



HEFRING MARINE

STANDARD SYSTEM OVERVIEW

VERSION 1.0

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CONFIDENTIAL



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1 Introduction

1.1 Hefring Marine System

The Hefring Marine system uses intelligent proprietary processing to determine a recommended speed for a vessel, where the system automatically varies its guidance to reflect prevailing sea and weather conditions. The information is presented as guidance to the operator on an intuitive screen interface, which can be displayed in selected multi-function display brands. The system also displays real-time impacts and shocks monitored.

The onboard system is supported by a cloud-based fleet management Admin Console for real-time monitoring and collection of detailed historical trip logs. Motions, speed, location, and other analysis and data can be reviewed on a second-by-second basis.

1.2 Purpose of the Document

This document describes the hardware and interfaces of the Hefring Marine system.

1.3 Scope of the Document

This document covers the interfaces between the multi-function display (MFD), NMEA2000 network, inertial measurement unit (IMU) and the Hefring Marine system. This document also includes hardware specifications for the Hefring Marine system.

2 Hardware Overview

The Hefring Marine system consists of two main components: the Control Unit and the Sensor Unit(s), an IMU. In addition to the main components, cables and a cellular antenna are included if requested.

2.1 Control Unit

The Control Unit is the central computing module of the system and handles data collection, data processing, presentation of data to a user interface and display, and uploading of data to the cloud, or the HM Admin Console.

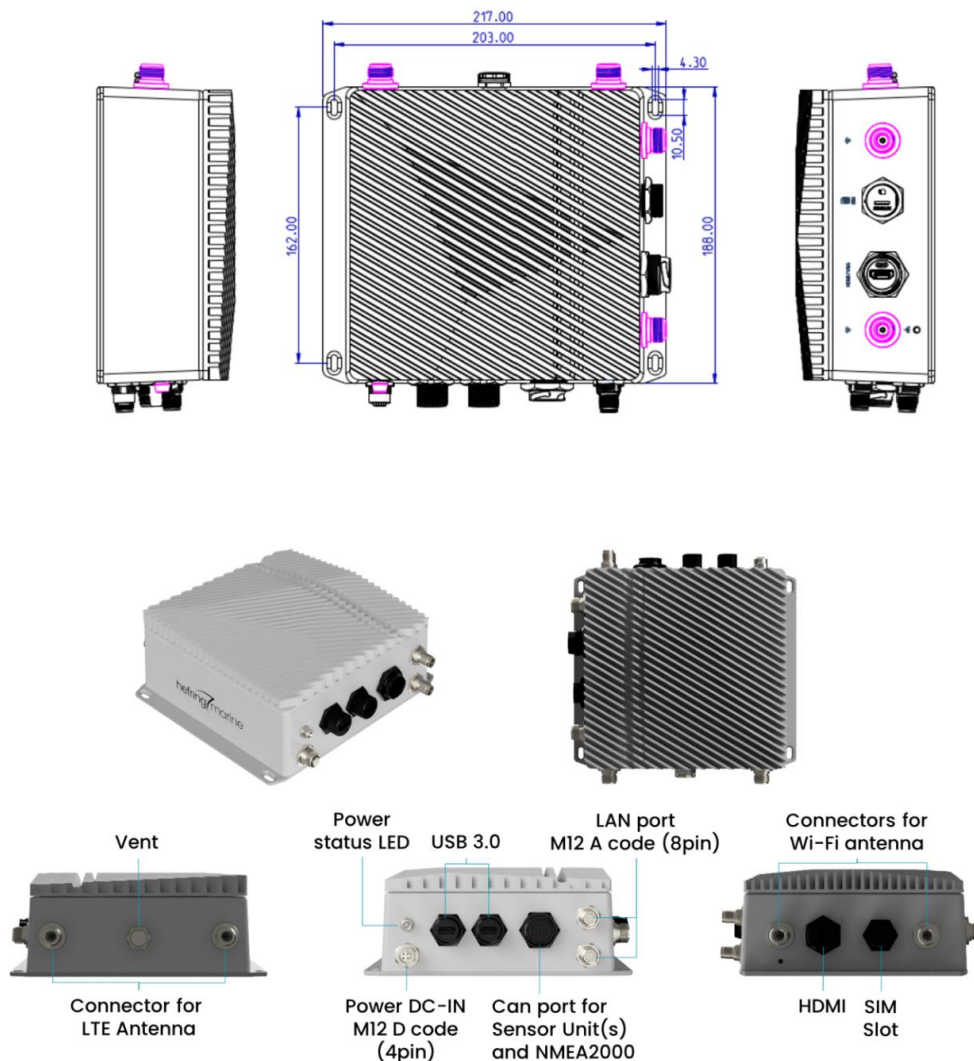


Figure 1: Control Unit

2.1.1 Hardware Specifications

Table 1: Hardware Specifications – Control Unit

Type:	- Embedded system computer
Dimensions:	- Enclosure: L217 x W188 x H87 mm Wall mount
Connectors:	- 9-36VDC (max 1.5A @ 12V) M12 4 pin D-code
	- CAN Bus to Sensor Unit(s) M12 8-pin female A-coded
	- NMEA2000 M12 5-pin male A-coded
	- 2x LAN / Ethernet M12 8-pin female A-coded
	- HDMI
	- 2x USB
	- SIM slot
Antennas:	- 2x LTE Cellular
	- 2x Wi-Fi
Construction:	- IP67 enclosure rating - Anti-vibration chassis
Weight	- 2.1 kg

2.1.2 Environmental Specifications

Table 2: Environmental Specifications – Control Unit

Operating Temperature	-	-40 to 70°C
Storage Temperature	-	-40 to 85°C
Relative Humidity	-	5 to 95% RH (non-condensing)

2.1.3 Standards and Certifications

Table 3: Standards and Certifications – Control Unit

Shock	-	Operation shock test: Half Sine Wave 15G, 11ms, 3 Shock Per Axis
Vibration	-	Operation Vibration test: MIL-STD-810G 514.6C-2, Figure 514.6C-2
Certifications	-	CE, FCC Class A, ROHS
Construction	-	IP67 enclosure

2.1.4 Interfaces

2.1.4.1 LAN

The Control Unit has two LAN ports.

Figure 2 shows the LAN ports on the Control Unit. They are both M12 8-pin, A-coded.

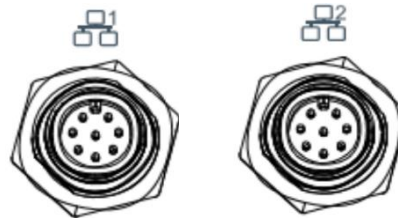


Figure 2: Control Unit LAN ports

The data that goes through the LAN ports, if connected to a plotter and/or a router includes various MQTT messages used for internal communications and information needed for the front-end on the system to be used on other connected devices.

The LAN ports are used to connect to an on-board MFD or/and an on-board router. The following MFDs are currently supported:

Garmin

All Garmin plotters with OneHelm support work with the Control Unit. The following is a list of supported Garmin plotters (as of June 2022).

Table 4: List of supported Garmin MFDs

Product Family	Product	OneHelm Full Screen support	OneHelm Combo Support
<i>GPSMap 7x2/9x2/12x2 Plus</i>	<i>GPSMap 7x2 Plus</i> <i>GPSMap 9x2 Plus</i>	x	
<i>GPSMap 7x2/9x2/12x2 Plus</i>	<i>GPSMap 12x2 Plus</i>	x	X
<i>GPSMap 7x3/9x3/12x3 Series</i>	<i>GPSMap 7x3</i> <i>GPSMap 9x3</i> <i>GPSMap 12x3</i>	x	X
<i>GPSMap 8400 / 8600 Series</i>	<i>GPSMap 8x10</i> <i>GPSMap 8x12</i> <i>GPSMap 8x16</i> <i>GPSMap 8x17</i> <i>GPSMap 8x22</i> <i>GPSMap 8x24</i>	x	X
<i>GPSMAP 8700 Black Box</i>	<i>GPSMap 8700</i>	x	X
<i>Volvo Penta Glass Cockpit / Beneteau</i>	<i>GPSMAP A12</i> <i>GPSMAP A7</i>	X	
<i>Volvo Penta Glass Cockpit - GPSMap 8400 / 8600 Series</i>	<i>GPSMap 8x10</i> <i>GPSMap 8x12</i> <i>GPSMap 8x16</i> <i>GPSMap 8x17</i> <i>GPSMap 8x22</i> <i>GPSMap 8x24</i>	x	x

Navico

The following MFDs from Navico are currently supported (as of June 2022).

Table 5: List of supported Navico products

Brand	Product Family	Display Size
<i>Simrad</i>	<i>NSO EVO3/S</i>	<i>16, 19 and 24</i>
<i>Simrad</i>	<i>NSS EVO3/S</i>	<i>7, 9, 12 and 16</i>
<i>Simrad</i>	<i>IDS</i>	<i>9 and 12</i>
<i>Simrad</i>	<i>GO</i>	<i>7*, 9, 12</i>
<i>B&G</i>	<i>Zeus3/S Glass Helm</i>	<i>16, 19 and 24</i>
<i>B&G</i>	<i>Zeus3/S</i>	<i>7, 9, 12 and 16</i>
<i>B&G</i>	<i>Vulcan</i>	<i>7, 9 and 12</i>
<i>Lowrance</i>	<i>HDS Live</i>	<i>7, 9, 12 and 16</i>
<i>Lowrance</i>	<i>HDS Carbon</i>	<i>7, 9, 12 and 16</i>
<i>Lowrance</i>	<i>Elite FS</i>	<i>7 and 9</i>

*Go7 XSR compatible (Go7 XSE is not compatible).

Raymarine

Integration is only supported on Raymarine Axiom, Axiom+, Axiom PRO, and Axiom XL MFDs running the LightHouse 3 operating system version 3.16 or above.

Table 6: List of supported Raymarine MFDs

Product	Display Size
<i>Raymarine Axiom</i>	<i>7, 9 and 12.1</i>
<i>Raymarine Axiom+</i>	<i>7, 9 and 12.1</i>
<i>Raymarine Axiom PRO</i>	<i>9, 12.1 and 15.6</i>
<i>Raymarine Axiom XL</i>	<i>15.6, 18.5, 21.5 and 24</i>

2.1.4.2 Combo Port (NMEA2000 and Sensor connection)

The Combo port is a 23-pin circular connector. A cable is provided with the device which converts the 23-pin combo port to a M12 5-pin A-coded male (NMEA2000) and M12 8-pin A-coded female (Sensor Unit) connectors.

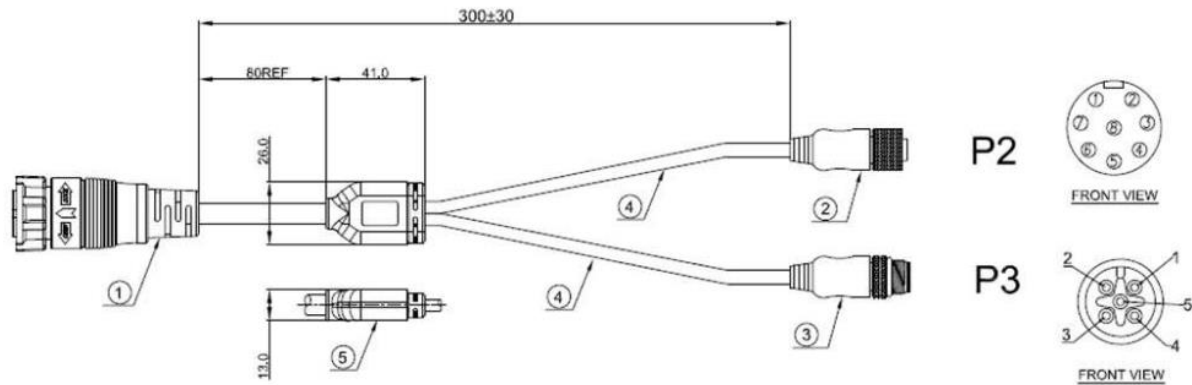


Figure 3: Combo port cable to NMEA2000 and Sensor Unit connectors

2.1.4.3 NMEA2000 (M12 5-pin male)

The Hefring Marine system reads all available NMEA2000 data. To deliver a guidance safety speed, it only requires speed over ground (SOG). No data is transmitted through the interface.

2.1.4.4 Sensor Connector (M12 8-pin female)

The Control Unit is connected to the Sensor Unit through a CAN bus interface. Data sent through includes acceleration, gyroscopic data and magnetic measurements.

2.1.4.5 Cellular

If the Control Unit is configured with a cellular connection, all collected data is transmitted to the cloud server where it is stored and presented to the end user using the HM Admin Console portal. This data includes GPS location, speed, acceleration and all motion. In addition, all the data that is collected through instruments connected to the NMEA2000 bus will be stored and presented to the user. Over the air updates (OTA) are also handled using the cellular connection and all remote support. This data is sent using standard security methods and all files are encrypted during transmission.

If requested, cellular transmission can be deactivated and the system instead paired to authorized networks, in which case the system will only upload data once within those networks. Other methods for data transmission, including logging to a USB flash drive, can be implemented on specific request. However, data would not be viewable in the HM Admin Console with this configuration.

2.1.4.6 HDMI

An HDMI screen can be connected to the Control Unit and the front-end on the device will be displayed.

2.1.4.7 Front-end

For both compatible MFDs and for HDMI displays, the image below is an example of the user interface displayed on board.

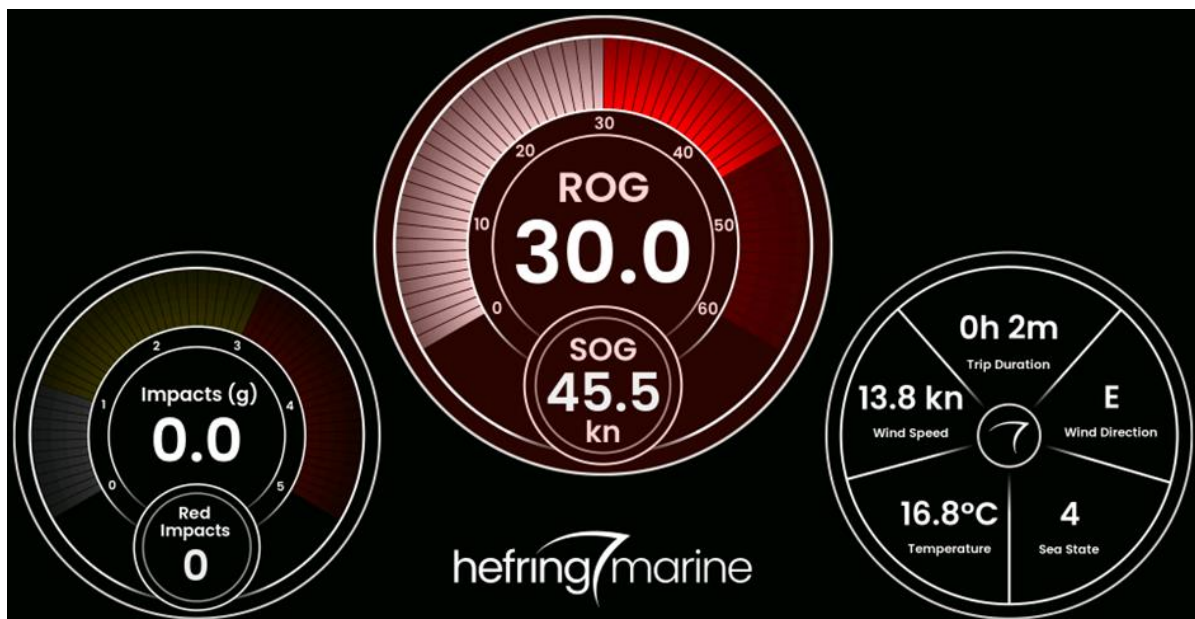


Figure 4: User interface front-end

2.1.4.8 Data Transmission

The main interfaces used for data are the LAN ports, NMEA2000 connection and the Sensor Unit connection. If the system is connected to the HM Admin Console cloud server with a cellular connection, all collected data is transmitted automatically to the cloud server.

A LAN port connected to an MFD or a similar device will send the following information:

- | IP address
- | Acceleration and motion data
- | SOG
- | Safety-optimized speed guidance (ROG)

- | Fuel optimized speed guidance (if requested)
- | Engine related data (if requested)
- | Course over ground (COG)
- | Weather related data (If GPS and internet access are available)
- | Trip related information, including duration of trip
- | All collected data in compressed files to a cloud server if LAN is used for the internet connection
- | Other misc. MQTT messages

NMEA2000 port connected to a NMEA2000 bus on the vessel collects the following information:

- | SOG
- | GPS location (optional)
- | COG (optional)
- | Engine related data (optional)
- | Data from various connected instruments (optional)

IMU port connected to the provided Sensor Unit(s) collects the following information:

- | Acceleration
- | Gyroscopic measurements
- | Magnetic measurements
- | Euler Angles

2.2 Sensor Unit

The Sensor Unit is connected to the Control Unit with a cable and utilizes CAN bus for communications. The Sensor Unit is an IMU that contains an accelerometer, two gyroscopes and a magnetometer.

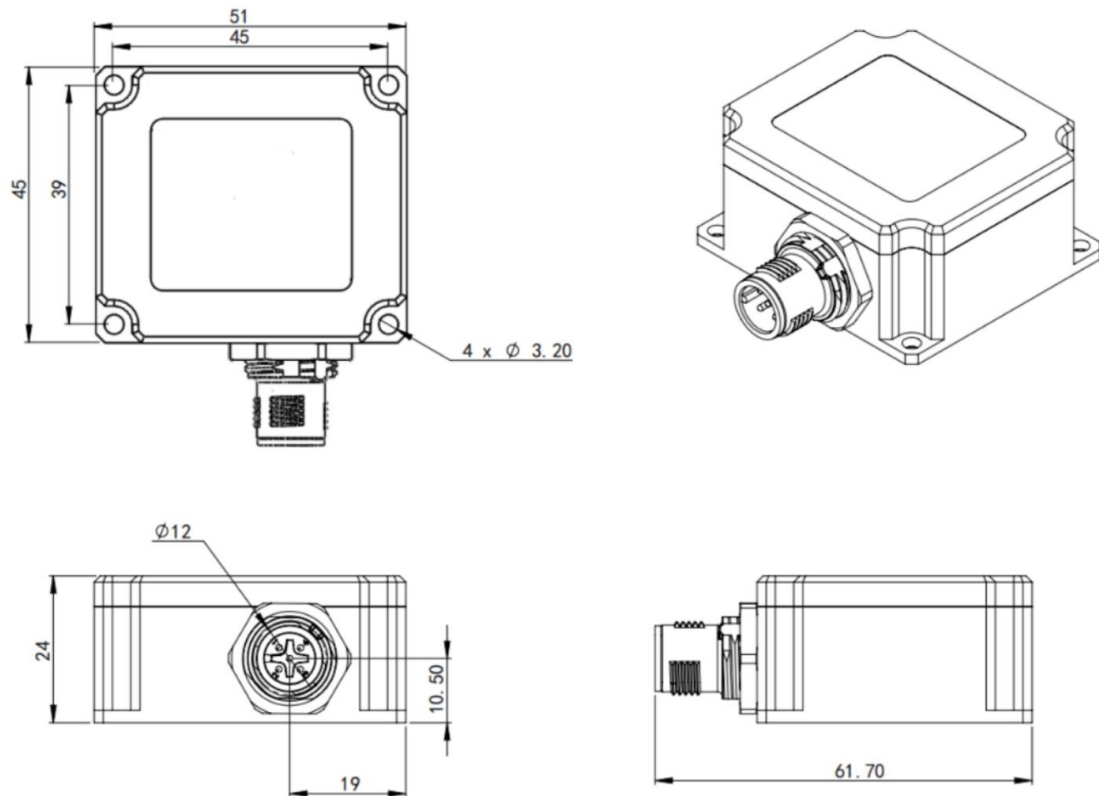


Figure 5: Sensor Unit

2.2.1 Hardware Specifications

Table 7: Hardware specifications – Sensor Unit

Type:	-	Inertial Measurement Unit (IMU)
Dimensions:	-	Enclosure: L51 x W45 x H24 mm Wall mount
Connectors:	-	CAN Bus and power (5V-36VDC) M12 8-pin male A-coded
Construction:	-	IP67 enclosure rating
Weight	-	74 g

2.2.2 Environmental Specifications

Table 8: Environmental specifications – Sensor Unit

Operating Temperature	-	-40 to 80°C
Storage Temperature	-	-40 to 85°C
Relative Humidity	-	5 to 95% RH (non-condensing)

2.2.3 Standards and Certifications

Table 9: Standards and Certifications - Sensor Unit

Certifications	-	CE, FCC Class B, ROHS
Construction	-	IP67 enclosure