

LOWRANCE®

HDS® LIVE

INSTALLATION MANUAL
ENGLISH



Preface

Disclaimer

As Navico is continuously improving this product, we retain the right to make changes to the product at any time which may not be reflected in this version of the manual. Please contact your nearest distributor if you require any further assistance.

It is the owner's sole responsibility to install and use the equipment in a manner that will not cause accidents, personal injury or property damage. The user of this product is solely responsible for observing maritime safety practices.

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Copyright

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Warranty

The warranty card is supplied as a separate document. In case of any queries, refer to the brand website of your unit or system:

www.lowrance.com

Compliance statements

Europe

Navico declare under our sole responsibility that the product conforms with the requirements of:

- CE under RED 2014/53/EU

The relevant declaration of conformity is available in the product's section at the following website:

- www.lowrance.com

Countries of intended use in the EU

AT - Austria	LI - Liechtenstein
BE - Belgium	LT - Lithuania
BG - Bulgaria	LU - Luxembourg
CY - Cyprus	MT - Malta
CZ - Czech Republic	NL - Netherlands
DK - Denmark	NO - Norway
EE - Estonia	PL - Poland
FI - Finland	PT - Portugal
FR - France	RO - Romania
DE - Germany	SK - Slovak Republic
GR - Greece	SI - Slovenia
HU - Hungary	ES - Spain
IS - Iceland	SE - Sweden
IE - Ireland	CH - Switzerland
IT - Italy	TR - Turkey
LV - Latvia	UK - United Kingdom

United States of America

Navico declare under our sole responsibility that the product conforms with the requirements of:

- Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation

⚠ Warning: The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

→ **Note:** This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that the interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that of the receiver is connected
- Consult the dealer or an experienced technician for help

Industry Canada

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et. (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Industry Canada Statement: Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Australia and New Zealand

Navico declare under our sole responsibility that the product conforms with the requirements of:

- level 2 devices of the Radiocommunications (Electromagnetic Compatibility) standard 2017
- radiocommunications (Short Range Devices) Standards 2014

Internet usage

Some features in this product use an internet connection to perform data downloads and uploads. Internet usage via a connected mobile/cell phone internet connection or a pay-per-MB type internet connection may require large data usage. Your service provider may charge you based on the amount of data you transfer. If you are unsure, contact your service provider to confirm rates and restrictions.

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About this manual

This manual is a reference guide for installing units.

Some features may not be activated or available for screenshots in the manual. As a result, screenshots of menus and dialogs may not match the look of your unit.

Important text that requires special attention from the reader is emphasized as follows:

→ **Note:** Used to draw the reader's attention to a comment or some important information.

⚠ Warning: Used when it is necessary to warn personnel that they should proceed carefully to prevent risk of injury and/or damage to equipment/personnel.

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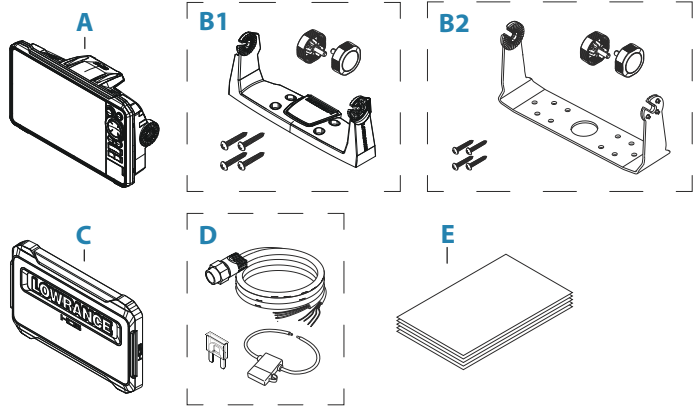
- 66 7" unit
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1

Introduction

Parts included

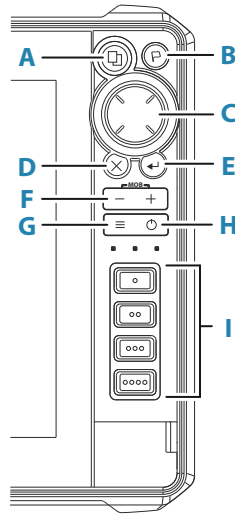
HDS Live



- A** HDS Live unit
- B1** U-bracket kit (plastic), HDS-7 Live and HDS-9 Live
- B2** U-bracket kit (metal), HDS-12 Live and HDS-16 Live
- C** Sun cover
- D** Power cable kit
- E** Documentation pack

Keys

The front panel keys



A Pages key

- Press once to activate the Home page. Repeat short presses to cycle the favorite buttons
- Press and hold is configurable. Refer to the operator manual for details

B Waypoint key

- Press to open the new waypoint dialog
- Press twice to save a waypoint
- Press and hold to access the find dialog

C Arrow keys

- Press arrows to move through menu items, to adjust a value, and to move the cursor on a panel

D Exit (X) key

- Press to exit a dialog, to return to previous menu level, to remove the cursor from the panel or to restore the cursor on the panel

E Enter key

- Press to select or save your settings

F Zoom keys and MOB key

- Zoom keys for panels and images
- Simultaneous pressing both keys saves a Man Overboard (MOB) waypoint at the current vessel position

G Menu key

- Press to display the menu for the active panel/overlay
- Press twice to display the settings dialog
- Press and hold to hide or show the menu

H Power key

- Press to turn the unit ON
- Press and hold to turn the unit OFF
- When ON, press once to display the System Controls dialog. Repeat short presses to cycle the backlight brightness

I Quick access keys (HDS-12 Live and HDS-16 Live units only)

- For configuration of the quick access keys refer to the operator manual.

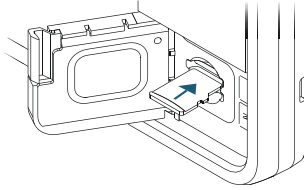
Card reader

A memory card can be used for:

- Chart data
- Software updates
- Transfer of user data
- System backup

→ **Note:** Do not download, transfer or copy files to a chart card. Doing so can damage chart information on the chart card.

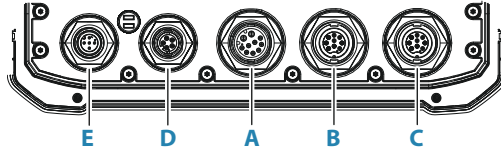
The protective door should always be securely shut immediately after inserting or removing a card, in order to prevent possible water ingress.



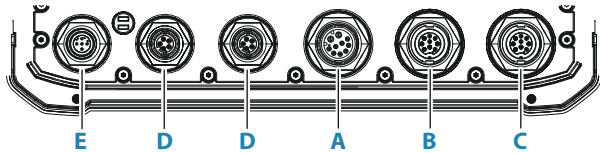
Connectors

HDS Live

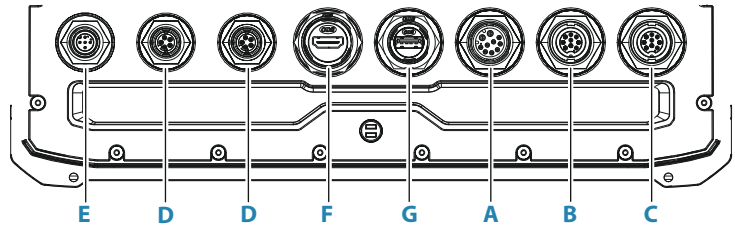
7" unit



9" unit



12" and 16" unit



- A** Power, video input and NMEA 0183 connector
- B** Sonar CH1 - blue 9-pin connector
- C** Sonar CH2 - black 9-pin connector
- D** Ethernet connector (5-pin)
- E** NMEA 2000 connector
- F** HDMI output connector
- G** USB connector

2

Installation

Installation guidelines

Choose the mounting location carefully, make sure that there are no hidden electrical wires or other parts behind the panel before you drill or cut. Ensure that any holes cut are in a safe position and will not weaken the boat's structure. If in doubt, consult a qualified boat builder, or marine electronics installer.

Don't:

- Mount any part where it can be used as a hand hold
- Mount any part where it might be submerged
- Mount any part where it will interfere with the operation, launching, or retrieving of the boat

Do:

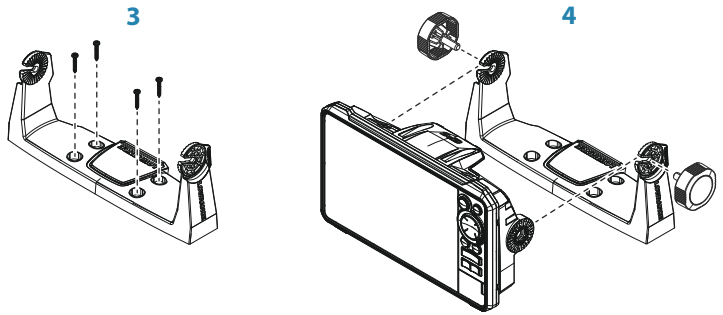
- Test the unit in its intended location to ensure satisfactory wireless and GPS performance. Metal and carbon materials are known to impact the performance in a negative way. A well placed external GPS source and/or wireless module can be added to overcome poor performance
- Consider the optimum viewing angles
- Consider the overall width and height requirements
- Consider access to the card reader
- Leave sufficient clearance to connect all relevant cables
- Check that it is possible to route cables to the intended mounting location

→ **Note:** Where flush mounted, the enclosure should be dry and well ventilated. In small enclosures, it may be required to fit forced cooling.

⚠ Warning: Inadequate ventilation and subsequent overheating of the unit may cause unreliable operation and reduced service life. Exposing the unit to conditions that exceeds the specifications could invalidate your warranty. Refer to the technical specifications in the "*Technical specifications*" on page 63.

U-bracket mounting

1. Place the bracket in the desired mounting location. Ensure that the chosen location has enough height to accommodate the unit fitted in the bracket, and allows tilting of the unit. Also adequate space is required on both sides to allow tightening and loosening of the knobs.
2. Mark the screw locations using the bracket as a template, and drill pilot holes. Use fasteners suited to the mounting surface material.
3. Screw down the bracket.
4. Mount the unit to the bracket using the knobs. Hand tighten only.



Panel mounting

Refer to the separate mounting template for panel mounting instructions.

3

Wiring

Connectors

Different models have different connectors. For available connectors and connector layout refer to "*Connectors*" on page 15.

Wiring guidelines

Don't:

- Make sharp bends in the cables
- Run cables in a way that allows water to flow down into the connectors
- Run the data cables adjacent to radar, transmitter, or large/high current carrying cables or high frequency signal cables.
- Run cables so they interfere with mechanical systems
- Run cables over sharp edges or burrs

Do:

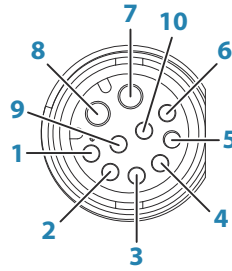
- Make drip and service loops
- Use cable-tie on all cables to keep them secure
- Solder/crimp and insulate all wiring connections if extending or shortening the cables. Extending cables should be done with suitable crimp connectors or solder and heat shrink. Keep joins as high as possible to minimize possibility of water immersion.
- Leave room adjacent to connectors to ease plugging and unplugging of cables

⚠ Warning: Before starting the installation, be sure to turn electrical power off. If power is left on or turned on during the installation, fire, electrical shock, or other serious injury may occur. Be sure that the voltage of the power supply is compatible with the unit.

⚠ Warning: The positive supply wire (red) should always be connected to (+) DC with a fuse or a circuit breaker (closest available to fuse rating).

Power, NMEA 0183 and video input

Connector details



Unit socket (female)

Pin	Purpose
1	Accessory wake up
2	Listener B (Rx_B)
3	Video in +
4	Talker B (Tx_B)
5	Drain
6	Talker A (Tx_A)
7	+ 12 V DC
8	DC negative
9	Video in -
10	Listener A (Rx_A)

→ **Note:** To use the video input functionality, an adapter cable has to be used (sold separately).

Power

The unit is designed to be powered by 12 V DC.

It is protected against reverse polarity, under voltage and over voltage (for a limited duration).

A fuse or circuit breaker should be fitted to the positive supply. For recommended fuse rating, refer to "*Technical specifications*" on page 63.

NMEA 0183

The unit has a built in NMEA 0183 serial interface, providing both input and output. The port(s) uses the NMEA 0183 (serial balanced) standard, and can be configured in the software for different baud rates up to 38,400 baud.

Talkers and listeners

Only one talker (output device) can be connected to a serial input (RX) on the unit, in accordance with the NMEA0183 protocol. However, an output port (TX) on the unit may be connected to up to three listener (receiver) devices, dependent on the hardware capabilities of the receiver.

Video input

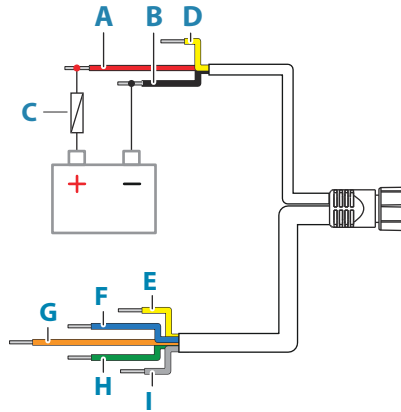
The unit can be connected to a composite video source, and display video images on its display.

- **Note:** Camera cables are not supplied, and will need to be selected to suit termination - RCA at the unit, and typically BNC or RCA plug at the camera end.
- **Note:** The video images will not be shared with another unit via the network. It is only possible to view video on the unit connected to the video source.
- **Note:** Both NTSC and PAL formats are supported.

Video input configuration

Configurations to video input are made in the video panel. Refer to the Operator Manual for more information.

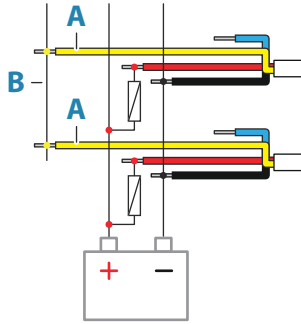
Power and NMEA 0183 cable



Key	Description	Color
A	+ 12 V DC	Red
B	DC negative	Black
C	Fuse	--
D	Accessory wake up	Yellow
E	Talker A (Tx_A)	Yellow
F	Talker B (Tx_B)	Blue
G	Listener A (Rx_A)	Orange
H	Listener B (Rx_B)	Green
I	Ground (shield)	--

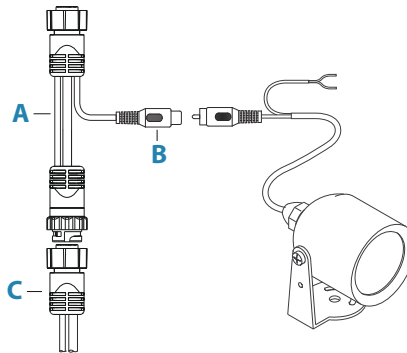
Accessory wake up

The accessory wake up wire may be used to control the power state of external equipment. Combine all accessory wake up wires on a common bus or to a single termination point. When connected in this manner, the connected equipment will turn on the moment the unit is powered up.



Key	Purpose	Color
A	Accessory wake up wire	Yellow
B	Accessory wake up line	

Video adapter cable (sold separately)



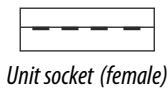
Key	Description
A	Video adapter cable (Connects to the unit socket)
B	BNC connector (female)
C	Power and NMEA 0183 cable

USB devices

The USB port(s) can be used to:

- Connect a storage device for software updates, transfer of user data, and for system backup
 - Charge a connected device. For maximum output power refer to the "Technical specifications" on page 63
- **Note:** USB cable length should not exceed 5 m when using regular cables. Lengths over 5 m may be possible with the use of an active USB cable.

USB connector details



Unit socket (female)



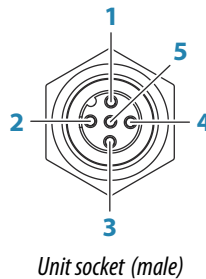
Cable plug/Device plug (male)

The unit is equipped with standard USB type-A connector(s).

NMEA 2000

The NMEA 2000 data port allows receiving and sharing of a multitude of data from various sources.

Connector details



Unit socket (male)

Pin	Purpose
1	Shield
2	NET-S (+12 V DC)
3	NET-C (DC negative)
4	NET-H

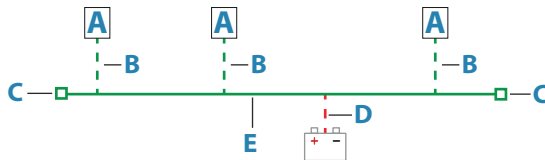
Pin	Purpose
5	NET-L

Plan and install an NMEA 2000 network

An NMEA 2000 network consists of a powered backbone from which drop cables connect to NMEA 2000 devices. The backbone needs to run within 6 m (20 ft) of the locations of all products to be connected, typically in a bow to stern layout.

The following guidelines apply:

- The total length of the backbone should not exceed 100 meters (328 ft).
- A single drop cable has a maximum length of 6 meters (20 ft). The total length of all drop cables combined should not exceed 78 meters (256 ft).
- A terminator must be installed at each end of the backbone. The terminator can be a terminator plug or a unit with built-in terminator.



- A** NMEA 2000 device
- B** Drop-cable
- C** Terminator
- D** Power supply
- E** Backbone

Powering the network

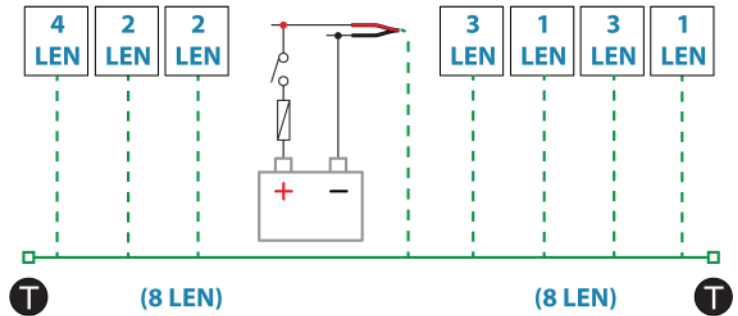
The network requires its own 12 V DC power supply, protected by a 3 amp fuse.

For smaller systems: connect power at any location in the backbone.

For larger systems: connect power at a central point in the backbone to balance the voltage drop of the network. Make the

installation such that the load/current draw on each side of the power node is equal.

→ **Note:** 1 LEN (Load Equivalency Number) equals 50 mA current draw.

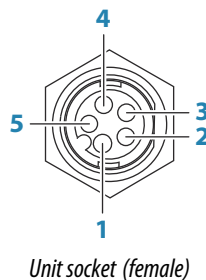


→ **Note:** Do not connect the NMEA 2000 power cable to the same terminals as the engine start batteries, autopilot computer, bow thruster or other high current devices.

Ethernet device connection

Connection of network devices can be made directly to the Ethernet port, or via a network expansion device to the Ethernet port.

Ethernet connector details



Pin	Purpose
1	Transmit positive TX+
2	Transmit negative TX-

Pin	Purpose
3	Receive positive RX+
4	Receive negative RX-
5	Shield

Ethernet devices

The Ethernet ports can be used for transfer of data and synchronization of user created data. It is recommended that each MFD in the system is connected to the Ethernet network.

No special setup is required for establishing an Ethernet network, it is all plug-and-play.

Ethernet expansion device

Connection of network devices can be made via an Ethernet expansion device. Additional expansion devices can be added to provide the required number of ports.

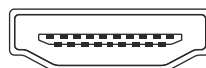
HDMI input

The unit can be connected to an external video source to display video images on its display.

HDMI connector details



Unit socket (female)



Cable plug (male)

The unit is equipped with standard HDMI (Type A) connector(s). The unit should be turned off prior to connecting or disconnecting an HDMI cable.

→ **Note:** While the HDMI standard does not state maximum cable length, signal may be compromised on long runs. Only use Navico or other high quality HDMI certified cables. 3rd party cables should be tested before installation. On runs over 10 m it may be required to add an HDMI amplifier or use HDMI-CAT6 adaptors.

Video input configuration

Configurations to video input are made in the video panel. Refer to the Operator Manual for more information.

Sonar CH1 - blue 9-pin connector

Supports:

- Sonar / CHIRP Sonar
 - DownScan
 - Active Imaging 3D transducer
 - LiveSight Down/Forward transducer
- **Note:** A 7-pin transducer cable can be connected to a 9-pin port using a 7-pin to 9-pin adaptor cable. However, if the transducer has a paddle wheel speed sensor, the water-speed data will not be displayed on the unit.
- **Note:** Channel 1 can do SideScan via an Active Imaging 3D transducer. It cannot do SideScan from an Active Imaging, Active Imaging 3-in-1, TotalScan, StructureScan or StructureScan HD transducer.

Sonar CH2 - black 9-pin connector

Supports:

- Sonar / CHIRP Sonar
 - DownScan
 - SideScan
 - Active Imaging/Active imaging 3-in-1/TotalScan/StructureScan
- **Note:** A 7-pin transducer cable can be connected to a 9-pin port using a 7-pin to 9-pin adaptor cable. However, if the transducer has a paddle wheel speed sensor, the water-speed data will not be displayed on the unit.

4

Software setup

First time startup

When the unit is started for the first time, or after a factory default, the unit displays a series of dialogs. Respond to the dialog prompts to make fundamental settings.

You can perform further setup and later change settings using the system settings dialogs.

Software setup sequence

- 1 General settings** - refer to "*System settings*" on page 29.
 - Make general settings as desired
- 2 Advanced settings** - refer to "*Advanced*" on page 29.
 - Enable or disable features
 - Review the advanced setting options and make changes as desired
- 3 Source selection** - refer to "*Network settings*" on page 48.
 - Make sure that the proper external data sources have been selected
- 4 Feature setup**
 - Configure specific features as described later in this chapter

Turning the system on and off

The system is turned on by pressing the Power key.

Press and hold the Power key to turn the unit off.

You can also turn the unit off from the System Controls dialog.

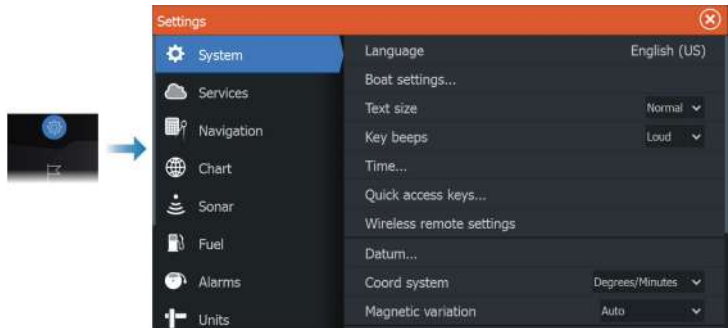
If the Power key is released before the shut-down is completed, the power off process is cancelled.

The settings dialog

The software setup is done from the settings dialog.



System settings



Boat settings

Used to specify the physical attributes of the boat.

Time

Controls the local time zone offset, and the format of the time and date.

Advanced

Used for configuration of advanced settings and how your system displays various user interface information.

Enabling or disabling features

Use the feature option to enable or disable features that are not automatically enabled or disabled by the system.



Alarms



Settings

List of all available alarm options in the system, with current settings.

From this list you can activate, deactivate and change alarm limits.

Siren enable

The Siren enabled option must be set in order for the unit to activate the buzzer when an alarm condition arises.

Its setting also determines the operation of the external alarm output.

Radar settings



Installation settings

The radar system requires radar sensor specific setting in order to adjust for a number of variables found in different installations.

→ **Note:** The installation settings available depends on the radar sensor.



Radar source

In a system with more than one radar sensor, the device to configure is selected from this menu.

→ **Note:** Radars that support dual radar mode are represented twice in the source list, with an A and B suffix.

Radar status

Displays scanner information and scanner features, primarily used for information and to assist with fault finding.



Adjust antenna height

Set the radar scanner height relative to the water surface. The Radar uses this value to calculate the correct STC settings.

Select antenna length

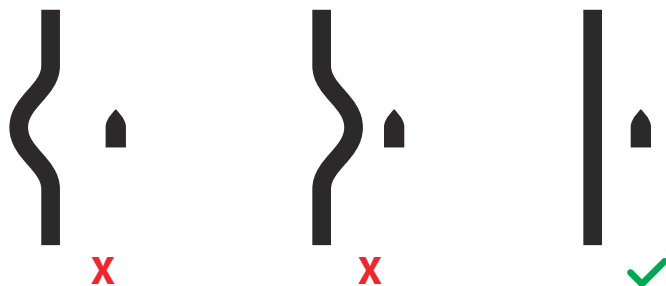
Select the proper antenna length.

Adjust range offset

The radar sweep should commence at your vessel (a radar range of zero). You may need to adjust the radar range offset to achieve this. If this is set incorrectly, a large dark circle in the center of the sweep might occur. You might notice straight objects such as straight sea walls or piers having curves or an indentation. Objects close to your vessel may appear pulled in or pushed out.

Adjust the range offset as below when the vessel is about 45 to 90 m (50 to 100 yards) from a straight-walled jetty or similar feature that produces a straight line echo on the display.

- 1 Point the vessel towards the jetty
- 2 Adjust the range offset to make the jetty echo appear as a straight line on the display



Adjust bearing alignment

This option is used to align the heading marker on the screen with the center line of the vessel. This will compensate for any slight misalignment of the scanner during installation.

Misalignment that is not corrected for will compromise target tracking and can result in dangerous misinterpretation of potential navigation hazards.

Any inaccuracy will be evident when using MARPA or chart overlay.

- 1 Point the vessel towards a stationary isolated object, or towards a far range AIS where the AIS icon matches the radar echo
- 2 Adjust the coarse and fine bearing alignment so that the heading line touches the end of the selected object

Sidelobe suppression

Occasionally false target returns can occur adjacent to strong target returns such as large ships or container ports. This occurs because not all of the transmitted radar energy can be focused into a single beam by the radar antenna, a small amount of energy is transmitted in other directions. This energy is referred to as sidelobe energy and occurs in all radar systems. The returns caused by sidelobes tend to appear as arcs.

→ **Note:** This control should only be adjusted by experienced radar users. Target loss in harbor environments may occur if this control is not adjusted correctly.

When the radar is mounted where there are metallic objects near the radar, sidelobe energy increases because the beam focus is degraded. The increased sidelobe returns can be eliminated using the sidelobe suppression control.

By default, this control is set to auto and normally should not need to be adjusted. However, if there is significant metallic clutter around the radar, sidelobe suppression may need to be increased.

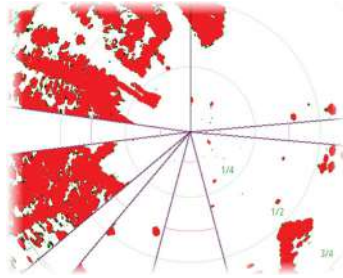
To adjust the sidelobe suppression value:

1. Set radar range to between 1/2 nm to 1 nm and the sidelobe suppression to auto
2. Take the vessel to a location where sidelobe returns are likely to be seen. Typically, this would be near a large ship, container port, or metal bridge.
3. Traverse the area until the strongest sidelobe returns are seen.
4. Change auto sidelobe suppression to OFF, then select and adjust the sidelobe suppression control until the sidelobe returns are just eliminated. You may need to monitor 5-10 radar sweeps to be sure they have been eliminated.
5. Traverse the area again and readjust if sidelobes returns still occur.

Sector blanking

Radar installed in close proximity to a mast or structure could cause unwanted reflections or interference to appear on the radar image. Use the sector blanking feature to stop the radar from transmitting on up to four sectors in the image.

- **Note:** Sectors are setup relative to the heading line of the radar. The bearing of the sector is measured from the center line of the sector.
- **Note:** Sector blanking should be applied very carefully to avoid reducing the radar's usefulness in identifying valid and potentially dangerous targets.



Main radar PPI



Radar overlay on a chart

Adjust open array park angle

The park angle is the final resting position of the antenna relative to the heading line of the radar when the radar is set to standby. The antenna will stop rotating at the desired offset.

Tune

The automatic tuning will work well in most installations. The manual tuning is used if it is required to adjust the result from an automatic tuning.

Adjust local interference reject

Interference from some onboard sources can interfere with the Broadband radar. One symptom of this could be a large target on the screen that remains in the same relative bearing even if the vessel changes direction.

Halo light

Controls the levels of the Halo Radar blue accent lighting. The accent lighting can only be adjusted when the radar is in standby mode.

→ **Note:** The blue accent pedestal lighting might not be approved for use in your boating location. Check your local boating regulations before turning the blue accent lights ON.

Reset radar to factory defaults

Clears all user and installer settings applied to the selected radar source, and restores factory settings.

→ **Note:** Use this option with caution. Take note of current settings first, especially those set by the operator if radar has already been in active service.

Sonar settings



Internal sonar

Used for making the internal sonar available for selection in the sonar panel menu.

When de-activated, the internal sonar will not be listed as a sonar source for any unit on the network.

De-activate this option on units which do not have a transducer connected.

Network sonar

Select to see or share sonar data from this unit with other units connected to the Ethernet network.

Network sonar mode

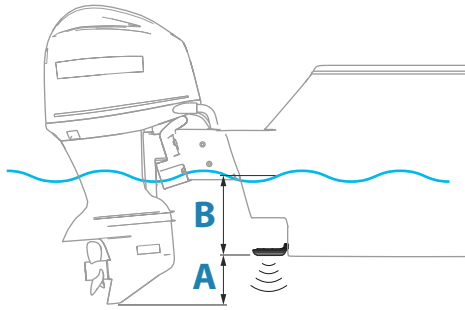
The network sonar mode setting selects whether only one or multiple sonar sources can be selected at the same time.

→ **Note:** Changing the mode requires that all connected sources are restarted.

Structure depth offset

Setting for Structure transducers.

All transducers measure water depth from the transducer to the bottom. As a result, water depth readings do not account for the distance from the transducer to the lowest point of the boat in the water or from the transducer to the water surface.



- To show the depth from the lowest point of the vessel to the bottom, set the offset equal to the vertical distance between the transducer and the lowest part of the vessel, **A** (negative value).
- To show the depth from the water surface to the bottom, set the offset equal to the vertical distance between the transducer and the water surface, **B** (positive value)
- For depth below transducer, set the offset to 0.

Use temp data from

Selects from which source the temperature data is shared on the NMEA 2000 network.

Installation

Use this dialog to setup and configure available sources.



Source

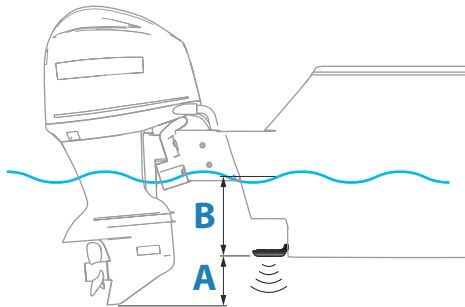
Select this option to display a list of sources available for setup. The settings you make in the rest of the dialog pertain to the source selected.

Source name

Select this option to set a descriptive name for the selected transducer.

Depth offset

All transducers measure water depth from the transducer to the bottom. As a result, water depth readings do not account for the distance from the transducer to the lowest point of the boat in the water or from the transducer to the water surface.



- To show the depth from the lowest point of the vessel to the bottom, set the offset equal to the vertical distance between the transducer and the lowest part of the vessel, **A** (negative value).
- To show the depth from the water surface to the bottom, set the offset equal to the vertical distance between the transducer and the water surface, **B** (positive value)
- For depth below transducer, set the offset to 0.

Water speed calibration

Water speed calibration is used to adjust the speed value from the paddle wheel to match the actual boat speed through the water. Actual speed can be determined from GPS speed over ground (SOG) or by timing the boat over a known distance. Water speed calibration should be performed in calm conditions, with minimal wind and current movement.

Increase this value above 100 % if the paddle wheel is under reading, and decrease this value if it is over reading. For example, if the average water speed reads 8.5 knots (9.8 MPH) and SOG records 10 knots (11.5 MPH) the calibration value needs to be increased to 117 %. To calculate the adjustment, divide the SOG by the paddlewheel speed, and multiply the product by 100.

Calibration range: 50-200 %. Default is 100 %.

Water speed averaging

Averages water speed by measuring your speed at a selected interval of time. Water speed intervals range from one to thirty seconds. For example if you select five seconds, your displayed water speed will be based on averaging over 5 seconds of sampling.

Calibration range: 1-30 seconds. Default is 1 second.

Water temperature calibration

Temperature calibration is used to adjust the water temperature value from the sonar transducer. It may be required to correct for localized influences to the measured temperature.

Calibration range: -9.9° - +9.9°. Default is 0°.

- **Note:** Water temperature calibration only appears if the transducer is temperature capable.

Transducer type

→ **Note:** The transducer type is automatically set for transducers that support Transducer ID (XID) and is not user selectable.

Transducer type is used for selecting the transducer model connected to the sonar module. The transducer selected will determine what frequencies the user can select during sonar operation. In some transducers with built-in temperature sensors, the temperature reading may be inaccurate or not available at all if the wrong transducer is selected. Transducer temperature sensors are one of two impedances - 5k or 10k. Where both options are given for the same model transducer, refer to paperwork supplied with transducer to determine impedance.

Autopilot settings

For the trolling motor autopilot, no special setup is required. See the operator manual for further details.

The NAC-1 autopilot computer (outboard motor autopilot) requires setup as described in the following sections.

→ **Note:** The word rudder is sometimes used in menus and dialogs. In this context, the outboard motor acts as a rudder.

Autopilot data sources

Provides automatic and manual data source selection for the outboard autopilot.

Commissioning

Used to calibrate your boat's steering (cable steer or hydraulic steering) with the NAC-1.

→ **Note:** The autopilot must be commissioned prior to first use and any time after autopilot default settings have been restored.

Cablesteer rudder calibration

1. Select **Commissioning**.
2. Select **Rudder feedback calibration**.
3. Follow the onscreen instructions.

- **Note:** When centering the motor during the calibration process, ensure that the motor is centered visually. The rudder feedback calibration dialog may show the motor is centered (00 value) when the motor is not centered. After centering the motor visually, press **OK** and the rudder center calibration setting is set to centered (00 value).
4. Select **Rudder test**.
 5. If the calibration does not pass the rudder test:
 - Confirm motor is moving.
 - Confirm rudder feedback reading moves accordingly.
 - Check NAC-1 drive cable.
 - Confirm motor can be manually moved smoothly in each direction.
 - Check for other mechanical issues.
 - Check wiring connections.
 - Repeat rudder calibration steps.

Hydraulic system calibration

Virtual rudder feedback (VRF) calibration is used for vessels with hydraulic steering.

1. Select **Commissioning**.
 2. Select **VRF calibration**.
 3. Follow the onscreen instructions.
- **Note:** When the autopilot attempts to turn the motor during the calibration process, ensure motor movement is noticeable and that it is turning in the correct direction before selecting **Yes** on the Virtual Rudder Feedback Calibration dialog. When **No** is selected in the dialog, the NAC-1 reverses direction and increases power the next time it turns the motor during the calibration process.
- **Note:** You may have to select **No** more than once to ensure the pump provides enough power to turn the motor at high boat speeds.

Steering response

Used to increase or decrease the steering sensitivity. A low response level reduces the rudder activity and provides a more loose steering. A high response level increases the rudder activity and provides

more tight steering. A too high response level will cause the boat to make S movements.

Troubleshooting

The following are possible symptoms or * messages displayed by the MFD. If the problem persists after trying the recommended action, contact support.

No active autopilot control unit

Probable cause: The NAC-1 computer has lost contact with the active control unit.

Recommended action: Check the cable connections from the NAC-1 and MFD to the CAN bus network.

No autopilot computer

Probable cause: The MFD has lost contact with the NAC-1 Computer.

Recommended action:

- Make sure the NAC-1 computer is powered.
- Check connections from the NAC-1 to the CAN bus network.

AP Position data missing*

Probable cause: Missing or invalid position data.

Recommended action:

- Check the GPS cable connections to CAN network.
- Check the GPS antenna location.
- Check that the correct position source is selected. (Run a new source selection.)

AP Speed data missing (SOG)*

Probable cause: Missing or invalid speed data.

Recommended action:

- Check the GPS cable connections to the CAN network.
- Check the GPS antenna location.
- Check that the correct position source is selected. (Run a new source selection.)

AP Depth data missing*

Probable cause: Missing or invalid depth data.

Recommended action:

- Check the depth transducer.

- Check transducer cable connections to the MFD or to the CAN network.
- Check that the correct depth source is selected. (Run a new source selection.)

AP Heading data missing*

Probable cause: Missing or invalid heading data.

Recommended action:

- Check the compass cable connections to the CAN network.
- Check that the correct heading source is selected. (Run a new source selection.)

AP Nav data missing*

Probable cause: Missing or invalid NAV data.

Recommended action:

- Check for valid data on the MFD screen.
- Check the source selection setting.

AP Rudder data missing (For Helm-1/ cable steer only)*

Probable cause:

- Rudder feedback signal missing due to a broken wire or connection.
- Misaligned potentiometer in the Helm-1.

Recommended action:

- Check cable and connector.
- Check the alignment as per the installation instructions.

AP Off course*

Probable cause:

- The boat's heading is outside the fixed off course limit of 20 deg. (Automatic reset when inside limit).
- The boat speed is too low.
- The response setting is too low.

Recommended action:

- Check the steering response setting and increase the steering response setting.
- Increase the boat speed if possible, or steer by hand.

AP clutch overload (For Helm-1/ cable steer only)*

Probable cause: The clutch in Helm-1 is drawing too much current.

Recommended action:

- Disconnect the Helm-1 and verify that the alarm disappears.
- Check resistance of the clutch coil equals 16 ohms (pin 1 and 2 in connector).

No rudder response (For Helm-1/cable steer only)*

Probable cause: No response to rudder commands.

Recommended action:

- Check the cable connections between NAC-1 and Helm-1.
- Check the Rudder FB potentiometer in Helm-1.
- Check the Helm-1 drive motor.

Rudder drive overload*

Probable cause: The drive unit shuts down due to an excessive load or a short circuit.

Recommended action:

- Check the drive unit and drive unit installation.
- Look for mechanical obstructions.
- Check the manual steering.

High drive temp*

Probable cause: The NAC-1 drive output circuit is overheated due to excessive load.

Recommended action:

- Switch the Autopilot to Standby.
- Check the drive unit (see "Rudder drive overload").

Drive inhibit*

Probable cause: There is an internal NAC-1 failure causing the drive output circuit to shut down.

Recommended action: Contact support.

Low CAN bus voltage

Probable cause: The CAN bus voltage is less than 9V.

Recommended action:

- Check cabling.
- Check battery condition.
- Check charging voltage.

Fuel settings

The fuel utility monitors a vessel's fuel consumption. This information is totaled to indicate trip and seasonal fuel usage, and is used to calculate fuel economy for display on instrument pages and the data bar.

To use the utility, a Navico Fuel Flow sensor, or a NMEA 2000 engine adaptor cable/gateway with Navico Fuel Data Storage device must be fitted to the vessel. The Navico Fuel Flow sensor, does not require the use of a separate Fuel Storage device. Refer to the engine manufacturer or dealer for information on whether or not your engine provides a data output, and what adaptor is available to connect to NMEA 2000.

Once the physical connection is made, ensure source selection is completed. Multiple engine installations using Fuel Flow sensors, or Fuel Data Storage devices, require setup of related engine location in the Device list. For general source selection information, refer to "*Network settings*" on page 48.



Vessel setup

The Vessel setup dialog must be used to select the number of engines, the number of tanks and vessel's total fuel capacity across all tanks.



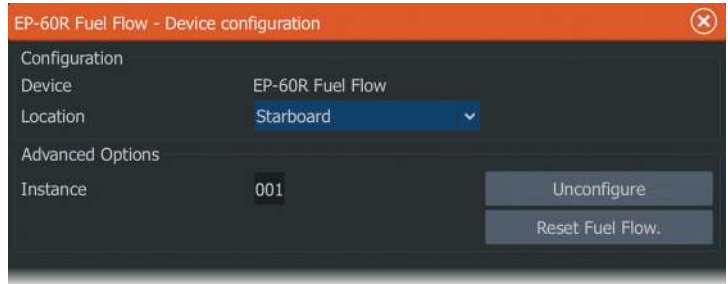
Fuel flow configuration

After the number of engines is set, it is required to set which fuel flow sensor is connected to which engine. Under Device list on the

Network page, view the Device Configuration dialog for each sensor, and set the Location to match the engine the device is connected to.

Unconfigure - defaults the device which clears all user settings.

Reset Fuel Flow - restores only the Fuel K-Value setting, if set in Calibrate. Only Navico devices can be reset.



Calibrate

Calibration may be required to accurately match measured flow with actual fuel flow. Access calibration from the Refuel dialog. Calibration is only possible on Navico's Fuel Flow sensor.

1. Start with a full tank and run the engine as it would normally be operated.
 2. After at least several liters (a few gallons) have been used, the tank should be fully refilled, and the Set to full option selected.
 3. Select the Calibrate option.
 4. Set the actual amount used based on amount of fuel added to the tank.
 5. Select OK to save settings. The Fuel K-Value should now show a new value.
- **Note:** To calibrate multiple engines repeat the steps above, one engine at a time. Alternatively, run all engines simultaneously, and divide the Actual amount used by the number of engines. This assumes reasonably even fuel consumption on all engines.
- **Note:** The Calibrate option is only available when Set to full is selected, and a Fuel Flow is connected and set up as a source.
- **Note:** A maximum of 8 engines is supported using Fuel Flow sensors.

Fuel Level

With the use of a Navico Fluid Level device connected to a suitable tank level sensor, it is possible to measure the amount of fuel remaining in any equipped tank. The number of tanks must be set in Vessel Setup dialog, initiated from the Fuel setting options page, to allow discrete tank assignment of the Fluid Level devices.

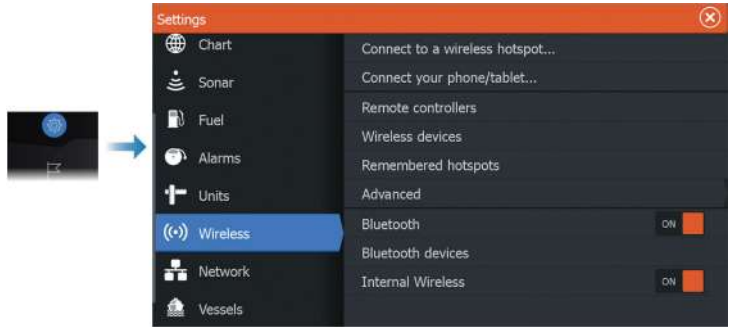
Select Device list on the Network page, and view the Device Configuration dialog for each sensor, and set the Tank location, Fluid type, and Tank size.

For setting up the Instrument bar or a gauge on the Instrument page with Fluid Level device data, refer to the Operator Manual.

- **Note:** A maximum of 5 tanks is supported using Fluid Level devices.
- **Note:** Tank data that is output by a compatible engine gateway can also be displayed, however tank configuration for such a data source is not possible from this unit.

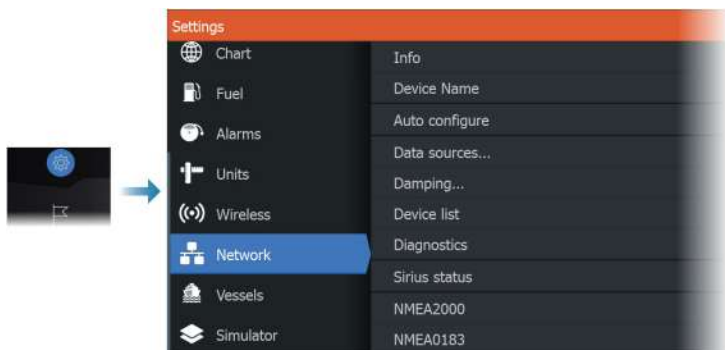
Wireless settings

Provides configuration and setup options for the wireless functionality.



Refer to the Operator Manual for details about wireless setup and connectivity.

Network settings



Network info

Lists basic network information.

Device name

Assigning a name is useful in systems using more than one device of the same type and size.

Auto configure

The auto configure option looks for all sources connected to the device. If more than one source is available for each data type, selection is made from an internal priority list.

→ **Note:** This option provides the best configuration of available data sources for the majority of installations.

Data sources

Data sources provide live data to the system. When a device is connected to more than one source providing the same data, the user can choose the preferred source.

Before commencing with source selection make sure all external devices and networks are connected and turned on. Manual selection is generally only required where there is more than one source for the same data, and the automatically selected source is not the one desired.

Damping

If data appears erratic or too sensitive, damping may be applied to make the information appear more stable. With damping set to off, the data is presented in raw form with no damping applied.



Device list

Selecting a device in this list will bring up additional details and options for the device.

All devices allow allocation of an instance number in the configure option. Set unique instance numbers on any identical devices on the network to allow the unit to distinguish between them. The data option shows all data being output by the device. Some devices will show additional options specific to the device.

→ **Note:** Setting the instance number on a 3rd party product is typically not possible.

Diagnostics

Provides information useful for identifying an issue with the network.

NMEA 2000

Provides information on NMEA 2000-bus activity.

→ **Note:** The following information may not always indicate an issue that can be simply resolved with minor adjustment to network layout or connected devices and their activity on the network. However, Rx and Tx errors are most likely indicating issues with the physical network, which may be resolved by

correcting termination, reducing backbone or drop lengths, or reducing the number of network nodes (devices).



UDB

Provides information on Ethernet activity.



NMEA 2000 setup

Receive waypoint

Select this option to allow another device capable of creating and exporting waypoints via NMEA 2000 to transfer directly to this unit.

Send waypoint

Select this option to allow this unit to send waypoints to another device via NMEA 2000.

→ **Note:** The system can only transmit or receive one waypoint at a time on creation of that waypoint. For bulk import or export of waypoints see the operator manual.

Backlight synchronization

Select this option to allow display brightness synchronization across display units connected to the same network.

NMEA 0183 setup

The NMEA 0183 port(s) must be set to suit the speed of connected devices, and can be configured to output only the sentences required by listening devices.

Receive waypoint

Select this option to allow a device capable of creating and exporting waypoints via NMEA 0183 to transfer directly to this unit.

Serial ports

Specifies the baud rate and protocol for the NMEA 0183 interface. The baud rate should be set to correspond with devices connected to the NMEA 0183 input and output.

Serial Output

Selection determines whether the data is output via Tx lines, and will enable editing of the output sentences list.

Serial output sentences

This list allows control over which sentences need to be transmitted to other devices from the NMEA 0183 port. Due to the limited bandwidth of NMEA 0183 it is desirable to only enable the data that is required. The less sentences that are selected, the higher the output rate of the enabled sentences.

Commonly used sentences are enabled by default.

Ethernet/Wireless

The NMEA 0183 data stream is output and made available to tablet devices and PCs, via the internal wireless or Ethernet. The dialogue provides IP and port data typically required for configuring the application on the third party device.

→ **Note:** Other MFDs cannot decode this information back to NMEA 0183, to use the data as a source. To share data a physical NMEA 2000 or NMEA 0183 connection is still required.

5

3rd party support

SmartCraft VesselView integration

When a compatible Mercury Marine VesselView product or VesselView Link is present on the NMEA 2000 network, the engines can be monitored and controlled from the unit.

When the feature is also enabled in the advanced settings features dialog:

- A Mercury icon is added to the home page - select it to display the engine instrument panel.
- A Mercury settings dialog is added - use this dialog to change engine settings.
- Mercury and Vessel Control buttons are added to the control bar:
 - Selecting the Mercury button displays engine and vessel data.
 - Selecting the Vessel button opens the engine controller.

When the features are enabled, the display may prompt the user for some basic configuration information.

For more information, refer to the VesselView manual or engine supplier.

Suzuki engine integration

If a Suzuki C-10 gauge is available on the NMEA 2000 network, the engines can be monitored from the unit.

When the feature is also enabled in the advanced settings features dialog:

- A Suzuki icon is added to the home page - select it to display the engine instrument panel.

For more information, refer to the engine manual or engine supplier.

Yamaha engine integration

If a compatible Yamaha gateway is connected to the NMEA 2000 network, the engines can be monitored from the unit.

When the feature is also enabled in the advanced settings features dialog:

- A Yamaha icon is added to the home page - select it to display the engine instrument panel.
- If the Yamaha system supports Troll Control, a Troll button is added to the Control Bar. Select this button to enable/disable troll control and control the trolling speed.

For more information refer to the engine manual or the engine supplier.

Evinrude engine integration

If an Evinrude engine control head is available on the NMEA 2000 network, the Evinrude engines can be monitored and controlled from the unit.

When the feature is also enabled in the advanced settings features dialog:

- An Evinrude icon is added to the home page - select it to display the engine instrument panel.
- An Evinrude settings dialog is added - use this dialog to change engine settings.
- An Evinrude button is added to the control bar - selecting this button opens the engine controller. Use the engine controller to control the engines.

A maximum of two control heads and four engines is supported.

For more information, refer to the engine manual or engine supplier.

Power-Pole anchors

Power-Pole anchors, which can be controlled by the C-Monster Control System installed on your boat, can be controlled from the unit. To control the Power-Poles, you pair the Power-Poles with the unit using Bluetooth wireless technology available in both products.

C-Zone

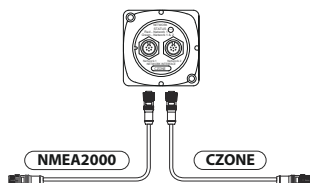
CZone connection to NMEA 2000

When interfacing to CZone network it is recommended to use a BEP Network interface bridge to join the two network backbones together.

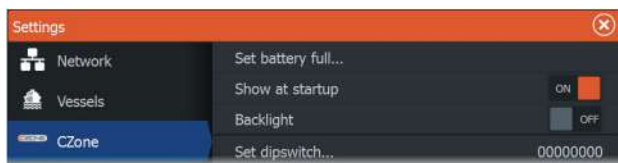
The CZone / NMEA 2000 Network interface bridge isolates the power of the two networks, but allows data to be freely shared between both sides.

The Interface Bridge can also be used for expansion of the NMEA 2000 network, when the maximum node limit (node = any device connected to network) for the network has been reached or the maximum cable length of 150 m will be exceeded. Once an Interface Bridge has been fitted, a further 40 nodes and additional cable length can be added.

The Network Interface is available from your BEP dealer. For more information please refer to the BEP web site www.bepmarine.com.



CZone setup



In order to communicate with the CZone modules connected to the network, the unit must be assigned a unique CZone Display Dipswitch setting.

The functionality of the CZone system is determined by the CZone Config File which is stored on all CZone modules and the HDS Live. The file is created using the CZone Configuration Tool, a specialized PC application available from BEP Marine Ltd, and associated CZone distributors.

For more information, refer to the documentation provided with your CZone system.

Assigning the dipswitch setting

Every product capable of controlling and viewing CZone devices must be assigned a virtual dipswitch setting. This setting is unique for each device. Typically it is set after the configuration file already

exists on the CZone system, but it may also be set in advance. To do so, access the CZone menu on the Settings page.

When the configuration is already available on the network, it will immediately commence uploading to the HDS Live once the dipswitch is set. Allow this to complete, without interruption.

Setting CZone to display at startup

With this option selected, the CZone control page is shown first, every time the HDS Live is powered up.

Backlight

Enabling this causes the HDS Live to synchronize its backlight setting with that of any CZone Display Interfaces set up to share backlight settings.

→ **Note:** CZone Config also needs to have the HDS Live set as a controller.

6

Accessories

The most up-to-date accessories list is available at:

- www.lowrance.com

7

Supported data

NMEA 2000 compliant PGN List

NMEA 2000 PGN (receive)

59392	ISO Acknowledgement
59904	ISO Request
60160	ISO Transport Protocol, Data Transfer
60416	ISO Transport Protocol, Connection M.
65240	ISO Commanded Address
60928	ISO Address Claim
126208	ISO Command Group Function
126992	System Time
126996	Product Info
126998	Configuration Information
127237	Heading/Track Control
127245	Rudder
127250	Vessel Heading
127251	Rate of Turn
127252	Heave
127257	Attitude
127258	Magnetic Variation
127488	Engine Parameters, Rapid Update
127489	Engine Parameters, Dynamic
127493	Transmission Parameters, Dynamic
127500	Load Controller Connection State / Control
127501	Binary Status Report
127503	AC input status
127504	AC Output Status
127505	Fluid Level
127506	DC Detailed Status

127507 Charger Status
127508 Battery Status
127509 Inverter Status
128259 Speed, Water referenced
128267 Water Depth
128275 Distance Log
129025 Position, Rapid Update
129026 COG & SOG, Rapid Update
129029 GNSS Position Data
129033 Time & Date
129038 AIS Class A Position Report
129039 AIS Class B Position Report
129040 AIS Class B Extended Position Report
129041 AIS aids to Navigation
129283 Cross Track Error
129284 Navigation Data
129539 GNSS DOPs
129540 AIS Class B Extended Position Report
129545 GNSS RAIM Output
129549 DGNS Corrections
129551 GNSS Differential Correction Receiver Signal
129793 AIS UTC and Date Report
129794 AIS aids to Navigation
129798 AIS SAR Aircraft Position Report
129801 Cross Track Error
129802 AIS Safety Related Broadcast Message
129283 Cross Track Error
129284 Navigation Data
129539 GNSS DOPs
129540 GNSS Sats in View
129794 AIS Class A Static and Voyage Related Data
129801 AIS Addressed Safety Related Message

129802 AIS Safety Related Broadcast Message
129808 DSC Call Information
129809 AIS Class B "CS" Static Data Report, Part A
129810 AIS Class B "CS" Static Data Report, Part B
130060 Label
130074 Route and WP Service - WP List - WP Name & Position
130306 Wind Data
130310 Environmental Parameters
130311 Environmental Parameters
130312 Temperature
130313 Humidity
130314 Actual Pressure
130316 Temperature, Extended Range
130569 Entertainment - Current File and Status
130570 Entertainment - Library Data File
130571 Entertainment - Library Data Group
130572 Entertainment - Library Data Search
130573 Entertainment - Supported Source Data
130574 Entertainment - Supported Zone Data
130576 Small Craft Status
130577 Direction Data
130578 Vessel Speed Components
130579 Entertainment - System Configuration Status
130580 Entertainment - System Configuration Status
130581 Entertainment - Zone Configuration Status
130582 Entertainment - Zone Volume Status
130583 Entertainment - Available Audio EQ Presets
130584 Entertainment - Bluetooth Devices
130585 Entertainment - Bluetooth Source Status

NMEA 2000 PGN (transmit)

60160	ISO Transport Protocol, Data Transfer
60416	ISO Transport Protocol, Connection M.
126208	ISO Command Group Function
126992	System Time
126993	Heartbeat
126996	Product Info
127237	Heading/Track Control
127250	Vessel Heading
127258	Magnetic Variation
127502	Switch Bank Control
128259	Speed, Water referenced
128267	Water Depth
128275	Distance Log
129025	Position, Rapid Update
129026	COG & SOG, Rapid Update
129029	GNSS Position Data
129283	Cross Track Error
129285	Navigation - Route/WP Information
129284	Navigation Data
129285	Route/Waypoint Data
129539	GNSS DOPs
129540	GNSS Sats in View
130074	Route and WP Service - WP List - WP Name & Position
130306	Wind Data
130310	Environmental Parameters
130311	Environmental Parameters
130312	Temperature
130577	Direction Data
130578	Vessel Speed Components

NMEA 0183 supported sentences

TX / RX - GPS

Receive	GGA	GLL	GSA	GSV	VTG	ZDA	
Transmit	GGA	GLL	GSA	GSV	VTG	ZDA	GLC

TX / RX - Navigation

Receive	RMC				
Transmit	AAM	APB	BOD	BWC	BWR

Receive					
Transmit	RMC	RMB	XTE	XDR	

TX / RX - Sonar

Receive	DBT	DPT	MTW	VLW	VHW
Transmit	DBT	DPT	MTW	VLW	VHW

TX / RX - Compass

Receive	HDG	HDT	HDM
Transmit	HDG		

TX / RX - Wind

Receive	MWV	MWD
Transmit	MWV	MWD

TX / RX - AIS / DSC

Receive	DSC	DSE	VDM
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→ **Note:** AIS sentences are not bridged to or from NMEA 2000.

TX / RX - MARPA

Transmit	TLL	TTM
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→ **Note:** These are only output sentences.

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Technical specifications

HDS Live

Display	
Resolution	
7" unit	1024 x 600
9" unit	1280 x 720
12" unit	1280 x 800
16" unit	1920 x 1080
Brightness	>1200 nits
Touch screen	Multi-touch
Viewing angles in degrees (typical value at contrast ratio = 10)	80° top/bottom, 80° left/right
Electrical	
Supply voltage	12 V DC (10 - 17 V DC min - max)
Power consumption - Max	
7" unit	33.12 W (2.4 A at 13.8 V DC)
9" unit	40.02 W (2.9 A at 13.8 V DC)
12" unit	49.68 W (3.6A at 13.8 V DC)
16" unit	67.62 W (4.9 A at 13.8 V DC)
Recommended fuse rating	
7" unit	3.5 A at 12 V DC
9" unit	4 A at 12 V DC
12" unit	5 A at 12 V DC
16" unit	6.5 A at 12 V DC
Environmental	
Operating temperature range	-15°C to +55°C (5°F to 131°F)
Storage temperature	-20°C to +60°C (4°F to 140°F)
Waterproof rating	IPX6 and IPX7

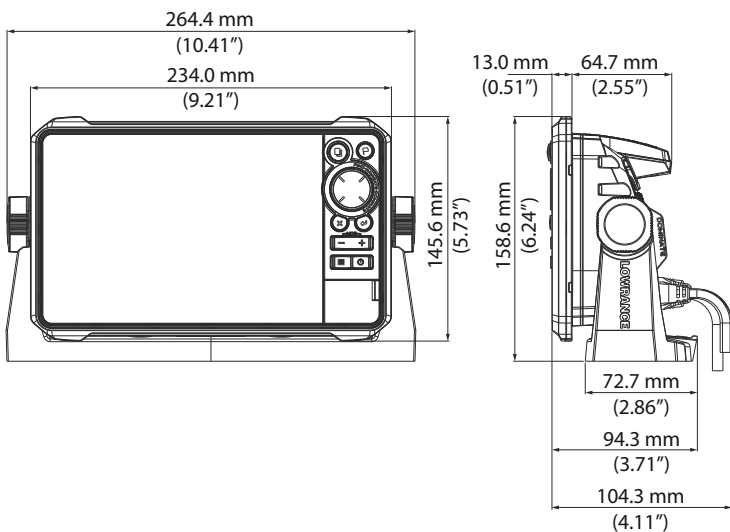
Humidity	IEC 60945 Damp heat 66°C (150°F) at 95% relative (48 hr)
Shock and vibration	100 000 cycles of 20 G
Interface/Connectivity	
NMEA 2000	1 port (Micro-C)
NMEA 0183	1 port (via the power connector)
Sonar	2 ports
HDMI in	
7" and 9" units	Not applicable
12" and 16" units	1 port (HDMI1.4 sink and HDCP)
Analog video	1 port (via the power cable, adapter cable sold separately)
Ethernet	
7" unit	1 port (5-pin connector)
9", 12" and 16" units	2 ports (5-pin connector)
USB	
7" and 9" units	Not applicable
12" and 16" units	1 port (USB A) Output: 5 V DC, 1.5 A
Data card reader	2 slots (microSD, SDXC)
Wireless	Internal 802.11b/g/n
Bluetooth	Bluetooth 4.0 with support for Bluetooth Classic
Physical	
Dimensions	Refer to " <i>Dimensional drawings</i> " on page 66
Weight (display only)	
7" unit	1.04 kg (2.29 lbs.)
9" unit	1.38 kg (3.04 lbs.)
12" unit	2.6 kg (5.73 lbs.)
16" unit	3.57 kg (7.87 lbs.)
Compass Safe Distance - Metric, imperial	50 cm

Mounting type	Panel mount or bracket mount
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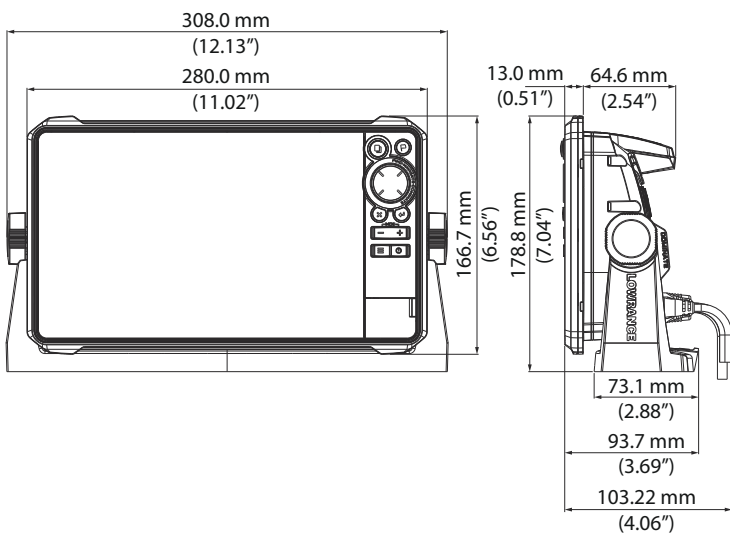
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Dimensional drawings

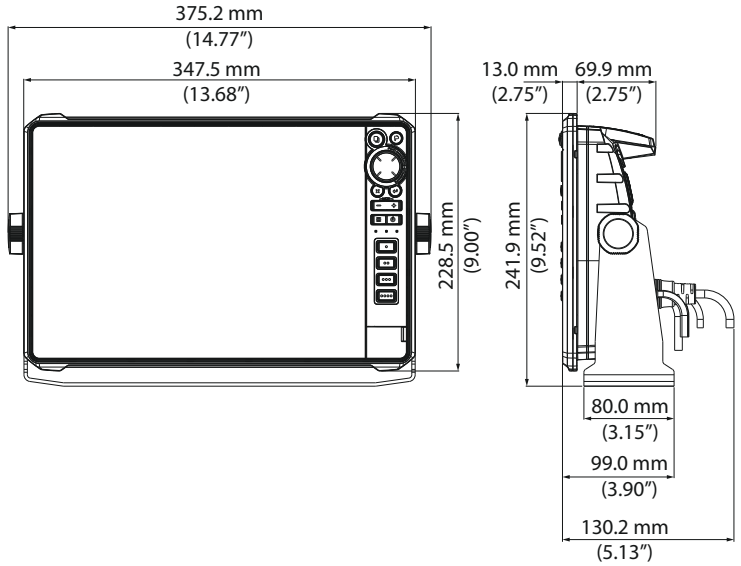
7" unit



9" unit



12" unit



16" unit

