NAVSTAR

NavStar GMS800 Installation and User Manual

All efforts have been made to ensure the accuracy and completeness of the information contained in this document. NavStar Geomatics Ltd. reserves the right to change the information at any time and assumes no liability for its accuracy.

Document Number:

NSM0002C

Release Date: 10 February 2025

NavStar Geomatics

11545 Kingston St.,

Maple Ridge, BC

Canada V2X 0Z5

SALES + SERVICE +MANUFACTURING

604-540-1100 |

Toll Free (USA & Canada) 1-800-665-5599

www.navstar.com

TABLE OF CONTENTS

REVISION HISTORY

Rev.	Revision History	Date	Prepared By	Approved By
A	Initial release	13 September, 2023	SM	JS
B	Figures updated	23 November 2024	SM	JS
C	Content and figures updated	17 January 2025	SM	SG,

1 Overview

NavStar's GMS800 is a compact, high-precision GNSS sensor that provides accurate three-dimensional displacement and tilt measurements for deformation monitoring. It has no moving parts and can provide 24/7 automated monitoring data in a wide variety of climates.

1.1 RTK Technology For Monitoring

The GMS800 uses Real Time Kinematic (RTK) GNSS processing to deliver highly accurate three-dimensional displacement measurements for deformation monitoring. The GMS700 also includes separate biaxial tilt sensors that provide tilt measurements independently of the RTK GNSS system, ensuring reliable data even when GNSS is not active.

Real-time kinematic GNSS is a type of satellite positioning technology that uses a combination of signals from multiple GNSS constellations (such as GPS, Galileo, GLONASS, BeiDou, and more) and a local Base Station to provide highly accurate positioning data. By using a local Base Station in addition to satellite signals, the RTK system can correct any errors that may be present in the GNSS data. This is achieved by comparing the GNSS data received by the Base Station and the GNSS data received by the rover. Any errors that are present in the data are then corrected, resulting in highly accurate positioning data.

A GNSS RTK-based monitoring system consists of one main Base Station and one or more GNSS rover units. The Base Station is always powered and active, receiving data from as many satellites as possible. Rover units make periodic calculations and, when active, receive satellite data as well as correction information from the Base Station (via terrestrial radio communication).

During the window of monitoring, the rover(s) must be able to receive information from the same set of satellites as the Base Station, while receiving corrections from the Base Station. It is advised for rover units to be as near as possible to the Base Station since error is introduced proportional to the distance from the base (approximately ±1mm error in displacement per km from the base).

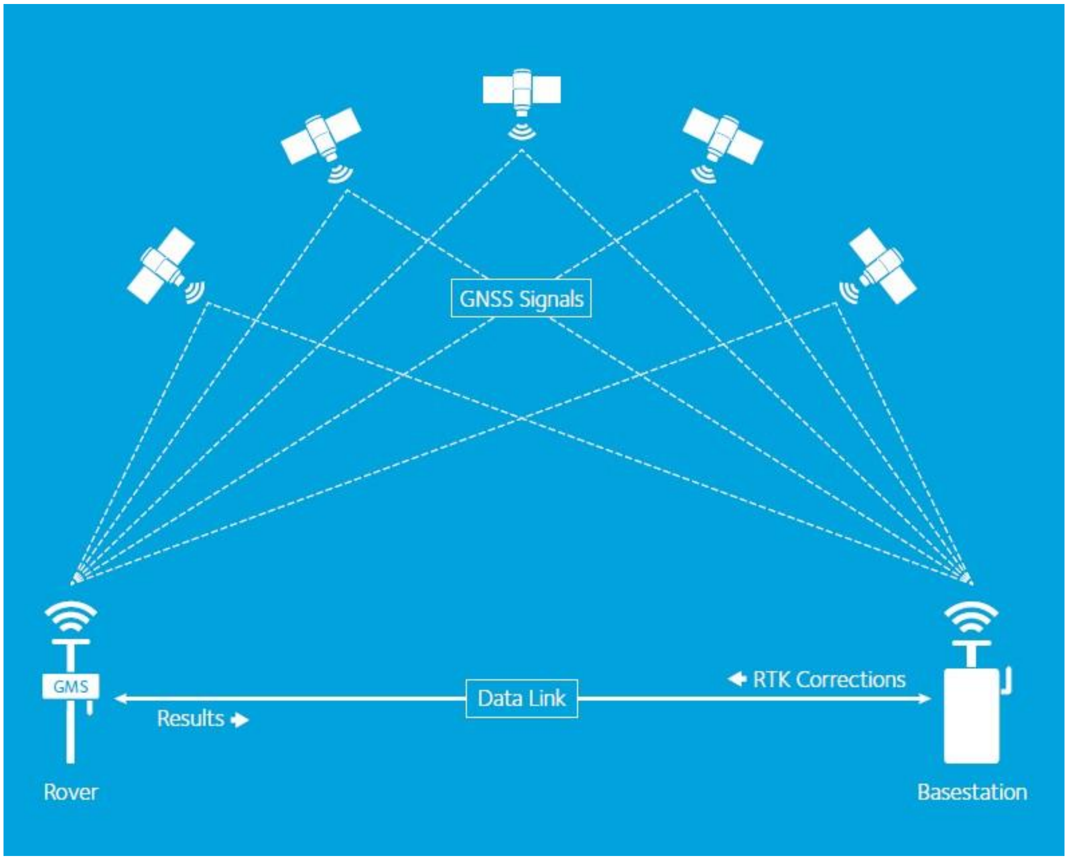


Figure 1: GMS800 System Overview

NavStar's monitoring system is also comprised of a pair of software applications called GeoExplorer and GeoServer (collectively referred to as GeoExplorer). These applications work with a client/server architecture so that many users of the client software can simultaneously access real-time monitoring data by connecting to the database via a corporate network or the internet.

1.2 NAVSTAR METHOLOGY AND EQUIPMENT

Each piece of equipment has 2 antennas. One allows for terrestrial radio communication and the other for satellite reception. Both communication networks are necessary for the technology to function properly.

NavStar generally uses the 900MHz frequency band for terrestrial communication or something similar depending on local governing bodies for RF communication. Corrections from the base to the Rovers are sent via this radio communication as well as the calculations from the Rovers back to the base.

→| **NOTE**: It is also possible to have the GMS800 operate via Wi-Fi or LTE communication to GeoExplorer (instead of the 900MHz radio link to Gateway/Base Station).

→| **NOTE**: For the remainder of the installation and user manual, the communication protocol will be simply referred to as radio communication.

1.2.1 NavStar FLP Gateway (FLP200) and GPM Module (GPM300)

The GPM300 is the GNSS Base Station module, and the FLP200 is the gateway/networking device. They are installed together in the main control box and are often referred to collectively by either name (Gateway or Base Station).

The FLP200 is a networking device that manages the connection between the software (GeoExplorer) and various hardware devices including GMS. NavStar refers to the FLP200 as a 'Gateway' because it often provides the pathway to the server where measurements are stored. The FLP200 also functions as a the RTK Base Station when a GPM300 high precision GNSS module is attached. Secondary FLP200s installed in the monitoring environment can act as additional Gateways, providing an important redundancy to the system.

The GPM300 is the GNSS module that clips onto the side of an FLP200 or FLL. The GPS connector (MCX) on the unit is attached to the base GNSS antenna.

Figure 2: FLP200 with attached GPM300 module

1.2.2 NavStar FLL Device (FLL400)

The FLL is a ‘lite’ version of the FLP having many of the same features but no ethernet connection. It is used for Base Stations without network access or in Repeater stations. The FLL is also used in other applications but for GNSS based monitoring solutions only the radio connector is important (radio 1, MCX). In the case of Repeaters, a small GPS antenna can be plugged into the GPS connector (MCX) but this is only to record the unit’s location (not for high-precision GNSS monitoring). The serial port (RJ45) is left disconnected when used for only GNSS monitoring.

Figure 3: FLL400 Unit

1.2.3 NavStar GMS800 Rover

The GMS800 rover units function automatically when power is applied.

The rovers calculate an accurate position based on RTK technology. The GMS800 is normally in a low power mode but activates on a set schedule to make an RTK positioning calculation. This is achieved by receiving satellite data as well as corrections from the base station.

Figure 4: GMS800 GNSS Rover Unit

1.3 Intended Audience

This guide is for the personnel responsible for installing or using NavStar's GMS800. This manual provides steps for installing and operating the GMS800.

1.4 Icons and Conventions Used In This Guide

This guide uses the following icons to call attention to important information.

	WARNING: This icon appears when an operating procedure or practice, if not correctly followed, could result in personal injury or loss of life.
	CAUTION: This icon appears when an operating procedure or practice, if not strictly observed, could result in damage to or destruction of equipment.
	NOTE: This icon appears to highlight specific non-safety related information.

2 SAFETY

WARNING: Always follow safety precautions and use proper personal protective equipment (PPE) including safety glasses and high-visibility clothing when working in the field with this equipment.

3 INSTALLATION

NOTE: The installation images provided in the following sections are for illustrative purposes and show a prototype GMS800 unit. The appearance of the actual GMS800 units will be such as the one shown in Figure 4.

3.1 PREREQUISITES

3.1.1 Sky View

To compute a three-dimensional position both the Base Station and Rover need to have a clear view of at least 5 GPS/GNSS satellites in common. In practice, this means that both the Base Station and Rover need to have clear views of thesky free of obstructions of any kind above 15 degrees from the horizon. This includes power poles, trees, buildings, rock faces, and other similar obstructions.

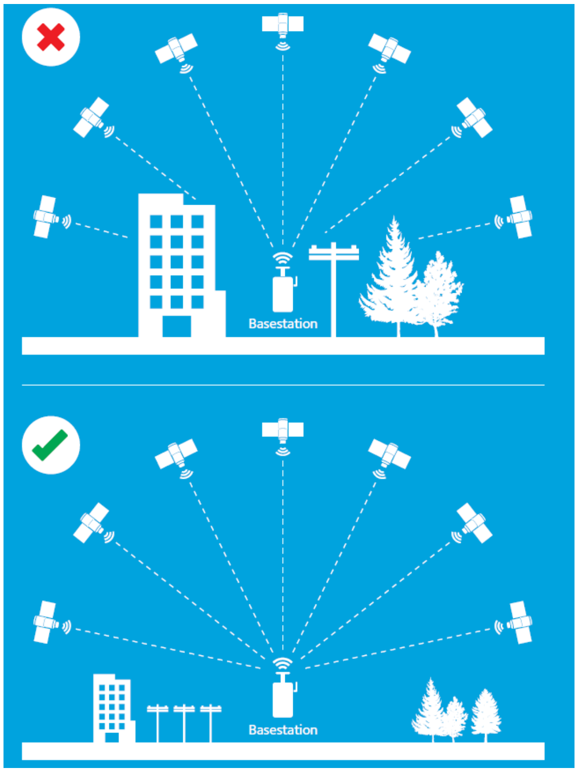


Figure 5: Non-Ideal and Ideal Base Station Sky View

EXAMPLE INSTALLATIONS

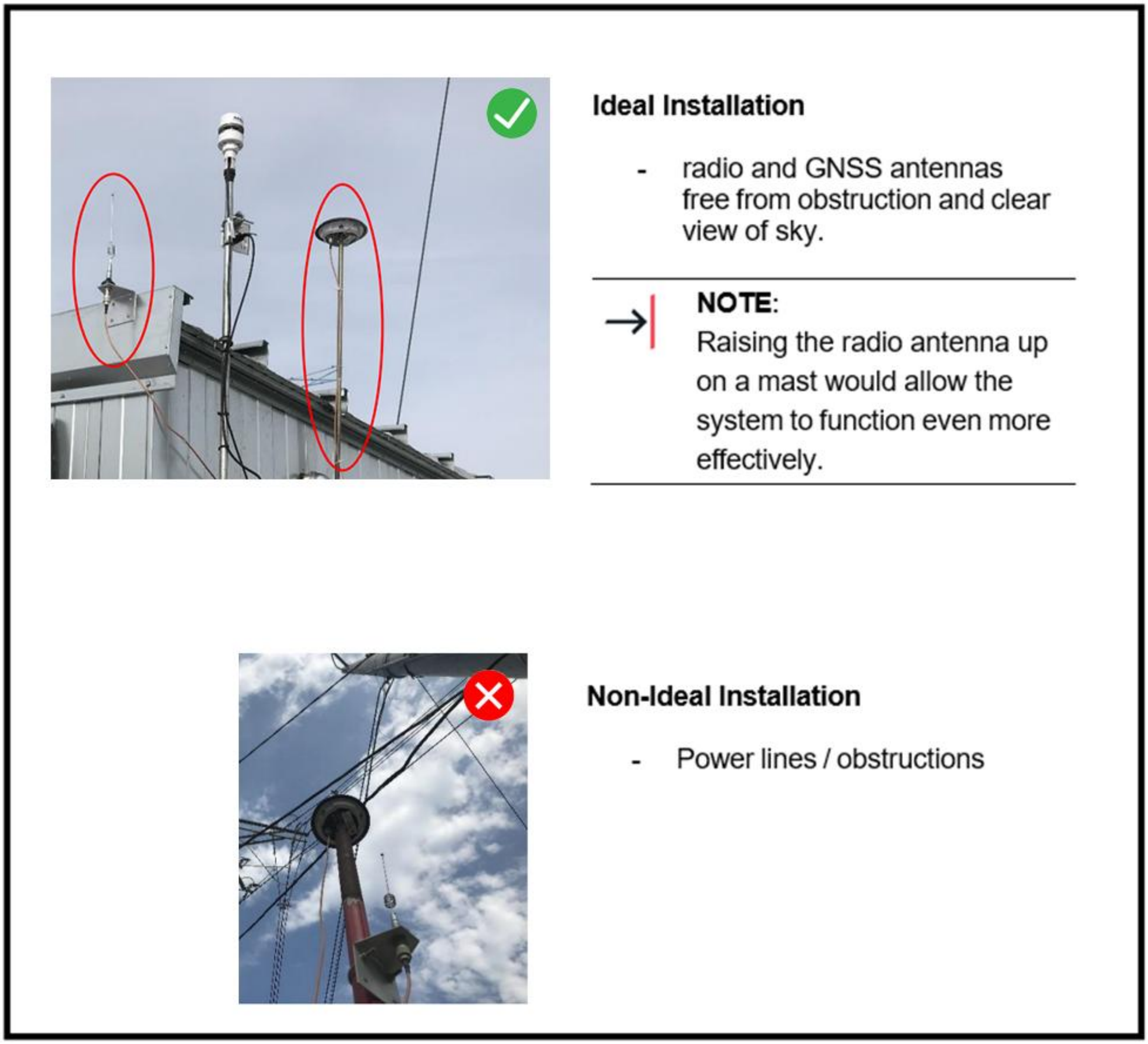


Figure 6: Example Installations

3.1.2 Base Station Installation Requirements

The RTK Base Station is the fixed point to which the computed coordinates for Rovers are referenced. If the Base Station is moving this will cause apparent movement of all Rovers that have an RTK radio link from the Base Station. It is critical to ensure there is reliable power and communications for the Base Station. If the Base Station goes offline, all Rovers will be unable to compute positions.

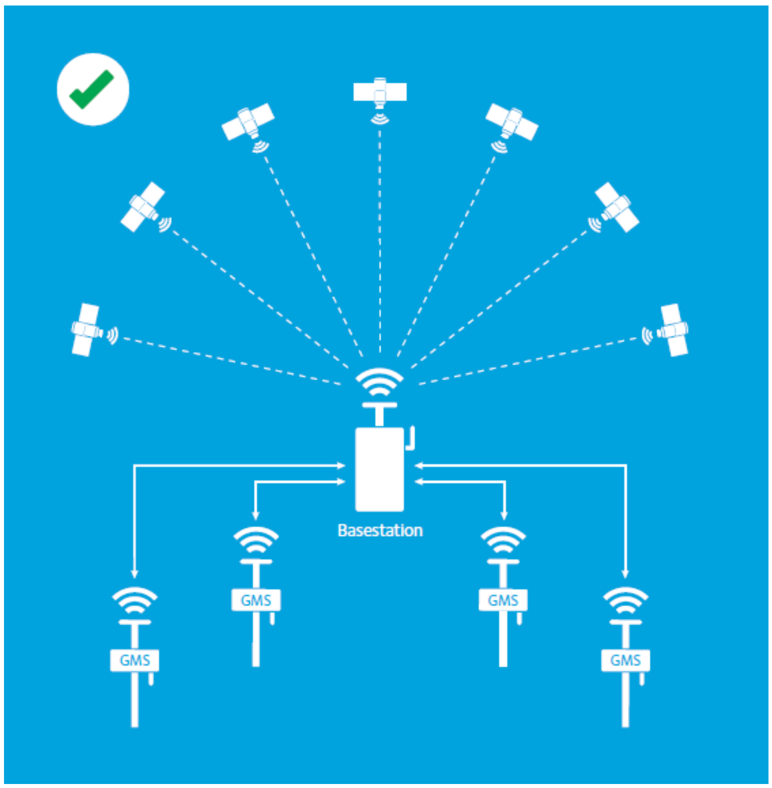


Figure 7: Base Station Installation

EXAMPLE INSTALLATION

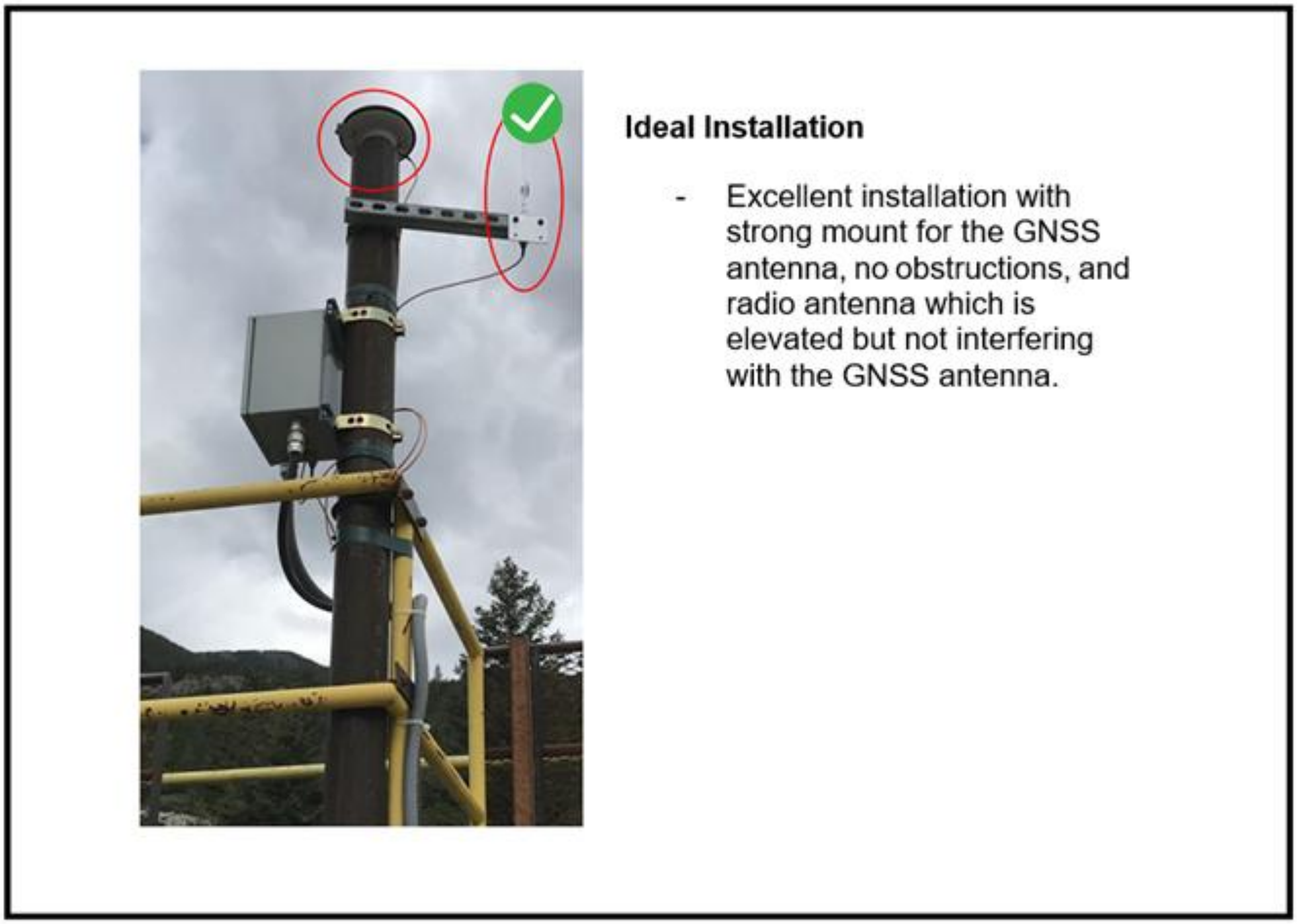


Figure 8: Example Installation

3.1.3 Reliable RTK Radio Link

The RTK Radio Link is critical to compute three-dimensional positions. As such, ensuring that every GMS800 has a clear radio link to the appropriate Gateway is essential.

The ideal location would be near the main AC power and close to a network switch. It is possible to have network access via point-to-point wireless link, but it is more reliable to have a wired connection if possible. If the base loses power OR network access, then the entire system is offline and not collecting data.

NOTE: If the base loses power OR network access, then the entire system is offline and not collecting data.

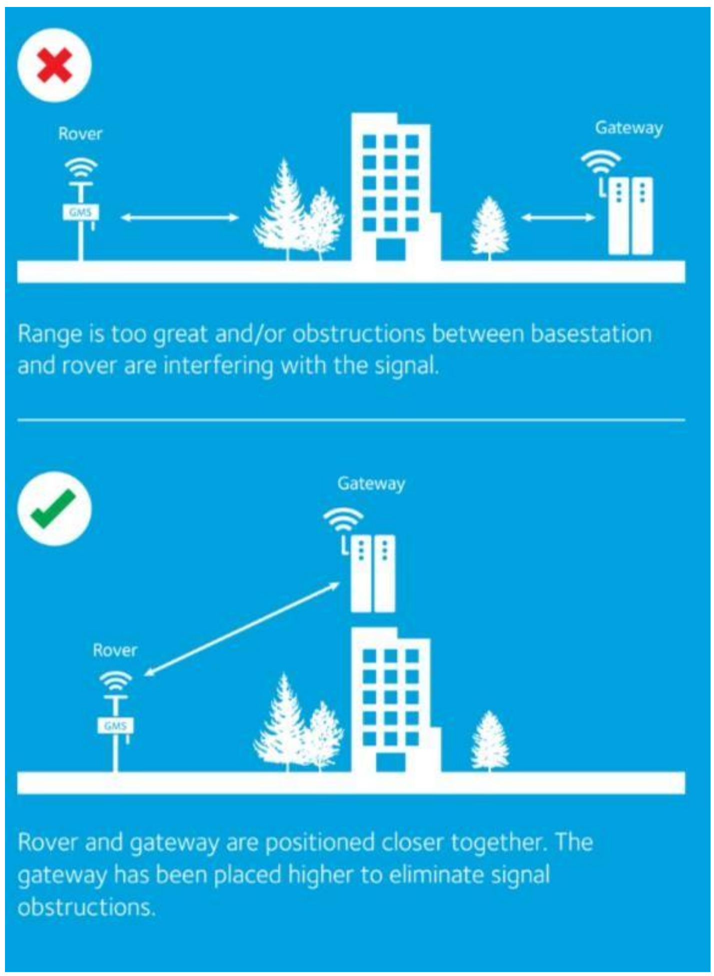


Figure 9: Non-Ideal and Ideal Rover and Base Stationorientation

3.1.4 GNSS Rover Installation Requirements

The GNSS antenna should be the highest point of the installation and secured permanently (concrete pillar is the best). The GNSS antenna should have a clear view of the sky, 15 degrees and higher from the horizon.

See next page for example installations.

EXAMPLE INSTALLATIONS

Figure 10: Example Installations

3.1.5 Other Installation Notes

The radio antenna with the Base Station should be as high as possible and free from obstructions. If possible, there would be a ‘line of sight’ view to each of the Rover units. The GNSS antenna should be secure without possibilityof vibration or movement. A concrete pillar is the best solution. NavStar uses an FLP based system for Base Stations with network access and an FLL when thereis no network access. When using an FLL based Base Station it is necessary to have an FLP gateway as part of the system. Every Base Station (FLP or FLL) has an attached GPM module which functions as the GNSS base.

3.1.6 Power

GMS800 rover units are solar powered.

GMS800 rover units are powered with a 10W solar panel. Users also have the option to connect a 20-24V DC source to the PBL103 solar panel terminals. This mimics a solar panel and can be used to charge battery packs or top up the charge after they have been sitting in storage.

Figure 10: Overview of PBL103 Unit with Attached Charger

3.1.7 Tiltmeters

The GMS800 rover units have built-in bi-axial Tiltmeters. It is important to choose a reference orientation for the A and B axis so that changesin tilt can be quantified in the future. For example, the A axis could be positionednorth/south or in a hillside situation, one of the axes could be positioned up/down slope.

Figure 11: Example of GMS800 showing direction for Tiltmeter orientation

3.1.8 Additional Gateways

It is possible and encouraged to have additional gateways, especially for larger installations. This adds an important level of redundancy to the system. Additional gateways can function as Repeaters for Rovers that are away from the base. The 'gateway' aspect of these stations is that they have another path to the network. These stations can also rebroadcast corrections from the base. NavStar uses the FLP line of products for gateways.

3.1.9 Repeaters

Repeater stations are essentially gateways without network access. They can 'repeat' the radio data but have no direct access to the network. NavStar uses FLL series equipment as Repeaters. FLPs can also act as Repeaters if required.

3.2 OPTIONAL CONFIGURATIONS

3.2.1 Base with No Network Accessibility

The gateway and base aspects of the Base Station can be separated. If there is a convenient location for sky visibility without network connection it is possible to set up an FLL-based station. Corrections are broadcast across the radio networkbut require an FLP based gateway to receive the Rover responses and pass thedata onto the network (GeoExplorer).

3.2.2 Base with No Access to Radio Network

It is also possible to have the base in a location with network access but no good line of sight to the Rover units for radio communication. In this case, it is possible for the base to pass correction information across the network to a separate gateway station. This other gateway can broadcast the base's corrections to the Rover units. In this situation the base would not need a radio antenna (only GNSS antenna).

3.2.3 Distant Rover Units

By default, NavStar provides a small omnidirectional radio antenna. For units that do not have line of sight or are further than a kilometer away, it is possible to install a directional or different type of antenna that can improve the quality of communication. It is also possible to install cable extensions so the small BNC antenna can be raised up on a mast.

3.2.4 Wi-Fi or Cellular

Instead of a direct radio link from gateway (FLP) to GMS800, the GMS Rover can be outfitted with a Wi-Fi or cellular radio. In both these cases, the management of data transfer and corrections communication is managed by GeoExplorer (instead of the FLP). In the case of Wi-Fi, the GMS800 connects through a Wi-Fi access point or hotspot to GeoExplorer. In the case of cellular connection, the GMS800 connects through a nearby cell tower to reach GeoExplorer.

3.3 GMS800 INSTALLATION

The user is encouraged to source a stand for mounting the GMS800 unit.

The most straight-forward solution is to have a 2” pole (4’ tall) secured in the ground with a 5/8” threaded rod protruding from the top of the pole.

The GMS800 is packaged with the mounting bracket pictured below. The bracket is secured to the GMS800 box at the four corners. The bracket is designed for simple attachment to the mentioned 2” pole or a flat surface. The bottom of the bracket has holes for 2” U-clamps which are also provided with the GMS800. Wood screws could also be used in the holes and for larger poles, the slots make it convenient to secure with pipe/band clamps.

Figure 12: GMS800 Mounting Bracket (Supplied with Order)

The GNSS antenna screws on to a 5/8” threaded rod. This follows standards found with other survey equipment (robotic total station, prism). This is the reason for the design recommendation above while also noting that the GNSS antenna should be at the top of the installation with 360-degree view of the sky.

Each piece of equipment has 2 antennas. One allows for terrestrial radio communication and the other for satellite reception. Both communication networks are necessary for the technology to function properly.

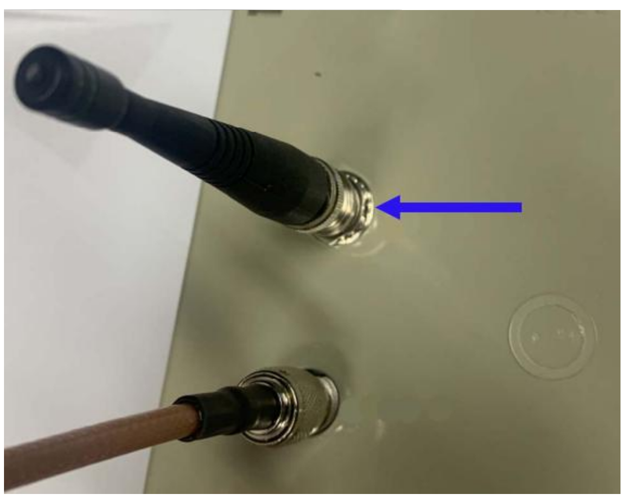
NavStar generally uses the 900MHz frequency band for terrestrial communication or something similar depending on local governing bodies for RFcommunication. Corrections from the base to the Rovers are sent via this radio communication as well as the calculations from the Rovers back to the base.

3.3.1 Step 1: Mount GNSS Antenna

Mount the GNSS antenna with a clear view of the sky and connect to the GMS800 using the supplied TNC – TNC antenna cable.

The GNSS antenna screws on to a 5/8" x 11 threaded rod. This rod size/threading is standard for survey equipment and is not supplied as part of the installation package.

3.3.2 Step 2: Attach Radio Antenna



Attach the radio antenna to the BNC port on the GMS800.

NOTE: If necessary, an external antenna with extension cable may be used.

3.3.3 Step 3: Solar Panel Mounting and Connection

The solar panel can be pole-mounted using supplied U-bolt clamps (same size as those for GMS800 enclosure mounting). Small mounting brackets are included to attach to the sides of the solar panel. It is recommended that the solar panel be installed vertically and attached to the same pole/surface as the GMS800 enclosure.

Figure 13: Solar Panel with Mounting Brackers and U-Bolts on Flat Surface/Stand

Attach the solar panel to the barrel plug connector on the bottom of the GMS800.

3.3.4 Step 4: Powering ON

The system is ready for commissioning/testing after the GMS800, and solar panel have been mounted and all cables/antennas have been connected. Start by removing the GMS800 lid and inserting the fuse into the solar battery module. Next, turn on the power switch (ON is to the right). The red PWR LED and other LEDs will illuminate immediately.

Figure 14: Fuse Inserted into Battery Module

3.4 GMS800 OPERATION

The GMS800 functions simply by applying power. All units have been programmed (firmware/application) prior to shipping and are plug and play ready for installation/operation immediately with no additional configuration required for default operation.

3.4.1 Default Operation

The GMS800 is by default on a measurement cycle of one hour. In between measurements it is in a ‘deep sleep’ (low battery usage) state. Removing and applying power can force a measurement (and the cycle to restart).

When the GMS800 is first powered, the PWR (red) LED will turn on and remain solid for the duration of the cycle. The TX (yellow) LED blinks during a transmission and the RX (green) LED blinks during reception. The CORR (green) LED blinks every time a correction is received from the Base Station.

When power is first applied or the GMS800 ‘wakes up’ for a new cycle, it sends a message via the Base Station to the server (GeoExplorer software) to request any new configuration that may have been sent since the last measurement. An example of this is the measurement cycle interval. If a new configuration is received, then that will be applied before measurement.

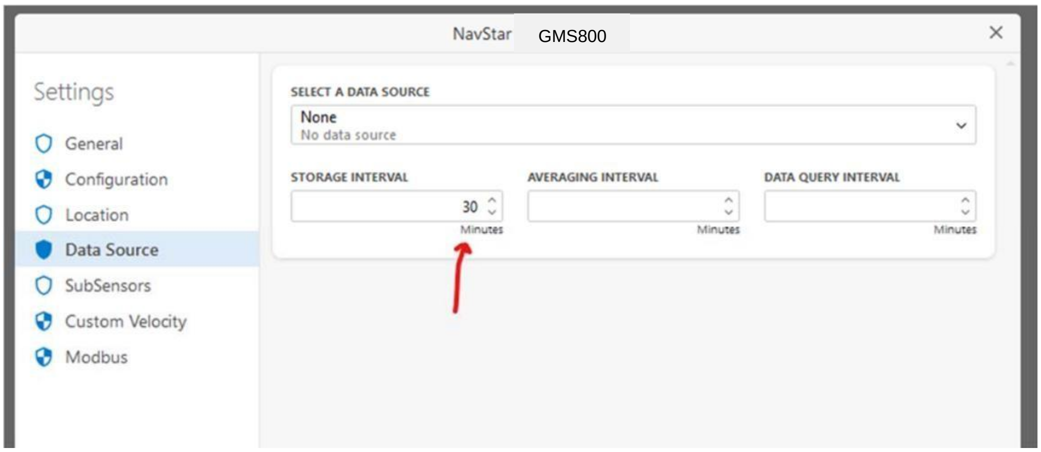


Figure 12: Measurement interval of GMS800 set to 30 mins in GeoExplorer

The GMS800 begins its measurement cycle by tracking and receiving data from satellites. At the same time, it receives correction information from the Base Station (CORR LED blinks). When sufficient data is received from both these sources, a calculation is made, and the result is sent to the server.

NOTE:

Operation with insufficient data

When the GMS800 is unable to properly track satellites (example: full view of sky is restricted because of nearby obstacles) or it is unable to receive enough quality corrections from the base, it will fail to make a calculation. A timeout of 120 seconds indicates that there was an inability to make a calculation (resolve a position). The GMS800 will enter its sleep cycle and wake after an hour (default) to try again.

Operation without a Base Station

At the beginning of a cycle, the GMS800 requests a configuration change from the server. If there is no response, this is interpreted as no Base Station found. In this case, the GMS800 times out after 14 seconds and enters deep sleep (and will try again next measurement cycle). Without a Base Station, the red PWR LED will turnon and there will be activity on the TX transmission LED but no activity on the RX (reception) or CORR LED (corrections from base).

3.5 GMS800 TESTING

A GMS800 is essentially tested and functions correctly if it can make a calculation and send it to the server (GeoExplorer software).

It is not possible to test a GMS800 for complete functionality without several other components of the system including:

1. Server with GeoServer (server portion of GeoExplorer) and SQL database installed.
2. Base Station (FLP200 + GPM200) with functioning radio and GNSS antennaand clear view of the sky.
3. GMS800 with GNSS and radio antennas attached and clear view of sky.

To perform a test, this setup must be complete (refer to Installation prerequisites) and the only required step is to apply power to the GMS800.

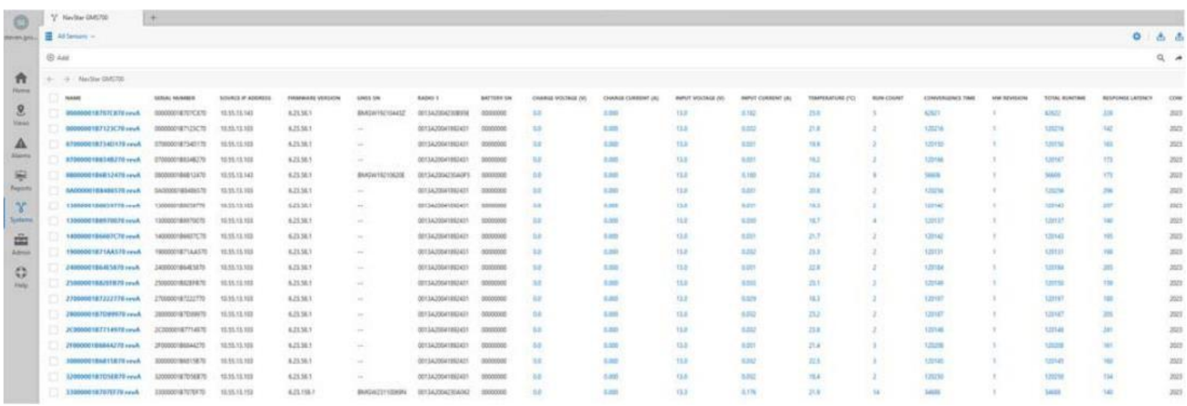


Figure 13: Screenshot of GMS800 tests in GeoExplorer

The GMS800 has a variety of communications methods, the goal of which is to pass user-defined configurations from GeoExplorer to the GMS800 and receive data collection from GMS800 to GeoExplorer. Radio settings should already be factory programmed but in some cases, it will be necessary to add configuration details after installation. For example, a local Wi-Fi SSID and password or local SIM card APN code would need to be programmed for the GMS800 radio in certain configurations.

NOTE:

A successful test in GeoExplorer provides an incredible amount of detail regarding the GMS800 operation and functionality.

A list of some details that can be seen in GeoExplorer:

1. Serial number of GMS800 (also a sticker on the PCB + enclosure)
2. IP address of gateway/Base Station
3. Firmware version
4. GNSS daughter board serial number
5. Radio module serial number
6. Battery board serial number
7. Solar power details (charge voltage, current)
8. Input voltage to GMS800 (can use to determine voltage/life of battery pack)
9. Input current to GMS800
10. Internal temperature of GMS800
11. Total number of measurement cycles ever performed.
12. Convergence time of calculation
13. Response latency (measurement of comms quality to gateway)
14. Tilt measurement (X, Y, Z axis)
15. Correction packets (received from the base for previous calculation)
16. Positioning info (lat/long/elevation etc.)
17. Number of satellites used in calculation.
18. 3D displacement referenced to chosen baseline.
19. Seconds since last measurement

3.6 COMMUNICATIONS OVERVIEW

Every time the GMS800 enters a measurement cycle there are a series of back-and-forth communications with GeoExplorer to deliver updated configurations and ultimately return measurement data. This can be followed during the measurement cycle by watching the flashing LEDs.

The TX LED will blink when the GMS800 sends a message and the RX will blink when it receives a message. Here is the general order of communication events:

1. The GMS800 is powered on (or wakes from sleep for next measurement cycle). The red power (PWR) LED turns on. For the wifi or LTE version of GMS800, a flashing STAT LED indicates successful authentication to a wifi network or cellular network. A series of TX flashes indicate that the GMS800 is requesting its configuration.

2. GeoExplorer acknowledges the request and sends the configuration. This culminates in several TX / RX flashes.

3. The CORR LED will blink every time a correction message is received from the Gateway/Base Station.

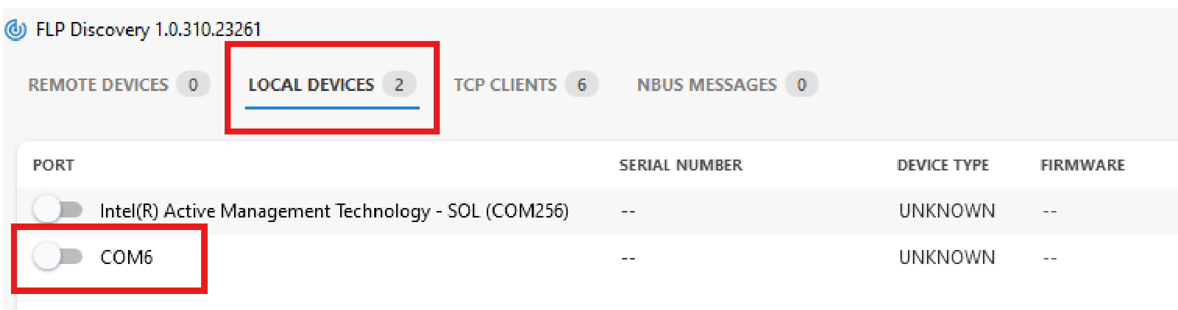
4. In the case of a successful RTK measurement, 40-80 seconds after power-up, a series of TX flashes will indicate final data transmission to GeoExplorer. Following final data transmission, all LEDs will turn off. indicating sleep mode until the next measurement interval.

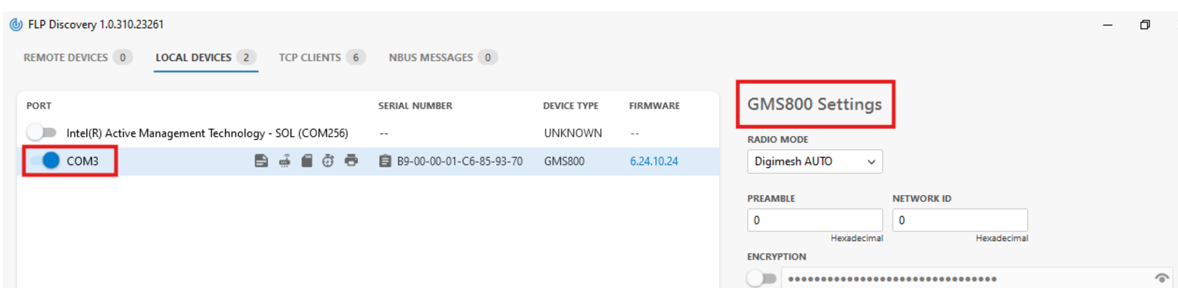
5. If unsuccessful in resolving an RTK position, the GMS800 will enter low-power sleep mode after 2 minutes. For Wi-Fi and LTE configurations, this timeout can be manually altered in the GeoExplorer configuration per device.

3.7 Radio Configuration

In most cases, radio configuration is performed at the factory but in certain cases it is necessary to switch radios or reconfigure settings before/after installation. To configure the radio settings, plug a USB-C from computer to NBUS connector on GMS800.

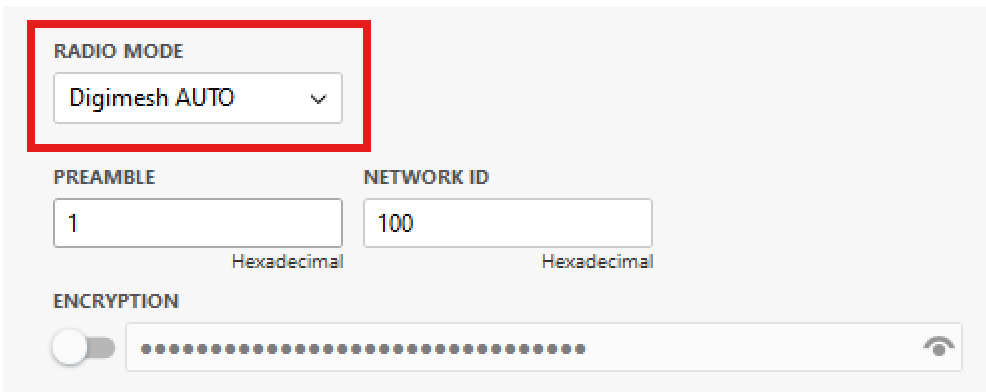
Open FLP Discovery and select the LOCAL DEVICES tab. There should be a new COM port generated when the USB-C cable is inserted. Click on the COM port and this should open the current radio settings. If no COM port is generated when a USB-C cable is inserted, it may be necessary to install additional drivers. Please contact NavStar support.





3.7.1 DigiMesh Radio Configuration

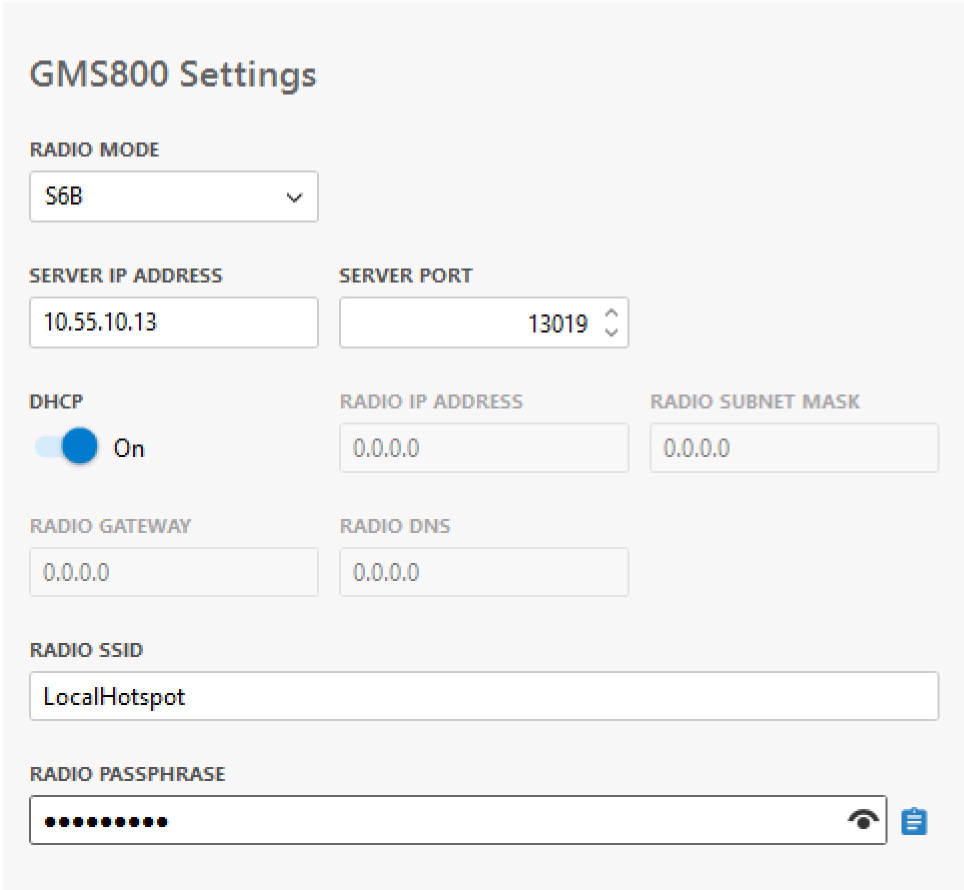
For the DigiMesh radio configuration, a GMS800 will require the presence of a (FLP200 based) gateway to be present. Both the gateway and GMS800 will need to be outfitted with matching radios and matching settings. Select DigiMesh AUTO for 900Mhz, 868Mhz or other similar radio (depending on country specification/regulations). Reach out to NavStar support to determine the specific settings for the other boxes (PREAMBLE, NETWORK ID, ENCRYPTION). For 2.4GHz, choose DigiMesh 24 and follow the same procedure.



→ **NOTE**: Please contact NavStar support to determine the specific settings for the other paramerters (PREAMBLE, NETWORK ID, ENCRYPTION).

3.7.2 Wi-Fi Radio Configuration

For the Wi-Fi configuration, select S6B as the “RADIO MODE”.



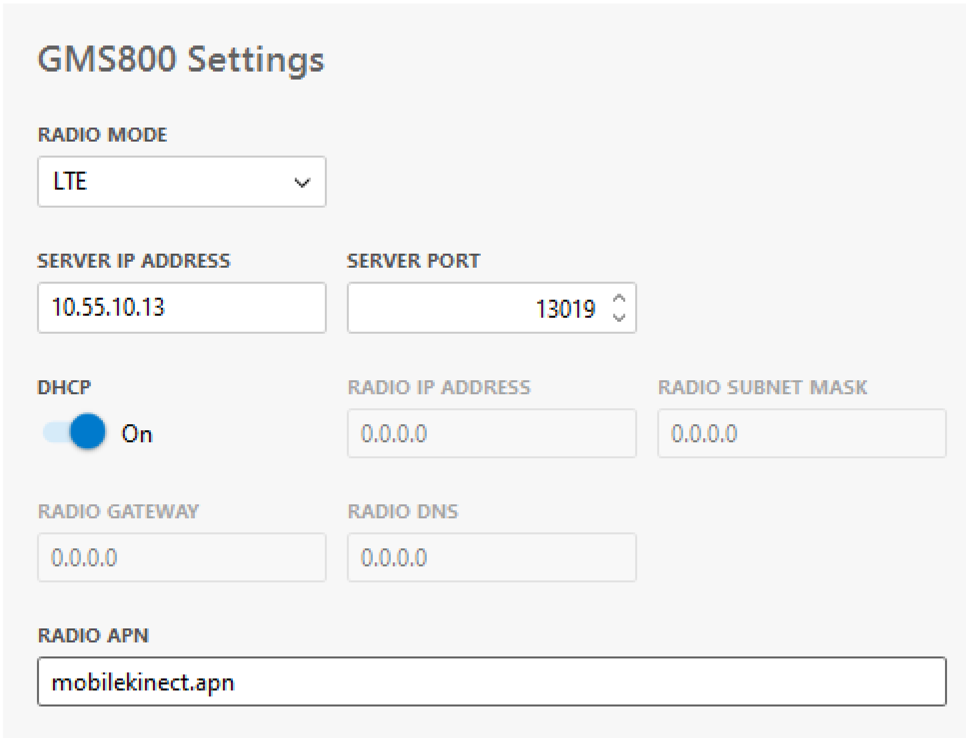
There are at least 4 required fields for configuration:

- SERVER IP ADDRESS – IP address of GeoExplorer
- SERVER PORT – GeoExplorer NBUS data port
- RADIO SSID – Wi-Fi network or hotspot name
- RADIO PASSPHRASE – Wi-Fi network password

For connecting testing, first ensure that the GMS800 can register on the Wi-Fi network. Either set a static IP or determine which IP has been issue from the DHCP server. A ping test is the easiest method to determine a successful connection to the network. Next, ensure there are no firewall restrictions preventing the GMS800 from connecting outbound to the GeoExplorer server and port.

3.7.3 LTE Configuration

For LTE configuration, choose LTE as the “RADIO MODE”



All 3 fields are mandatory for configuration:

- SERVER IP ADDRESS – IP address of GeoExplorer
- SERVER PORT – GeoExplorer NBUS data port
- RADIO APN – Access Point Name will be a standard code issued by the cellular provider based on the type of SIM card inserted in the GMS800’s radio and data package subscription type.

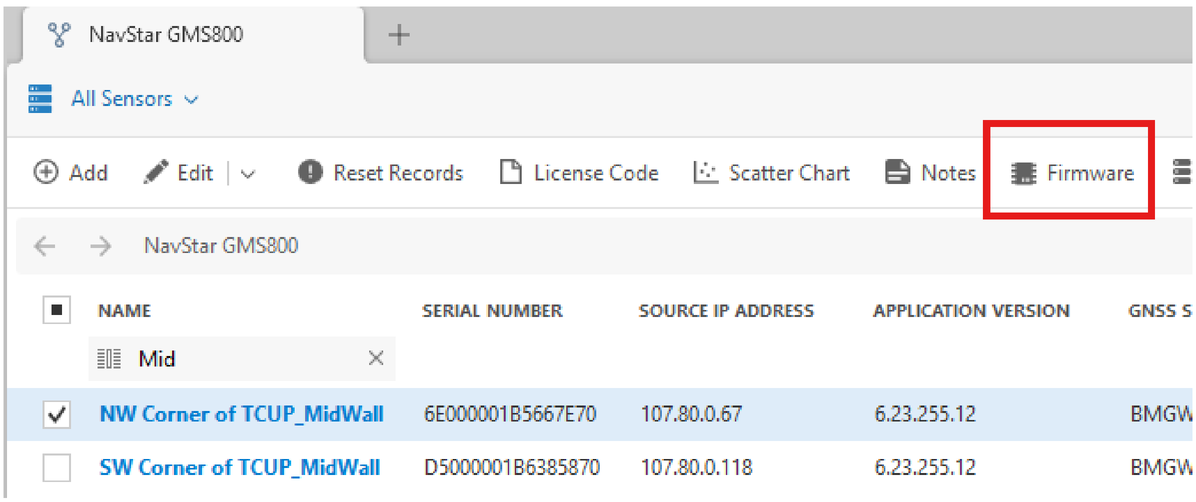
GeoExplorer will automatically create the GMS800 sensor at first successful diagnostic or sensor measurement message received. With respect to GMS800 on cellular service, there are normally several extra steps associated with opening ports through firewalls on both the cellular side and inbound to GeoExplorer.

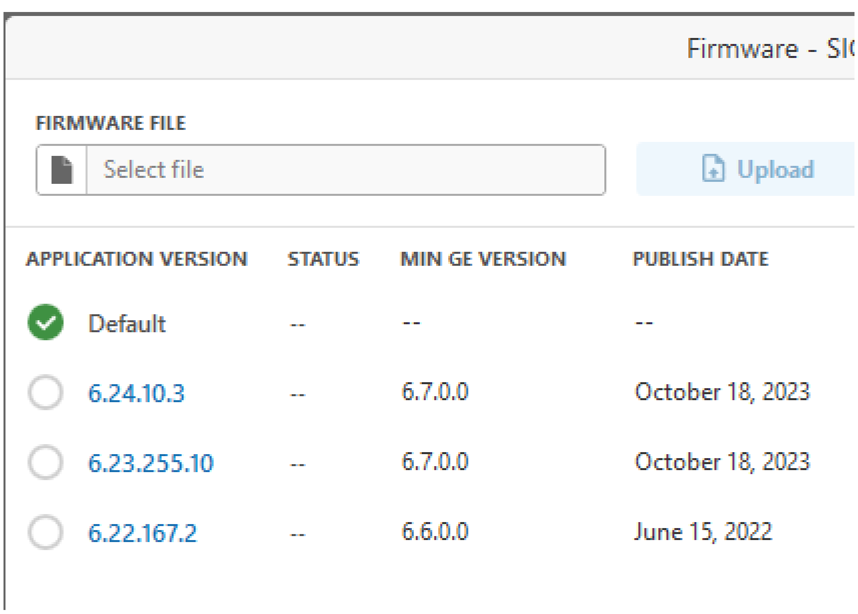
4 GMS800 Firmware Update

GMS800 is shipped with the latest available firmware but there are instances when it is necessary to update or restore firmware manually (or remotely).

4.1 Remote Firmware Update

It is possible to update the GMS800 firmware remotely through the GeoExplorer interface. Navigate to the 'systems view' – Left Side Bar > Systems > GMS800. Select the appropriate GMS800 and choose firmware.





The specific firmware file will be named according to release code and is supplied by NavStar. Reach out to support to receive a link to the specific firmware version required. Upload the firmware (.zip) file and then select the file to initiate the firmware update process. Depending on connection method, this could take several hours or days. The firmware file is slowly transferred to the GMS800 before installation can initiate. Check the 'application version' in GeoExplorer to ensure the correct version is actively being used.

4.2 Manual Firmware Update

In certain circumstances it is necessary to manually update the GMS800 firmware. The app 'TinyCLR Config' is required.

Please see a recent download link below, but note that there are new versions periodically posted:

http://files.ghielectronics.com/downloads/TinyCLR/Config/TinyCLR-Config-Setup-v2.2.0.5000.msi

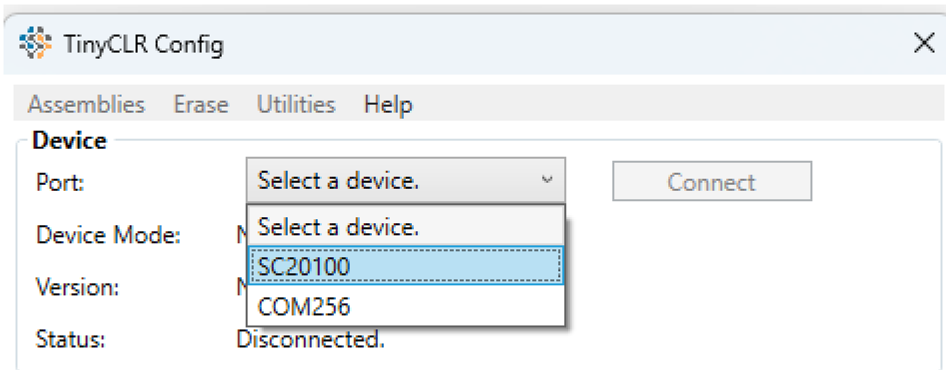
Locate the connector for firmware (labeled "GHI").

1. Plug a USB-C cable from laptop to port labeled "GHI".

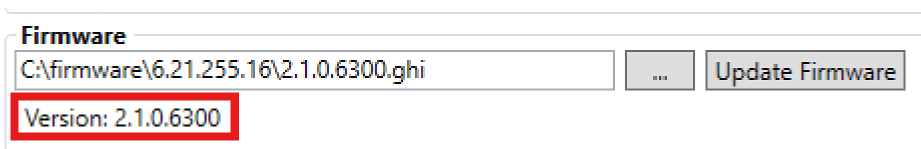
2. Three files are needed to perform the firmware update. These can be received directly from NavStar support on a case-by-case basis. There is a 'firmware' file (.ghi extension) and an 'application' file (.tca extension). There is also a hex application key that needs to be entered (in the .txt file).

3. The following steps show a firmware update in TinyCLR Config using the example of firmware file "2.1.0.6300.hex" and application file '6.21.255.16.tca'. The actual firmware will certainly be named differently.

4. Select 'SC20260' or 'SC20100' in the port menu and 'connect' (the letters/numbers here might change depending on device).

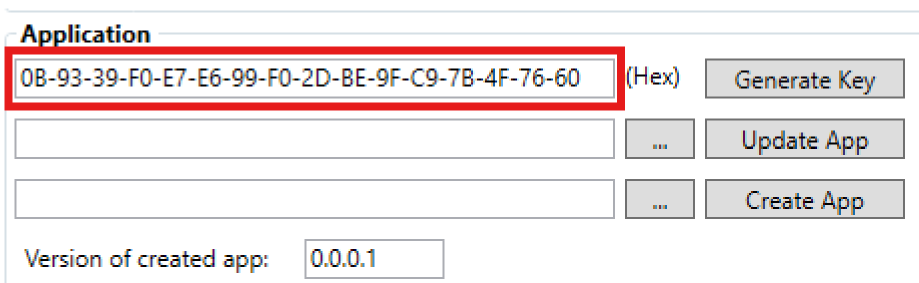


5. Browse to the firmware file (3 dots menu) and then click update firmware. You'll see an erase and the load process complete.

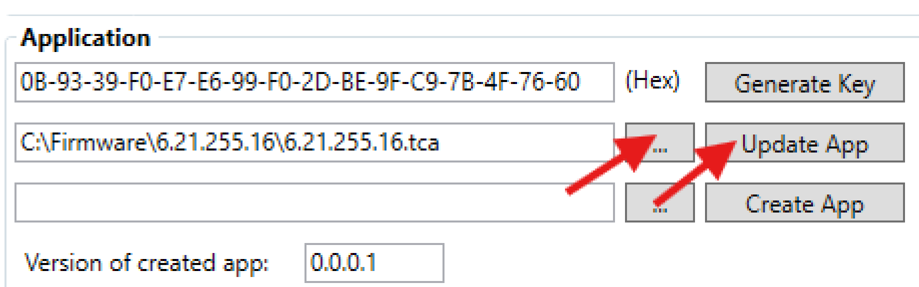


6. Reconnect to the SC20260 using the port menu above

7. Copy the Key into the key field. Careful not to have any extra text in there



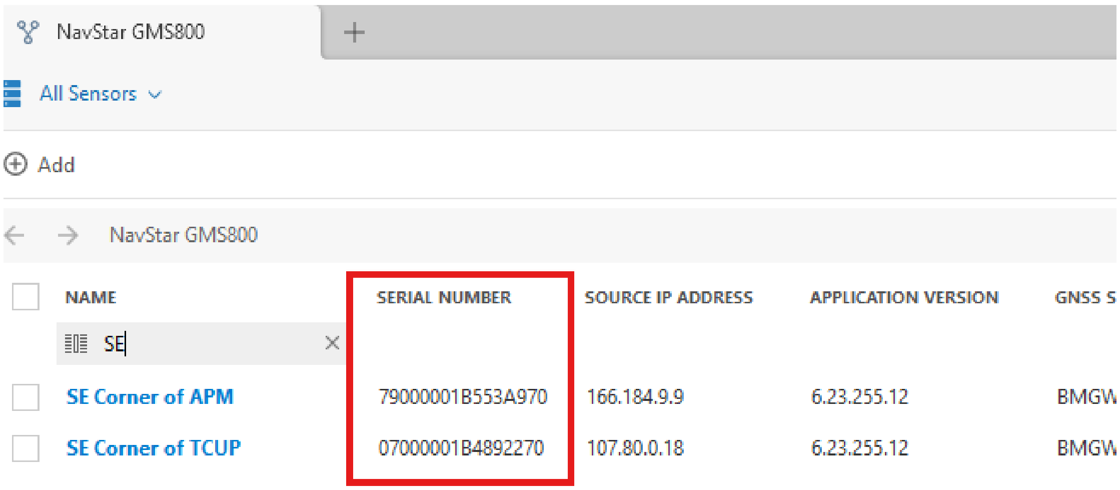
8. Browse to the .TCA file from the download using the browse button below. Then click Update App.



9. The user should see a successful update message.

5 GMS800 GeoExplorer Configuration

There is no mandatory configuration required for GMS800 unless outfitted with a Wi-Fi or cellular radio. The GMS800 will appear automatically in the default GeoExplorer project at the time the first measurement is sent. The GMS800 can be identified in GeoExplorer by its serial number.



5.1 Wi-Fi and Cellular Overview

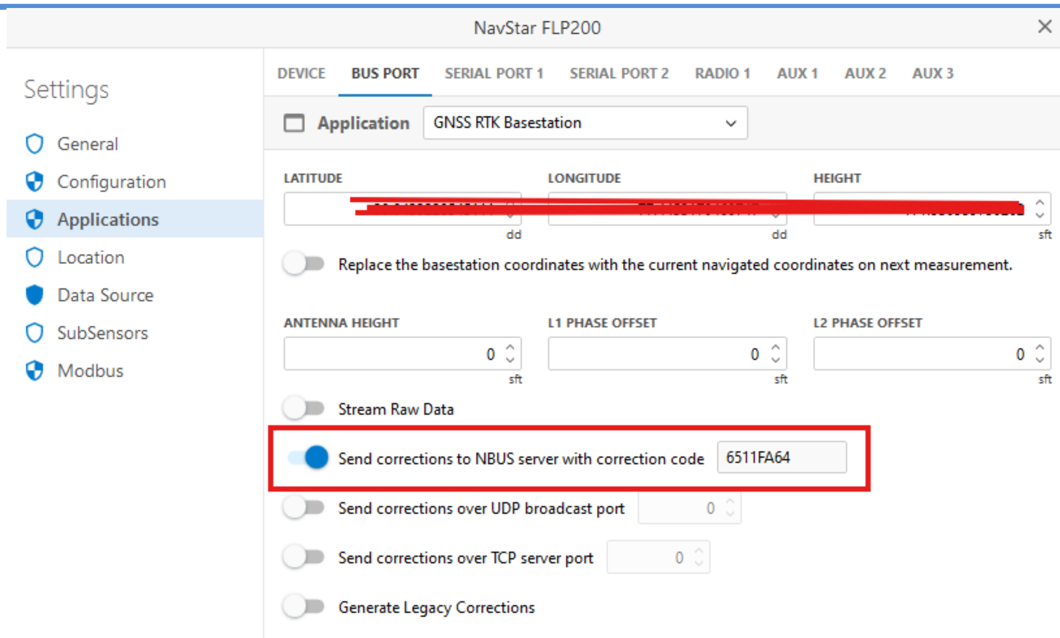
In certain circumstances it is necessary to manually update the GMS800 firmware. The app 'TinyCLR Config' is required.

Please see a recent download link below, but note that there are new versions periodically posted:

http://files.ghielectronics.com/downloads/TinyCLR/Config/TinyCLR-Config-Setup-v2.2.0.5000.msi

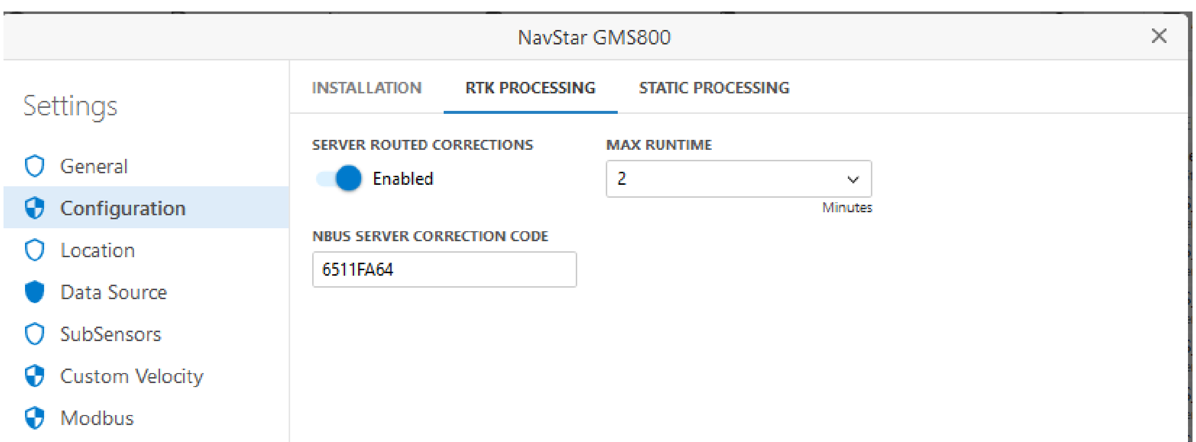
For the GMS800 Wi-Fi and Cellular options, there will be no direct communication between the Gateway (FLP200) and GMS800. Instead, GeoExplorer's NBUS server manages the communication between GMS800, Gateway/Base Station and GeoExplorer.

The following assumes that the Base Station is already configured. During this configuration process (in the FLP200 Settings > Applications > Bus Port > GNSS RTK Base Station) the option to send corrections to NBUS server will be enabled. A unique correction code is generated as there could be cases where multiple Base Stations are installed in the same GeoExplorer system.



5.2 GMS800 Configuration for Wi-Fi or Cellular

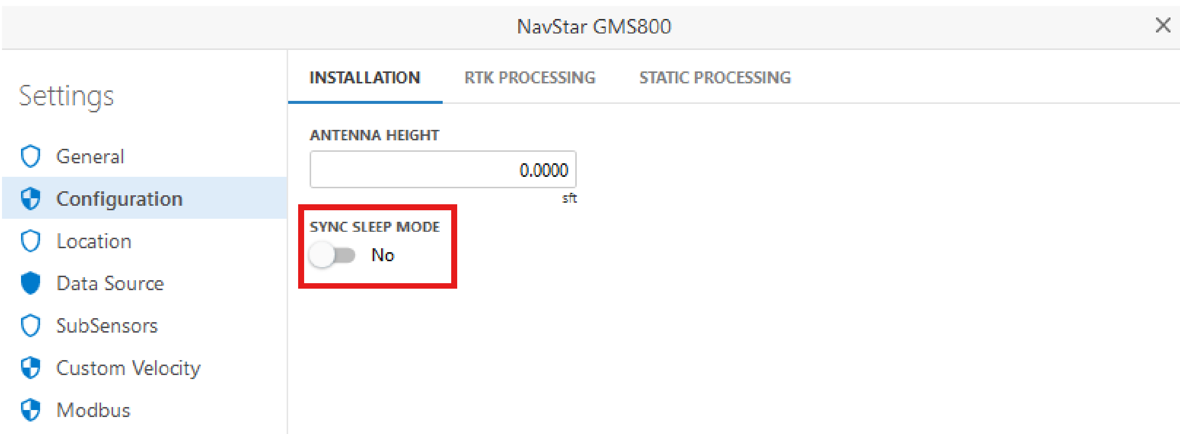
After a GMS800 first appears in GeoExplorer (generated after first measurement), it is necessary to link the GMS800 to the appropriate Base Station. This is achieved in the GMS800 Settings under Configuration > RTK Processing. Enable 'Server Routed Corrections'. This allows GeoExplorer to manage the transfer of data over Wi-Fi or Cellular networks. Enter the exact code mentioned in the previous section in the NBUS SERVER CORRECTION CODE field. This will link the GMS800 to the appropriate Base Station and ensure on the next measurement cycle it will receive the corresponding RTK corrections.



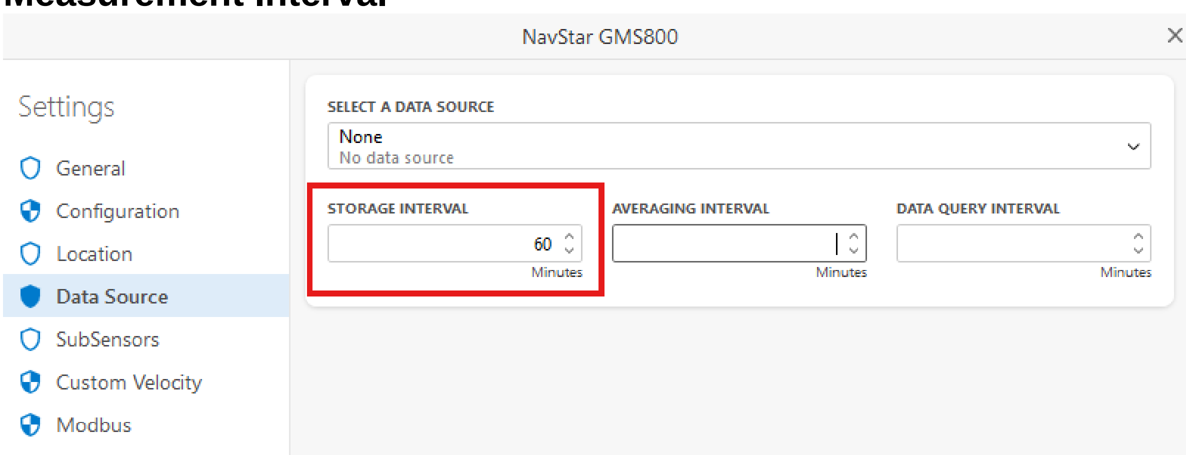
5.3 GMS800 ADDITIONAL/OPTIONAL SETTINGS IN GEOEXPLORER

5.3.1 Sync Sleep Mode

Sync Sleep Mode can be selected to have the GMS800 take a measurement on the hour.



5.3.2 Measurement Interval



The STORAGE INTERVAL setting in GMS800>Data Source is an important value which sets a number of intervals:

1) GMS800 diagnostic message frequency
2) Database measurement storage frequency
3) RTK position calculation frequency

It is not possible to have different measurement intervals for each of the items mentioned.

6 MAINTENANCE

The GMS800 has an internal battery module which contains 2 x lead acid (4.2mA) solar batteries and an integrated solar controller. The battery module is referred to with part number PBL103. Under ideal conditions, sealed lead-acid solar batteries have a 3–5-year lifespan. Therefore, it is necessary to replace this module at end of life. The PBL103 can be removed from the GMS800 by removing 4 x 2.5mm hex bolts with an Allen/hex wrench/key. Remove the fuse before removing/installing the PBL103.

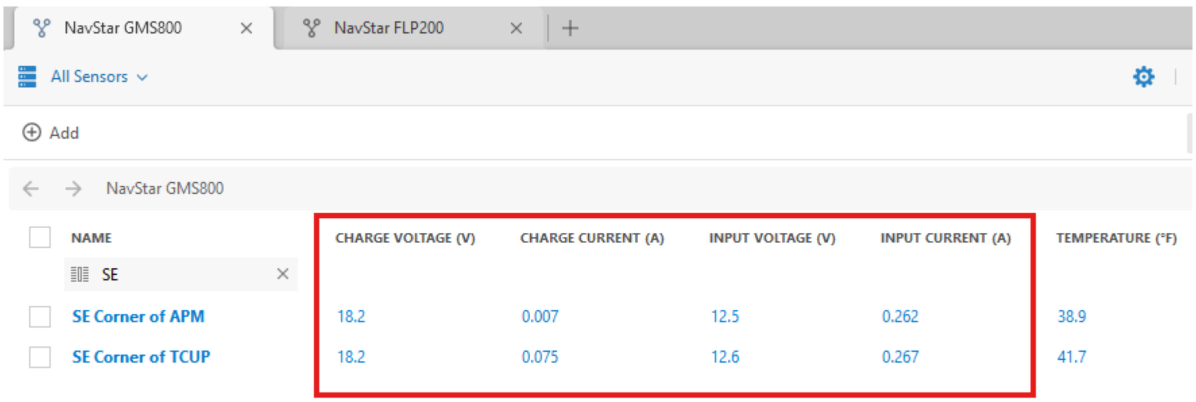
To ensure the solar panel is operating at full efficiency, make sure to periodically wipe of dust, snow, and ice.

7 TROUBLESHOOTING

→ **NOTE**: The troubleshooting procedures mentioned here are for most encountered issues, which relate to communications and power. For additional support, contact RST Instruments.

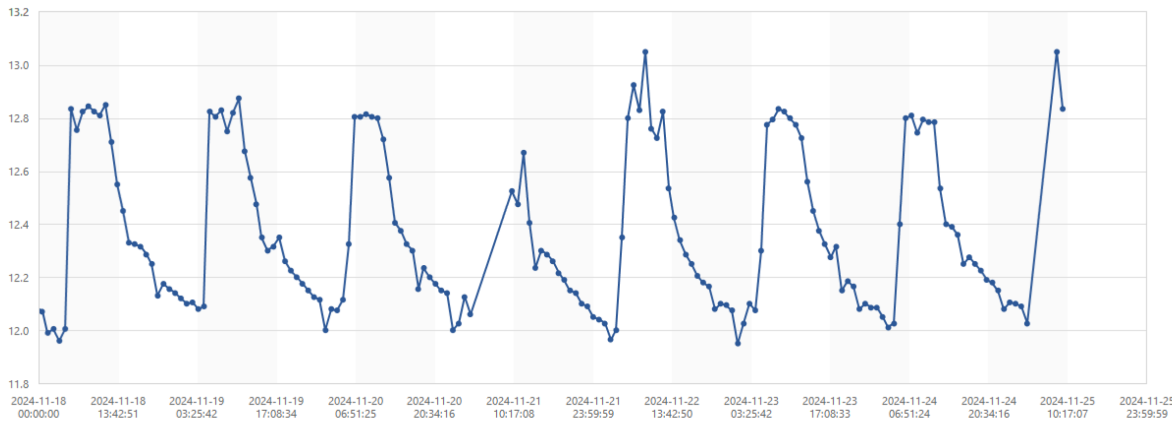
7.1 POWER TROUBLESHOOTING

A power issue can be monitored and detected by watching the 'input voltage' trend from the GMS800 diagnostic messages in GeoExplorer.



Since the GMS800 is powered from the internal PBL103 battery module, the input voltage to the GMS800 is essentially the voltage of the batteries/system.

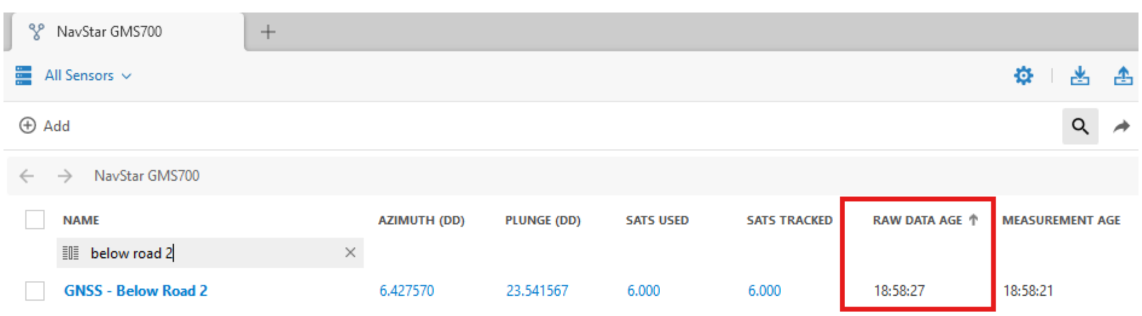
The daily trend of charge during sunlight hours and discharge after dark can be clearly seen in the input voltage graph. It is also straightforward to diagnose when there is a problem with the power system. The GMS800 will be disconnected from the battery module when the voltage drops below 11.5V. This is to protect the battery from deep discharge. The system will not be reconnected until the battery is charged above 12.5V. Observing this in the input voltage trend can help identify a power-related issue. In many cases, it is not necessary to visit the physical device in the case of low power disconnect as the system will automatically reconnect after charging.



The charge voltage and charge current are measurements generated from the PBL103 battery pack. These can also be useful in diagnosing power issues. The charge voltage is a measurement of the input voltage on the solar panel. The charge current is the current from output on the solar panel into the PBL103 battery module.

7.2 Communications Troubleshooting

Monitoring the 'raw data age' in GeoExplorer is the best way to detect any communications failure. The raw data age shows the time since last diagnostic measurement from the GMS800. If this time is larger than the measurement interval, there may be a communication problem (or weak connection). If communication stops (especially if there is nothing unusual from a power perspective), it is likely necessary to visit the device to investigate the reason for the outage (perhaps physical damage to antenna / antenna cable or a new comms obstruction).



7.3 GNSS Measurement Troubleshooting

From time to time, the GMS800 may not make a successful RTK calculation.

A lack of positioning data in the regular GMS800 diagnostic message indicates that a successful RTK calculation did not occur.

Please see below for the most common reasons for the GMS800 not making a successful calculation:

1. Lack of correction data from the Base Station.

If the user is physically present at the GMS800, inspect the CORR LED.

It will blink every time the GMS800 receives a correction message from the Base Station. If the CORR LED does not blink at all, the GMS800 is not receiving corrections from the Base Station.

NAME	DELTA TILT X (MM/M)	DELTA TILT Y (MM/M)	CORRECTION PACKETS
apm			
SE Corner of APM	-0.694	-1.066	170

2. Sky blocked or partially blocked by vegetation or other obstruction

It is necessary for the GMS800 units to have a line of sight to the same set of satellites as the Base Station. If some or all the skyline is blocked for either the base or the rover, a successful calculation will not be achieved every measurement cycle.
A convergence time of 120000 (or 120 seconds / 2 minutes) indicates the GMS800 has timed out and was not able to calculate an RTK position.

3. Noisy data results

Noisy data is often related to a portion of the sky being obstructed from the GNSS antenna for either the Base Station or rover. Noise can also be introduced depending on installation quality. For example, vibration or movement at the GNSS antenna could affect data quality. Note that any noise introduced at the base (reference) will present in all rover data.

4. Hardware problem

If there is a problem with the GMS800's GNSS antenna or antenna cable, it will fail to calculate a successful RTK position. In this situation, the GMS800 may be regularly contacting GeoExplorer and receiving ample correction data but the convergence time will consistently show approximately 120000ms.

8 PRODUCT SPECIFICATIONS

Table 1: Product and Technical Specifications

Item	Specification
Physical and Electrical	
Enclosure Dimensions	160 mm x 160 mm x 100 mm
Enclosure Material	Fiberglass Reinforced Polyester
Weight* **Without battery*	1.35 kg
Connectors	TNC(F) for GNSS Antenna BNC(F) for Radio Antenna
Mounting	2" Pole Clamps included. Flexible hole pattern also works for alternate mounting
Temperature	Operating: -40°C to +85°C Storage: -55°C to +85°C
Power Consumption	42 mWH per measurement ~8000 measurements with 6 X Lithium D Batteries at room temperature with 'In RTK mode'
Sensors	
GNSS Channels	555
GNSS Signals Received	GPS L1 C/A, L1C, L2C, L2P, L5 GLONASS* L1 C/A, L2 C/A, L2P, L3, L5 Galileo* E1, E5 AltBOC, E5a, E5b, E6 BeiDou* B1I, B1C, B2I, B2a, B3I QZSS* L1 C/A, L1C, L2C, L5, L6 **Optional, requires extra license*
Biaxial Tilt Accuracy	< 0.01°
Environmental Sensors	Temperature, Input Voltage, Input Current, Charge Voltage, Charge Current, Runtime Metrics

Typical GNSS Measurement Performance		
	Post-processing mode	RTK mode
Horizontal Repeatability (24 hr. average)	3 mm	8 mm
Vertical Repeatability (24 hr. average)	5 mm	15 mm
Included GNSS Antenna* **Additional antenna options available*		
Signals Received	GPS L1/L2 GLONASS L1/L2 Galileo E1 BeiDou B1	
Dimensions	176 mm D x 55 mm H	
Connector	TNC (F)	
Mounting	5/8" Coarse Thread Mount	
Phase Center Ability	< 2.0 mm	
Noise Figure	< 2.0 dB (typical)	
Power Supply Options		
Solar / Lead Acid	2.6AH 12V Integrated Lead Acid power supply system including internal solar controller 10 W solar panel typical	
Solar / Supercapacitor	Maintenance free supercapacitor system with advanced charge efficiency 10 W solar panel typical	
Telemetry		
Mesh Radio	868 MHz, 900 MHz, 2.4 GHz	
Wi-Fi	802.11 B/G/N	
LTE	Bands 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28 and 39	
LTE Carrier Approvals	AT&T (LTE-M), Verizon (LTE-M), Bell (LTE-M), Telus (LTE-M)	

The repeatability and precision of GNSS measurements at a particular location and time are affected by the number and geometric distribution of satellites in the visible sky, the effect of multipathing, unit distance from Base Station, and other factors. The measurement performancestated above assumes a typical installation with favourable topography.

9 SERVICE, REPAIR AND CONTACT INFORMATION

This product does not contain any user-serviceable parts.

- For technical support: support@navstar.com
- Website: www.navstar.com

NavStar Canada Office

Address: 11545 Kingston Street, Maple Ridge, BC, Canada V2X 0Z5

Telephone: 604-540-1100

Fax: 604-540-1005

Business hours: 7:30 a.m. to 5:00 p.m. (PST) Monday to Friday, except holidays