C-NavX1 Integrated Mobile Receiver

Installation and Operation Manual

Document Number: DDK-MAN-21-0002_C

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1. Introduction

The purpose of this document is to provide an overview and instruction of how to install the C-NavX1 (Installation Manual), and on the functionality of the C-NavX1 (Operation Manual).

a) Glossary of Terms

Abbreviation	Description
AC	Alternating Current
BeiDou	GNSS system owned and operated by the Peoples Republic of China, China National Space Administration
°C	Degrees Celsius
CE	CE Marking
CMR	Compact Measurement Record
C-Nav	OII branded GNSS equipment and services
DC	Direct Current
DDK	DDK Positioning Ltd.
DGPS	Differential GPS
DGNSS	Differential GNSS
EGNOS	European Geostationary Navigation Overlay Service (SBAS, EU)
EU	European Union
FCC	Federal Communications Commission
GAGAN	GPS-Aided Geo Augmented Navigation (SBAS, India)
Galileo	GNSS system owned and operated by the European Union, European GNSS Agency and the European Space Agency
GLONASS	GNSS system owned and operated by the Russian Federation, Roscosmos State Corporation for Space Activities
GNSS	Global Navigation Satellite System
GPS	Global Positioning System (GNSS system owned and operated by USA, Department of Defence)
GSM	Global System for Mobile Communications
Hz	Hertz
I/O	In/Out
Kg	Kilogrammes
LED	Light Emitting Diode
LTE	Long-Term Evolution (Standard for Wireless Broadband Communications)
mA	Milliamps
MBRTK	Moving-Baseline RTK
mm	Millimetres
MSAS	Multi-Functional Satellite Augmentation System (SBAS, Japan)
NMEA	National Marine Electronics Association
NTRIP	Networked Transport of RTCM via Internet Protocol
OII	Oceaneering International Inc.
PPP	Precise Point Positioning
PPS	Pulse-Per-Second
PSU	Power Supply Unit
QZSS	Quasi-Zenith Satellite System (SBAS, Japan)
RINEX	Receiver Independent Exchange
RTCA	Radio Technical Commission for Aeronautics

RTCM	Radio Technical Commission for Maritime Services
RTK	Real-Time Kinematic
Rx	Receive
SBAS	Satellite Based Augmentation Service
Tx	Transmit
USA	United States of America
W	Watts
WAAS	Wide Area Augmentation Service (SBAS, USA)
V	Volts

Table 1: Glossary of Terms

b) Release Notes

REVISION	DESCRIPTION	DATE	AUTHOR	CHECKED
A	Draft	25/08/2021	SC	SI
B	Draft for Internal Review	25/08/2021	SC	SI
C	Draft for External Review	23/09/2021	SC	BD/RM/KP

Table 2: Revision History

c) C-NavX1 Integrated Mobile Receiver

The C-NavX1 is an IP67 rated rugged mobile device designed for a wide range of uses in the marine and land sectors.

The C-NavX1 is an integrated multi constellation GNSS and PPP augmentation receiver that incorporates GPS, GLONASS, BeiDou, Galileo and QZSS reception capability. In addition, the device tracks SBAS WAAS, EGNOS, MSAS and GAGAN.

The C-NavX1 device receives DDK augmentation exclusively via Iridium's satellite network and any LTE/GSM telecoms network, or internet connection. The C-NavX1 has positioning accuracies in excess of < 5cm (@ 1σ) anywhere in the world, including polar regions.

d) Trademarks

The C-Nav and C-NavX1 logo is a trademark of Oceaneering International Inc. and the DDK logo and icon is a trademark of DDK Positioning Ltd.

All other brand names are trademarks of their respective holders.

e) Disclaimer of Warranty

Except as indicated in "limited warranty" herein, C-Nav Software, firmware and documentation are provided "as is" and without expressed or limited warranty of any kind by either C-Nav, or anyone who has been involved in its creation, production, or distribution including but not limited to the implied warranties of merchantability and fitness for a particular purpose. The entire risk, as to the quality and performance of the C-Nav Hardware, software, firmware, and documentation, is with the user. Some states do not allow the exclusion of implied warranties, so the above exclusion may not apply.

f) Limited Liability

In no event will C-Nav or any person involved in the creation, production, or distribution of the C-Nav Software, hardware, firmware and documentation be liable to you on account of any claim for any damages, including any lost profits, lost savings, or other special, incidental, consequential, or exemplary damages, including but not limited to any damages assessed against or paid by you to any third party, rising out of the use, liability to use, quality or performance of such C-Nav Software, hardware, and documentation, even if C-Nav or any such person or entity has been advised of the possibility of damages, or for any claim by any other party. Some states do not allow the limitation or exclusion of liability for incidental or consequential damages so, the above limitations may not apply to you

g) Notices and Licensing

I. FCC Notice

This device complies with Part 15 Subpart B Class B of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

The GNSS sensor has been tested in accordance with FCC regulations for electromagnetic interference. This does not guarantee non-interference with other equipment. Additionally, the GNSS sensor may be adversely affected by nearby sources of electromagnetic radiation.

II. C-Nav Licensing

Access to the C-Nav Augmentation Service requires a subscription that must be purchased. Licenses are non-transferable and are subject to the terms of the C-Nav License Agreement. Activation of the subscription will be initiated by the user, whereupon the billing period will commence. The billing period will end, only after the user deactivates the device. Activation and deactivation will be carried out on request by contacting C-Nav as follows:

https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

III. Software License Agreement

By powering on and using this C-NavX1 device and C-NavMAX GNSS PPP augmentation service, you agree to the terms and conditions of the C-Nav World GNSS Receiver Software License and Open-Source Software Licenses.

IV. Global Navigation Satellite Systems

Global Navigation Satellite Systems (i.e., GPS, Galileo and GLONASS) are under the control of the respective Governmental agencies and the operation of these satellites may be changed at any time without warning.

GPS Selective availability (S/A code) was disabled on 02 May 2000 at 04:05 UTC. The United States government has stated that present GPS users use the available signals at their own risk.

The U.S. State Department International Traffic in Arms Regulations (ITAR) limits the performance of commercial GNSS products. As a result, access to satellite measurements and navigation results will be limited from display and recordable output when predetermined values of velocity and altitude are exceeded. These threshold values are far in excess of the normal and expected operational parameters of the C-NavX1 device.

h) Related Standards

I. ICD-GPS-200

NAVSTAR GPS Space Segment / Navigation User Interfaces Standard. ARINC Research Corporation; 2250 E. Imperial Highway; El Segundo, California 90245

IEC 60945, IEC 61108-1, IEC 61162-1, IEC 61162-2

II. GLONASS ICD, Version 5.0, 2002

Russian Space Agency, Information Analytical Centre
Internet: http://glonass-iac.ru/en/

III. RTCM-SC-104

Recommended Standards For Differential GNSS Service. Radio Technical Commission For Maritime Services; 1611 N. Kent St, Suite 605; Arlington, Virginia 22209

IV. NTRIP

Radio Technical Commission for Maritime Services (RTCM) Standard 10410.0 (RTCM Paper 200-2004/SC104-STD, Version 1.0 for Networked Transport of RTCM via Internet Protocol (NTRIP)

Radio Technical Commission for Maritime Services (RTCM) Standard 10410.1 (RTCM Paper 111-2009-SC104-STD, Version 2.0 for Networked Transport of RTCM via Internet Protocol (NTRIP)

V. CMR, CMR+

Compact Measurement Record; Trimble Navigation Limited; 935 Stewart Drive; Sunnyvale, CA 94085

VI. RINEX

Receiver Independent Exchange Format; Astronomical Institute of the University of Bern

VII. QZSS

Quasi Zenith Satellite System. Japan Aerospace Exploration Agency (JAXA). 7-44-1 Jindaiji Higashi-machi, Chofu-shi, Tokyo 182-8522.

VIII. NMEA-0183

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

IX. SJ/T11363-2006

Standard of the Electronics Industry of the People's Republic of China.

Issued: 11-06-2006 Implemented 11-06-2006

Issued by: Ministry of Information Industry of the People's Republic of China.

i) Publicly Operated SBAS Signals

I. RTCA/DO-229D

The Radio Technical Commission for Aeronautics (RTCA) develops consensus-based recommendations regarding communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues.

RTCA. 1828 L Street, NW, Suite 805, Washington, DC 20036.

These organizations implement the RTCA/DO-229D standard set by RTCA:

II. WAAS (Wide Area Augmentation System)

U.S. Department of Transportation. Federal Aviation Administration. 800 Independence Ave, SW, Washington, DC 20591

III. EGNOS (European Geostationary Navigation Overlay Service)

European Space Agency. 8, 10 rue Mario-Nikis,
F-75738 Paris Cedex 15, France.

IV. MSAS (MTSAT Satellite-based Augmentation System)

Japan Civil Aviation Bureau. Ministry of Transport. Kasumigaseki 2-1-3, Chiyoda-ku, Tokyo 100, Japan.

V. GAGAN (GPS Aided Geo Augmented Navigation)

Indian Space Research Organization. Antariksh Bhavan, New Bel Road, Bangalore - 560 094, India.

j) Manual Conventions

This symbol means that there is an important note or information that should not be ignored

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.

INSTALLATION MANUAL

This section of your manual contains information regarding the installation of the antennas, cables, mounting the device and the power requirements, as well as interfacing the device.

1. Taking Care of Your C-NavX1 Hardware

a) Provision and Delivery of Your Equipment

Please confirm that all of the equipment that you have ordered has been delivered.

If any items are missing or damaged, please contact C-Nav Support immediately – contact details are provided below:

https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

Your C-NavX1 has already been tested and configured by qualified C-Nav Technicians.

Please note that any damaged equipment should be returned in the original packaging. Where the damaged equipment is not returned in its original packaging, we cannot be held responsible and will not accept liability for the damage.

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b) Safe Installation of Your Device

The following safety information must be read, understood, and followed at all times;

- Never open or otherwise tamper with the device enclosure screws or connectors or you will void the warranty;
- Ensure that the device is installed securely;
- Do not install or use your device in damp or wet conditions and always avoid installing the device where it may be dripped on or splashed by any substance;
- Do not install your device in a location that is subject to excessive heat, humidity, dust, or vibration;
- Always make sure that the installation location has good ventilation to prevent a build-up heat in and around the device;
- Always connect the device to a power supply that is specified on the device;
- When connecting any other equipment to the device always ensure that any and all power to the device has been disconnected.

c) Maintaining Your Device

Inspect [external only] the device enclosure for physical damage or cracks, perished rubber collars and oxidisation as often as is reasonably practicable. Inspect [external only] the device connectors for physical damage, looseness, thread wear and ensure that the connector is seated securely and firm into the enclosure. Ensure that the device is dry, clean and dust free.

Never clean the device with water, solvents, or liquid of any kind. Only clean your device with a lint free, clean, dry cloth.

The device may only be serviced by DDK Positioning and does not contain any elements or parts that may be serviced by the user. Removing or otherwise tampering with the enclosure screws or connectors will void your warranty.

2. Installing Your C-NavX1 Hardware

This section of the manual contains information regarding the installation of your equipment.

If you have any questions or encounter any difficulty installing your equipment, please contact your support team 24/7 through the following channel;

https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

a) Typical List of Equipment

The table below contains a list of equipment typically supplied to a user.

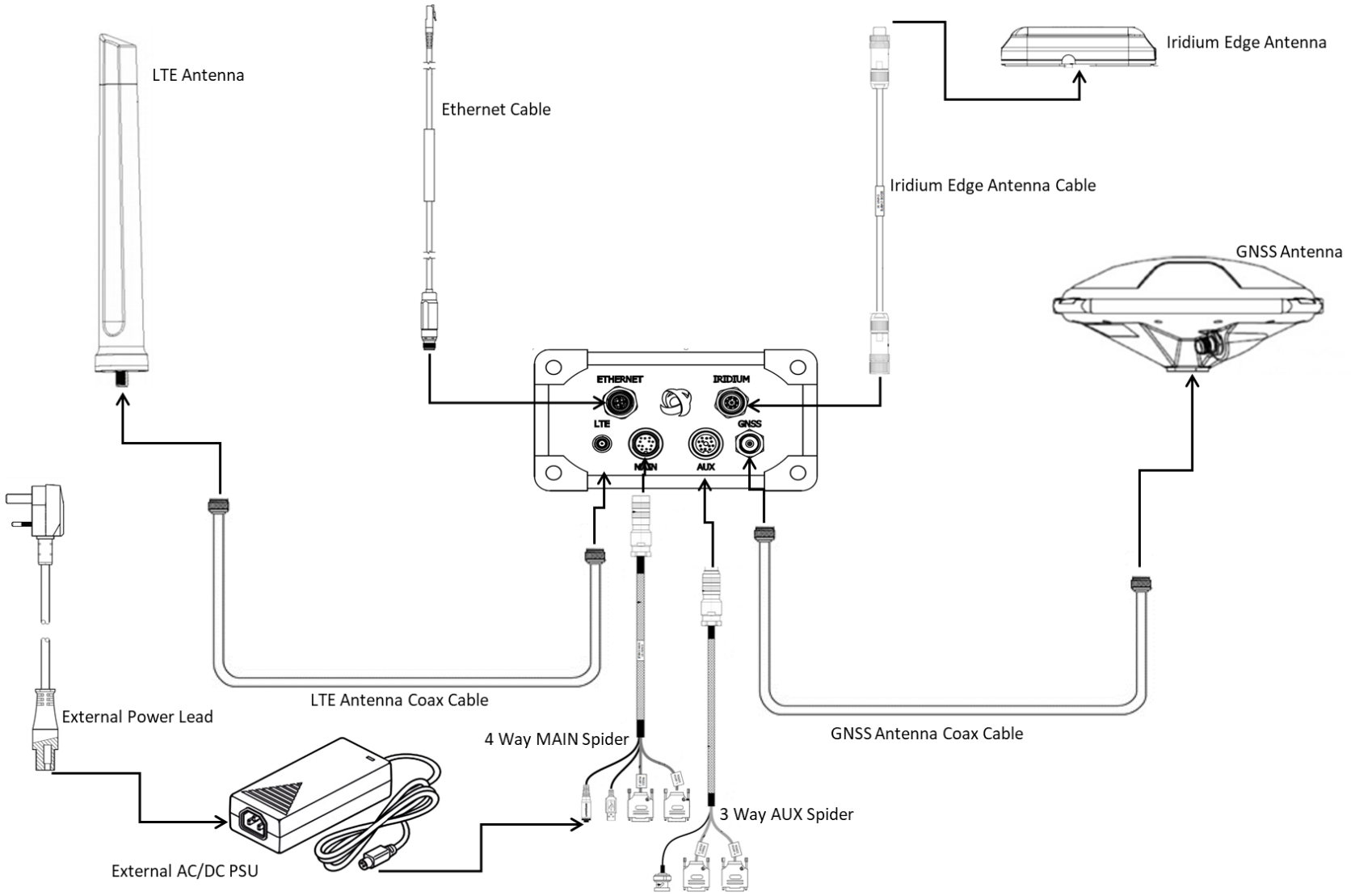
Item	Description	Number	Part Number
1	C-NavX1 [MAX]	1	DDK-CX1-MAX-1-1
2	50m Iridium Edge Cable	1	DDK-C-EDGE-50-1
3	4-Way Spider Cable [MAIN] – consists of power supply connector, 2x DM9S female RS232 connectors, 1x USB connector	1	DDK-C-PWD-CX1-2-1
4	3-Way Spider Cable [AUX] – consists of 1x BNC 1-PPS connector, 2x DM9S female RS422 connectors	1	DDK-C-AUX-CX1-2-1
5	Ethernet Cable [ETHERNET] – 1x RJ45 ethernet connector	1	DDK-C-DAT-CX1-2-1
6	AC/DC Power Supply c/w mains plug *Most power lead socket types A to O may be available on request	1	DDK-C-PSU-CX1-2-1 / *DDK-C-PWR-UK-2-1
7	GNSS Antenna, TNC, 5/8” Mount c/w requested cable	1	NAV82-001020-3001LF
8	Iridium Edge (Iridium Antenna and Modem) c/w requested cable	1	DDK-A-IRDM-EDGE-1
9	Poynting (LTE Antenna) c/w requested cable	1	DDK-A-LTE-PYG-1

Table 3: C-NavX1 Typical List of Equipment.

Please note that the list of equipment in the above table is not exhaustive and different users may require different equipment, dependent upon the use case for the equipment.

If you require any assistance or advise, please always contact the tech support team https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

b) Typical Equipment Setup Schematic



c) Installing Your Antennas

Your equipment will nominally come with three (3) antennas, information about your antennas, and how to install them can be found in the following section.

Installing antennas usually requires personnel to work at height.

Any and all personnel working at height should not do so unless they are competent. That is, that they have a valid in date working at height certificate, that they have had previous experience, and that they have and are familiar with the correct PPE, and the correct PPE that they intend to use is in good working order.

If you require any assistance or advise, please always contact the tech support team https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

VI. General Notes on Antenna Installation

You have bought equipment and subscribed to a GNSS PPP service, this service increases the accuracy, robustness, and resilience of standard GNSS making your GNSS position highly accurate and stable by mitigating or cancelling out errors that are present in the GNSS constellation, in space and in all GNSS equipment. Your GNSS PPP solution makes your GNSS position solution more accurate by;

- Mitigating satellite orbit errors;
- Mitigating satellite clock errors;
- Mitigating ionospheric errors;
- Mitigating tropospheric errors.

There are also additional errors that may cause your GNSS PPP positioning solution to not perform at its optimum level, despite the above errors being mitigated. These additional errors are largely due to the antenna installation location, and are characterised as follows;

- **Interference** – this is when the GNSS, [Iridium] augmentation, or LTE signal is intentionally or unintentionally swamped by transmitted signals;
- **Multi-path** – this is when the GNSS, [Iridium] augmentation, or LTE signal returns [bounces] off of another surface prior to reception at the antenna. This is a particular issue for GNSS signals and should be avoided as much as is practicably possible;
- **Masking** – this is when the GNSS, [Iridium] augmentation, or LTE signal is blocked or masked by a manmade or natural feature.

Interference, multi-path and or masking on their own or in any combination will result in reduced positioning performance and or a loss of position or augmentation.

If you require any assistance or advise, please always contact the tech support team https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

When installing your antennas, be mindful of proximity to other antennas. Other antennas may cause interference or masking. To mitigate these issues always mount your antennas at least one (1) metre away [in all directions] from any other receive antennas and mount your antennas at least two and a half (2.5) metres away [in all directions] from any other transmit antennas. Failure to do so may result in intermittent or complete loss of signals.

If you require any assistance or advise, please always contact the tech support team https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

Cable runs are an important part of antenna installation and a reconnaisance of the cable run should always be completed prior to running any antenna cables. When completing the cable run reconnaisance, personnel should be mindful that in order to optimise the cable run, the following should be adhered to;

- The recommended cable should be used;
- The recommended cable length should not be exceeded;
- The cable run should have no sharp edges that might cut into the cable;
- Any required bends in the cable do not exceed the maximum bend radius for the cable;
- Loops are turned at both ends of the cable prior to connection in order to reduce the strain on the connectors;
- No load strain is put on the cable, and it is secure, neat, and tidy, and does not create a hazard;
- The cable does not run with or over / under mains power or high power communications cables and is not in close proximity to fluorescent tubes.

It should be noted that when installing antennas and cables, it is not always possible to site the antenna or run the cables in / through the ideal location, and a certain amount of compromise is always required. Therefore, best endeavours should always be made to locate and use the ideal locations / runs. However, where this is not possible, the senior client representative should be made aware, and a note should be made in the installation report.

If you require any assistance or advise, please always contact the tech support team https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

VII. C-Nav289 GNSS Antenna

The C-Nav289 GNSS antenna has a durable non-corrosive all-polymer housing and tracks all current GNSS constellations. The GNSS antenna also contains out-band rejection filters for Inmarsat and Iridium. The antenna also features reverse polarity shutdown which is used to mitigate the effects of multi-path.

For the best performance, GNSS antennas should be installed in a location with the following properties;

- A good clear 360° sky view as high as is practicably possible – to ensure that all available GNSS satellites can be tracked at all times, or as many as is practicably possible;
- Not close to any other Tx / Rx antennas – to avoid unintentional interference;
- Not close to or near any large flat surfaces – to ensure that the risk of multi-path is mitigated;
- Not behind any structure – to ensure that the risk of masking is mitigated;
- Maximum cable run should not exceed 50m using the recommended LMR400 cable.

The following procedure should be carried out when installing your GNSS antenna;

Step	Activity
1	Carry out a reconnaissance to establish the most appropriate location to install the GNSS antenna, and agree with the senior client representative
2	Carry out a reconnaissance to establish the most appropriate GNSS antenna cable run, and agree with the senior client representative
3	Install the GNSS antenna in the agreed location
4	Prior to running your GNSS antenna cable to your device, turn a loop in the GNSS antenna cable and secure it to a mounting point. This will protect the connector by reducing the strain caused by the cable pulling on the connector
5	Connect the TNC connector to the GNSS antenna connector and wrap the connector and cable with self-amalgamating tape
6	Prior to running the cable, ensure that there are no sharp edges that might cut into the cable, ensure that any required bends in the cable do not exceed the maximum bend radius for the cable

Step	Activity
7	Run the GNSS antenna cable from the GNSS antenna to your device, ensuring at all times that the cable is secure neat and tidy and does not create a hazard
8	Ensure that any excess cable is coiled neat and tidy
9	Prior to connecting your GNSS antenna cable to your device, turn a loop in the GNSS antenna cable and secure. This will protect the connector by reducing the strain caused by the cable pulling on the connector
10	Connect the GNSS cable TNC connector to the GNSS connector on your device
11	Make good as required, leaving the location as you found it and agree and sign off the installation with the senior client representative

Table 4: GNSS Antenna Installation Procedure.

Your GNSS antenna may be mounted using our Universal Mounting Bracket, the figure below shows the Universal Mounting Bracket;

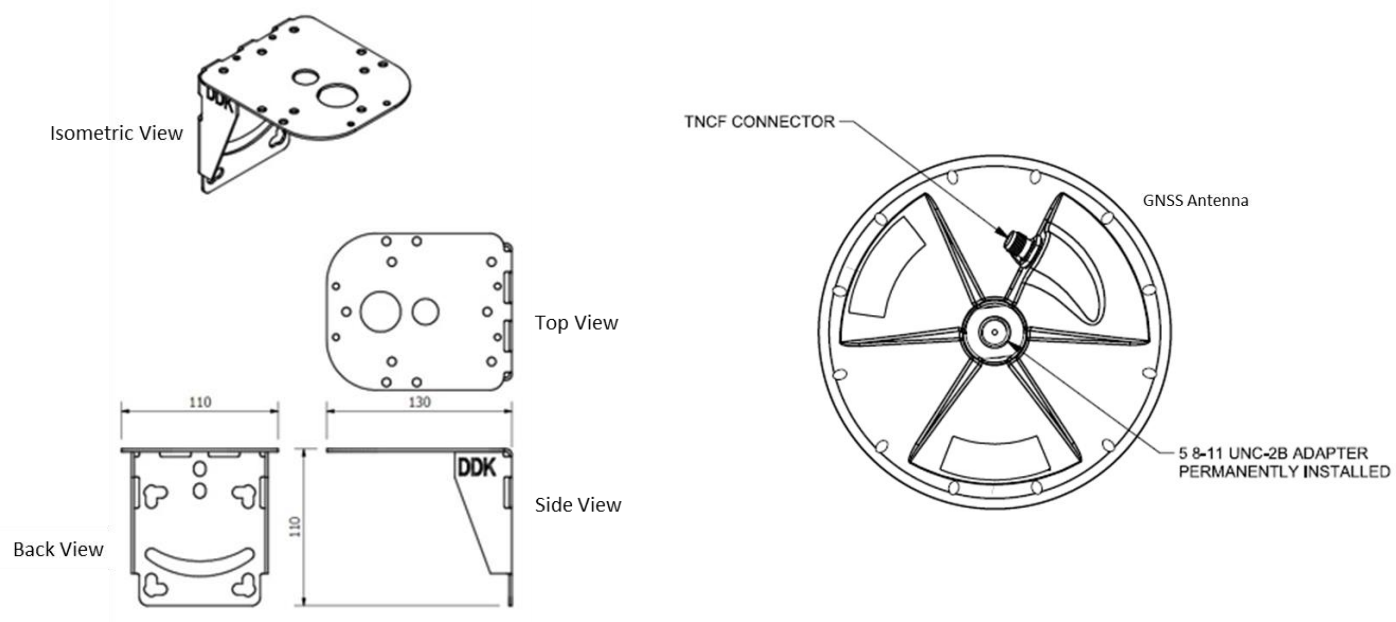


Figure 1: Universal Mounting Bracket and C-Nav289 GNSS Antenna

VIII. Iridium Edge Antenna

The Iridium Edge antenna is a finished satellite device with a power supply and antenna in a sealed enclosure. It is able to receive Iridium Burst data and also receive / transmit Iridium Short Burst Data (SBD).

For the best performance Iridium Edge antennas should be installed in a location with the following properties;

- A good clear 360° sky view as high as is practicably possible – to ensure that all available Iridium satellites can be tracked at all times;
- Not close to any other Tx / Rx antennas – to avoid unintentional interference;
- Not behind any structure – to ensure that the risk of masking is mitigated;
- Maximum cable run should not exceed 50m using the Iridium Edge cable provided.

The following procedure should be carried out when installing your Iridium Edge antenna;

Step	Activity
1	Carry out a reconnaissance to establish the most appropriate location to install the Iridium Edge antenna, and agree with the senior client representative
2	Carry out a reconnaissance to establish the most appropriate Iridium Edge antenna cable run, and agree with the senior client representative
3	Install the Iridium Edge antenna in the agreed location
4	Prior to running your Iridium Edge antenna cable to your device, turn a loop in the Iridium Edge antenna cable and secure it to a mounting point. This will protect the connector by reducing the strain caused by the cable pulling on the connector
5	Connect the Iridium Edge connector to the Iridium Edge antenna connector and wrap the connector and cable with self-amalgamating tape
6	Prior to running the cable, ensure that there are no sharp edges that might cut into the cable, ensure that any required bends in the cable do not exceed the maximum bend radius for the cable
7	Run the Iridium Edge antenna cable from the Iridium Edge antenna to your device ensuring at all times that the cable is secure neat and tidy and does not create a hazard
8	Ensure that any excess cable is coiled neat and tidy
9	Prior to connecting your Iridium Edge antenna cable to your device, turn a loop in the Iridium Edge antenna cable and secure. This will protect the connector by reducing the strain caused by the cable pulling on the connector
10	Connect the Iridium Edge cable connector to the IRIDIUM connector on your device
11	Make good as required leaving the location as you found it and agree and sign off the installation with the senior client representative

Table 5: Iridium Edge Antenna Installation Procedure.

Your Iridium Edge antenna may be mounted using our Universal Mounting Bracket, the figure below shows the Universal Mounting Bracket;

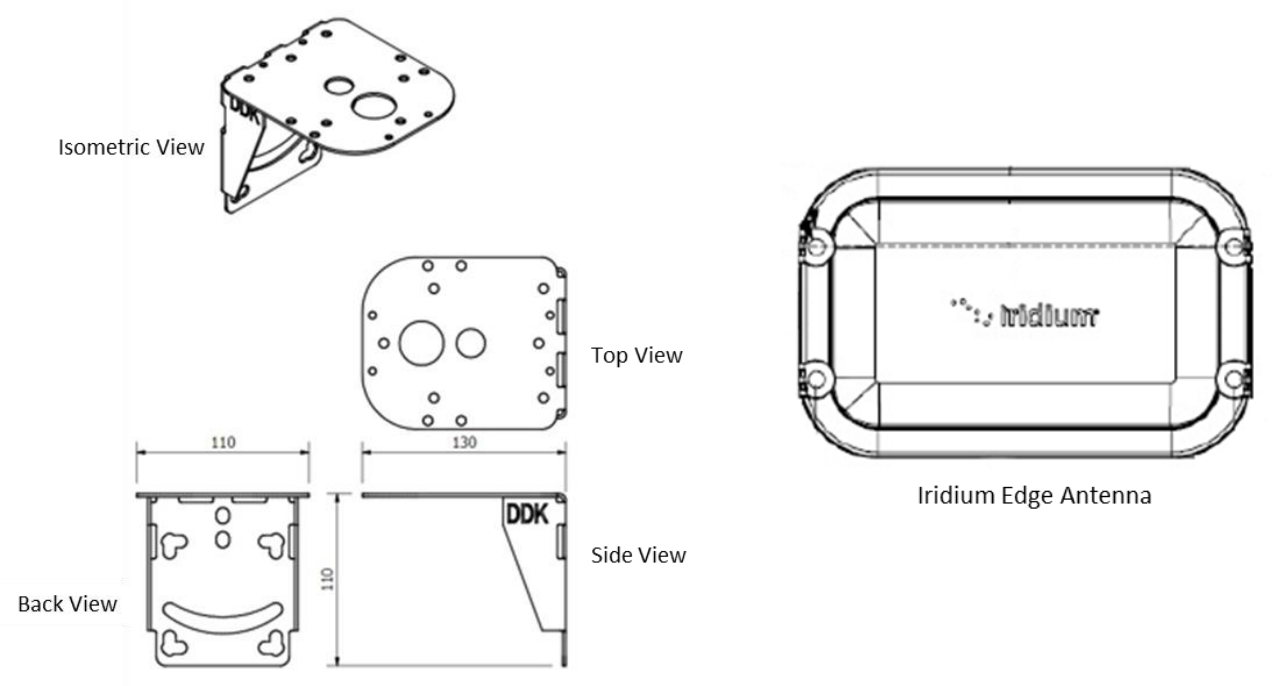


Figure 2: Universal Mounting Bracket and Iridium Edge Antenna

IX. Poynting LTE Antenna

The LTE antenna is a high gain omni-directional antenna that covers all cellular frequencies bands needed for LTE, but also covers the bands for HSDPA, 3G, EDGE, GPRS, voice and 2.4 GHz LTE and Wi-Fi bands.

For the best performance LTE antennas should be installed in a location with the following properties;

- Not close to any other Tx / Rx antennas – to avoid unintentional interference;
- Not behind any structure – to ensure that the risk of masking is mitigated;
- Maximum cable run should not exceed 50m using the recommended LMR400 cable.

The following procedure should be carried out when installing your LTE antenna;

Step	Activity
1	Carry out a reconnaissance to establish the most appropriate location to install the LTE antenna, and agree with the senior client representative
2	Carry out a reconnaissance to establish the most appropriate LTE antenna cable run, and agree with the senior client representative
3	Install the LTE antenna in the agreed location
4	Prior to running your LTE antenna cable to your device, turn a loop in the LTE antenna cable and secure it to a mounting point. This will protect the connector by reducing the strain caused by the cable pulling on the connector
5	Connect the LTE N-Type connector to the LTE antenna connector and wrap the connector and cable with self-amalgamating tape

Step	Activity
6	Prior to running the cable, ensure that there are no sharp edges that might cut into the cable, ensure that any required bends in the cable do not exceed the maximum bend radius for the cable
7	Run the LTE antenna cable from the LTE antenna to your device ensuring at all times that the cable is secure neat and tidy and does not create a hazard
8	Ensure that any excess cable is coiled neat and tidy
9	Prior to connecting your LTE antenna cable to your device, turn a loop in the LTE antenna cable and secure. This will protect the connector by reducing the strain caused by the cable pulling on the connector
10	Connect the LTE cable connector to the LTE connector on your device
11	Make good as required leaving the location as you found it and agree and sign off the installation with the senior client representative

Table 6: LTE Antenna Installation Procedure.

Your LTE antenna may be mounted using our LTE Mounting Bracket, the figure below shows the LTE Mounting Bracket;

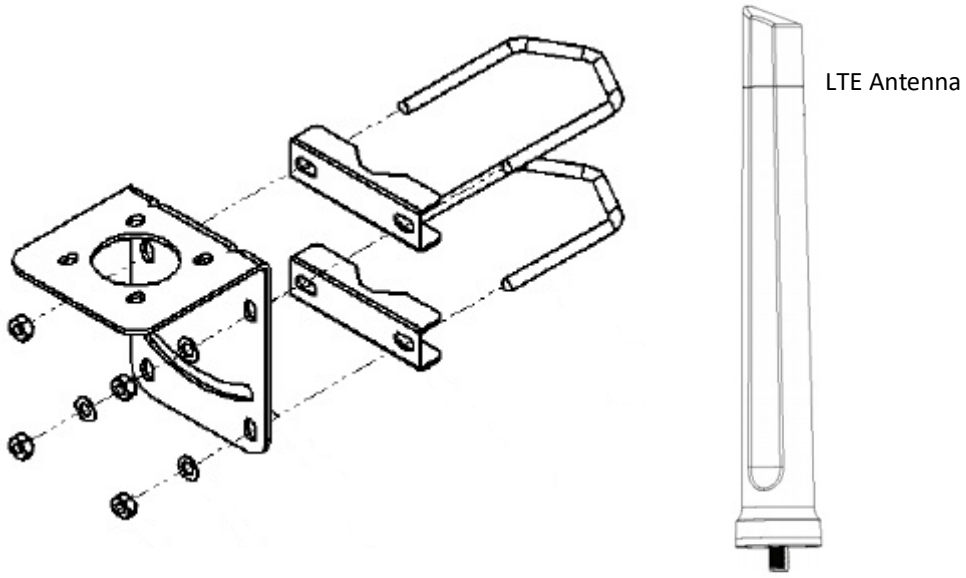


Figure 3: LTE Mounting Bracket and LTE Antenna

d) Installing Your Device

Your device will nominally come with four (4) power and interface cables, information about your device, and how to install it can be found in the following section.

The following safety information must be read, understood, and followed at all times;

- Never open or otherwise tamper with the device enclosure screws or connectors or you will void the warranty;
- Ensure that the device is installed securely;
- Do not install or use your device in damp or wet conditions and always avoid installing the device where it may be dripped on or splashed by any substance;
- Do not install your device in a location that is subject to excessive heat, humidity, dust, or vibration;
- Always make sure that the installation location has good ventilation to prevent a build-up heat in and around the device;
- Always connect the device to a power supply that is specified on the device;
- When connecting any other equipment to the device always ensure that any and all power to the device has been disconnected.

The following procedure should be carried out when installing your device;

Step	Activity
1	Carry out a reconnaissance to establish the most appropriate location to install the device, and agree with the senior client representative
2	Install the device in the agreed location
3	Ensure that the device is installed securely such that there is no movement
4	Prior to connecting your antenna cables to your device, turn loops in the antenna cables and secure. This will protect the connectors by reducing the strain caused by the cable pulling on the connector
5	Connect the device ethernet cable to the ETHERNET connector on the device
6	Connect the device 4 Way MAIN spider to the MAIN connector on the device
7	Connect the device 3 Way AUX spider to the AUX connector on the device
8	Connect the device PSU to the power tail on the device 4 Way MAIN spider
9	Connect the device power lead to the device PSU
10	Ensure that there are no sharp edges that might cut into the cables, ensure that any required bends in the cables do not exceed the maximum bend radius for the cables
11	Make good as required leaving the location as you found it and agree and sign off the installation with the senior client representative

Table 7: Device Installation Procedure.

e) How to Activate and Deactivate Your Device

In order to use the C-NavMAX GNSS PPP augmentation service to position yourself, globally from pole-to-pole, you will need to activate your device. Once activated your device will start to receive the C-NavMAX GNSS PPP augmentation service [corrections] via the Iridium satellite communications network, concurrently your billing period will also start, and you will start to be charged for the service. To stop receiving the C-NavMAX GNSS PPP augmentation service, you will need to deactivate your device. Once deactivated your device will stop receiving C-NavMAX GNSS PPP augmentation, concurrently your billing period will cease, and you will stop being charged for the service.

To activate or deactivate your device *please note down the serial number of your device*. Then visit the link below and call or email our 24/7 support team, or use the online form provided;

https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

The figure shown below indicates the location of the device serial number on the device ident sticker, placed on the top-front of the device;

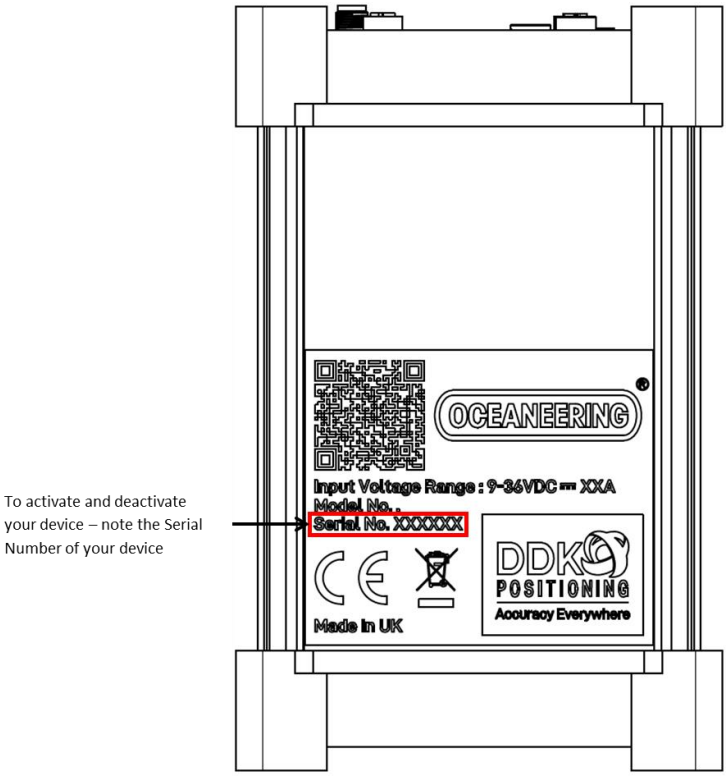


Figure 4: Device Ident Sticker and Serial Number Location

Once activated you will need to deactivate the device in order to stop the billing period. The billing period must be stopped at the end of use, or you will be invoiced.

OPERATION MANUAL

This section of your manual contains information regarding the C-NavX1 device, specifically regarding the device form factor, what's in the box, the LED state descriptions, and cables. This section of the manual also describes how to integrate the hardware and User Interface (UI), what the hardware configuration options are within the UI and what the views are within the UI after integration.

1. C-NavX1 Hardware Overview

a) Provision and Delivery of Equipment

Please confirm that all of the equipment that you have ordered has been delivered.

If any items are missing or damaged, please contact C-Nav Support immediately – contact details are provided below:

https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

Your C-NavX1 has already been tested and configured by qualified C-Nav Technicians.

Please note that any damaged equipment should be returned in the original packaging. Where the damaged equipment is not returned in its original packaging, we cannot be held responsible and will not accept liability for the damage.

---

b) Physical and Environmental Specifications

I. Physical Dimensions

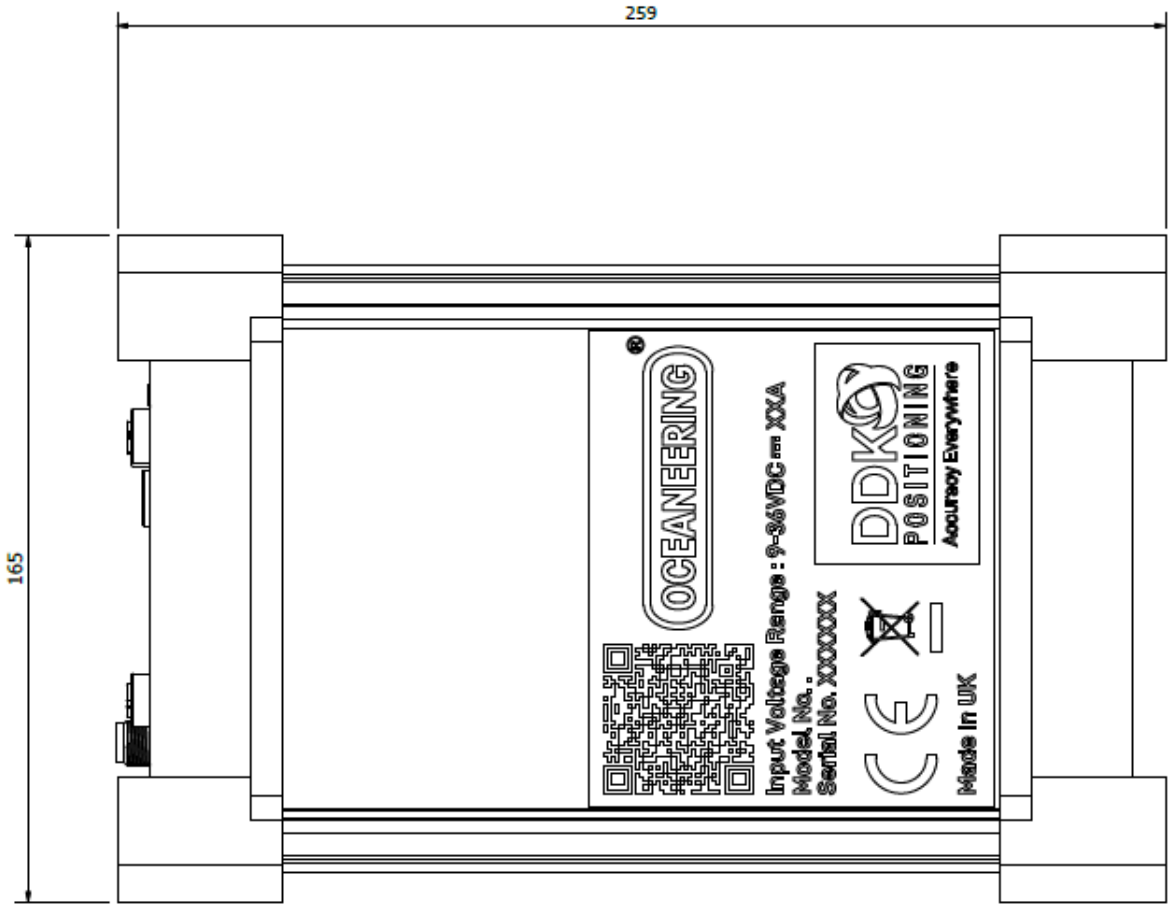


Figure 5: C-NavX1 Dimensions [Top] – Length 259mm x width 165mm

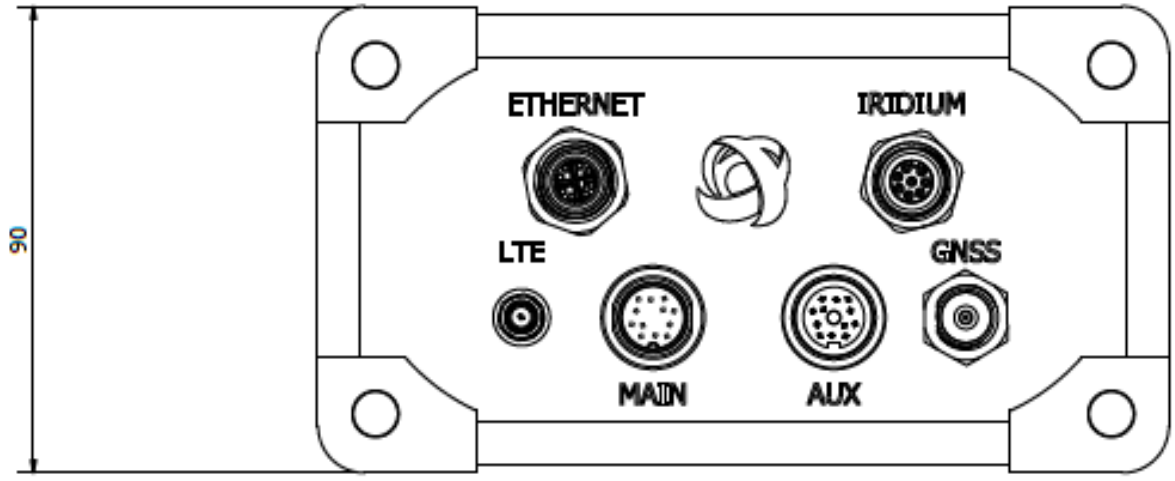


Figure 6: C-NavX1 Dimensions [Back] – Height 90mm x width 165mm

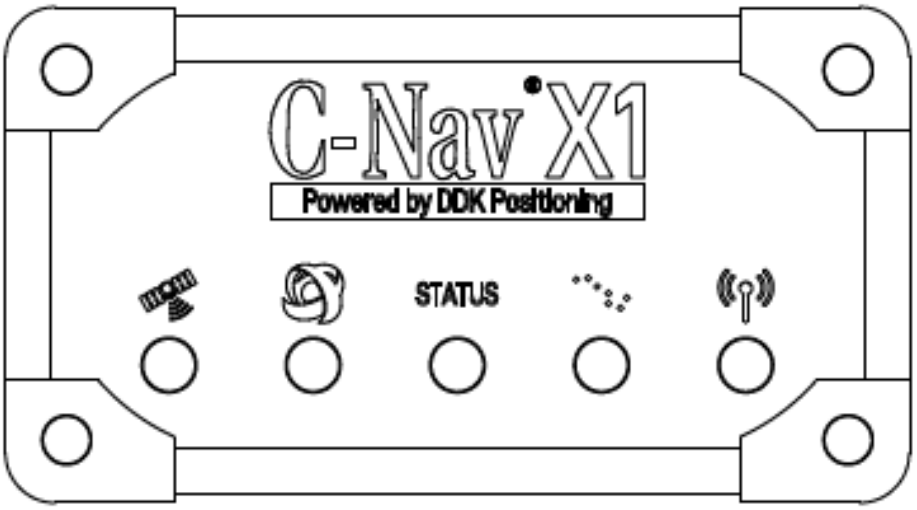


Figure 7: C-NavX1 Dimensions [Front] – Height 90mm x width 165mm

II. Physical Weight

The device ***weighs 2.2Kg***, excluding the installation brackets and antennas etc.

III. Physical Power Considerations

Item	Description	Value
1	Device Power Consumption	10W
2	Device Voltage Input	9V to 36V DC
3	GNSS Antenna Voltage	5V DC
4	GNSS Antenna Current	100mA
5	Iridium Edge Antenna Power Consumption	1.6W (Max)
6	Iridium Edge Antenna Current	0.2mA

Table 8: Device and Antenna Power Considerations.

The values in the above table will fluctuate with the device use case and the number of satellites being tracked, and so the values may be considered as a guide and not absolute values.

IV. Physical Environment Considerations

The device has been tested in compliance with EN60945 and as such the device is tested to withstand;

Item	Description	Value
1	Vibration	EN 60945 Section 8.7 2Hz – 13.2Hz @ 1.0mm peak amplitude 13.2Hz -100Hz @ 0.7g 2h @ 30Hz / resonance

Table 9: Device Vibration Considerations.

V. Environmental Ingress Protection

The device is a sealed unit and is rated as ***IP67*** in compliance with ***EN60945***.

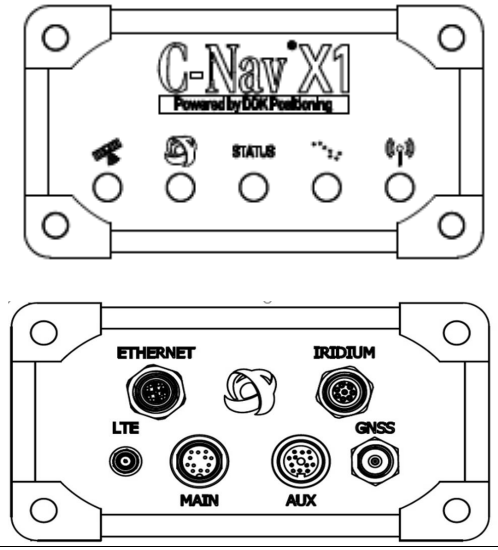
VI. Environmental Temperature and Humidity Considerations

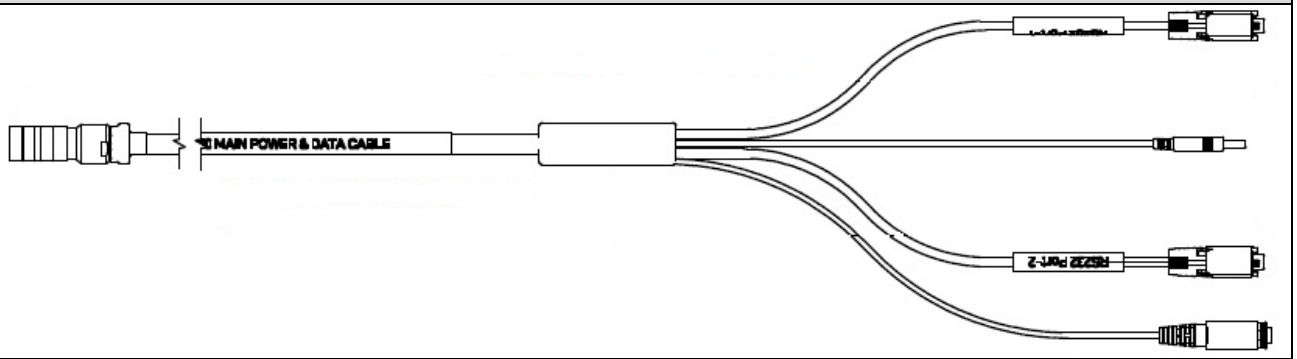
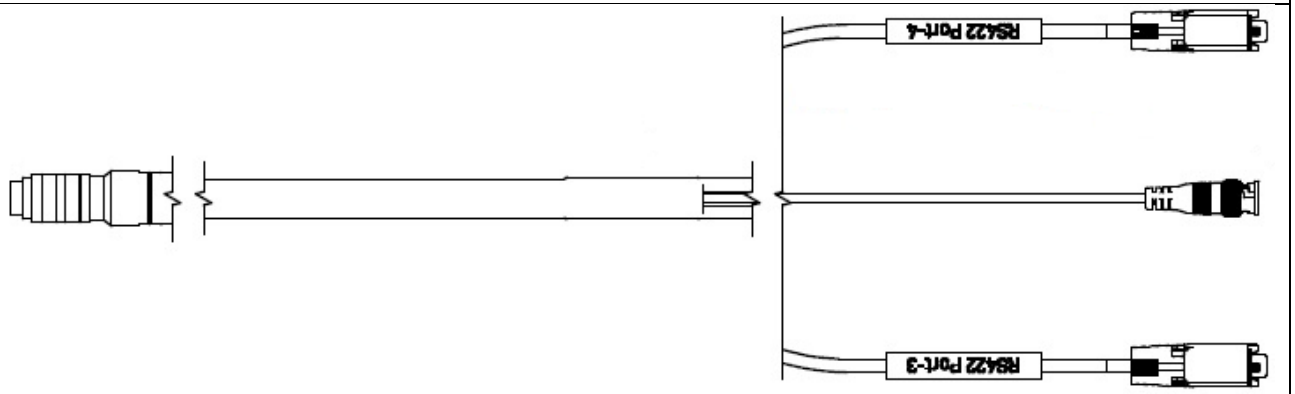
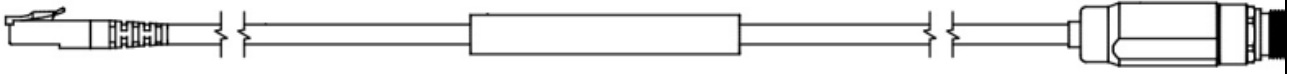
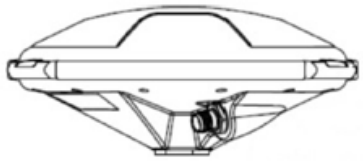
Item	Description	Value
1	Operating Temperature	-15°C to +55°C
2	Storage Temperature	-30°C to +70°C
3	Operating Maximum Relative Humidity	95% Non-Condensing

Table 10: Temperature and Humidity Considerations.

c) C-NavX1 Supplied Equipment – What's in the Box

The table below contains the C-Nav equipment nominally provided to our customers and forms a standard, "What's in the Box", equipment list, the equipment provided to you may vary depending upon your requirements;

Item	Description	Part Number	Image
1	DDK X1 [MAX]	DDK-CX1-MAX-1-1	
2	Iridium Edge Cable	DDK-C-EDGE-50-1	

Item	Description	Part Number	Image
2	4-Way Spider Cable [MAIN]	DDK-C-PWD-CX1-2-1	
3	3-Way Spider Cable [AUX]	DDK-C-AUX-CX1-2-1	
4	Ethernet Cable [ETHERNET]	DDK-C-DAT-CX1-2-1	
5	AC Power Supply	DDK-C-PSU-CX1-2-1 / *DDK-C-PWR-UK-2-1	Standard PSU and Power Leads for the UK, USA and EU are available on request – *Most power lead socket types A to O may be available on request
6	GNSS Antenna	NAV82-001020-3001LF	

Item	Description	Part Number	Image
	GNSS Antenna Cables	-	Standard Cables are LMR400 cable at 50m, 30m, 15m – LMR195 5m cable and LMR195 0.5m tails
	Iridium Edge Antenna	DDK-A-IRDM-EDGE-1	
	Iridium Edge Antenna Cable	-	Standard Cables are AWG22 cable at 50m, 30m, 15m, 5m – LSZH cables are also available at 50m, 30m, 15m, 5m
	LTE Antenna	DDK-A-LTE-PYG-1	
	LTE Antenna Cable	-	Standard Cables are LMR400 cable at 50m, 30m, 15m – LMR195 5m cable and LMR195 0.5m tails

Table 11: C-NavX1 Supplied Equipment.

d) C-NavX1 Device Overview

I. C-NavX1 Device Back Panel Connectors

The C-NavX1 device has six (6) connectors on the back of the device. The connector type and function are listed below;

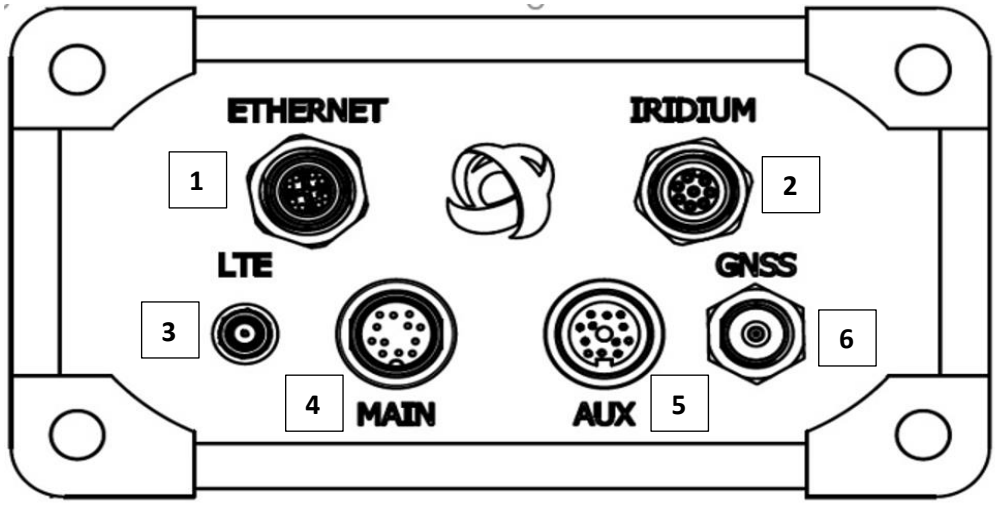


Figure 8: C-NavX1 [Back Panel] – Connectors

Item	Connector / Type	Connector Function
1	ETHERNET / Female M12 8-WAY CODE-X	RJ45 I/O Port
2	IRIDIUM / Female M12 8-WAY CODE-A	Iridium Edge Antenna Connector
3	LTE / Male SMA	LTE Antenna Connector
4	MAIN / Male Panel Mount 12-WAY	4-way spider [or multi-cable] MAIN connector for; • Power supply to the unit; • I/O: 2x DM9SS female RS232 ports; • I/O: 1x USB port.
5	AUX / Female Panel Mount 12-WAY	3-way spider [or multi-cable] AUX connector for; • 1-PPS: 1x BNC connector; • I/O: 2x DM9SS female RS422 ports.
6	GNSS / Male TNC	GNSS Antenna Connector

Table 12: C-NavX1 Connector Type and Function

II. C-NavX1 Device Front Panel LEDs

The C-NavX1 has five (5) LEDs on the front panel, these are shown in the figure below;

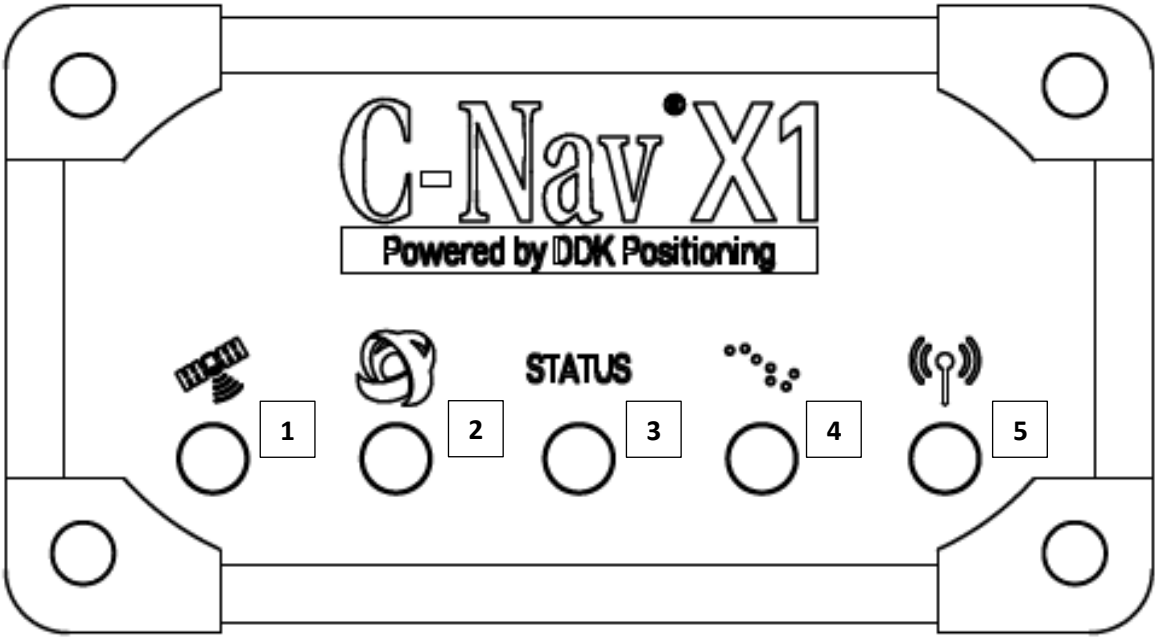


Figure 9: C-NavX1 [Front Panel] – LEDs

The LED state schedule should be read in conjunction with Figure 8 and is shown below;

LED No.	Icon	Description	LED States
1		GNSS Status Icon	• **RED**: GNSS Antenna Not Connected / No or ≤3 SVs in View • **AMBER**: Signal Strength ≤40% / ≤4 SVs In View • **GREEN**: Signal Strength ≥40% / ≥4 SVs in View / GNSS Position Solution Computed
2		DDK Status Icon	• **RED**: Iridium Antenna Not Connected / No signal • **AMBER**: Augmentation Latency >10 mins • **GREEN**: Augmentation Latency ≤10 mins
3		DDK X1 Device Status Icon	• **AMBER**: Device Not Booted / No Position Solution / No signal from GNSS antenna and or Iridium antenna and or LTE antenna / Augmentation Latency >10 mins • **GREEN**: PPP Solution Computed
4		Iridium Status Icon	• **RED**: Iridium Antenna Not Connected / No Signal • **AMBER**: Iridium Augmentation Received but Signal Strength is Low • **GREEN**: Iridium Connection Made and Steady
5		LTE Status Icon	• **RED**: LTE Antenna Not Connected / No Signal • **AMBER**: Connection Made but Signal Strength is Low • **GREEN**: LTE Connection Made and Steady

Table 13: C-NavX1 Front Panel LED States

e) C-NavX1 Device Cables

Item	Description
1	4-way spider [or multi-cable] into the MAIN connector. Use this cable for; • Power supply to the unit; • I/O: 2x DM9SS female RS232 ports; • I/O: 1x USB port.
2	3-way spider [or multi-cable] into the AUX connector. Use this cable for; • 1-PPS: 1x BNC connector; • I/O: 2x DM9SS female RS422 ports.
3	Ethernet cable into the ETHERNET connector. Use this cable for; • I/O: 1x RJ45 ethernet port.
4	Power: • Connect the 4-way spider power cable to the PSU; • Connect the mains lead to the PSU; • Connect the mains lead plug to the vessel power socket.

Table 14: C-NavX1 Device Cable Schedule

I. 4-Way MAIN Spider Cable - STANDARD

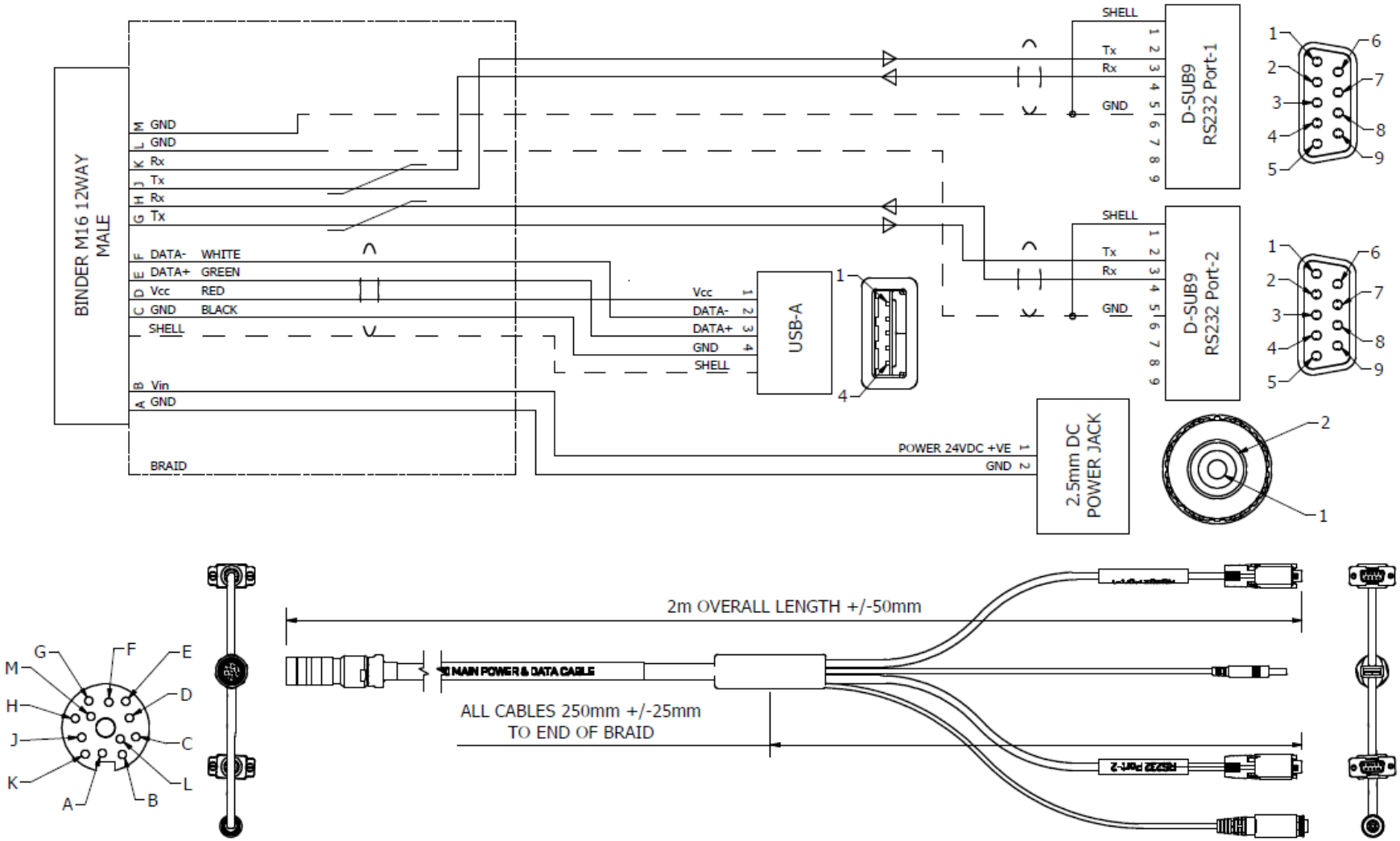


Figure 10: C-NavX1 4-Way MAIN Spider Cable Schematic

II. 3-Way AUX Spider Cable - OPTIONAL

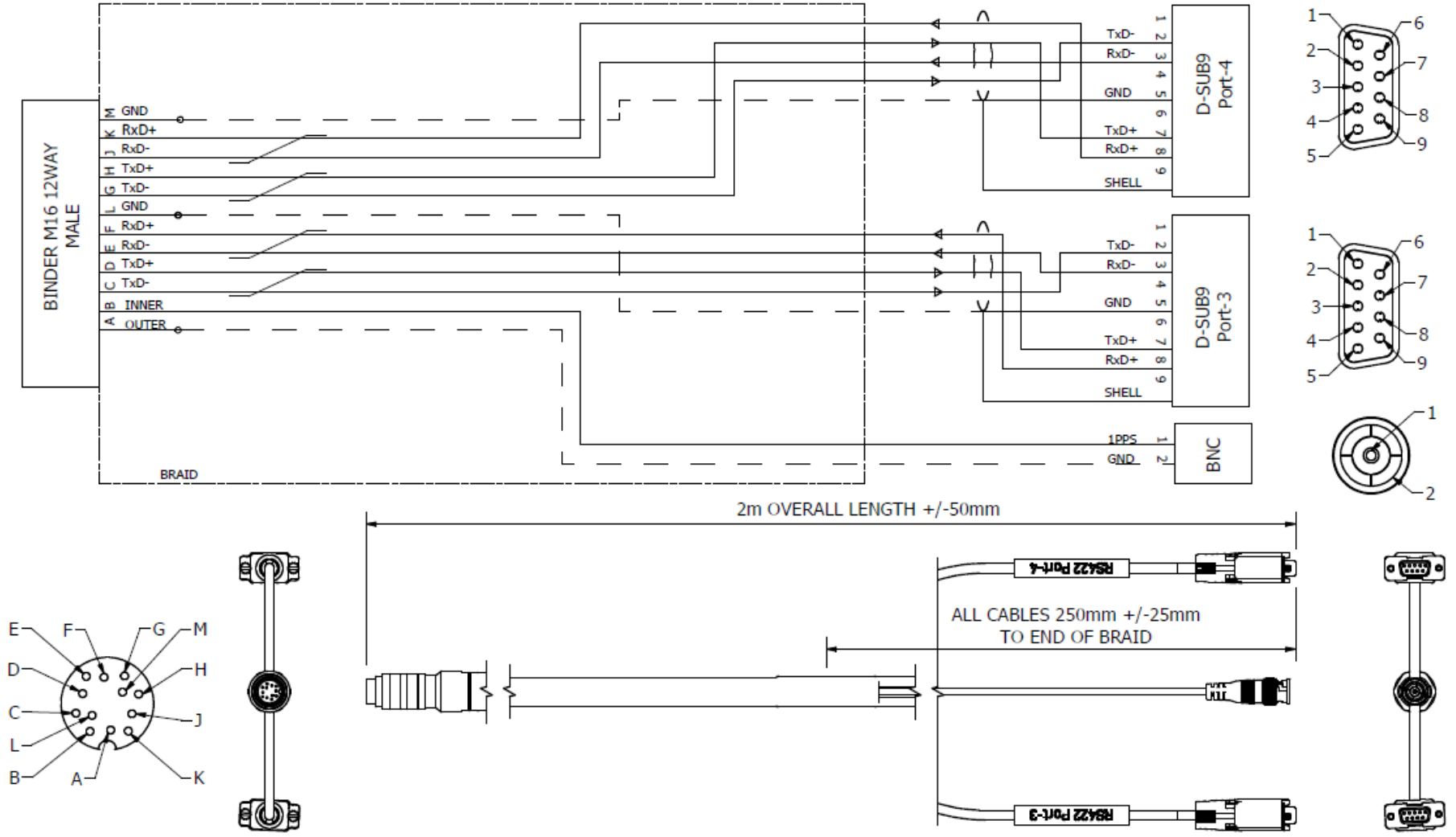


Figure 11: C-NavX1 3-Way AUX Spider Cable Schematic

III. Iridium Edge Cable - STANDARD

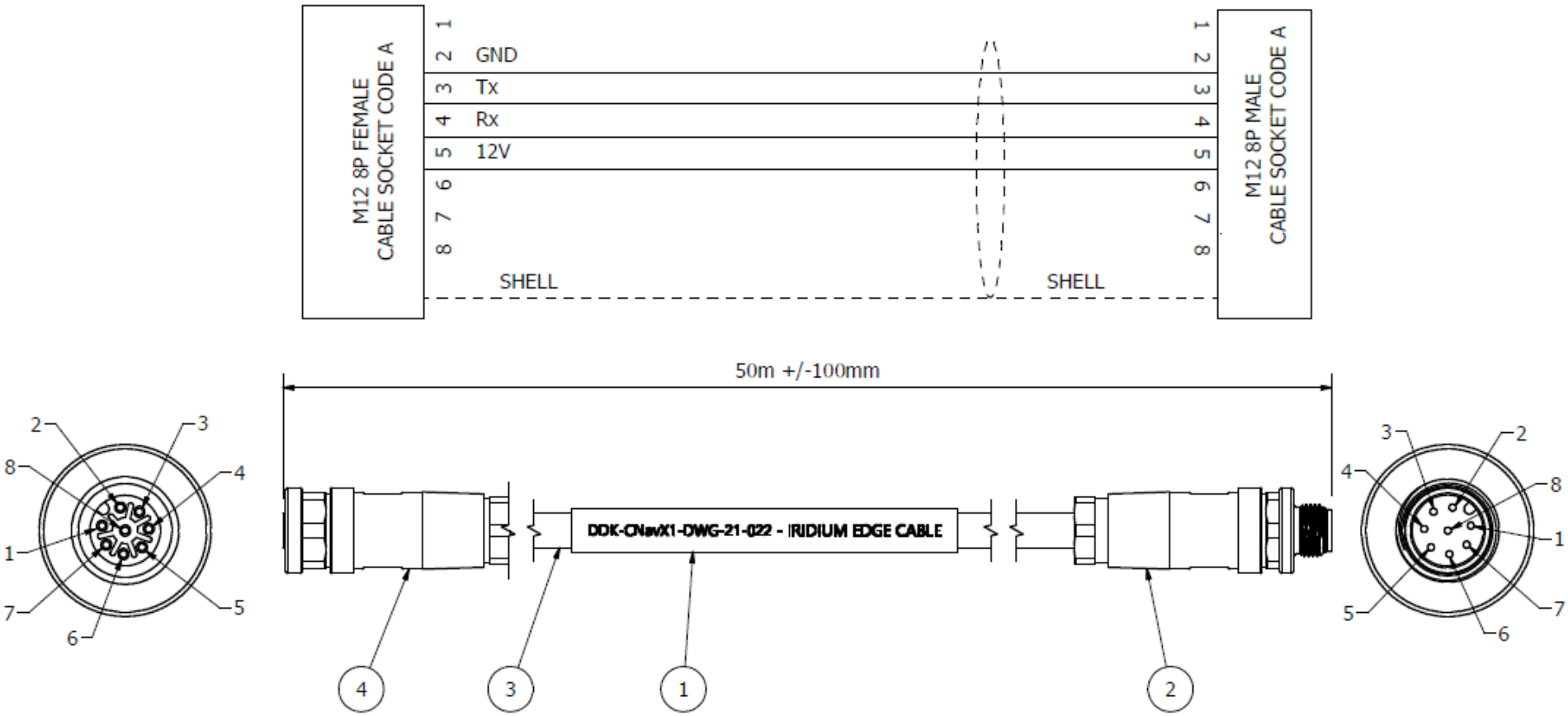


Figure 12: C-NavX1 Iridium Edge Cable Schematic

2. C-NavX1 User Interface (UI)

The C-NavX1 device is configured using C-Nav, C-Monitor software.

The C-Monitor software can be downloaded from the following location;

https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

Updating from version 6.x to version 7.x requires a complete uninstallation of the C-Monitor version 6.x. Failure to completely uninstall C-Monitor version 6.x will produce unexpected results.

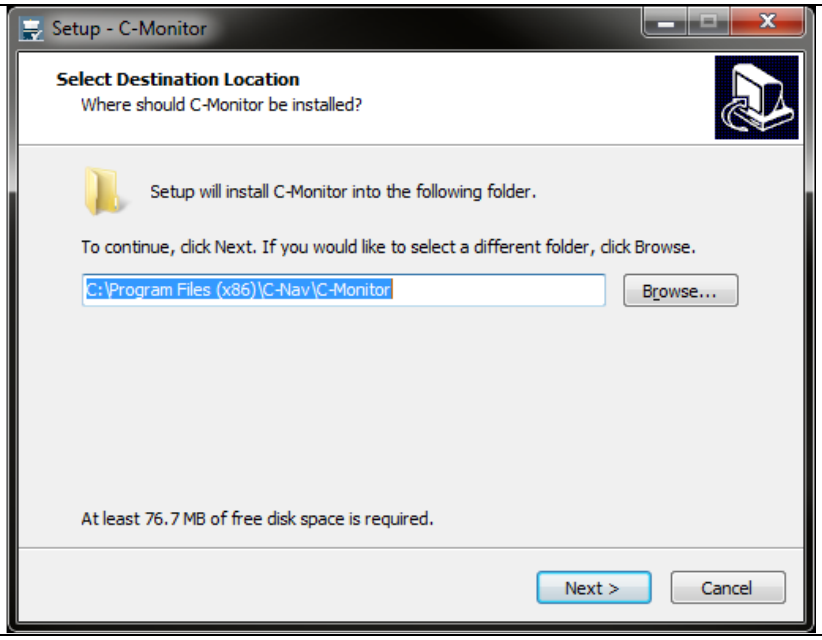
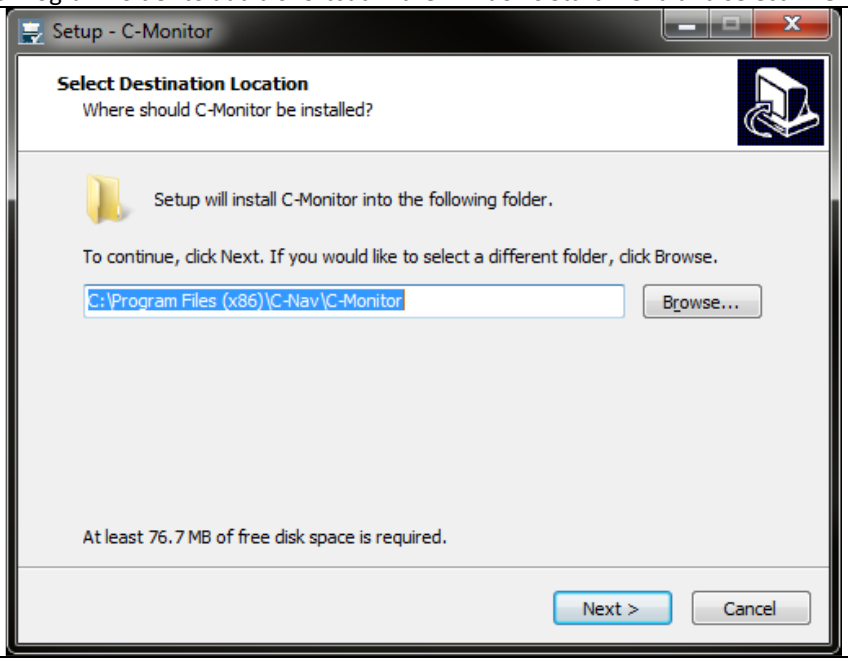
a) C-Nav Dongle Driver Installation

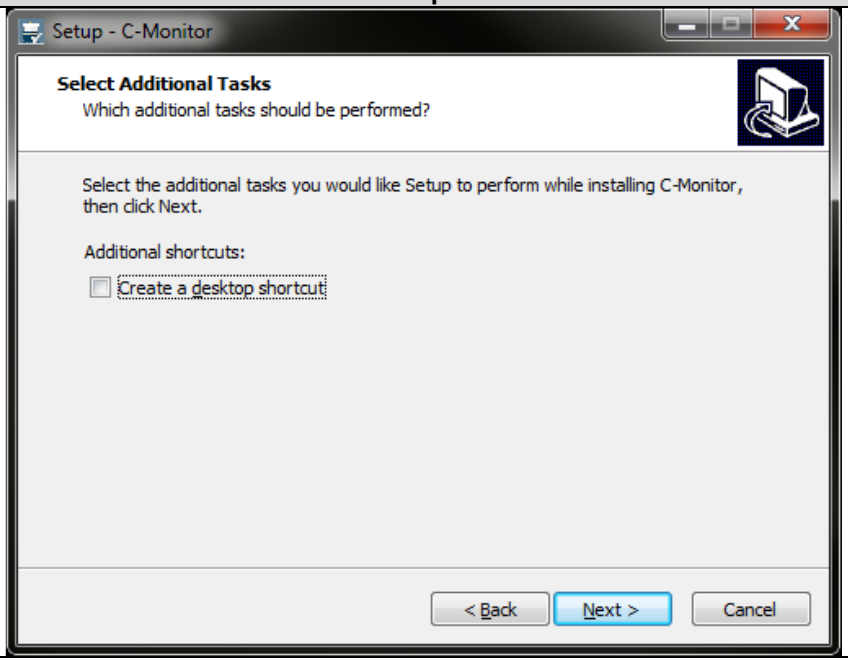
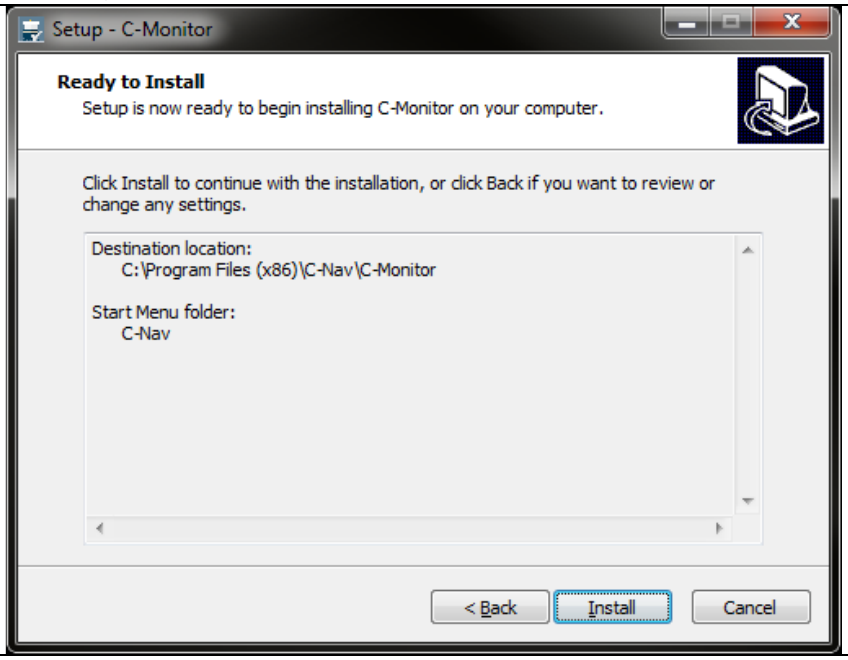
The C-Monitor® QA/QC software is protected by a security dongle that must be installed prior to running the application. The dongle driver and associated installation instructions may be found in the following location;

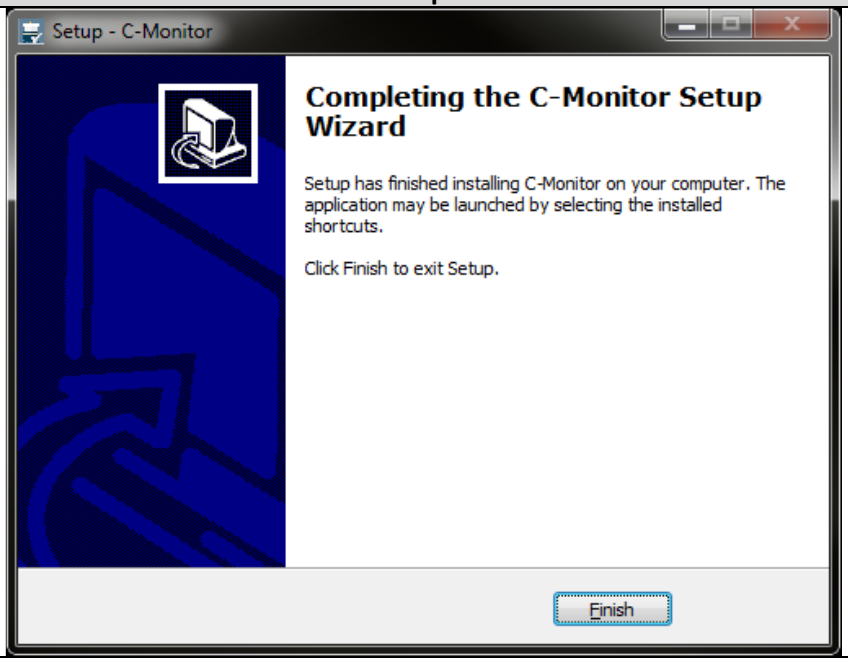
https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/

The figure below indicates the information available for installing the dongle driver, as well as the driver itself and associated information.

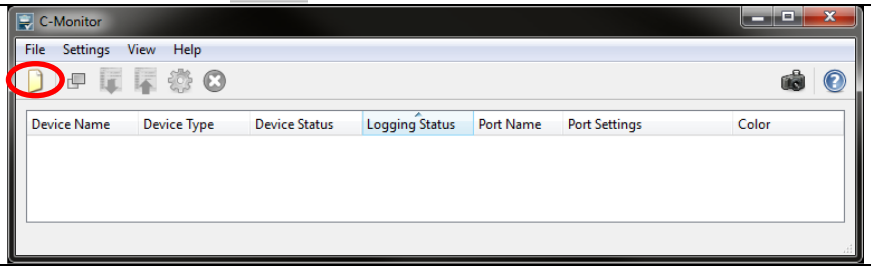
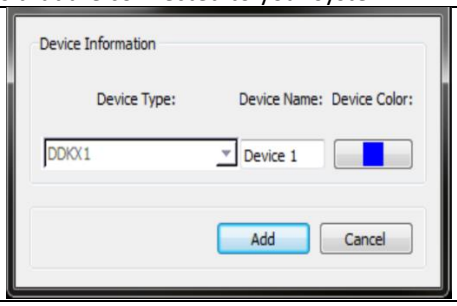
b) C-Monitor Installation

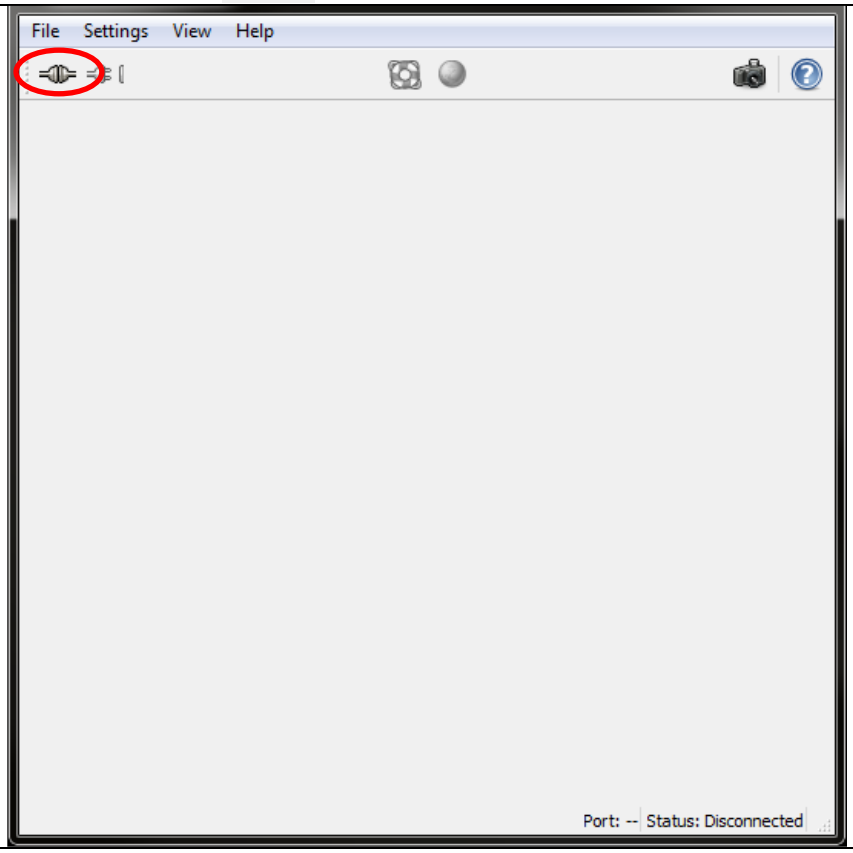
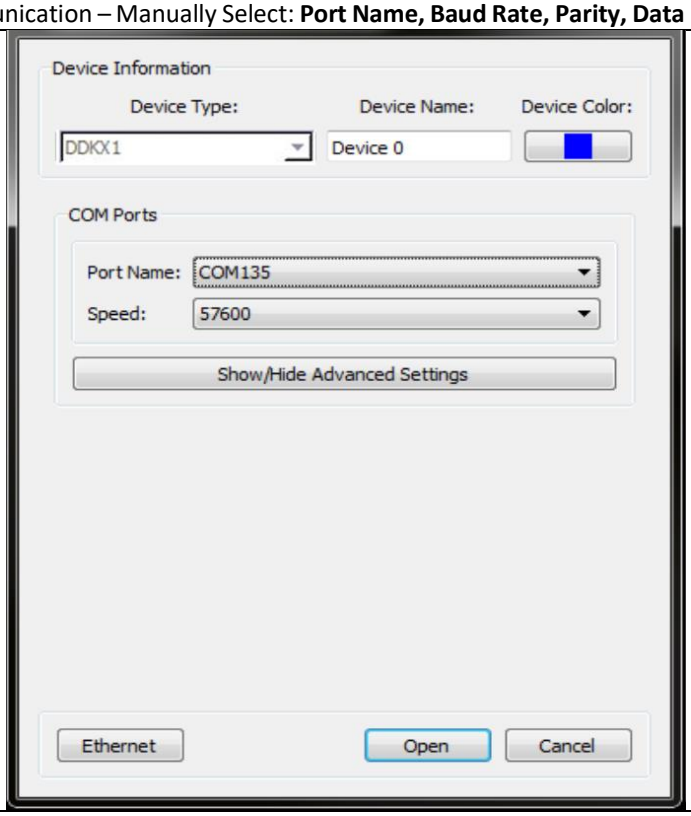
Step	Description
1	Download C-Monitor
2	Click “C-Monitor vX.Y.Z Installar.exe” to start the install
3	Choose the destination location or use the default location and select **“Next >”**
4	
5	Select the Program folder to add a shortcut in the Windows Start menu and select **“Next >”**
6	
7	If you wish – ✓ the “Creat a desktop shorcut” box in order to automatically create a C-Monitor shortcut on your desktop 

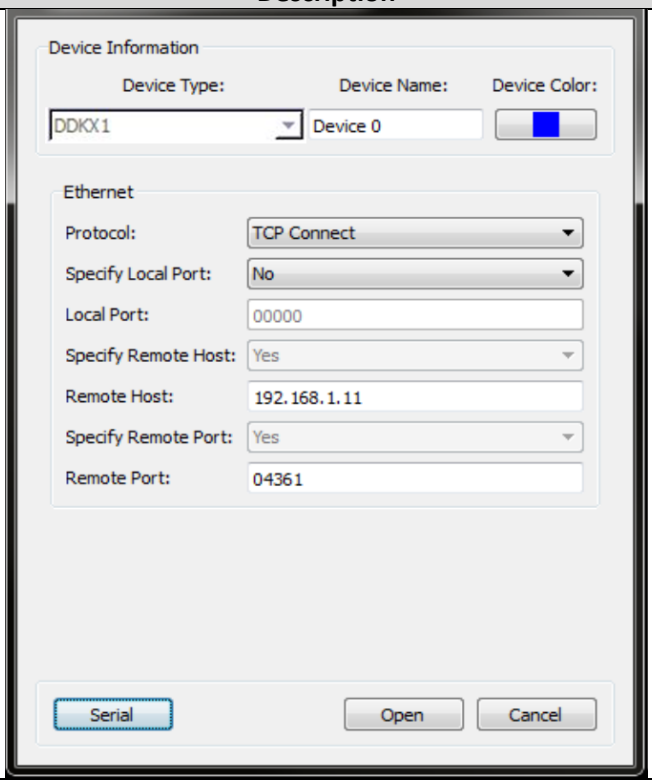
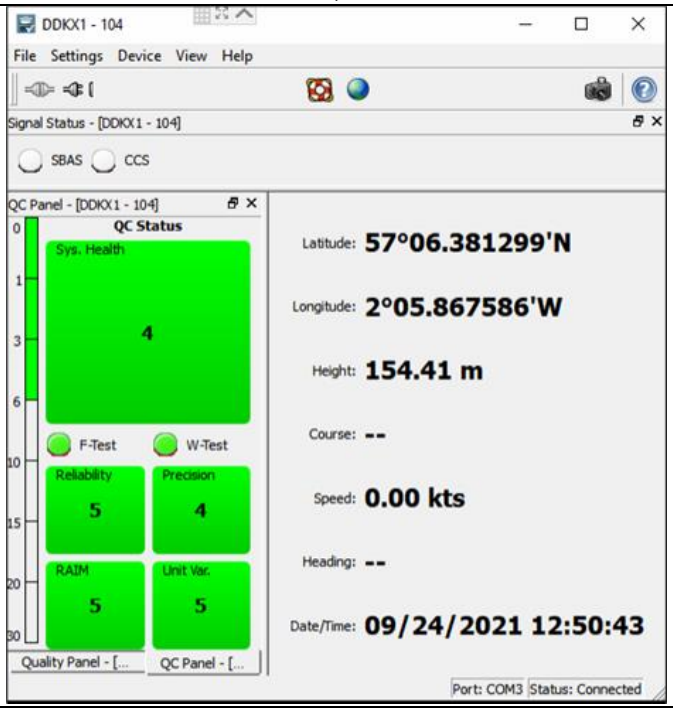
Step	Description
8	
9	Review your settings and click the "**Install"** button
10	
11	Click **"Finish"** and start to monitor and configure your DDK X1 using C-Monitor

Step	Description
12	

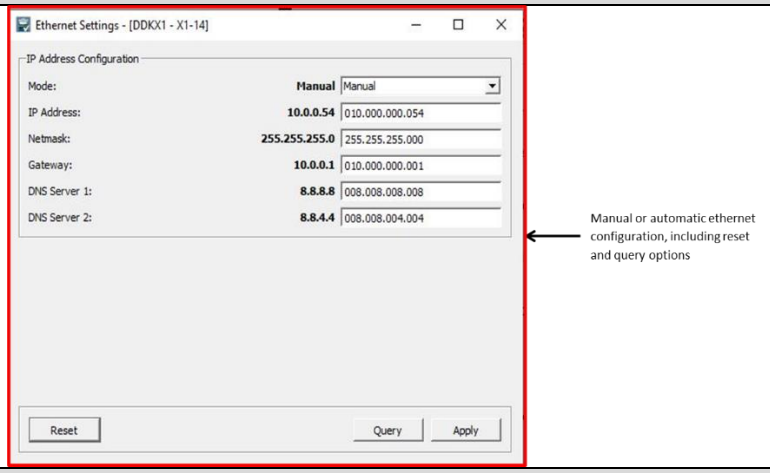
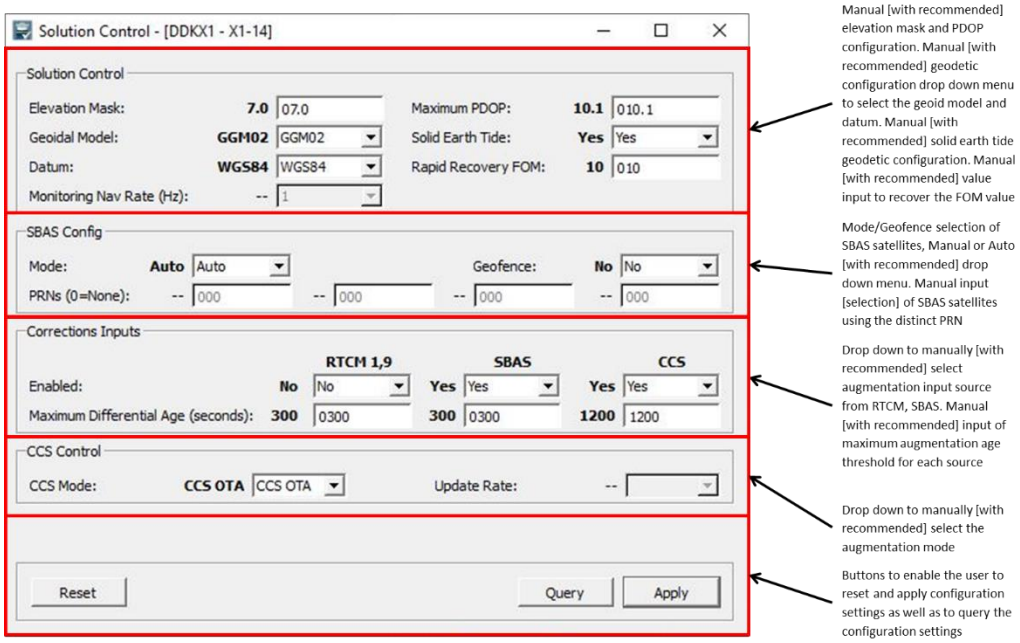
c) C-Monitor – Connecting Your C-NavX1

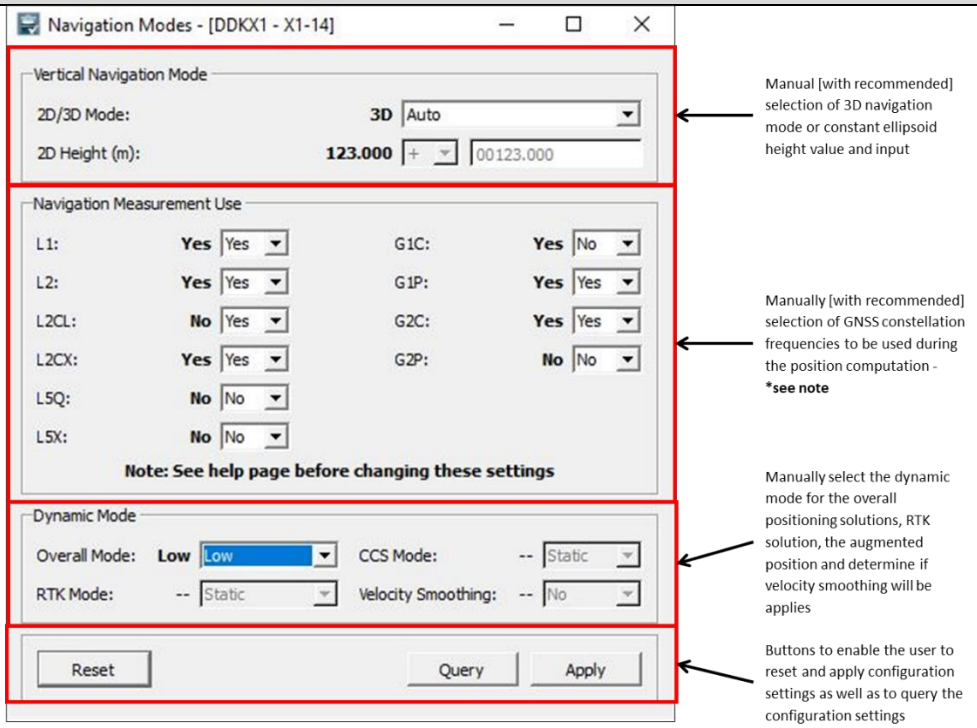
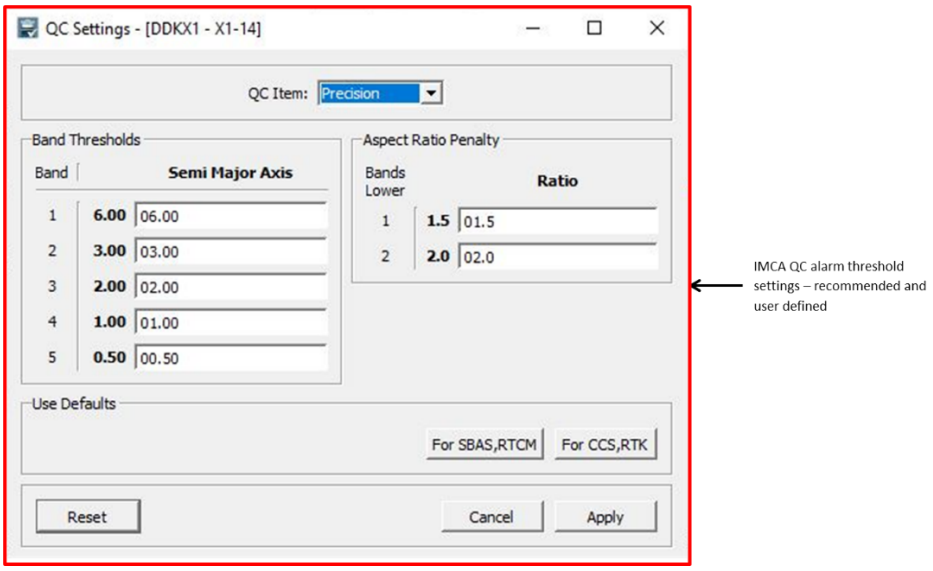
Step	Description
1	Double Click the C-Monitor icon in the Windows Start Menu to run the application
2	Click 
3	Connect your C-NavX1 to your device using one of the RS232, RS422, USB or Ethernet switches
4	Click **"File > New"** or Click  to open the Add New Device dialog pain
5	Click 
6	Using the the drop down menu select you C-NavX1 device, choose a colour for your device to identify it from other devices that are connected to your system
7	

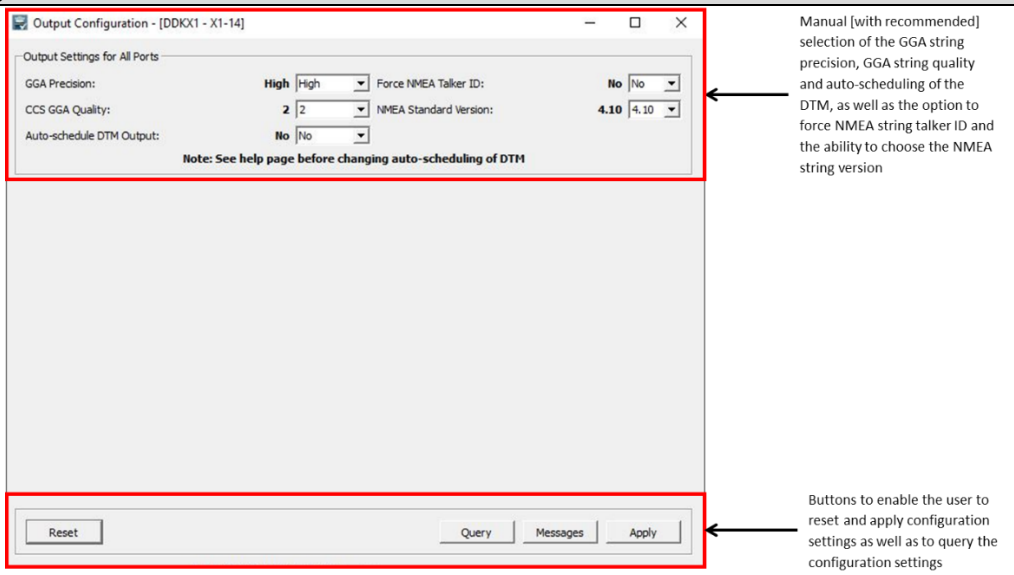
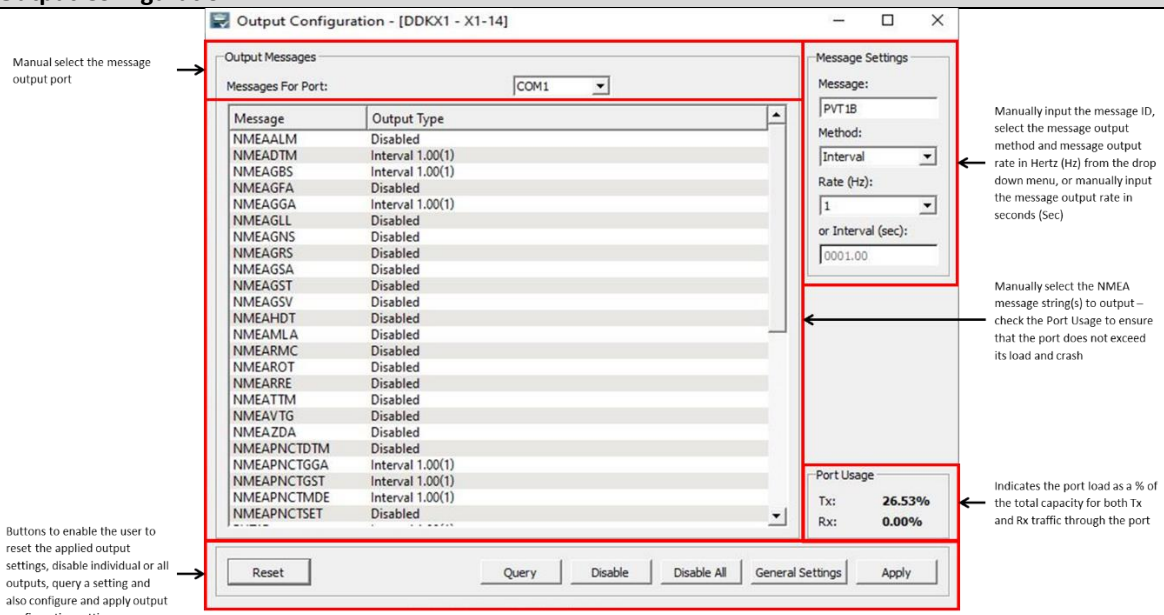
Step	Description
8	Click **"File > Connect Port"** or Click  to start configuring the communications settings
9	Click 
10	For Serial Communication – Manually Select: **Port Name, Baud Rate, Parity, Data Bits** and **Stop Bits**
11	
12	For Ethernet Communication – Manually Select: **Protocol** – Manually Input: **Remote Host [IP Address]** and **Remote Port [Port Number]**

Step	Description
13	
14	It will nominally take between two (2) to five (5) seconds to connect to the device, and additional time may be required where Auto Baud is selected.
15	When the C-NavX1 and C-Monitor are connected, the **Status Bar** will read **Connected**
16	

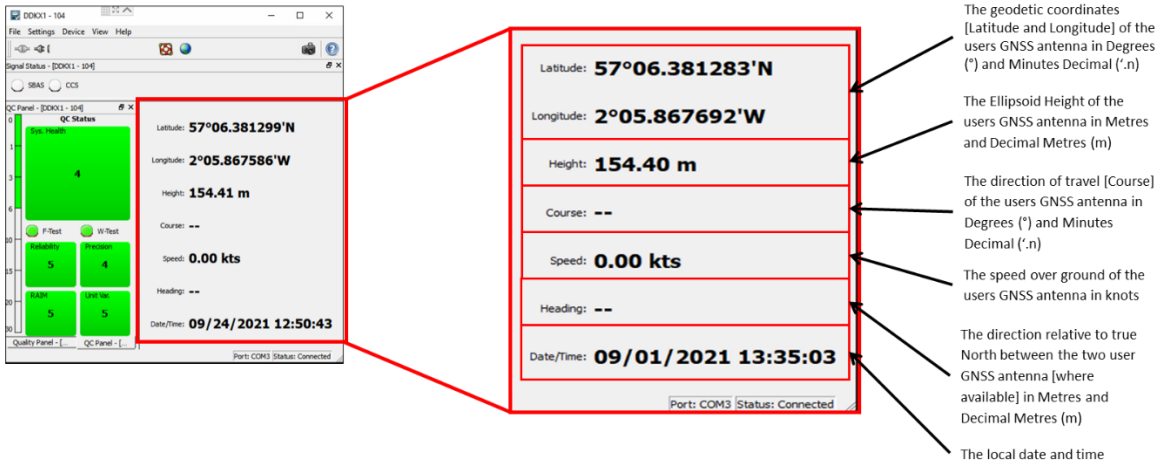
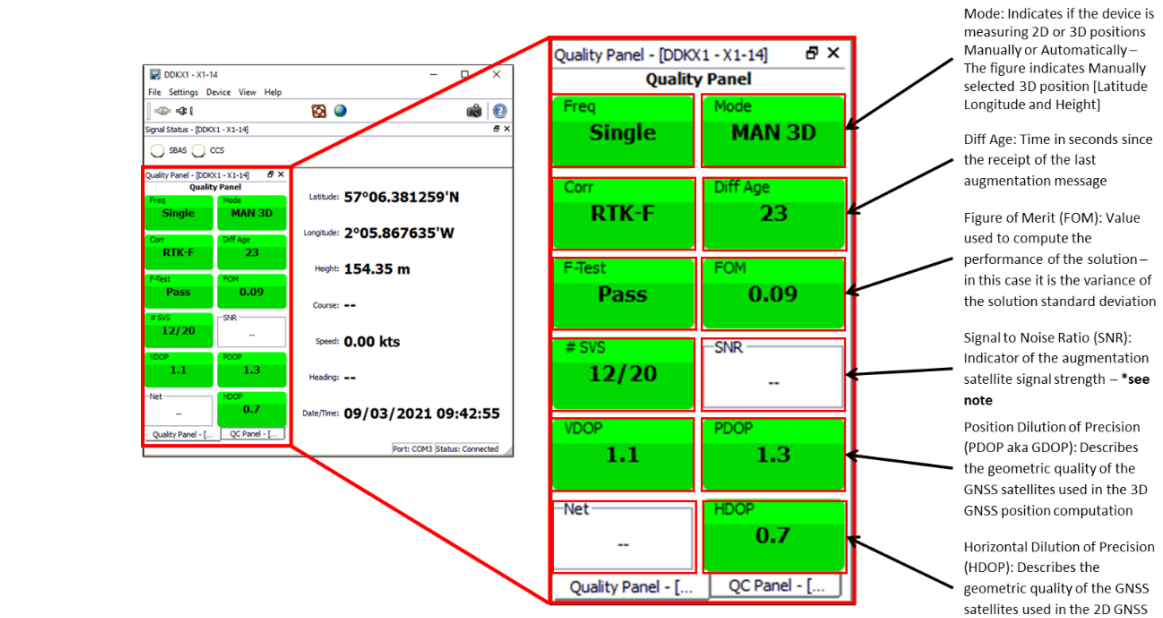
d) C-Monitor – Configuring Your C-NavX1 and Software

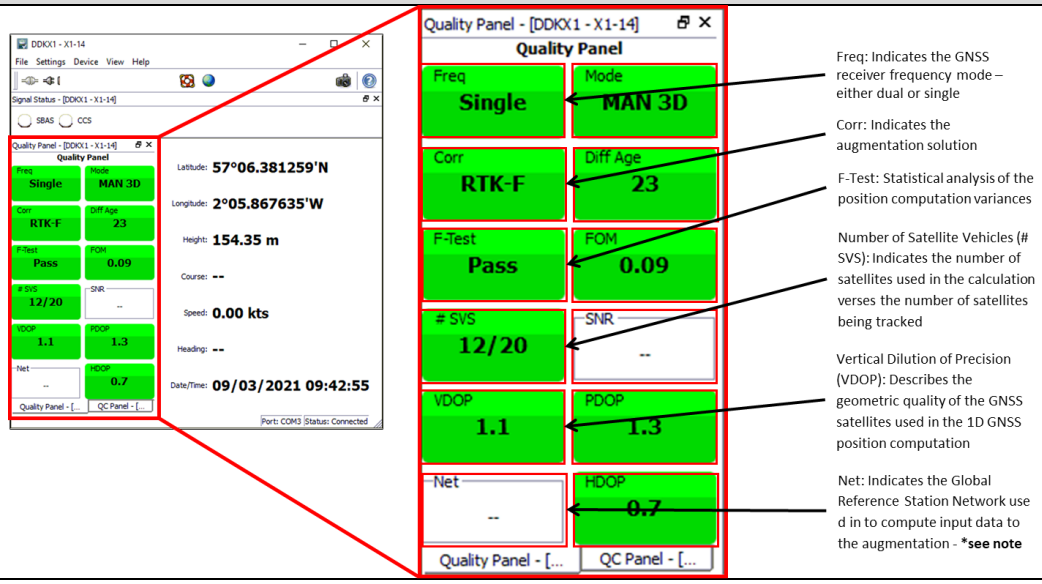
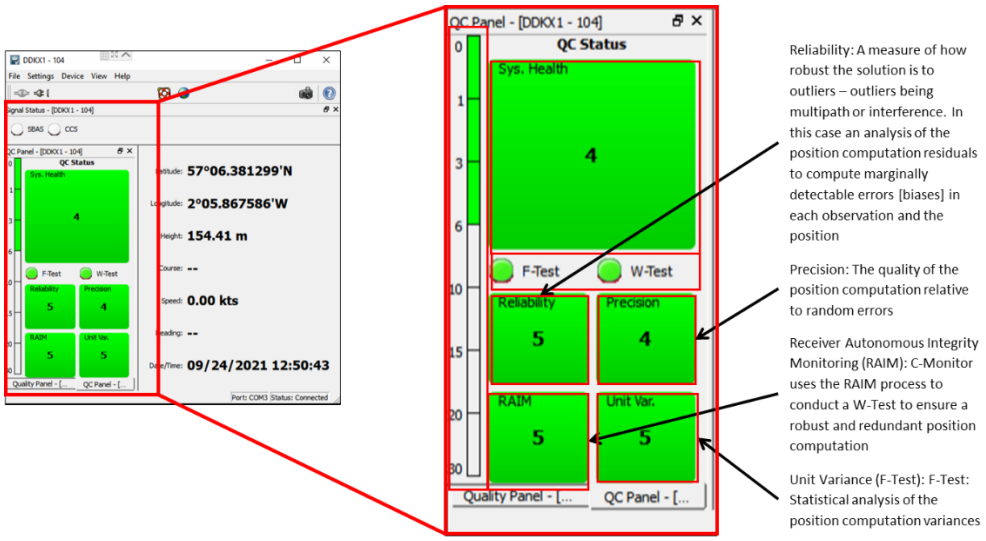
Step	Description
	The recommended settings should be used at all times if the user is not competent to change the configuration settings. If there is any doube please always contact the tech support team https://www.oceaneering.com/positioning-solutions/customer-access-and-resources/
	Ethernet Settings
1	
	Solution Control
3	

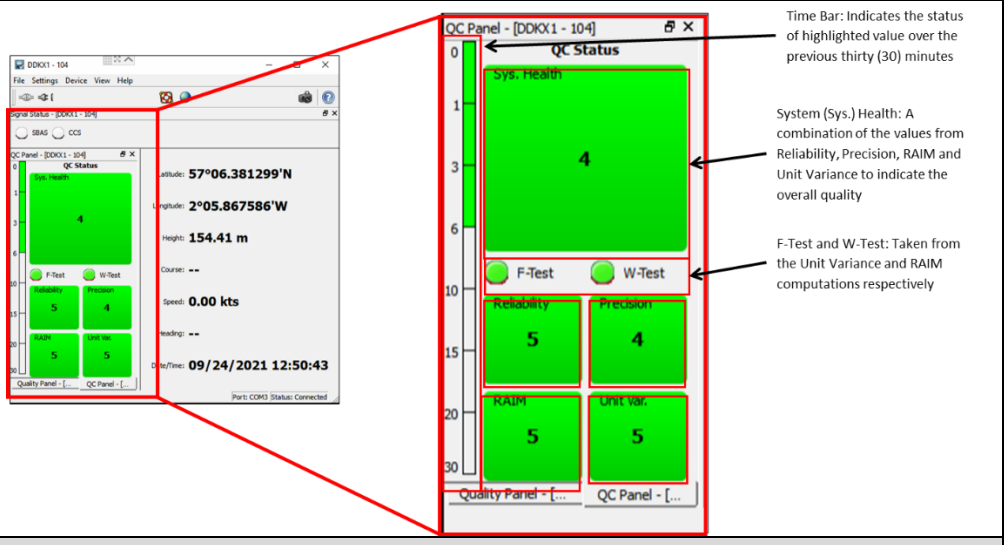
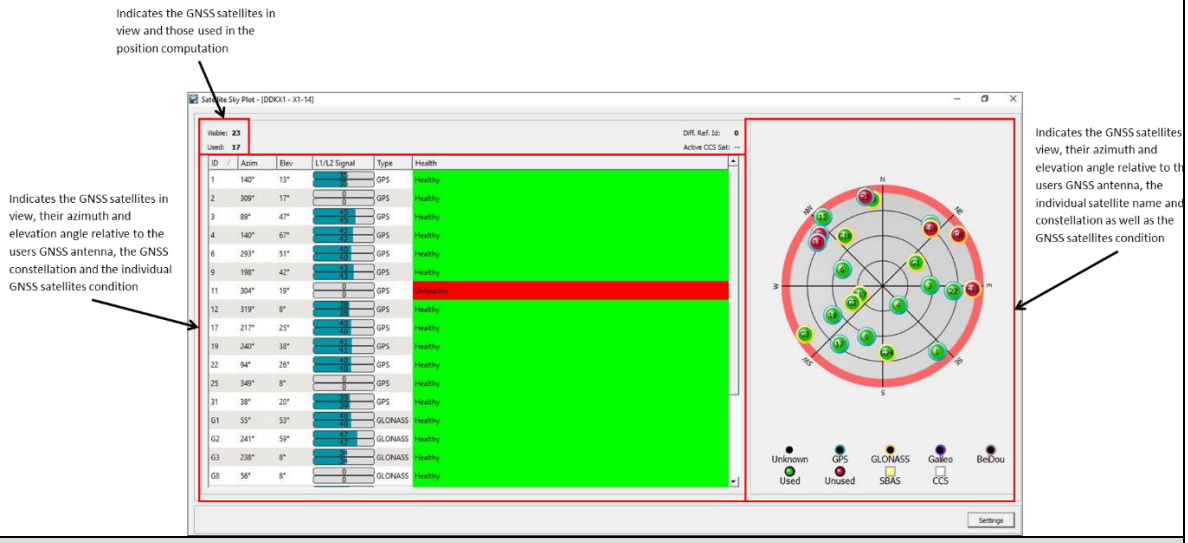
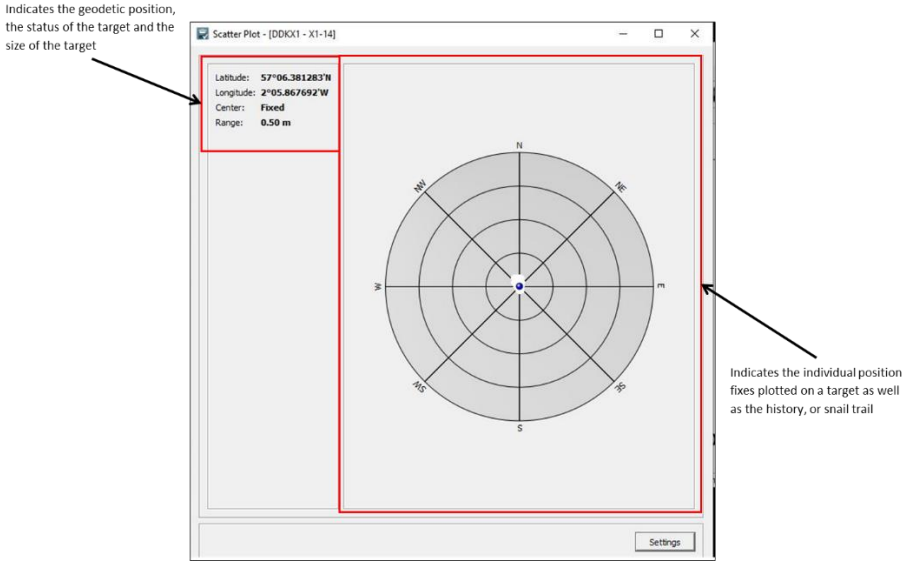
Step	Description
	Navigation Mode
5	
	IMCA QC Threshold Settings
7	

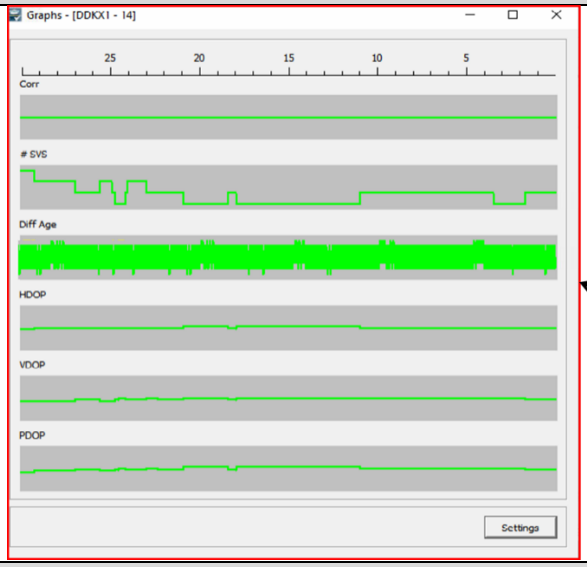
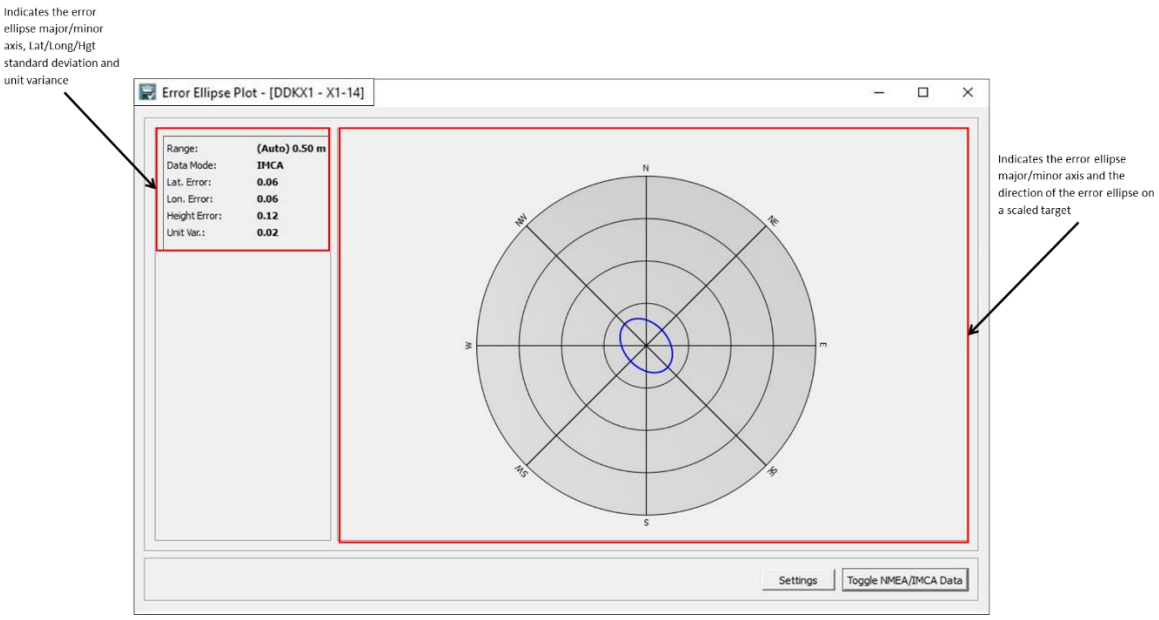
Step	Description
	Output Configuration 1
9	
	Output Configuration 2
11	

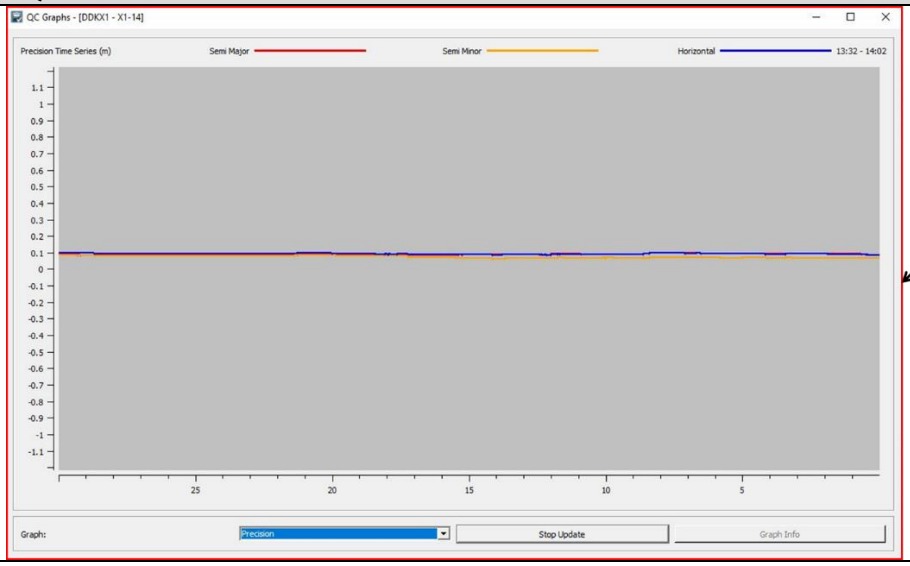
e) C-Monitor – Viewing Your C-NavX1 Status

Step	Description
	Main View
1	
	Quality Panel 1
2	
3	***Note on SNR:** Your C-NavX1 uses the Iridium LEO satellite communications network and so does not use an SNR value.

Step	Description
	Quality Panel 2
4	
5	***Note on Net:** DDK leverages two (2) global reference station networks and takes two (2) feeds from each network, with a total of four (4) feeds. The system activley chooses the highest quality feed, based on continuous testing scenarios. Therefore, the Net panel is not applicable to your C-NavX1 solution.
	QC Panel 1
6	

Step	Description
	QC Panel 2
8	
	Satellite Sky Plot
9	
	Scatter Plot
10	

Step	Description
	Quality Indicator Time Series
11	
	Error Elipse Plot
12	

Step	Description
	Satellite Calculations
13	Indicates the calculation position, elevation mask and calculation time period, as well as the age of the GNSS satellite almanacs  Time series showing the number of satellites predicted to be in view, and the predicted DOP values for the input position with the associated elevation mask
	IMCA QC Time Series
14	 Scrolling thirty (30) minute time series showing the error ellipse semi major and semi minor axis values and precision computation value, with drop down option for the remaining computation QC values such as RIAM and unit variance etc.