# Subsea ROV/AUV & USV

## Integration Manual

## 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.

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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.

## Release Notice

This is the May 3, 2023 release of the NORBIT ROV/AUV/USV Integration Manual.

## Reference Documentation

This manual should be used in conjunction with the following documents. Please contact NORBIT Support if you do not have these documents.

TN-180196 - Data Format Definition
TN-140075 - Multibeam User Manual

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# Contents

# 1 General Guidelines

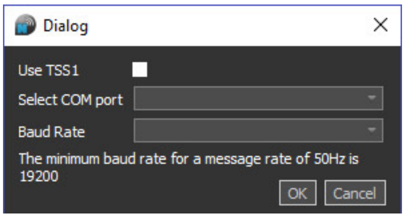
This document describes the special considerations when mounting NORBIT sonars on ROVs, AUVs, ASVs and USVs. The focus is on the electronic and technical side of the installation and should be used in conjunction with the NORBIT Multibeam User Manual (TN-140075).

## 1.1 Subsea Hardware Configuration

The topside SIU is **NOT** required for subsea (ROV and AUV) installations, and NORBIT does not recommend using it. Refer to sections 2 and 3 for the recommended ROV and AUV hardware configurations, respectively.

## 1.2 Motion Stabilization

For standalone NORBIT sonars, without integrated INS functionality, a TSS1 message can be interfaced from an external motion sensor for roll stabilization (and pitch stabilization on certain models), to allow wider swaths and more even sounding coverage in dynamic sea states. TSS1 is a common data format which most ROV and AUV motion sensors can output.




The message should be interfaced to the PC on which the NORBIT GUI is installed, via a serial COM port. Under **INS Tools > TSS1**, enable the **Use TSS1** checkbox, and select the **COM port** and **Baud Rate**. Click **OK**. Stabilization should then be enabled under the **Advanced** menu.

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

# 2 ROV Configurations

The following configurations are valid with WINGHEAD, WBMS Bathy, FLS, STX, Deep Sea and FullOcean NORBIT sonars.

## 2.1 WBMS Single Head

The recommended setup for single head is shown below:

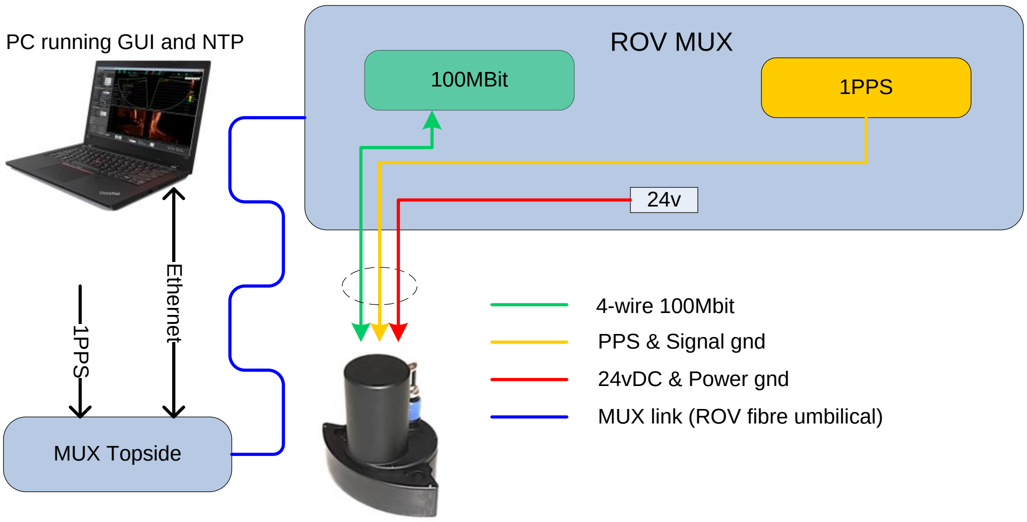



Figure 1. Typical WBMS Single Head ROV Setup

## 2.2 WBMS Dual Head

The recommended setup for dual head is shown below:

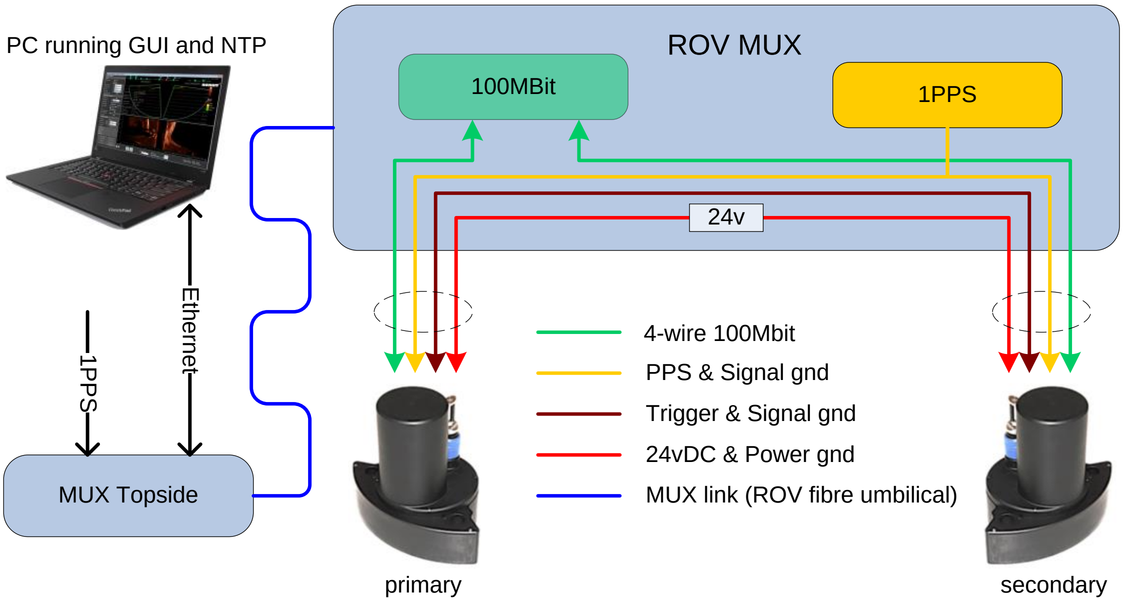



Figure 2. Typical WBMS Dual Head ROV Setup

### 2.2.1 WBMS Trigger & Timing Connection

To connect the trigger signal between the dual head sonars, the RS232 trigger signal must be crossed over (TX to RX):

| Signal | Pin | Comment |
|---|---|---|
| RS232 TX/Trig Out | 5 | Trigger between sonars |
| RS232 TX/Trig In | 6 | Trigger between sonars |
| PPS/IRIG-B in | 7 | To MUX/timing output |
| Signal GND | 8 | Shared signal GND (do not connect to PWR GND) |
| PWR GND | 9 | To PSU (do not common with Signal GND) |
| PWR 24V | 10 | To PSU |

Table 1. Trigger & Timing Connections

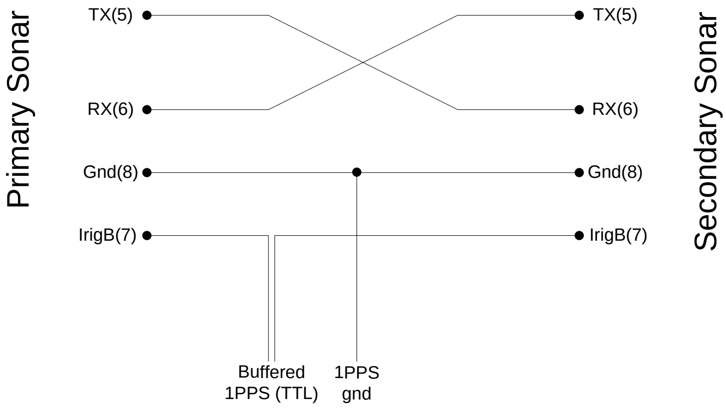



Figure 3. Dual Head ROV synchronization and 1PPS wiring

## 2.3 WINGHEAD Single Head

The WINGHEAD ROV setup is very similar to the WBMS, however options can be available.

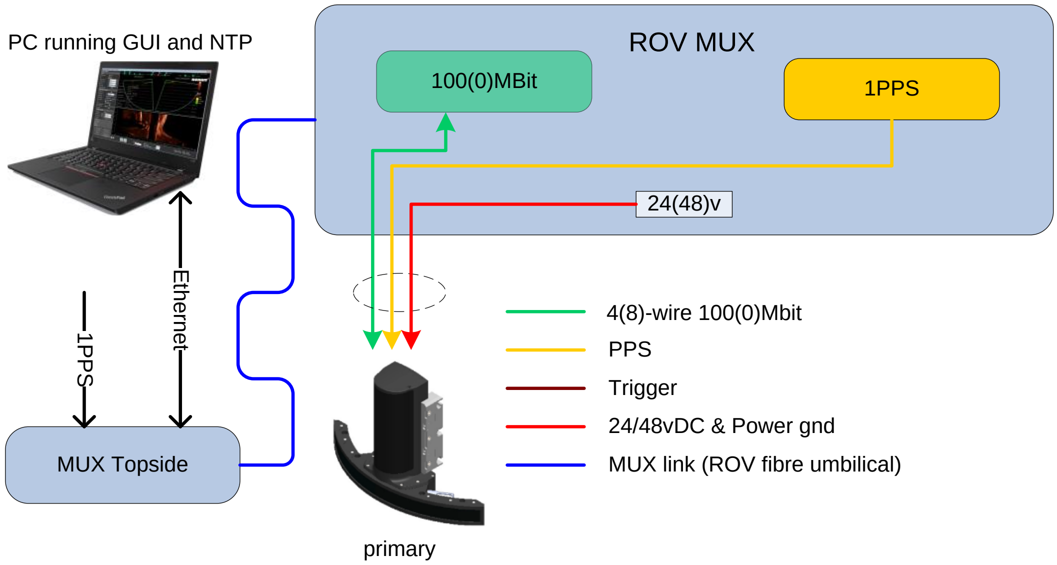



Figure 4. Typical WINGHEAD Single Head ROV Setup

**Notes:**

- 18-pin variant uses RS422 serial interfacing and 100Mbit Ethernet.
- 24-pin variant uses RS422 or TTL serial interfacing and 100Mbit or 1000Mbit ethernet.
- Non-WINGHEAD “S” series models will run on 24v/48v DC.

## 2.4 WINGHEAD Dual Head

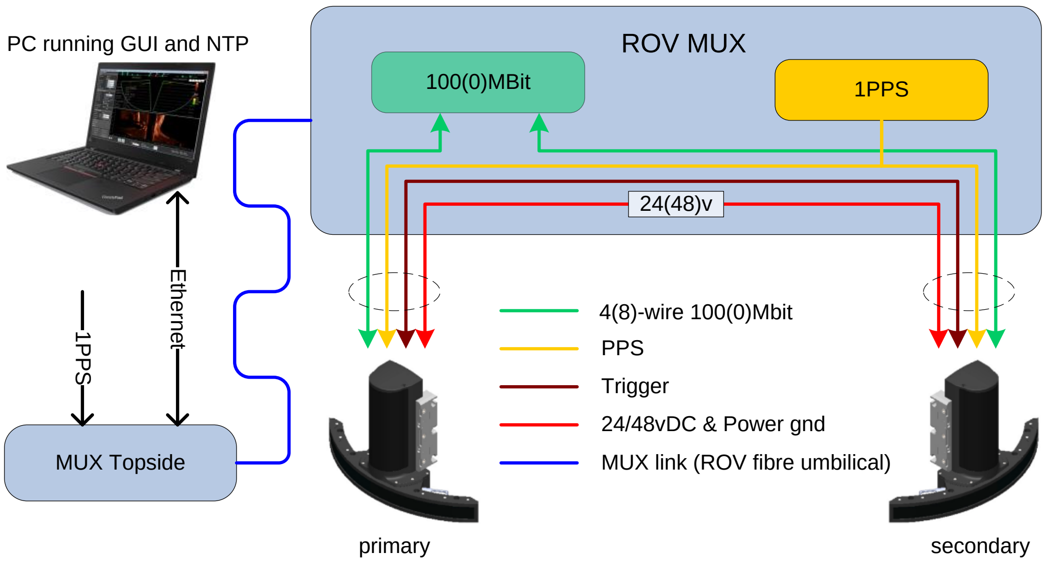



Figure 5. Typical WINGHEAD Dual Head ROV Setup

### 2.4.1 WINGHEAD Trigger & Timing Connection

To connect the trigger signal between the dual head sonars, the RS422 trigger should be pin-to-pin as it uses half duplex signaling:

| Signal/Sonar | 18-pin (RS422) | 24-pin (RS422 PPS) | 24-pin (TTL PPS) | Comment |
|---|---|---|---|---|
| Trigger+ | 15 | 24 | 24 | RS422 Trigger between sonars |
| Trigger- | 16 | 23 | 23 | |
| TIME+ | 9 | 1 | 1 | 1PPS signal<br>Do not connect Time GND to PWR GND |
| TIME- | 14 | 2 | N/A | |
| TIME GND | N/A | N/A | 3 | |

Table 2. Trigger and Timing Connections

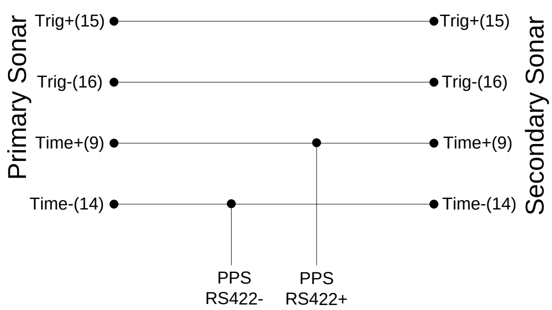



Figure 6. WINGHEAD 18-pin Trigger and Timing RS422 Connections

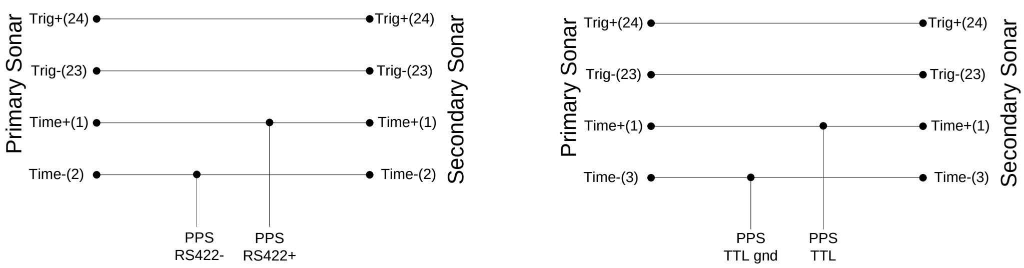



Figure 7. WINGHEAD 24-pin Trigger and Timing RS422 and TTL Connections

# 3 AUV Configurations

## 3.1 WINGHEAD Single Head

The recommended setup for single head AUV installations is shown below:

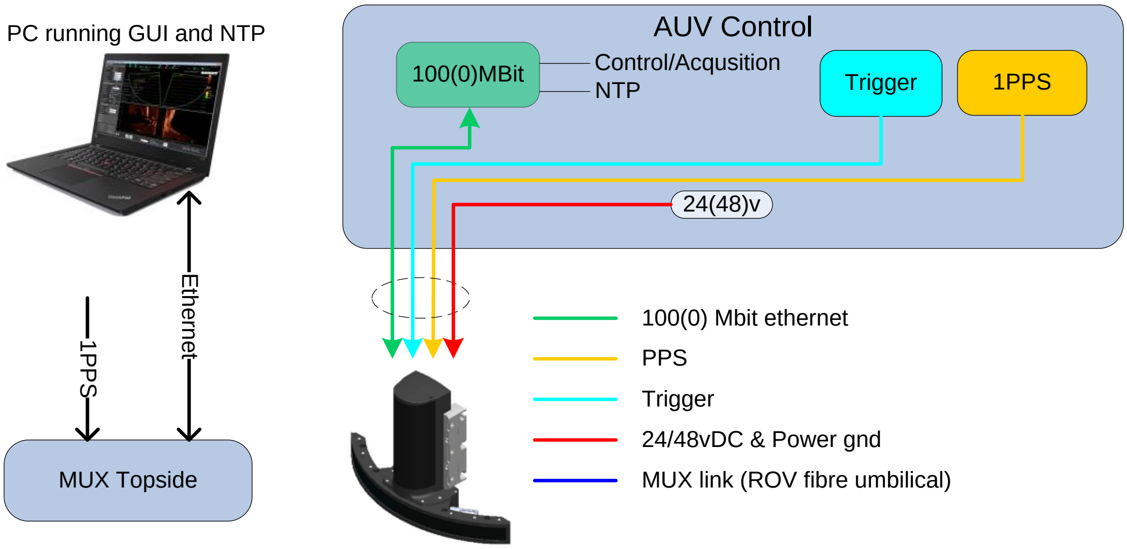



Figure 8. Typical WINGHEAD Single Head AUV Setup

# 4 WINGHEAD Series

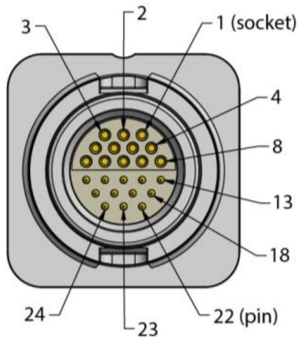
## 4.1 WINGHEAD Bulkhead Options

Depending on the sonar model, the WINGHEAD contains either an 18-pin or 24-pin bulkhead connector. The pinout descriptions and electrical specifications are detailed in the following sections.

The 24-pin connector supports an extra INS channel for synchronization purposes, and can therefore support longer cables, extra wires for Gigabit Ethernet communications, and ground connections allowing single-ended time and trigger interfacing.

By default, the TRIG+/- and TIME+/- inputs are configured for RS422 to allow better noise immunity. The input characteristics can be modified in the sonar Web UI, which can be accessed in a web browser at http://<sonar-ip>:8080 (for example: http://192.168.53.XX:8080, where XX is the last 2 digits of the sonar serial number). Refer to section 4.4.2 for more details.

### 4.1.1 Option 1: PN 33227 (24-Pin Connector)




**WINGHEAD Bulkhead Connector, PN 33227**

Connector type : NORBIT 33227
Material : Titanium Grade 5
Insert : Lemo 24 pin
Endurance : > 5000 cycles IEC 60512-5 test 9a
BH O-ring life : Situation dependent – check regularly.
BH O-ring : Parker 6-725 NBR 70 Ø16.56x1.78

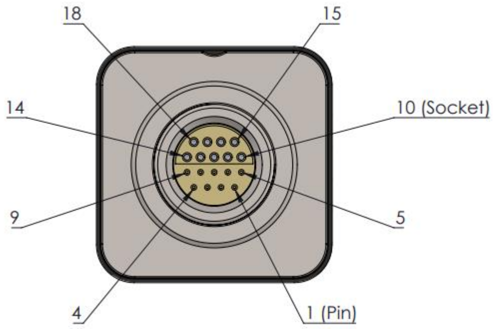
| Pin | Function | Electrical Spec | Comment |
|---|---|---|---|
| 1 | TIME+ | RS422 | Selectable Single-ended/Balanced TTL/ RS422* |
| 2 | TIME- | RS422 | |
| 3 | TIME_GND | RS422 GND | |
| 4 | PWR- | Power GND | Main Power GND |
| 5 | ETH_B- | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 6 | ETH_B+ | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 7 | PWR- | Power GND | Main Power GND |
| 8 | ETH_A+ | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 9 | IMU_A+ | RS422 | RS422 |
| 10 | IMU_B- | RS422 | RS422 |
| 11 | IMU_C+ | RS422 | RS422 |
| 12 | ETH_C- | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 13 | ETH_A- | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 14 | IMU_A- | RS422 | RS422 |
| 15 | IMU_B+ | RS422 | RS422 |
| 16 | IMU_C- | RS422 | RS422 |
| 17 | ETH_C+ | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 18 | PWR+ | 24v or 24v-48v | DC Main power input (-S models or other models) |
| 19 | ETH_D+ | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 20 | ETH_D- | 1000BASE-T | Selectable 1000BASE-T and 100BASE-T |
| 21 | PWR+ | 24v or 24v-48v | DC supply input (24v-S models or 24-48v other models) |
| 22 | TRIG_GND | RS422 GND | Selectable Single-ended/Balanced TTL/ RS422* |
| 23 | TRIG- | RS422 | |
| 24 | TRIG+ | RS422 | |

Table 3. WINGHEAD 24-Pin Bulkhead Pinout

The 24-pin connection allows selection of electrical input types for Trigger pulse and Time input between balanced (RS422) and single-ended (TTL). The default is RS422 for better noise immunity. RS422 connections should be made between the TRIG+/- or TIME+/- connections, and TTL connections should be between TRIG_GND and TRIG+, or TIME_GND and TIME+ connections.

*RS232 (12v-24v) can be input using the Single-ended input type with the introduction of a 220Ω in-line resistor.

### 4.1.2 Option 2: PN 33237 (18-Pin Connector)




**WINGHEAD Bulkhead Connector, PN 33237**

| | | |
|---|---|---|
| Connector type | : | NORBIT 33237 |
| Material | : | Titanium Grade 5 |
| Insert | : | Lemo 18 pin |
| Endurance | : | > 5000 cycles IEC 60512-5 test 9a |
| BH O-ring life | : | Situation dependent – check regularly. |
| BH O-ring | : | Parker 2-014 NBR70 Ø12.42x1.78 |

| Pin | Function | Electrical Spec | Comment |
|---|---|---|---|
| 1 | PWR- | Power GND | Main Power GND |
| 2 | PWR- | Power GND | Main Power GND |
| 3 | PWR+ | 24v or 24v-48v | DC supply input (24v-S models or 24-48v other models) |
| 4 | PWR+ | | |
| 5 | IMU COM1 | RS422 | RS422 |
| 6 | IMU COM2 | RS422 | RS422 |
| 7 | LAN TX+ | 100BASE-T | 100BASE-T |
| 8 | LAN RX+ | 100BASE-T | 100BASE-T |
| 9 | IRIG B+ | RS422 | RS422 Only |
| 10 | IMU COM3 | RS422 | RS422 |
| 11 | IMU COM4 | RS422 | RS422 |
| 12 | LAN TX- | 100BASE-T | 100BASE-T |
| 13 | LAN RX- | 100BASE-T | 100BASE-T |
| 14 | IRIG B- | RS422 | RS422 Only |
| 15 | TRIGGER+ | RS422 | RS422 Only |
| 16 | TRIGGER- | RS422 | RS422 Only |
| 17 | NC | | |
| 18 | NC | | |

Table 4. WINGHEAD 18-Pin Bulkhead Pinout

## 4.2 Power

### 4.2.1 Input Voltage

When not using the SIU, i.e., when powering the WINGHEAD sonar directly, as per the recommended setup for ROV and AUV installations, the following specifications should be followed:

| Input | Voltage | Comments |
|---|---|---|
| Minimum | 24V (cut-off: 20v) | If the PSU and power lines create voltage drops, or spikes that fall under 20V, unexpected behavior may be encountered, with sudden system reboots. |
| Maximum for "S" series models | 28V (break-down: 30v) | Approaching the break down voltage will burn the input on the sonar, requiring service. |
| Maximum for all other models | 48V (shut-off: 52v) | |

### 4.2.2 Power Consumption

Consumption may vary according to the model and TX settings applied during operation. The guiding numbers provided in Table 5 were measured with an 8m cable and 48V PSU. Note that these do not cover all models and hardware revisions. If the power budget is tight, contact NORBIT Support for advice. NORBIT recommends using a 150W PSU (minimum) for all WINGHEAD models.

| WINGHEAD Model | Description | Idle | 5Hz 1600µs Peak | 5Hz 1600µs Mean |
|---|---|---|---|---|
| B41, B41 Titanium, B44 Deep Sea, B44 Full Ocean | WINGHEAD Non-Integrated | 47W | 106W | 76W |
| i77h, i79h | WINGHEAD Integrated | 50W | 109W | 79W |
| B51S, B57S | WINGHEAD Stabilized | 50W | 103W | 59W |
| i80S | WINGHEAD Stabilized (Integrated) | 53W | 106W | 62W |

Table 5. Power Consumption

**Note:** Figures quoted are for relatively low ping rates with longer pulse lengths for long range operations. For short range operations the sonars will ping faster, however shorter pulse lengths are used, therefore the current drawn is normally less.

### 4.2.3 Power Inrush

Power inrush is determined by several factors. Cable length (impedance between the PSU and sonar), input capacitor bank and PSU output capacitor bank are the most important factors. Below is a list of the NORBIT WINGHEAD sonars and the inrush specifications.

#### 4.2.3.1 WINGHEAD B41, B41 Titanium, B44 Deep Sea, B44 Full Ocean, i77h & i79h

PSU Capacitor bank : ~70uF
TX PSU : ~90uF

#### 4.2.3.2 WINGHEAD B51S, B57S, i80S & i87S

PSU Capacitor bank : ~170uF
TX PSU : ~70uF

### 4.2.4 Sonar Grounding

The sonar has multiple ground nodes, as detailed below.

#### 4.2.4.1 Chassis Ground

Coupled to Internal Isolated Ground.

#### 4.2.4.2 Power Ground

External power ground.

- **24-Pin Connector (PN 33227)**: Connected to Pins 4 & 7 (ref Table 3)
- **18-Pin Connector (PN 33237)**: Connected to Pins 1 & 2 (ref Table 4)

#### 4.2.4.3 Time Ground

**24-Pin Connector (PN 33227)**

- For single-ended inputs (TTL) the WINGHEAD timing input has a separate signal ground. It is galvanically isolated from all other ground nodes. For 1PPS/Time input, connect to pins 1&3 (ref Table 3)
- For balanced inputs (RS422) connect to pins 1&2 for the 1PPS/Time input, with optional RS422 ground on pin 3 (ref Table 3)

**18-Pin Connector (PN 33237)**

- For single-ended inputs (TTL) a signal ground is not available. Therefore, a TTL/RS422 converter is needed, and the input is connected in the balanced mode described below.
- For balanced inputs (RS422) connect to pins 9 & 14 for the 1PPS/Time input (ref Table 4)

#### 4.2.4.4 Trigger Ground

Note that the trigger input and output are across the same pairs, independent of pulse type.

**24-Pin Connector (PN 33227)**

- For single-ended inputs (TTL) the WINGHEAD timing input has a separate signal ground. It is galvanically isolated from all other ground nodes. For Trigger input, connect to pins 22-24 (ref Table 3)
- For balanced inputs (RS422) connect to pins 23-24 for the trigger input, with optional RS422 ground on pin 22 (ref Table 3)

**18-Pin Connector (PN 33237)**

- For single-ended inputs (TTL) a signal ground is not available. Therefore, a TTL/RS422 converter is needed, and the input is connected in the balanced mode described below.
- For balanced inputs (RS422) connect to pins 15-16 for the trigger input (ref Table 4)

### 4.2.5 Common Mode Choke

If the sonar is mounted without the SIU, as per the recommended setup for ROV and AUV installations, NORBIT advises the use of a common mode choke on the power lines to limit noise to the sonar through the power lines. A suitable choke is suggested below:

| | | |
|---|---|---|
| Manufacturer | : | Bourns Inc. |
| Part | : | 7124-RC |
| Description | : | Common Mode, CMC 2.55MH 10A 2LN Through Hole |

# 4.3 Ethernet

## 4.3.1 General

NORBIT WINGHEAD sonars use the following:

- 4 wire 100BASE-T with HP Auto-MDIX Support for the 18-pin variant.
- 4/8 wire 100BASE-T/1000BASE-T with HP Auto-MDIX Support for the 24-pin variant. This is selected though the sonar web user interface.

## 4.3.2 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 entering: *http://<sonar-ip>:8080* (for example: http://192.168.53.XX:8080, where XX is the last 2 digits of the sonar serial number). Use the mode selection to change between static and DHCP. Use the IP address, Netmask and Gateway to change the static settings.

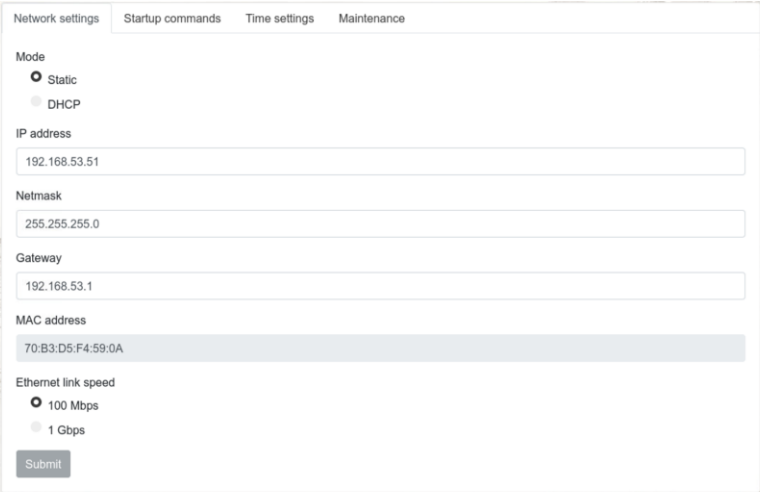



Figure 9. Web UI Network Settings

## 4.3.3 Change Ethernet Speed

The default Ethernet link speed is 100Mbit, however the 24-pin variant will run at 1000Mbit. The Auto-MDIX should auto-detect the link speed, however this might not be the case with some multiplexers. If necessary, the maximum auto-negotiated speed can be changed in the sonar Web UI, selecting 1000Mbit or 100Mbit, as shown in Figure 9.

# 4.4 Trigger

## 4.4.1 General

Many installations require synchronization of sensors to prevent acoustic interference. NORBIT WINGHEAD sonars contain trigger lines for input and output of synchronization pulses. To run NORBIT sonars in dual head mode, the trigger lines are required.

| | | |
|---|---|---|
| Description | : | Transceiver RS422, Isolated, Configurable |
| Ground | : | Trig_GND |
| Maximum ratings | : | See Table 3 |

The trigger input is RS422 (default), optional TTL 5V and 3V3.

### 4.4.2 IO Configuration

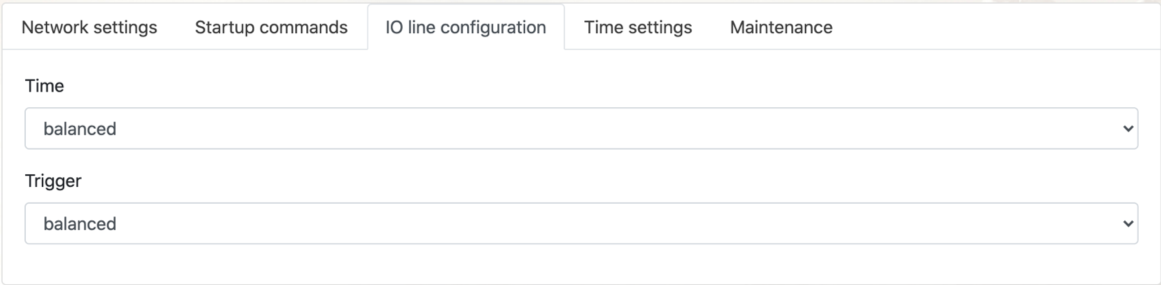



Figure 10. IO Line Configuration

How inputs are electrically interfaced is dependent on how they are wired. In the Web UI **IO Line Configuration** tab, selecting the “Balanced” input switches in a termination load resistor across the + & - inputs for RS422 operations. This load resistor is switched in (Balanced) or out (Single-ended).

If a Dual Head set up is used and the inputs are in parallel, then only one sonar should be in the “Balanced” mode otherwise the signal may be double terminated.

To connect the signals to the input:

- **TTL:** For TTL, connect TTL+ to Trig+ and TTL GND to Trig_GND.
- **RS422:** For RS422, connect as standard RS422. NORBIT does not, in general, recommend using the GND.
- **RS232**: RS232 can be used providing the inputs do not exceed +/-15v. For this reason, for voltages in the regions of +12v to +24v and/or -24v to -12v a 220Ω series resistor should be used to protect the input. If voltages are greater than +/-24v then more significant protection should be considered.

### 4.4.3 Trigger Delays

**Trigger In:** The Trigger In signal will initiate the TX. An adjustable trigger delay is possible with millisecond resolution.

**Trigger Out:** The Trigger Out signal is adjustable. Contact NORBIT Support for further details.

## 4.5 Timing

### 4.5.1 General

| | | |
|---|---|---|
| Description | : | Transceiver RS422, Isolated, Configurable |
| Ground | : | Time_GND |
| Maximum ratings | : | See Table 3 |

The timing input is RS422 (default), TTL (5V & 3V3).

### 4.5.2 IO Configuration

See section 4.4.2.

### 4.5.3 IRIG-B

Most common method when using the NORBIT SIU topside unit. The SIU timing processor uses ZDA + 1PPS to generate the IRIG-B signal. The timing signal is then connected from the SIU via the deck cable to the sonar.

| | | |
|---|---|---|
| Accuracy | : | Good, <0.1ms |
| USV | : | Recommended |
| ROV/AUV | : | Not recommended |

### 4.5.4 NTP+PPS

Most common method when not using the NORBIT SIU topside. The sonar accepts the 1PPS pulse on the TIME/IRIG connection and qualifies the time using an NTP server though Ethernet. NTP can be run on a topside time-synchronized PC. This could be the PC running the data acquisition software, which obtains time from a GNSS source. Several NTP services are available including Qinsy SNTP and Meinberg NTP, both of which are free.

| | | |
|---|---|---|
| Accuracy | : | Good, <0.1ms |
| USV | : | Not recommended |
| ROV/AUV | : | Recommended |

### 4.5.5 NTP

The sonar connects to an NTP server though Ethernet. For platforms with lots of motion and dynamics, this method is not recommended. For steady slow-moving platforms, this is an adequate solution if 1PPS is not available. NTP servers can be run on a topside time-synchronized PC on the same subnet as the sonar. This could be the PC running the data acquisition software, which obtains time from a GNSS source. Several NTP services are available including Qinsy SNTP and Meinberg NTP, both of which are free. Windows built-in NTP service is not recommended.

| | | |
|---|---|---|
| Accuracy | : | Medium, <2ms |
| USV | : | Not recommended |
| ROV/AUV | : | Optional |

## 4.6 Cable Options

NORBIT can supply customized cables if required. Please contact NORBIT Support for more information.

### 4.6.1 USV

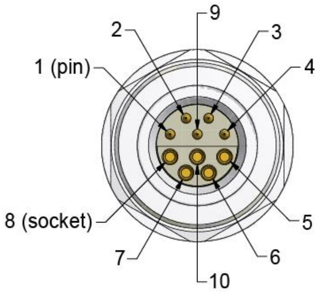
NORBIT offers a USV mounting cable kit. With this kit, the same bulkhead connector used on the sonar can be supplied to fit to the USV's watertight compartment, along with a deck cable with two underwater connectors to connect to the sonar. Internal to the compartment, various options can be made available. Contact NORBIT Support for more information.

### 4.6.2 ROV/AUV

For ROV mounting, NORBIT offers the WINGHEAD Titanium Interface Pigtail 24pin (PN 33256).

# 5 WBMS Series

## 5.1 WBMS Bulkhead Pinout




**WBMS Bulkhead Connector**

| | | |
|---|---|---|
| Connector type | : | NORBIT 33049 |
| Material | : | Titanium Grade 5 |
| Insert | : | Lemo 10 pin |
| Endurance | : | > 5000 cycles IEC 60512-5 test 9a BH |
| O-ring life | : | Situation dependent – check regularly. |
| BH O-ring | : | Type 2-014 NBR-70 12.42x1.78mm |
| Pressure rating | : | 600 Bar (mated) |

| Pin | Function | Electrical spec | Maximum Rating | Comment |
|---|---|---|---|---|
| 1 | LAN, TX+ | 100Base-T | 1500 Vrms | Twisted Pair |
| 2 | LAN, TX- | 100Base-T | 1500 Vrms | |
| 3 | LAN, RX+ | 100Base-T | 1500 Vrms | Twisted Pair |
| 4 | LAN, RX- | 100Base-T | 1500 Vrms | |
| 5 | Trig OUT | RS232 | -15V to +15V | Debug/trigger. $V_{low}$=-6.1V $V_{high}$=6.6V |
| 6 | Trig IN | RS232 (TTL comp.) | -25V to +25V | Debug/trigger. Trigger threshold 1.7±0.5V |
| 7 | PPS/IRIG-B | TTL 5V | -9V to +14V | Timing input. 3.3V and 5V TTL |
| 8 | Signal GND | GND | - | Shared ground for Pin 5, 6 and 7. |
| 9 | GND | GND | - | Power ground |
| 10 | 24VDC | 24VDC | 28V | Power input |

Table 6. WBMS Bulkhead Pinout

## 5.2 Power

### 5.2.1 Input Voltage

All NORBIT WBMS sonars have the same input voltage specification when not using the SIU.

| Input | Voltage | Comments |
|---|---|---|
| Minimum | 24V (cut-off: 30v) | If the PSU and power lines create voltage drops, or spikes that fall under 20V, unexpected behavior may be encountered, with sudden system reboots. |
| Maximum | 28V (break-down: 30v) | Approaching the break down voltage will burn the input on the sonar, requiring service. |

### 5.2.2 Power Consumption

Consumption may vary according to the model and TX settings applied during operation. The guiding numbers provided in Table 7 were measured with an 8m cable and 24V PSU with no drop. Note that these do not cover all models and hardware revisions. If the power budget is tight, contact NORBIT Support for advice.

| 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 |
| 24003, 24007, 24010 | WBMS Bathy (2x1 deg), all materials | 0.6 A | 2.7 A | 1.5 A |
| 24016, 24017 | WBMS STX (1x1 deg), all materials | 0.8 A | 2.5 A | 2.0 A |

Table 7. Power Consumption

### 5.2.3 Power Inrush

Power inrush is determined by several factors. Cable length (impedance between PSU and sonar), input capacitor bank and PSU output capacitor bank are the most important factors. Below is a list of the most common NORBIT sonars and some data on inrush.

#### 5.2.3.1 WBMS FLS (24002/24009)

PSU Capacitor bank : 70uF
TX PSU : No TX inrush

#### 5.2.3.2 WBMS Bathy (24003/24007/24010)

PSU Capacitor bank : 70uF
TX PSU : ~10mF

The NORBIT bathy sonars have a power input capacitance of around 10000uF. Most PSUs will handle this, but if there is other equipment operating in parallel with the sonar, and power issues are experienced when the sonar is powered on, NORBIT recommends adding at least 10000uF (35V rated) output capacitance to the PSU.

#### 5.2.3.3 WBMS STX (24016/24017)

PSU Capacitor bank : 170uF
TX PSU : No TX inrush

### 5.2.4 Sonar Grounding

The sonar has three different ground nodes, as detailed below.

#### 5.2.4.1 Chassis Ground

Capacitively coupled to Power Ground with high voltage capacitors.
All models : 110-130nF 500V

#### 5.2.4.2 Power Ground

Internal power ground, connected to Pin 9 (see section 5.1)

#### 5.2.4.3 Signal Ground

Signal ground is galvanically isolated from all other ground nodes. See sections 5.4 and 5.5.

### 5.2.5 Common Mode Choke

If the NORBIT sonar is mounted without the SIU, as per the recommended setup for ROV and AUV installations, NORBIT advises using a common mode choke on the power lines to limit noise to the sonar through the power lines. A suitable choke is suggested below:

Manufacturer : WURTH ELEKTRONIK
Part : 744834433
Description : Common Mode, Power Line, Horizontal, 3.3 mH, 5 A, WE-CMBH Series

# 5.3 Ethernet

## 5.3.1 General

NORBIT WBMS sonars uses a 4 wire 10BASE-T/100BASE-TX with HP Auto-MDIX Support, and it cannot be reconfigured.

Estimated data rates for a single head WBMS system at maximum ping rate are provided 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 |

Table 8. WBMS Data Rates

## 5.3.2 Change Sonar IP Address

Refer to the NORBIT Multibeam User Manual (TN-140075) for instructions.

# 5.4 Trigger

## 5.4.1 General

Many installations require synchronization of sensors to prevent interference. NORBIT sonars have separate trigger lines for input and output of synchronization pulses. Note that some of the oldest system revisions may not have this capability. To run NORBIT sonars in dual head mode, the trigger lines are required.

Hardware Description : Transceiver RS232, Isolated
Ground : SigGND
Maximum ratings : See Table 6

The trigger input is TTL 5V and 3V3 compatible and the SigGND is isolated from power ground.

## 5.4.2 Trigger Delays

**Trigger In:** The default delay from the Trigger In signal to the center of the transmit pulse is 3300µs (half the transmit pulse buffer plus additional). An adjustable trigger delay is possible in millisecond resolution.

**Trigger Out:** The Trigger Out signal is sent out at 3300µs (half the transmit pulse buffer plus additional) before the center of the following transmit pulse. An adjustable trigger delay is possible in millisecond resolution.

The command `set_trigger_mode` and `set_trigger_delay` will control the trigger and adjust the trigger delay in both Trigger In and Out. Refer to the Data Format Definition document (TN-180196) for details.

## 5.5 Timing

### 5.5.1 General

| | | |
|---|---|---|
| Hardware description | : | Transceiver RS485, Isolated |
| Ground | : | SigGND |
| Maximum ratings | : | See Table 6 |

The timing input is TTL 5V and 3V3 compatible and the SigGND is isolated from power ground. There are several ways of time synchronizing a NORBIT sonar. The timing pins are Pins 7 and 8 (see section 5.1). The time synchronization methods are detailed below.

### 5.5.2 IRIG-B

Most common method when using the NORBIT SIU topside. The SIU timing processor uses ZDA + 1PPS to generate the IRIG-B signal. The timing signal is then connected from the SIU via the deck cable to the sonar.

| | | |
|---|---|---|
| Accuracy | : | Good, <0.1ms |
| USV | : | Recommended |
| ROV/AUV | : | Not recommended |

### 5.5.3 NTP+PPS

Most common method when not using the NORBIT SIU topside. The sonar takes 1PPS + SigGND on pins 7 and 8 and connects to an NTP server though Ethernet. NTP can be run on the topside PC where the data acquisition software is installed, and there are many free NTP services available, such as Qinsy NTP and Meinberg NTP, both of which are free.

| | | |
|---|---|---|
| Accuracy | : | Good, <0.1ms |
| USV | : | Not recommended |
| ROV/AUV | : | Recommended |

### 5.5.4 NTP

When there is no 1PPS available, the last method is NTP only, but NORBIT strongly advises against this unless there is no alternative. The sonar connects to an NTP server though Ethernet. For platforms with lots of motion and dynamics, this method is not recommended. For steady slow-moving platforms, this is an adequate solution if 1PPS is not available. NTP can be run on the topside PC where the data acquisition software is installed, and there are many free NTP services available, such as Qinsy SNTP and Meinberg NTP, both of which are free.

| | | |
|---|---|---|
| Accuracy | : | Medium, <2ms |
| USV | : | Not recommended |
| ROV/AUV | : | Optional |

### 5.5.5 1PPS+ZDA Direct

The WBMS accepts 1PPS on pins 7 and 8 and $GPZDA on pins 5 and 6. This option uses the trigger lines and requires a firmware upgrade. As such, when this option is used, it is not possible to use the trigger function in dual head operations. Refer to 0 for more details.

| | | |
|---|---|---|
| Accuracy | : | Good, <0.1ms |
| USV | : | See section 4.5.3 |
| ROV/AUV | : | Not typically used, see section 4.5.4 |

NORBIT

## 5.6 Cable Options

NORBIT can supply customized cables if required. Please contact NORBIT Support for more information.

### 5.6.1 USV

NORBIT can offer a USV mounting cable kit. Contact NORBIT Support for more information.

### 5.6.2 ROV/AUV

For ROV mounting, NORBIT offers the following cables:

- PN 33095, WBMS Interface Pigtail
- PN 33205, WBMS Interface Pigtail Angled (longer lead times should be expected)

# 6 Mounting

## 6.1 Weights & Dimensions

Approximate sonar weights are given below. For dimensions, please refer to the datasheets on the NORBIT website. DeepSea refers to WBMS sonars with 4500m depth rating, while FullOcean refers to 6000m. Standard systems are depth rated to 100m.

| | | Weight in air | | Weight in water | |
|---|---|---|---|---|---|
| **Sonar** | **Displacement $m^3$** | **Sonar (kg)** | **Sonar & Bracket (kg)** | **Sonar (kg)** | **Sonar & Bracket (kg)** |
| WBMS Standard TX, DeepSea | 2.40 | 6.4 | 7.9 | 4.00 | 4.50 |
| WBMS Standard TX, FullOcean | 2.50 | 7.0 | 8.5 | 4.50 | 5.00 |
| WBMS Narrow TX, Standard | 2.85 | 5.1 | 6.6 | 2.25 | 2.75 |
| WBMS Narrow TX, DeepSea | 3.00 | 7.6 | 9.1 | 4.60 | 5.10 |
| WBMS Narrow TX, FullOcean | 3.10 | 8.2 | 9.7 | 5.10 | 5.60 |
| WBMS STX, Standard | 2.30 | 5.2 | 6.7 | 2.90 | 3.40 |
| WINGHEAD B41 (100m rated) | 3.10 | 6.6 | 8.1 | 3.5 | 4.7 |
| WINGHEAD B41Ti (1500m rated) | 3.10 | 9.0 | 10.5 | 5.9 | 7.1 |

Table 9. Approximate Weights

## 6.2 Acoustic Clearance Zones

Both the WBMS and WINGHEAD sonars need 180º coverage side to side for normal seabed operations and more if the user wants to look "up" for special operations. The along track clearance should be >15º and >30º for S series or STX sonars

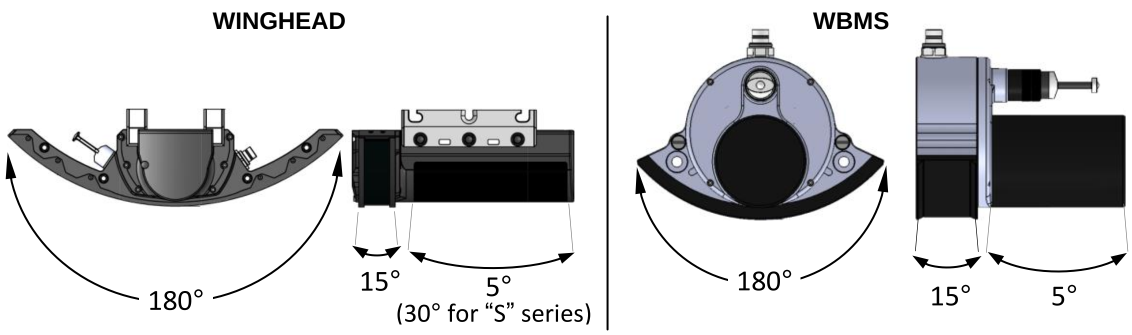



Figure 11. Acoustic Clearance Zones

## 6.3 Isolation

It is important to keep the NORBIT sonar electrically isolated from the mounting structure that it is attached to, such as brackets, poles and the vessel's hull. This can lead to severe corrosion otherwise. It is good practice to test the electrical isolation using a low voltage DMM (not a Megger).

Use the NORBIT protection plate if mounted directly on metal (PN 45459) and the correct plastic spacers for the screws which fasten the sonar.

## 6.4 ROV Mounting

### 6.4.1 WINGHEAD Mounting Including Bracket

| | | |
|---|---|---|
| Bracket part number | : | 451214, 451215 |
| Bracket material | : | PETP Plastic |
| Bracket flange | : | Figure 12 |

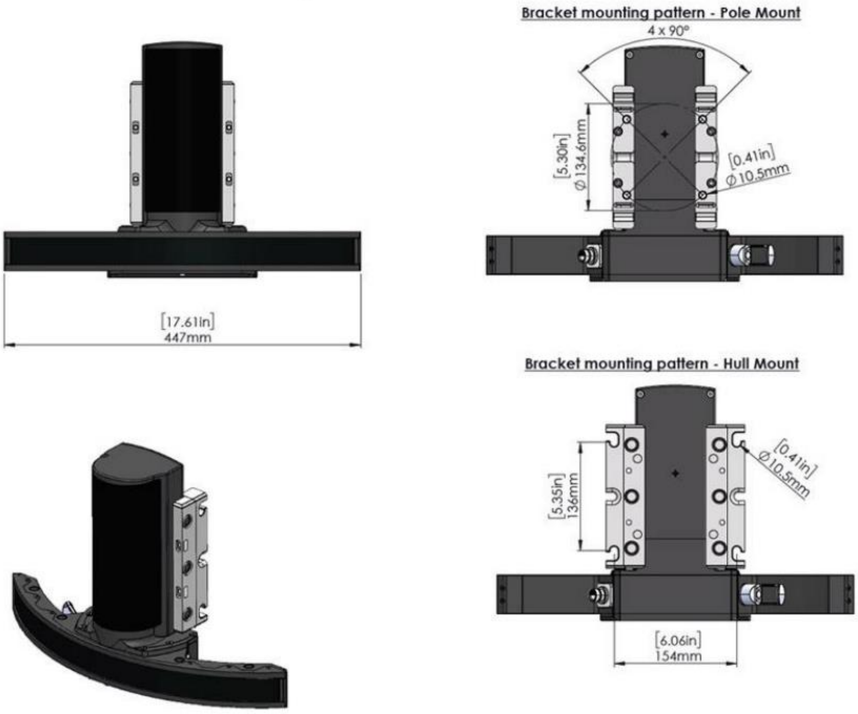



Figure 12. WINGHEAD with Standard Bracket

The WINGHEAD bracket can be reconfigured as required (Figure 13). The “hull mount” configuration is typically used for ROV and AUV installations.

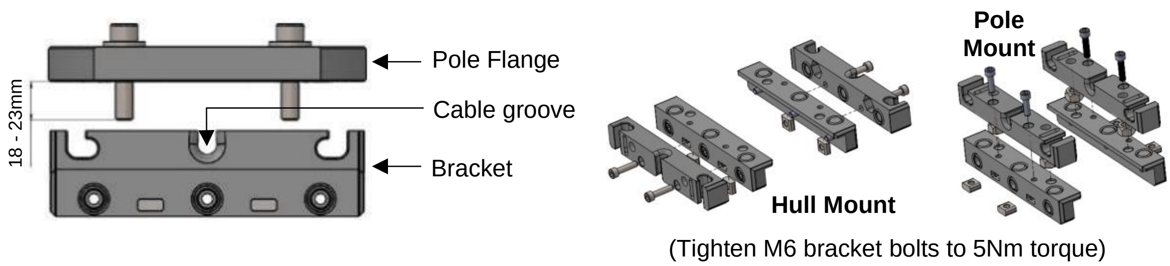



Figure 13. Reconfiguring the Bracket

### 6.4.2 WBMS Mounting Including Bracket

| | | |
|---|---|---|
| Bracket part number | : | 35047 |
| Bracket spacers | : | 45466 |
| Bracket material | : | POM Plastic |
| Bracket flange | : | Figure 14 |

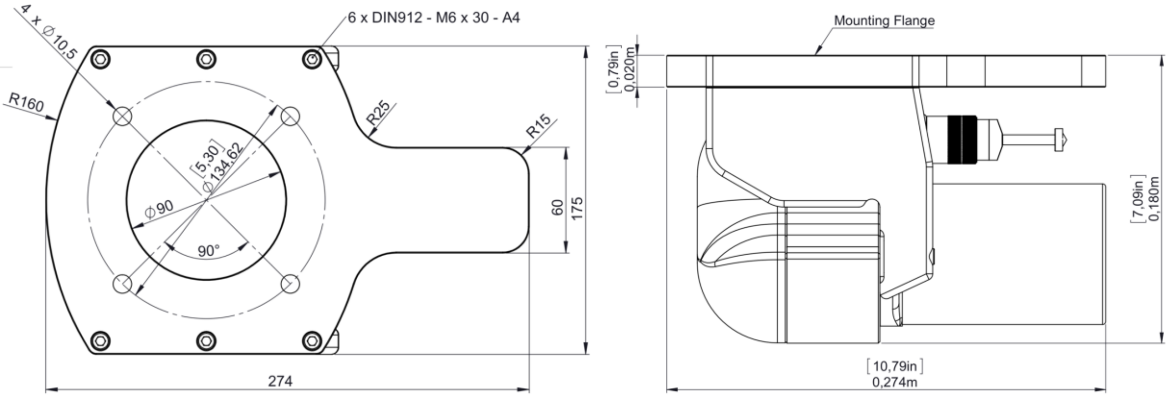


Figure 14. WBMS standard bracket 35047 flange (left) and WBMS mounted on standard bracket (right)

For detailed drawings of the WBMS and WBMS Narrow Transmit sonars, please refer to the NORBIT Multibeam User Manual. (TN-140075).

### 6.4.3 WBMS Mounting Excluding Bracket

| | | |
|---|---|---|
| Protection plate | : | 1 x 45459 |
| WBMS spacer | : | 2 x 45466 (included with the compact bracket, PN 35165) |
| | | 2 x 45193 (supplied when compact bracket is not included) |
| Screws | : | M6 x 70-100mm |
| Hole spacing | : | 160mm |

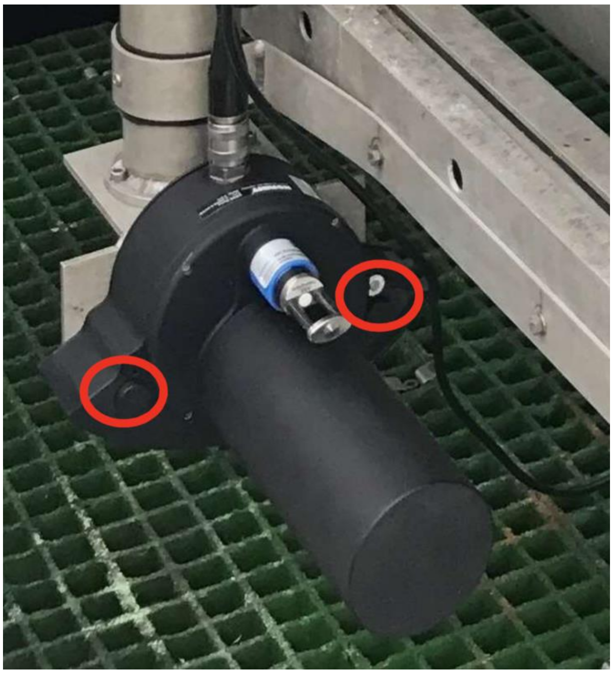


Figure 15. WBMS mounted without bracket

## 6.5 Mounting Examples

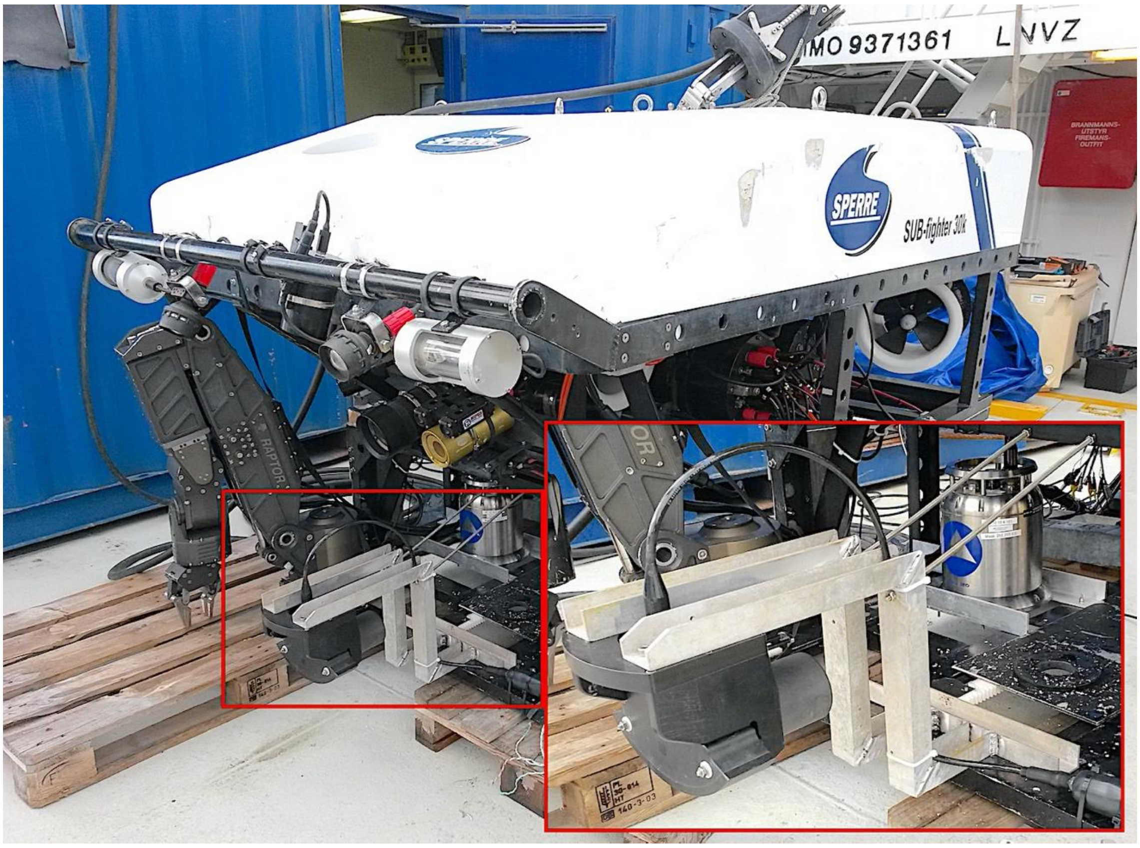



Figure 16. WBMS Basic on Sperre SUB-fighter 30k with IXBLUE PHINS

Figure 17. Dual WBMS Basic on a STD Quasar ROV with IXBLUE ROVINS


Figure 18. Up looking WBMS Bathy on Seatronics

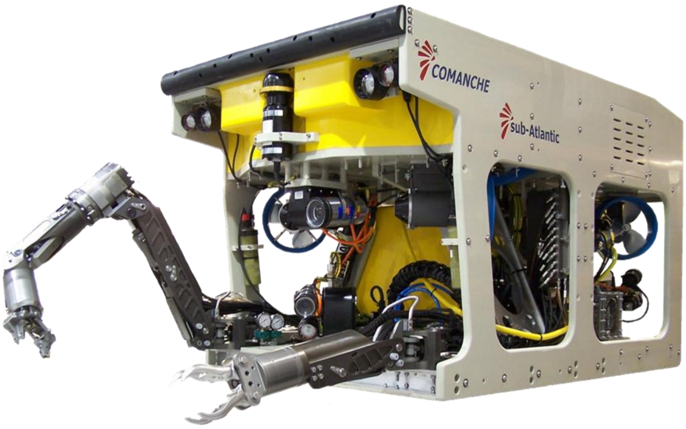



Figure 19. Sub-Atlantic Comache ROV

Figure 20. Mounted on Comanche

Figure 21. WINGHEAD mounted on Resolve Marine's Helix XLX66 ROV

# 7 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). 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.

## 7.1 Passive Mode

Passive mode is a special operating mode of the GUI where the user has no interaction with the sonar. The data flows through the GUI and is visualized as normal, but the sonar settings cannot be changed. 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 manner. It is mostly used for data visualization in real time and prevents unintended setting adjustments.

**Step 1.** Connect the GUI to the sonar as normal (i.e. active mode).

**Step 2.** Setup the sonar as needed with the desired operator settings.

**Step 3.** Close the GUI.

**Step 4.** Modify the sonar ini file, located at: *%appdata%\Norbit\settings_sonarid_<sonarName>.ini*

**Step 5.** Under `[Gui]`, change `use_passive_connection` from `false` to `true.` Save and close.

**Step 6.** Start the GUI to connect it in passive mode.

**Step 7.** To revert the sonar to active mode, modify the sonar ini file, or select “Set Sonar Factory Defaults” on the Connection dialog within the GUI.

## 7.2 Headless Mode

Headless mode is a further simplification of passive mode, where the data flow is the same, however no GUI is displayed for visualization. Instead, only a simple console is displayed. In this case the software acts as a proxy server with no interaction. The NORBT GUI must have been connected to the sonar once in normal (active) mode prior to using headless mode. To activate headless mode:

**Step 1.** Connect the GUI to the sonar as normal (i.e. active mode).

**Step 2.** Setup the sonar as needed with the desired operator settings.

**Step 3.** Make a note of the sonar name, which is found on the info box next to the wedge. Close the GUI.

**Step 4.** From the command prompt, type: `wbmsgui.exe -headless -sonarName <sonarName>`

(For example: `wbmsgui.exe -headless -sonarName #24003-6-acdb_#77`)

**Step 5.** The GUI will now connect in passive mode and act as a proxy only. Commands must be sent separately to the sonar each time a setting change is required.

**Step 6.** Press the Esc key to clow down the console application.

---

⚠ **NOTE:** If the sonar name contains "#" the entire name must be surrounded with quotation marks (“”) otherwise Ubuntu will get confused. It is also important that the sonar has the correct firmware version which the GUI expects, otherwise it will fail to connect automatically in headless mode.

---

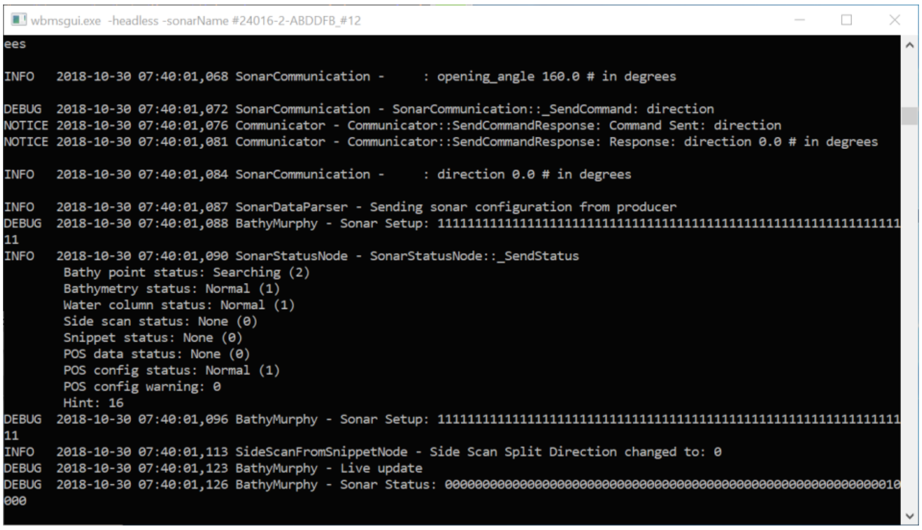



Figure 22. GUI in Headless Mode

## 7.3 Stop Sonar Pinging

For AUV installations, it is often not desirable to have the sonar pinging when the GUI connects. To prevent the sonar from pinging, add the start_playing_on_connection command to the GUI ini file, under the [General] section. The file is located at: %appdata%\Norbit\wbmsgui.ini

```
[General]
start_playing_on_connection=false
```

## 7.4 Start/Stop Recording

The GUI implements two WebSocket servers which clients can connect to. The communication format on the binary sockets is UTF-8 encoded JSON. The control port (40804) is used to send messages to the GUI, and the status port (40803) is used to receive messages from the GUI.

After the GUI is started, the following commands are used on the control port using a WebSocket client app or Google Chrome extension on the following URL: *ws://<host-ip>:40804/WBMSControl* (where <host-ip> is the IP address of the PC which runs the headless GUI).

`start_recording`
Starts recording bathymetric data to a .wbm file and simultaneously starts grid generation to the database. A recording_status message is output on the status port when the recording status is successfully changed. Usage example:
`{ "method": "start_recording", "bin_size": 0.0, "database_name": "unknown", "record_type": "unknown", "datum": "unknown" }`
**Note:** bin_size value shall be 0.0 in case no grid generation is requested. The database_name, record_type and datum parameters are not relevant unless using DCT, therefore “unknown” values can be set.

`stop_recording`
Stops the recording of bathymetric data and grid generation. A system_status message is output on the status port when the recording status is changed. Usage example:
`{“method”: “stop_recording”}`

Starting and then stopping recording will result in a new recording being generated in the %USER%\Norbit\WBMS folder.

# 8 Time Synchronization

## 8.1 Subsea Timing Options

For ROV and similar operations, there are three timing options available for timestamping the data produced by the sonar:

1. The same **IRIG-B** timing scheme that is used by surface applications. This requires the timing data to be sent from the SIU, which in turn is being fed by 1PPS & ZDA. This is not normally used for remote operations.
2. **NTP timing** relies on the network to set the NTP clock in the sonar from an accurate source at the dry-end. Various factors rely on this, but it is usually better than 10ms. This is suitable for platforms where there are little dynamics, e.g. an ROV that is moving linearly and not experiencing sudden movements.
3. **PPS & NTP timing** uses the PPS clock, which needs a 1PPS signal to reset the sonar PPS clock once every second. The PPS event is qualified using the NTP clock to set the whole second time. This means that the NTP clock must be accurate to just under 500ms for this to work correctly. This method is better than 1ms accuracy and is therefore suitable for all subsea scenarios.

In the remote situation, unexpected errors may happen:

- Noise causing false 1PPS events. This can be caused by such things as unshielded cables and common signal grounds. Connecting power supply grounds to signal grounds can also generate noise on the signal line.
- Sharing the 1PPS line amongst sensors can load the signal causing the amplitude to decrease. This can lead to missed events or misfiring due to noise.
- NTP updates can be missed due to network traffic and issues with the NTP server, Windows operating systems issues, etc.
- A complete break in network communications with the sonar GUI running topside.

Refer to Appendix D for more information on available timing methods, including instructions on how to configure NTP time servers.

## 8.2 WINGHEAD Timing

### 8.2.1 Prerequisites

- A Single-ended or Balanced signal should be correctly interfaced to the sonar head(s). If long transmission lines are used, the IO configuration may be changed to **Balanced** to switch in the RS422 termination resistor. However, this may load the signal, so it should be tested in Single-ended mode first. If a dual head system is sharing a Balanced signal, only one sonar should have balanced selected (only one termination resistor switched in).
- An NTP server should be set up on a time-synchronized PC on the same subnet as the sonar(s) as described above.
- The NTP time should be closer than 100ms to the 1PPS event, otherwise the time will be invalid.

### 8.2.2 Configuration

To receive the NTP message on the sonar, access the sonar web UI (*http://192.168.53.XX*, where XX is the last 2 digits of the sonar serial number) and go to the **Time Settings** tab. In the **NTP servers** field, enter the network IP address of the PC which runs the NTP time server. In a normal, single NTP time source situation, leave the **Preferred** checkbox deselected.

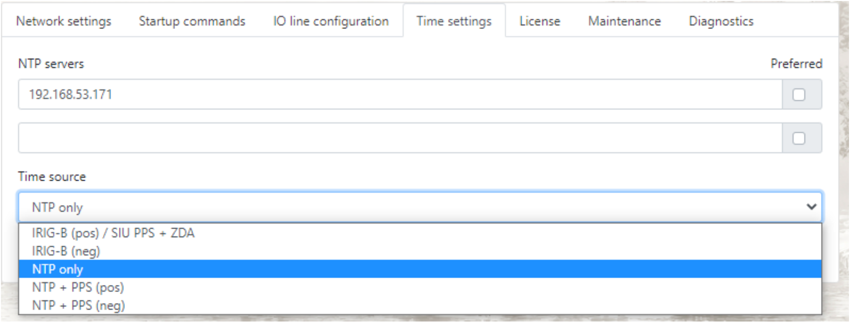


Figure 23. WINGHEAD Timing Inputs

In the **Time Source** drop down menu, select the **NTP only** option, or the correct **NTP+PPS** option according to the polarity of the 1PPS pulse being sent. For the method to take effect, it is necessary to reboot the sonar, which can be performed via the **Maintenance** tab.

If everything is set correctly, the time reported in the GUI will change to the current UTC time. If an error is present, the GUI date/time will be flagged red on the main GUI display with a date of 1970.

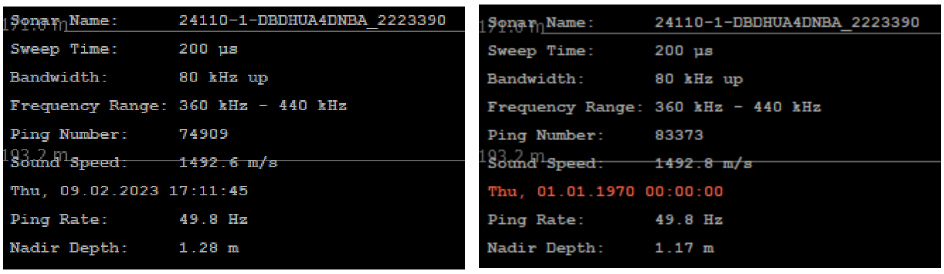


Figure 24. GUI showing valid (left) and invalid (right) timing.

If a valid date and time is reported in the GUI, the **Timing Status** in the sonar web UI **Diagnostics** tab will show green with the "**No Error"** message:

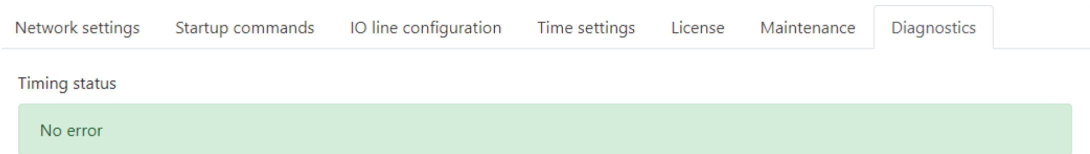


Figure 25. Web UI diagnostics reporting No Error.

If an error is detected, it will be described in the **Time Status** field.

### 8.2.3 PPS Loss

If the 1PPS signal is missing for more than 5 seconds, an error will be flagged and the GUI time will revert to 1970. The time from this event will be displayed in seconds in the **Time Status** field:

Figure 26. Error associated with PPS loss

The 1PPS time synchronization takes a couple of seconds to re-acquire after the signal is restored.

### 8.2.4 PPS Noise

Noise on the line will result in loss of PPS, which will make the signal look more than 100ms off the NTP time resulting in a signal offset error. It may also cause the loss of the PPS signal, resulting in both an “offset error” and “missing PPS signal”:

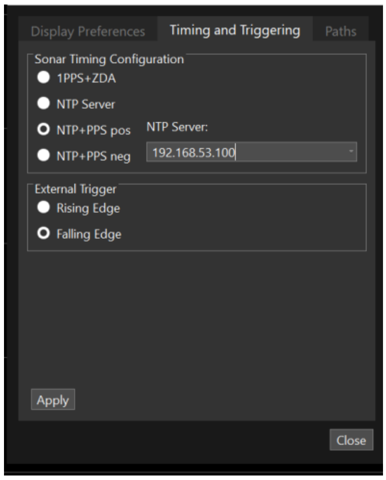

Figure 27. Errors associated with PPS noise

Either way, the signal should be robust and noise free and will be re-acquired after a couple of seconds of “clear” 1PPS pulses.

## 8.3 WBMS Timing

### 8.3.1 Configuration

For WBMS sonars, the time source is set in the **Advanced > Options > Timing & Triggering** menu of the GUI. Enter the network IP address of the PC which runs the NTP time servier.




After a few seconds, the date and time reported in the NORBIT GUI should change from the invalid time in 1970 (highlighted red in the GUI) to the current UTC date and time (now white). The time should be the same as the broadcasting PC, and the IP address of the sonar should appear in the SNTP server status dialog if Qinsy SNTP is used.

If there is a break in network communications with the topside, the default action is for the GUI to send the configuration parameters, including the Time Source, which would result in a restart of the NTP service causing a jump in the reported time to 1970 for a short period.

If the current Time Source is the same as the one sent by the GUI, it does **NOT** restart the service and there is no interruption to time.

To achieve this, commands must be applied in the sonar startup script facility which is accessed via web UI (http://192.168.53.XX where XX is the last two digits of the sonar serial number). If we assume that the IP address of the NTP server is found at the address 192.168.53.150, then:

For “NTP Server” Time source, the script is:

```
set_ntp_server 192.168.53.150
set_time_source 1
```

For “NTP + PPS pos” Time source, the script is:

```
set_ntp_server 192.168.53.150
set_time_source 3
```

For “NTP + PPS neg” Time source, the script is:

```
set_ntp_server 192.168.53.150
set_time_source 4
```

For example, using NTP time as the time source, check **Enable Script**, enter the required script lines from the previous section, click **Submit** and then **Reboot** at the bottom of the page:


**Notes:**

- This step is only needed once and the sonar will execute it during every boot up.
- If the method of time synchronization is changed, the `set_time_source` number should be updated accordingly.
- The startup script should always be visible in the sonar web page.
- Following the use of the sonar in an ROV environment, even if the script is not disabled and time is changed from the SIU to, for example, “1PPS & ZDA” (i.e. IRIG-B) the system will still start up OK with the setting from the GUI. There would only be a timing issue if a communications break occurred.
- The behavior described above is valid from WBMS firmware version 5.5.82 and later.

### 8.3.2 Invalid Time Reporting

When an error in timing occurs, the sonar date/time will be flagged red on the main GUI display with a date of 1970. The data output will also reflect this invalid time stamp. The accuracy of the internal clock is, however, such that it will drift by up-to approximately 3ms in one minute. The sonar can therefore afford to miss the timing events for short periods and remain within specification.

Once time has been established correctly (i.e. the time noted on the sonar wedge appears white and shows the correct UTC time), the WBMS sonar will behave as follows when a timing event is missed:

- ***Bad or missing NTP updates –*** the clock will note that an update has not occurred but will wait for 5 minutes before flagging the time as bad (red) in the GUI.
- ***Missing 1PPS –*** the sonar will note that an update has not occurred but wait for 30 seconds of missing 1PPS events before flagging the time as bad (red) in the GUI.

This allows a robust handling of timing in a less than ideal situation. Note that the behavior described above is valid as of WBMS firmware version 5.5.82 and later.

### 8.3.3 Troubleshooting

If the instructions above are executed correctly but the sonar time remains invalid, it may be because:

- The 1PPS pulse does not reach the sonar. This is most likely due to hardware issues.
- The NTP message does not reach the sonar. This could be due to network issues.

In the NORBIT GUI, the **Info** tab within the **Sonar Connection** dialog shows a log of system events. If there is a problem with the time setting service, the log will display a message which includes the text “Time status change” and a corresponding error code. A summary of these codes is provided below. The code is an 8-bit byte constructed as follows:

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Content | $T_0$ | PPS Synch | PPS Old | | | NTP Status | | |

Table 10. WBMS Error Code

| Bit | Description | Comment |
|---|---|---|
| 7 | T0 – set when time fails the required criteria | Time will jump to 1970 in the GUI when set. |
| 6 | PPS out of sync | PPS not arriving at 1 second interval. |
| 5 | PPS old | PPS has not arrived for more than 2 seconds. |
| 4-3 | Not used | |
| 2-0 | NTP status | See below. |

Table 11. WBMS Error Code Summary

| 2 | 1 | 0 | |
|---|---|---|---|
| 0 | 0 | 0 | OK |
| 0 | 0 | 1 | No data from server |
| 0 | 1 | 0 | Parse Error |
| 0 | 1 | 1 | NTP Timeout from server |
| 1 | 0 | 0 | NTP Synch offset too large |
| 1 | 0 | 1 | NTP update too old |

Table 12. WBMS NTP Error Code Status Summary

| Code | Description |
|---|---|
| 0 | OK |
| 1 | NTP log is empty, no peer message has been received since last NTP startup. |
| 2 | Could not parse NTP log. Garbled NTP log. |
| 3 | Timeout when trying to communicate with NTP server. |
| 4 | NTP out of sync. Offset to server is more than 10ms. |
| 5 | More than 5 minutes since last NTP update. |
| 32 | NTP is in sync, PPS missing. |
| 64 | PPS Out of sync. |
| 160 | Time is bad, PPS is missing. |

Table 13. Example NTP Error Codes reported in the GUI **Info** tab

## 8.4 General Timing Issues

### 8.4.1 PPS Issues

- If the 1PPS is wired but is not detected by the time synchronization, check that the wiring is correct for the signal type, i.e. single ended or balanced (applicable for WINGHEAD only).
- If the signal is shared amongst other sensors, the level might be loaded below a detection threshold. In the case of the WINGHEAD, check the signal type is switched to Single-ended in the web UI IO line configuration tab. For test purposes, unplug some of the sharing sensors to decrease the loading.
- Check the 1PPS signal using an oscilloscope. An RS422 signal should use dual channel differential input and a TTL/RS232 signal should use a single channel input with ground.
- If the 1PPS+NTP time synchronization is not working, first check that NTP only works before proceeding with additional troubleshooting.

### 8.4.2 NTP Issues

- Remember that the NTP server must be on the same subnet as the sonar and the Windows time service must be disabled.
- Meinberg takes several minutes to become active from PC reboot or service restart.
- The PC should be time synchronized to the master time source. Roughly setting the clock is not sufficient. The use of the 1PPS signal should be used to aid PC synchronization (i.e. PPS box for Qinsy and HYPACK, and handshake line toggling for PDS.)
- NTP time occurs on port 123, so this port should not be blocked.
- Ship networks and switches should be avoided as they can lead to complications.
- The IP address of the PC which runs the NTP server should be entered in the sonar configuration and not the IP address of the sonar itself.
- For test purposes, try NTP only using a different PC in case there is some machine-specific issue.

# Appendix A: Sonar Head Signal Input

## A1. WINGHEAD Signal Input

The WINGHEAD sonar has two serial inputs:

1. ***Synchronization and Miscellaneous Communications*** – this is normally used for dual head synchronization between two WINGHEAD sonars, however it can also be used as a "back door" input for troubleshooting.
2. ***Time Synchronization*** – normally used to receive an IRIG-B time message from a SIU, however in the case of an ROV installation this is changed to accept a 1PPS input with the pulse being qualified by a NTP time synch.

The input circuitry is as follows:

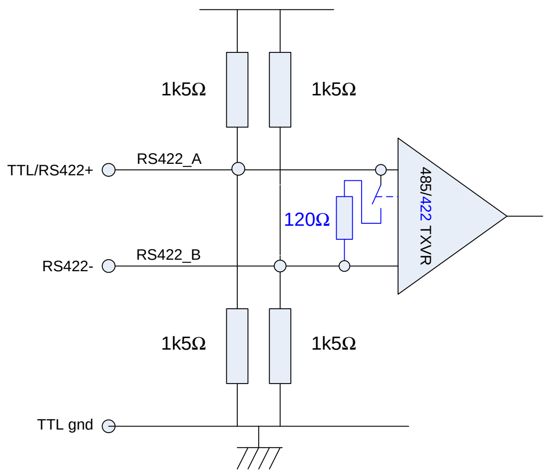



Figure 28. Input Circuitry

These inputs have two options, and have limits of -15v/+15v.

- **"Balanced"** RS422 using 2 wire half duplex communications. This is noise tolerant differential signaling.
- **"Single-Ended"** nominally TTL using signal and ground connections. This is more traditional to be compatible with existing ROV-type infrastructure. It should be noted that this is available on 24-pin variants only and typically accept a 5v/3v3 TTL input.

---

⚠ **NOTE:** There is a selectable 120Ω termination resistor across the input of the transceiver which can be used for RS422 communications. This is selectable in the **IO configuration** menu of the sonar web UI, using **"Balanced"** mode. Selecting **"Single-ended"** deselects this termination resistor.

---

***Signal Driver Type*** – the 1PPS input should be a Source type driver that can maintain the voltage swing. It has been found that Sink drivers will not work well in this application.

***Dual Head*** – it is common practice to share a 1PPS source from a MUX, so in a dual head installation the load to the source could be as shown in the following diagram.

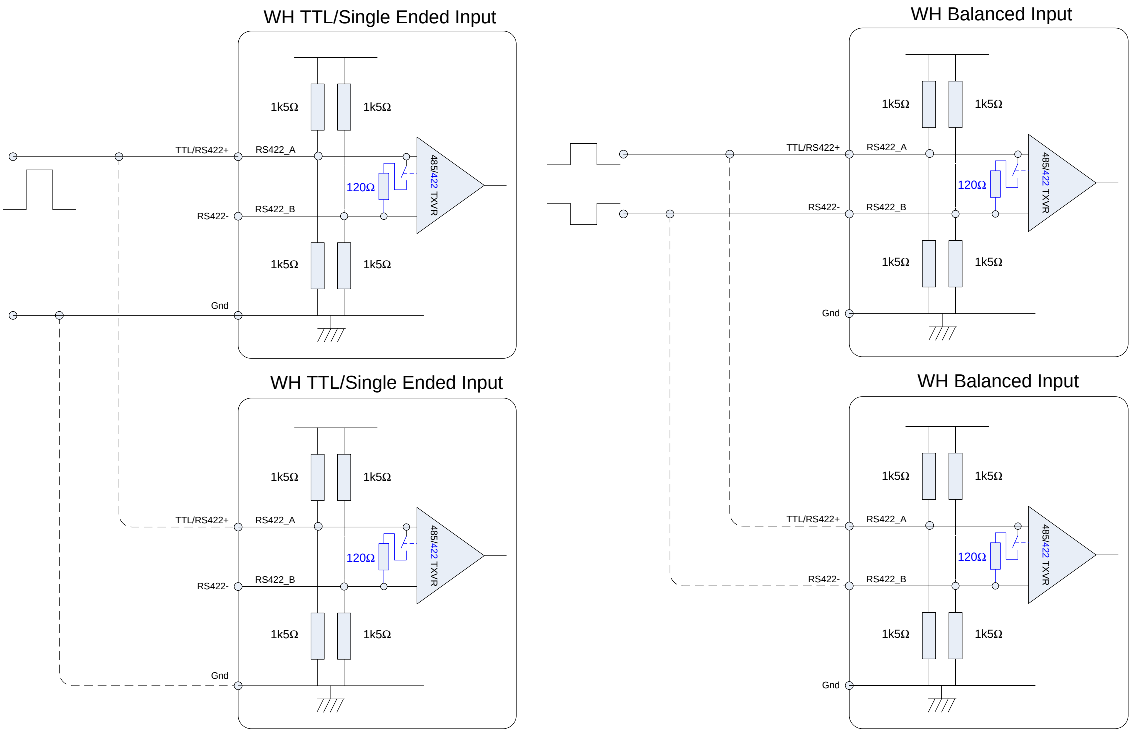



Figure 29. Dual Head

It is therefore important to check the **loaded** signal with an oscilloscope for

- **Noise** – Is there noise on the signal that may cause false triggering?
- **Level** – Is the signal level sufficient to trigger the input?

The **Single-Ended** input can be driven from a TTL or RS232 output, however the same considerations to the input for RS232 should be noted as shown in the WBMS section, i.e. note instances where the pulse polarity is swapped through RS232 coding and set the detection in the sonar software accordingly. The input can accept a minimum voltage transition window between 0v and 3v3.

The **Balanced** input can be driven by RS422/485 and has been tested with RS232. With RS232 GND connected to RS422-, the same considerations to the input for RS232 inversion through coding should be noted as shown in the WBMS section. Alternatively, if the signal is inverted through coding, the signals can be swapped, i.e. RS232 GND is connected to RS422+ and RS232 signal is connected to RS422-, and the input to the WINGHEAD will be the same polarity as the pulse from the source.

The differential input requires that the difference between A&B is >200mv, however there is inline protection for each line which will slightly reduce the voltage available. The difference window should be around 0.6v without the termination resistor enabled, and 1v with the resistor enabled.  Additionally, any noise will lead to phantom switching, therefore a window of 2v is recommended. A&B voltages should not exceed +/-15v, and if they do, a series 220Ω resistor should be used.

If RS232 is to be used, then the voltage limits should be respected (-15v/+15v). If they exceed these limits, again a series 220Ω resistor must be used, or in-line breakers may activate temporarily stopping inputs. With this scheme, NORBIT does not recommend that the voltage exceed +/-24v.

## A2. WBMS Signal Input

The WBMS sonar has two serial inputs:

1. ***Synchronization and Miscellaneous Communications*** – RS232 with TX/RX w.r.t a common signal ground. This is normally used for dual head synchronization between two WBMS sonars. However, it can also be used as a “back door” input for troubleshooting. In later firmware versions it will also accept a ZDA time message.
2. ***Time Synchronization*** – TTL with RX only w.r.t a common signal ground. This is normally used to receive an IRIG-B time message from an SIU. However, in the case of an ROV installation, this is changed to accept a 1PPS input with the pulse being qualified by a NTP time synchronization.

The RS232 channel is normally used for inter-sonar handshakes (other than in the situation described above), however the TTL Time input is interfaced extensively for ROV and similar applications where the TTL input accepts a 1PPS pulse, usually via a MUX.

The circuit for the Time input uses a RS485 transceiver and is set up as follows:

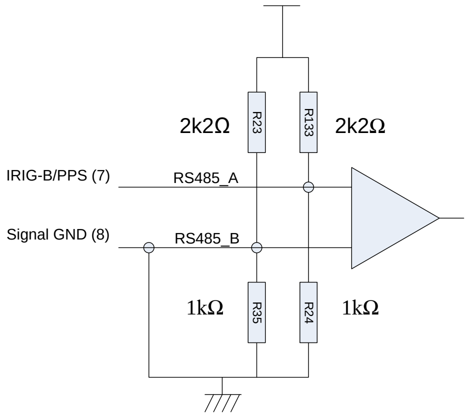



Figure 30. Time Input Circuit

The system is designed to accept 5v/3v3 TTL (after loading) and the inputs to the device have limits of -8v/+15v. This means RS232 levels can also be used. However, the voltage limits should be respected. If they exceed these limits, a series 220Ω resistor must be used.

***Signal Driver Type*** – the 1PPS input should be a **Source** type driver that can maintain the voltage swing. It has been found that Sink drivers will not work well in this application.

***Dual Head*** – it is common practice to share a 1PPS source from a MUX. Therefore, in dual head installations, the load to the 1PPS source could be as shown in the following diagram.

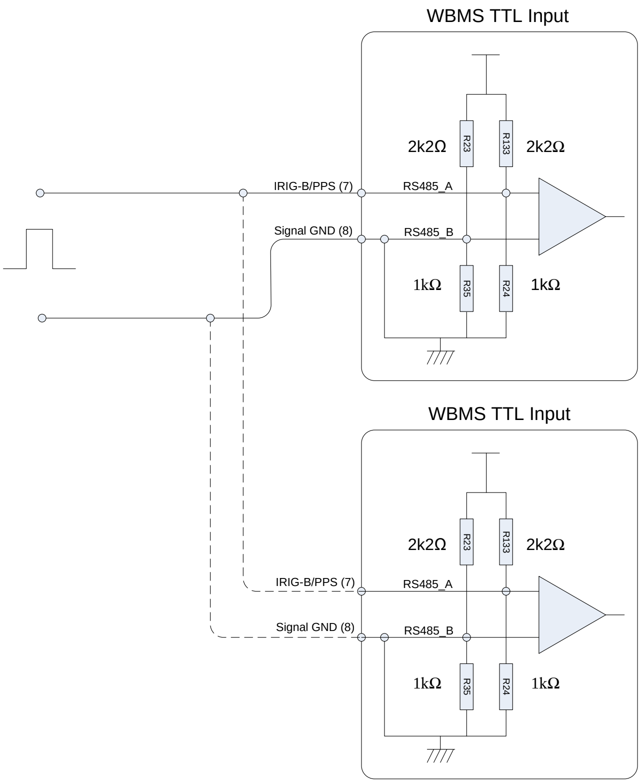



Figure 31. Dual Head

It is therefore important to check the **loaded** signal with an oscilloscope for:

- **Noise** – Is there noise on the signal that may cause false triggering?
- **Level** – Is the signal level sufficient to trigger the input?

# Appendix B: RS232 Considerations

RS232 works by switching between +ve and -ve voltages with respect to a common ground. It is coded as follows: **Logic 0 is +ve voltage**, **Logic 1 is -ve voltage**

Usually, a PPS pulse is available as a TTL or similar pulse. Some Multiplexors can accept TTL topside and output RS232 at the wet end (or other signal combinations). Additionally, users can convert the signal to RS232 from TTL before inputting to the topside. The following possibilities then exist:

1. TTL input topside with serial channel configured RS232 IO topside & RS232 IO wet-end.
2. The TTL pulse is converted to RS232 topside and input to the MUX with the serial channel configured RS232 IO topside & RS232 IO wet-end.
3. The TTL input topside with the MUX serial channel configured TTL topside and RS232 wet-end.

If options 2 or 3 are used, the signal is effectively inverted. Therefore, for a +ve 1PPS pulse input the scenario is as follows:

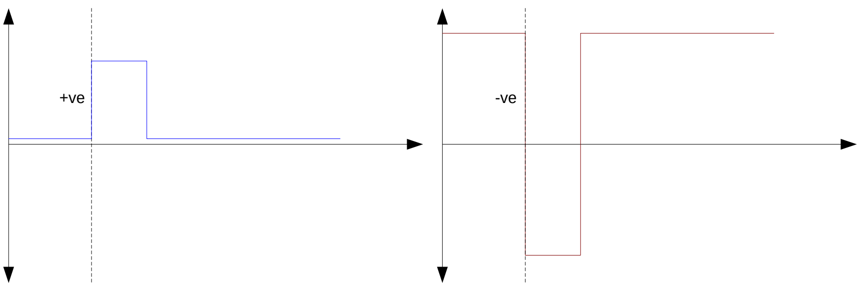



Figure 32. PPS pulse input topside from a timing source and resulting RS232 waveform from the MUX

The Trigger direction of the event should be set accordingly in the **Timing and Triggering** setup for WBMS sonars, and for WINGHEAD sonars should be set in the **Time** settings tab in the sonar web UI. For scenarios 2 & 3 above where the polarity is reversed:

- For a +ve 1PPS pulse input and a RS232 pulse presented to the sonar, the Sonar Timing Configuration should be set to NTP&PPS neg
- For a -ve 1PPS pulse input and a RS232 pulse presented to the sonar, the Sonar Timing Configuration should be set to NTP&PPS pos

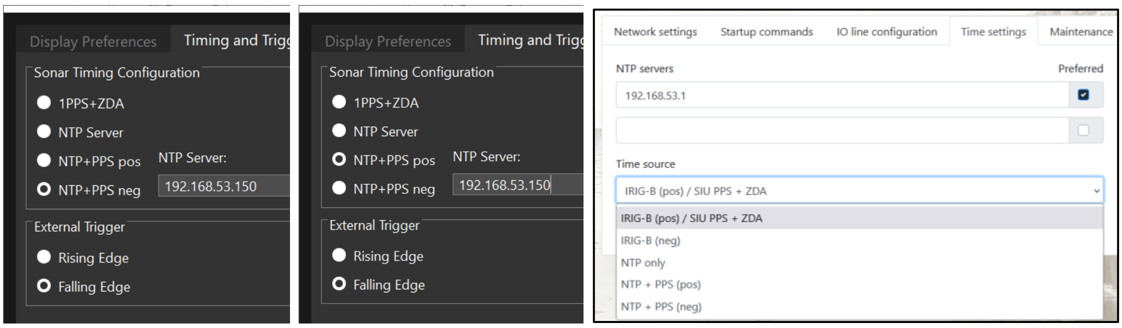



Figure 33. WBMS timing/trigger for +ve (left) and -ve (center) topside input pulses; WINGHEAD inputs (right)

If the pulse is inverted and the trigger is set incorrectly, the time of the sonar will be incorrect by the width of the pulse. This is insignificant if the pulse width is <1ms, however if it is greater than that, there may be an impact on the multibeam data, especially in dynamic conditions.

For this reason, using wide 1PPS pulses (is discouraged in **ANY** scenario and a maximum of 1ms should be selected if possible. The pulse should also not be set too narrow as this has implications with rise time in some situations (0.5ms is a good compromise).

# Appendix C: Integration Guides

## C1. RTS Gen5 Quick Start

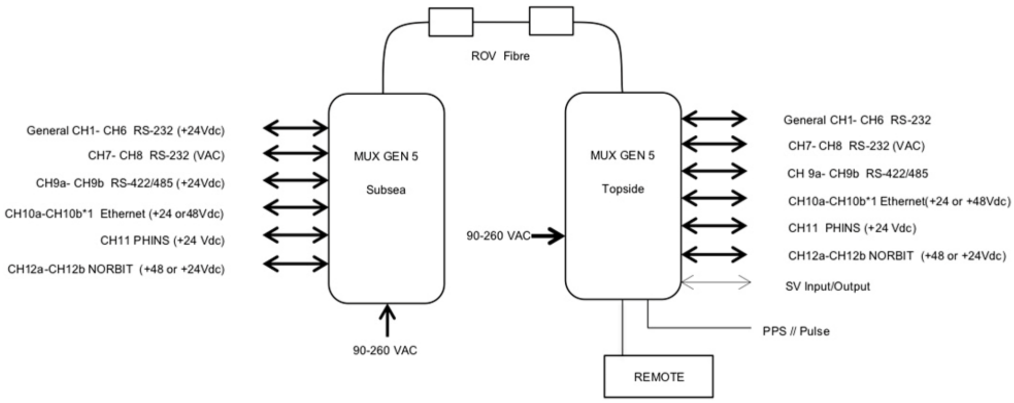
Rental Technology & Services AS
Devoted to Solutions

# RTS GEN 5 MUX MkII

Quick Reference Guide 3000TI-Norbit

| | |
|---|---|
| • Depth rating: 3000 meter<br>• Optical fiber range 10km, optional 70km for single mode fiber<br>• 16 channel C-WDM, 1271nm-1611nm<br>• 8 channels RS-232 fully isolated<br>• One channel RS-422 fully isolated<br>• One channel RS-485 fully isolated<br>• Four channel 10/100Mbit Ethernet | • PPS Timing pulse available subsea for CH6 and INS Ethernet<br>• PPS Timing pulse available subsea for CH12a and CH12b<br>• HD/SD video (optional)<br>• 14 configurable Relay outputs (24Vdc/48vdc)<br>• Two channel AC relay output 110VAC<br>• Small size, and a highly flexible modular system |

| RTS MUX GEN 5 Topside Unit | RTS MUX GEN 5 Subsea Unit |
|---|---|
|  |  |
| Power Requirement Topside unit: 100W max<br>Voltage requirement: 90-264VAC or 120-370VDC<br>Operating ambient Temperature. -15°C to +45°C<br>Weight: 8.5kg ± 1.0kg<br>Size: 134mm x 374mm x 483mm [ HxDxW]<br>19" panel and 3U height | Power requirement Subsea unit: 800W max.<br>(AC output relays OFF)<br>Voltage requirement: 90-264VAC or 120-370VDC<br>Operating ambient temperature: -2°C to +35°C<br>Weight in air: 32 kg ± 2.0 kg<br>Weight in water: 15 kg ± 2.0 kg<br>Size: 435mm x Ø 230mm |



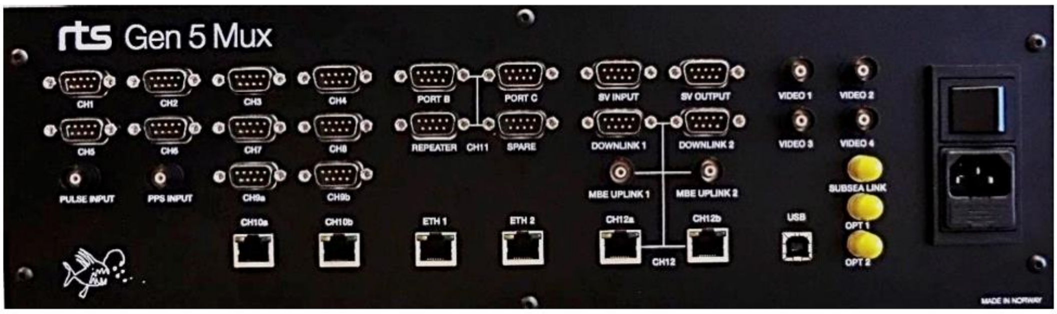

**Block schematic RTS MUX GEN 5 system.**

Rental Technology & Services AS
tel: +47 52 81 47 60
e-mail: sales@rts.as

Aakrehavn Teknologisenter
Sjøenveien 52
NO-4270 Åkrehamn NORWAY


| REF | CONNECTOR SUBSEA UNIT |
|---|---|
| 1. | CH1 RS-232 (24V) |
| 2. | CH2 RS-232 (24V) |
| 3. | CH3 RS-232 (24V) |
| 4. | CH4 RS-232 (24V) |
| 5. | CH5 RS-232 (24V) |
| 6. | CH6 RS-232 (24V) |
| 7. | CH7 RS-232 (Vac) |
| 8. | CH8 RS-232 (Vac) |
| 9. | CH9a RS-422 (24Vdc) |
| 10. | CH9b RS-485 (24Vdc) |
| 11. | CH10a Ethernet (24Vdc/48Vdc) |
| 12. | CH10b (24Vdc/48Vdc) |
| 13. | Power input connector (90-260Vac) |
| 14. | CH11 PHINS Ethernet (24Vdc) |
| 15. | CH12b NORBIT (48Vdc/24Vdc) |
| 16. | CH12a NORBIT (48Vdc/24Vdc) |

Connections on subsea bottle cap




Back panel RTS MUX GEN 5Topside unit.

**NOTES:**

1. CH10b in the GEN 5 MUX equipped with INS Ethernet is fitted only with Power function.
2. Video 1-4 currently not in use. (Optional SDI or Composite Video)
3. OPT1/OPT2 currently not in use.
4. USB is currently not in use.
5. Remote option is currently not in use.

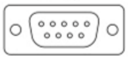
**Specifications subject to change without further notice.**

## RTS GEN 5 MUX: TOPSIDE CONNECTORS

MUX GEN5 INS_ETH REV 1.79 Norbit
Date 08.02.2019

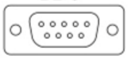
| LABEL | FUNCTION | BULKHEAD | PINOUT |
|---|---|---|---|

**LABEL:** CH1, CH2, CH3, CH4, CH5, CH6, CH7, CH8 — **FUNCTION:** GENERAL PORT RS232 — **BULKHEAD:** DB-9



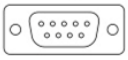
| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | NC | 7 | NC |
| 2 | RX Data Down | 8 | NC |
| 3 | TX Data Up | 9 | NC |
| 4 | NC | | |
| 5 | SerGND | | |
| 6 | NC | | |

**LABEL:** CH9a — **FUNCTION:** GENERAL PORT RS422 — **BULKHEAD:** DB-9



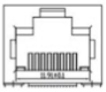
| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | NC | 7 | RX+ Data Down |
| 2 | NC | 8 | TX+ Data Up |
| 3 | NC | 9 | TX- Data Up |
| 4 | NC | | |
| 5 | Signal GND | | |
| 6 | RX- Data Down | | |

**LABEL:** CH9b — **FUNCTION:** GENERAL PORT RS485 — **BULKHEAD:** DB-9



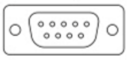
| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | NC | 7 | Data + |
| 2 | NC | 8 | NC |
| 3 | NC | 9 | NC |
| 4 | NC | | |
| 5 | Signal GND | | |
| 6 | Data - | | |

**LABEL:** CH10a, CH11 — **FUNCTION:** GENERAL PORT ETHERNET — **BULKHEAD:** RJ45



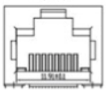
| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | TXD+ WHITE/ORANGE | 7 | NC |
| 2 | TXD- ORANGE | 8 | NC |
| 3 | RXD+ WHITE/GREEN | | |
| 4 | NC | | |
| 5 | NC | | |
| 6 | RXD- GREEN | | |

**LABEL:** CH11 (Repeater) — **FUNCTION:** GENERAL PORT RS232 — **BULKHEAD:** DB-9



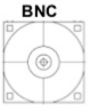
| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | NC | 7 | NC |
| 2 | RX Data Down | 8 | NC |
| 3 | TX Data Up | 9 | NC |
| 4 | NC | | |
| 5 | SerGND | | |
| 6 | NC | | |

**LABEL:** CH12a, CH12b — **FUNCTION:** NORBIT — **BULKHEAD:** RJ45



| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | BiDiA+ WHITE/GREEN | 7 | BiDiD+ WHITE/BROWN |
| 2 | BiDiA- GREEN | 8 | BiDiD- BROWN |
| 3 | BiDiB+ WHITE/ORANGE | | |
| 4 | BiDiC+ BLUE | | |
| 5 | BiDiC- WHITE/BLUE | | |
| 6 | BiDiB- ORANGE | | |

**LABEL:** PULSE INPUT PPS INPUT — **FUNCTION:** PULSE — **BULKHEAD:** BNC



| PIN | Function |
|---|---|
| 1 | GND |
| 2 | +5V |

**LABEL:** POWER — **FUNCTION:** POWER 110VAC — **BULKHEAD:** C14

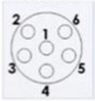
| PIN | Function |
|---|---|
| 1 | VAC 110V L |
| 2 | VAC 110V H |
| 3 | GND |

# RTS GEN 5 MUX: SUBSEA CONNECTORS

rts

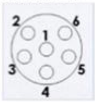
| LABEL | FUNCTION | BULKHEAD | PINOUT |
|---|---|---|---|

**CH1 CH2 CH3 CH4** — GENERAL PORT RS232 — MCBH-6-F



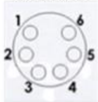
| PIN | Function |
|---|---|
| 1 | +24V |
| 2 | GND |
| 3 | TX Data Down |
| 4 | RX Data Up |
| 5 | SerGND |
| 6 | NC |

**CH5 CH6** — GENERAL PORT RS232 — MCBH-6-F



| PIN | Function |
|---|---|
| 1 | +24V |
| 2 | GND |
| 3 | TX Data Down |
| 4 | RX Data Up |
| 5 | SerGND |
| 6 | NC |

**CH7 CH8** — AC SUPPLY PORT RS232 — MCBH-6-F SPECIAL

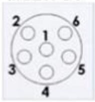


| PIN | Function |
|---|---|
| 1 | Mech GND |
| 2 | AC 110/240V L |
| 3 | TX Data Down |
| 4 | RX Data Up |
| 5 | SerGND |
| 6 | AC 110/240V N |

Note: Special Modified Seacon MCBH-6-F Modified Penetrator

AC power output voltage is depending on AC main supply (power input)

**CH9a CH9b** — GENERAL PORT RS422 RS485 — MCBH-6-F

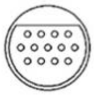


| PIN | Function Channel 9a RS422 | PIN | Function Channel 9b RS485 |
|---|---|---|---|
| 1 | +24V | 1 | +24V |
| 2 | GND | 2 | GND |
| 3 | RX- Data Up | 3 | Data + |
| 4 | RX+ Data Up | 4 | Data - |
| 5 | TX+ Data Down | 5 | NC |
| 6 | TX- Data Down | 6 | NC |

**CH10a** — GENERAL PORT ETHERNET — MCBH-8-F

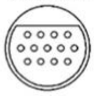
| PIN | Function | PIN | Function |
|---|---|---|---|
| 1 | +24V | 7 | GND |
| 2 | GND | 8 | +48V |
| 3 | TXD+ WHITE/ORANGE | | |
| 4 | TXD- ORANGE | | |
| 5 | RXD+ WHITE/GREEN | | |
| 6 | RXD- GREEN | | |

**CH11** — PHINS Ethernet — 5506-2013



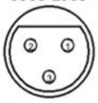
| PIN | Function | PIN | |
|---|---|---|---|
| 1 | GND PPS & SerGND | 8 | RS232 Reperater RX |
| 2 | PPS OUT, TTL 5V | 9 | Vout INS: +24VDC |
| 3 | Eth TXD+ WHITE/ORANGE | 10 | Vout INS: GND |
| 4 | Eth TXD- ORANGE | 11 | NC |
| 5 | Eth RXD+ WHITE/GREEN | 12 | Vout EXTSENS: GND |
| 6 | Eth RXD- GREEN | 13 | Vout EXTSENS: +24VDC |
| 7 | RS232 Repeater TX | | |

**CH12a CH12b** — NORBIT — 5506-2013



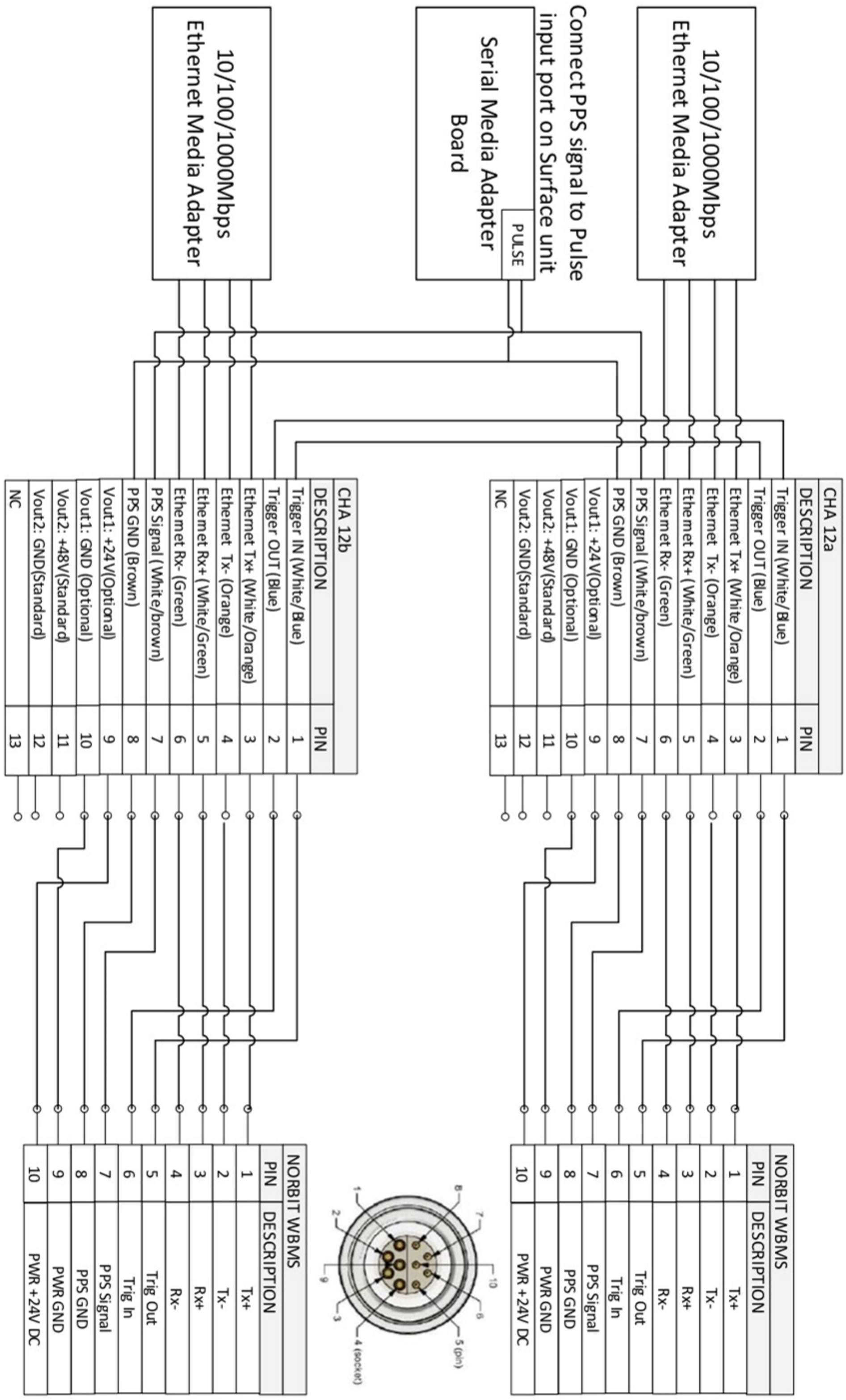
| PIN | Function | PIN | |
|---|---|---|---|
| 1 | Trigger IN | 8 | Pulse(PPS) GND |
| 2 | Trigger OUT | 9 | Vout 1: +24VDC(Optional) |
| 3 | Ethernet Tx+ (White/Orange) | 10 | Vout 1: GND(Optional) |
| 4 | Ethernet Tx- (Orange) | 11 | Vout 2: +48VDC(Standard) |
| 5 | Ethernet Rx+ (White/Green) | 12 | Vout 2: GND(Standard) |
| 6 | Ethernet Rx- (Green) | 13 | NC |
| 7 | Pulse(PPS) Signal | | |

**POWER** — POWER 110VAC — 5506-2003



| PIN | Function |
|---|---|
| 1 | VAC 110V L |
| 2 | VAC 110V H |
| 3 | Mech GND |

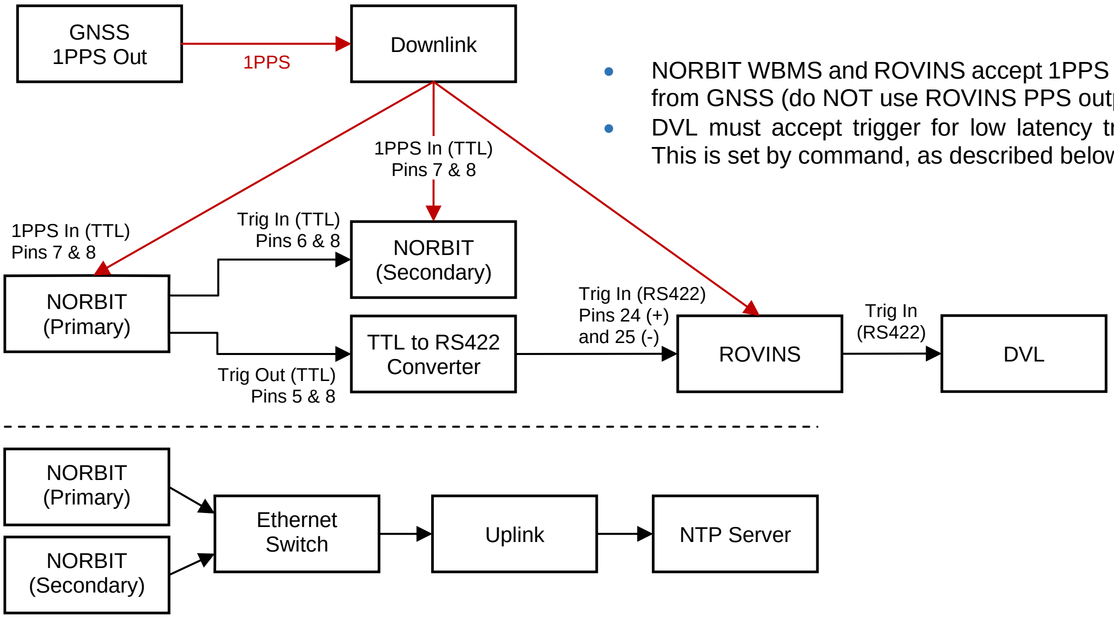
RTS Gen5 NORBIT MOD



## C2. ROV Integration Example with WBMS & ROVINS

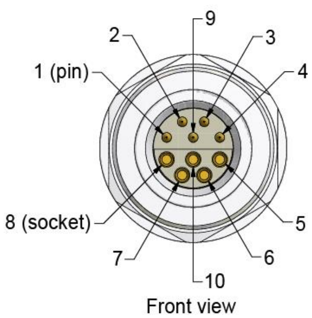
### Interfacing Scheme for Dual Head WBMS, iXblue ROVINS and RDI DVL

- NORBIT WBMS and ROVINS accept 1PPS signal from GNSS (do NOT use ROVINS PPS output!)
- DVL must accept trigger for low latency trigger. This is set by command, as described below.




To configure the DVL for low latency triggering, set the `CX` command to enable the trigger input by sending `CX1`. Start the DVL pinging with the `CS` command. The DVL will then wait for a trigger before each ping. Setting the RS-485 lines to a break state for not less than 10 microseconds sends the trigger. The DVL will then ping within 250 microseconds of the leading edge of the break pulse (see also RDI document FSA-018: "Triggering a DVL with a TTL signal").

### WBMS Bulkhead Pinout

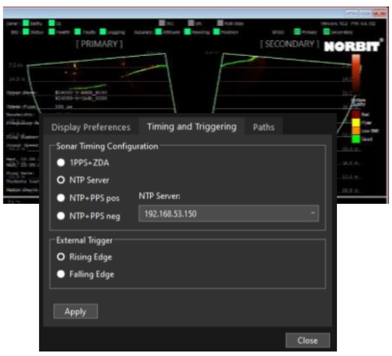



| Pin | WBMS Function | Cable |
|---|---|---|
| 1 | Tx + | Black (red pair) |
| 2 | Tx - | Red |
| 3 | Rx + | Black (blue pair) |
| 4 | Rx - | Blue |
| 5 | RS232 Tx/Trig Out | Black (green pair) |
| 6 | RS232 Rx/Trig In | Green |
| 7 | IRIG-B | Black (white pair) |
| 8 | Signal GND | White |
| 9 | PWR GND | Black 0,5mm$^2$ |
| 10 | PWR +24V | White, 0.5mm$^2$ |

### NORBIT WBMS Configuration

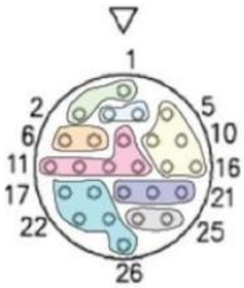
In dual head mode, the secondary WBMS head is configured automatically by the GUI to use external trigger from the primary head, which allows correct synchronization. However, the user must ensure the proper electrical connections.

For subsea installations, the 1PPS+NTP scheme must be used to achieve the best timing accuracy. If the 1PPS is not available, the NTP alone can be used with limited timing accuracy. The timing is set in the NORBIT GUI and is sent to both sonar heads.



## Interfacing to ixBlue ROVINS and RDI DVL

To slave the DVL to the multibeam, the best method is to supply a pulse on pins 24 (+) and 25 (-) of the central connector on the ROVINS.




**Central Connector**

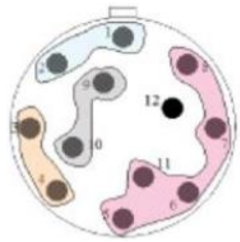


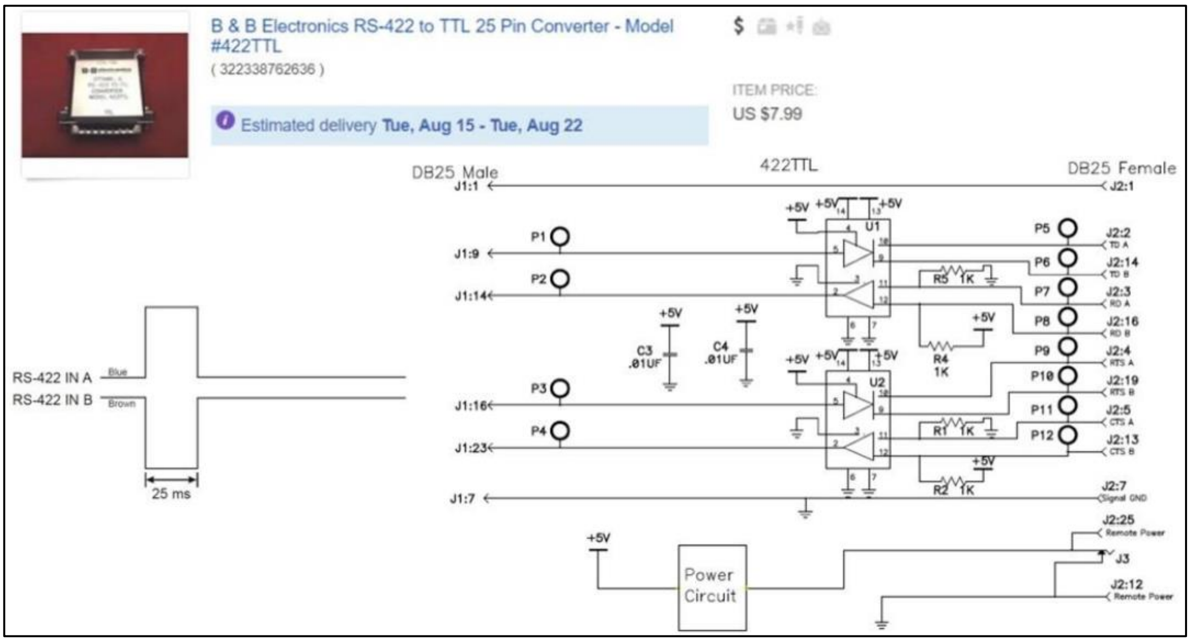
**Diagram of Port X (X being C, D or E) Connector**

| Pin | Signal | Pin | Signal |
|---|---|---|---|
| 1 | System Power In (+24 V) | 14 | Port A: RS422 RX(+)(B) |
| 2 | System Power In GND (0/24v) | 15 | Repeater: RS422 RX(-)(A)/RS232 RX(+) |
| 3 | Ext Sensor 1 In (+V1) | 16 | Repeater: RS422 RX(+)(B) |
| 4 | Ext Sensor 1 In GND (0/ +V1 V) | 17 | Port B: RS422 TX(+)(B)/RS232 TX(+) |
| 5 | Repeater: GND_R | 18 | Port B: RS422 TX(-)(A) |
| 6 | Ext Sensor 2 In (+V2) | 19 | Pulse A: OUT TTL |
| 7 | Ext Sensor 2 In GND (0/+V2) | 20 | Pulse A: IN TTL |
| 8 | Port A: GND_A | 21 | Pulse A: GND_A |
| 9 | Repeater: RS422 TX(+)(B)/RS232 TX(+) | 22 | Port B: RS422 RX(-)(A)/RS232 RX(+) |
| 10 | Repeater: RS422 TX(-)(A) | 23 | Port B: RS422 RX(+)(B) |
| 11 | Port A: RS422 TX(+)(B)/RS232 TX(+) | 24 | Ext Pulse IN + |
| 12 | Port A: RS422 TX(-)(A) | 25 | Ext Pulse IN - |
| 13 | Port A: RS422 RX(-)(A)/RS232 RX(+) | 26 | Port B: GND_B |

| Pin | Signal |
|---|---|
| 1 | Ext Sensor 1 Out (+V1) |
| 2 | Ext Sensor 1 Out GND (0/ +V1 V) |
| 3 | Ext Sensor 2 Out (+V2) |
| 4 | Ext Sensor 2 Out GND (0/+V2 V) |
| 5 | Port X: RS422 TX(+)(B)/RS232 TX(+) |
| 6 | Port X: RS422 TX(-)(A) |
| 7 | Port X: RS422 RX(-)(A)/RS232 TX(+) |
| 8 | Port X: RS422 RX(+)(B) |
| 9 | Ext Pulse OUT + |
| 10 | Ext Pulse OUT - |
| 11 | Port X: GND_X |
| 12 | Reserved except if X=C : Pulse C: IN TTL |

Then, on the connector which goes to the DVL (port C, D or E) on the ROVINS, the pulse will be available on Pin 9 (+) and 10 (-).

## Sample TTL to RS422 Converter from B&B



## C3. Innova Matrix 2+ Quick Start

Wet-end summary and channel list taken from manufacturers manual (*MAN-000015294_R7*):

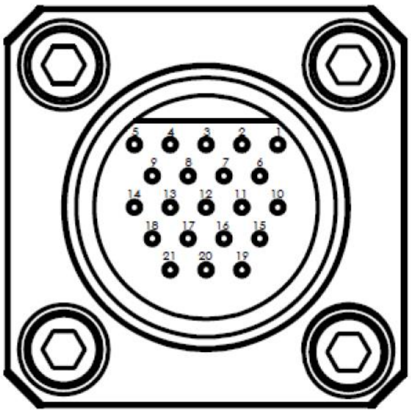
- Dimensions: L=584mm, Ø=220 mm (Ø=210mm in centre)
- Depth rating: 5000 m
- Supply voltage: 85-260VAC, 50-60Hz
- 120-370VDC
- Maximum power consumption: 1200W
- Minimum power consumption: 150W
- Recommended fuse: 16A (@110VAC)
- Maximum inrush current: 40A (@265VRMS, Cold start)
- Housing material: Titanium grade 5
- Weight in air: 35 kg
- Weight in water: 13 kg


Multiple channels are available. C1, C2 and C3 are normally used for multibeam sensor interfacing.

| Identifier | Connector Type | Signals | Power |
|---|---|---|---|
| C1 | 5506-2021-E | • Ethernet (1 Gbps)<br>• PECL (optional) | • 24VDC (6A)<br>• 48VDC (6A)<br>Software switchable |
| C2 | 5506-2021-E | • Ethernet (1 Gbps)<br>• PECL (optional) | • 24VDC (6A)<br>• 48VDC (6A)<br>Software switchable |
| C3 | 5506-2021-E | • Ethernet (2x 100Mbps)<br>• PECL (optional)<br>• RS232/RS485<br>• 5V TTL (PPS) | • 24VDC (6A)<br>• 48VDC (3A)<br>Hardware switchable.<br>24VDC is standard. |
| C4 | MINL-5515-75Ω<br>5506-1508 (Optional) | • HD-SDI<br>• Analog Video (optional)<br>• RS232 | • 24VDC (2A |
| C5 | MINL-5515-75Ω<br>5506-1508 (Optional) | • HD-SDI<br>• Analog Video (optional)<br>• RS232 | • 24VDC (2A) |
| C6 | MINL-5515-75Ω<br>5506-1508 (Optional) | • HD-SDI<br>• Analog Video (optional)<br>• RS232 | • 24VDC (2A) |
| C7 | MCBH8F | • RS232 | • 24VDC (2A) |
| C8 | MCBH8F | • RS232 | • 24VDC (2A) |
| C9 | MCBH8F | • Ethernet (100Mbps)<br>• TTL (Same as C10) | • 24VDC (2A) |
| C10 | MCBH8F | • RS232<br>• TTL (Same as C9) | • 24VDC (2A) |
| C11 | MCBH8F | • RS232/RS485 | • 24VDC (2A) |
| C12 | MCBH6F | • RS232 | • 110/230VAC (Depending on input power) (3.15A) |
| C13 | MCBH8F | • RS232/RS485 | • 24VDC (2A) |

## Connectors C1 & C2

- 24v or 48v DC max 6A selectable in software.
- 100Mbit or 1Gbit **independent** ethernet communications selectable from the topside.
- RS232 communications.
- Synchronization loop back between the two connectors for a dual head synchronization connection, so no flying lead required for this function. They connect C1-20 to C2-20 & C1-21 to C2-21.



| 5506-2021 | | | |
|---|---|---|---|
| **PIN** | **FUNCTION** | **PIN** | **FUNCTION** |
| 1 | Eth, BiDir B- | 12 | N/C |
| 2 | Eth, BiDir B+ | 13 | Eth, BiDir C+ |
| 3 | N/C | 14 | Eth, BiDir C- |
| 4 | Eth, BiDir D- | 15 | RS232 0V |
| 5 | Eth, BiDir D+ | 16 | RS232 Tx (Downlink) |
| 6 | 48VDC | 17 | RS232 Rx (Uplink) |
| 7 | 0V | 18 | N/C (PECL Screen) |
| 8 | 24VDC | 19 | N/C (PECL Signal) |
| 9 | NC | 20 | Sync - |
| 10 | Eth, BiDir A- | 21 | Sync + |
| 11 | Eth, BiDir A+ | | |

Figure 34. C1 & C2 Wet-End Connections (from MAN-000015294_R7)

| RS232 Interface | | Ethernet Interface | | | PECL (75 Ω) Interface | |
|---|---|---|---|---|---|---|
| **RJ-45 (1)** | | **RJ-45(C1)** | | | **BNC(C1)** | |
| **Pin** | **Function** | **Pin** | **Function** | **Color** | **Pin** | **Function** |
| 1 | N/C | 1 | Eth, BiDir A+ | White/Orange | Screen | PECL Screen |
| 2 | N/C | 2 | Eth, BiDir A- | Orange | Center | PECL Signal |
| 3 | N/C | 3 | Eth, BiDir B+ | White/Green | | |
| 4 | RS232 - 0V | 4 | Eth, BiDir C+ | Blue | | |
| 5 | RS232 – RX (Downlink) | 5 | Eth, BiDir C- | White/Blue | | |
| 6 | RS232 – TX (Uplink) | 6 | Eth, BiDir B- | Green | | |
| 7 | N/C | 7 | Eth, BiDir D+ | White/Brown | | |
| 8 | N/C | 8 | Eth, BiDir D- | Brown | | |

Figure 35. C1 & C2 Topside Connections (from MAN-000015294_R7)

The 18-pin variant of the WINGHEAD does not have Gigabit or single-ended 1PPS input capability, therefore it is better used on C3. If 1PPS input is not being employed, it could be used on this connector with 100Mbit communications.

If the communications are set to 100Mbit, the connector can be used with the WBMS. The wiring below is only a suggestion, and users should test the wiring before committing to moulding cables for installations.

| C1/2 Pin | C1/2 Function | 24-pin WINGHEAD | | 10-pin WBMS | |
|---|---|---|---|---|---|
| | | Pin | Function | Pin | Function |
| 1 | Eth, BiDir B- | 5 | ETH_B- | 4 | LAN RX- |
| 2 | Eth, BiDir B+ | 6 | ETH_B+ | 3 | LAN RX+ |
| 3 | N/C | | | | |
| 4 | Eth, BiDir D- | 20 | ETH_D- | | |
| 5 | Eth, BiDir D+ | 19 | ETH_D+ | | |
| 6 | 48vDC | | | | |
| 7 | 0v | 7 & 4 | Power gnd | 9 | Power Gnd |
| 8 | 24vDC | 18 & 21 | 24-48vDC | 10 | 24vDC |
| 9 | N/C | | | | |
| 10 | Eth, BiDir A- | 13 | ETH_A- | 2 | LAN TX- |
| 11 | Eth, BiDir A+ | 8 | ETH_A+ | 1 | LAN TX+ |
| 12 | N/C | | | | |
| 13 | Eth, BiDir C+ | 17 | ETH_C+ | | |
| 14 | Eth, BiDir C- | 12 | ETH_C- | | |
| 15 | RS232 0v | 3 | Time_gnd | 8 | Signal Gnd |
| 16 | RS232 TX (Dn) | 1 | Time+ | 7 | PPS |
| 17 | RS232 RX (Up) | | | | |
| 18 | NC | | | | |
| 19 | NC | | | | |
| 20 | Sync - | 23 | Trig- | 8 | Signal Gnd |
| 21 | Sync + | 24 | Trig+ | 5 or 6* | Trig out OR Trig in |

Table 14. C1 or C2 Connections to 24-pin WINGHEAD

*If using a dual head WBMS setup, it is necessary to make one cable with connection to sonar head RS232 Trigger out and one to RS232 Trigger in. For example, if we make C1 connected to the Primary sonar, then pin 5 from this sonar will go to pin 21 of the MUX connector, and for the secondary sonar, pin 6 will connect to pin 21 of the MUX connector.

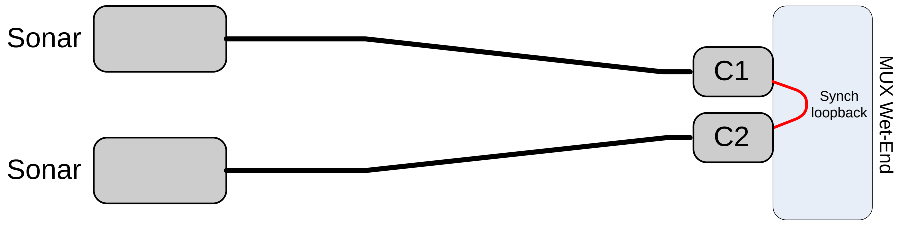



Figure 36. Setup Using C1 & C2

## Connector C3

- Hardware selectable 24v or 48v DC. Max 6A selectable in software.
- Dual 100Mbit ethernet communications connected to a gigabit switch and output from a single gigabit connection topside. See Figure 37 below.
- RS232/RS485 communications.
- Open collector Trigger downlink.

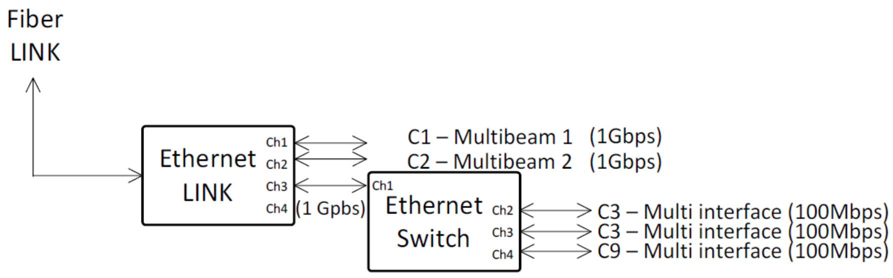
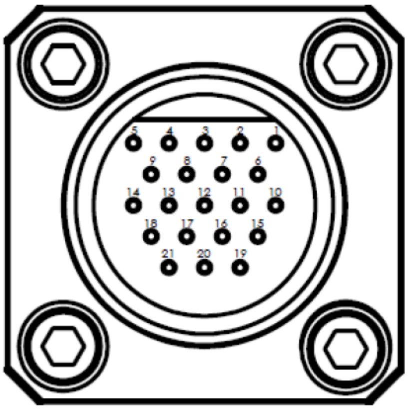



Figure 37. C3 Network Configuration at the wet-end



| 5506-2021 | | | |
|---|---|---|---|
| PIN | FUNCTION | PIN | FUNCTION |
| 1 | Eth, Rd- 1 | 12 | RS485+ |
| 2 | Eth, Rd+ 1 | 13 | Eth, Td+ 2 |
| 3 | Trigger | 14 | Eth, Td- 2 |
| 4 | Eth, Rd- 2 | 15 | RS232/RS485 0V |
| 5 | Eth, Rd+ 2 | 16 | RS232 Tx (Downlink) |
| 6 | 48VDC* | 17 | RS232 Rx (Uplink) |
| 7 | 0V | 18 | NC |
| 8 | 24VDC* | 19 | NC |
| 9 | RS485- | 20 | Trigger 0V |
| 10 | Eth, Td- 1 | 21 | NC |
| 11 | Eth, Td+ 1 | | |

* Standard set-up is 24VDC output voltage; pin 8 is NC in this case. The unit can be modified to output 48VDC

Figure 38. C3 Wet-End Connections (from MAN-000015294_R7)

| Serial Interface | | Ethernet Interface | | | TTL Interface | |
|---|---|---|---|---|---|---|
| RJ-45 (3 - Top) | | RJ-45(C3) | | | RJ-45 (3 - Bottom) | |
| Pin | Function | Pin | Function | Color | Pin | Function |
| 1 | N/C | 1 | Eth, BiDir A+ | White/Orange | 1 | TTL – 5V |
| 2 | RS485 + | 2 | Eth, BiDir A- | Orange | 2 | N/C |
| 3 | RS485 - | 3 | Eth, BiDir B+ | White/Green | 3 | N/C |
| 4 | Serial - 0V | 4 | Eth, BiDir C+ | Blue | 4 | N/C |
| 5 | RS232 – RX (Downlink) | 5 | Eth, BiDir C- | White/Blue | 5 | N/C |
| 6 | RS232 – TX (Uplink) | 6 | Eth, BiDir B- | Green | 6 | N/C |
| 7 | N/C | 7 | Eth, BiDir D+ | White/Brown | 7 | N/C |
| 8 | N/C | 8 | Eth, BiDir D- | Brown | 8 | TTL – 0V |

Figure 39. C3 Topside Connections (from MAN-000015294_R7)

Connections to one head use 4-wire ethernet, 24vDC (or 48v optional for WINGHEAD) and a 1PPS pulse downlink using one of 3 methods:

- **RS485 (Blue)** – The communications transceivers have been designed using a RS485 hardware and the system has been tested with this.
- **RS232 (Green)** – The communications transceivers can handle input voltages within the limits specified previously. The Innova system has been found to work using this.
- **Trigger (Gold)** – The output from the MUX uses an open collector output to sink from the instrument being triggered. It therefore has little drive capability and, although it gives TTL voltages unloaded, with 2 WBMS sonars connected the pulse height drops to below the required 3v3 threshold. This results in occasional loss of 1PPS pulse and in a noisy situation is unlikely to be reliable. It has, however, been used offshore.

It should be remembered that a link between dual head sonars for synchronization should be achieved by wiring in the harness; it is not addressed in the C3 connector.

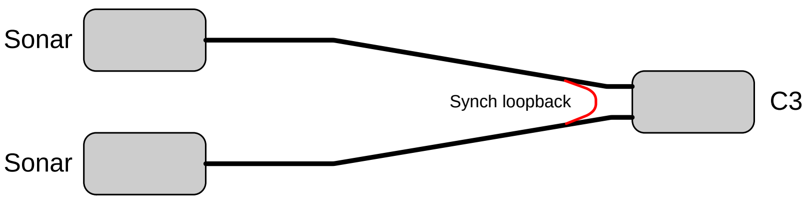



Figure 40. Setup Using C3

Wiring for one or two WINGHEAD sonars to C3 is shown below. This is only a suggestion and users should test the wiring for themselves before committing to molding cables for installations.

| C3 Pin | C3 Function | Pri. WINGHEAD Pin | Function | Sec. WINGHEAD Pin | Function |
|---|---|---|---|---|---|
| 1 | Ethernet Rd- 1 | 13 | Eth_A- | | |
| 2 | Ethernet Rd+ 1 | 8 | Eth_A+ | | |
| 3 | Trigger | 1 | TIME+ | 1 | TIME+ |
| 4 | Ethernet Rd- 2 | | | 13 | Eth_A- |
| 5 | Ethernet Rd+ 2 | | | 8 | Eth_A+ |
| 6 | 48vDC | | | | |
| 7 | 0v | 9 | GND | 9 | GND |
| 8 | 24vDC | 10 | 24vDC | 10 | 24vDC |
| 9 | RS485- | 8 | TIME- | 8 | TIME- |
| 10 | Ethernet Td- 1 | 5 | Eth_B- | | |
| 11 | Ethernet Td+ 1 | 6 | Eth_B+ | | |
| 12 | RS485+ | 1 | TIME+ | 1 | TIME+ |
| 13 | Ethernet Td- 2 | | | 5 | Eth_B- |
| 14 | Ethernet Td+ 2 | | | 6 | Eth_B+ |
| 15 | RS232/RS485 0v | 3 | TIME_Gnd | 3 | TIME_Gnd |
| 16 | RS232 TX (Down) | 1 | TIME+ | 1 | TIME+ |
| 17 | RS232 RX (Up) | | | | |
| 18 | NC | | | | |
| 19 | NC | | | | |
| 20 | Trigger 0v | 3 | TIME_Gnd | 3 | TIME_Gnd |
| 21 | NC | | | | |

Table 15. 24-pin WINGHEAD Connections to C3

If a WINGHEAD sonar with an 18-pin connector is used, the use of RS485 is recommended for 1PPS downlink.

Wiring for one or two WBMS sonars to C3 is shown below. This is only a suggestion and users should test the wiring for themselves before committing to moulding cables for installations.

| C3 Pin | C3 Function | Pri. WBMS Pin | Function | Sec. WBMS Pin | Function |
|---|---|---|---|---|---|
| 1 | Ethernet Rd- 1 | 4 | LAN RX- | | |
| 2 | Ethernet Rd+ 1 | 3 | LAN RX+ | | |
| 3 | Trigger | 7 | PPS/IRIG-B | 7 | PPS/IRIG-B |
| 4 | Ethernet Rd- 2 | | | 4 | LAN RX- |
| 5 | Ethernet Rd+ 2 | | | 3 | LAN RX+ |
| 6 | 48vDC | | | | |
| 7 | 0v | 9 | GND | 9 | GND |
| 8 | 24vDC | 10 | 24vDC | 10 | 24vDC |
| 9 | RS485- | 8 | Signal Gnd | 8 | Signal Gnd |
| 10 | Ethernet Td- 1 | 2 | LAN TX- | | |
| 11 | Ethernet Td+ 1 | 1 | LAN TX+ | | |
| 12 | RS485+ | 7 | PPS/IRIG-B | 7 | PPS/IRIG-B |
| 13 | Ethernet Td- 2 | | | 2 | LAN TX- |
| 14 | Ethernet Td+ 2 | | | 1 | LAN TX+ |
| 15 | RS232/RS485 0v | 8 | Signal Gnd | 8 | Signal Gnd |
| 16 | RS232 TX (Down) | 7 | PPS/IRIG-B | 7 | PPS/IRIG-B |
| 17 | RS232 RX (Up) | | | | |
| 18 | NC | | | | |
| 19 | NC | | | | |
| 20 | Trigger 0v | 8 | Signal Gnd | 8 | Signal Gnd |
| 21 | NC | | | | |

Table 16. WBMS Connections to C3

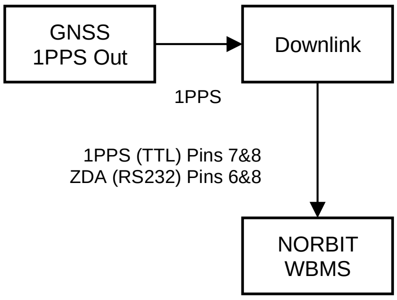
# Appendix D: Timing Methods

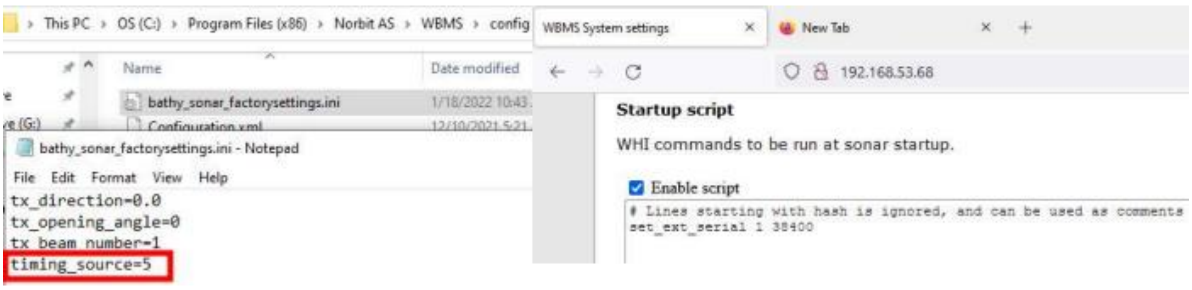
## D1. WBMS 1PPS+ZDA Direct Timing Scheme

### Description

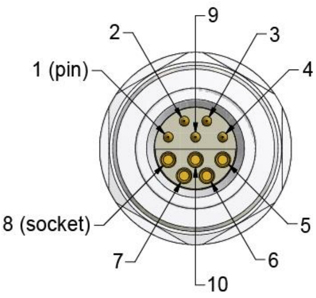
When it is not possible to use NTP+PPS timing for subsea installations, another option is to use the 1PPS+ZDA direct timing scheme, as outlined below. Note that this scheme uses the trigger lines, therefore the trigger function is no longer available. It also requires a firmware upgrade. Contact NORBIT Support for more details.

- The NORBIT WBMS timestamps data directly in the sonar head with high accuracy timing.
    - WBMS accepts the 1PPS signal from GNSS on pin 7 with GND pin 8.
    - WBMS accepts serial $GPZDA on pin 6 with GND pin 8.
- To activate this timing mode, the following commands must be executed:
    - `set_time_source 5`
    - `set_ext_serial 1 38400`
- The baud rate of the serial port (38400 in the above example) can be changed to whatever is required. Use startup commands via the sonar web UI (shown below) to execute the change.
- The `set_time_source` command must be provided in the bathy_sonar_factorysettings.ini file, as shown below.
- This timing scheme can work with NORBIT GUI 10.4.37, but the firmware version must be updated to WBMS_FW_5.5.57.tar.gz or later




### WBMS Bulkhead Pinout




| 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$^2$ |

## D2. NTP Configuration on a Time-Synchronized PC

This appendix explains how to configure two examples of NTP time servers. Other NTP servers are available as stand-alone services (like Meinberg) or as part of a package (like Qinsy). The server generally runs on the time-synchronized PC, which is normally the data acquisition PC, as it is synchronized to a source such as GNSS time.

### Notes

- SNTP time to the sonar **WITHOUT** a 1PPS synchronization pulse is accurate to approximately 10s of milliseconds and is suitable for platforms moving linearly, e.g. ROV with no tugging from the umbilical.
- The time received at the sonars is also only as good as the time on the time serving PC. This should have a time source such as 1PPS & ZDA, or similar.
- The time from the server takes a few seconds to become valid on the sonar.
- It is possible to have multiple instances of the Qinsy SNTP server active by mistake. Ensure that only one icon is displayed in the system tray.
- Only one NTP service should be active. The W32Time Service should be stopped and the Startup should be disabled.

### Qinsy SNTP Server

The SNTP time server is available with a Qinsy distribution. This is free to use and no license is required. If it is not visible in the Qinsy Console, it should be added by selecting **View > Add/Remove QPS Programs**, and in the **Add/Remove Programs** dialog, select **SNTP Server**. The SNTP server is now available and can be started via the shortcut icon within the Qinsy Console.

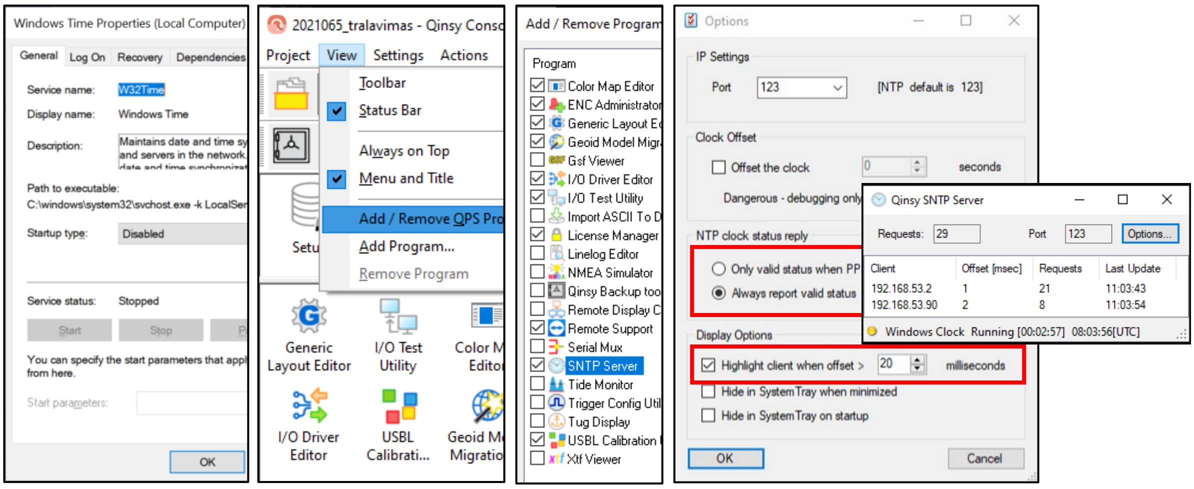



Figure 41. Disabling Windows Time Service (left) and adding SNTP Server to Qinsy Console

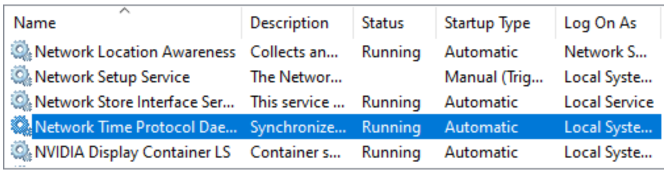
Once the SNTP server is started, it is necessary to set the **NTP clock status reply** in the **Options** dialog to **Only valid status when PPS driver is running** if the Qinsy PPS driver is interfaced, otherwise, if time is set with a different method, then select **Always report valid status**.

Change the **Highlight client when offset** threshold to **>20ms**. Incoming requests for time updates will be shown in the main display along with the time of request.

## Meinberg NTP Server

The Meinberg NTP server runs as a Windows service and can be downloaded from:
https://www.meinbergglobal.com/english/sw/ntp.htm#ntp_stable

After completing the installation, it may be necessary to restart the PC.



| Name | Description | Status | Startup Type | Log On As |
| --- | --- | --- | --- | --- |
| Network Location Awareness | Collects an... | Running | Automatic | Network S... |
| Network Setup Service | The Networ... | | Manual (Trig... | Local Syste... |
| Network Store Interface Ser... | This service ... | Running | Automatic | Local Service |
| Network Time Protocol Dae... | Synchronize... | Running | Automatic | Local Syste... |
| NVIDIA Display Container LS | Container s... | Running | Automatic | Local Syste... |

Figure 42. Windows Task Manager Services (after Meinberg installation)

On the **Services** tab within Windows Task Manager, the **Network Time Protocol Daemon Startup Type** should be configured for **Automatic** startup, and the **Status** should be **Running**. If this is not the case, the properties should be changed to allow this. The setup is configured by an editable .ini file found in the following directory: *C:\Program Files (x86)\NTP\etc\ntp.conf*

A simple example of the configuration is shown below, which assumes that the sonar and time-synchronized PC are on the default subnet of 192.168.53.XXX.

```
#Use drift file.  This ensures a fast resynch following a reboot
driftfile "%ProgramFiles%\NTP\etc\ntp.drift"
# you are the time server
server 127.127.1.0
#broadcast time on your subnet ie x.x.x.255
broadcast 192.168.53.255 minpoll 0 maxpoll 0
```

The .ini file is most easily accessible from the Windows Start Menu, by typing “NTP” into the search, where the **Edit NTP Configuration App** can then be accessed. Note that it is necessary to restart the PC with each new configuration.

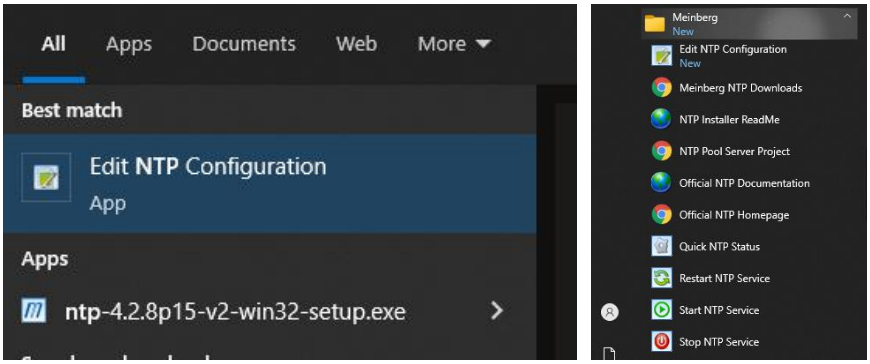



Figure 43. Edit NTP Configuration App (left) and Windows Start Menu (right)

The Meinberg group from the Windows Start Menu provides access to various functions, including starting and stopping the NTP services, and opening a status window for the server.

The NORBIT GUI must be configured to communicate with the time server, and therefore requires the network IP address of the PC. There may be a short delay for the time synchronization to become active. When the time in the GUI becomes valid, the reported date/time will change from red to white.

Meinberg also offers a Status monitoring tool. The use of this tool is recommended to check that the service is running OK and the timing is valid. It also offers easy viewing, editing and saving of the configuration file. Unfortunately, it does not show incoming time requests like the Qinsy SNTP utility.

The tool can be downloaded from: https://www.meinbergglobal.com/english/sw/ntp-server-monitor.htm#download

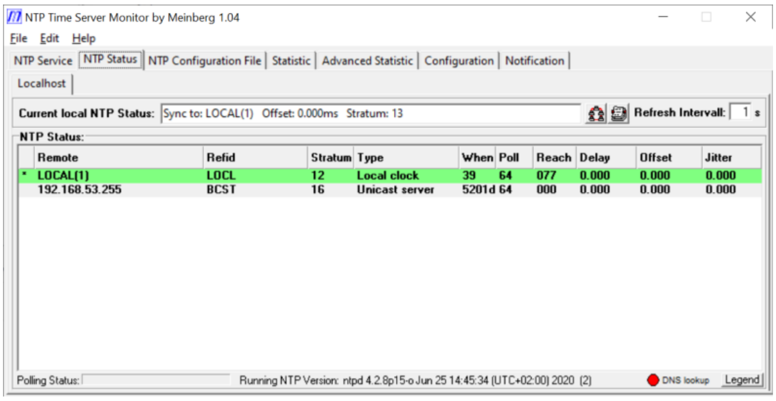



Figure 44. Meinberg Monitoring Tool

**NOTE:** The Meinberg NTP server will not immediately start to provide time updates to the sonar. It monitors the PC clock for a few minutes and when the "Reach" gets high enough (77 to a maximum of 377) it will start to reply to time requests. In the Monitoring tool, the LOCAL status will show this progression and turn green when it is ready to serve.