NORBIT

Multibeam Echosounder

User and Technical Manual

NORBIT WINGHEAD®

NORBIT WBMS

Notice
We make every effort to provide the latest technical documentation. There may be updates. For this, please contact NORBIT Support for the latest information.

Copyright Statement

Disclaimer
While every effort is made to ensure the information given is accurate, NORBIT does not accept liability for any errors or omissions. All non-metric weights and measurements are approximate. Specifications, equipment, and other information in this document are subject to change without notice.

All performance metrics mentioned in this document, such as attainable depths, was derived from tests in Portland, Oregon and Seattle/Tacoma, Washington, USA in May 2017. Acoustic conditions are described when describing performance capabilities.

Software Release
WINGHEAD: GUI 10.5.3 / FW 5.1.9
WBMS: GUI 11.3.0 / FW 5.5.93
iWBMSh Stabilised: GUI 10.5.3 / FW 5.2.0

Release Notice
This is the January 21, 2024 release of the NORBIT sonar user and technical manual.

Reference Documentation
The supporting documents listed below can be found on the USB memory stick delivered with the system. They can also be requested from NORBIT Support.

TN-180196 - WBMS Data Format Definition
TN-210082 - WINGHEAD Interface Description
TN-190018 - Tilted Sonar Head Offsets
TN-190041 - ROV/ASV/USV Integration

Contact Information
NORBIT Subsea AS
Stiklestadveien 1
7041 Trondheim
Norway

Phone: +47 739 82 569
Support: https://norbit.com/subsea/support/
Email: subsea_support@norbit.com
Web: https://norbit.com/subsea/

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Contents

Glossary of Terms, Abbreviations & Acronyms

AP+	Applanix Latest Generation INS (introduced in 2024)
ASV	Autonomous Surface Vehicle
AUV	Autonomous Underwater Vehicle
Aux	Auxiliary
Bandwidth	Range of frequency sweep
BNC	Bayonet Neil-Concelman (connector)
BSO	Backscattering Strength Output
C/A	Coarse Acquisition
CMR	Compact Measurement Record (a GNSS correction format from Trimble)
CoR	Centre of Rotation (or Centre of Gravity)
CW	Continuous Wave (single frequency)
EA	Equal Angle beam distribution
ED	Equal Distance beam distribution
FM	Frequency Modulation (swept frequency)
FPGA	Field-Programmable Gate Array
DGNSS	Differential Global Navigation Satellite System
GND	Ground
GNSS	Global Navigation Satellite System
GPS	US Global Positioning Satellites (often describes all GNSS)
GUI	Graphical User Interface
HDS	High Density Soundings
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
iSIU	Integrated SIU
iWBMSe	Integrated WBMS (with entry level SurfMaster INS)
iWBMS	Integrated WBMS (with mid-grade with WaveMaster INS)
iWBMSh	Integrated WBMS (with top level OceanMaster INS)
LED	Light Emitting Diode
N/C	No Connection
NMEA	National Marine Electronics Association
NTP	Network Time Protocol
NTRIP	Networked Transport of RTCM via Internet Protocol
PPK	Post Processed Kinematic
PPS	Pulse Per Second
ROV	Remotely Operated Vehicle
RTCM	Radio Technical Commission for Maritime Services
RTK	Real Time Kinematic
Rx	Receive
SBAS	Satellite Based Augmentation System
SIU	Sonar Interface Unit for WBMS systems
SIU-WH	Sonar Interface Unit for WINGHEAD systems
SNR	Signal to Noise Ratio
SONAR	Sound Navigation and Ranging
STX	Steerable Transmission
SV	Space Vehicle (GNSS/INS) or Sound Velocity
SVP	Sound Velocity Probe
SVT	Sound Velocity and Temperature
TTL	Transistor-Transistor Logic
Tx	Transmit
USV	Unmanned Surface Vehicle
VDC	Volts – Direct Current
WBMS	Wideband Multibeam System
WINGHEAD	WINGHEAD Multibeam System

1 Introduction

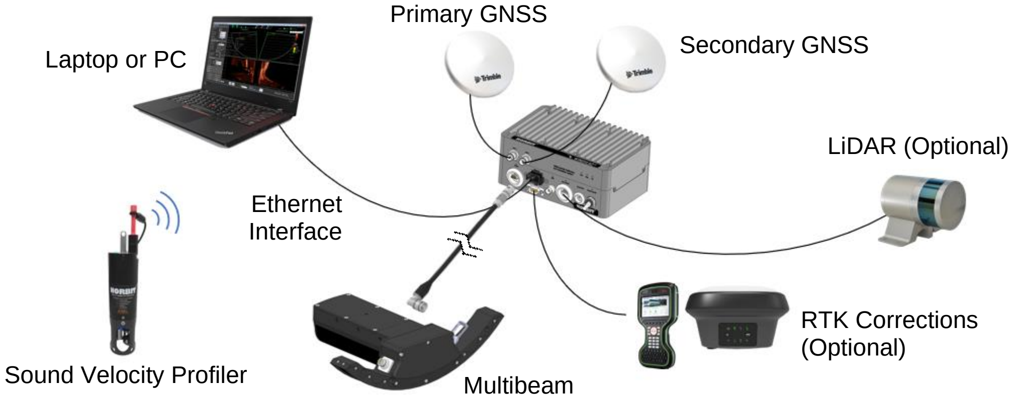
NORBIT sonars are the most compact, high resolution, wide swath multibeam sonars available. With a dry weight of less than 4.5kg (10lbs), beam widths of only 0.5° at 400kHz, and low power consumption, the stand-alone multibeam sonar easily mounts to a survey platform of any size.

NORBIT's sonar technology is unique to the industry as the first platform designed as a cylindrical array wideband system with frequency modulated (FM) transmission. From the returning signal, 256, 512 or 1024 beams are formed within a user-selectable 5° to 210° fan-shaped swath. NORBIT has implemented cutting edge signal gain compensation, adaptive gating/thresholding, steerable transmission capability, and proprietary amplitude and phase detection algorithms to achieve accurate and repeatable bottom detections.

All processing and export of time-stamped bottom detection occurs within the sonar head. The system requires very little user intervention to achieve clean and repeatable bathymetry. Hardware installation is similarly easy and quick. A single cable powers and connects the sonar to a small Sonar Interface Unit (SIU). The SIU connects to a data acquisition PC by a single Ethernet cable.

With latest FPGA circuits, integrated surface sound speed probe, and 21st century engineering, NORBIT systems provide the resolution and capabilities of much bulkier systems. Efficiency savings begin with the installation: the compact (and lightweight) form-factor enables for simpler mounting infrastructure than earlier generation box-shaped multibeam sonar systems. Low power requirements allow added flexibility on very small survey vessels as well as any vessel of opportunity.

NORBIT offers many options for a tightly integrated bathymetric mapping solution that combines all sensors required to carry-out high-grade bathymetric surveys. The integrated systems, with a complete GNSS/INS system, drastically streamline the setup process and reduces measurement uncertainties.



1.1 NORBIT WINGHEAD Series & WBMS Series

NORBIT sonars are based on a state-of-the-art analogue and digital platform featuring powerful signal processing capabilities, offering high resolution bathymetry and several imagery and backscatter outputs, ensuring the highest quality survey data performance.

The WINGHEAD series offers a receiver beam width of just 0.5º at 400kHz and is the first cylindrical ultra-high-resolution bathymetry product on the market. Both the WINGHEAD and WBMS series are available in a range of configurations, both as standalone sonars and with tightly integrated GNSS/INS systems.

NORBIT WINGHEAD®

Ultra High-Resolution Curved Array Bathymetry System

0.5 x 0.9º at 400kHz
0.3 x 0.5º at 700kHz
2.0 x 2.0º at 100kHz (Long Range Option)

NORBIT WBMS

Wideband Multibeam Sonar for High Resolution Bathymetry

0.9 x 0.9º at 400kHz (Narrow TX Option)
0.5 x 0.5º at 700kHz (Narrow TX Option)
1.8 x 1.8º at 200kHz (Long Range Option)

The table below compares the key features of the WINGHEAD series. Note that some features are license controlled. Refer to Appendix B1 for more details.

Product Name	Nominal Frequency	Beam Width Across x Along	Integrated GNSS/INS	Depth Rating	Dual Swath	Stabilisation		
						Roll	Pitch	Yaw
WINGHEAD B41	400kHz	0.5 x 0.9º		100m	✗	✓	✗	✗
WINGHEAD B41 Titanium	400kHz	0.5 x 0.9º		100m	✗	✓	✗	✗
WINGHEAD B44 Deep Sea	400kHz	0.5 x 0.9º		4500m	✗	✓	✗	✗
WINGHEAD B44 Full Ocean	400kHz	0.5 x 0.9º		6000m	✗	✓	✗	✗
WINGHEAD i77h / i79h	400kHz	0.5 x 0.9º	Applanix OceanMaster	100m	✗	✓	✗	✗
WINGHEAD B51S	400kHz	0.5 x 0.9º		100m	✓	✓	✓	✓
WINGHEAD B57S	100kHz	2.0 x 2.0º		100m	✓	✓	✓	✓
WINGHEAD i80S	400kHz	0.5 x 0.9º	Applanix OceanMaster	50m	✓	✓	✓	✓
WINGHEAD i87S	100kHz	2.0 x 2.0º	Applanix OceanMaster	50m	✓	✓	✓	✓

1.2 Advantages of NORBIT Technology

1.2.1 Advantages of the Cylindrical Array

- Unlike a flat array, bottom detections from a cylindrical array are much less susceptible to surface sound speed errors.
- Due to proprietary progressive beamforming techniques supported only by cylindrical arrays, NORBIT sonars form narrower beams than flat arrays, resulting in superior bathymetry quality.
- At all frequencies, NORBIT sonars provide increased swath coverage with a smaller beam footprint for a fixed aperture.
- The cylindrical array of the NORBIT sonars can cover a full 210°. Flat array systems would lose data fidelity at much lower swath angles (± 80°) and would necessitate mounting two or three sonars at angles to achieve higher swath coverage.
- The cylindrical array presents a more hydrodynamic profile allowing for faster transit, less vibration, and use of lighter mounting hardware. Sturdier mounting, such as hull mounts, enables a maximum transit speed of >20 knots.

1.2.2 Advantages of the Integrated INS

Factory integration of critical sensors provides several benefits. Offsets between the sonar and inertial navigation system are fixed and predefined within the system setup. The user need only measure the offset to the bottom of the primary GNSS antenna.

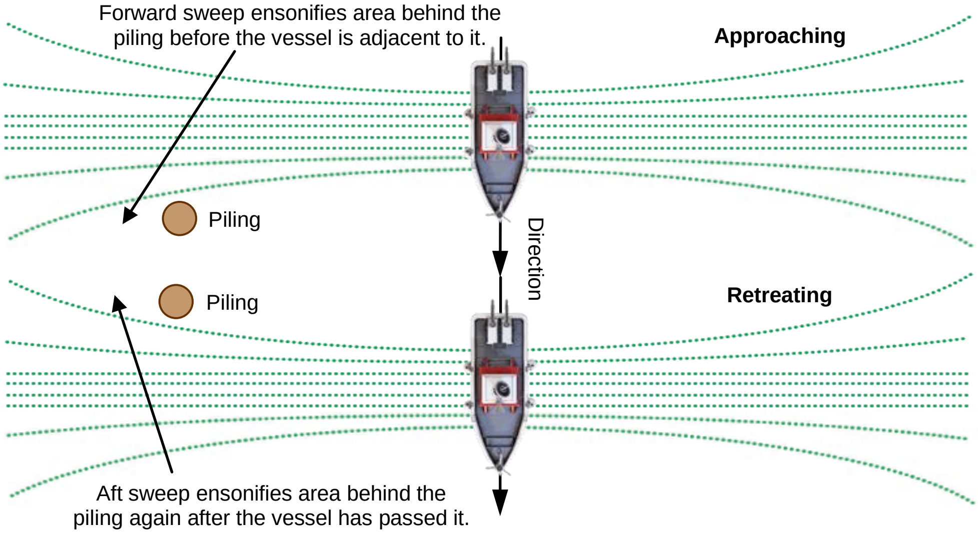
Cabling and software integration between the sonar, positioning, heading, attitude and sound speed probe is handled internally. The onboard surveyor need only connect the wet end to the topside via a single cable and then connect the primary and secondary GNSS cables (which are each labelled on both ends of the cable to remove installation uncertainty).

1.2.3 Advantages of Steerable Transmission

NORBIT WINGHEAD “S” series, iWBMSh Stabilised and WBMS STX models have steerable transmission functionality, which brings several new features to the user. The STX scanning feature allows the transmit beam to be directed ±10° in a scanning pattern, providing a revolutionary new data deliverable. On some models, steerable transmission enables Dual Swath (higher sounding density, or increased survey speed, by transmitting multiple pings simultaneously), as well as active pitch (and optional yaw) stabilisation to compensate for vessel motion, providing uniform sounding density.

In its most basic configuration, the STX scanning feature allows the system to ensonify areas that otherwise would not be. This functionality aids inspection surveys by giving a more complete picture of the survey area or target. Additionally, it can be used to capture extra detail on complex structures, such as shipwrecks, during a single pass.

STX scanning can be activated by the user at any time. The user defines a step size, and each step angle occurs with each ping. The time to complete a full scan depends on the current ping rate, for example a ping rate of 20Hz, and a step size of 20, means 1 second per scan.



STX scanning can be used for many applications, including obstacle avoidance, dredge monitoring, and cable lay operations. It can be mounted in any orientation to change the scanning pattern. For example, a 90° rotation in heading and upward tilt allows the sonar to scan a ±10° sector ahead of the vessel.

The special STX 360 configuration integrates the STX with a rotator to provide 360° real-time coverage from a static platform. This provides rapid and efficient dredge monitoring compared to conventional methods, since no sailing is required.

1.3 System Specifications

While continual improvements are being implemented, specifications may change. To obtain the most current specification sheets please visit https://www.norbit.com/subsea/

1.4 Export, Shipping Weight & Dimensions

Each standard NORBIT system is shipped in a single, lightweight Pelican case that meets airline baggage guidelines. Refer to the NORBIT website for shipping weights and dimensions.

Airline Checked Luggage: Despite the rugged freight case construction with dense form-cut foam shock absorption, it is prudent to handle the full cases with care. Please ensure an airline “Fragile” label is prominently displayed.

Airline Carry-On Baggage: The sonar case may be hand-carried onto many airplanes but when checking through airport security it is often required to remove the sonar from the case for x-ray.

1.4.1 ITAR Restrictions

All systems are free of Canadian and EU export controls. NORBIT recommends DHL as a preferred shipper when shipping internationally. All shipping documents from the USA should quote:

- ECCN **7A994** classification number for all integrated systems (containing an integrated GNSS/INS) e.g. WINGHEAD i77h, iWBMS, iWBMS Long Range, iWBMS STX, etc.
- ECCN **6A991** classification number for all non-integrated systems (i.e. not containing an integrated GNSS/INS) e.g. WBMS, FLS, WINGHEAD B41, etc.

1.5 Technical Support

NORBIT operates an online helpdesk that is monitored 24/7. The global hotline is also available for urgent matters. Please refer to section 7 before contacting NORBIT Support.

To raise a support request or request an RMA, visit the NORBIT helpdesk to register an account. Select “Technical Support” and complete the form. Each ticket is assigned a unique ID (NSS-XXXX) which must be included in the email subject if replying to the ticket from a regular email client. A support engineer will be assigned to your case and will contact you shortly.

Please include as much information as possible when contacting NORBIT Support:
- Your name and organisation.
- NORBIT system model, serial number and software versions.
- Detailed description of the problem or request, including photos of the installation if relevant.
- Relevant screenshots, error messages and system logs (see section 4.8.6.4)
- For INS faults and general data quality issues, include the relevant Applanix logs, which can be found at: *C:\Users\<user>\Norbit\WBMS\Applanix Logs*
- Data samples if relevant. Raw data recordings from the GUI should include water column data (ensure that WC Resolution is set under Backscatter Controls and displayed on the wedge.)

When emailing NORBIT Support directly, a ticket and account will automatically be generated for you. To access the ticket, select the “Forgot your password” link to reset your password.

NORBIT Subsea AS
Stiklestadveien 1
7041 Trondheim
Norway

Email: subsea_support@norbit.com
Support: https://norbit.com/subsea/support/
Phone (GMT): +47 739 82 569 (For 24/7 support)
Phone (US Time): +1 929 2667 248
Phone (APAC): +65 65 457 155

2 Hardware Installation

For well-seasoned multibeam users, the quick start in Appendix A1 can be used. All first-time NORBIT sonar operators, however, are strongly encouraged to fully review this manual prior to commencing a survey project. The warning boxes may not cover all critical notices.

⚠ **NOTE:** For subsea ROV/AUV and USV installations, please consult TN-190041 for detailed technical guidance as well as critical safety notices. This document can be obtained from NORBIT Support.

2.1 Power Requirements

NORBIT sonars require clean, continuous power for reliable operation. Please refer to the requirements below for AC and DC power options and refer to the datasheets on the NORBIT website for power consumption values.

2.1.1 AC Power

As most vessels use an inverter to provide continuous power, it is important that it be **a true sine wave inverter**. A modified sine wave inverter may cause unexpected behaviour, even when using the included power brick (PN 23008). Use high quality inverters to provide power.

In general, inexpensive inverters are likely modified sine wave. “Dirty” power input may produce unexpected behaviour such as data loss, system reboots or damage to the electronics. Connecting the system directly to a 12-24VDC battery can be done to confirm, as well as using an electronics scope to monitor AC power.

Note that for some configurations (e.g. dual head WBMS from a single SIU-I-NAV), the 220W power brick (PN 23008-P220) is required.

2.1.2 DC Power

Additionally, power can be provided directly from a 12-24V deep cycle battery using the included pigtail that plugs into the power port on the SIU. The SIU will accept 12-24V DC power. Thick wires should be used to avoid voltage drops. Use two 12V batteries in series so that the voltage drop is not significant. DC voltage spikes above 29V may cause damage to the system.

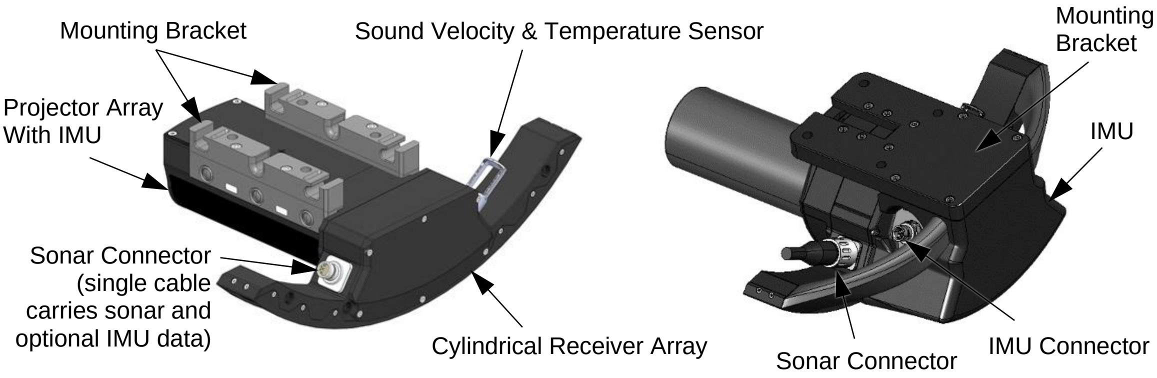
2.2 Wet-End Overview

NORBIT can provide 3D models of transducers, in the STEP file format, to support your installation plan. For such requests, please contact NORBIT Support.

⚠ **CAUTION:** The wet-end connection must be properly sealed. Inspect the O-Ring before connecting the wet-cable and replace as needed. Apply a thin coat of synthetic grease (e.g. Molykote 55) to O-Rings. Hand-tighten the wet-connector (push in and tighten until firmly connected). If it sticks, apply a **THIN** coat of grease to the threads, but **NOT** to the pins.

2.2.1 WINGHEAD

The WINGHEAD sonar is available in several configurations, depending on the frequency, INS and pressure-rating requirements, to suit all application needs. Refer to Appendix C4 for details on the optional fairing. When handling the unit, do **NOT** support it by the SVT or strictly by the projector.



Standard WINGHEAD

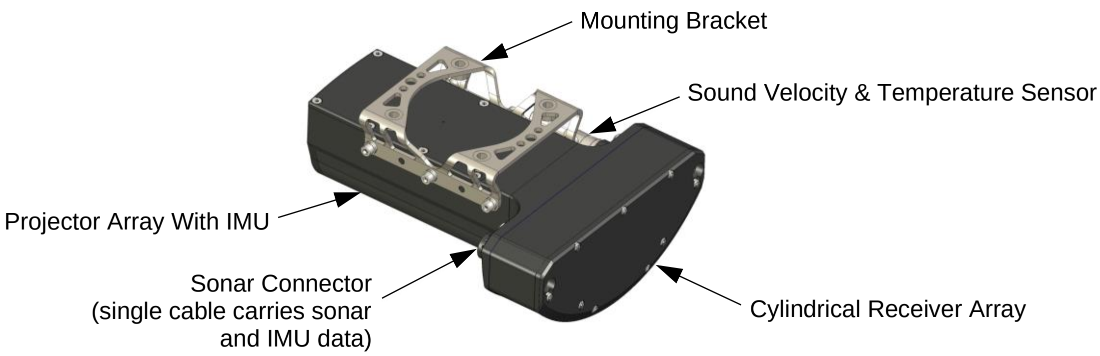
WINGHEAD Stabilised System

Integrated models feature an IMU housed inside the projector, resulting in a very compact form factor. On WINGHEAD Stabilised systems, the IMU is located inside the front enclosure. The systems are optionally available with POSPac MMS for full positioning and attitude PPP or PPK solutions.

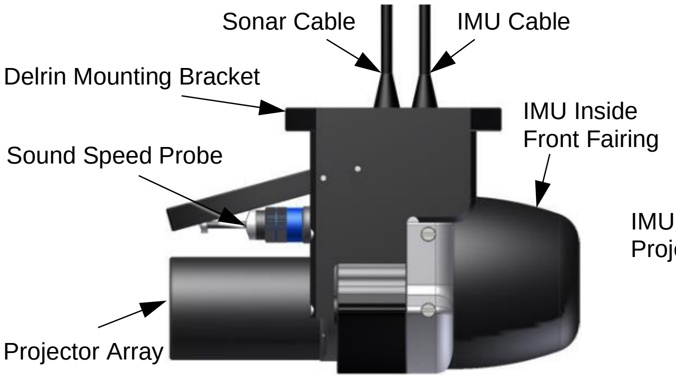
2.2.2 WBMS Integrated Systems

Integrated WBMS systems contain OEM versions of the Applanix GNSS/INS systems. The systems are optionally available with POSPac MMS for full positioning and attitude PPP or PPK solutions.

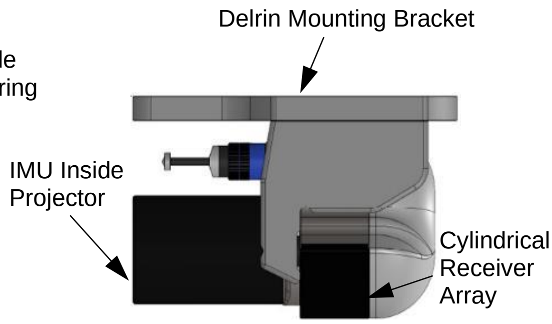
The IMU on iWBMSh Stabilised and iWBMSe models is housed inside the projector, resulting in a very compact form factor. For other models, the IMU is housed inside the front fairing of the wet-end assembly.



iWBMSh Stabilised



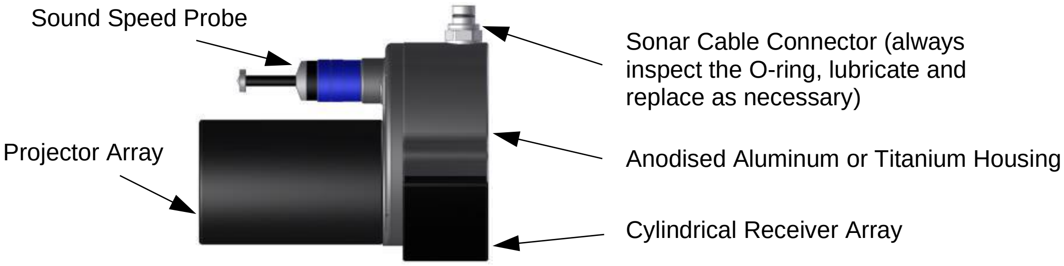
iWBMS or iWBMSh with standard 1.9°projector



iWBMSe with standard 1.9°projector

2.2.3 WBMS

The WBMS is the most basic model of the WBMS series, containing only a sonar. The receiver housing contains FPGA boards where all sonar processing occurs.



WBMS with standard 1.9°projector

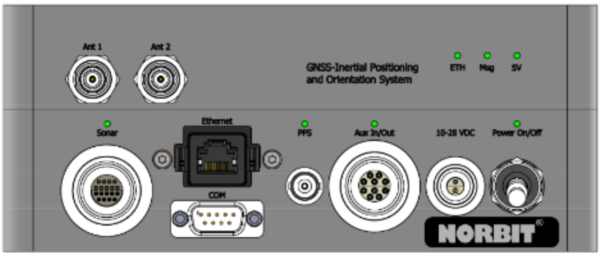
2.3 Dry-End Overview

All NORBIT systems include a compact topside Sonar Interface Unit (SIU) which distributes power, time information and data between the sonar wet-end and the survey acquisition system. This environmentally sealed fan-less topside is dust-proof and splash resistant. The SIU will shut down automatically at 70°C to prevent damage to electronics due to overheating.

⚠ **CAUTION:** The COM (DB9) and PPS connections on the SIU are not rated for voltages higher than 5V. Exceeding this limit could damage the system. Check all potential connections for unexpected voltages.

⚠ **CAUTION:** When operating in open environments, all connection ports on the SIU should be tightly sealed either with the NORBIT supplied cables or, if the port is unused, with the port covers provided with the system.

2.3.1 WINGHEAD Integrated Sonar Interface Unit (iSIU-WH, PN 29060 / 29093)



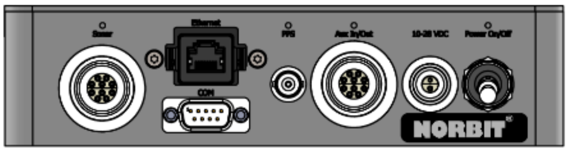
Connector	Description
Sonar	18-pin interface to sonar and integrated IMU
Ant 1	Primary GNSS antenna
Ant 2	Secondary GNSS antenna
COM (Serial)*	GNSS corrections input (RTK/DGNSS) and GNSS/INS NMEA output.
PPS	1PPS output for external sensor (not typically used)
Ethernet	For communication between topside PC and sonar (SAMTEC Part No. RCE-01-G-05.00-D)
Aux In/Out	10-pin interface for communication with auxiliary devices (iLiDAR) and Trigger In/Out. Refer to section 2.3.5 for more details.
10-28 VDC	Input DC voltage. Refer to section 2.1 for power requirements.

* NORBIT offers a split serial option, which allows ASCII/Binary output of GNSS/INS information for up to 3 serial connections. Refer to Appendix B2 for more information.

Note 1: PN 29093 contains the Applanix AP+ GNSS/INS subsystem, whereas PN 29060 contains the legacy Applanix subsystem.

Note 2: This model is also used for iWBMSh Stabilised systems.

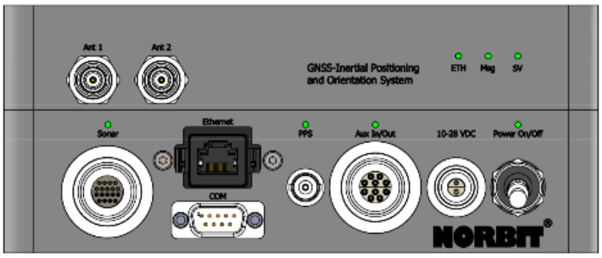
2.3.2 WINGHEAD Sonar Interface Unit (SIU-WH, PN 29064)



Connector	Description
Sonar	10-pin interface to sonar
COM (Serial)	NMEA ZDA timing input
PPS	1PPS input for timing
Ethernet	For communication between topside PC and sonar (SAMTEC Part No. RCE-01-G-05.00-D)
Aux In/Out	Trigger In/Out. Refer to section 2.3.5 for more details.
10-28 VDC	Input DC voltage. Refer to section 2.1 for power requirements.

Note: This model can also be combined with PN 29093 / 29060 for dual head configurations with iWBMSh Stabilised systems. Refer to section 2.7.1 for more details.

2.3.3 WBMS Integrated Sonar Interface Unit (SIU-I-NAV, PN 29028)

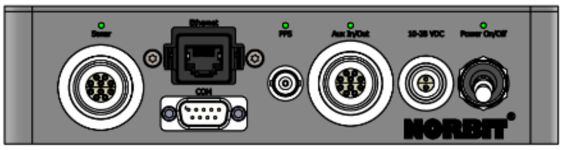


Connector	Description
Sonar	18-pin interface to sonar and integrated IMU
Ant 1	Primary GNSS antenna
Ant 2	Secondary GNSS antenna
COM (Serial)*	GNSS corrections input (RTK/DGNSS) and GNSS/INS NMEA output.
PPS	1PPS output for external sensor (not typically used)
Ethernet	For communication between topside PC and sonar (SAMTEC Part No. RCE-01-G-05.00-D)
Aux In/Out**	10-pin interface for communication with auxiliary devices (iLiDAR or additional sonar for dual head), and Trigger In/Out. Refer to section 2.3.5 for more details.
10-28 VDC	Input DC voltage. Refer to section 2.1 for power requirements.
Fuse Socket	12A slow blow on rear of unit. Rev 5 and later has a 20A internal fuse.

* NORBIT offers a split serial option, which allows ASCII/Binary output of GNSS/INS information for up to 3 serial connections. Refer to Appendix B2 for more information.
** To run dual head from one SIU-I-NAV, revision 5 or later is required. See section 2.7.2 for details.

The STX model, in bathy mode, may be coupled to another NORBIT sonar to form a dual-head system for increased coverage and faster results. However, due to the STX's higher power requirements, a dual-head system compromising at least one STX requires two topside units.

2.3.4 WBMS Sonar Interface Unit (SIU, PN 29024)



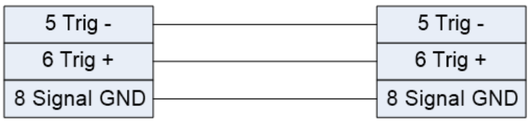
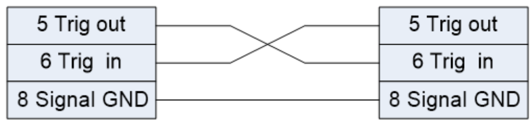
Connector	Description
Sonar	10-pin interface to sonar
COM (Serial)	NMEA ZDA timing input
PPS	1PPS input for timing
Ethernet	For communication between topside PC and sonar (SAMTEC Part No. RCE-01-G-05.00-D)
Aux In/Out	Trigger In/Out. Refer to section 2.3.5 for more details.
10-28 VDC	Input DC voltage. Refer to section 2.1 for power requirements.
Fuse Socket	6A slow-blow on rear of unit. Rev 5 and later has a 20A internal fuse.

This SIU works with all WBMS Bathy, STX and FLS systems. The iWBMSe requires an 18-pin to 10-pin adaptor.

2.3.5 Aux In/Out Port & Triggering

The 10-pin Aux port on the integrated SIU allows users to expand NORBIT sonar capabilities by integrating additional sensors. For the full pin description, refer to Appendix D. The Aux port can connect to an additional sonar to operate in a traditional bathymetric dual head configuration, or else an obstacle avoidance configuration with one sonar looking forward and one looking down. The Aux port can also communicate with the NORBIT iLiDAR to simultaneously collect multibeam and topographic data.

Pins 5 and 6 can be used to trigger to or from an external sensor (e.g. sidescan sonar or DVL) to avoid interference. The trigger input is TTL 5V compatible.

<table>
<tr><th>WINGHEAD and iWBMSh Stabilised Models</th><th>WBMS Models</th></tr>
<tr><td>The trigger uses RS-422 in a half-duplex mode, i.e. the same pair can receive synchronisation, or transmit it, depending on the designation. If synchronising with another WINGHEAD sonar, pins 5 and 6 should be wired pin to pin with the corresponding unit's SIU Aux port. NORBIT cable PN 33249 can be used to achieve this.

</td>
<td>The signal is RS-232, with the trigger output available on pin 5, and reference signal ground on pin 8. If synchronising with another WBMS sonar, the trigger signal should go to pin 6 of the corresponding Aux port on the second SIU and vice versa. NORBIT cable PN 33143-C can be used to achieve this.

</td></tr>
</table>

Additional Notes:

- The output trigger is sent 3300µs before the centre of the following transmit pulse.
- The default delay from the incoming trigger is 3300µs to the centre of the next transmit pulse.
- NORBIT has developed a standard trigger cable solution (PN 33403, standard length 1m) for WINGHEAD and iWBMSh Stabilised models which converts the RS-422 trigger output from the SIU to a 5V TTL output on a BNC cable. Contact NORBIT Support to enquire about this option.

2.3.6 LED Status Indicators

Indicator	Pattern	Description
Sonar LED	Steady Green Blinking Green (Short Blink 1Hz) Blinking Green (Long Blink 1Hz) Blinking Green (5Hz) Off	Sonar Pinging Sonar Stand By Sonar Booting Sonar Over Current Failure Sonar Off
PPS LED	Blinking Orange (1Hz) Blinking Orange (5Hz) Steady Orange Off	Sync/Timing OK No Sync, NMEA Missing No Sync, PPS Missing No Sync, NMEA and PPS Missing
Aux In/Out LED	Off	LED not currently in use (status always off)
Power On/Off LED	Steady Green Blinking Green (5Hz) Off	Input Voltage OK Input Voltage <10v or >28V No Input Voltage
ETH	Blinking Green Off	INS established valid Ethernet connection No INS Ethernet connection
Msg*	Blinking Green Off	INS receiving RTK corrections No RTK corrections
SV*	Blinking Green Off	INS detecting satellite vehicles No satellite vehicles detected

** Not supported on AP+ models.*

2.4 Sensor Mounting

The sonar must be mounted with the transmitter (projector) pointing aft, so that the receiver is measuring in the quietest, least turbulent water for best SNR. Mount the sonar in-line with the keel or centreline of the survey platform and parallel to the water surface, ideally to within about 0.5°.

It is best practice to feed the sonar cable through the mounting pole to protect against vibration or flotsam collision. Ensure connectors are always clean and dry and that pins are not bent. If there are any hazards that may expose cables to abrasion, use a chafing guard to protect it by adding rubber tape around the cable at the point of concern.

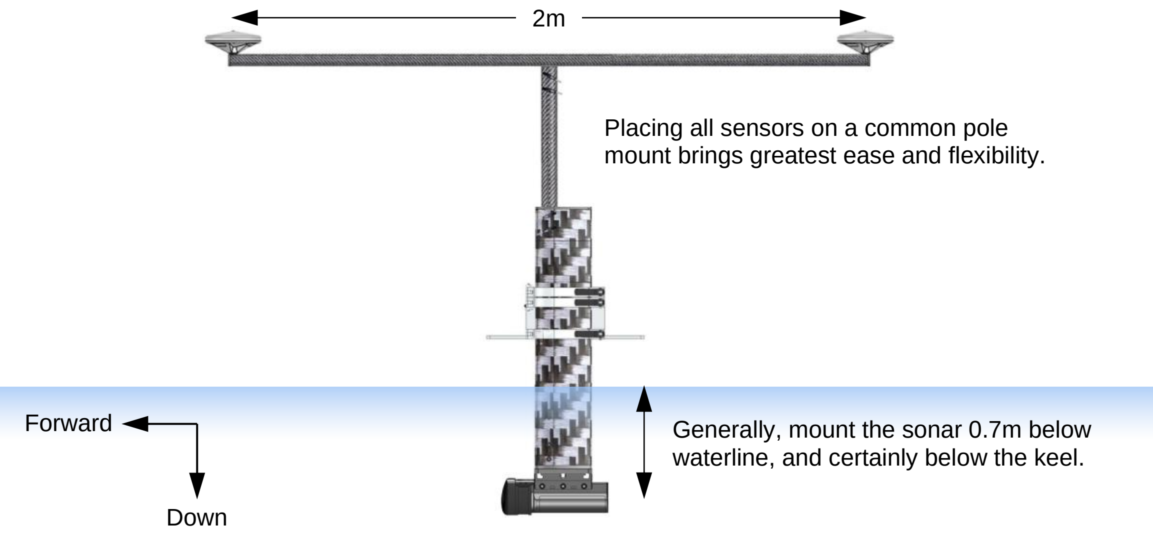
CAUTION: The cables are **NOT** wet-mateable. Only connect cables to the connectors when dry. Use compressed air to ensure that they are clean and dry, and **DO NOT** apply grease to the pins.

Care should be taken when routing sensor cables so as not to damage the equipment. It is advised to keep bends in the cables to a minimum and to avoid kinks, twists or cable stretching. Avoid pinching the cables in windows, doors, and other equipment. Cables should be secured to avoid excess movement or prevent wear on the cable sheath. Long cables should be kept away from power sources and separated from itself (not coiled tightly and placed in a corner) to avoid electrical interference.

NORBIT sonars have been tested at a transit speed of 20 knots without damage to the system. If not performing a survey, it is best to transit with the sonar out of the water to protect the system from physical damage from flotsam.

2.4.1 Sonar Mounting Location

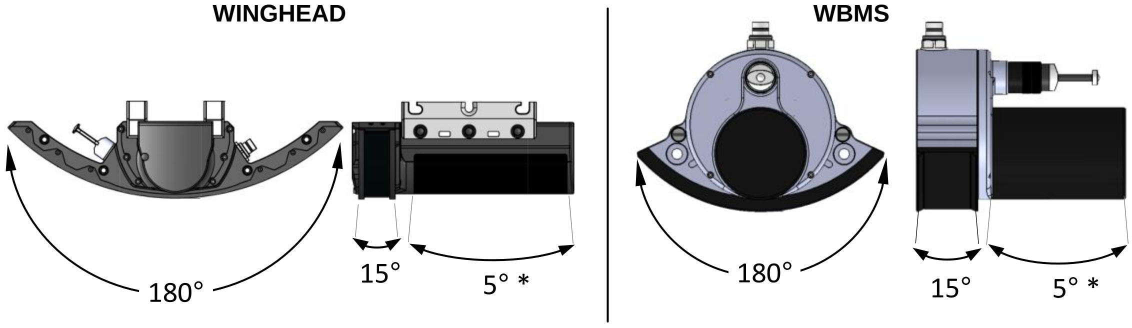
The Sonar Reference Point should be clear of the lowest part of the hull to avoid reflections from the hull and water surface. Additional sonar draft may be required depending on the characteristics of the vessel hull which may create bubbles during vessel motion, especially as the sea state worsens. It is critical that the sound speed sensor on the NORBIT sonar has clean bubble-free water.



2.4.2 Acoustic Clearance Zones

In general, the area around the sonar should be kept clear and unmasked to minimise the chance of acoustic reflections and blocking in both the across-track and along-track directions.

To achieve 210° across-track coverage (e.g. for lock surveys) the receiver must have 210° clearance. This is not always possible on pole mount installations, however as a minimum it is recommended that the sonar is level with the vessel keel so that full seabed coverage can be achieved on both sides. Therefore, for normal seabed coverage, 180° clearance is required. If the user wants to take advantage of the ability to measure above horizontal, the clearance angle should be extended up to above the required field of view. The **minimum** clearance zones for normal seabed surveys are shown below.



* 30° for Stabilised models

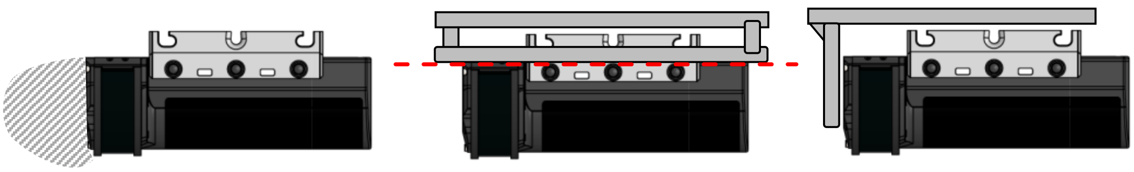
For subsea (ROV/AUV) or other complex mounts, it is not always possible to achieve the minimum along-track clearance for the projector. It should be noted that objects within the minimum angle can cause reflections or echoes, especially acoustically bright surfaces, therefore the widest possible along-track clearance should always be sought.

2.4.3 Sonar Protection

If the vessel is operating in shallow waters, and there is danger of collision with objects, protection should be considered. The INS nose cone on integrated WBMS sonars acts as a fairing, however this, or the sonar alone, could be protected by a larger fairing which extends slightly below the front of the sonar for additional protection.

A bullbar or cage assembly could also be placed around the sonar. The height of the bar should not be lower than the edges of the receiver array to maintain the necessary acoustic clearance. The cage must be **absolutely rigid** with respect to the sonar and must not generate excessive drag. If vibration is induced, it can negatively impact the integrated INS performance.

An alternative option is to add one or more knives protruding down in front of the sonar. However, knives can introduce turbulence which affects acoustic performance, so it should not have a large cross section and the number of knives should be kept to a minimum, e.g. 1 or 2.



Extended Fairing Example

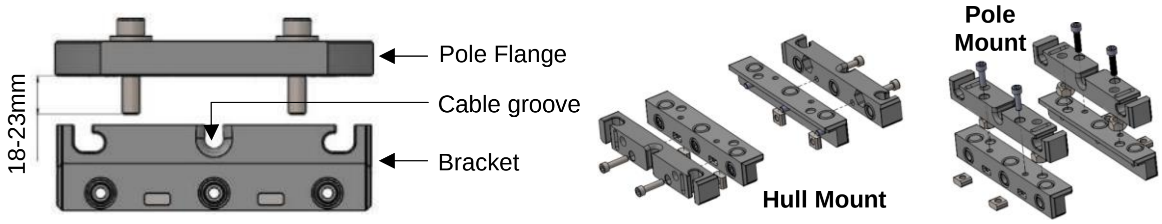
Cage Assembly

Knives

2.4.4 WINGHEAD Mounting Instructions

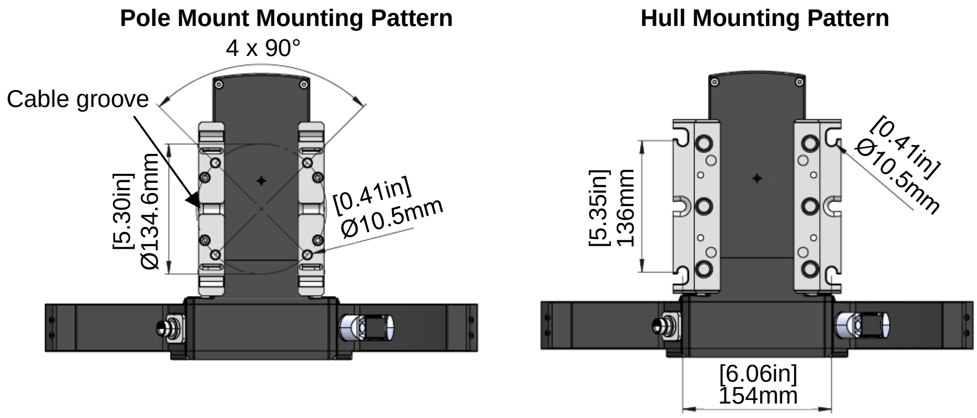
2.4.4.1 Standard WINGHEAD Systems

By default, the two bracket sections are oriented vertically for pole mount installations. Secure the sonar using 4 M10 bolt screws, inserting the screws from the top into the lock nut inserts contained within the brackets. The screw length should be 18-23mm longer than the thickness of the mounting flange. All systems are provided with M10x20, M10x30 and M10x40 bolts (4 of each) to accommodate most installations. For long term mounting, use an anaerobic thread adhesive such as Loctite 242 Blue (do **NOT** use anything stronger) to prevent the screws from loosening.



(Tighten M6 bracket bolts to 5Nm torque)

The pole should have a minimum internal diameter of **5.8cm** to allow the connector to pass through. Secure the cable in the groove at the centre of the bracket, as indicated below.



The brackets can be oriented in the horizontal direction for hull mount installations, except for WINGHEAD B44 models (see section 2.4.7). In this configuration, up to 6 bolts can be used to secure the sonar.

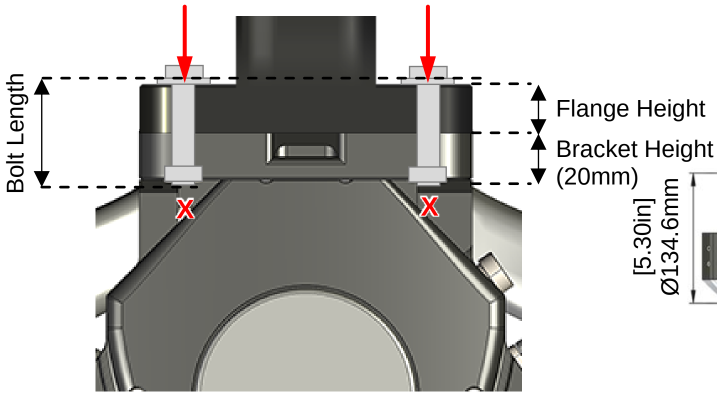
2.4.4.2 WINGHEAD Stabilised Systems

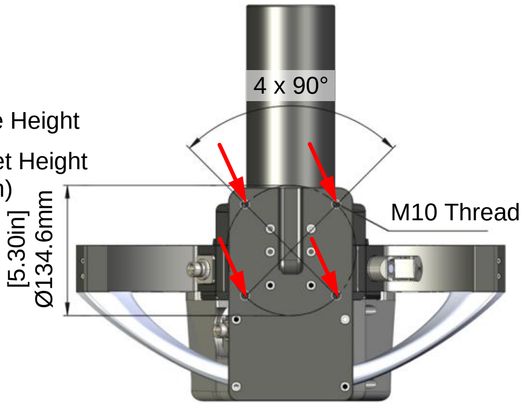
The sonar is secured by bolting down 4 M10 bolt screws from the top of the bracket, into the captive Nyloc nuts contained within the bracket. The mounting hole pattern is identical to regular WINGHEAD systems (see section 2.4.4.1).

The bolts should not protrude more than 5mm below the sonar mount, ensuring it does not dig into the material of the sonar body. The correct shank length for the securing bolts should be:

Sonar Bracket Height (20mm) + Mounting Flange Height + Washer Thickness

If the bolt is slightly longer than required, the length can be padded out with extra washers to take up the length. When the sonar is mounted on the NORBIT PORTUS pole, the required length is 20mm + 20mm + 1-2mm, therefore M10x40mm bolt screws are suitable.



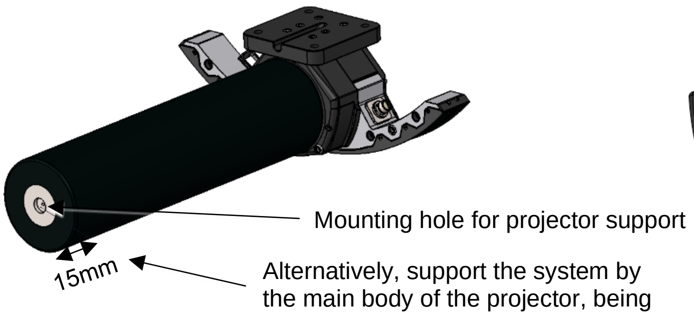


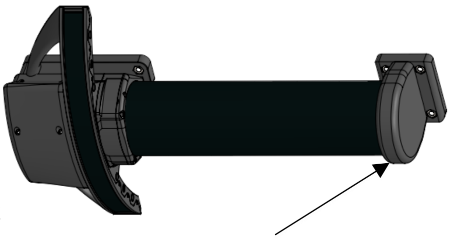
For long term mounting, use an anaerobic thread adhesive such as Loctite 242 Blue (do **NOT** use anything stronger) to prevent the screws from loosening. The pole should have a minimum internal diameter of **5.8cm** to allow the connector to pass through.

CAUTION: Cables should be securely fixed to prevent vibration and damage. NORBIT suggests using steel flatbar or rodding for routing, plus hosepipe (or similar) as sheathing. Jubilee clips or band-it as the primary securing method is recommended. If the cable is secured directly by metal clips, add protection between them to prevent cuts, e.g. rubber or hosepipe.

WINGHEAD Long Range Stabilised systems include an additional bracket on the aft edge of the projector to support its weight (see Appendix C3). If the standard bracket is not used, it is essential to support the weight of the projector by either:

- Using the internal mounting hole (indicated on the diagram below) to attach it to a supporting structure on the vessel.
- Support the projector on its cylindrical surface. The support must only cover the first 15mm (measured from the aft edge) to ensure that it does not block the active array.



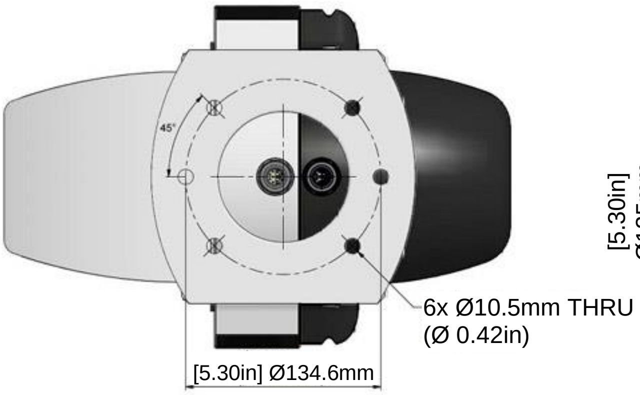


2.4.5 WBMS Mounting Instructions

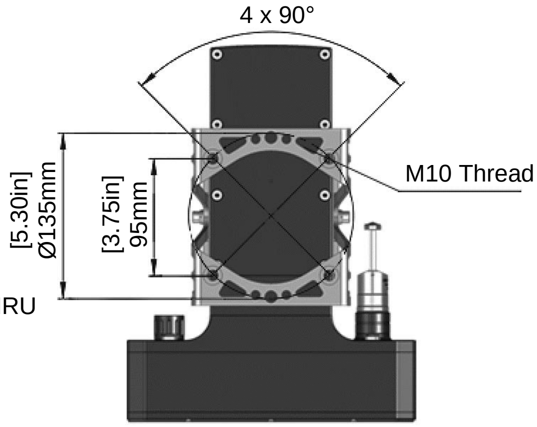
2.4.5.1 iWBMS Integrated Systems

For iWBMSh Stabilised systems, secure the sonar using 4 M10 bolt screws and spring washers, inserting the screws through the top of the bracket into the threaded holes. Ensure that the screws do not protrude below the bracket such that they come into contact with the projector. Use high-quality stainless-steel bolts.

For all other integrated WBMS systems, use at least 4 bolts (2 forward and 2 aft) made of high-quality stainless steel to prevent corrosion, especially in saltwater environments. Use a lock washer and/or an anaerobic thread adhesive such as Loctite 242 Blue to prevent loosening of sonar during long deployments. The bolt hole pattern shown is applicable for all integrated iWBMS systems.



iWBMS with standard 1.9°projector
(Bracket PN 35021)

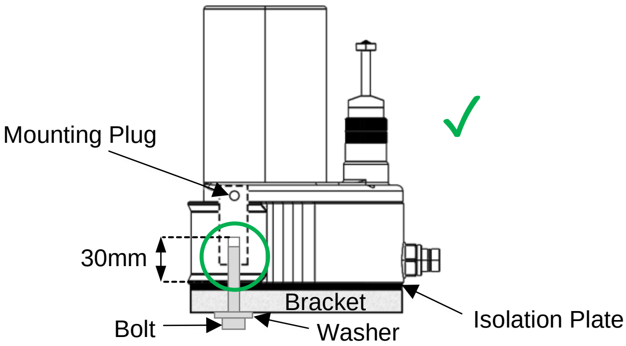


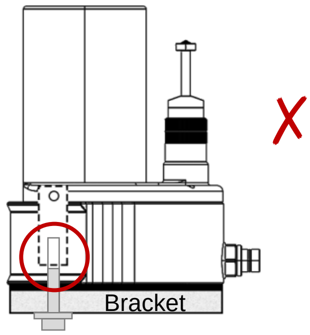
iWBMSh Stabilised

CAUTION: The mounting bracket requires that wet-end cables be run through the top centre opening of the bracket. If the mounting pole is a pipe (recommended), its minimum inner diameter should be **5.8cm**. The iWBMSe requires the pole be centred over the single connector.

2.4.5.2 WBMS Standalone Systems

The bolts that secure the sonar to the pole/bracket should be 30-35mm longer than the thickness of the mounting bracket and made of high-quality stainless steel to prevent corrosion, especially in saltwater environments. Use a lock washer and/or an anaerobic thread adhesive such as Loctite 242 Blue to prevent loosening of sonar during long deployments.





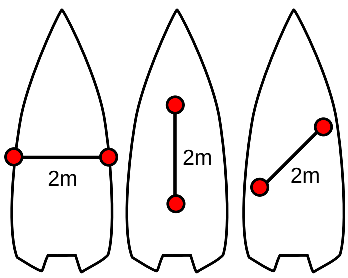
CAUTION: It is important to electrically isolate the sonar from metal boats to prevent corrosion. If using a custom-built sonar mount, use a non-conductive plate to electrically isolate the sonar.

2.4.6 GNSS Antenna Installation

Integrated NORBIT systems are supplied with 2 Trimble 540AP GNSS antennas as standard, which are mounted by screwing onto 5/8” UNC threads. Only the supported antenna models, shown below, should be used. Both antennas must have a clear view of the sky to the horizon so that every satellite can be continuously tracked without obstruction. The mountings should be free from vibration and rigid with respect to each other and the IMU. Note that the maximum recommended antenna cable length is 30m, as longer lengths cause signal degradation.

Antenna:	Trimble 540AP	Trimble 382AP	Trimble GA830	Trimble Zephyr 3 Rugged
L1 Phase:	58mm from base	66mm from base	88mm from base	84.3mm from base of bracket 58.9mm from base of antenna

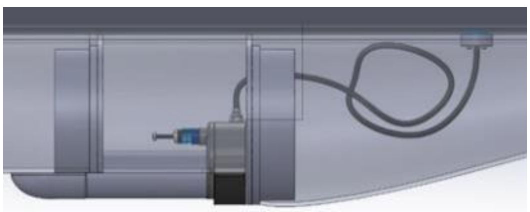
The Primary Antenna (Antenna 1) should be closest to the IMU so that offset measurement errors are minimised. The Secondary Antenna (Antenna 2) should be a fixed distance from Antenna 1, with 2m separation recommended. Longer separation increases heading accuracy, but also increases the possibility of independent movement between the antennas which degrades performance. The antennas should be positioned parallel to the water surface to within 2-3cm.

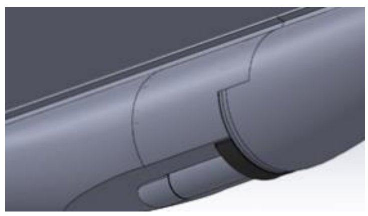


While the antennas may be oriented in any direction horizontally, it is good practice to orient them to be parallel or perpendicular to the vessel centreline.

2.4.7 Hull Mounted Systems

NORBIT sonars can be permanently hull-mounted to a vessel for operations that do not require the system to be portable. Examples of hull-mounted assemblies are shown below. The sonar pod must be carefully designed to prevent formation of bubbles and to allow water to flow over the SV sensor.





To enquire about NORBIT’s complete hull-mounted design and installation service, please contact NORBIT Support.

CAUTION: On permanent hull-mount installations, it is essential to support the weight of the projector. This should be considered during the installation design phase.

2.5 Standalone System Interfacing

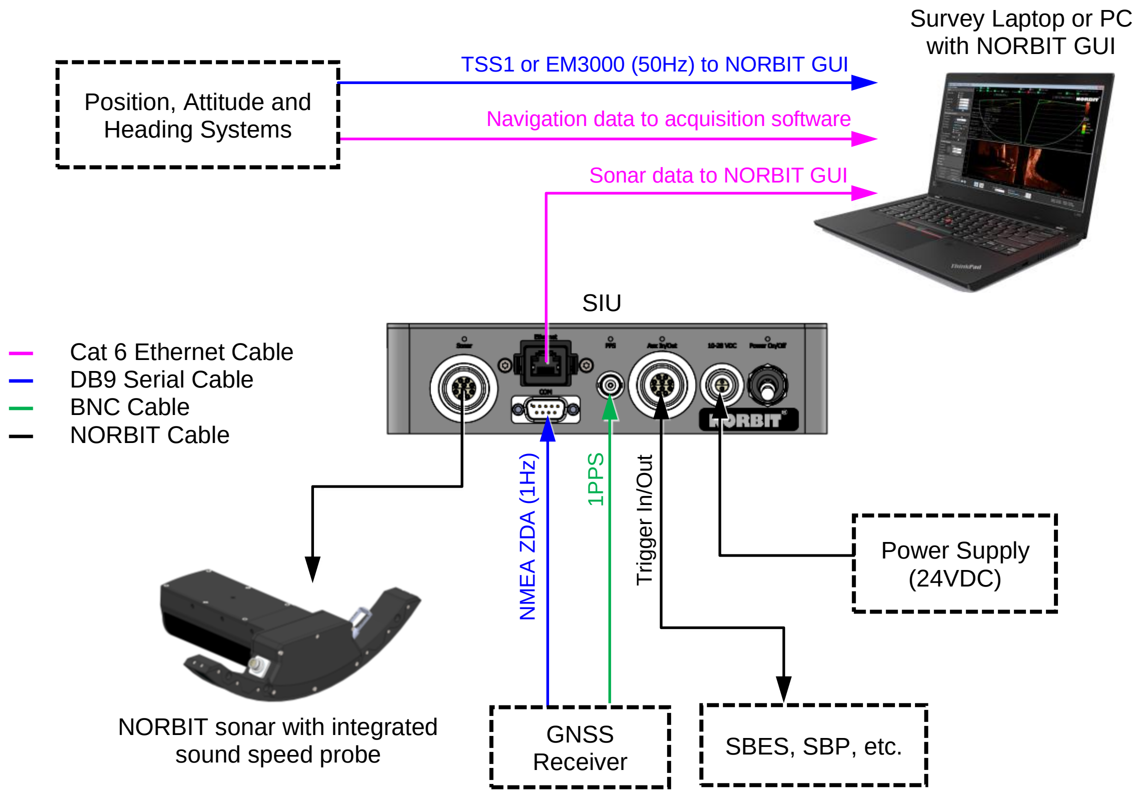
Standalone NORBIT sonars, which do not include integrated GNSS/INS subsystems, should be interfaced to the data acquisition PC along with external navigation sensors which provide position, heading, motion and timing data. While the precise configuration may differ based on the sensors employed, the essential requirements on the sonar side remain consistent:

- The sonar requires a NMEA ZDA and 1PPS input from a GNSS receiver for sonar time synchronisation (refer to section 2.6 for more details).
- For active roll stabilisation (and pitch and yaw, where supported on certain models), motion data should be interfaced to the PC or laptop which runs the NORBIT GUI. The accepted formats are TSS1 and EM3000, and high update rates of at least 50Hz are recommended. Refer to section 4.6.8 for more details.

Optionally, external sensors such as single beam echosounders and sub-bottom profilers can be triggered to (or from) using the Aux In/Out port on the SIU to avoid signal interference by ensuring synchronised transmission. Refer to section 2.3.5 for more details.

If the PC or laptop does not have multiple network ports, a network switch should be used. Otherwise, the sonar Ethernet cable can be connected directly to the PC.

A general interfacing diagram is shown below for standalone systems. Consult the manuals of your chosen ancillary sensors for details on configuring the required outputs for the sonar.



2.6 Time Synchronisation

Timing is crucial for synchronising signals from the sonar, GNSS and IMU. See section 4.8.5 for details on how to configure the timing method in the GUI. Note that only standalone NORBIT sonars (non-integrated) require a PPS & NMEA ZDA hardware input, since all integrated NORBIT systems receive timing from the internal GNSS card. The system can handle baud rates from 4800 to 115200 and will have no problem maintaining sync with other NMEA messages output on the same port as the ZDA+PPS. The input baud rate is automatically detected at startup, therefore if the baud rate is changed, the SIU must be rebooted. Ensure that the baud rate is fast enough to allow throughput of all strings.

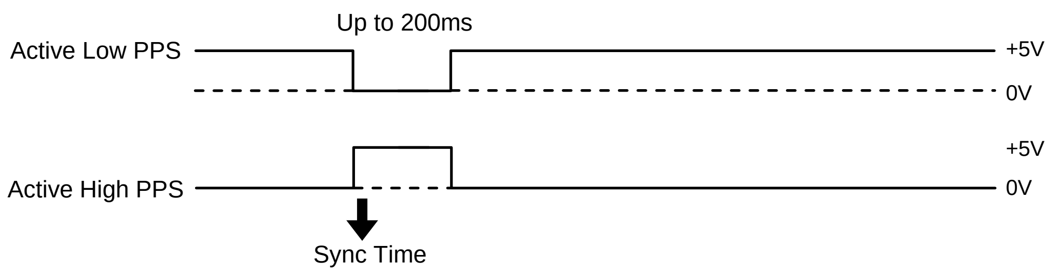
The PPS can be input in two ways:

- To the BNC “PPS” connector on the SIU
- To the Serial “COM” DB9 connector on the SIU (pin 9 for pulse & pin 5 for ground)

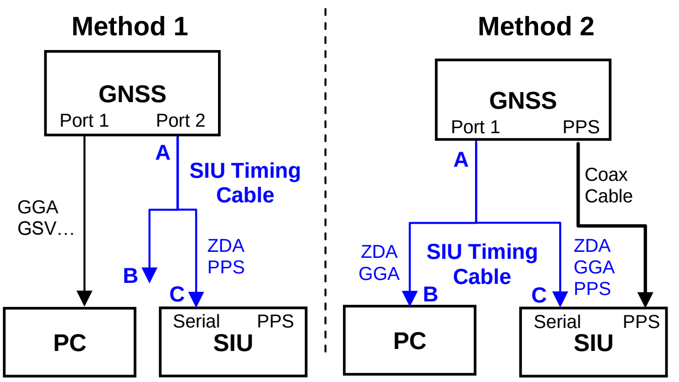
The PPS signal can be either active low or active high. The SIU synchronises to the falling edge of an active low signal, or the rising edge of an active high signal. The voltage on the PPS should not exceed 5V.

For standalone models, the SIU should receive a PPS TTL input at 3.3V (5V tolerant). The SIU can autodetect a negative or positive PPS input and has $\pm$15kV ESD protection, $\pm$60V fault protection. Integrated GNSS/INS NORBIT systems can output a (positive or negative configurable) PPS TTL signal at 5V. However, it is **NOT** fault protected and is rated for a maximum absolute voltage of 6V.

CAUTION: The integrated versions of the SIU **output** PPS pulses on the PPS port. It is not an input. Attaching an active PPS cable to this port will damage the internal electronics and void the warranty.



The included DB9 timing cable should be used to interface a GNSS for timing. It splits the signal so that both the survey computer and SIU can be connected to the same GNSS port.



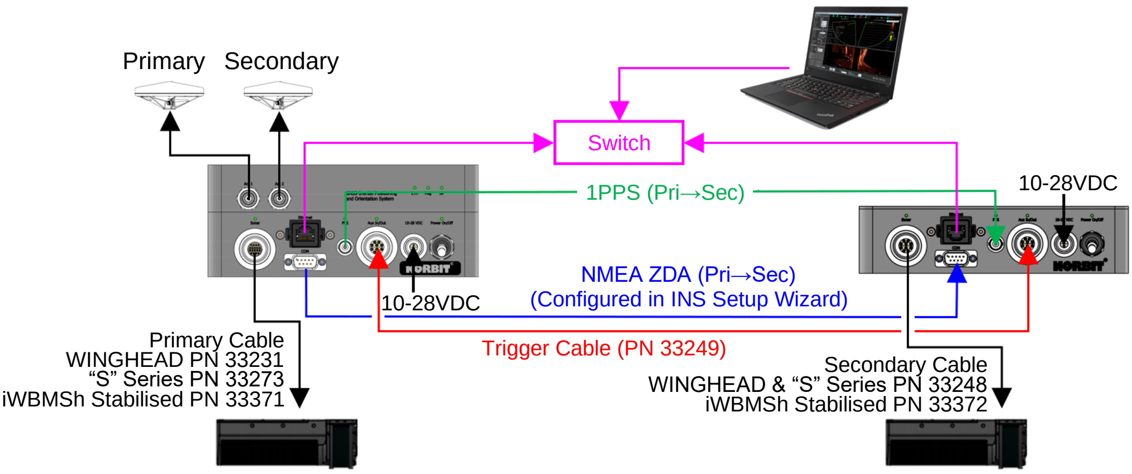
Timing Cable Pinouts			
A	**B**	**C**	**Description**
1	1	1	N/C
2	2	2	Transmit Data (from GNSS)
3	3		Receive Data (to GNSS) e.g. for NTRIP
4			N/C
5	5	5	Ground
6			N/C
7			N/C
8			N/C
9	-	9	PPS (from GNSS)

2.7 Dual Head

NORBIT sonars can be mounted in the standard dual-head brackets, or alternatively each sonar can be attached to a single-head bracket. For more details, refer to Appendix A2.

2.7.1 WINGHEAD and iWBMSh Stabilised Configurations

To run dual head with integrated INS, one iSIU-WH (PN 29093 or 29060) and one SIU-WH (PN 29064) is required. Timing is supplied (ZDA and 1PPS) from the iSIU-WH to the SIU-WH with a null modem cable. In addition, the WINGHEAD Trigger Cable (PN 33249) is required for synchronisation. Alternatively, two iSIU-WH and the trigger cable can be used, however the secondary system must have at least one GNSS antenna connected to provide timing to the sonar, and the IP address of the secondary INS must be changed to avoid conflict with the primary system.

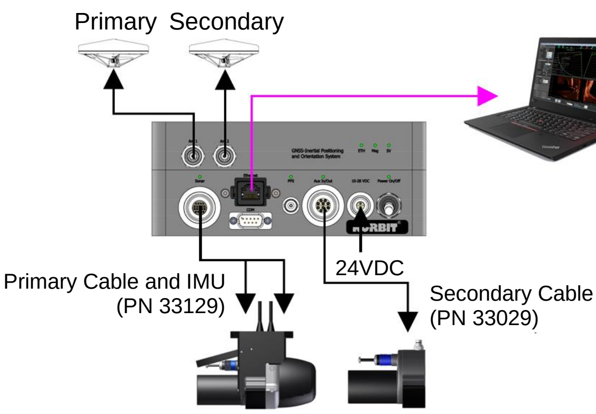


To run dual head without integrated INS functionality, two SIU-WH (PN 29064) can be used. Both systems require a timing input (ZDA & 1PPS), and the WINGHEAD Trigger Cable (PN 33249), similar to Option 3 shown in section 2.7.2.2.

2.7.2 WBMS Configuration

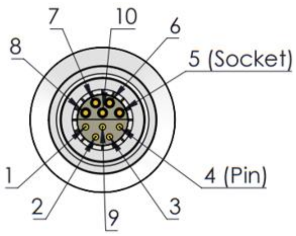
2.7.2.1 Option 1: Two sonars with one SIU-I-NAV

The simplest, and recommended, setup uses one SIU-I-NAV (PN 29028, revision 5 or later) with both sonars connected to the same topside. It must be supplied with 24VDC and use the NORBIT-supplied 220W power brick (PN 23008-P220). The standard 120W power brick for single head systems (PN 23008-P120) is not sufficient. For older SIU-I-NAV revisions (revision 4 and earlier), the internal power supply unit must be upgraded. Timing requirements are handled internally.



2.7.2.2 Options 2 & 3: One SIU-I-NAV and one SIU-I, or two SIU-I

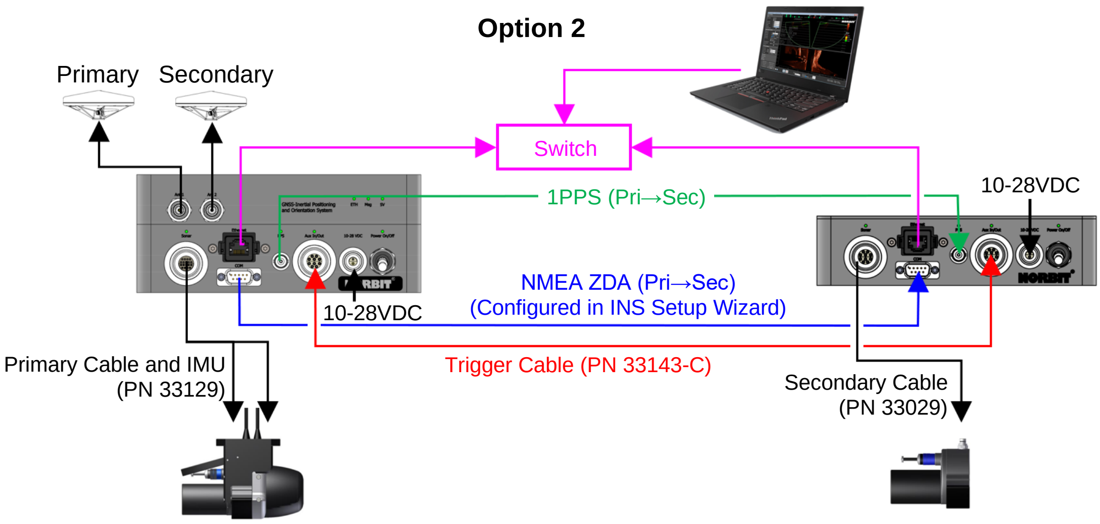
Alternatively, two SIU-I (PN 29024) may be used, or one SIU-I-NAV can be combined with one SIU-I. In each case, sonar timing (NMEA ZDA & 1PPS) must be supplied to both systems, and the topside units must be linked with a TTL sync cable via the Aux ports. With Option 2, the PPS port on the SIU-I-NAV acts as PPS Out, and NMEA ZDA can be output from the serial port if configured as such on the last page of the INS Setup Wizard.



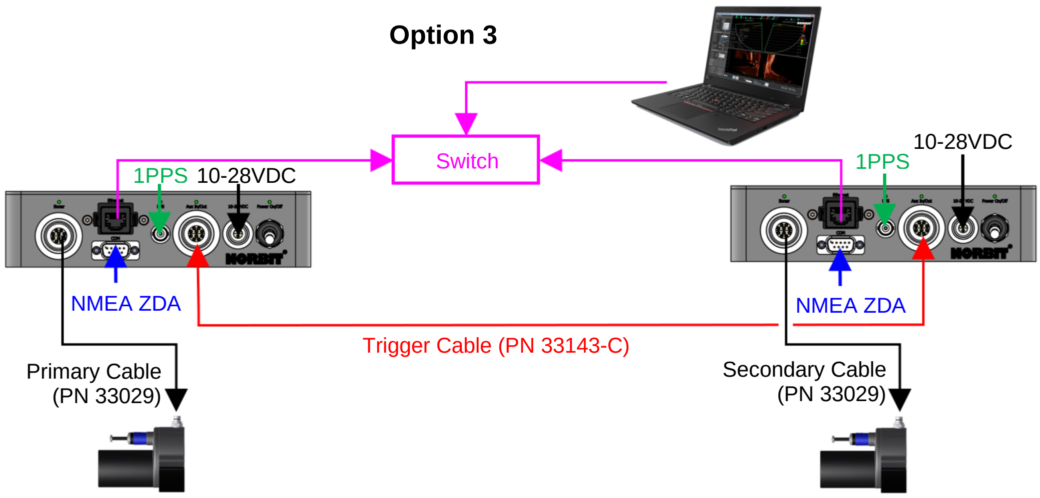
Aux In/Out Socket	
No.	**WBMS Function**
1	LAN TX+
2	LAN TX-
3	LAN RX+
4	LAN RX-
5	Trig Out (RS232)
6	Trig In (RS232)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24VDC

Sync Cable Connections	
Primary	**Secondary**
8-Signal GND	8-Signal GND
5-Trig Out	6-Trig In
6-Trig In	5-Trig Out

Option 2



Option 3



2.8 Detached IMU

When it is necessary to install the IMU at a separate location from the sonar, the supplied bulb IMU (IMUb) on the iWBMS series can be detached from the sonar. The IMUd option, shown in Appendix C10, can also be used, which comes in a box-shaped housing with a depth rating of 50m. The IMUd option is compatible with all NORBIT integrated WINGHEAD and iWBMS models.

To separate the IMUb from the WBMS, remove the 4 bolts at the back of the iWBMS bracket. Do this with the iWBMS resting on padding to prevent any damage. Carefully separate the IMUb, ensuring that you do not lose the dowel nuts in the base plate of the IMU. NORBIT provides an optional plate for mounting the separated IMUb in its NORBIT housing, detailed in Appendix G2.

If the optional mounting plate is not used, the dowel nuts can be used. This requires the IMUb to be secured to a mounting location that facilitates tightening the mounting screws from underneath. The screws should be M6 and of sufficient length to extend 23mm from the top of the mounting plate.

NOTE: When the IMUb is mounted with the flat surface on the bottom, the reference point is located **0.08m** below the top of the bulb. For IMUd offsets, refer to Appendix C10. In the INS Setup Wizard, a Custom Sonar Ref. Point to IMU Ref. Point offset must be applied.

Two cables are typically required when operating the WBMS in a detached configuration. The sonar should be interfaced to the **Aux In/Out** port on the SIU and the IMUb (or IMUd) should, counterintuitively, be interfaced to the **Sonar** port.

The WINGHEAD series has separate interfacing requirements. For full details, please refer to the technical note on detached IMU configurations (TN-230138). Contact NORBIT Support if you require this document.

3 Offsets & Reference Points

The **Sonar Reference Point** is where all sonar (and navigation data, for integrated systems) is valid upon output. Therefore, all sensors in the acquisition and processing software must have the same offset applied to this location, which is defined as:

- The centre of the projector in the fore-aft direction.
- The centre of the cylindrical receiver array in the port-starboard direction.
- A vertical offset referenced to the top centre of the bracket in the up/down direction for WINGHEAD and iWBMSh Stabilised sonars, and at the centre of the cylindrical receiver array for all other WBMS sonars. For standard WINGHEAD models, the reference point is located 5mm below the target marked on top of the sonar housing.

The **IMU Reference Point** is shown for reference, but generally it is irrelevant as the IMU offset is fixed and known and applied automatically. The **Top Centre of Bracket** is merely a convenient point from which to measure the primary GNSS antenna offset for integrated systems. For dual head setups, it is more convenient, and practical, to use the Top Centre of Dual Head Bracket as the Measure Point.

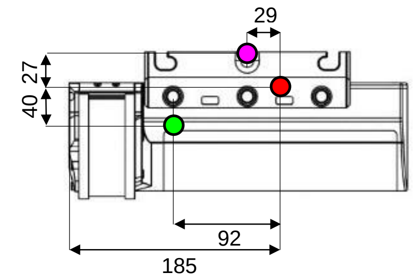
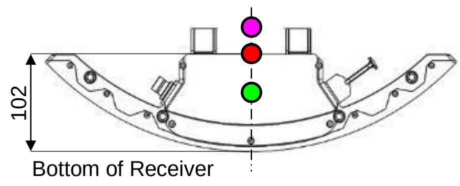
When the sonar and IMU are rotated, the offsets and angles must be adjusted accordingly. Consult the technical note TN-190018 for details and contact NORBIT Support if you require this document.

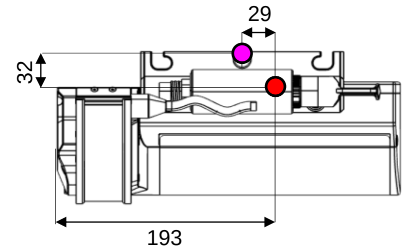
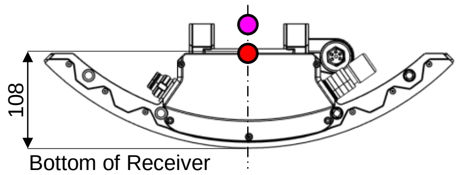
3.1 WINGHEAD Reference Points

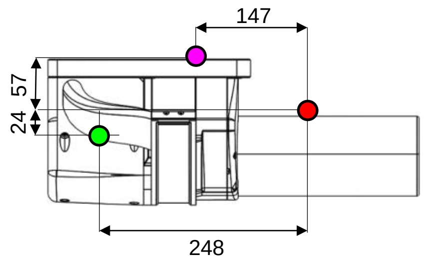
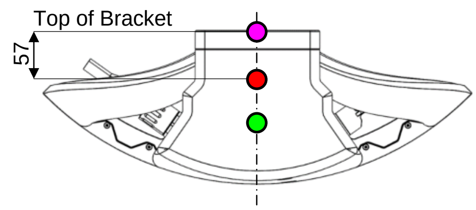
For single head integrated systems, the **Top Centre of Bracket** and **IMU** offsets are applied automatically in the INS Setup Wizard. Refer to section 3.1.1 for all offsets and mounting angles, and refer to section 1.1 for more information about product codes.

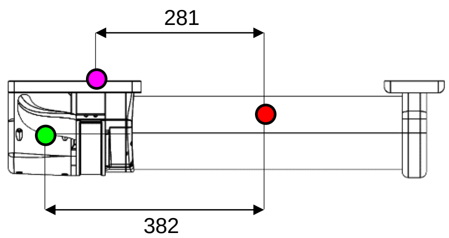
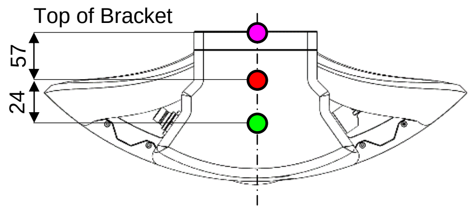
When the standard mounting bracket is not used, the **Sonar Reference Point** can be measured using the definition provided in section 3 together with the measurements in the table below. For standard WINGHEAD models, the reference point is located 5mm below the target marked on top of the sonar housing.

<table>
<tr><th>Sonar Kit[1] [2]</th><th>Side View</th><th>Front View</th></tr>
<tr><td>WINGHEAD
Standard

Product Codes:
B41, B41 Titanium,
i77h, i79h</td><td></td><td></td></tr>
<tr><td>WINGHEAD
Deep Sea / Full
Ocean

Product Codes:
B44 Deep Sea
B44 Full Ocean</td><td></td><td></td></tr>
<tr><td>WINGHEAD
Stabilised

Product Codes:
B51S, i80S</td><td></td><td></td></tr>
<tr><td>WINGHEAD
Long Range
Stabilised

Product Codes:
B57S, i87S</td><td></td><td></td></tr>
</table>

Note [1] WINGHEAD "B" series sonars operate as standalone (non-integrated) sonars, therefore the IMU offsets can be ignored.
Note [2] WINGHEAD "S" series sonars have steerable transmission functionality which allows full roll, pitch and (optional) yaw stabilisation to provide uniform sounding coverage in dynamic sea states.

3.1.1 Offsets & Mounting Angles

Sonar Kit	Integrated Models		Sonar Ref. Point to Top Centre of Bracket
	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles	
WINGHEAD Standard B41, B41 Titanium, i77h, i79h	**+Fwd:** 0.092 m **+Stbd:** 0.000 m **+Down:** 0.040 m	**X:** 0º **Y:** 90º **Z:** 0º	**+Fwd:** 0.029 m **+Stbd:** 0.000 m **+Down:** -0.027 m
WINGHEAD Deep Sea / Full Ocean B44 Deep Sea, B44 Full Ocean			**+Fwd:** 0.029 m **+Stbd:** 0.000 m **+Down:** -0.032 m
WINGHEAD Stabilised B51S, i80S	**+Fwd:** 0.248 m **+Stbd:** 0.002 m **+Down:** 0.024 m	**X:** -55º **Y:** 0º **Z:** 180º	**+Fwd:** 0.147 m **+Stbd:** 0.000 m **+Down:** -0.057 m
WINGHEAD Long Range Stabilised (100kHz) B57S, i87S	**+Fwd:** 0.382 m **+Stbd:** 0.002 m **+Down:** 0.024 m	**X:** -55º **Y:** 0º **Z:** 180º	**+Fwd:** 0.281 m **+Stbd:** 0.000 m **+Down:** -0.057 m

3.1.2 Dual Head Offsets (IMU on Port, Bracket PN 35163)

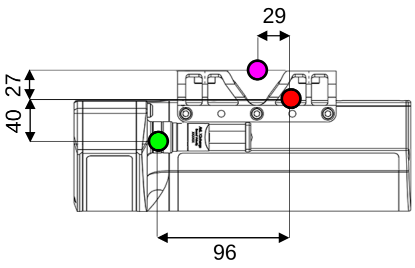
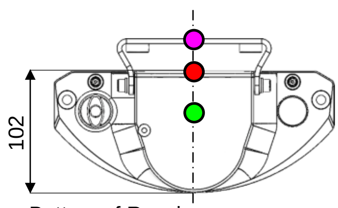
Sonar Kit	Integrated Models		Sonar Ref. Point to Measure Point (Top Centre of Dual Head Bracket)	Sonar Ref. Point (Primary) to Sonar Ref. Point (Secondary)
	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles (IMU on Port)		
WINGHEAD Standard B41, B41 Titanium, i77h, i79h	**+Fwd:** 0.092 m **+Stbd:** -0.007 m **+Down:** 0.039 m	**X:** 89º **Y:** 80º **Z:** 89º	**+Fwd:** 0.029 m **+Stbd:** 0.226 m **+Down:** -0.064 m	**+Fwd:** 0.000 m **+Stbd:** 0.452 m **+Down:** 0.000 m
WINGHEAD Stabilised B51S, i80S	**+Fwd:** 0.248 m **+Stbd:** -0.004 m **+Down:** 0.024 m	**X:** -65º **Y:** 0º **Z:** 180º	**+Fwd:** 0.147 m **+Stbd:** 0.231 m **+Down:** -0.094 m	**+Fwd:** 0.000 m **+Stbd:** 0.462 m **+Down:** 0.000 m

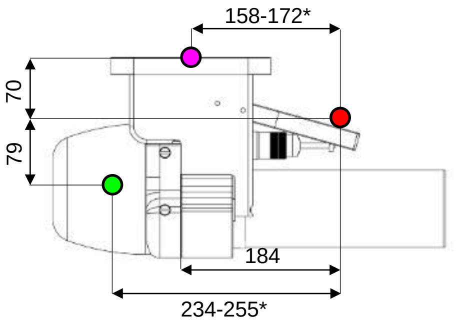
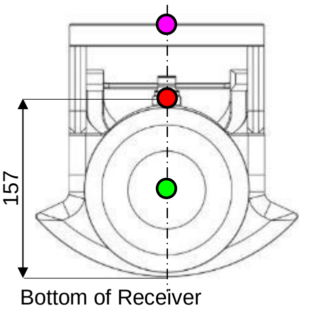
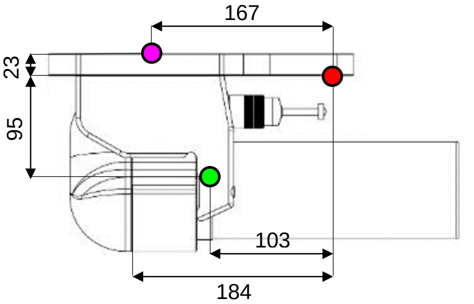
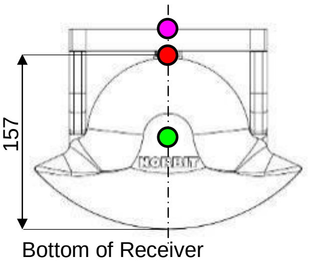
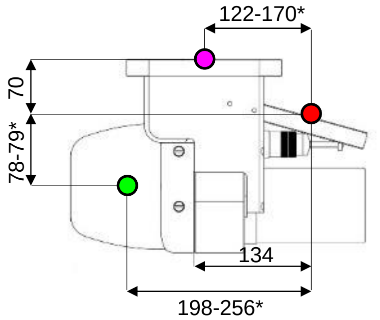
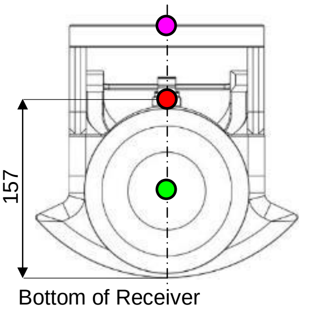
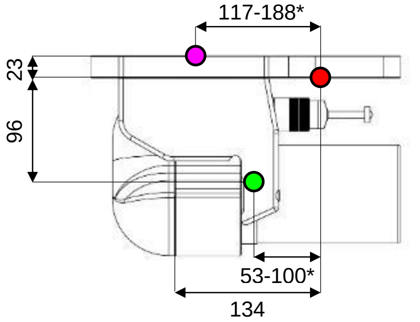
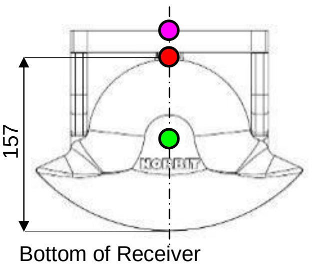
For custom arrangements (e.g. different rotation angles, or IMU installed on starboard side) please consult the technical note TN-190018**.** Contact NORBIT Support if you require this document.

3.2 WBMS Reference Points

For single head integrated systems, the **Top Centre of Bracket** and **IMU** offsets are applied automatically in the INS Setup Wizard. When the standard mounting bracket is not used, the **Sonar Reference Point** can be measured using the definition provided in section 3 together with the measurements in the table below, using the bottom of the receiver as a reference for the vertical offset.

Note that offsets marked with an asterisk (*) vary depending on projector type, IMU type and mounting bracket. Refer to section 3.2.1 for a full summary of offsets and mounting angles for each model.

Sonar Kit & Bracket	Side View	Front View
iWBMSh Stabilised		

<table>
<tr>
<td>12004 & 12007
iWBMS, iWBMSh
Projector: Narrow TX
Bracket PN 35021</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>12003 & 12006
WBMS, iWBMSe
Projector: Narrow TX
Bracket PN 35047</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>12004 & 12007
iWBMS, iWBMSh
Projector: Standard TX
Bracket PN 35021</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>12003 & 12006
WBMS, iWBMSe
Projector: Standard TX
Bracket PN 35047</td>
<td>
</td>
<td>
</td>
</tr>
</table>

* Depends on sonar model. Refer to section 3.2.1 for full summary of offsets.

3.2.1 Offsets & Mounting Angles

Sonar Kit & Bracket[1]	Sonar PN (*values that may be ignored)	IMU PN[2]	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles	Sonar Ref. Point to Top Centre of Bracket
400KHZ SONARS WITH NARROW TRANSMIT (0.9º) OPTION					
iWBMSh Stabilised	24216-GBDJFA4*3**	24006-9X (Type 89)	**+Fwd:** 0.096 m **+Stbd:** 0.000 m **+Down:** 0.040 m	**X:** 0º **Y:** -90º **Z:** 180º	**+Fwd:** 0.029 m **+Stbd:** 0.000 m **+Down:** -0.027 m
12007 iWBMSh STX -or- **12004 iWBMS STX** Bracket PN: 35021	24016-*-*B***B	24015 (Type 64) 24006-4X (Type 42)	**+Fwd:** 0.234 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 90º **Y:** 0º **Z:** -90º	**+Fwd:** 0.158 m **+Stbd:** 0.000 m **+Down:** -0.070 m
		24006-9X (Type 89) 24006-8X (Type 82)	**+Fwd:** 0.242 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12007 iWBMSh -or- **12004 iWBMS** Bracket PN: 35021	24003-*-*B****	24015 (Type 64) 24006-4X (Type 42)	**+Fwd:** 0.248 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 90º **Y:** 0º **Z:** -90º	**+Fwd:** 0.172 m **+Stbd:** 0.000 m **+Down:** -0.070 m
		24006-9X (Type 89) 24006-8X (Type 82)	**+Fwd:** 0.255 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12006 iWBMSe Bracket PN: 35047	24018-*-*B****	24013 (Type 69)	**+Fwd:** 0.103 m **+Stbd:** 0.000 m **+Down:** 0.095 m	**X:** 0º **Y:** 0º **Z:** 180º	**+Fwd:** 0.167 m **+Stbd:** 0.000 m **+Down:** -0.023 m
400KHZ SONARS WITH STANDARD TRANSMIT (1.9º) OPTION					
12007 iWBMSh -or- **12004 iWBMS** Bracket PN: 35021	24003-*-*C**** 24003-1b (old)	24015 (Type 64) 24006-4X (Type 42)	**+Fwd:** 0.198 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 90º **Y:** 0º **Z:** -90º	**+Fwd:** 0.122 m **+Stbd:** 0.000 m **+Down:** -0.070 m
		24006-9X (Type 89) 24006-8X (Type 82)	**+Fwd:** 0.206 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12006 iWBMSe Bracket PN: 35047	24018-*-*C****	24013 (Type 69)	**+Fwd:** 0.053 m **+Stbd:** 0.000 m **+Down:** 0.096 m	**X:** 0º **Y:** 0º **Z:** 180º	**+Fwd:** 0.117 m **+Stbd:** 0.000 m **+Down:** -0.023 m
200KHZ LONG RANGE SONARS					
12007 iWBMSh -or- **12004 iWBMS** Bracket PN: 35021	24007-*-*C****	24015 (Type 64) 24006-4X (Type 42)	**+Fwd:** 0.241 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 90º **Y:** 0º **Z:** -90º	**+Fwd:** 0.170 m **+Stbd:** 0.000 m **+Down:** -0.070 m
		24006-9X (Type 89) 24006-8X (Type 82)	**+Fwd:** 0.256 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12006 iWBMSe Bracket PN: 35047	24022-*-*C****	24013 (Type 69)	**+Fwd:** 0.100 m **+Stbd:** 0.000 m **+Down:** 0.095 m	**X:** 0º **Y:** 0º **Z:** 180º	**+Fwd:** 0.188 m **+Stbd:** 0.000 m **+Down:** -0.022 m

[1] For STX Deepsea models (PN 24032/24033), the Sonar Ref. Point is located further aft than regular models, and the +Fwd offsets must be adjusted. The IMU Ref. Point +Fwd offset becomes **0.249m** (for IMU PN 24015/24006-4X) and **0.261m** (for IMU PN 24006-9X/24006-8X). The Top Centre of Bracket +Fwd offset becomes **0.177m**.

[2] Applanix OceanMaster: PN 24015 or 24006-9X (Type 64 or 89), WaveMaster: PN 24006-4X or 24006-8X (Type 42 or 82), SurfMaster: PN 24013 (Type 69). IMU type can also be found in the NORBIT GUI, under **INS Tools > System Status > POS Version**.

3.2.2 Dual Head Offsets (IMU on Port, Bracket PN 954121)

Sonar and IMU Type	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles (IMU on Port)	Sonar Ref. Point to Measure Point (Top Centre of Dual Head Bracket)	Sonar Ref. Point (Primary) to Sonar Ref. Point (Secondary) *
iWBMSh (IMU Type 64) iWBMS (IMU Type 42)	**+Fwd:** 0.248 m **+Stbd:** -0.048 m **+Down:** 0.063 m	**X:** 90º **Y:** 37.5º **Z:** -90º	**+Fwd:** 0.172 m **+Stbd:** 0.210 m **+Down:** -0.210 m	**+Fwd:** 0.006 m **+Stbd:** 0.390 m **+Down:** -0.037 m
iWBMSh (IMU Type 89) iWBMS (IMU Type 82)	**+Fwd:** 0.255 m **+Stbd:** -0.048 m **+Down:** 0.063 m	**X:** 90º **Y:** -52.5º **Z:** -90º	**+Fwd:** 0.172 m **+Stbd:** 0.210 m **+Down:** -0.210 m	**+Fwd:** 0.006 m **+Stbd:** 0.390 m **+Down:** -0.037 m
iWBMSe (IMU Type 69)	**+Fwd:** 0.103 m **+Stbd:** -0.058 m **+Down:** 0.075 m	**X:** -37.5º **Y:** 0º **Z:** 180º	**+Fwd:** 0.167 m **+Stbd:** 0.181 m **+Down:** -0.173 m	**+Fwd:** 0.000 m **+Stbd:** 0.362 m **+Down:** 0.000 m

*Assumes that the dual head system comprises one iWBMS or iWBMSh (bracket PN 35021) or iWBMSe (bracket PN 35047) on the port side, and one WBMS (bracket PN 35047) on starboard. For alternative configurations, refer to Appendix G5.

The IMU type can be found in the NORBIT GUI under **INS Tools > System Status > POS Version**. For custom arrangements (e.g. different rotation angles, or IMU installed on starboard side) please consult the technical note TN-190018**.** Contact NORBIT Support if you require this document.

4 System Operation

The system is setup and controlled using the NORBIT Graphical User Interface (GUI). The GUI can also be controlled in headless/passive mode, as described in section 4.5. NORBIT recommends disabling Windows Firewall, or adding a port exception, to allow communication with the integrated INS. See section 7.2 for more details. Note that some features of the sonar are license controlled, as described in Appendix B1.

The GUI can be monitored by multiple computers, but only one GUI can control the sonar. To communicate with the GUI using more than one computer through a network switch, each computer requires its own unique IP address on the same IP range, as described in section 4.2. The acquisition software should always connect to the local IP address of the PC that operates the GUI.

4.1 System Requirements

Since all sonar data processing happens inside the sonar head, the GUI can be run on the same PC as the acquisition software. Therefore, please refer to the manual of your chosen acquisition software for the recommended system requirements.

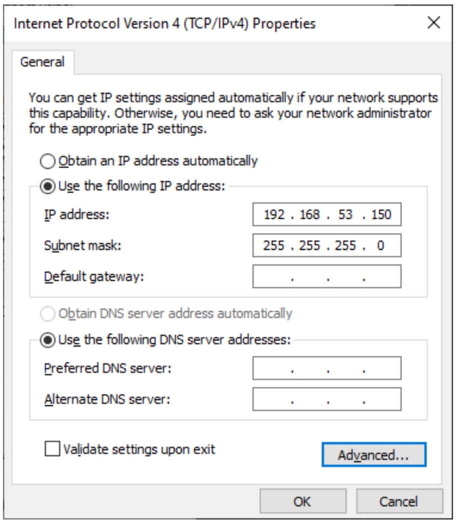
The requirements for the GUI alone are light compared data acquisition and processing software. In general, NORBIT recommends a Windows 10 or 11 PC or laptop, with a 2GHz+ processor, and at least 8GB of memory. Integrated motherboard graphics are sufficient for running the GUI alone, but dedicated graphics is required for running data acquisition software with 3D displays. The recommended display resolution is 1400x900 or higher.

4.2 Network Configuration

NORBIT sonars connect to the acquisition computer via standard Ethernet protocol. To communicate with the SIU, the PC network adapter must be configured on the same static IP range.

⚠ **CAUTION:** Changing the IP address of the integrated INS from the factory configured IP address (192.168.53.100) will disable INS functionality within the GUI. Many of the options under INS Tools will be greyed out.

To configure the IP address in Windows 10, go to **Settings > Network & Internet > Change adapter options**, right click the relevant connection and select **Properties**. Double click **Internet Protocol Version 4 (TCP/IPv4)**. NORBIT recommends setting the IP address to **192.168.53.150**, with subnet mask **255.255.255.0**. In Windows 11, the same settings can be found in **Advanced Network Settings > More Network Adapter Options**.



The last 3 digits of the IP address must not conflict with the address of the sonar or integrated INS. The INS is pre-configured with an IP address of 192.168.53.100, and the sonar is 192.168.53.XX, where XX represents the last two digits of the sonar serial number.

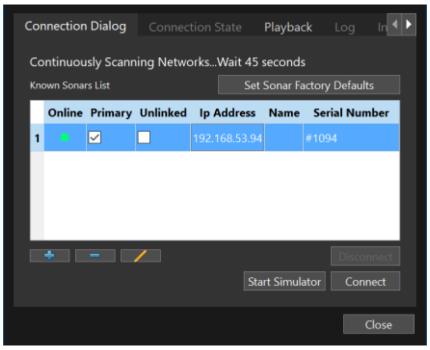
In rare circumstances, some users may wish to change the IP address of the sonar. See section 7.4 for details. Do NOT change the sonar IP address unless absolutely necessary.

CAUTION: Do not connect multiple network cards to the same IP range. Connecting multiple adapters to the same static IP range (e.g. 192.168.53.XX) causes duplication of navigation data, resulting in sonar data artifacts. The subnet mask does not matter.

NOTE: Make sure that DCHP servers are not running on the same network as the sonar. This causes automatic IP address assignment during bootup. If this occurs, power off the SIU, assign a static IP address, and power cycle.

4.3 Sonar Connection

Upon launching the GUI, the **Connection Dialog** is displayed. If a sonar is active on the network, a green indicator is displayed, while a red indicator shows that the sonar is offline. Select the sonar to highlight the row and click **Connect**. After the first successful connection is established, all subsequent connections are automatic.



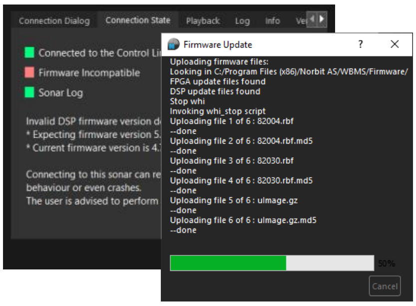
To connect to two sonars in dual head mode, specify which sonar is primary, highlight both rows, and click **Connect**. For more information, refer to Appendix A2.

Once connected, an automatic check is performed to ensure firmware compatibility. A warning is displayed on the **Connection State** tab if the firmware is incompatible. Operating a firmware and GUI with mismatching versions may cause unstable operation.

CAUTION: Whenever firmware is updated or a new GUI is installed, users are strongly advised to select **Set Sonar Factory Defaults** on the Connection dialog afterwards.

4.4 Firmware Update

4.4.1 WINGHEAD (Standard) and WBMS Firmware Updates

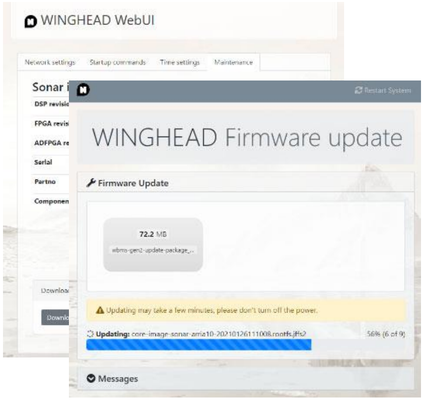


When a firmware mismatch is detected, click **Perform Update** and follow the instructions. Please note that it is unsafe to turn off power to the sonar once the upgrade process has started, and that doing so risks corrupting the system configuration.

When the upgrade is complete, power cycle the sonar and select **Set Sonar Factory Defaults** on the Connection dialog.

4.4.2 WINGHEAD "S" Series Firmware Updates

Firmware updates on WINGHEAD Stabilised systems are executed via the web interface after the GUI is installed:



Step 1. With the sonar powered on, open a web browser, and go to: http://192.168.53.XX:8080 (where XX is the last 2 digits of the sonar serial number).

Step 2. Depending on which version is installed, click **Boot to recovery**, or go to the **Maintenance** tab and click **Reboot** in the "Reboot to firmware upgrade mode" box.

Step 3. Click **OK** when prompted.

Step 4. The update file is located inside the GUI installation folder, in the Firmware subfolder: *C:\Program Files (x86)\Norbit AS\WBMS\Firmware\wh-fw.swu*

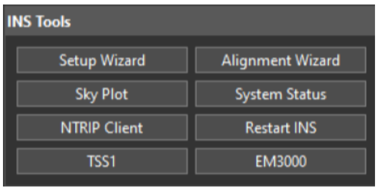
Step 5. Drag and drop the *.swu file into the Firmware Update box. The update will begin automatically.

Step 6. Do **NOT** turn off the sonar during the update. Upon completion, power cycle the system and select **Set Sonar Factory Defaults** on the GUI Connection dialog.

4.5 Operation Without GUI (Direct Connection, Passive & Headless Modes)

Some setups, such as those on AUVs, may require operation without the NORBIT GUI. Users can interface with the sonar on a script level, providing direct commands to the sonar (ref. TN-180196, TN-210082). In addition, the GUI can be operated in **Passive** and **Headless** modes. These modes are not intended to be used where several observers are required, as it substantially increases sonar bandwidth and may cause data loss. For details on how to configure the sonar in passive and headless modes, refer to the ROV/AUV/USV Integration Manual, TN-190041.

4.6 INS Tools for Integrated Systems



The NORBIT GUI contains integrated INS functionality, allowing the sonar and INS to be setup and controlled from the same user interface.

For users with standalone WINGHEAD or WBMS systems, most settings under **INS Tools** are greyed out.

4.6.1 INS Setup Wizard

4.6.1.1 Factory Settings

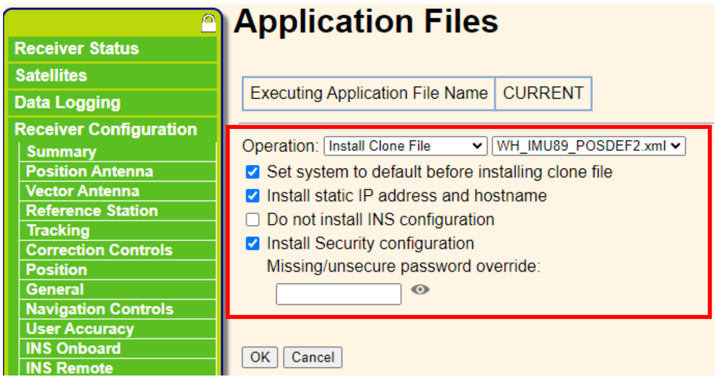
NORBIT advises that, prior to each new installation, the factory default settings are restored. Open the **INS Setup Wizard** and select **Factory**. Note, this only resets the INS configuration and has no impact on the sonar configuration or GUI display preferences.

⚠ **CAUTION:** Offsets are stored on the PC from which the setup was performed. If the PC is changed, the displayed **Measure Point to Antenna Bottom** offset is from the Sonar Reference Point to the primary antenna phase centre. This does not affect operation unless the configuration is re-saved. NORBIT recommends reviewing all inputs prior to each survey.

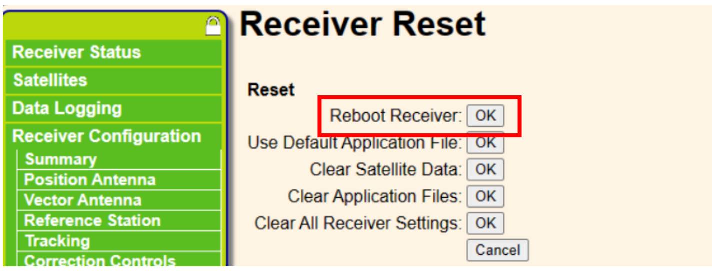
For models containing the Applanix AP+ GNSS/INS subsystem, introduced in 2024, the factory INS settings must be restored through the Web UI as follows:

Step 1. Open the AP+ Web UI in a browser (http://192.168.53.100)
Step 2. Navigate to **Receiver Configuration > Application Files**
Step 3. Select **Operation: Install Clone File**
Step 4. Select the clone file (*.xml) from the drop-down menu. The file name differs by model.
Step 5. Ensure that the following selections are made:

☑ Set system to default before installing clone file
☑ Install static IP address and hostname
☒ Do not install INS configuration
☑ Install Security configuration



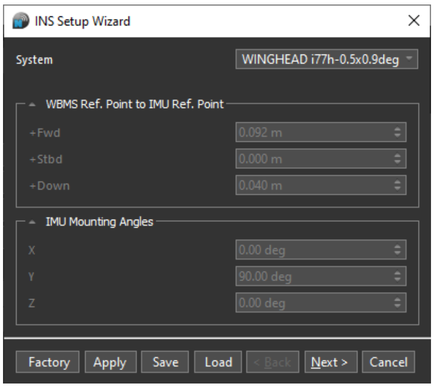
Step 6. Do **NOT** set a missing/unsecure password override.
Step 7. Click **OK** and wait for the clone file to install.
Step 8. Navigate to **Receiver Configuration > Reset**
Step 9. Next to **Reboot Receiver**, click **OK**



4.6.1.2 IMU Offset & Mounting Angles

The first page of the setup wizard shows the sonar model in the **System** selection and the relevant offsets and mounting angles. The model is automatically detected, and for most users there is nothing to change here.

If custom offsets or mounting angles are required, select the **Custom** system option. This is only required for advanced installations where the IMU is physically detached from the sonar (see section 2.8) and installed at a separate location. Note that WINGHEAD integrated IMUs cannot be separated from the sonar, and the IMUd option (see Appendix C10 is available for this purpose.

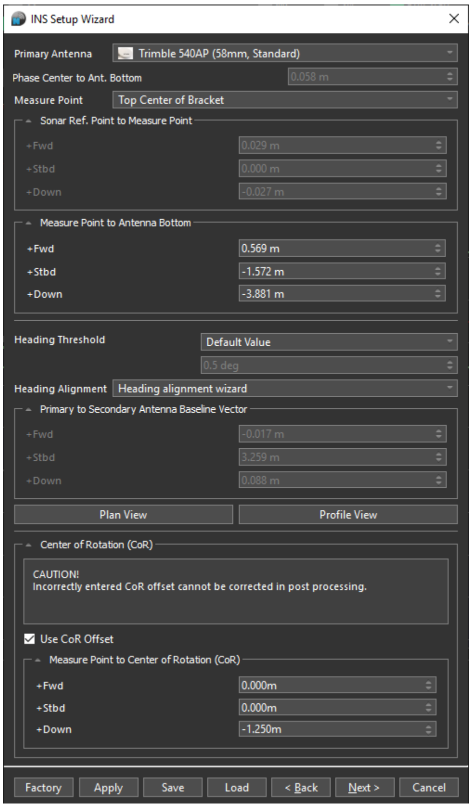


NOTE: The IMU mounting angles and offsets must be adjusted when the sonars are tilted, which is typical for dual head installations. For further information, refer to the technical note TN-190018 and Appendix A2. If you do not have this document, contact NORBIT Support.

4.6.1.3 Antenna Offsets

Select the **Primary Antenna** model, which in most cases will be **Trimble 540AP**, to ensure that the correct phase centre offset is applied. See section 2.4.6 for more details.

Select the **Measure Point** to define a convenient reference point from which to measure the primary antenna offset. **Top Centre of Bracket** should normally be selected. A **Custom** point may also be defined. For dual head setups, it is more convenient and practical to define a custom point and use the top centre of the dual head bracket.



Carefully measure the distance from **Measure Point to Antenna Bottom** and enter the correct values, bearing in mind the sign convention (positive down).

Users can specify the **Heading Threshold** for the heading alignment procedure which follows later. The **Default Value** (0.5º) is suitable in most cases. It may be necessary to change the threshold, e.g. if operating a large vessel and aggressive manoeuvring is not possible. If the heading alignment does not start within 30 minutes, select **Custom** and increase the threshold in 0.5º increments until the alignment starts successfully. Every time a heading alignment is performed, a patch test should be performed afterwards.

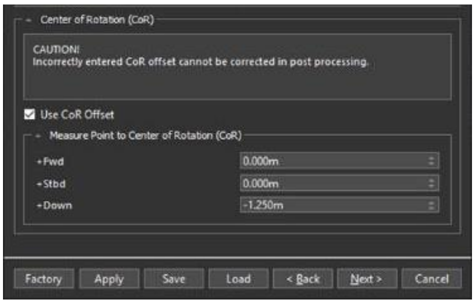
For **Heading Alignment** method, select **Heading Alignment Wizard** to populate the fields in **Primary to Secondary Antenna Baseline Vector** with zeros initially. Correct values are displayed after the alignment is complete (described in section 4.6.2). If the antenna baseline vector is already known, i.e. if it was measured using land survey techniques, the results can be entered by selecting **Custom**.

Selecting **Plan View** or **Profile View** displays a diagram showing the antenna positions with respect to the Sonar Reference Point. This can be used for a visual check of the system layout/offsets.

⚠ **NOTE:** Offsets displayed in POSPac for **Ref. to Primary GNSS Lever Arm** differ from those entered in the NORBIT GUI due to the GUI offsets being referenced from the **Measure Point** (typically **Top Centre of Bracket**), whereas POSPac offsets are referenced from the **Sonar Reference Point.** The same is true for offsets displayed in POSView and the AP+ Web UI.

4.6.1.4 Centre of Rotation Offset

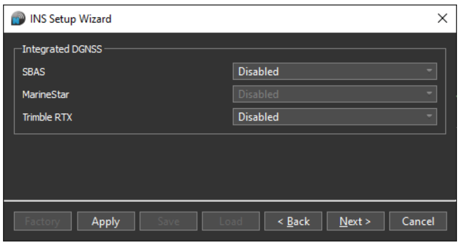
The vessel **Centre of Rotation** (CoR) offset should be entered relative to the **Measure Point**. Note that the centre of rotation is more of an area rather than a well-defined point on the vessel, therefore an approximation will suffice. Select **Use CoR Offset** and enter the measured values under **Measure Point to Centre of Rotation (CoR).**



The CoR, for most commercial vessels, is documented in the vessel design plans. For other vessels, it must be estimated. The location can be hard to determine, as it may change over time depending on fuel stowage and distribution of personnel body weight. Generally, choose a location that is about 3/4 distance from bow to stern, centred on the keel, and located at approximately water level.

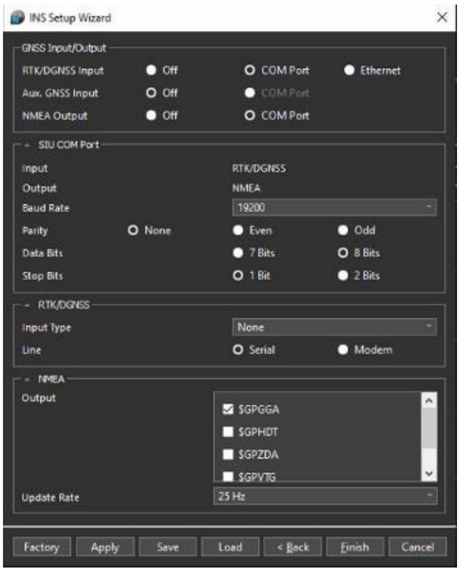
4.6.1.5 Integrated DGNSS

The **Integrated GNSS** settings are used to configure satellite-based GNSS correction services. Satellite Based Augmentation Service (**SBAS**) is a regional and free correction source.



Alternatively, **Marinestar** or **Trimble RTX**, paid subscription services which provide typically decimetre accuracy, may be enabled. Refer to sections 4.6.6 and 4.6.7 for details on activating these services.

4.6.1.6 RTK/Aux GNSS Input & NTRIP Client

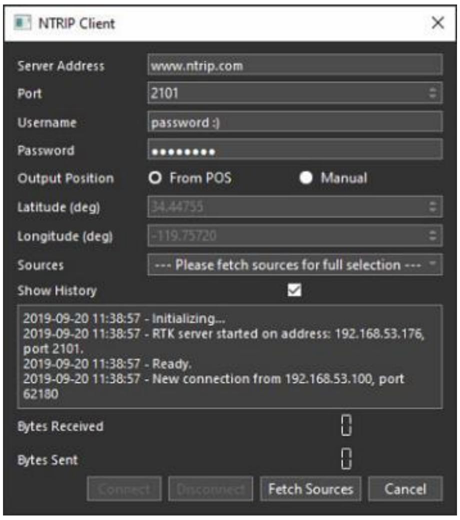


RTK corrections may be transmitted to the vessel from a land base station (via radio) and interfaced to the system via the serial COM port on the SIU. The radio on the vessel must therefore have a serial output, containing **only** the correction message. The incoming radio baud rate must match the selection in the setup wizard.

Select the correct RTK **Input Type** (**CMR**, **CMR+**, **RTCM**, etc.) as well as the input **Line**, either **Serial** or **Modem**. Note that on some models, the **Input Type** is detected automatically and therefore cannot be configured.

If an input type other than **None** is selected, the INS only uses GPS satellites in Tightly Coupled modes, so it will likely result in fewer satellite vehicles being detected. Selecting **None** enables the INS to use additional satellites from other constellations in Closely Coupled modes, however not all of that data is being used in the Kalman Filter. Having fewer satellites in Tightly Coupled modes is not necessarily a problem; it is more about the quality of the observables. On AP+ models, multiple constellations are supported in Tightly Coupled modes. Refer to section 4.7.1 for descriptions of the INS Status modes.

Select the desired **NMEA** output messages. If using a radio link to receive corrections, you may need to set this output to **Off** to avoid issues related to decoding the correction message from the radio's output.



Although not recommended, some models support using an external GNSS system, which is enabled by selecting **Aux. GNSS Input**. Then enter the offset to the auxiliary antenna phase centre. It is important to note that this offset should be measured from the **Sonar Reference Point** (see section 3) to the phase centre of the auxiliary antenna. When the auxiliary system is connected, the INS compares its own solution against the quality of the auxiliary solution and automatically selects the best. The auxiliary input must include NMEA GGA as a minimum, and optionally GSV, GSA and GST. The update rate must not exceed 1Hz.

To enable RTK corrections via NTRIP, select **Ethernet** as the **RTK/DGNSS Input**. Select **NTRIP Client** and enter the login details. Select **Fetch Sources** and select the source from the dropdown menu. Click **Connect**.

Click **Finish** to complete the setup wizard. If **Heading Alignment Wizard** was selected in section 4.6.1.3, finishing the setup wizard automatically starts the alignment wizard. If performing a heading alignment calibration is not possible at this time, you may select **Cancel**, with no loss of input values, and perform the calibration later.

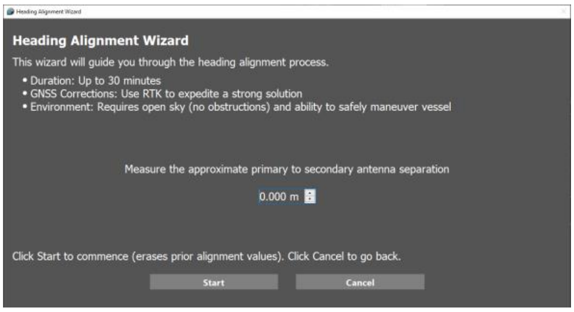
4.6.2 Heading Alignment Wizard

If the antenna baseline vector was not measured using land survey techniques, a heading alignment must be performed when the NORBIT sonar is first installed, or when one of the INS sensors (IMU or GNSS antennas) is moved.

This procedure determines the vector offset from the primary to secondary antenna, and in doing so ensures proper alignment of the IMU with the GNSS antenna pair. GNSS corrections are essential for completing the calibration, and the best results are achieved with RTK. If a heading alignment was not performed at the end of the **INS Setup Wizard**, select **INS Tools** > **Alignment Wizard**.

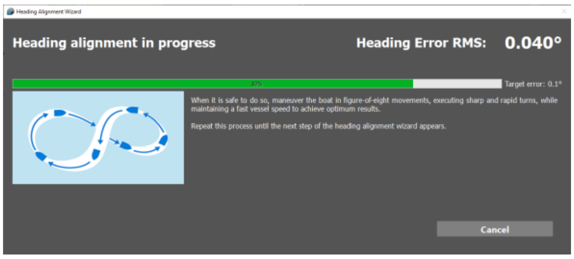
> ⚠ **NOTE:** The heading alignment procedure varies slightly depending on the model. The guidelines relevant to your specific model are displayed on the alignment wizard in the GUI.

Step 1. Press **Start** to begin the calibration. AP+ models require users to enter the approximate antenna separation beforehand. If prompted to do so, carefully measure the antenna separation, and enter the estimated offset before clicking **Start**.

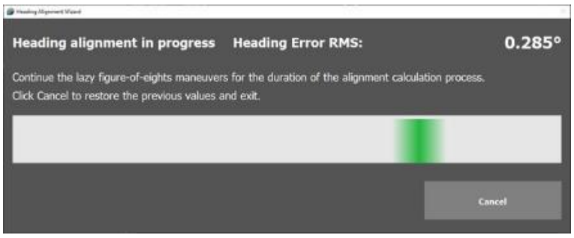


A clear sky view is required, away from tall structures which impede GNSS performance. The installation must be rigid and vibration-free, and the primary antenna offset must be accurately measured and applied during the INS setup described in the preceding section.

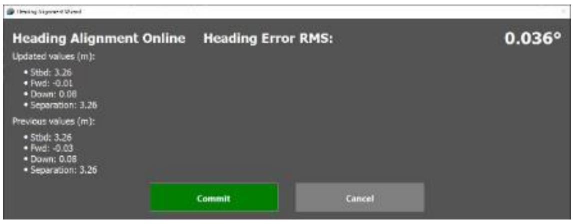
Step 2. Follow the recommended manoeuvres during the pre-alignment stage and observe the display as the **Heading Error RMS** decreases from its initial value of 55°. Once the value drops below the defined threshold (**Target Error**) and stabilises, the heading alignment begins. Continue to manoeuvre the vessel until this occurs.



Step 3. Follow the instructions and continue to perform figure-of-eight manoeuvres while the heading alignment is in progress. The overall time to complete the calibration depends on the size of the vessel and the speed at which the manoeuvres are performed, as well as positioning quality.

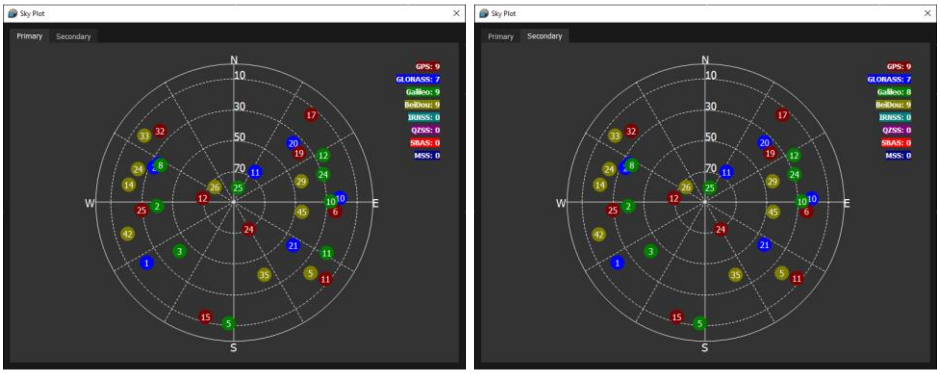


The computed results are unique to each installation. If the primary to secondary antenna baseline was manually measured beforehand, the calculated results should be similar. Select **Commit** to save the results. NORBIT recommends performing a patch test after the heading alignment.



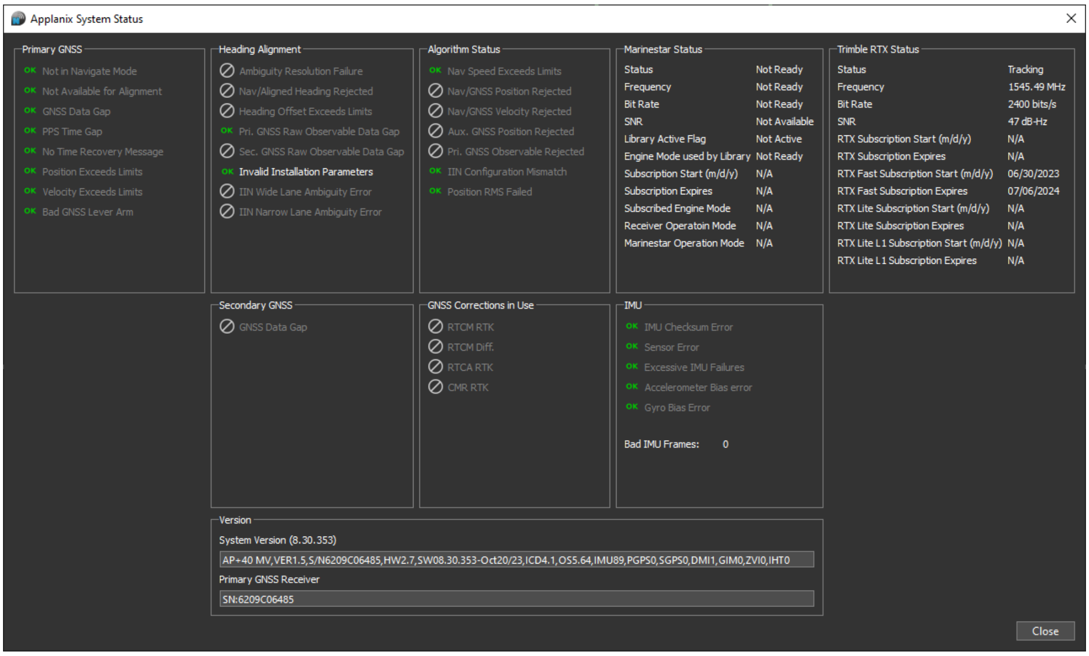
4.6.3 Sky Plot

The **Sky Plot** displays currently tracked satellites on the primary and secondary GNSS antennas.



4.6.4 System Status

The **System Status** window displays the status of the INS and reports any fault conditions that may occur during operation. Check this display if the **Faults** indicator on the GUI status bar appears red. Note that some items may display a red indicator intermittently during initialisation and operation, and further note some items are disabled (greyed out) on certain models. Refer to section 7.2 for more details on INS fault descriptions.



Version information is displayed at the bottom. It displays all INS related hardware, software, and firmware versions. Additionally, the **Marinestar** and **Trimble RTX** subscription expiry dates are shown, in the format MM/DD/YYYY.

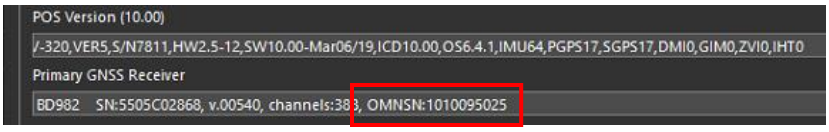
4.6.5 Restart INS

This **Restart INS** option resets the Kalman Filter, prompting the IMU to restart its levelling routine. Note that the navigation output stops temporarily while this process is underway. It takes a short time for the system to reinitialise and enter the normal operation mode.

4.6.6 Marinestar Subscription

Follow these steps to activate a Marinestar (paid) subscription for satellite-based corrections:

Step 1. Select **INS Tools** > **System Status** and obtain the **OMNSN** ID:



Step 2. Go to http://www.fugroMarinestar.com/Order_form and request a subscription. In your request, you must supply the OMNSN ID from the previous step.

Step 3. Arrange a time with Fugro to activate the subscription, as the system must be powered on and tracking satellites when the activation code is transmitted. Be sure to consider time zone differences when organising the activation time.

Step 4. Enable **Marinestar** in the **INS Setup Wizard**, as described in section 4.6.1.5. In most cases you can leave the selection on **Auto**, however you may be advised to set a specific mode and frequency by Fugro, in which case select the **Custom** option.

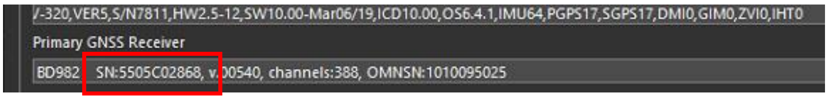
Step 5. Advise Fugro when the system is ready and wait for the activation code to be sent. It may take 30-45 minutes after the code is sent for the subscription to activate.

Step 6. Confirm that the subscription is valid by observing the **System Status** window. You should expect to see the status updates as well as an updated expiration date. The INS status displays **Pri. Marinestar…** when the mouse is hovered over the INS **Status** indicator.

4.6.7 Trimble RTX Subscription

Follow these steps to activate a Trimble RTX (paid) subscription for satellite-based corrections:

Step 1. Select **INS Tools** > **System Status** and obtain the **Primary GNSS Receiver** serial number:



Step 2. Arrange a suitable time to activate the subscription, as the system must be powered on and tracking the appropriate satellite when the activation code is transmitted over-the-air. Be sure to consider time zone differences when organising the activation time.

Step 3. Enable **Trimble RTX** in the **INS Setup Wizard**, as described in section 4.6.1.5. In most cases you can leave the selection on **Auto**, however you may be advised to set a specific satellite, frequency, and bit rate by Trimble, in which case select the **Custom** option.

Step 4. Advise Trimble when the system is ready and wait for the activation code to be sent. The activation will be transmitted every 10 minutes for the next hour after the initial transmission.

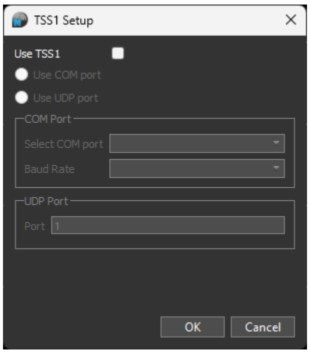
Step 5. Users may wish to connect over NTRIP when working at high/low latitudes where geostationary elevation is not sufficient for tracking. Only an Internet connection is required, however a valid subscription must be in place beforehand. The **NTRIP Client** under **INS Tools** can be used, using **www.trimblertx.net** as the server address and port **2101**. No username or password is needed.

Step 6. Confirm that the subscription is valid by observing the **System Status** window. You should expect to see the status **Tracking** as well as an updated expiration date. The INS status displays **Trimble RTX** when the mouse is hovered over the INS **Status** indicator.

NOTE: If the Trimble RTX option is not available, a firmware upgrade may be required. Refer to the technical note TN-230051 for more details on Trimble RTX requirements and contact NORBIT Support for guidance.

4.6.8 External TSS1 or EM3000 Input for Roll/Pitch/Yaw Stabilisation

For standalone NORBIT sonars, which do not include integrated GNSS/INS subsystems, motion data can be interfaced to the NORBIT GUI from an external sensor for roll stabilisation and, for supported models, pitch, and yaw stabilisation. The accepted formats are TSS1 and EM3000. Both are common formats which most sensors can output. Note that yaw stabilisation requires heading data, therefore the EM3000 option **MUST** be used.

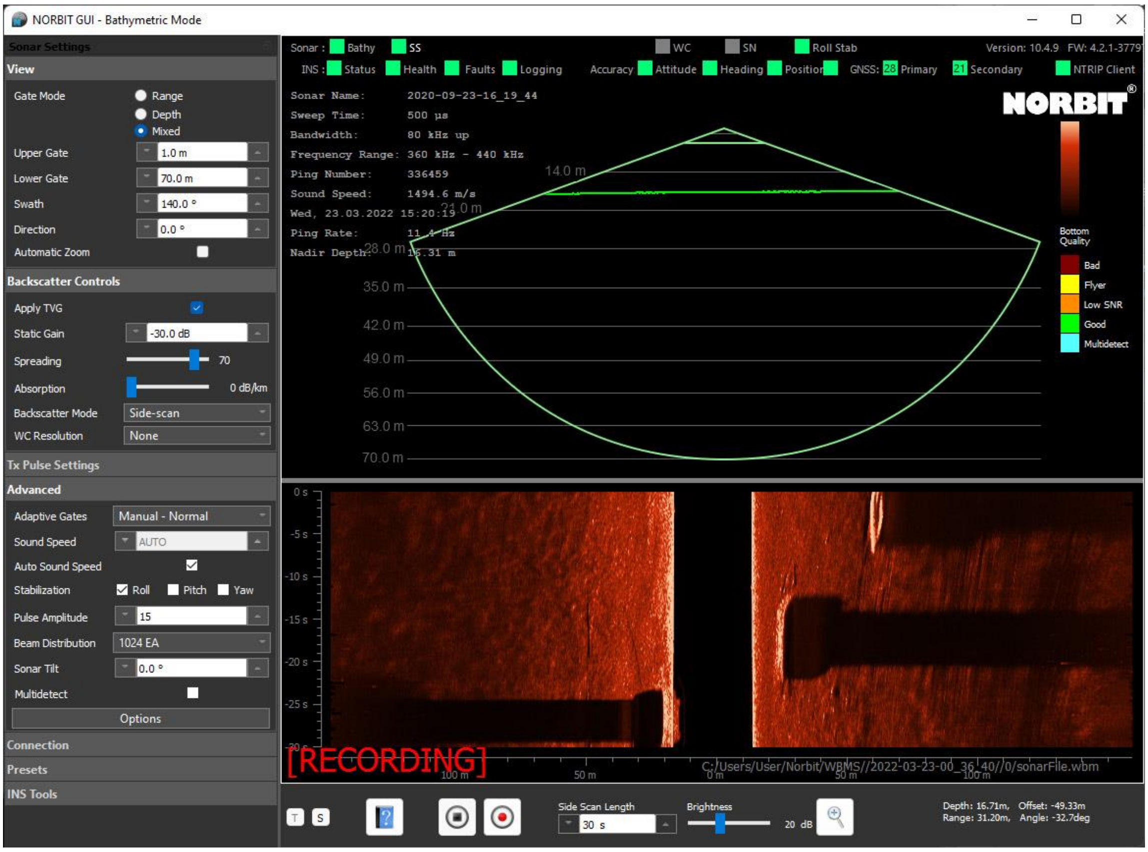


The message should be interfaced serially to a COM port on the PC where the NORBIT GUI is installed, or through Ethernet using the UDP protocol. The required sign convention is port up positive for roll, bow up positive for pitch, and in the case of EM3000, heading is positive clockwise. Enable the **Use TSS1** or **Use EM3000** checkbox as appropriate, select the communication method (**Use COM Port** or **Use UDP Port**) and set the required communication parameters.

High update rates of at least 50Hz are recommended. The minimum baud rate for a 50Hz update rate is 19200. The selected baud rate must match the output setting from the external sensor.

4.7 Sonar Wedge Display

The sonar wedge shows a single ping of data from a thin slice of the water column. The wedge comprises 256, 512, or 1024 overlapping beams, which each produces a depth sounding.



The sonar wedge is used to assess data quality and swath coverage. Currently applied settings and statistics are summarised and displayed next to the sonar wedge, e.g. frequency, sound speed, date and time, and ping number. The software and firmware versions are displayed at the top right corner.

Each detection has an associated quality flag, which can be used as filters in post-processing software (HYPACK, Qimera, etc.). Multi detections are flagged as such when the Multidetect option is enabled (see section 4.8.5 for details).

Quality	Description	Flag
Bad	Low SNR, low collinearity	0
Flyer	High SNR, low collinearity	1
Low SNR	Low SNR, high collinearity	2
Good	High SNR, high collinearity	3
Multidetect	Additional detections	4

When two sonars are connected in dual head mode, two swaths are displayed, and each swath is labelled primary and secondary. For more information refer to Appendix A2.

4.7.1 Status Indicators

The ***Sonar*** indicators show the streaming status of various data types, as requested by the acquisition software via TCP/IP subscription. If the **SS**, **SN** or **WC** indicators are red, it indicates that the signal is saturated. Adjust the TVG settings under **Backscatter Controls**, as described in section 4.8.3.

Indicator	Description
Bathy	Bathymetric detections
SS	Side Scan
WC	Water Column
SN	Snippets
Roll/Pitch Stab	Stabilisation Status

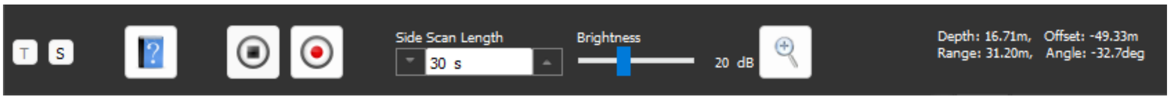
The ***INS*** indicators relate to the function and health of the integrated INS. Mouseover the indicators to display additional information such as current position, attitude, and accuracy.

The **Logging** indicator shows when raw INS data is recording. The GUI automatically logs INS data when the GUI is launched. This can be used for POSPac processing or for applying True Heave data. The log folder path is displayed by hovering over the indicator and can be changed as described in section 4.8.5.

The **Status** indicator provides the current solution status (FIXED RTK, Pri. DGNSS, etc.) as well as the status of the current corrector stream.

INS Status	Navigator Description
DR (Dead Reckoning)	No GNSS input is available; navigation is using only the IMU data
RTCM DGNSS	Tightly coupled using raw observables plus corrections (RTCM 1 or 9)
CODE DGNSS	Tightly coupled using raw observables plus corrections (RTCM 18 and 19, CMR, CMR+)
FLOAT RTK	Tightly coupled using raw observables plus corrections (RTCM 18 and 19, CMR, CMR+)
FIXED RTK	Same as Float RTK but better accuracy
Pri. C/A	Closely coupled using primary GNSS position data in C/A mode
Pri. DGNSS	Closely coupled using primary GNSS position data in DGNSS mode
Pri. P Code	Closely coupled using primary GNSS position data in P-CODE mode
Pri. RTK	Closely coupled using primary GNSS position data in RTK mode
Aux. DGNSS	Loosely coupled using auxiliary GNSS position data in DGNSS mode
Aux. P Code	Loosely coupled using auxiliary GNSS position data in P-CODE mode
Aux. Float RTK	Loosely coupled using auxiliary GNSS position data in Float RTK mode
Aux. WL RTK	Loosely coupled using auxiliary GNSS position data in Wide Lane RTK mode
Aux. NL RTK	Loosely coupled using auxiliary GNSS position data in Narrow Lane RTK mode

4.7.2 Viewer Bar



By default, the sonar starts pinging once connected to the GUI. The Play /Stop button is used to start/stop pinging. Pinging should be stopped when the GUI is running with the sonar out of water, to prevent electronics from overheating.

Users may also set the **Side Scan Length** and adjust display **Brightness**. The **Brightness** control bar only adjusts the wedge intensity displayed on the GUI; it does **not** affect the raw data signal. This can be used to effectively increase the illumination of received acoustic data. Applying too much brightness will saturate the image of the more reflective areas of the acoustic display, while applying too little results in a very dark image.

The **Zoom** tool opens an adjustable pop-up window on the sonar wedge. The window can be dragged to any part of the wedge to magnify any segment of the swath.

T Displays a time trace for each beam separately when the water column is active. Right clicking allows the user to zoom in, while left clicking resets the zoom. Channels can be selected using the arrows at the bottom. A graphical selection appears on the wedge.

S Hide/unhides the sonar settings menu. The user still has control of the gates, and therefore the sonar range, by clicking/dragging the gates interactively on the wedge.

Selecting activates raw data recording, which is described in further detail in section 4.9.1. Recorded data can be replayed at any time (even during real time sonar operation and recording), as described in section 4.8.6.3.

4.7.3 Backscatter Optimisation

Tuning the display **Brightness** (on the lower GUI bar) and **Gamma Correction** (under **Advanced > Options**) is only for visual purposes and does not impact the raw data signal. TVG settings, on the other hand, impacts data output, as described in section 4.8.3.

Step 1. From the factory sonar settings, do not adjust **Brightness**. Use the default value of 20dB.
Step 2. Under **Backscatter Controls**, enable **Apply TVG**, set the **WC Resolution**, and select the **Backscatter Mode** (Side scan, Snippets or Snippets/Scan).
Step 3. Set **Absorption** to 0dB or **Use calculated absorption** when the environmental parameters (**Temperature** and **Salinity**) are known.
Step 4. Adjust **Static Gain** until the backscatter image appears unsaturated.
Step 5. Adjust **Spreading** so that on flat seafloor the entire swath is of equal intensity.
Step 6. Make minor adjustments to **Spreading** and **Absorption** to maintain a display with equal intensity across the seafloor.
Step 7. Adjust **Brightness** on the display control bar if desired (for visual purposes only).

These settings are dependent on current environmental conditions (water sediment content, salinity, temperature, etc.) but work well in general for shallow water operation. Ensure that the **SS**, **SN** and **WC** indicators remain green (unsaturated) as saturated imagery will not be salvageable.

4.8 Sonar Settings

4.8.1 Recommended Settings

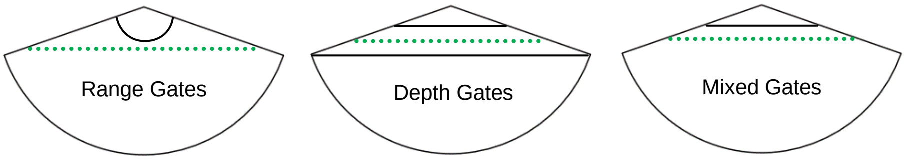
As a starting point, the following settings are recommended for general bathymetric surveys in shallow water. For specific applications (e.g. quay wall inspections), or deep-water surveys, the settings should be adjusted as per the recommendations in the following sections.

- ✓ Use **Mixed** gates and set the **Upper Gate** to at least 1m.
- ✓ Enable **Adaptive Ping Rate** and set the **Lower Gate** beyond the expected maximum depth, e.g. at 20m depth, set the Lower Gate to 100m in Range/Mixed modes, or 200m in Depth mode.
- ✓ With **Adaptive Ping Rate** enabled, setting the **Lower Gate** beyond the maximum depth ensures fast ping rates, regardless of the Lower Gate (range) setting. This makes the sonar effectively “hands-off” by removing the need for constant gate adjustments as the depth changes.
- ✓ Enable **Automatic Zoom** to keep the active portion of the wedge visible on the display.
- ✓ Set a **Frequency** that matches the sonar’s optimised frequency (400kHz for standard systems).
- ✓ Enable **Auto Mode** and **Resolution** under Tx Pulse Settings.
- ✓ Set the **Swath** angle to 120-140°. Monitor the quality of the outer beams and adjust accordingly.
- ✓ Set **Adaptive Gates** to Normal and choose the desired **Beam Distribution** mode.
- ✓ Enable **Roll Stabilisation** (along with Pitch and Yaw Stabilisation, when available on certain models) to provide even sounding coverage in dynamic sea states.

4.8.2 View

View settings control the size of the swath and distance (range) over which the sonar will search for bottom detections. The sonar range (i.e. how far the sonar listens for a return signal) is a function of the **Lower Gate**, **Swath** angle, and swath pointing **Direction**, and must be greater than the expected maximum depth.

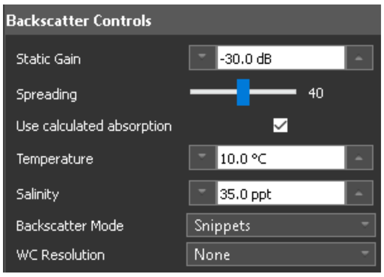
As well as controlling range, the gates also serve as a noise filter by forcing bottom detections between the upper and lower gates.

Setting	Description
Gate Mode	Gates set the range of the sonar, as well as forcing bottom detections between the **Upper Gate** and **Lower Gate**, acting as a noise filter. There are 3 options: • **Range**: The upper gate is radial, and the lower gate is the outer edge of the swath. Ideal for shallow water bank to bank surveys, or when changing the **Direction** to survey vertical structures up to waterline. • **Depth: T**he upper and lower gates represent fixed depths, with the lower gate attached to the two corners of the wedge. Suitable for most environments. • **Mixed (Recommended):** A combination of the previous two modes, with the upper gate a fixed depth and the lower gate attached to the lower edge of the swath. Useful for surveys with rapid depth changes because the lower gate does not require as much attention from the operator.  When **Depth** mode is active, changing the **Direction**, or operating with a physically tilted head, may drastically reduce the ping rate. To avoid this, select **Range** or **Mixed** mode.

Upper Gate	Sets the upper limit for bottom detections. Adjust by entering a number and pressing Enter on the keyboard, by clicking the up/down arrow buttons, or by clicking/dragging the gate. A minimum of at least 1m is recommended to avoid false surface detections. **Minimum Value:** 0.1m **Maximum Value:** 599m
Lower Gate	Sets the maximum depth (or range) limit for bottom detections. It should be adjusted so that the seabed is above the two corners of the wedge. Adjust by entering a number and pressing Enter on the keyboard, by clicking the up/down arrow buttons, or by clicking/dragging the gate. **Minimum Value:** 1.0m **Maximum Value:** 600m (1600m for 100kHz Long Range models)
Swath	Sets the total angular swath coverage. For typical harbour dredge surveys, this value is normally set to 120-150°. Reducing the angle compresses the beams into a smaller sector, increasing the overlap between adjacent beams. **Minimum Value:** 5° **Maximum Value:** 210°
Direction	Sets the direction of the swath pointing angle. Useful when surveying slopes, shoreline or for mapping vertical structures. 0° places the swath symmetrically around nadir. To maximise ping rate while using this feature, it is recommended that **Range** mode is activated.
Automatic Zoom	Makes the active portion of the wedge full screen (for display purposes only). This ensures that detections are clearly visible on the display, even when the range is very long. This is most effective when using **Adaptive Ping Rate** with a large lower depth or range gate.

CAUTION: In **Equidistant** mode, the swath angle cannot be increased such that any part of the swath exceeds an 80° pointing angle, i.e. 10º from horizontal (so, a 160° swath with 0° rotation or a 120° swath pointed 20° is the maximum.)

4.8.3 Backscatter Controls



Backscatter Controls change the data dynamics and apply gain to fit in the dynamic range of the output data format (s7k). The sonar hardware has a limited time varied gain (TVG) which operates up to around 30m. Thereafter, TVG yields a constant level. This may be a problem for some processing software when creating seamless mosaics. The GUI removes this native TVG and applies the user specified TVG defined by:

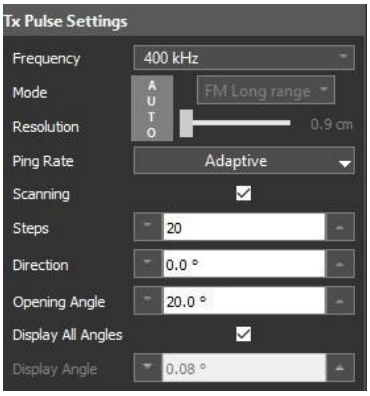
$$TVG = Spreading*Log_{10}(R) + 2*Absorption*R/1000 + Gain$$

This TVG curve is a standard continuous function to allow the signal to fit in the data format range and prevent signal saturation. This digital gain is applied to all imagery output (backscatter and water column) but has **NO** impact on bathymetry data. Refer to section 4.7.3 for tuning recommendations.

NOTE: Snippets and water column data output are automatically disabled when the 1024 High Density Soundings (HDS) beam distribution option is enabled on the WBMS series.

Setting	Description
Static Gain	Sets a fixed gain value that is used to together with **Spreading** and **Absorption** to form the TVG curve. The default setting of -30dB (WINGHEAD) or -20dB (WBMS) is suitable in most cases. Adjust the setting if the sonar signal becomes saturated, in which case the **SS/WC/SN** LED indicators appear red at the top of the GUI (see section 4.7.1). This setting is recalculated automatically when the **Spreading** or **Absorption** settings are adjusted.
Spreading	Sets the spreading component of the TVG calculation. Spreading loss is a geometrical phenomenon in which signal intensity is reduced with increasing range, as wave fronts are spread over a larger area. The default setting is 70 for WINGHEAD and 60 for WBMS.
Absorption	Sets the absorption component of the TVG calculation, accounting for transmission loss caused by conversion of acoustic energy into heat, the rate of which depends on the environment. The default setting is 0dB/km. When **Use calculated absorption** is enabled, users can specify **Temperature** and **Salinity** settings, which, alongside the centre frequency and sonar-measured nadir depth, are used to determine the correct absorption value. The sonar incorporates safeguards to prevent rapidly fluctuating nadir depth values impacting the calculated absorption. When Dual Swath or Yaw Stabilisation are enabled, the absorption value is computed individually for each centre frequency.
Backscatter Mode	Sets the backscatter mode to **Side Scan**, **Snippets**, **Snippet/Scan** or **None**. If side scan data is requested by the acquisition software when **Snippet/Scan** mode is selected, **Snippets-Sidescan** is generated so that (unlike regular side scan) a correctly positioned side scan can be derived from snippets. When surveying with a NORBIT STX model, if backscatter data is required, users are advised to deactivate **Scanning** under **Tx Pulse Settings**. If the goal is to classify bottom types, collection of Snippets will be most helpful. Otherwise, snippets should be deactivated to conserve disk space and computational resources and note that snippets collection is limited to 18Hz on the WBMS series to ensure smooth data collection.
WC Resolution	Sets the resolution of water column data and displays it on the wedge. Water column data is output on record 7042. Note that if the resolution is set to **None**, water column will **NOT** be recorded to raw *.wbm/*.s7k files. It is advised to keep the resolution low when computational resources are scarce. WC data collection is limited to 5Hz on the WBMS series.

4.8.4 Tx Pulse Settings



Tx Pulse Settings control the characteristics of the acoustic transmission signals, which impacts data quality, resolution, ping rate, and range performance. For most survey applications, the default settings are suitable, and these settings do not need to be changed.

When the GUI detects a sonar model with steerable transmission functionality, this menu activates additional options. These controls are not visible if a standard WINGHEAD or WBMS is detected. For additional information on STX operation, refer to section 1.2.

Setting	Description
Frequency	Sets the centre frequency of the transmitted pulse. For a given depth, higher frequencies have higher bottom detection resolution, but also higher signal attenuation, especially in the presence of sediments. For most applications, NORBIT recommends maintaining a frequency close to the centre frequency, e.g. select 400kHz for standard systems. **Standard Systems:** 200kHz – 700kHz (optimised for 400kHz) **Long Range 200kHz:** 160kHz – 400kHz (optimised for 200kHz) **Long Range 100kHz:** 70kHz – 240kHz (optimised for 100kHz)

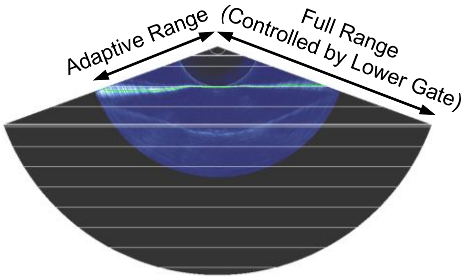
<table>
<tr><td>Mode</td><td>Sets the sweep time of the signal transmission, which impacts range performance and ping rate. The available selections are:

FM Long Range (recommended for most applications)
FM Short Range (for surveys in shallow water <5m)
FM Extended Range (for deep water surveys, generally >150m)
CW (legacy option, not recommended)

FM Extended Range (available on certain models) applies longer sweep times to increase range performance and should generally be used with 200kHz frequency or less. Note that reducing sweep time increases the effective ping rate in very shallow water. For CW mode (not recommended) sweep time controls the range resolution and increases range performance at the expense of bottom detection quality. In FM modes (recommended), sweep time has no impact on range resolution.</td></tr>
<tr><td>Resolution</td><td>Sets the acoustic range resolution by controlling the pulse bandwidth. For FM modes, resolution is calculated as c/2*Bandwidth, where c is the speed of sound. When maximum resolution (0.9cm) is set, 80kHz bandwidth is applied. Therefore, with a centre frequency of 400kHz, the transmission sweeps from 360-440kHz.

Moving the slider to the right enhances range performance in deep water by reducing bandwidth, but it generally should not exceed 8cm (9kHz bandwidth) to ensure high data quality. In CW mode, the frequency transmission is constant. However, the system performs optimally in FM modes, yielding highest resolution regardless of depth.</td></tr>
<tr><td>Automatic Mode and Resolution (Auto)</td><td>Adjusts Mode and Resolution for best performance in nearly all survey conditions. For backscatter surveys, unless very high ping rates are desired in shallow water, disable Auto and use FM Long Range with 0.9cm Resolution to ensure full processing of the backscatter signal. The system will otherwise switch between short and long pulses, which some processing software is unable to compensate for. For Long Range models in deep water (generally >150m), disable Auto and manually activate FM Extended Range.</td></tr>
<tr><td>Ping Rate</td><td>Sets the rate at which acoustic pulses are transmitted, which, together with vessel speed, impacts along-track sounding density. Certain factors such as depth and sweep time (Mode) will limit the maximum achievable ping rate. In deeper water, lower ping rates should be expected since the signal travel times are longer.

Adaptive (Recommended): The system searches for the greatest bottom detection range over a certain number of pings and revises the transmission timing to match this. This ensures that the system always pings at the maximum rate, regardless of where the Lower Gate (range) is set. Ideal for high resolution data over rapidly changing bottoms or surveys that do not allow for full-time, hands-on operators.



Full Range: The ping rate is based on the total effective range as defined by the Swath angle, swath Direction and Lower Gate. The rate is a function of the two-way travel-time of the signal from the projector to the bottom and back again, plus a small duration for ping processing and capacitor charge.
Fixed: The ping rate will not exceed the fixed value, even when the range makes it theoretically possible to do so. The maximum rate is based on the range as determined by the Lower Gate. Useful for reducing data volumes when operating at very short ranges (e.g. low altitude ROV surveys), as the system will attempt to ping as fast as possible up to the user defined threshold or the sonar range.
</td></tr>
</table>

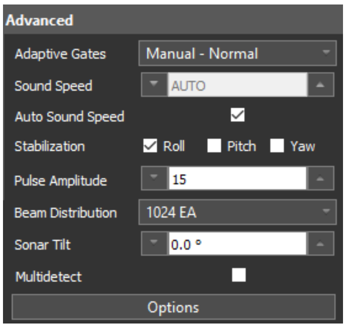
	• **External:** Each ping is triggered externally and only happens if the sonar is 'ready' when the signal arrives, e.g. if the sonar cannot ping faster than 10Hz due to range limitations, but the external signal is 12Hz, every other event will be skipped resulting in a 6Hz ping rate per every other signal. The external signal polarity is configurable. The minimum delay from the transmit signal to the centre of the transmit pulse is 500µs (half the transmit pulse buffer plus additional). An adjustable trigger delay is possible with millisecond resolution.
Scanning*	Directs the sonar to sweep an along-track angular sector defined by the **Opening Angle**. If disabled, the sonar is directed to ping in one direction only, effectively behaving as a conventional multibeam sonar. It is **NOT** advised to perform an entire survey with scanning enabled. Use scanning only when attempting to further develop areas of interest.
Steps*	The number of steps corresponds to the number of slices, or pings, in each defined along-track sector. For most applications, use a step size equal to, or less than, 20. This is configurable only if **Scanning** is enabled and the **Opening Angle** is set to a non-zero value. If the number of **Steps** is 20, and the **Opening Angle** is 20°, and the sonar ping rate is 20Hz, it will take exactly 1 second for the sonar to scan the 20° sector.
Direction*	Defines the angular direction forming the centre of the along-track sector, e.g. for a **Direction** of 5° and **Opening Angle** of 10°, the STX sonar will scan across a sector from 0° to 10°.
Opening Angle*	Defines the angular sector through which the transmit beam is steered. Steering is limited to ±10°, and as the angular **Direction** increases by 1°, the maximum **Opening Angle** decreases by 2°. If the **Direction** is 0°, the maximum **Opening Angle** is 20°.
Display all Angles*	When enabled, this instructs the GUI to display all angles in the sector being scanned by the STX. When disabled, the GUI will display only the angle defined in **Display Angle**.
Display Angle*	The user may define a single angle within the sector to show on the display. If **Display all Angles** is enabled, this setting is greyed out.

** Available on steerable models only. License-controlled for WINGHEAD "S" series and iWBMSh Stabilised.*

CAUTION: High quality sonar data requires excellent Signal to Noise Ratio (SNR). For most conditions (temperature and salinity dependent) use **FM Long Range** mode with **0.9cm** resolution. If the useable swath width becomes narrow, gradually move the **Resolution** slider to the right. If in doubt, use **Auto.**

CAUTION: To obtain optimal backscatter results for bottom classification surveys using snippets, disable **Auto** and set **Mode** and **Resolution** manually. Changing these settings during a survey, or using **Auto** mode, may degrade data quality as the processing software is unable to compensate for variable pulse characteristics. In general, **FM Long Range** should be used. When faster ping rates are required, use **FM Short Range**.

4.8.5 Advanced

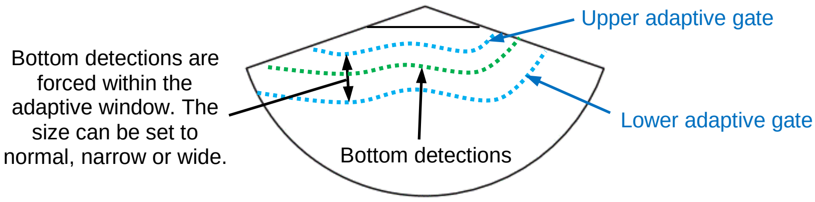


Advanced settings allow the user to further customise the sonar configuration. The options shown in the GUI depends on the sonar model, as some features are hardware limited, and some features are license controlled.

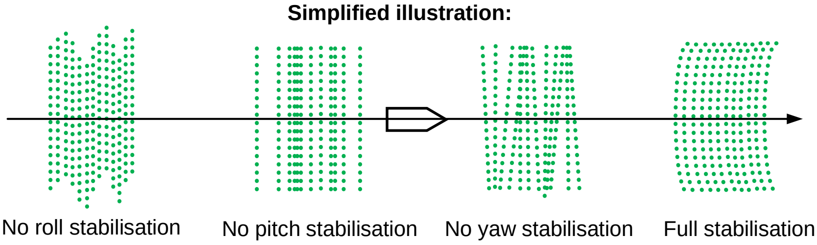
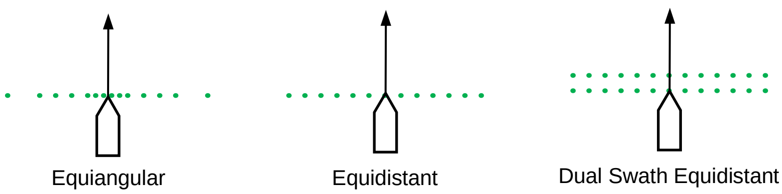
Pitch and yaw stabilisation are only available on NORBIT sonars with steerable transmission functionality. When Multidetect is enabled, additional options are shown to control the detection sensitivity and output settings.

<table>
<tr><th>Setting</th><th>Description</th></tr>
<tr><td>Adaptive Gates</td><td>Adaptive Gates automatically track and follow the shape of the seafloor and are used to improve detection quality, working on conjunction with the fixed upper/lower gates. Note that they are NOT visible on the display. In areas with steep gradients or rapidly changing seabed, select Wide or Off. If the gates are too wide (or off), false detections may occur due to noise, second returns or marine life. The following applications are well suited for the corresponding settings:

Dredging Surveys: Normal Adaptive Gates
Engineering Surveys: Normal or Wide Adaptive Gates
General Bathy Surveys >40m: Narrow Adaptive Gates
General Bathy Surveys <40m: Normal Adaptive Gates
Wreck or Complex Structure Surveys: Wide Adaptive Gates or Off

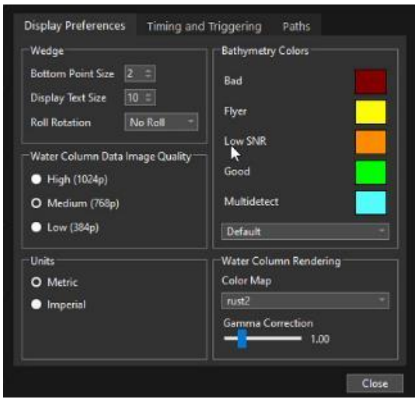


In some sea states, the gates may need to be set wider to avoid clipping data during large roll events. It is advisable to use adaptive gates in nearly all environments.</td></tr>
<tr><td>Sound Speed</td><td>Controls how the surface sound speed is applied for beam steering computations. If Auto Sound Speed is enabled (recommended) the sonar uses values from the integrated SV sensor. An incorrect surface sound speed will irreparably compromise data quality. The input range is 1300m/s to 1700m/s, which reflects default hardware capabilities. For marine conditions requiring a larger range, other models of the sound speed probe are available. When Auto Sound Speed is disabled, the last value at the head is used.</td></tr>
<tr><td>Auto Sound Speed</td><td>When this option is enabled, the speed of sound is taken from the probe at the sonar head. This is recommended unless the probe is damaged, out of calibration, or there are too many bubbles affecting data quality, e.g. when surveying in rapids or surf-zone. If the sonar is powered on and out of water, or excessive bubbles are present, the GUI displays a warning that the sonar is “Out of water” and the sonar will stop pinging after a short period of time to prevent damage due to overheating. If the sonar temperature exceeds 65°C it will shut down automatically as a safety precaution.</td></tr>
</table>

Stabilisation	Motion stabilisation is used to increase survey efficiency, and is unrelated to motion compensation for georeferencing purposes, which is handled separately. Note that not all options may be available. • **Roll:** Allows for a wider swath width in more dynamic sea states. Roll stabilisation compensates up to ±10º of roll and is limited to 160º swath angle. • **Pitch:** Allows the transmit beam to be compensated for up to ±10º of vessel pitch motion, providing more even along-track sounding coverage. • **Yaw:** Provides evenly distributed along-track soundings, and prevents gaps in coverage, by compensating for changes in vessel heading (up to ±10º) using NORBIT's steerable transmission technology. **Simplified illustration:** 
Pulse Amplitude	Sets the transmission power. For shallow waters (<10m) in highly reflective areas (e.g. lock chambers) it may be necessary to slightly reduce the pulse amplitude to reduce acoustic reflections and noise. Otherwise, it is best to leave it set to 15. Note that this option is disabled when **Auto** Mode/Resolution is enabled (recommended).
Beam Distribution	Several options are available providing both Equiangular (EA) and Equidistant (ED) beam spacing. Do not switch modes while logging data, as there is a short 1 second lag when switching modes. Note that not all options may be available. • **1024/512/256 EA**: The angular swath coverage is divided equally by 1024, 512 or 256 (the total number of beams) to determine the angular beam spacing. Use this mode to increase resolution around the nadir zone. • **1024/512/256 ED**: The beams are distributed across the swath so that the footprints have the same distance between them. The angular spacing varies across the swath. Use to increase resolution at the outer swath edges. • **Dual Swath 2048 EA/ED**: Use this mode to increase along-track sounding density, or increase survey speed, by transmitting multiple pings simultaneously. This mode outputs 2x1024 soundings per ping, offset by ±1°. The benefits are most evident in deeper waters; at very short ranges (<10m depth) the benefits are minimal. • **Pipeline Mode**: A combination of high-sounding density in the central swath region (±50°), where the pipeline is located, and equidistant distribution in the outer region, allowing more hits on the pipe. This mode also optimizes the transmit pulse settings (frequency and pulse mode) for pipeline detection. **Simplified illustration:** 
Displayed Swath	Controls which ping is displayed when the Dual Swath beam distribution option is enabled. Applicable for certain models only.
Sonar Tilt	Specifies the tilting angle in special mounting configurations such as dual head when the sonar is mounted at an angle. For display purposes only. Allows the user to normalise the display in the GUI, otherwise a flat seafloor will appear as a slope. Note that additional considerations are required when the integrated IMU is tilted. Refer to the technical note TN-190018 for details.

<table>
<tr><td>Multidetect</td><td>Record up to 3 detections per beam, with one additional detection above and below the primary bottom detection. The upper/lower gates control which part of the water column is considered for additional detections. Adaptive Gates control how close the additional detections are to the primary detection. If set to Wide or Off, the additional detections could be further away from the primary detection, and if set to Narrow, the additional detections are closer to the primary detection. Multidetect should not be enabled for the entire duration of the survey, as it may increase false detections and require additional data cleaning. It should only be used to further develop areas of interest.</td></tr>
<tr><td>Multidetect Sensitivity</td><td>Adjusting the slider increases or decreases the sensitivity of the multi-detection algorithm to qualify the water column as a potential extra detection.</td></tr>
<tr><td>Multidetect in S7k Output</td><td>Select whether to output an additional detection above (Upper) and/or below (Lower) the bottom detection in s7k files generated by the GUI.</td></tr>
<tr><td>Options (Display Preferences, Timing and Triggering, Paths)</td><td>

Display Preferences



Bottom Point Size: Changes the point size on the wedge. Adjustable from 1-10.

Display Text Size: Changes the text size on the wedge area. Adjustable from 1-12.

Roll Rotation: Viewing options to show the roll stabilised wedge.

Water Column Data Image Quality: Sets the resolution of the water column display. This does not affect output resolution. To ensure system resources are kept to a minimum for low-grade field laptops, run with medium or low graphics selected.

Units: Selects the display units in the GUI to be shown as either metric or imperial.

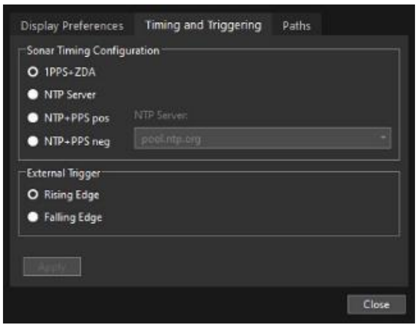
Bathymetry Colours: Adjusts the colour palette of bottom detection quality flags.

Colour Map: Offers different colour settings for visualising the swath intensity data.

Gamma Correction: Changes the visual contrast of the wedge intensity data. Setting the gamma too low will mute the intensity in the wedge display to nearly all off (black). Setting gamma too high will fuse the darkest areas with the brightest areas. A value of 2 is often the best.

Timing and Triggering

Users can specify the synchronisation method for sonar timing. Note that for the WINGHEAD series, the timing scheme is controlled from the Web UI at http://192.168.53.XX:8080, where XX is the last 2 digits of the sonar serial number. For most installations, 1PPS+ZDA should be selected, in which case the GNSS signal provides the time stamp and associated 1PPS signal to the sonar.



If timing direct from the SIU (via the GNSS receiver) is not possible, e.g. on ROV/AUV or other types of custom installations, then timing from an NTP Server may be used. Enter the network IP address of the computer that runs the NTP service. The port number is not required.

NTP+PPS has the same accuracy as 1PPS+ZDA and is recommended for all other installation types where 1PPS+ZDA is not possible. A PPS pulse must be sent to the system on the timing pin, and an NTP server should be made available on the network. If the timing error exceeds 10ms, the sonar will discard timing. Select NTP+PPS pos/neg if using time from an NTP server to provide PPS. “pos” and “neg” refers to a positive and</td></tr>
</table>

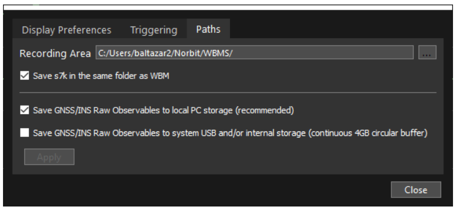
negative signal spike, respectively. When this mode is activated, an error of >100ms renders the data unusable.

If there is no PPS available, NTP without PPS can be used by selecting **NTP Server**. It possesses less accuracy but is OK to use for platforms with lower dynamics. This option requires that the NTP server is at a low STRATUM (<2) value and not too far away in the network (public servers are usually not good enough).

More advanced users can use an external signal to trigger the sonar. The **External Trigger** polarity can be set to **Rising Edge** or **Falling Edge**. **NOTE: For integrated systems, triggering via the BNC connector is not possible. Inputting any voltage to the BNC of an integrated SIU can damage the internal electronics.**

Paths

Recording Area
Sets the recording folder location for native NORBIT (*.wbm), INS (*.000 or *.T04), and s7k (*.s7k) data files. Note that the GUI must be relaunched when the recording path is changed.



Save s7k in the same folder as WBM
When this option is deselected, it is possible to define a separate logging folder for s7k files. Otherwise, s7k and WBM files will be recorded to the same folder.

Save GNSS/INS Raw Observables to local PC storage
Enables INS Ethernet data logging (*.000 or *.T04 format) for post-processing and/or True Heave extraction. This option should always be enabled, even when not post-processing INS data, as it is also useful for troubleshooting purposes.

Save GNSS/INS Raw Observables to system USB and/or internal storage
Enables INS data logging to the internal 4GB (or 10GB on certain models) storage in the SIU. When the storage is full, the oldest recordings are automatically overwritten. Recordings can be retrieved with an FTP client (e.g. FileZilla) using the following credentials:

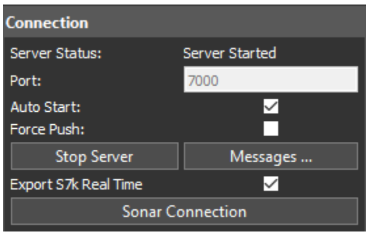
Host: 192.168.53.100 **Username:** guest **Password:** applanix

Note that for later models delivered after 2020, the password is **PSWXXXXX**, where XXXXX is the Applanix serial number found on the **INS Tools > System Status** dialog, for example PSW12345.

On Applanix AP+ models, introduced in 2024, no username or password is required.

4.8.6 Connection

NORBIT sonars operate in a native data format. To ensure compatibility with other data acquisition and processing software, the system includes a proxy that translates native NORBIT sonar data to the well-known s7k data format. The proxy is therefore run from the GUI and is initiated automatically. The connection can be reset should a conflict arise. If necessary, to avoid conflict with other sensors, the **Port** number can also be changed.



In a dual head configuration, the **Port** number set in the GUI applies to the primary sonar only. The secondary sonar port is one greater than the primary. For example, if the **Port** is set to **17000**, the primary sonar will use port **17000**, and the secondary sonar will use port **17001**. Qinsy users should note that port 7001 is occupied by the Qinsy dongle, therefore this port should be avoided.

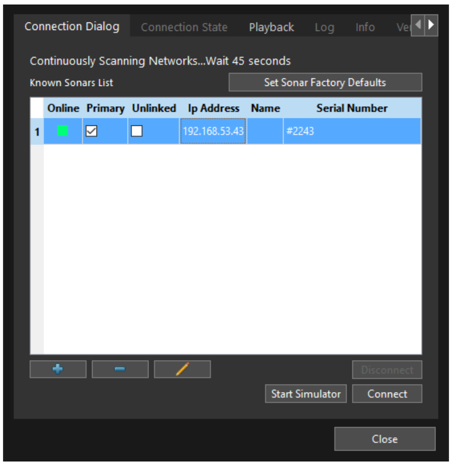
NOTE: To receive sonar and INS data into PDS and NaviScan, the **Force Push** option must be enabled. This option forces the output of 7k records without a TCP/IP subscription.

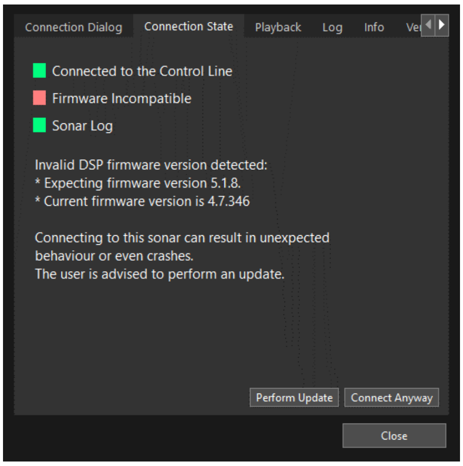
4.8.6.1 Connection Dialog & Connection State

Select **Sonar Connection** to open the **Connection Dialog**. Selecting **Set Sonar Factory Defaults** resets the sonar configuration but does not reset the integrated INS. Note that, when this option is selected, raw GNSS/INS logging briefly terminates.

Connection State contains basic information about the current connection status. If any indicators are red, action is required by the user. Such is the case in the example presented below, which shows that the sonar is not loaded with the firmware expected by the GUI (see section 4.4).

To shut down and disconnect the sonar, select **Connection Dialog**, select the sonar on the **Known Sonars List**, and select **Disconnect**.





The **Primary** and **Unlinked** options relate to dual head operation. The **Primary** selection determines which sonar is primary and secondary. By default, any setting changes apply to both systems. The **Unlinked** option allows dual head sonars to be operated independently.

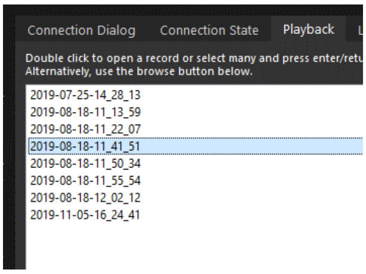
4.8.6.2 Sonar Simulator

The simulator is started via the Connection Dialog. Press **Start Simulator**, highlight the bathy simulator on the sonar list, and click **Connect**. You may receive an incompatible firmware warning; ignore this and click **Connect Anyway**.

The simulator data can be used in acquisition software for testing and training purposes. The simulator does not output sound velocity, navigational or inertial data. Consequently, simulated sonar data will not be time stamped.

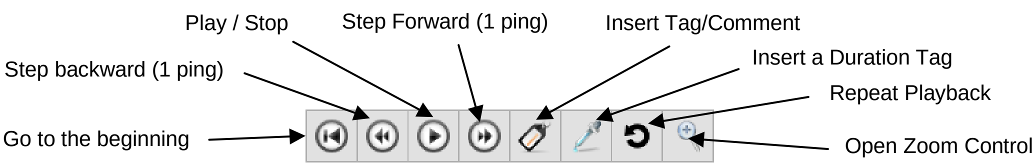
4.8.6.3 Playback

The **Playback** tab displays all detected GUI recordings. If there are GUI recordings in other folders, USB drives, etc. select **Browse** and navigate to the correct folder. To play back a recording, double-click the file name. This opens a second display next to the active wedge.



During playback, only bathymetry and water column data is displayed. By default, recordings are stored at this location: *C:\Users\<user>\NORBIT\WBMS*

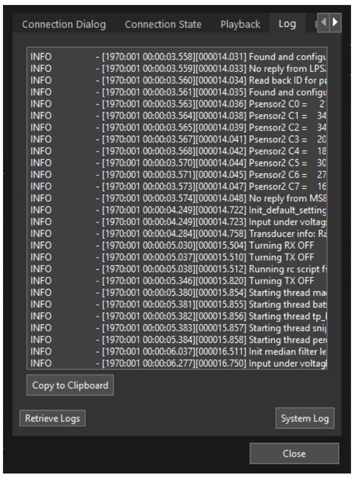
The playback window can be resized by dragging the central divider. **Settings** and **Controls** are found on the left. Users can also change the **Sonar Orientation** as required. To export the current ping, or a series of pings, use the **Export Current Ping** and **Export** buttons. Other options including s7k export and video export are found on the left menu, while playback controls are displayed at the bottom:

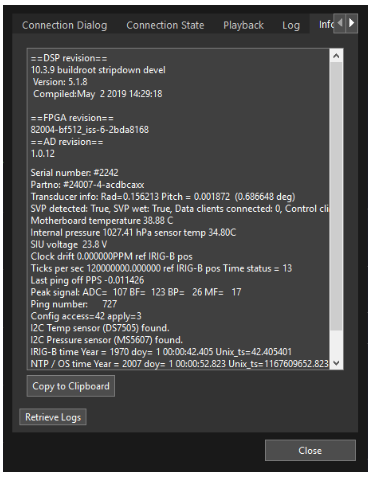


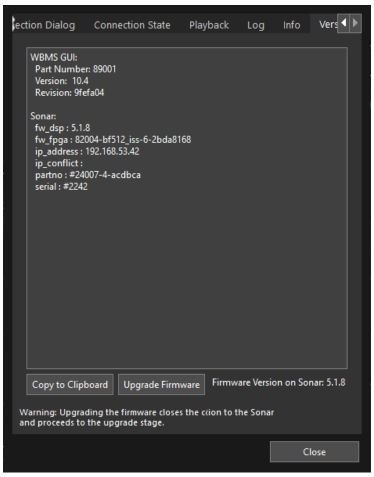
4.8.6.4 Log, Info & Version

The **Log** tab contains a record of system events, and the log files are stored at: *C:\Users\<user>\AppData\Roaming\Norbit\Logs*

The **Info** tab contains a record of serial numbers, part numbers, revision numbers, and various system statistics. The **Version** tab displays the current NORBIT GUI and firmware versions.

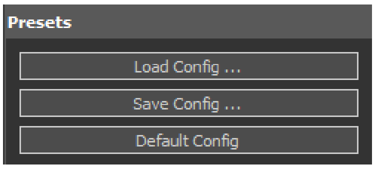






4.8.7 Presets

Users can save preferred sonar configurations by selecting **Save Config**. These files can be loaded, as and when needed, by selecting **Load Config**. Saved configurations are stored in: *%appdata%\NORBIT\PredefinedSonarSettings*



Configuration files contain all sonar settings (frequency, swath angle, static gain, etc.) and all GUI display preferences. Users may transfer files between computers to load desired presets. This functionality allows rapid reconfiguration of the sonar.

4.9 Data Formats, Recording & Output

4.9.1 Raw Data Recording

Bathymetry data with full navigation and motion data, including True Heave data (for integrated systems only) can be recorded in the native NORBIT format with extension *.wbm. At the same time, s7k files are exported automatically. The s7k format has a publicly available data format definition (DFD). If requested, NORBIT Support can provide documentation on the DFD.

The logging directory can be changed as described in section 4.8.5. Files are saved by default to: *C:\Users\{user}\NORBIT\WBMS* and each session generates a folder with the naming convention: YYYY-MM-DD-HH_MM_SS. The s7k files are automatically split into 1GB files with numerical suffixes, e.g. YYYYMMDD_HHMMSS_1.s7k, YYYYMMDD_HHMMSS_2.s7k, etc.

Recorded data types depends on the selections made within **Backscatter Controls**. The **WC Resolution** setting controls whether compressed water column data is recorded, and the **Backscatter Mode** controls what backscatter imagery is recorded. This is only relevant for raw data files recorded in the GUI and does not affect data output to acquisition software (see section 4.9.2).

Backscatter Mode Selection	WC Resolution	Recorded Data Types in WBM file	7k Records in s7k file
None	None	✓ Bathymetry ✗ Side scan ✗ Water Column ✗ Snippets	✓ 7027 ✗ 7007 ✗ 7042 ✗ 7028*
None	High/Medium/Low	✓ Bathymetry ✗ Side scan ✓ Water Column ✗ Snippets	✓ 7027 ✗ 7007 ✓ 7042 ✗ 7028*
Side scan	High/Medium/Low	✓ Bathymetry ✓ Side scan ✓ Water Column ✗ Snippets	✓ 7027 ✓ 7007 ✓ 7042 ✗ 7028*
Snippets/scan	High/Medium/Low	✓ Bathymetry ✓ Side scan ✓ Water Column ✓ Snippets	✓ 7027 ✓ 7007 ✓ 7042 ✓ 7028*

** When the Backscattering Strength Output option is enabled, record 7058 is used. See Appendix B4 for details.*

Additional Notes:

- Acquisition software subscriptions overwrite selections made in the GUI. Therefore, if the GUI does **NOT** have **Side scan** selected for **Backscatter Mode**, but side scan data is requested by the acquisition software, side scan will be recorded in the raw data files.
- Bathy intensity values at the bottom detection point are recorded within the bathymetry data packets. This is automatically output and requires no configuration in the GUI. It can be used to provide coarse backscatter, separately from side scan and snippets outputs.
- Further note that the position output for integrated systems is valid in the real time navigation datum. By default, positions are referenced to the WGS84 ellipsoid, but when GNSS corrections are interfaced, the datum may change. For example, when RTK corrections are used with NAD83, the output is NAD83.

4.9.2 Data Output via Network Subscription

Currently, the NORBIT GUI supports streaming s7k records `7000`, `7004`, `7006`, `7007`, `7027`, `7028`, `7042` and `7058` via the subscription model (record `7500` with ID 1051). All subscriptions can be ended with record `7500`, ID `1052`.

Supported single request records (via record `7500` with ID `1050`): `7001`

Successful requests are replied with record `7501` (ACK) while unsuccessful requests return record `7502` (NACK). This is based on the DFD version 2.43. The adjacent table lists the current s7k records output by the Proxy Server in the NORBIT GUI.

Record	Description
7000	Sonar settings
7004	Beam Geometry
7006	Bathymetry data (obsolete)
7007	Side scan data
7027	Bathymetry data (including bathy intensity values)
7028	Snippets data
7042	Compressed water column data
7058	Snippet Backscattering Strength (See Appendix B4)
7500	7k remote control with ID 1051
7501	7k remote control acknowledge
7502	7k remote control not acknowledge

4.9.3 Data Rates

Estimated data rates for a single head system are given below. When water column (WC) is recorded, it is assumed that Medium resolution is used.

When data recording is enabled, files are recorded in the native NORBIT format (.wbm) and are simultaneously exported to the s7k format, as detailed in section 4.9.1. The s7k files are automatically split into 1GB files with numerical suffixes, e.g. YYYYMMDD_HHMMSS_1.s7k, YYYYMMDD_HHMMSS_2.s7k, etc.

	Data Types					Data Rate by Ping Rate (Mbps)							
						50Hz		25Hz		10Hz		5Hz	
	Bathy	INS	SS	SN	WC	WBM	s7k	WBM	s7k	WBM	s7k	WBM	s7k
1024 Beams	✓	✗	✗	✗	✗	19.27	16.78	10.17	8.52	4.25	3.41	2.48	1.70
	✓	✓	✗	✗	✗	25.16	16.80	16.10	8.63	10.23	3.59	8.45	1.88
	✓	✓	✓	✗	✗	26.20	17.85	18.33	10.78	11.18	4.45	9.05	2.36
	✓	✓	✗	✓	✗	35.26	37.36	23.47	31.54	13.50	13.81	10.32	7.05
	✓	✓	✗	✗	✓	27.53	25.65	18.92	20.17	13.05	14.20	11.27	12.45
512 Beams	✓	✗	✗	✗	✗	19.73	8.54	10.17	4.31	4.30	1.72	2.48	0.86
	✓	✓	✗	✗	✗	25.15	8.62	16.10	4.45	10.23	1.90	8.46	1.04
	✓	✓	✓	✗	✗	26.25	9.56	18.37	6.61	11.18	2.77	9.04	1.52
	✓	✓	✗	✓	✗	35.26	18.92	23.47	15.94	13.50	7.00	10.32	3.61
	✓	✓	✗	✗	✓	27.53	12.41	18.92	10.21	13.05	7.23	11.27	6.33

Applanix Log files (*.000) containing raw GNSS/INS observables are recorded at 2MB/min, and models which support the *.T04 format produce considerably smaller files due to compression.

5 Data Acquisition

NORBIT recommends consulting the respective manuals of your chosen acquisition software, as this section only describes the basic setup steps for the most common software packages.

By default, integrated NORBIT systems output sonar and navigation data at the Sonar Reference Point (refer to section 3 for more details). Therefore, each device in the acquisition software requires the same offset to this location, i.e. the offset as measured from the acquisition software reference point (e.g. vessel centre of gravity) to the Sonar Reference Point. If the optional iLiDAR is installed, note that its output is valid at the iLiDAR reference point.

If the reference point in the acquisition software is chosen as the Sonar Reference Point, no further offsets are required, except for the draft offset. For HYPACK users, it is always recommended to apply offsets relative to vessel centre of gravity and note that the vertical offset is the same for all systems and should be measured from waterline to Sonar Reference Point.

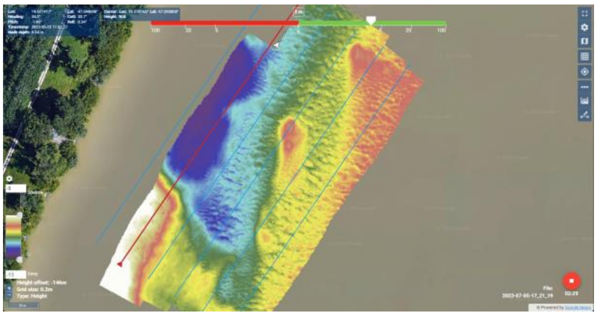
5.1 NORBIT Data Acquisition Software (DCT)

DCT is a web-based survey acquisition utility, developed by NORBIT, aimed to simplify standard bathymetry survey operations. A grid can be displayed on any computer or mobile device, allowing quick estimation of survey coverage and data quality in real-time. To enquire about DCT, please contact NORBIT Support.

DCT reports horizontal coordinates in the real time navigation datum, together with depths when the **Height** vertical datum option is selected. By default, the reported positions and depths are referenced to the WGS84 ellipsoid, however when GNSS corrections are interfaced, the datum may change. For example, when RTK corrections are used with NAD83, the DCT output is NAD83. DCT does not change the datum or apply transformations.

The basic setup steps are described below. Refer to the dedicated DCT manual for full guidance.

Step 1. Download Tiles
Background tiles from OSM and Google Maps can be optionally downloaded and saved at the office prior to commencing the survey. This is useful when an Internet connection is not available onboard.



Step 2. Start DCT
Start the application from the desktop shortcut icon using Google Chrome or Mozilla Firefox. DCT can be accessed from the same PC as the NORBIT GUI, or remotely from anywhere in the world via tablets, office computers, etc. if they are on the same network.

Step 3. Data Acquisition
Press the record button to start and stop data logging. This commands the NORBIT GUI to start logging s7k files, and a real time grid is displayed. Recorded files contain the complete survey solution (depth, position, and attitude data, including delayed heave). Line plans may also be generated, and a left/right helmsman indicator is displayed.

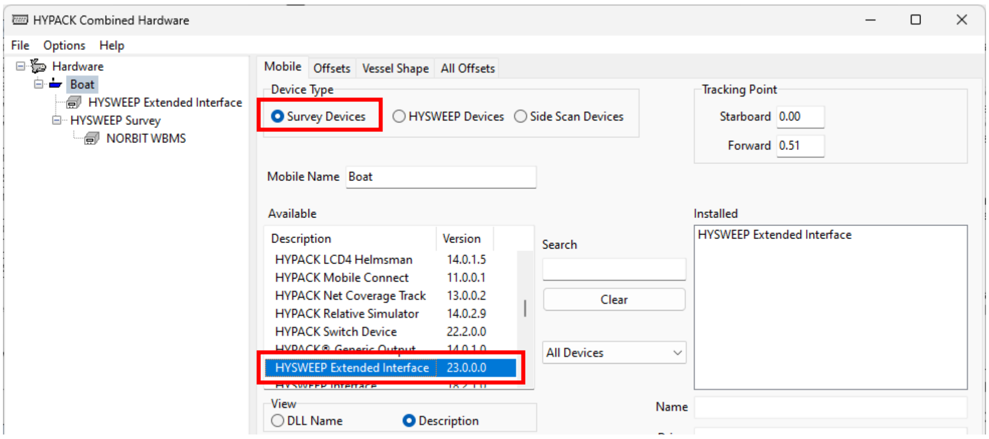
Step 4. Data Processing
The acquired s7k files should be processed using your software of choice (e.g. HYPACK, Qimera, CARIS, etc.). Here, patch test results and sound velocity profiles can be applied or refined, and the geodetic setup is defined.

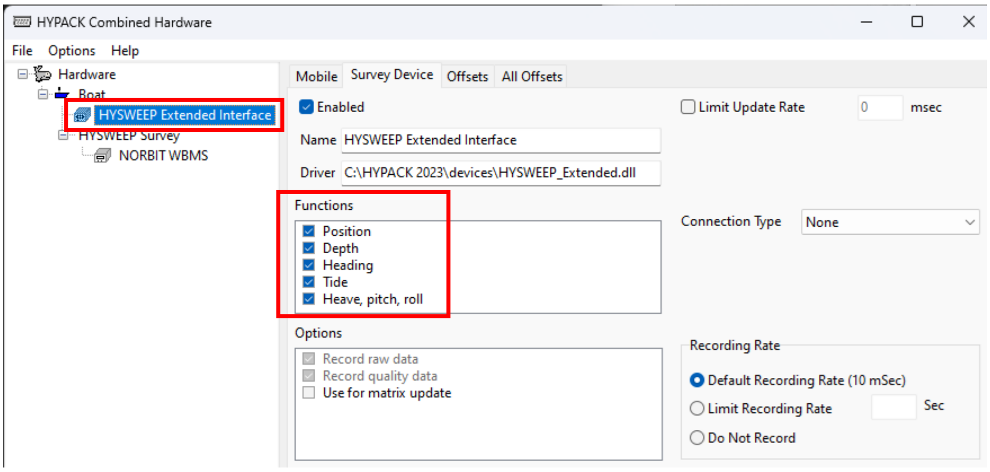
5.2 HYPACK

For more comprehensive guidance, refer to the HYPACK manuals, and note that the setup described below is based on HYPACK 2023. With integrated NORBIT sonars, all systems (navigation, attitude and multibeam) should have the same offset applied, as measured from the vessel centre of gravity to the Sonar Reference Point, while the vertical offset should be measured from the waterline. The HYPACK sign convention uses **+Forward**, **+Starboard**, and **+Down.**

Step 1. Configure HYSWEEP Extended Interface

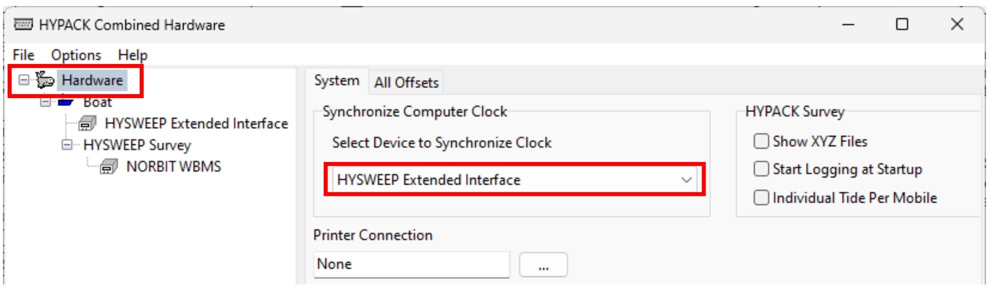
Add HYSWEEP Extended Interface from the Survey Devices list and enable all the function checkboxes (Position, Depth, Heading, Tide and Heave/Pitch/Roll).





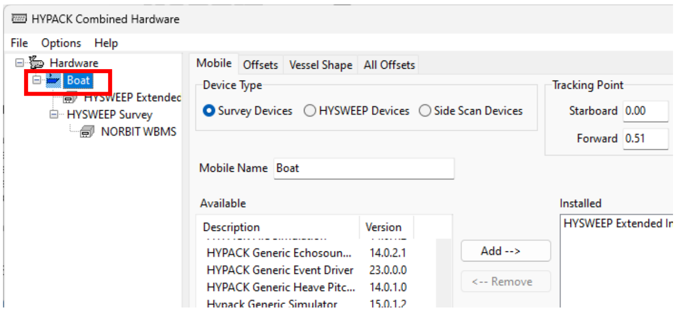
Step 2. Configure Clock Synchronization

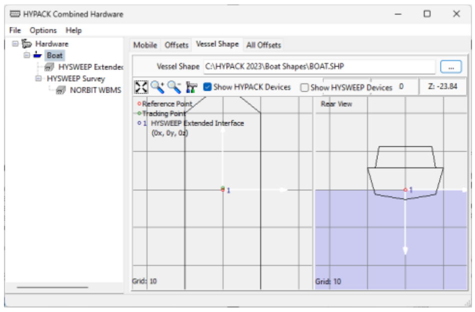
Select Hardware on the left pane and then, on the System tab, select HYSWEEP Extended Interface as the device to synchronize the computer clock.



Step 3. Define Boat

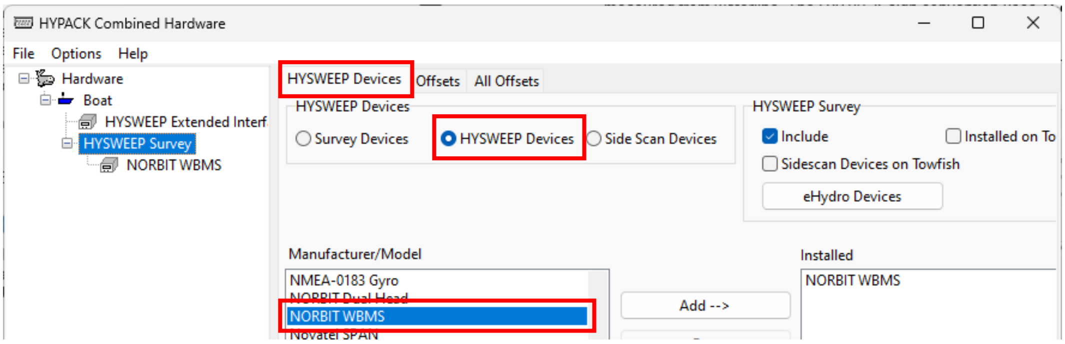
Select **Boat** and assign a name. For more intuitive visualisation, add a tracking point, preferably to the Sonar Reference Point (for standard installations). Edit the Vessel Shape as appropriate.

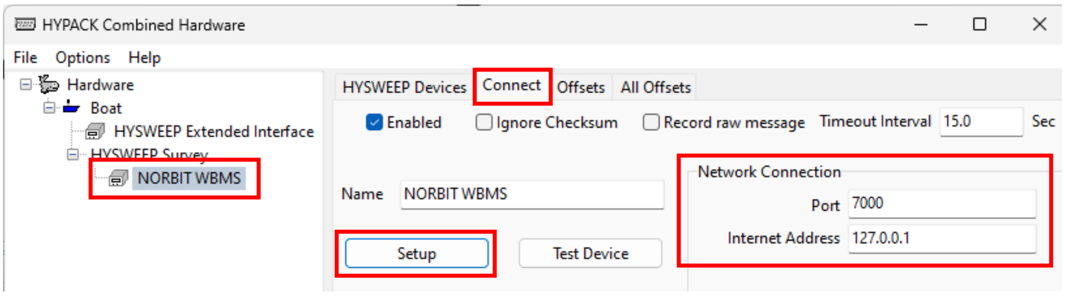




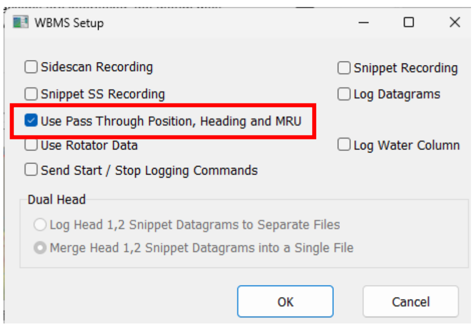
Step 4. Configure Multibeam Device

Select HYSWEEP Devices and add NORBIT WBMS from the list. On the Connect tab, the **Internet Address** should be set as the IP address of the PC running the NORBIT GUI.





On the Setup dialog, enable the **Use Pass Through Position, Heading and MRU** option. This provides the navigation solution, simplifying the setup by removing the need for the Applanix POS/MV Network devices that were required in previous versions of HYPACK.



Optionally, select **Sidescan Recording** (for recording Sidescan data), **Snippet SS Recording** (for Snippets-Sidescan), or **Snippet Recording** (for Snippets). If Snippets is requested, users must also select **Log Datagrams**.

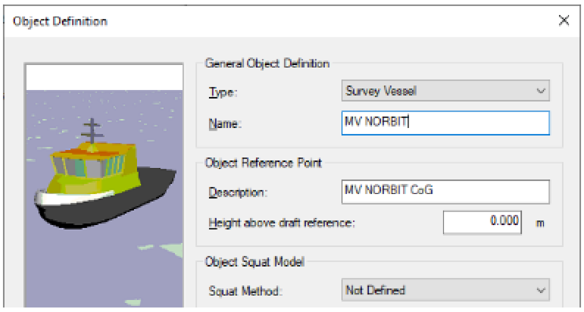
Note that bathymetry data automatically includes bathy intensity values at the bottom detection point, which provides coarse backscatter.

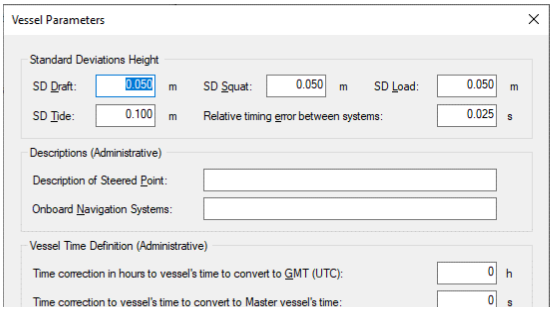
5.3 Qinsy

The following sections show recommended configuration of Qinsy v9 for all NORBIT sonars. It assumes that the INS reference is collocated with the Sonar Reference Point. Note that the Qinsy sign convention uses **X+ Starboard**, **Y+ Forward** and **Z+ Up**. Qinsy structures all data in a native database format. All data and hardware settings, including offsets, are saved to a database file.

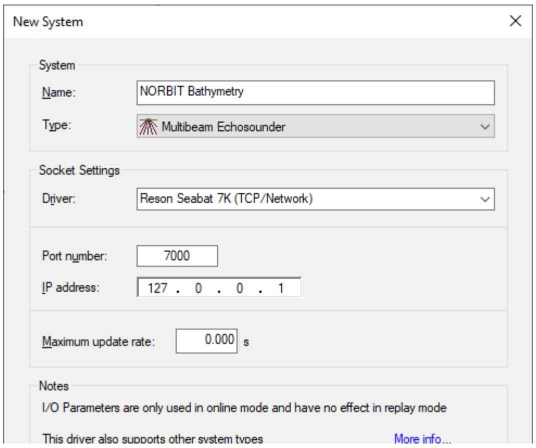
Step 1. Configure Geodesy
Access the Geodetic Configuration from the Qinsy console and specify the relevant geodesy.

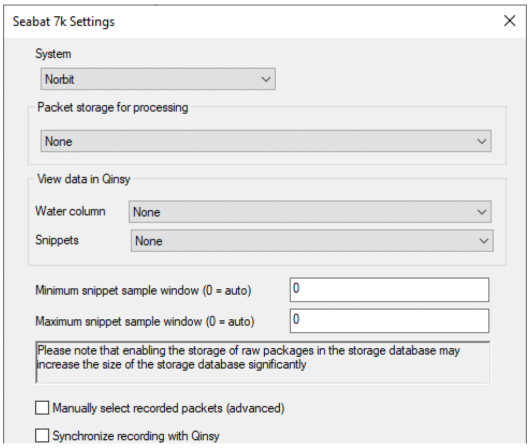
Step 2. Object Definition
From the Qinsy console, select **Setup** > **New Database** Specify the shape of the vessel and the reference point for Qinsy (e.g. vessel centre of gravity)





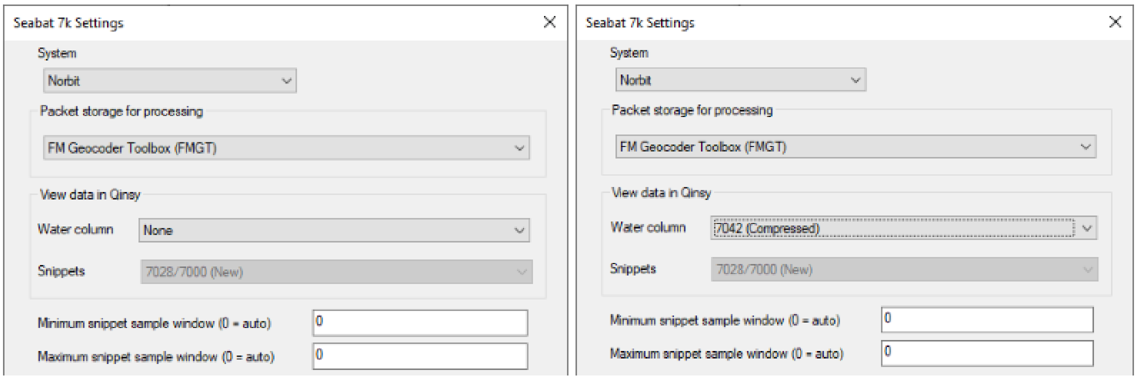
Step 3. Add Multibeam System
Specify a system name, e.g. NORBIT, and select **Multibeam Echosounder** as the type**.** Select the **Reson SeaBat 7k (TCP/Network)** driver, use port **7000** and IP address **127.0.0.1** (unless the GUI is installed on a different PC, in which case use the local network address).





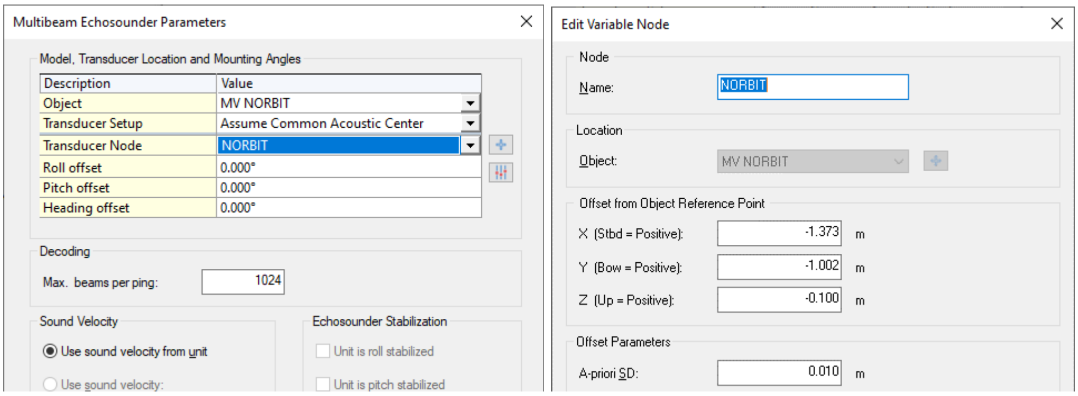
Under Raw Data Recording, for standard bathymetric data collection select the **NORBIT** System and **None** for Packet Storage, Water Column and Snippets.

Step 4. Configure Snippets and/or Water Column Recording (Optional)
To collect water column, select the 7042 (Compressed) option. To collect snippets without water column, configure the system as shown below (left); or for snippets and water column (right)



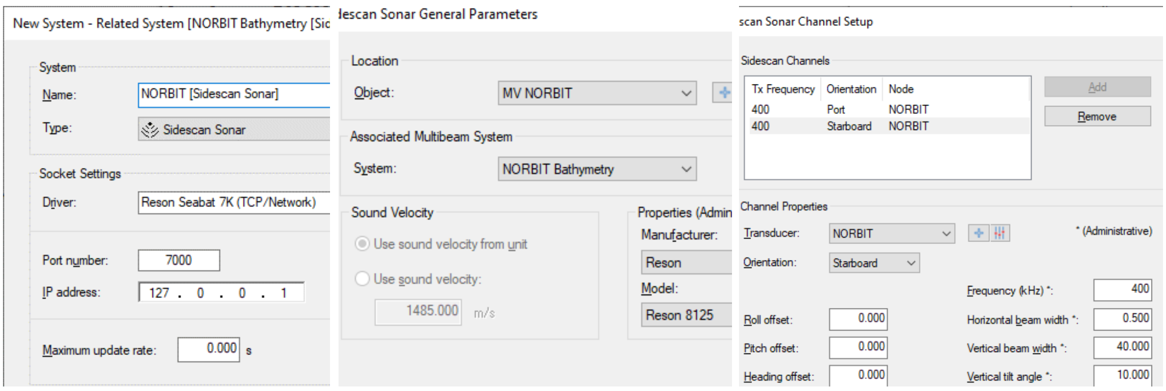
Step 5. Enter Offset to Sonar Reference Point

In Multibeam Echosounder Parameters, click the **+** button to generate a node. Patch test values (roll, pitch and heading) should be entered if known. Enter 1024 under max beams per ping. Use the default echosounder accuracy and correction values. The offsets shown are an example only.



Step 6. Add Side Scan System (Optional)

To add side scan, a port and starboard channel should be added, and the frequency should also be specified. Items marked with an asterisk (*) will not impact the data and are only for record keeping.



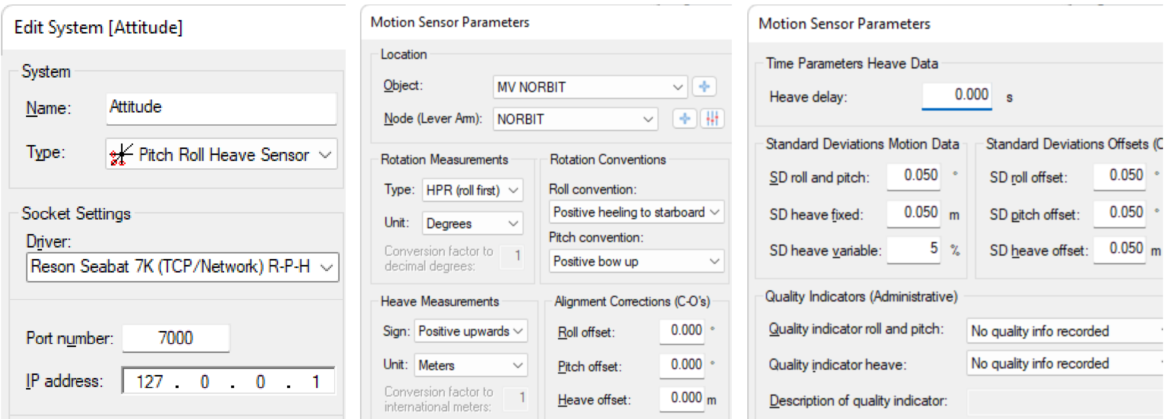
Step 7. Add True Heave System

To record delayed heave (True Heave), the **Network - POS MV V5 (Binary Group 111 - True Heave)** system should be added under the **Miscellaneous System** category. True Heave data is logged to a .bin / .txt file in the **Import** directory of the project and can be applied in post-processing to replace real time heave.

True Heave is more accurate than real time heave and is logged with a 3-minute delay. This means that Qinsy must remain open for 3 minutes before closing once the last line of the survey is finished.

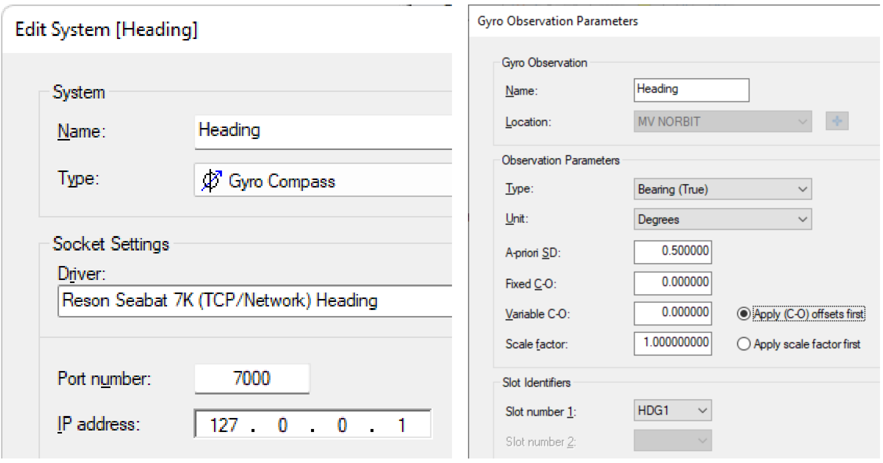
Step 8. Add Pitch/Roll/Heave System

From the Database Setup window, add a new Pitch/Roll/Heave sensor, using the **Reson SeaBat 7k (TCP/Network) R-P-H** driver and the same port number and IP address as in the previous steps.



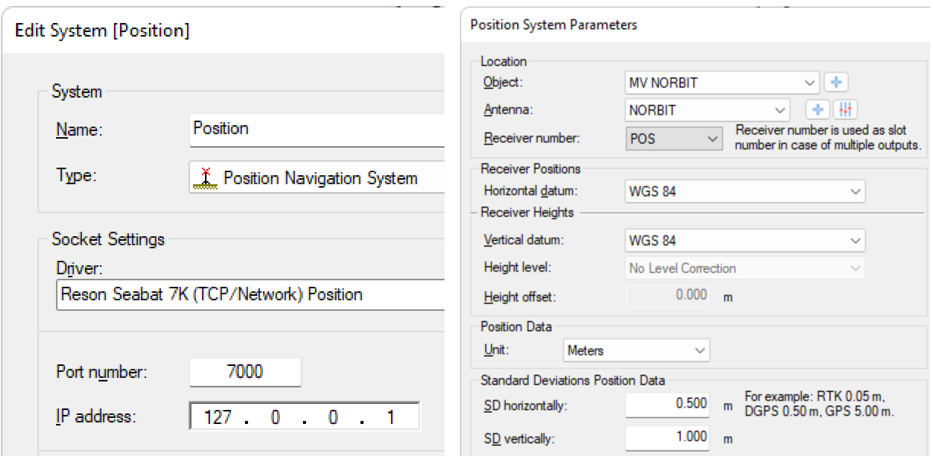
Step 9. Add Gyro Compass System

Repeat the previous step to add a new system, but this time select Gyro Compass. The latest versions of Qinsy allow users to specify the slot number. If you see this option, select HDG1.



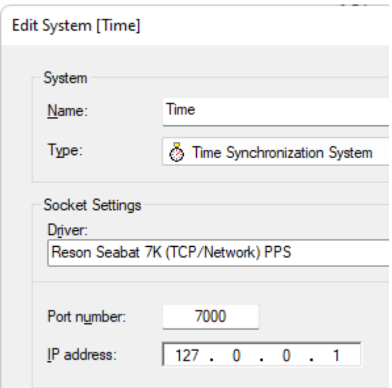
Step 10. Add Position Navigation System

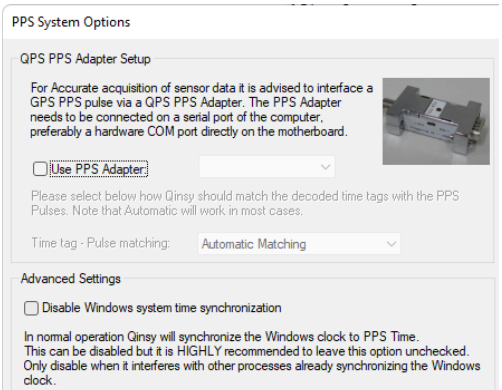
Repeat the previous step to add a new Position Navigation System. The datums will depend on the project specifications. For older versions of Qinsy, the receiver number should be 0. For newer versions, the slot options POS and NAV are available, and either can be used.



Step 11. Add Time Synchronisation System

Add a time synchronisation system, as per below. No PPS adapter is necessary.





Step 12. Configure Qinsy Online Filters

NORBIT recommends adding a Range filter (minimum 0.5m) and Brightness/Collinearity filters. This is set under **Controller > Settings > Echosounder Settings** in Qinsy Online. It removes the false trail of soundings at nadir which have 0m range and quality flag zero.

Item	Min	Max
☐ Depth outside	2.00	20.00
☑ Range outside	0.50	500.00
☐ Sector outside	-75.00	75.00
☐ Heave above		5.00
☐ TPE exceeds		
☑ Brightness test fails		
☑ Colinearity test fails		

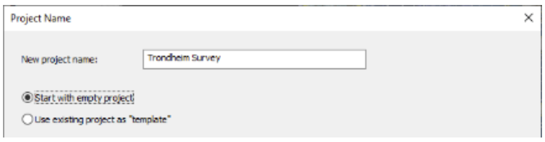
NOTE: Red time synchronisation alerts in Qinsy Online are generally not a concern, as all data is time stamped at source. These alerts can safely be ignored.

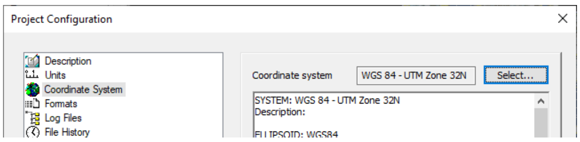
5.4 PDS

The NORBIT GUI requires that **Force Push** be enabled in the Connection settings to receive data in PDS. Refer to section 4.8.6 for more information. Note that the PDS sign convention uses **Y+ Forward**, **X+ Starboard**, and **Z+ Up**. The Applanix Ethernet groups required by PDS are automatically configured on integrated NORBIT systems, thus no action is required.

Step 1. Create New Project and Setup Geodesy

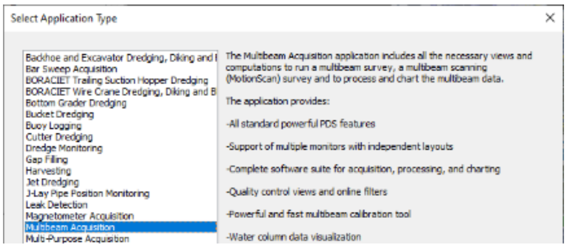
Create a new project in PDS Control Centre via **File** > **New Project**. Specify a name for the project, and on the next page select a coordinate system from the geodatabase or define a new coordinate system according to the survey requirements.

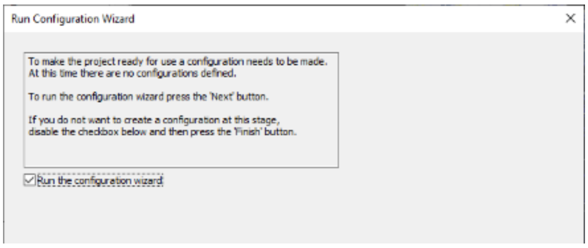




Step 2. Select Application Type and Run Configuration Wizard

Select **Multibeam Acquisition** as the application type. Click **Next** and run the configuration wizard.





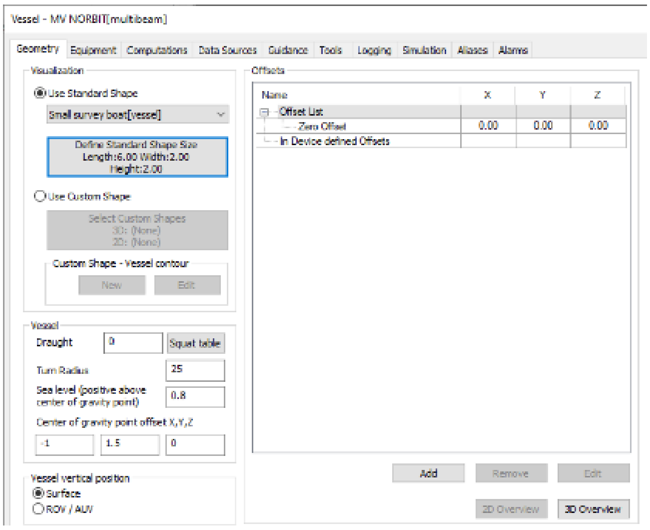
Step 3. Add New Vessel

Specify a name for the configuration (e.g. “Survey Vessel Pole Mount”) and on the next page add a Local vessel which will contain all drivers and offsets.

Step 4. Enter Offsets

On the Geometry page, define the shape of the vessel (only for display) and enter the Centre of Gravity offset as measured from the Sonar Reference Point. Leave the CoG Z field zero to keep the setup simple, as the Sea Level offset is defined in relation to the CoG. Then enter the Sea Level offset relative to the Sonar Reference Point. This should be a positive value.

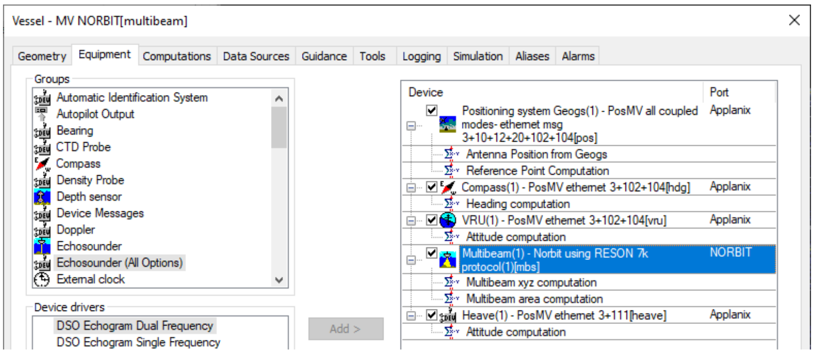
If the optional iLiDAR is installed, add its offset to the list. This is the measured offset from Sonar Reference Point to iLiDAR Reference Point. Refer to the iLiDAR manual for more details.



Step 5. Add Essential Devices

Devices for each data type are added on the Equipment list. On the left side, select the Group and then select the driver to add. As a minimum, the following drivers are required:

Group	Driver	I/O Port	Offset
Positioning system Geogs	PosMV all coupled modes- ethernet msg 3+10+12+20+102+104[pos]	192.168.53.100, UDP 5602	Zero Offset
Compass	PosMV ethernet 3+102+104[hdg]	192.168.53.100, UDP 5602	Zero Offset
VRU	PosMV ethernet 3+102+104[vru]	192.168.53.100, UDP 5602	Zero Offset
Multibeam	NORBIT using RESON 7k protocol (1) [mbs]	127.0.0.1 (if GUI and PDS are on same PC), TCP 7000	Zero Offset

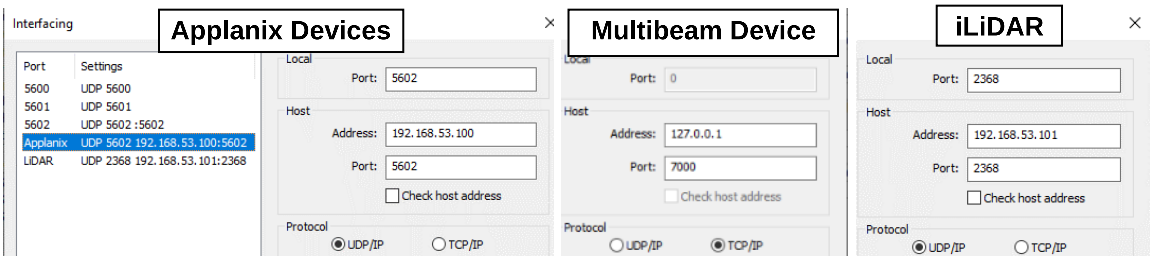


Step 6. Add Optional Devices

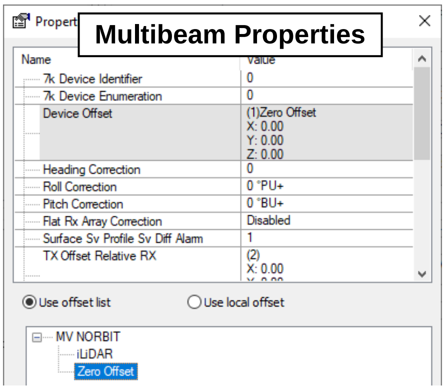
Optional drivers may be added for snippets or side scan data, true heave data, and LiDAR data:

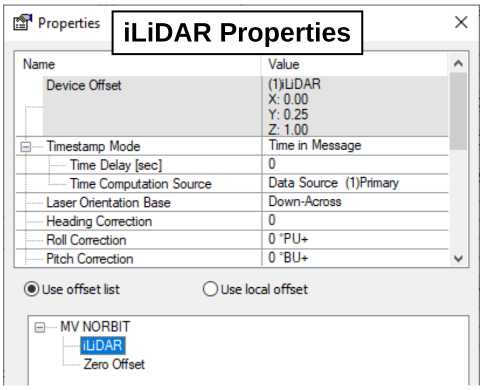
Group	Driver	I/O Port	Offset
Snippets	NORBIT using RESON 7k protocol (1) [snp]	127.0.0.1, TCP 7000	Zero Offset
Sidescan Sonar	NORBIT using RESON-7k protocol (1) [sss]	127.0.0.1, TCP 7000	Zero Offset
Heave	PosMV ethernet 3+111[heave]	192.168.53.100, UDP 5602	Zero Offset
Laser Scan	Velodyne LiDAR VLP-16[laser-scan]	192.168.53.101, UDP 2368	iLiDAR

Step 7. Configure I/O Ports
Select each device on the Equipment list and click I/O Port to configure the interfacing parameters, as per the tables in the previous sections.

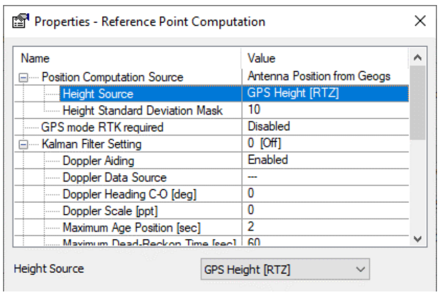


Step 8. Configure Device Properties and Apply Offsets
For each device on the Equipment list, click Edit to open the Device Properties. Here you must select the offsets to apply, as defined previously on the Geometry setup. Recall that all applied offsets should be zero, except the optional iLiDAR. The patch test values, if known, may be entered in the device properties for the multibeam and optional iLiDAR.





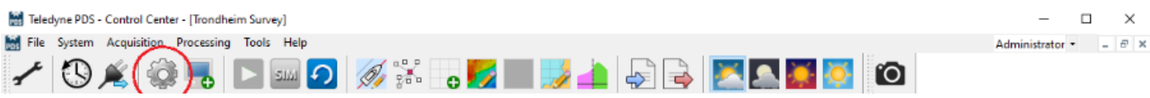
Step 9. Configure Optional LiDAR Properties
If the optional iLiDAR is installed, the orientation base must be set in device properties. This should be set to **Down-Across** assuming the scanner is installed in the standard configuration with connector aft. Refer to the PDS manual for more details.



Step 10. Configure Height Source
Select **Reference Point Computation** under the positioning device and double click, or press Edit. The height source can be set to **GPS Height [RTZ]** if RTK positioning is available, otherwise, set this to **None**.

Height Standard Deviation Mask is a user-defined quality threshold for utilising RTK heights in the depth calculation. By default, it is set to 0.1m, which means that the GPS Height source will only be applied if the altitude quality reported by the sensor is <0.1m.

Step 11. Complete the Wizard
Now the essential steps are complete. The next pages of the wizard contain optional setup steps, details of which are available in the PDS manual. Finish the wizard to return to PDS Control Centre. To return to these settings and modify the vessel configuration, click the gear icon on the toolbar.



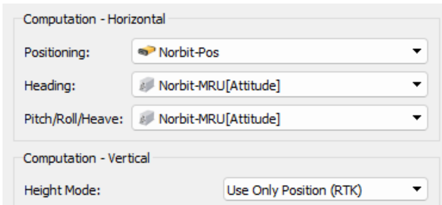
5.5 BeamworX

This short guide explains how to configure NavAQ for data collection with NORBIT integrated systems. Please refer to the BeamworX manuals for more detailed guidance.

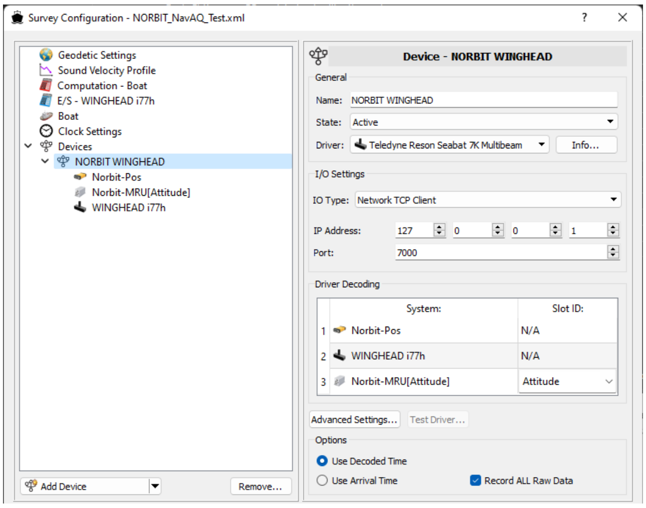
Step 1. Create Survey Configuration
In NavAQ, select **File > New Survey Config**, and select the **NORBIT STX** template for single head, or **NORBIT DUAL** for dual head. This adds the required devices for NORBIT integrated systems.

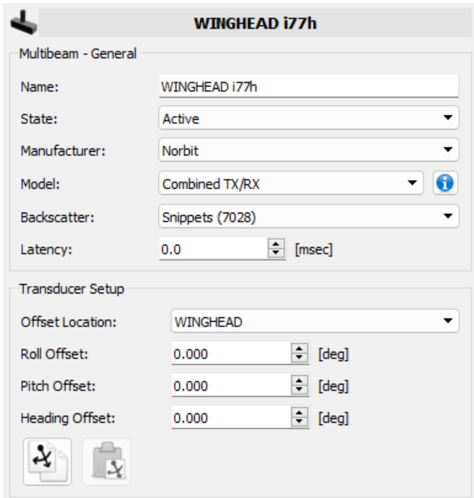
Step 2. Remove Redundant Devices
If the iLiDAR is not used, this device can be removed. BeamworX can retrieve INS data directly from the 7k record stream for integrated NORBIT systems, therefore the **Applanix POS MV** devices can be removed. Alternatively, the **Norbit-Pos** and **Norbit-MRU[Attitude]** devices can be removed.

Step 3. Configure Computation Settings
Under computation settings, select which devices to use for Positioning, Heading, and Pitch/Roll/Heave based on the devices that were added in the previous steps. The Height Mode can also be configured here.



Step 4. Configure Device Settings
Configure the IP Address and Port settings for each device. When the Applanix device is added (i.e. when not using INS data from the 7k data stream), it should interface to UDP port **5602**. The multibeam device interfaces to the IP address of the GUI PC (typically **127.0.0.1**) on TCP port **7000**.





Step 5. Configure Offsets
For systems that support pitch stabilisation (WINGHEAD "S" series and WBMS STX) BeamworX recommends defining **Separate TX/RX** offset locations to increase the accuracy of the footprint calculation. Otherwise, the **Combined TX/RX** model should be selected for the multibeam device.

Step 6. Configure Backscatter
To collected snippets backscatter data, select the **Snippets (7028)** backscatter option in the multibeam device settings. The **Per Beam Intensity** option can also be used, to record single intensity values at the bottom detection point (a form of coarse backscatter).

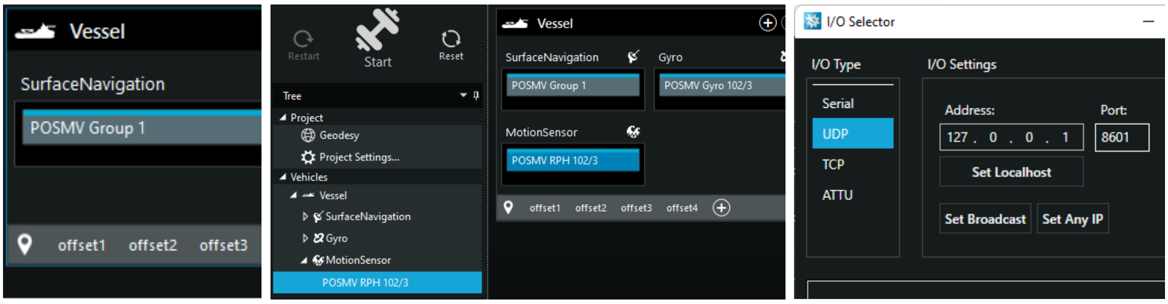
5.6 NaviSuite

It may be necessary to enable **Force Push**, as described in section 4.8.6, to receive data into NaviScan. The sections below describe a typical setup using NaviPac and NaviScan. Note that with Kuda Core, the setup is greatly simplified, and NaviPac and NaviScan are essentially combined. Refer to section 5.6.3 for details. The sign convention uses **X+ Starboard**, **Y+ Forward**, and **Z+ Up.**

5.6.1 NaviPac

Step 1. Configure POSMV IF Module
The POSMV IF Module is required to send Applanix UDP data to NaviPac and NaviScan:
https://eiva.freshdesk.com/support/solutions/articles/43000565394-navipac-posmv-if-module

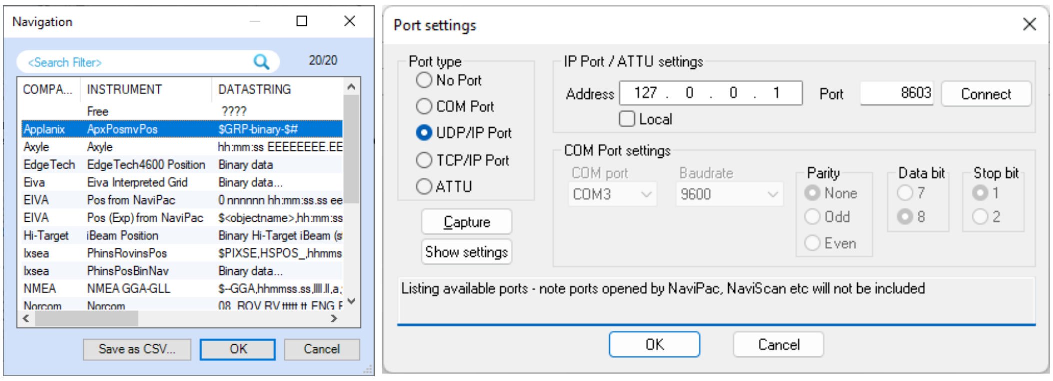
Step 2. Add Surface Navigation, Gyro and Motion Instruments
Add a Surface Navigation instrument to the vessel. Select **POSMV Group 1** from the list and use IP address **127.0.0.1** with the correct UDP port as set in POSMV IF. Repeat this step for Gyro and Motion, using **POSMV Gyro 102/3** and **POSMV RPH 102/3**, respectively.



5.6.2 NaviScan Config

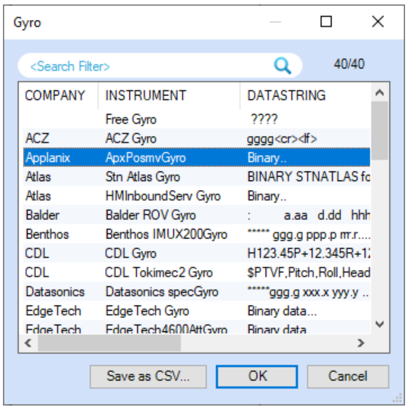
Step 3. Enable Automatic Packet Subscription
In **Options > Global Parameters > MBE/SS**, enable the *Norbit 7k always subscribe* option. NaviScan will then automatically subscribe for packets when the connection port differs from 7000.

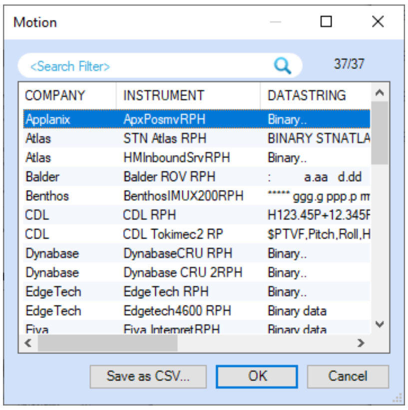
Step 4. Add Navigation Sensor
Begin by adding the navigation sensor. Go to **Equipment > Add Sensor** and select the **Applanix** option. For port settings, enter the IP address **127.0.0.1** (if NaviPac and NaviScan are installed on the same PC), and the UDP/IP Port as defined in POSMV IF.



Step 5. Add Gyro Sensor and Motion Sensor

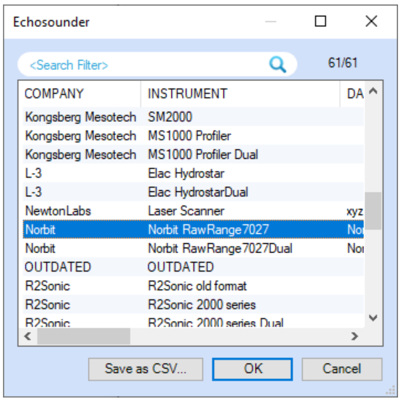
Repeat the previous step to add the Gyro sensor and Motion sensor. Select the Applanix options and configure the network settings as per the previous step, noting that the UDP port for each sensor depends on the POSMV IF configuration.

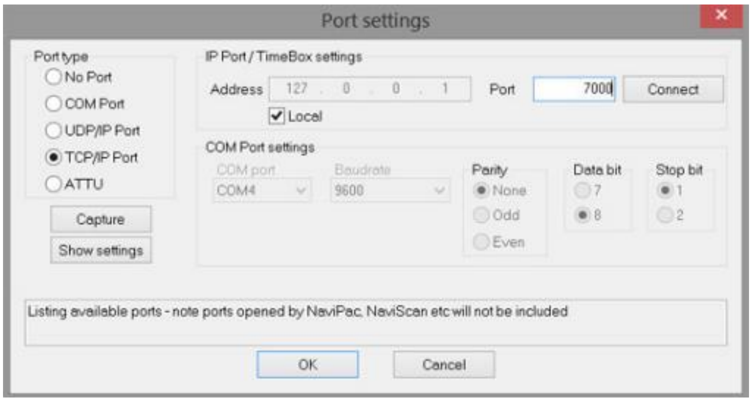




Step 6. Add Echosounder

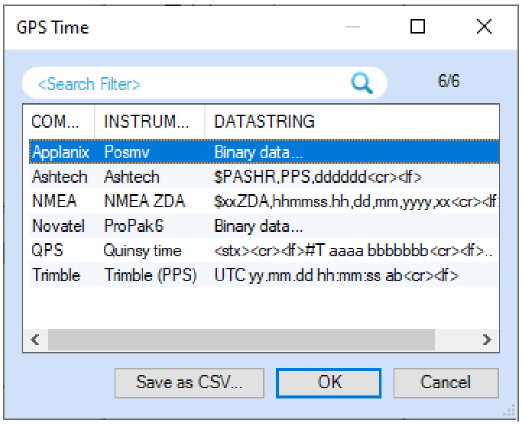
Add an Echosounder, selecting the **Norbit RawRange 7027** option. In port settings, select **TCP/IP Port**, enable **Local** if the NORBIT GUI and NaviScan are installed on the same PC, and use port **7000** (unless configured otherwise in the NORBIT GUI). For dual head operations, select the **Norbit RawRange 7027 Dual** option.

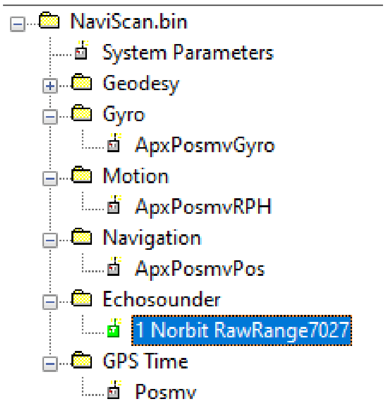




Step 7. Time Synchronisation

If NaviPac and NaviScan are on the same computer, Ethernet timing can be used for time synchronisation. Add a GPS Time sensor and select the Applanix option, using the same port settings as the other Applanix sensors. The final NaviScan project tree is shown below.



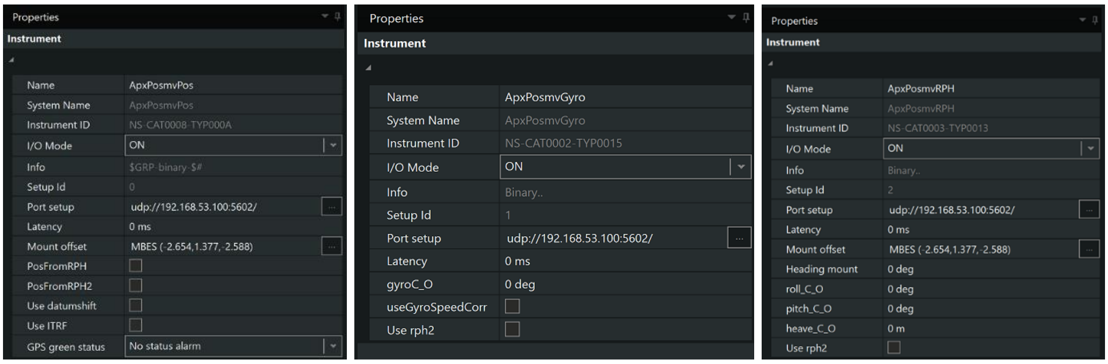


5.6.3 NaviSuite Kuda Core

Kuda Core is an entry-level software variant that simplifies the setup by combining the functions of NaviPac and NaviScan into a single interface. Note that POSMV IF is not required with Kuda Core.

Step 1. Add Surface Navigation, Gyro and Motion Instruments

Add a Surface Navigation instrument to the vessel and select the **ApxPosmvPos** option. Configure the port to **192.168.53.100** on **UDP 5602**. Repeat this step for Gyro and Motion, selecting the **ApxPosmvGyro** and **ApxPosmvRPH** options, respectively.

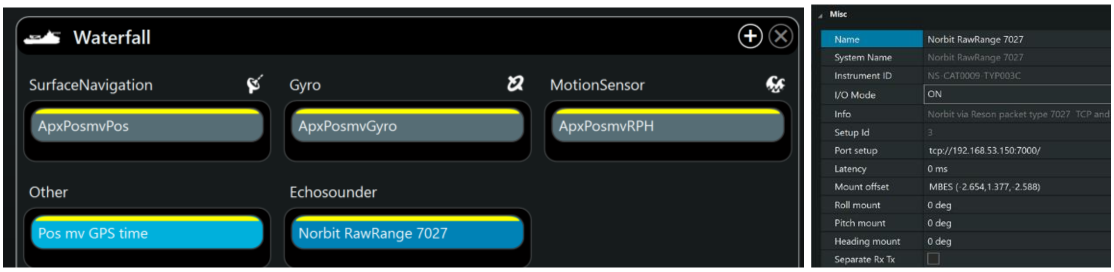


Step 2. Add Time Synchronisation Instrument

Repeat the above step to add a time synchronisation instrument. From the **Other** category, select the **Pos mv GPS time** option, and use the same Port setup as the previous instruments.

Step 3. Add Echosounder

Add an Echosounder, selecting the **Norbit RawRange 7027** option. Configure the port to localhost (**127.0.0.1**) if the GUI and NaviSuite are installed on the same PC, on **TCP** port **7000** (unless configured otherwise in the NORBIT GUI). If the GUI and NaviSuite are installed on different PCs, the IP address should be configured to the address of the GUI PC. For dual head operations, select the **Norbit RawRange 7027 Dual** option. Snippets and/or sidescan instruments can also optionally be added from the **Sidescan** category, using the same port settings as the Echosounder.



Step 4. Enable Automatic Packet Subscription

In **Project Settings > Instrument Extra**, enable the *Norbit 7k always subscribe* option. The software will then automatically subscribe for packets when the connection port differs from 7000. The port is set to 7000 by default in the NORBIT GUI but can be changed to any number by the user.

6 Maintenance

6.1 Caring for Your Investment

Take care when handling the sonar, and use “Fragile” labels when shipping via courier. Never support the NORBIT sonar by the sound speed probe or strictly by the projector, and do not allow the wet end to rest on the polyurethane as this may scratch or wear this sensitive area. When mounting the sonar, always use a sturdy padding (foam) underneath it.

⚠ **CAUTION:** The Inertial Measurement Unit (IMU) on integrated NORBIT models contains sensitive solid-state accelerometer and gyro components. Permanent damage to these components will result if handled roughly.

For the stand-alone WBMS sonar, when shipping in a non-foam cut case, remove the SVP and replace it with the blue dust cap. For WINGHEAD sonars, the integrated SVT should **NEVER** be removed.

⚠ **CAUTION:** The standard WINGHEAD sound velocity & temperature (SVT) sensor is **NOT** field-swappable and should never be removed. Attempting to do so will damage the system. Refer to Appendix B3 for details on the field-swappable option.

⚠ **CAUTION:** The SIU has an IP67 ingress protection rating, which means it can be submerged in up to 1m of fresh water for 30 minutes, assuming all connectors are properly sealed with cables or dust caps. If exposed to salt water for any period of time, the SIU must be cleaned and dried to prevent damage from saltwater corrosion.

Do not leave the system in the sun for long durations. Prolonged exposure to UV rays may cause degradation of the polyurethane coating on the transducers; potential damage includes drying and crack formation which would permanently expose and damage sensitive sonar electronics.

⚠ **CAUTION:** When submerged for long periods, the sonar is at risk of biofouling (especially in warm salty water) or may be subjected to stray electric currents. NORBIT offers both titanium housing, additional anodes and factory applied bio-fouling paint that is tested against acoustical losses.

To clean the NORBIT sonar, only use mild, nonabrasive soap, fresh water, and a soft brush to gently scrub the sonar. Do not use a pressure washer to clean the sonar, as this can damage the housing. To protect the system from corrosion, take extra care when handling to not scratch the anodised aluminium housing (not a concern for titanium housing). It is also good practice to rinse off the sonar after use, especially if used in saltwater, and allow it to dry completely prior to storage.

If the sonar will be in the water for extended periods, it is recommended that sacrificial anodes be used to protect against electrolysis. Anodes can be collared around the cable connection and inserted into the receiver frame. Care must be taken to not scratch the anodising on the aluminium housing during installation. Spare anodes can be purchased directly from NORBIT.

If the system is protected with antifouling paint, then additional care is required to ensure the paint is not scraped or degraded during mobilisation, shipping or handling. After retrieving the sonar from the water, wipe down the system with a clean towel to clear off dirt, grime, marine growth, etc. that may otherwise compromise the sonar.

⚠ **CAUTION:** To protect the system electronics, always turn off the power before disconnecting or swapping cables. Never connect or disconnect cables with power on.

6.2 Marine Growth Removal Procedure

Step 1. Remove the system from the vessel and secure dust resistant caps on the sonar bulkhead and cable.

Step 2. Remove as much fouling from the sonar as possible by hand.

Step 3. Obtain a bucket large enough to fit the entirety of the sonar. In the container, mix in a 50/50 ratio of CLR® (Calcium, Lime, Rust cleaner) to water.

Step 4. With the bulkhead cap tightened, completely submerge the system in the 50/50 solution for approximately 2 hours.

Step 5. Remove the sonar from the solution and scrub the sonar using a super fine abrasive pad and water.

Step 6. If fouling remains, repeat the soaking process. This process can be repeated until all biofouling has been removed from the system.

Step 7. Allow the system to dry fully prior to storage.

⚠ **CAUTION:** Do **NOT** use pressure washers to clean the sonar as it may damage the instrument. Only scrub the sonar using super fine abrasive pads, such as 3M™ Scotch-Brite™ Light Cleansing Hand Pad 7445.

6.3 Maintenance Schedule

It is good practice to perform periodic inspections or checks of the sonar system. The table below lists several checks, recommended by NORBIT, to guide users in performing maintenance checks.

6.3.1 Before Each Survey

Component	Inspection	Additional Notes
Receiver Array	Inspect polyurethane for gouges, nicks or separation from housing. The array face should be smooth and uniform.	Water intrusion will result in damage and be costly to repair. Always store sonar away from sun.
Projector Array	Inspect the projector array for gouges or nicks and check the attachment area of the projector with the sonar housing. The projector surface should be smooth and uniform.	Water intrusion will result in damage and be costly to repair. Always store sonar away from sun.
O-Rings on wet end cable connections	Check O-rings for damage and particulates that may interfere with O-ring operation and keep it lightly lubricated. Use Silicone Grease that is	If missing a spare O-ring, please remove and borrow one from the cable wet-end protective cap and

	min. 90% pure, but **DO NOT** apply grease to the connector pins.	contact NORBIT Support for replacements.
Sound Speed Probe	Remove sound velocity probe (WBMS only) and check connector for corrosion. Note that integrated WINGHEAD probes **CANNOT** be removed. Probe O-ring should be in good condition. Replace probe and ensure a tight fit. Apply light coating of silicone grease to O-ring prior to re-attaching probe. Compare value with corresponding value from profiler at same depth. Difference should not exceed 1m/s.	Bad or missing surface sound speed will create beam steering errors and affect outer swath data performance. It is recommended that the probe be calibrated every 18-24 months. For WINGHEAD, the detachable SVP option is available. Refer to Appendix B3 for details.
Sonar Housing	Inspect housing for scratches and corrosion. Ensure anode is in good condition (for aluminium housing).	Small scratches compromise the galvanic barrier of the aluminium housing.
Sonar Connector	Check for debris and clean with compressed air. Cable connector must be dry and clean. Use protective cap when not in use.	Sonar connection is not wet-mateable. Do not disconnect or connect when sonar is submerged or in wet areas.
Sonar Cable	Check connectors and clean with compressed air. Run cable through hand and check that cable is smooth, without kinks and tears. Check that pins are shiny and not bent. Check O-rings for wear and replace as necessary. Use small amount of silicone lubricant.	A bad connection or bad cable will corrupt survey data. Treat the cable with great care (do not stand on it).
Sonar Mounting Bolts	Check that threads on plastic sleeves are intact and not de-threaded. Vibration over long term can loosen bolts and compromise data quality or loss of wet-end.	Use only stainless-steel bolts and washers. Use Loctite 242 Blue, lock washers and/or nylon nuts.
Mounting Bracket	Check that all hardware for the mounting bracket is tight. Care must be taken when checking the mounting screws for the sonar as over tightening may damage the connections.	The bracket is very robust and provides electrical isolation from the vessel. The M6 bolts which secure the 2x WINGHEAD brackets to the sonar should be tightened to 5Nm torque.
Electrical & Galvanic Isolation Shield	Check that plate is included in shipping case and used between sonar and sonar bracket when mounted. For the WBMS (non-integrated systems), it is imperative to use the included electrical isolation shield.	This protects the aluminium sonar housing from galvanic corrosion.
Firmware & GUI Versions	Ensure that both firmware and GUI versions match and are latest. For integrated INS systems, this may require an annual maintenance cost.	Contact NORBIT Support for details.

6.3.2 After Each Survey

Component	Inspection	Additional Notes
Complete Kit	Perform all inspections in the previous section.	Store the system in a dry location at room temperature.
Wet-End	The wet end should be rinsed with fresh water. Clean off marine growth with a soft rag. If barnacles are present, remove them carefully so as not to pit or nick the polyurethane. If any damage occurs to the anodised aluminium or polyurethane, send photos to NORBIT Support for analysis. Allow the kit to dry before storing. Once back at the office, store with lid open.	When not in use, the sonar cable (and IMU cable for integrated iWBMS systems) should be secured with the included protective caps. The length may be adjusted by grabbing one of the collars and pulling on the cable.

6.3.3 Monthly

Component	Inspection	Additional Notes
Complete Kit	Perform all inspections in the previous sections.	Ensures that users are ready for the next survey.
Sound Speed Probe	Compare surface sound speed probe with another sensor. If the difference exceeds 1m/s and the comparison conditions are similar, determine which sensor is bad and return for calibration.	The surface sound speed sensor should provide reliable data for an 18-24-month period.

6.3.4 Annually

Component	Inspection	Additional Notes
Complete Kit	Perform all inspections in the previous sections. NORBIT offers factory health checks or on-site system health checks. The factory health check is recommended as it allows a full system inspection and calibration service to be performed, whereas the on-site health check is limited. A factory health check is recommended every two years.	Calibration service includes surface sound speed calibration. Contact NORBIT Support for details on our factory health check. It is the responsibility of the user to schedule the calibration.

6.4 PORTUS Pole Tool Bag Contents

Item	Qty A*	Qty B*
Tool Pouch	1	1
Safety Line (5m)	1	1
Gear Ties	4	4
Silver Permanent Marker	1	1
5/8” 0.12” Rubber Washer	2	0
5/8” ASME B18.21.1 Exter. Tooth Lock Washer	2	0
GNSS End Caps 20149P017-4	2	0
M6 x 12mm DIN580 Eye Bolt	2	2
M8 x 80mm Ball Lock	2	2
M8 x 60mm Ball Lock	2	2
M8 x 39mm Ball Lock	2	2
M8 x 90mm DIN912 A4 Cap head Screw	2	1
M8 x 30mm DIN931 A4 Hexagon Bolt	4	4
M8 x 30mm DIN912 A4 Cap Head Screw	4	4
M8 From A DIN123 Flat Washers	12	10
M8 DIN985 A4 Nylon Locking Nuts	10	9
M8 DIN127B A2 Spring Washer (short term use only)	6	6
M8 DIN315AF Wing Nut (short term use only)	6	6
M6 x 25mm DIN7991 A2 Socket Screw	2	2
M8 x 30mm GN927.5-82 Levers	0	2

*A: When purchased with PORTUS Pole
*B: When purchased as standalone tool bag

7 Troubleshooting

If the below troubleshooting steps fail to resolve the problem, contact NORBIT Support and include as much information as possible, including relevant photos, screenshots and data recordings.

7.1 Sonar

Problem	Solution
Sonar or GUI does not behave as expected.	• If sonar is connected but not behaving as expected, perform a factory reset. Select **Set Sonar Factory Defaults** on the Connection dialog.
No sonar connection.	• Verify SIU is powered on. • Check that cable connections are free from corrosion, properly secured, and that pings are not bent. • Check for IP address conflicts. The network card on the PC should be configured to 192.168.53.XXX where XXX is neither 100 (INS) nor the sonar serial number, nor 101 (optional iLiDAR). • If using a network switch, bypass the switch and connect directly to the computer to check for faults with the switch. • Reboot PC, wait 30 seconds, then power-cycle the system. • Open Windows Command Prompt and type `ping 192.168.53.XX` (XX being the last 2 digits of the sonar serial number). This indicates whether the sonar is detectable by the acquisition PC. • GUI and BathyProxy should be allowed in Windows Firewall. • Ground SIU, as explained in section 7.5. This is generally not required.
Sonar does not power up, or power is lost during operation.	• Check power supply voltage with a voltmeter. • Depending on the power source, check the battery/inverter for failure and replace. • If power is <12V or >28V, power LED on SIU blinks at 5Hz. Test system using an alternative power source, e.g. power from a wall outlet or fully charged battery.
Data quality issues (e.g. motion artefacts)	• Ensure that multiple network cards (Wi-Fi and wired) are **NOT** connected to the same static IP range. This causes duplication of navigation data. • Review physical installation, ensuring that mounting structure is rigid and free from vibration. • Check that there is no independent movement between GNSS antennas and review the antenna separation (2m is recommended). • Review offsets and positioning quality. • Review section 7.3 for guidance on how to maximise data quality.
GUI does not match description.	• Obtain latest installer from NORBIT Support.
No timing in sonar, or GUI date/time line is red (invalid).	• Check pins on cable and SIU. If a pin is bent, VERY gently bend it back. *This may result in damage, so do so at own liability* • Go to **INS Tools > Sky Plot** and check that satellites are detected on both GNSS antennas. • Check that PPS LED on SIU is blinking at 1Hz (see section 2.3.6). • If satellites are detected but the LED is not blinking at 1Hz, open POSView and check that COM4 is configured to output NMEA ZDA at 1Hz, 9600 baud. For later models with AP+ hardware, COM2 must be configured in the AP+ Web UI to output NMEA ZDA in a similar manner. • Users can also obtain reliable NTP timing from Qinsy SNTP, which does not require a license. Open Qinsy and double-click SNTP Server. Enable the option “Always report valid status”, and change “Highlight client when offset” to 90ms. If server does not start, change UDP port in Options menu. Once server is running, go to the NORBIT GUI, select **Advanced** > **Options** > **Timing and Triggering**, select **NTP+PPS pos**, enter the network IP address of the PC running the server (no port number required), and click **Apply**. Another source of external, free timing server is Meinberg.

Surface SV sensor is not connected or shows incorrect values.	• Check SV sensor connection and tighten if necessary. Applicable for WBMS only; integrated WINGHEAD SV sensors should never be removed. • Stop vessel to allow air bubbles to dissipate to see if reasonable values return. Adjust mounting to reduce bubble formation. • Inspect sensor for visible damage. Any distortion in the sensor may cause incorrect measurements. • Check for foreign objects or debris on the sensor.
Sonar display freezes and/or data packets are dropped.	• The sonar output stops when the sound speed probe is detected 'Out of water'. This is a protection measure to prevent damage to electronics. • Run Windows Task Manager to check if unnecessary programs or processes are consuming excessive network bandwidth. • Bad switch, hub or cable. Replace. • Update computer network card driver. • Select **Set Sonar Factory Defaults** on the Connection dialog.
Network disconnection errors, or no data from sonar and/or INS.	• Check sonar and/or IMU cables. Check that wet-end connection is tight. If it has loosened, remove connection, clean threads at both male and female fittings and apply a very small amount of grease (O-Ring grease mentioned in this manual works well), then re-tighten. If fingers are weak from cold weather, use a tool but **do not overtighten!**
Soundings are lost in GUI.	• **Adaptive Gates** are on **Narrow** and may need to be changed to a wider setting or disabled altogether.
Data shows trail of soundings with 0m range.	• Apply brightness and collinearity filters, and/or 0.5m minimum range filter in acquisition and processing software to remove false trail of soundings.
Bottom detection quality is degraded.	• Check sonar head for marine biofouling. Clean barnacles off gently. • Check that sonar cable connectors are clean, dry and properly seated.
Lower Gate is beyond expected depth, but no bottom is detected.	• Move the **Upper Gate** closer to the expected bottom.
No roll/pitch/yaw stabilisation with standalone (non-integrated) systems.	• Follow the instructions in section 4.6.8. • Use terminal emulator such as PuTTY to verify TSS1/EM3000 message data stream. Select "Serial" type connection, enter port number and baud rate of the data source, and select Open to display the data stream.
Data is received in GUI, but not in acquisition software.	• Ensure that both firewalls (Private and Guest or public networks) are disabled. • Check that acquisition software has correct IP address and ports specified. For sonar data, the acquisition software must connect to the IP address of the NORBIT GUI PC (usually 127.0.0.1) and not the IP of the sonar itself.
No sonar data in acquisition software from secondary sonar in dual head mode.	• Sentinel dongles (e.g. Qinsy license dongles) occupy port 7001, which is also the default port of the secondary sonar. To avoid conflict, change the primary port number in the GUI **Connection** settings to 17000, for example.
"Sonar timing incorrect" pop-up window appears.	• May happen if INS boots-up slower than the sonar. Close the pop-up window. If sonar timing is incorrect, the timing row in the main GUI display remains red.
No sonar data in PDS or EIVA NaviScan.	• Ensure that Force Push is checked under **Connection** settings in GUI.
Smears appear in the snippets record.	• PC load is too high and is unable to properly process high data load. Reduce load by closing unused programs and non-critical windows in the acquisition software. Slower computers may not be able to handle the data load.
Text in GUI appears too condensed.	• In Windows 10, go to **Display Settings**, and change the Scale and Layout values. Change the value under "Change the size of text, apps, and other items"

7.2 Integrated INS

Problem	Solution
No INS data or intermittent connection.	• Disable Windows Firewall, or allow GUI access and add exception for UDP port: ▪ Open legacy Windows Control Panel and go to **System and Security > Windows Defender Firewall**. ▪ Choose **Advanced Settings** on the left menu. Create a new **Inbound Rule**, select **Port** and click **Next**. ▪ Apply the rule to UDP port 5602 and click **Next**. ▪ Select **Allow the connection** and click **Next**. ▪ Apply the rule to **Domain, Private and Public**, and click **Next**. ▪ Specify a rule name and **Finish** the wizard. • Open Windows Command Prompt and type `ping 192.168.53.100`. This indicates whether the INS is detectable by the acquisition PC. • Check network configuration and ensure that the acquisition PC IP address is NOT configured to 192.168.53.100. If it is, change it to 192.168.53.150. • Check that cables are secure and tight, and check for bent pins on cable and SIU. • Low quality power supplies may cause this issue. Try alternative power source. • Ground SIU, as explained in section 7.5. • Go to **INS Tools > INS Setup Wizard** and select **Factory** to restore defaults.
No GNSS satellite data.	• Check cables and ensure that all connections are secure. • Use only antennas provided with kit. Other antennas may not work. • Ensure that antennas have clear sky view with no obstructions.
INS Wizard fails to update, "Failed to connect to…"	• The error "Failed to connect to the POS MV Control port" indicates that POSView is open and in the Connected state. POSView is not required, and is not recommended, for use with integrated NORBIT systems. At the very least, it should be in "Monitor" mode during operation.
No RTK corrections received.	• Check COM port settings and cable connections. • Verify IP address and mount point if using network solution. • Check radio link and frequency. Verify that baud rates and corrector types match. • Try with Null Modem to swap pins 2 and 3. • Check on a different unit to verify data stream. • For serial RTK data, use terminal emulator such as PuTTY to verify the data stream. Select "Serial" type connection, enter port number and baud rate of data source, and select Open to display data stream. • If using NTRIP, check the Internet connection and verify login details.
Heading alignment fails.	• Ensure that at least DGNSS (and ideally RTK) corrections are received. • Check antenna connections and ensure that antennas are connected to correct primary/secondary sockets. • Verify offset measurements. • Review GNSS environment. Try different area or time.
Faults LED is red and System Status window shows red alerts.	If any of the following errors are shown permanently, check offsets and mounting angles. Then check raw GNSS data for cycle slips or interference. If that is OK, check hardware. • **Ephemeris Data Gap:** This is a normal occurrence and indicates a short GNSS data outage. It is generally not a concern. • **Accelerometer Bias or Gyro Bias:** May indicate that the IMU is outside specification limits and requires service. Can also be caused by incorrect offsets. • **Nav/Aligned Heading Rejected:** The vector between the two antennas has not been accurately determined by the Kalman filter. Not uncommon to flicker red. • **Pri. GNSS Observable Rejected:** Similar to the above. • **Invalid Installation Parameters:** Usually caused by incorrect offsets, incomplete heading alignment, or low satellites. If error persists, reboot system. • **Bad IMU Frames:** Should always be zero. If number is increasing, it could indicate a cable problem or electronics error. If using POSPac, check that time tag anomalies is 0 (under **Message Logs > IMU Data Continuity Checking**).
INS Logging light is red or orange.	• Open **INS Setup Wizard** and apply **Factory** defaults. • Reboot PC. • Disable Windows Firewall.

7.3 Data Quality Checklist

- ✓ ***Review Hardware Installation:*** Ensure that all sensors are fixed, rigid, and free from vibration. There must not be any independent movement of sensors.
- ✓ ***Primary Antenna Location:*** Ensure that the primary antenna is closest to the NORBIT system and connected to the correct SIU port (Ant 1).
- ✓ ***Network Configuration:*** Ensure that multiple network cards (Wi-Fi and wired) are **NOT** connected to the same static IP range. This causes duplication of navigation data in the files.
- ✓ ***Offsets:*** Measure offsets correctly to the nearest 1cm or better, and check sign inputs.
- ✓ ***Sensor Alignment:*** Ensure that the integrated system is closely aligned with the vessel centreline. Agreement to within ±0.5° is ideal.
- ✓ ***Centre of Rotation:*** If the sonar and IMU are not mounted at the CoR, measure and apply this offset in the INS Setup Wizard to eliminate heave artefacts.
- ✓ ***GNSS Corrections:*** Only Narrow Lane RTK is suitable for RTK tides. Position errors increase with distance from the base station. DGNSS is accurate only to about 60cm horizontally. Ideally use a post-processed kinematic solution.
- ✓ ***Sound Speed:*** In many environments, sound speed varies more in the upper layer of the water column. Mounting the sonar lower helps to overcome errors related to unaccounted changes in sound velocity. Perform SV casts on a regular basis and compare them to the surface sound speed, ensuring that the difference does not exceed 1m/s.
- ✓ ***Patch Test:*** Review multibeam roll, pitch, and yaw misalignments. Repeat measurements as and when required. Generally, roll should not vary by more than ±0.02°, pitch by ±0.1° and heading by ±0.5°. Perform a patch test every time the sonar and IMU are moved.
- ✓ ***Swath Angle:*** Soundings are most accurate within a ±70° sector from nadir (depending on water depth), or wider if the beam footprint and incidence angle are very small, e.g. when the swath is perpendicular to a steep shoreline sloping up from nadir. Soundings sloping down from nadir have a large footprint and incidence angle. It is always better to 'look' up a slope than down one, and therefore survey lines should generally be parallel to the bottom contour.

7.4 Change Sonar IP Address

- To change the IP address of WINGHEAD S series sonars (e.g. i80S, B51S), please contact NORBIT Support for assistance and **DO NOT** attempt to change it through the web interface.
- To change the IP address of regular WINGHEAD or iWBMSh Stabilised sonars, use a web browser such as Google Chrome and go to: *http://<sonar-ip>:8080* (for example: http://192.168.53.51:8080)
- To change the IP address of WBMS sonars, log onto the sonar with telnet. Press **Windows+R** to open the **Run** dialog, and type `cmd` to open Command Prompt. Use the following commands:

  `Telnet 192.168.53.XX` (where XX is the last two digits of sonar wet-end serial number)
  `fw_printenv` (prints to screen all u-boot parameters)

  Options:
  `fw_printenv ip_addr` (print to screen all ip_addr parameters)
  `fw_setenv ip_fallback 192.168.53.99` (sets IP to 99 if no DHCP server on network)
  `fw_setenv ip_addr 192.168.53.99` (sets static IP to 99 regardless of DHCP)

7.5 Grounding

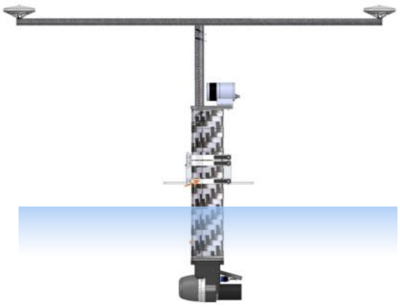
In general, grounding is not required, and is not recommended. However, some early revision SIUs may require grounding for stable operation. Grounding issues may cause IMU failures and bootup issues. If there is no grounding screw on the SIU, break off the pin inside a BNC connector, and on the other end expose the ground shielding (using the outer braid of wires) and crimp a connection. Connect the BNC to the connector on the SIU, and the other end to a metal part of the vessel, or a wire placed into the water.

Appendix A: Quick Start Guides

A1. Single Head Installation

Standalone WINGHEAD or WBMS users should skip sections related to INS configurations.

1. ***Unpack and Inspect:*** Unpack sonar system and inspect all cables and connectors for damage, dirt and moisture. Inspect the transducers for cuts or gouges.
2. ***Sonar Installation:*** Make an installation plan. Mount sonar on the vessel and align unit so that it is parallel with the vessel keel with the projector pointing aft. Bolt sonar bracket to pole with minimum of 4 bolts. Use lock-washers and/or Loctite 242, especially for longer duration setups as nuts will vibrate and loosen over time. Users are advised to connect wet-end cables before mounting the system to simplify the process of securing cables.
3. ***Antennas:*** For GNSS/INS integrated systems, mount the GNSS antennas with 5/8” threaded bolts. While not necessary, it is helpful to align GNSS antennas to be parallel or perpendicular to vessel keel. The antenna closest to the sonar is typically the primary. Connect the primary antenna to Ant 1 on the SIU, and the secondary antenna to Ant 2.



4. ***Cables:*** Run cables from sonar and antennas to SIU. Avoid sharp bends and beware of chafing. Handle cables with care; rough handling will bend connector pins and may cause damage. Do not run cables next to high voltage lines – spread cable out to avoid RF interference.
5. ***SIU & PC:*** Connect the SIU to the control and acquisition PC via Ethernet. Before powering the sonar, set the IP address of the PC to 192.168.53.XXX, where XXX can be any number from 101 to 255, and set the subnet mask to 255.255.255.0.
6. ***RTK:*** If RTK positioning is used, configure it as required.
7. ***Offsets:*** For the default setup, measure XYZ offsets from Top Centre of Bracket to the base of primary GNSS antenna.
8. ***Power:*** Ensure power source is clean. Beware of batteries that are under powered or cheap inverters.
9. ***Software:*** Install the NORBIT GUI and disable Windows Firewall. With all hardware connected to the SIU, power it on and open the NORBIT GUI. Connect to the sonar via the Connection dialog. Once connected, the GUI starts logging raw GNSS/INS observables automatically.
10. ***INS Setup:*** Open the **INS Setup Wizard** under INS Tools. Follow the prompts and have the measured offsets, from Top Centre of Bracket to the base of primary antenna, at hand. For the baseline vector, select **Alignment Wizard**. This ensures that the heading alignment starts automatically once the INS Setup Wizard is complete.
11. ***Acquisition:*** Setup your acquisition software of choice, e.g. DCT, HYPACK or Qinsy. Select the Norbit driver (or Reson SeaBat 7125 network driver if that is not available) and connect to the GUI IP address (typically 127.0.0.1) on TCP port 7000.
12. ***Tides:*** For verification that the INS system is ready for survey in RTK mode, it is a good practice to examine a time series graph of RTK tide values. As soon at the graph stabilises on a narrow value range, the system is ready for survey.
13. ***Bar Check:*** Run a bar check to validate sonar draft.
14. ***Sound Speed:*** Verify the sound velocity reported by the sensor on the sonar by comparing it to another sensor, e.g. a sound velocity profiler.
15. ***Online Filters:*** In your acquisition software, enable online filters to remove low quality soundings. Enable the brightness and collinearity filters, and if using Qinsy, enable a 0.5m minimum range filter to remove the false trail of soundings at nadir with 0m range. Note that filtered soundings are not permanently deleted, they are merely flagged and can be recovered in processing.
16. ***Patch Test:*** Perform a patch test each time the sonar is installed or moved from its previous location.

A2. Dual Head Installation

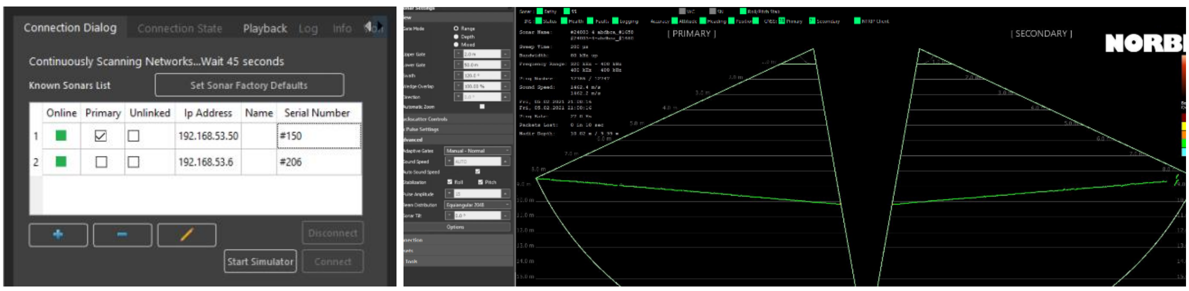
Standalone WINGHEAD or WBMS users should skip the sections related to the INS configuration.

1. ***Bracket and Mount:*** Mount the sonars to the dual head bracket or two single head brackets. For the WINGHEAD ±10° bracket, attach the sonars using M10x40 screws, and do **NOT** use anything longer.
2. ***Power:*** For WINGHEAD sonars, two SIU-WH are required. If a single SIU-I-NAV is used for dual head iWBMS, it must be revision 5 or later, and must be supplied with 24VDC using the NORBIT-supplied 220W power brick (PN 23008-P220). The standard power brick provided with a single head WBMS (PN 23008-P120) does not provide sufficient power for dual head.
3. **Cables:** Secure, direct and connect all cables to the SIU. The sonar cable of the secondary sonar can connect to the Aux port of the SIU-I-NAV for dual head iWBMS.
4. ***SIU & PC:*** Connect the SIU to the GUI PC via Ethernet. Before powering the sonar, set the IP address of the PC to **192.168.53.XXX** where XXX can be any number from 101 to 255, except the last two digits of the sonar serial number, or 100 which is reserved for the integrated GNSS/INS. Set the subnet mask to 255.255.255.0.

WINGHEAD Bracket
(±10° Roll, ±1° Pitch)

WBMS Bracket (±37.5° Roll)

5. ***GUI:*** Install the NORBIT GUI and, with the SIU powered on, launch the GUI. On the **Connection Dialog**, highlight the two online sonars and define the **Primary** sonar, then click **Connect**.
6. ***INS Setup:*** Complete the INS Setup Wizard, adjusting the offsets and IMU rotations accordingly if the integrated IMU is tilted. Consult the technical note TN-190018 for details on adjusting the offsets. Please contact NORBIT Support if you require this document.
7. ***Sonar Controls:*** Two swaths appear in the main display with the primary sonar appearing on the left. Thus, visualisation is more intuitive if the primary sonar is installed on the port side. If side scan is enabled, the image displayed is that from the two sonars combined. All setting changes apply to both systems unless the Unlinked mode is checked. In Unlinked mode, the two sonars are controlled independently, and steering (Direction) can be adjusted separately for each sonar.
8. ***Wedge Overlap:*** For WINGHEAD sonars, the percentage overlap can be controlled in the GUI under the View menu. WBMS sonars are configured to overlap by 20° and this is controlled from a .ini file in the GUI installation folder. Contact NORBIT Support for advice on changing the WBMS wedge overlap. The Sonar Tilt setting (under Advanced) should also be set to match the physical rotation of the sonars.
9. ***Frequency Separation:*** The transmit frequencies must not overlap. When 2 sonars are selected, the GUI automatically applies a frequency separation. When a centre frequency is defined, 1.9cm Resolution (i.e. 40kHz bandwidth) is applied by default, since the sonars are optimised for a total bandwidth of 80kHz. When 400kHz is selected with the default resolution of 1.9cm, the sonars ping through a total frequency range of 360kHz-440kHz, with one sonar transmitting from 360-400kHz, and the other from 400-440kHz. This allows the sonars to ping in sync without interference. To change the frequency spread, adjust the Resolution slider under Tx Pulse Settings.
10. ***Port Numbers:*** In the acquisition software, the default port number is 7000 for primary and 7001 for secondary. The secondary port is always one greater than the primary. Some packages give the option to select one head as primary and one as secondary. In this case, both heads are primary. Please note that Sentinel dongles (e.g. those used by Qinsy) occupy port 7001, therefore the port in the GUI must be changed to avoid conflict. Change the primary port to 17000, for example.



Appendix B: Optional Features

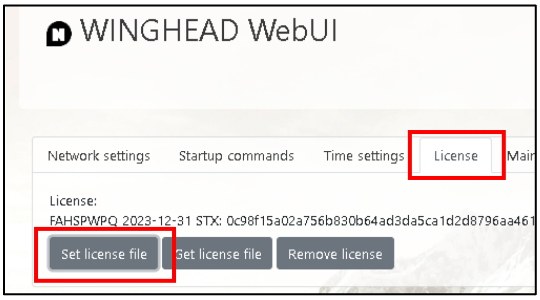
B1. Licensed Controlled Features

⚠ NORBIT sonar functionality can be expanded with the following optional features, which are license controlled. Contact NORBIT Support to enquire about these options.

Feature	Description	Available On… WINGHEAD	WINGHEAD Stabilised	WBMS	iWBMSh Stabilised	WBMS STX
Dual Swath (2048 Beams)	The system transmits multiple pings simultaneously, generating 2x1024 beams per ping, and offsets them ±1°. This is used to increase along-track data density or increase survey speed.	✗	✓	✗	✓	✗
Yaw Stabilisation with 1024 Beams	Provides evenly distributed along-track soundings, and prevents gaps in coverage, by compensating for changes in vessel heading (up to ±10º). It uses NORBIT's steerable transmission technology to direct acoustic energy of multiple pulses at the angle adaptively derived from INS information. These pulses operate concurrently based on orthogonal signals, eliminating interference between them and keeping the ping rate intact.	✗	✓	✗	✓	✗
Backscattering Strength Output (BSO)	Provides backscatter strength output, demonstrating how strong, in absolute form, the bottom reflects transmitted acoustic signals. It provides fully repeatable backscatter results, as well as compatibility with physical models. See Appendix B4 for more information.	✓	✓	✓	✓	✓
STX Scanning	Directs the sonar to sweep the transmit beam along-track in an angular sector (±10°) set by the user, to increase survey coverage. Refer to section 1.2.3 for more information. Available as standard (non-licensed) on WBMS STX models.	✗	✓	✗	✓	✓
1024 High Density Soundings (HDS)	Increases the maximum number of soundings for WBMS sonars to 1024 per ping. Backscatter and water column output are automatically disabled when this option is active in the GUI. WINGHEAD and iWBMSh Stabilised sonars output 1024 soundings as standard (non-licensed).	✓	✓	✓	✓	✓

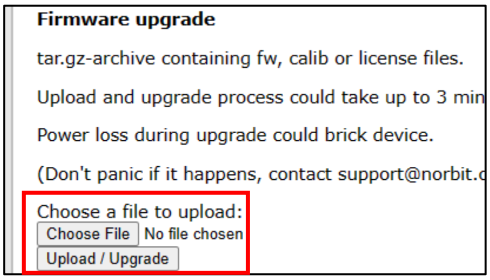
WINGHEAD & iWBMSh Stabilised Activation:

1. In a web browser, go to the Web UI at *http://192.168.53.XX:8080*, where XX is the last 2 digits of the sonar serial number.
2. Go to the **License** tab and click **Set License File**
3. Select the ***.lic** file provided by NORBIT to activate the license.



WBMS License Activation:

1. In a web browser, go to the Web UI at *http://192.168.53.XX*, where XX is the last 2 digits of the sonar serial number.
2. Scroll to the **Firmware Upgrade** section.
3. Click **Choose File**, select the ***.tar.gz** file provided by NORBIT and click **Upload / Upgrade**
4. Reboot the sonar.



B2. Additional SIU COM Ports

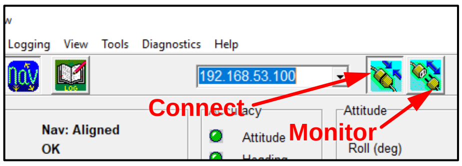
Standard NORBIT systems contain one serial COM port on the SIU for receiving GNSS corrections and/or outputting GNSS/INS information to external systems. For users who require additional COM ports, NORBIT offers a split serial cable option.

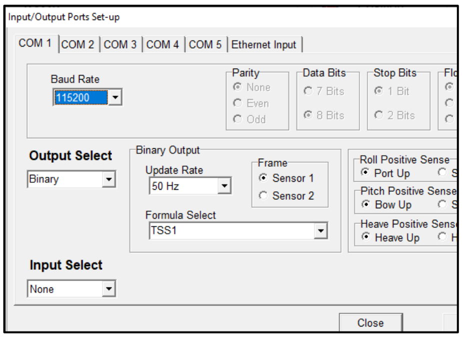
This option includes the split cable itself (PN 33209) plus a small factory modification to the SIU to allow it to output ASCII/Binary information for multiple ports. The cable connects to the COM port on the SIU and splits into 3 separate connectors, which are labelled COM1, COM2 and COM3, respectively. Contact NORBIT Support to enquire about this option.

CAUTION: The serial split option includes an internal hardware modification, which means the SIU COM port is no longer a standard serial port. No cables, other than the split serial cable provided by NORBIT, should be connected.

The additional ports are configured using the POSView software from Applanix or, on later models, using the AP+ Web UI. Use the correct version of POSView that matches the INS firmware, as advised by the NORBIT Support team. Most common data formats are supported, including NMEA and binary formats such as TSS1 and SIMRAD. Follow the steps below to configure the additional ports:

POSView





Step 1. Ensure that POSView is in the **Connect** state.

Step 2. Go to **Settings > Input/Output Ports…**

Step 3. For each port (**COM1**, **COM2** and **COM3**), select the output type (NMEA or Binary), output message(s) and baud rate.

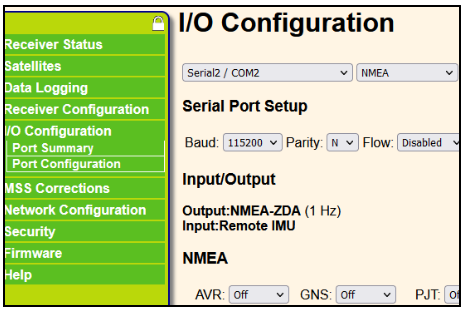
Step 4. Click **Apply** and **Close**

Step 5. Select **Settings > Save Settings**

Step 6. Activate the **Monitor** state or close POSView. The NORBIT GUI cannot communicate with the integrated INS if POSView is connected at the same time.

The port configured on the last page of the INS Setup Wizard corresponds to COM3 in POSView. Therefore, COM3 can be configured via the NORBIT GUI, but COM1 and COM2 must be configured using POSView. Note that COM4 is reserved for sonar timing and should **NOT** be changed.

AP+ Web UI



Step 1. For systems equipped with Applanix AP+ hardware, only one additional port (COM1) can be configured through the Web UI at: http://192.168.53.100

Step 2. Go to **I/O Configuration > Port Summary** to configure **Serial / COM1**. The port configured on the last page of the INS Setup Wizard corresponds to COM3 in the Web UI. Therefore, COM3 can be configured via the NORBIT GUI, but COM1 must be configured using the Web UI.

Step 3. Select the output type (NMEA or Binary), output message(s) and baud rate, then click **OK**. Note that COM2 is reserved for sonar timing and should **NOT** be changed. If additional outputs are required on AP+, network output options are available.

B3. Detached WINGHEAD SVP (SVPd)

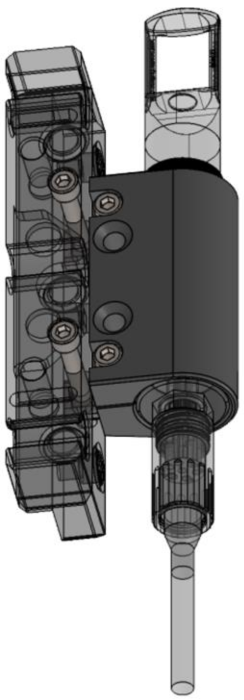
The detached SVP option is available for WINGHEAD users that require an external, field-swappable, AML sound velocity sensor. It is supported out of the box and there are no special software requirements.

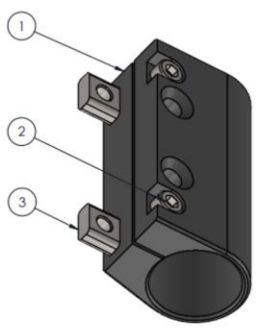
Hardware Requirements

- WINGHEAD SVPd sonar variant, containing SVPd bulkhead connector.
- Optional mounting bracket (PN 35216)
- AML SV sensor which comprises:
  - SV sensor housing (PN 954147)
  - Swappable SVT sensor (PN 954145)
  - AML SV cable with 50cm length standard, 2m optional (PN 33300)

Mounting

- The sensor is mounted using the supplied bracket (PN 35216) that attaches to the standard WINGHEAD mounting bracket (PN 35150).
- The regular nuts on the bracket are swapped with extended nuts that allows the SVPd bracket to be attached. Note that the bracket is not compatible with WINGHEAD “S” series models.





No.	Part Number	Description	Torque	Qty
1	451521	Clamp Bracket	5 Nm	1
2	DIN 912 M6x25 --- 25C	M6 Screws		2
3	451522	Extended Bracket Nut, M6	5 Nm	2

Connection Details

- The AML SVPd connects to the 10-pin connector on the sonar using cable PN 33300. The pinout details are provided below:

Probe	Sonar	Function
1	1	RS232 to Probe
2	5	Signal & PWR GND
3	6	12/24 vDC
4	2	RS232 from Probe

Supported Probes

- All AML SV sensors are supported, except for salinity sensors on the AML-1.

B4. Backscattering Strength Output

The Backscattering Strength Output (BSO) is an optional feature that provides backscatter strength output, demonstrating how strong, in absolute form, the bottom reflects transmitted acoustic signals. It provides fully repeatable backscatter results, as well as compatibility with physical models. To enquire about the BSO option, please contact NORBIT Support.

Requirements

- To use BSO, the unit must first be calibrated at NORBIT's production facility in Norway.
- Note that the calibration is not performed as standard with newly produced systems.
- The calibration results are unique to each system, therefore if multiple systems are calibrated, the correct file must be applied for each unit.

Applying the Calibration

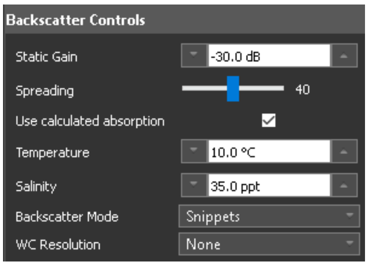
Step 1. Following the factory calibration, an XML file is delivered on a USB with the system. Copy the file to this location on the GUI PC: *%appdata%\norbit\CalibrationFiles\CalBSSdata.xml*

Step 2. Once the file is copied, the system can generate 7058 7k records containing backscattering strength snippet data.

Step 3. The 7058 record is available for TCP subscription from the GUI and is saved within s7k files when raw data recording is activated in the GUI.

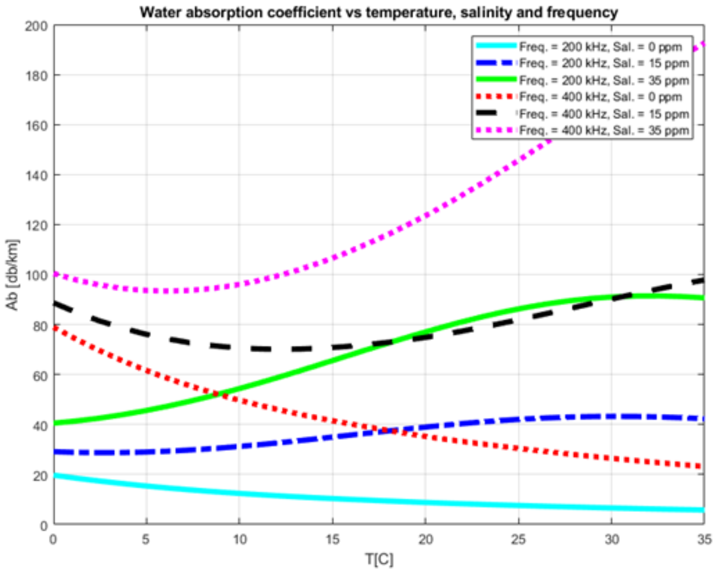
Step 4. The XML file is a specific file to each unit and cannot be shared with other units.

Sonar Settings



- It is critical that the TVG settings are configured correctly under Backscatter Controls:
  - **Static Gain** should be set to 0 by default.
  - **Spreading** should be set to 40.
  - **Absorption** should be set to the correct physical value for the current environment.
- All applied TVG settings are reported in the s7k datagrams.
- Recorded WBM files can be replayed in the GUI to regenerate 7058 records, in case the TVG was set incorrectly. The TVG settings can then be adjusted as necessary to create new files.

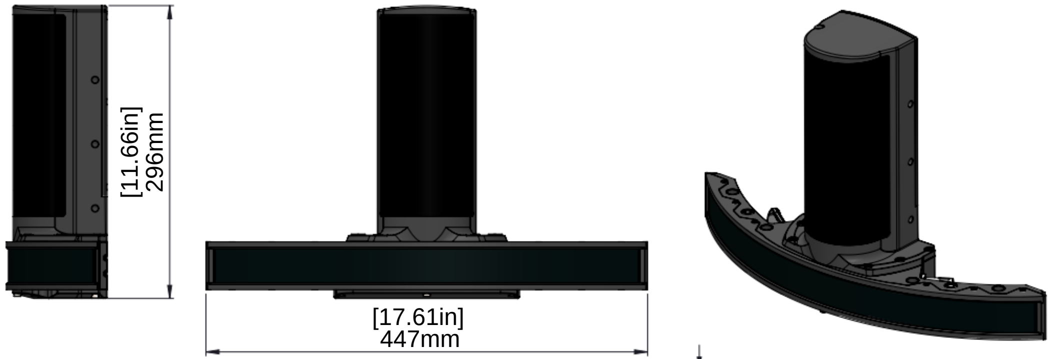
The Absorption graph provides approximate values only. The correct value should be determined by enabling the **Use calculated absorption** option in the GUI, or by using this external calculator: http://resource.npl.co.uk/acoustics/techguides/seaabsorption/ (Francois and Garrison, 1982)

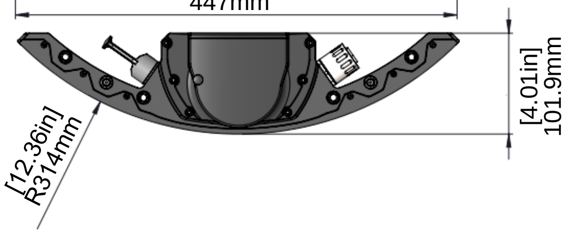


Appendix C: Hardware Dimensions

C1. WINGHEAD Standard System (PN 24103)

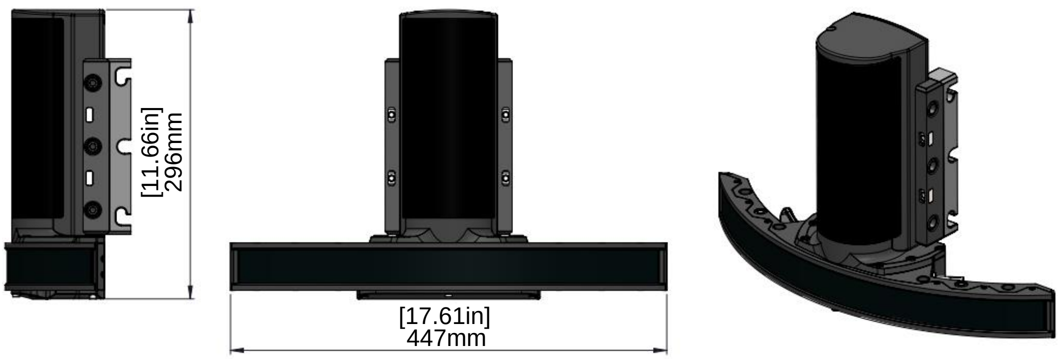
Excluding Mounting Bracket

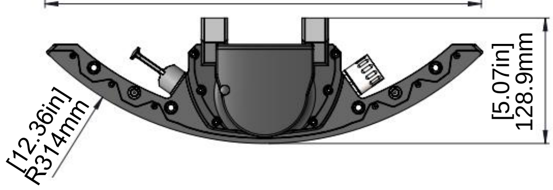




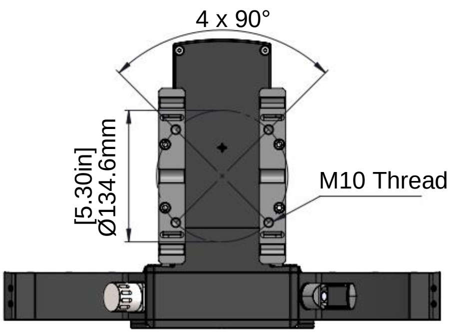
Weight:
B41 : 6.6kg (air), 3.5kg (water)
B41 Titan : 9.0kg (air), 5.9kg (water)
i77h : 6.9kg (air), 3.6kg (water)
i79h : 9.3kg (air), 6.2kg (water)

Including Mounting Bracket



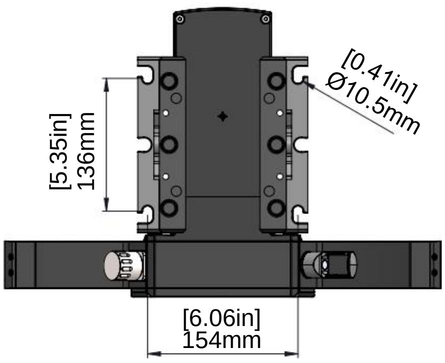


Weight:
B41 : 8.1kg (air), 4.7kg (water)
B41 Titan : 10.5kg (air), 7.1kg (water)
i77h : 8.4kg (air), 5.0kg (water)
i79h : 10.8kg (air), 7.4kg (water)



Bracket Mounting Pattern – Pole Mount

Bracket Mounting Pattern – Hull Mount

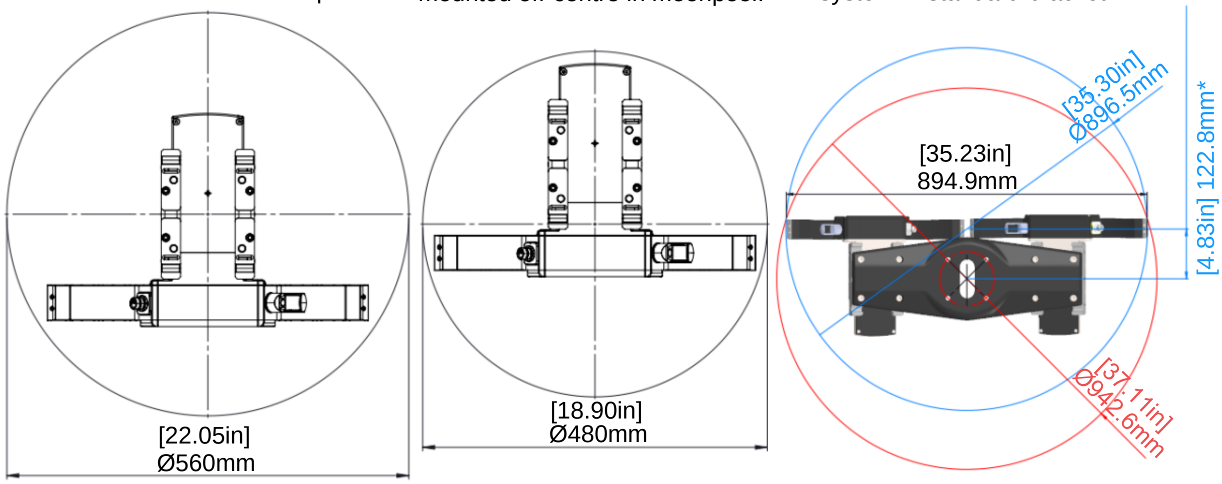


Moonpool Dimensions

Recommended minimum internal diameter with centre of sonar bracket in centre of moonpool.

Recommended minimum internal diameter with sonar mounted off-centre in moonpool.

Recommended minimum internal diameter with dual head system in standard bracket.

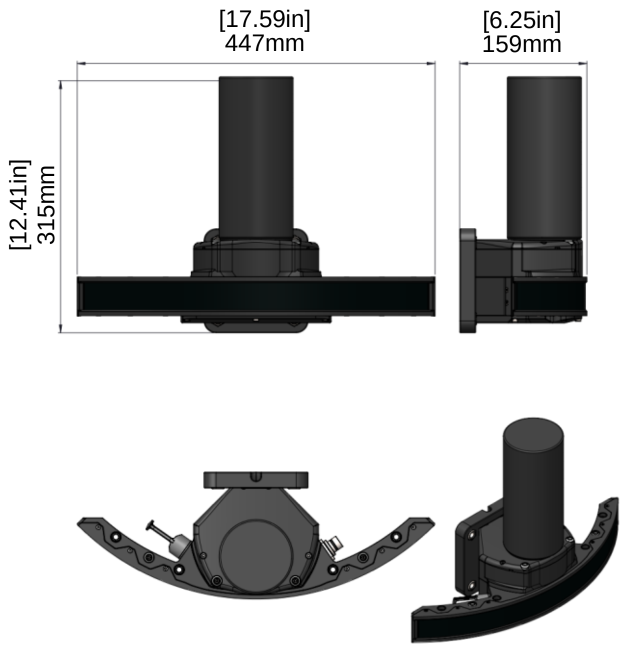


Centre of sonar bracket off-centre of moonpool
Centre of sonar bracket in centre in moonpool

* Bracket centre to centre of moonpool

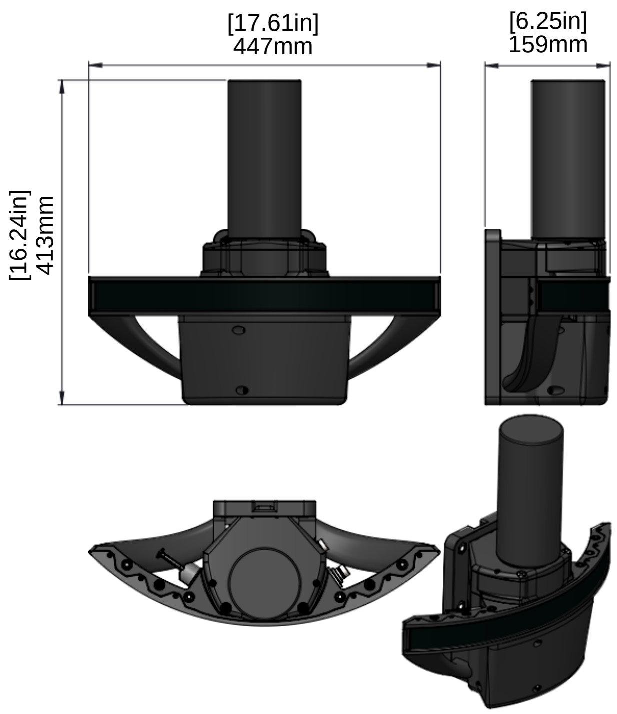
C2. WINGHEAD Stabilised System (PN 24115)

WINGHEAD B51S



Weight: 6.7kg (air), 3.0kg (water)

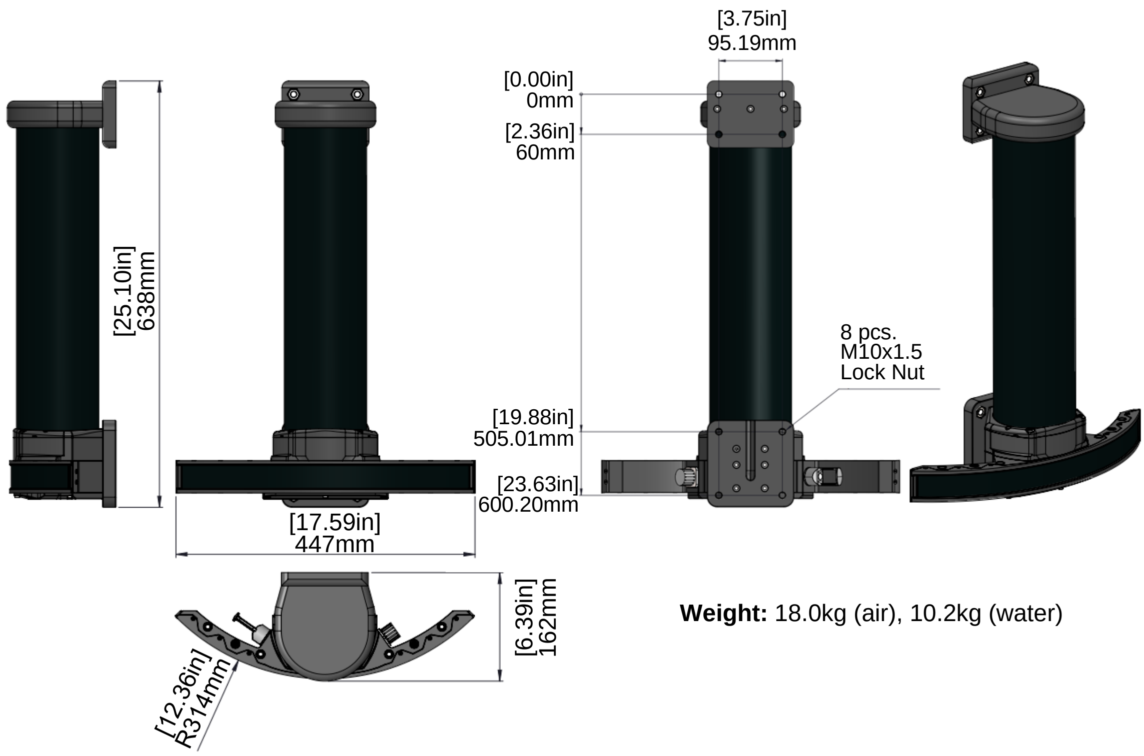
WINGHEAD i80S (Integrated)



Weight: 11.0kg (air), 4.9kg (water)

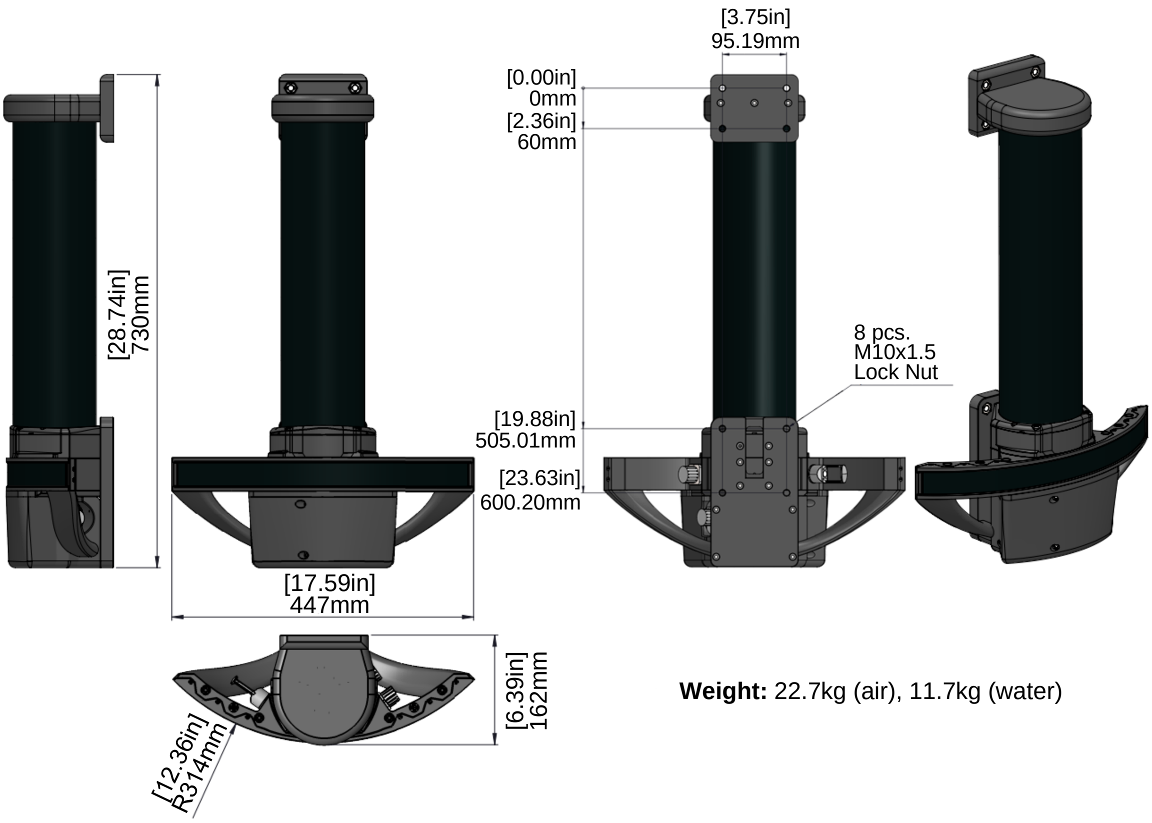
C3. WINGHEAD Stabilised Long Range 100kHz System (PN 24120)

WINGHEAD B57S



Weight: 18.0kg (air), 10.2kg (water)

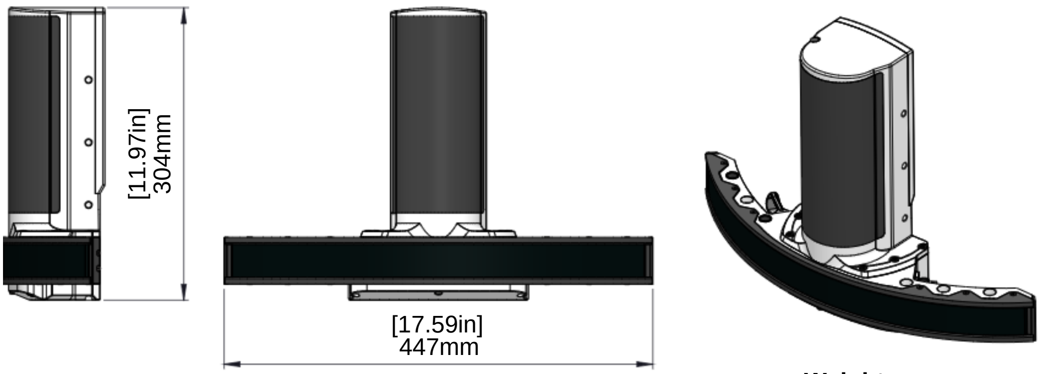
WINGHEAD i87S (Integrated)

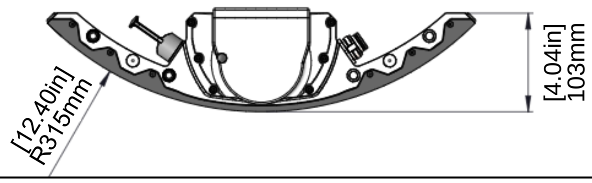


Weight: 22.7kg (air), 11.7kg (water)

C4. WINGHEAD Deep Sea System (PN 24110)

Excluding Mounting Bracket

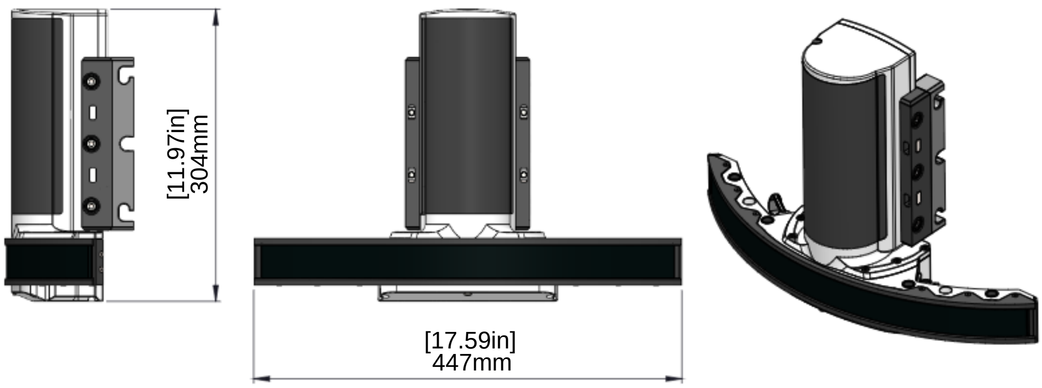


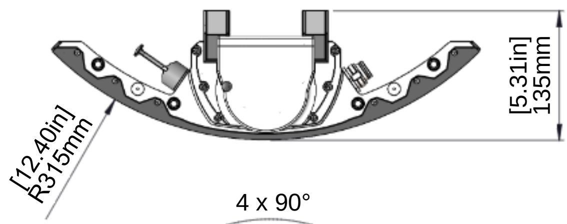


Weight:
B44 : 10.8kg (air), 7.1kg (water)

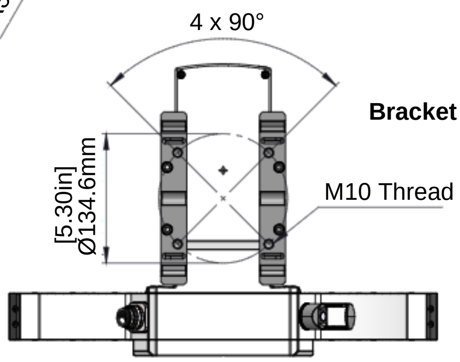
> **CAUTION:** The vent screw beneath the sonar allows controlled pressure release after deep dives in case of suspected leaks. Do **NOT** tamper with it. Contact NORBIT Support for guidance if in doubt.

Including Mounting Bracket





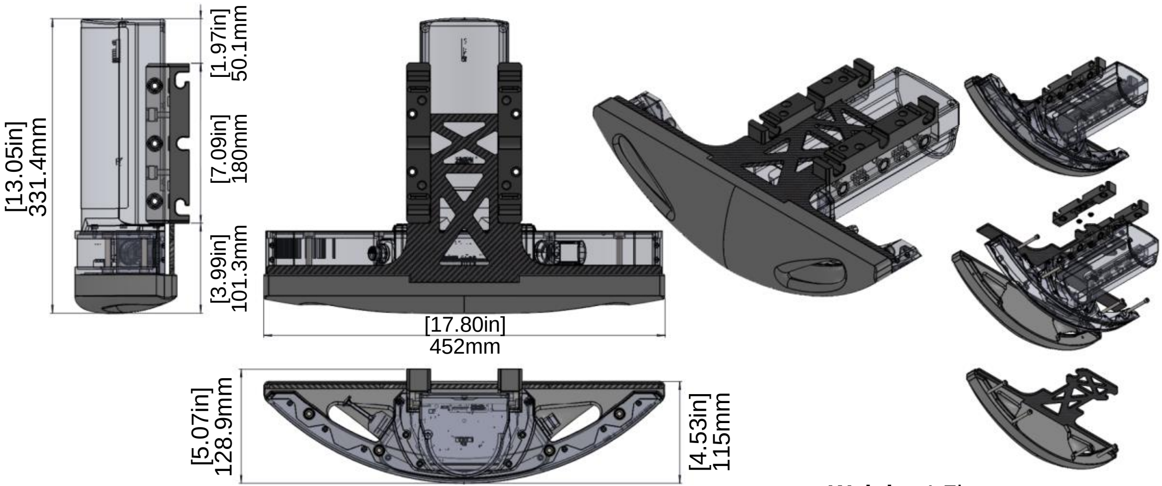
Weight:
B44 : 12.4kg (air), 8.5kg (water)



Bracket Mounting Pattern

C5. WINGHEAD Fairing (PN 35166)

Option A: Standard WINGHEAD

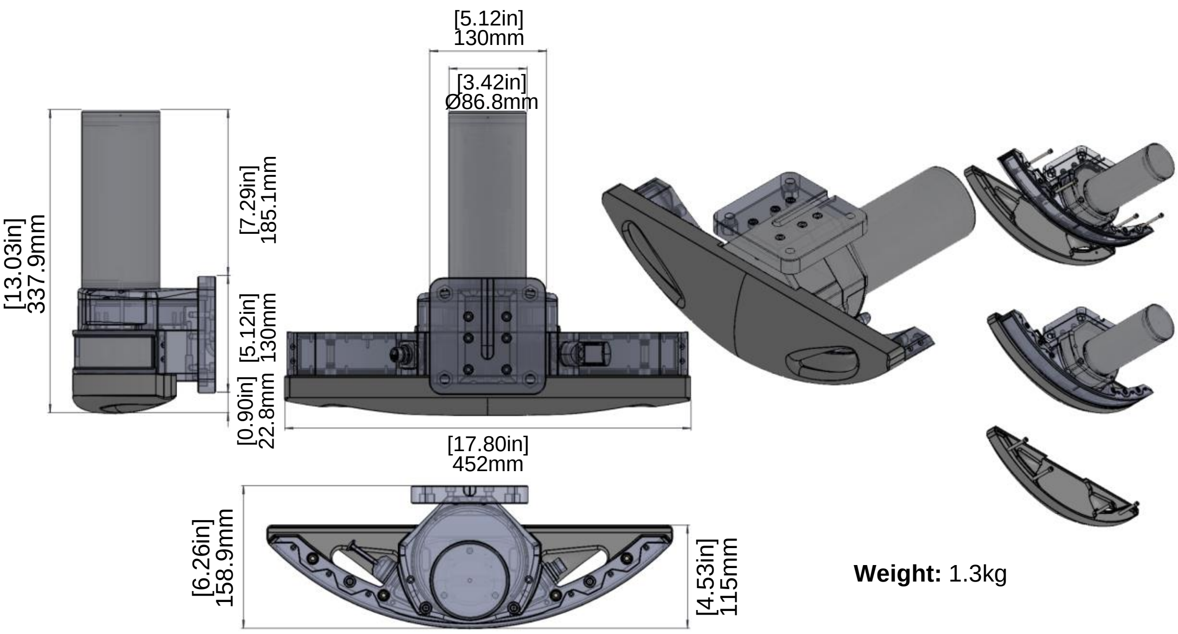


Weight: 1.7kg

Assembly Instructions:
1. Detach bracket from sonar.
2. Attach carbon support into fairing slot.
3. Place fairing onto sonar.
4. Attach 4x M6 screws through sonar.
5. Torque to 0.5Nm after all bolts are aligned.
6. Mount knobs into bracket holes.
7. Re-attach bracket over carbon plate.

Part No.	Description	Qty
SJ-5012	Rubber Feet	4
451280	WINGHEAD Fairing Bumper	1
451281	WINGHEAD Fairing Support	1
-	DIN 912 M6 x 60 – A4	4

Option H: WINGHEAD Stabilised (“S” Series)



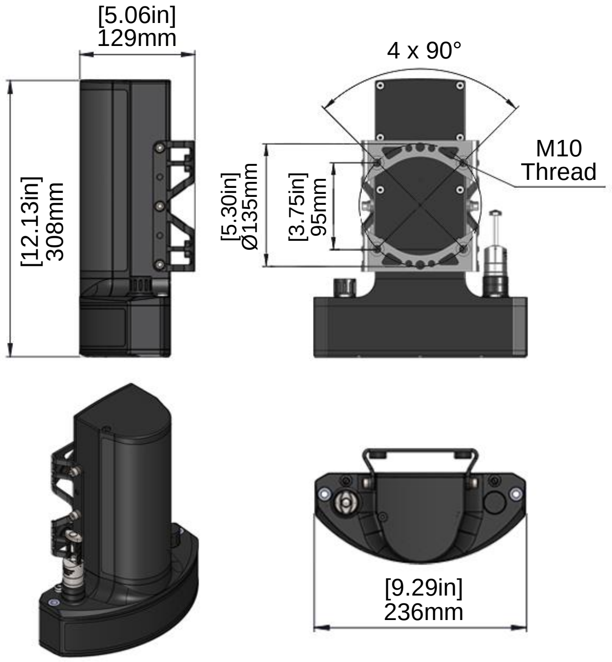
Weight: 1.3kg

Assembly Instructions:
1. Place fairing onto sonar.
2. Attach 4x M6 screws through sonar.
3. Torque to 0.5Nm after all bolts are aligned.

Part No.	Description	Qty
451280	WINGHEAD Fairing Bumper	1
-	DIN 912 M6 x 60 – A4	4

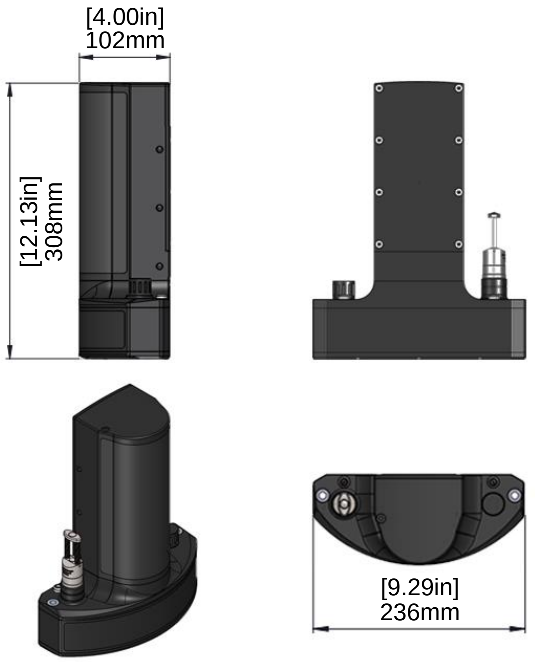
C6. iWBMSh Stabilised (PN 24216)

Including Mounting Bracket



Weight: 7.0kg (air), 3.5kg (water)

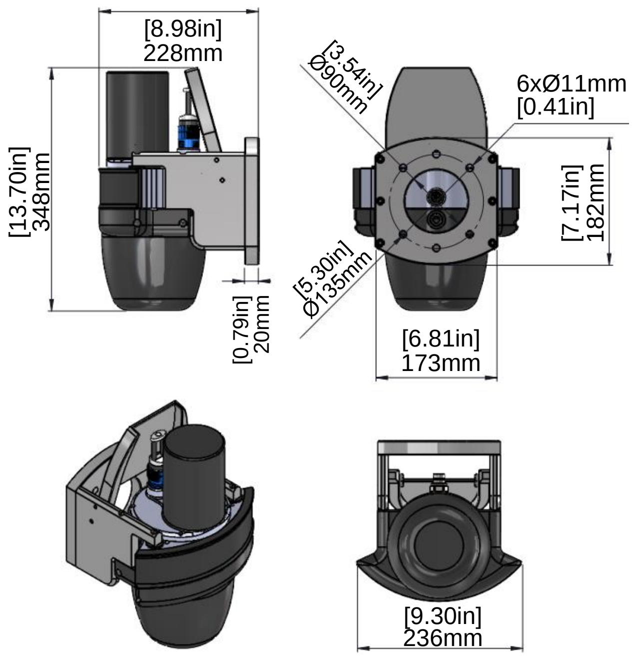
Excluding Mounting Bracket



Weight: 6.5kg (air), 3.1kg (water)

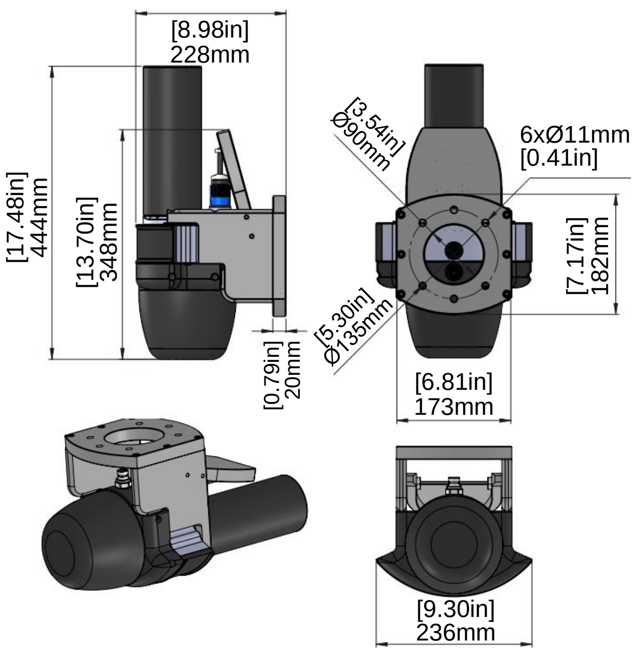
C7. iWBMS / iWBMSh (PN 12004/12007)

Standard Option (1.9° TX)



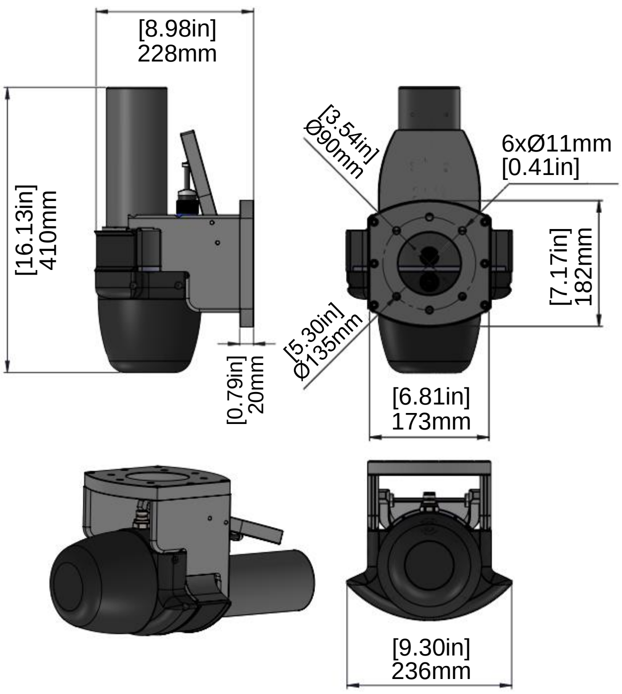
Sonar PN: 24003 / **Bracket PN:** 35021
Weight: 8.5kg (air), 5.0kg (water)

Narrow TX Option (0.9° TX)



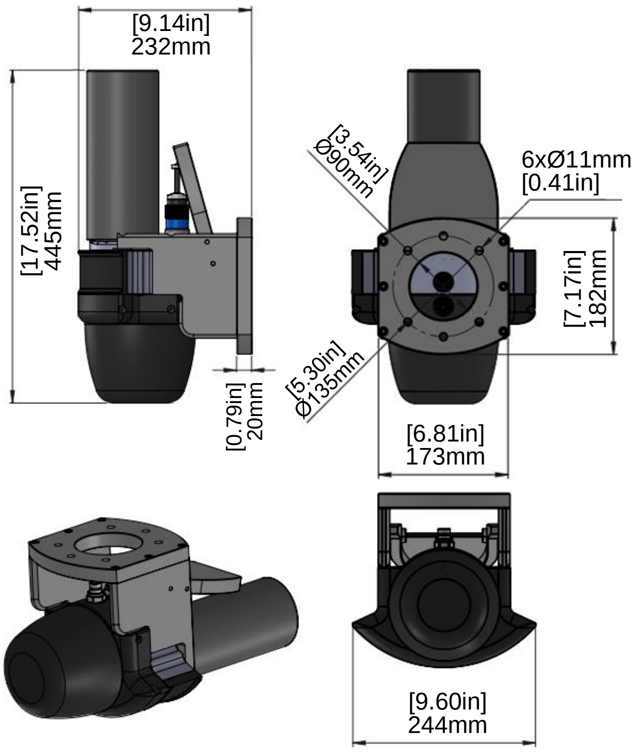
Sonar PN: 24003 / **Bracket PN:** 35021
Weight: 9.4kg (air), 3.6kg (water)

STX Option



Sonar PN: 24016 / **Bracket PN:** 35021
Weight: 10.1kg (air), 5.1kg (water)

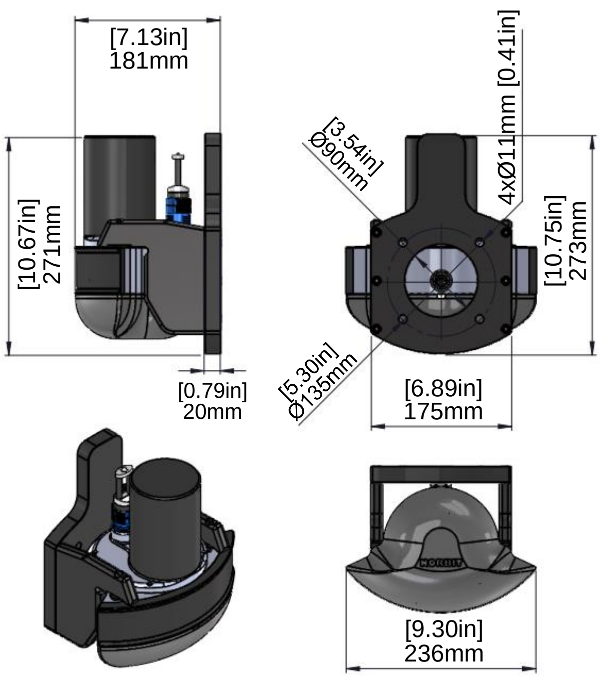
Long Range (200kHz) Option



Sonar PN: 24007 / **Bracket PN:** 35021
Weight: 11.0kg (air), 7.0kg (water)

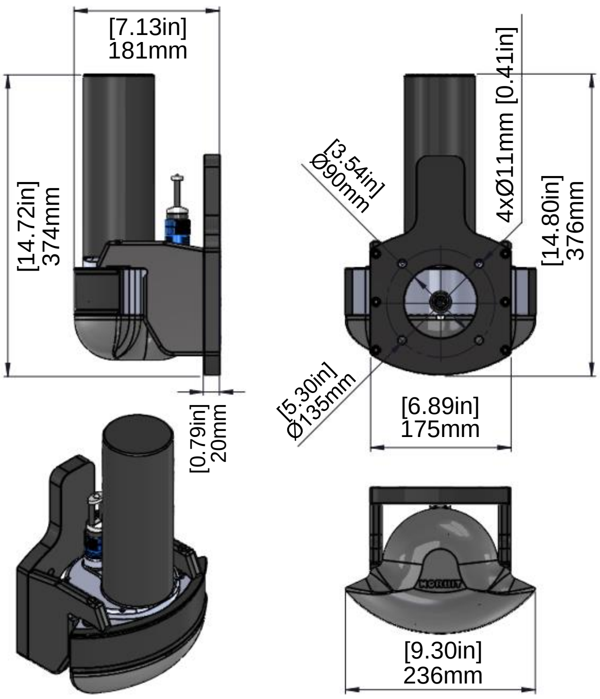
C8. iWBMSe (PN 12006)

Standard Option (1.9° TX)



Sonar PN: 24018 / **Bracket PN:** 35047
Weight: 6.5kg (air), 2.4kg (water)

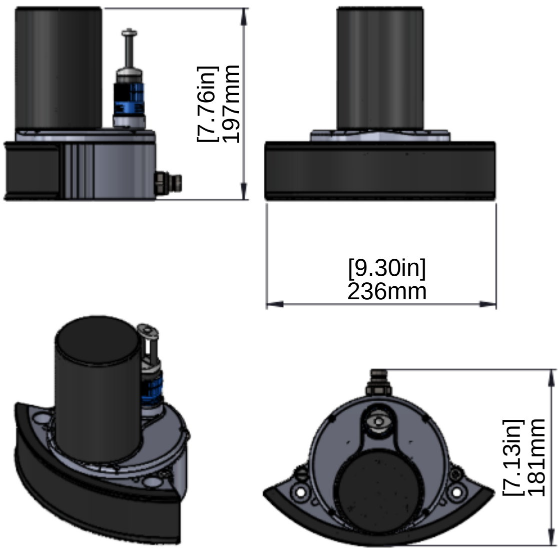
Narrow TX Option (0.9° TX)



Sonar PN: 24018 / **Bracket PN:** 35047
Weight: 7.4kg (air), 2.5kg (water)

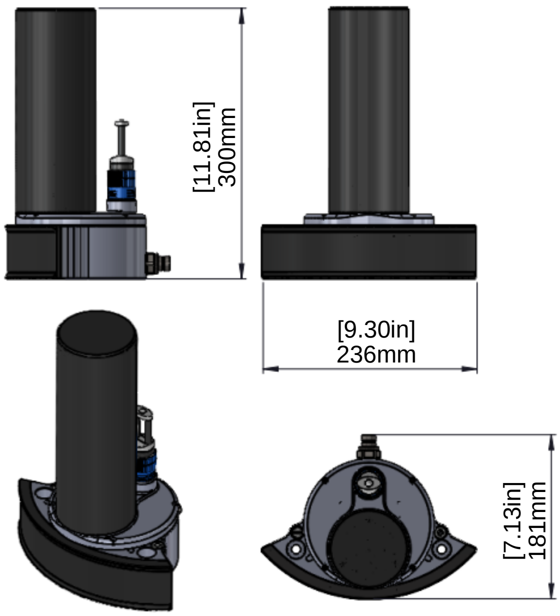
C9. WBMS (PN 12003)

Standard Option (1.9° TX)



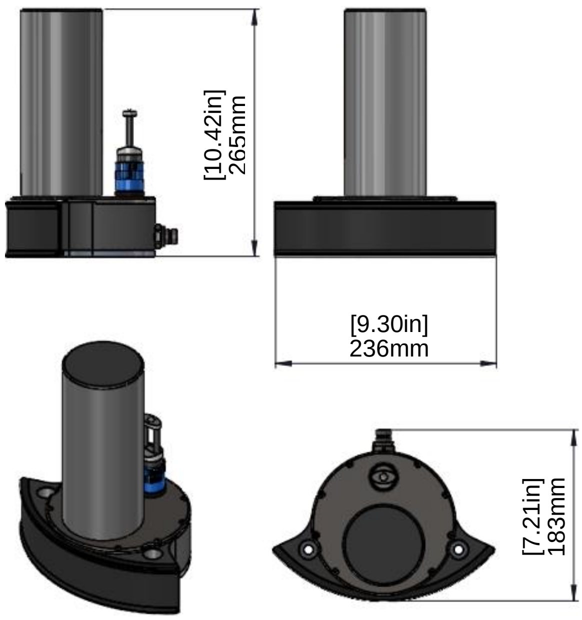
Sonar PN: 24003
Weight: 4.2kg (air), 1.9kg (water)

Narrow TX Option (0.9° TX)



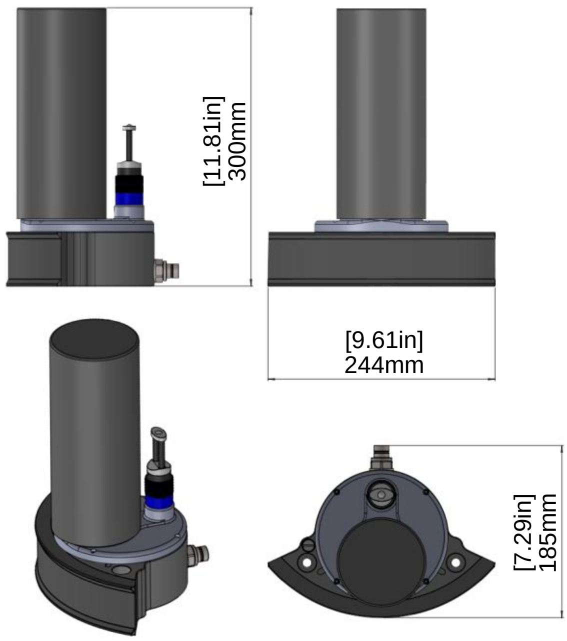
Sonar PN: 24003
Weight: 5.1kg (air), 2.3kg (water)

STX Option



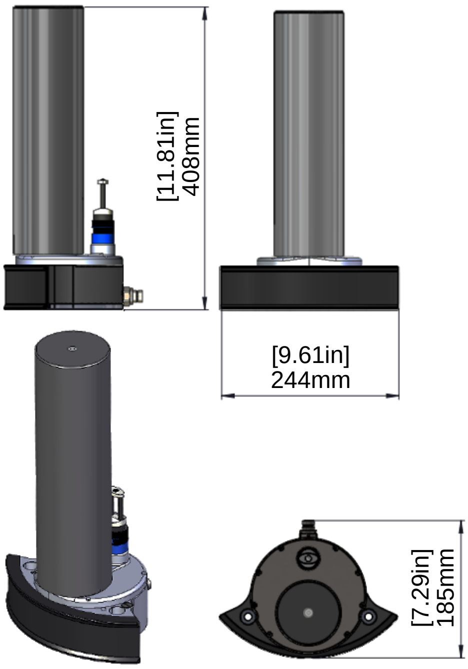
Sonar PN: 24016
Weight: 5.4kg (air), 3.1kg (water)

Long Range (200kHz) Option



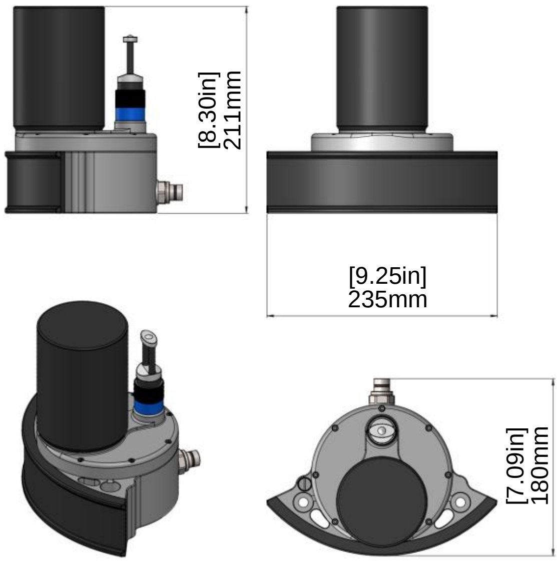
Sonar PN: 24007
Weight: 6.3kg (air), 3.1kg (water)

STX Long Range (200kHz) Option



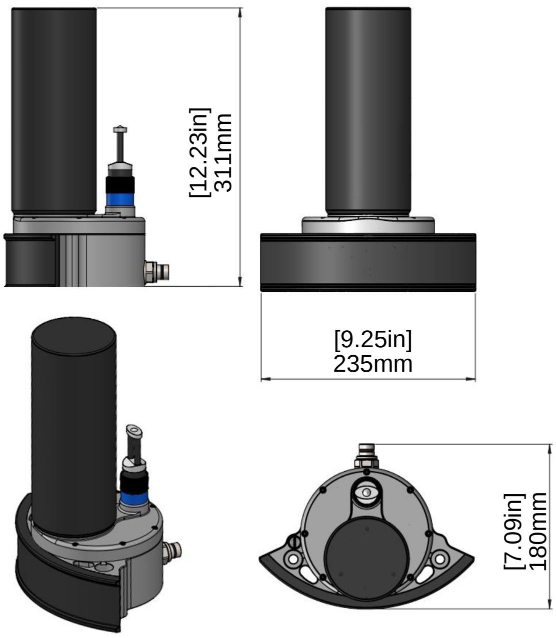
Sonar PN: 24017
Weight: 7.9kg (air), 4.9kg (water)

Deepsea/Fullocean (1.9° TX)



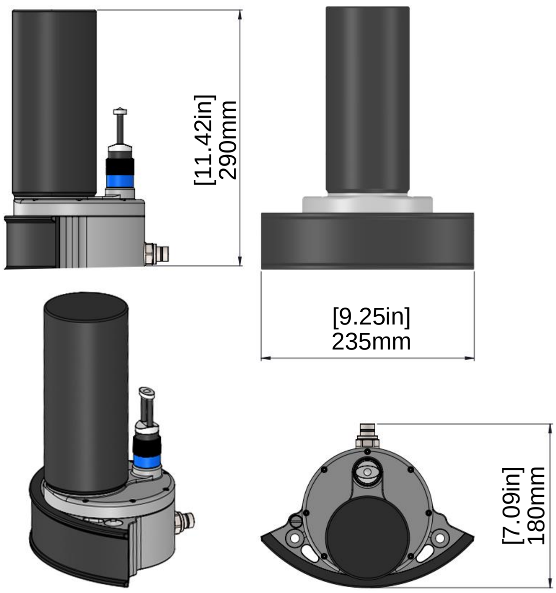
Weights:
Deepsea (PN 24010): 6.4kg (air), 4.0kg (water)
Fullocean (PN 24030): 7.0kg (air), 4.5kg (water)

Deepsea/Fullocean Narrow TX (0.9° TX)



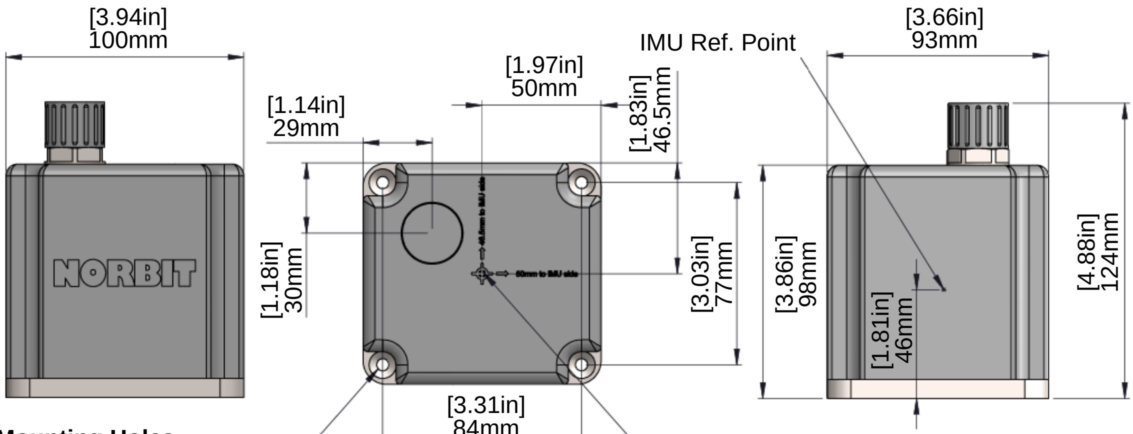
Weights:
Deepsea (PN 24010): 7.6kg (air), 4.6kg (water)
Fullocean (PN 24030): 8.2kg (air), 5.1kg (water)

STX Deepsea/Fullocean Narrow TX (0.9° TX)



Weights:
Deepsea (PN 24033): 7.9kg (air), 4.9kg (water)
Fullocean (PN 24032): 8.5kg (air), 5.4kg (water)

C10. IMU Detached (IMUd, PN 24036)



Mounting Holes

- For through-hole mounting, use M5 countersunk bolts.
- For direct attachment, use M6 bolts.

IMU Mounting Angles

Connector front/left and NORBIT logo at back:

X	0.00°
Y	0.00°
Z	0.00°

Connector front/right and NORBIT logo on port side:

X	0.00°
Y	0.00°
Z	90.00°

The IMUd has a depth rating of 50m.

IMU Reference Point

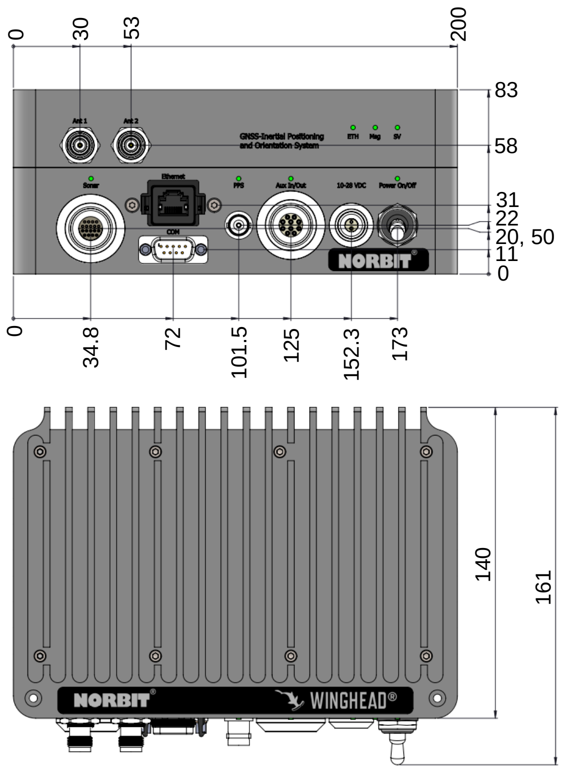
+Fwd	46.5mm aft from front edge of IMU
+Stbd	50mm from side edge of IMU
+Down	52.3mm down from top edge of IMU

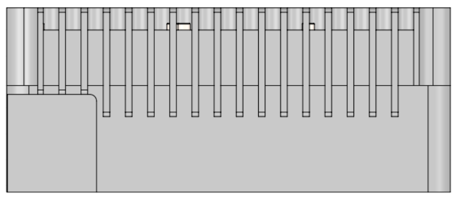
WINGHEAD to IMUd Offset using PORTUS Pole (excluding “S” series)

+Fwd	-148 mm
+Stbd	0 mm
+Down	-88 mm

C11. WINGHEAD / iWBMSh Stabilised Sonar Interface Unit (PN 29093 / 29060 / 29064)

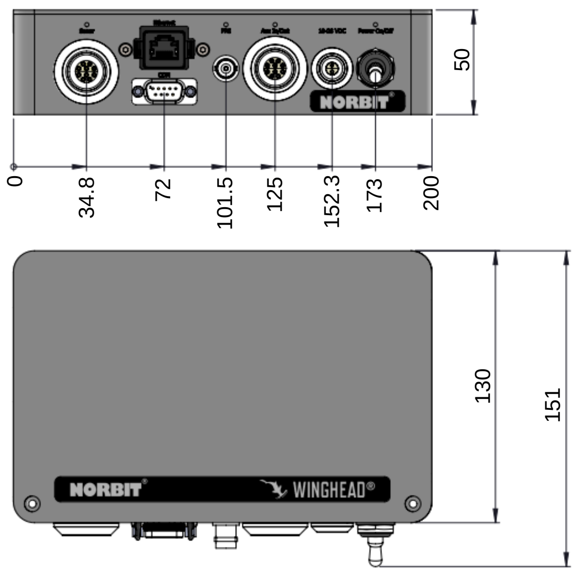
WINGHEAD / iWBMSh Stabilised Integrated iSIU-WH (PN 29093 / 29060)





Weight: 2.3kg

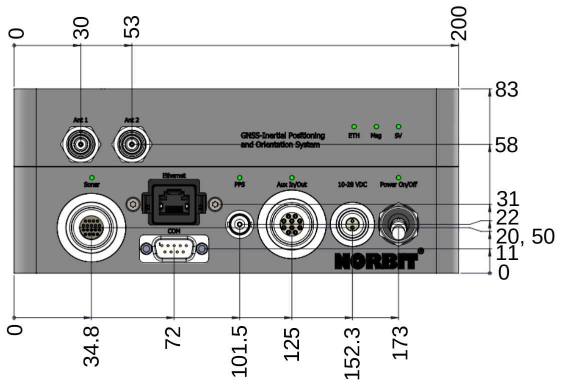
WINGHEAD Non-Integrated SIU-WH (PN 29064)

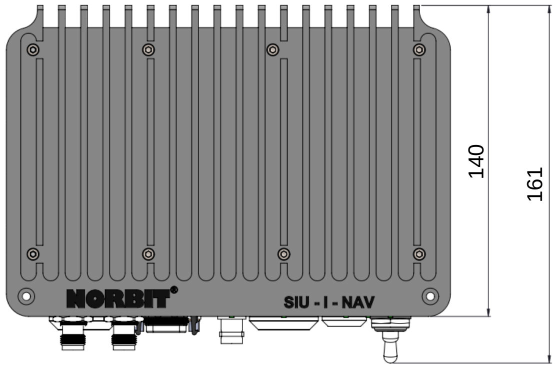


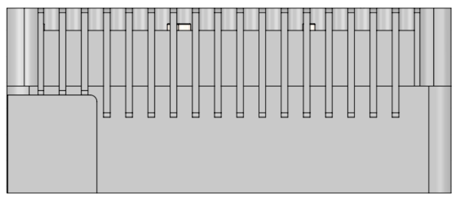
Weight: 1.5kg

C12. WBMS Sonar Interface Unit (PN 29028 / 29024)

WBMS Integrated SIU-I-NAV (PN 29028)

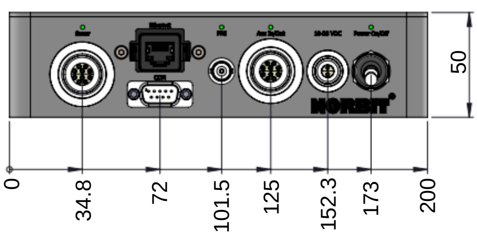


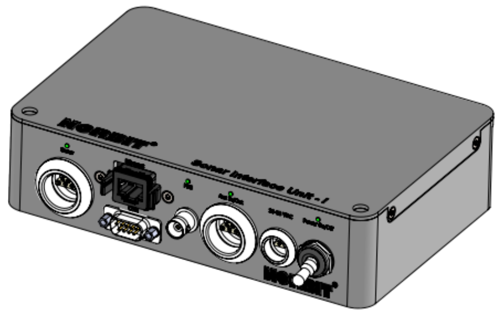


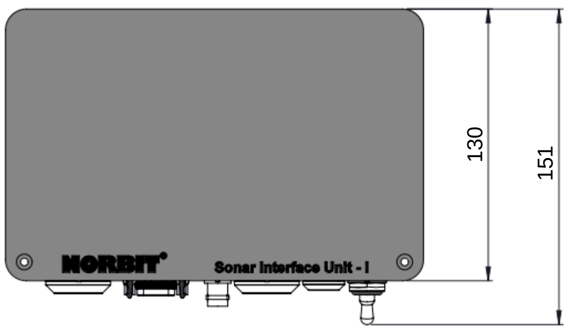


Weight: 2.3kg

WBMS Non-Integrated SIU-I (PN 29024)





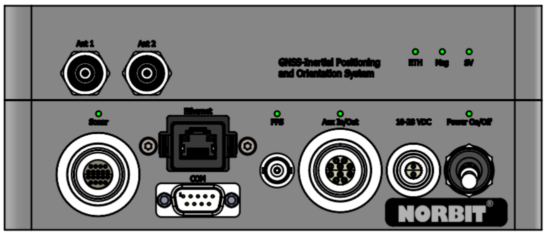


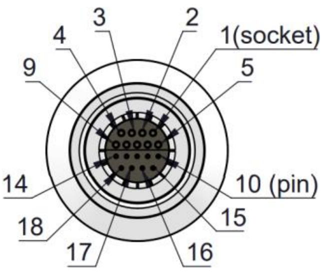
Weight: 1.5kg

Appendix D: SIU Pinout Diagrams

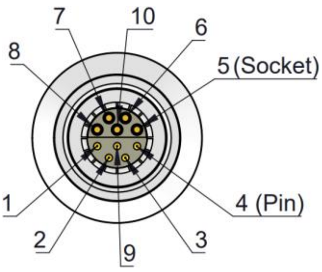
D1. WINGHEAD / iWBMSh Stabilised Sonar Interface Unit (PN 29093 / 29060 / 29064)

Integrated iSIU-WH (PN 29093 / 29060)

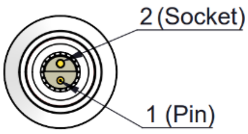




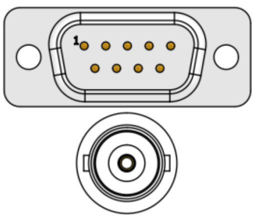
Sonar Socket	
Pin	Function
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COMM1
6	IMU COMM2
7	LAN, TX+
8	LAN, RX+
9	Time Out
10	IMU COMM3
11	IMU COMM4
12	LAN, TX-
13	LAN, RX-
14	Signal GND
15	Trig+ (RS422)
16	Trig- (RS422)
17	IMU COMM8
18	IMU COMM9



AUX Socket	
Pin	Function
1	LAN TX+
2	LAN TX -
3	LAN RX+
4	LAN RX-
5	Trig- (RS422)
6	Trig+ (RS422)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24 VDC

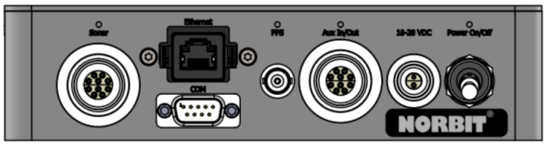


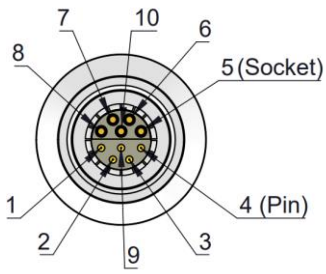
12-28 VDC Socket	
Pin	Function
1	PWR GND
2	PWR+12-28 VDC



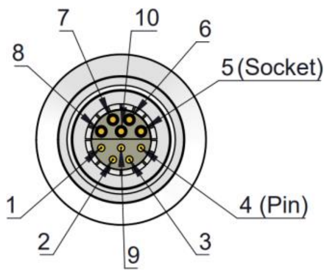
COM Socket / BNC	
Pin	Function
2	INS COM3 RX
3	INS COM3 TX
5	GND
9/BNC	PPS Out

Non-Integrated SIU-WH (PN 29064)

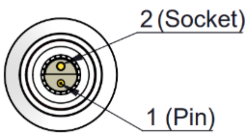




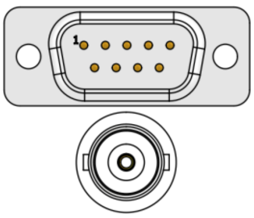
Sonar Socket	
Pin	Function
1	LAN TX+
2	LAN TX -
3	LAN RX+
4	LAN RX-
5	Trig+ (RS422)
6	Trig- (RS422)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24 VDC



AUX Socket	
Pin	Function
1	NC
2	NC
3	NC
4	NC
5	Trig- (RS422)
6	Trig+ (RS422)
7	NC
8	Signal GND
9	NC
10	NC



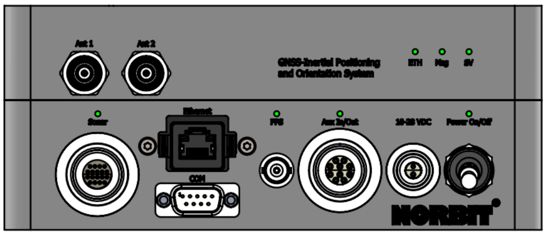
12-28 VDC Socket	
Pin	Function
1	PWR GND
2	PWR+12-28 VDC

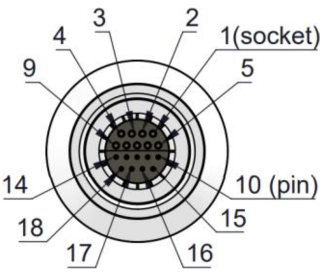


COM Socket / BNC	
Pin	Function
2	ZDA In, RS232 RX
3	RS232 TX
5	GND
9/BNC	PPS In

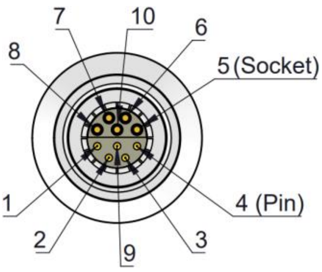
D2. WBMS Sonar Interface Unit (PN 29028 / 29024)

Integrated SIU-I-NAV (PN 29028)

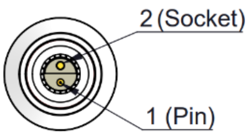




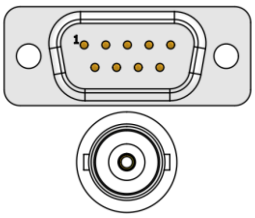
Sonar Socket	
Pin	**Function**
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COMM1
6	IMU COMM2
7	LAN, TX+
8	LAN, RX+
9	Time Out
10	IMU COMM3
11	IMU COMM4
12	LAN, TX-
13	LAN, RX-
14	Signal GND
15	Trig Out (RS232)
16	Trig In (RS232)
17	IMU COMM8
18	IMU COMM9



AUX Socket	
Pin	**Function**
1	LAN TX+
2	LAN TX -
3	LAN RX+
4	LAN RX-
5	Trig Out (RS232)
6	Trig In (RS232)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24 VDC

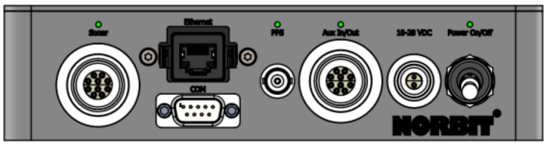


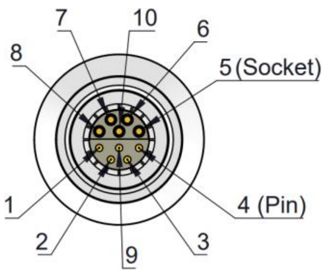
12-28 VDC Socket	
Pin	**Function**
1	PWR GND
2	PWR+12-28 VDC



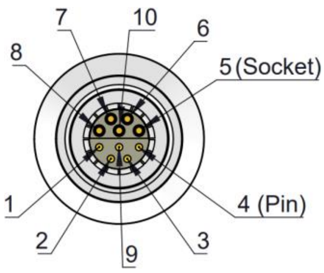
COM Socket / BNC	
Pin	**Function**
2	INS COM3 RX
3	INS COM3 TX
5	GND
9/BNC	PPS Out

Non-Integrated SIU-I (PN 29024)

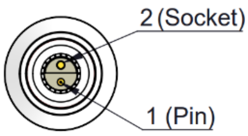




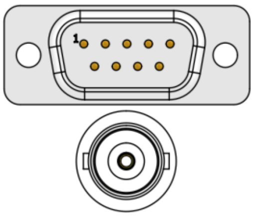
Sonar Socket	
Pin	**Function**
1	LAN TX+
2	LAN TX -
3	LAN RX+
4	LAN RX-
5	Trig Out (RS232)
6	Trig In (RS232)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24 VDC



AUX Socket	
Pin	**Function**
1	NC
2	NC
3	NC
4	NC
5	Trig Out (RS232)
6	Trig In (RS232)
7	NC
8	Signal GND
9	NC
10	NC



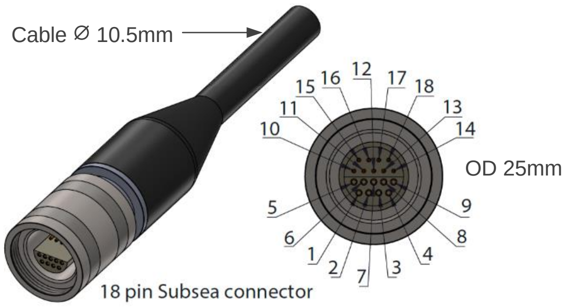
12-28 VDC Socket	
Pin	**Function**
1	PWR GND
2	PWR+12-28 VDC



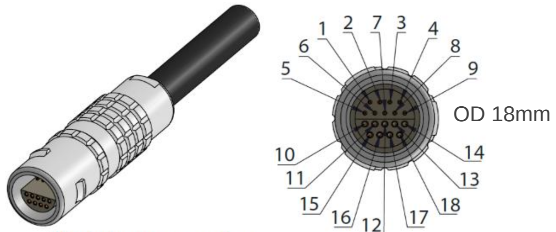
COM Socket / BNC	
Pin	**Function**
2	ZDA In, RS232 RX
3	RS232 TX
5	GND
9/BNC	PPS In

Appendix E: Cable Pinout Diagrams

E1. WINGHEAD Integrated Cable (PN 33231)



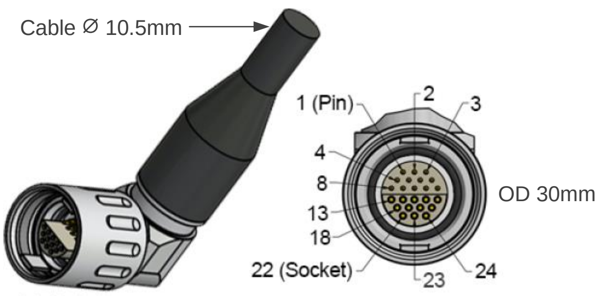
18 pin Subsea connector



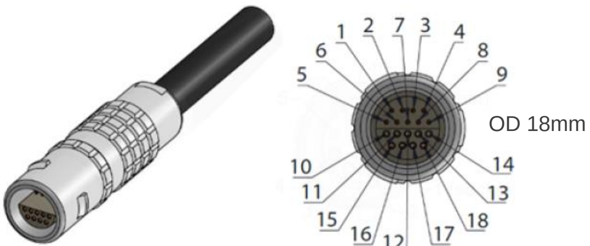
18 pin Lemo connector

Subsea (18-pin)	Topside (18-pin)	Function
1	1	GND
2	2	GND
3	3	24 VDC
4	4	24 VDC
5	5	IMU COM1
6	6	IMU COM2
7	7	LAN, TX+
8	8	LAN, RX+
9	9	IRIG-B+
10	10	IMU COM3
11	11	IMU COM4
12	12	LAN, TX-
13	13	LAN, RX-
14	14	IRIG-B-
15	15	Trigger+
16	16	Trigger-
17	17	N/C
18	18	N/C

E2. WINGHEAD Integrated Cable, Titanium (PN 33228)



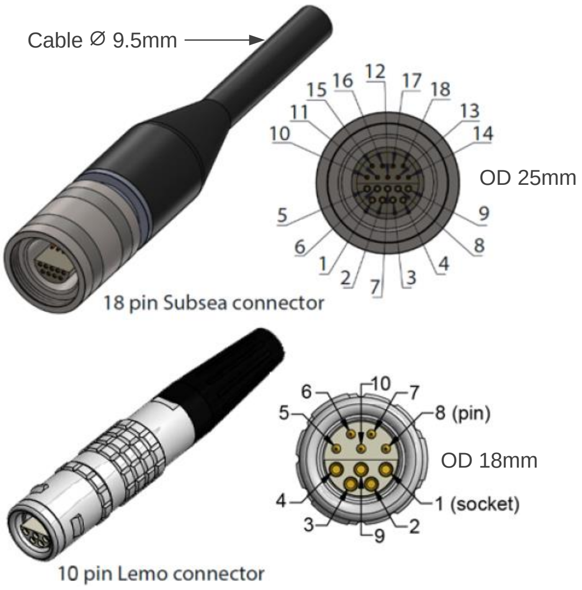
24 pin Subsea connector



18 pin Lemo connector

Subsea (24-pin)	Topside (18-pin)	Function
1	9	TIME+
2	14	TIME-
3	N/C	
4	1	PWR-
5	13	ETH_B-
6	8	ETH_B+
7	2	PWR-
8	7	ETH_A+
9	5	IMU_A+
10	11	IMU_B-
11	17	IMU_C+
12	N/C	
13	12	ETH_A-
14	6	IMU_A-
15	10	IMU_B+
16	18	IMU_C-
17	N/C	
18	3	PWR+
19	N/C	
20	N/C	
21	4	PWR+
22	N/C	
23	16	TRIG-
24	15	TRIG+

E3. WINGHEAD Interface Cable (PN 33248)



Subsea (18-pin)	Topside (10-pin)	Function
1	9	GND
2	9	GND
3	10	24 VDC
4	10	24 VDC
5	N/C	
6	N/C	
7	1	LAN, TX+
8	3	LAN, RX+
9	7	IRIG-B+
10	N/C	
11	N/C	
12	2	LAN, TX-
13	4	LAN, RX-
14	8	IRIG-B
15	5	Trigger+
16	6	Trigger-
17	N/C	
18	N/C	

E4. WINGHEAD Interface Cable, Titanium (PN 33267)

Subsea (24-pin)	Topside (10-pin)	Function
1	7	TIME+
2	8	TIME-
3	N/C	
4	9	PWR-
5	4	ETH_B-
6	3	ETH_B+
7	9	PWR-
8	1	ETH_A+
9	N/C	
10	N/C	
11	N/C	
12	N/C	
13	2	ETH_A-
14	N/C	
15	N/C	
16	N/C	
17	N/C	
18	10	PWR+
19	N/C	
20	N/C	
21	10	PWR+
22	N/C	
23	6	TRIG-
24	5	TRIG+

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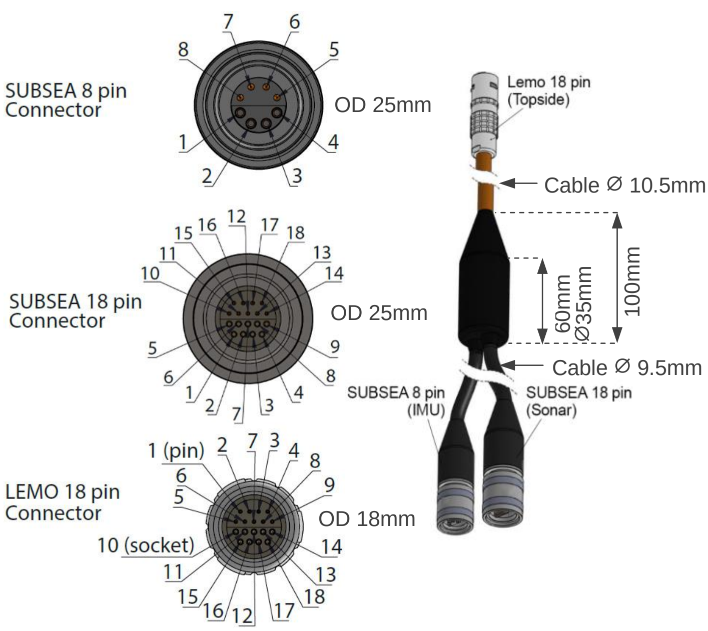
E5. WINGHEAD Subsea Interface Cable, Titanium (PN 33264)

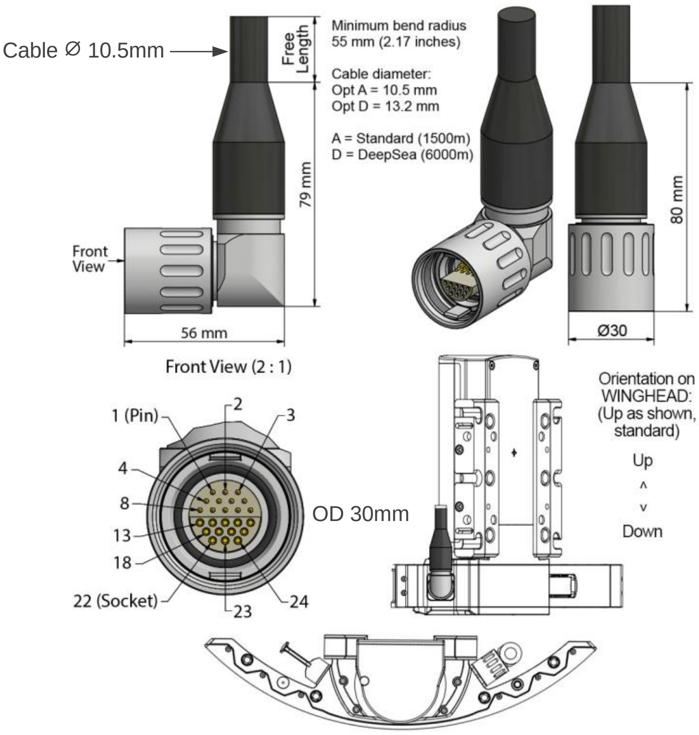
Subsea (24-pin)	Topside (10-pin)	Function
1	7	TIME+
2	N/C	
3	8	TIME_GND
4	9	PWR-
5	4	ETH_B-
6	3	ETH_B+
7	9	PWR-
8	1	ETH_A+
9	N/C	
10	N/C	
11	N/C	
12	N/C	
13	2	ETH_A-
14	N/C	
15	N/C	
16	N/C	
17	N/C	
18	10	PWR+
19	N/C	
20	N/C	
21	N/C	
22	6	TRIG_GND
23	N/C	
24	5	TRIG+

E6. WINGHEAD Split Cable (PN 33273)



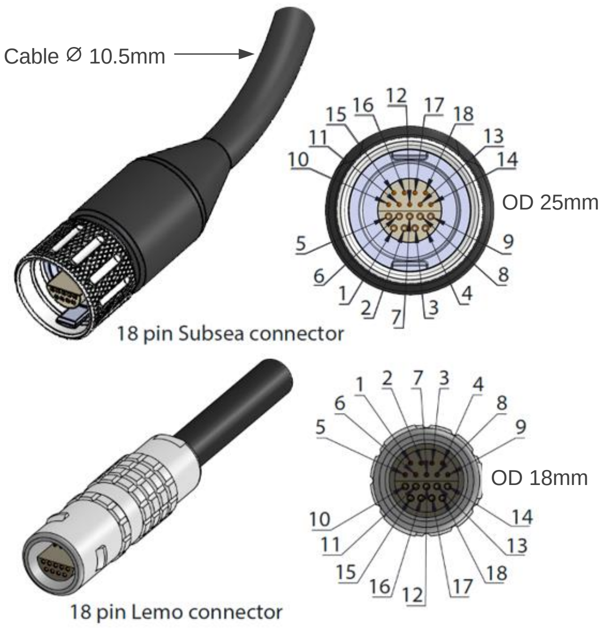
Topside (18-pin)	Subsea 18-pin	Subsea 8-pin	Function
1	1	4	GND
2	2		GND
3	3	3	24 VDC
4	4		24 VDC
5		8	IMU COM1
6		7	IMU COM2
7	7		LAN, TX+
8	8		LAN, RX+
9	9		IRIG-B+
10		6	IMU COM3
11		5	IMU COM4
12	12		LAN, TX-
13	13		LAN, RX-
14	14		IRIG-B-
15	15		Trigger+
16	16		Trigger-
17		2	IMU COM8
18		1	IMU COM9

E7. WINGHEAD Integrated Pigtail, Titanium (PN 33256)



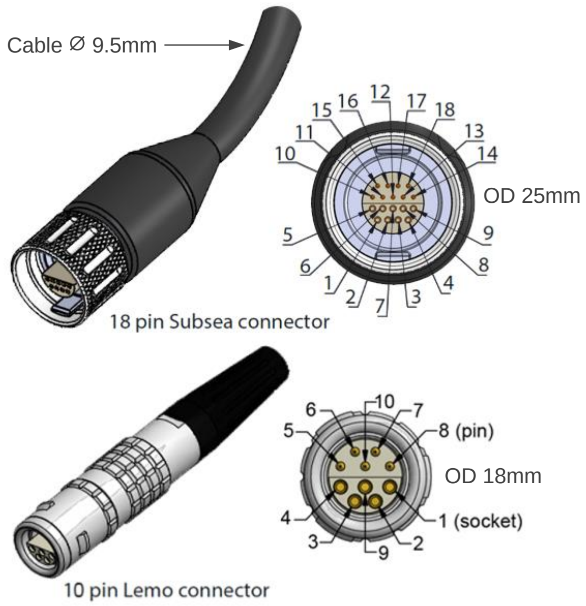
Pin	Function	Comment
1	TIME+	TTL/RS422
2	TIME-	TTL/RS422
3	TIME_GND	TTL/RS422
4	PWR-	PWR GND
5	ETH_B-	1000BASE-T
6	ETH_B+	1000BASE-T
7	PWR-	PWR GND
8	ETH_A+	1000BASE-T
9	IMU_A+	RS422
10	IMU_B-	RS422
11	IMU_C+	RS422
12	ETH_C-	1000BASE-T
13	ETH_A-	1000BASE-T
14	IMU_A-	RS422
15	IMU_B+	RS422
16	IMU_C-	RS422
17	ETH_C+	1000BASE-T
18	PWR+	24-48VDC
19	ETH_D+	1000BASE-T
20	ETH_D-	1000BASE-T
21	PWR+	24-48VDC
22	TRIG_GND	TTL/RS422
23	TRIG-	TTL/RS422
24	TRIG+	TTL/RS422

E8. iWBMSh Stabilised Integrated Cable (PN 33371)



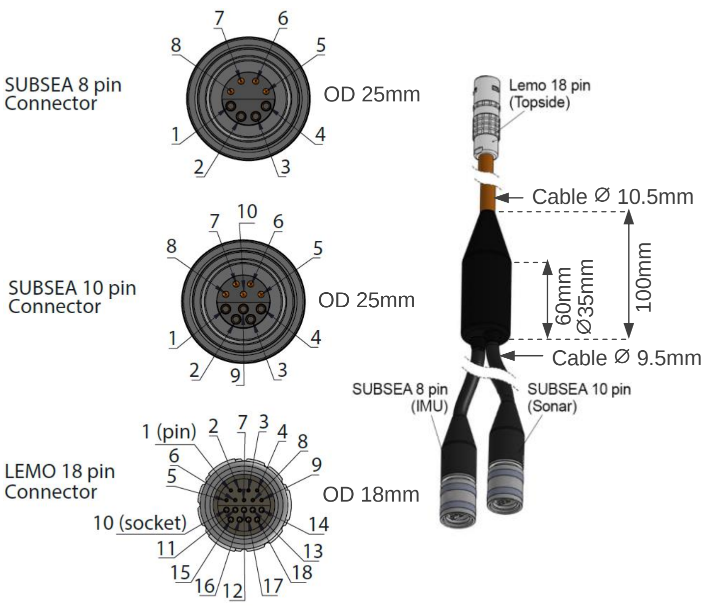
Subsea (18-pin)	Topside (18-pin)	Function
1	3	PWR+
2	7	ETH1_A+
3	12	ETH1_A-
4	4	PWR+
5	5	IMU_A+
6	9	TIME+
7	14	TIME-
8	10	TIME_GND
9	18	IMU_C-
10	6	IMU_A-
11	11	Trigger_GND
12	16	TRIGGER-
13	15	TRIGGER+
14	17	IMU_C+
15	1	GND
16	8	ETH1_B+
17	13	ETH1_B-
18	2	GND

E9. iWBMSh Stabilised Interface Cable (PN 33372)



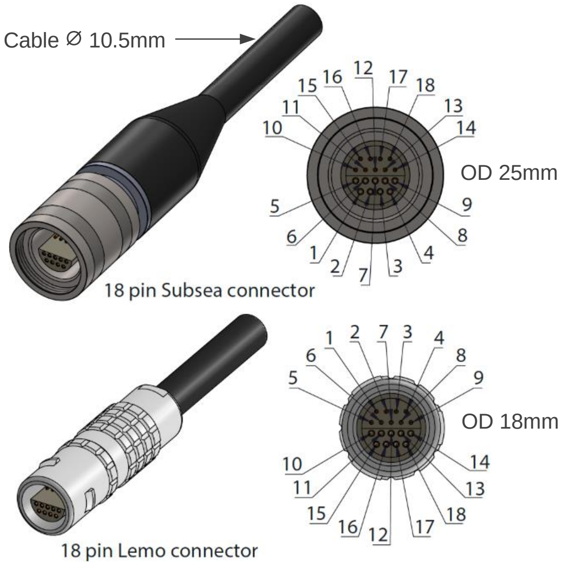
Subsea (18-pin)	Topside (10-pin)	Function
1	10	PWR+
2	1	ETH1_A+
3	2	ETH1_A-
4	10	PWR+
5	N/C	
6	7	TIME+
7	8	TIME-
8	N/C	
9	N/C	
10	N/C	
11	N/C	
12	6	TRIGGER-
13	5	TRIGGER+
14	N/C	
15	9	GND
16	3	ETH1_B+
17	4	ETH1_B-
18	9	GND

E10. iWBMS Split Cable (PN 33129)



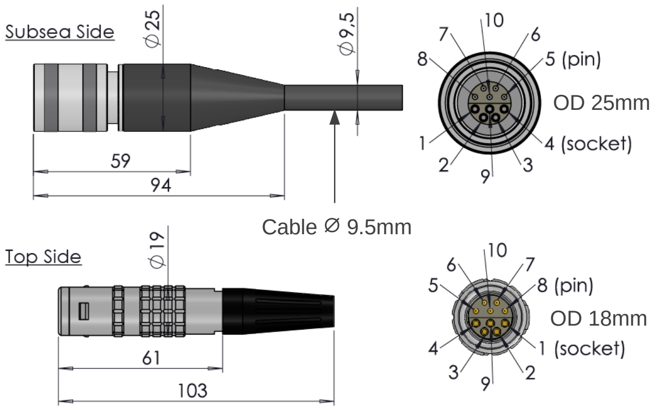
Topside (18-pin)	Subsea 10-pin	Subsea 8-pin	Function
1		4	IMU GND
2	9		GND
3		3	IMU 24 VDC
4	10		24 VDC
5		8	IMU COM1
6		7	IMU COM2
7	1		LAN, TX+
8	3		LAN, RX+
9	7		IRIG-B
10		6	IMU COM3
11		5	IMU COM4
12	2		LAN, TX-
13	4		LAN, RX-
14	8		GND (IRIG-B/RS232)
15	5		RS232 TX
16	6		RS232 RX
17		2	IMU COM8
18		1	IMU COM9

E11. iWBMSe Interface Cable (PN 33088)



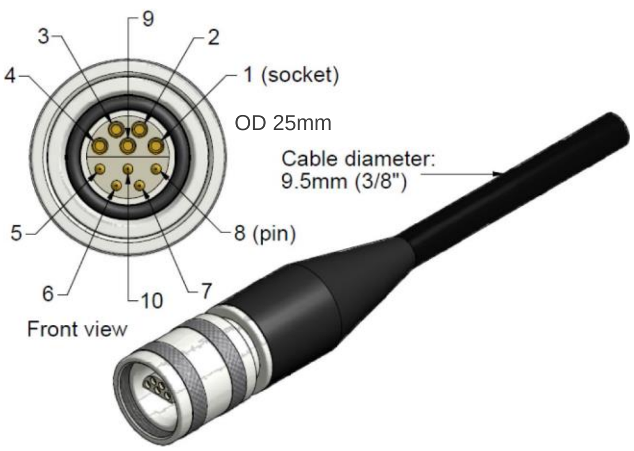
Subsea (18-pin)	Topside (18-pin)	Function
1	1	GND
2	2	GND
3	3	24 VDC
4	4	24 VDC
5	5	IMU COM1
6	6	IMU COM2
7	7	LAN, TX+
8	8	LAN, RX+
9	9	IRIG-B
10	10	N/C
11	11	N/C
12	12	LAN, TX-
13	13	LAN, RX-
14	14	Signal GND
15	15	N/C
16	16	N/C
17	17	RS232 TX
18	18	RS232 RX

E12. WBMS Interface Cable (PN 33029)



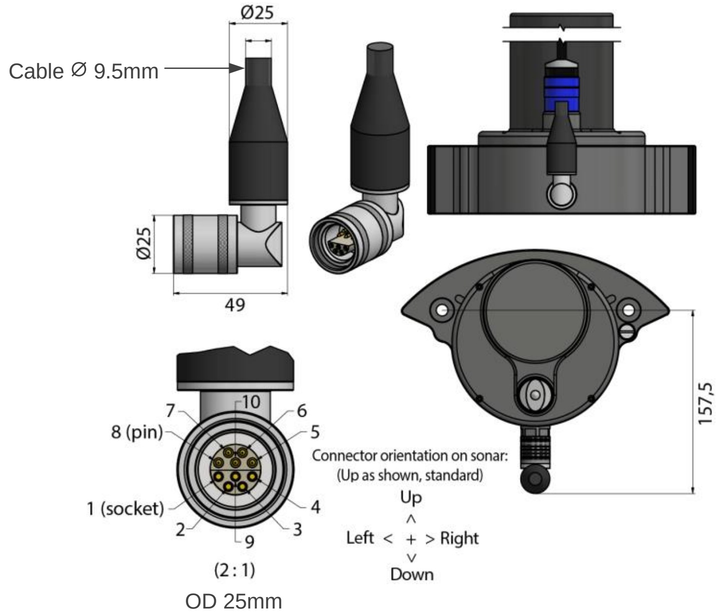
Subsea (10-pin)	Topside (10-pin)	Function
1	1	Tx +
2	2	Tx -
3	3	Rx +
4	4	Rx -
5	5	RS232 Tx/Trig Out
6	6	RS232 Rx/Trig In
7	7	IRIG-B
8	8	Signal GND
9	9	PWR GND
10	10	PWR +24VDC

E13. WBMS Interface Pigtail Deepsea Cable (PN 33095)



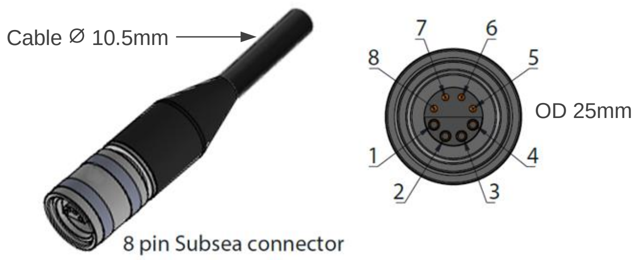
Pin	Function	Cable / Colour
1	Tx +	24 AWG, white/orange
2	Tx -	24 AWG, orange
3	Rx +	24 AWG, white/green
4	Rx -	24 AWG, green
5	RS232 Tx/Trig Out	24 AWG, white/brown
6	RS232 Rx/Trig In	24 AWG, brown
7	PPS/IRIG-B	24 AWG, white/blue
8	Signal GND	24 AWG, blue
9	PWR GND	Black, $0.5mm^2$
10	PWR +24V	White, $0.5mm^2$

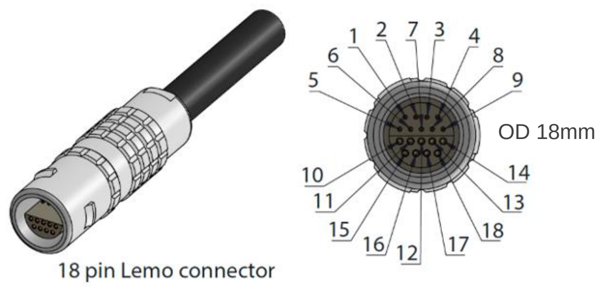
E14. WBMS Interface Pigtail Angled (PN 33205)



Pin	Function	Cable / Colour
1	Tx +	24 AWG, white/orange
2	Tx -	24 AWG, orange
3	Rx +	24 AWG, white/green
4	Rx -	24 AWG, green
5	RS232 Tx/Trig Out	24 AWG, white/brown
6	RS232 Rx/Trig In	24 AWG, brown
7	PPS/IRIG-B	24 AWG, white/blue
8	Signal GND	24 AWG, blue
9	PWR GND	Black, 0.5mm^2
10	PWR +24V	White, 0.5mm^2

E15. IMU Cable (PN 33172)





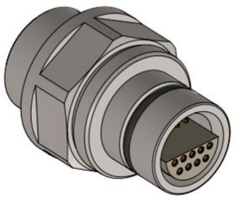
Topside (18-pin)	Subsea (8-pin)	Function
1	4	IMU GND
2		
3	3	IMU 24 VDC
4		
5	8	IMU COM1
6	7	IMU COM2
7		
8		
9		
10	6	IMU COM3
11	5	IMU COM4
12		
13		
14		
15		
16		
17	2	IMU COM8
18	1	IMU COM9

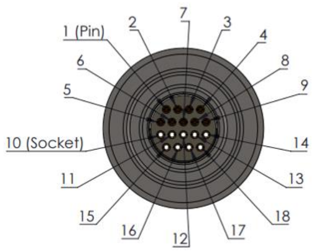
NORBIT

Appendix F: Bulkhead Pinout Diagrams

F1. WINGHEAD Bulkhead

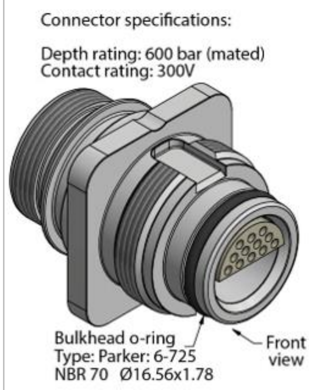
Standard (PN 33237)

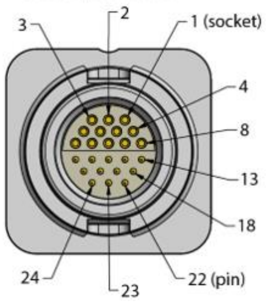




Pin	Function
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COM1
6	IMU COM2
7	LAN, TX+
8	LAN, RX+
9	IRIG-B+
10	IMU COM3
11	IMU COM4
12	LAN, TX-
13	LAN, RX-
14	IRIG-B-
15	Trigger+
16	Trigger-
17	IMU COM8
18	IMU COM9

Titanium (PN 33227)



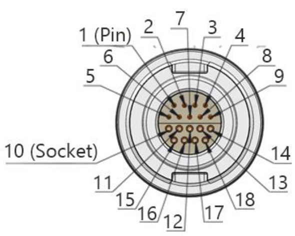


Pin	Function	Comment
1	TIME+	TTL/RS422
2	TIME-	TTL/RS422
3	TIME_GND	TTL/RS422
4	PWR-	PWR GND
5	ETH_B-	1000BASE-T
6	ETH_B+	1000BASE-T
7	PWR-	PWR GND
8	ETH_A+	1000BASE-T
9	IMU_A+	RS422
10	IMU_B-	RS422
11	IMU_C+	RS422
12	ETH_C-	1000BASE-T
13	ETH_A-	1000BASE-T
14	IMU_A-	RS422
15	IMU_B+	RS422
16	IMU_C-	RS422
17	ETH_C+	1000BASE-T
18	PWR+	24-48VDC
19	ETH_D+	1000BASE-T
20	ETH_D-	1000BASE-T
21	PWR+	24-48VDC
22	TRIG_GND	TTL/RS422
23	TRIG-	TTL/RS422
24	TRIG+	TTL/RS422

Note: Any NBR 70 ∅16.56 x 1.78mm O-Ring can be used.

F2. iWBMSh Stabilised Bulkhead

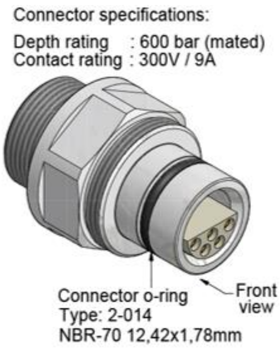
PN 33360



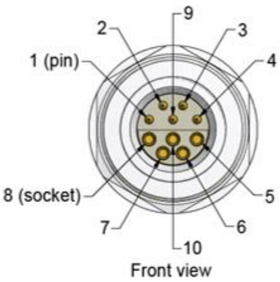
Pin	Function
1	PWR+
2	ETH1_A+
3	ETH1_A-
4	PWR+
5	IMU_A+
6	TIME+
7	TIME-
8	TIME_GND
9	IMU_C-
10	IMU_A-
11	Trigger_GND
12	TRIGGER-
13	TRIGGER+
14	IMU_C+
15	GND
16	ETH1_B+
17	ETH1_B-
18	GND

F3. WBMS Bulkhead

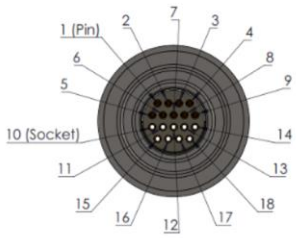
Standard (PN 33049)



Pin	Function
1	Tx +
2	Tx -
3	Rx +
4	Rx -
5	RS232 Tx/Trig Out
6	RS232 Rx/Trig In
7	IRIG-B
8	Signal GND
9	PWR GND
10	PWR +24V



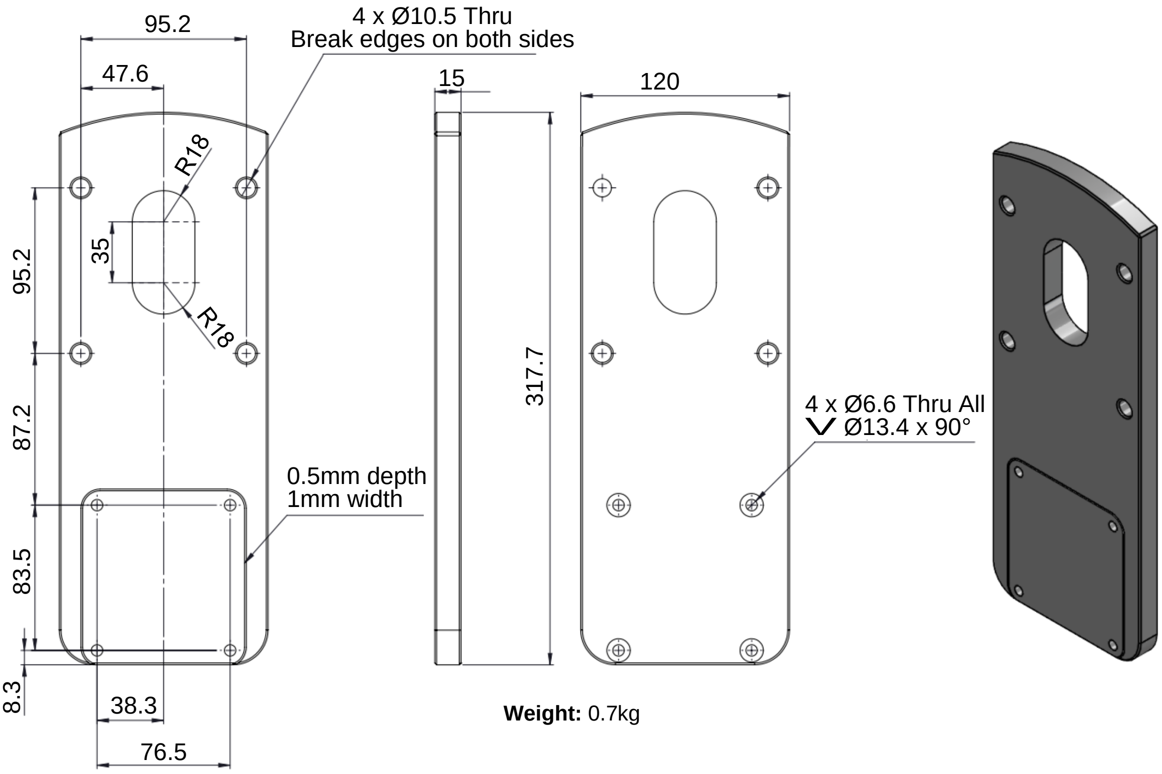
iWBMSe (PN 33169)



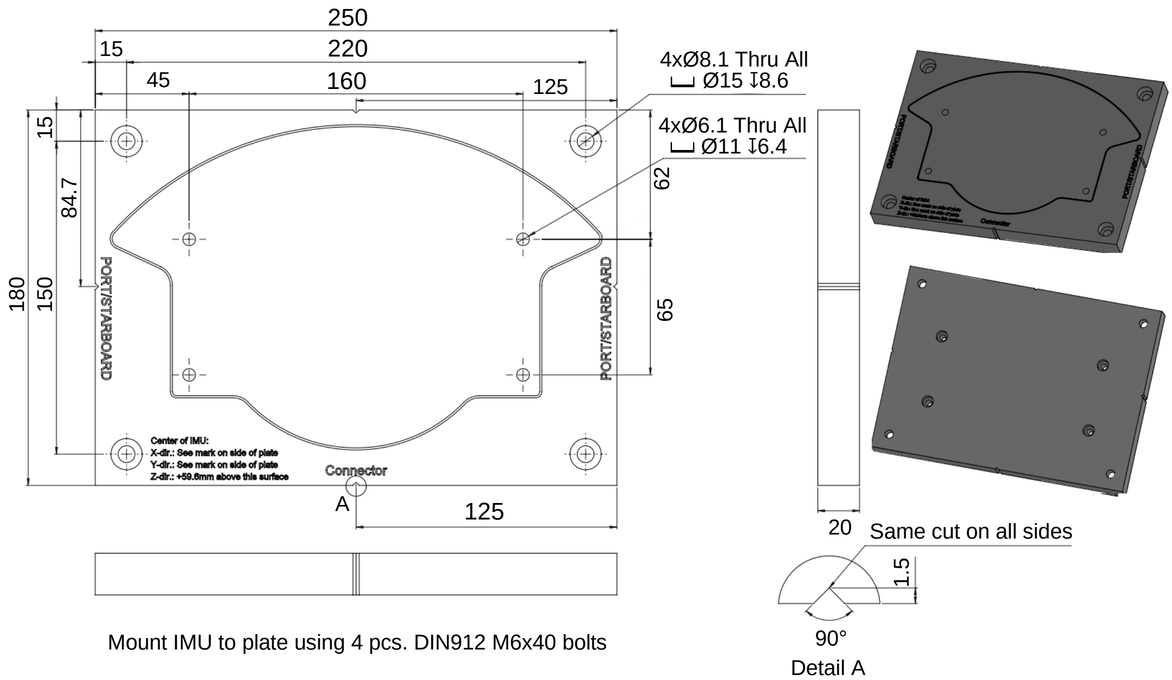
Pin	Function
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COM1
6	IMU COM2
7	LAN, TX+
8	LAN, RX+
9	IRIG-B
10	N/C
11	N/C
12	LAN, TX-
13	LAN, RX-
14	Signal GND
15	N/C
16	N/C
17	RS232 TX
18	RS232 RX

Appendix G: Mounting Bracket & Pole Dimensions

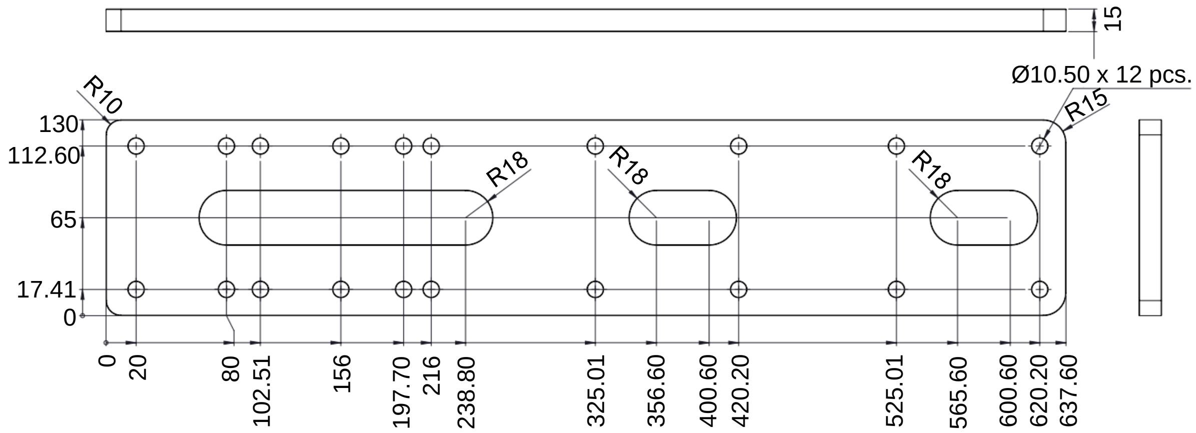
G1. WINGHEAD Detached IMU (IMUd) Mounting Bracket (PN 451314)



G2. WBMS Detached IMU (IMUb) Mounting Bracket (PN 45654)

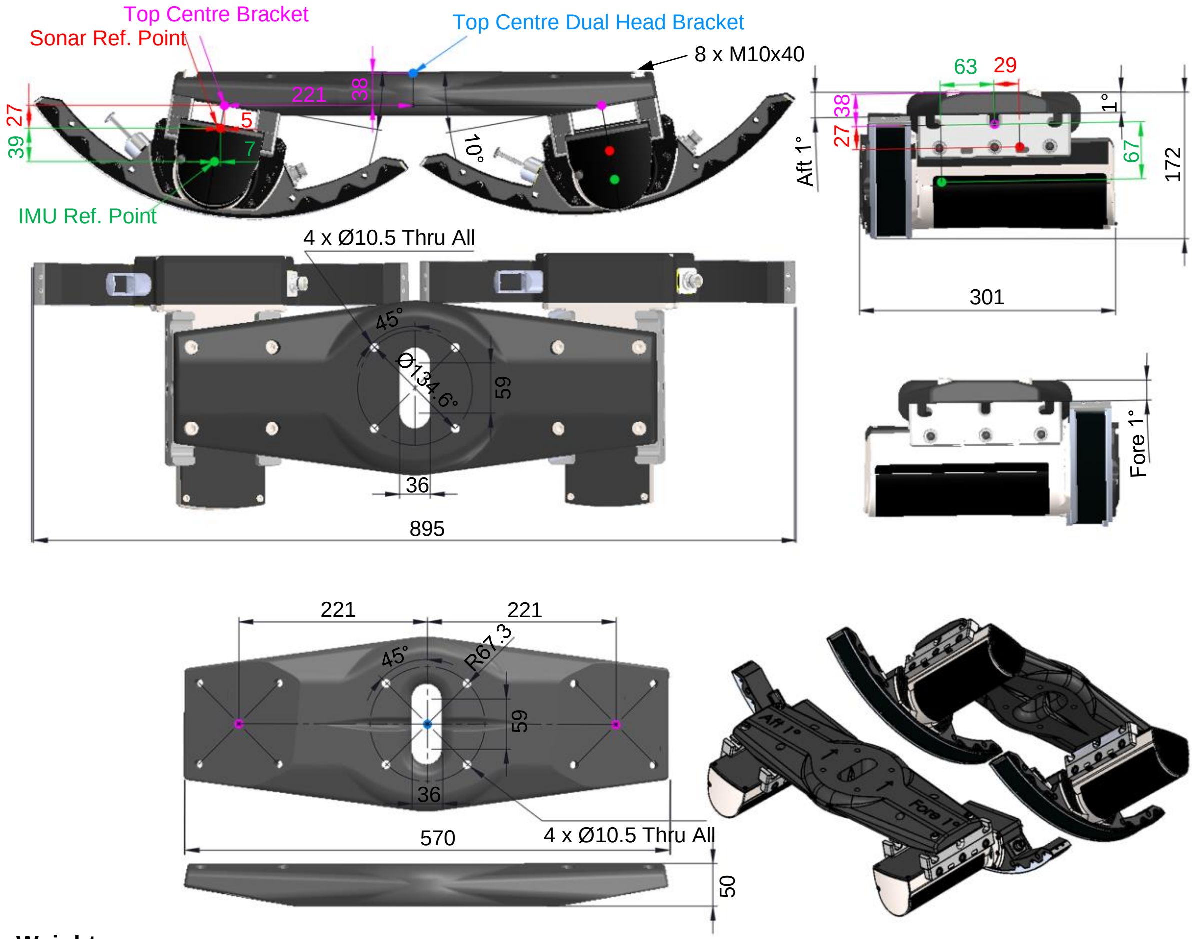


G3. WINGHEAD Multi-Purpose Bracket (PN 451547)



Stainless steel bracket for WINGHEAD 100kHz models, or dual head i80S/B51S in fore/aft configuration.

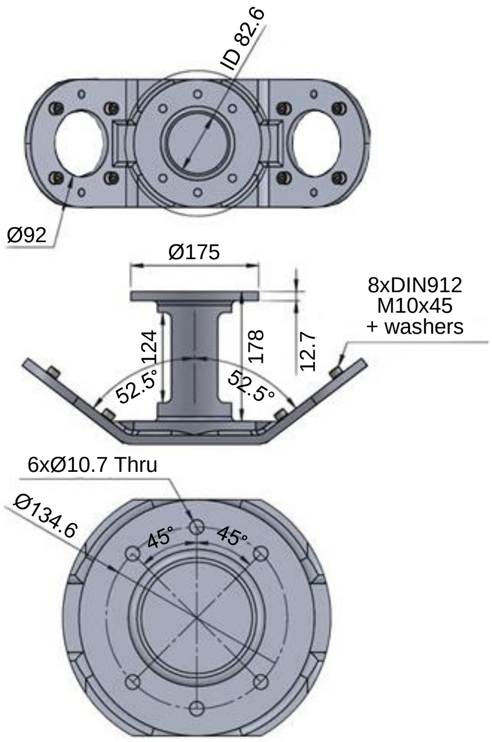
G4. WINGHEAD Dual Head Bracket (PN 35163)



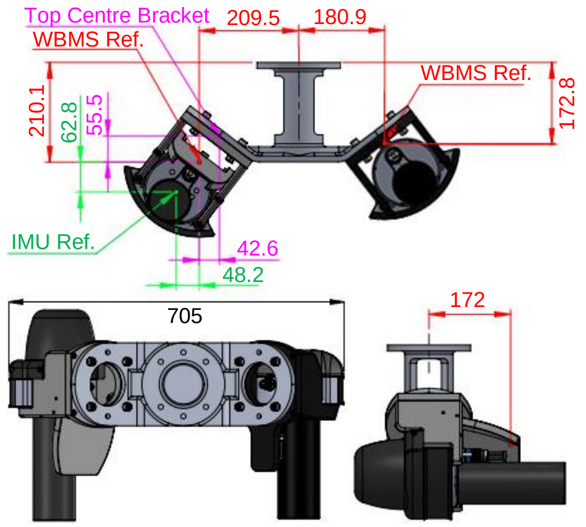
Weight:
i77h :19.9kg (air), 9.4kg (water)
B41 : 19.6kg (air), 8.8kg (water)
B44 Full Ocean : 30.1kg (air), 20.0kg (water)

G5. WBMS Dual Head Bracket (PN 954121)

Dual Head Bracket



iWBMS + WBMS, Narrow TX (0.9°)



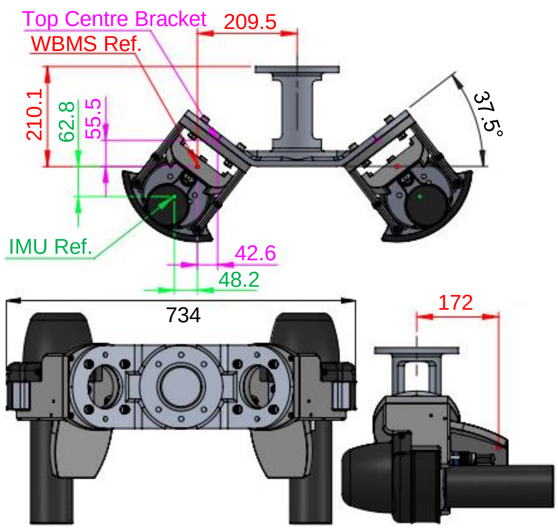
WBMS Ref. (Port) to Top Centre of Dual Head Bracket

+Fwd	0.172m
+Stbd	0.210m
+Down	-0.210m

Primary Sonar (Port) to Secondary Sonar (Stbd)

+Fwd	0.006m
+Stbd	0.390m
+Down	-0.037m

2 x iWBMS, Narrow TX (0.9°)



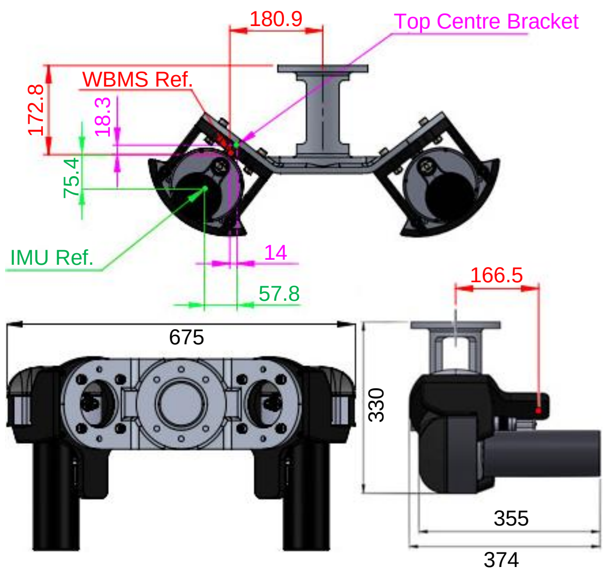
WBMS Ref. (Port) to Top Centre of Dual Head Bracket

+Fwd	0.172m
+Stbd	0.210m
+Down	-0.210m

Primary Sonar (Port) to Secondary Sonar (Stbd)

+Fwd	0.000m
+Stbd	0.419m
+Down	0.000m

2 x WBMS or iWBMSe, Narrow TX (0.9°)



WBMS Ref. (Port) to Top Centre of Dual Head Bracket

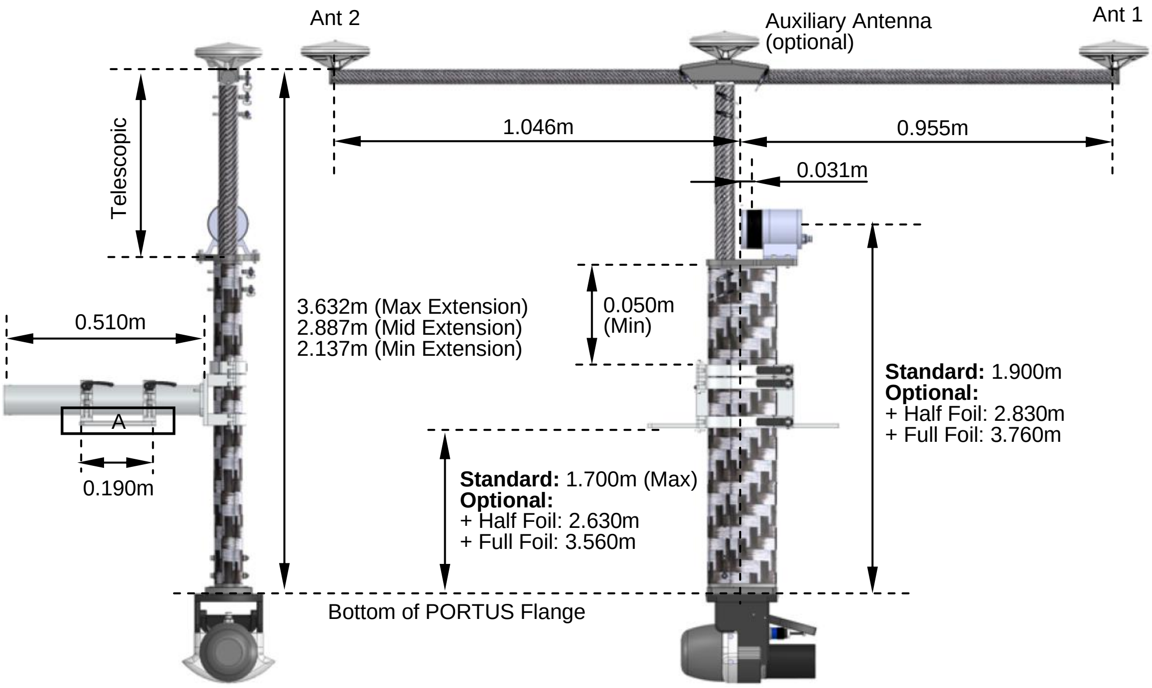
+Fwd	0.167m
+Stbd	0.181m
+Down	-0.173m

Primary Sonar (Port) to Secondary Sonar (Stbd)

+Fwd	0.000m
+Stbd	0.362m
+Down	0.000m

Moonpools: Minimum diameter is Ø767mm when at least one system is a iWBMS, iWBMSh or iWBMSe with Narrow Transmit. Assumes that centre of dual head bracket is offset 72.64mm forward from moonpool centre.

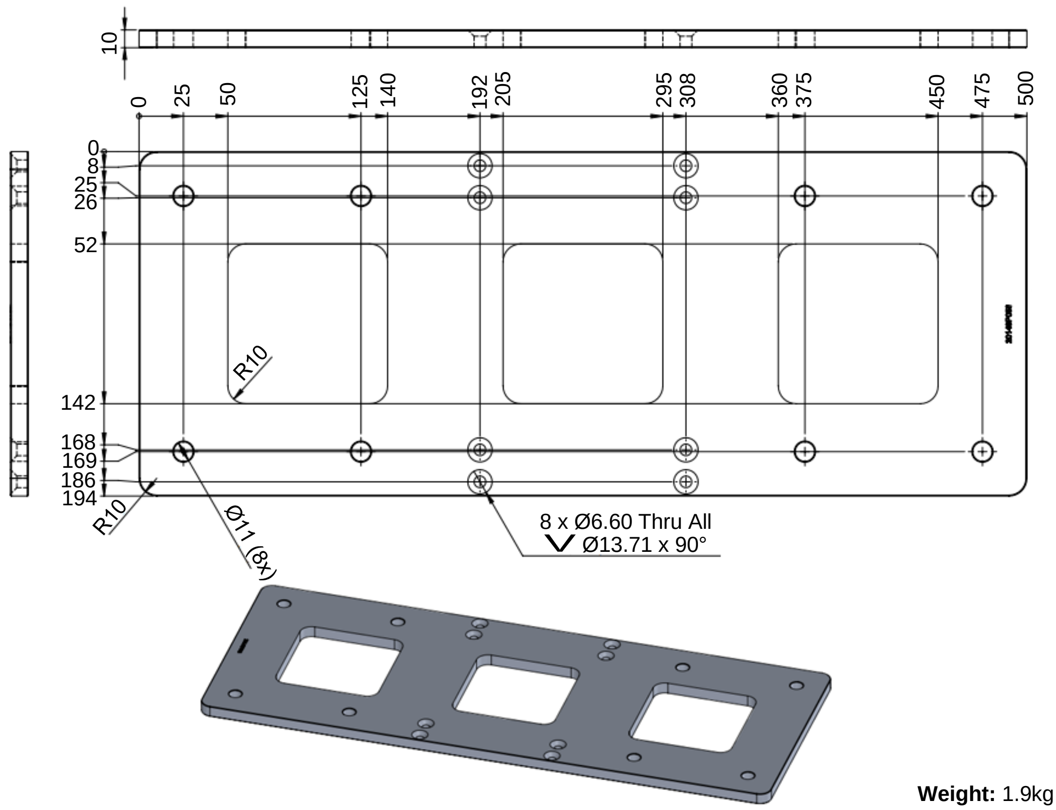
G6. NORBIT Carbon Fibre PORTUS Mounting Pole MKIII



Standard Foil Case Dimensions – with case and all hardware

Length: 200cm / 79” | Width: 33cm / 13” | Depth: 25cm / 10” | Total Weight: 27kg / 60lbs

Detail A – Gunwhale Plate



Weight: 1.9kg