NORBIT

Forward Looking Sonar

User and Technical Manual

NORBIT WINGHEAD®

NORBIT WBMS

Notice

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

Copyright Statement

Disclaimer

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

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

Software Release

WINGHEAD: GUI 10.5.3 / FW 5.1.9
WBMS: GUI 11.3.0 / FW 5.5.93

Release Notice

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

Reference Documentation

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

TN-180196 - WBMS Data Format Definition
TN-210082 - WINGHEAD Interface Description
TN-190041 - ROV/ASV/USV Integration

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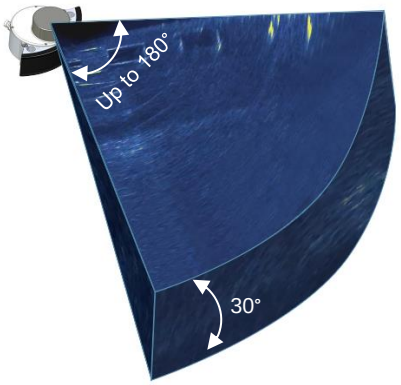
Contents

Glossary of Terms, Abbreviations & Acronyms

ASV	Autonomous Surface Vehicle
AUV	Autonomous Underwater Vehicle
Aux	Auxiliary
Bandwidth	Range of frequency sweep
BNC	Bayonet Neil-Concelman (Connector)
CW	Continuous Wave (single frequency)
FLS	Forward Looking Sonar
FPGA	Field-Programmable Gate Array
FPS	Frames Per Second
FM	Frequency Modulation (swept frequency)
GND	Ground
GUI	Graphical User Interface
LED	Light Emitting Diode
N/C	No Connection
NMEA	National Marine Electronics Association
NTP	Network Time Protocol
PPS	Pulse Per Second
ROV	Remotely Operated Vehicle
Rx	Receive
SIU	Sonar Interface Unit for WBMS systems
SIU-WH	Sonar Interface Unit for WINGHEAD systems
SNR	Signal to Noise Ratio
SONAR	Sound Navigation and Ranging
STX	Steerable Transmission
TTL	Transistor-Transistor Logic
Tx	Transmit
USV	Unmanned Surface Vehicle
VDC	Volts – Direct Current
WBMS	Wideband Multibeam System
WINGHEAD	WINGHEAD Multibeam System

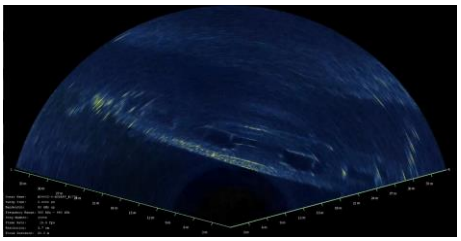
1 Introduction

NORBIT's Forward Looking Sonars (FLS) provide real time 2D images ahead of the survey platform, acting like an underwater camera. With a user adjustable horizontal field of view of up to 180° and a vertical field of view of 30°, FLS is ideal for detecting moving targets in the water column such as marine life, divers and submarines. It is therefore a useful tool for obstacle avoidance, waterside security and object detection.



The WINGHEAD series has a receiver beam width of just 0.5 at 400kHz° and provides ultra-high-resolution imagery. The WBMS series has a beam width of 0.9° and is suitable for smaller vehicles where the space for mounting sensors is limited.

The real time display is a fan-shaped wedge divided into multiple beams, showing the real time acoustic intensity of targets. The brightness of the signal corresponds to the strength of the return signal. Closer targets (at short ranges) are more clearly defined on the display.



The example on the right shows a shipwreck approximately 30m in length, situated at approximately 10m range from the sonar. Targets cast acoustic shadows, which appear as dark areas on the display, due to obstruction of the sonar signal by the target. These shadows are often useful in aiding feature detection.

1.1 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/

1.2 Technical Support

NORBIT operates an online helpdesk that is monitored 24/7. The global hotline is also available for urgent matters. Please refer to section 6 before contacting NORBIT Support. To raise a support request or request an RMA, visit the NORBIT helpdesk to register an account. Select "Technical Support" and complete the form. Each ticket is assigned a unique ID (NSS-XXXX) which must be included in the email subject if replying to the ticket from a regular email client. A support engineer will be assigned to your case and will contact you shortly.

Please include as much information as possible when contacting NORBIT Support:

- Your name and organisation.
- NORBIT system model, serial number and software versions.
- Detailed description of the problem or request, including photos of the installation if relevant.
- Relevant screenshots, error messages and system logs (see section 3.6.4.2.)
- Data samples if relevant.

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

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2 Hardware Installation

All first-time NORBIT sonar operators are strongly encouraged to fully review this manual prior to commencing a survey project. The warning boxes may not cover all critical notices.

NOTE: For subsea ROV/AUV and USV installations, please consult TN-190041 for more detailed technical guidance. This document can be obtained from NORBIT Support.

2.1 Power Requirements

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

2.1.1 AC Power

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

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

2.1.2 DC Power

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

2.1.3 Power Consumption

Power consumption varies according to the sonar model and applied TX settings. Refer to the table below for guiding numbers. These numbers were measured with an 8m cable and a 24V PSU with no drop. Please note these do not cover all hardware revisions so there may be some differences. Contact NORBIT Support if your power requirements dictate a lower power consumption.

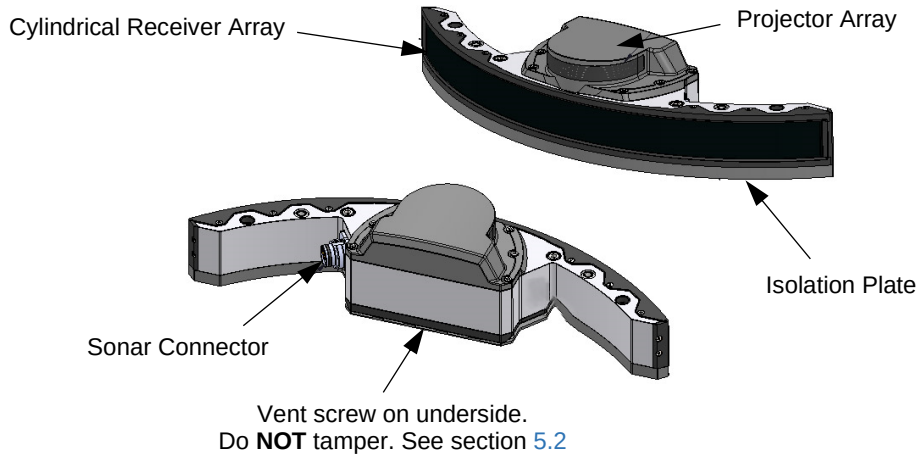
Model	Description	Idle	20Hz 500µs Peak	20Hz 500µs Mean
24002, 24009	WBMS FLS Wide, all materials	0.6 A	2.4 A	1.4 A
22102, 24109	WINGHEAD F11, all variants	0.6 A	2.4 A	1.4 A

2.2 Wet-End Overview

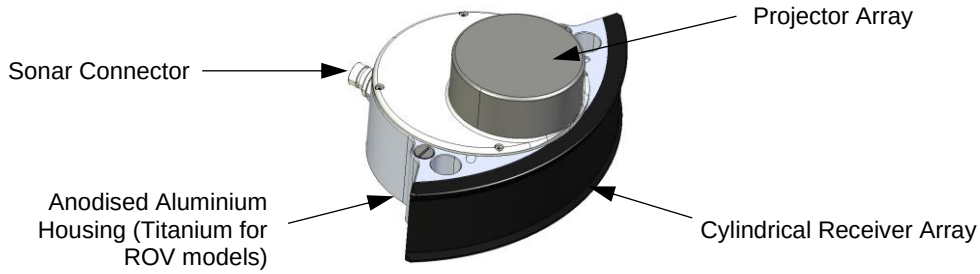
NORBIT can provide 3D models of transducers, in the STEP file format, to support your installation plan. For such requests, please contact NORBIT Support.

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

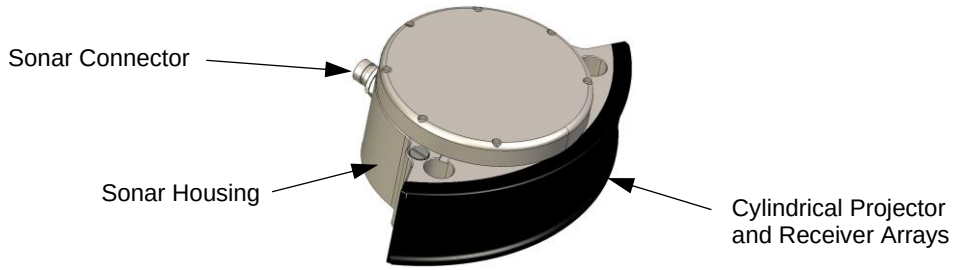
2.2.1 WINGHEAD FLS



2.2.2 WBMS FLS



2.2.3 WBMS FLS Compact



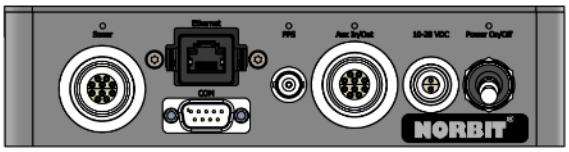
2.3 Dry-End Overview

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

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

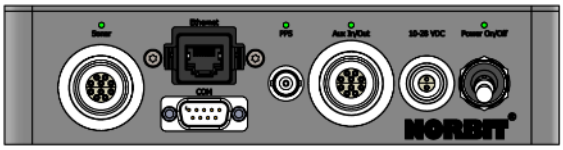
CAUTION: When operating in open environments, all connection ports on the SIU should be tightly sealed either with the NORBIT supplied cables or, if the port is unused, with the port covers provided with the system.

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



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

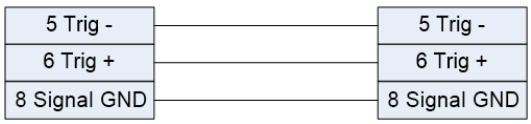
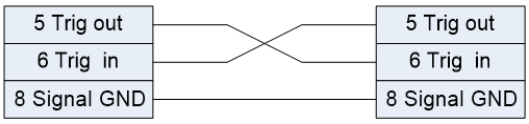
2.3.2 WBMS Sonar Interface Unit (SIU, PN 29024)



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

2.3.3 Aux In/Out Port & Triggering

For the full pin description, refer to Appendix B. Pins 5 and 6 can be used to trigger to or from an external sensor (e.g. sidescan sonar or DVL) to avoid interference. The trigger input is TTL 5V compatible.

WINGHEAD	WBMS
The trigger uses RS-422 in a half-duplex mode, i.e. the same pair can receive synchronisation, or transmit it, depending on the designation. If synchronising with another WINGHEAD sonar, pins 5 and 6 should be wired pin to pin with the corresponding unit's SIU Aux port. NORBIT cable PN 33249 can be used to achieve this.	The signal is RS-232, with the trigger output available on pin 5, and reference signal ground on pin 8. If synchronising with another WBMS sonar, the trigger signal should go to pin 6 of the corresponding Aux port on the second SIU and vice versa. NORBIT cable PN 33143-C can be used to achieve this.
	

Additional Notes:

- The output trigger is sent 3300µs before the centre of the following transmit pulse.
- The default delay from the incoming trigger is 3300µs to the centre of the next transmit pulse.
- The trigger delay can be adjusted using the `set_trigger_delay` command on a TCP/IP socket connection. The connection is established on port 2209 on the sonar's IP address. Refer to the NORBIT Data Format Definition (TN-180196, TN-210082) for more details.

2.3.4 LED Status Indicators

Indicator	Pattern	Description
Sonar LED	Steady Green Blinking Green (Short Blink 1Hz) Blinking Green (Long Blink 1Hz) Blinking Green (5Hz) Off	Sonar Pinging Sonar Stand By Sonar Booting Sonar Over Current Failure Sonar Off
PPS LED	Blinking Orange (1Hz) Blinking Orange (5Hz) Steady Orange Off	Sync/Timing OK No Sync, NMEA Missing No Sync, PPS Missing No Sync, NMEA and PPS Missing
Aux In/Out LED	Off	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

2.4 Pigtails

NORBIT offers both straight and right-angled pigtails. Please refer to the appendices for details. All NORBIT pigtails can be customised for length, and NORBIT offers full factory capability to provide terminated pigtails.

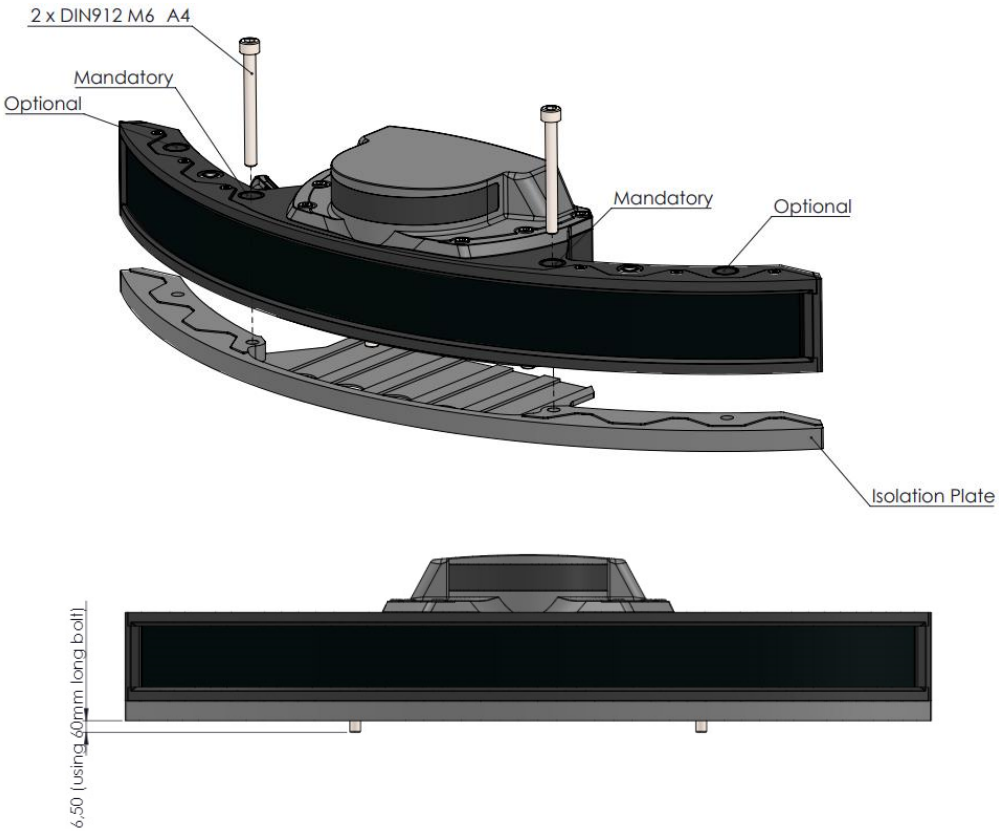
2.5 Sensor Mounting

2.5.1 WINGHEAD Mounting Instructions

The sonar should be mounted using two M6 bolts attached to the inner holes, which are mandatory, while the outer holes are optional. Tighten the bolts to 7Nm torque.

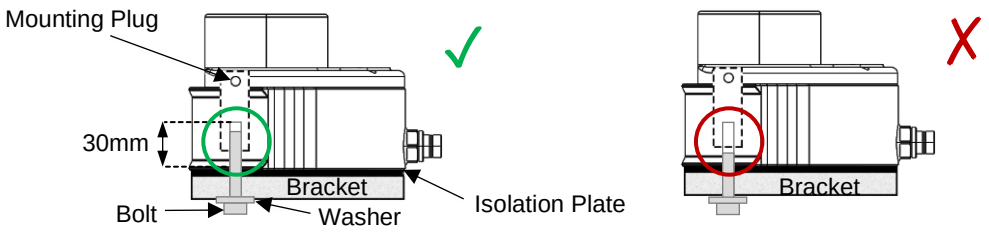
An isolation plate is provided with the sonar and must be installed between the bracket and sonar to avoid mechanical wear and galvanic corrosion.

The minimum screw length is **60mm** for standard models (PN 24102) and **70mm** for Deep Sea models (PN 24109) with the required isolation plate. They must be made of high-quality stainless steel to ensure anti-corrosion, especially in saltwater environments. Apply Loctite or use lock washers to prevent loosening of sonar during long deployments. If lock washers are used, they must be placed on the **underside** of the unit, together with lock nuts.



2.5.2 WBMS Mounting Instructions

The sonar is mounted with two bolts spaced 160mm apart, typically onto a mounting bracket. An insulating plate is provided with the sonar. This is to be installed between the bracket and the sonar to avoid mechanical wear and galvanic corrosion (rubber feet may need to be removed from the sonar's base plate). Mounting plugs provided with the sonar are designed for M6 fastening bolts, used as per the following illustration.



The bolts that secure the sonar to the mount should be 30-35mm longer than the thickness of the mounting bracket and made of high-quality stainless steel to ensure anti-corrosion, especially in saltwater environments. Use a lock washer, lock-nut and/or thread adhesive to prevent loosening of sonar during long deployments.

2.5.3 Electrical Isolation

It is important to isolate the NORBIT sonar from other metal objects such as brackets, mounting poles and the vessel hull. Failure to do so can cause severe corrosion due to ground currents and potential differences. For the WBMS series, use the NORBIT protection plate if the sonar is mounted directly onto metal (PN 45459) and the correct plastic spacers for the screws which fasten the sonar.

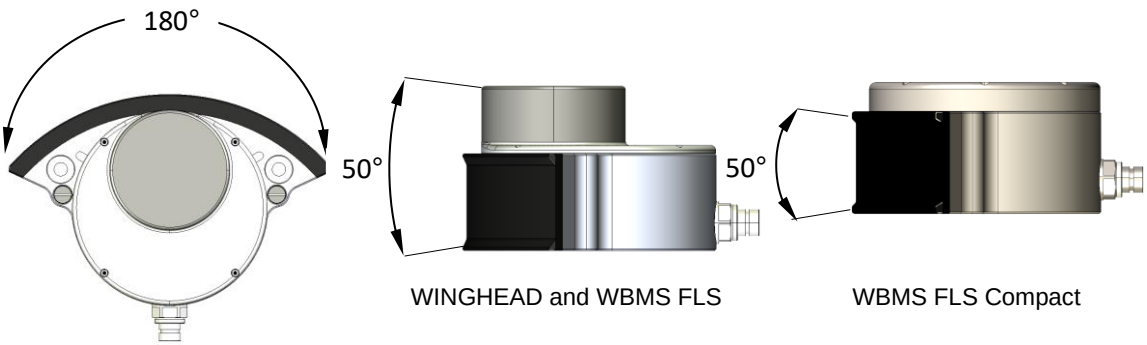
2.5.4 Sonar Orientation

For most applications, the cylindrical receiver array points forward, and the sonar may be tilted up or down as necessary to adjust the field of view.

The projector typically points up but can also point down. This determines how the beams are ordered on the display, and in the event that the beams are reversed, the “Flip Image” option (under Advanced settings) should be enabled to correct it.

2.5.5 Acoustic Clearance Zones

In general, the area around the sonar should be kept clear and unmasked to minimise the chance of acoustic reflections and blocking in both the across-track and along-track directions. The following images indicate areas that must be kept clear as a minimum. These clearance zones are true for both the WINGHEAD and WBMS series.



WINGHEAD and WBMS FLS

WBMS FLS Compact

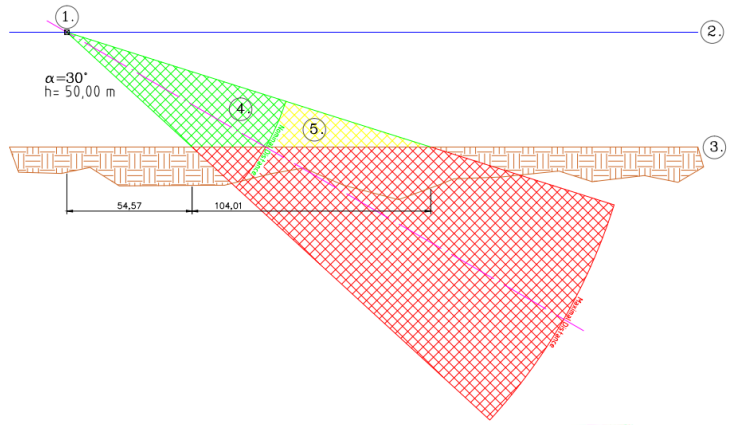
2.5.6 Field of View

The sonar field of view is determined by the opening angle, the physical angle at which the sonar is mounted, and the depth of the bottom (or distance to target).

Example A (30° tilt)

In this example, the sonar is tilted 30° down, and the height above seafloor is 50m. The sonar illuminates a wide area of seabed that is 104m in length in the across-track direction.

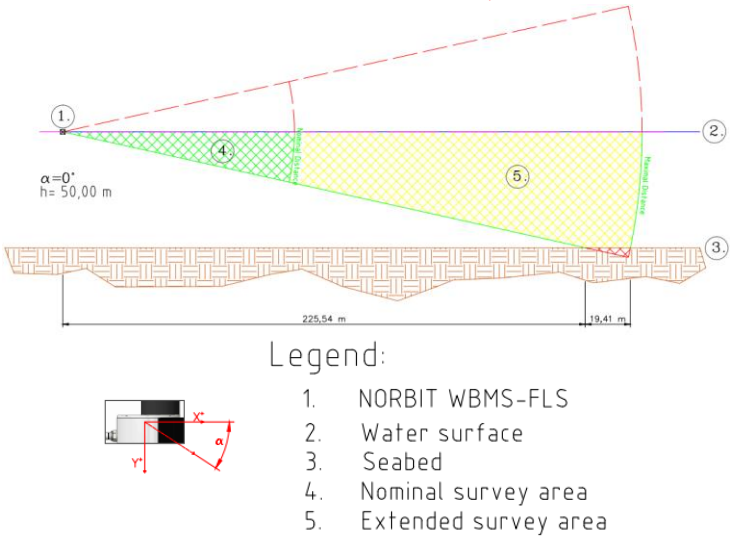
Also note that the sonar is “blind” to the area directly beneath the sonar, and no signals are measured here.



Example B (0° tilt)

In this example, the sonar is pointing straight forward. Only a small patch of seafloor is illuminated, just 19.41m in length, at a long distance (>200m) from the sonar.

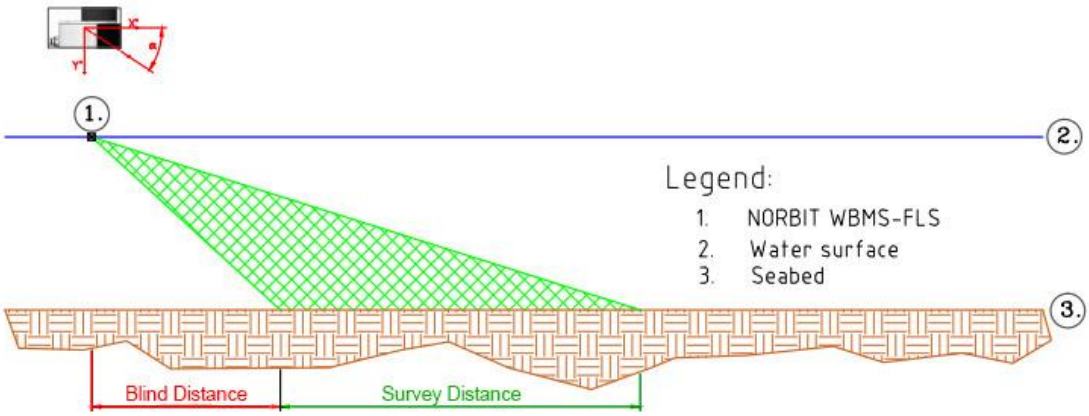
This configuration may be beneficial for applications where the aim is to detect targets which are close to the surface, or directly ahead of the sonar.



In general, it should be noted that:

For shallow mounting angles	For steep mounting angles
✓ There is a higher chance of water surface reflections, which impacts acoustic performance. ✓ Faster vessel speeds are possible, since shallow grazing angles tend to yield wider coverage of the seafloor. ✓ Targets may be easier to detect visually, since they cast longer shadows.	✓ Slower vessel speeds are advised due to the narrow field of view. ✓ There is less shadow effect on targets, as targets are imaged directly from above, which may make detection more difficult.

The table below indicates the along-track distance of seafloor that is illuminated and blind as a function of depth and sonar tilt angle:



Water Depth	Sonar Tilt Angle						
	0°	5°	10°	15°	20°	25°	30°
2.5m	11.28m	7.93m	6.04m	4.80m	3.92m	3.26m	2.73m
	238.71m	242.06m	243.95m	52.46m	15.07m	8.02m	5.20m
5m	22.55m	15.86m	12.07m	9.60m	7.85m	6.52m	5.46m
	227.92m	234.06m	237.88m	104.91m	30.18m	16.04m	10.40m
10m	45.11m	31.72m	24.14m	19.21m	15.70m	13.03m	10.91m
	204.69m	218.08m	225.66m	209.83m	60.26m	32.07m	20.80m
25m	112.77m	79.29m	60.36m	48.02m	39.24m	32.58m	27.28m
	135.98m	169.46m	188.39m	200.72m	150.65m	80.19m	52.01m
50m	225.54m	158.58m	120.71m	96.05m	78.48mm	65.16m	54.57m
	19.41m	86.37m	124.24m	148.90m	166.46	160.37m	104.01m

2.6 Time Synchronisation

Generally, FLS systems do not require time synchronisation and it does not impact performance. Should time synchronisation be required, for example to time tag the output data for subsequent eventing of recorded data, then the sonar head can receive time data in two ways. If the FLS is installed on an ROV, then the SIU is not required, and so the NTP option (see section 2.6.2) should be used for time synchronisation.

2.6.1 NMEA ZDA & 1PPS

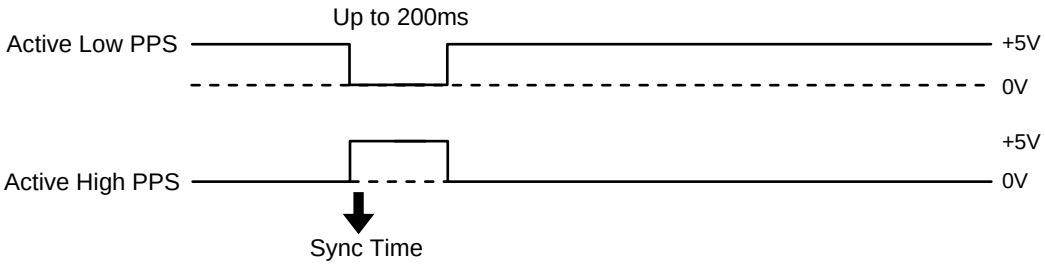
For surface applications, an NMEA ZDA and 1PPS hard-wired input to the SIU is recommended. RS-232 data is input on pin 3 with respect to ground on pin 5. The system can handle baud rates from 4800 to 115200. Note that the input baud rate is automatically detected at startup, therefore if the baud rate is changed, the SIU must be rebooted. Ensure that the baud rate is fast enough to allow throughput of all strings.

The 1PPS pulse can be input in two ways:

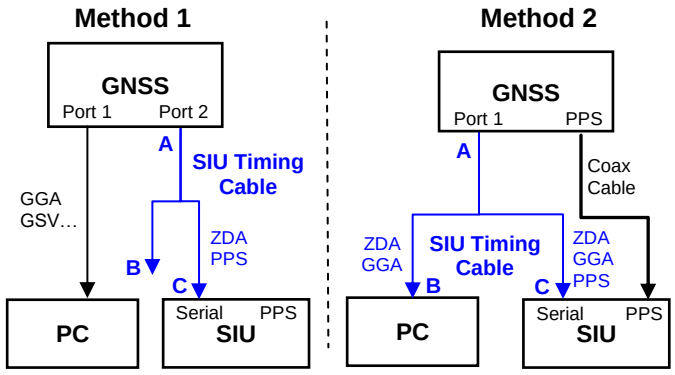
- To the BNC “PPS” connector on the SIU
- To the Serial “COM” DB9 connector on the SIU (pin 9 for pulse & pin 5 for ground)

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

The SIU should receive a PPS TTL input at 3.3V (5V tolerant). The input and has ±15kV ESD protection, ±60V fault protection.



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



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

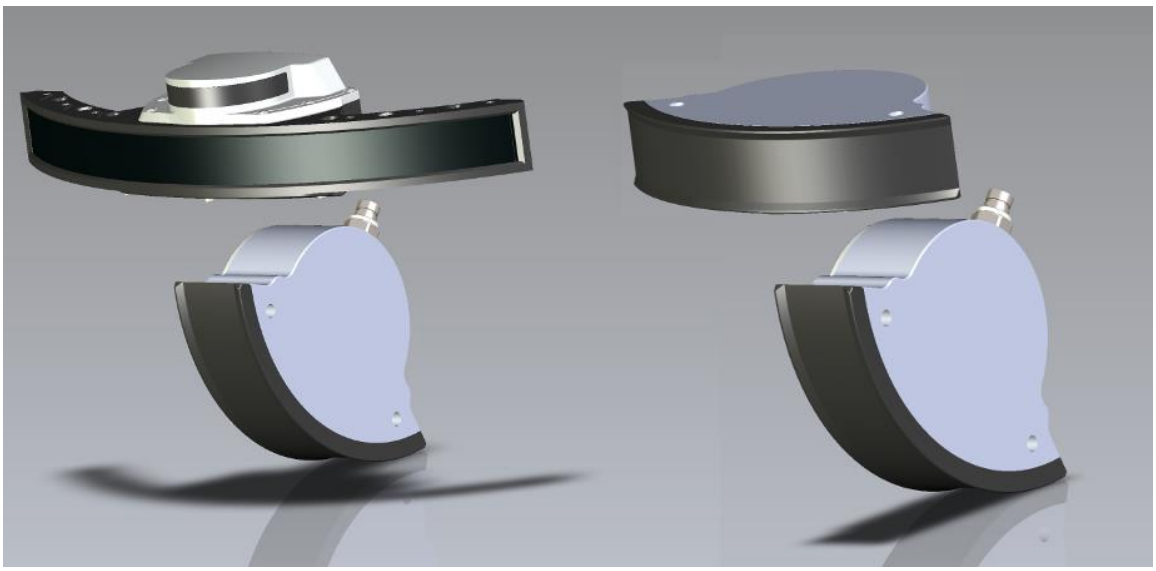
2.6.2 Network Time Protocol (NTP)

NTP timing can also be used to provide network-based timing to the sonar. Refer to section 3.6.1 for information on how to configure the NTP time server in the GUI.

For optimal timing, NORBIT recommends using NTP together with 1PPS to maintain the best time accuracy available, but for FLS purposes, NTP alone is sufficiently accurate for time tagging of the FLS sonar data. There are several free NTP services available, such as Qinsy SNTP and Meinberg. This should preferably be running on the same PC, or at least the same network as the SIU.

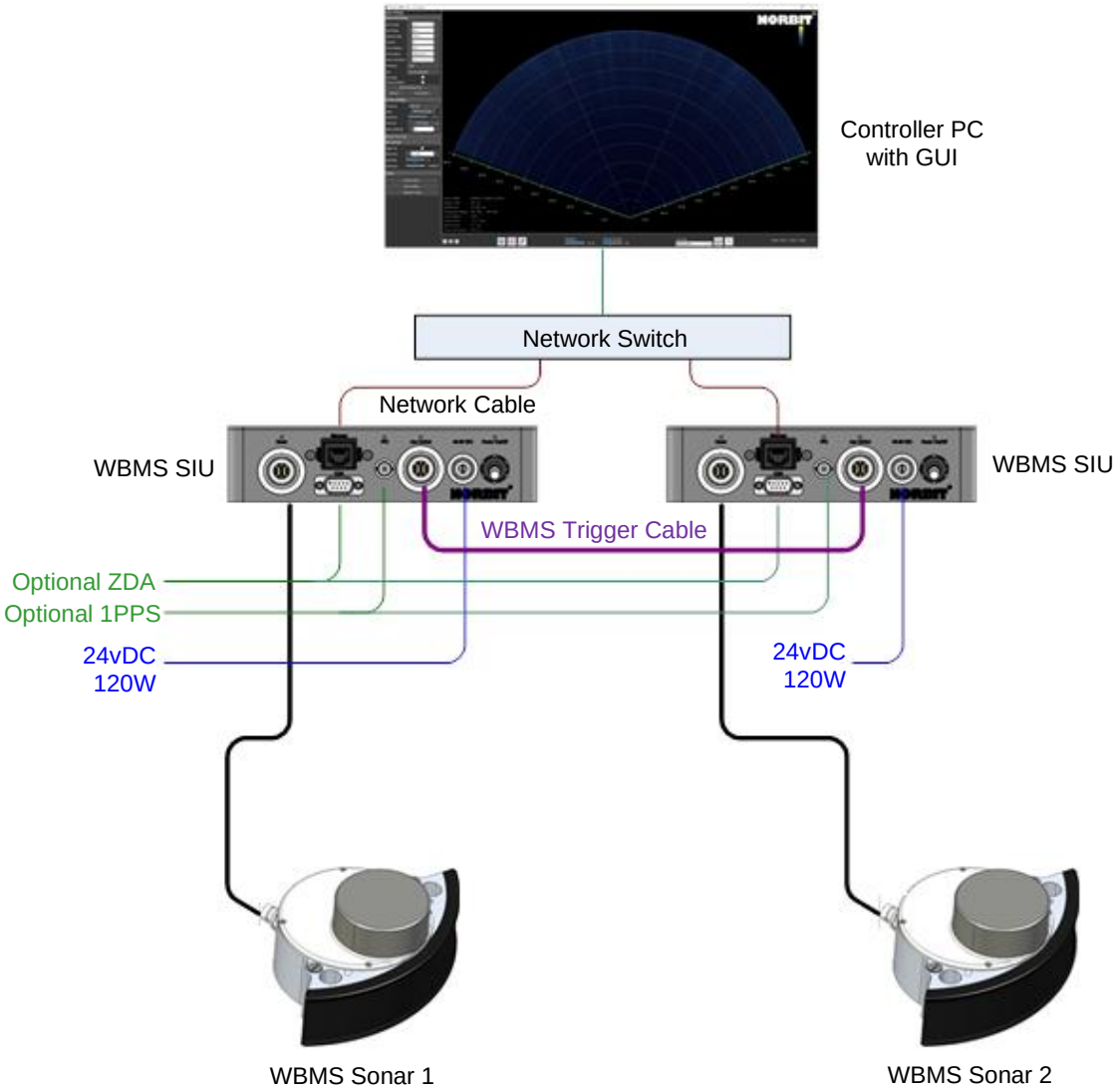
2.7 Crossfire Configuration

The crossfire configuration contains 2 FLS sonars, with one mounted horizontally and one mounted vertically. This can either be 2 WBMS FLS sonars, 2 WINGHEAD FLS sonars, or 1 WINGHEAD and 1 WBMS FLS sonar.



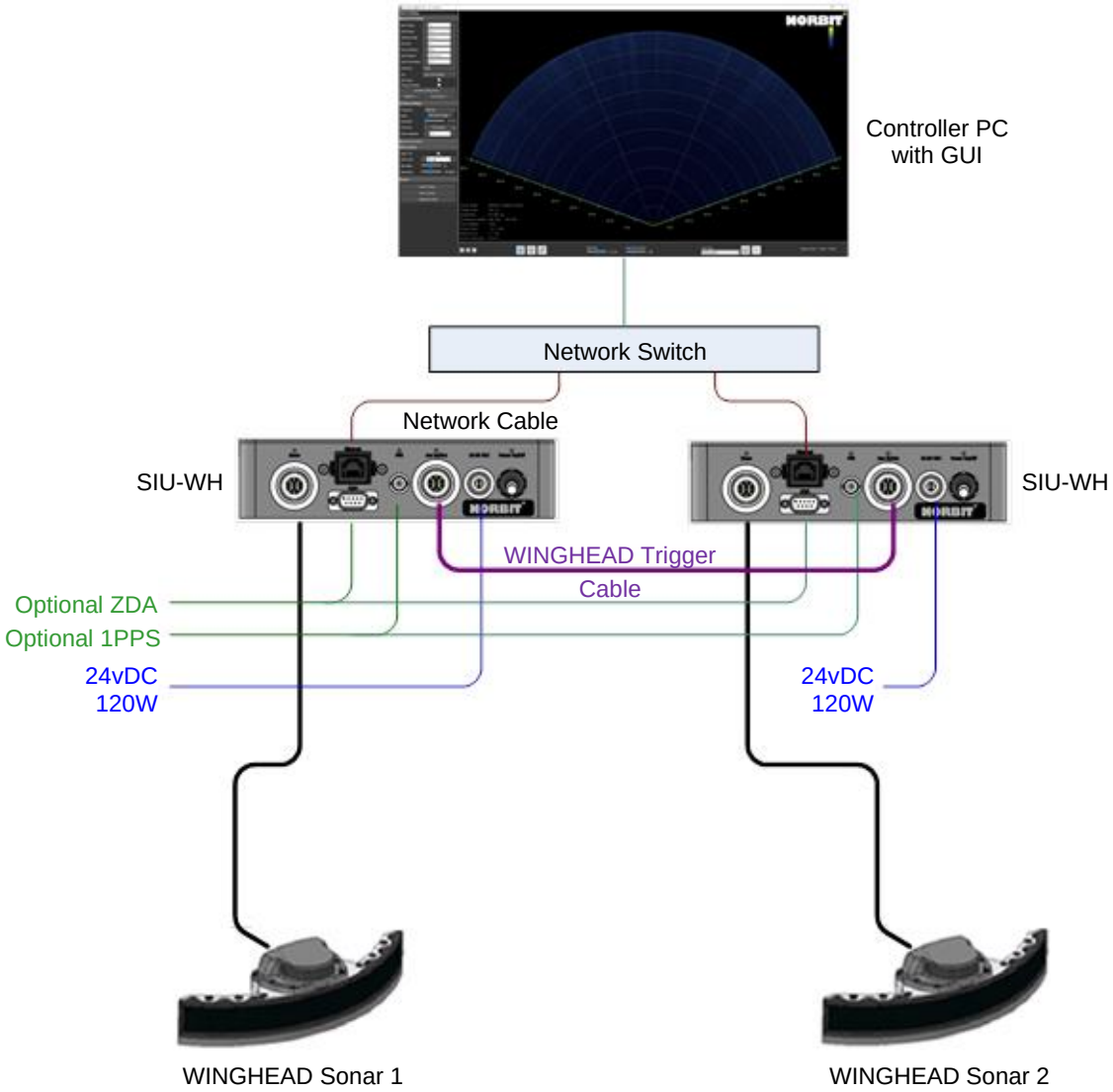
Left: WINGHEAD and WBMS FLS. Right: 2x WBMS FLS

2.7.1 Dual WBMS Sonars



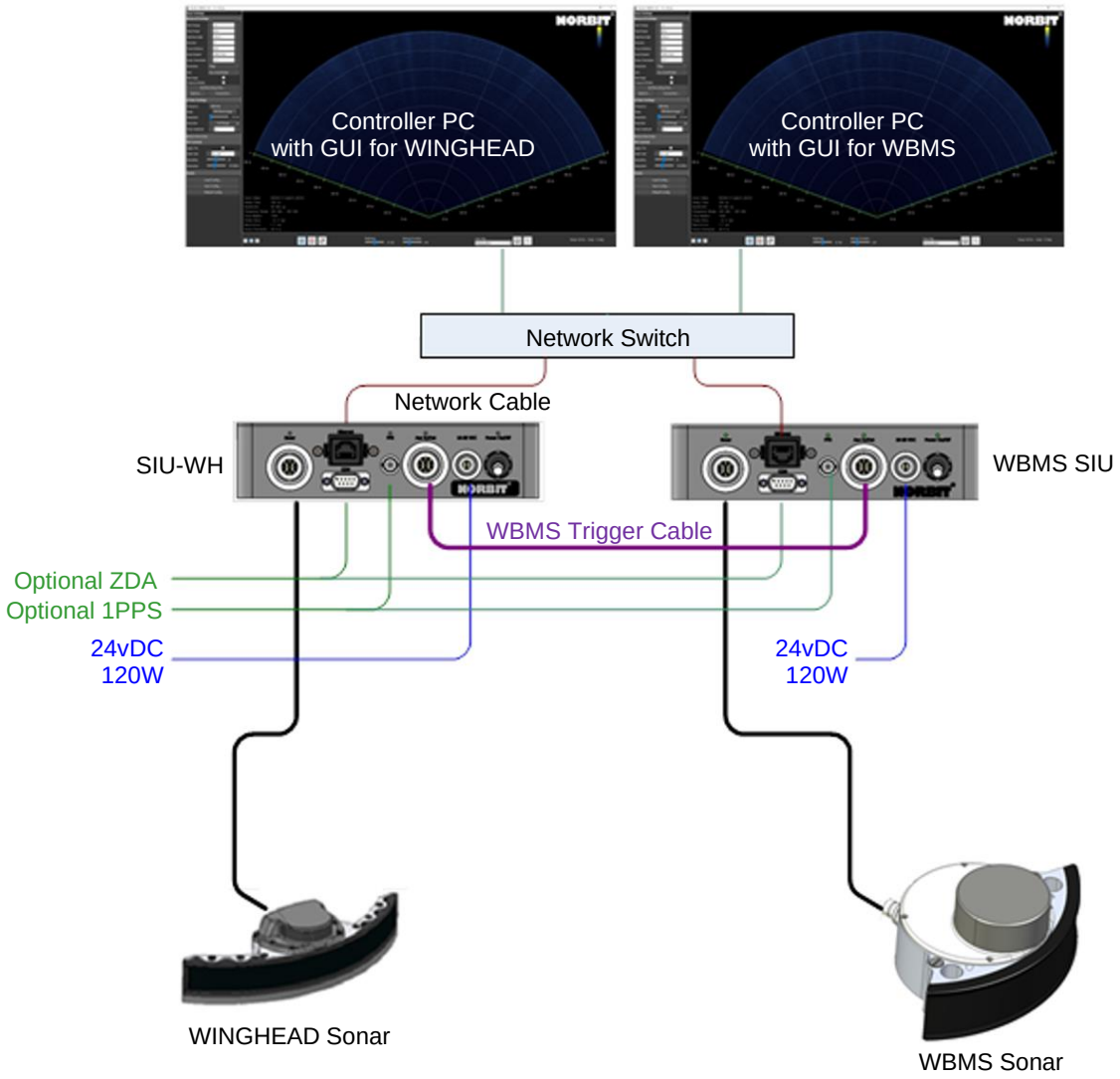
In this example, the two sonars are running independently, however they are linked with the WBMS trigger cable (PN 33143-C) between the two SIU Aux ports. This allows one sonar to act as secondary to the other. One sonar will be the primary trigger and occupy one half of the bandwidth. The other will act as secondary and occupy the other half of the bandwidth.

2.7.2 Dual WINGHEAD Sonars



In this example, the two sonars are running independently, however they are linked with the WINGHEAD trigger cable (PN 33249) between the two SIU Aux ports. This allows one sonar to act as secondary to the other. One sonar will be the primary trigger and occupy one half of the bandwidth. The other will act as secondary and occupy the other half of the bandwidth.

2.7.3 WINGHEAD and WBMS Sonars



In this example, the two sonars are running independently, however they are linked with the WBMS trigger cable (PN 33143-C) between the two SIU Aux ports. This allows one sonar to act as secondary to the other, however it should be noted that the WINGHEAD sonar defaults to a RS-422 trigger signal while the WBMS sonar uses a RS-232 trigger signal, therefore the WINGHEAD sonar needs to change its signal from RS-422 to RS-232. This is done using the sonar web interface, which is accessed via a web browser at: http://192.168.53.XX:8080 (where XX is the last 2 digits of the sonar serial number).

One sonar will be the primary trigger and occupy one half of the bandwidth. The other will act as secondary and occupy the other half of the bandwidth. This needs to be set manually.

3 System Operation

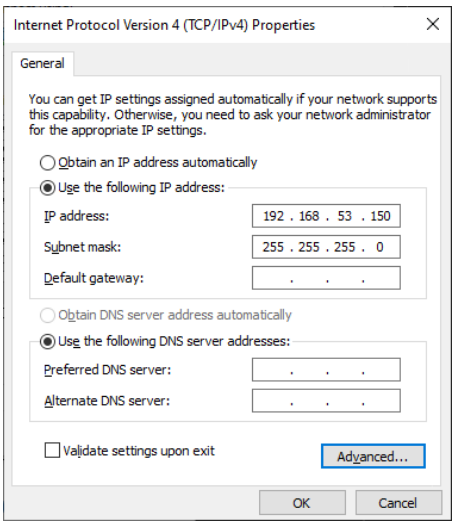
The system is setup and controlled using the NORBIT Graphical User Interface (GUI). The GUI may also be controlled in headless/passive mode, as described in section 3.4. NORBIT recommends disabling Windows Firewall in case of any communication problems with the GUI.

The GUI can be monitored by multiple computers, but only one GUI can control the sonar. To communicate with the GUI using more than one computer through a network switch, each computer requires its own unique IP address on the same IP range, as described in section 3.1. The acquisition software should always connect to the local IP address of the PC that operates the GUI.

3.1 Network Configuration

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

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



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

In rare circumstances, some users may wish to change the IP address of the sonar. See section 6.1 for details. Do NOT change the sonar IP address unless absolutely necessary.

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

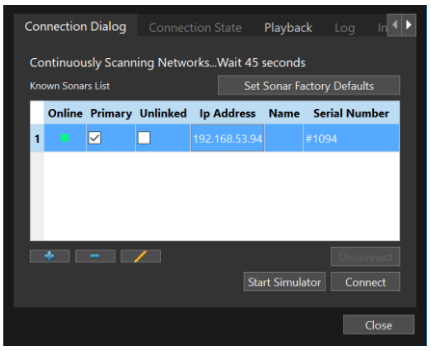
3.2 Power On

The sonar requires a 20-40 second boot period once the power switch on the SIU is toggled. The boot process can be monitored on the green “Sonar” LED on the SIU. Different states of the sonar can be identified by SIU “Sonar” LED blink patterns in section 2.3.4

CAUTION: Do **NOT** power the sonar in air for more than 5 minutes. It may cause the system to overheat and damage the internal electronics. Always place the sonar in water when possible.

3.3 Sonar Connection

Upon launching the GUI, the **Connection Dialog** is displayed. If a sonar is active on the network, a green light is displayed, while 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.



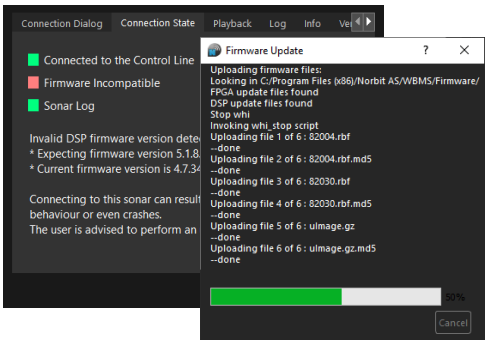
Once connected, an automatic check is performed to ensure firmware compatibility. A warning is displayed on the **Connection State** tab if the firmware is incompatible. Operating a firmware and GUI with mismatching versions may cause unstable operation. Do not use a GUI version newer than what is indicated on Page 2.

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

3.3.1 Firmware Update

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

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



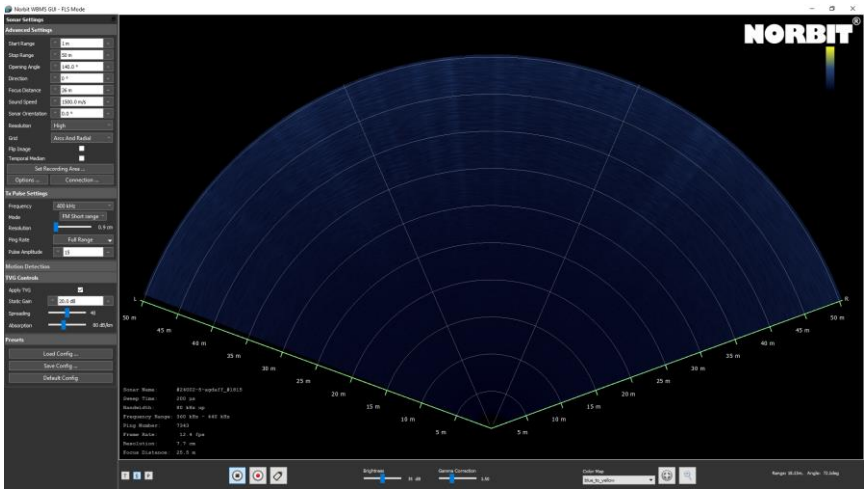
3.4 Operation Without GUI

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

For details on Passive and Headless modes, please refer to the ROV/AUV/USV Integration Manual, TN-190041. Contact NORBIT Support if you require this document.

3.5 Sonar Wedge Display

Upon connection, the sonar wedge and controls are displayed in the GUI. This is used to monitor incoming data and tune the sonar for optimal target detection.



CAUTION: Prolonged periods of energised dry sonar will deteriorate channel sensitivity resulting in decreased performance. The sonar should only be operated in air for testing purposes, for very short periods (<5 minutes).

3.5.1 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 adjust the 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.

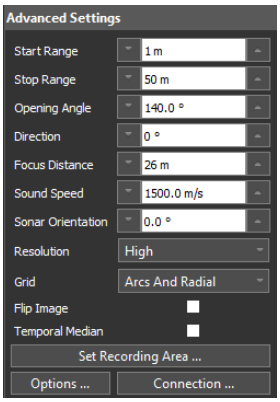
T Displays a time trace for each beam separately when the water column is active. Right clicking allows the user to zoom in, while left clicking resets the zoom. Channels can be selected using the arrows at the bottom. A graphical selection appears on the wedge.

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.

P Hide/unhides the predefined sonar settings window, where pre-saved configurations can be loaded.

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 3.6.4.1. 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. Please note that there is no storage capacity on the sonar itself, and all recordings are saved on the operator PC/laptop.

3.6 Sonar Settings

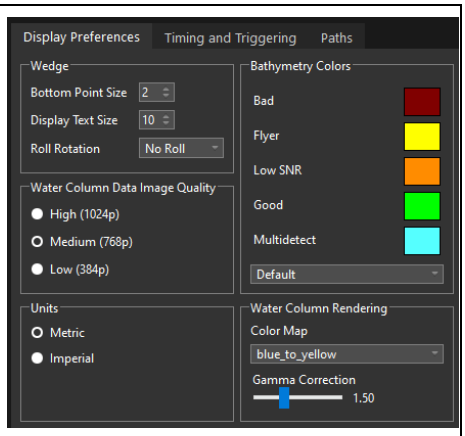
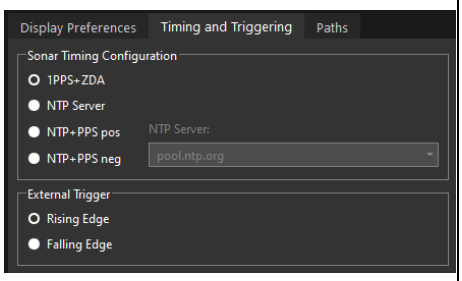
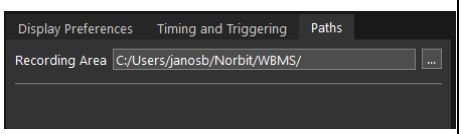


The sonar setting menus can be collapsed or expanded by clicking on the menu titles. For normal operation with the default settings, only the first tab (Advanced) needs to be visible.

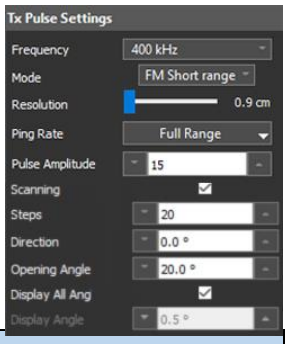
3.6.1 Advanced

Most FLS control settings are found on the Advanced menu. Here, the operator can adjust the **Start Range** and Stop Range, **Opening Angle**, **Sonar Orientation**, **Sound Speed** and resolution parameters.

Function	Description
Start Range	Sets the minimum range at which the sonar will detect targets.
Stop Range	Sets the maximum range that the sonar will detect targets. **Minimum Value:** 0.0m **Maximum Value:** 300m
Opening Angle	Total angular swath coverage. **Minimum Value:** 7° **Maximum Value:** 180°
Direction	Sets the direction of the swath pointing angle. Places the swath symmetrically around the central beam. Direction angle is dependent on swath width, as no portion of the swath may exceed the allowable view.
Focus Distance	While the sonar has a good performance in all ensonified areas, target clarity can be optimised for a specific range of interest by defining the focus distance. The focus distance is a range from the sonar with the sharpest image return.
Sound Speed	Sets the speed of sound in water at the sonar depth. Critical for measuring the correct range to targets.
Sonar Orientation	Rotates the display. Used to aid interpretation when the sonar is physically rotated.
Resolution	Sets the sonar data resolution. Several options are available: **WINGHEAD:** **Highest:** 2048x1024 **High:** 1024x1024 **Medium:** 512x1024 **Low:** 256x512 **Lowest:** 128x256 **WBMS:** **Highest:** 1024x256 **High:** 1024x64 **Medium:** 512x64 **Low:** 256x64 **Lowest:** 128x64
Grid	Sets the grid display on the swath: **None:** Only the range scale with values is displayed. **Arcs:** Range arcs are visible on the swath. **Radial Lines:** Lines radiating form the source to the end of the range. Shows three equal angular sectors based on the Opening Angle.
Flip Image	Reverses the left and right quadrants of the sonar display.
Temporal Median	Smoothing filter which removes small momentary noise spikes caused within the environment, such as small fish.
Set Recording Area…	Selects the folder on the acquisition computer for storing recorded data. Applicable for the WBMS series only.

Options (Display Preferences, Timing and Triggering, Paths)	***Display Preferences***  **Bottom Point Size –** Changes the point size on the wedge. Adjustable from 1-10 (not relevant for FLS systems). **Display Text Size –** Changes the text size on the wedge area. Adjustable from 1-12. **Roll Rotation –** Viewing options to show the roll stabilised wedge. **Water Column Data Image Quality –** Sets the resolution of the water column display. This does not affect output resolution. To ensure system resources are kept to a minimum for low-grade field laptops, run with medium or low graphics selected. **Units –** Selects the display units in the GUI to be either metric or imperial. **Bathymetry Quality Colours –** Changes colour palette of bottom detection quality flags. **Colour Map –** Offers different colour settings for visualising the swath intensity data. **Gamma Correction –** Changes the visual contrast of the wedge intensity data. Setting the gamma too low will mute the intensity in the wedge display to nearly all off (black). Setting gamma too high will fuse the darkest areas with brightest areas. A value of 2 is often the best. ***Timing and Triggering***  Users can specify the synchronisation method for sonar timing. Note that for the WINGHEAD series, the timing scheme is controlled from the web UI at *http://192.168.53.XX:8080*, where XX is the last 2 digits of the sonar serial number. For most installations, **1PPS+ZDA** should be selected, in which case the GNSS signal provides the time stamp and associated 1PPS signal to the sonar. If timing direct from the SIU (via the GNSS receiver) is not possible, e.g. on ROV/AUV or other types of custom installations, then timing from an **NTP Server** may be used. Enter the IP address of the computer that runs the NTP service. The port number is not required. NTP+PPS has the same accuracy as 1PPS+ZDA and is recommended for all other installation types where 1PPS+ZDA is not possible. A PPS pulse must be sent to the system on the timing pin, and an NTP server should be made available on the network. If the timing error exceeds 10ms, the sonar will discard timing. Select **NTP+PPS pos/neg** if using time from an NTP server to provide PPS. “pos” and “neg” refers to a positive and 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**. ***Paths***  Users can specify the folder path for recording native NORBIT (*.wbm) and s7k (*.s7k) files.
Connection…	Opens the sonar connection dialog.

3.6.2 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. All functions are explained in the table below.

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 FLS is detected.

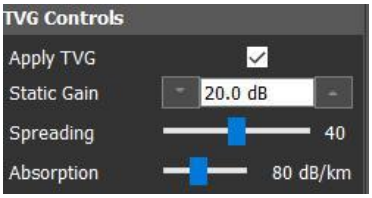
Function	Description
Frequency	Sets the centre frequency of the transmitted pulse. NORBIT sonars are optimised for a centre frequency of 400kHz. For most applications, NORBIT recommends maintaining a frequency close to the centre frequency. To ensure optimal performance, only use the standard range. **WINGHEAD Frequency Range:** 200kHz – 700kHz (optimised for 400kHz) **WBMS Frequency Range:** 360kHz – 440kHz (optimised for 400kHz)
Mode	Sets the sweep time of the signal transmission, which impacts range performance and ping rate. The available selections are **FM Long Range** (500µs, recommended for most applications), **FM Short Range** (200µs, applicable for surveys with very short ranges, <10m), **FM Extended Range** (1600µs, for long range surveys, available on certain models only), or **CW** (legacy option). Note that reducing the sweep time increases the effective ping rate at very short ranges. For **CW** mode (which is not recommended) the sweep time controls range resolution and increases range performance at the expense of image quality. In **FM** modes (recommended), the sweep time has no impact on range resolution.
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 centre frequency of 400kHz, transmission sweeps from 360-440kHz. Decreasing resolution enhances range performance 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 range.
Ping Rate	Sets the rate at which acoustic pulses are transmitted. Certain factors such as range and sweep time (**Mode**) will limit the maximum achievable ping rate. At longer ranges, lower ping rates should be expected since the signal travel times are longer. • **Full Range:** The ping rate is based on the total effective range as defined by the **Opening Angle**, swath **Direction** and **Stop Range**. The rate is a function of the two-way travel-time of the signal from the projector to the bottom and back again, plus a small duration for ping processing and capacitor charge. • **Fixed:** The ping rate will not exceed the fixed value, even when the range makes it theoretically possible to do so. The maximum rate is based on the range as determined by the **Stop Range**. Useful for reducing data volumes when operating at very short ranges, as the system will attempt to ping as fast as possible up to the user defined threshold or the sonar range. • **External:** Each ping is triggered externally and only happens if the sonar is 'ready' when the signal arrives, e.g. if the sonar cannot ping faster than 10Hz due to range limitations, but the external signal is 12Hz, every other event will be skipped resulting in a 6Hz ping rate per every other signal. The external signal polarity is configurable. The minimum delay from the transmit signal to the centre of the transmit pulse is 500µs (half the transmit pulse buffer plus additional). An adjustable trigger delay is possible with millisecond resolution.
Pulse Amplitude	Sets the pulse amplitude (transmission power). Generally, this should be set to 15, and should only be reduced when operating at very short ranges when there are major saturating echoes

	close to the sonar. The saturation tends to show up as a bright arc in the data occurring at a constant range.
Scanning*	Directs the sonar to sweep an along-track sector of angle given by **Opening Angle**. This is a licensed option on the WINGHEAD series. If disabled, the sonar is directed to ping in one direction, effectively behaving as a conventional multibeam sonar. It is **NOT** advised to perform an entire survey with scanning enabled. Use scanning only when attempting to further develop areas of interest.
Steps*	The number of steps corresponds to the number of slices, or pings, in each defined along-track sector. For most applications, use a step size equal to, or less than, 20. This is configurable only if **Scanning** is enabled and the **Opening Angle** is set to a non-zero value. If the number of **Steps** is 20, and the **Opening Angle** is 20°, and the sonar ping rate is 20Hz, it will take exactly 1 second for the sonar to scan the 20° sector.
Direction*	Defines the angular direction forming the centre of the along-track sector. For example, for a **Direction** of 5° and **Opening Angle** of 10°, the STX sonar will scan across a sector from 0° to 10°.
Opening Angle*	Defines the angular sector through which the transmit beam is steered. Steering is limited to ±10°, and as the angular **Direction** increases by 1°, the maximum **Opening Angle** decreases by 2°. If the **Direction** is 0°, the maximum **Opening Angle** is 20°.
Display all Ang*	When enabled, this instructs the GUI to display all angles in the sector being scanned by the STX. When disabled, the GUI will display only the angle defined in **Display Angle**.
Display Angle*	The user may define a single angle within the sector to show on the display. If **Display all Angles** is enabled, this setting is greyed out.

** Available on STX models only. License-controlled for WINGHEAD series.*

CAUTION: 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.

3.6.3 TVG Controls



TVG Controls allow the user to change the settings that govern the time-varied gain. Adjusting these settings may improve the image clarity within the sonar display. These settings only affect the display.

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.

Default values for these settings are applied by the GUI and can be modified to suit a variety of environmental conditions.

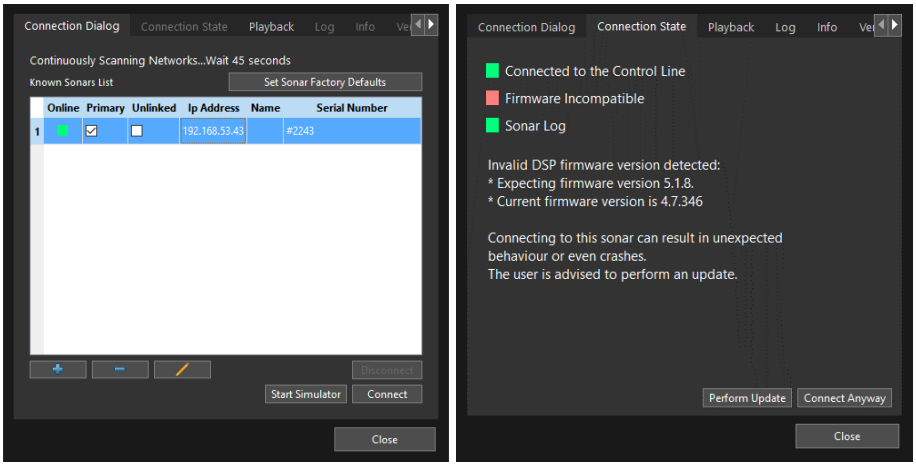
Function	Description
Apply TVG	Removes the native sonar TVG that is applied in the sonar hardware and instead applies the user specified TVG, based on **Static Gain**, **Spreading** and **Absorption**. When TVG is applied, all parameters are reported along with the data to the acquisition software to 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. Adjust this setting if the sonar signal becomes saturated.
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.
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.

3.6.4 Connection Dialog & Connection State

Select **Connection** to open the **Connection Dialog**. Selecting **Set Sonar Factory Defaults** resets the sonar configuration. NORBIT recommends restoring factory defaults whenever a new version of the GUI or firmware is installed.

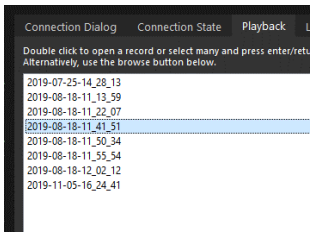
Connection State contains basic information about the current connection status. If any of the indicators are red, action is required by the user. Such is the case in the example presented here, which shows that the sonar is not loaded with the firmware expected by the GUI.

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



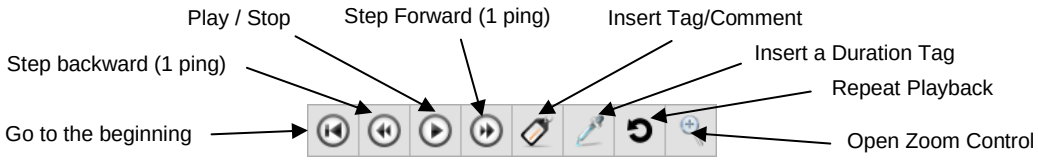
3.6.4.1 Playback

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*

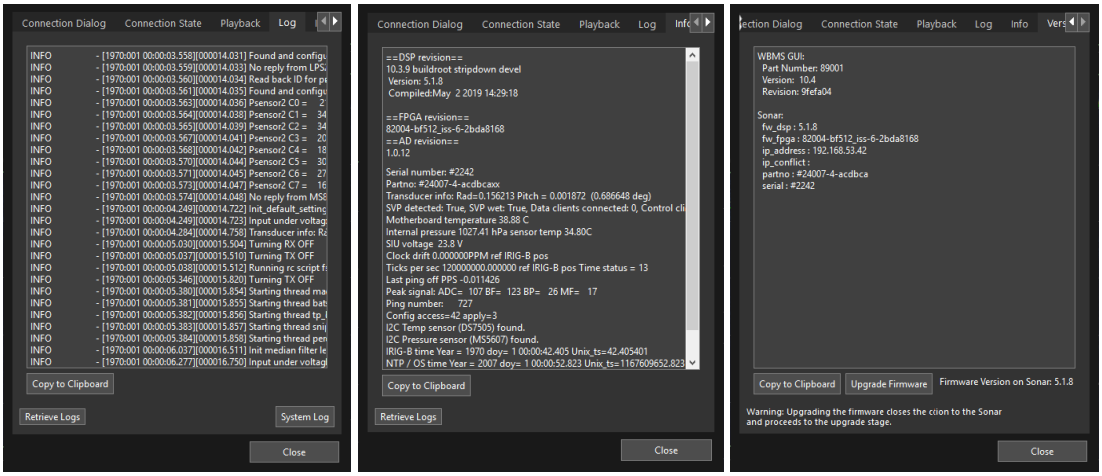
The playback window can be resized by dragging the central divider. **Settings** and **Controls** are found on the left. Users can also change the **Sonar Orientation** as required. To export the current ping, or a series of pings, use the **Export Current Ping** and **Export** buttons. Other options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



3.6.4.2 Log, Info & Version

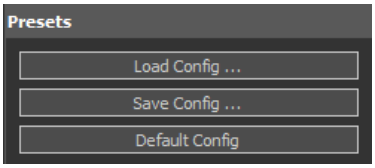
The **Log** tab contains a record of system events, and the log files are stored at: *C:\Users\<user>\AppData\Roaming\Norbit\Logs*

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



3.6.5 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.

3.7 Keyboard Shortcuts

The FLS can be operated using keyboard shortcuts for rapid configuration changes during operation. These controls also allow users to save preferred sonar configurations ("Save Config") to a file that can be loaded ("Load Config"). The saved configuration files are stored at: *%appdata%\NORBIT\PredefinedSonarSettings*

Key	Action	Description
Q	Start Sonar Pinging	Start the sonar pinging.
W	Stop Sonar Pinging	Stop the sonar pinging.
X	Start Recording	Start recording sonar raw data.
C	Stop Recording	Stop recording sonar raw data.
E	Start Range Increment	Increment the Start Range by 1m.
D	Start Range Decrement	Decrement the Start Range by 1m.
R	Stop Range Increment	Increment Stop Range by 20m.
F	Stop Range Decrement	Decrement Stop Range by 20m.
A	Opening Angle Increment	Increment Opening Angle by 10°.
S	Opening Angle Decrement	Decrement Opening Angle by 10°.
Z	Frequency Change	Change Frequency to next option in drop-down menu.
T	Bandwidth Increment	Increment bandwidth with 10kHz.
G	Bandwidth Decrement	Decrement bandwidth with 10kHz.
Y	Sweep Time Increment	Increment sweep time by 50s.
H	Sweep Time Decrement	Decrement sweep time by 50s.
I	Pulse Amplitude Increment	Increment the Pulse Amplitude power by 1.
K	Pulse Amplitude Decrement	Decrement the Pulse Amplitude power by 1.
Shift+E	Brightness Increment	Increment display brightness by 1dB.
Shift+D	Brightness Decrement	Decrement display brightness by 1dB.
Shift+R	Gamma Correction Increment	Increment gamma correction by 0.25.
Shift+F	Gamma Correction Decrement	Decrement gamma correction by 0.25.
Shift+T	TVG Increment	Increment time variable gain by 1dB.
Shift+G	TVG Decrement	Decrement time variable gain by 1dB.
F1	Display T Window	Display view of time trace window.
F2	Display S Window	Display view of sonar settings window.
F3	Display P Window	Display view of predefined settings window.
F4	Hide T Window	Hide view of time trace window.
F5	Hide S Window	Hide view of sonar settings window.
F6	Hide P Window	Hide view of predefined sonar settings window.
V	Set Colour Map "rust1"	Change colour map in wedge to "rust1".
B	Set Colour Map "blue/yellow"	Change colour map in wedge to "blue/yellow".
Alt+1	Load Preset 1	Apply saved pre-settings #1.
Alt+2	Load Preset 2	Apply saved pre-settings #2.
Alt+3	Load Preset 3	Apply saved pre-settings #3.
Alt+4	Load Preset 4	Apply saved pre-settings #4.
Alt+5	Load Preset 5	Apply saved pre-settings #5.
Ctrl+R	Update Display	Read settings from sonar and update GUI accordingly.

3.8 Data Formats, Recording & Output

The FLS outputs a stream of image data, which is basically a rectangular array (pixel bitmap) that represents the intensities returned by the FLS, where each beam returns a time series of intensities in sonar relative geometry (unadjusted for offsets and motion). Most techniques for processing these bitmaps are supplied by end users or purchased on the third-party market for integration.

Imagery data is 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, and *.s7k files can be changed by selecting **Advanced** > **Options** > **Paths.** See section 3.6.1 for more details.

3.9 WBMS Data Rates

The data rate depends on the frame rate (which is determined automatically) and the resolution as set by the user. The estimates below represent the combined file sizes of WBM and s7k files, which are both recorded simultaneously by default, containing water column data only. If only WBM files are recorded, the figures below should be halved.

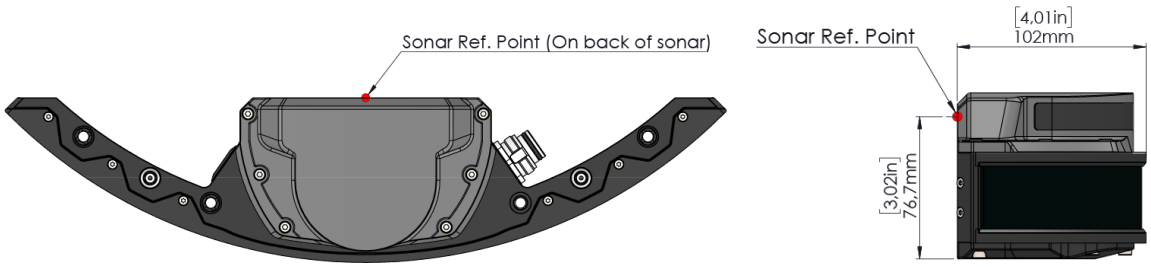
Range (m)	Frame Rate (Hz)	Combined WBM and s7k File Size by Resolution (MB/min)				
		Lowest	Low	Medium	High	Highest
5	5	24.8	44.8	44.8	84.8	84.8
10	5	24.8	44.8	64.8	184.8	184.9
20	5	24.8	24.8	44.8	164.8	324.0
50	5	24.8	24.8	44.8	144.8	264.0
80	5	24.8	24.8	44.8	144.8	264.0
150	5	24.8	24.8	44.8	144.8	284.0
300	2.5	24.8	24.8	24.8	84.8	144.8

Range (m)	Frame Rate (Hz)	Data Rate (Mbps)				
		Lowest	Low	Medium	High	Highest
5	5	1.67	3.13	3.13	5.93	5.93
10	5	1.67	3.13	4.53	12.92	12.92
20	5	1.67	1.67	3.13	11.52	22.65
50	5	1.67	1.67	3.13	10.12	18.46
80	5	1.67	1.67	3.13	10.12	18.46
150	5	1.67	1.67	3.13	10.12	19.83
300	2.5	1.67	1.67	1.67	5.93	10.12

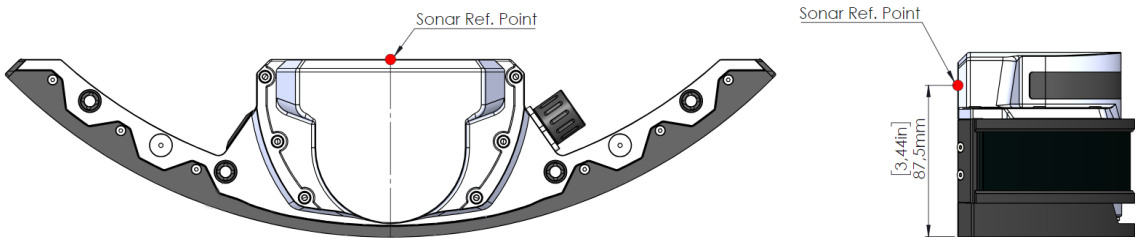
4 Sonar Reference Point

The sonar reference point (i.e. the acoustic centre) is indicated by the red dot on the drawings below. For most users, the location of the sonar reference point is irrelevant, but it may be required for some specific applications, for example very accurate obstacle avoidance when PPS timing is combined, or when the bathymetry output mode is enabled.

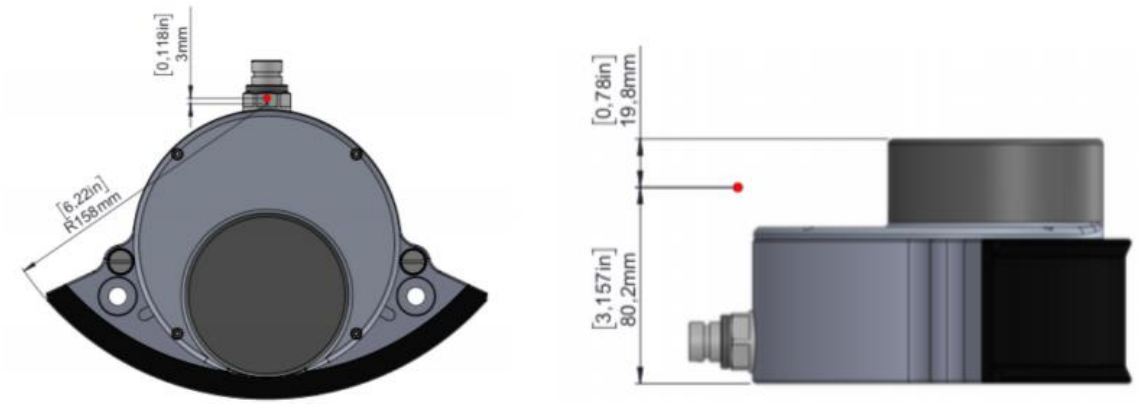
4.1 WINGHEAD (PN 24102)



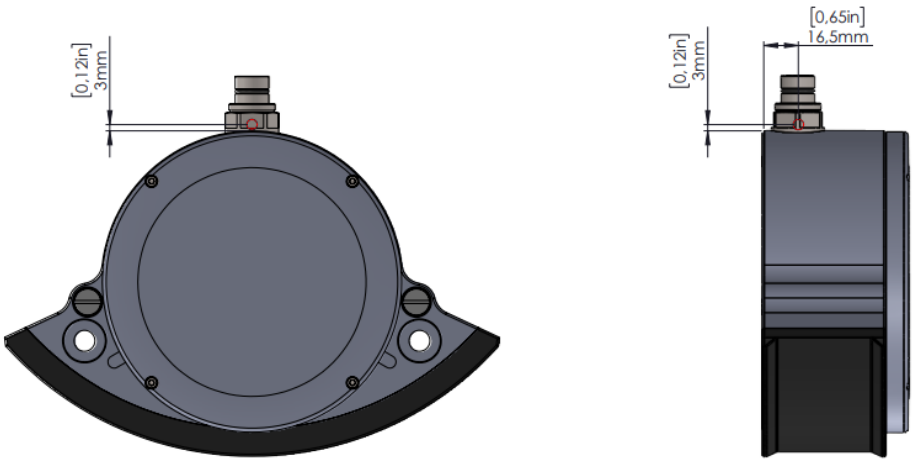
4.2 WINGHEAD F11 Deep Sea (PN 24109)



4.3 WBMS FLS (PN 24002)



4.4 WBMS FLS Compact (PN 24002)



Note that for the Full Ocean (6000m rated) version (PN 24031), the sonar reference point is offset **21.8mm** from the flat edge of the sonar instead of 16.5mm for standard (non-depth rated) models.

5 Maintenance

5.1 Caring for Your Investment

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

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

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

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

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

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

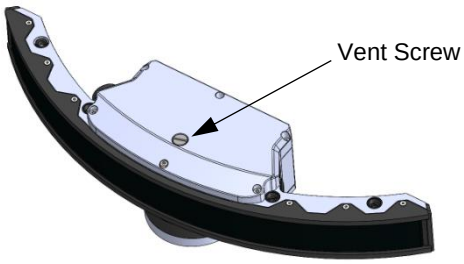
If the system is protected with antifouling paint, then additional care is required to ensure the paint is not scraped or degraded during mobilisation, shipping or handling. After retrieving the sonar from the water, wipe down the system with a clean towel to clear off dirt, grime, marine growth, etc.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

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

5.2 Vent Screw

WINGHEAD F11 models are equipped with a pressure vent screw located on the bottom lid. This primarily serves the purpose of facilitating production procedures carried out by qualified NORBIT personnel.

Additionally, it functions as a safety measure following deep dives, should there be any concerns about potential leaks, by enabling the controlled release of pressure in a safe and controlled manner. Do **NOT** tamper with the vent screw unless absolutely necessary, as doing so may result in irreparable damage to the sonar. If in doubt, contact NORBIT Support for guidance.



5.3 Marine Growth Removal Procedure

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

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

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

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

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

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

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

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

5.4 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.

5.4.1 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.
Sonar Housing	Inspect housing for scratches and corrosion. Ensure anode is in good condition (for aluminium housing).	Small scratches compromise the galvanic barrier of the aluminium housing.
Sonar Connector	Check for debris and clean with compressed air. Cable connector must be dry and clean. Use protective cap when not in use.	Sonar connection is not wet-mateable. Do not disconnect or connect when sonar is submerged or in wet areas.
Sonar Cable	Check connectors and clean with compressed air. Run cable through hand and check that cable is smooth, without kinks and tears. Check that pins are shiny and not bent. Check O-rings for wear and replace as necessary. Use small amount of silicone lubricant.	A bad connection or bad cable will corrupt survey data. Treat the cable with great care (do not stand on it).
Sonar Mounting Bolts	Check that threads on plastic sleeves are intact and not de-threaded. Vibration over long term can loosen bolts and compromise data quality or loss of wet-end.	Use only stainless-steel bolts and washers. Use Loctite 242 Blue, lock washers and/or nylon nuts.
Mounting Bracket	Check that all hardware for the mounting bracket is tight. Care must be taken when checking the mounting screws for the sonar as over tightening may damage the connections.	The bracket is very robust and provides electrical isolation from the vessel.
Electrical & Galvanic Isolation Shield	Check that plate is included in shipping case and used between sonar and sonar bracket when mounted. It is imperative to use the included electrical isolation shield.	This protects the aluminium sonar housing from galvanic corrosion.
Firmware & GUI Versions	Ensure that both firmware and GUI versions match and are latest.	Contact NORBIT Support for details.

5.4.2 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	When not in use, the sonar cable should be secured with the included protective caps. The length may be

	damage occurs to the anodised aluminium or polyurethane, send photos to NORBIT Support for analysis. Allow the kit to dry before storing. Once back at the office, store with lid open.	adjusted by grabbing one of the collars and pulling on the cable.

5.4.3 Monthly

Component	Inspection	Additional Notes
Complete Kit	Perform all inspections in the previous sections.	Ensures that users are ready for the next survey.

5.4.4 Annually

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

6 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.

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 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 different from 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.
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.
GUI does not match description	• Obtain latest installer from NORBIT Support.
No timing in sonar or GUI date/time line is red (invalid)	• Check pins on cable and SIU. If a pin is bent, VERY gently bend it back. *This may result in damage, so do so at own liability* • Check that PPS LED on SIU is blinking at 1Hz (see section 2.3.4 for more info.) • Users can also obtain reliable NTP timing from Qinsy SNTP, which does not require a license. Open Qinsy and double-click SNTP Server. Enable the option “Always report valid status”, and change “Highlight client when offset” to 90ms. If server does not start, change UDP port in Options menu. Once server is running, go to the NORBIT GUI, select **Advanced** > **Options** > **Timing and Triggering**, select **NTP+PPS pos**, enter the network IP address of the PC running the server (no port number required), and click **Apply**. Another source of external, free timing server is Meinberg.
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, or no data from sonar	• Check sonar cable. Check that wet-end connection is tight. If it has loosened, remove connection, clean threads at both male and female fittings and apply a very small amount of grease (O-Ring grease mentioned in this manual works well), then re-tighten. If fingers are weak from cold weather, use a tool but **do not overtighten!**
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 that acquisition software has correct IP address and ports specified. For sonar data, the acquisition software must connect to the IP address of the NORBIT GUI PC (usually 127.0.0.1) and not the IP of the sonar itself.

Text in GUI appears too condensed	• In Windows 10, go to **Display Settings**, and change the Scale and Layout values. Change the value under “Change the size of text, apps, and other items”
Image clarity issues and signal multipath	• Signal multipath may occur when the sonar is mounted in a small tank pointed directly at wall. This behaviour is normal. • Reducing the Pulse Amplitude from the default setting of 15 may help when operating at very short ranges.

6.1 Change Sonar IP Address

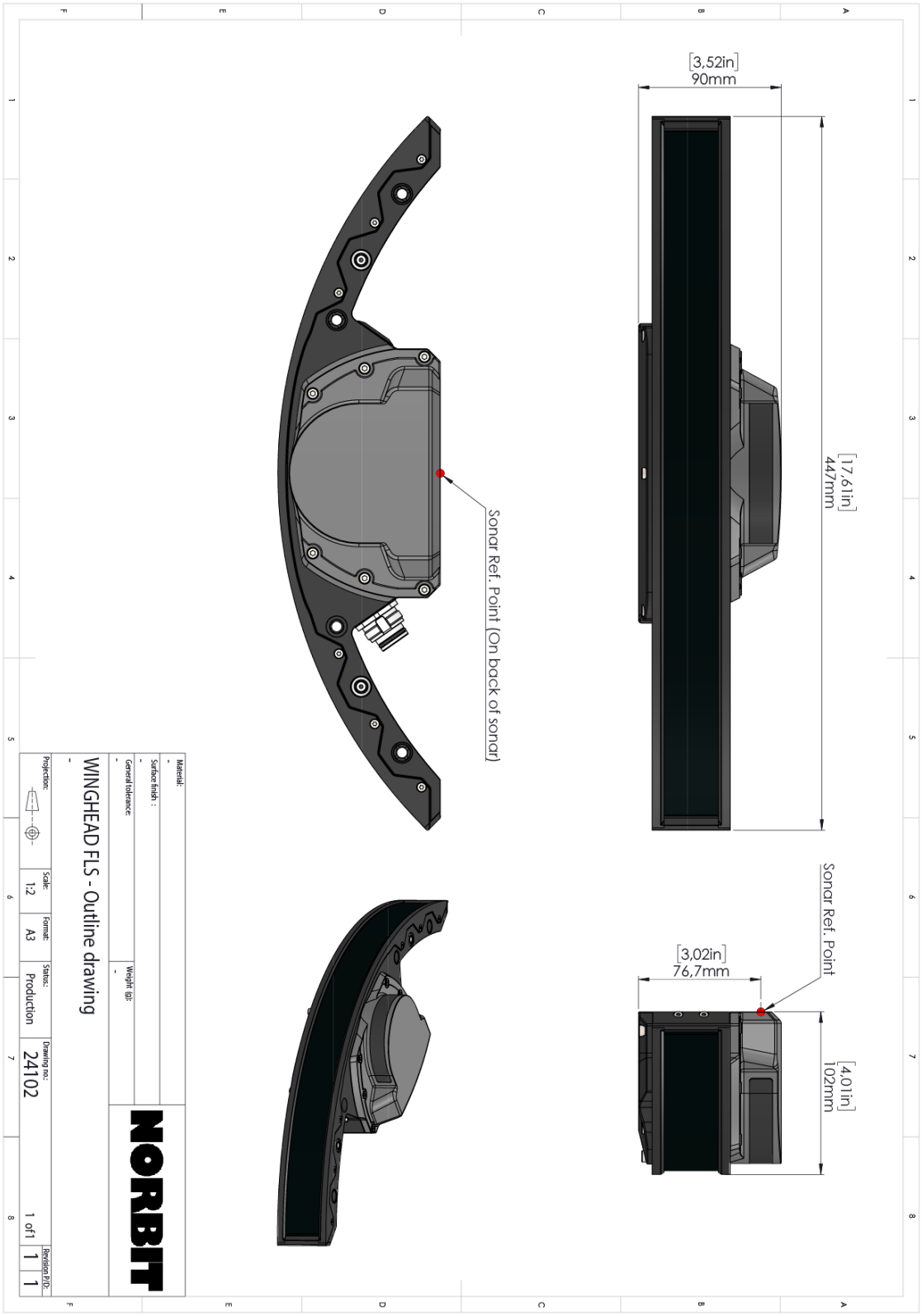
- To change the IP address of WINGHEAD S series sonars (e.g. i80S, B51S), please contact NORBIT Support for assistance and **DO NOT** attempt to change it through the web interface.
- To change the IP address of regular WINGHEAD sonars, use a web browser such as Google Chrome and go to: *http://<sonar-ip>:8080*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

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

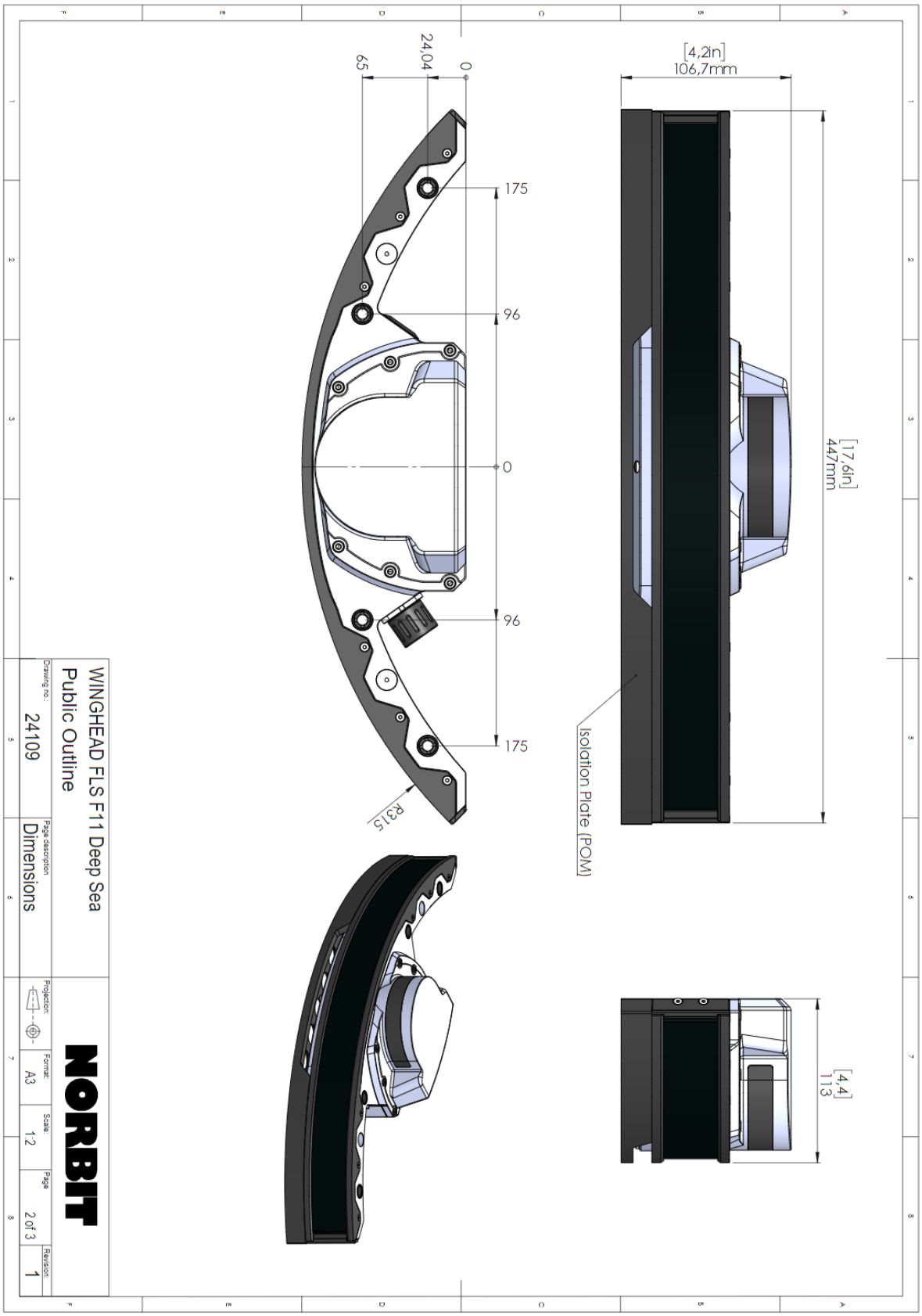
  Options:
  `fw_printenv ip_addr` (print to screen all ip_addr parameters)
  `fw_setenv ip_fallback 192.168.53.99` (sets IP to 99 if no DHCP server on network)
  `fw_setenv ip_addr 192.168.53.99` (sets static IP to 99 regardless of DHCP)

Appendix A: Hardware Dimensions

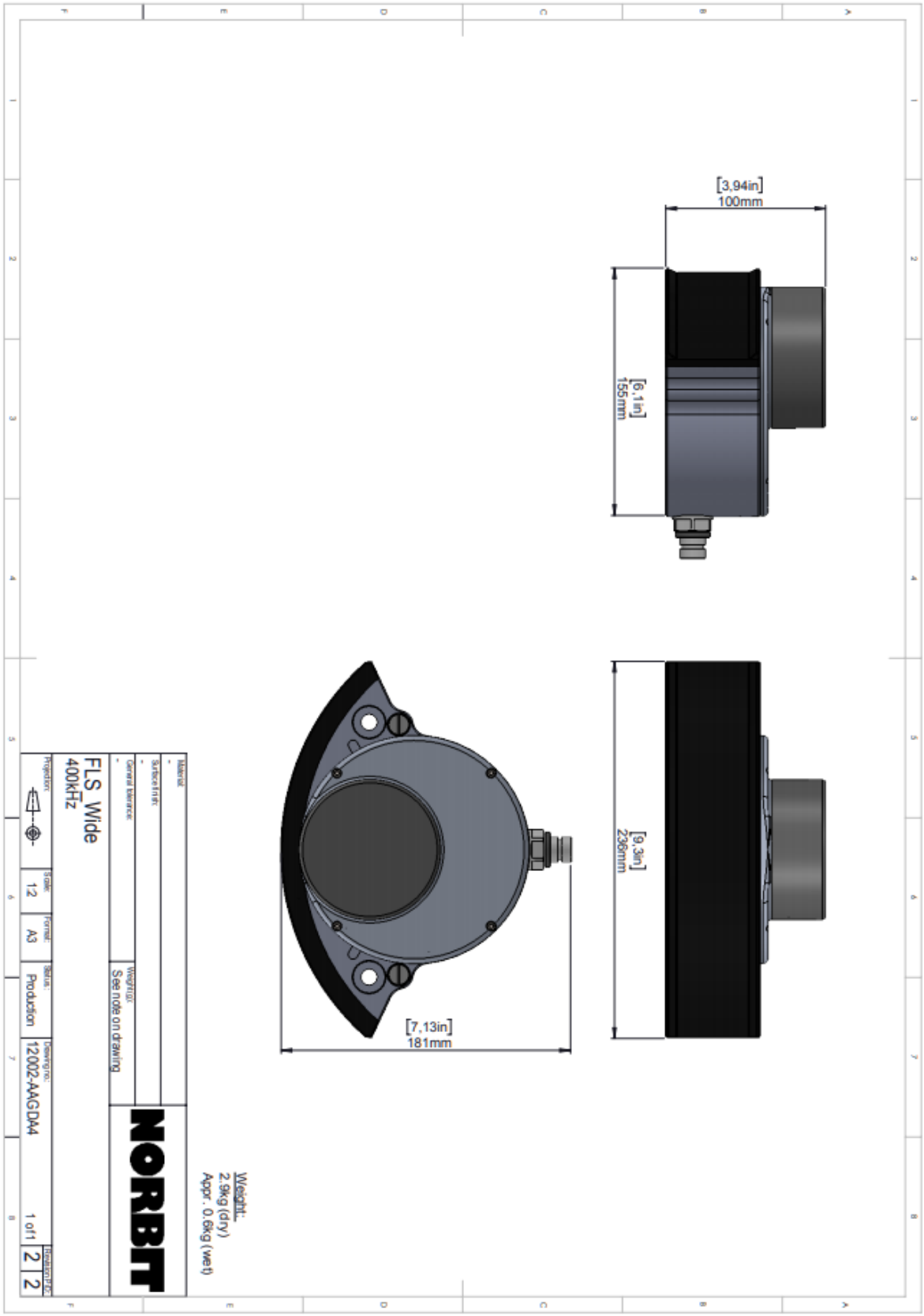
A1. WINGHEAD FLS (PN 24102)



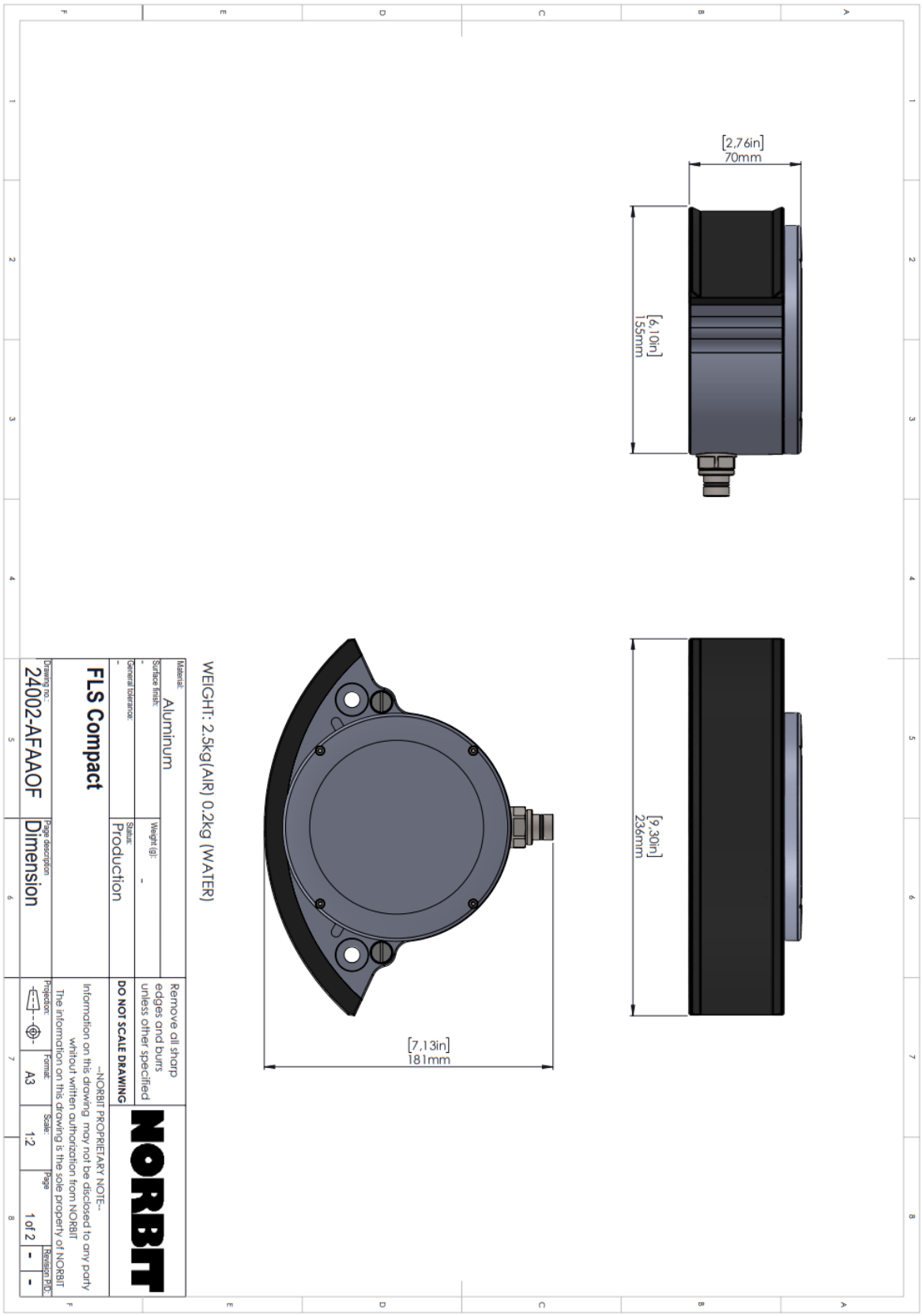
A2. WINGHEAD F11 Deep Sea (PN 24109)



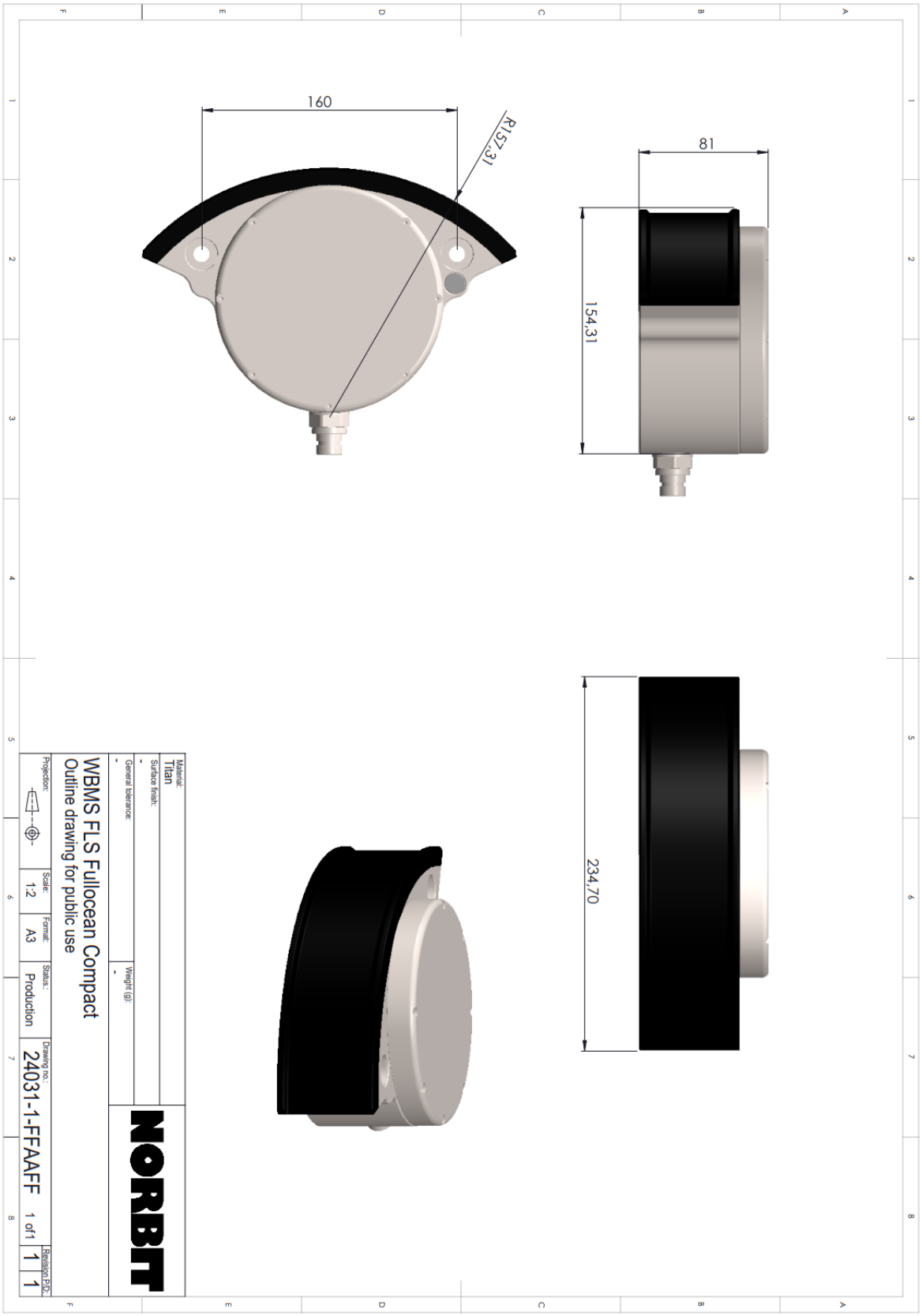
A3. WBMS FLS (PN 24002)



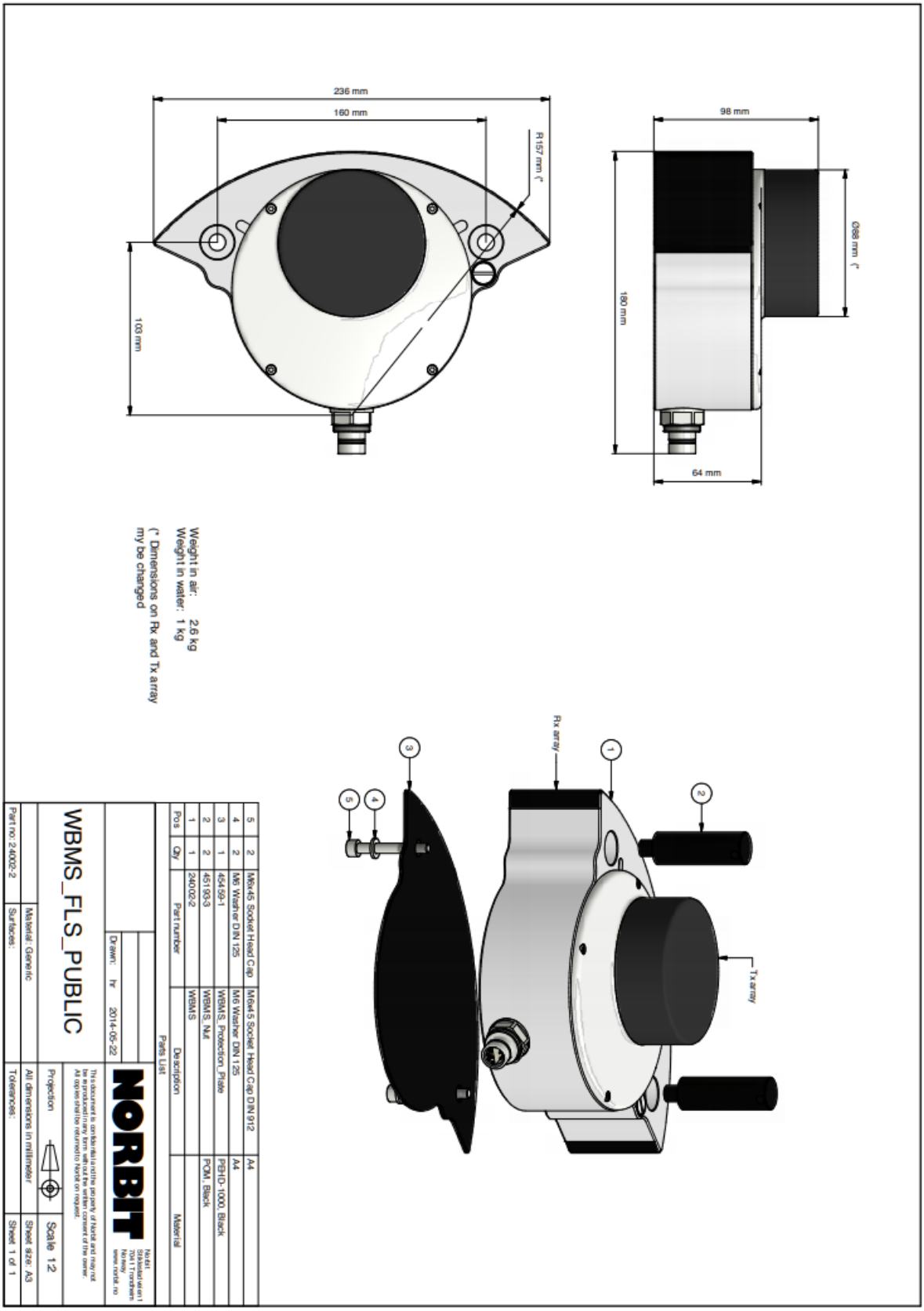
A4. WBMS FLS Compact (PN 24002)



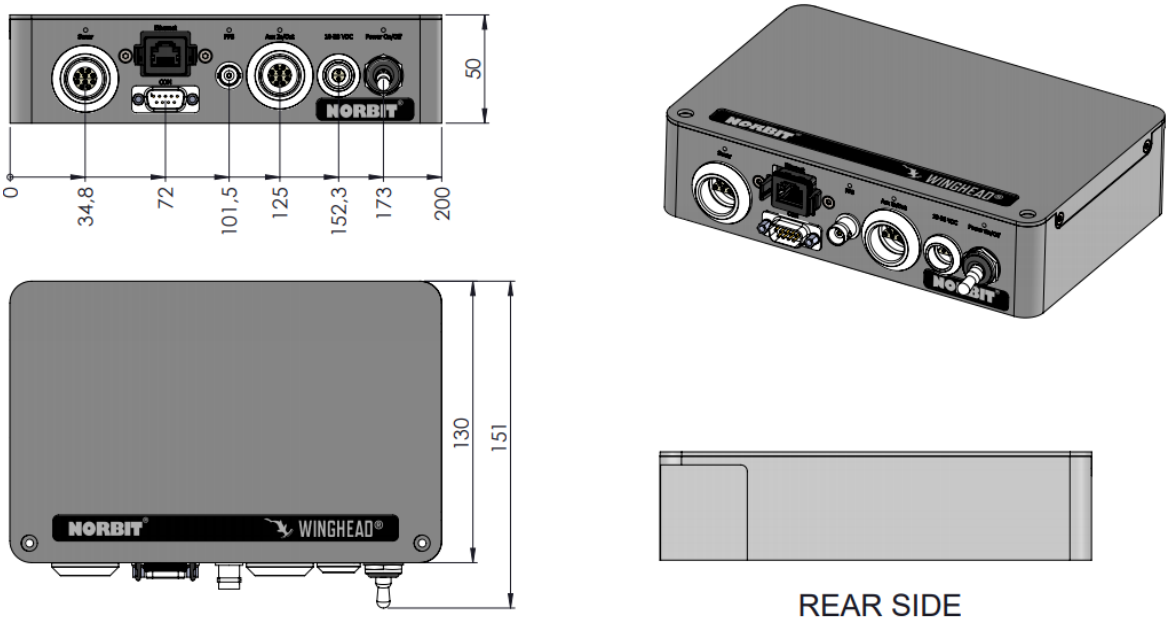
A5. WBMS FLS Compact Full Ocean (PN 24031)



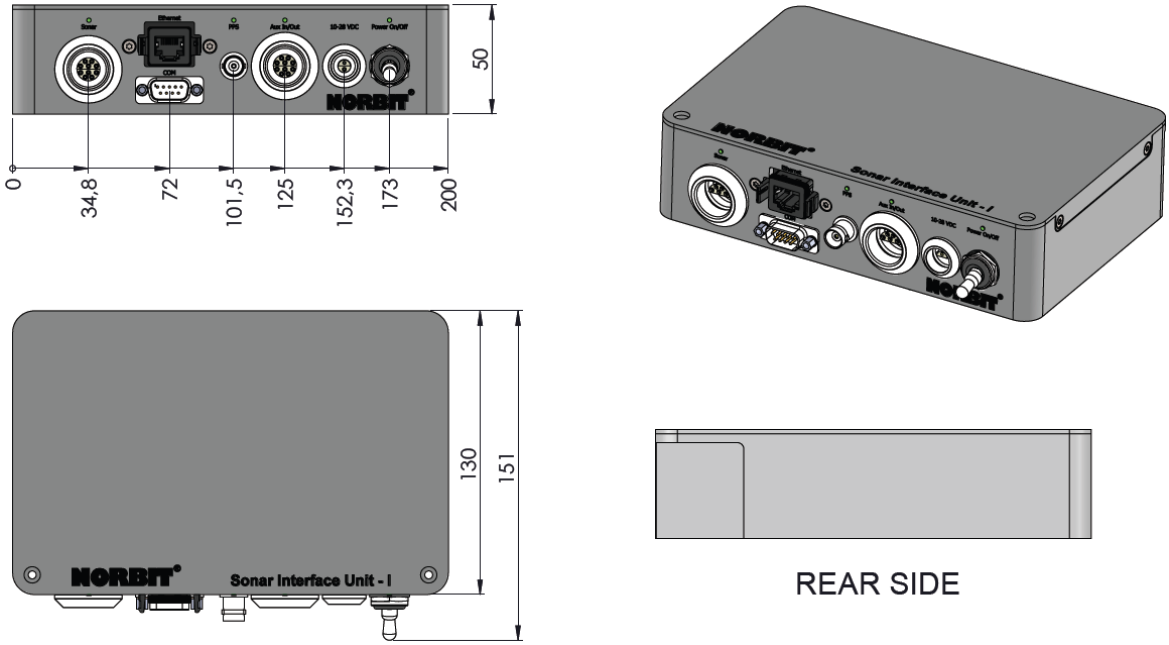
A6. WBMS FLS Mounting (PN 24002)



A7. WINGHEAD Sonar Interface Unit (PN 29064)



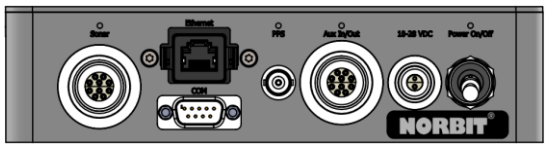
A8. WBMS Sonar Interface Unit (PN 29024)

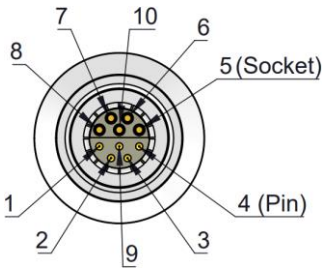


Appendix B: SIU Pinout Diagrams

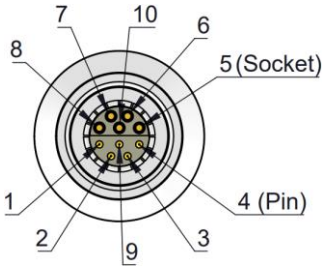
B1. WINGHEAD / WBMS FLS Sonar Interface Unit (PN 29064 / 29024)

WINGHEAD SIU-WH (PN 29064)

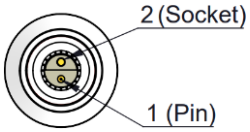




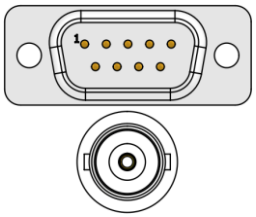
Sonar Socket	
Pin	**Function**
1	LAN TX+
2	LAN TX -
3	LAN RX+
4	LAN RX-
5	Trig+ (RS422)
6	Trig- (RS422)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24 VDC



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

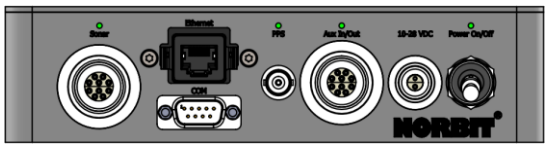


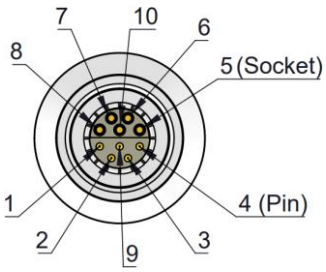
12-28 VDC Socket	
Pin	**Function**
1	PWR GND
2	PWR+12-28 VDC



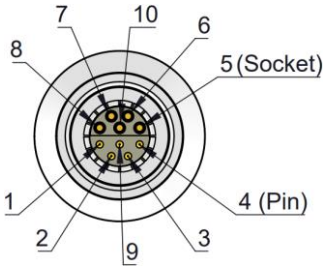
COM Socket / BNC	
Pin	**Function**
2	ZDA In, RS232 RX
3	RS232 TX
5	GND
9/BNC	PPS In

WBMS SIU-I (PN 29024)

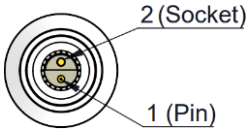




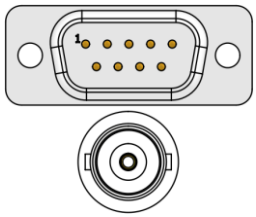
Sonar Socket	
Pin	**Function**
1	LAN TX+
2	LAN TX -
3	LAN RX+
4	LAN RX-
5	Trig Out (RS232)
6	Trig In (RS232)
7	Time Out
8	Signal GND
9	PWR GND
10	PWR + 24 VDC



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



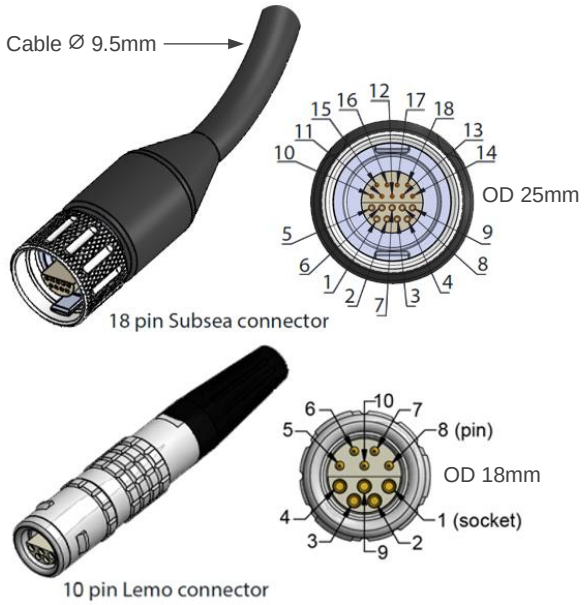
12-28 VDC Socket	
Pin	**Function**
1	PWR GND
2	PWR+12-28 VDC



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

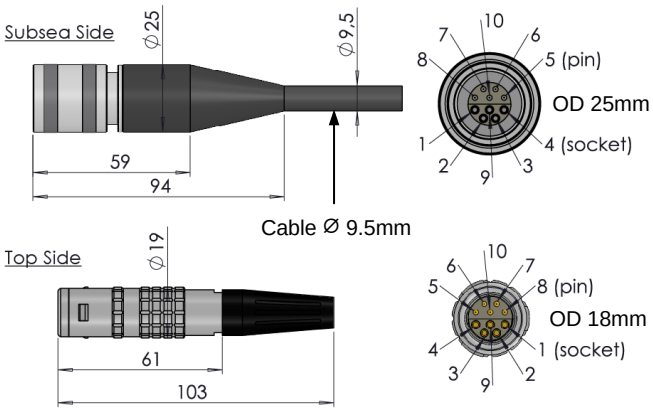
Appendix C: Cable Pinout Diagrams

C1. WINGHEAD Interface Cable (PN 33372)



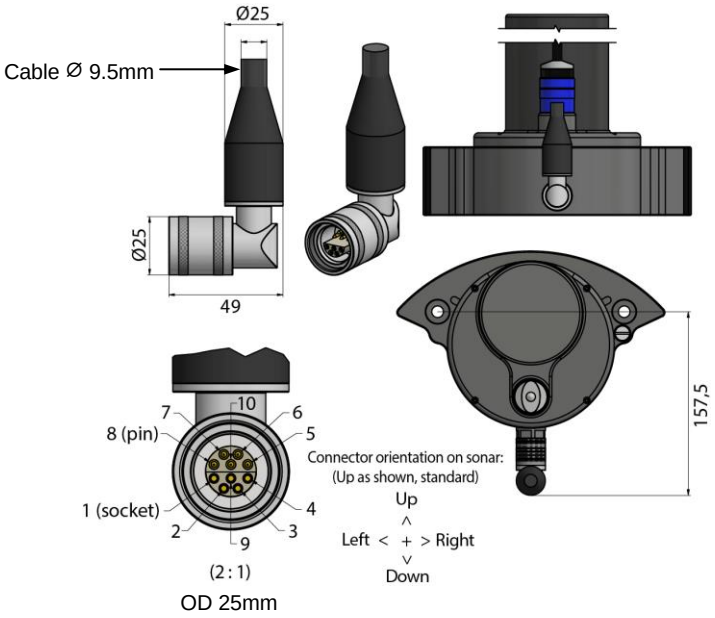
Subsea (18-pin)	Topside (10-pin)	Function
1	10	PWR+
2	1	ETH1_A+
3	2	ETH1_A-
4	10	PWR+
5	N/C	
6	7	TIME+
7	8	TIME-
8	N/C	
9	N/C	
10	N/C	
11	N/C	
12	6	TRIGGER-
13	5	TRIGGER+
14	N/C	
15	9	GND
16	3	ETH1_B+
17	4	ETH1_B-
18	9	GND

C2. WBMS Interface Cable (PN 33029)



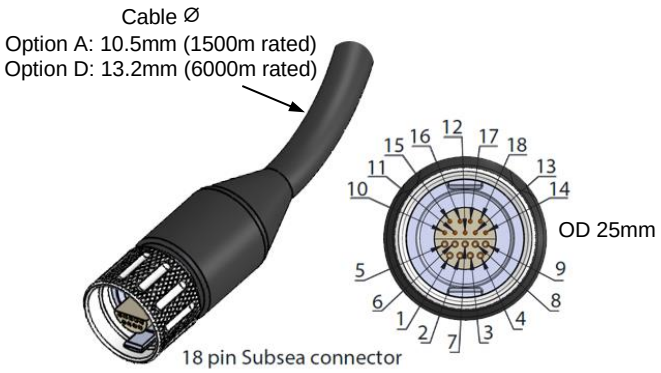
Subsea (10-pin)	Topside (10-pin)	Function
1	1	Tx +
2	2	Tx -
3	3	Rx +
4	4	Rx -
5	5	RS232 Tx/Trig Out
6	6	RS232 Rx/Trig In
7	7	IRIG-B
8	8	Signal GND
9	9	PWR GND
10	10	PWR +24VDC

C3. WBMS Interface Pigtail Angled (PN 33205)

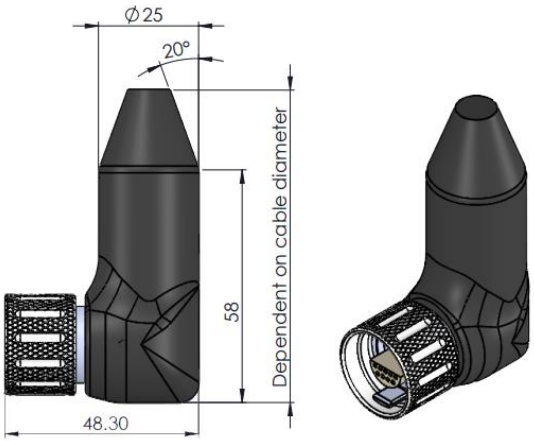


Pin	Function	Cable / Colour
1	Tx +	24 AWG, white/orange
2	Tx -	24 AWG, orange
3	Rx +	24 AWG, white/green
4	Rx -	24 AWG, green
5	RS232 Tx/Trig Out	24 AWG, white/brown
6	RS232 Rx/Trig In	24 AWG, brown
7	PPS/IRIG-B	24 AWG, white/blue
8	Signal GND	24 AWG, blue
9	PWR GND	Black, 0.5mm^2
10	PWR +24V	White,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

C4. WINGHEAD Interface Pigtail (PN 33370)



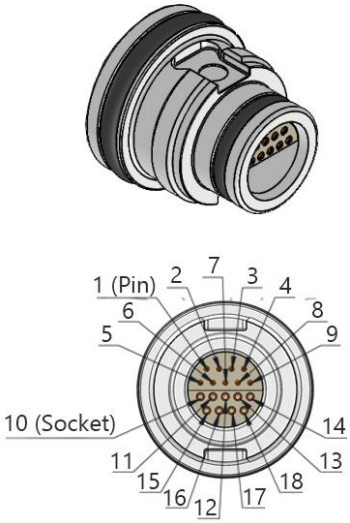
Straight connector is the default option.
Right-angled options also available.



Pin	Function
1	PWR+
2	ETH1_A+
3	ETH1_A-
4	PWR+
5	ETH1_C+
6	TIME+
7	TIME-
8	TIME_GND
9	ETH1_D-
10	ETH1_C-
11	Trigger_GND
12	TRIGGER-
13	TRIGGER+
14	ETH1_D+
15	GND
16	ETH1_B+
17	ETH1_B-
18	GND

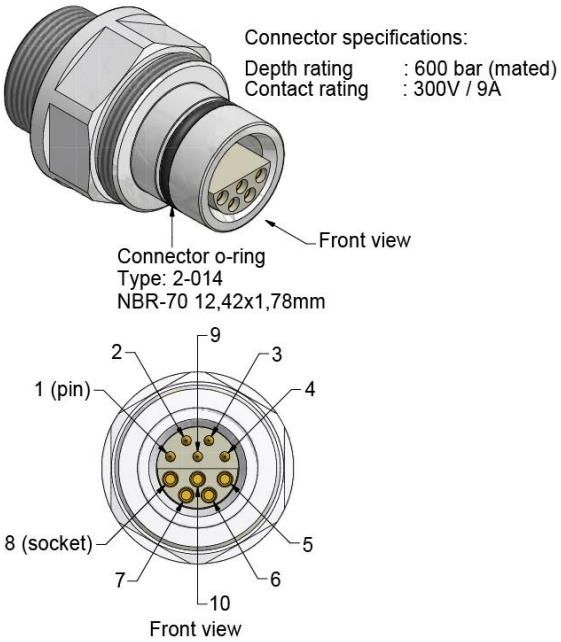
Appendix D: Bulkhead Pinout Diagrams

D1. WINGHEAD Bulkhead (PN 33362)



Pin	Function
1	PWR+
2	ETH1_A+
3	ETH1_A-
4	PWR+
5	ETH1_C+
6	TIME+
7	TIME-
8	TIME_GND
9	ETH1_D-
10	ETH1_C-
11	Trigger_GND
12	TRIGGER-
13	TRIGGER+
14	ETH1_D+
15	GND
16	ETH1_B+
17	ETH1_B-
18	GND

D2. WBMS Bulkhead (PN 33049)



Pin	Function	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 0,5mm^2
10	PWR +24V	White, 0.5mm^2