VIKING MANUAL

Carlson Software, Inc.

33 East Second Street

Maysville, KY, USA 41056

www.carlsonsw.com

VIKING MANUAL

Version 1.09

Revision C

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Thank you for choosing the Carlson Viking product.

This manual provides you with essential safety guidelines and instructions for setting up and using Viking GNSS Smart Antenna. See “User Notices” and "Safety Information" sections for more details. Please review this User Manual thoroughly before turning on the product.

This User Manual covers all the necessary steps to operate the Carlson Viking product at a basic level. It also gives you a summary of the product along with technical specifications and safety instructions.

Viking is designed for optimal use with Carlson SurvPC. For guidance on how to use Viking with Carlson SurvPC please consult the dedicated manual.

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User Notices

CE Notice

Viking product carries the CE mark and may be operated in all EU member countries (BE, BG, CZ, DK, DE, EE, IE, EL, ES, FR, HR, IT, CY, LV, LT, LU, HU, MT, NL, AT, PL, PT, RO, SI, SK, FI, SE, UK), Norway and Switzerland.

The product has been tested and found to comply with the requirements for a Radio Equipment device pursuant to European Council Directive 2014/53/EU on EMC, thereby satisfying the requirements for CE Marking and sale within the European Economic Area (EEA).

The product covered by this guide contains a Bluetooth radio module. These requirements are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential or commercial environment.

The Viking receiver is a Class B device for EMC compliance, intended for residential or business use. In a domestic environment, this product could cause radio interference, so the user might have to take suitable actions if necessary.

CE Declaration of Conformity

Hereby, Carlson Software Inc., declares that the GNSS receiver is in compliance with the essential requirements and other relevant provisions of Radio Equipment Directive 2014/53/EU.

FCC Suppliers Declaration of Conformity

47 CFR 2.1077 Compliance Information

Unique Identifier: Carlson Viking

This equipment has been tested and found to comply with 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 correct 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.

Responsible party – U.S. Contact Information:

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Canada ISED

CAN ICES-003(B) / NMB-003(B)

This class B device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-exempt RSS(s).

Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. L'appareil ne doit pas produire de brouillage.
2. L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

ROHS/WEEE Notice

Viking is compliant with the latest WEEE, RoHS and REACH directives. For more information see www.carlsonsw.com/environmental-compliance.

COCOM Limits

The U.S. Department of Commerce mandates stringent regulations for exportable GPS products to ensure that their usage does not pose a threat to the security of the United States. This product incorporates specific performance limitations to comply with these requirements:

Immediate access to satellite measurements and navigation results is automatically disabled if the receiver velocity exceeds 1,000 knots or its altitude is calculated to be above 18,000 meters. In such instances, the receiver's GPS subsystem disables all output streams and logging functionalities until the COCOM situation clears. These measures are in place to uphold national security standards and prevent any misuse of the GPS technology.

Product Limited Warranty Information

For applicable product Limited Warranty information, please refer to the Limited Warranty Card included with this product, or consult your local Carlson Software authorized dealer.

Wie aktualisiere ich GNSS Viking?

Verbinden Sie Viking mit dem Viking Blue Blue USB-A-Datenkabel mit Ihrem PC und öffnen Sie einen Webbrowser mit der IP-Adresse 192.168.10.1

Stellen Sie sicher, dass der PC mit dem Internet

Safety Information

Use and Care

This product comes with a release note, manual or other documents that specify how to use the equipment and any accessories. Please read this documentation before operating the receiver and follow these specifications during its operation.

This product is made to handle the hard use and tough conditions that often happen in land surveying, machine control and other field applications. However, the receiver is a high-accuracy electronic device and needs reasonable care.

The receiver may get damaged if you operate or store it outside the specified temperature range.

The receiver has multiple internal radios that can send and receive signals through Bluetooth wireless technology, Wi-Fi, cellular modem, and UHF. There are different rules for using radio-modems in different countries. In some countries, you can use the unit without a license. In other countries, you need a license. Ask your local Carlson Software dealer for licensing information.

Before using a Carlson Software receiver with a radio-modem, find out if you need permission or a license to use the unit in your country. The end user is responsible for getting the right permit or license for the receiver for the place or country of use.

Safety Notice: Approved Antenna Usage for Viking Receiver Internal Radios

To ensure compliance with regulations and maintain optimal performance, the Viking receiver internal radios are designed to operate only with the antennas listed below. Using antennas not included in this list is strictly prohibited.

Approved Antennas (Country Dependent):

- For the 400 MHz radio:
  - 0 dBi and 5 dBi whip antenna
- For the 900 MHz radio:
  - 0 dBi and 5 dBi whip antenna

Important Usage Guidelines:

1. Impedance Requirement: The required antenna impedance for this device is 50 ohms.
2. Interference Prevention: To minimize potential radio interference with other users, the selected antenna type and gain must be configured so that the equivalent isotropically radiated power (e.i.r.p.) does not exceed the limits necessary for successful communication.
3. Prohibited Use: Antennas not explicitly listed above are not authorized for use with this device and may result in regulatory non-compliance, degraded performance, or potential interference.

Safety Notice: Ensure Adequate Airflow for Cooling

To maintain the optimal performance and safety of this product, it is recommended to ensure minimal airflow around the unit to ensure basic cooling requirements. Insufficient airflow may result in overheating.

Follow these recommendations to ensure adequate airflow:

1. Placement: Do not place the product in an enclosed or confined space without proper ventilation.
2. Clearance: Maintain at least 1 inch (2.5 cm) of space around all sides of the product to allow for air circulation.

Safety Notice: Do Not Remove Both Batteries Simultaneously

To prevent potential damage to the unit, do not remove both batteries at the same time. Removing both batteries simultaneously can disrupt the device's power management system, potentially leading to data loss, system malfunction, or permanent damage.

Follow these guidelines when handling the batteries:

1. Remove batteries one at a time: Always replace or service batteries one at a time to maintain uninterrupted power.
2. Power down if necessary: If the unit must be powered off, ensure you follow proper shutdown procedures before removing any batteries.
3. Refer to the manual: Consult the detailed instructions in the user manual for correct battery handling procedures.

Important: Failure to adhere to these precautions may void the warranty and result in costly repairs or irreversible damage to the unit.

Safety Notice: Power Off Before Inserting or Removing SIM or SD Card

To avoid damage to the unit or the card, always ensure the device is completely powered off before inserting or removing the SIM card or SD card. Performing these actions while the device is powered on can result in data corruption, hardware damage, or malfunction.

Type Approval

Type approval, or acceptance, refers to the technical parameters of the equipment that relate to emissions that can interfere with other signals. Type approval is given to the maker of the transmission equipment, regardless of the operation or licensing of the units. Some countries have specific technical requirements for operating in certain radio frequency bands. Carlson Software may have adjusted your equipment to meet those requirements to obtain type approval.

Unauthorized modification of the units voids the type approval, the warranty, and the operational license of the equipment.

Product Disposal

Ultimate disposal of this product should be handled according to all national laws and regulations.

Glossary

- **4G**: Fourth generation of broadband cellular network technology, succeeding 3G.
- **ANTEX**: Antenna Exchange Format. A standardized text file format that describes the physical and electrical characteristics of GNSS antennas. ANTEX files provide crucial data on PCVs and PCOs, facilitating precise positioning and ensuring the accuracy and consistency of satellite-based measurements. Maintained by the IGS, these files support interoperability among various GNSS systems and devices.
- **APC**: Antenna Phase Center. The effective point on a GNSS antenna from which satellite signals are measured, crucial for determining accurate position data.
- **ARP**: Antenna Reference Point. The specific physical location on a GNSS antenna used as a reference for all positional measurements, typically marked for accurate setup and calibration.
- **BT**: Acronym for Bluetooth.
- **Bluetooth**: A wireless technology standard for short-range communication between devices, enabling the exchange of data and connection of peripherals like headphones, keyboards, and sensors without the need for cables.
- **BDS:** Abbreviation for BeiDou GNSS.
- **BeiDou**: A global satellite navigation system operated by China, providing precise positioning, navigation, and timing services. It serves as an alternative and complement to other GNSS systems such as GPS and GLONASS.
- **CLI**: Command Line Interface. A means of interacting with a computer program where the user issues commands to the program in the form of successive lines of text.
- **CMR**: Compact Measurement Record. Proprietary format developed by Trimble for transmitting differential correction data from a reference station to a rover receiver.
- **CMR+**: An enhanced version of CMR, CMR+ offers improved data compression and error correction.
- **CPU**: Central Processing Unit. The electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logical, control and input/output operations specified by the instructions.
- **DDNS**: Dynamic DNS is a service that updates DNS records automatically when a device's IP address changes, allowing consistent remote access to services without needing a static IP.
- **DGNSS**: Differential GNSS. A technique used to enhance the accuracy of GNSS positioning by applying correction data from a reference station to the rover receiver.
- **DGPS**: Synonym for DGNSS.
- **DHCP**: Dynamic Host Configuration Protocol. A network management protocol used on Internet Protocol networks whereby a DHCP server dynamically assigns an IP address and other network configuration parameters to each device on a network so they can communicate with other IP networks.
- **DOP**: Dilution of Precision. A quality metric for satellite geometry on positioning accuracy. Lower DOP values represent better satellite geometry and higher positioning accuracy, while higher DOP values indicate poorer satellite geometry and reduced accuracy.
- **EEA**: European Economic Area. An international agreement that enables the extension of the European Union's single market to non-EU member parties.
- **EMC**: Electromagnetic Compatibility. The ability of electrical equipment and systems to function acceptably in their electromagnetic environment, by limiting the unintentional generation, propagation and reception of electromagnetic energy.
- **FCC**: Federal Communications Commission. It is an independent agency of the United States government that regulates interstate and international communications by radio, television, wire,

satellite, and cable. The FCC is responsible for implementing and enforcing America's communications law and regulations.

- **GAL**: Abbreviation for Galileo GNSS.
- **Galileo**: A satellite navigation system operated by the European Union, providing accurate positioning, navigation, and timing services. It serves as an independent and complementary system to other GNSS such as GPS, GLONASS, and BeiDou.
- **GNSS**: Global Navigation Satellite System. A satellite navigation system that provides geolocation and time information to a receiver anywhere on or near the Earth.
- **GLO**: Abbreviation for GLONASS GNSS.
- **GLONASS**: Global Navigation Satellite System. A satellite navigation system operated by Russia, providing global positioning and timing information. It is an alternative and complementary system to the U.S. GPS.
- **GPS**: Global Positioning System. A satellite-based radionavigation system owned by the United States government and operated by the United States Space Force.
- **IGS**: International GNSS Service. An international organization providing high-precision GNSS data and products for scientific and practical applications, supported by a global network of GNSS stations.
- **IMU**: Inertial Measurement Unit. An electronic device that measures and reports a body's specific force, angular rate, and sometimes the orientation of the body, using a combination of accelerometers, gyroscopes, and sometimes magnetometers.
- **IRNSS:** Indian Regional Navigation Satellite System also known as NavIC (see entry for NavIC).
- **LAN**: Local Area Network. A computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.
- **NavIC**: Navigation with Indian Constellation. An Indian regional satellite navigation system, also known as IRNSS, providing accurate positioning and timing services primarily over India and surrounding regions. It is designed to enhance GNSS performance with a focus on regional accuracy and reliability.
- **NMEA**: National Marine Electronics Association. An American-based marine electronics trade organization setting standards of communication between marine electronics.
- **PCO**: Phase Center Offset. The fixed offset between a GNSS antenna's physical center (ARP) and its phase center (APC).
- **PCV**: Phase Center Variation. Variations in the position of the GNSS antenna's phase center, affecting the accuracy of positioning measurements. These variations need to be accounted for to improve the precision of GNSS data.
- **PPS**: Pulse Per Second. An electrical signal that has a width of less than one second and a sharply rising or abruptly falling edge that accurately repeats once per second.
- **QZSS:** Quasi-Zenith Satellite System. A regional satellite navigation system operated by Japan, designed to enhance GNSS performance in the Asia-Oceania region.
- **RF**: Radio Frequency. It refers to the rate of oscillation of electromagnetic radio waves in the range of 3 kHz to 300 GHz, as well as the alternating currents carrying the radio signals. RF is commonly used in wireless communication and broadcasting.
- **RINEX**: Receiver Independent Exchange Format. A data interchange format for raw satellite navigation system data.
- **RS232**: A standard for serial communication transmission of data.
- **RTCM:** Radio Technical Commission for Maritime Services. A set of standards for the transmission of GNSS data. RTCM protocols are used to improve the accuracy of GNSS positioning by providing correction data to GNSS receivers. These standards are widely adopted in marine navigation, surveying, agriculture, and other applications requiring high-precision positioning.
- **RTK**: Real-Time Kinematic. A technique used to enhance the precision of position data derived from satellite-based positioning systems.
- **SHMP**: Slant Height Measurement Point. Reference point to make slant height measurements.

- **SSID**: Service Set Identifier. A sequence of characters that uniquely identifies a wireless local area network.
- **UHF**: Ultra High Frequency. The ITU designation for radio frequencies in the range between 300 MHz and 3 GHz.
- **VRS:** Virtual Reference Station. A technique used in GNSS to enhance the accuracy of positioning. VRS generates a set of corrections from a network of physical reference stations, creating a virtual station near the user's location. This approach improves real-time kinematic (RTK) positioning accuracy by accounting for local atmospheric conditions and reducing errors related to distance from reference stations.
- **WAN**: Wide Area Network. A telecommunications network that extends over a large geographical area for the primary purpose of computer networking.
- **Web UI**: Web User Interface. The visual and interactive part of the embedded web based that users interact with through a browser, including layouts, buttons, menus, forms, and other on-screen elements.
- **WLAN**: Wireless Local Area Network. It is a type of local area network (LAN) that uses high-frequency radio waves rather than wires to communicate and transmit data. It provides wireless network communication over short distances, typically within a building or a campus.

1 Introduction

1.1 Viking Product Overview

The Viking: Precision, Reliability and Versatility Redefined

The Viking is Carlson Software's new ultimate solution for precision positioning. An all-new high-precision GNSS multi-frequency RTK smart antenna, designed to deliver reliable centimeter level positioning together with 3D orientation. Equipped with a best-in-class GNSS antenna element and an integrated IMU, the Viking provides exceptional flexibility, durability, and automatic pole tilt compensation – completely calibration-free and immune to magnetic interference.

The Viking is your ultimate solution for precision positioning, whether as a base station delivering RTK corrections to your existing rover network or as a lightweight, easy-to-use rover. Seamlessly connect the Viking to your base station via UHF radio or a cellular network, and manage every aspect of its functionality through the intuitive, built-in Web User Interface (Web UI).

See Carlson Viking RTK White Paper for an overview of the main technologies deployed in the new Viking RTK Receiver and how it delivers best-in-class performance as tested in the field.

Triple-Fix RTK

For the first time in the industry, Viking integrates two GNSS chips with three independent RTK engines, delivering exceptional accuracy and reliability even in the most challenging environments. When the GAMA® RTK engine and one of the secondary OEM engines are in agreement, the Viking reports RTK Fixed+. When all three engines achieve RTK Fixed and align perfectly, it reports Triple-Fix.

Cutting-Edge Connectivity and Performance

Featuring a built-in 4G cellular modem and UHF radio, the Viking delivers stable internet connectivity and reliable RTK data transmission. It can be configured to operate either as a Rover or a Base Station, offering exceptional versatility for a wide range of applications.

With support for 632 channels, the Viking can simultaneously track all major satellite constellations — GPS, GLONASS, BeiDou, Galileo, QZSS, and NavIC (IRNSS). This broad compatibility ensures outstanding accuracy and reliability in any environment.

Advanced Technology for Every Challenge

At the heart of the Viking is the powerful GAMA® RTK Navigation engine, seamlessly integrated with an advanced Web User Interface (Web UI) for effortless configuration, management, and upgrades. Its cutting-edge RTK Triple-Fix technology delivers ultra-precise positioning with near-100% reliability, ensuring accuracy in every application.

Built for the toughest jobs, the Viking's ruggedized antenna is engineered to withstand extreme conditions and meets IP67 protection standards, making it the perfect solution for demanding environments.

Uninterrupted Power for Maximum Efficiency

Powered by two long-lasting lithium batteries, the Viking offers up to 14 hours of uninterrupted operation. The hot-swappable design allows replacing its batteries without downtime, ensuring seamless performance and maximizing your Return on Investment (ROI).

Versatility Across Industries

Whether you're conducting land or marine surveys, GIS mapping, construction projects, or advanced RTK applications, the Viking is your trusted partner.

Precision, Performance, and Reliability

The Viking is more than just a positioning system, it's a powerful tool engineered to boost your efficiency, simplify your workflows, and provide unparalleled accuracy. Take your operations to the next level with the Viking and experience a new era of RTK precision.

Purpose-built for seamless integration into land surveying and machine control applications, Viking is meticulously designed for optimal compatibility with Carlson SurvPC.

Viking also features the following communication interfaces:

- Wi-Fi
- Bluetooth
- Cellular modem
- UHF Radio (400 + 900 MHz)
- 2x Serial RS232
- 1x USB for Ethernet over USB
- 1x removable SD card

1.2 GAMA® RTK Technology

The GAMA® RTK Engine (named after famous explorer Vasco da Gama) is Carlson Software's next generation RTK engine.

GAMA® deploys a range of innovative technologies to deliver best-in-class performance.

Key features of GAMA® include:

Optimization for Next-Gen CPUs:

- Takes advantage of modern CPU architecture to enable powerful multi-core computations in embedded and handheld devices.
- Designed to utilize multi-threaded computation routines, unlocking new possibilities and computational performance.

Next-Gen Filters:

- Relies on multiple Extended Kalman Filters that estimate individual error components for each GNSS signal.
- New CPU architecture allows the deployment of extended mathematical models, eliminating past approximations.
- Can estimate over 1000 parameters per second for high accuracy in various environments.

GNSS Signal and Frequency Diversity:

- Designed to maximize the use of all available GNSS signals, including current and potential future signals.
- Implements independent handling of all GNSS signals in multiple frequencies and modulations.
- Can operate in single-frequency mode or with specific subsets of frequencies based on signal availability or interference.

Outlier Detection and Handling:

- Utilizes multiple protection layers for outlier detection and handling.
- Employs iterative robust statistics and strict statistical analysis to identify and manage measurements that deviate from the predefined model.
- Real-time adaptive filtering adjusts GNSS observation models to changing environmental conditions.

Real-Time Adaptive Filtering:

- Employs techniques to ensure accurate GNSS error models despite changing conditions.
- Data-driven error models derived from real environment data provide a solid foundation for estimation processes.
- Pre-processing filters monitor GNSS signal quality and adjust observation models in real-time based on various metrics.

Advanced IMU Integration:

- Processes data from six-axis Inertial sensors for high-accuracy position, velocity, tilt, and heading information.
- Delivers best-in-class tilt compensation.
- Tightly-coupled hybridization engine enables continuous operation even during GNSS outages and is immune to magnetic interference.
- Life cycle automatic IMU error calibration maximizes integration accuracy and maintains long-term reliability.

1.3 Advanced GNSS Signal Processing Technologies

Viking features a variety of technologies at the GNSS digital signal processing level, improving acquisition, tracking but also accuracy and reliability of the GNSS raw measurements. These technologies offer a first layer of protection for the Carlson GAMA® RTK engine.

Anti-jamming and anti-spoofing protection

Industry-leading interference monitoring and mitigation technology offers resistance against radio interference and protects against intentional GNSS jamming and spoofing.

Optimal tracking under high vibration

Optimal tracking even under rapid antenna displacement, maintaining high accuracy together with:

- Resilience to heavy vibrations and shocks
- Stable operation during high dynamics

Resilience to space weather events

Mitigates adverse impact of both normally active and scintillating ionosphere:

- Resilience to ionospheric scintillation
- Stable operation during solar storms

Multipath mitigation

Multipath mitigation technology for mitigation of reflected GNSS signals for higher accuracy and reliability. Extra correlators in each tracking channel to estimate the multipath error on the pseudorange and carrier phase measurements.

- Resilience to multipath error
- Stable operation near buildings, heavy machinery and construction sites

2 Hardware Description and Installation

2.1 Viking Front Panel and LEDs

The front panel of the Viking features the UI panel, which includes the Power Button and LED indicators:

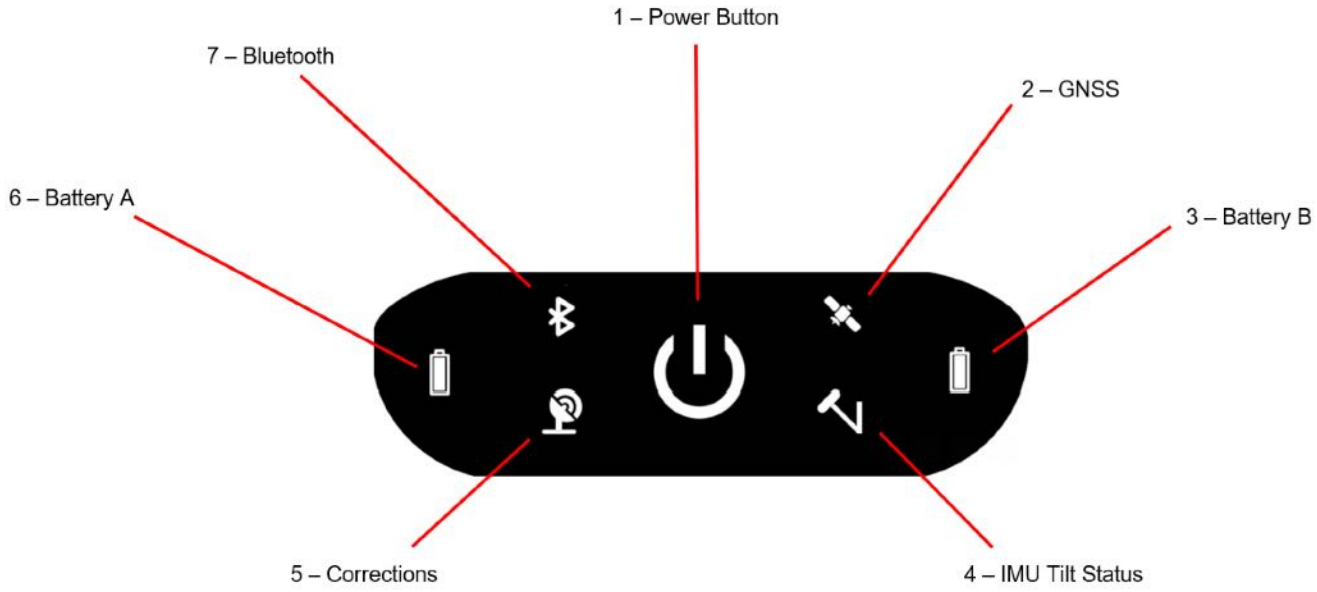


Figure 1 - Viking front UI panel view and LEDs.

Viking LED Description:

1. Power Button – Power Button (On/Off)
2. GNSS – GNSS Status (Blinking when position is valid, solid when RTK Fixed)
3. Battery B – Battery B status (see Table 2 below)
4. Tilt – IMU Tilt Status (see Table 1 below)
5. Corrections – Corrections (Blinks when new GNSS corrections are received)
6. Battery A – Battery A status (see Table 2 below)
7. Bluetooth – Bluetooth status (On/Off)

When the system is idle (booting completed but no GNSS tracking connected) the Satellite and Corrections LEDs will continuously blink in a ping-pong sequence.

Viking IMU Tilt LED Status Behavior:

IMU Tilt Status	LED Color
Not initialized	Blue
Motion required	Pink
Initialized but losing accuracy (motion advised)	Yellow
Initialized	Green

Table 1 - Viking IMU Tilt LED Status Behavior.

Battery LED Status Behavior:

Battery Status	LED Behavior
40% or higher	Solid green
20-40%	Blinking yellow
Below 20%	Blinking red

Table 2 - Battery LED Status Behavior Table.

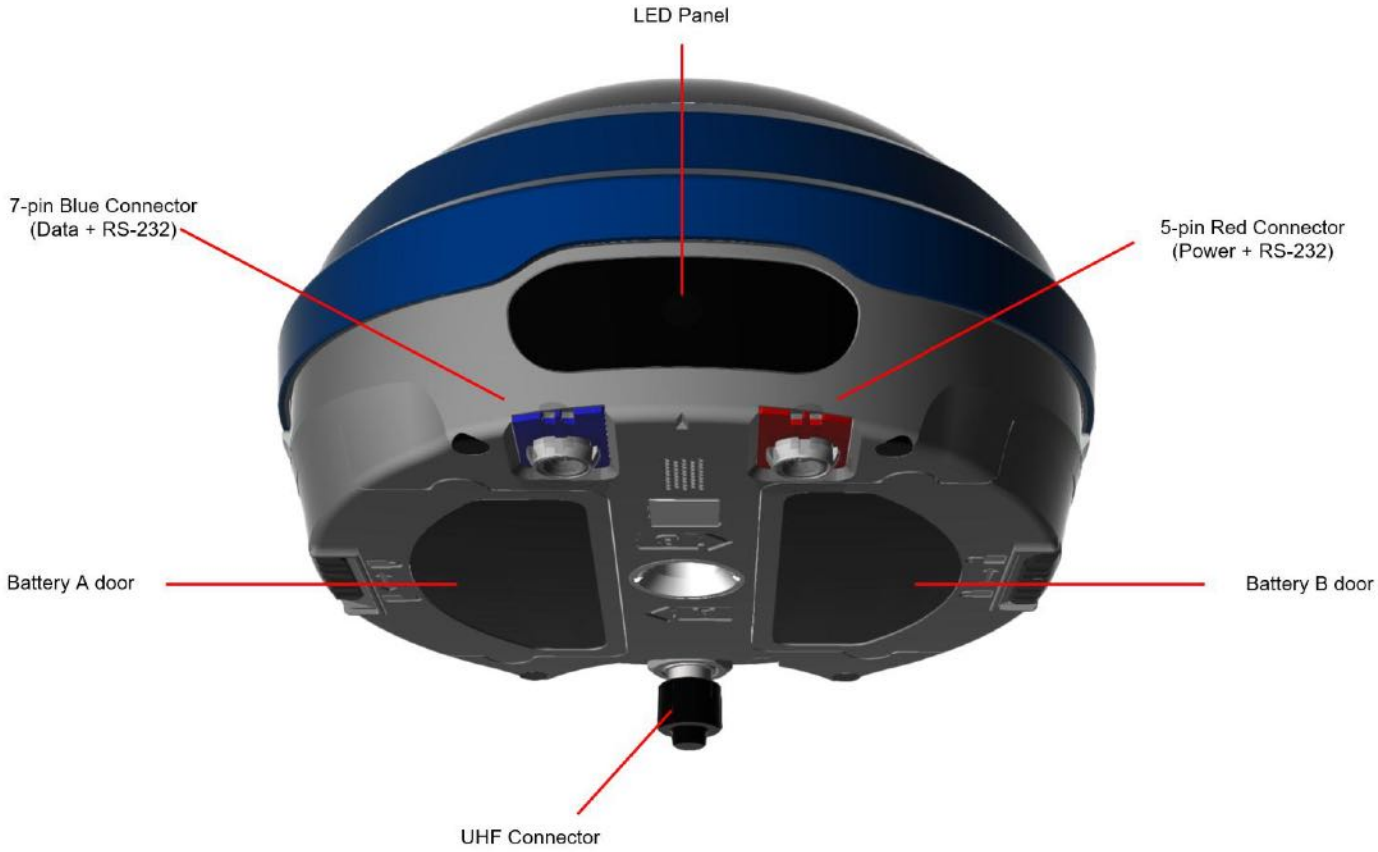


Figure 2 - Viking front view.

2.2 Viking Bottom

The bottom side of Viking provides access to all ports and physical connections, namely the 2 hot-swappable battery bays, TNC connector for the UHF radio antenna, 5 and 7 pin connectors for advanced functionalities and communication interfaces.

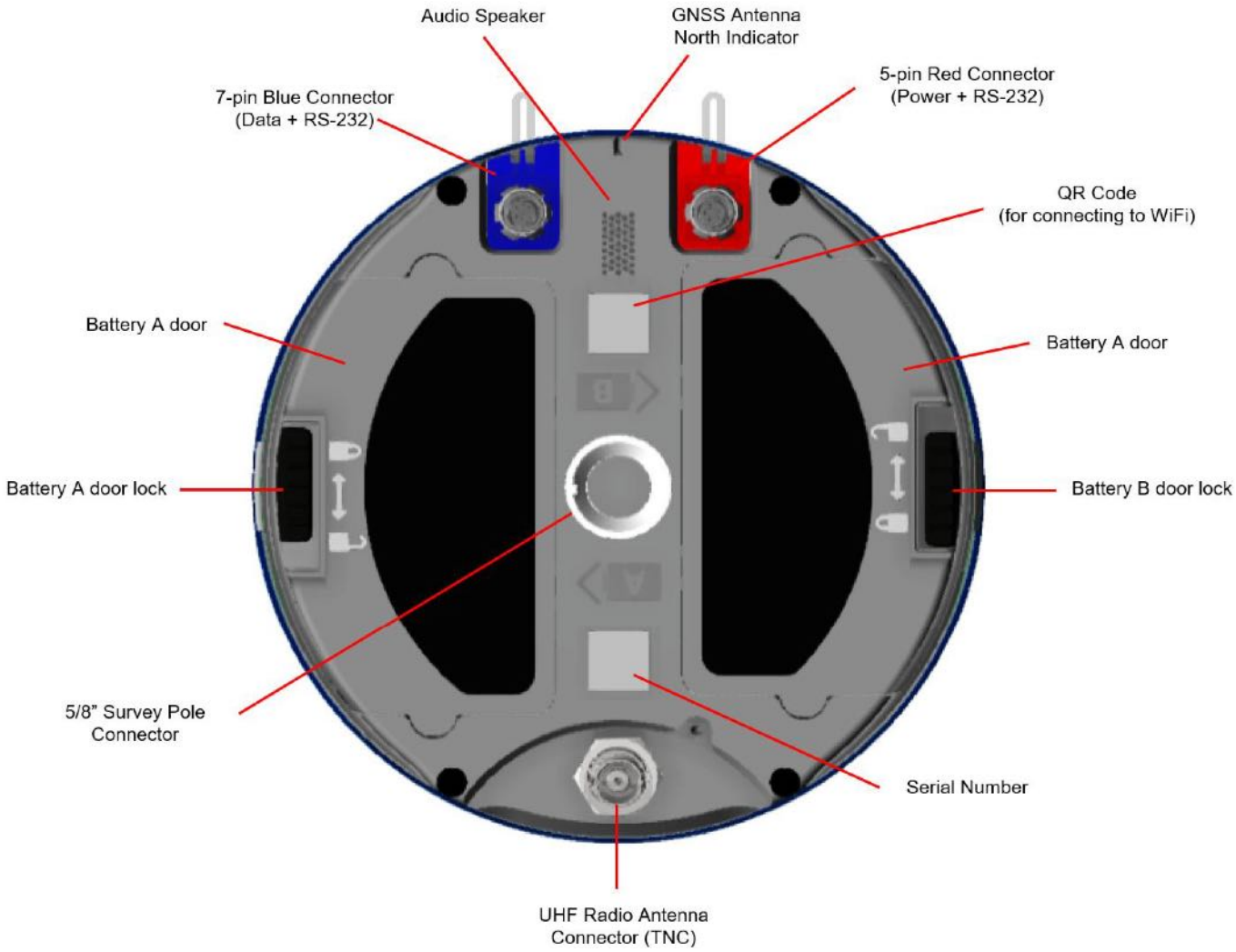


Figure 3 – Viking bottom view.

Connector pinouts are specified in section 10.4.

To easily access the Viking Web UI, use your smartphone to scan the QR code on the bottom of the Viking to automatically connect to the Viking Wi-Fi Hotspot, then open an internet browser on 192.168.10.1.

The device's serial number and default password can be found inside the Battery B compartment.

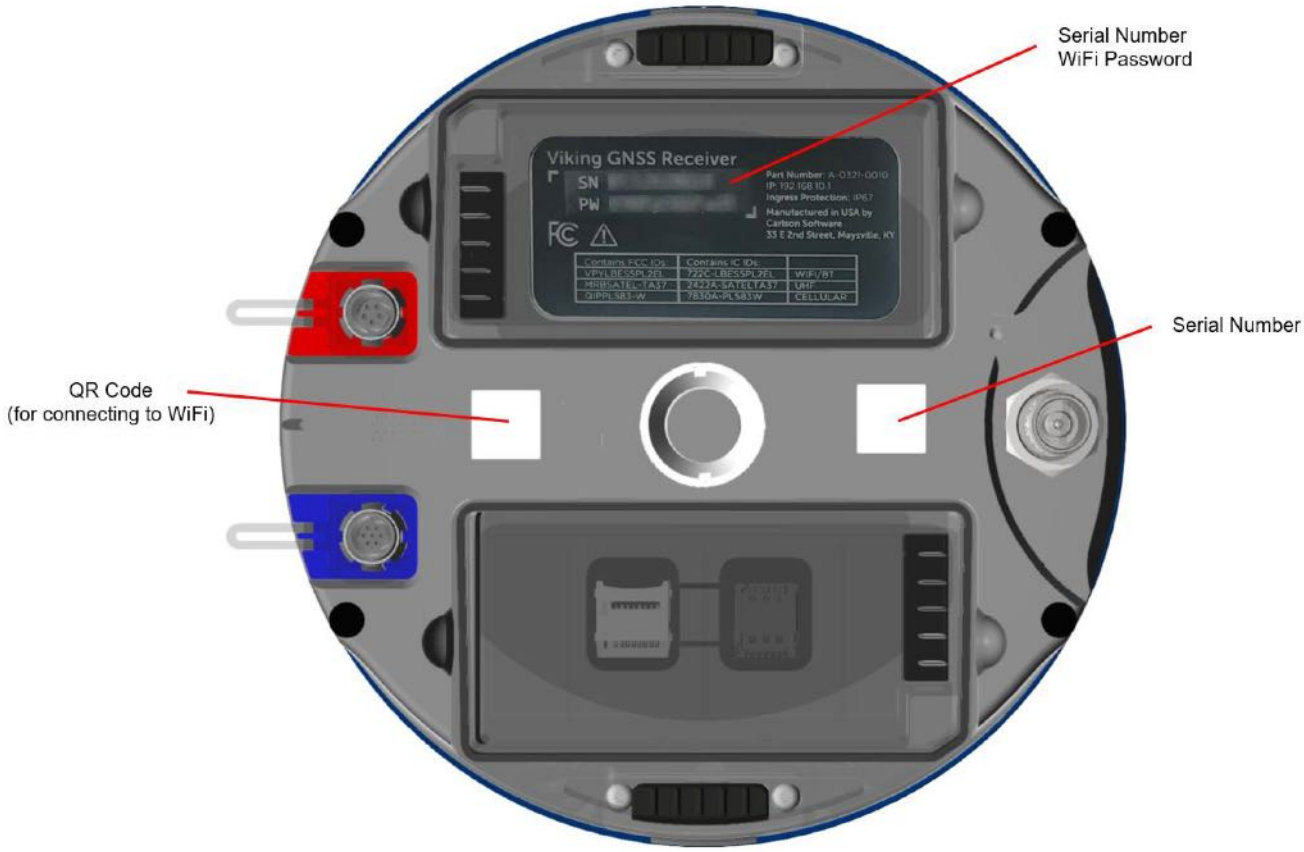


Figure 4 - Viking WiFi QR code, serial number and password.

2.3 Powering Viking On/Off

Powering On:

Click and hold Power Button pressed for a few seconds (3 seconds) until LED lights turn on. If no LED lights turn on then confirm that the batteries are inserted and are sufficiently charged.

Powering Off:

Click and hold Power Button pressed for a few seconds (3 seconds) until LED lights turn off.

2.4 Swapping Batteries

The procedure to swap the batteries is as follows:

1. Slide battery lock to unlocked position – see Figure 5.
2. Push battery lid release button on the side of the unit – see Figure 6.
3. Remove battery door
4. Pull battery out
5. Insert new battery
6. Insert battery door
7. Slide battery door lock to locked position – see Figure 5.

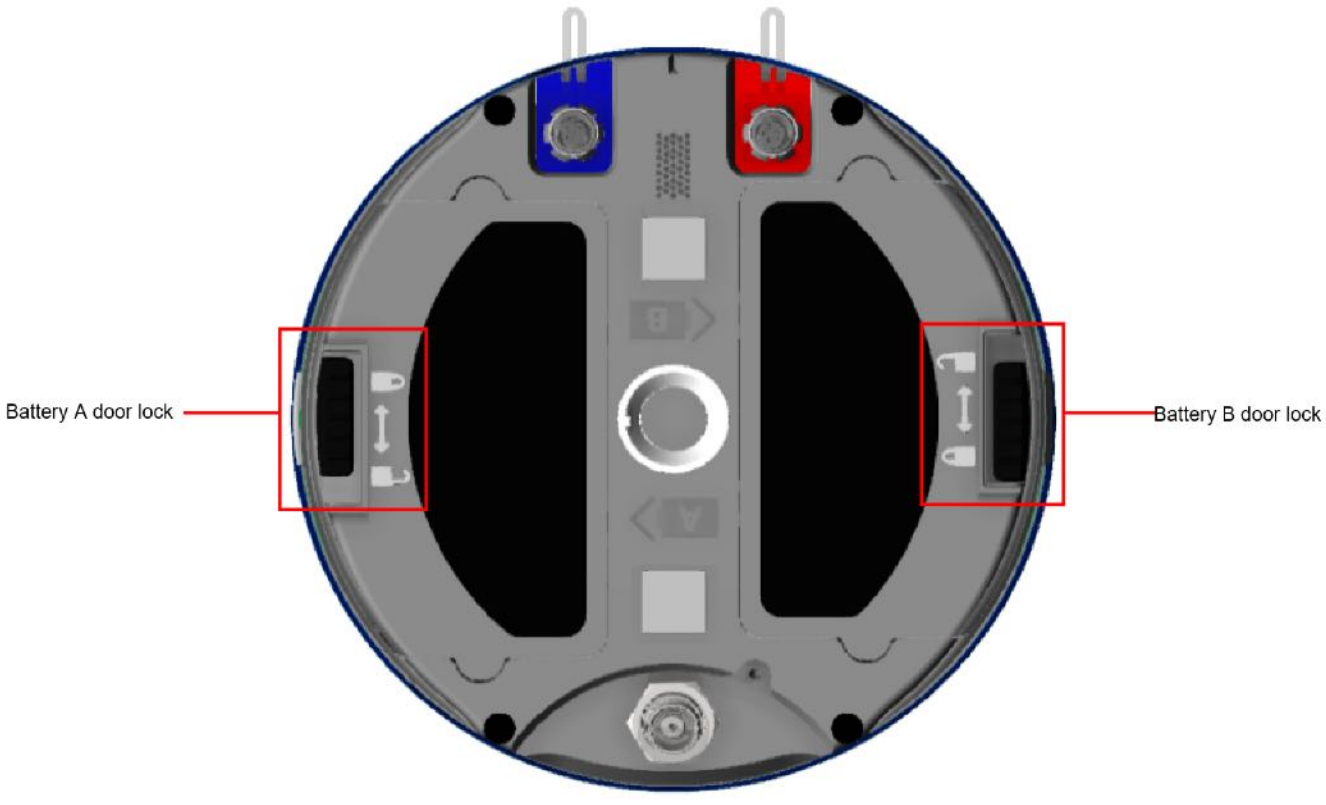


Figure 5 – Viking Battery Lock Buttons.

Safety Notice: Do Not Remove Both Batteries Simultaneously

To prevent potential damage to the unit, do not remove both batteries at the same time. Removing both batteries simultaneously can disrupt the device's power management system, potentially leading to data loss, system malfunction, or permanent damage.

Follow these guidelines when handling the batteries:

1. Remove batteries one at a time: Always replace or service batteries one at a time to maintain uninterrupted power.
2. Power down if necessary: If the unit must be powered off, ensure you follow proper shutdown procedures before removing any batteries.
3. Refer to the manual: Consult the detailed instructions in the user manual for correct battery handling procedures.

Important: Failure to adhere to these precautions may void the warranty and result in costly repairs or irreversible damage to the unit.

Figure 6 – Viking battery lid release button.

2.5 SIM Card Installation Procedure

The SIM card location and installation procedure are illustrated in Figure 7 and Figure 8.

The procedure to install the SIM card is as follows:

1. Power off Viking
2. Remove Battery A door
3. Remove Battery A
4. Remove SIM card rubber cover
5. Slide metal lid from ‘LOCK’ position to ‘OPEN’ position
6. Flip SIM card holder to open position
7. Insert SIM card
8. Slide metal lid from ‘OPEN’ position to ‘LOCK’ position
9. Close metal lid and slide back to ‘LOCK’ position (makes clicking sound)
10. Install SIM card rubber cover
11. Re-insert battery and insert battery door
12. Power on Viking and configure internal cell modem (see section 5.4)

Safety Notice: Power Off Before Inserting or Removing SIM or SD Card

To avoid damage to the unit or the card, always ensure the device is completely powered off before inserting or removing the SIM card or SD card. Performing these actions while the device is powered on can result in data corruption, hardware damage, or malfunction.

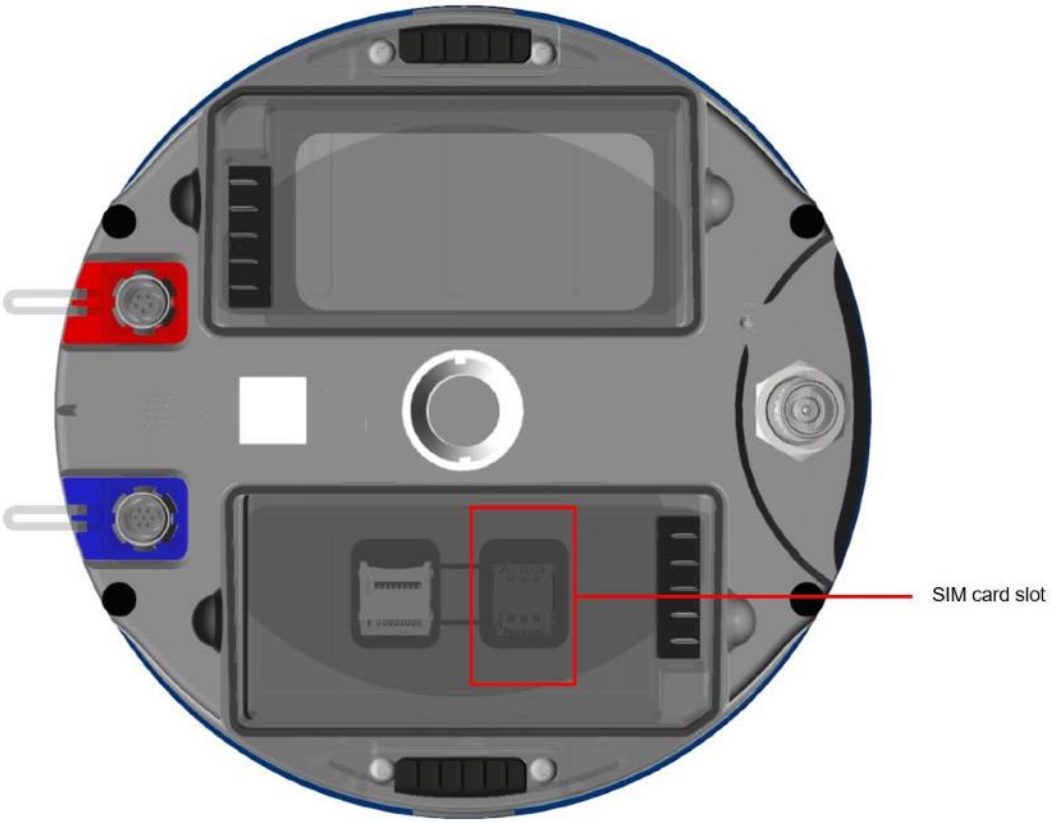


Figure 7 - SIM card and SD card slot location.

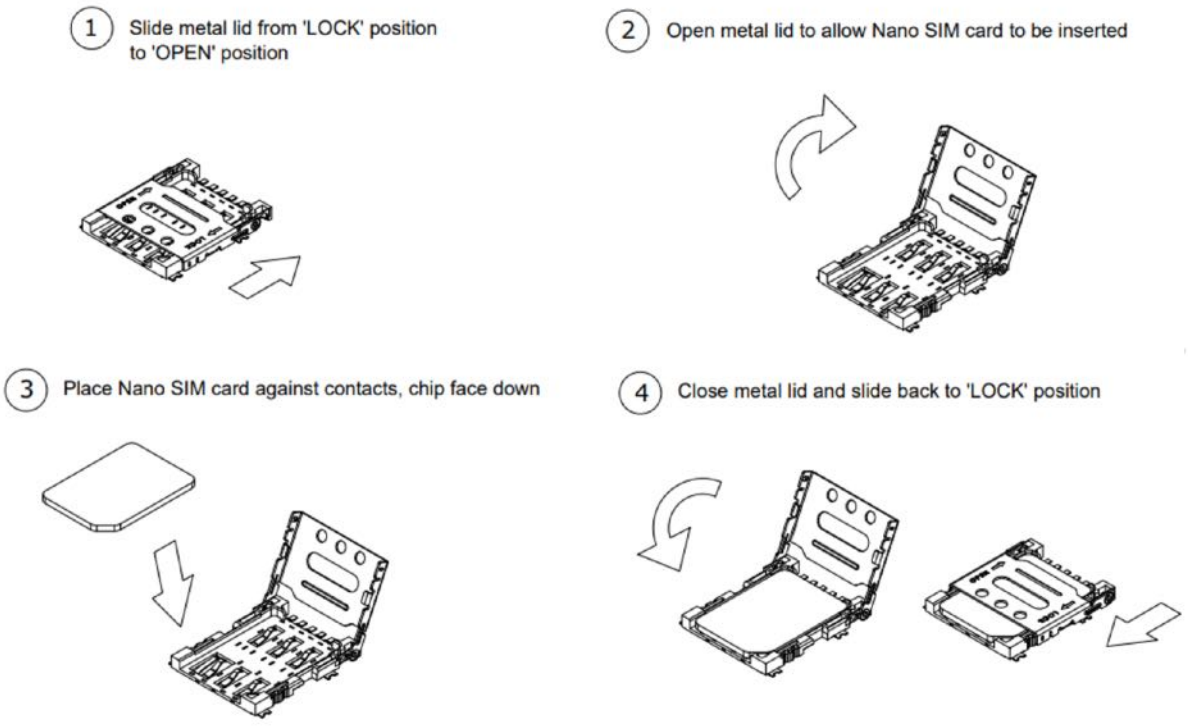


Figure 8 - SIM card installation procedure.

2.6 SD Card Installation Procedure

The SD card location and installation procedure are illustrated in Figure 9 and Figure 10.

The procedure to install the SD card is as follows:

1. Power off Viking
2. Remove Battery A door
3. Remove Battery A
4. Remove SD card rubber cover
5. Slide metal lid from ‘LOCK’ position to ‘OPEN’ position
6. Flip SD card holder to open position
7. Insert SD card
8. Slide metal lid from ‘OPEN’ position to ‘LOCK’ position
9. Close metal lid and slide back to ‘LOCK’ position (makes clicking sound)
10. Install SD card rubber cover
11. Re-insert battery and insert battery door

Safety Notice: Power Off Before Inserting or Removing SIM or SD Card

To avoid damage to the unit or the card, always ensure the device is completely powered off before inserting or removing the SIM card or SD card. Performing these actions while the device is powered on can result in data corruption, hardware damage, or malfunction.

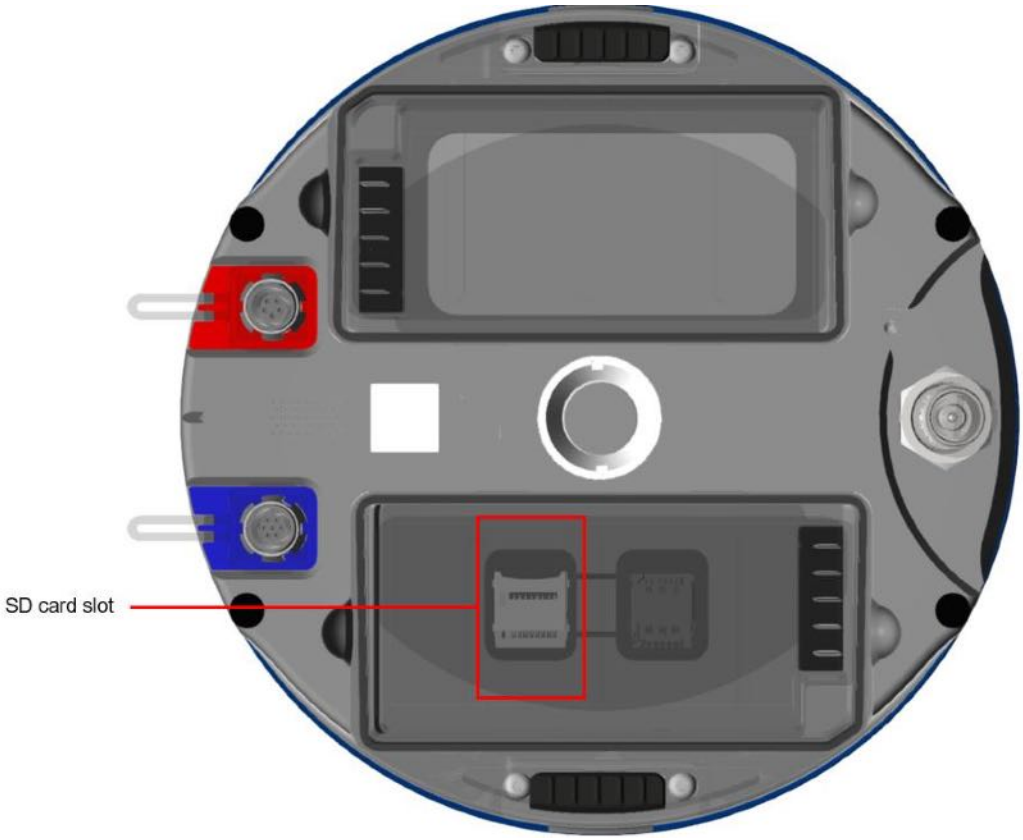


Figure 9 - SIM card and SD card slot location.

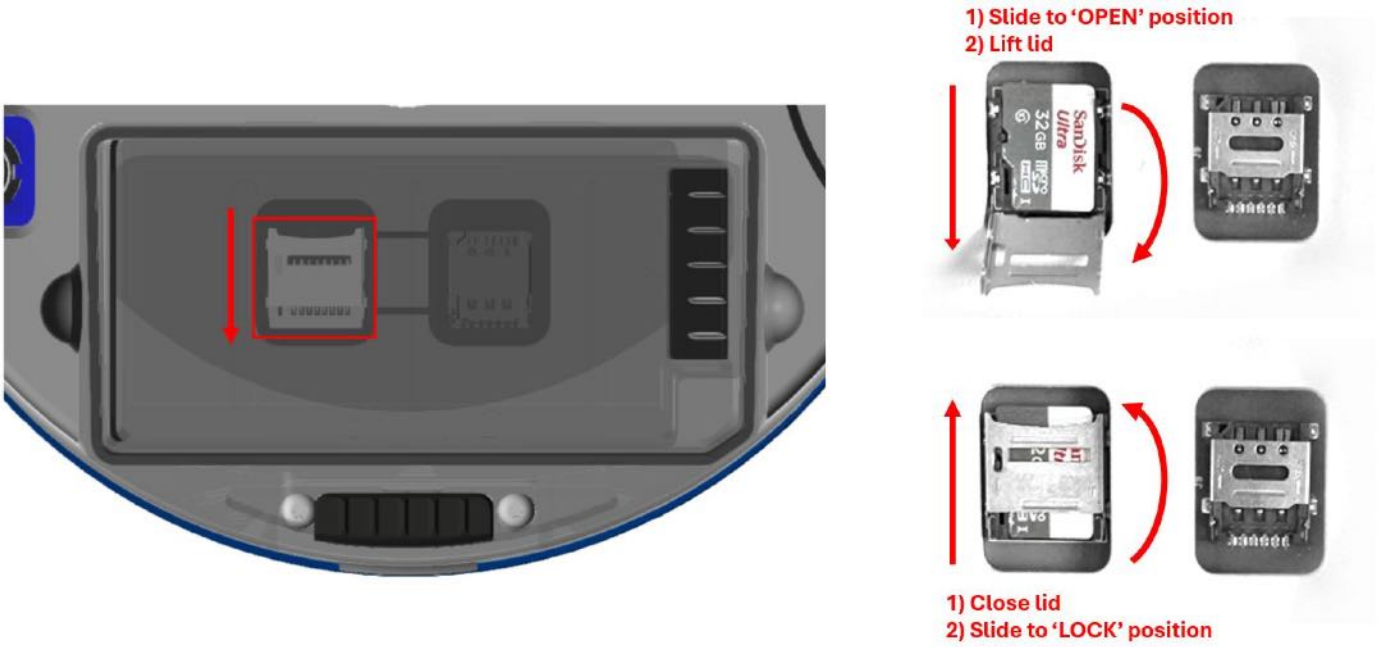


Figure 10 - SD card installation procedure.

2.7 Installing UHF Antenna

To install the external UHF antenna for the Viking, begin by identifying the official Carlson UHF antenna included in the Viking Kit. Locate the UHF TNC connector situated on the underside of the unit and remove its protective cover. Align the connector end of the UHF antenna with the TNC port, then rotate it clockwise until the antenna is securely attached to the Viking.

2.8 Installing Viking on a Range Pole

To mount the Viking on a range pole, use the standard 5/8” mount located at the base of the Viking to attach it securely to a 5/8” mount on the range pole. Carefully position the Viking on the range pole, ensuring proper alignment to prevent cross-threading during clockwise rotation. Tighten the unit by hand with sufficient force to ensure it is firmly secured. Take care to handle the Viking cautiously and avoid dropping it while attaching it to the range pole.

Figure 11 - Viking Installed on range pole with UHF antenna.

2.9 Installing Viking on a Tribrach

To mount the Viking onto a tribrach, align the 5/8” female metal connector of the Viking with the corresponding 5/8” male connector on the tribrach. Rotate the Viking clockwise and hand-tighten it with enough force to ensure it is securely fastened to the mount.

Figure 12 - Viking installed on a tribrach.

2.10 Connecting Viking to External Power Supply

The Viking can be powered through two methods:

1. Internal lithium batteries (hot-swappable)
2. External power supply (5-pin Red Cable)

The lithium batteries are hot-swappable (refer to section 2.4 Swapping Batteries) and can be charged either externally using the provided charger or while installed in the unit. When the unit is connected to an external power source with the batteries installed, the internal batteries will automatically charge.

To connect the Viking to an external power source, connect the 5-pin Power cable (Red marked cable) to the 5-pin port (Red connector port) on the bottom side of the unit (see Figure 3 in section 2.2 Viking Bottom) and connect the power connector to a 12 V external battery or power supply (11-17 V is the accepted range).

2.11 Viking Cables

The following cables are provided as standard in the Viking kit:

Viking Rover Kit:

- 7-pin Blue USB-A Data Cable (P/N 8015.064.001)
- 5-pin Red USB-C Power Cable (P/N 8015.064.005)

Viking Base-Rover Kit:

- 7-pin Blue USB-A Data Cable (P/N 8015.064.001)
- 5-pin Red USB-C Power Cable (P/N 8015.064.005)
- 5-pin Red SAE Power Cable set with alligator clips (P/N 8015.064.002 + P/N 8015.064.003)

Additional cables are available as optional accessories to enable usage of advanced features:

- 7-pin Y Cable (Serial RS-232 + USB-A Data)
- 5-pin Y Cable (Serial RS-232 + Power)

Figure 13 – 7-pin Blue USB-A Data Cable.

P/N 8015.064.001

Figure 14 – 5-pin Red USB-C Power Cable.

P/N 8015.064.005

Figure 15 – Power Cable SAE to alligator clips.

P/N 8015.064.002

Figure 16 – SAE to alligator clips Cable.

P/N 8015.064.003

Important Notice: Using Fuses with Alligator Clips

Fuse values of 2 A to 3 A are acceptable when using the Power Cable with Alligator Clips with fuses,

2.12 Advanced Features

Using External UHF Radio (5-pin Y Cable)

Viking is able to send / receive RTK corrections using an external UHF radio by connecting to the radio using serial RS-232 interface. Connect the 5-pin Serial + Power Cable to the 5-pin port (Red connector port) on the Viking (see Figure 3 in section 2.2 Viking Bottom) and connect the other end of the cable to the serial RS-232 interface of the external UHF radio.

For instructions on how to configure the Viking to use and external UHF radio using the Web UI see sections “Settings – Configuration” and “Settings – Configuring RTK Base station mode” under chapter 7.5.

Stream Data Over Serial Port (5-pin Y Cable)

Viking is able to stream NMEA-0183 protocol using the serial RS-232 interface exposed on the 5-pin port. Connect the 5-pin Serial + Power Cable to the 5-pin port (Red connector port) on the Viking (see Figure 3 in section 2.2 Viking Bottom) and connect the other end of the cable to the serial RS-232 interface on the device receiving the NMEA.

For instructions on how to configure the Viking to configure and stream NMEA using the Web UI see section “Settings – NMEA Output” under chapter 7.5.

Connect Ethernet over USB (Blue USB-A Cable or 7-pin Y Cable)

The Viking can be connected to a PC using the USB, establishing and Ethernet-over-USB connection between the Viking and a PC. This enables a robust and higher-speed connection which can be used for maintenance, FW updates, downloading large files from the Viking and for product support purposes.

When the Viking is connected to a PC over USB the Web UI is accessible on IP 192.168.10.1.

To establish the USB connection, connect the 7-pin Support Cable (Blue cable) to the 7-pin port (Blue connector port) on the Viking (see Figure 3 in section 2.2 Viking Bottom) and connect the USB-A end of the cable to the a USB-A port on the PC.

Before connecting the cable to the PC make sure the appropriate drivers and installed and up to date. You can request the drivers from Carlson Support.

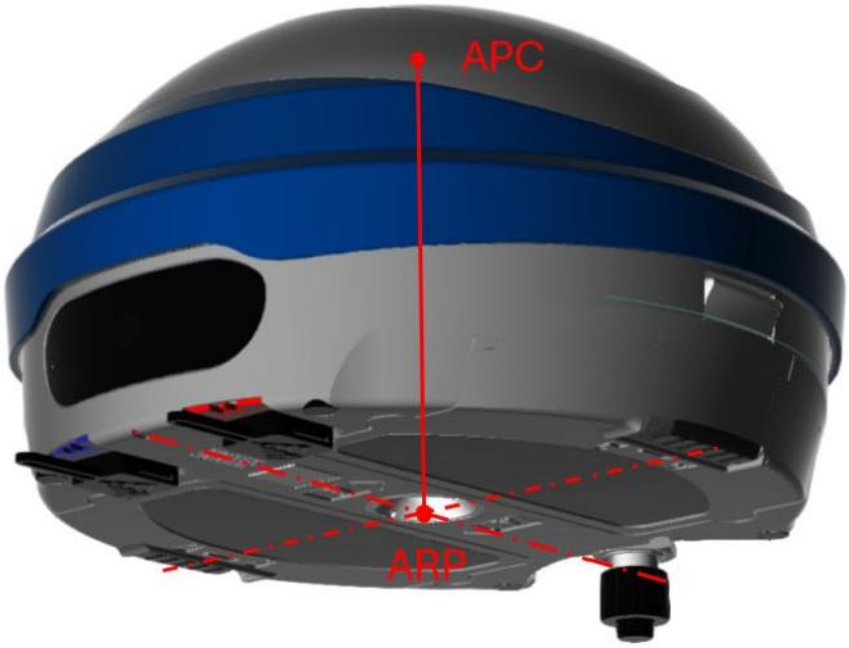
Diagnostics Port (7-pin Y Cable)

The 7-pin Support Cable can be used to establish a direct serial connection to the internal radio modules on the Viking for diagnostics and support purposes.

Connect the 7-pin Support Cable to the 7-pin port (Blue connector port) on the Viking (see Figure 3 in section 2.2 Viking Bottom) and connect the other end of the cable to the serial RS-232 interface of the a device or PC which will be diagnosing the internal radio modules.

2.13 ARP and PCOs

The following figure depicts the location and physical relationship between the Viking ARP, APC and PCOs:



Phase Center Offsets (PCO)

GPS L1 = 77.20 mm
GPS L2 = 79.76 mm
GPS L5 = 83.44 mm

Figure 17 - Viking APC, ARP and PCOs.

Definitions:

APC: Antenna Phase Center. The effective point on a GNSS antenna from which satellite signals are measured, crucial for determining accurate position data.

ARP: Antenna Reference Point. The specific physical location on a GNSS antenna used as a reference for all positional measurements, typically marked for accurate setup and calibration.

PCO: Phase Center Offset. The fixed offset between a GNSS antenna's physical center (ARP) and its phase center (APC).

2.14 Slant Height Measurement Point

When the Viking is used as a base station on a tripod, it is not always possible to take an accurate vertical reading of the antenna height. It is then necessary to take a slant reading and select ‘Slant’ instead of ‘Vertical’ in SurvPC.

Note that the Slant Height Measurement Point (SHMP) is the outer edge of the blue integrated Viking antenna – see figure below.

The SHMP is 42 mm above the Antenna Reference Point (ARP). The ARP is the base of the antenna mount. The slant antenna height is taken from the ground marker to the edge of the antenna.

Figure 18 - Viking Slant Height Measurement Point.

2.15 Adaptor Height Offsets

When using the quick-release adaptor (P/N 8015.085.001) an additional height offset of 40 mm must be accounted for.

Figure 19 - 5/8" quick release adapter (P/N 8015.085.001).

When using the UHF extension bracket (P/N 8015.064.004) an additional height offset of 3 mm must be accounted for.

Figure 20 - UHF cable extension bracket (P/N 8015.064.004).

2.16 What's Included in Your Kit

As shown in the tables below, the Viking is available in a variety of kits, with supplementary products sold as "controller/option kits", "accessory kits" or simply as separate accessories. Contents can change without prior notice. Check the official price list to confirm contents.

Viking Rover Kit

Part Number 8015.020.001

Item	Qty	Part Number
Viking GNSS Smart Antenna	1	8015.020.001
Viking Battery	2	8015.058.001
Viking dual-bay external battery charger	1	8015.060.001
Viking USB Wall Charger	1	8015.060.002
Viking 7-pin Blue USB-A Data Cable	1	8015.064.001
Viking 5-pin Red USB-C Power Cable	1	8015.064.005
UHF 400 MHz UHF antenna	1	8015.042.001
UHF 900 MHz UHF antenna	1	8015.042.002
5/8" quick release adapter	1	8015.085.001
Viking Rover Case	1	8015.080.002

Viking Rover + Base Kit

Part Number 8015.020.002

Item	Qty	Part Number
Viking GNSS Smart Antenna	2	8015.020.001
Viking Battery	4	8015.058.001
Viking dual-bay external battery charger	2	8015.060.001
Viking USB Wall Charger	1	8015.060.002
Viking 7-pin Blue USB-A Data Cable	1	8015.064.001
Viking 5-pin Red USB-C Power Cable	2	8015.064.005
Viking 5-pin Red Power Cable to SAE	1	8015.064.002
Viking Power Cable SAE to alligator clips	1	8015.064.003
UHF 400 MHz UHF antenna	2	8015.042.001
UHF 900 MHz UHF antenna	2	8015.042.002
5/8" quick release adapter	2	8015.085.001
UHF cable extension bracket	2	8015.064.004
Tape Measure	1	8015.080.004
Tribrach	1	8030.054.001
Tribrach Adapter	1	8030.054.020
Viking Rover + Base Case	1	8015.080.003

3 QuickStart Guide

3.1 Setting up Viking

To easily access the Viking Web UI, use your smartphone to scan the QR code on the bottom of the Viking to automatically connect to the Viking Wi-Fi Hotspot, then open an internet browser on 192.168.10.1.

The device's serial number and default password can be found inside the Battery B compartment.

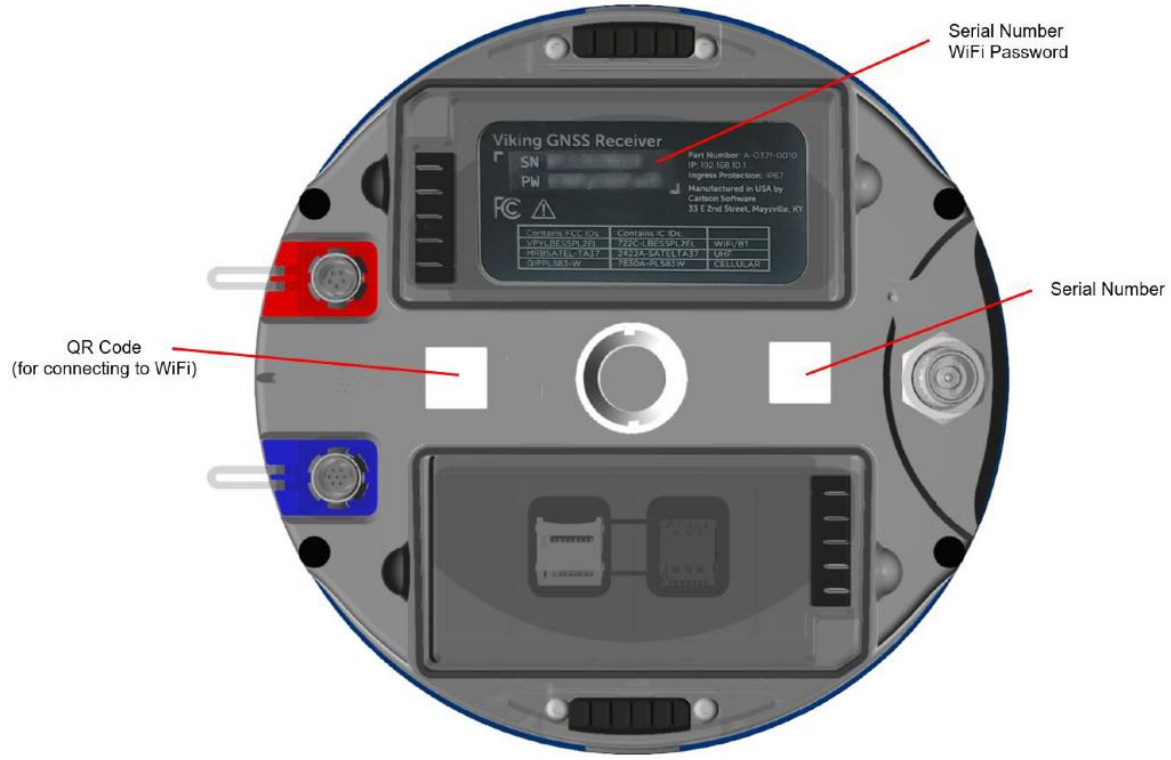


Figure 21 - Viking WiFi QR code, serial number and password.

Basic procedure:

1. Connect all antennas and cables (see 2.2 Viking Bottom)
2. Power on Viking (see 2.3 Powering Viking On/Off)
3. Access Web UI for basic configuration (see chapter 5.3 Accessing the Web UI)
4. Ensure system is up to date (to update FW see section 4 FW Update)
5. Configure Viking for operation using Carlson SurvPC or internal Web UI (see below)
6. For status and diagnostics see Web UI Overview section (chapter 7.3 Overview)

See 3.2 for examples of Viking installation diagrams.

Contact Carlson Software for detailed installation information and support for specific applications.

Setup Viking with Carlson SurvPC

Connect Viking to a Survey Data Collector Tablet running Carlson SurvPC using Bluetooth.

Please refer to Carlson SurvPC user manual for set up and configuration procedure.

Setup Viking with internal Web UI

Please consult chapter 7 Web UI for instructions on how to use the Viking Web UI.

Under “Settings->Configuration” make sure to configure:

- Operation Mode (Rover or Base)
- Output rate
- Base Station Input

Configure Viking networking settings under “Settings-Networking” – see chapter 5 - Network Setup (Cell, Wi-Fi, Eth-USB, Bluetooth) for detailed instructions.

See Settings – Configuring RTK Base station mode under chapter 7.5 for instructions on how to configure Viking as a base station.

3.2 Installation Example Diagrams

Viking RTK Rover for Land Surveying

The following diagram shows an installation example for a Viking RTK Rover setup on a range for land surveying station applications. Optionally, the UHF antenna can also be installed in this setup.

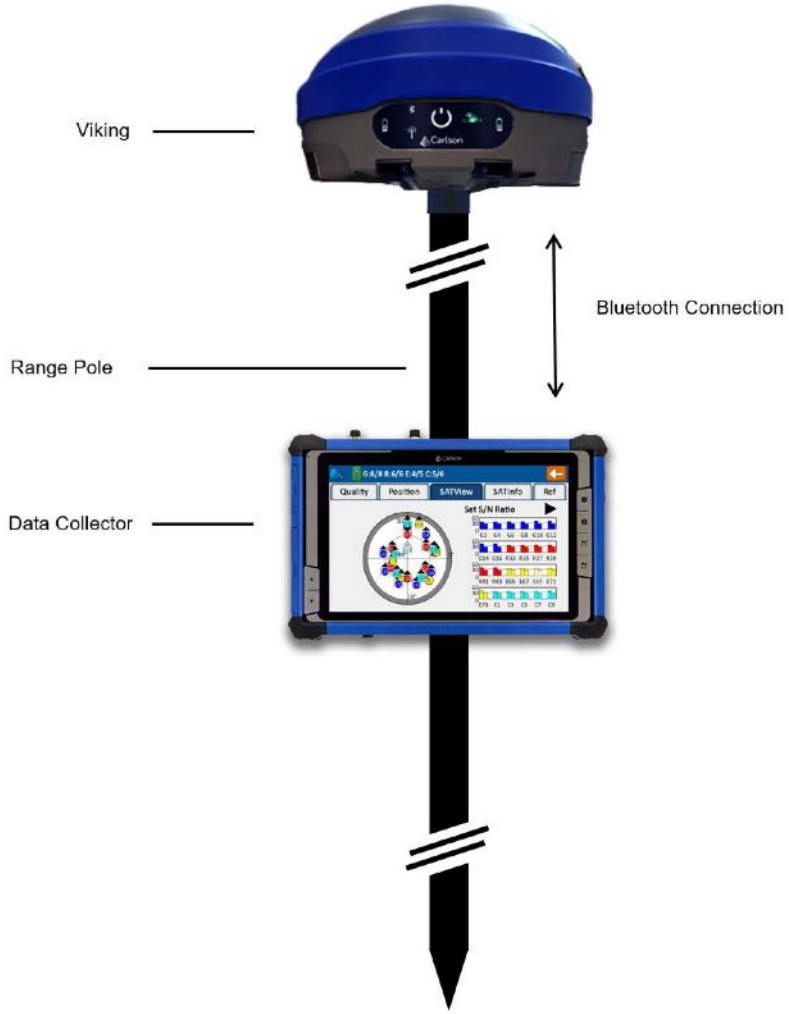


Figure 22 - Viking RTK Rover setup for Land Surveying.

Viking RTK Base station

The following diagram shows an installation example for a Viking RTK Base station on a tripod using a 12 V external battery for power. Optionally, the UHF antenna can also be installed in this setup.

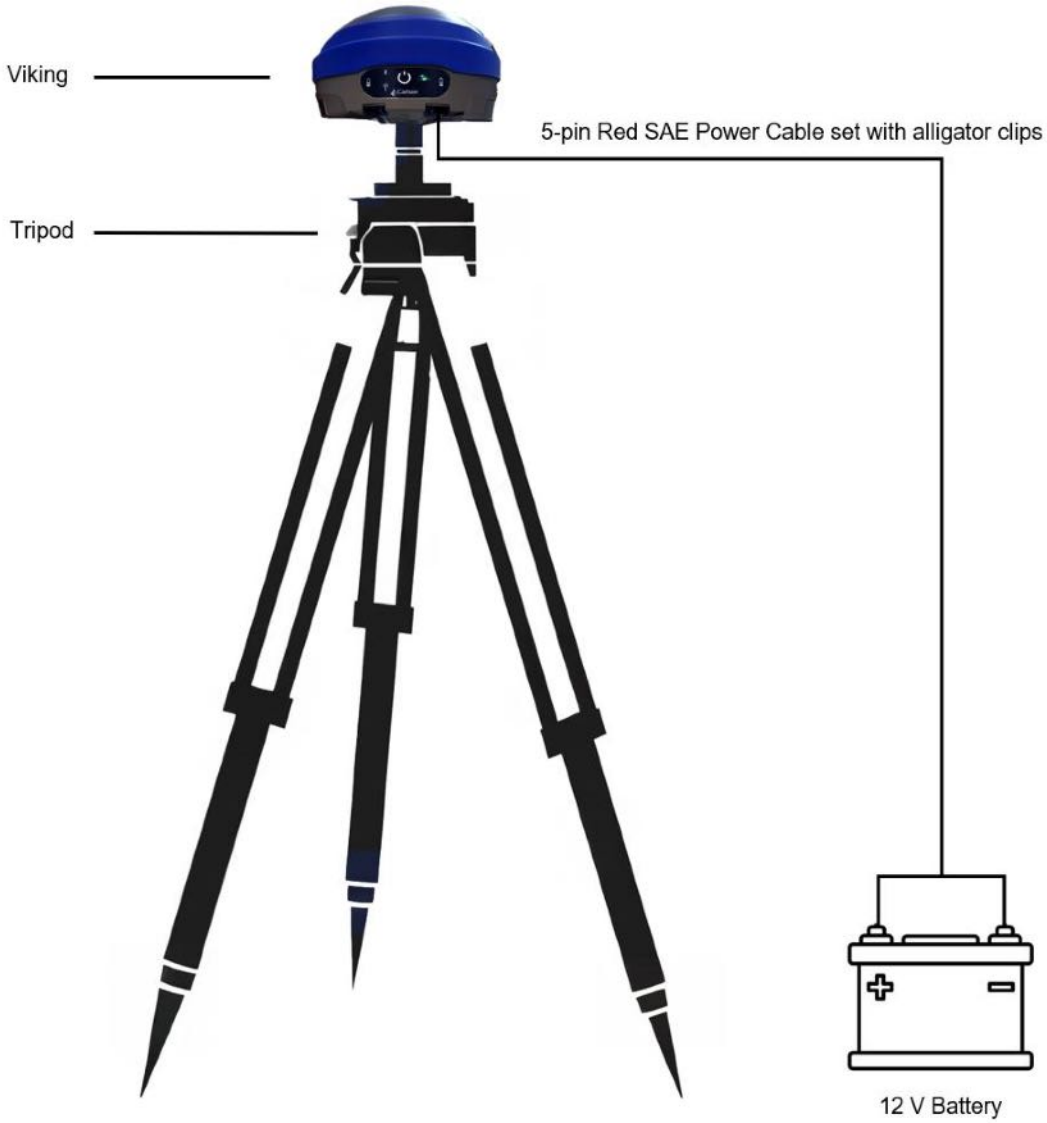


Figure 23 - Viking RTK Base station setup on tripod.

4 FW Update

Viking can automatically check for updates as long as it has internet connection (using internal cell modem) or if it is connected to a PC with internet connection (using the 7-pin Blue USB-A Data Cable).

Alternatively, a manual FW update can be performed by uploading a FW update file through the Viking Web UI.

4.1 Automatic FW Update

Viking can automatically check if a new update is available if it is connected to the internet using the internal cell modem or if is connected to a PC with internet connection (using the 7-pin Blue USB-A Data Cable).

If using the 7-pin Blue USB-A Data Cable:

1. Connect the cable to the Viking and the PC
2. Confirm the PC has active internet connection
3. Open Web UI on the PC by opening a page on 192.168.10.1 using a web browser.

Updating Viking via Check for Updates:

1. Open the Viking Web UI and go to “Admin->Update”
2. Click “Check for Updates”
3. The resulting dialog will either display the current firmware is up-to-date, or if there’s a new update
4. To proceed with the update, select “Yes”
5. Wait until update procedure finishes
6. Once update finishes it will automatically restart and the Web UI will show up again with the new firmware version.

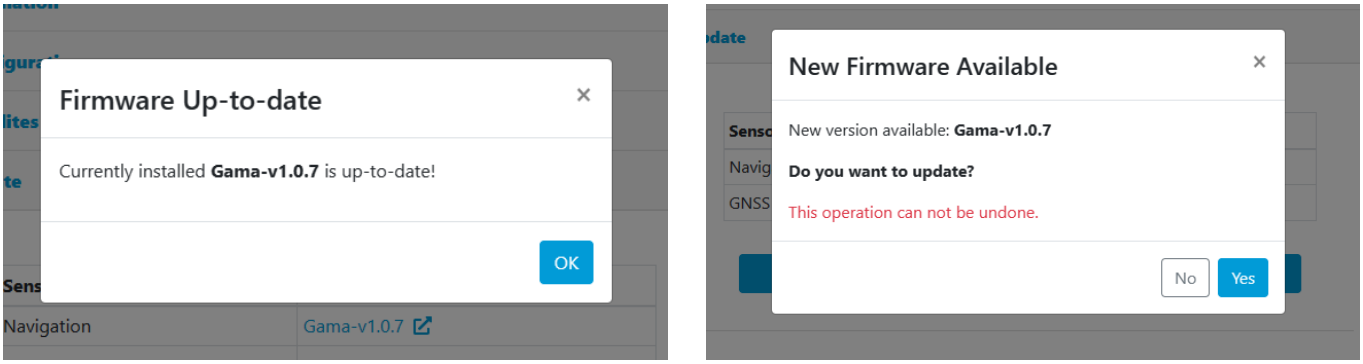


Figure 24 - The resulting dialog will either display the current firmware is up-to-date, or if there’s a new update.

4.2 Manual FW Update

To perform a manual FW update please request an update binary file from your Carlson supplier and then:

1. Open the Viking Web UI and go to “Admin->Update”
2. Click “Upload Update File” and select the desired update file
3. Follow the instructions in the new webpage
4. The system will automatically reboot once the update is complete.

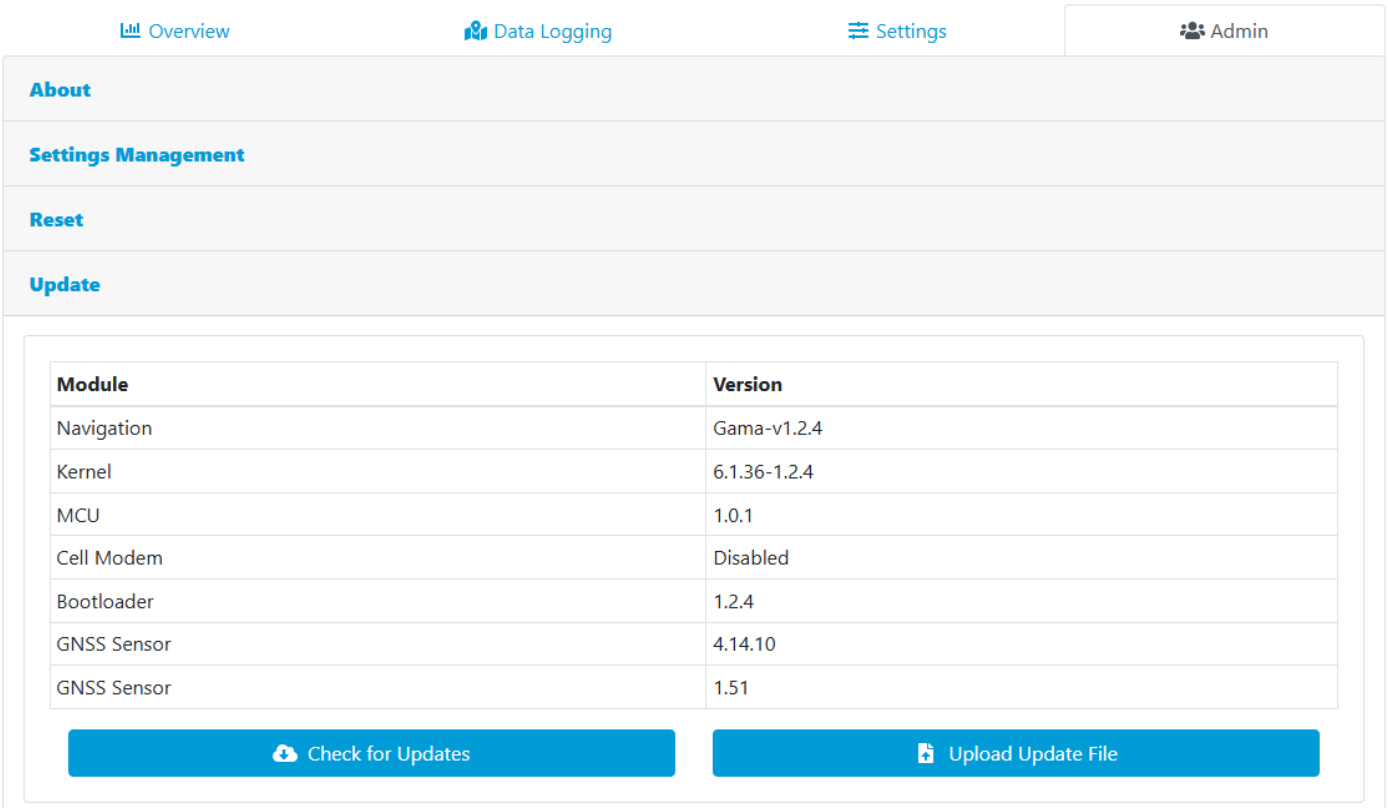


Figure 25 - Viking Web UI Update section (Admin menu).

5 Network Setup (Cell, Wi-Fi, Eth-USB, Bluetooth)

5.1 Quick guide

To easily access the Viking Web UI, use your smartphone to scan the QR code on the bottom of the Viking to automatically connect to the Viking Wi-Fi Hotspot, then open an internet browser on 192.168.10.1.

5.2 Viking Network Description

The networking configuration in Viking is similar to that of a Wi-Fi hotspot router, as such, devices connected to Wi-Fi:

- Are assigned an IP in the LAN subnet (192.168.10.1/24) via DHCP.
- Can communicate with other devices connected to LAN.
- Will have access to the internet if the cellular modem is enabled and has an active internet connection.

5.3 Accessing the Web UI

The Web UI is hosted on port 80.

Connecting via WLAN

Connect to Viking's WLAN

- **Default SSID:** viking-"serial number" (e.g.: viking-123456789)
- **Default password:** unique password printed inside the Battery B bay compartment

To easily access the Viking Web UI, use your smartphone to scan the QR code on the bottom of the Viking to automatically connect to the Viking Wi-Fi Hotspot.

Viking will assign an IP to connecting device using DHCP.

Open web browser to Gateway IP: 192.168.10.1.

Connecting via LAN

Connect to Viking's LAN via Ethernet using the 7-pin Support Cable – see Connect Ethernet over USB under chapter 2.12.

Viking will assign an IP to connecting device using DHCP.

Open web browser to Gateway IP: 192.168.10.1.

5.4 Cell Modem Configuration

To use the internal cell modem Viking requires a valid SIM card to be inserted in the SIM card holder – see SIM Card Installation Procedure in chapter 2.5.

Modem and SIM card settings can be configured under "Networking > Modem".

- Ensure the APN matches the settings required by your SIM card carrier.
- Username and Password are typically not needed.
- The PIN is optional and only necessary if the SIM card has an enabled PIN code.

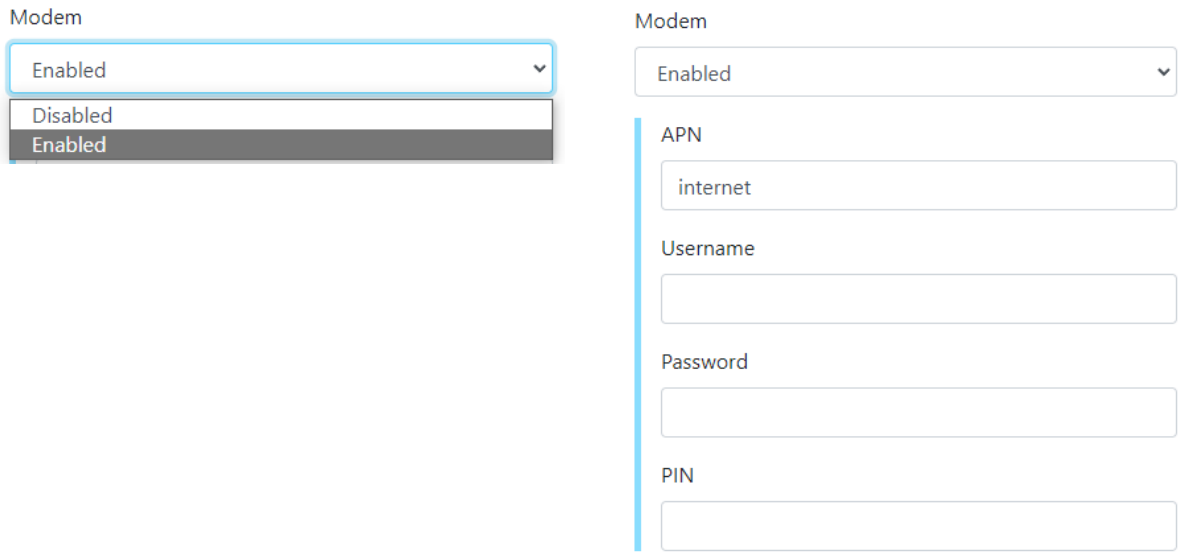


Figure 26 - Modem Configuration Options.

To find the APN (Access Point Name) for your SIM card, you can follow these steps:

- Carrier Website: Visit your carrier's official website and search for "APN settings."
- Customer Support: Contact your carrier's customer support for the APN details.
- Carrier Documentation: Check any documentation or setup guides provided with your SIM card.

5.5 Wi-Fi Configuration

Wi-Fi settings, including SSID and Password are configurable through the Web UI under “Networking->Wi-Fi”:

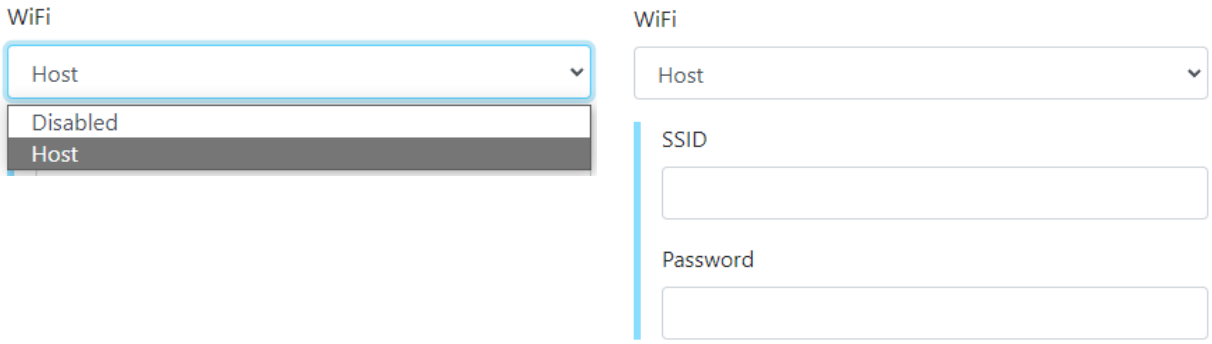


Figure 27 – Wi-Fi Configuration Options.

Gateway Configuration for GNSS Corrections

The Gateway selection determines what internet-source will be used for GNSS corrections and shared with clients connected on LAN.

Figure 28 - Gateway Configuration.

5.6 Bluetooth Configuration

Bluetooth can be enabled / disabled under “Networking->Bluetooth”.

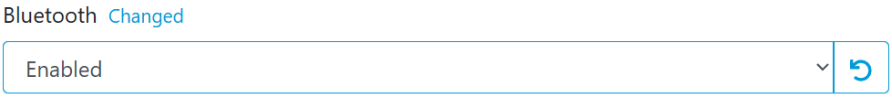


Figure 29 - Bluetooth Configuration.

5.7 Dynamic DNS (DDNS)

This menu enables configuration of a Dynamic DNS (DDNS) service which can be used to facilitate remote access without a static IP address.

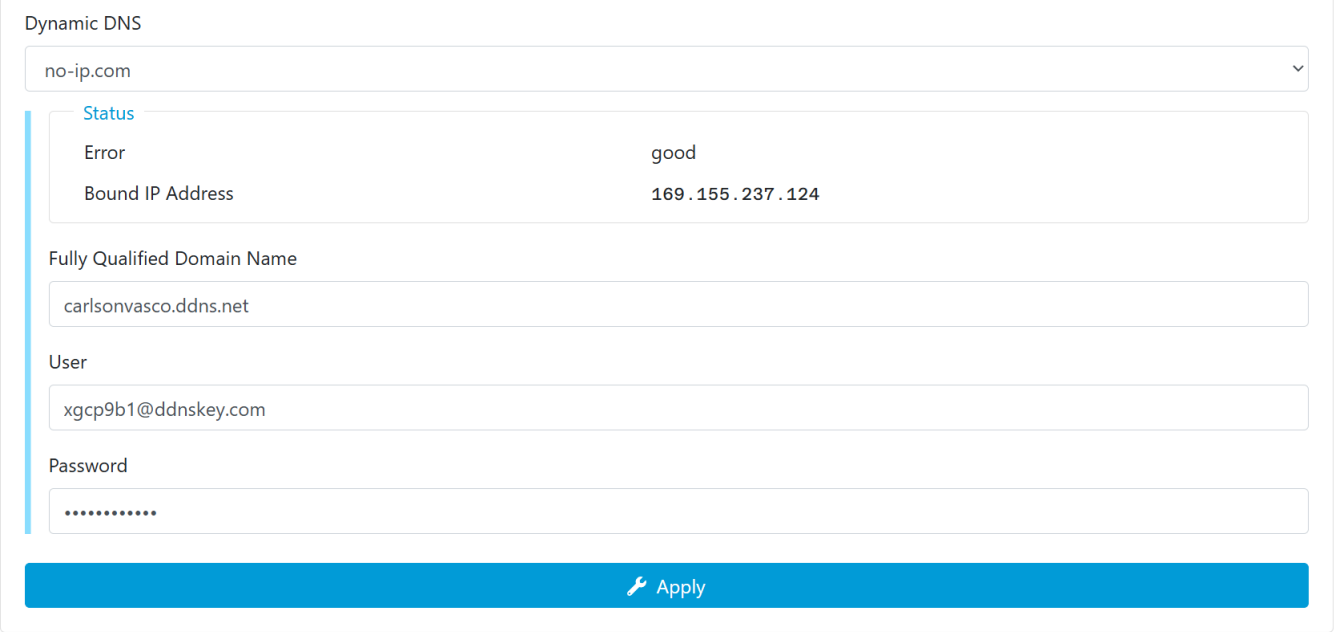


Figure 30 - DNS Configuration.

5.8 Networking Status

Networking status can be monitored using the Web UI, under Overview->Networking tab, to see which networking interfaces are active and find the device IP addresses.

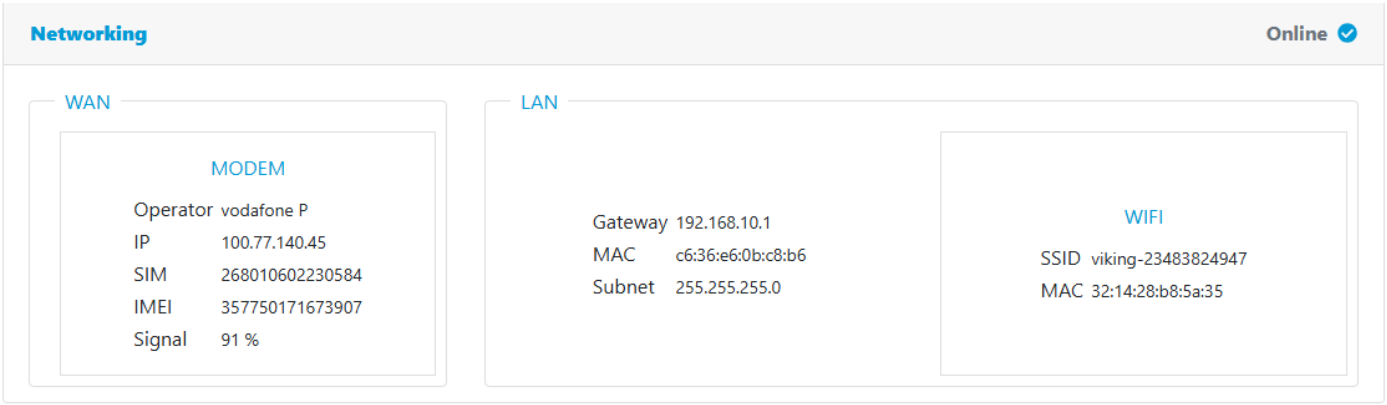


Figure 31 - Web UI Networking Status under System tab (Overview menu).

6 Factory Reset

Factory reset of the device can be done in 2 ways:

- Factory reset procedure using Power Button
- Trigger factory reset using the Web UI

6.1 Factory Reset Procedure Using Power Button

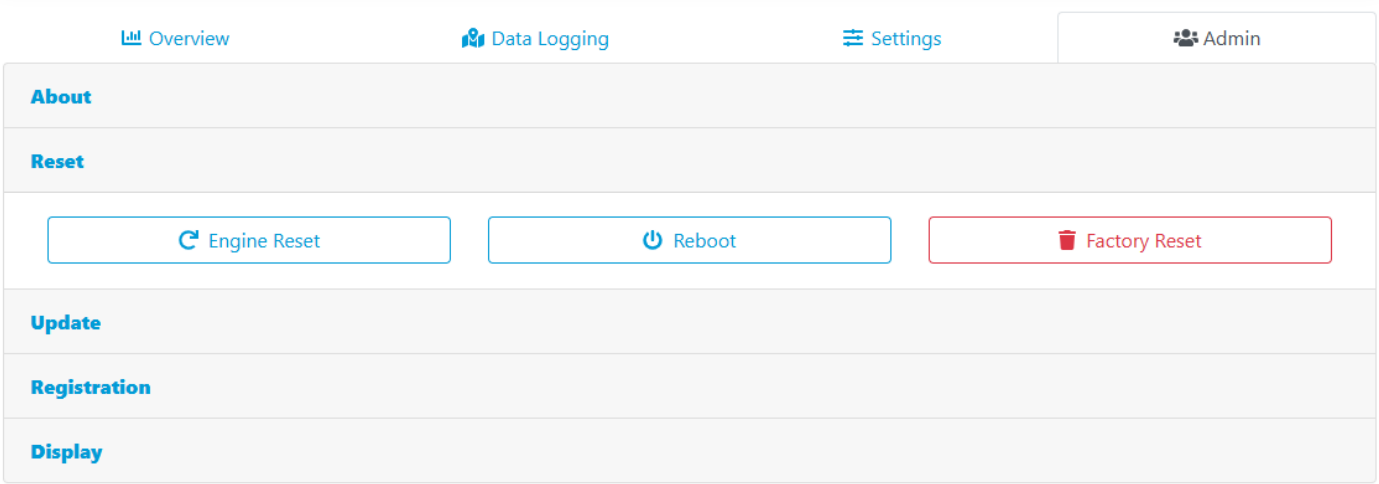
To trigger a factory reset using the Power Button follow this procedure:

1) Ensure Viking turned off (turn off Viking otherwise)
2) Press Power Button for 10 seconds (while the unit is turned off)
3) Viking responds with blinking all LEDS and beep sound
4) Immediately release the Power Button within 2s
5) Viking confirms Factory Reset by blinking all LEDs and a beep sound
6) Viking will reboot with all settings reset to the factory default.

6.2 Factory Reset from Web UI

A Factory Reset can also be initiated through the Web UI by navigating to Admin > Reset > Factory Reset.

A full system restores all settings and passwords to the factory default.



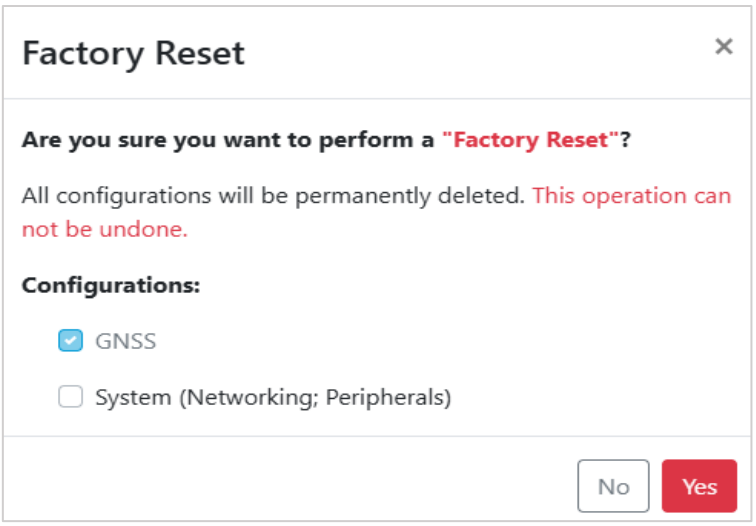


Figure 32 - Web UI Factory Reset (Admin menu).

7 Web UI

7.1 Web UI Introduction

To easily access the Viking Web UI, use your smartphone to scan the QR code on the bottom of the Viking to automatically connect to the Viking Wi-Fi Hotspot, then open an internet browser on 192.168.10.1. For more details on how to access the Web UI see Chapter 5 Network Setup (Cell, Wi-Fi, Eth-USB, Bluetooth).

Viking features an integrated webserver and Web UI which enables standalone configuration, diagnostics, and use.

Key features of the Web UI:

- Stand-alone tool for using Viking without Carlson SurvPC
- Update Viking and perform Factory Reset
- GNSS monitor and diagnostics
- Record raw GNSS data and download RINEX
- Support and issue tracking

The Web UI has 4 main tabs:

- Overview
- Data Logging
- Settings
- Admin

Figure 33 - Viking Web UI.

7.2 Web UI Icons

The header of the Web UI provides multiple status indicators in the form of icons:

Rover Mode Position Status

- No position (invalid)
- Autonomous
- DGNSS
- RTK Float
- RTK Fixed
- RTK Fixed+ or RTK Triple-Fix

IMU Tilt Status

- Blue - Tilt unavailable (requires short static period)
- Yellow - Tilt compensation is initialized but losing accuracy (requires motion)
- Pink - Tilt compensation not initialized (requires motion)
- Green - Tilt compensation initialized

Base Mode Status

- Base Mode Enabled but not broadcasting
- Base Mode Enabled and broadcasting

Base Warnings (RTK Rover Mode)

- Connected base station is failing general quality control checks. Base observations are still used but performance may be degraded.
- Connected base station is failing major quality control checks. Base observations are discarded.

Logging Status

- Logging Disabled
- Logging Active

Battery Status

- Full battery level
- Medium battery level
- Low battery level
- Depleted battery
- Battery not inserted

RF Interference Status

- RF Interference detected and mitigated
- RF Interference detected but not mitigated

Space Weather Alert Status

- Moderate Alert
- Strong Alert
- Severe Alert
- Extreme Alert

Temperature Warnings

- Low temperature warning (approaching operational limit)
- Very low temperature warning (reached or exceeded operational limit)
- High temperature warning (approaching operational limit)
- Very high temperature warning (reached or exceeded operational)

Storage Space Warnings

- Remaining storage space is low for at least one partition (consider removing unnecessary files)
- Storage space is full for at least one partition (data may be lost)

7.3 Overview

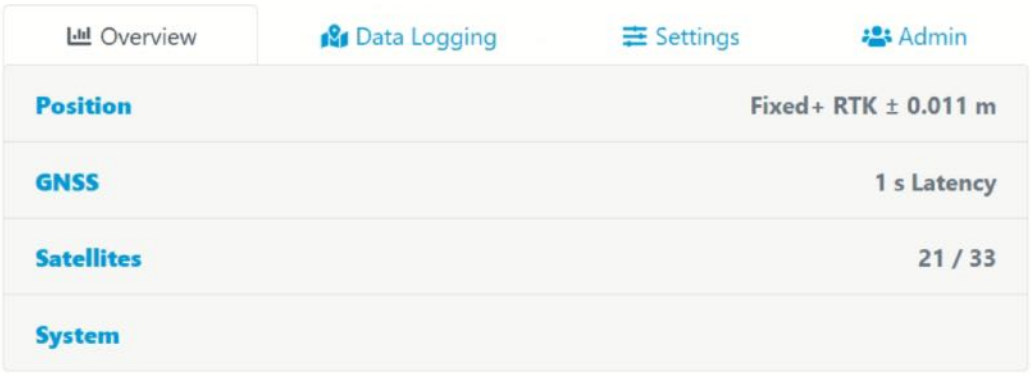


Figure 34 - Web UI Overview tab.

Overview – Position

Monitor detailed information about the GNSS solution, namely status, value, accuracy and differential correction age.

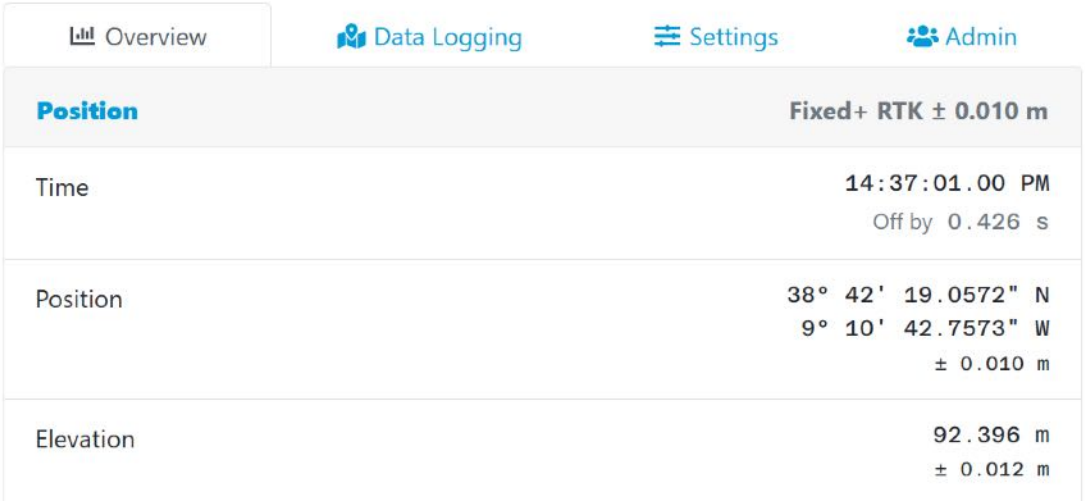


Figure 35 - Web UI Position tab (Overview menu).

Overview – Attitude

Monitor detailed information about the Attitude solution, namely tilt angles (Roll and Pitch) and Heading for value and accuracy. This feature requires IMU Sensor to be enabled in the Configuration tab – see Settings – Configuration under chapter 7.5.

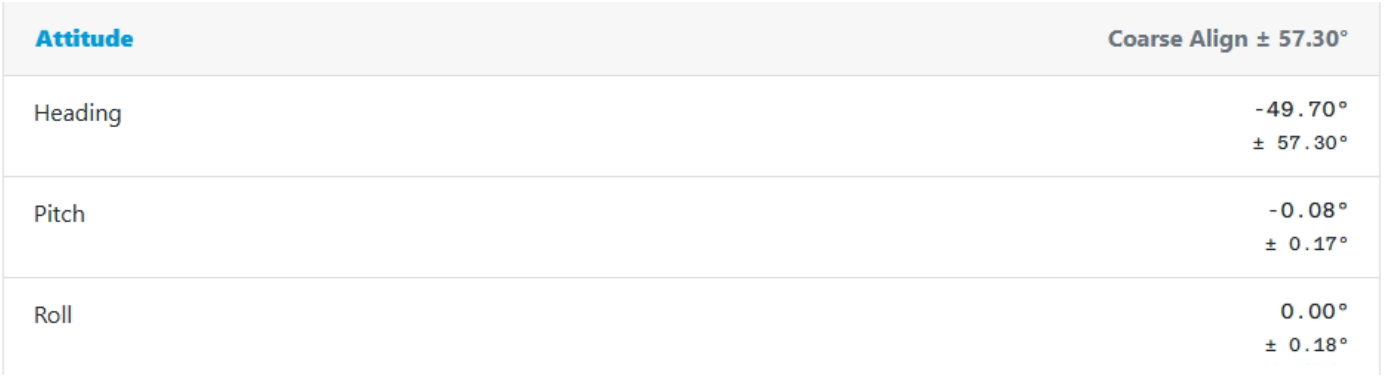


Figure 36 - Web UI Attitude tab (Overview menu).

Overview – GNSS

Monitor detailed information about the GNSS status and data flow.

Here you can also issue a Reset of the GAMA® engine.

In this section you can inspect detailed diagnostics about the GNSS system, namely if the receiver is powered on and connected, if it is tracking and receiving observations, if GAMA® is running correctly, etc.

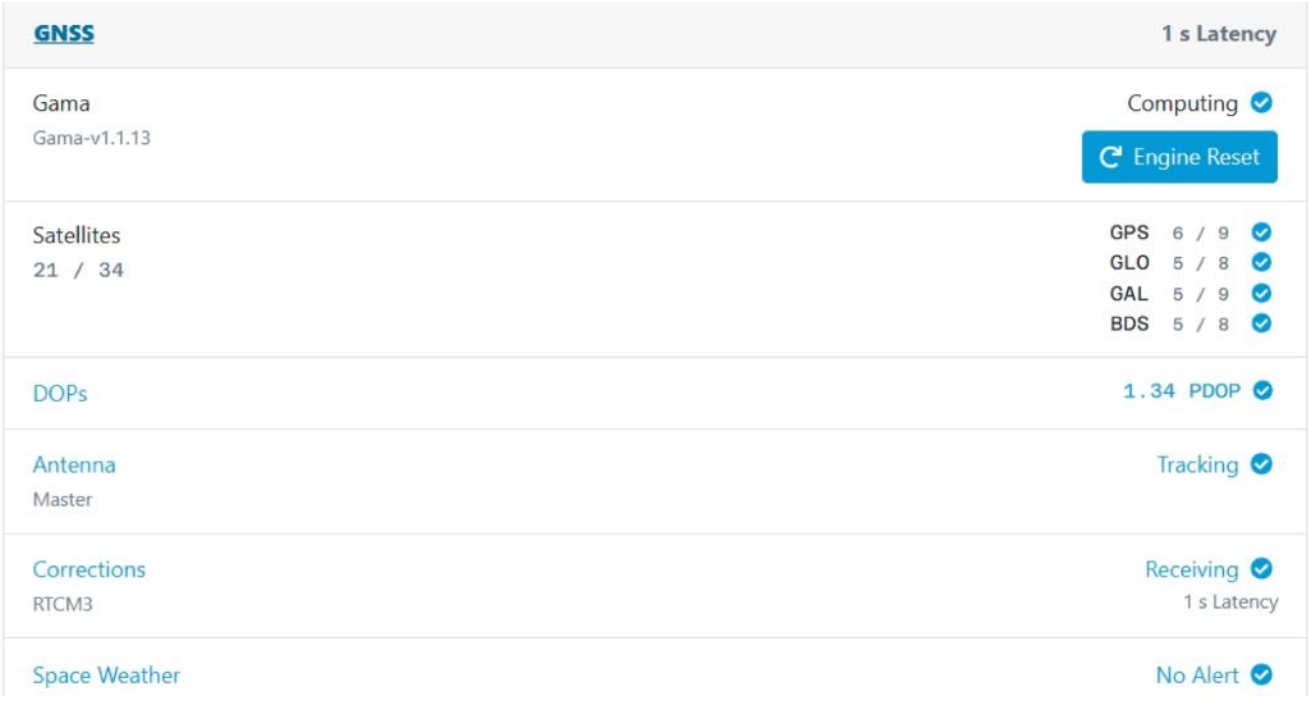


Figure 37 - Web UI GNSS tab (Overview menu).

In addition, Space Weather provides valuable information on active or future Space Weather events that can disrupt GNSS performance.

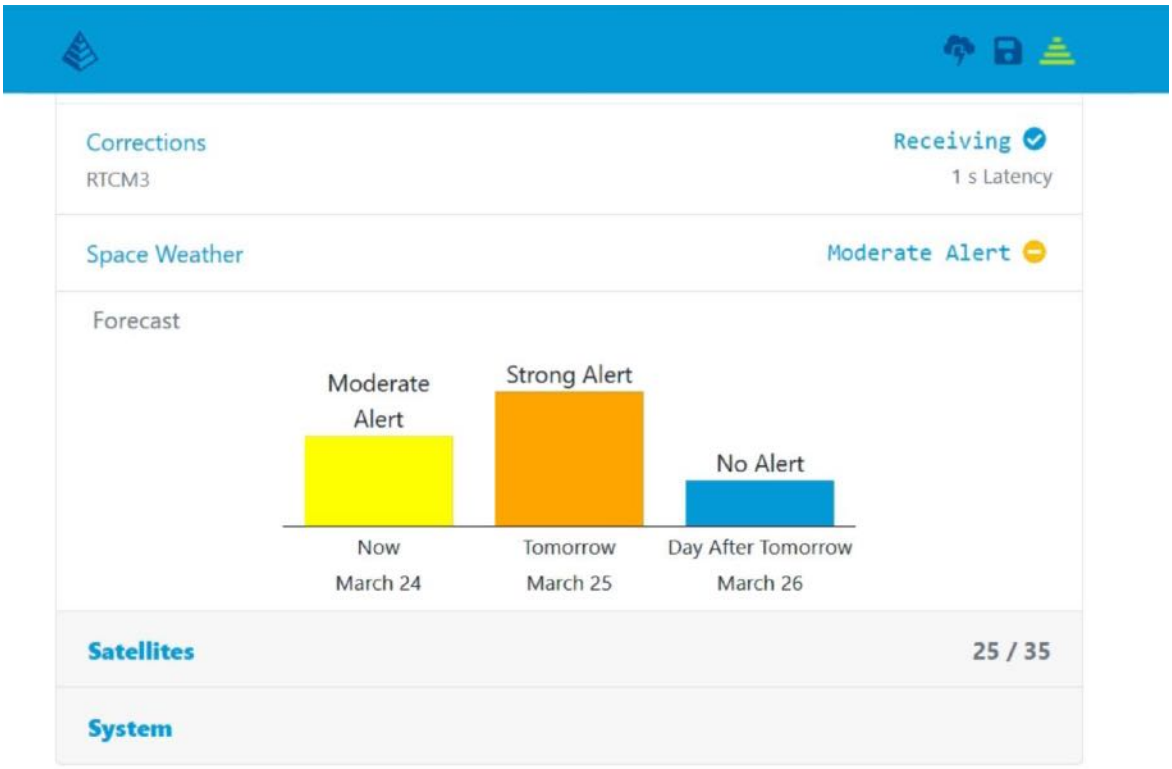


Figure 38 - Web UI Space Weather tab (Overview menu).

Overview – Sensors

Monitor status of internal IMU sensor.

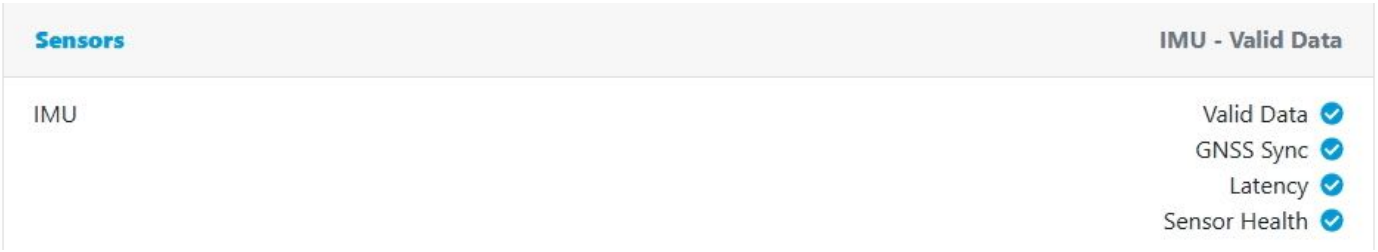


Figure 39 -Web UI Sensors status tab (Overview menu).

Overview – Satellites

Monitor satellite sky plot, SNR values and satellite usage status.

Figure 40 - Web UI Satellites tab (Overview menu).

Overview – System

Monitor detailed information about system networking, CPU, RAM memory, internal storage and internal temperatures.

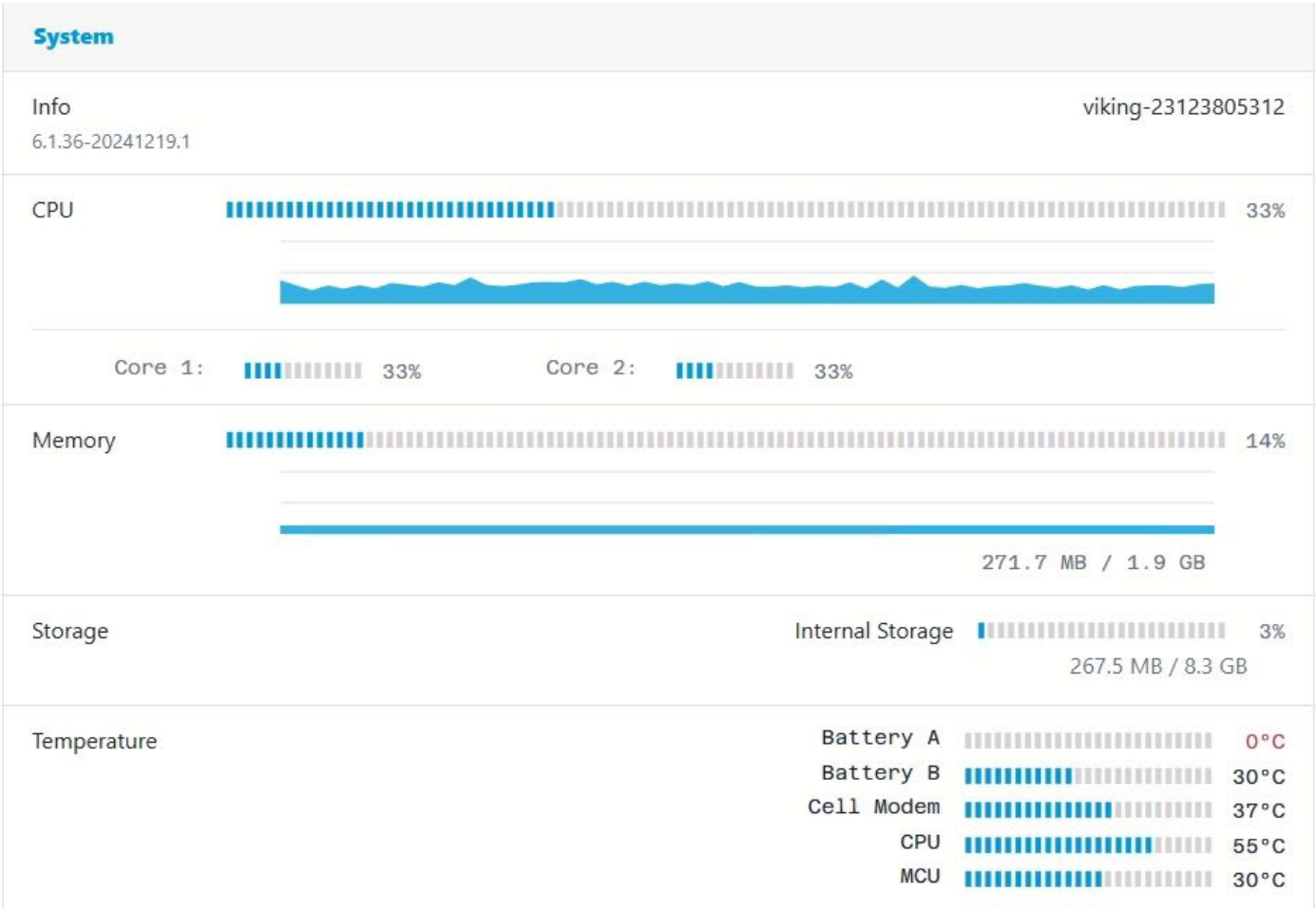


Figure 41 - Web UI System tab (Overview menu).

Overview – Networking

Monitor networking status and IP addresses.

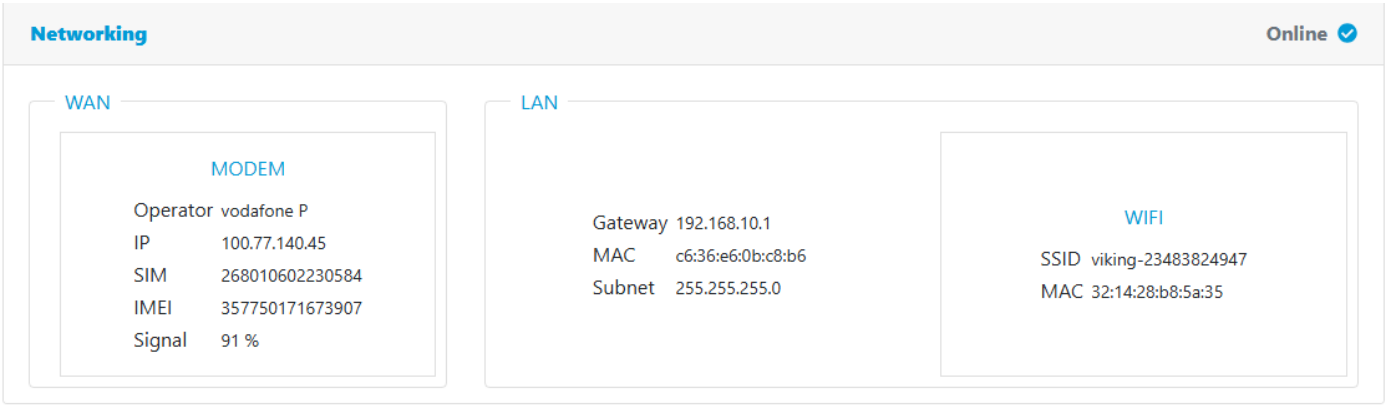


Figure 42 - Web UI Networking Status under System tab (Overview menu).

7.4 Data Logging

Data Logging – Binary NJS and NMEA Logging

Menu for administrating raw data logging independently from Carlson SurvPC.

NJS is Carlson Software's proprietary GNSS raw data format. Binary NJS data files can be converted to RINEX format – see chapter 8.4 RINEX.

Under "Binary / NMEA Logging" section you can:

- Open and close binary NJS log files:
  - Static
  - Stop+Go
  - Kinematic
- Log NMEA;
- Delete existing log files;
- Download existing log files (in order to download you must first close the file by unchecking the "active box");
- Add "static" and "moving" events to active Stop+Go log files.

You can log multiples files simultaneously. The Web UI is intelligent enough to only add Stop+Go event markers to an open Stop+Go log file.

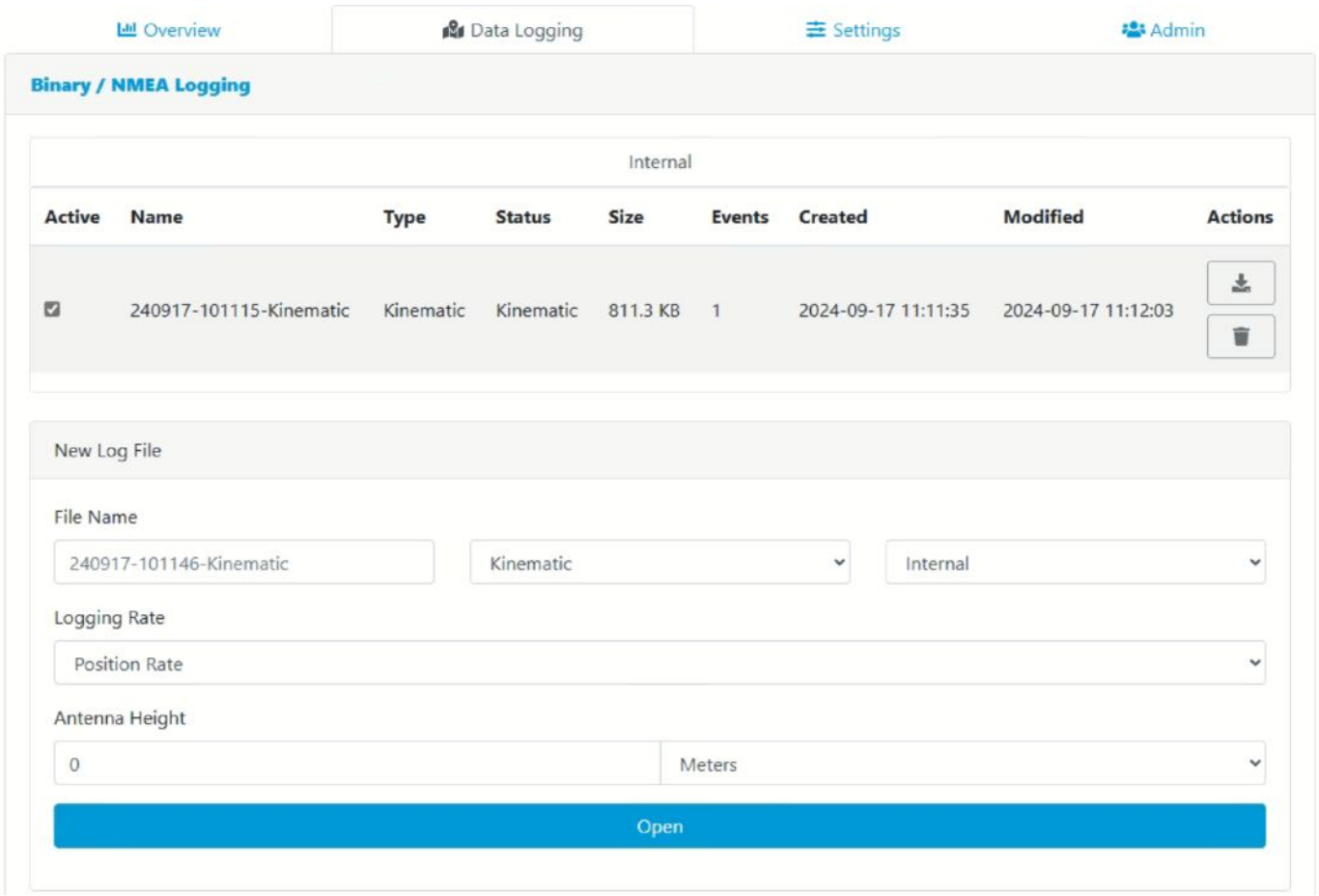


Figure 43 - Web UI NJS Logging tab (Data Logging menu).

Data Logging – Extended Binary Logging

Log binary file for issue tracking and product support.

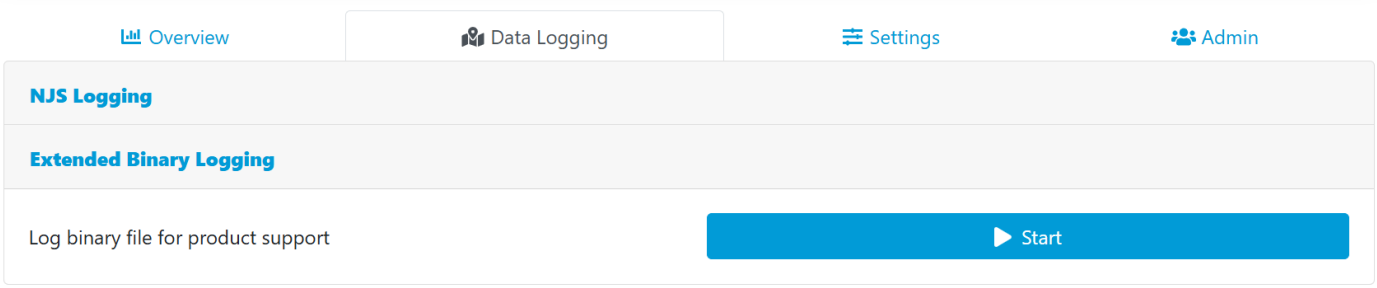


Figure 44 - Web UI Extended Binary Logging tab (Data Logging menu).

7.5 Settings

Configure Viking via the Web UI.

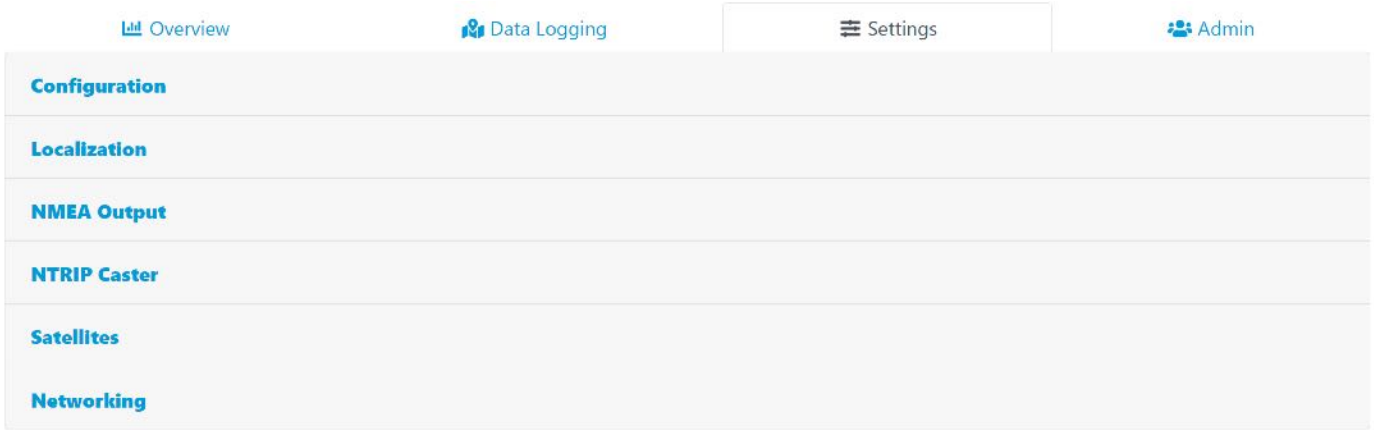


Figure 45 - Web UI Settings menu.

Settings – Configuration

- Configure mode (Rover/Base)
- Set output rate
- Set data logging rate
- RTK Protocol
  - Auto - Automatically detect RTK corrections protocol
  - RTCM3
  - CMR
  - CMR+
- Configure RTK Corrections Input (Rover Mode)
  - None - Disabled
  - CLI - Corrections provided by Carlson Grade or Carlson SurvPC
  - Direct IP - Connect to direct IP
  - Listen-Listen - Connect to Carlson Listen-Listen service
  - TCP Server - Connect to TCP server
  - NTRIP - Connect to NTRIP caster
  - Serial - Correction received on the serial port
  - UHF - Connect over UHF
- Configure Base Station Output (Base Mode)

If UHF is selected under “RTK Corrections Input” the Web UI will also expose the UHF configuration:

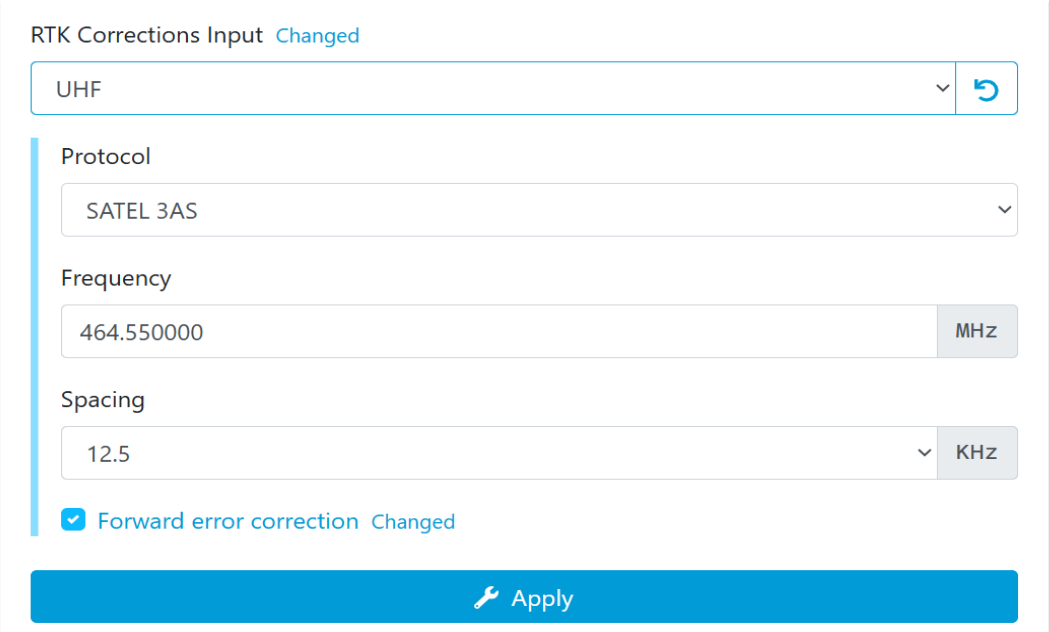


Figure 46 - Web UI Configuration tab (Settings menu).

Settings – Configuring RTK Base station mode

1. Select the correct antenna type under Installation -> Antenna.
2. Under Settings -> Configuration select Base operation mode.
3. Set base station antenna position:

> **TIP 1:** Set up Viking as RTK rover, wait for an RTK Fixed solution, and then click Poll for current position to use the RTK rover position for the Viking base station position. This will anchor the Viking base position to the RTK network that was used.

> **TIP 2:** To accurately measure antenna position, record a static RINEX 3 file and use an online post-processor to estimate an accurate position for the antenna. See Recommended Procedure for Logging a RINEX for Setting up a Permanent Reference Station under chapter 8.4 RINEX.

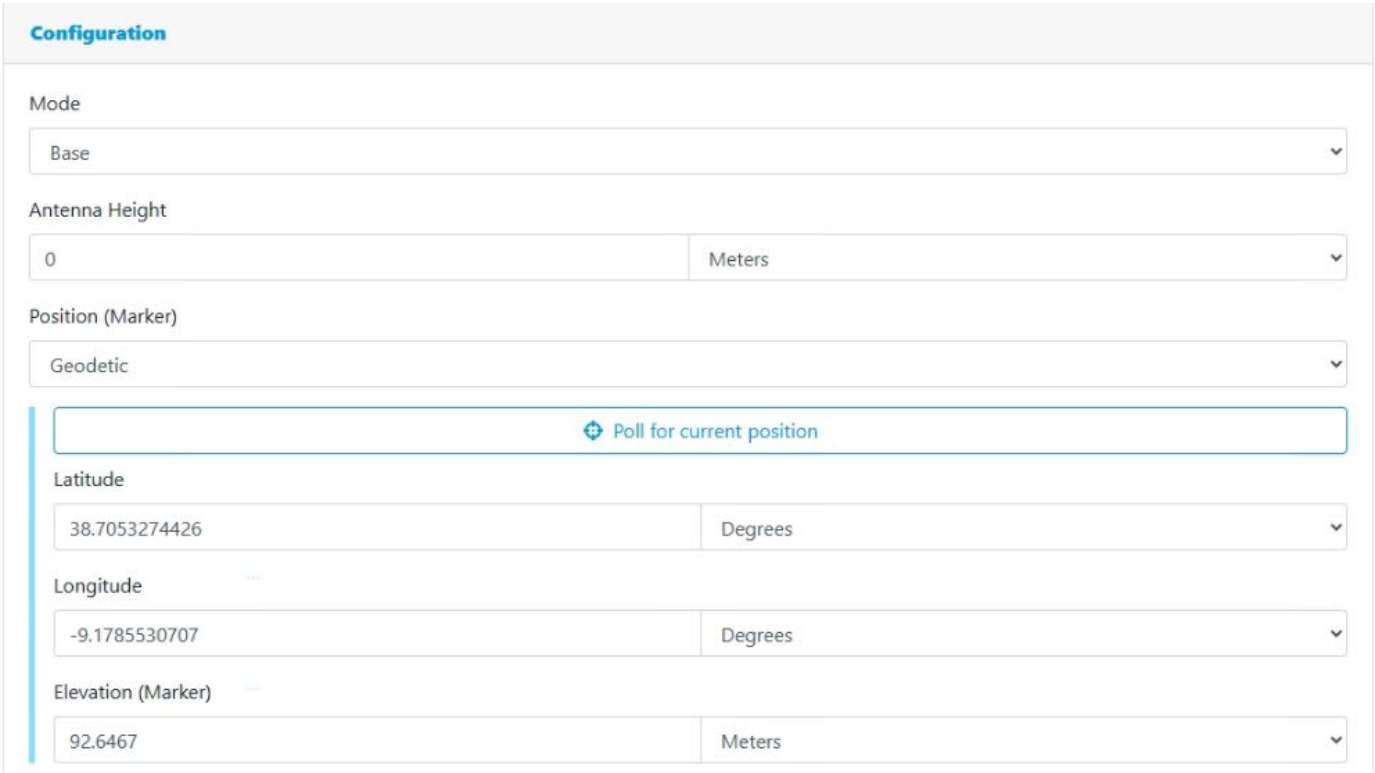


Figure 47 - Web UI Base Position configuration (Settings menu).

4. Configure desired Output Channels. Viking can provide RTK base corrections on multiple output channels using independent correction settings (e.g.: RTCM3 on Port 1 and CMR+ over UHF).

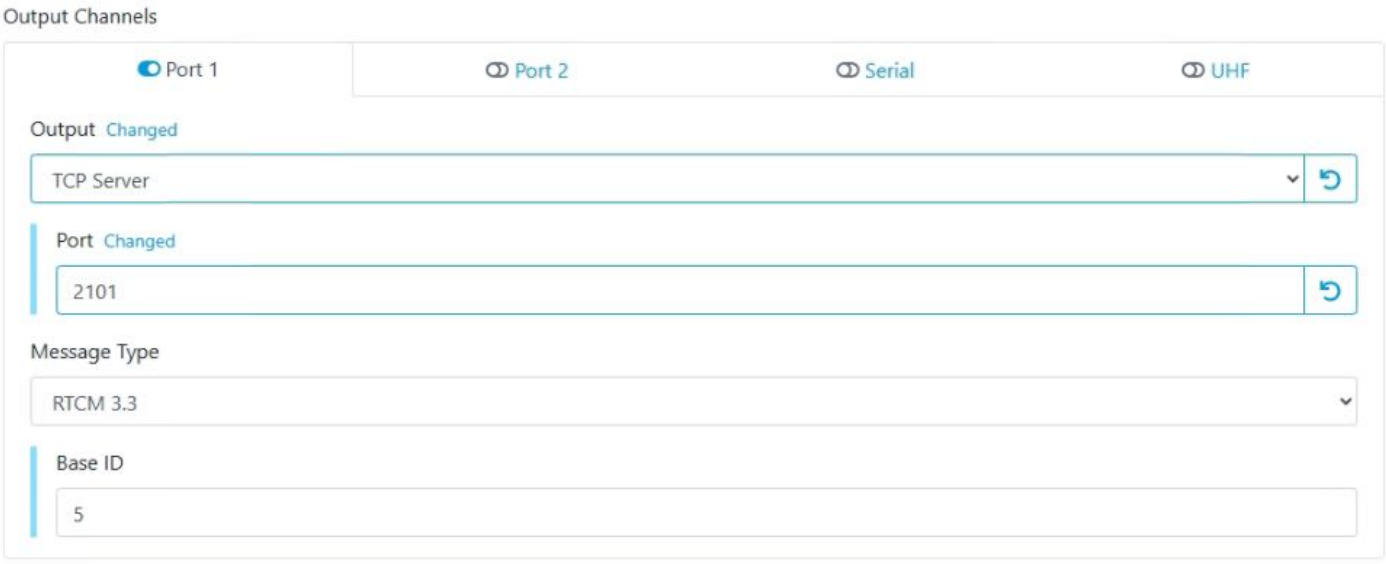


Figure 48 – Web UI Base Output Channels configuration (Settings menu).

Serial and External UHF Radio Configuration

Serial output provides the possibility to output corrections over serial. Viking can be connected to an external UHF radio and has the ability to do pass-through UHF configuration via Carlson Grade or using GAMA® CLI - see chapter 9 GAMA® Command Line Interface (GAMA® CLI).

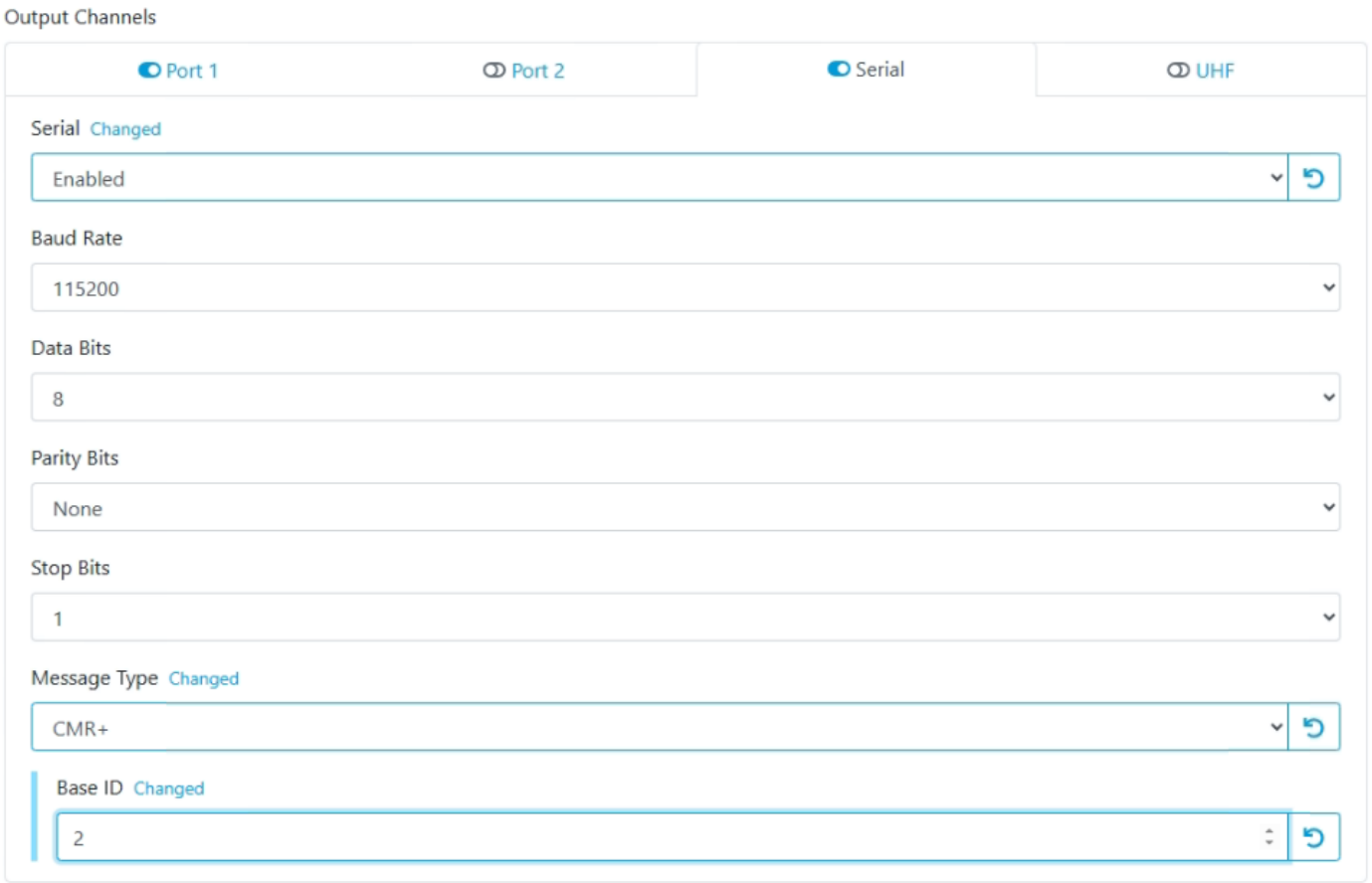


Figure 49 – Web UI Base Serial output configuration (Settings menu).

Settings – NTRIP Caster

- Configure internal NTRIP Caster.

Basic steps to configure a new internal NTRIP Caster:

1. Enable internal NTRIP Caster
2. Configure authentication settings for clients (RTK rovers connecting to NTRIP Caster as NTRIP Clients)
3. Configure authentication settings for server (RTK base stations connecting to NTRIP Caster as NTRIP Servers)
4. Create new NTRIP Mountpoints
5. Click Apply

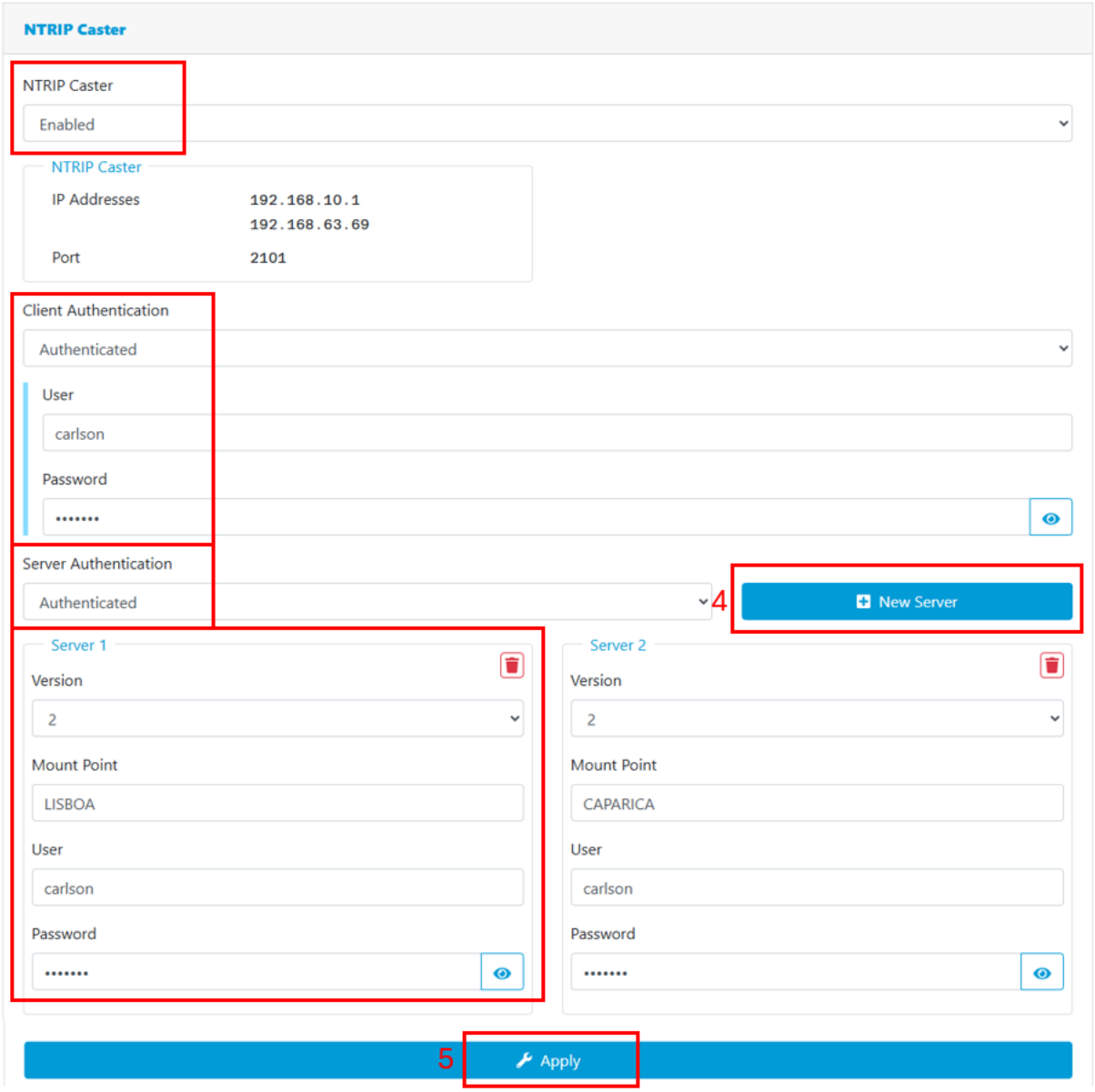


Figure 50 - Web UI NTRIP Caster configuration tab (Settings menu).

Settings – NMEA Output

- View information on which ports NMEA messages are output;
- Configure NMEA output over serial.
- Configure settings related to real-time output of NMEA messages.

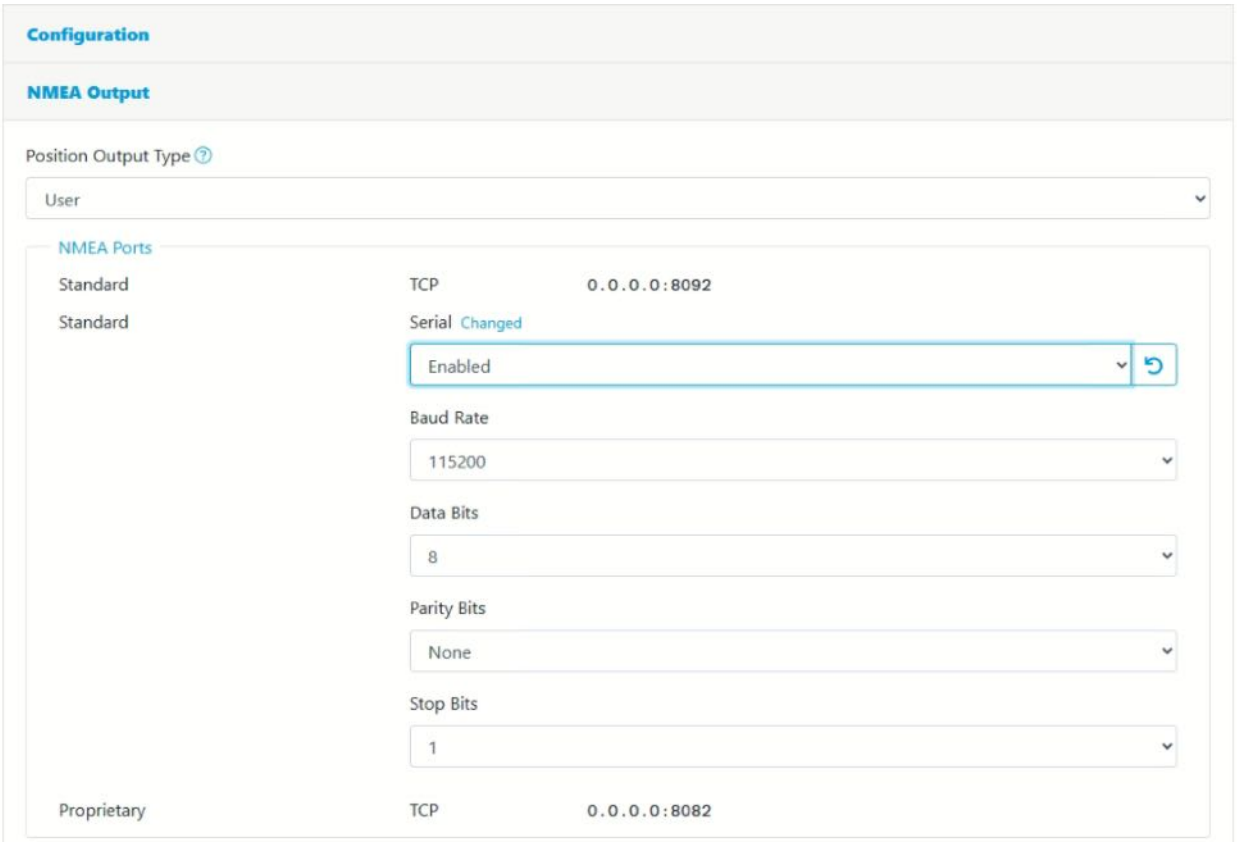


Figure 51 - Web UI NMEA Output tab (Settings menu).

Different output options are available for NMEA Position Output Type:

- APC – Antenna Phase Center
- ARP – Antenna Reference Point
- User – User defined offset

If the system is operating in AINS mode (with IMU enabled) and the IMU is initialized (Attitude status is Fine Alignment) then APC and User positions will be tilt-compensated (position is propagated to the ARP or User defined offset considering the roll, pitch and heading of the IMU).

In all other cases the GNSS antenna is assumed to be levelled and the ARP and User offset are assumed to be vertical offset (no tilt-compensation).

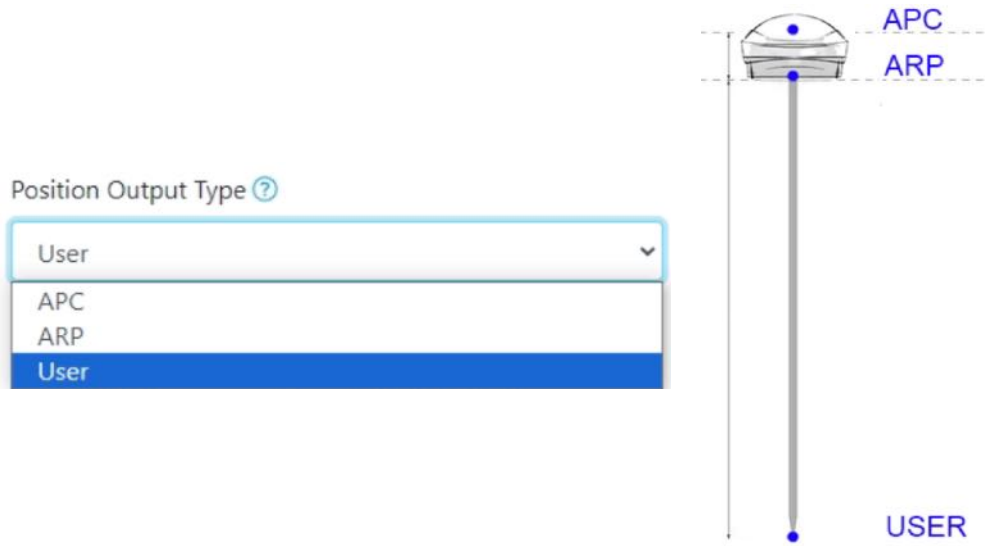


Figure 37 - Web UI NMEA Position Output Type configuration.

Settings – Satellites

- Configure satellite elevation mask;
- Enable/disable GNSS constellations;
- Exclude satellites.

Settings – Networking

- Set default Gateway (Ethernet / Cell modem)
- Enable/disable cell modem
- Configure Wi-Fi

For instructions on how to properly configure Viking networking please see chapter 5 Network Setup (Cell, Wi-Fi, Eth-USB, Bluetooth).

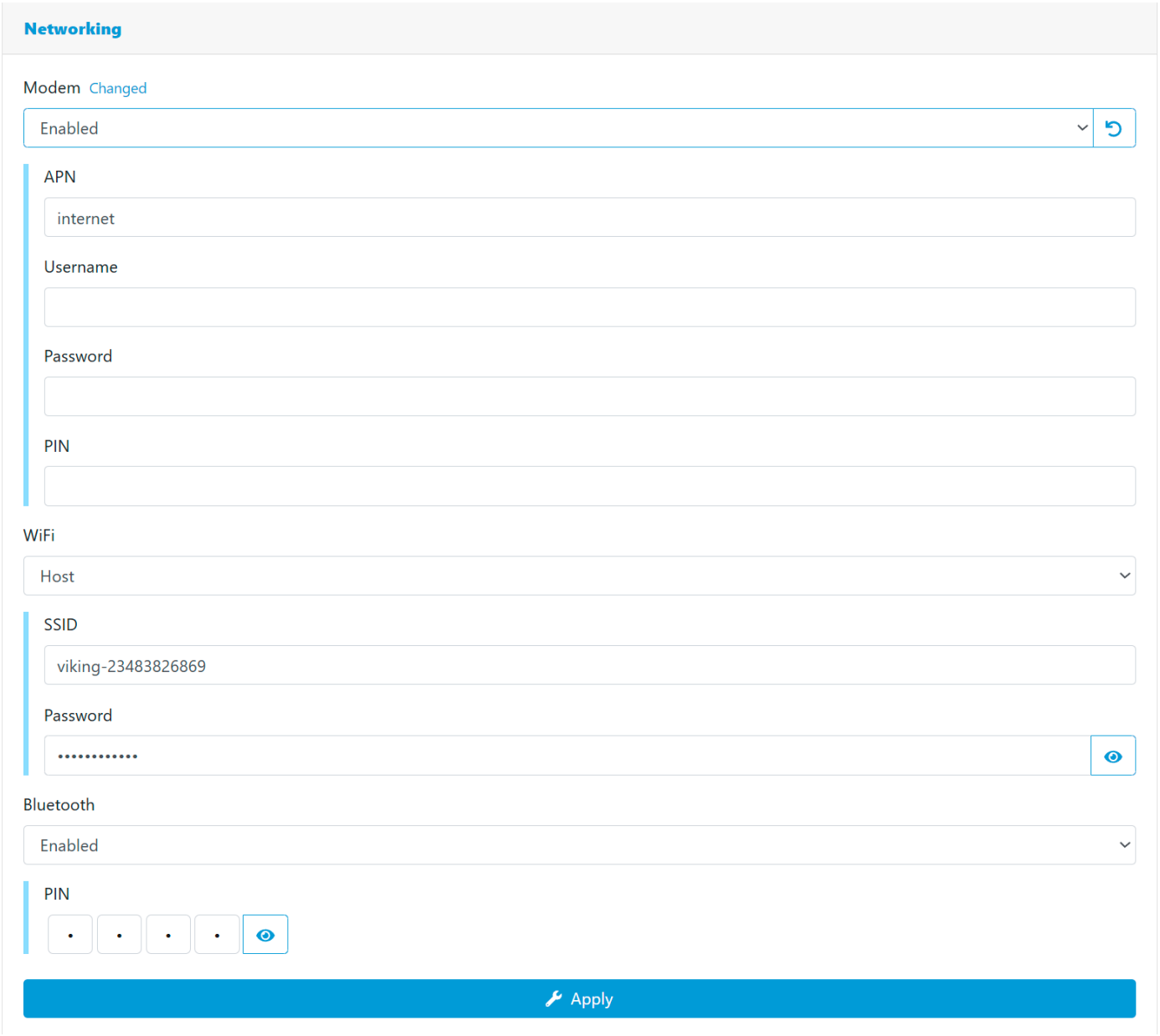


Figure 52 - Web UI Networking tab (Settings menu).

7.6 Admin

Administration tab:

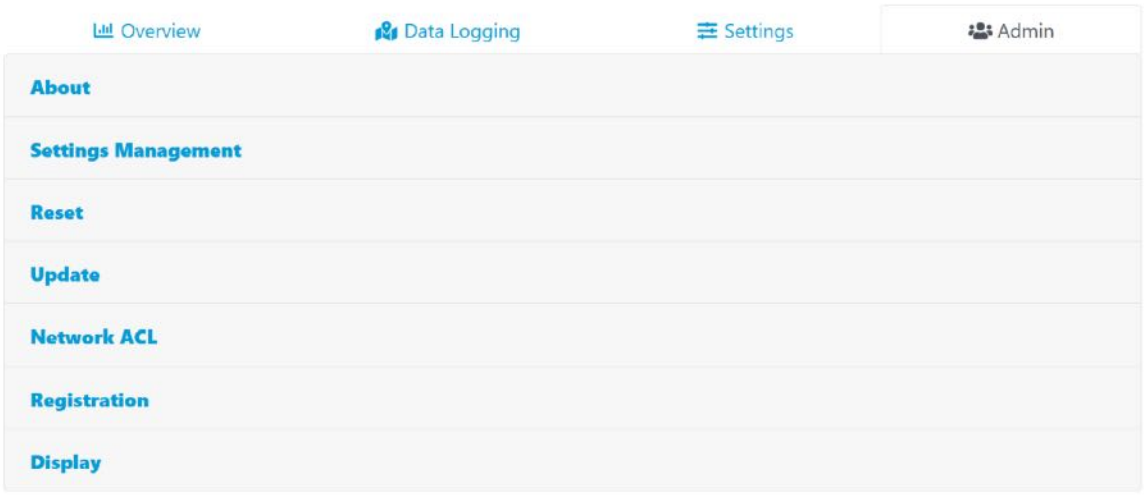


Figure 53 - Web UI Admin menu.

Admin – About

- View product license and SW/FW versions;
- View Release Notes and User Manual;
- View License Agreement and Privacy Policy;
- Enable/Disable Remote Access Support and view Remote Access Policy.

Admin – Settings Management

- Import / Export settings.

Admin – Reset

- Trigger Engine Reset, Reboot, Power Off, or Factory Reset;
- For instructions on how to do a Factory Reset see chapter 6 Factory Reset.

Admin – Update

- Update FW – see section 4 FW Update.

Admin – Network Admin

- Services Firewall - Configure Network Access Control List (firewall security settings).

Admin – Registration

- Manage license and registration
- The Viking license modules are:
    - Basic - Allows recording of Raw Data (NJS) and Communication with SurvPC
    - RTK - Allows usage of corrections streams to go RTK-Fixed
    - North America - Allows usage of RTK within North America

Admin – Hardware Settings

- Configure audio settings;
- Configure power management settings.

Admin – Display

- Configure display settings and units (metric/imperial);
- Configure Web UI Theme.

8 Output Protocol and Data Logging

8.1 Proprietary NMEA 0183

Proprietary NMEA messages are streamed on port 8082 and therefore available over Ethernet or Wi-Fi.

See section Settings – NMEA Output under chapter 7.5 for additional details on how to configure NMEA messages.

See chapter 5 Network Setup (Eth, Cell, Wi-Fi) for instructions on how to connect to Viking.

See Appendix A2 – PCSW Proprietary NMEA 0183 Messages Messages for a reference guide on Carlson Software Proprietary NMEA messages.

8.2 Standard NMEA 0183

Standard NMEA messages are streamed on port 8092 and therefore available over Ethernet or Wi-Fi. Viking complies with the NMEA 0183 v4.11 standard.

See section Settings – NMEA Output under chapter 7.5 for additional details on how to configure NMEA messages.

See chapter 5 Network Setup (Cell, Wi-Fi, Eth-USB, Bluetooth) for instructions on how to connect to Viking.

For details on the NMEA message protocol please refer to the NMEA standard available for purchase on National Marine Electronics Association (NMEA) website:

- https://www.nmea.org/nmea-0183.html

8.3 NJS Binary Format

Viking is capable of logging NJS binary data, employing a proprietary format that caters to post-processing requirements and facilitates efficient product support.

For instructions on logging NJS data see section Data Logging – Binary NJS and NMEA Logging under chapter 7.4.

8.4 RINEX

RINEX Download Using Web UI

RINEX 3 and RINEX 4 files can be downloaded directly from the Web UI, under the Data Logging tab.

1) Open a new log file (Binary NJS)
2) Click RINEX download button

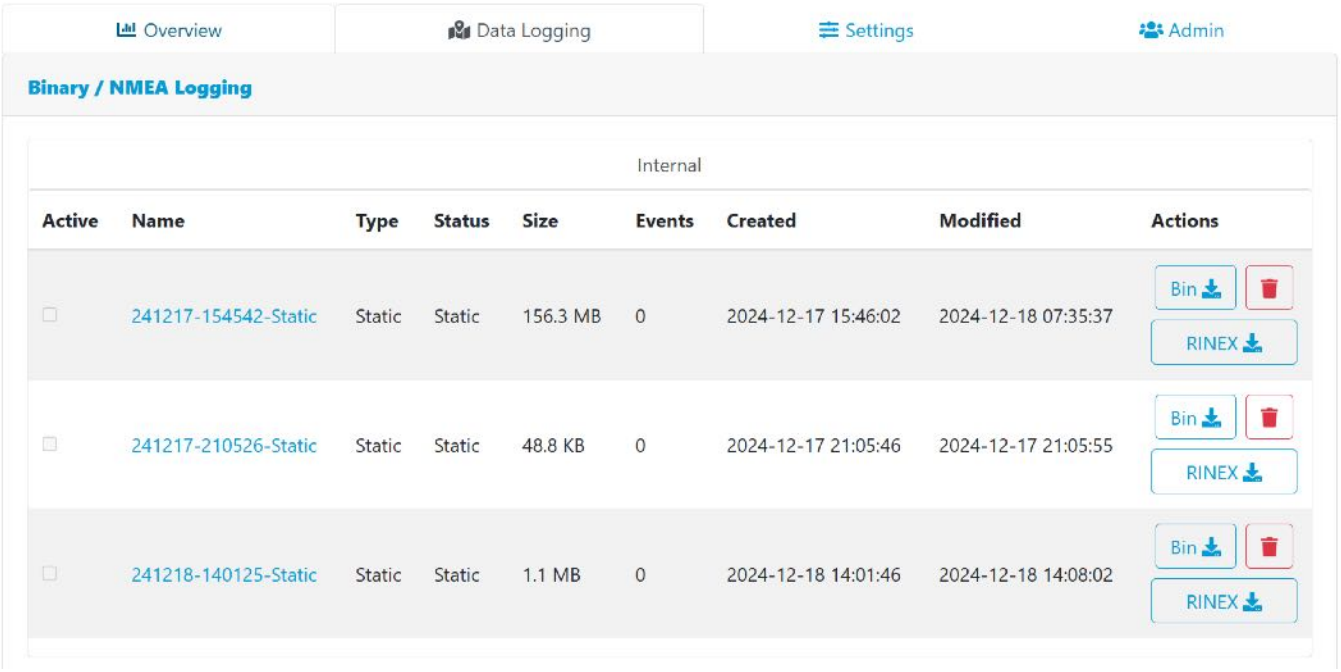


Figure 54 - RINEX Download from Web UI - Data Logging tab.

Recommended Procedure for Logging a RINEX for Setting up a Permanent Reference Station

To set up Viking as a new reference station it is necessary to accurately measure the position of the GNSS antenna. A standard recommend procedure is to log RINEX data and use online GNSS Post-Processing services such as OPUS and AUSPOS to post-process the RINEX file and generate a solution report with an accurate estimate of the GNSS antenna position:

1) Ensure Viking is correctly configured (Rover mode, correct GNSS antenna type and height are configured).
2) Start a new Static binary recording under “Data Logging” tab:
    a. Make sure to pick a file name without special characters to avoid incompatibility issues with OPUS / AUSPOS (avoid special characters, symbols or spaces, e.g. " * ", " _ ", " - ").
    b. Set Logging Rate to 30 seconds. Online Post-Processors decimate data to 30 seconds so there is no need to record at a higher data than that.
3) Keep the system online, static, and record for a recommended minimum duration of 4 hours (ideally 6 hours or longer to ensure best results).
4) Stop recording by unchecking the active logging box on the left side of the filename.
5) Download RINEX 3 with a decimation rate of 30 seconds (OPUS does not support RINEX 4).
6) Extract the downloaded .zip file. The file ending in “_MO.rnx” contains the GNSS raw observables and is the file to be uploaded (“_MN.rnx” contains information on satellite orbits and is not required in this exercise).
7) Wait until the next UTC day before submitting the RINEX 3 data to the online post-processor.
8) Ensure correct antenna type and height are properly configured when uploading to the online post-processor.

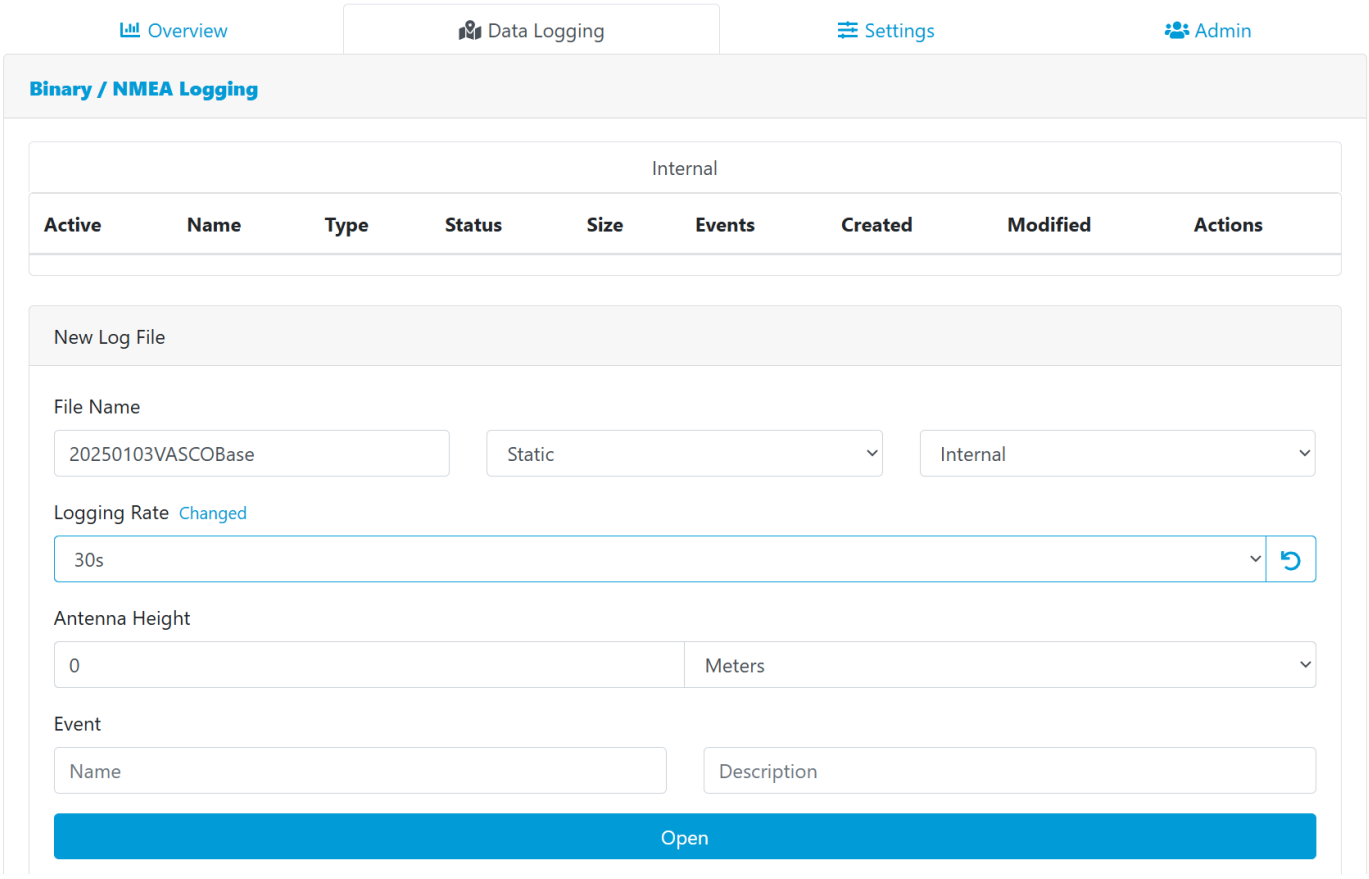


Figure 55 - Start a new Static binary recording under “Data Logging” tab.

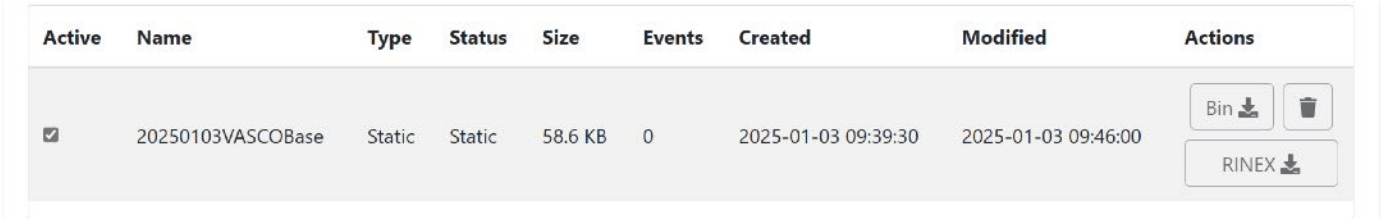


Figure 56 - Stop recording by unchecking the active logging box on the left side of the filename.

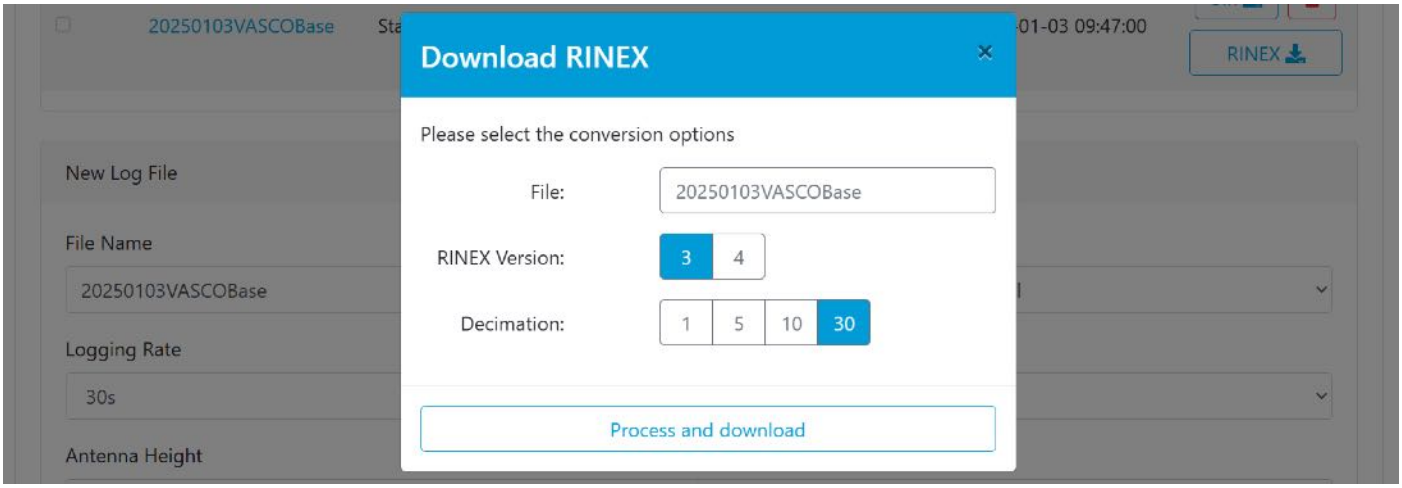


Figure 57 - Download RINEX 3 with a decimation rate of 30 s (OPUS does not support RINEX 4).

RINEX Conversion Using Nj-Ops

NJS Binary files can be converted to RINEX 3 and RINEX 4 format using the Carlson NjOps GUI application for Windows. Instructions are provided below:

1) Download and Nj-Ops GUI for Windows from this url:

   https://files.carlsonsw.com/mirror/carlsongnss/Nj-Ops/nj-ops-gui-1.8.1.exe

2) Run installer and follow instructions.

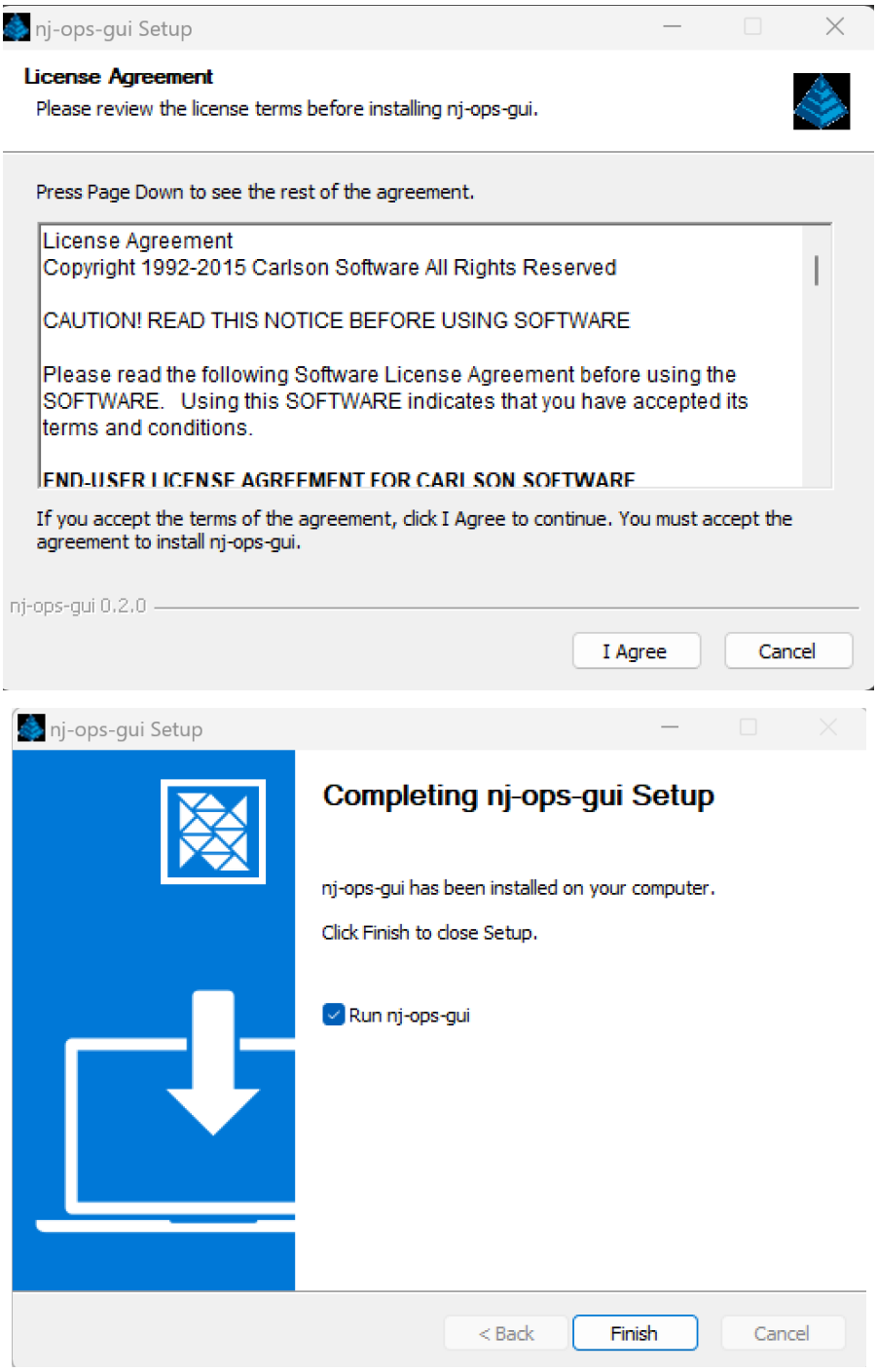


Figure 58 - Nj-ops Installation.

3) Run Nj-Ops GUI.

4) Click File->Convert->File and select the NJS file you wish to convert to RINEX.

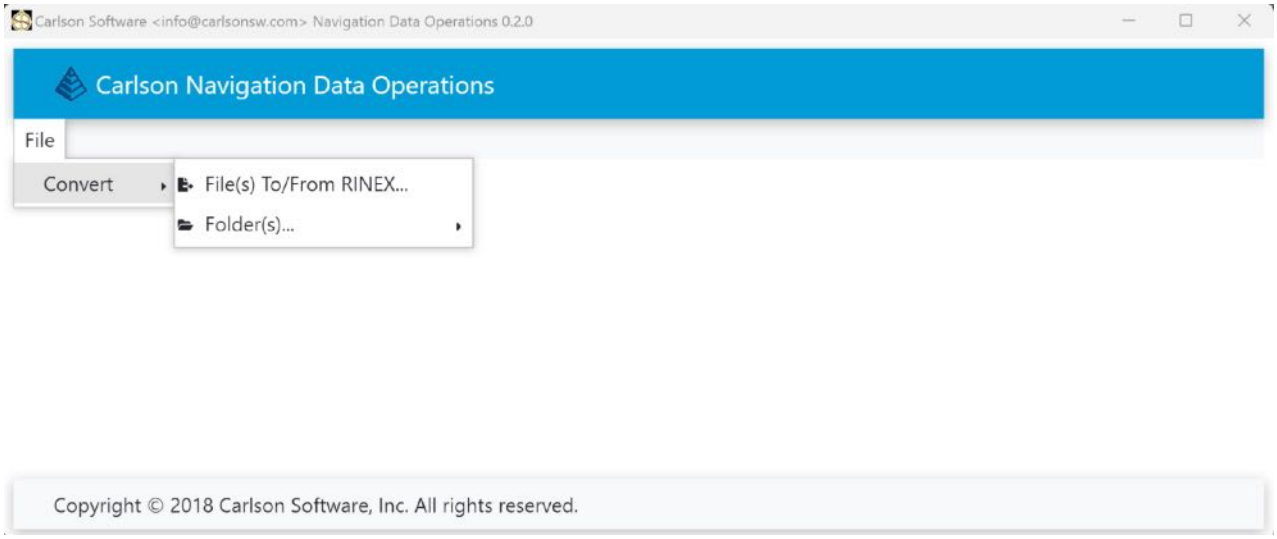


Figure 59 - Nj-ops GUI.

9 GAMA® Command Line Interface (GAMA® CLI)

Viking offers complete configuration capabilities through direct commands using the GAMA® Command Line Interface (GAMA® CLI). This interface serves as the foundational layer used by other Carlson SW products for configuring Viking, including but not limited to Carlson Grade and Carlson SurvPC. Consequently, it is the recommended interface for third-party software as well, ensuring seamless integration and optimal compatibility with Viking.

For details on GAMA® CLI see Appendix A3 – GAMA® Command-Line Interface (GAMA® CLI).

10 Specifications

10.1 Viking Hardware Specifications

Feature	Specification	Description
Power		
Batteries	2x lithium batteries	Hot-swappable batteries Charged externally or internally using external power supply. Battery life up to 12h Storage life more than 6 months (5% discharge per month)
External Power	11 to 17 V DC external power	13.8 V DC Recommended
GNSS		
GNSS	632 channels	High Precision GNSS with RTK support (rover and base) 2 GNSS RTK Modules and 3 RTK Engines for redundancy Support for all GNSS constellations and signals Support for L-Band corrections
Internal Radios		
Cellular radio	Integrated cell modem	Worldwide network coverage, LTE Cat 4, Modules used for different regions (N. America, S. America. APAC, EMEA, ASIA). 2 antennas fitted internally.
UHF radio	Integrated UHF radio	Fully configurable, with TX and RX capability for rover and base station modes
CPU		
CPU	ARM CPU	ARM dual-core 1.7 GHz 64 bit Processor 2GB DDR4, 16GB eMMC
Wi-Fi/BT		
Wi-Fi	Integrated Wi-Fi	Single band 2.4 GHz Wi-Fi 802.11 ax/ac/a/b/g/n
Bluetooth	Integrated Bluetooth	BT 2.1 + EDR and BLE 5.4
External Connectivity (Ports)		
5-pin Port	ODU G80F1C-P05QF00-0000	Power + Serial RS-232
7-pin Port	ODU G80F1C-P07QC00-0000	Serial RS-232 (diagnostics) USB (for Ethernet over USB connection)
Memory		
Internal Memory	16 GB eMMC	For data recording
SD Card	Removable SD card	For data recording
Indicators		
LED	5x	For indication of power and status
Audio		
Audio Speaker	1x	For user indication of GNSS status and audio warning beeps

10.2 Viking Mechanical Specifications

Mechanical		
Dimensions (W x L x H)	159 x 159 x 95 mm	
Mass	1.35 Kg	With 2 lithium batteries installed
Material	Anodized aluminum housing Plastic top cover Nitrile rubber O-ring Steel screws	

10.3 Viking Environmental Specifications

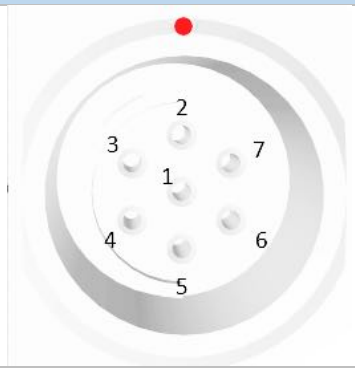
Environmental		
Ingress	IP67	Protected from temporary immersion to a depth of 1 m
Operating Temp	-40° to + 65°C	
Storage Temp	-40°C to + 85°C	
Humidity	Up to 100%	
Mechanical Shock	MIL-STD-810G, method 516.6	
Vibration	MIL-STD-810G, method 514.6	
Unprotected Drop	2 m range pole drop on concrete floor 1 m free drop on hardwood floor	
Inflammability	Fulfill US, EU Safety standards UL recognized batteries	
Chemical Resistance	Cleaning agents, soapy water, industrial alcohol, water vapor, solar radiation (UV)	

10.4 Connector Pinouts:

5-Pin Power and Serial Cable Connector

ODU G80F1C-P05QF00-0000		Power, Serial	
	Pin 1	GND	
	Pin 2	TXD	RS232 out
	Pin 3	GND	
	Pin 4	RXD	RS232 in
	Pin 5	Power	External power in

7-Pin Support Cable Connector

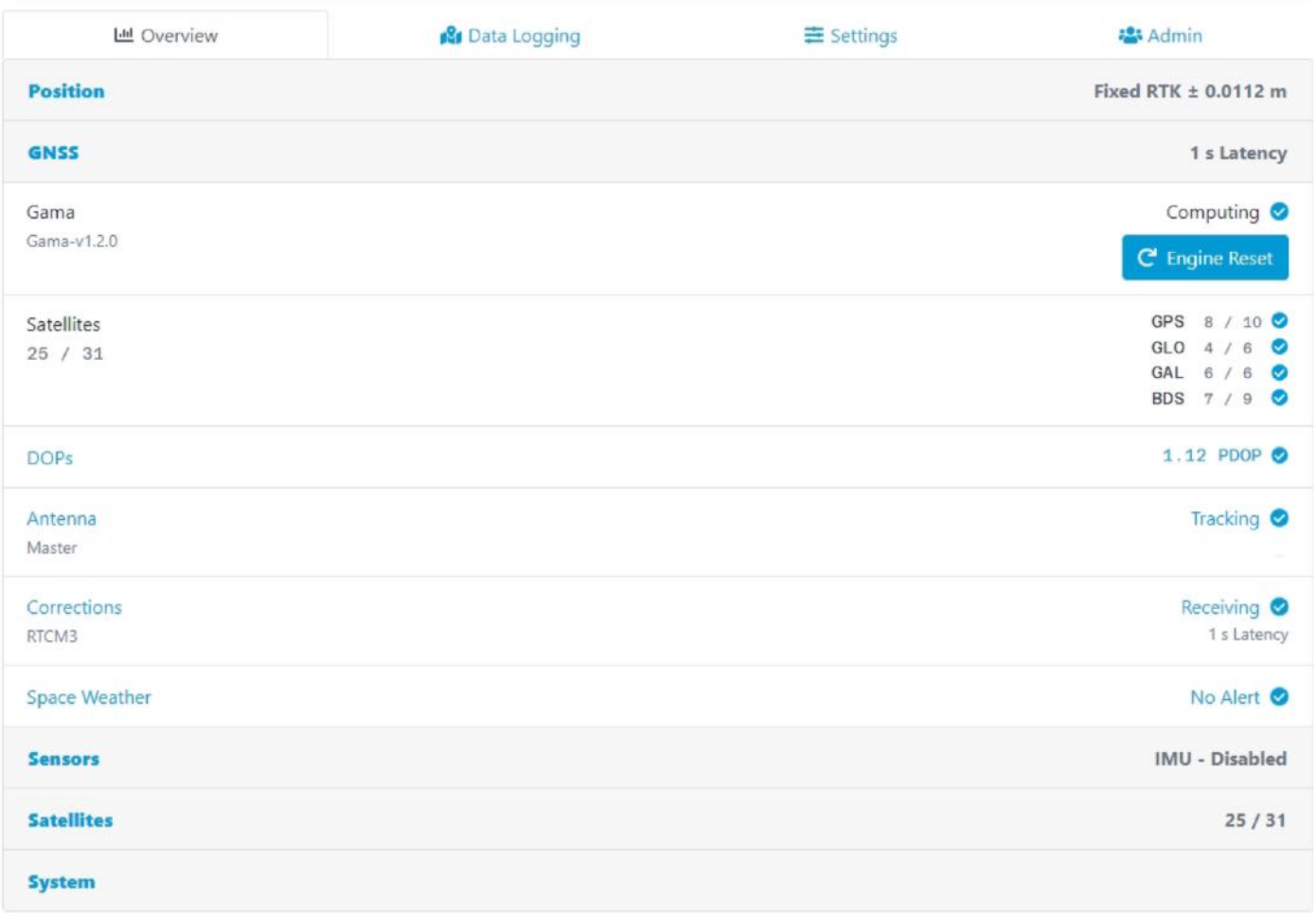
ODU G80F1C-P07QC00-0000		USB, Serial	
	Pin 1	-	Reserved
	Pin 2	RXD	RS232 in
	Pin 3	USB_DN (-)	
	Pin 4	USB DP (+)	
	Pin 5	GND	
	Pin 6	USB VBUS	
	Pin 7	TXD	RS232 out

Appendix A1 – Troubleshooting

If Viking becomes unresponsive or is not operating as expected follow these steps:

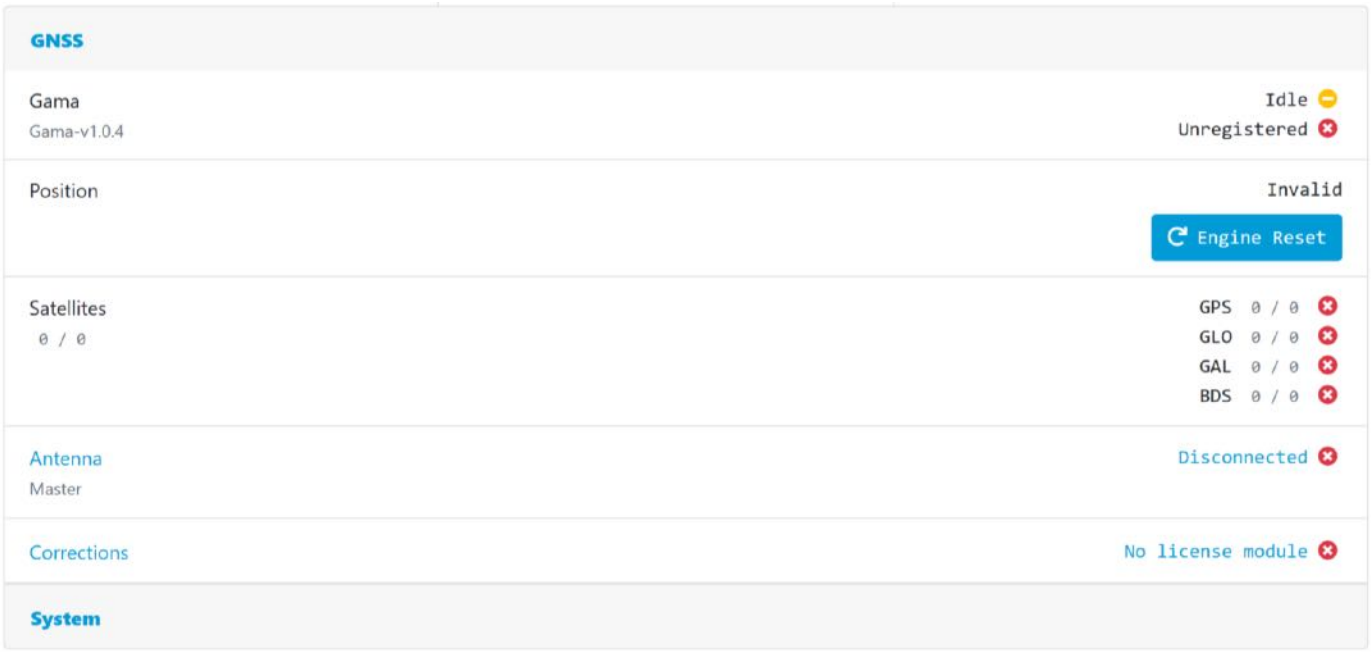
1) Open Web UI (see 5.3 Accessing the Web UI)
2) Inspect Status tab on the Web UI and check if all statuses are OK.

Normally, all statuses should be in blue color as shown below. If you see any item in red continue reading below for troubleshooting.



A1.1. Viking is unregistered

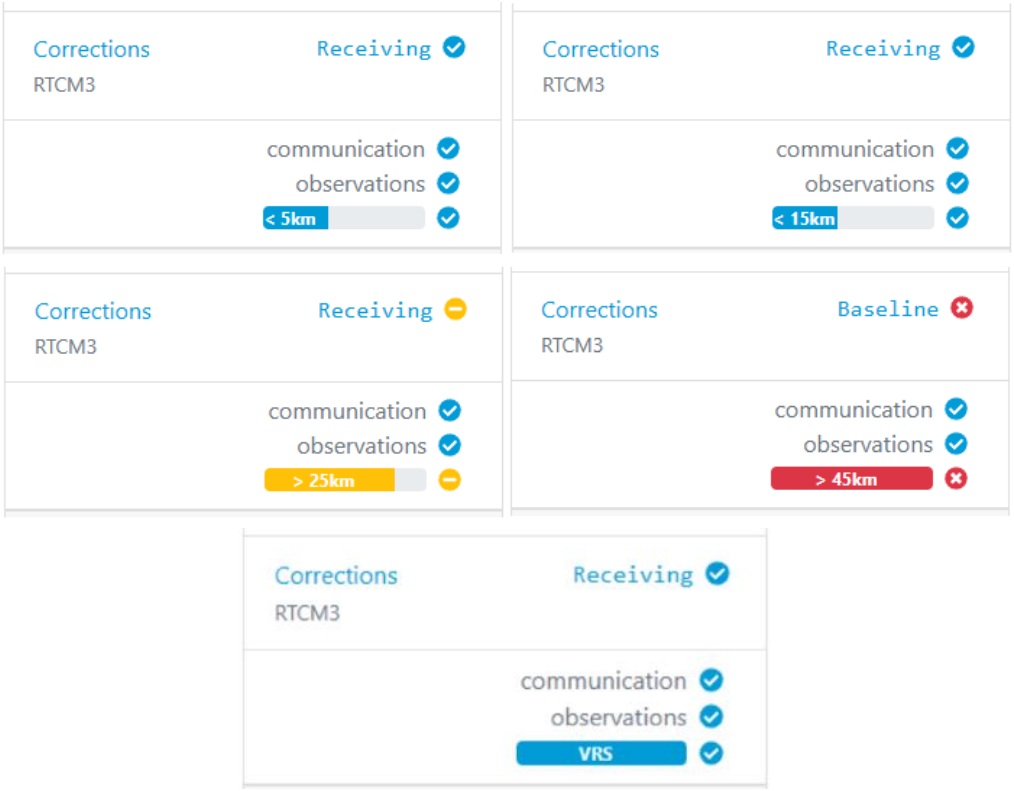
If Viking is not fixing, if you cannot connect Grade/SurvPC to Viking, or some features appear disabled (not able to log NJS raw data) make sure Viking is correctly Registered. To Register Viking see Admin – Registration under chapter 7.6.



A1.2. Baseline degrading performance

If the selected base is too far away (RTK baseline is too long), Viking may have sub-optimal RTK performance.

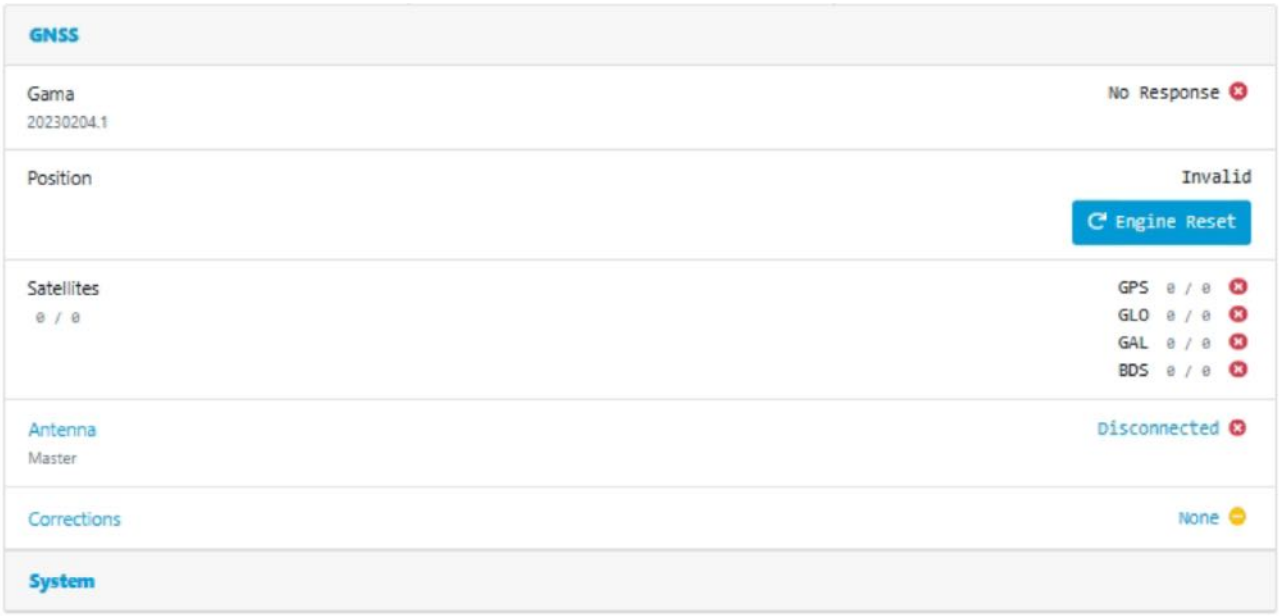
VRS is unique in that the base observations are synthetically generated. Ensure you are within the VRS network.



Review the selected Base and ensure the distance is an appropriate length.

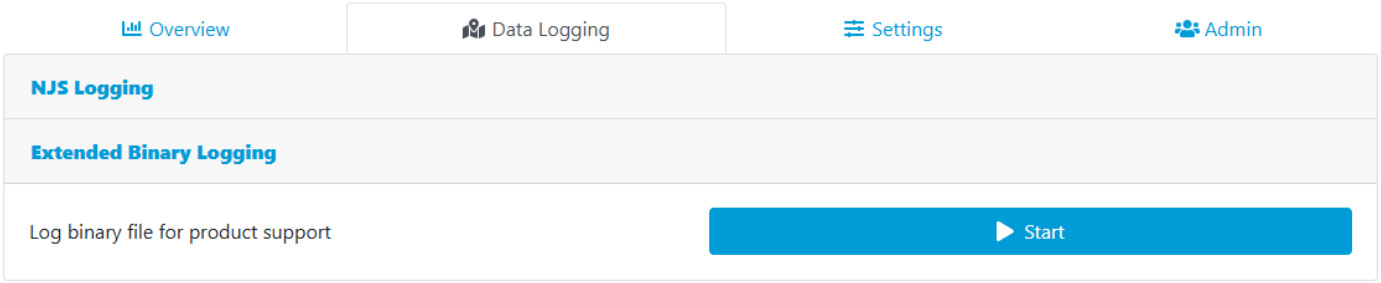
A1.3. Hard crash

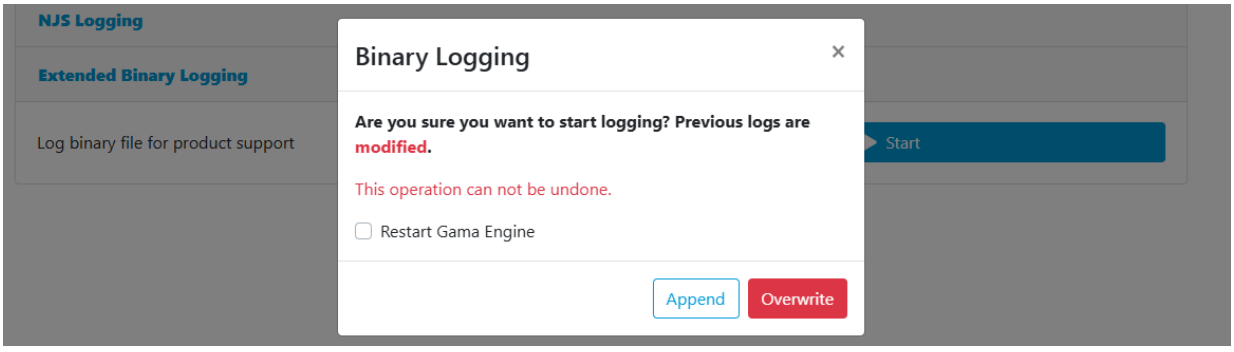
If a hard crash occurred but the Web UI is still responsive, you may see a status like this:



Follow these steps:

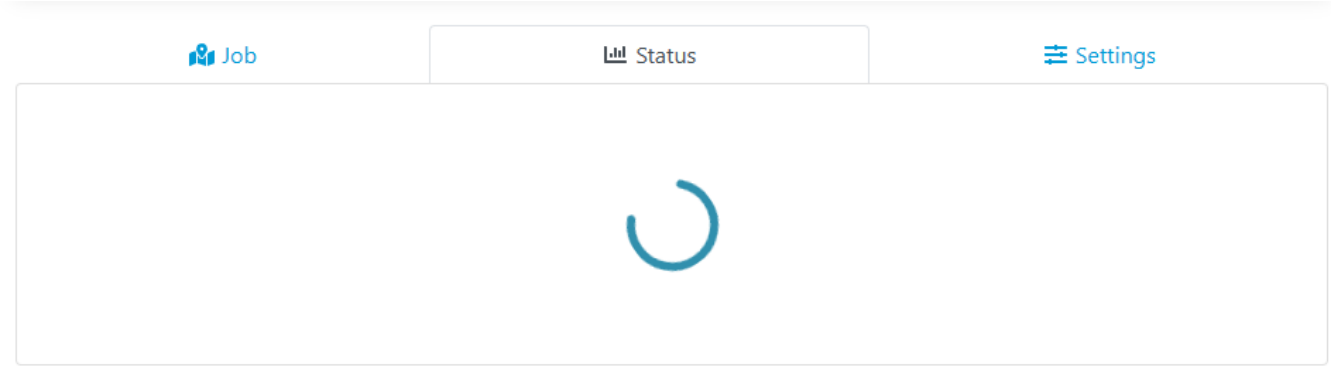
1) Open Web UI Data Logging page;
2) Start Extended Binary Log without restarting the GAMA engine and click Append;
3) Stop logging after a minute;
4) Click “Download All”;
5) Copy downloaded file and forward it to your Carlson Software Support point of contact;
6) Reboot device.





A1.4. Web UI unresponsive

If the Viking Web UI is unresponsive, you may observe the following:



This is expected behavior after updating Viking/GAMA®. Please wait and refresh (press F5).

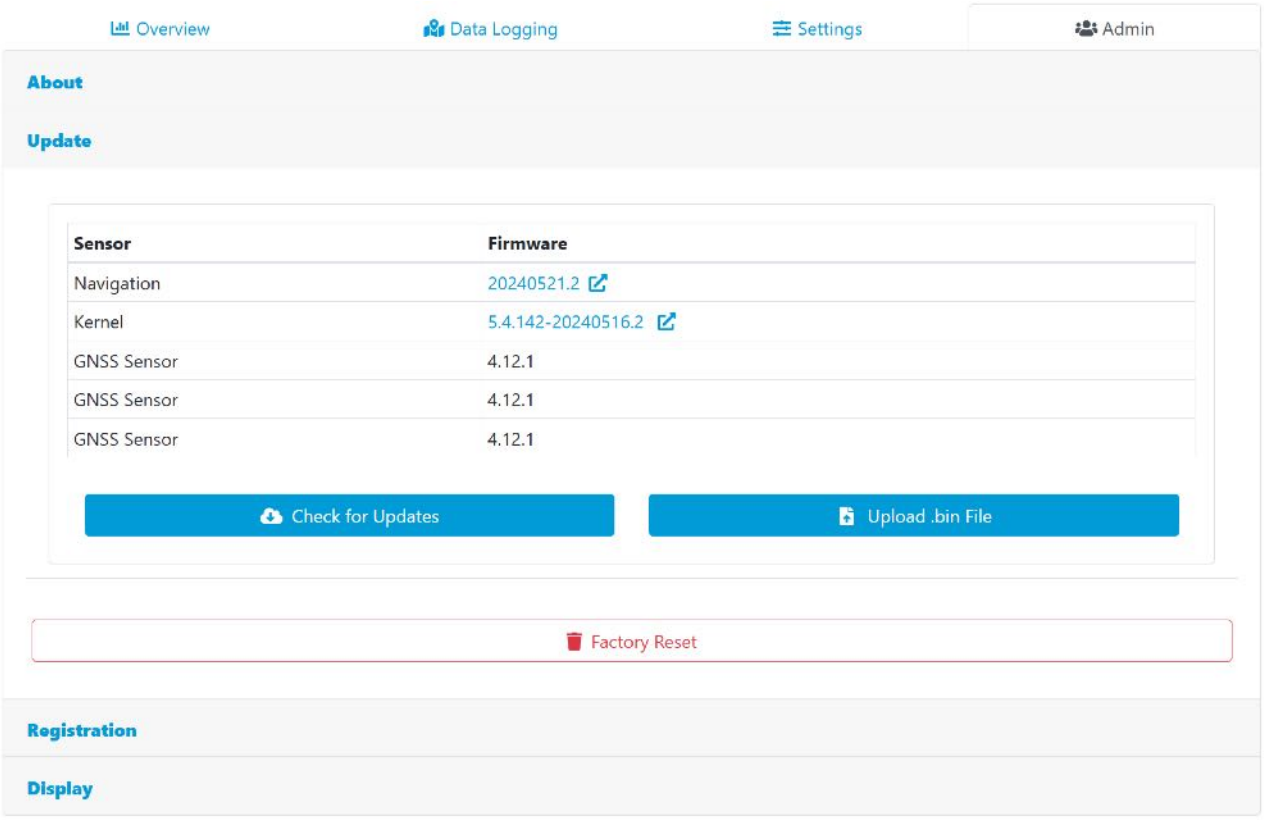
If the Web UI continues unresponsive, follow these steps:

1) Open Web UI Support page (http://192.168.10.1/support);
2) Start a new support log without rebooting Viking;
3) Copy all logs and forward them to your Carlson Software Support point of contact;
4) Power cycle Viking.

A1.5. GNSS Sensor Firmware Out-of-Date

To ensure Viking performs optimally, it is required that the GNSS Sensor be operating within a specified range of firmware (FW) versions.

The current FW version of the internal GNSS Sensor is located on the GAMA® Web UI update section.



At the time of this document, the latest GNSS Sensor firmware is:

- **GNSS Sensor: 4.15.0 for the primary GNSS sensor**
- **GNSS Sensor: 1.51 for the secondary GNSS sensor**

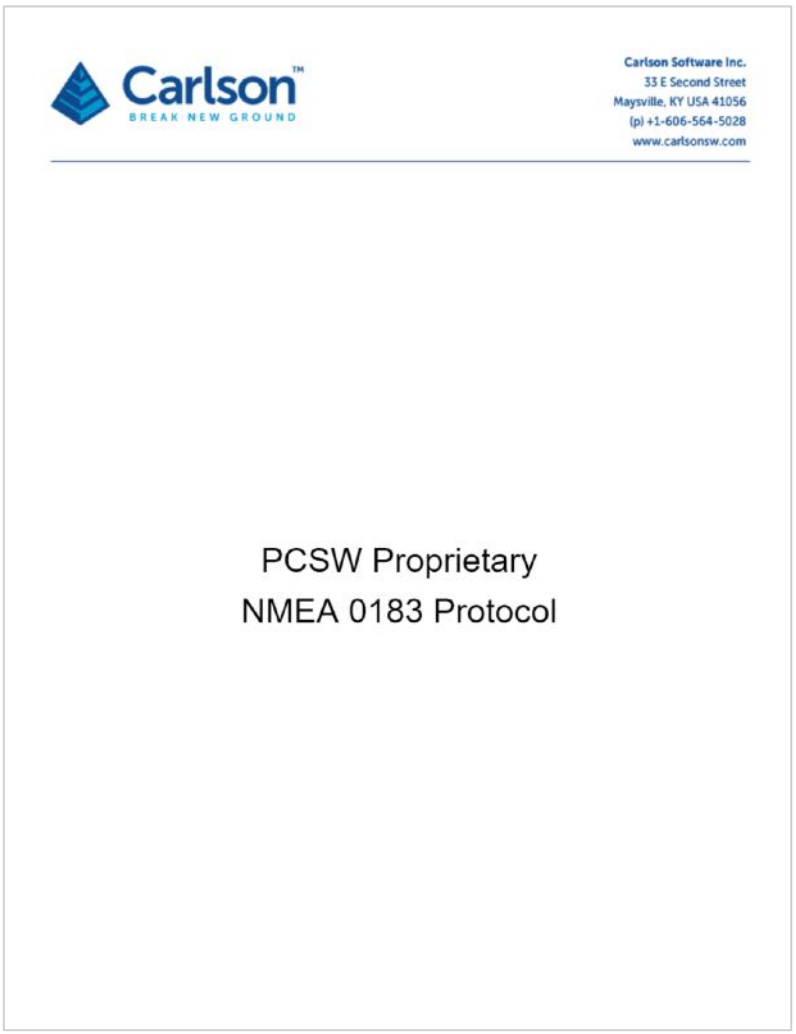
If your displayed version is less than the above, the GNSS Sensor FW can be updated by following the Viking FW update procedure – see chapter 4 FW Update.

Appendix A2 – PCSW Proprietary NMEA 0183 Messages

The NMEA 0183 standard grants hardware manufacturers the flexibility to define proprietary sentences tailored to their specific needs. These exclusive sentences are denoted by commencing with the letter P, succeeded by three letters uniquely identifying the controlling manufacturer. In the case of Carlson Software, its proprietary NMEA sentences start with PCSW.

For the most up-to-date information on Carlson's proprietary NMEA messages, you can download the latest version of the reference guide here:

- https://files.carlsonsw.com/mirror/carlsongnss/Doc/Carlson-PCSW-Proprietary-NMEA-0183.pdf

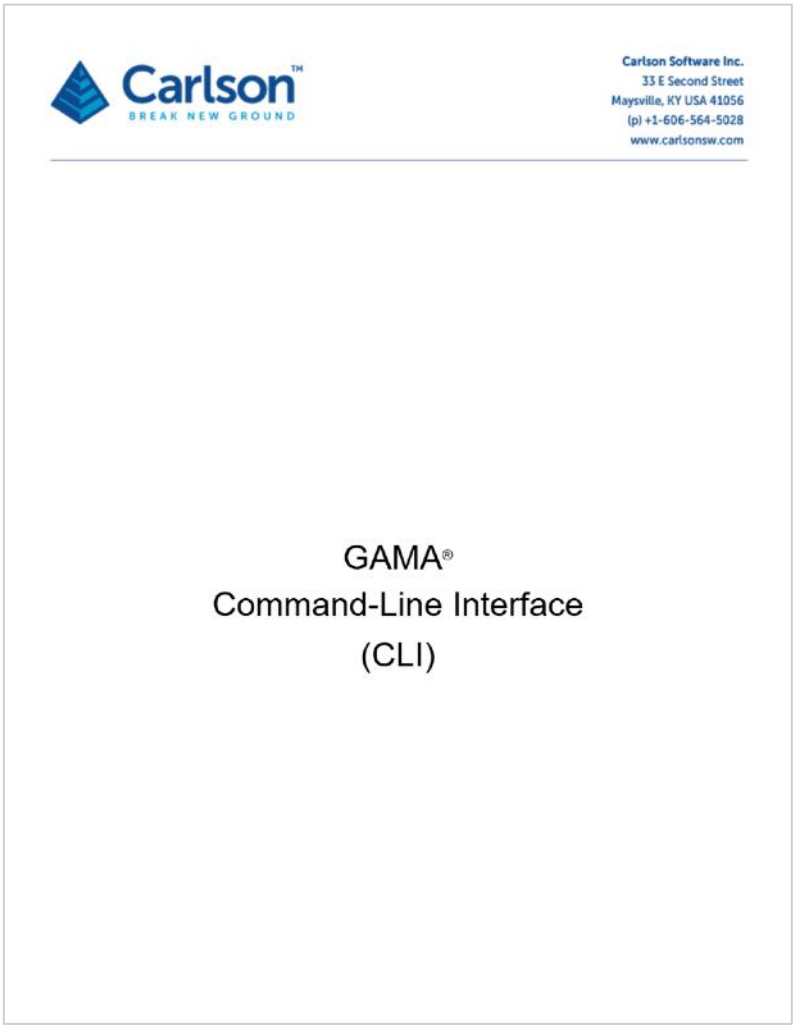


Appendix A3 – GAMA® Command-Line Interface (GAMA® CLI)

Viking offers complete configuration capabilities through direct commands using the GAMA® Command-Line Interface (GAMA® CLI). This interface serves as the foundational layer used by other Carlson SW products for configuring Viking, including but not limited to Carlson Grade and Carlson SurvPC. Consequently, it is the recommended interface for third-party software as well, ensuring seamless integration and optimal compatibility with Viking.

The latest version of the GAMA® CLI reference guide document is available for download here:

- https://files.carlsonsw.com/mirror/carlsongnss/Doc/Carlson-GAMA-CLI.pdf



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