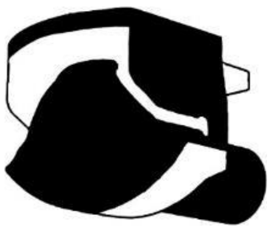
NORBIT

Multibeam Sonar
User and Technical Manual

WINGHEAD Series

WINGHEAD i77h
WINGHEAD B41



WBMS Series

iWBMSh
iWBMS
iWBMSe
WBMS

NORBIT

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.

Sonar Kits

This manual covers the following NORBIT products:

WINGHEAD Series
WINGHEAD i77h
WINGHEAD B41

WBMS Series

iWBMSh/STX	12007
iWBMS/STX	12004
iWBMSe	12006
WBMS	12003

Software Release

NORBIT GUI Version: 10.4.8
Firmware Version: 5.2.1

Release Notice

This is the September 11, 2020 release of the NORBIT sonar user and technical manual.

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Contents

1 Introduction

1.1 Terms & Abbreviations

AMPS	Amperes
Aux	Auxiliary
Bandwidth	Range of frequency sweep
CoR	Center of Rotation (or Center of Gravity)
CW	Continuous Wave (single frequency)
DCT	Data Collection Tool
EA	Equal Angle beam distribution
ED	Equal Distance beam distribution
FM	Frequency Modulation (swept frequency)
GAMS	GNSS Azimuth Measurement Subsystem
GNSS	Global Navigation Satellite System
GPS	US Global Positioning Satellites (often describes all GNSS)
GUI	Graphical User Interface
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
INS	Inertial Navigation System
iSIU	Integrated SIU
iWBMSe	Integrated WBMS – Entry Level (SurfMaster)
iWBMS	Integrated WBMS – Standard (mid-grade with WaveMaster)
iWBMSh	Integrated WBMS – Pro (with top level OceanMaster)
LED	Light Emitting Diode
MBES	Multibeam Echosounder Sonar
NTP	Network Time Protocol
POS	Positioning & Orientation System
PPK	Post Processed Kinematic
PPS	Pulse Per Second
PTP	Precise Time Protocol
RTK	Real Time Kinematic
Rx	Receive
SBAS	Satellite Based Augmentation System
SIU	Sonar Interface Unit
SNR	Signal to Noise Ratio
SONAR	Sound Navigation and Ranging
STX	Steerable Transmission
Tx	Transmit
USACE	USA Army Corps of Engineers
VDC	Volts – Direct Current
WBMS	Wideband Multibeam System
WINGHEAD B41	WINGHEAD Multibeam
WINGHEAD i77h	Integrated WINGHEAD Multibeam – Pro (with top level OceanMaster)

1.2 Technical Overview

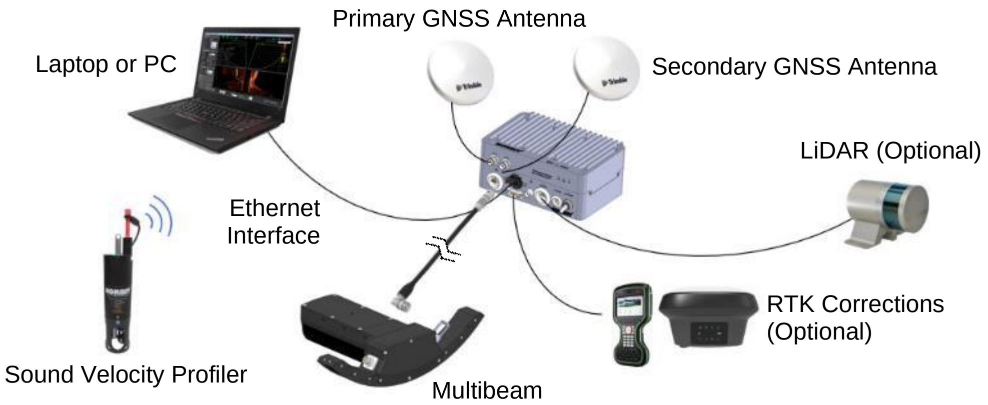
NORBIT sonars are the most compact, high resolution, wide swath multibeam sonars available. With a dry-weight of less than 4.5kg (10lbs), beam widths of only 0.5° at 400kHz, and low power consumption, the stand-alone multibeam sonar easily mounts to a survey platform of any size.

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.



1.3 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 has 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

WINGHEAD i77h
WINGHEAD B41

NORBIT
WBMS

Wideband Multibeam Sonar for High Resolution Bathymetry

0.9 x 0.9º at 400kHz (Narrow TX)
0.5 x 0.5º at 700kHz (Narrow TX)

iWBMSh iWBMS
iWBMSe WBMS

1.4 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.

1.5 Advantages of the Integrated INS

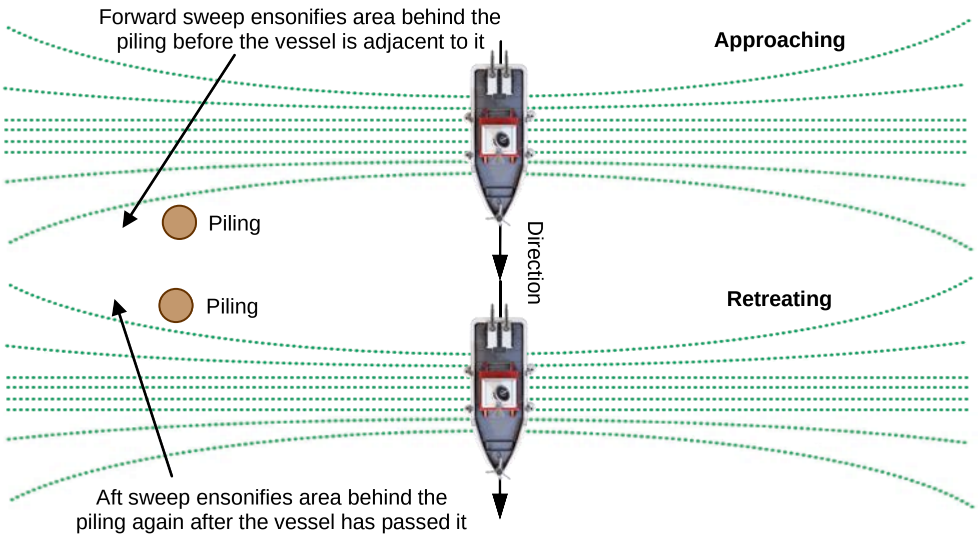
Factory integration of critical sensors provides several benefits. Offsets between the sonar and inertial navigation system are fixed and predefined within the system setup. The user need only measure the offset to the bottom of the primary GNSS antenna.

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).

1.6 Advantages of Steerable Transmission (STX)

The NORBIT STX is a steerable projector system that allows the transmit beam to be directed ±10° in a scanning pattern. In its most basic configuration, this scanning 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.

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 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.

1.7 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/

1.8 Export, Shipping Weight & Dimensions

The compact size of the NORBIT systems allows for simplified shipping and handling. The lightest NORBIT system wet-end is the 0.9° x 1.9º WBMS at 4.5kg in air while the heaviest system is the 0.9° x 0.9º iWBMSh, which weighs 11kg in air and 7kg in water.

1.8.1 ITAR Restrictions

All systems are free of Canadian and EU export controls. When exported from the U.S., the U.S. Department of Commerce ECCN **7A994** reference number needs to be quoted on all shipping documentation.

⚠ **CAUTION: Shipping Internationally from USA**

Shipping documents should quote ECCN 7A994. This number is the same for all NORBIT systems. NORBIT recommends DHL as a preferred shipper when shipping internationally.

1.8.2 Shipping

Each standard NORBIT system (including all components) are shipped in a single, lightweight Pelican case that meets airline baggage guidelines.

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.

1.9 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. For the stand-alone WBMS sonar, when shipping in a non-foam cut case, remove the sound speed probe and replace it with the blue dust cap. For WINGHEAD sonars, the sound speed probe should never be removed.

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: Sonar Protection & Biofouling**
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 anodized aluminum 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 anodizing on the aluminum housing during installation. Spare anodes can be purchased directly from NORBIT.

If your system is protected with antifouling paint then additional care is required to ensure the paint is not scraped or degraded during mobilization, 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: Do Not Connect or Disconnect Cables with Power On**
To prevent damage to system electronics, always turn off power before disconnecting or swapping cables.

1.10 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.

1.10.1 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 min. 90% pure.	If missing a spare O-ring, please remove and borrow one from the cable wet-end protective cap and contact NORBIT Support for replacements.
WBMS Sound Speed Probe	Remove sound speed probe and check connector for corrosion. 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. WINGHEAD probes should never be removed.
Sonar Housing	Inspect housing for scratches and corrosion. Ensure anode is in good condition (for aluminum housing).	Small scratches compromise the galvanic barrier of the aluminum 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.
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 aluminum sonar housing from galvanic corrosion.
Firmware & GUI Versions	Ensure that both firmware and GUI versions match and are latest. This may require an annual maintenance cost.	Contact NORBIT Support for details.

1.10.2 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 anodized aluminum 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.

1.10.3 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.

1.10.4 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.

1.11 Cleaning Hull-Mounted & Bio-Fouled Systems

⚠ **CAUTION: Do NOT Use Pressure Washer**

The sonar is a very delicate instrument. To prevent damage, do not use a pressure washer, and only scrub the sonar using super fine abrasive pads, such as 3M™ Scotch-Brite™ Light Cleansing Hand Pad 7445.

1. Remove the system from the vessel and secure dust resistant caps on the sonar bulkhead and cable.
2. Remove as much fouling from the sonar as possible by hand.
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.
4. With the bulkhead cap tightened, completely submerge the system in the 50/50 solution for approximately 2 hours.
5. Remove the sonar from the solution and scrub the sonar using a super fine abrasive pad and water.

6. If fouling remains, repeat the soaking process. This process can be repeated until all biofouling has been removed from the system.
7. Allow the system to dry fully prior to storage.

1.12 Support

NORBIT operates an online helpdesk, powered by Atlassian JIRA, that is monitored 24 hours a day, 7 days a week. The global hotline is also available 24/7 for urgent matters. For basic support issues, please refer to the Troubleshooting section before contacting NORBIT Support.

To raise a support request, visit the NORBIT helpdesk to register an account and create a ticket. After logging in, 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 organization
- NORBIT system model and serial number
- Software versions
- Detailed description of the problem or request
- Relevant screenshots, error messages and system logs (see section 4.6.5.4)
- For INS faults and data quality issues, send the raw INS data, stored at: *C:\Users\<user>\Norbit\WBMS\Applanix Logs*
- Details and photos of the installation, if relevant
- Data samples if relevant. Raw data recordings from the GUI should include water column data (enable the “View WC” checkbox under Backscatter Controls)

The JIRA helpdesk can also be used to request a service RMA.

When emailing the NORBIT Support address directly, a JIRA ticket will automatically be created and NORBIT will generate an account for you. To access the ticket, visit the helpdesk and select the “Forgot your password” link to reset your password.

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*UTC time offsets above may be ±1hr off due to daylight savings time

2 Hardware Installation

For well-seasoned multibeam users, the Quick Start 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: Subsea (ROV/AUV) and USV Installations**
For ROV/AUV/USV installations, please consult the technical note (TN-190041) for integration guidance. Contact NORBIT Support if you do not have this document.

2.1 Power Requirements

NORBIT sonars require clean power for proper operation. As most vessels utilize an inverter for this purpose, it is important that it be **a true sine wave inverter**. A modified sine wave inverter may cause unexpected behavior, even when using the included power brick. In general, inexpensive inverters are likely modified sine wave. Use high quality inverters for providing power to the NORBIT sonar. If dirty power is assumed, connect the system directly to a 12-24VDC battery and test.

Additionally, power can be provided directly from a 12V deep cycle battery using the included pigtail that plugs into the power port on the SIU.

2.1.1 Power Consumption

Contact NORBIT Support if your power requirements dictate a lower power consumption.

System	Average	Maximum
WINGHEAD B41	TBC	75W
WINGHEAD i77h	TBC	90W
WBMS Bathy (12003)	40W	55W
WBMS STX (12003)	50W	65W
WBMS Bathy Long Range (12003)	40W	60W
iWBMSe / iWBMSe Long Range (12006)	55W	70W
iWBMS / iWBMS Long Range (12004) and iWBMSh (12007)	60W	75W
iWBMSh STX (12007)	70W	80W
iWBMSh Dual Head (12007)	100W	160W

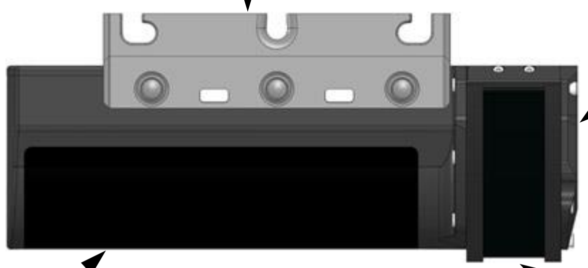
2.2 Wet-End Overview

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

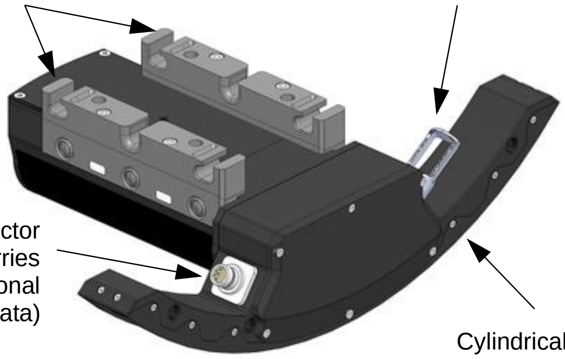
CAUTION: Properly Seal Wet-End Connection
Always inspect O-Ring before connecting wet-cable and replace as needed. Apply a thin coat of synthetic grease (e.g. Molykote 55) to O-Rings. Strongly hand-tighten wet-connector (push in and tighten until firmly connected). If the connector sticks, apply a very thin coat of grease to the threads.

2.2.1 WINGHEAD B41 & WINGHEAD i77h

WINGHEAD B41 is a standalone sonar, whereas WINGHEAD i77h contains the well-known Applanix GNSS/INS system. All sonar processing occurs in the sonar head. Dimensions are the same for both models.



Side View

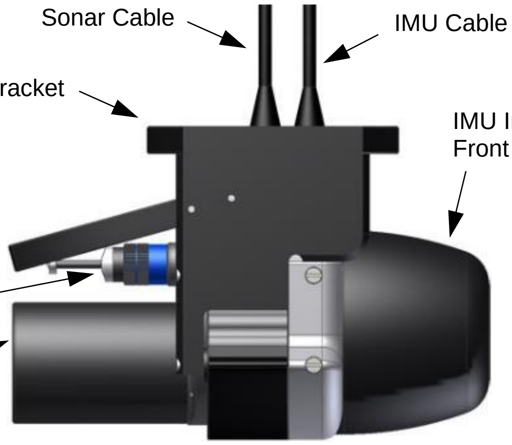


Perspective

The WINGHEAD i77h contains the Applanix OceanMaster (AP-30). This MEMS-based IMU is housed inside the projector of the wet end assembly, resulting in a very compact form factor. The systems are optionally available with POSPac MMS for full positioning and attitude PPP or PPK solutions.

2.2.2 iWBMS, iWBMSh & STX

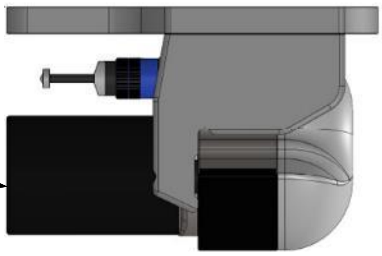
iWBMS, iWBMSh, iWBMSe and STX models contain the well-known Applanix GNSS/INS systems. The systems are optionally available with POSPac MMS for full positioning and attitude PPP or PPK solutions. The IMU is housed inside the ballistic grade front fairing of the wet-end assembly.



iWBMS with standard 1.9°projector. The 0.9° projector adds only 10cm to the length.

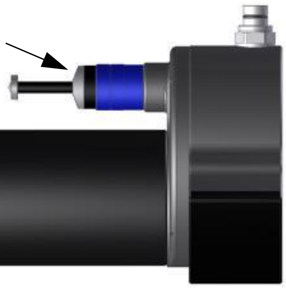
2.2.3 iWBMSe

The iWBMSe contains the Applanix SurfMaster (AP-18). The IMU is housed inside the projector of the wet end assembly resulting in a very compact form factor. The IMU may be optionally mounted on the front nose (like the iWBMS/iWBMSh) so that it may be easily upgraded later. The system is optionally available with POSPac MMS for a full positioning and attitude PPK solution.



2.2.4 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.



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: Voltage Ratings**
The DB9 and PPS connections on the SIU are not rated for voltages higher than 5V, and exceeding this could damage the system. Check all potential connections for unexpected voltages.

⚠ **CAUTION: Cover Connection Ports**
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)

Connector	Description
Sonar	18-pin interface to sonar and IMU
Ant 1	Primary GNSS antenna
Ant 2	Secondary GNSS antenna
COM (Serial)	GNSS corrections input (RTK/DGNSS)
PPS	1PPS output for external sensor (not typically used)
Ethernet	For communication between topside PC and sonar (SAMTEC Part# RCE-01-G-05.00-D)
Aux In/Out	10-pin interface for communication with auxiliary devices
10-28 VDC	Input DC voltage

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

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# RCE-01-G-05.00-D)
Aux In/Out	For communication with auxiliary devices
10-28 VDC	Input DC voltage

2.3.3 iWBMS, iWBMSh, iWBMSe & STX Sonar Interface Unit (SIU-I-NAV, PN 29028)

Connector	Description
Sonar	18-pin interface to sonar and IMU
Ant 1	Primary GNSS antenna
Ant 2	Secondary GNSS antenna
COM (Serial)	GNSS corrections input (RTK/DGNSS)
PPS	1PPS output for external sensor (not typically used)
Ethernet	For communication between topside PC and sonar (SAMTEC Part# RCE-01-G-05.00-D)
Aux In/Out	10-pin interface for communication with auxiliary devices
10-28 VDC	Input DC voltage
Fuse Socket**	12A slow blow (Rear of unit)

* NORBIT offers a split serial option, which allows ASCII/Binary output of GNSS/INS information for up to 3 serial connections. Contact NORBIT Support for more information.
** SIU-I-NAV revisions 29028-5 and newer have an internal 20A fuse instead of the 12A fuse at the rear.

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 will require 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# RCE-01-G-05.00-D)
Aux In/Out	For communication with auxiliary devices
10-28 VDC	Input DC voltage
Fuse Socket*	6A slow-blow (Rear of unit)

* SIU-I revisions 29024-5 and newer have an internal 20A fuse instead of the 6A fuse at the rear.

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

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 the appendices at the end of the manual. The Aux port can connect to an additional sonar to operate in a traditional dual head configuration with either sonar projecting down, or one looking forward for obstacle avoidance in challenging environments. This port can also communicate with the iLiDAR, a topographic laser, to simultaneously collect multibeam and topographic data.

2.3.6 LED Status Indicators

All SIU versions have activity LEDs that behave as detailed below:

Indicator	Pattern	Description
Sonar LED	Steady Green Blinking Green (1Hz) Blinking Green (ISO 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	Not currently in use
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

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 centerline 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 ensure 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: Cables Are Not Wet Mateable

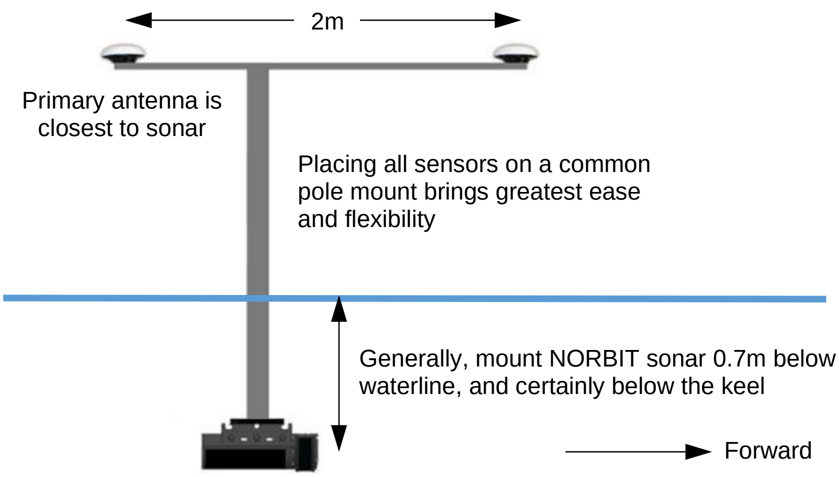
Only connect cables to connectors when dry. Use compressed air to ensure that they are clean and dry.

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.

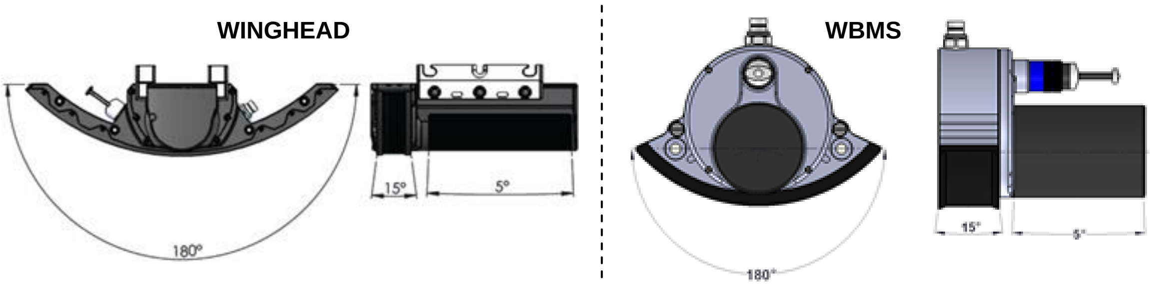
2.4.1 Sonar Mounting Location

Generally, the Sonar Reference Point should be clear of the lowest part of the hull to avoid reflections from the hull and water surface. A strong hull-reflection will reduce SNR for all beams. 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.



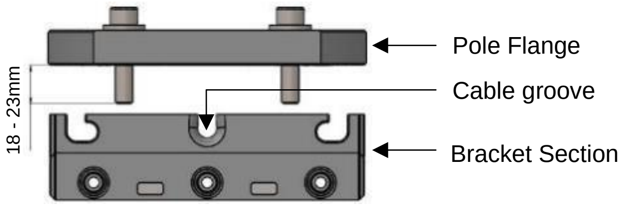
2.4.2 Acoustic Clearance Zones

In shallow water conditions, when danger of collision is especially high, users may want to build a safety cage around the sonar. The following images indicate areas that must be kept clear.

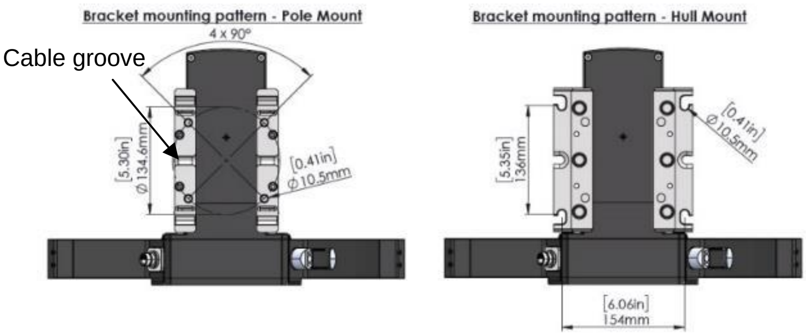


2.4.3 WINGHEAD B41 & WINGHEAD i77h

By default, the two bracket components are oriented vertically for pole mount installations. Secure the sonar using 4 M10 bolt screws, inserting the screws from the top. The screw length should be 18-23mm longer than the thickness of the mounting flange. For long term mounting, use an anaerobic thread adhesive such as Loctite 242 Blue to prevent the screws from loosening. Do **NOT** use anything stronger than Loctite 242.



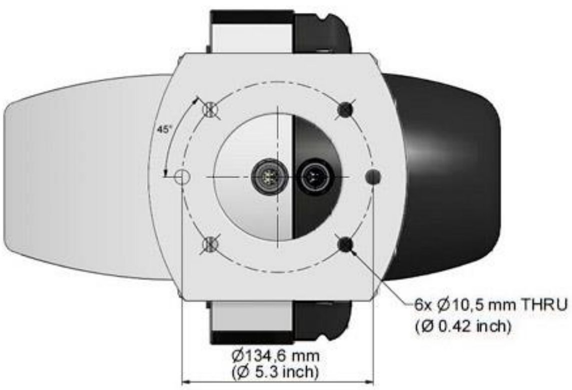
The pole should have a minimum internal diameter of 5.8cm to allow the connector to pass through. Secure the cable in the groove at the center of the bracket, as indicated below.



The bracket can be oriented in the horizontal direction for hull mount installations. In this configuration, up to 6 bolts can be used to secure the sonar. For more information on hull mounts, refer to section 2.4.7.

2.4.4 iWBMS, iWBMSh, iWBMSe & STX

Use at least 4 bolts (2 forward and 2 aft) made of high-quality stainless steel to ensure of anti-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.



iWBMS with standard 1.9°projector (Bracket PN 35021)

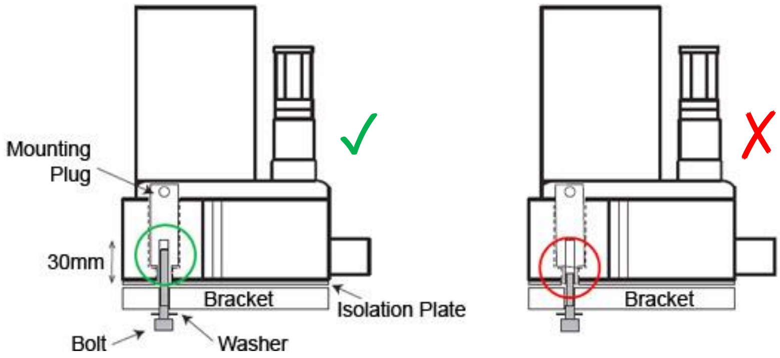
The bolt hole pattern shown above is applicable for all integrated iWBMS systems. The sonar and IMU cables should never be connected or disconnected underwater. Ensure all connector pins and sockets are clean and dry. Always use the supplied connector caps on wet-end, cables and topside. Use a synthetic O-ring lubricant on connector O-rings that are in good condition.

⚠ **CAUTION: Feed Cables Through Center of Bracket**

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

2.4.5 WBMS (Sonar Only)

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. It is also possible to permanently hull mount the sonar. For more information refer to section 2.4.7.



⚠ **CAUTION: Electrically Isolate Sonar from Metal Boat**

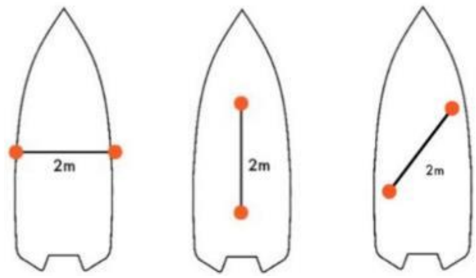
If using a custom-built sonar mount, use a non-conductive plate to electrically isolate the sonar. This will help prevent corrosion.

2.4.6 GNSS Antennas

Integrated NORBIT systems are supplied with 2 GNSS antennas, usually Trimble 540AP or Trimble 382AP. They must have a clear view of the sky to the horizon so that every satellite may be continuously tracked without obstruction. The mounting locations 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.

Trimble 540AP Antenna
L1 Phase: 58mm from base

Trimble 382AP Antenna
L1 Phase: 66mm from base

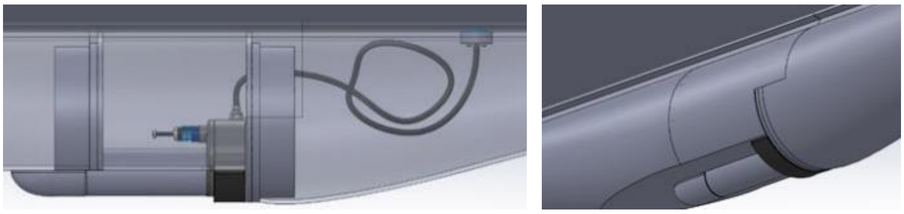


The Primary Antenna (Antenna 1) should be nearest to the IMU so that offset measurement errors are minimized. The Secondary Antenna (Antenna 2) should be a fixed distance from Antenna 1. It is recommended that the antennas be at least 2m apart. The antennas should be positioned parallel to the water 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 centerline.

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.

2.5 Time Synchronization (Non-Integrated Systems)

Timing is crucial for synchronizing signals from the sonar, GNSS and IMU. Only the standalone NORBIT sonars (WINGHEAD B41 and WBMS) require PPS & NMEA ZDA hardware input. 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. Ensure that the baud rate is fast enough to allow throughput of all strings.

The PPS can be input in two ways:

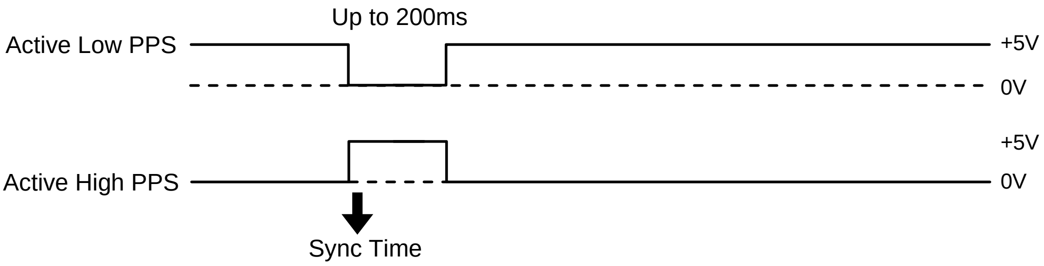
- To the BNC "PPS" connector on the SIU
- To the Serial "GPS" DB9 connector on the SIU (pin 9 for pulse & pin 5 for ground)

The PPS signal can be either active low or active high. The SIU synchronizes 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.

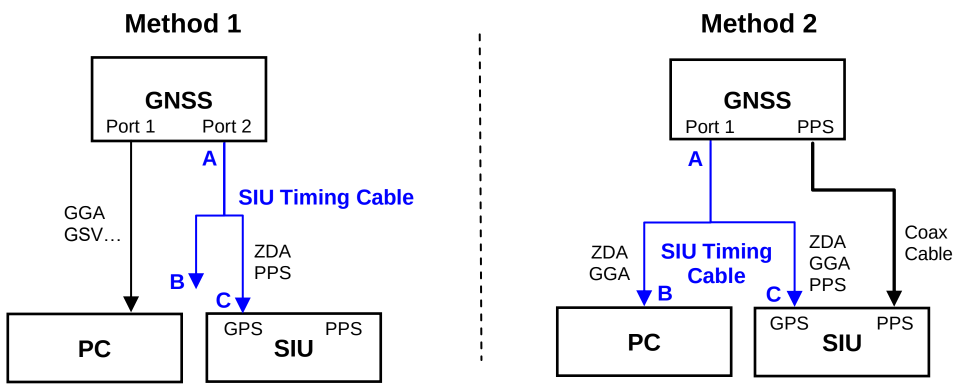
For standalone models, the SIU should receive a PPS TTL input at 3.3V (5V tolerant). The SIU can autodetect a negative or positive PPS input and has ±15kV ESD protection, ±60V fault protection.

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: Do Not Connect Active PPS to SIU for Integrated Systems
The integrated versions of the SIU outputs PPS pulses. Attaching an active PPS cable to this port will damage 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			
Connector A	**Connector B**	**Connector C**	**Description**
1	1	1	Not Connected
2	2	2	Transmit Data (from GNSS)
3	3	-	Receive Data (to GNSS) e.g. for NTRIP
4	-	-	Not Connected
5	5	5	Ground
6	-	-	Not Connected
7	-	-	Not Connected
8	-	-	Not Connected
9	-	9	PPS (from GNSS)

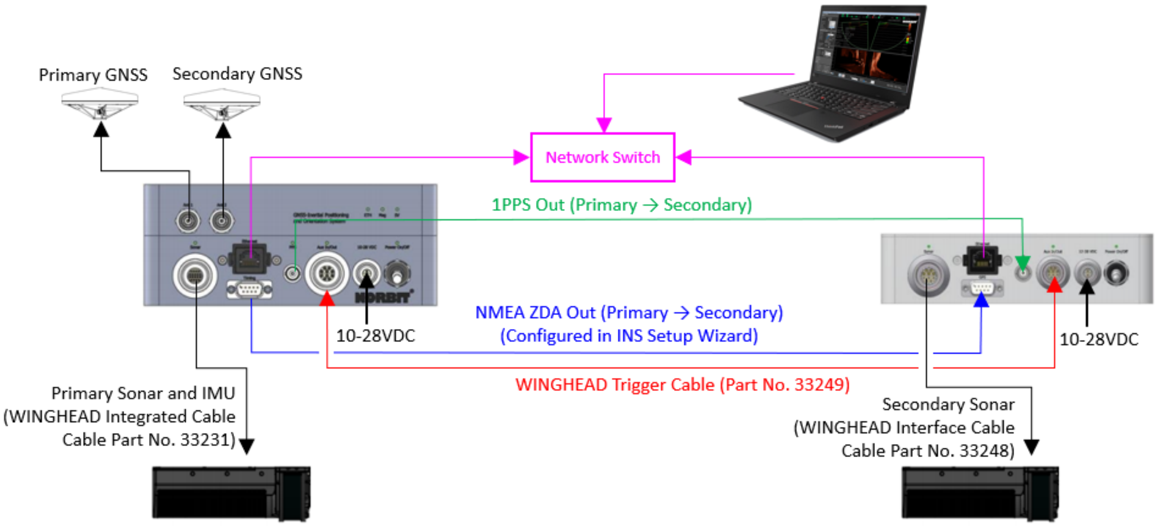
NORBIT

2.6 Dual Head Setup

NORBIT sonars can be mounted in the standard dual-head brackets, sold separately. Alternatively, each sonar may be attached to a single-head bracket. For more details on dual head setup, refer to the Dual Head Quick Start at the end of this manual.

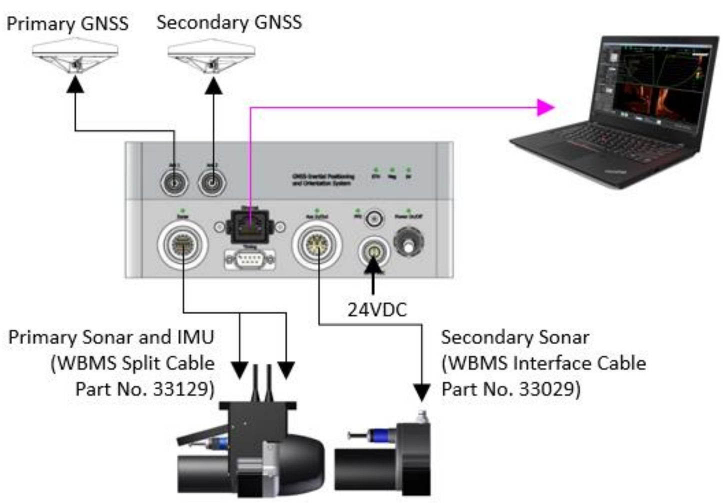
2.6.1 WINGHEAD

One iSIU-WH (part no. 29060) and one SIU-WH (part. no. 29064) is required. Timing must be supplied (NMEA ZDA and 1PPS) from the iSIU-WH to the SIU-WH. In addition, a WINGHEAD Trigger cable (part no. 33249) is required to synchronize the topside units.

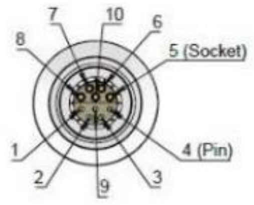


2.6.2 iWBMS & WBMS

There are several ways to configure a dual head system, depending on what components are available. The simplest and recommended setup uses one SIU-I-NAV (Part No. 29028, revision 5 or later) with both sonars connected to the same topside. It must be supplied with 24VDC, and a 220W power brick is required. The standard power brick for single head systems (120W) is not sufficient. For older SIU-I-NAV revisions (revision 4 and earlier), the power supply unit must be upgraded. Timing requirements are handled internally and no additional cables are needed.



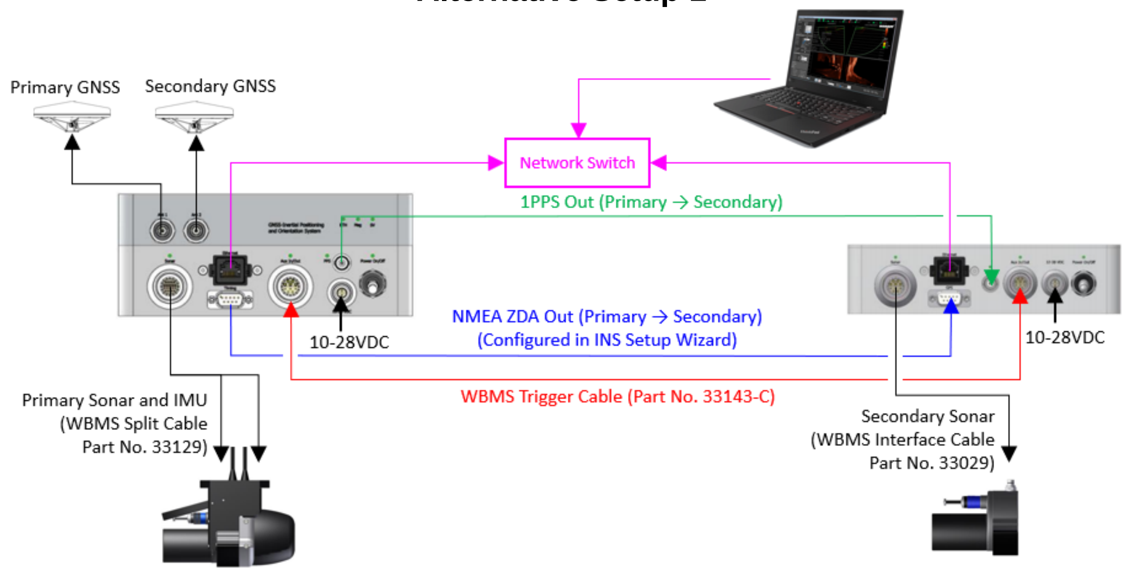
Alternatively, two SIU-I (stand-alone SIU, part no. 29024) may be used, or one SIU-I-NAV can be combined with one SIU-I. In each case, sonar timing (NMEA ZDA and 1PPS) must be supplied to both systems, and the topside units must be linked with a TTL sync cable via the Aux ports. For Alternative Setup 1, 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.



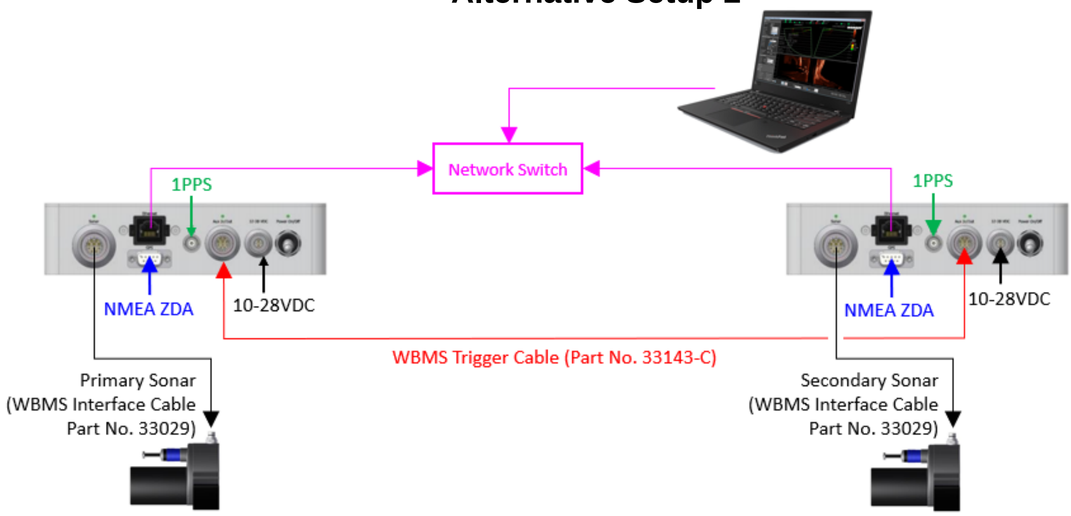
Aux In/Out Socket	
No.	**WBMS Function**
1	LAN TX+
2	LAN TX-
3	LAN RX+
4	LAN RX-
5	RS232 TX
6	RS232 RX
7	Trigger/GPIO
8	RS232/Trig GND
9	PWR GND
10	PWR + 24VDC

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

Alternative Setup 1



Alternative Setup 2



2.7 Decoupled IMU

In some scenarios it may be necessary to decouple the IMU from the sonar and mount it elsewhere on the survey platform. Note, this only applies to the iWBMS series.

To decouple the IMU from the WBMS, start by removing the 4 bolts at the back of the iWBMS bracket. This should be done with the iWBMS resting on a padded surface to reduce the risk of damage. Carefully separate the IMU from the sonar, taking care not to lose the dowel nuts located in the base plate of the IMU. NORBIT provides an optional plate for mounting the decoupled IMU in its NORBIT housing, with the connector facing towards the bow. Refer to Appendix E1.

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

⚠ **NOTE: Decoupled IMU Offset**

The IMU is **0.08m** below the top of the fairing. In the INS Setup Wizard, apply a custom Sonar Ref. Point to IMU Ref. Point offset.

Two cables are typically required if operating the system in a decoupled configuration: the standard split cable for the IMU (PN 33129), and a WBMS cable (PN 33029) for the sonar. In this case the sonar must be interfaced to the Aux port on the SIU.

3 Offsets & Reference Points

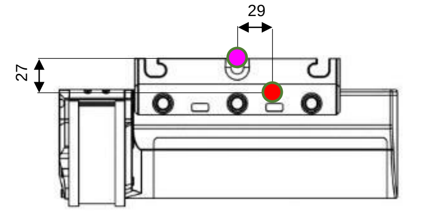
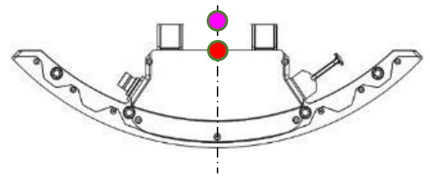
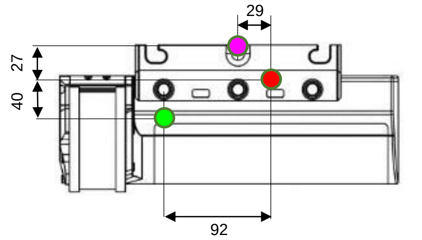
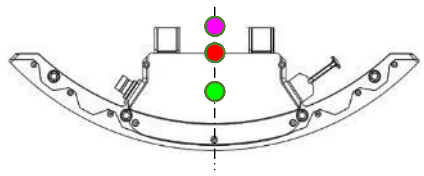
The **Sonar Reference Point** is where all sonar (and navigation data, for integrated systems) is valid. Thus, all sensors in the acquisition and processing software must have the same offset to this location. It is located at the center of the projector in the fore-aft direction, and at the center of the cylindrical receiver array in the port-starboard and vertical directions.

The **IMU Reference Point** is shown for reference, but generally the user need not concern themselves with this. The **Top Center 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 Center 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

Refer to section 3.2 and 3.3 for all relevant offsets and mounting angles for each WINGHEAD configuration. For single head configurations, the offsets and IMU mounting angles are applied automatically in the INS Setup Wizard based on the detected sonar model.

Sonar Kit	Side View	Front View
WINGHEAD B41		
WINGHEAD i77h		

3.2 WINGHEAD Offsets & IMU Angles

Sonar Kit	Name in GUI	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles	Sonar Ref. Point to Top Center of Bracket
WINGHEAD i77h (Applanix OceanMaster)	WINGHEAD i77h	**+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

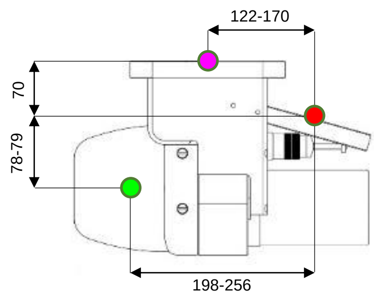
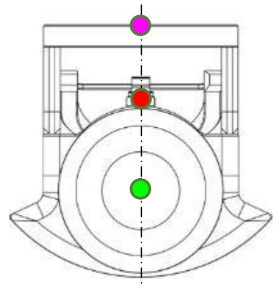
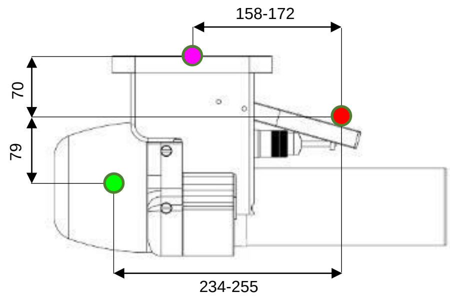
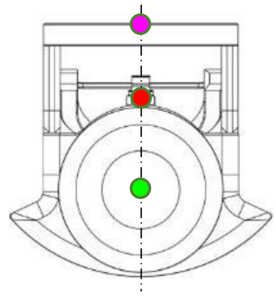
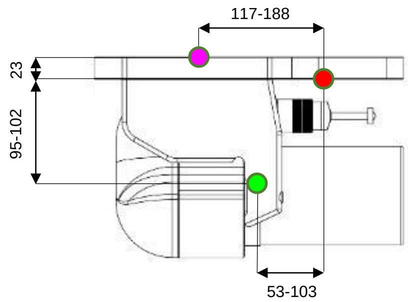
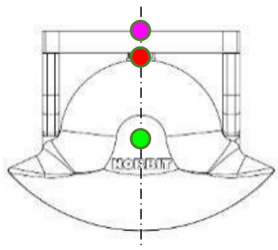
3.3 WINGHEAD Dual Head Offsets & Mounting Angles (IMU +10° on Port)

Sonar Kit	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles (IMU mounted on Port)	Sonar Ref. Point to Measure Point (Top Center of Dual Head Bracket)	Sonar Ref. Point (Primary) to Sonar Ref. Point (Secondary)
WINGHEAD i77h (Applanix OceanMaster)	**+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

3.4 WBMS Reference Points

The drawings below are only intended as a visual indication of the reference points, as the offsets differ depending on the operating frequency, bracket, projector and IMU type. Refer to section 3.5 for all relevant offsets and mounting angles for each WBMS configuration.

For single head configurations, the offsets and IMU mounting angles are applied automatically in the INS Setup Wizard based on the detected sonar model.

Sonar Kit and Bracket	Side View	Front View
12004 & 12007 **iWBMS, iWBMSh** Projector: Standard 1.9° Bracket PN: 35021		
12004 & 12007 **iWBMS, iWBMSh** Projector: Narrow 0.9° Bracket PN: 35021		
12006 **iWBMSe** Projector: Standard 1.9° Bracket PN: 35047		

3.5 WBMS Offsets & Mounting Angles

Sonar Kit	Name in GUI	Sonar and Bracket PN (* values that may be ignored)	IMU PN	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles	Sonar Ref. Point to Top Center of Bracket
400KHZ SONARS WITH NARROW TRANSMIT (0.9º) OPTION						
12007 iWBMSh STX, 400kHz (Applanix OceanMaster)	iSTX-0.9°x0.9°	24016-*-*B***B Bracket: 35021	24015 (Type 64)	**+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)	**+Fwd:** 0.242 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** 90º **Z:** 0º	
12007 iWBMSh 400kHz (Applanix OceanMaster)	iWBMS-0.9°x0.9°	24003-*-*B**** Bracket: 35021	24015 (Type 64)	**+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)	**+Fwd:** 0.255 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** 90º **Z:** 0º	
12004 iWBMS STX, 400kHz (Applanix WaveMaster)	iSTX-0.9°x0.9°	24016-*-*B***B Bracket: 35021	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
			24006-8X (Type 82)	**+Fwd:** 0.242 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12004 iWBMS, 400kHz (Applanix WaveMaster)	iWBMS-0.9°x0.9°	24003-*-*B**** Bracket: 35021	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
			24006-8X (Type 82)	**+Fwd:** 0.255 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12006 iWBMSe, 400kHz (Applanix SurfMaster)	iWBMSe-0.9°x0.9°	24018-*-*B**** Bracket: 35047	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, 400kHz (Applanix OceanMaster)	iWBMS-0.9°x1.9°	24003-*-*C**** Bracket: 35021	24015 (Type 64)	**+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)	**+Fwd:** 0.206 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** 90º **Z:** 0º	
12004 iWBMS, 400kHz (Applanix WaveMaster)	iWBMS-0.9°x1.9°	24003-*-*C**** 24003-1b (old) Bracket: 35021	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
			24006-8X (Type 82)	**+Fwd:** 0.206 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12006 iWBMSe, 400kHz (Applanix SurfMaster)	iWBMSe-0.9°x1.9°	24018-*-*C**** Bracket: 35047	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 200kHz (Applanix OceanMaster)	iWBMS-1.9x1.9°	24007-*-*C**** Bracket: 35021	24015 (Type 64)	**+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)	**+Fwd:** 0.256 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** 90º **Z:** 0º	
12004 iWBMS, 200kHz (Applanix WaveMaster)	iWBMS-1.9°x1.9	24007-*-*C**** Bracket: 35021	24006-4X (Type 42)	**+Fwd:** 0.241 m **+Stbd:** 0.000 m **+Down:** 0.078 m	**X:** 90º **Y:** 0º **Z:** -90º	**+Fwd:** 0.170 m **+Stbd:** 0.000 m **+Down:** -0.070 m
			24006-8X (Type 82)	**+Fwd:** 0.256 m **+Stbd:** 0.000 m **+Down:** 0.079 m	**X:** 0º **Y:** -90º **Z:** 0º	
12006 iWBMSe, 200kHz (Applanix SurfMaster)	iWBMSe-1.9°x1.9°	24022-*-*C**** Bracket: 35047	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:** -0.023 m

3.6 WBMS Dual Head Offsets & Mounting Angles (IMU +37.5° on Port)

Sonar and IMU Type	Sonar Ref. Point to IMU Ref. Point	IMU Mounting Angles (IMU mounted on Port)	Sonar Ref. Point to Measure Point (Top Center of Dual Head Bracket)	Sonar Ref. Point (Primary) to Sonar Ref. Point (Secondary)
iWBMSh (IMU Type 42) **iWBMS (IMU Type 64)**	**+Fwd:** 0.248 m **+Stbd:** -0.048 m **+Down:** 0.063 m	**X:** 90º **Y:** 37.5º **Z:** -90º	**+Fwd:** 0.172 m **+Stbd:** 0.215 m **+Down:** -0.210 m	**+Fwd:** 0.000 m **+Stbd:** 0.430 m **+Down:** 0.000 m
iWBMSh (IMU Type 89)	**+Fwd:** 0.255 m **+Stbd:** -0.048 m **+Down:** 0.063 m	**X:** 90º **Y:** 52.5º **Z:** 90º	**+Fwd:** 0.172 m **+Stbd:** 0.215 m **+Down:** -0.210 m	**+Fwd:** 0.000 m **+Stbd:** 0.430 m **+Down:** 0.000 m
iWBMS (IMU Type 82)	**+Fwd:** 0.255 m **+Stbd:** -0.048 m **+Down:** 0.063 m	**X:** 90º **Y:** -37.5º **Z:** -90º	**+Fwd:** 0.172 m **+Stbd:** 0.215 m **+Down:** -0.210 m	**+Fwd:** 0.000 m **+Stbd:** 0.430 m **+Down:** 0.000 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:** 0.186 m **+Down:** -0.173 m	**+Fwd:** 0.000 m **+Stbd:** 0.372 m **+Down:** 0.000 m

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 sonar system is setup and controlled using the NORBIT GUI. The GUI can be monitored by multiple computers, but only one GUI can control the sonar. The GUI may also be controlled in headless/passive mode, refer to Section 4.1.2 for details.

4.1 NORBIT GUI Installation

The GUI executable file installs the NORBIT Graphical User Interface (GUI) and copies firmware to the PC. NORBIT recommends disabling Windows Firewall, or adding a port exception, to allow communication with the integrated INS. See the Troubleshooting section for more details.

4.1.1 PC System Requirements

Since all sonar data processing happens inside the sonar head, the GUI can be run on the same computer as the acquisition software. The minimum system requirements are shown below. Note that these may change depending on the acquisition software used.

Hardware	Requirements
Operating System	Windows 10 Pro (Recommended) / Windows 8.1 (Fully Updated) / Windows 7 or Vista (Unsupported) * / Windows XP (Untested)
Processor	2GHz or more
Memory	4GB or more
Display Resolution	1400x900 or higher Lower resolution can be used but it is not optimal. It will not impair data acquisition.
Graphics Card	Integrated graphics are sufficient for running the GUI. A dedicated graphics card is required for running data acquisition or processing software.
Network Speed	1Gbit Ethernet (WINGHEAD Series) 100Mbit Ethernet (WBMS Series)
Storage	GUI operation only: <1GB; Full system with logging: >100GB

*The GUI may work on Windows 7 if Microsoft Visual C++ 2015 (Redistributable Update 3 RC) is installed. The installation file is provided on the USB device, and can also be downloaded from Microsoft. Microsoft has stopped mainstream support of Windows 7 as of January 13, 2015. Starting from v10.3, NORBIT does not test software for compatibility with Windows 7.

4.1.2 Operation Without GUI (Direct Connection), Headless Mode & Passive Mode

Some setups, such as those on AUV/ROVs, may require operation without the NORBIT GUI. Users can interface with the sonar on a script level, providing direct commands to the sonar.

In addition, the GUI can be operated in **headless** and **passive** mode. Please note that both modes increase bandwidth consumption. These modes are not intended to be used where several observers are required, as it substantially increases sonar bandwidth and may cause data loss.

Passive mode is a special operating mode of the GUI where user has no interaction with the sonar. The data flows through the GUI and is visualized as normal, but the user cannot change any sonar settings. The data is also output as an s7k stream, so the GUI acts as a proxy server. In this mode, the user can still change some GUI related options in a limited way. This mode is mostly used for data visualization in real time, without the risk that the user will change any sonar settings.

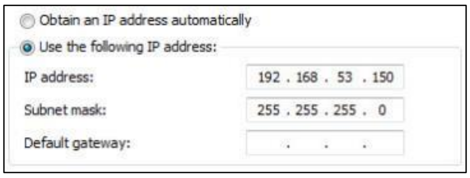
Headless mode is a further simplification of passive mode, where the data flow is the same, however no graphical user interface is displayed for visualization, and instead only a simple console is displayed. In this case the software acts as a proxy server with no interaction.

For further information on these modes, please contact NORBIT Support.

4.2 Network Configuration

NORBIT sonars connect to the acquisition computer via standard Ethernet protocol. To communicate with the SIU, the computer network adaptor must be configured to the same subnet.

To configure the computer IP address, navigate to the network adaptor properties and change the **TCP/IPv4** settings. The last 3 digits of the IP address must not conflict with the address of the sonar or integrated INS.



The INS systems come pre-configured with an IP address of **192.168.53.100**. The IP address of the sonar is always **192.168.53.XX**, where XX represents the last two digits of the sonar serial number. A subnet mask of **255.255.255.0** should be used. NORBIT recommends setting the IP address of the acquisition computer to **192.168.53.150**.

In rare circumstances, some users may wish to change the IP address of the sonar. See section 5.4 for details. It is recommended to NOT change the sonar IP address unless absolutely necessary.

CAUTION: Do NOT Connect Multiple Network Cards to Same Subnet

When connecting multiple network cards, do **NOT** have a Wi-Fi adapter connected to the same subnet as the wired network. This causes duplication of navigation data and introduces artefacts to the sonar data.

CAUTION: Changing IP Address of INS Disables GUI Functionality

Changing the IP address of the INS from the factory configured IP address (192.168.53.100) will disable INS capabilities within the GUI.

4.2.1 DHCP Connection

Unless otherwise required, make sure that DCHP servers are not running on the same network as the sonar. This causes an automatic IP address assignment during bootup. If this occurs, and a DHCP network is not desired, power off the SIU, assign a static IP address, and power cycle.

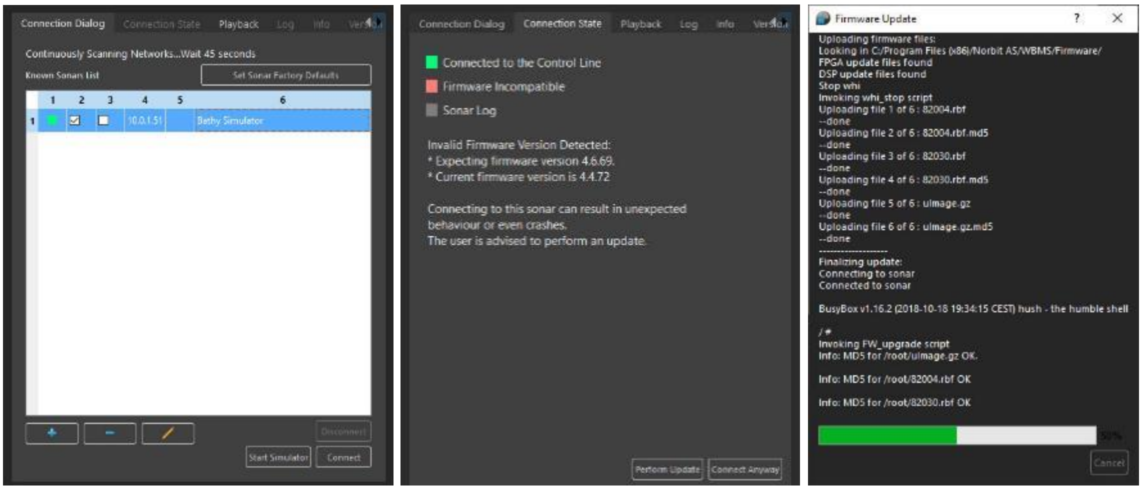
4.3 Connect to Sonar

Upon launching the GUI, the **Connection Dialog** is displayed. If a sonar is active on the network, a green light is displayed. A red light indicates 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 to the sonar 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 the Dual Head Quick Start Guide.

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

When the upgrade is complete, power cycle the sonar. NORBIT recommends selecting **Set Sonar Factory Defaults** after each installation or upgrade.

4.4 INS Tools for WINGHEAD i77h, iWBMS, iWBMSh & iWBMSe

The NORBIT GUI contains integrated INS functionality, allowing the sonar and INS to be setup and controlled from the same user interface. The **INS Tools** are found at the bottom of the settings menu, and the **INS Setup Wizard** allows users to configure offsets and GNSS corrections.

For users with standalone WINGHEAD or WBMS systems. most settings under **INS Tools** are greyed out. Users with integrated systems must have INS firmware v9.03 or later. To request an upgrade, contact NORBIT Support with the serial number, and a screenshot of the **System Status** dialog.

4.4.1 INS Setup Wizard

4.4.1.1 Factory Settings

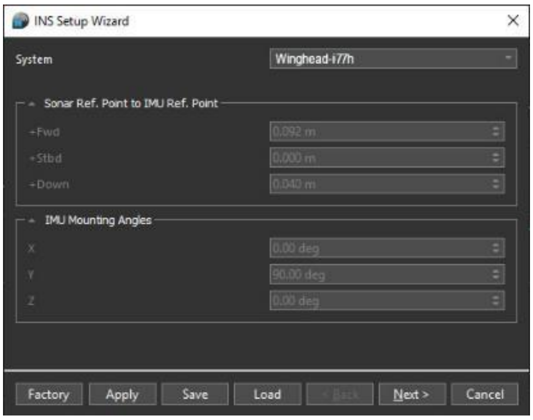
NORBIT advises that, prior to each new installation, the factory default settings are restored. Open the **INS Setup Wizard** and select **Factory**. Note, this only resets the INS configuration and has no impact on the sonar configuration or GUI display preferences.

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

4.4.1.2 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 decoupled from the sonar (see section 2.7) and installed at a separate location. Note that WINGHEAD IMUs cannot be decoupled.



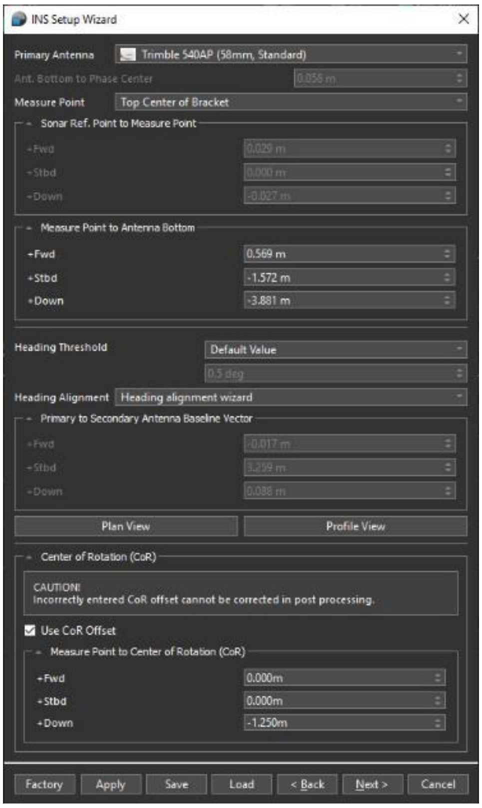
NOTE: Dual Head Tilted Offsets
In dual head configurations, the IMU rotations and offsets must be modified if the sonars are tilted. For further information, refer to the NORBIT tilted sonar technical note (document TN-190018) and the NORBIT Dual Head Quick Start. If you do not have this document, please contact NORBIT Support.

4.4.1.3 Antenna Offsets

Select the **Primary Antenna** model, which in most cases will be **Trimble 540AP**, to ensure that the correct phase center offset is applied.

Select the **Measure Point** to define a convenient reference point from which to measure the primary antenna offset. **Top Center 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 center 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 maneuvering 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 4.4.2). 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.

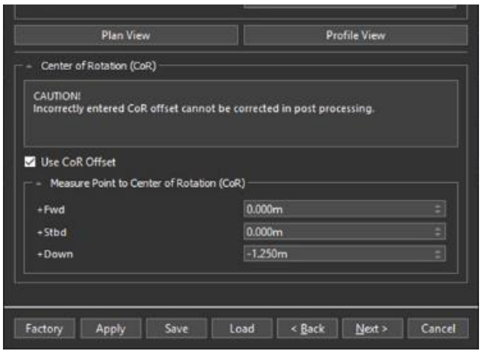
⚠

NOTE: NORBIT GUI and POSView / POSPac Offsets Are Different

Offsets displayed in POSView/POSPac for **Ref. to Primary GNSS Lever Arm** are different from those entered in the NORBIT GUI. GUI offsets are referenced from **Measure Point** (typically **Top Center of Bracket**), whereas POSView/POSPac offsets are referenced from **Sonar Ref. Point.**

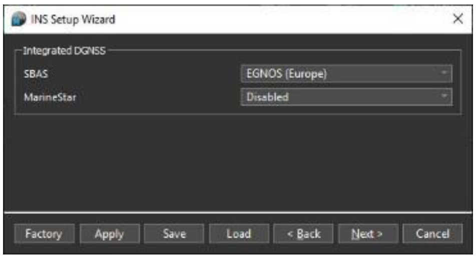
4.4.1.4 Center of Rotation Offset

The vessel **Center of Rotation** (CoR) offset should be entered relative to the **Measure Point**. Note that the center 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 Center 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, centered on the keel, and located at approximately water level.

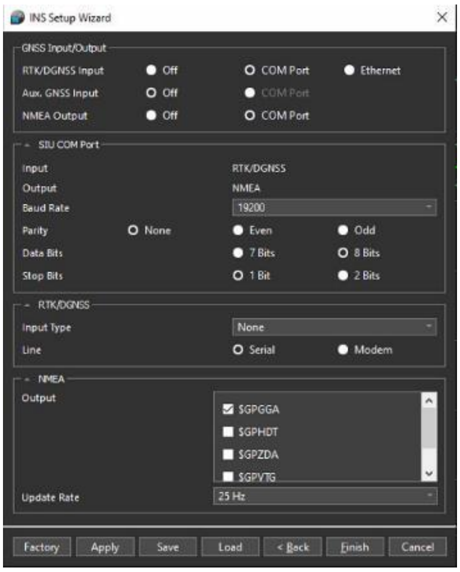
4.4.1.5 Integrated DGNSS



The **Integrated GNSS** settings are used to specify the desired satellite GNSS correction service. Satellite Based Augmentation Service (**SBAS**) may be configured here. This is a correction source that is regional and free.

Alternatively, **Marinestar**, a paid subscription service providing decimeter accuracy, may be configured. Refer to section 4.4.5 for details on activating a subscription.

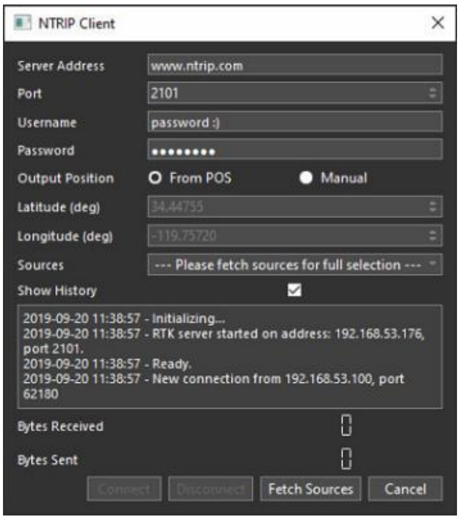
4.4.1.6 RTK/Aux GNSS Input & NTRIP Client



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+**, **CMRx**, **RTCM**, etc.) as well as the input **Line**, either **Serial** or **Modem**. Please note that if an input type other than **None** is selected, the INS only uses GPS satellites, so it will likely result in fewer satellite vehicles being detected. Selecting **None** enables the INS to use additional satellites from other constellations such as GLONASS.

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.



When an external GNSS system is used, select **Aux. GNSS Input**. Then enter the offset to the auxiliary antenna phase center. It is important to note that this offset should be measured from the **Sonar Reference Point** (see section 3) to the phase center 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.

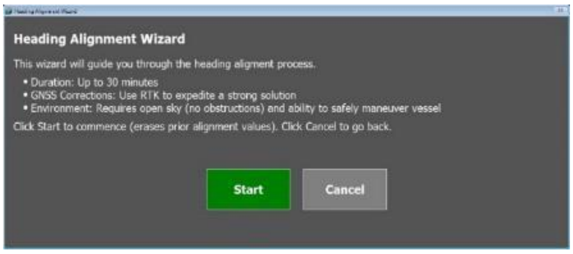
To enable RTK corrections via NTRIP, select **Ethernet** as the **RTK/DGNSS Input**. Select **NTRIP Client** and enter the login details. Select **Fetch Sources** and select the source from the dropdown menu. Click **Connect**.

Click **Finish** to complete the setup wizard. If **Heading Alignment Wizard** was selected in section 4.4.1.3, 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.

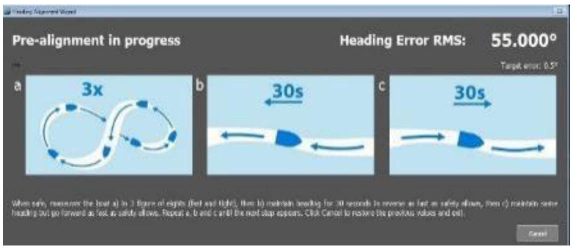
4.4.2 Heading Alignment Wizard

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. The heading alignment determines the vector offset from primary antenna to secondary antenna, and in doing so ensures proper alignment of the IMU with the GNSS antenna pair. If a heading alignment was not performed at the end of the **INS Setup Wizard**, select **INS Tools** > **Alignment Wizard**.

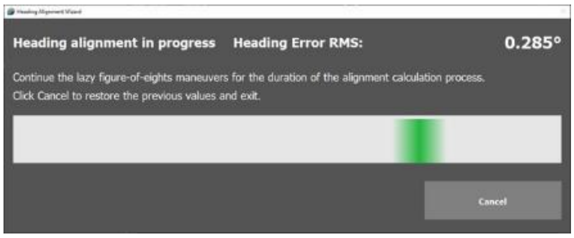
Step 1. Press **Start** to begin the calibration. The best results are achieved using RTK GNSS, with a clear sky view, away from tall structures that impede GNSS performance. The installation must be completely rigid and free from vibration. The primary antenna offset must be accurately measured and applied during the INS setup stage described in the preceding section.



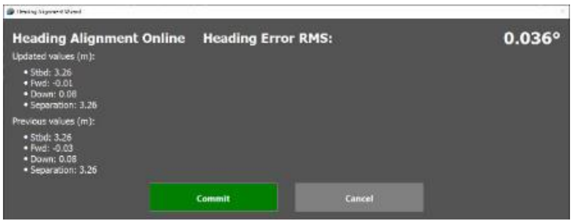
Step 2. Follow the recommended maneuvers during the pre-alignment stage and observe the display as the **Heading Error RMS** decreases from its initial value of 55°. Once the value drops below the defined threshold (**Target Error**) and stabilizes, the heading alignment begins. Continue to maneuver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



Step 3. Follow the instructions and continue to perform figure-of-eight maneuvers 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 maneuvers are performed, as well as positioning quality.

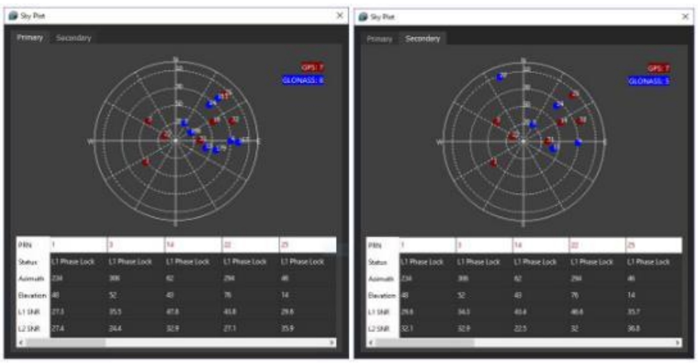


The computed results are unique to each installation. If the primary to secondary antenna baseline was manually measured beforehand, the calculated results should be similar. Select **Commit** to save the results. NORBIT recommends performing a patch test after the heading alignment.



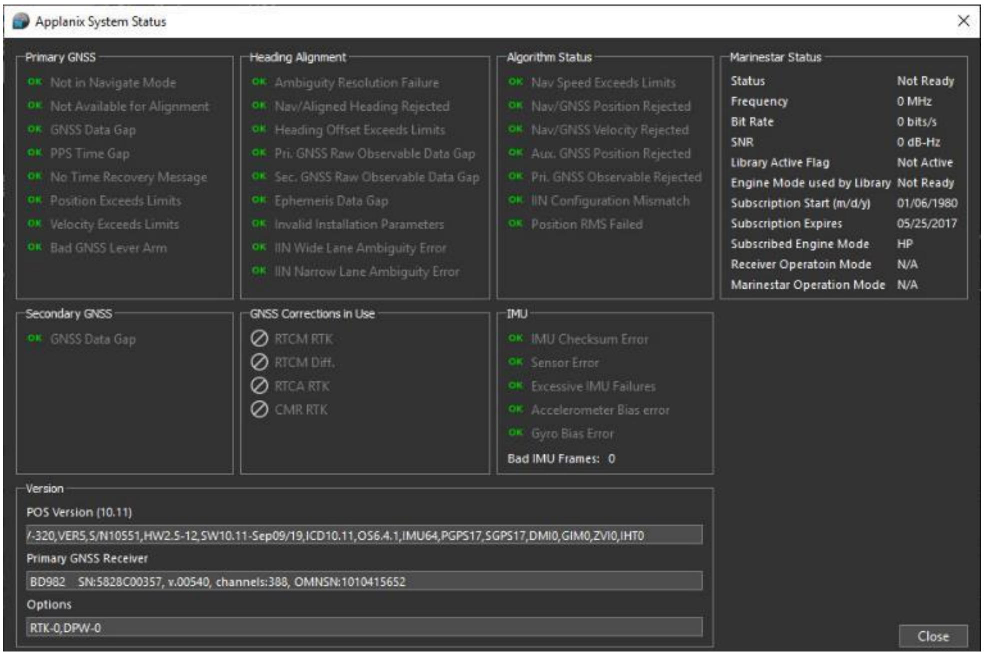
4.4.3 Sky Plot

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



4.4.4 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 initialization and operation.

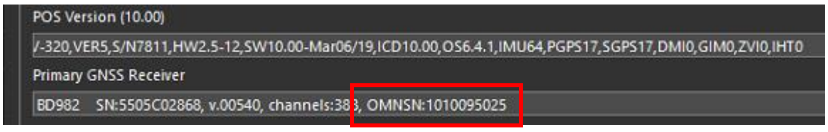


Version information is displayed at the bottom. It displays all INS related hardware, software and firmware versions. Additionally, the **Marinestar Status** and subscription expiry date is shown.

4.4.5 Marinestar Subscription

Follow these steps to activate a Marinestar (paid) subscription for decimeter-level GNSS corrections:

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



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

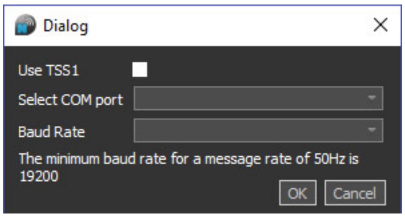
Step 3. Arrange a time with Fugro to activate the subscription, as the system must be powered on and tracking satellites when the activation code is transmitted. Be sure to consider time zone differences when organizing the activation time.

Step 4. Enable **Marinestar** in the **INS Setup Wizard**, as described in section 4.4.1.5. 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.

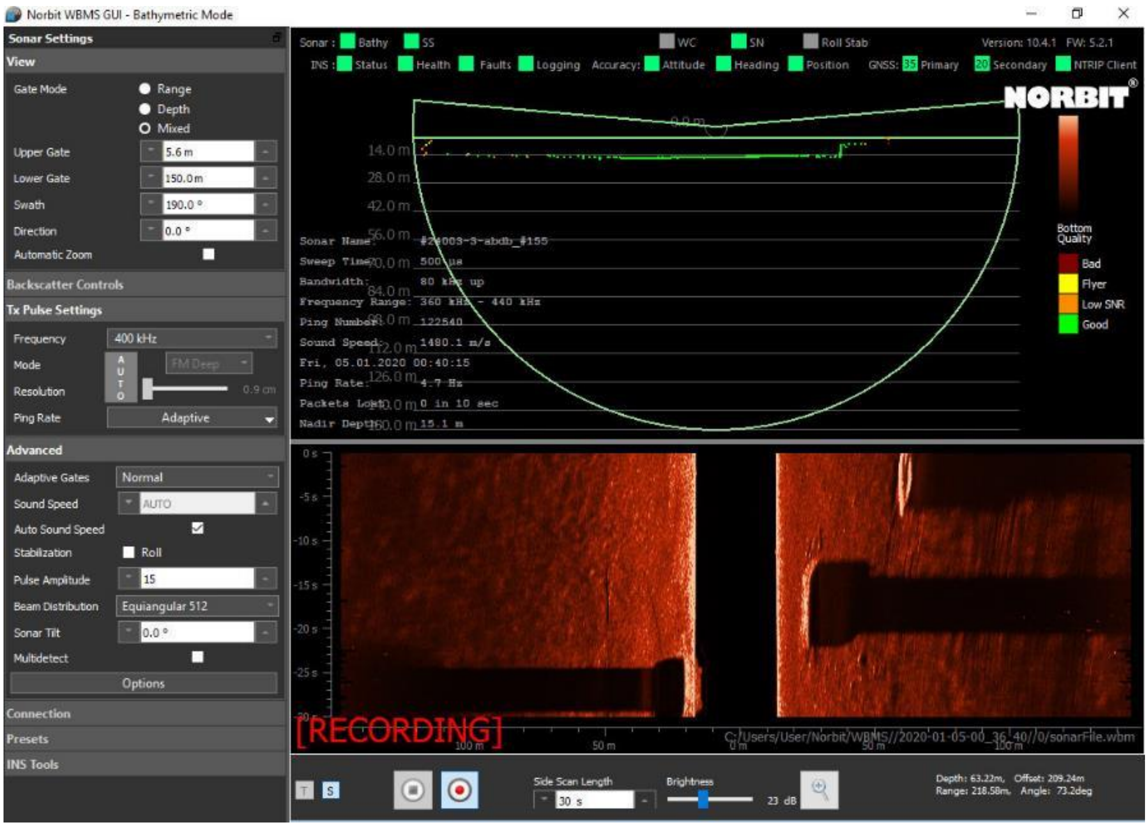
4.4.6 TSS1



For standalone (non-integrated) NORBIT sonars, a TSS1 message can be interfaced from an external motion sensor for roll stabilization. The TSS1 message should be interfaced to the computer via a COM port. Select **Use TSS1** and select the **COM port** and **Baud Rate**. Click **OK**. The baud rate must match the output from the motion sensor.

4.5 Main NORBIT GUI 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 contains a depth sounding.



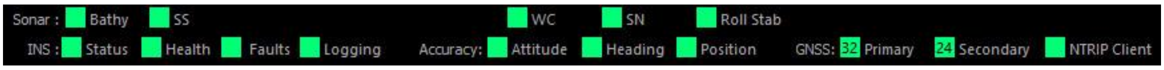
The sonar wedge is used to assess data quality and swath coverage. Currently applied settings and statistics are summarized and displayed right of the sonar settings, and left of the sonar wedge, e.g. frequency, sound speed, date and time, and ping number. The software and firmware versions are displayed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

Each detection has an associated quality flag, which may be utilized by filters in post-processing software (HYPACK, Qimera, etc.). Multi detections are flagged as such when the Multidetect option is enabled (see section 4.6.4 for details).

Quality		Description	Flag
(red)	Bad	Low SNR, low collinearity	0
(yellow)	Flyer	High SNR, low collinearity	1
(orange)	Low SNR	Low SNR, high collinearity	2
(green)	Good	High SNR, high collinearity	3
(cyan)	Multidetect	Additional detections	4

When two sonars are connected in dual head mode, two swaths are displayed. Each swath is labelled primary and secondary. For more information on dual head operation, refer to the Dual Head Quick Start Guide.

4.5.1 Upper GUI Status Indicators



The ***Sonar*** indicators shows the streaming status of various data types as requested by the acquisition software. 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 4.6.2.

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.

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

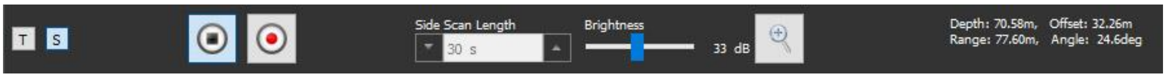
The **Logging** indicator shows when raw INS data is recording. The GUI automatically logs INS data when the GUI is launched. This can be used for POSPac processing or for applying True Heave data. The log folder path is displayed by hovering over the indicator, and the path may be changed by selecting **Advanced** > **Options** > **Paths**.

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

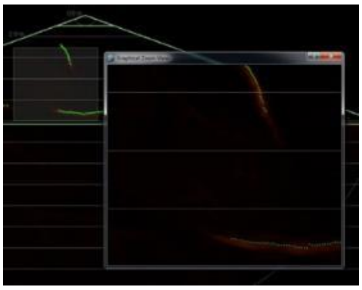
Currently, only the primary antenna tracks all GNSS constellations and SBAS satellites, therefore the primary GNSS antenna shows more satellites than the secondary antenna.

4.5.2 Lower GUI 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. Recorded data can be replayed at any time (even during real time sonar operation and recording), as described in section 4.6.5.3. The GUI recording files are saved by default in: *C:\Users\user\NORBIT\WBMS*. Each recording session generates a folder with the naming convention YYYY-MM-DD-HH_MM_SS.

4.5.3 Optimizing Backscatter Display

Tuning the display **Brightness** and **Gamma Correction** (in **Options**) does not have any impact on the raw data signal and is only used to adjust the display. However, TVG settings impact data output. See section 4.6.2 for details.

To optimize backscatter images visually:

1. Adjust **Brightness** on the display control bar
2. Under **Backscatter Controls**, ensure that **Apply TVG** is selected
3. Adjust the settings for **Static Gain, Spreading and Absorption** until the side scan image appears unsaturated, and ensure that the **SS/SN/WC** indicators are green.

These settings are dependent on current environmental conditions (water sediment content, salinity, temperature, etc.) and may have to be adjusted as the survey progresses. Ensure that the **SS** and **SN** indicators remain green (unsaturated) as saturated soundings will not be salvageable.

4.6 Sonar Settings Menus

4.6.1 View

Most sonar control features can be found in the **View** menu. The user may specify **Gate Mode**, the **Upper** and **Lower Gates**, **Swath** angle and swath pointing **Direction**. Sonar range is a function of the **Lower Gate**, angular **Swath** width and swath pointing **Direction**. These parameters affect the total distance bottom detections can be from the sonar, and the ping rate is then determined by factoring in the speed of sound in water.

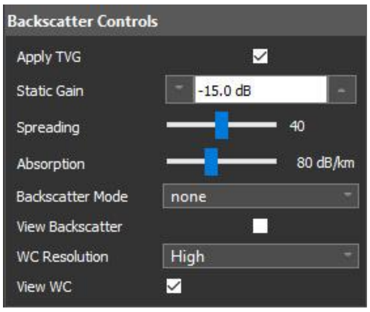
Function	Description
Gate Mode	Allows for selection of manual gates by upper and lower depth (**Depth** mode), by upper and lower range (**Range** mode) or by upper depth and lower range (**Mixed** mode). **Depth** gates are suitable for most environments. **Range** gates are ideal for shallow water bank to bank surveys, or when changing the **Direction**. A bottom search is performed between the **Upper Gate** and **Lower Gate** independently for each beam. 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 (minimum depth) for bottom detections. Change values by entering a number and press Enter, by using up/down arrows next to the corresponding control bar, or by interactively clicking and dragging the gate to the desired depth on the wedge. For most surveys the minimum should be at least 1m to avoid false detections at the surface. **Minimum Value:** 0.1m **Maximum Value:** 599m
Lower Gate	Maximum depth for calculating bottom detections. Change values by entering a number and press Enter, by using up/down arrows next to the corresponding control bar, or by interactively clicking and dragging the gate to the desired depth on the wedge. **Minimum Value:** 1.0m **Maximum Value:** 600m
Swath	User-defined total angular swath coverage. For typical harbor dredge surveys, this value is normally set to 120-150° **Minimum Value:** 5° **Maximum Value:** 210°
Direction	Direction of swath pointing angle. 0° places the swath symmetrically around nadir. Under normal operations, direction angle is dependent on swath width as no portion of the swath may exceed the 179° allowable view. If the survey requires that depth be attained above the sonar draft, the direction can be extended further up by first selecting 180° **Swath**. Next select the desired **Direction,** then select the final desired overall **Swath**. Useful when surveying slopes, shoreline or for mapping vertical structures. To maximize the ping rate while using this feature, it is recommended that **Range** mode be activated and regularly adjusted.
Automatic Zoom	Makes the active portion of the wedge full screen. This ensures that detections are clearly visible on the display, even when the range is very high. This is most effective when using **Adaptive Ping Rate** with a large lower depth/range gate.

CAUTION: Steering Direction Limited in Equidistant Mode

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.)

4.6.2 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 **Apply TVG** option removes this native sonar TVG applied by the hardware and instead applies the user specified TVG described by the mathematical formula:



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

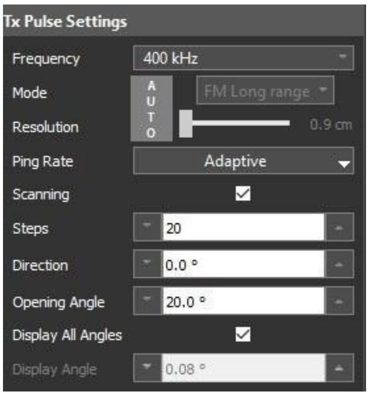
This TVG curve is a standard continuous function to let the signal fit in the data format (s7k) range and prevent signal saturation. This digital gain is applied to all imagery output data: side scan, snippets, snippet-side scan and water column. For most cases, a **Static Gain** setting of -15dB, **spreading** 40 and **Absorption** of 80dB/km will sufficiently scale the data.

Function	Description
Apply TVG	Removes the native sonar TVG that is applied in the sonar hardware and instead applies the user specified TVG, based on **Static Gain**, **Spreading** and **Absorption**. When TVG is applied, all parameters are reported along with the data to the acquisition software to process the data more effectively, e.g. for mosaicking. When the option is deselected, the native sonar TVG is not removed and no additional digital gain is applied to the data. Therefore, it is prudent to always enable this option.
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 -15dB is suitable in most cases. Adjust this setting if the sonar signal becomes saturated, in which case the **SS/WC/SN** indicators will appear red on the main GUI display (see section 4.5.1).
Spreading	Sets the spreading component of the TVG calculation. Spreading loss is a geometrical phenomenon in which signal intensity is reduced as the range increases and wave fronts are spread over an increasingly larger area. The default setting is 40.
Absorption	Sets the absorption component of the TVG calculation. Transmission loss due to absorption is caused by conversion of acoustic energy into heat. The rate of absorption loss depends on the water environment and sonar operating frequency. The default setting of 80dB/km is recommended for 400kHz operation.
Backscatter Mode	Sets the backscatter mode to one of three options: **None**, **Side Scan**, or **Snippet/Scan**, the latter of which is a side scan composed of snippet data. Snippet collection rate will be limited to maximum 18Hz. These limits to data output rate were implemented to ensure smooth collection of data without burdening computational resources. If side scan data is requested by the acquisition software when **Snippet/Scan** mode is selected, **Snippets-Sidescan** will be generated so that (unlike regular side scan) a correctly positioned side scan can be derived from snippets data. When surveying with a NORBIT STX model, if snippets and/or side scan data are 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. If that is not the case, snippets should be deactivated to conserve disk space and computational resources.
View Backscatter	Displays backscatter data under the sonar wedge. Even if it is not displayed in the GUI, backscatter data is still sent to the acquisition software if a TCP subscription is made. The **SN/SS** indicators at the top of the GUI appear green when a subscription is active.
WC Resolution	Sets the resolution of water column data. Water column data is output on record 7042. It is advised to keep the resolution low when computational resources are scarce.
View WC	Displays water column data on the sonar wedge. WC data collection is limited to 5Hz. Note that it will only be recorded to raw .wbm/.s7k files if the **View WC** checkbox is enabled.

CAUTION: Snippets Is Data Intensive

To ensure smooth data collection, make sure that the acquisition PC is not near its maximum CPU load. If CPU load is too great, artefacts may appear in the snippets record.

4.6.3 Tx Pulse Settings



The **Tx Pulse Settings** control the acoustic transmission (Tx) signals. Typically, with default settings, these values are automatically determined based on sonar range. For most survey applications, these settings need not be changed.

If the GUI detects a NORBIT STX model, this menu activates additional options to allow transmit pulse steering. These controls are not visible if a standard WINGHEAD or WBMS is detected. All functions are explained in the table below.

For additional information on STX operation, refer to section 1.6.

Function	Description
Frequency	Sets the center frequency of the transmitted pulse. NORBIT sonars are optimized for a center frequency of 400kHz for standard systems and 200kHz for long range systems. For a given depth, higher frequencies theoretically 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 center frequency. **Standard Systems:** 200kHz – 700kHz (optimized for 400kHz) **Long Range Systems:** 160kHz – 400kHz (optimized for 200kHz)
Mode	Sets the sweep time of the signal transmission. The available selections are **FM Long Range** (recommended setting for most applications), **FM Short Range** (applicable for surveys in very shallow water, <5m), or **CW** (legacy option). With **FM Long Range**, a long sweep time of 500µs is applied. **FM Short Range** reduces the sweep time to 200µs. Reducing sweep time increases effective ping rate in very shallow water. For **CW** mode, the duration of the signal transmission increases range performance at the expense of detection quality. NORBIT systems are optimized for FM operation.
Resolution	Sets the acoustic range resolution by controlling pulse bandwidth. For FM modes, resolution is calculated as c/2*BW, where c is the speed of sound and BW is the bandwidth. When maximum resolution (0.9cm) is set in **FM Long Range** or **FM Short Range** modes, 80kHz bandwidth is used. Therefore, with a center frequency of 400kHz, transmission sweeps from 360-440kHz. Decreasing resolution enhances range performance in deep water by reducing bandwidth. In **CW** mode, frequency transmission is constant. However, the system is designed from conception as an FM system and performs optimally in this mode, yielding highest resolution regardless of depth. **Auto** selection is recommended.
Automatic Mode and Resolution (Auto)	Adjusts **Mode** and **Resolution** for best performance in nearly all survey conditions, as determined by the software. For backscatter, unless very high ping rate is desired in shallow water, disable **Auto** and set **Mode** to **FM Long Range** and **Resolution** to **0.9cm** to ensure full processing of the backscatter signal. The system will otherwise switch between 200µs and 500µs and some software cannot process out the signal change.
Ping Rate	Sets the rate at which acoustic pulses are transmitted. Certain factors such as depth will limit the maximum achievable ping rate. For instance, in deeper water, lower ping rates should be expected since signal travel time and path length from projector to seabed, and then back to receiver, are longer. Tx pulse **Mode** also affects ping rate. The system automatically transmits with 200µs sweep time in shallow waters so that maximum ping rate is maintained.

Ping Rate: Full Range	If enabled, sets the ping rate to maximum possible value over the total effective range as defined by the **Swath** width, swath **Direction** and **Lower Gate**. Ping rate is a function of the two-way travel-time of the signal from projector to the bottom and back, plus a small duration for ping processing and capacitor charge. The effective range is determined from the angular swath width, swath pointing angle and lower depth or range gate.
Ping Rate: Adaptive	System searches for greatest bottom detection range based on adaptive gate over a certain number of pings and revises the transmission timing to match this. **Lower Gate** may therefore be set to very deep values, but the system will ping at a much higher rate as it is based on maximal adaptive gate for range. Ideal for high resolution data over rapidly changing bottoms or for surveys that do not allow for full-time, hands-on operators (e.g. on AUVs). While operating in this mode, sonar bandwidth and sweep time are determined by the **Lower Gate**. If surveying in shallow waters, the **Lower Gate** should not be set too deep unless **Auto Mode**/**Resolution** is disabled.
Ping Rate: Fixed	Sets the maximum ping rate of the sonar. Even if possible, the sonar will not ping faster than the fixed rate. Useful for general bathymetric surveys with deep and shallow water to reduce data volume in very shallow waters as the system will continually attempt to ping as fast as possible up to the user defined threshold or the sonar range.
Ping Rate: External	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, but the external signal is 12Hz, then every other event will be skipped resulting in a 6Hz ping rate per every other signal. The external signal polarity is configurable. Minimum delay from transmit signal to center of transmit pulse is 500µs (half the transmit pulse buffer plus additional). An adjustable trigger delay is possible in millisecond resolution.
Scanning (STX only)	Directs the sonar to sweep an along-track sector of angle given by **Opening Angle**. If unchecked, the sonar is directed to ping in one direction, effectively behaving as a conventional multibeam sonar. **NOTE: It is not advised to perform an entire survey with scanning enabled. Use scanning only when attempting to further develop areas of interest. For most applications, step size should be limited to 20.**
Steps (STX only)	This is configurable only if **Scanning** is enabled and the **Opening Angle** is set to a non-zero value. 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.
Direction (STX only)	Defines the angular direction forming the center of the along-track sector, e.g. for a **Direction** of 5°, and **Opening Angle** 10°, the STX will scan across a sector from 0° to 10°.
Opening Angle (STX only)	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 **Direction** is 0°, the maximum **Opening Angle** is 20°.
Display all Ang (STX only)	If checked, this instructs the GUI to display all angles in the sector being scanned by the STX. If unchecked, the GUI will display the angle defined in **Display Angle**.
Display Angle (STX only)	If **Display all Ang** is unchecked, this field will be greyed out. However, if the previous field is unchecked, the user may define a single angle within the sector to visualize on the display.

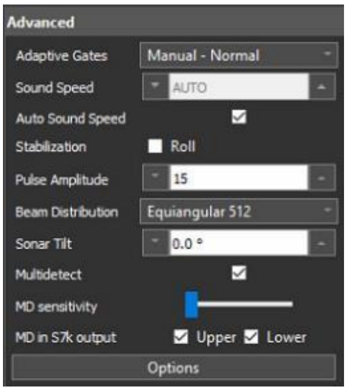
⚠ **CAUTION: Data Quality Is a Function of TX Pulse Settings**

High quality sonar data requires excellent Signal to Noise (SNR). For most conditions (temperature & salinity dependent) use **FM Long Range** mode and **0.9cm** resolution. If useable swath width becomes narrow, gradually decrease **Resolution**. If in doubt. use **Auto** selection.

CAUTION: Bottom Classification Surveys Using Snippets

For optimal backscatter data quality, deactivate **Auto** and manually define **Mode** and **Resolution**. Changing these settings during a survey, or operating in **Auto** mode, may cause degradation as the processing software is not able to compensate for variable pulse characteristics. In general, **FM Long Range** mode should be used, however this limits the ping rate to a maximum of 20Hz. If a faster ping rate is required, select **FM Short Range**.

4.6.4 Advanced



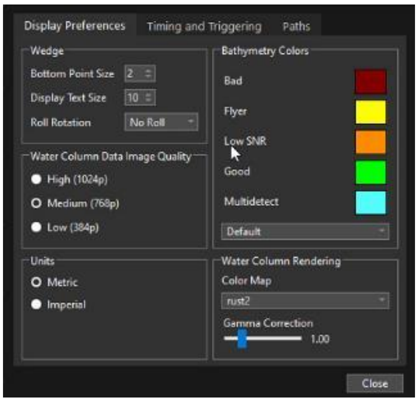
If a NORBIT STX system is utilized, an additional checkbox appears for activating pitch stabilization. Note that pitch stabilization should **not** be used when **Scanning** is selected.

When **Multidetect** is selected, additional options become available to control the detection sensitivity and customize the output. All functions contained are explained in the table below.

Function	Description
Adaptive Gates	**Adaptive Gates** work in a similar way to upper/lower gates, except they follow the shape of the seafloor. Note that they are **not** visible on the sonar wedge. If the gates are too narrow, bottom detections may be noisy for large depth changes. In areas with steep gradients it is recommended that the gates be turned **Off**. If the gates are too wide (or off), false bottom detections may occur due to noise, second returns or fish. 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 cutting out data during large roll events. It is advisable to use adaptive gates in nearly all environments.
Sound Speed	Controls how the surface sound speed is applied. If **Auto Sound Speed** is selected (recommended) the sonar uses values from the integrated SVP. If this sound speed probe fails, users can disable the auto option and manually input the speed, based on a sound speed profiler for example. An incorrect surface sound speed will irreparably compromise data quality. Minimum value is 1300m/s, maximum is 1700m/s. When **Auto Sound Speed** is deselected, the last value at the head is used to populate the SV value. Please note that this range reflects default hardware capabilities. For marine conditions requiring a larger range, other models of the sound speed probe are available; please contact NORBIT Support for more information.
Auto Sound Speed	If this option is selected the speed of sound is read 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 the data quality, e.g. when surveying in rapids or surf-zone. If necessary, this option may be deselected, and the value set manually. If the sonar is powered on and out of the water, or there are excessive bubbles, the GUI displays a warning that the sonar is "Out of water". If the sonar is pinging out of water, it automatically takes measures to prevent damage due to overheating. If the sonar temperature exceeds 65°C it will shut down automatically as a safety precaution.

Roll Stabilization	Allows for a wider swath width in more dynamic sea states. Roll stabilization compensates up to ±10º of roll and is limited to 160º swath angle. Note that this is unrelated to roll compensation for georeferencing, which is handled separately.
Pitch Stabilization (STX only)	Allows for pitch compensated transmit beams for more even along-track coverage with minimal loss. **STX scanning must be deactivated prior to use.**
Pulse Amplitude	Sets the pulse amplitude (transmission power). For shallow waters (<10m) in highly reflective areas (lock chamber, for example) it may be necessary to reduce the pulse amplitude to reduce acoustic reflections/noise in the survey area. Otherwise it is best to leave it set to 15.
Beam Distribution	Several modes are available: • **Equiangular 1024*/512/256**: The angular swath coverage is divided equally by 1024, 512 or 256 (the total number of beams) to determine angular beam spacing. Use to increase resolution around the nadir zone. • **Equidistant 1024*/512/256**: The maximum chord distance of the swath is divided by 1024, 512 or 256 to determine the linear beam spacing. Use to increase resolution at outer swath edges. For WBMS systems there is a short 1 second lag when switching modes. Do not switch while logging data. • **Pipeline***: A combination of high-sounding density in the central swath region (±50°) where the pipeline is located and Equi-Distant distribution in the outside region. This allows more hits on the target, while still obtaining a general impression of the surrounding seabed. ** Available for WINGHEAD sonars only*
Sonar Tilt	Specifies the tilting angle in special mounting configurations such as dual head when the sonar is mounted at an angle. Allows the user to normalize the display in the GUI, otherwise a flat seafloor will appear as a slope. Note, additional considerations are required when the integrated IMU is tilted; refer to technical note TN-190018 for details.
Multidetect	Record up to 3 detections per beam - one additional detection above and below the bottom detection. The upper and 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 bottom detection: if set to **Wide** or **Off**, the additional detections could be further away from the bottom detection, and if set to **Narrow**, the additional detections are closer to the bottom detection.
Multidetect Sensitivity	Adjusting the slider increases or decreases the sensitivity of the multi-detection algorithm to qualify the water column as a potential extra detection.
Multidetect in S7k Output	Select whether to output an additional detection above (**Upper**) and/or below (**Lower**) the bottom detection in s7k files generated by the GUI.
Options (Display Preferences, Timing and Triggering, Paths)	***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 stabilized 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 either metric or imperial. **Bathymetry Quality Colors –** Changes color palette of bottom detection quality flags. **Color Map –** Offers different color settings for visualizing 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

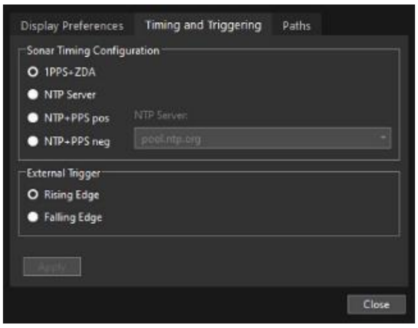
off (black). Setting gamma too high will fuse the darkest areas with brightest areas. A value of 2 is often the best.



Timing and Triggering

Users can specify the synchronization method for sonar timing. For more 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 IP address of the computer that runs the NTP service.



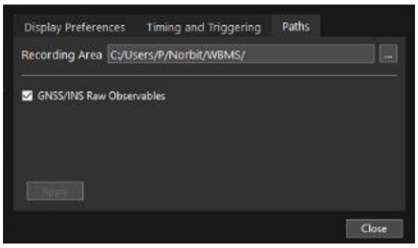
NTP+PPS has the same accuracy as 1PPS+ZDA and is recommended for all other installation types where 1PPS+ZDA is not possible. A PPS pulse must be sent to the system on the timing pin, and an NTP server should be made available on the network. If the timing error exceeds 10ms, the sonar will discard timing.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

Paths

Users can specify the folder path for recording native NORBIT (*.wbm), INS (*.000), and s7k (*.s7k) files.

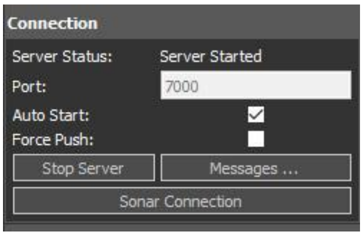


Users can choose to disable INS data logging by deselecting **GNSS/INS Raw Observables**. However, NORBIT recommends that this option is always enabled.

Note that the GUI must be closed/re-opened when the recording path is changed, otherwise data will continue to be recorded to the previous location.

4.6.5 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**.

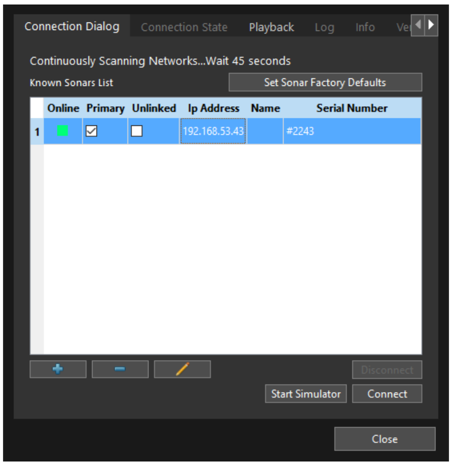
NOTE: Enable Force Push for PDS and EIVA Acquisition
To receive sonar and INS data into PDS or EIVA, the **Force Push** option must be selected.

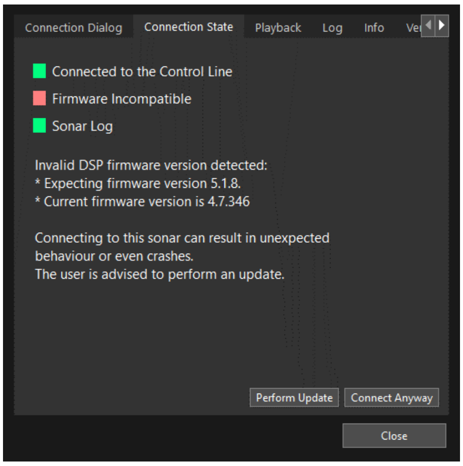
4.6.5.1 Connection Dialog & Connection State

Select **Sonar Connection** to open the **Connection Dialog** (described also in section 4.3). Selecting **Set Sonar Factory Defaults** resets the sonar configuration but does not reset the integrated INS. NORBIT recommends restoring factory defaults whenever a new version of the GUI or firmware is installed. 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 of the indicators are red, action is required by the user. Such is the case in the example presented here, which shows that the sonar is not loaded with the firmware expected by the GUI.

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 master/slave. By default, any setting changes apply to both systems. The **Unlinked** option allows dual head sonars to be operated independently.

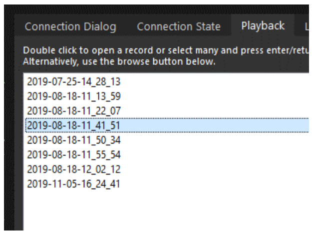
4.6.5.2 Sonar Simulator

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.

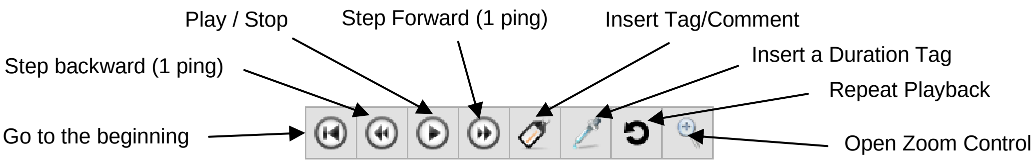
4.6.5.3 Playback

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.



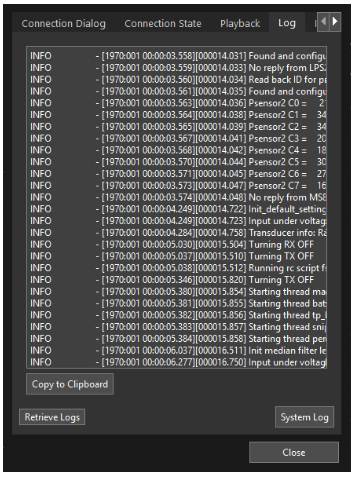
During playback, only bathymetry and water column data is displayed. By default, recordings are stored in: *C:\Users\<user>\NORBIT\WBMS*

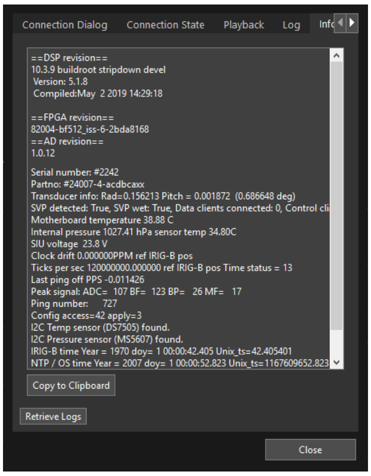
The playback window can be resized by dragging the central divider. **Settings** and **Controls** are found on the left. Users can also change the **Sonar Orientation** as required. To export the current ping, or a series of pings, use the **Export Current Ping** and **Export** buttons. Other options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



4.6.5.4 Log, Info & Version

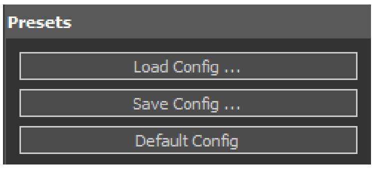
The **Log** tab contains a record of system events. The **Info** tab contains a record of serial numbers, part numbers, revision numbers, and various system statistics. The **Version** tab displays the current NORBIT GUI and firmware versions.





4.6.6 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.

4.7 Data Formats, Recording & Output

4.7.1 Raw Data Recording

Bathymetry data with full motion and navigation data, including True Heave data (for integrated INS systems only) can be recorded in the native NORBIT format with extension *.wbm. At the same time, s7k files are generated automatically. The s7k format has a publicly available data format definition (DFD). If requested, NORBIT Support can provide documentation on the DFD. The logging location for *.wbm, *.s7k and *.000 files can be changed by selecting **Advanced** > **Options** > **Paths.** See section Advanced for more details.

Stored data types depend on selections made in the **Backscatter Controls** settings. The **View WC** Checkbox 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 Data Output via Network Subscription.)

All 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 is requested by the acquisition software, side scan will be recorded in the raw data files regardless.

Note also that 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 the side scan and snippets outputs.

Backscatter Mode Selection	View WC Checkbox	Recorded Data Types in WBM file	7k Records in s7k file
None	☐	✓ Bathymetry ✗ Side scan ✗ Water Column ✗ Snippets	✓ 7027 ✗ 7007 ✗ 7042 ✗ 7028
None	☑	✓ Bathymetry ✗ Side scan ✓ Water Column ✗ Snippets	✓ 7027 ✗ 7007 ✓ 7042 ✗ 7028
Side scan	☑	✓ Bathymetry ✓ Side scan ✓ Water Column ✗ Snippets	✓ 7027 ✓ 7007 ✓ 7042 ✗ 7028
Snippets/scan	☑	✓ Bathymetry ✓ Side scan ✓ Water Column ✓ Snippets	✓ 7027 ✓ 7007 ✓ 7042 ✓ 7028

4.7.2 Data Output via Network Subscription

Currently, the NORBIT GUI supports streaming s7k records `7000, 7004, 7006, 7007, 7027, 7028,` and `7042` 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
7500	7k remote control with ID 1051
7501	7k remote control acknowledge
7502	7k remote control not acknowledge

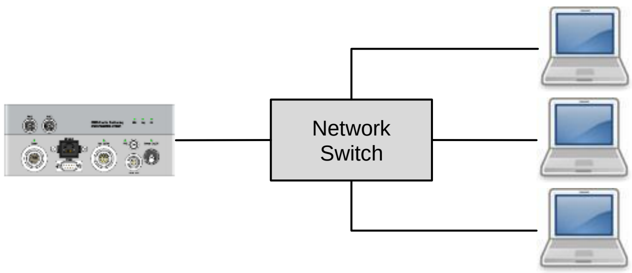
4.7.3 Data Rates

Estimated data rates for a single head iWBMS system at maximum ping rate are given below:

Ping Rate	Bathy	INS	WC	SS	SN	SNS	Data Rate
50 Hz	✓	✓	✗	✗	✗	✗	5 Mbps
50 Hz	✓	✓	✓	✓	✗	✗	13 Mbps
50 Hz	✓	✓	✓	✓	✓	✗	13 Mbps
50 Hz	✓	✓	✗	✗	✗	✓	11 Mbps

4.8 Interfacing with Multiple Computers

It is possible to communicate with the GUI using more than one computer, e.g. one computer to configure and control the sonar and a second, more computationally resourceful PC, to run acquisition software such as DCT, HYPACK or Qinsy. It requires a network switch and an Ethernet cable for each connected computer.



Each computer requires its own unique IP address on the same IP range (see section 4.2 for more details). The acquisition software should always connect to the IP address of the PC that operates the GUI, on TCP port 7000.

5 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.

5.1 Sonar Issues

Problem	Action
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 to clear the configuration.
Cannot connect to the sonar	• 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. • 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. • Ground SIU, as explained in section 5.3.
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 (motion artefacts, etc.)	• Ensure that multiple network cards (Wi-Fi and wired) are **NOT** connected to the same subnet. This causes duplication of navigation data in the files. • 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 ideal) • Review offsets and positioning quality • Review Data Quality Control Checklist.
GUI does not match description or is not performing as described	• Obtain latest installer from NORBIT Support.
IMU is connected but there is no sonar connected	• Check cable connections and re-seat if necessary. • Possible IP address conflict. Check network settings. • GUI and BathyProxy should be allowed in Windows Firewall. • Ground SIU, as explained in section 5.3.
There is no timing in the sonar or GUI timing line is red	• 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 for more info.) • If satellites are detected but LED is not blinking at 1Hz, open POSView and check COM4 output to verify that it is configured to output NMEA ZDA at 1Hz, 9600 baud.

	• Users can also obtain reliable NTP timing from Qinsy SNTP, which does not require a license. Open Qinsy and double-click SNTP Server. 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**, select the IP of the PC running the server, and click **Apply**. Another recommended 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. • 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 data packets are dropped	• 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 occur, or no data from sonar and/or IMU	• Check sonar and/or IMU cables. Check that the connection at wet-end 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, then use a tool, but **do not overtighten!**
Soundings are being filtered	• Adaptive gates are on Narrow and may need to be changed to a wider setting, or disabled altogether.
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	• Lower the upper gate closer to the expected bottom.
No external roll stabilization with standalone (non-integrated) NORBIT sonars	• Follow the instructions in section 4.4.6. • Use terminal emulator such as PuTTY (free to download) to verify the TSS1 message data stream. Select a “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 NORBIT GUI, but data is not received in acquisition software	• Ensure that both firewalls (Private and Guest or public networks) are disabled. • Check to see if acquisition software has correct ports specified.
“Sonar timing incorrect” pop-up window remains when satellites detected	• 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 will remain red.
No sonar data in PDS or EIVA	• Ensure that Force Push is checked under **Connection** settings in GUI.
Smears appear in the snippets record	• PC load is too high, and it is unable to properly process the high data load. Try reducing PC 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, go to Change Display Settings, and change the Scale and Layout values. Change the value under “Change the size of text, apps, and other items”

5.2 INS Issues

Problem	Action

Sonar is connected but no INS data is received	• Disable Windows firewall, or allow NORBIT GUI access and add an exception for UDP port 5602:
	  ▪ Open legacy Windows Control Panel
	  ▪ 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 computer IP address does not conflict with the INS IP address (192.168.53.100).
	• Check cable connections and re-seat if necessary.
	• Check for bent sonar cable pins.
	• Possible IP address conflict. Check network settings.
	• Ground SIU, as explained in section 5.3.
	• Go to INS Tools > INS Setup Wizard and select **Factory** to restore default settings.
	• Perform the “resistance test” to check status of circuit components. Refer to Appendix for pinout diagrams.

Unable to receive RTK corrections	• Check COM port settings. • Check cable connections. • Verify IP address and mount point if using network solution. • Check radio link, check frequency, and verify that baud rates and corrector types match. • Try with Null Modem to swap pins 2/3. • Check on a different unit to verify data stream. • For serial RTK data, use terminal emulator such as PuTTY (free to download) to verify the data stream. Select a “Serial” type connection, enter the port number and baud rate of data source, and select Open to display the data stream. • If using NTRIP, check the Internet connection and verify login details.
Unable to achieve successful heading alignment	• Check antenna connections, ensure that antennas are connected to correct primary/secondary sockets. • Verify offset measurements. • Reset INS to factory defaults and start configuration over. • Review GNSS environment. Try different area or time.
No GNSS Data in INS System	• 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.
System status shows faults	• Check that cables are secure and tight. • Check for bent pins on cable and SIU. • Low quality power supplies may cause this issue. Try alternative power source. • Possible damaged sonar cable. • Ground SIU, as explained in section 5.3.
INS Logging light is red or orange	• Open **INS Setup Wizard** and apply **Factory** defaults. • Reboot PC. • Disable Windows Firewall.

5.3 Grounding

In some cases, the SIU may need grounding for proper operation. Grounding issues may cause IMU failures and bootup issues. If there is no grounding screw on the SIU, NORBIT recommends using a BNC connection. Find a BNC cable, break off the pin inside the connector, and on the other end expose the ground shielding (using the outer braid of wires) and crimp a connection to them. Connect the BNC to the SIU and the other end to a metal part of the vessel, or a wire that is in the water.

5.4 Change Sonar IP Address

Log onto the sonar with telnet. To do this, press **Windows+R** to open the **Run** dialog. Type `cmd` to open command prompt and 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)

5.5 Data Quality Checklist

Should the acquired data quality be degraded, review the steps below:

1. ***Review Hardware Installation:*** Ensure that all sensors are fixed, rigid, and free from vibration. There must not be any independent movement of sensors.
2. ***Primary Antenna:*** Ensure that the primary antenna is closest to the NORBIT system and connected to the correct SIU port (Ant 1).
3. ***Network Configuration:*** Ensure that multiple network cards (Wi-Fi and wired) are **NOT** connected to the same subnet. This causes duplication of navigation data in the files.
4. ***Offsets:*** Measure offsets correctly to the nearest 1cm or better, and check that the sign inputs are correct.
5. ***Alignment:*** Ensure that the integrated system is closely aligned with the vessel centerline. Agreement to within ±0.5° is ideal.
6. ***Center 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.
7. ***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.
8. ***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.
9. ***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.
10. ***Swath Angle:*** Soundings are most accurate if they are 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.

6 Basic Acquisition Software Setup

6.1 Offsets

By default, integrated NORBIT systems output all sonar and navigation data at the Sonar Reference Point (refer to the Offsets section for more details). Therefore, each device in the acquisition software requires the same offset; that is, the offset from the acquisition software reference point (e.g. Center of Rotation) to Sonar Reference Point. If the optional iLiDAR is installed, this offset must be separately measured and applied.

If the acquisition software and sonar reference points are the same, no offsets are required. In HYPACK, the vertical offset is the same for all systems and should be measured from the waterline to the Sonar Reference Point.

6.2 Data Collection Tool (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. Unlike other data acquisition packages, DCT requires no setup or offsets; all data is output with WGS84 coordinates and depth below sonar.

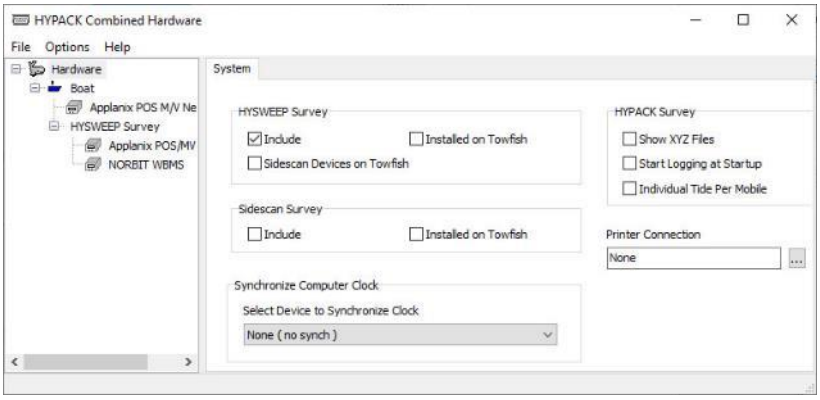
To enquire about DCT, please contact NORBIT Support. Refer to the dedicated DCT manual for operational guidance.

6.3 HYPACK

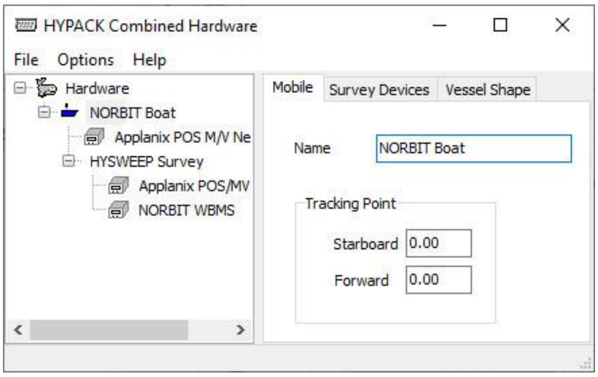
The following sections show only one of many possible methods for configuring HYPACK for NORBIT sonars. It assumes that the INS reference is collocated with the Sonar Reference Point. The vertical offset should be measured from the waterline to the Sonar Reference Point, and is the same offset for all systems (navigation, attitude and multibeam).

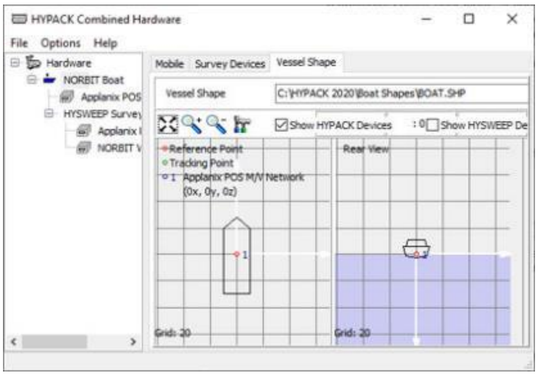
Note that the HYPACK sign convention uses **+Forward**, **+Starboard**, and **+Down. I**ncorrect entry of the sign may corrupt data

Step 1. Enable HYSWEEP Survey
Check **Include** under HYSWEEP Survey. This allows devices to be added for multibeam surveys.



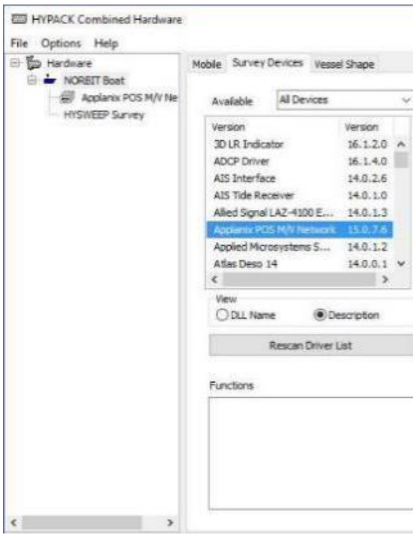
Step 2. Define Boat
Select **Boat** and give it a name. For more intuitive visualization, add a tracking point, preferably to the Sonar Reference Point (for standard installations). Edit Vessel Shape as appropriate.

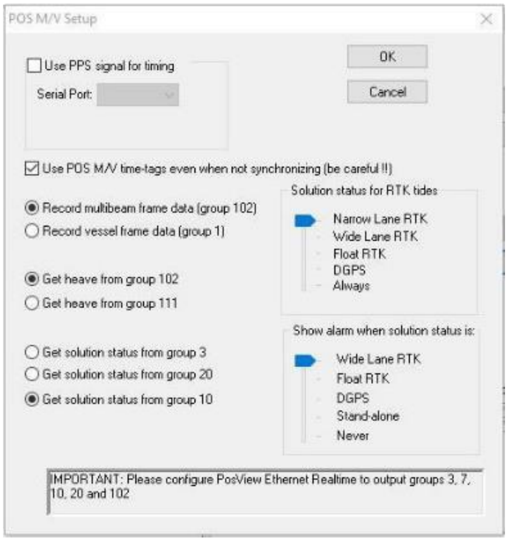


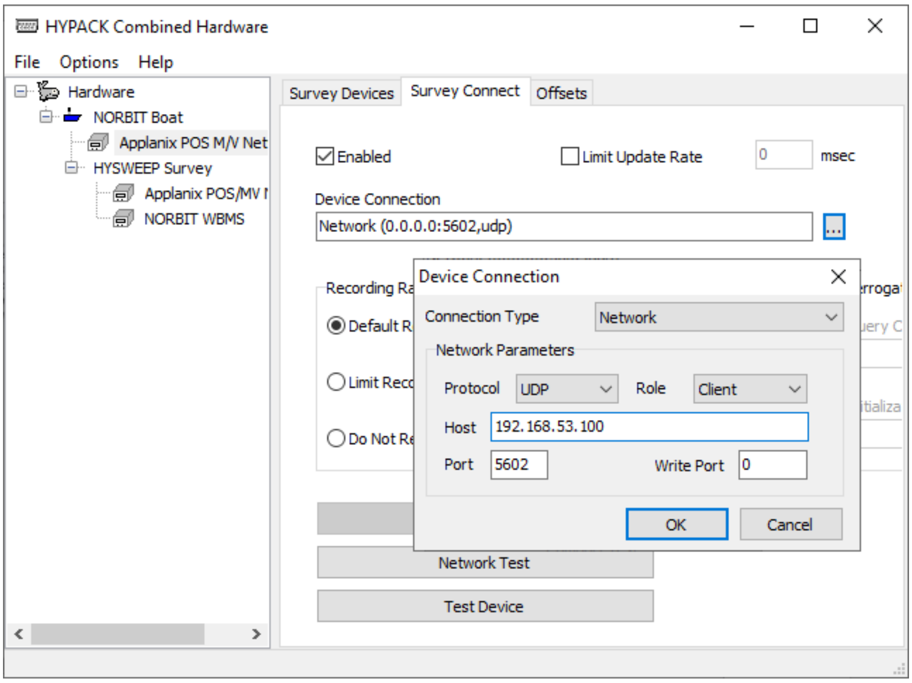


Step 3. Configure Position and Heading Device

In Survey Devices, add the Applanix POS M/V Network device and configure it as shown below.

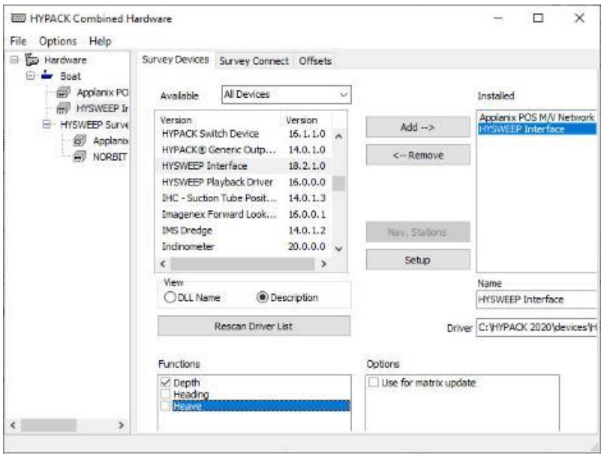


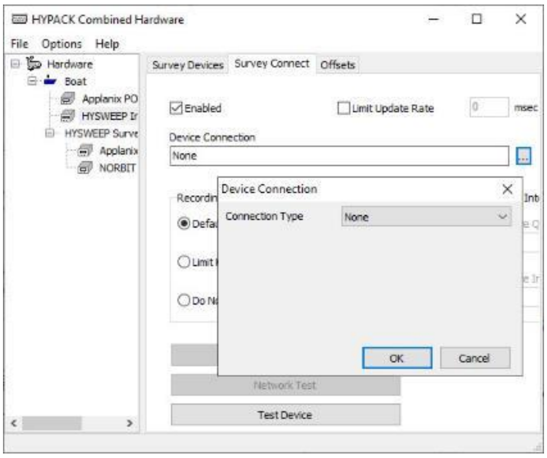




Step 4. Configure HYSWEEP Interface

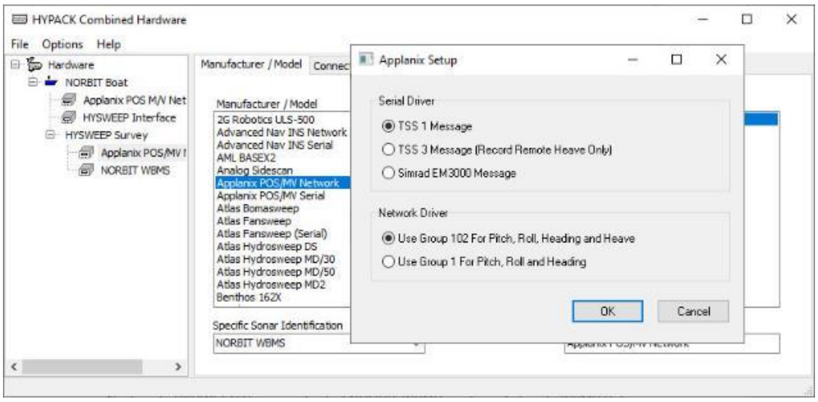
Then add, and configure, HYSWEEP Interface, checking only the Depth function under Functions:

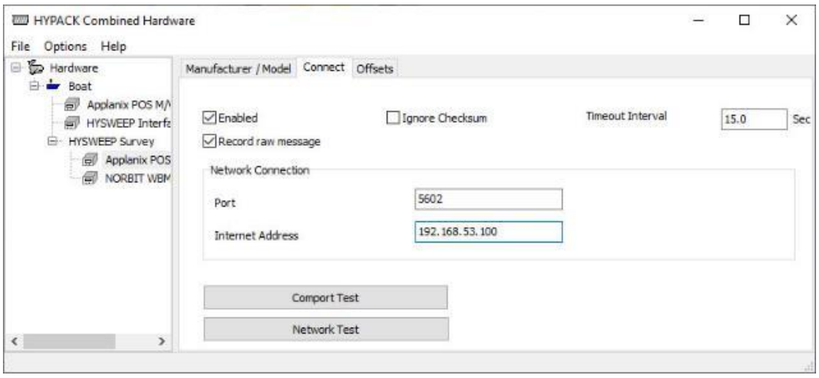




Step 5. Configure Motion Device

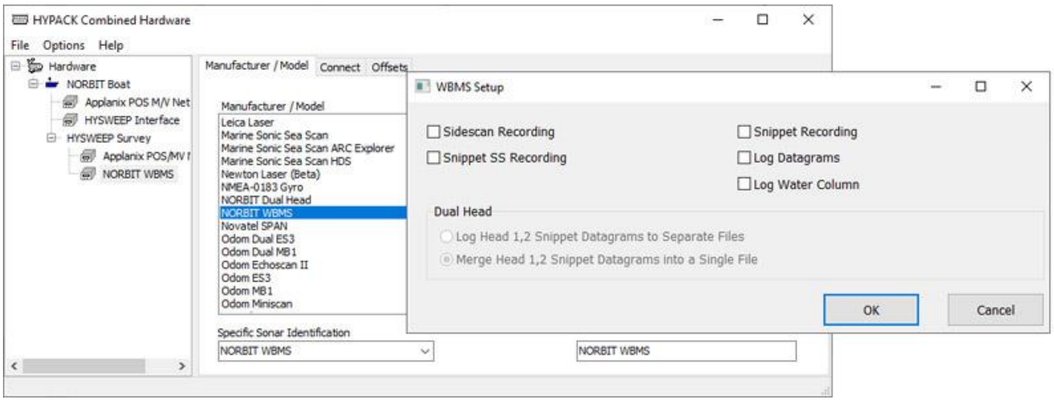
In HYSWEEP Survey, add the Applanix POS/MV Network device and configure it as shown below:

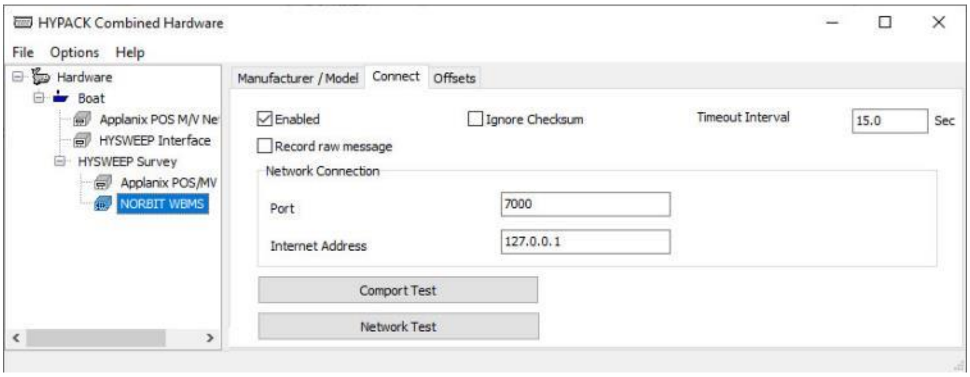




Step 6. Configure Multibeam Device

Go to HYSWEEP Survey and select NORBIT WBMS, as shown below. In WBMS Setup, select **Sidescan Recording** for recording Sidescan only, or **Snippet SS Recording** for Snippet-Sidescan, or **Snippet Recording** for logging Snippets. If Snippet data 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.





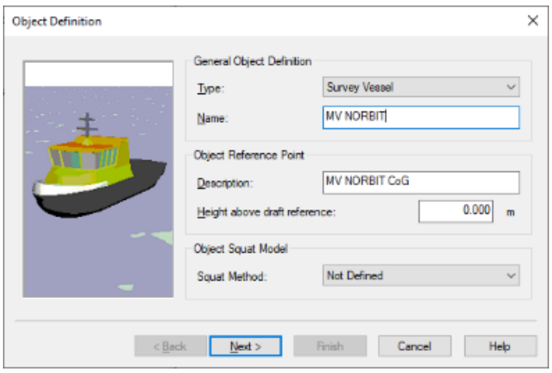
6.4 Qinsy

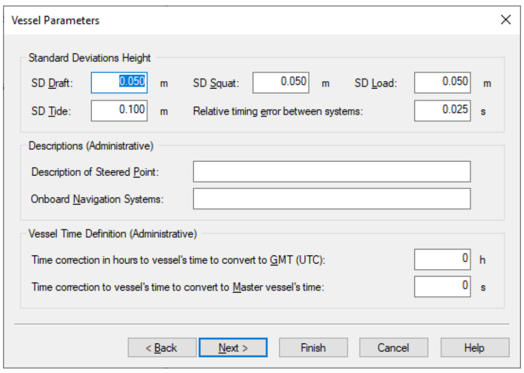
The following sections show recommended configurations of Qinsy v9.2 for all NORBIT sonars. It assumes that the INS reference is collocated with the Sonar Reference Point. Note that the Qinsy sign convention uses **Y+ Forward**, **X+ Starboard**, and **Z+ Up**.

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.

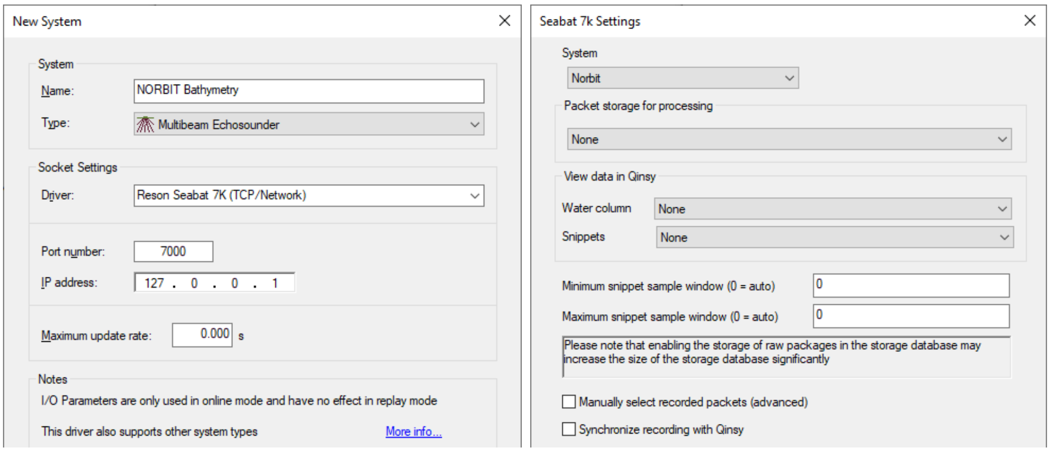
Step 2. Object Definition
From the Qinsy console, select **Setup** > **New Database** Specify the shape of the vessel and the reference point for Qinsy (e.g. vessel center of gravity)





Step 3. Add Multibeam System

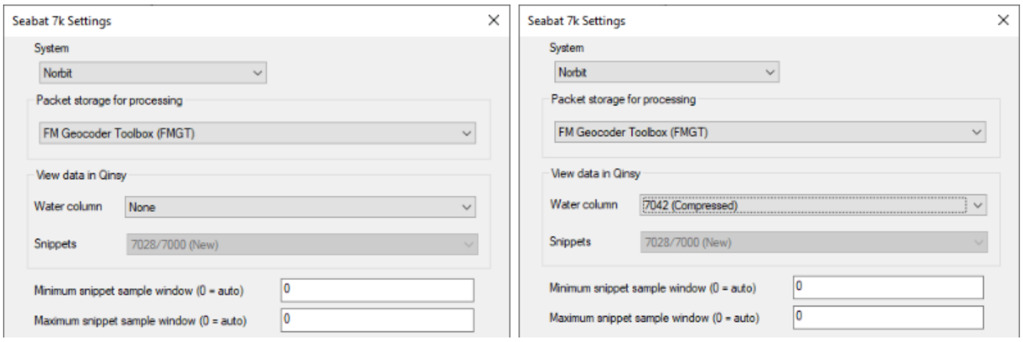
Specify a system name, e.g. NORBIT, and select **Multibeam Echosounder** as the type**.** Select the **Reson SeaBat 7k (TCP/Network)** driver, use port **7000** and IP address **127.0.0.1**.



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

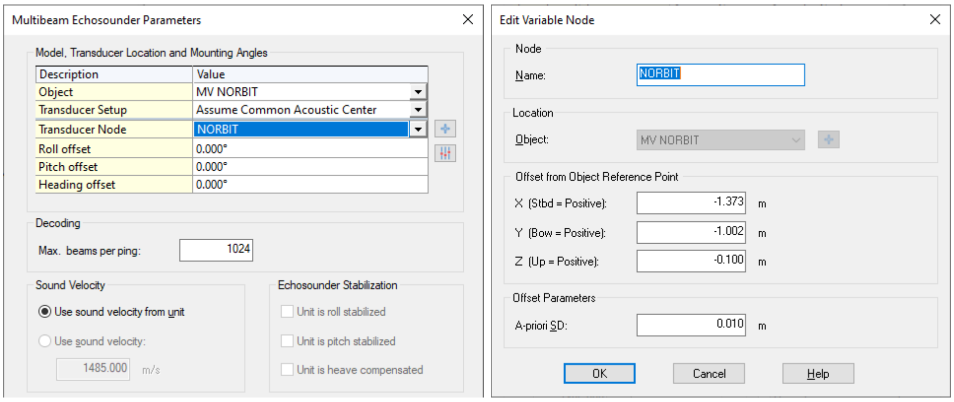
Step 4. Configure Snippets and/or Water Column Recording (Optional)

To collect water column, select the 7042 (Compressed) option. To collect snippets but no water column, configure the system as shown below (left); or for snippets and for water column (right)



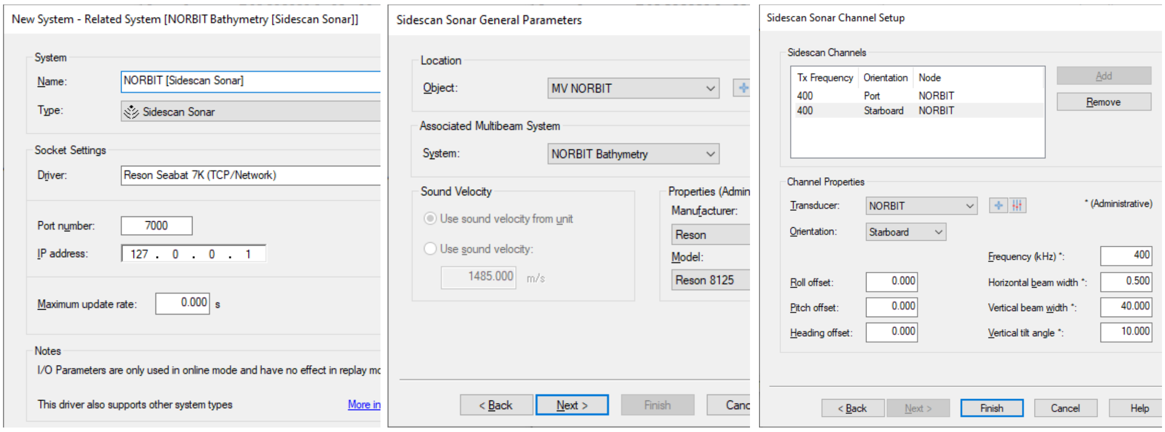
Step 5. Enter Offset to Sonar Reference Point

In Multibeam Echosounder Parameters, click the **+** button to create a node. Patch test values (roll, pitch and heading) may be entered if known. Enter 1024 under max beams per ping. Use the default echosounder accuracy and correction values. Click Finish.



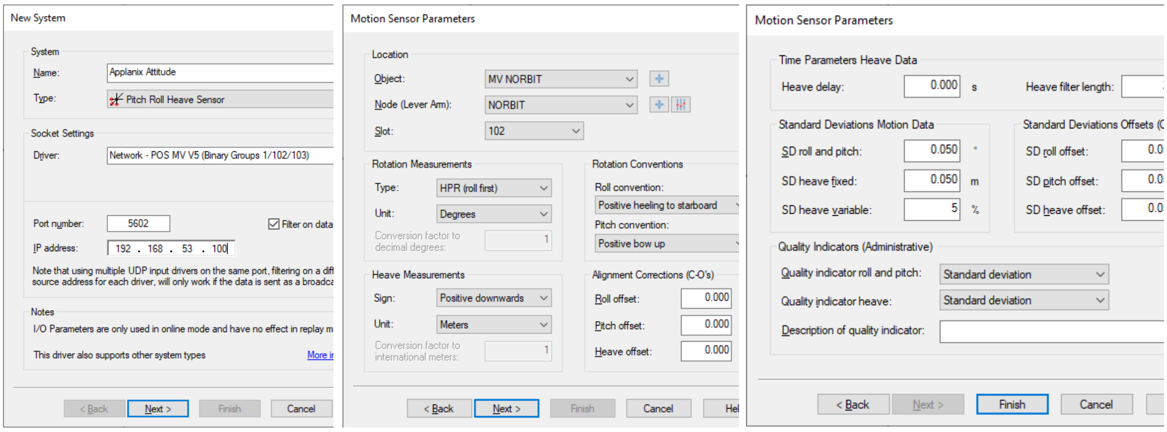
Step 6. Add Side Scan System (Optional)

Related systems may now be added. To add side scan, a port and starboard channel should be added and the frequency should be specified. Items marked with an asterisk (*) will not impact the data and are only for record keeping. Click Finish when done.



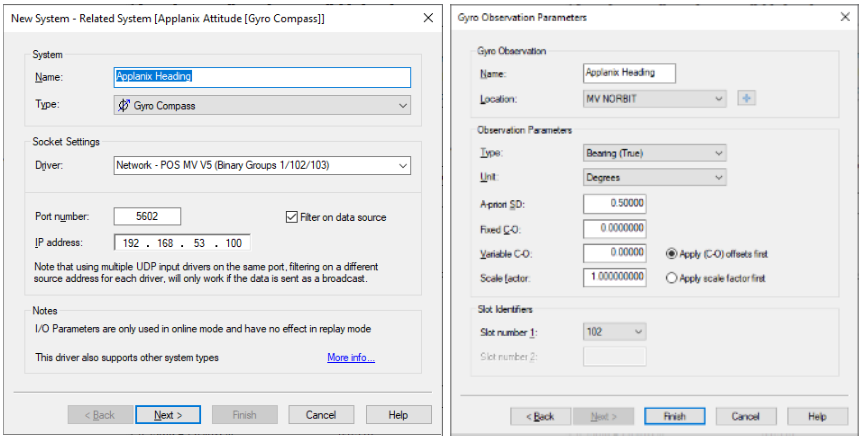
Step 7. Add Pitch/Roll/Heave System

From the Database Setup window, right-click System, click New System and add a Pitch/Roll/Heave sensor. Please note that for Applanix systems, the sign convention is positive downwards:



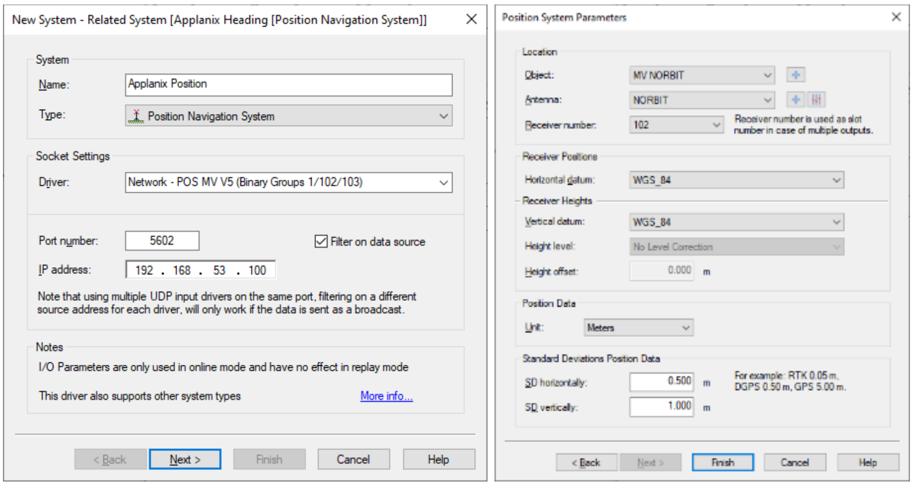
Step 8. Add Gyro Compass System

Repeat the previous step to add a new system, but this time add a Gyro Compass:



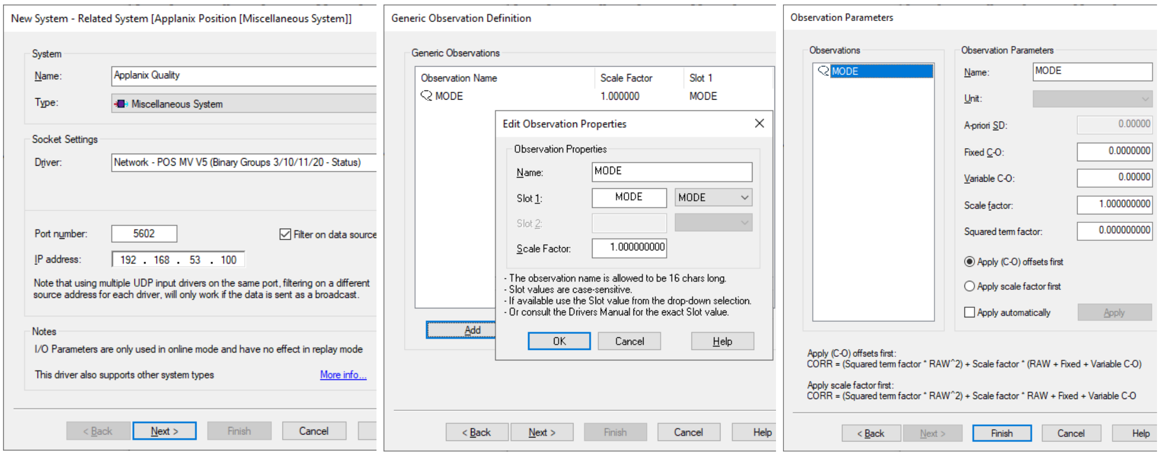
Step 9. Add Position Navigation System

Repeat the previous step to add a new system, but this time add a Position Navigation System. The Horizontal and Vertical datum will obviously depend on project specifications.



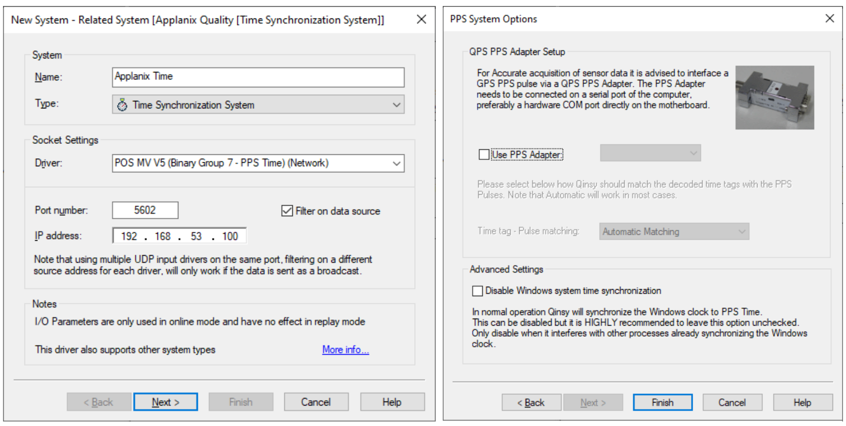
Step 10. Output Quality Information (Optional)

To configure the sonar to output quality information, add a Miscellaneous system:



Step 11. Add Time Synchronization System

A time synchronization system must be added. Use binary group 7 without a PPS box.



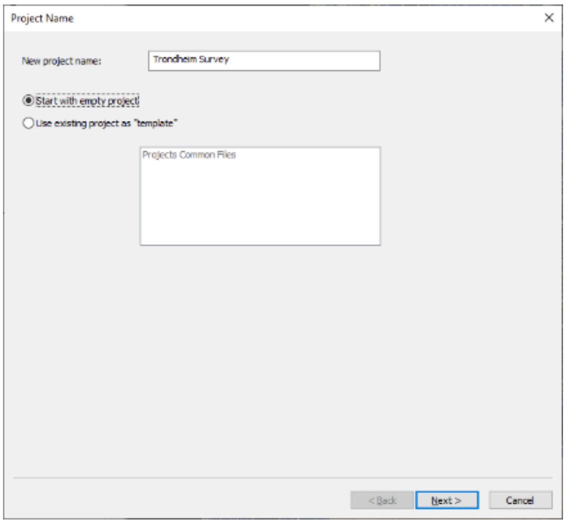
6.5 PDS

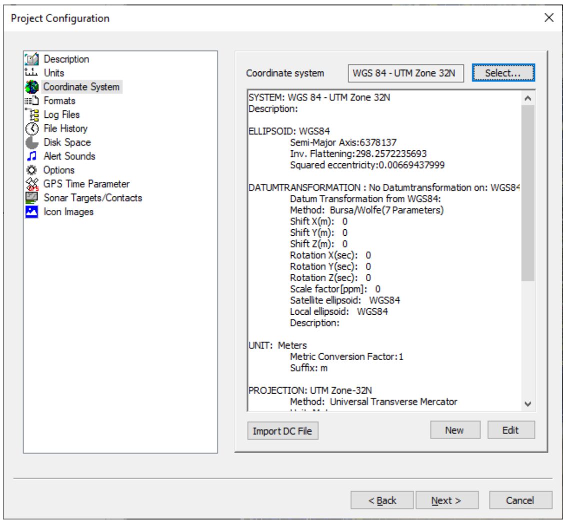
The NORBIT GUI requires that **Force Push** be enabled in the NORBIT GUI Connection settings to receive data in PDS. Refer to section 4.6.5 for more information on its functionality.

Note that the PDS sign convention uses **Y+ Forward**, **X+ Starboard**, and **Z+ Up**. Incorrect entry of the sign may corrupt data. The Applanix Ethernet groups required by PDS are automatically configured on integrated NORBIT systems, thus no action is required.

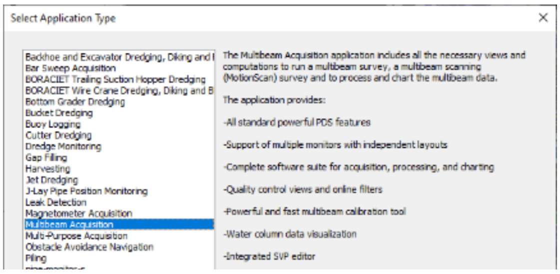
The Sea Level offset is used when depths are reduced using tide and heave. When RTK heights are used for depth reduction, the Sea Level offset is only used for applying the sound velocity profile at the correct depth.

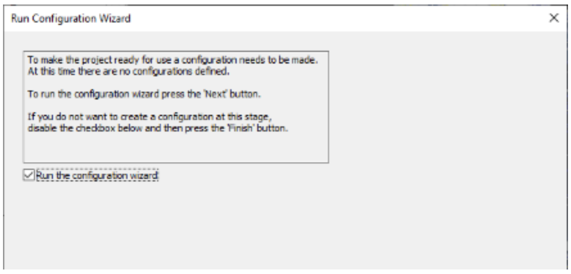
Step 1. Create New Project and Setup Geodesy
Create a new project in PDS Control Center via **File** > **New Project**. Specify a name for the project, and on the next page select a coordinate system from the geodatabase or define a new coordinate system according to the survey requirements.





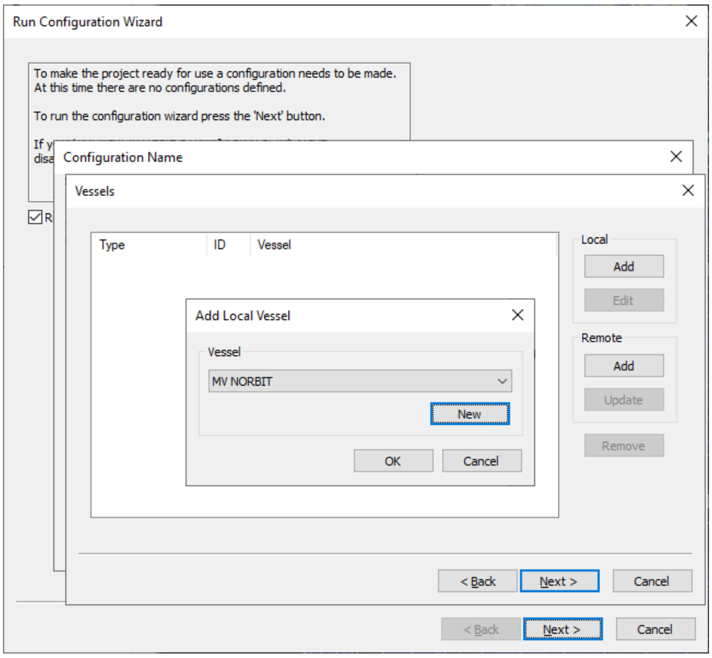
Step 2. Select Application Type and Run Configuration Wizard
Select **Multibeam Acquisition** as the application type. Click **Next** and run the configuration wizard.





Step 3. Add New Vessel

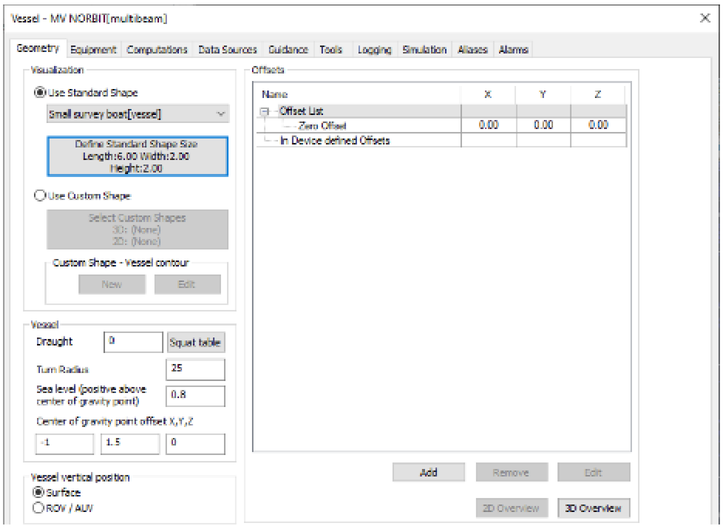
Specify a name for the configuration (e.g. “Survey Vessel Pole Mount”) and on the next page add a Local vessel which will contain all drivers and offsets.



Step 4. Enter Offsets

On the Geometry page, define the shape of the vessel (only for display) and enter the Center 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.

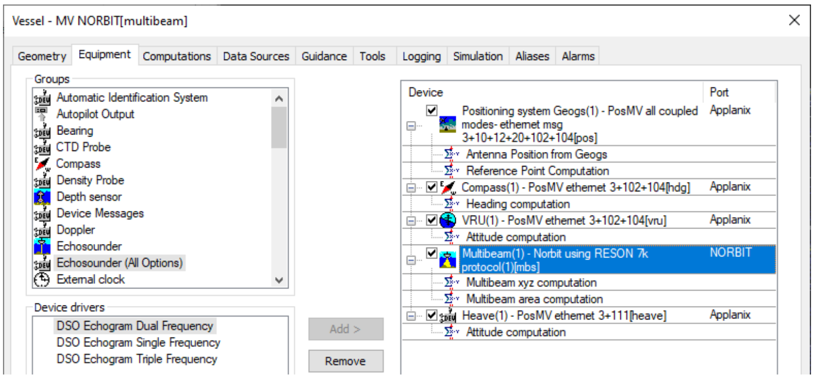
If the optional iLiDAR is installed, add its offset to the list. This is the measured offset from Sonar Reference Point to iLiDAR Reference Point. Refer to the iLiDAR manual for more details.



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 TCP 7000	Zero Offset



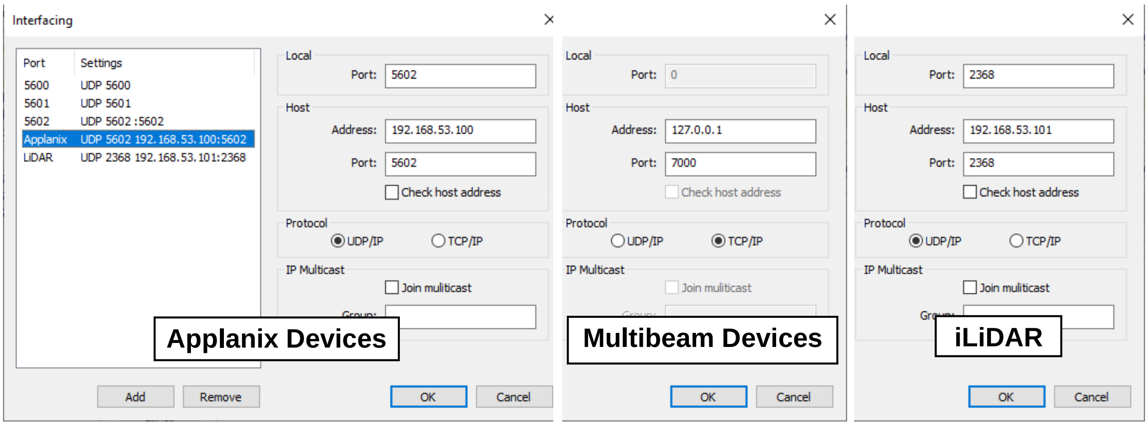
Step 6. Add Optional Devices

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

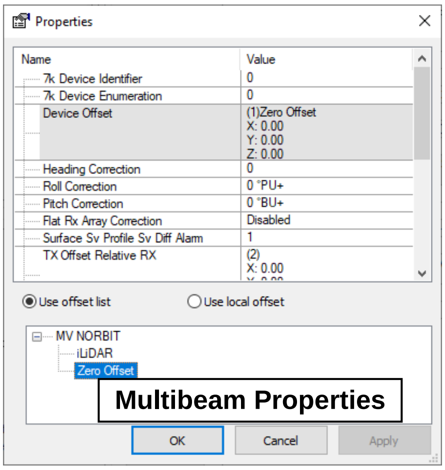
Step 7. Configure I/O Ports

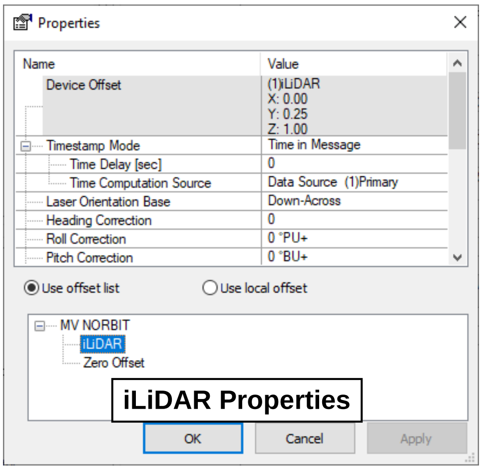
Select each device on the Equipment list and click I/O Port to configure the interfacing parameters, as per the tables in the previous sections.



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.





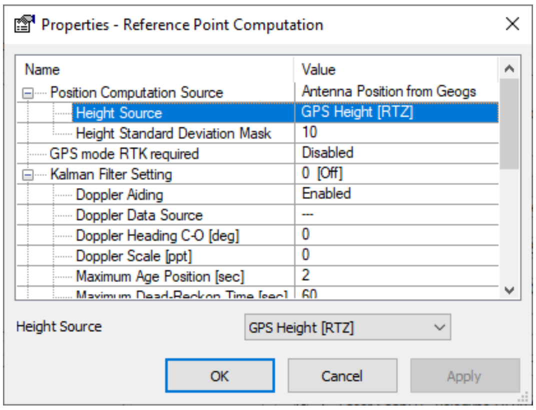
The patch test values, if known, may be entered in the device properties for the multibeam and optional iLiDAR. They should be entered in the **Roll Correction**, **Pitch Correction**, and **Heading Correction** fields.

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, and if you wish for these heights to be used for depth reduction. Otherwise, set this to **None**.



Height Standard Deviation Mask is a user-defined quality threshold for utilizing 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. To ensure that RTK heights are always used regardless of reported quality, set the deviation mask to a high value, e.g. 10m.

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 Center. To return to these settings and modify the vessel configuration, click the gear icon on the toolbar.

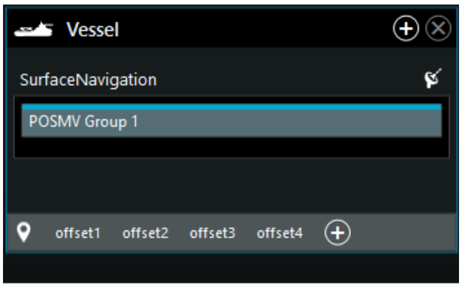
6.6 EIVA

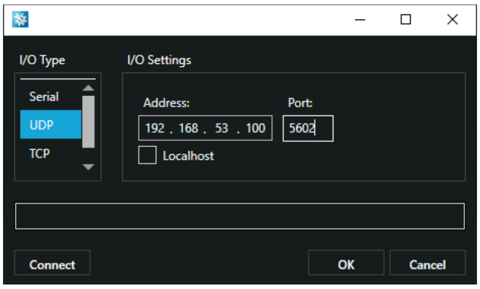
The NORBIT GUI requires that **Force Push** be enabled in the NORBIT GUI Connection settings to receive data in EIVA. Refer to section 4.6.5 for more information. Note that the EIVA sign convention uses **+Up**. Incorrect entry of the sign will cause georeferencing errors.

6.6.1 NaviPac

Step 1. Add Surface Navigation Instrument

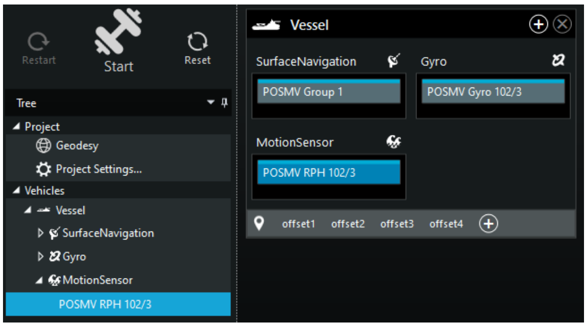
Add a surface navigation instrument to the vessel. Select **POSMV Group 1** from the list, and use IP address **192.168.53.100** on **UDP port 5602** for the I/O Settings.





Step 2. Add Gyro and Motion Instruments

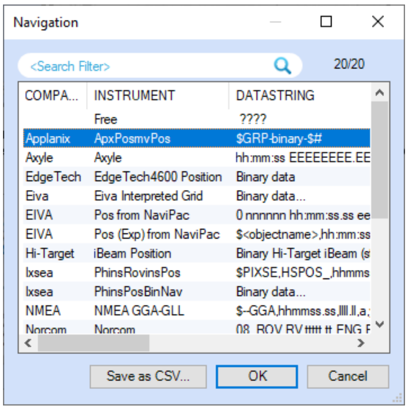
Repeat the above step for Gyro and Motion, using the **POSMV Gyro 102/3** and **POSMV RPH 102/3** options.

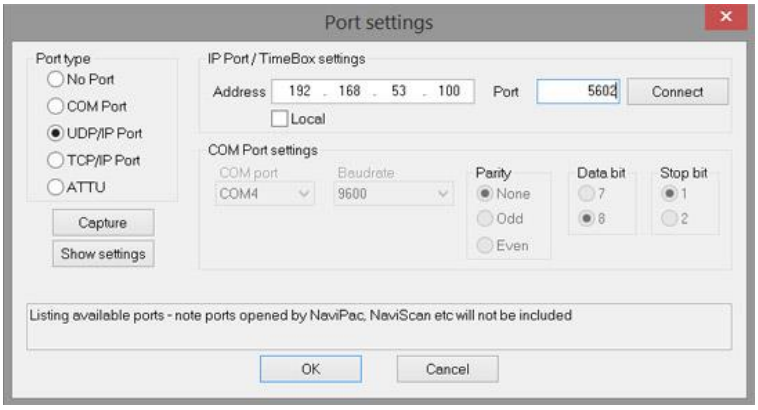


6.6.2 NaviScan Config

Step 3. Add Navigation Sensor

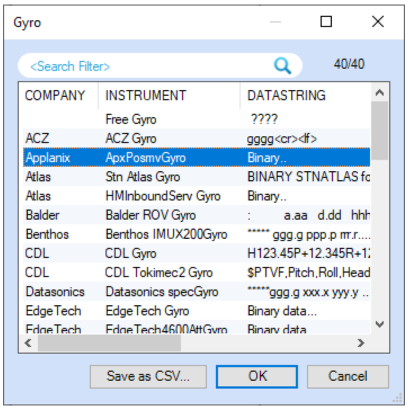
Begin by adding the navigation sensor. Go to **Equipment > Add Sensor** and select the **Applanix** option. For port settings, enter the IP address **192.168.53.100** and **UDP/IP Port 5602**.

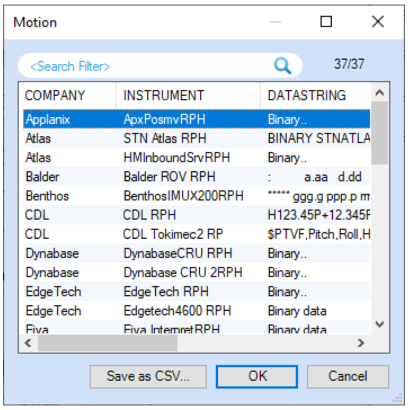




Step 4. Add Gyro Sensor and Motion Sensor

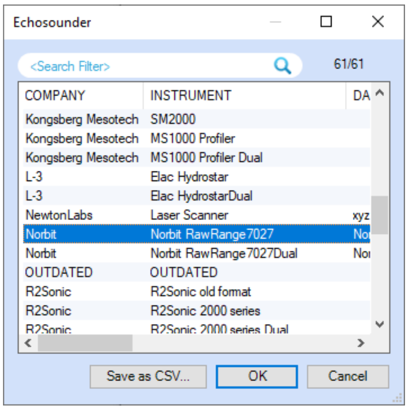
Repeat the previous step to add the Gyro sensor and Motion sensor. Select the Applanix options and configure the network settings as per the previous step.

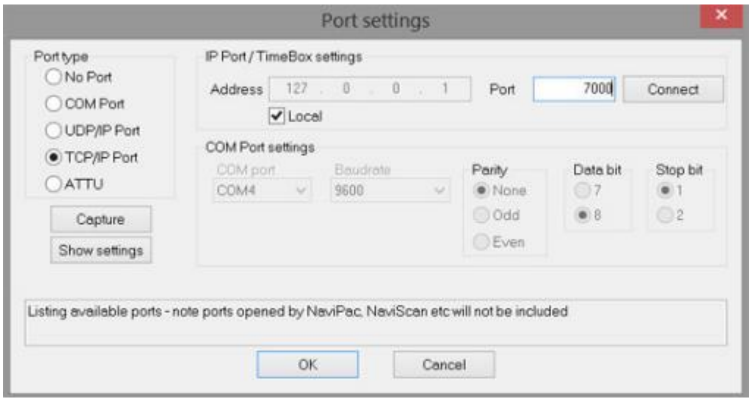




Step 5. Add Echosounder

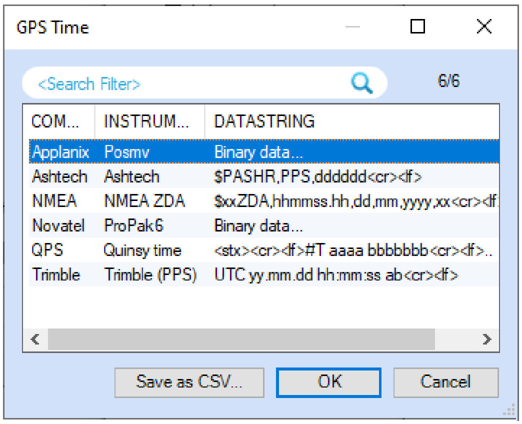
Add an Echosounder sensor, selecting the **Norbit RawRange 7027** option. In port settings, select **TCP/IP Port**, enable **Local**, and use port **7000** (unless configured otherwise in the NORBIT GUI). For dual head operations, select the **Norbit RawRange 7027 Dual** option.

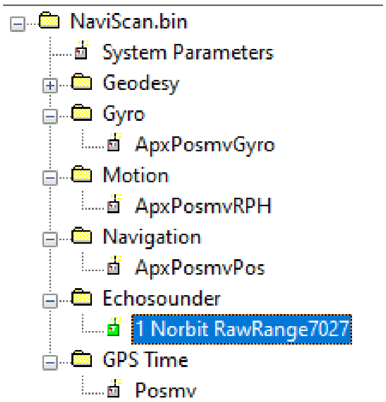




Step 6. Time Synchronization

If NaviPac and NaviScan are on the same computer, Ethernet timing can be used for time synchronization. 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.

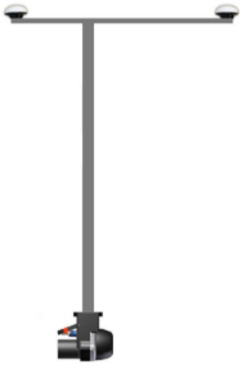




Appendix A: Quick Start Guide

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



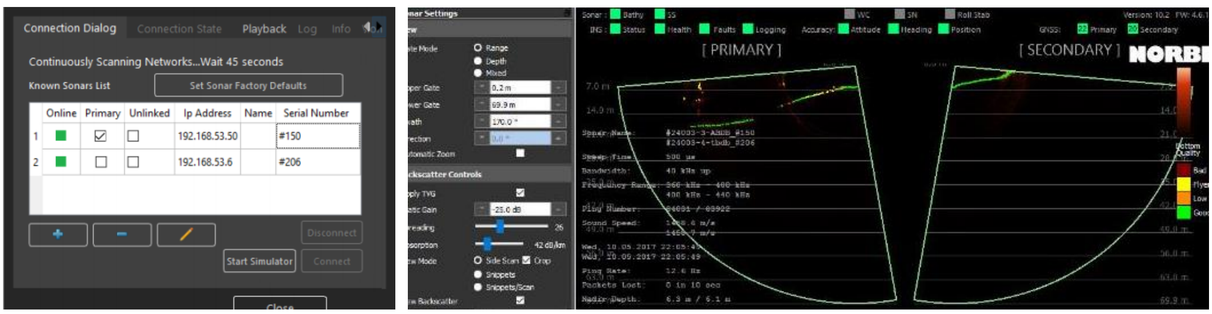
6. ***RTK:*** If RTK positioning is used, configure it as required.
7. ***Offsets:*** For the default setup, measure XYZ offsets from Top Center of Bracket to the base of primary GNSS antenna.
8. ***Power:*** Ensure power source is clean. Beware of batteries that are under powered or cheap inverters.
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 Center 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 stabilizes 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. ***Patch Test:*** Perform a patch test each time the sonar is installed or moved from its previous location.

Appendix B: Dual Head Quick Start Guide

1. ***Bracket and Mount:*** Mount the sonars to the dual head bracket or two single head brackets.
2. ***Power:*** For WINGHEAD configurations, 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. Note that, in this case, the standard power brick provided with a single head system (120W) does not provide sufficient power for dual head (220W).
3. ***Antennas:*** Install the antennas with 2m separation, ideally.
4. **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.
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, except 100 which is reserved for the GNSS/INS, or the last two digits of the sonar serial number. Set the subnet mask to 255.255.255.0.
6. ***GUI:*** Install the NORBIT GUI and, with the SIU powered on, run the GUI to detect and communicate with the sonars. On the **Connection Dialog**, select the two online sonars (highlight them on the table) and define the **Primary** sonar. Click **Connect**.
7. ***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. If you do not have this document, please contact NORBIT Support.
8. ***Sonar Controls:*** Two swaths appear in the main display with the primary sonar appearing on the left. Thus, visualization 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 sonar systems combined. All setting changes apply to both systems, unless the Unlinked mode is checked.
9. ***Frequency Separation:*** The transmit frequencies must not overlap. When 2 sonars are selected, the GUI automatically applies a frequency separation. When a center frequency is defined, 40kHz bandwidth is applied by default, since the sonars are optimized for a total bandwidth of 80kHz. For example, when 400kHz is selected with the default bandwidth of 40kHz, the sonars ping through a total frequency range of 360kHz-440kHz, with one sonar transmitting from 360kHz to 400kHz, and the second sonar transmitting from 400kHz to 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.

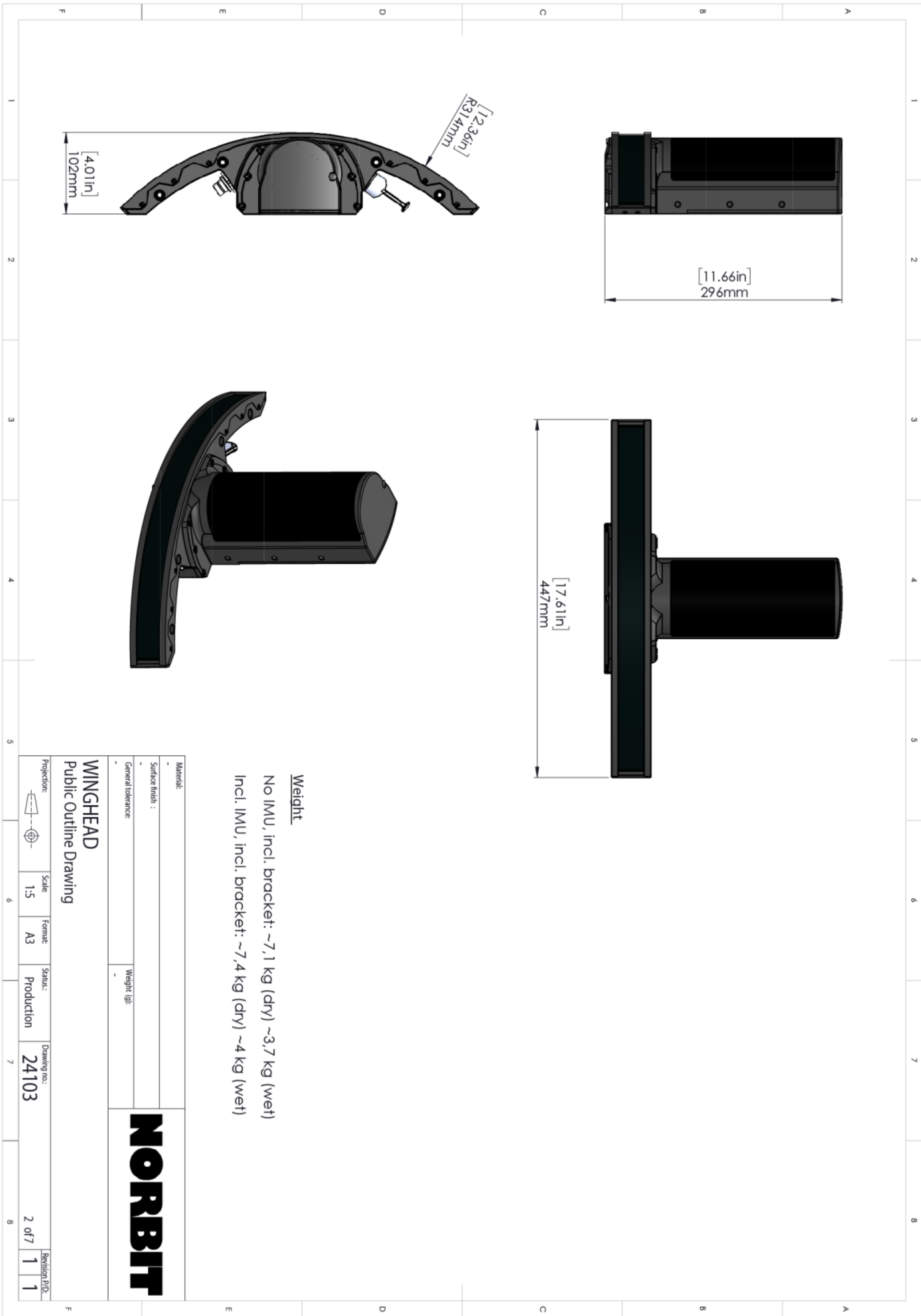
WINGHEAD Bracket
(±10° roll, ±1° pitch)

WBMS Bracket (±37.5° roll)

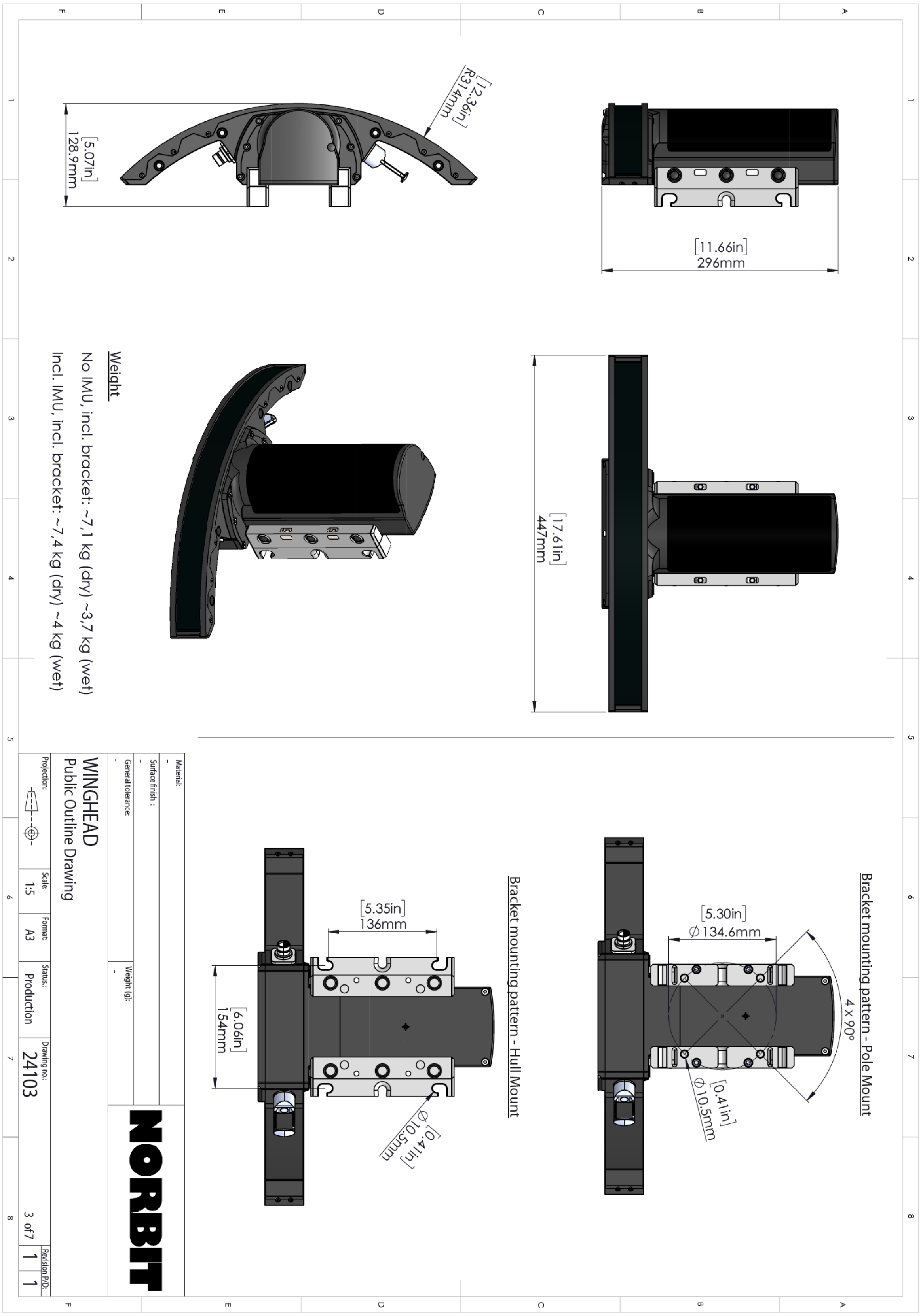


Appendix C: Sonar Hardware Dimensions

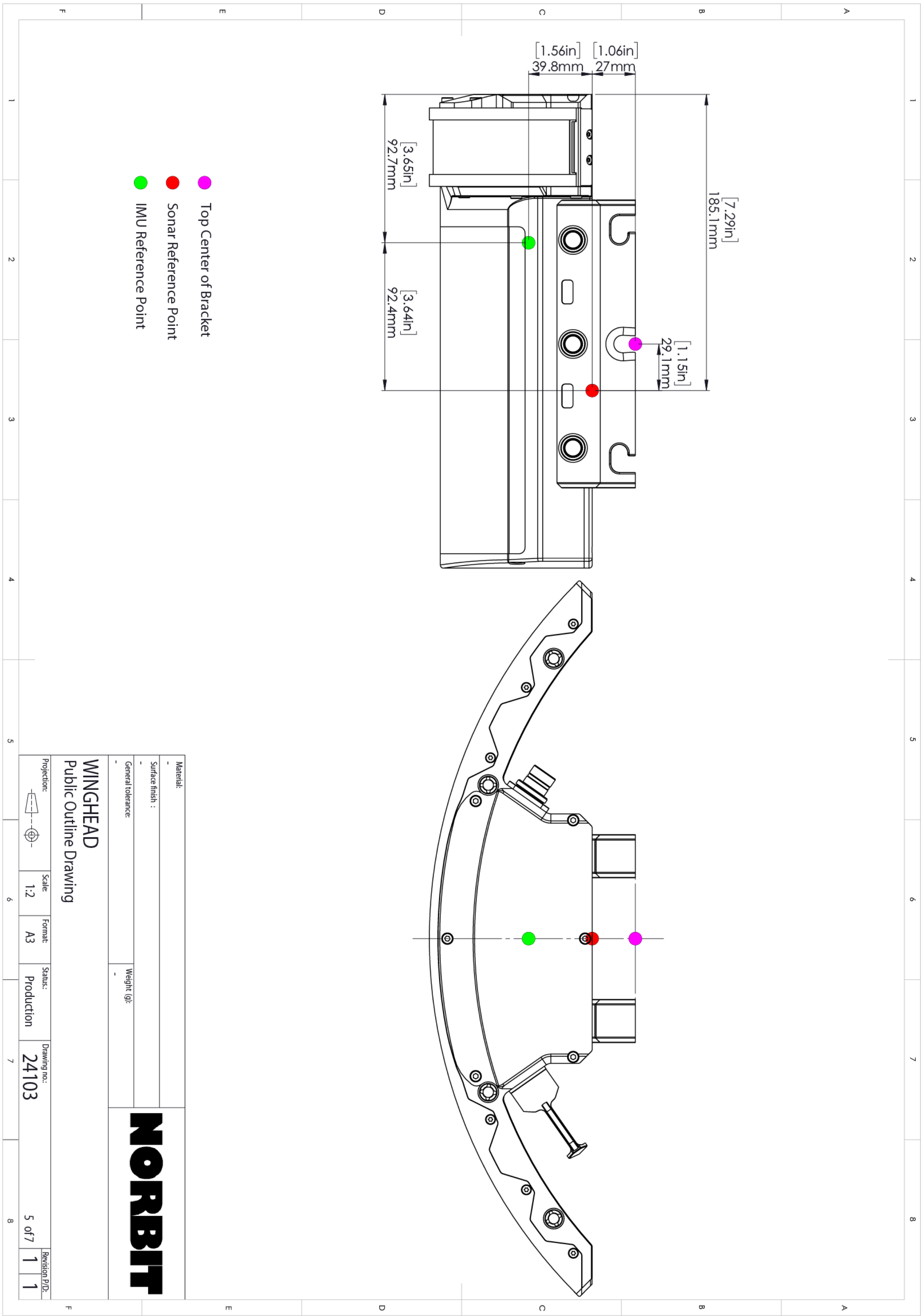
C1. WINGHEAD B41 & i77h – Wet-End Dimensions Excluding Bracket (PN 24103)



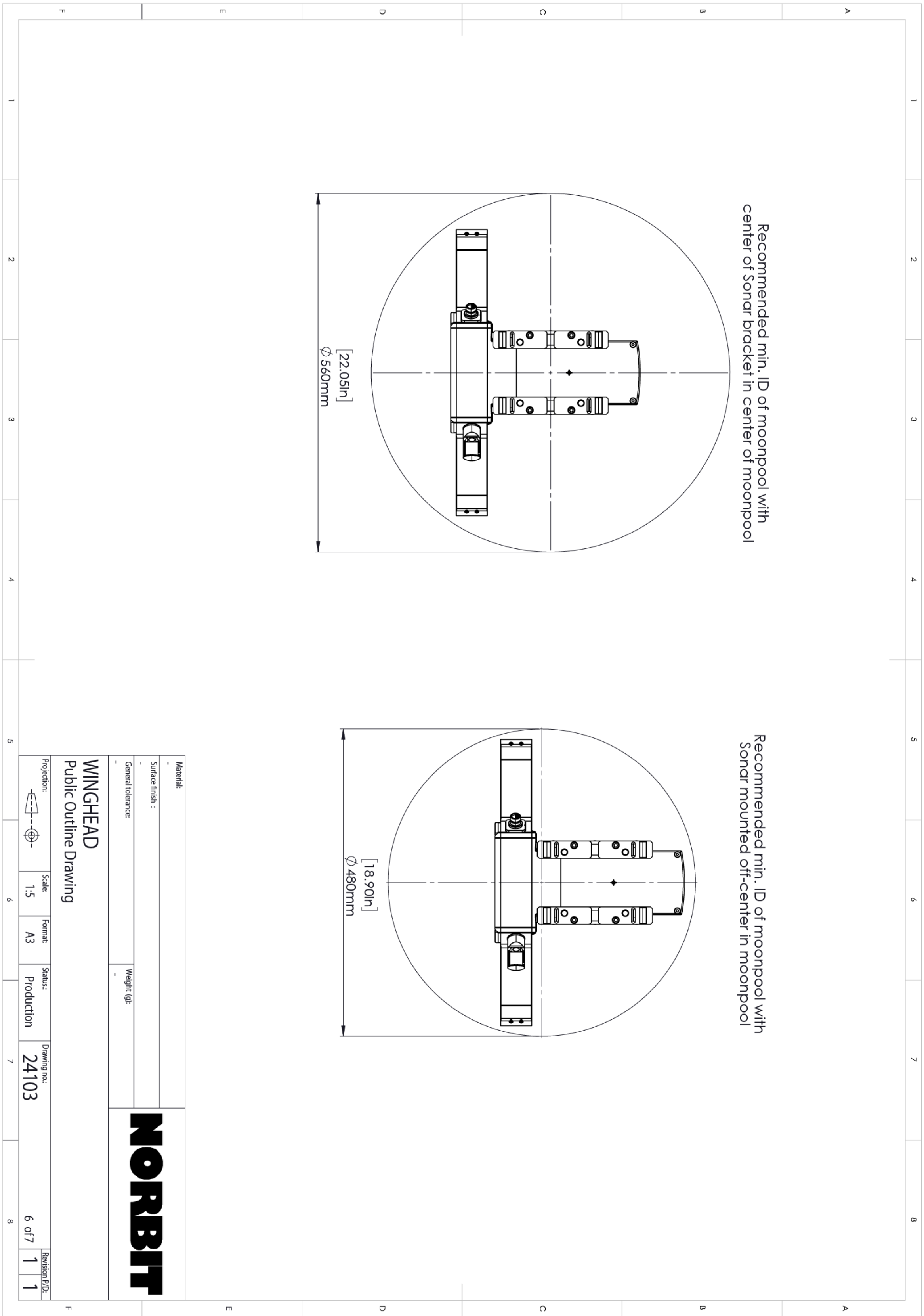
C2. WINGHEAD B41 & i77h – Wet-End Dimensions Including Bracket (PN 24103)



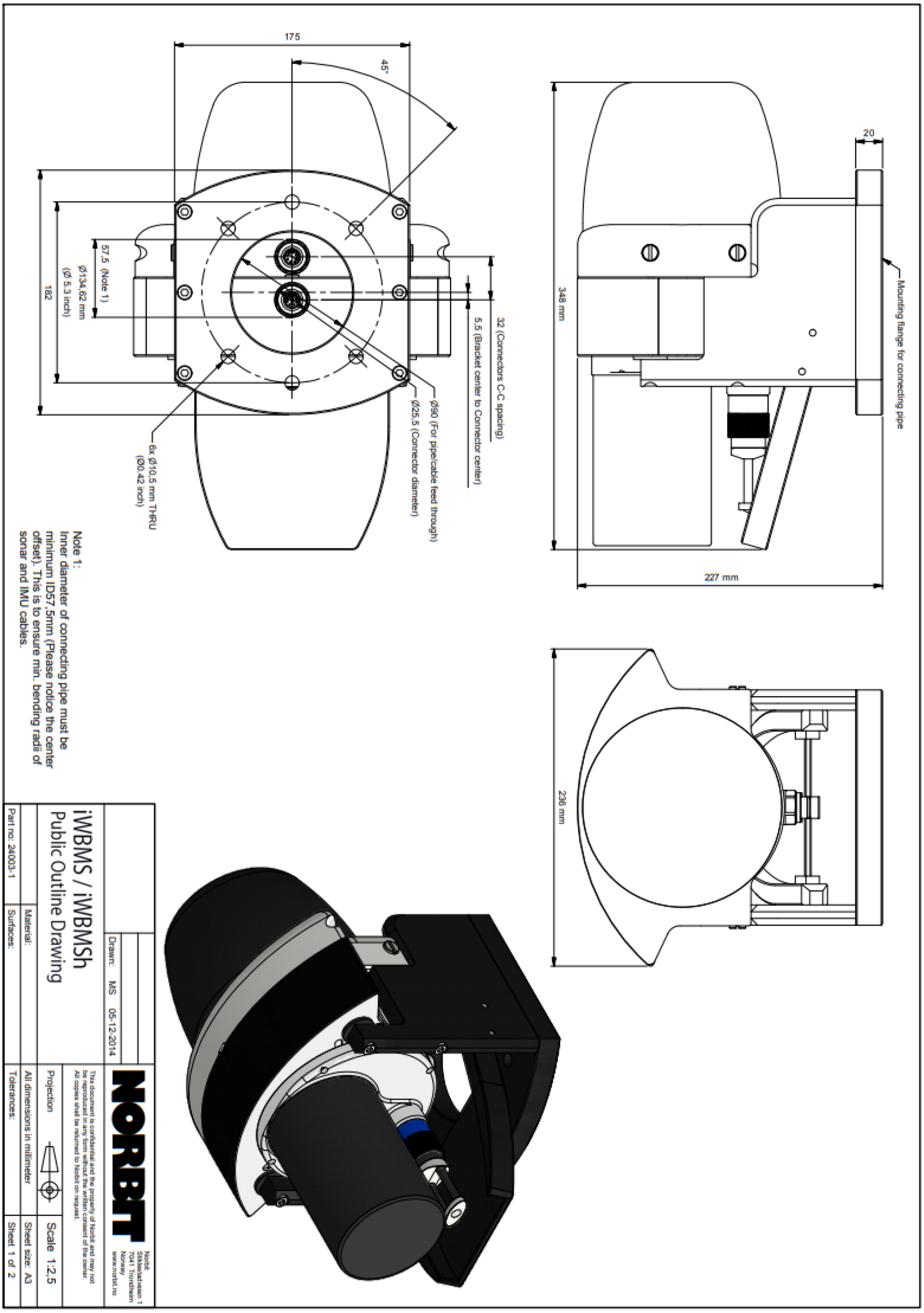
C3. WINGHEAD B41 & i77h – Reference Points and Offsets (PN 24103)



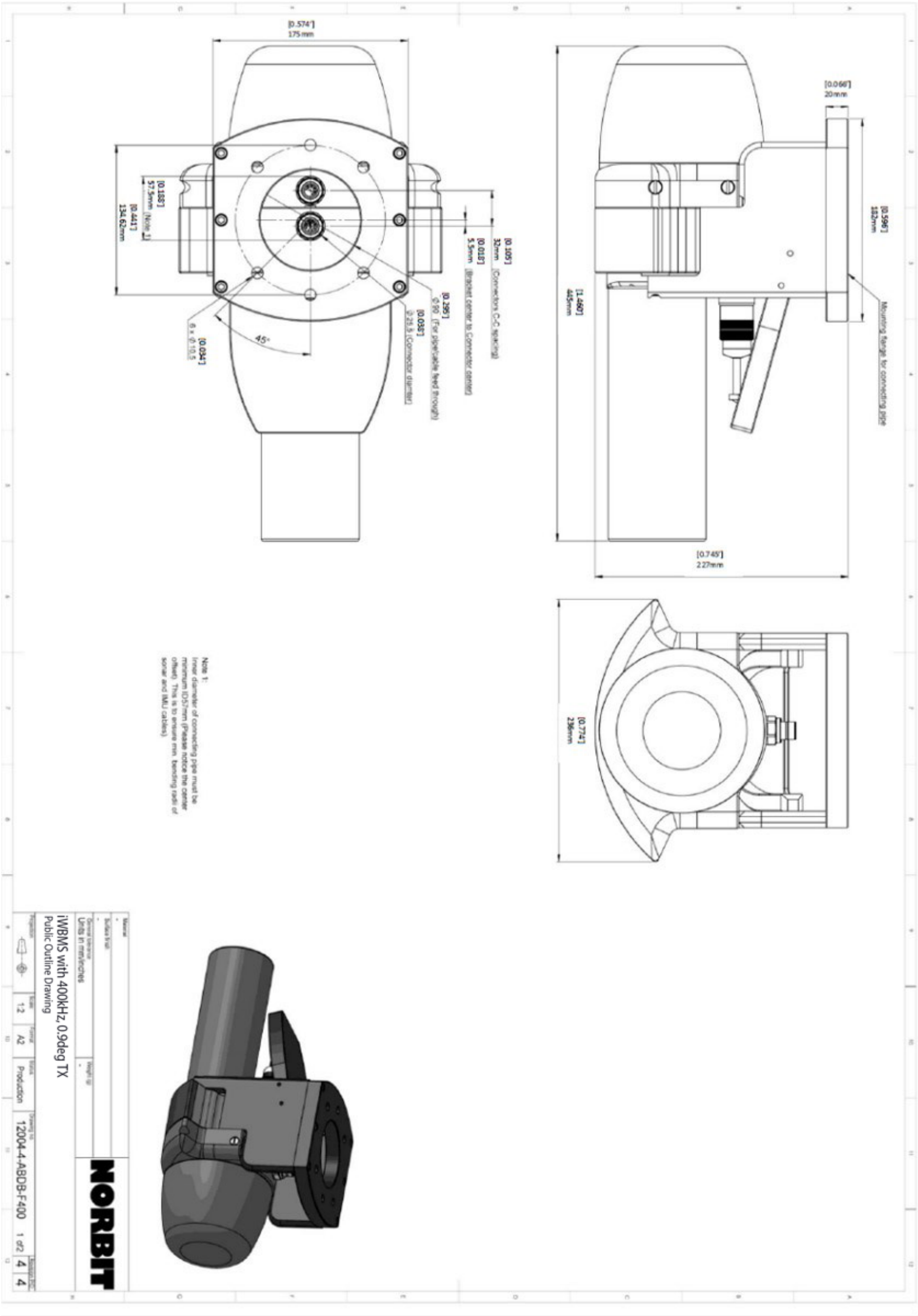
C4. WINGHEAD B41 & i77h – Moon Pool Dimensions (PN 24103)



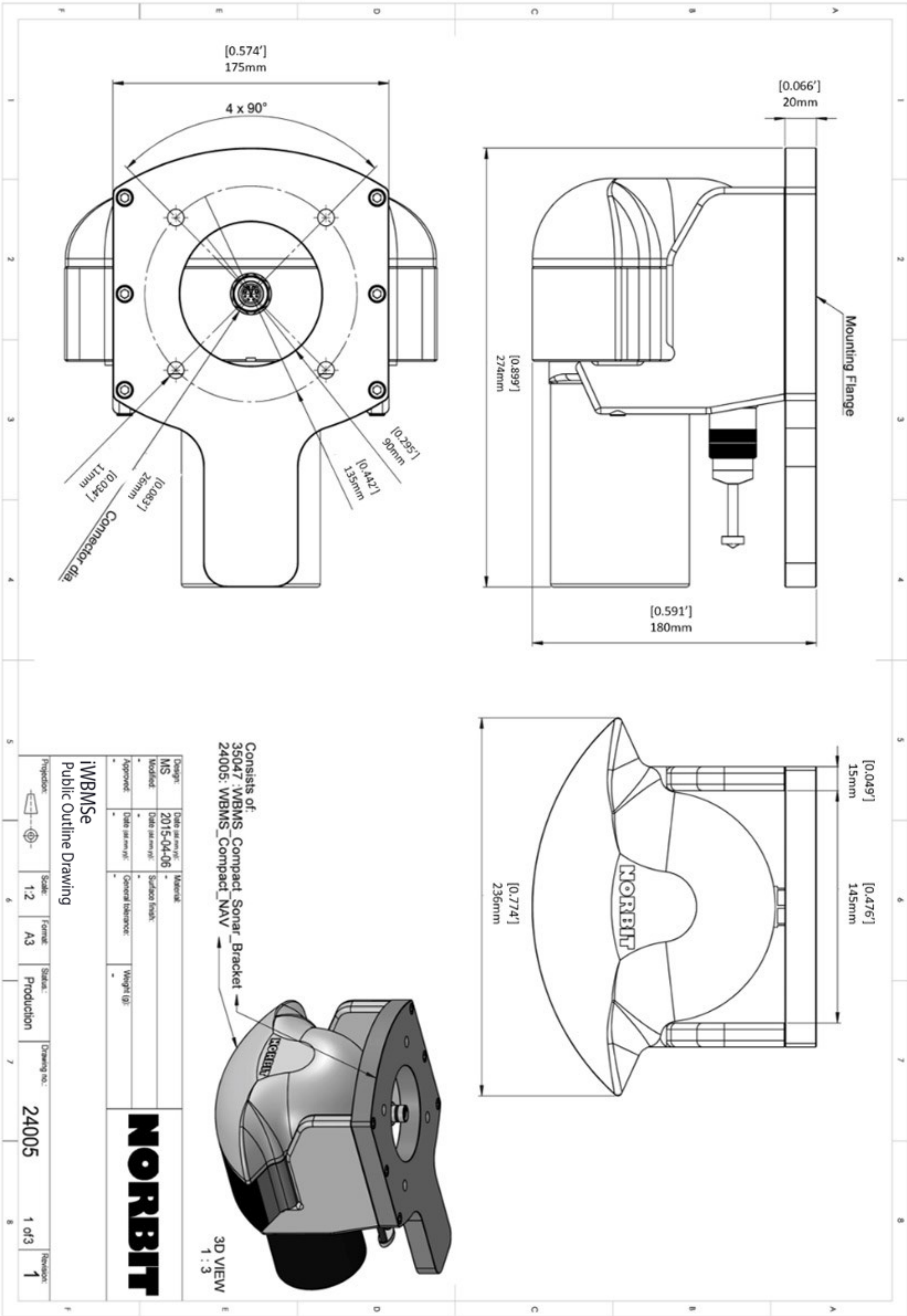
C5. 12004 iWBMS / 12007 iWBMSh – Wet-End Dimensions (PN 24003-ACDB)



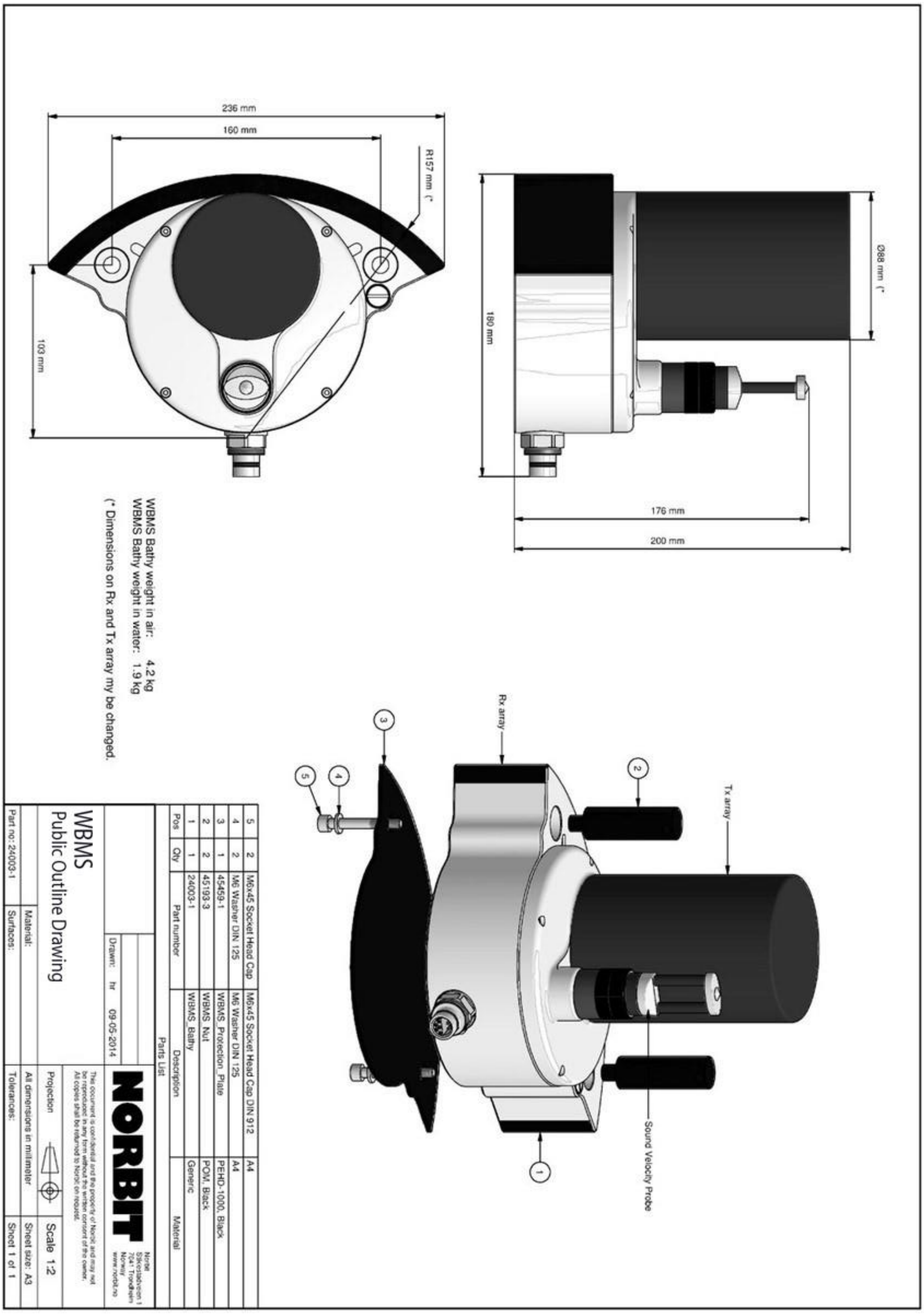
C6. 12004 iWBMS / 12007 iWBMSh 0.9°Tx – Wet-End Dimensions (PN 24003-ABDB)



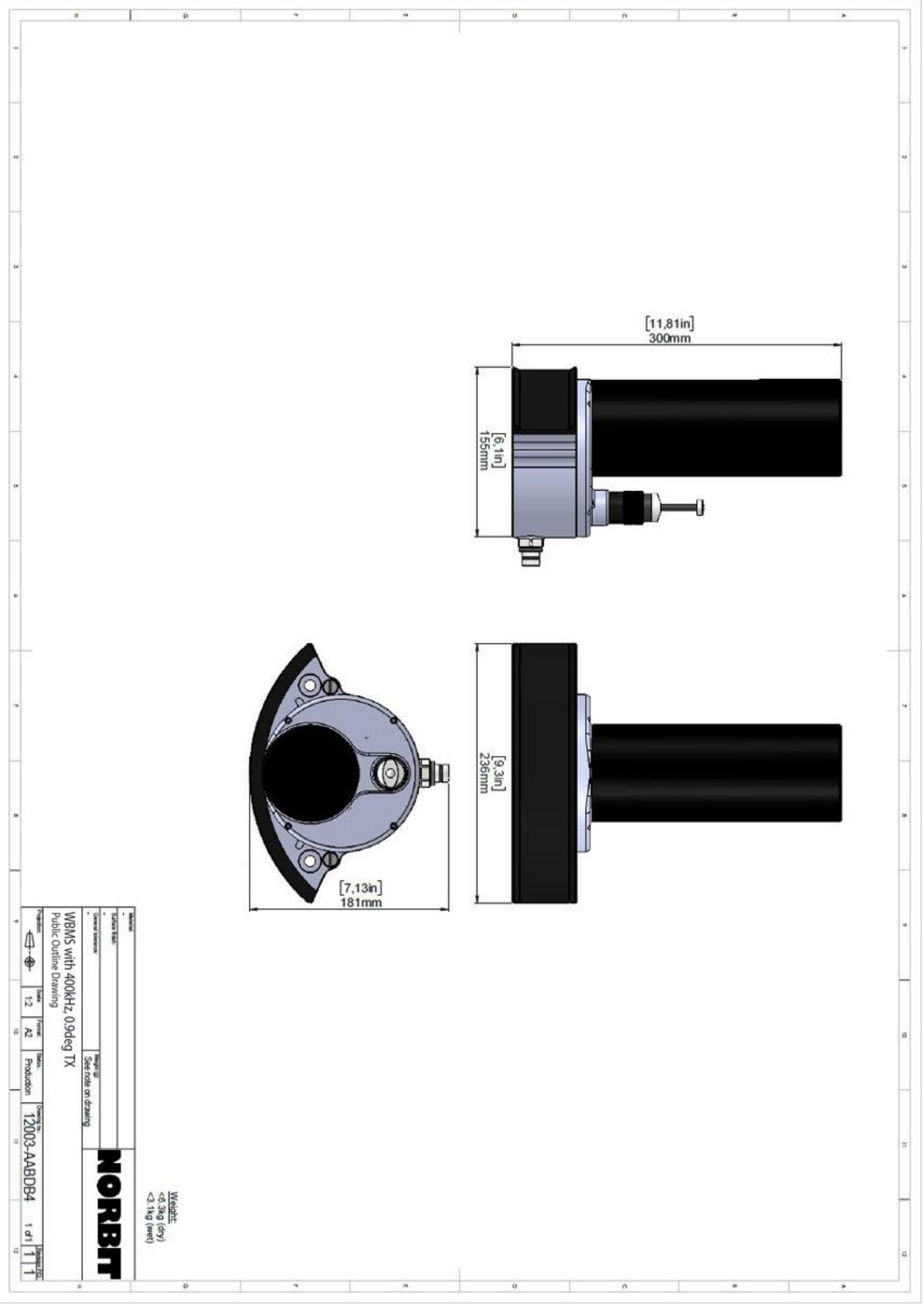
C7. 12006 iWBMSe – Wet-End Dimensions (PN 24005/24018)



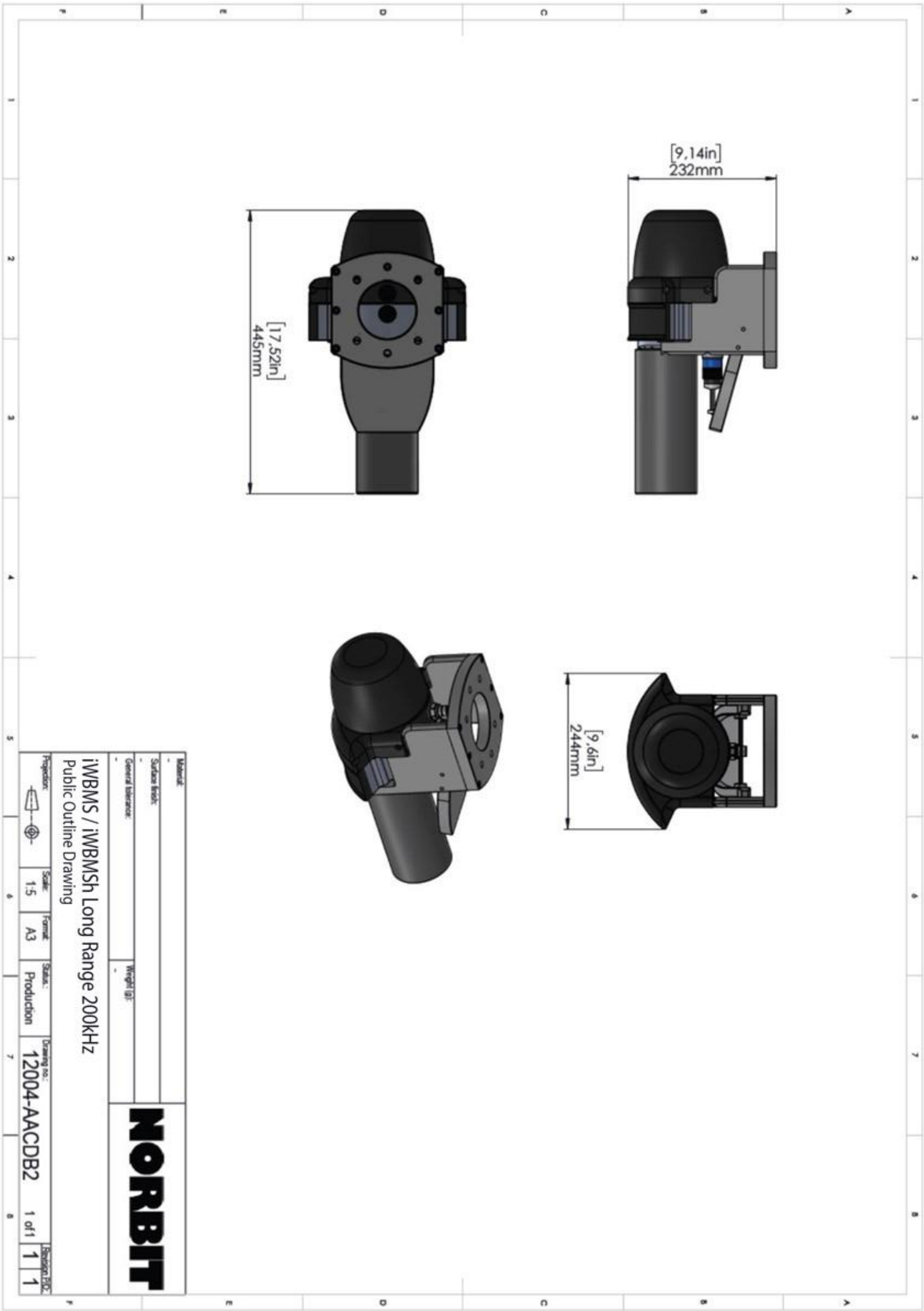
C8. 12003 WBMS – Wet-End Dimensions (PN 24003-ACDB)



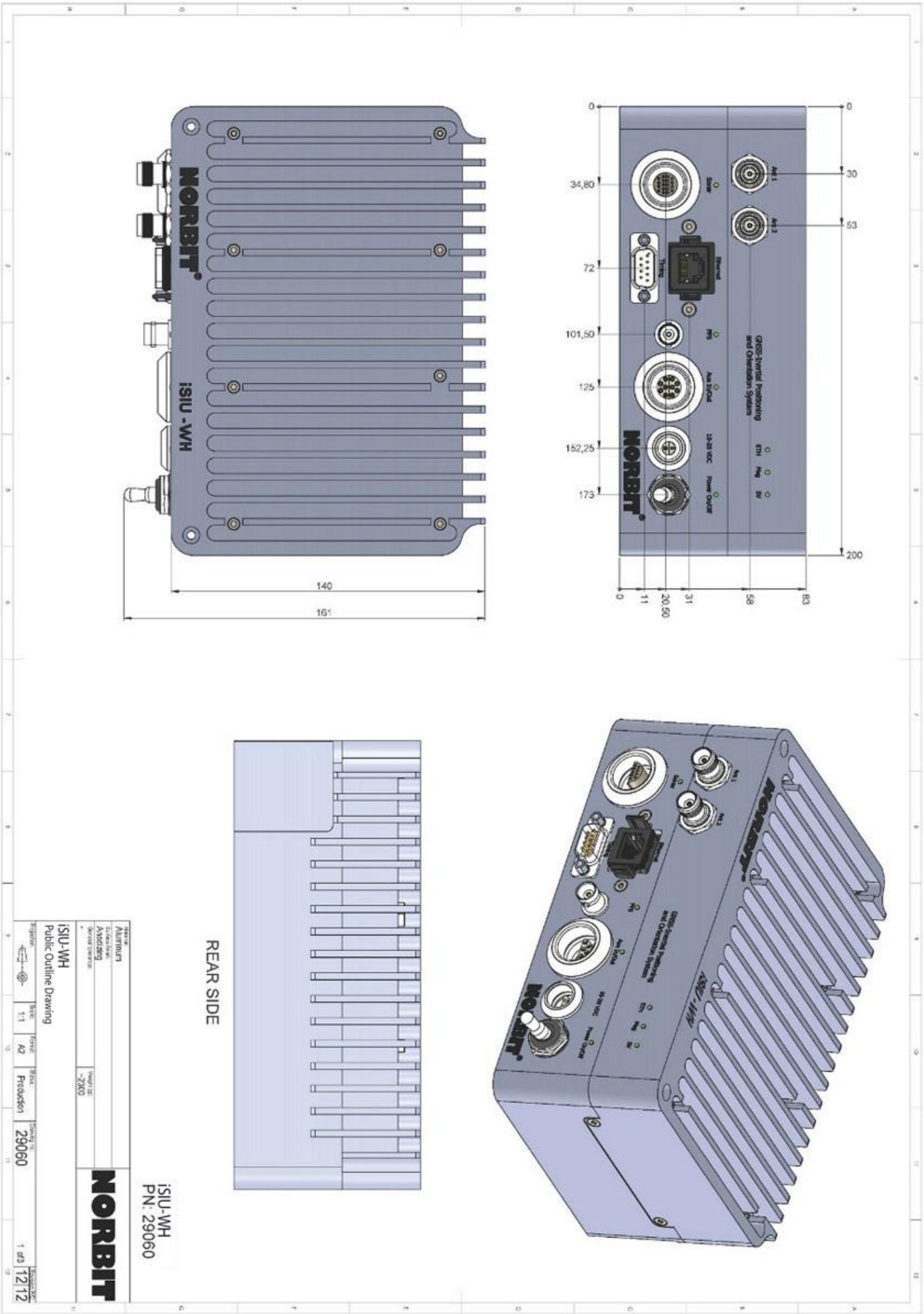
C9. 12003 WBMS 0.9° Tx – Wet-End Dimensions (PN 24003-ABDB)



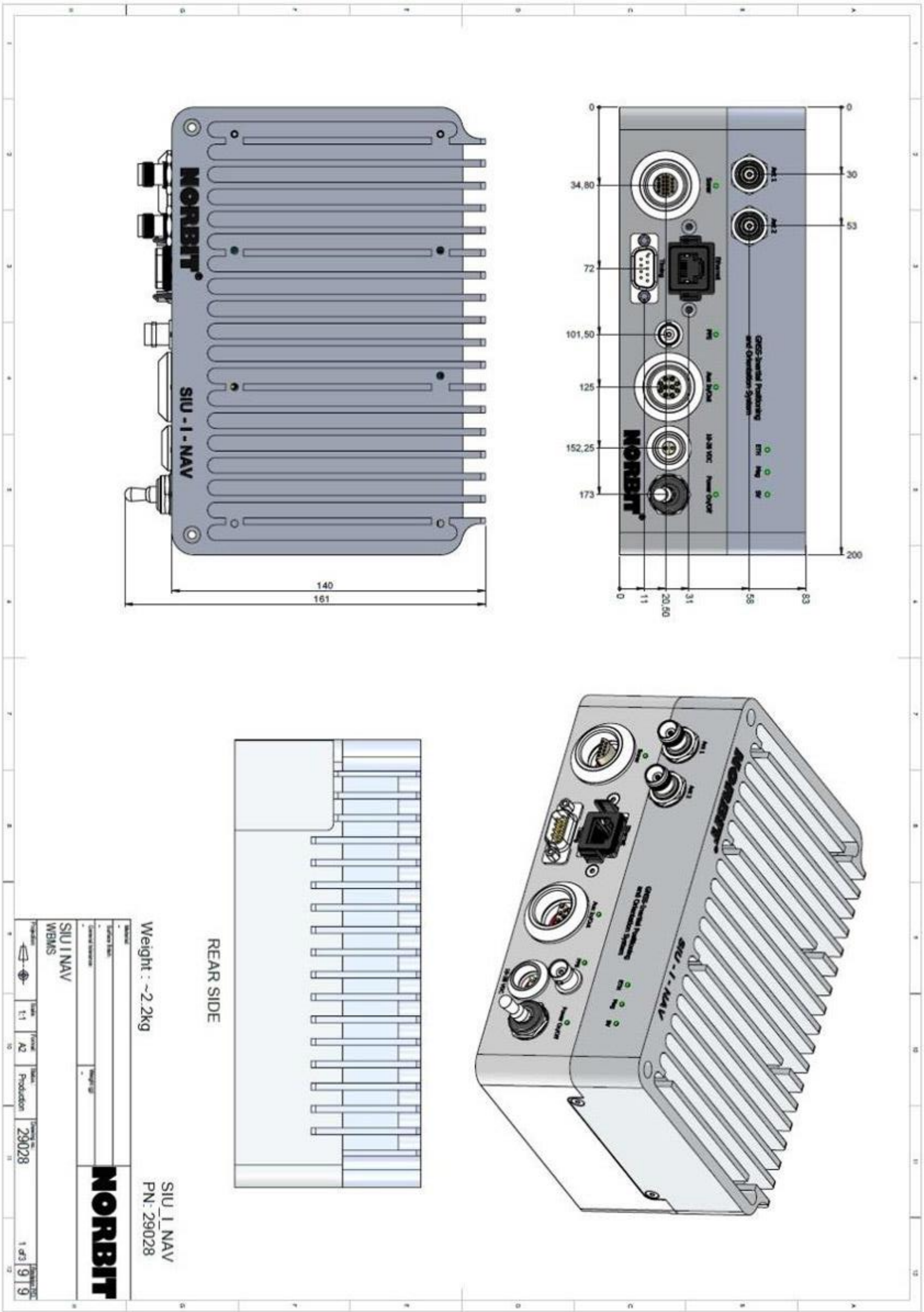
C10. 12004 iWBMS / 12007 iWBMSh Long Range – Wet-End Dimensions (PN 24007)



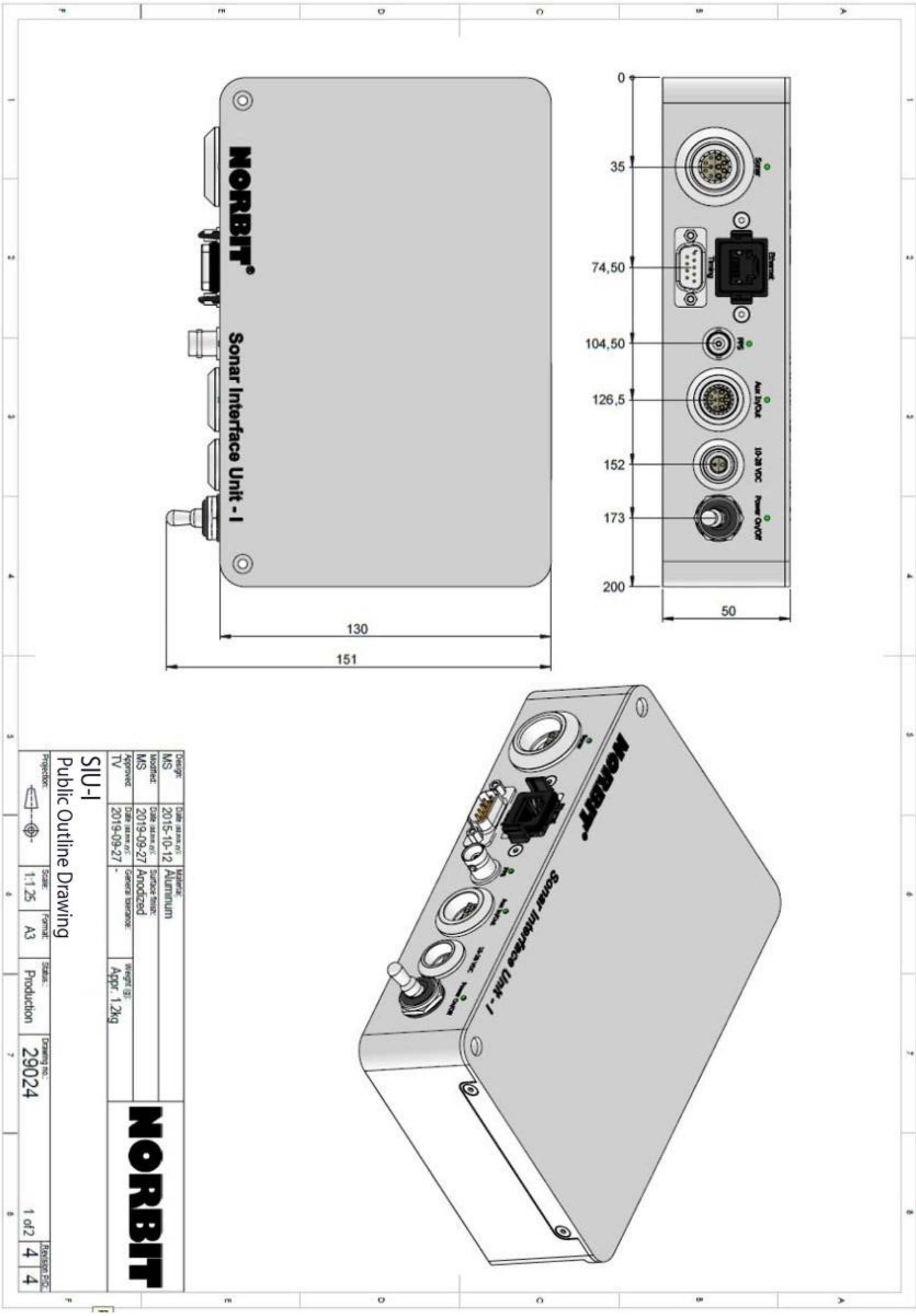
C11. WINGHEAD Sonar Interface Unit (iSIU-WH) Dimensions (PN 29060)



C12. iWBMS Sonar Interface Unit (SIU-I-NAV) Dimensions (PN 29028)



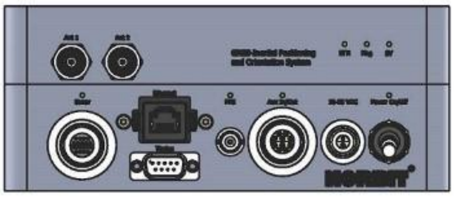
C13. WBMS Sonar Interface Unit (SIU) Dimensions (PN 29024)

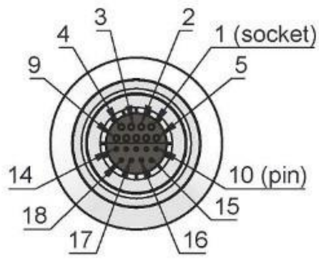


Appendix D: Pinout Diagrams

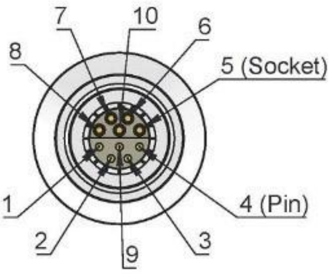
D1. WINGHEAD Sonar Interface Unit (iSIU-WH) Socket Pin Description (PN 29060)

iSIU-WH
PN: 29060

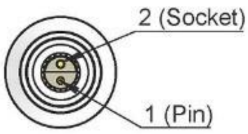




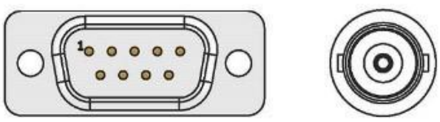
Sonar Socket	
No.	**WBMS function**
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COMM1
6	IMU COMM2
7	LAN, TX+
8	LAN, RX+
9	IRIG-B
10	IMU COMM3
11	IMU COMM4
12	LAN, TX-
13	LAN, RX-
14	Signal GND (IRIG-B, RS232)
15	RS232 TX
16	RS232 RX
17	IMU COMM8
18	IMU COMM9



AUX In/Out Socket	
No.	**WBMS Function**
1	LAN TX+
2	LAN TX-
3	LAN RX+
4	LAN RX-
5	RS232 TX
6	RS232 RX
7	Trigger/GPIO
8	RS232/Trig GND
9	PWR GND
10	PWR + 24 VDC



12-28 VDC Socket	
No.	**WBMS Function**
1	PWR GND
2	PWR + 12-28 VDC



GPS Socket / BNC	
No.	**WBMS Function**
2	Applanix COM3 TX
3	Applanix COM3 RX
5	GND
9 / BNC	PPS

Design: HR	Date (dd.mm.yy): 2014-04-23	Material: Aluminum	
Modified: MS	Date (dd.mm.yy): 2019-09-27	Surface finish: Anodizing	
Approved: TV	Date (dd.mm.yy): 2019-09-27	General tolerance: -	Weight (g): ~2300

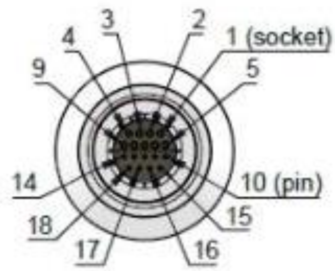
NORBIT

iSIU-WH Socket
WINGHEAD

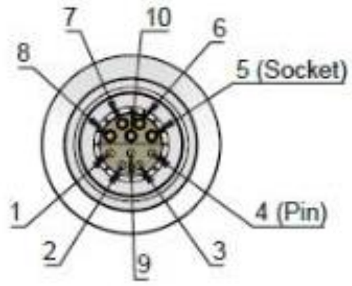
Projection:	Scale:	Format:	Status.:	Drawing no.:		Revision P/D:
	1:2	A4	Production	29060	2 of3	12 / 12

D2. iWBMS Sonar Interface Unit (SIU-I-NAV) Socket Pin Description (PN 29028)

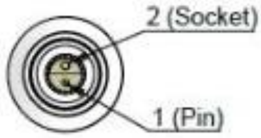
SIU_I_NAV
PN: 29028



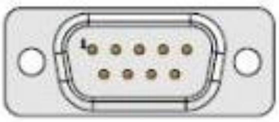
Sonar Socket	
No.	WBMS function
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COMM1
6	IMU COMM2
7	LAN, TX+
8	LAN, RX+
9	IRIG-B
10	IMU COMM3
11	IMU COMM4
12	LAN, TX-
13	LAN, RX-
14	Signal GND (IRIG-B, RS232)
15	RS232 TX
16	RS232 RX
17	IMU COMM8
18	IMU COMM9



AUX In/Out Socket	
No.	WBMS Function
1	LAN TX+
2	LAN TX-
3	LAN RX+
4	LAN RX-
5	RS232 TX
6	RS232 RX
7	Trigger/GPIO
8	RS232/Trig GND
9	PWR GND
10	PWR + 24 VDC



12-28 VDC Socket	
No.	WBMS Function
1	PWR GND
2	PWR + 12-28 VDC



GPS Socket / BNC	
No.	WBMS Function
2	Applanix COM3 TX
3	Applanix COM3 RX
5	GND
9 / BNC	PPS

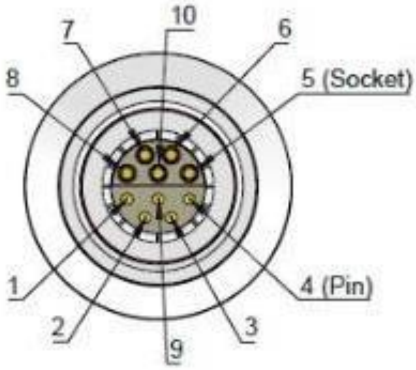
Design: HR	Date (dd.mm.yy): 2014-04-23	Material: -		NORBIT
Modified: MS	Date (dd.mm.yy): 2019-09-27	Surface finish: -		
Approved: TV	Date (dd.mm.yy): 2019-09-27	General tolerance: -	Weight (g): 1452.44	

SIU I NAV Socket
WBMS

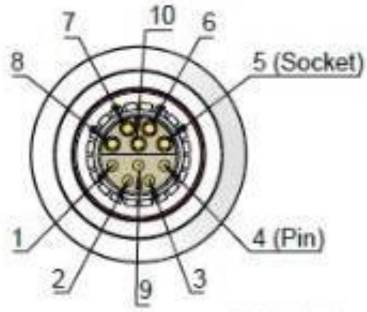
Projection:	Scale:	Format:	Status:	Drawing no.:		Revision P/D:	
	1:2	A4	Production	29028	2 of 3	9	9

D3. WBMS Sonar Interface Unit (SIU) Socket Pin Description (PN 29024)

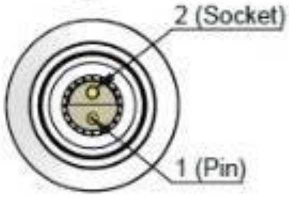
SIU-I
Part No: 29024-4



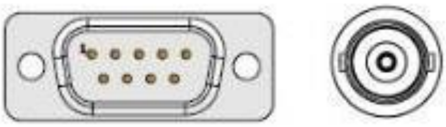
Sonar Socket	
No.	WBMS Function
1	LAN TX +
2	LAN TX -
3	LAN RX +
4	LAN RX -
5	RS-232 TX
6	RS-232 RX
7	IRIG-B
8	IRIG-B/RS-232 GND
9	PWR GND
10	PWR +24V



AUX In/Out Socket	
No.	WBMS Function
1	
2	
3	RS-232 TX
4	RS-232 RX
5	
6	
7	
8	
9	PWR GND
10	



12-28 VDC Socket	
No.	WBMS Function
1	PWR GND
2	PWR + 12-28 VDC



GPS Socket / BNC	
No.	WBMS Function
2	TIMING TX (RS-232)
3	TIMING RX (RS-232)
5	GND
9 / BNC	PPS

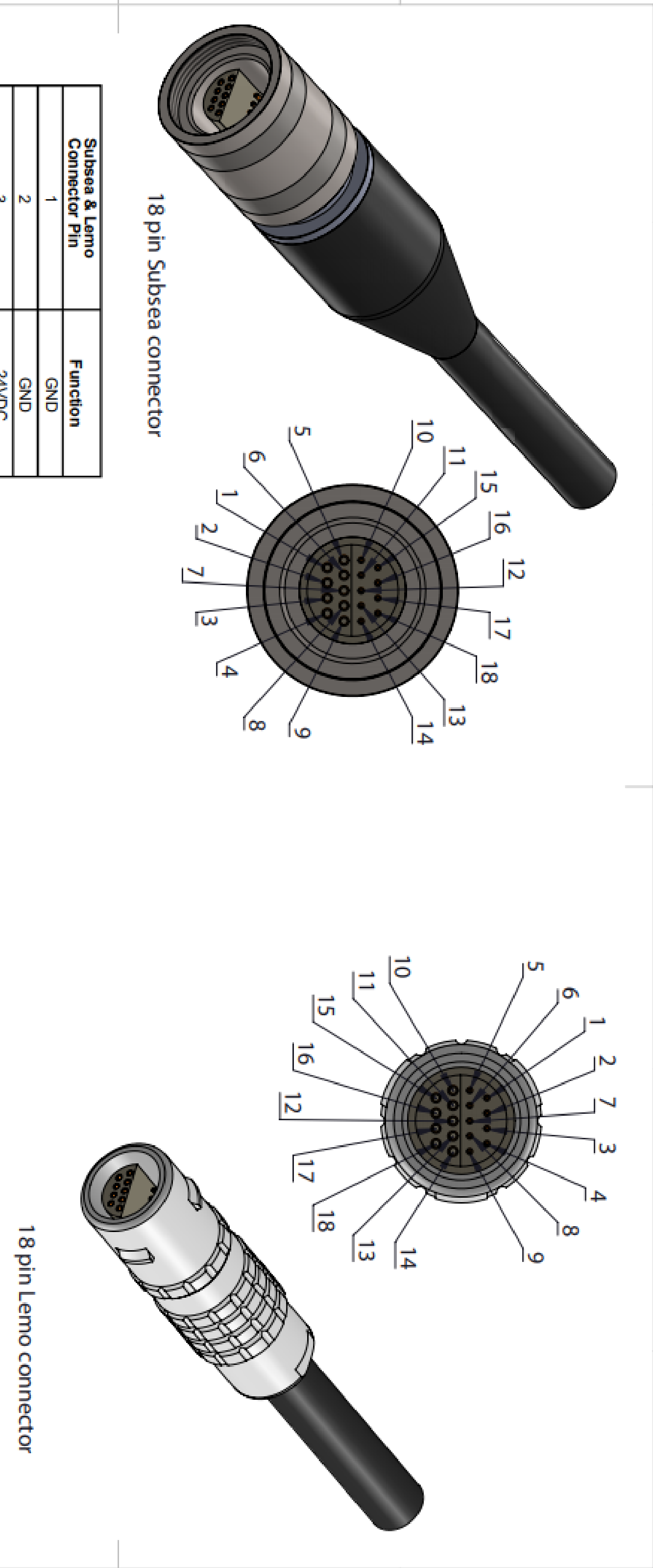
Design:	Date (dd.mm.yy):	Material:	
MS	2015-10-12	Aluminum	
Modified:	Date (dd.mm.yy):	Surface finish:	
MS	2019-09-27	Anodized	
Approved:	Date (dd.mm.yy):	General tolerance:	Weight (g):
TV	2015-10-12	-	Appr. 1.2kg

NORBIT

SIU-I Socket
WBMS

Projection:	Scale:	Format:	Status:	Drawing no.:		Revision P/D:	
	1.5:1	A4	Production	29024	2 of 2	4	4

D4. WINGHEAD Integrated Cable Pin Description (PN 33231)



Subsea & Lemo Connector Pin	Function
1	GND
2	GND
3	24VDC
4	24VDC
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	NC
18	NC

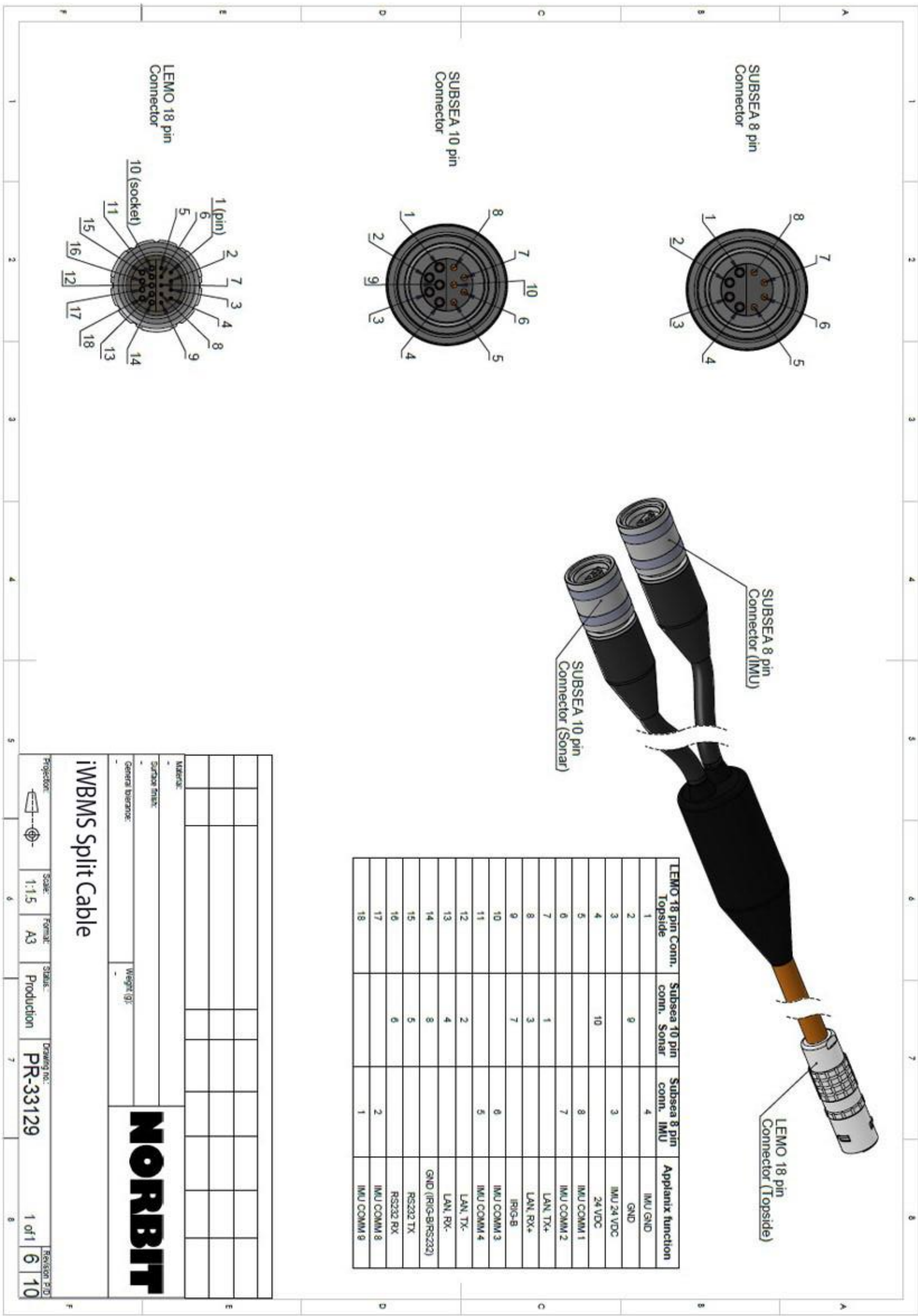
Material: -
Surface finish: -
General tolerance: -
Weight (g): -

NORBIT

WINGHEAD_Integrated_Cable
Wiring Diagram - Pin out

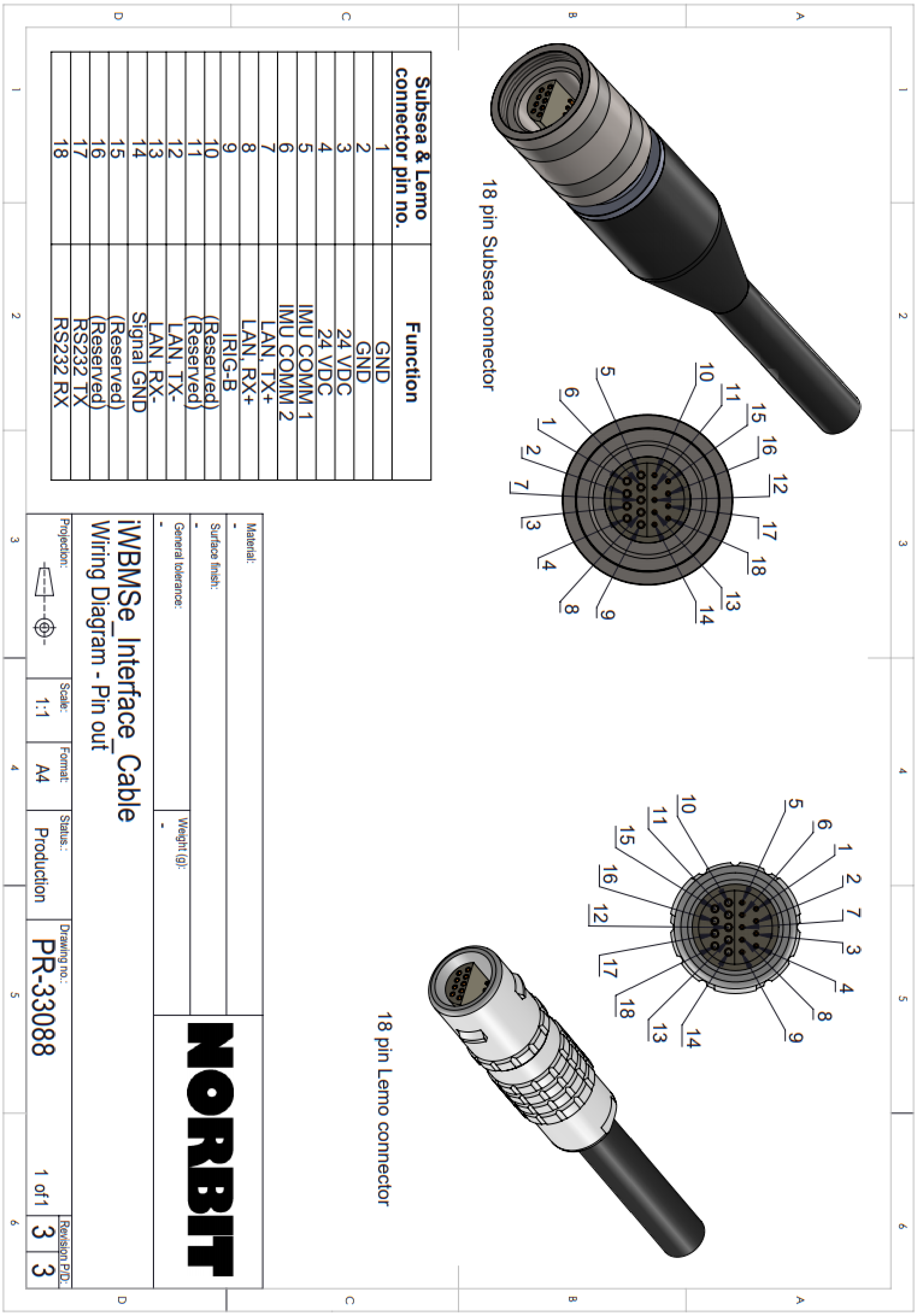
Projection: | Scale: 1:1 | Format: A4 | Status: Production | Drawing no.: PR-33231 | 1 of1 | Revision P/D: 3 | 4

D5. iWBMS Split Cable Pin Description (PN 33129)



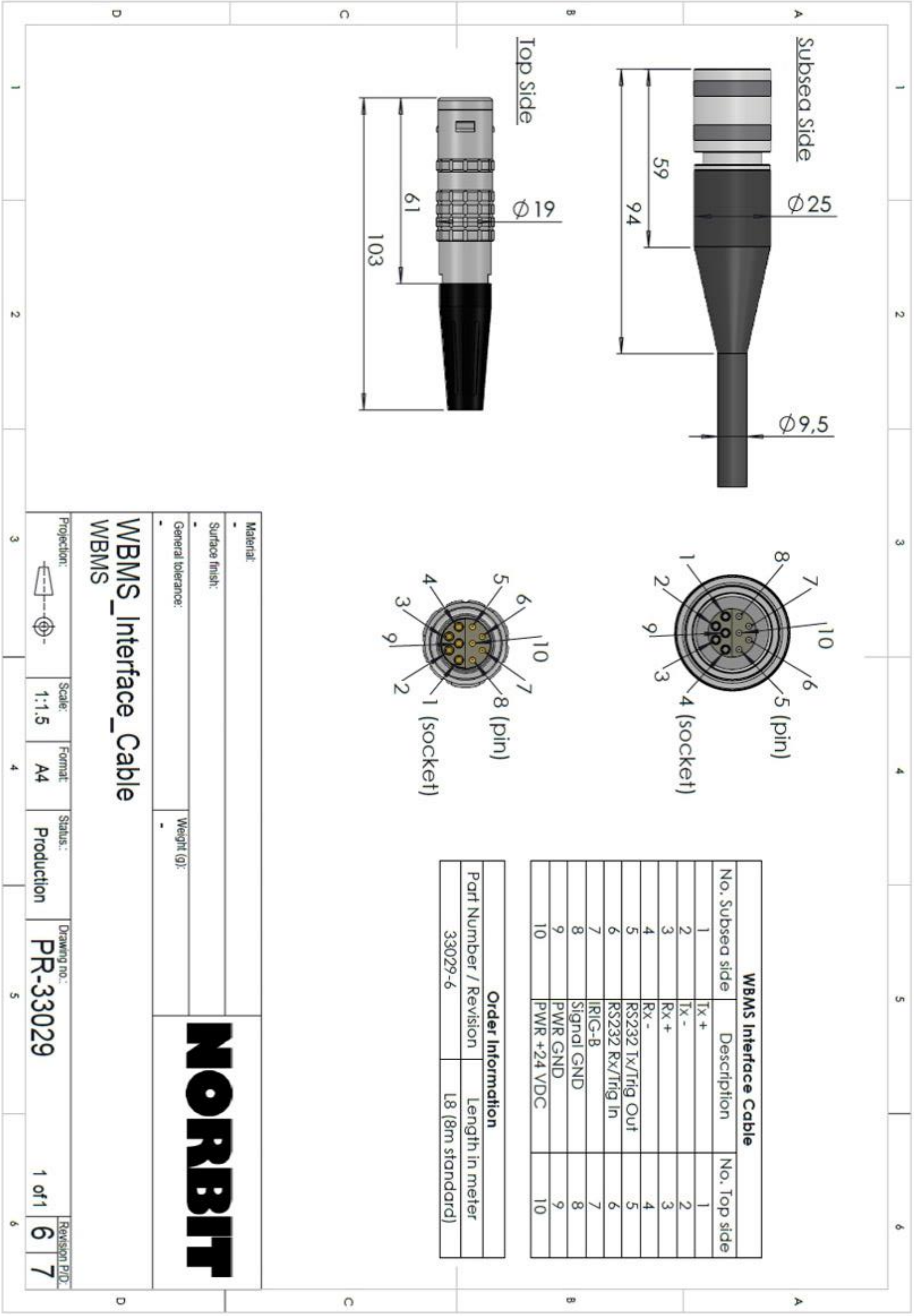
LEMO 18 pin Conn. Topside	Subsea 10 pin conn. Sonar	Subsea 8 pin conn. IMU	Applanix function
1		4	IMU GND
2	9		GND
3		3	IMU 24 VDC
4	10		24 VDC
5		8	IMU COMM 1
6		7	IMU COMM 2
7	1		LAN, TX+
8	3		LAN, RX+
9	7		IRIG-B
10		6	IMU COMM 3
11		5	IMU COMM 4
12	2		LAN, TX-
13	4		LAN, RX-
14	8		GND (IRIG-B/RS232)
15	5		RS232 TX
16	6		RS232 RX
17		2	IMU COMM 8
18		1	IMU COMM 9

D6. iWBMSe Interface Cable Pin Description (PN 33088)



Subsea & Lemo connector pin no.	Function
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COMM 1
6	IMU COMM 2
7	LAN, TX+
8	LAN, RX+
9	IRIG-B
10	(Reserved)
11	(Reserved)
12	LAN, TX-
13	LAN, RX-
14	Signal GND
15	(Reserved)
16	(Reserved)
17	RS232 TX
18	RS232 RX

D7. WBMS Interface Cable Pin Description (PN 33029)



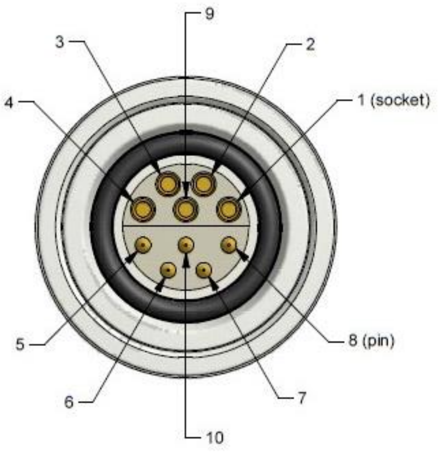
WBMS Interface Cable

No. Subsea side	Description	No. Top side
1	Tx +	1
2	Tx -	2
3	Rx +	3
4	Rx -	4
5	RS232 Tx/Trig Out	5
6	RS232 Rx/Trig In	6
7	IRIG-B	7
8	Signal GND	8
9	PWR GND	9
10	PWR +24 VDC	10

Order Information

Part Number / Revision	Length in meter
33029-6	L8 (8m standard)

D8. WBMS Interface Pigtail Deepsea Cable Pin Description (PN 33095)



Front view

Pin out		
Pin	Description	Cable, Color
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 0.5 mm2
10	PWR +24V	White 0.5 mm2

Order information	
Part number/revision	Lenght in meter
33095-3	L2 (2m standard)

Drawn: TV 2018-09-10

NORBIT

Norbit Subsea
Stiklestadveien 1
7041 Trondheim
Norway
www.norbit.no

WBMS Interface Pigtail Deepsea, PUBLIC

Projection

Scale

Material: Titanium

All dimensions in millimeter

Sheet size: A4

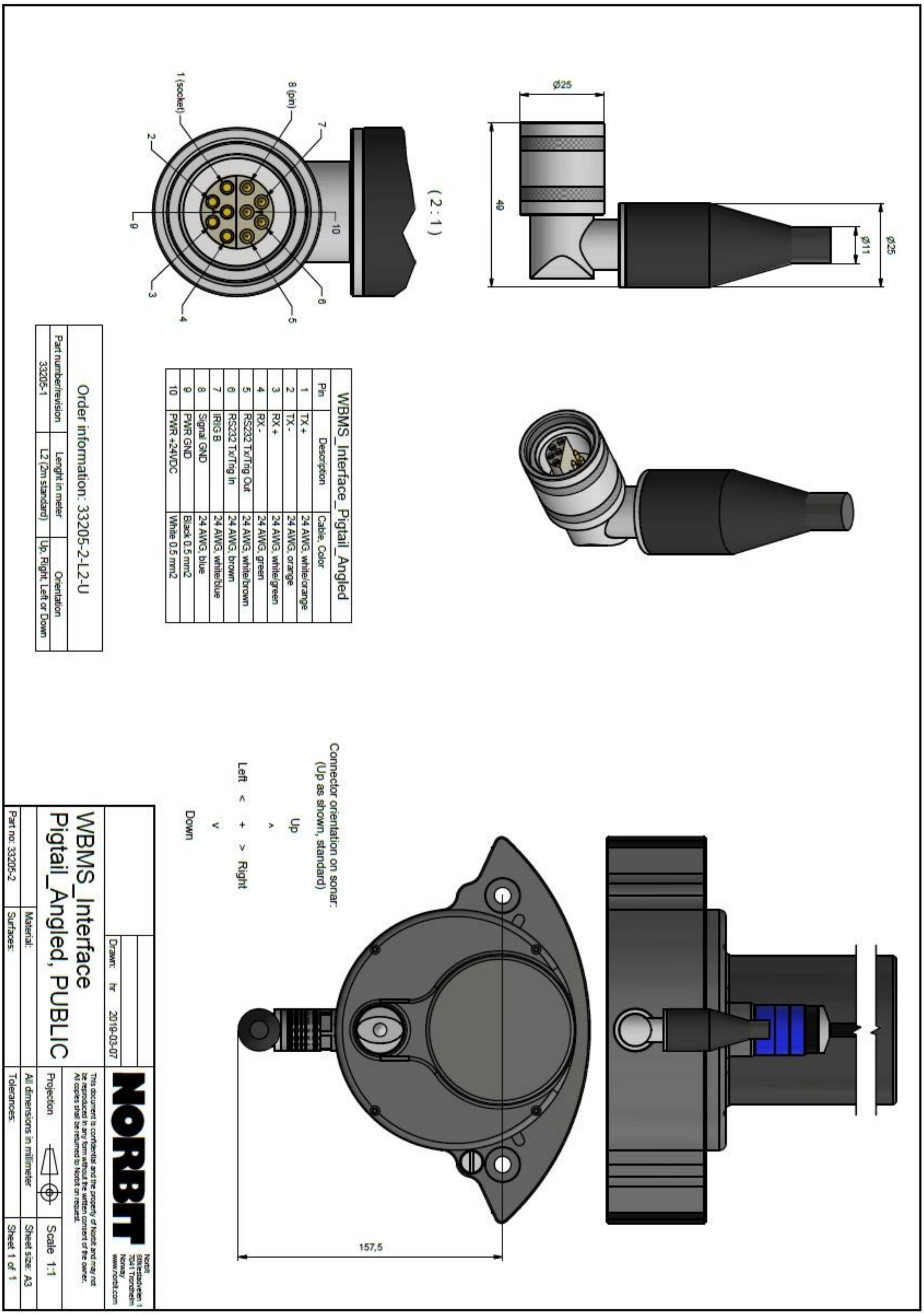
Part no: 33095-3-L2-D

Surfaces:

Tolerances:

Sheet 1 of 1

D9. WBMS Interface Pigtail Angled Pin Description (PN 33205)



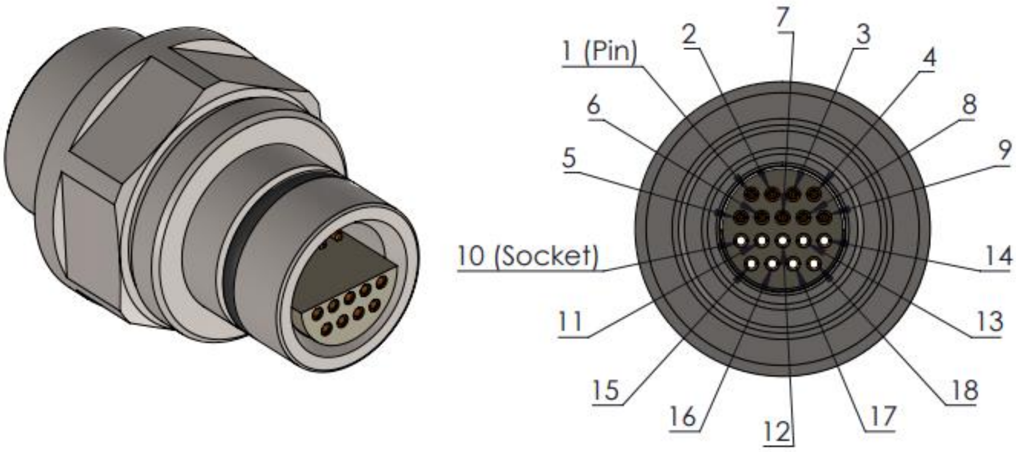
WBMS_Interface_Pigtail_Angled

Pin	Description	Cable, Color
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 Tx/Trig In	24 AWG, brown
7	IRIG B	24 AWG, white/blue
8	Signal GND	24 AWG, blue
9	PWR GND	Black 0.5 mm2
10	PWR +24VDC	White 0.5 mm2

Order information: 33205-2-L2-U

Part number/revision	Lenght in meter	Orientation
33205-1	L2 (2m standard)	Up, Right, Left or Down

D10. WINGHEAD Bulkhead Pinout (PN 33327)



Pin out diagram	
Pin / Socket	WINGHEAD 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

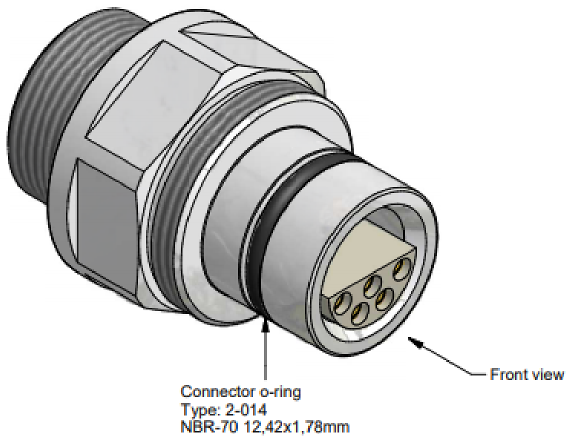
Design: MS	Date (dd.mm.yy): 2020-07-07	Material: Titan Gr. 5	
Modified: AJ	Date (dd.mm.yy): 2020-07-07	Surface finish: -	
Approved: TV	Date (dd.mm.yy): 2020-07-07	General tolerance: -	Weight (g): -

NORBIT

WINGHEAD Bulkhead

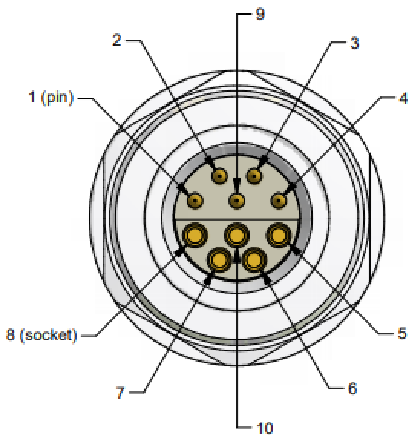
Projection:	Scale:	Format:	Status:	Drawing no.:		Revision P/D:
	2:1	A4	Production	PR-33237	1 of1	2 | 2

D11. WBMS Bulkhead Pinout (PN 33049)



Connector specifications:

Depth rating : 600 bar (mated)
Contact rating : 300V / 9A



Front view

Pin out		
Pin	Description	Cable
1	Tx +	black (red pair)
2	Tx -	red
3	Rx +	black (blue pair)
4	Rx -	blue
5	RS232 Tx/Trig Out	black (green pair)
6	RS232 Rx/Trig In	green
7	IRIG-B	black (white pair)
8	Signal GND	white
9	PWR GND	black 0,5mm2
10	PWR +24V	white 0,5mm2

Drawn: HR 2013-05-16

NORBIT

Norbit
Stiklestadveien 1
7041 Trondheim
Norway
www.norbit.no

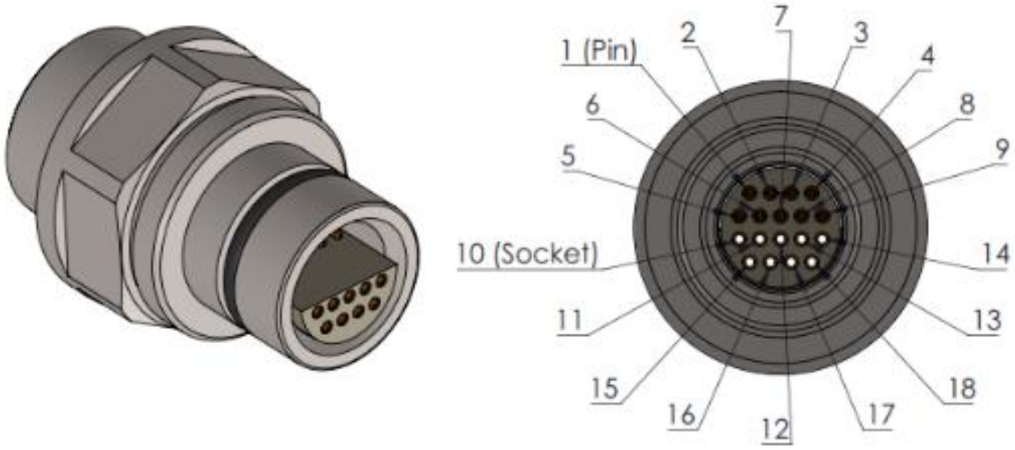
WBMS_Bulkhead
PUBLIC

Projection Scale 2:1

Material: All dimensions in millimeter Sheet size: A4

Part no: 33049-2 Surfaces: Tolerances: Sheet 1 of 1

D12. iWBMSe Bulkhead Pinout (PN 33169)



Pin out diagram	
Pin / Socket	WBMS function
1	GND
2	GND
3	24 VDC
4	24 VDC
5	IMU COMM1
6	IMU COMM2
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

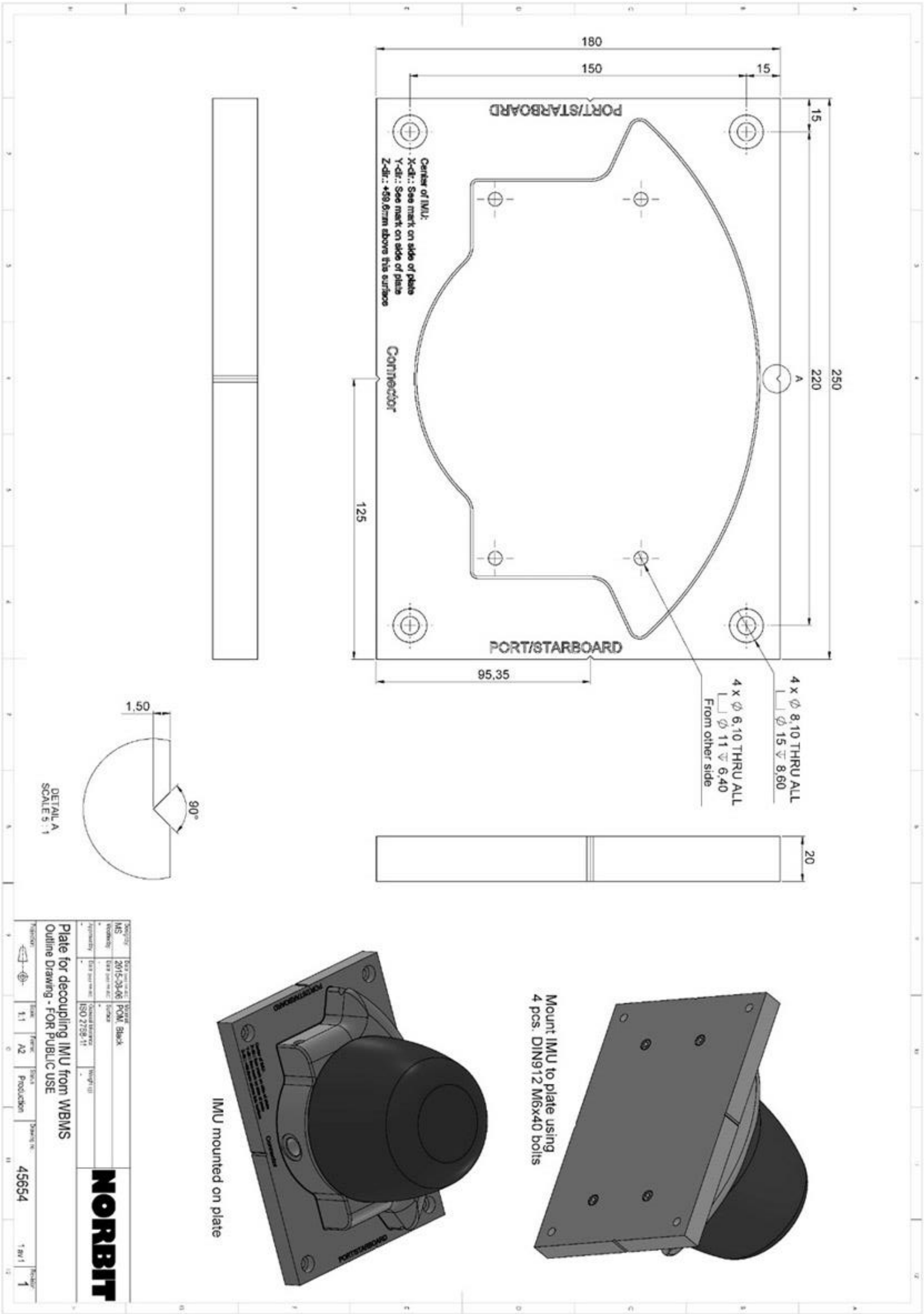
Design: MS	Date (dd.mm.yy): 2019-03-26	Material: Titan Gr. 5	
Modified: MS	Date (dd.mm.yy): 2019-03-26	Surface finish: -	
Approved: TV	Date (dd.mm.yy): 2019-03-26	General tolerance: -	Weight (g): -

iWBMSe Bulkhead
WBMS

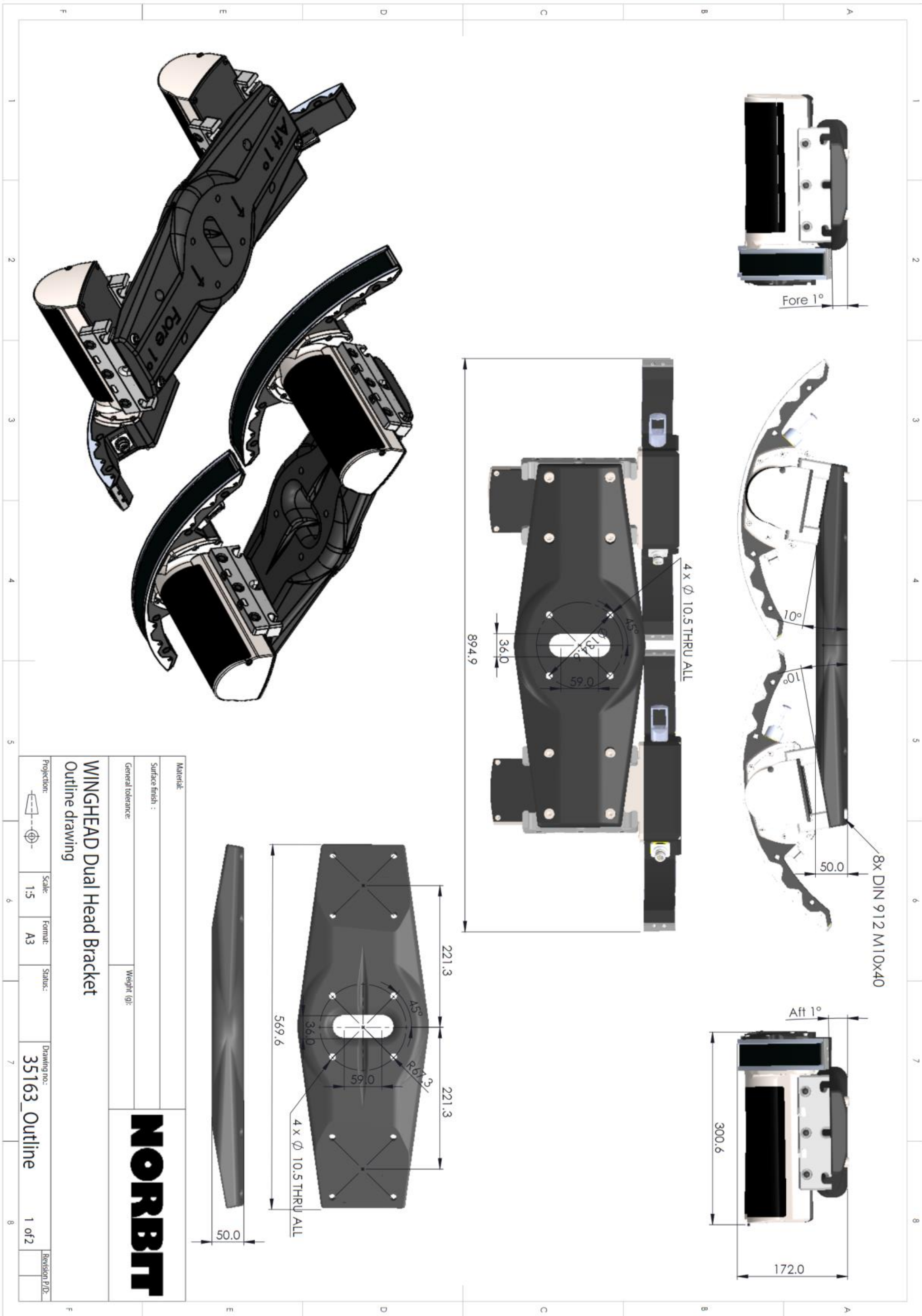
Projection:	Scale:	Format:	Status:	Drawing no.:		Revision P/D:
	2:1	A4	Production	PR-33169	1 of 1	3 | 4

Appendix E: Mounting Bracket & Pole Dimensions

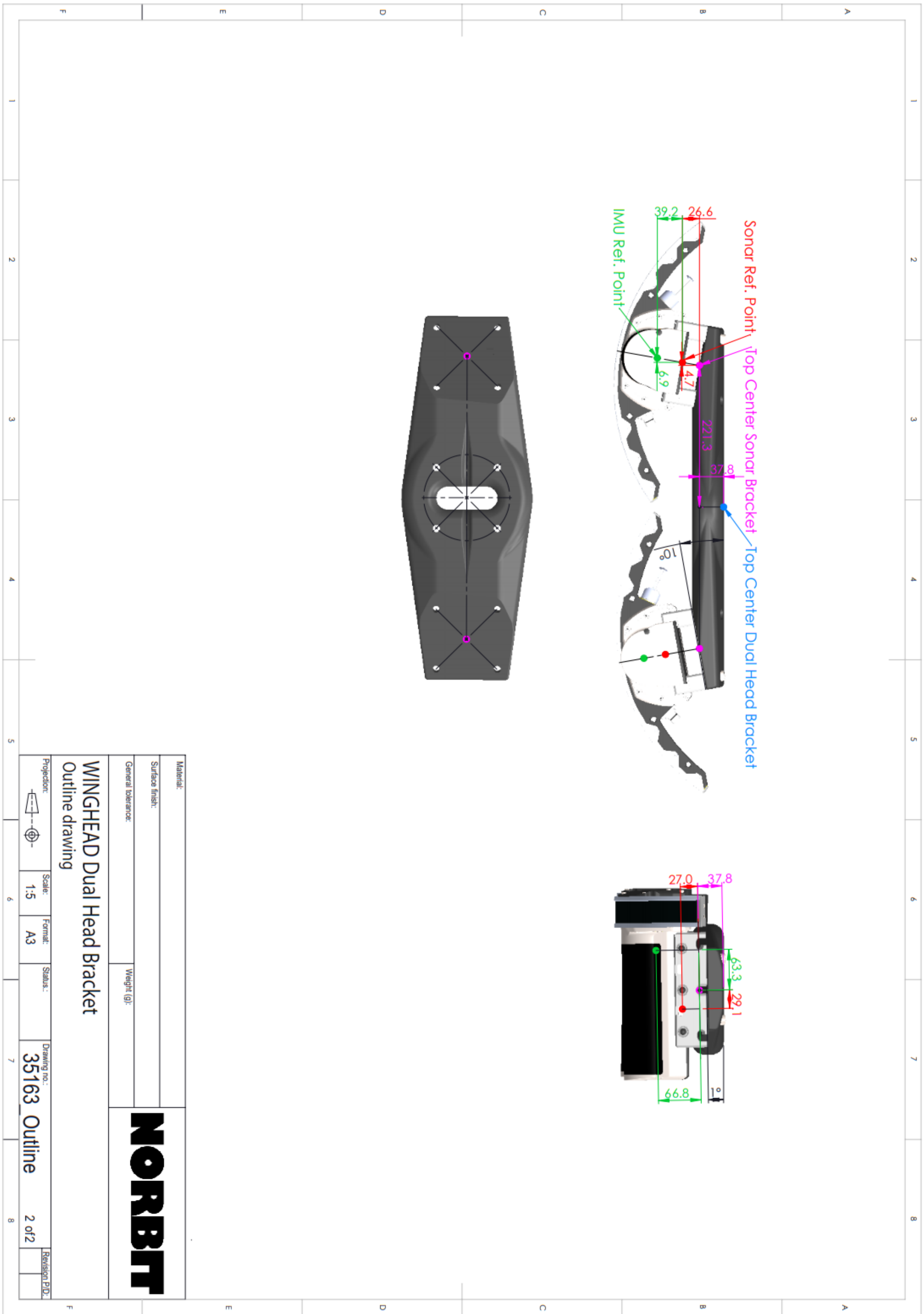
E1. iWBMS Decoupled IMU Mounting Bracket (PN 45654)



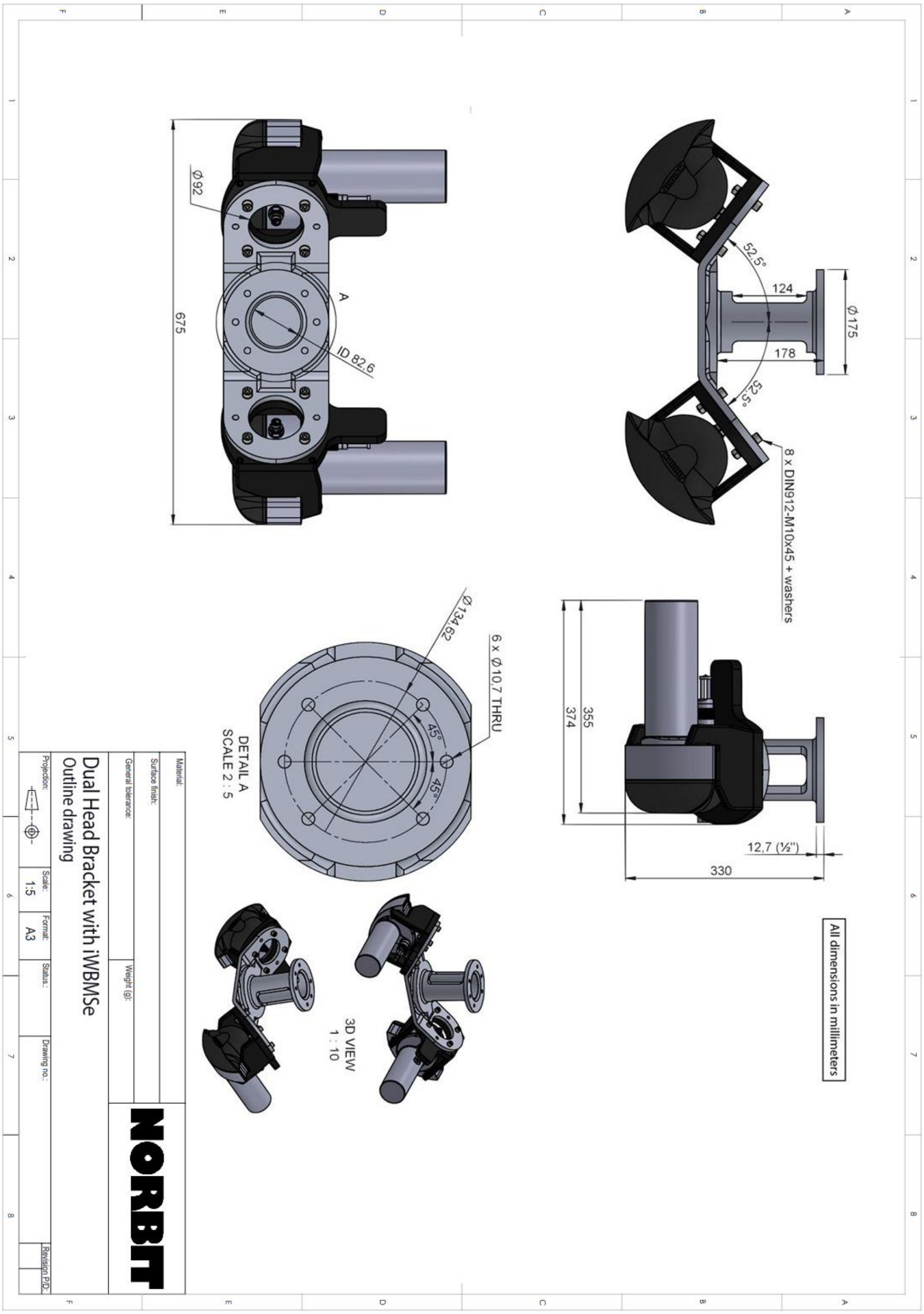
E2. Dual Head Bracket with WINGHEAD - Dimensions



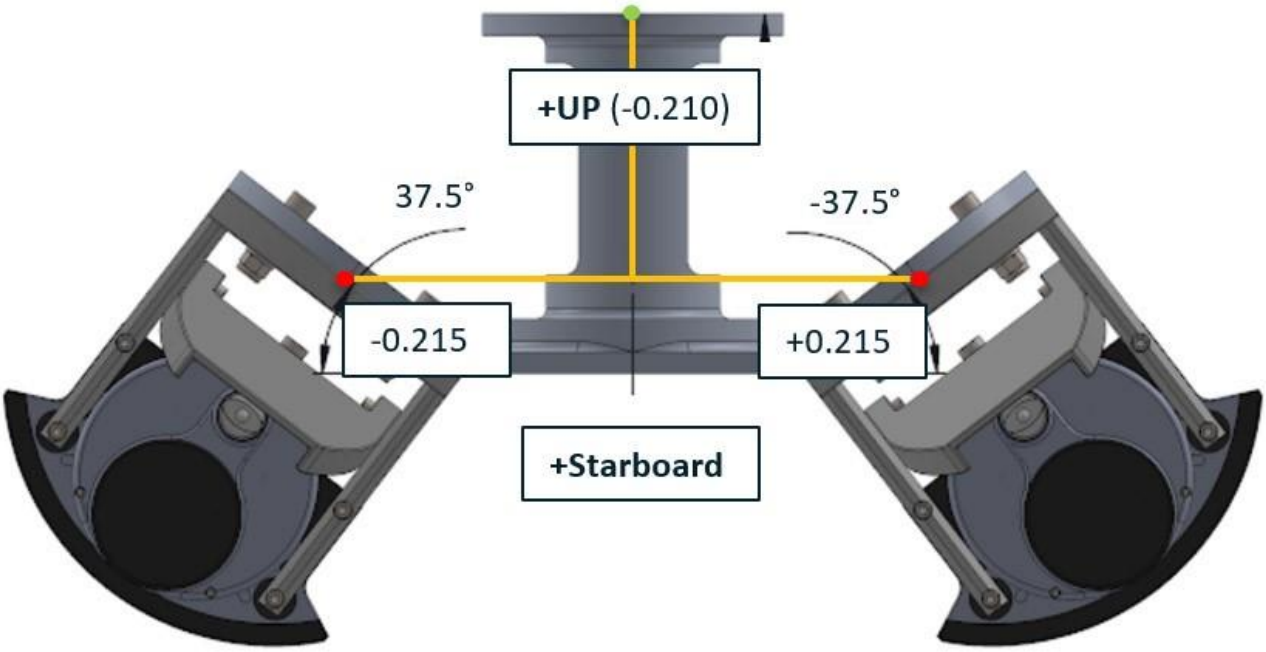
E3. Dual Head Bracket with WINGHEAD – Offsets



E4. Dual Head Bracket with iWBMSe - Dimensions



E5. Dual Head Bracket with iWBMS / iWBMSh - Offsets



E6. NORBIT Carbon Fiber PORTUS Pole