a valid location. Different casters will have different policies for this. For caster.emlid.com or rtk2go.com, select "Every 100 seconds".

g) <u>Failover to</u>: if streaming fails for an extended period, the CRG will automatically switch to a different profile (with a different mount point) as specified.

h) <u>Auto Connect</u>: when the CRG powers on, it will automatically contact the caster and begin streaming. This is often desirable, but if you are not using RTK for an extended period and wish to prevent unnecessary cellular data usage, then switch this off. (Note: only the selected profile will auto-connect, so other profiles that have it selected will be ignored.)

i) <u>Save</u>: DON'T FORGET TO SAVE once changes are complete

COLOR INDICATORS

Colors on the NTRIP page indicate the connection stage using the cellular modem, and green is displayed when a stage is complete. Grey means incomplete.

1) Init
   - Blinking yellow: while initializing & configuring modem
   - Red: if modem is not found or the wrong modem type is specified in General Settings

2) APN
   - Blinking yellow: while contacting the cellular network
   - Red: - missing SIM card
     - APN invalid or not received

3) Connect
   - Blinking yellow: while contacting the NTRIP caster
   - Red: Bad IP or port settings

4) Request
   - Red: Bad username or password

5) Stream
   - Grey: Not streaming. If all other indicators are green, it is likely that the base station is not connected (or not streaming) to the caster

6) Idle
   - Green if all other settings are good, but not streaming. Press "Start NTRIP Stream" to start.
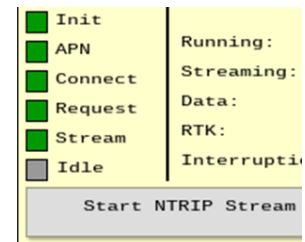
When the Stream indicator shows green, you are streaming! With a good satellite signal, you should now have RTK Fix quality precision. Go to the CRG Diagnostics page to verify that all RTK settings show green. Streaming rates that successfully achieve RTK Fix can typically measure between 10 to 40 kB per minute, depending on how the base station's output rate is configured.

Step 4: Bluetooth Setup

If using the CRG without an internal modem, the Agra-GPS app provides RTCM correction streaming via Bluetooth, through your mobile phone. As always, you will require a reliable cellular network signal at your work site.

NOTE: Streaming data through your phone may incur extra data charges from your mobile phone network provider. However, the data rate is fairly low: for example, a typical 30kb/min streaming rate means that it will take almost 600 hours to consume 1 GB of data.

1) Ensure the Bluetooth service on your mobile phone is enabled. Also, ensure it is not being used by another app on your phone (for example, it may try to automatically connect with the audio in your tractor cab or perhaps with a set of headphones).

2) Android: Go to the Google Play Store
   iPhone: Go to the App Store
   - Search for the Agra-GPS app, and install it.

3) Start the app, and using the upper left menu, go to the Settings page.
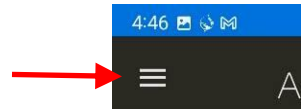
4) Under Settings → NTRIP, specify the parameters, for example:

   - <u>Host</u>   caster.emlid.com:2101
   - <u>Mount Point</u>   MP9999
   - <u>Login</u>   u12345
   - <u>NMEA Source</u>   Receiver

   - The Host can also be specified with an IP address, e.g. 159.89.221.86:2101
   - 2101 refers to the "Port Number", and must be separated from the address with a colon
   - A list of Mount Points may also be obtained by typing the Host name (along with port number) into a web browser like Google Chrome or Safari
   - The Login user name must be obtained from your NTRIP service provider like Emlid
   - The NMEA Source may also be specified manually in terms of Lat/Long/Altitude position. This must be the precise location of the stationary base station receiver.

5) Under Settings → Receiver, select the CRG device such as "AGRA-CRG-xxxx", where xxxx is a unique identifier for your CRG. The Bluetooth name may also be seen at the bottom of the CRG's Diagnostics page. The CRG must be powered on in order to be found by your mobile phone. If you have multiple CRGs on different machines, you will need to change this setting in the Agra-GPS app each time you move to a different machine.

6) User Profile: this is a way to store different NTRIP settings. If you move to work in a different field, you may need to change to a different mount point or even a different caster. By saving a different profile for different locations, it makes changing the setup easier.

7) Return to the Home screen and press Connect. RTCM data from the caster should start streaming to the CRG, and under ideal conditions an RTK fix can be achieved in under 10 seconds. Your phone screen can be turned off and streaming will continue. For long work days, it is recommended to keep your phone plugged into a charger so there is no interruption due to phone battery drain.

Troubleshooting

If you are not getting RTK messages at your CRG, check the following:

1) CHECK SIGNAL AT THE TRACTOR: If you are using a cellular modem with the CRG, ensure the signal strength is adequate. The signal strength can be viewed on the CRG main page. <u>Check the antenna</u>: a loose or missing antenna will often still pick up a strong local cellular signal, but this signal will be unstable (it may appear strong in some locations and then fall to zero nearby).

   If you are using Bluetooth to connect to the NTRIP caster through your phone, you can also try 3rd party apps to check if the NTRIP caster is streaming properly. For Android devices, try the Lefebure app (get it from Google Play, and test with the Receiver set to NTRIP testing mode, which removes any Bluetooth interaction). If the CRG does not seem to be getting access to the caster (based on messages that you see on the NTRIP Settings screen), you may have a problem with your SIM card or your cellular provider.

2) CHECK THE CASTER FOR YOUR MOUNT POINT: You can use a browser (Edge, Chrome, Firefox, Safari, etc) to check if your mount point shows up on the NTRIP caster. Usually, just type the caster address & port into your browser's address bar. For example, type: caster.emlid.com:2101 into the address bar, and you should get a large list of mount points with associated info. For other casters, you may get a menu that leads you to the mount point list. Use Ctrl-F to search for the name of your own mount point in the list. If your mount point does not show up, you likely have a problem with the base station on your local network.

3) CHECK YOUR LOCAL NETWORK FOR THE BASE STATION: If your base station is connected properly to your local network, you should be able to use your phone and the ReachView app to interact with it. Ensure your phone is connected to the same Wi-Fi network as the base station. In addition, the base station must be able to communicate with your internet connection point (usually the router supplied by your Internet Service Provider). You can log into your router and make sure that the base station shows up as a "client connection".

4) RTK FLOAT: The "RTK state" (reflected on the main CRG Info page, the Diagnostics page, and the NTRIP page) should show green (RTK Fix) when running normally. When streaming starts, it is normal for the state to be yellow for a short period (up to a minute) before achieving RTK Fix. If it shows yellow (RTK Float), accuracy will be degraded, and may be much worse than the Accuracy figure would suggest. There could for a number of reasons:
   a. You may be too far away from the base station
   b. There may not be enough satellites in view
   c. GPS reception may be poor near metal structures, trees, or other obstacles
   d. Space weather events may disrupt GPS or correction signals. Please refer to https://www.swpc.noaa.gov/communities/global-positioning-system-gps-community-dashboard

RTK CORRECTION SYSTEM

GPS signals go
to base station
and CRG

Fixed Base Station
(e.g. Emlid Reach RS2)

Cellular Network

CRG with internal
cellular modem

Wi-Fi network

Router

NTRIP
CASTER
(server)

Bluetooth™
via cell phone
(optional)

On Farm

Public Internet

In Field

For best results, keep distance under 35 km / 22 mi (accuracy decreases when distance increases)

Flow of RTCM correction messages from base station to CRG