C-NaviGator III Software Manual

Revision 4

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Release Notice

This is the July 2018 release of the C-NaviGator III Software Manual.

Revision History

Revision	Date	Description	Author
4	07/30/2018	Updated for version 7.2.6	C. Thompson
3	08/31/2017	Updated for version 7.2.4	C. Thompson
2	05/09/2017	Updated for version 7.2.3	C. Thompson
1	03/21/2016	Initial document creation	C. Thompson

Trademarks

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Table of Contents

Manual Organization

This manual describes how to operate the C-NaviGator III Control & Display unit. Sections are organized in a manner that facilitates quick operator orientation.

Section 1 - Overview (Page 9) gives a general overview of the software running on the C-NaviGator III. Instructions to guide the operator through installation and setup are provided in Section 2 - Operator Instructions (Page 12).

A detailed description of the C-NaviGator III pages can be found in Section 3 - Pages (Page 19).

Section 4 - Maintenance (Page 57) concentrates on maintenance and troubleshooting.

Related Documents

CNAV-MAN-055.3 (C-NaviGator III Hardware Manual)

Describes how to install, configure, and operate the C-NaviGator III Control & Display unit. It is available on the C-Nav® website at https://www.oceaneering.com/C-Nav/Software/C-NaviGatorIII/PDFDownloads/CNAV-MAN-055.3%20%28C-NaviGator%20III%20Hardware%20Manual%29.pdf.

Related Standards

NMEA 0183

National Marine Electronics Association Standard for Interfacing Marine Electronic Devices. NMEA National Office; 7 Riggs Avenue; Severna Park, Maryland 21146

Manual Conventions

Arial font is used for plain text in this document.
Arial italic font is used for settings names.
“Arial quoted” font is used for settings values.
Arial Bold font is used for button names.
Arial Bold Italic font is used for menu items.
Arial Blue font is used for cross-references.
Arial Blue Underline font is used for hyperlinks.
Arial red italic is used for typed commands.
Arial Bold font size 10 is used for captions.
ARIAL BLACK ALL-CAPS font is used for port connection names.

This symbol means Reader Be Careful. It indicates a caution, care, and/or safety situation. The user might do something that could result in equipment damage or loss of data.

This symbol means Danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical and RF circuitry and be familiar with standard practices for preventing accidents.

Important notes are displayed in shaded text boxes.

> ***Please note***:
> Such note boxes display important information that should not be ignored.

Simple file content is displayed in Courier New Black font in a text box.

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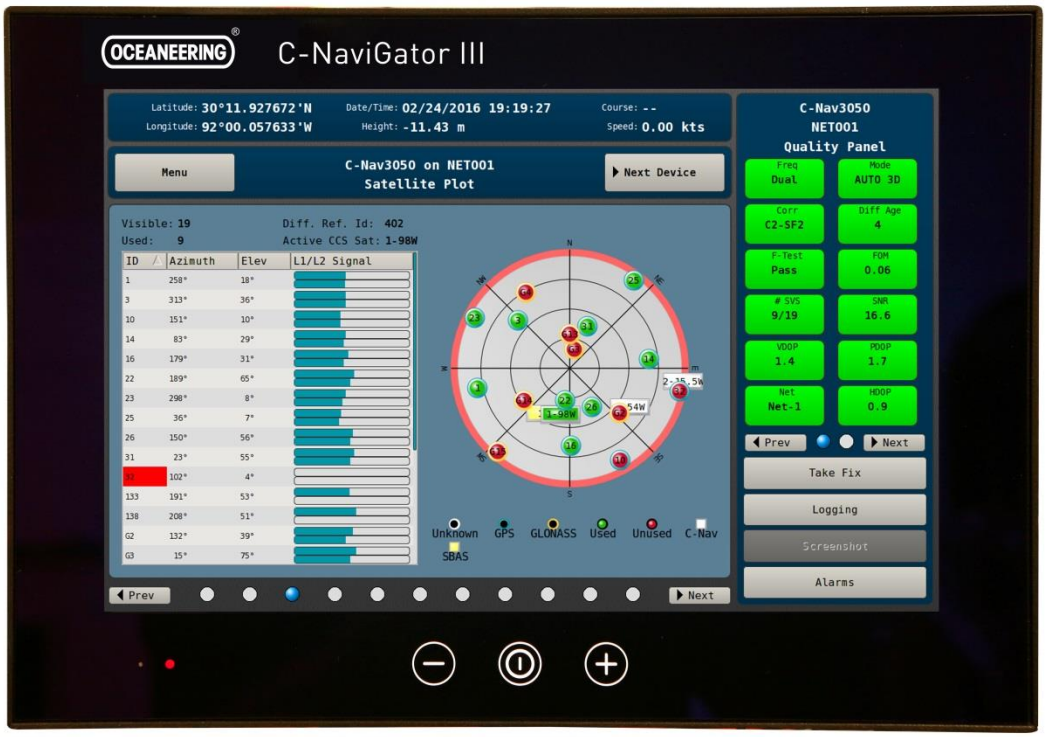
#Sample File
Version 0.1
```

Section 1 - Overview



Introduction

The C-NaviGator III is a self-contained Control / Display Unit that provides a number of visual aids to help the user monitor the quality, performance, and accuracy of the position information supplied by the GNSS receiver. Position calculations are performed by the C-NaviGator III, along with data quality assessments to create visual and graphical data representations that instantly convey critical information to the operator. Information from external sensors is displayed in a form that enables the user to quickly recognize a decrease in reliability of the position solution. The C-NaviGator III has a processor-based, windows-style operating environment that is straightforward and easy to use.

Information screens provide the necessary user interface. Data entry and command functions are entered through the use of the touch-screen. Information displays, alarm indicators, parameter settings, data analysis, etc. are displayed

on the color LCD screen of the C-NaviGator III. Alarm or alert states are configured by the operator.

Position calculations are performed for data output to other systems as configured by the operator. Through the C-NaviGator III, the operator has easy access to input and output controls.

Features and Functions

- Monitoring of NMEA compliant GNSS systems
- Saving / loading of settings
- Logging of GNSS data
- User selectable units for distance, height, and speed
- User selectable time zones
- Day / night display brightness settings
- Help documentation
- Software updates via USB
- Input / Output all NMEA versions (2.1 / 3.0 / 3.1)
- Multiple Input / Output ports (4 x RS232)
- Single RS422 Input / Output port
- Monitoring screens include
  - Satellite Information
  - Error Ellipse
  - Scatter Plot
  - Quality Alert Graphs
  - Position Comparison
  - Tape Display
  - Compass Rose
  - Event Log “Fixes”
  - Alarms
- Display of current Quality Information with Alerts
  - Frequency Mode of Solution
  - 2D / 3D Status
  - Correction Type
  - Correction Age
  - Number of Satellites used for Position Solution
  - HDOP, VDOP, and PDOP
  - Figure of Merit
  - Signal Strength

C-Nav® Specific Features and Functions

- Control and monitoring of C-Nav3050® GNSS receivers
- Control and monitoring of C-Nav2050 receivers
- Control and monitoring of C-Nav2000 receivers
- Control and monitoring of C-Nav1010 receivers
- Control and monitoring of C-Mariner INS
- Control and monitoring of Hemisphere Eclipse and Vector receivers
- Interface for the user to enter activation / deactivation codes
- Monitoring and control of the correction signal demodulator
- Updating of the receivers' firmware
- Viewing of L1 and L2 signal strengths for each tracked satellite

Section 2 - Operator Instructions

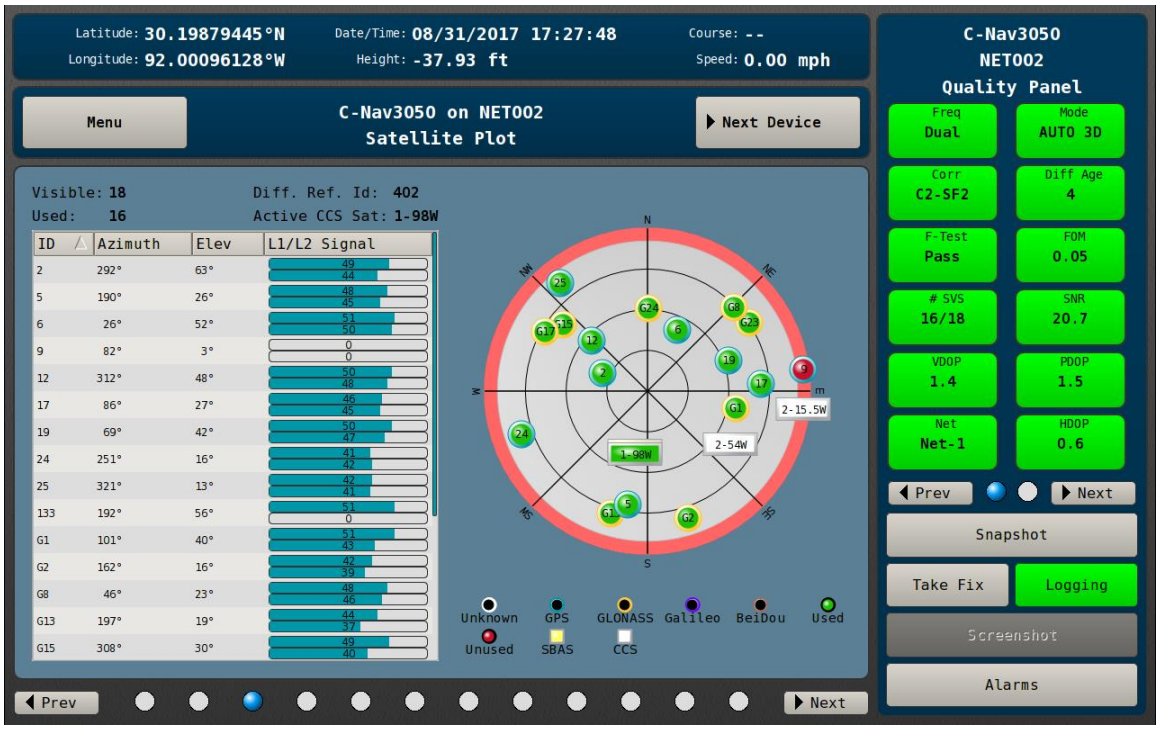
Power-Up

During the power up sequence, the operator has the option to install new software from C-Nav®. As updates become available, the user will be able to download the software from the C-Nav® website (oceaneering.com/cnav) and transfer it to a USB memory device. A flash memory stick is supplied with each unit. See Updating Software (Page 57) for details.

Allow at least one minute for the system to initialize. Program start is automatic and the last settings stored by the user are recalled. The default screen is the Satellite Info (Page 26) screen.

For a description of the C-NaviGator III display screens, see View Menu Screens (Page 22). If this page does not contain the information described, refer to Troubleshooting (Page 57).

Screen Layout



The C-NaviGator III screen provides easy access to system information and control functions. Positioning information and time of the active device are shown across the top of the screen. Below the position information is the menu. The type of information to be displayed in the center of the screen is selected by the operator using the menus described in Section 3 - Pages (Page 19). System performance and the quality of the position solution are conveyed by means of red, yellow, and green indicators in the right screen panel (GNSS Quality Alert Indicators (Page15)). Indicator colors change according to the limits set by the operator for each parameter. See Quality Panel Thresholds (Page 44) for details. The main system “Alarm” appears in red on the right side of the screen. Along the bottom are navigation buttons to move between screens, as well as an indicator of which screen is displayed in relation to the menu grouping.

Menus

Menu	Functions
File	Configuration, storage, recall, and reset
View	Monitoring screen selection
Settings	View, enter, or adjust operating parameters
{Device} Settings	Settings for individual receivers
Help	Display and control screen setting descriptions

Active Device Information

- Position (Latitude, Longitude, and Height)
- Date and time
- Course
- Speed
- Heading (If available)

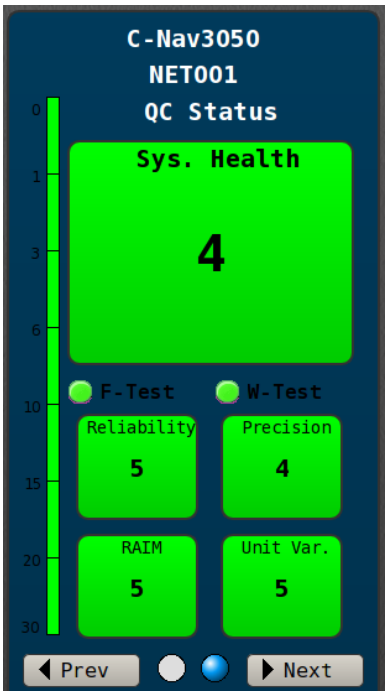
GNSS Quality Alert Indicators

Each device connected to the C-NaviGator III will have a Quality Panel that displays basic quality information for the device. The standard GNSS indicator, valid for any GNSS receiver, has the following parameters:

Freq	Mode of operation
Mode	Position solutions with or without height
Corr	Current source of correction data
Diff Age	Time in seconds since last valid correction
F-Test	Pass or Fail of the F-Test
FOM	Figure of Merit
# SVS	Number of satellites used in position solution
SNR	Signal to Noise Ratio
VDOP	Vertical Dilution of Precision
PDOP	Position Dilution of Precision
Net	The Network of the CCS Satellite
HDOP	Horizontal Dilution of Precision

Some devices, like the C-Mariner INS, will have their own GNSS Quality Indicators.

QA / QC Status Indicator



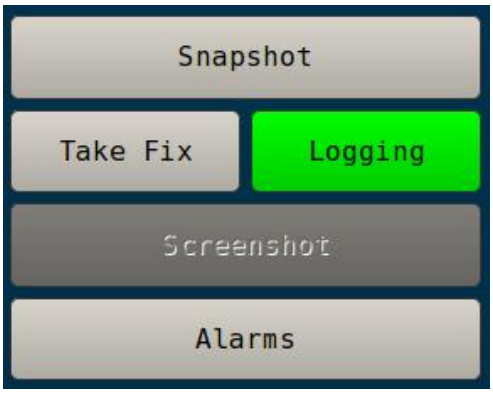
Some devices are capable of producing more detailed QC parameters. These devices will a QA / QC Status Indicator. Each value displayed is a weighted value that is scaled between 1 - 5. The standard QA / QC Status Indicator has the following values:

Sys. Health	Overall recent health of the system
F-Test	Recent F-Test health
W-Test	Recent W-Test health
RAIM	Recent RAIM health
Unit Var.	Recent Unit Variance health

The user can select any of the indicators to be the “active” indicator, which will place it in the largest indicator at the top.

Some devices, like the C-Mariner INS, will have their own QA /QC Status Indicators.

Main Buttons



Five buttons are permanently available to the user on the bottom right-side of the screen.

The **Snapshot** button will create a human-readable report of the system, including information for each device. This file is helpful when communicating with C-Nav® Support (cnavsupport@oceaneering.com) for troubleshooting.

The **Take Fix** button will take a fix of the current position. You can access the fix in the Fixes (Page 38) page.

When clicked, the **Logging** button will take you to the Logging (Page 49) page. The button will be displayed in green when there is a device actively logging. If there is a problem with an active log, the button will be displayed in red.

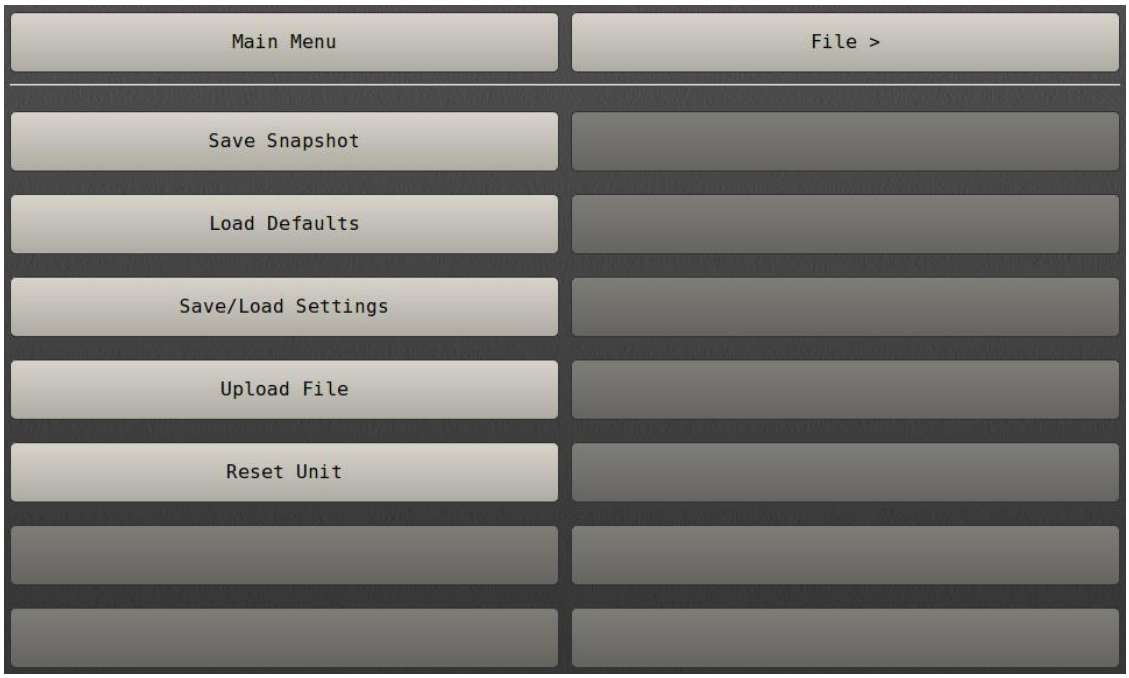
Pressing the **Screenshot** button will take a screenshot of the current display. This is useful for sending troubleshooting information to C-Nav® Support. After taking a screenshot, the image can be access in the Screenshots (Page 40) page.

The final button is the **Alarms** button. This button will flash red when there is an active alarm. To view the alarms in the Alarms (Page 39) page, simply press the **Alarms** button.

Operation

1. Apply power to the C-NaviGator III by connecting the power supply to the back of the C-NaviGator III unit.
2. In a few seconds, the system menu will appear allowing the option to update the internal program, calibrate the touch-screen, or begin normal operation (default). If no action from the operator is detected, the C-NaviGator III will automatically launch the program. This will take several seconds.
3. The C-NaviGator III automatically recalls the last settings saved and displays the Satellite Info (Page 26) screen. System operating modes and status indicators are seen on the right in the Quality Panel. To the right are the active ports switch, the active port indicator, and the general “Alarm” Indicators.
4. The **Next Device** button provides a means to quickly switch between different input sources for monitoring. The actual port programming and activation are accessed from the ***Menu / Settings / Serial Ports*** (Serial Ports (Page 45)) or ***Menu / Settings / Network Virtual Ports*** (Network Virtual Ports (Page 47)).
5. Press **Prev** and **Next** on the C-NaviGator III display to scan through the various screens in a menu grouping. The user can also swipe left or right to ‘walk’ through the available screens.

Section 3 - Pages



Pull down menus allow operator access to the C-NaviGator III configuration, display options, parameter settings, support documentation, etc. Menus are selected by pressing **Menu** on the display and pressing each subsequent menu item.

File Menu Screens

The ***File*** menu screens contain pages that handle the configuration files of the C-NaviGator III and any connected devices.

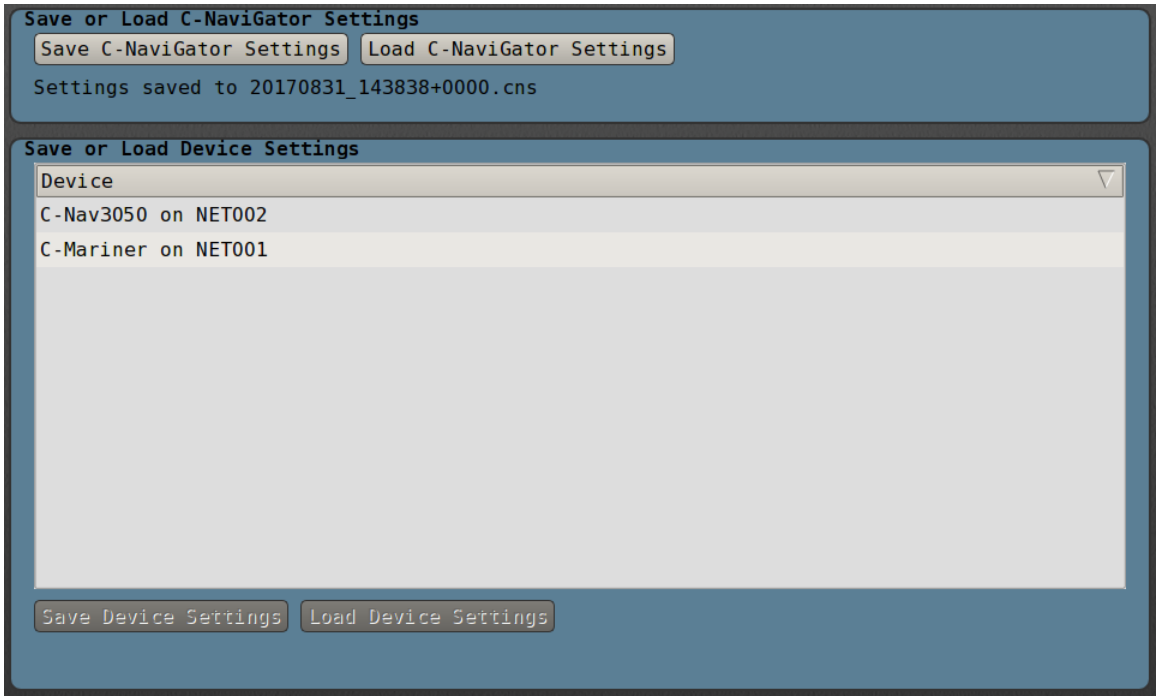
Save Snapshot

The C-NaviGator III can create a human-readable report of the system, including information for each device. This file is helpful when communicating with C-Nav® Support for troubleshooting.

Load Defaults

The user can quickly revert the C-NaviGator III to all factory settings as a starting point for a new configuration. When ***File / Load Defaults*** is selected, the user is required to configure the system, starting with assigning devices to Serial Ports (Page 45) or Network Virtual Ports (Page 47).

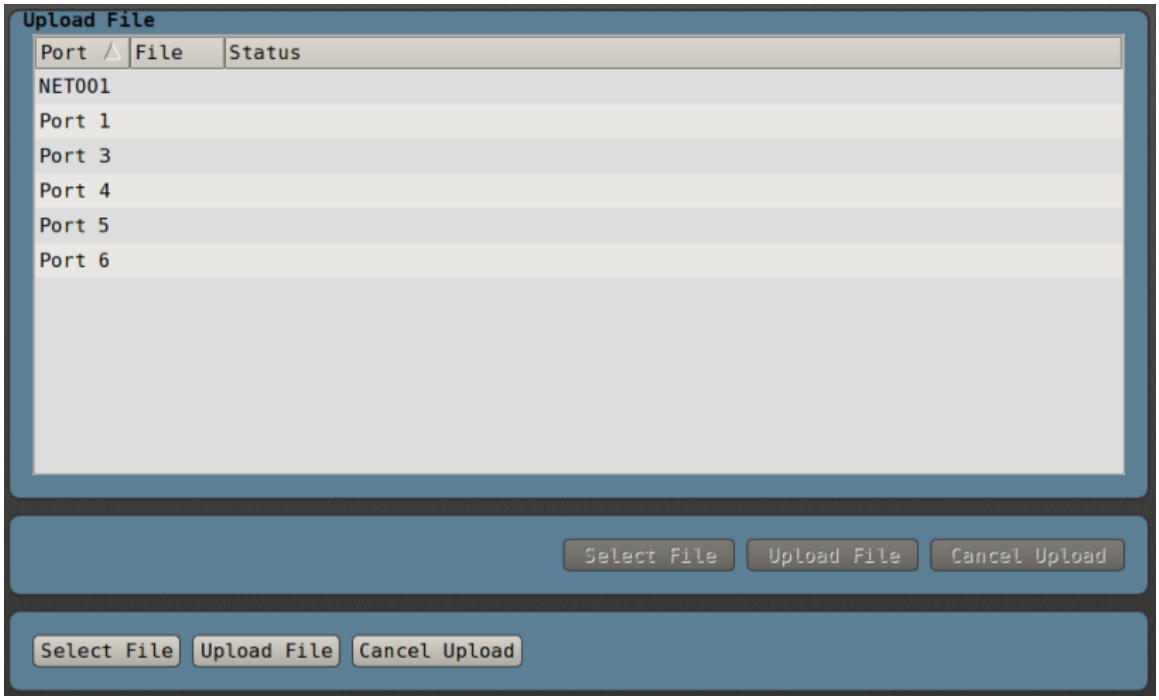
Save / Load Settings



To store the current configuration of the C-NaviGator III, select **Save C-NaviGator Settings**. These settings can be recalled with the **Load C-NaviGator Settings** command.

To store a receiver's specific configuration, select the device in the table and press **Save Device Settings**. These settings can be recalled with the **Load Device Settings**.

Upload File



This opens the file upload screen, allowing the user to quickly upload a file to a device.

Warning:
Uploading an inappropriate file to the device may render the device inoperable. Use care to only upload files designed for the device.

Reset Unit

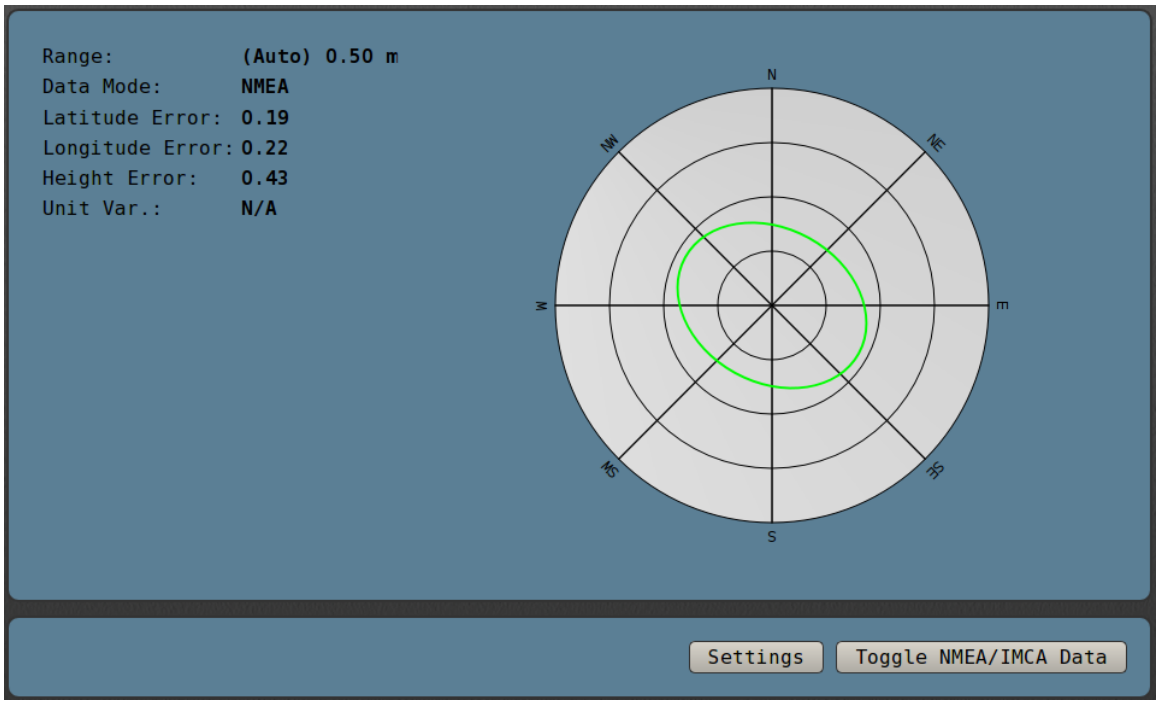
Reset Unit causes the C-NaviGator III to restart the internal program. The operator is asked to confirm the ***Reset Unit*** command.

View Menu Screens

The ***View*** menu screens contain pages that display real-time data from the active device. Pressing **Next Device** will cycle the active device between all connected devices, and update the current screen with the new device's data.

Not all devices will be able to populate all ***View*** screens. For example, only the C-Nav3050® GNSS receiver and C-Mariner INS will populate the ***QC Graphs*** screen. Only devices providing heading will populate the ***Compass Rose*** screen.

Error Ellipse

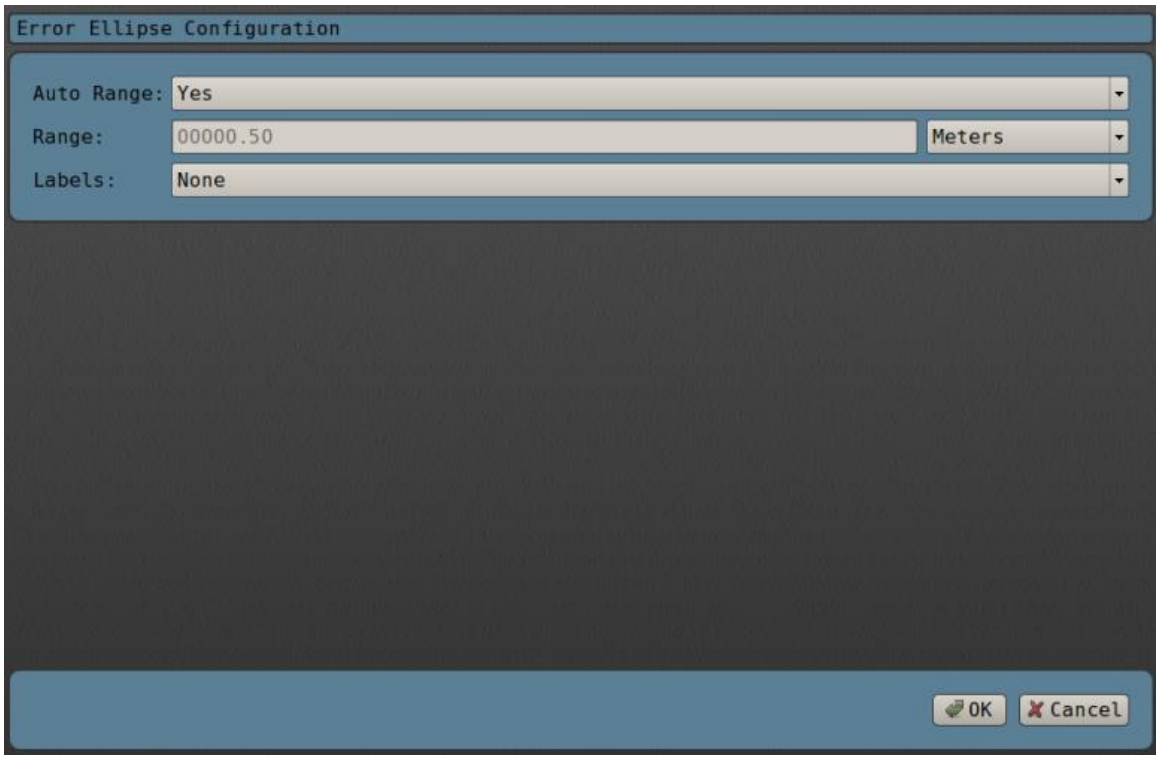


The error ellipse graphically represents the sum of the horizontal error uncertainty in the system. Graphics on the ***Error Ellipse*** screen show the error estimate of the PVT solution accuracy (in meters) based on residual analysis.

Pressing the **Toggle NMEA/IMCA Data** button will alternate the display between the standard NMEA error levels and the more accurate IMCA error levels.

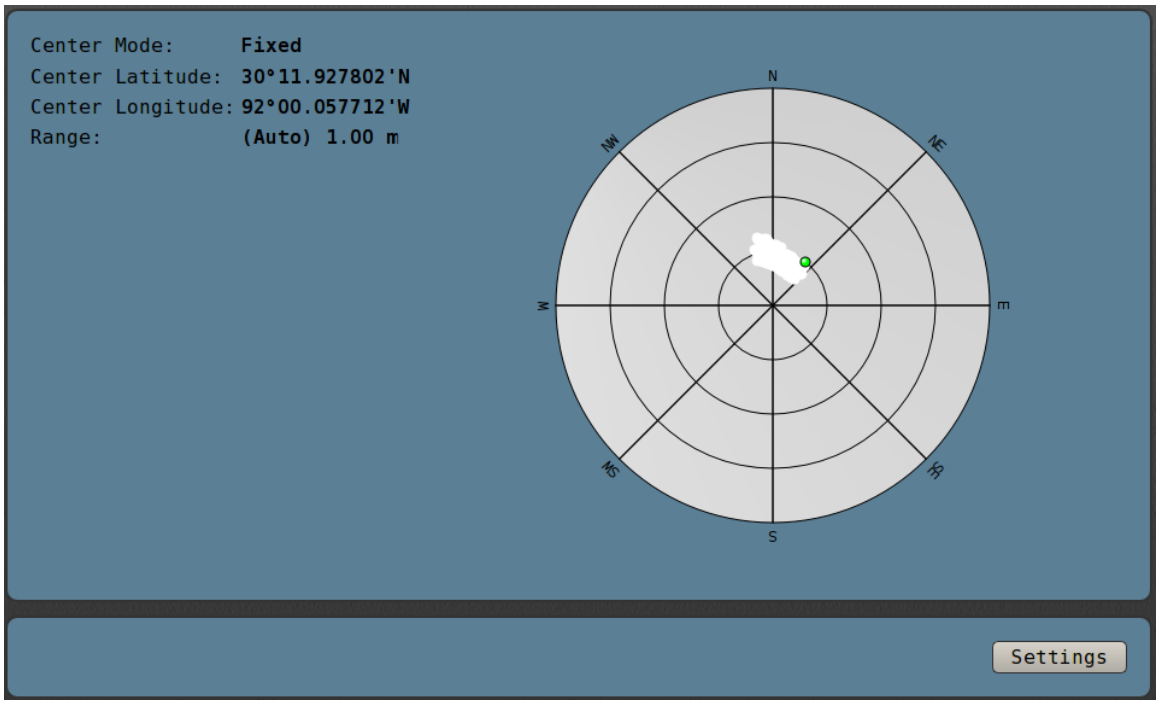
To configure the look of the graph, press the **Settings** button.

Error Ellipse Settings



Allows the user to set the range of the graph or set it to A*uto Range*. When A*uto Range* is set to “Yes”, the range will grow to accommodate the size of the error ellipse. The operator can also choose to display distance labels on the graph.

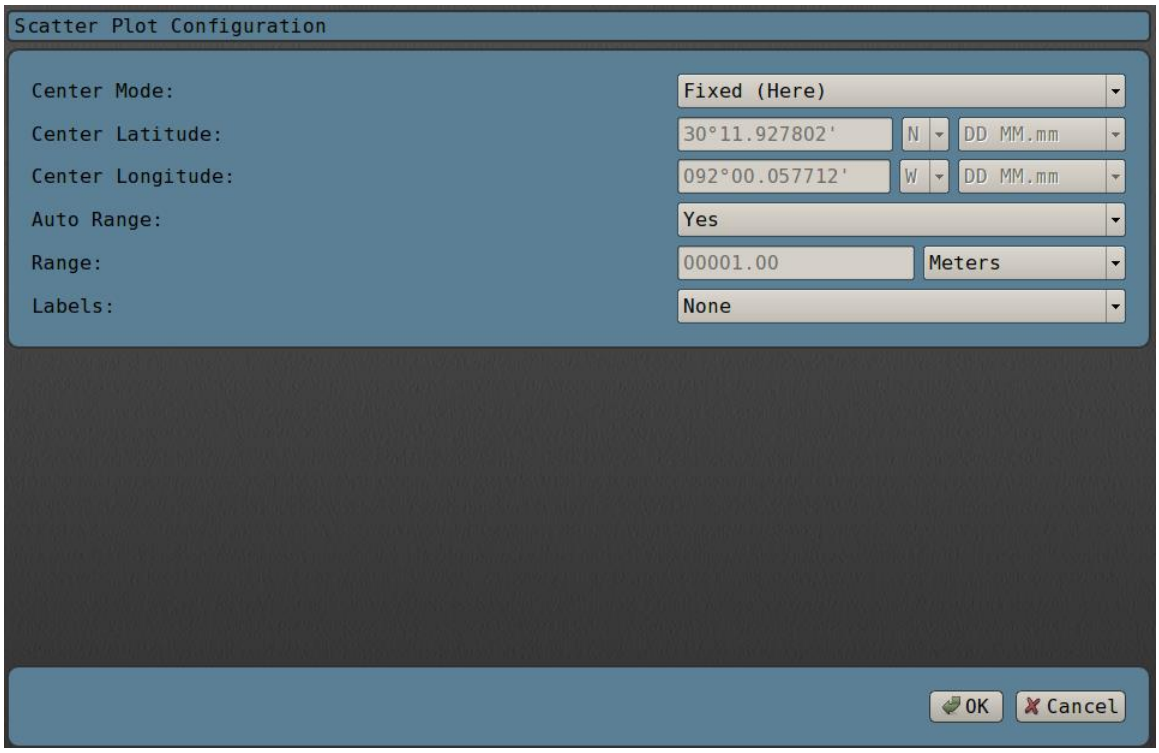
Scatter Plot



This screen displays a five minute history of the positions received from the GNSS receiver. The reference *Center Latitude* and *Center Longitude* shown indicate the center position of the graph.

New positions are computed and presented on the scatter plot with error displacements shown referenced to the reference position. The reference position may be set to a “Fixed” position or set to “Track” the latest GNSS fix. The range is the distance from the center of the graph to the outer ring. To configure the reference position or range, press the **Settings** button.

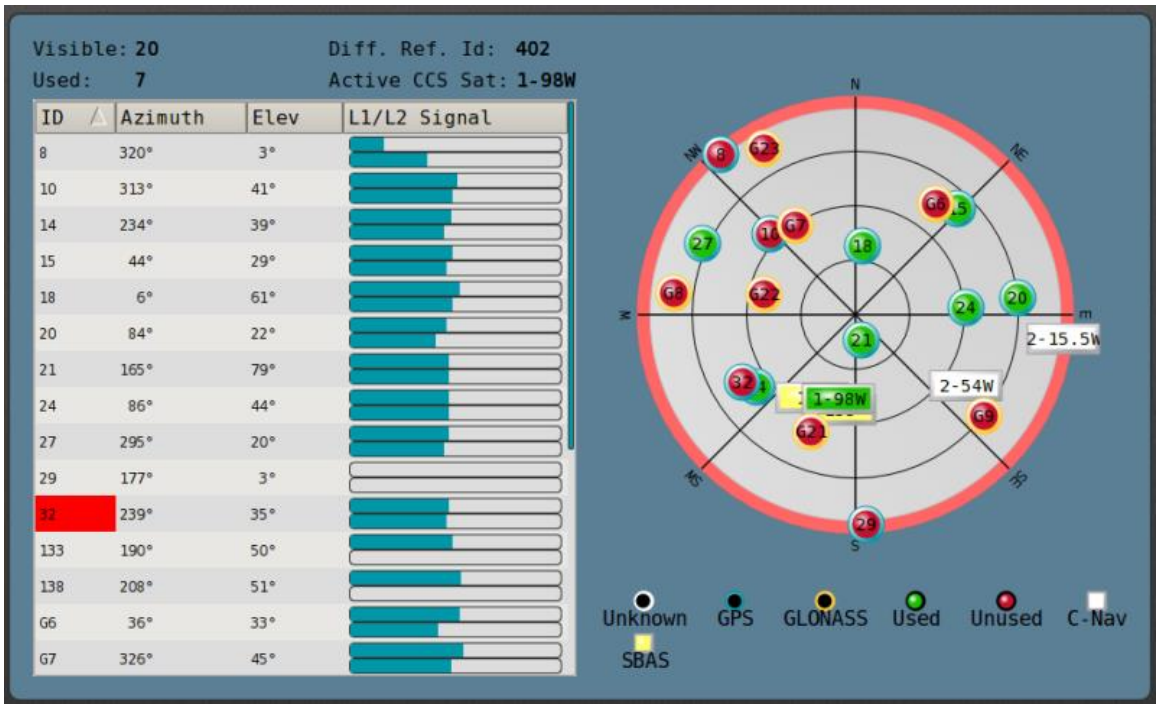
Scatter Plot Settings



Using the *Center Mode* drop-down you can set the position for the center of the graph. Select “Track Current” to always use the current position as the reference position. Choose “Fixed (Manual)”, to enter a latitude and longitude. Choose “Fixed (Here)”, to use the current position as the graph center.

Enter the *Range* for the graph in the *Range* field. The display can also be set to automatically adjust the range of the graph if *Auto Range* is set to “Yes”. The operator can also choose to display distance labels on the graph.

Satellite Info



This screen provides the operator with information about the constellation configuration and the signal strengths received from each visible satellite. Relative locations of the GNSS satellites to the GNSS receiver are plotted based on azimuth and elevation information provided by the GNSS receiver. The plot includes corrections satellite information. Additionally, the receiver's current elevation mask is annotated on the plot.

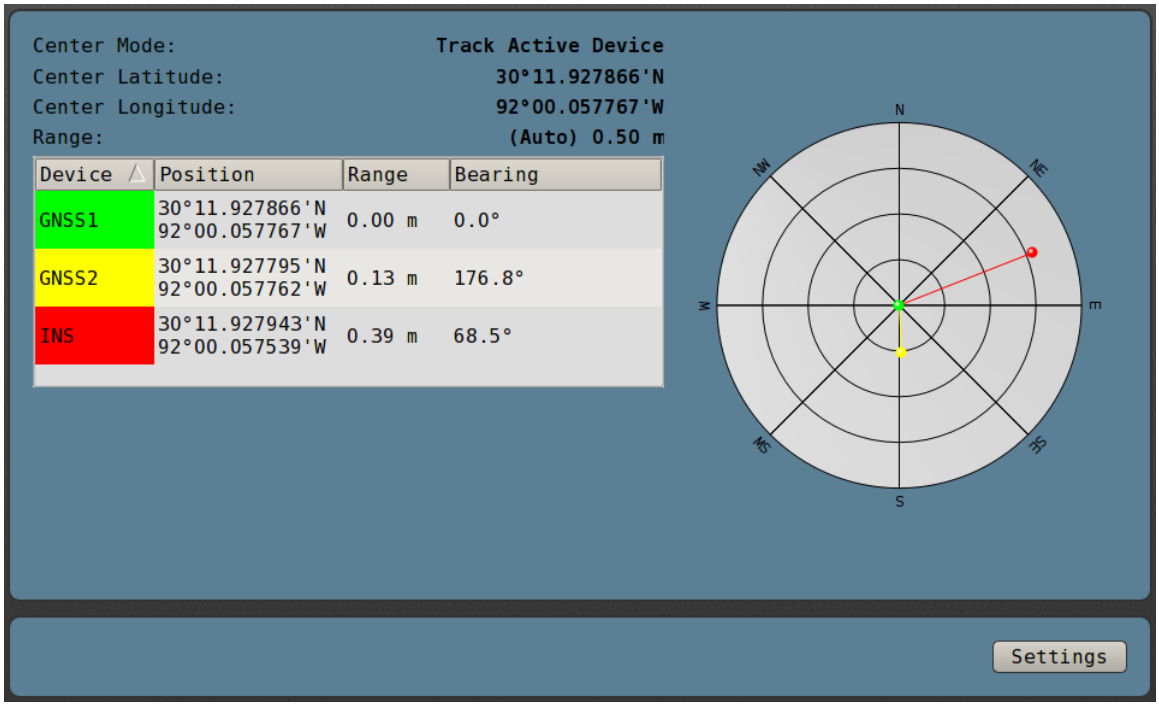
Each visible satellite is represented in the plot by a circle with the satellite ID number inside. All satellites used to compute the PVT solution are identified with green circles. Circles turn red if data from the satellite becomes too noisy or obstructed.

Circles with a blue border represent GPS satellites and those with a yellow border represent GLONASS satellites.

The graphic center point reference represents a point directly overhead and the grid lines from the center of the graph inversely indicate satellite elevation. There is a circle every 15 degrees of elevation and azimuth lines at every 45 degrees.

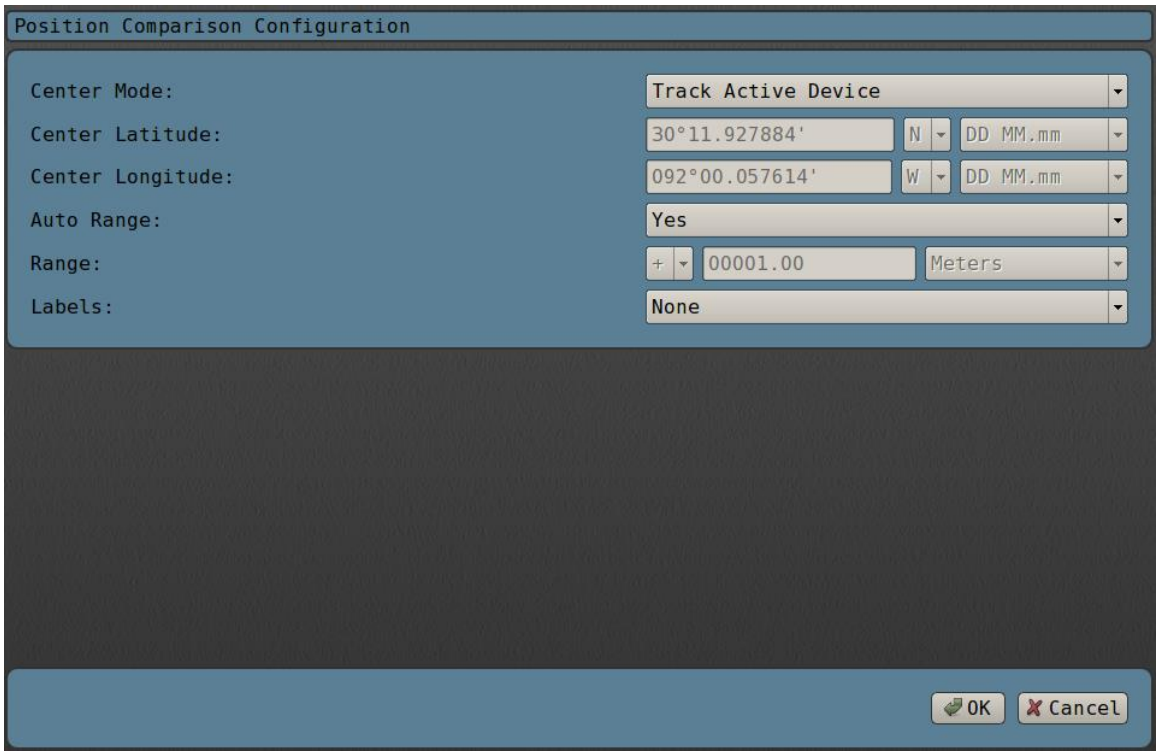
If the plot becomes too crowded, the operator can toggle the visibility of groups of satellites by pressing the legend item. For example, pressing the “Unused” legend item will hide all unused satellites. This would include both GNSS satellites and corrections satellites.

Position Comparison



The ***Position Comparison Plot*** shows the relative range and bearing between the active device or a static position and all other devices connected to the C-NaviGator III. If the *Center Mode* is set to “Track Active Device”, pressing the **Next Device** button will re-center the graph on the new active device position.

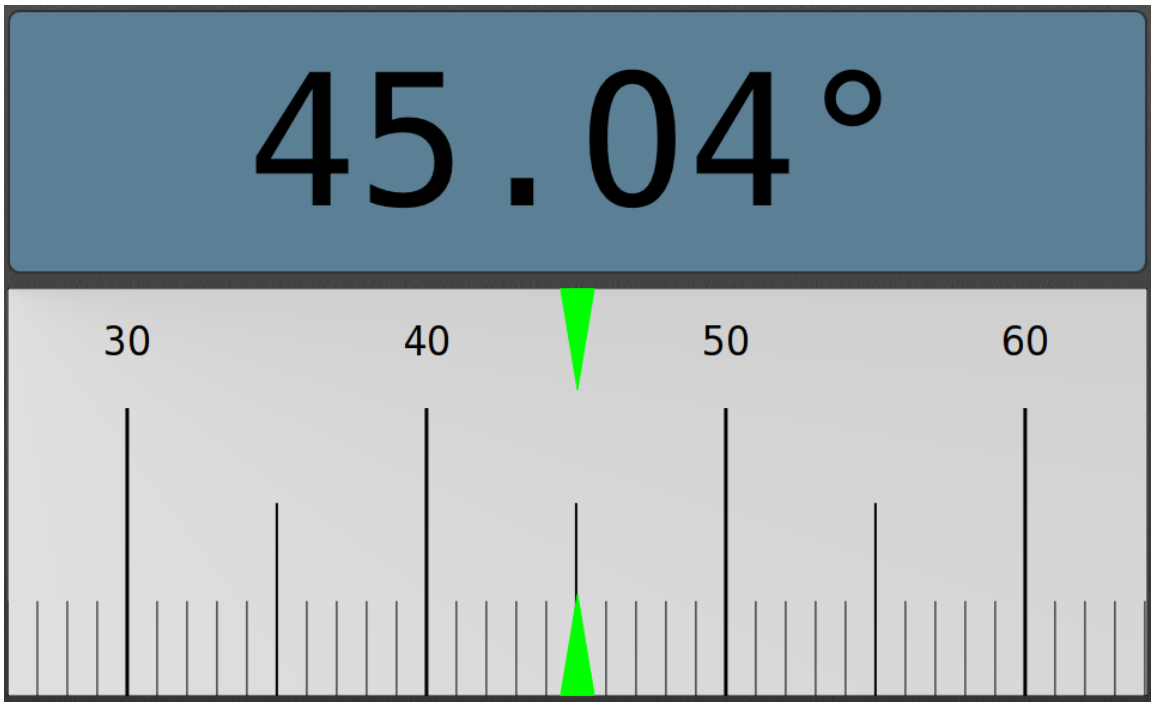
Position Comparison Settings



The *Center Mode* setting allows the user to choose a “Fixed” center coordinate, or use “Track Active Device”, which will use the coordinate of the currently selected device as the center.

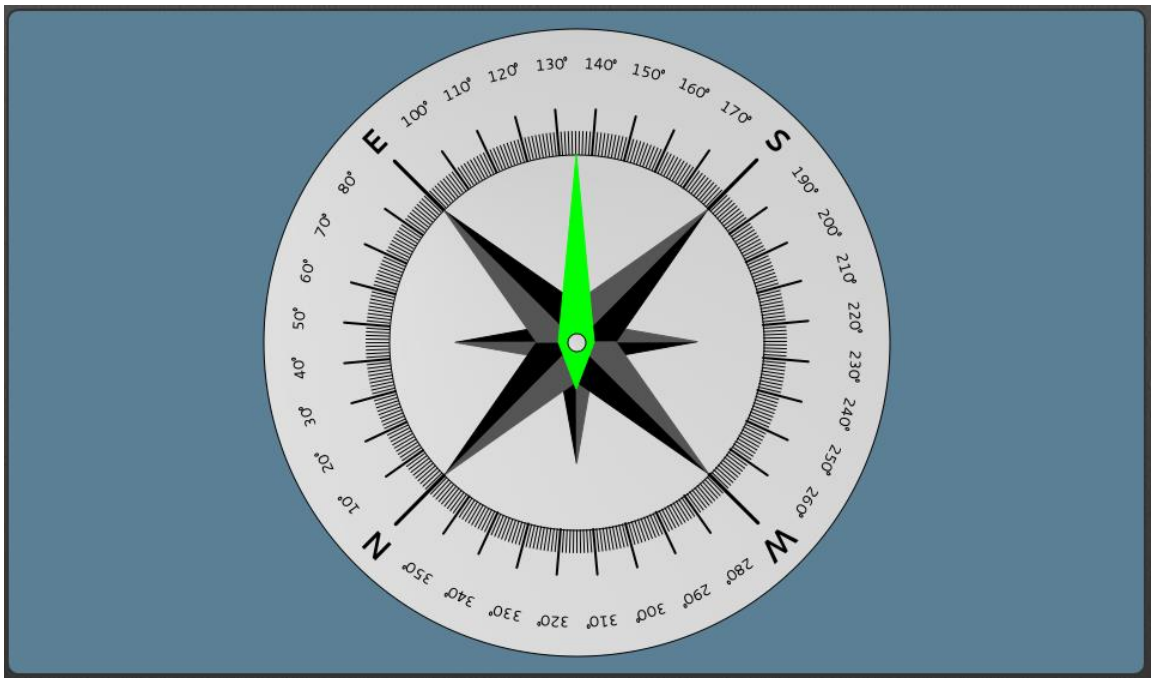
Also allows the user to set the range of the graph or set it to auto range. When auto range is selected, the range will grow to accommodate the largest range between the reference device and any other device. The operator can also choose to display distance labels on the graph.

Heading



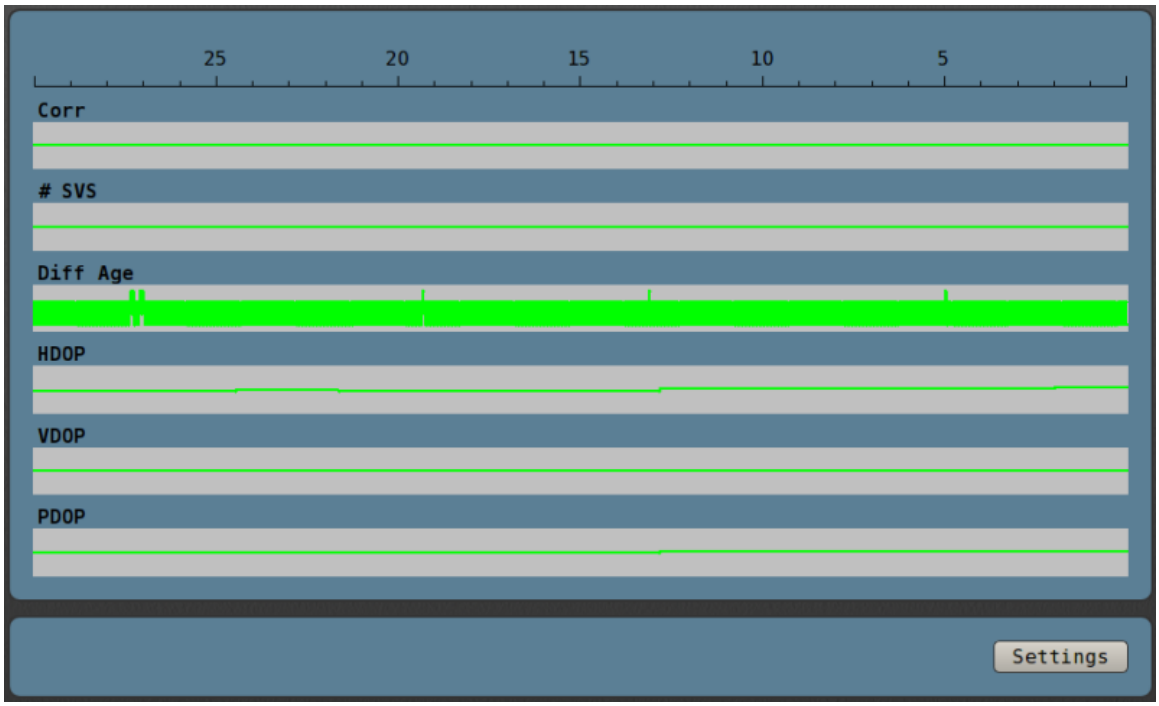
If the active device is capable, the ***Heading*** dialog will display a tape display of the device's heading.

Compass Rose



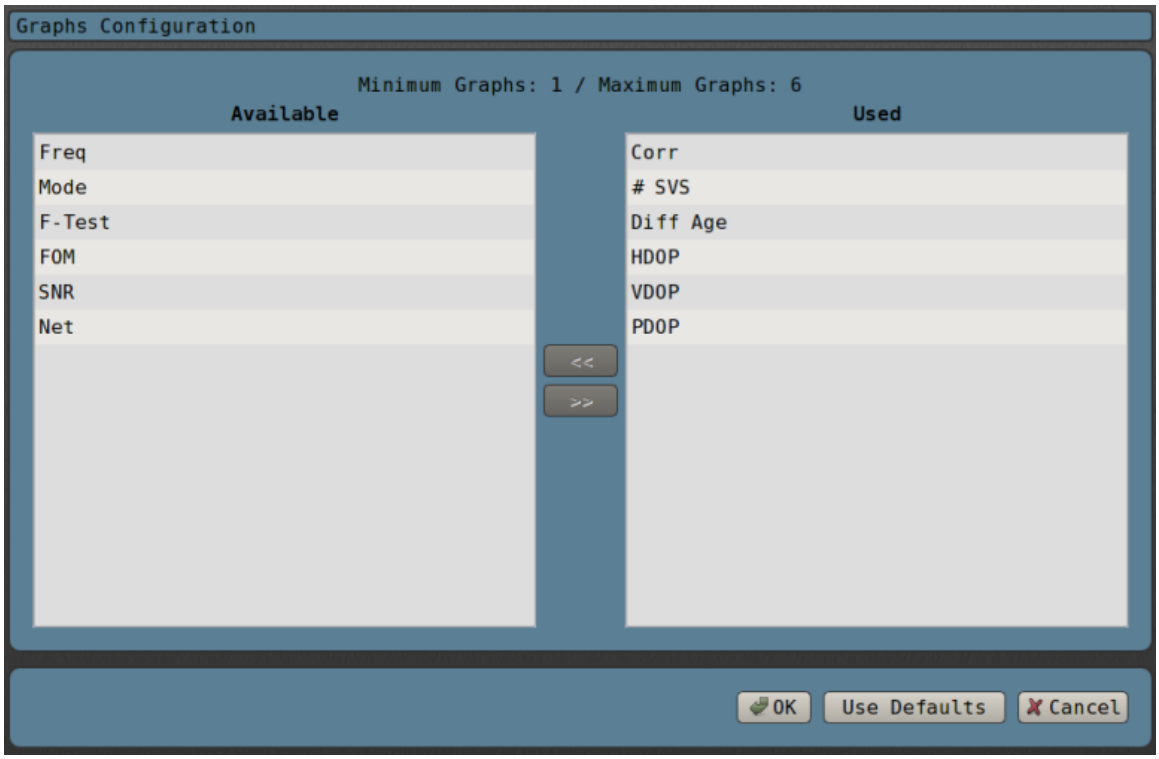
If the active device is capable, the ***Compass Rose*** dialog will display a compass rose of the device's heading.

Graphs



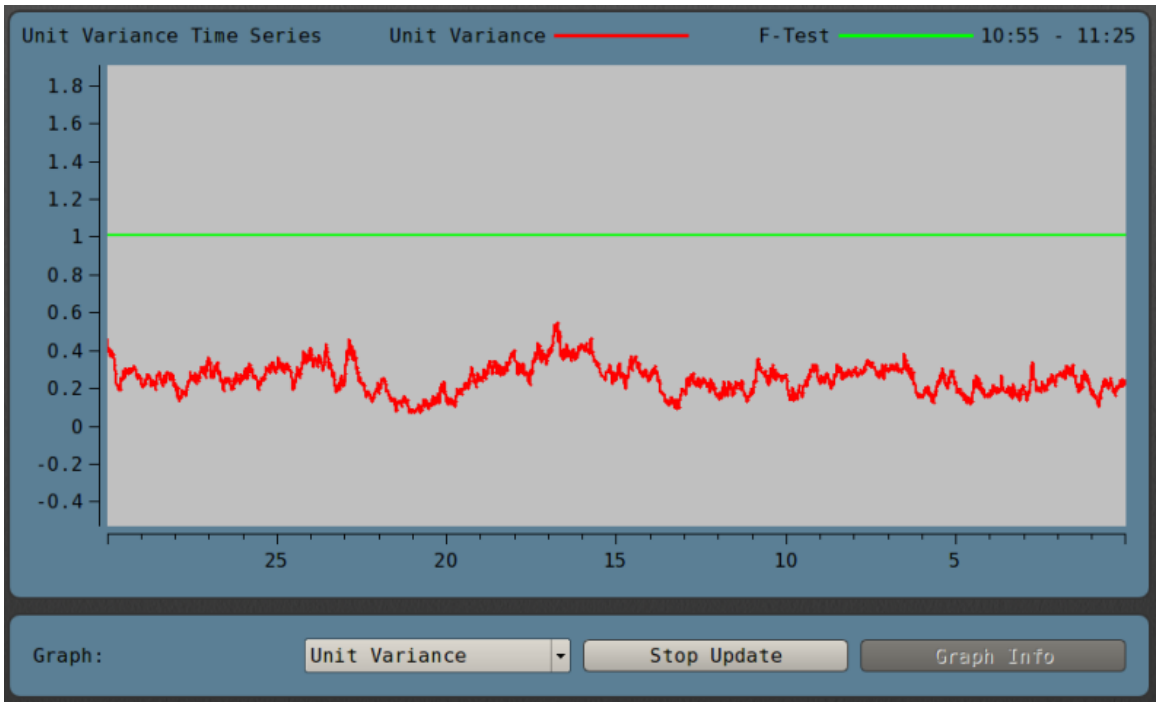
Quality information for the previous 30 minutes is displayed in graphs. The color of the graph line is based on the quality alert settings for that parameter.

Graphs Settings



Allows the user to select up to six graphs to display. The user can choose from any of the Quality Panel Thresholds (Page 44).

QC Graphs



The ***QC Graphs*** screen displays several graphs showing IMCA compatible quality assurance data over a 30 minute time period, if the active device provides that data. The *Graph* drop-down menu at the bottom of the screen allows selection of which graph is currently shown.

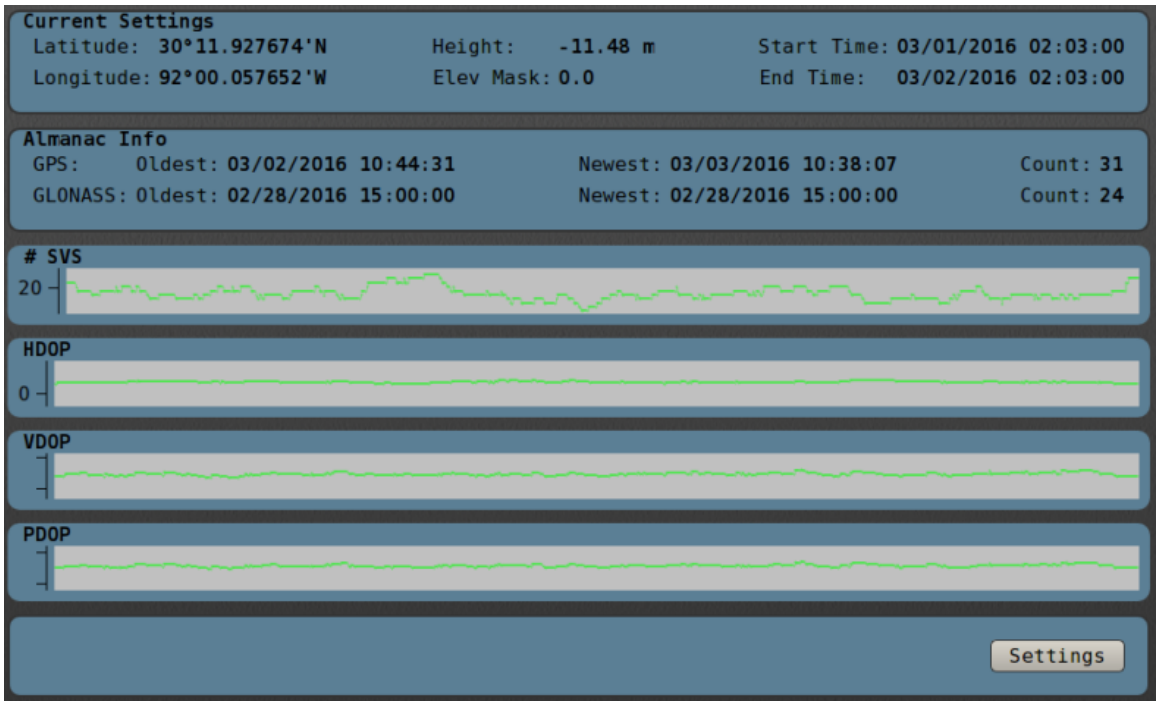
The **Stop Update** / **Start Update** button allows the continuous update of the graphs to be started or stopped. If the currently selected graph has extra information to display, the **Graph Info** button will bring up a screen with this information.

QC Settings

The ***QC Settings*** screen allows you to configure the quality thresholds used to qualify the QC data as displayed in the ***QC Graphs*** and the QC Status mode of the Quality Panel.

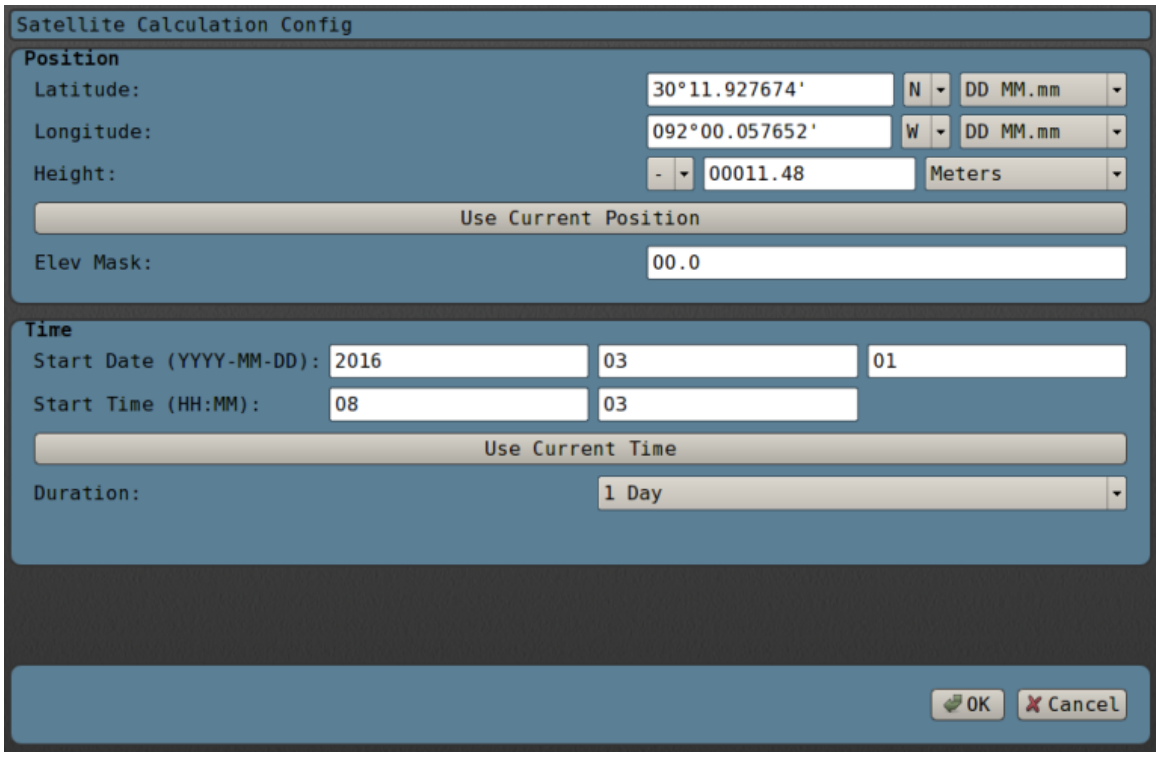
Pressing the **For SBAS,RTCM** or **For CCS,RTK** button will populate the fields with default values appropriate for the different expected navigation modes.

Satellite Calculations



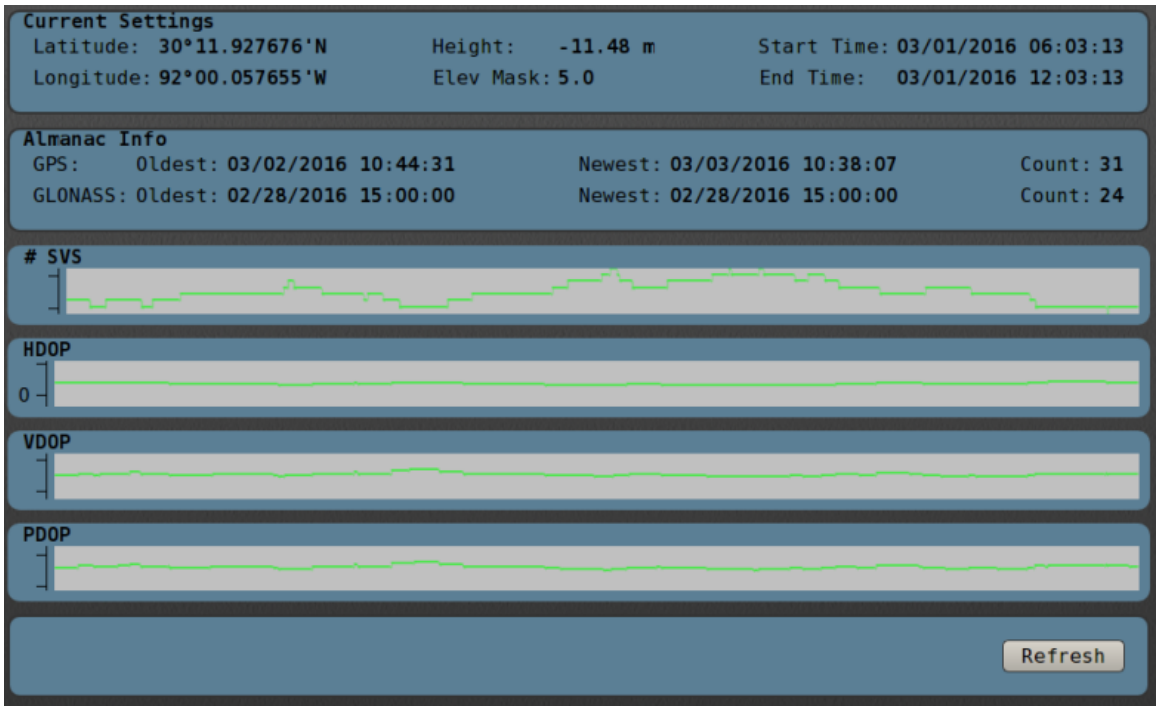
The ***Satellite Calculations*** screen displays graphs showing several characteristics of the available GPS and GLONASS satellites over time. The top part of the screen displays the parameters used to perform the calculations as well as a summary of the available almanac data.

Satellite Calculations Settings



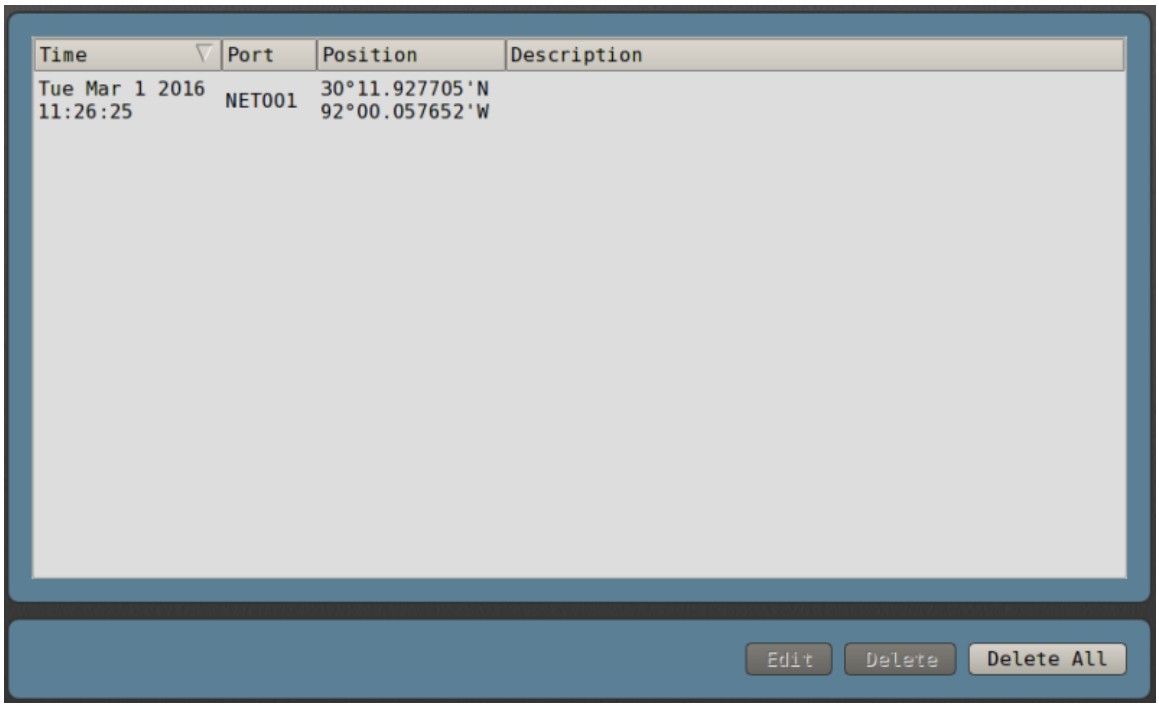
Allows the user to configure the parameters used in the calculations. The **Use Current Position** button will use the latest position from the active device if position data is available. The **Use Current Time** button will use the latest time from the active device if available. The graphs can display either one day or one week worth of data by setting the *Duration*.

Satellite Forecast



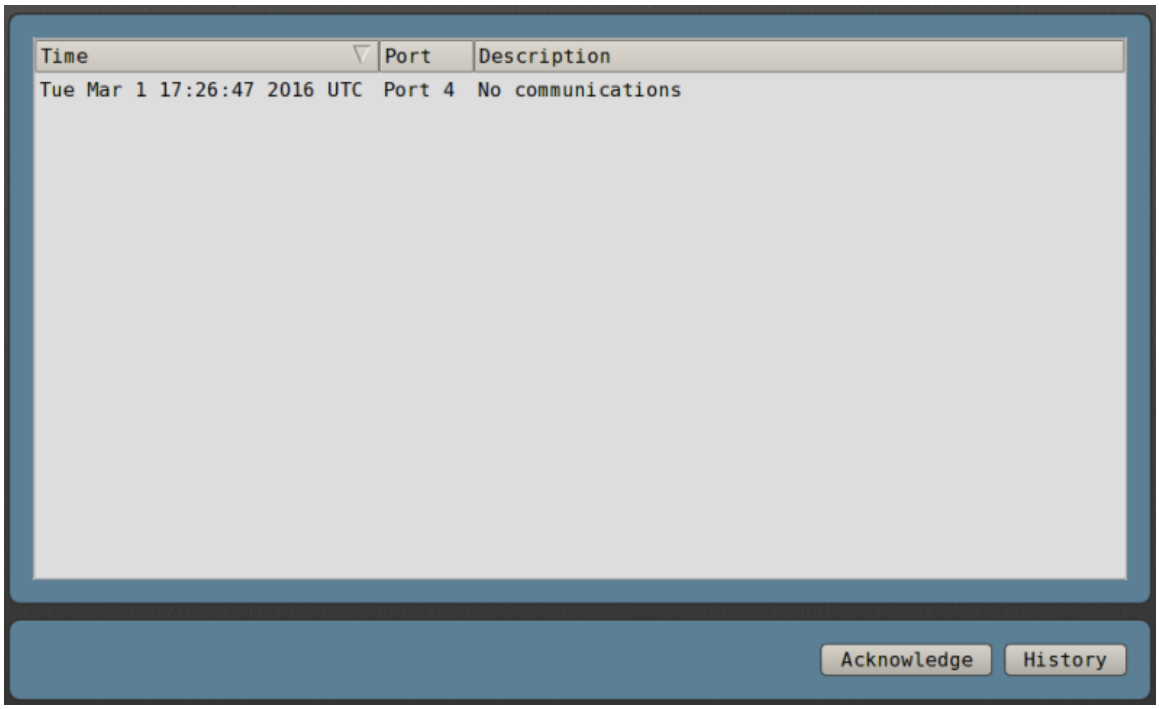
The ***Satellite Forecast*** page displays graphs showing several characteristics of the available GPS and GLONASS satellites over a time interval from two hours in the past to four hours in the future. The top part of the screen displays the parameters used to perform the forecast as well as a summary of the available almanac data. The forecast parameters are taken from the characteristics of the active device. The forecast automatically updates every five minutes.

Fixes



Position fixes are logged into the C-NaviGator III memory when the **Take Fix** button is pressed. The **Edit** button allows the user to name / describe the fix.

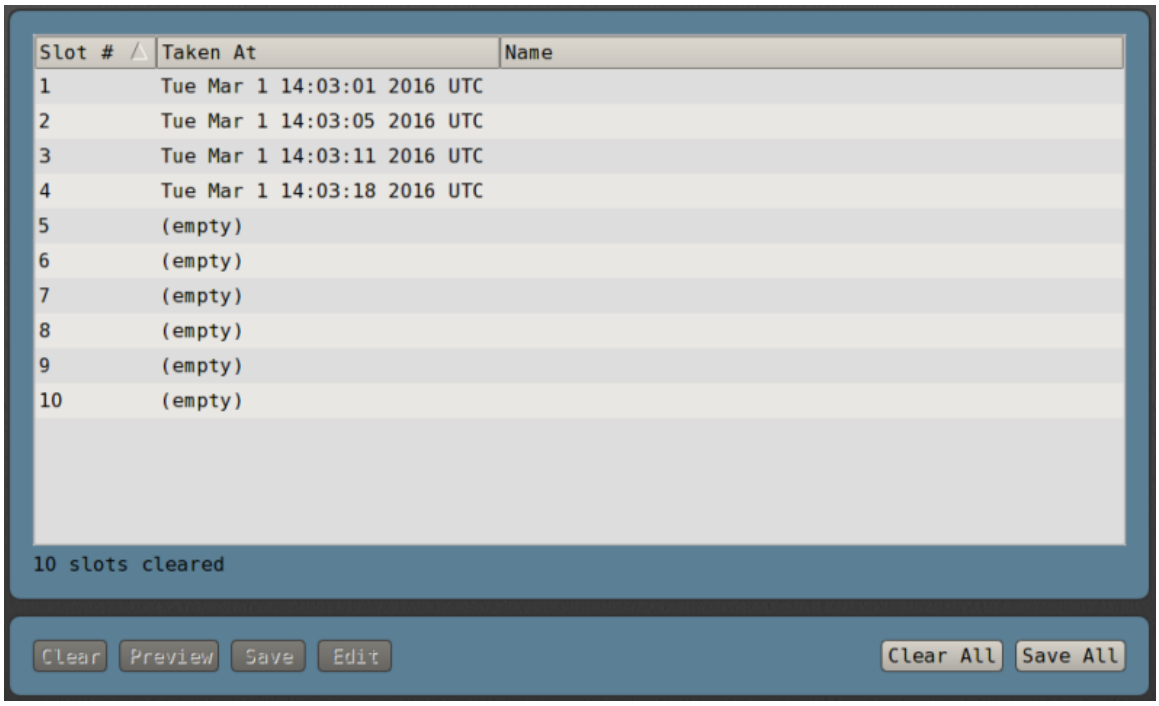
Alarms



Several alarm conditions are logged and displayed on this screen. The **Acknowledge** button can be used to turn off the alarm indicator in the lower right corner of the display until a new alarm is raised.

Certain more serious alarms will continuously cause the alarm indicator to light up.

Screenshots

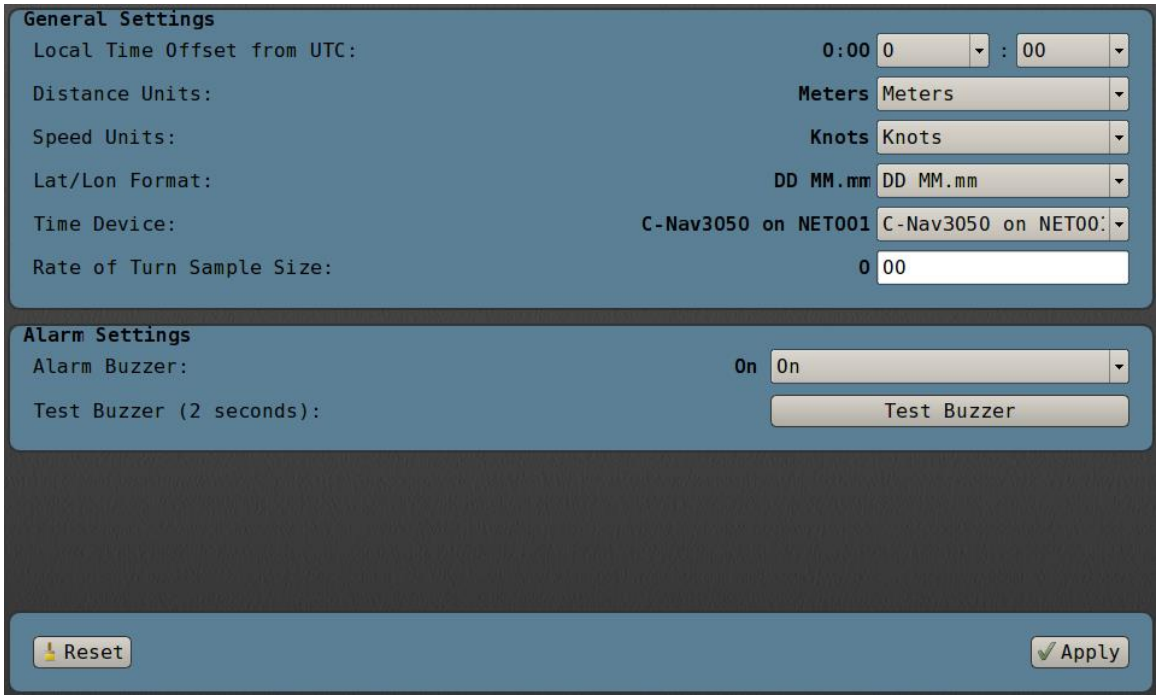


From this screen, the operator can preview or manage existing screenshots. To preview a screenshot, select it in the list and press **Preview**. To copy a screenshot to a USB device, select the screenshot in the list and choose a USB device, then press **Save**. To copy all screenshots to a USB device, select **Save All**. To clear all screenshots from memory, press **Clear All**.

Settings Menu Screens

The ***Settings*** menu screens contain pages that control the various settings of the C-NaviGator III unit.

General Settings



The major system settings are accessed through this screen. These include:

Set Time Zone Offset
The offset from UTC time is set here by adjusting the hour and minute values.

Time Device
The device used to sync system time with GPS time.

Rate of Turn Sample Size
The number of heading samples to use to generate rate-of-turn data.

Sample Size	ROT Generate Data
0	Does not calculate an ROT value, will use any ROT

	input data from the device instead.
1	Calculates ROT data from consecutive heading data.
2 - 60	Calculate an average ROT value from the number of samples

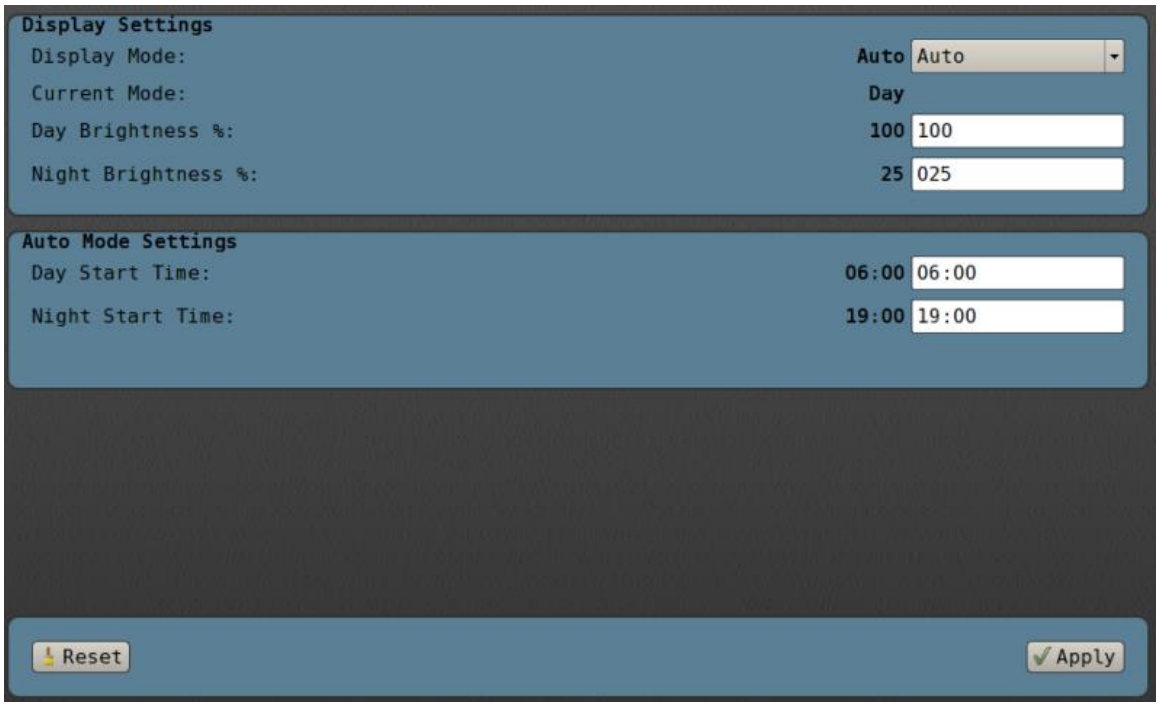
Units

Distance, speed, and latitude / longitude units used for the C-NaviGator III displays are selected in this section of the screen.

Alarm Buzzer

The C-NaviGator III is capable of producing a buzzer sound when an alarm is activated. The buzzer can be enabled and disabled here.

Display Settings



Brightness of the C-NaviGator III LCD backlight is controlled through settings on this screen. It can be adjusted for optimum viewing depending on the time of day and physical location of the unit. Night mode settings are necessary for installations on the bridge of a vessel where bright lights interfere with the helmsman's view.

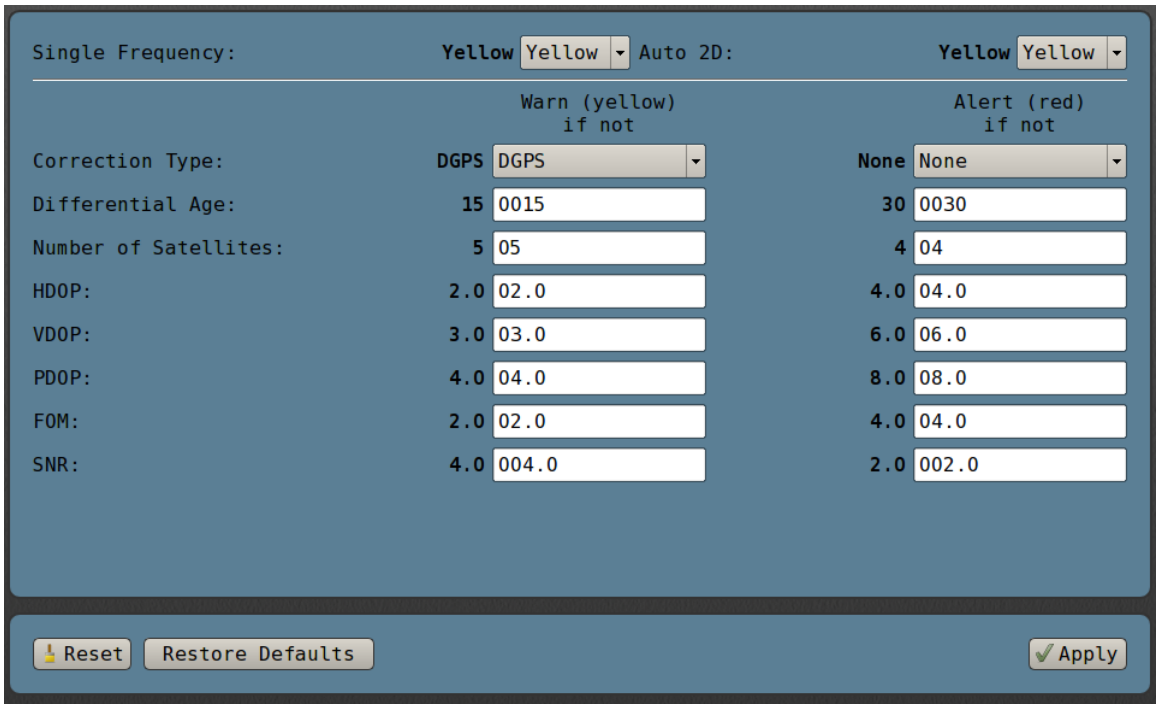
Display Mode

This option selects the "Day" or "Night" backlight levels. The user can modify how bright either "Day" or "Night" modes appear by changing the *Day Brightness %* or *Night Brightness %*.

Auto Mode Settings

Programs the display to automatically switch between "Day" and "Night" modes at the desired time.

Quality Panel Thresholds

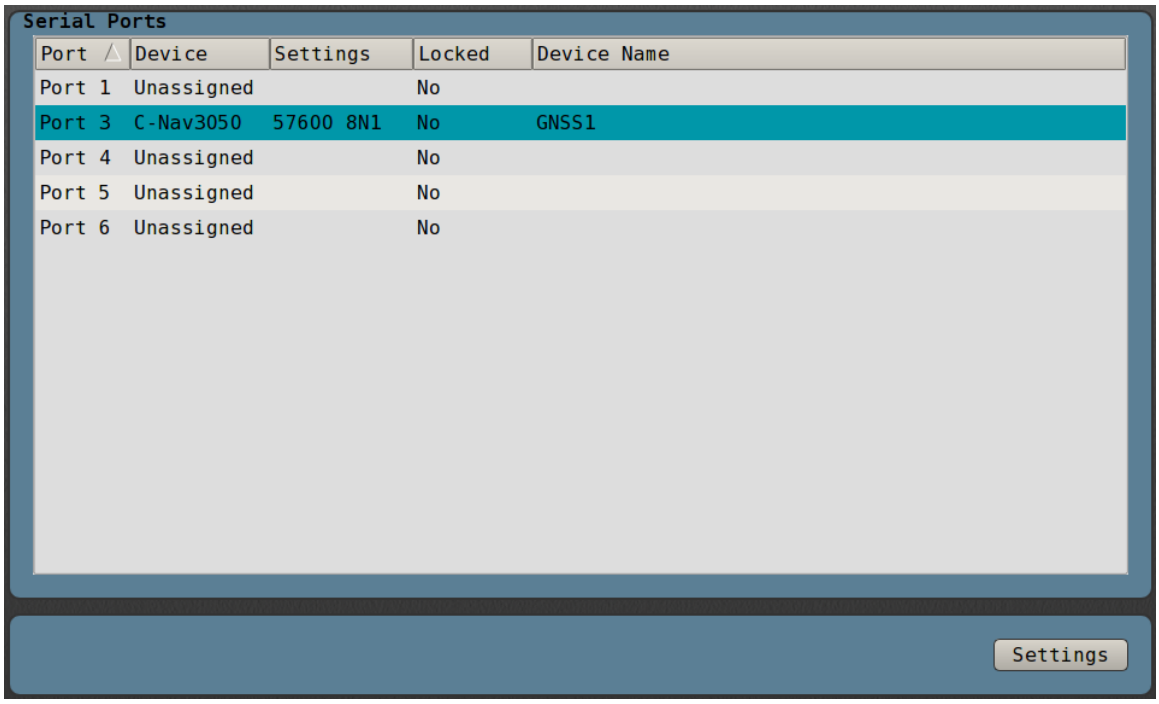


The pane on the right side of the screen displays various GNSS quality figures that are color-coded based on user-configurable limits. Red indicates that the data or status of the parameter is out of the acceptable range selected by the user. Similarly, yellow indicates that the value being displayed is in the range that is borderline or requires attention. A green indicator signifies that the value or status of the parameter is within the acceptable limits.

The ***Quality Panel Thresholds*** screen allows you to configure when the quality indicators change colors for the active device. "Single Frequency" and "Auto 2D" positioning may or may not indicate a problem, depending on the situation. So, you can select any of the colors for these states. For the rest of the alerts, you have two columns of settings. In the *Warn (Yellow) if not* column, you select at what point the indicator turns from green to yellow. In the *Alert (Red) if not* column, you select at what point the indicator turns from yellow to red.

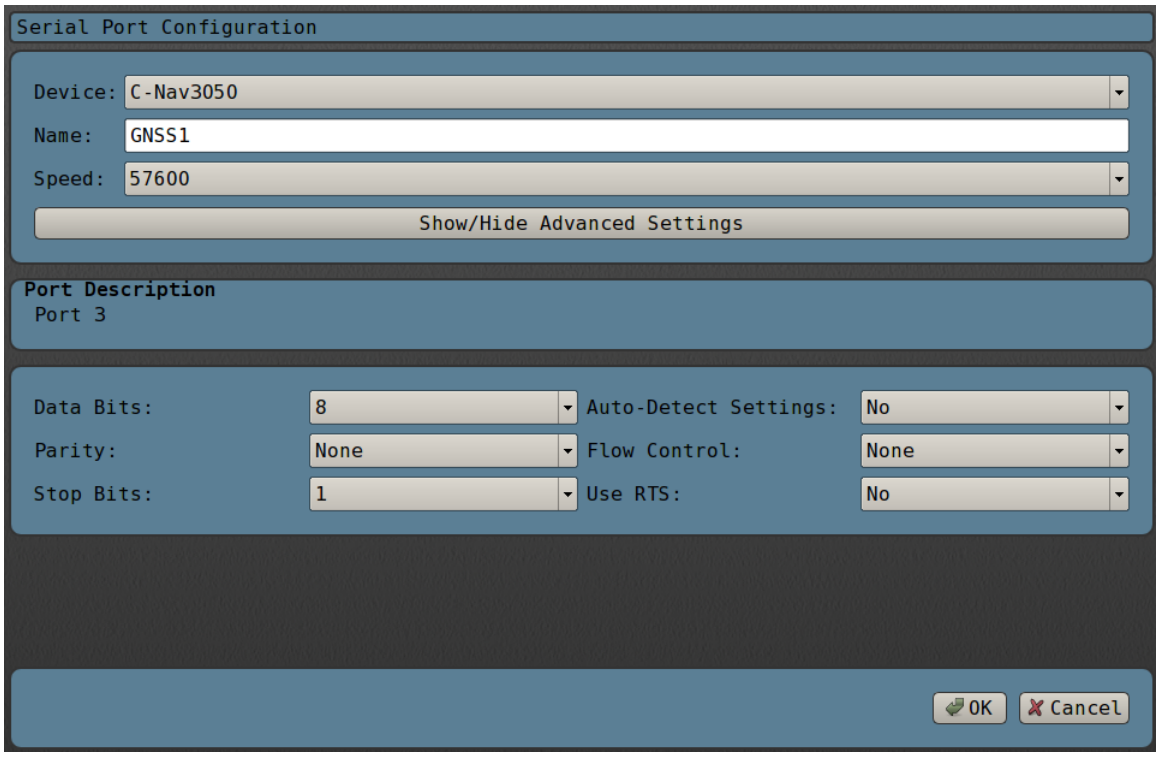
Some devices, like the C-Mariner, will have their own Quality Panel Thresholds screen different from the one described here.

Serial Ports



This screen allows the operator to assign input and output devices to the desired physical ports of the C-NaviGator III unit. Each port is activated by selecting a device / port in the table and pressing the **Settings** button.

Serial Port Configuration

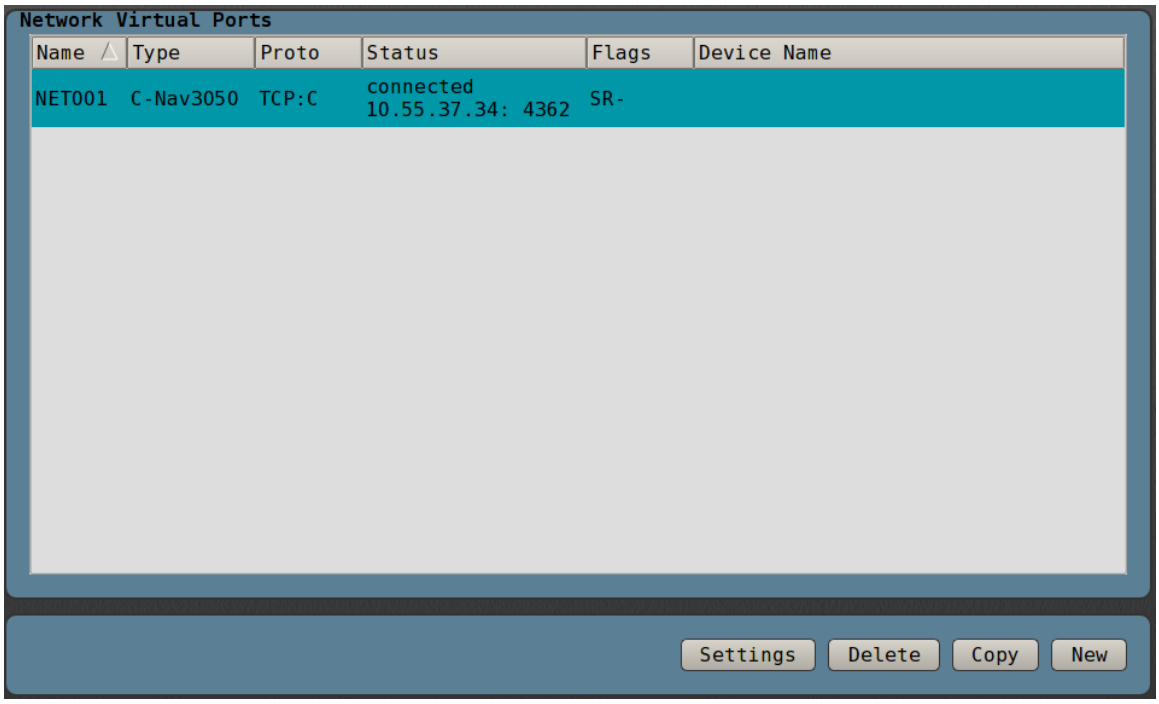


In the settings page, the operator can adjust the serial data transfer settings, including *Baud Rate* (speed), number of *Data Bits*, *Parity*, and the number of *Stop Bits*. Always press **OK** after all changes are made.

The default settings for each receiver are listed below.

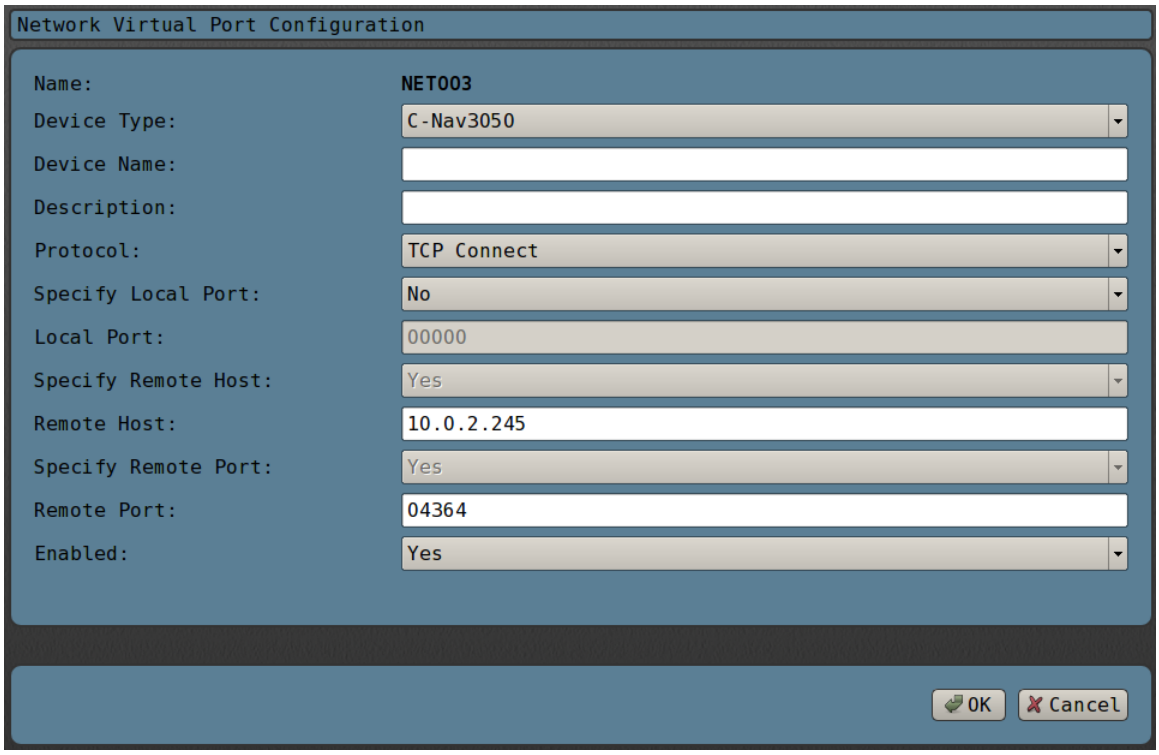
Receiver	**Default Communication Settings**
C-Nav3050® GNSS Receiver	57600 / 8 / None / 1
C-Nav2050	19200 / 8 / None / 1
C-Nav2000	19200 / 8 / None / 1
C-Nav1010	57600 / 8 / None / 1
Hemisphere Eclipse	19200 / 8 / None / 1
Hemisphere Vector	19200 / 8 / None / 1

Network Virtual Ports



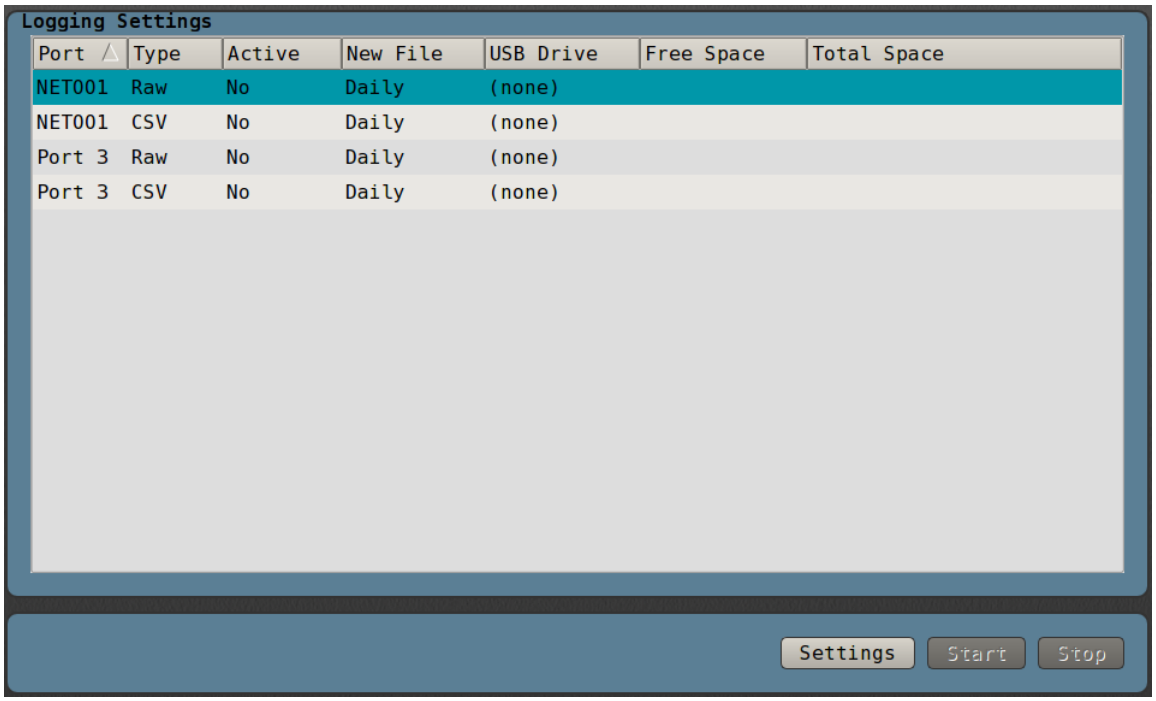
This screen shows the network virtual port summary and allows the operator to configure network connections. Press the **New** button to create a new network device connection. Use the **Settings** to show details of an existing network device connection. To copy an existing configuration, press the **Copy** button. Pressing **Delete** will remove a network device connection.

Network Virtual Port Configuration



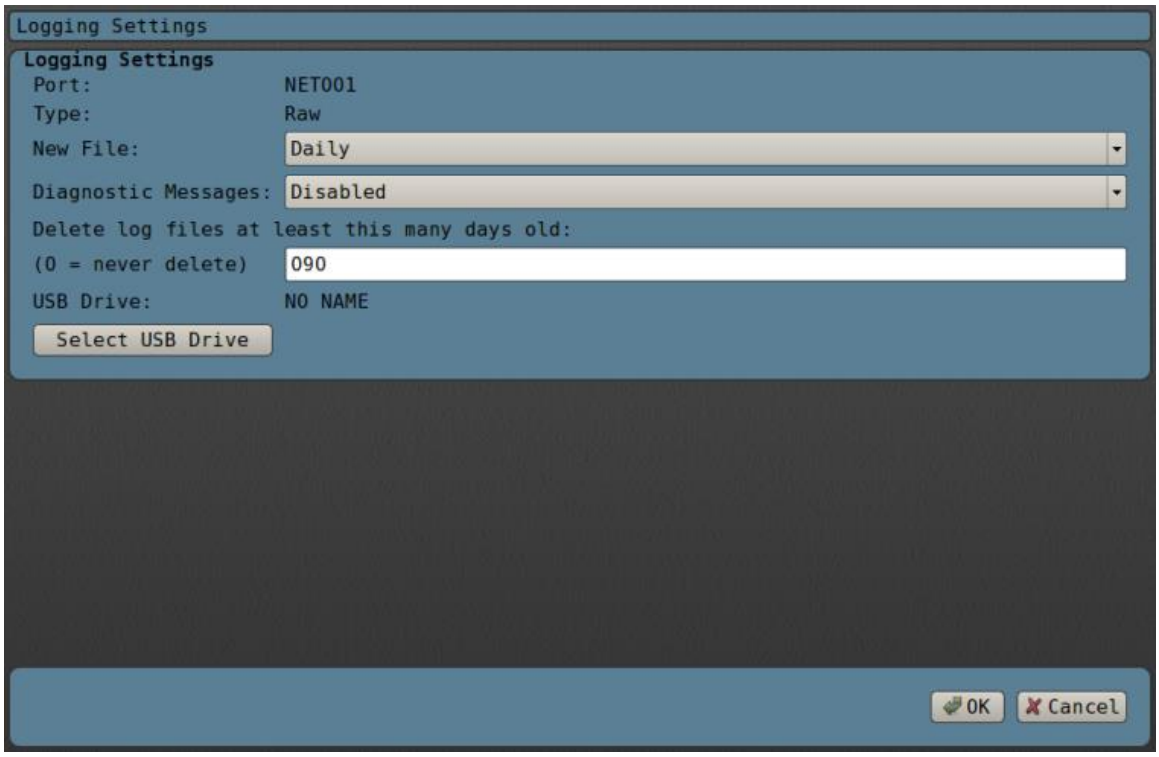
The configuration page allows the user to configure the network connection to the desired device.

Logging



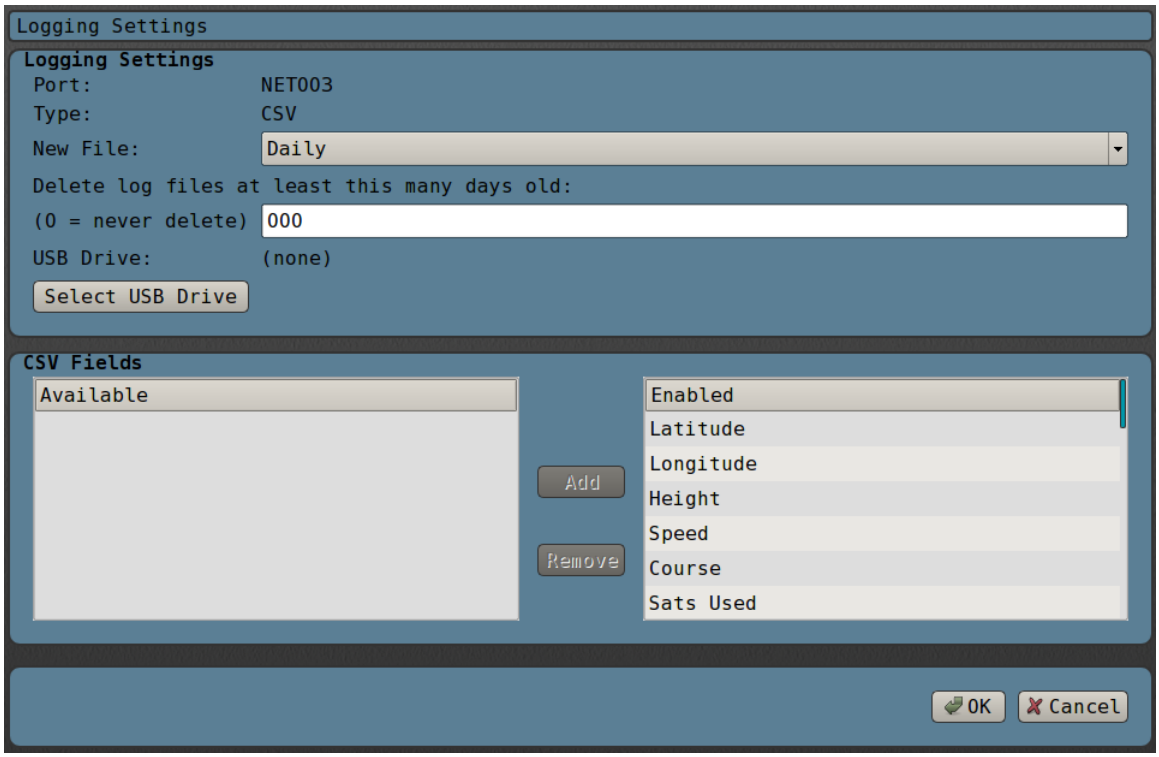
This screen allows the operator to configure logging of the data from an input device to a USB mass storage device. Each port can be configured to log input data. Select the “Raw” port from the list, and press the **Settings** button. Once configured, you can use the **Start** and **Stop** buttons to control logging.

Logging Settings



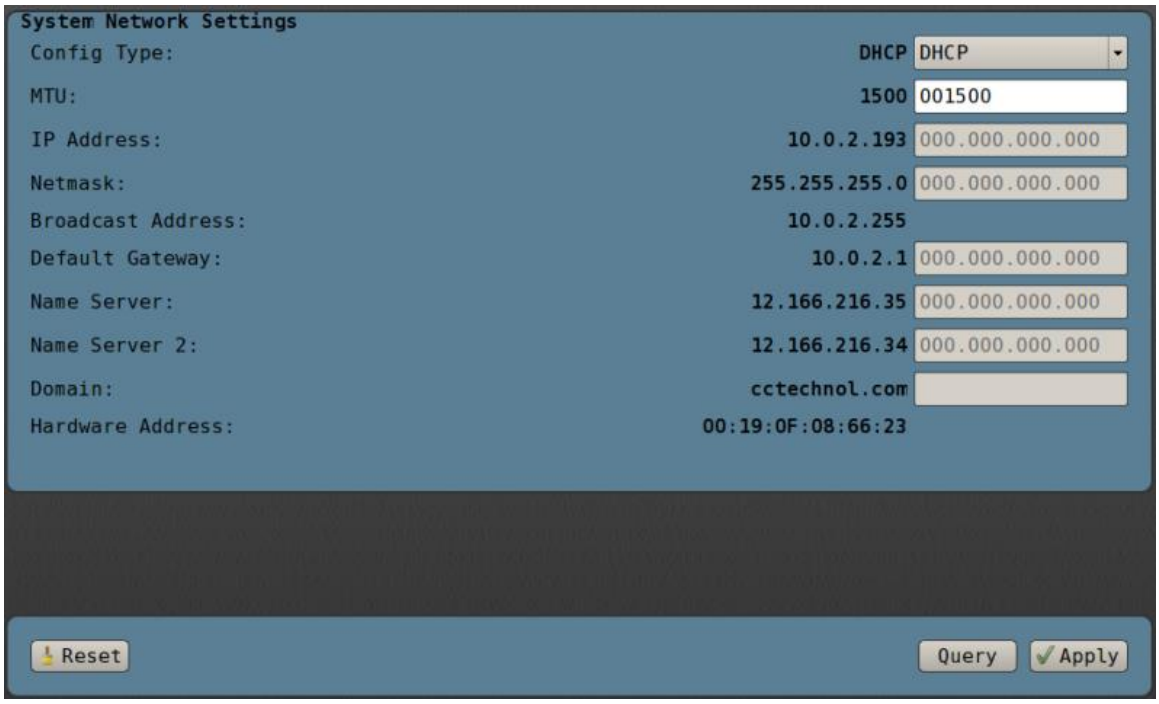
On the logging settings dialog select the frequency to create new files, and the USB device to place the files.

CSV Logging Settings



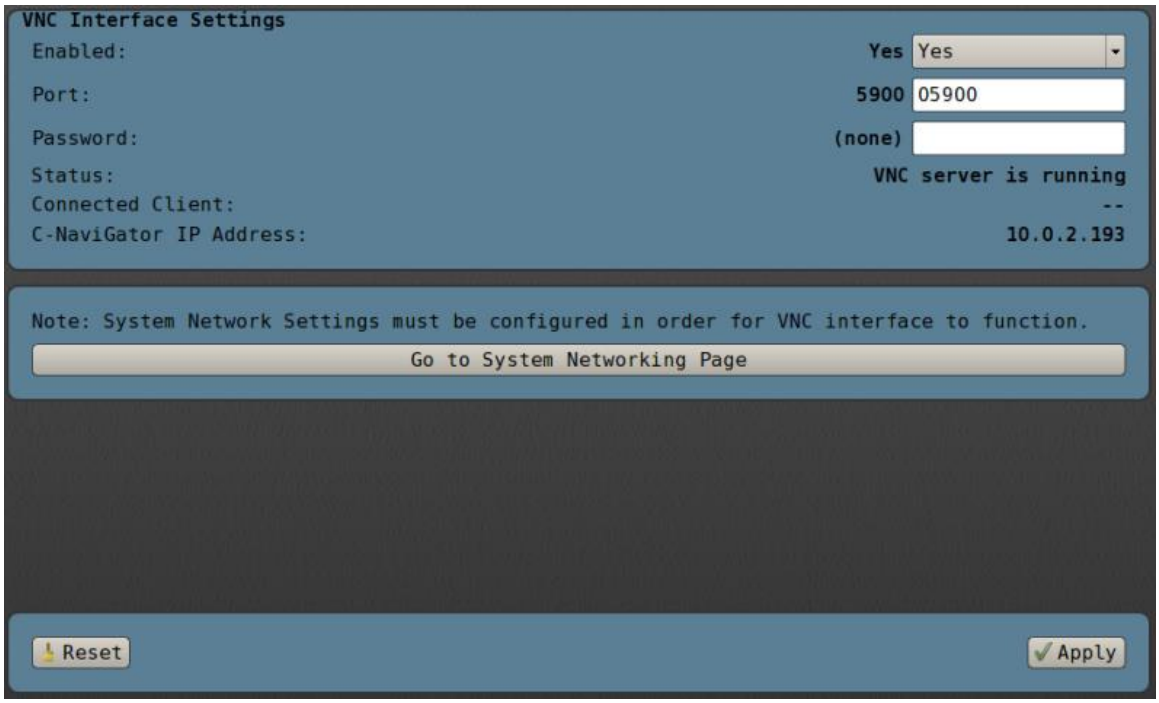
C-Nav® receivers are also capable of logging a to a human-readable CSV format. Select the “CSV” port from the list and press the **Settings** button. Aside from the normal logging settings, which fields are logged can be configured from this screen. Simply highlight the desired field, and press **Add** or **Remove**.

System Network Settings



This screen allows the operator to networking configuration for the unit. Choose the *Config Type* "DHCP"**, "**Static", or "Disabled". Provide settings from your network administrator, and press the **Apply** button.

VNC Interface



This screen allows the operator to configure the VNC server. Once configured, VNC clients can connect and control the C-NaviGator III.

System networking must be configured in order for VNC to function.

CCS OTI Configuration

This page allows for the configuration of the information necessary for supporting receivers (currently only the C-Nav3050® GNSS receiver) to receive CCS corrections over the Internet.

Press the **Load Configuration** button to upload a new CCS OTI configuration file from a USB mass storage device.

To learn more about configuring the C-Nav3050® GNSS receiver to use CCS OTI, please see the C-Nav3050® CCS OTI Manual.

Corrections Satellite Configuration

This page allows for the configuration of the information necessary for receivers to receive CCS corrections during INMARSAT frequency changes.

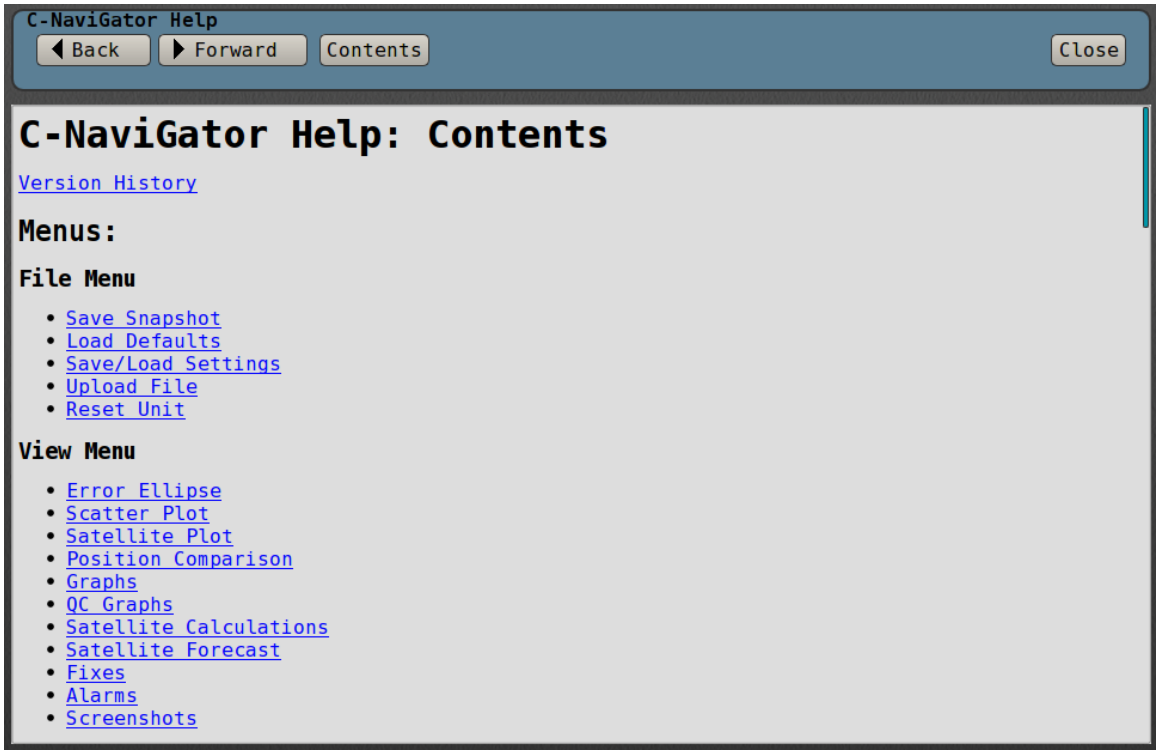
Press the **Load Configuration** button to upload a new Corrections Satellite configuration file from a USB mass storage device.

Device Menu Screens

Each connected device will have a menu grouping associated with its screens.

Help Menu Screens

Contents

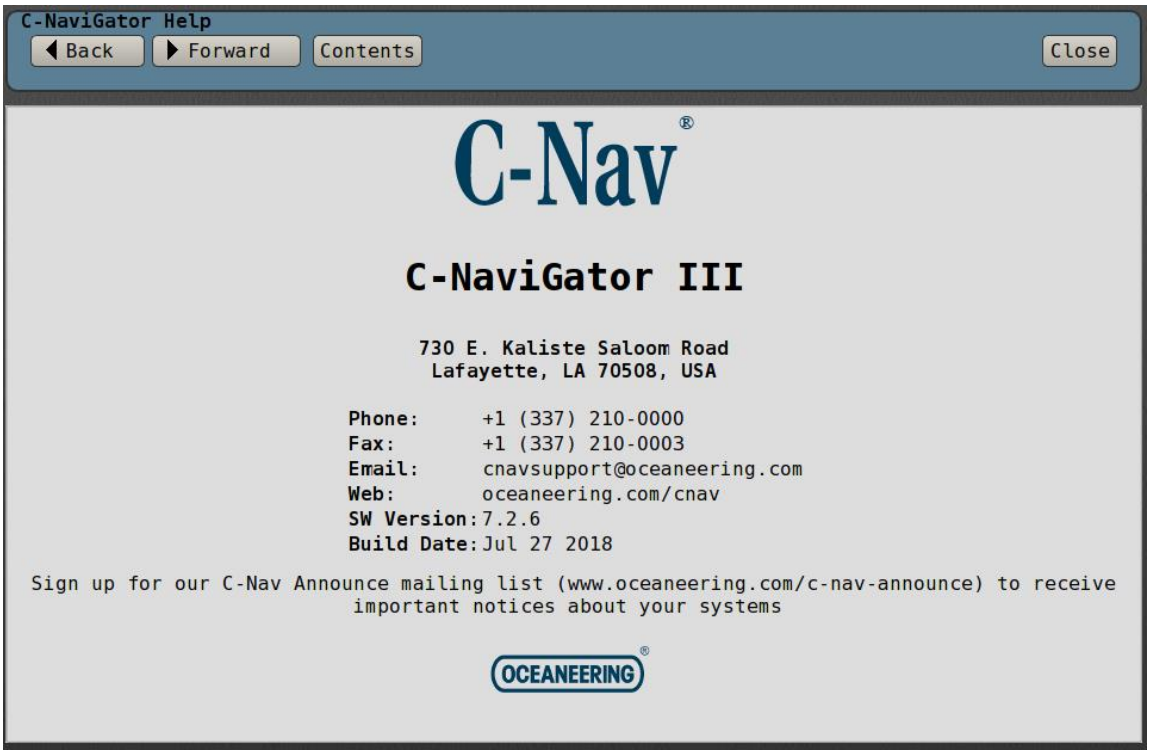


Under ***Menu / Help***, the operator can also find the latest information relating to other menu items. The information here is similar to that presented in this manual.

This Page

As an operator aid, ***This Page*** contains information about the screen currently displayed. It provides a quick reference should there be a question that requires a quick answer.

About



Support contact information from C-Nav® can be found by selecting ***Menu / Help / About*** menu. Here you will find the current software version number, contact information, etc. to assist the operator should problems arise.

Section 4 - Maintenance

Troubleshooting

No Position Information

Position Information on the top of the screen is blank.

1. Check cable interconnections.
2. Go to ***Menu / Settings / Serial Ports*** or ***Menu / Settings / Network Virtual Ports*** and verify that the settings correspond to the correct input connection.
3. Ensure the *Time Device* setting is set in the ***Menu / Settings / General Settings*** page.

No Serial Input / Output

The most common cause of data transfer problems is an incorrect setting in the port configuration.

1. Check that the serial port settings are correct and that they match the input / output device. Select ***Menu / Settings / Serial Ports / xxxx***.
2. For C-Nav2000 and C-Nav2050, the data transfer settings should be 19200 / 8 / None / 1.
3. For C-Nav1010 and C-Nav3050® GNSS receivers, the data transfer settings should be 57600 / 8 / None / 1.

Updating Software

New software versions for the C-NaviGator III will be posted on the C-Nav® website (oceaneering.com/cnav). The software can be downloaded and saved to the supplied USB Thumb Drive for use with C-NaviGator III.

To verify that the latest software is installed, check the About (Page 56) screen from the Help (Page 55) menu.

Follow these procedures:

1. Plug the USB memory device that contains the new software into one of the USB ports on the C-NaviGator III underside panel.
2. Reset the C-NaviGator III unit.
3. When the system menu screen appears, press the **Update** button.
4. Follow the on screen instructions.

Appendix A - Glossary

1PPS	**(1 P**ulse **P**er **S**econd**)** A precision electronic pulse output (at TTL levels) from the GNSS receiver that marks exact second intervals (1 s). It is used for precise timing and to synchronize sensors and acquisition computers.
Azimuth	The horizontal angle of the observer's bearing in surveying, measured clockwise from a referent direction, as from the north, or from a referent celestial body, usually Polaris.
Bad Packets	The percentage of bad C-Nav® correction packets received since the unit was turned on.
Bit Error Rate	Number of received bits of a data stream over a communication channel that have been altered due to noise, interference, distortion or bit synchronization errors. The Bit Error Rate is considered good if less than 20. The maximum reported value is 500.
C-Monitor	A utility program used to monitor the quality of the position information received from a GNSS receiver. No position calculations are done in C-Monitor. C-Monitor simply creates a visual representation of the data received from a GNSS unit.
C-Nav1010	The C-Nav1010 GNSS receiver combines a dual-frequency, geodetic grade, GNSS receiver with an integrated LBAND communication RF detector and decoder -- all linked by an internal microprocessor. The entire assembly is combined into a single integrated package that is durable, lightweight and water/weatherproof.
C-Nav2000	The C-Nav2000 GNSS navigational receiver is a 10-channel dual frequency unit with two additional channels for receiving Satellite Based Augmentation System (SBAS) signals and an L-Band demodulator for reception of the C-Nav® Correction Service. For more information, go to oceaneering.com/cnav. 

C-Nav2050	The C-Nav2050 survey GNSS receiver has expanded capabilities including RTK, 1PPS output, etc. As with the model C-Nav2000, the C-Nav2050 is a 10-channel, dual frequency, precision GNSS receiver, with two additional channels for receiving SBAS signals and an L-Band demodulator for reception of C-Nav® subscription signals. Maximum data output rate is 50Hz and Position Velocity Time (PVT) data can output at 25Hz. Two 115kbps serial ports are available. For more information, go to oceaneering.com/cnav. 
C-Nav3050	The C-Nav3050® GNSS receiver has expanded capabilities including RTK, 1PPS output, etc. As with other C-Nav® receivers, the C-Nav3050® GNSS receiver includes dual frequency, precision GNSS receiver, with two additional channels for receiving SBAS signals and an L-Band demodulator for reception of C-Nav® subscription signals. For more information, go to oceaneering.com/cnav.
Correction Signal	The Correction Signal-to-Noise ratio. This graph is only available with the C-Nav® system.
Correction Type	The type or source of differential corrections being applied to the GNSS receiver.
Course True	The course computed by the GNSS receiver.
Differential Age	The time in seconds since the GNSS unit received the last differential correction update.
Differential GPS	A technique for improving GPS solution accuracy by reducing the error based on signals received at a known location. Single point code positioning with pseudorange corrections are applied from simultaneous observations at the known position. One to ten meter accuracy is typical.
DOP	**D**ilution **o**f **P**recision is a scale factor representing the effect of satellite constellation geometry positioning accuracy. Standard terms for GNSS applications are:

	GDOP	**G**eometric **D**ilution of **P**recision -- three coordinates plus clock offset
	PDOP	**P**osition **D**ilution **o**f **P**recision) -- three coordinates (See PDOP definition below)
	HDOP	**H**orizontal **D**ilution **o**f **P**recision -- two coordinates
	VDOP	**V**ertical **D**ilution **o**f **P**recision -- height only
	TDOP	**T**ime **D**ilution **o**f **P**recision) -- clock offset only
Elevation	Height of the GNSS antenna above the reference ellipsoid.	
Error Ellipse	A statistical measure of the positional error at a given point computed from the propagation of all errors affecting the position solution and expressed by its semi-major and semi-minor axis (vectors of greatest and least magnitude) and the covariance (rotation angle in the reference coordinate system). Two-dimensional errors are typically propagated at one-standard deviation (39.4% probability that the position lies on or within the ellipse) or 2.1447 times the standard deviation (95% confidence) level.	
FOM	**F**igure **o**f **M**erit	
GNSS Receiver	A GNSS receiver consists of a number of basic components: an antenna with optional preamplifier, a radio-frequency and intermediate- frequency (RF/IF) "front end" section, a signal tracker / correlator section, and a micro- processor to control the receiver, process the signals, and compute the receiver's coordinates. The receiver will also include a power supply and memory devices to store instructions and data.	
HAE	**H**eight **A**bove **E**llipsoid – RTK vertical reference plane.	
L1-L2 Sig. Strength	GNSS satellites transmit spread spectrum signals in two frequency bands, L1 and L2 (1575.42 and 1223.6 MHz, respectively). The satellite signals carry both time information and a data strings, referred to as the GNSS navigation message. This message is transmitted at a rate of 50 bits per second. Using the data from four or more satellites, a GNSS receiver can accurately determine local latitude, longitude, and height. Civilian applications are confined to the L1 band for computing position. The Oceaneering International, Inc. and military receivers employ	

	both L1 and L2 bands, offering a significant improvement in accuracy.
NMEA 0183	This guideline for Interfacing marine electronics devices is a voluntary industry standard, first released in March of 1983. NMEA 0183 defines electrical signal requirements, data transmission protocol, timing, and specific sentence formats for up to 38.4K-baud serial data bus.
PDOP	**P**osition **D**ilution **o**f **P**recision is the most common mathematical expression of the quality of solutions. It is based on the geometry of the satellites with the best case being a value of 1. Higher numbers indicate worse quality. The best DOP would occur with one satellite directly overhead and three others evenly spaced about the horizon. PDOP has a multiplicative effect on range error. For example, a range error of 32 meters with a PDOP of 1 would give a user an assumed best accuracy of 32 meters. A PDOP of 2 would result in an assumed accuracy of 64 meters. C-NaviGator III can be programmed to stop providing position solutions above a specific PDOP level (6 is common).
Position	Includes Current Latitude, Longitude, Geoidal Height, HDOP, PDOP, Type of corrections, Current Station ID, Differential Age, Velocity, UTC Time and UTC Date if available.
PPS	**P**recise **P**ositioning **S**ervice – a positioning service that includes velocity and timing information. PPS is continuously available, worldwide to authorized users. PPS information is usually (but not always) encrypted to prevent use by unauthorized users.
Pseudorange	A measure of the apparent propagation time from the satellite to the receiver antenna, expressed as a distance. The apparent propagation time is determined from the time shift required to align a replica of the GNSS code generated in the receiver with the received GNSS code. The time shift is the difference between the time of signal reception (measured in the receiver time frame) and the time of emission (measured in the satellite time frame). Pseudorange is obtained by multiplying the apparent signal-propagation time by the speed of light. Pseudorange differs

	from the actual range by the amount that the satellite and receiver clocks are offset, by propagation delays, and other errors including those introduced by selective availability.
PVT	**P**osition **V**elocity **T**ime
RTCM	**R**adio **T**echnical **C**ommission for **M**aritime Services) – A Commission set up to define a differential data link to relay GNSS correction messages from a monitor station to a field user. The RTCM SC-104 recommendation is the de facto standard for differential GNSS correction transmission. It defines the correction message format and 16 different correction message types.
RTG	**R**eal **T**ime **G**ypsy -- Developed by NASA's Jet Propulsion Laboratory (JPL) to provide centimeter-level accuracy for space applications. A single RTG subscription service, combined with C-Nav® hardware, can provide you with worldwide positioning capability on the order of 0.1 meter.
RTK	**R**eal **T**ime **K**inematic (or Kinematic Surveying) involves a roving receiver that does not need to stop to collect precision information. Meter / centimeter level accuracy is available using modern dual-frequency carrier-phase measurement techniques.
SBAS	**S**atellite **B**ased **A**ugmentation **S**ystem - Includes, but is not limited to: WAAS (**W**ide **A**rea **A**ugmentation **S**ystem) and EGNOS (**E**uropean **G**eo-stationary **N**avigation **O**verlay **S**ystem). Ranging signals generated on the ground and provided via C-band (or K-band) downlink are provided to the end user. These signals contain integrity data on satellite system.
Sky Plot	This option displays a plot of the current GNSS satellite locations with reference to the GNSS receiver. C-NaviGator III refers to this presentation as “Position Information”.
Scatter Plot	This option displays a plot of satellite positions relative to the receiver and provides an indication of relative signal strength in the two frequency bands.

Visible Sats	The number of Satellites used by the receiver in the position solution.
WAAS	**W**ide **A**rea **A**ugmentation **S**ervice -- A system of satellites and ground stations that provide GNSS signal corrections over a wide area. An accuracy improvement on the order of three meters, with 95 percent confidence, is realized.
WCT	**W**ide Area **C**orrection **T**ransform

Appendix B - NMEA Data Strings

The C-NaviGator III is capable of reading and writing NMEA 0183 compliant messages as they relate to positioning. Version 2.1, 3.0, and 3.01 are supported. The following table lists the available strings:

NMEA String	Description
ALM	Almanac data
GBS	GNSS Satellite Fault Detection
GRS	GPS Range Residuals
MLA	GLONASS Almanac Data
GGA	Global Positioning System Fix Data
GLL	Geographic Position – Latitude / Longitude
GNS	GNSS Fix Data
GSA	GNSS DOP and Active Satellites
GST	GNSS Pseudorange Error Statistics
GSV	GNSS Satellites in View
HDT	Heading data
RMC	Recommended Minimum Specific GNSS Data
VTG	Course Over Ground and Ground Speed
ZDA	Time & Date

In addition to standard NMEA messages, the C-NaviGator III outputs the following C-Nav® proprietary sentences:

NMEA String	Description
DPGGA	Filtered GGA output for DP vessels
NAVQ	Navigation quality information
RXQ	CCS reception quality information
SATS	Sky Plot information
TRINAV	Statistical information
WGPOS	Statistical information

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W

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Version 2, June 1991

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