KOBELT

Vessel System Monitoring & Smart Alarm Device

Vitals™

Installation Manual

November 2019

Kobelt Manufacturing Co. Ltd.

NOTES:

RECORD DATA BEFORE INSTALLATION FOR FUTURE REFERENCE	
Model #:	
Serial #:	
Date of Purchase:	
Date of Installation:	

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1 INTRODUCTION

This document is intended to clearly present comprehensive product data and provide technical information to assist the end user in operating Vitals. Kobelt reserves the right, without notice, to change the design, or construction, of any products and to discontinue or limit distribution of any products. Kobelt also reserves the right to change or update any technical information contained within this document without notice.

1.1 CONTACT

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Kobelt recommends that customers visit our website to check for updates to this Manual. Once a product has been selected for use, it should be tested by the user to ensure proper function in all possible applications. For further instructions, please contact our distributors or visit our website.

1.2 COMPLIANT USE

Vitals is an aid only and should not be used as the sole method of decision making. Vitals will not protect the systems that it is monitoring. Vitals utilizes digital and analog data and electronic information from the various marine electronic instruments or sensors on-board the vessel. This device is only intended for use by persons trained in operating marine systems and only as an operational aid.

The installer shall:

- Only use non-defective products.
- Check the safety of operation and the condition of the device before each use.
- Verify that the product is operational at all times and keep it in good working conditions.

Only Kobelt Manufacturing Co. Ltd. Authorized Dealers or Authorized Technicians are to repair Vitals.

1.3 COPYRIGHTS & TRADEMARKS

2 SAFETY

Throughout this manual, the following symbols are used to alert the installer to special instructions concerning a service or operation that may be hazardous if performed incorrectly or carelessly. The associated risk levels are stated below.

2.1 SAFETY ALERTS

⚠ DANGER	This symbol indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	This symbol indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	This symbol indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
NOTICE	This symbol informs the reader of events not related to personal injury but which there is a risk of damage to property or equipment.
SAFETY INSTRUCTIONS	This symbol informs the reader of safety-related instructions or procedures.

2.2 PRODUCT HAZARDS

⚠ WARNING	**Disconnect Power:** Turn off power at distribution panel before beginning installation to protect installer from electrical hazards.
⚠ CAUTION	**Voltage and Current Compatibility:** Confirm that the power source is compatible with the maximum voltage and current ratings of is product variant. Failure to do so could result in damage or fire.

3 ABOUT VITALS

3.1 PRODUCT DESCRIPTION

Vitals by Kobelt Manufacturing Co. Ltd. is an integrated touchscreen monitor and data acquisition system that acts as an alarm hub for sensors connected to the NMEA 2000 network, or directly to the multiple digital or analog inputs on back of the unit. This system is designed to monitor and provide warnings and alarms for basic vessel configurations, or to be expanded to cover a multitude of sophisticated vessel systems.

Vitals will work with analog senders such pressure sensors, temperature sensors, etc., attached to the installers' engine and digitize the information and display digital gauges with the corresponding values on the screen. Vitals will raise warnings and alarms if the preconfigured warning and alarm conditions are met. It can output the acquired data of the live engine status to the NMEA 2000 network to be displayed or read by other devices.

3.2 INTENDED USE

Vitals is designed to aid the installer to quickly identify possible issues and malfunctions of systems on the vessel, thus help the installer make a timely decision to protect equipment from sudden failure.

3.3 TECHNICAL SPECIFICATIONS

The table below lists the Technical Specifications of the Vitals device.

Table 1: Technical Specifications

MODEL	VT700
KOBELT PART #	6700
OPERATING VOLTAGE	9 - 32 VDC (Nominal 12 VDC or 24 VDC)
OPERATING CURRENT	**Sleep:** 160 mA / **Active:** 230 mA / **Alarming:** 530 mA @ 12 VDC **Sleep:** 80 mA / **Active:** 120 mA / **Alarming:** 270 mA @ 24 VDC
DISPLAY SIZE	7.0" [177.4 mm]
DISPLAY RESOLUTION	800 x 480 pixels
DISPLAY CONTRAST RATIO	500:1
OPERATING TEMPERATURE	-13°F to 131°F [-25°C to 55°C]
STORAGE TEMPERATURE	-22°F to 158°F [-30°C to 70°C]
OPERATING HUMIDITY	95 % (Non-Condensing)
STORAGE HUMIDITY	75 % (Non-Condensing)
IP RATING	IP66 / IP42 (Front / Back)
DIMENSIONS	8.7" x 5.28" x 2.03" [221 mm x 134 mm x 52 mm]
WEIGHT	1.42 lbs. [0.64 kg]

4 INSTALLATION

Installing Vitals involves the following steps. Please refer to the individual sections for installation details. Following this guide will ensure the device is securely installed and ready for use.

4.1 UNPACKING THE PRODUCT

When unpacking the box containing Vitals, the box should include the following additional items:

- 1x Vitals Monitor
- 4x Mounting Screws
- 1x Vitals Installation Manual
- 1x Vitals Monitor Cutout Template

If any of these items are missing or damaged, please contact Kobelt to arrange a replacement.

4.2 CHOOSING THE INSTALLATION LOCATION

The Vitals Monitor is recommended to be mounted to your dash, or close by, to ensure easy visibility while operating your vessel.

The installer should consider the following parameters when choosing a mounting location:

1. Vitals Monitor should be mounted to be visible while underway.
2. A nearby location should be selected for mounting the speaker and/or visual indicator.
3. The backside of Vitals should be protected from direct water exposure.

4.3 MOUNTING VITALS

Securing Vitals to the dash is a crucial step in the installation process. This ensures safety to the product while providing ease of access to the installer.

The five steps to securing Vitals to the dash are:

1. Use the provided Cutout Template to cut a hole in the dash or command bridge to fit Vitals.
2. Ensure the back of the product is protected from the elements. While the front screen is waterproof, the back is not.
3. Ensure that there is enough room in the dash cabinet to accommodate the depth of the product and the attached cables.
4. Insert the unit into the hole cut in the dash. There should be no pressure applied to the cables when installing the unit into the cutout.
5. Use the supplied screws, of the unit to secure it into place at each corner. Do not over-tighten the screws as it can lead to damaging the enclosure. Alternative non-wood screws are available if desired.

NOTICE	The back of Vitals cannot be exposed to water.

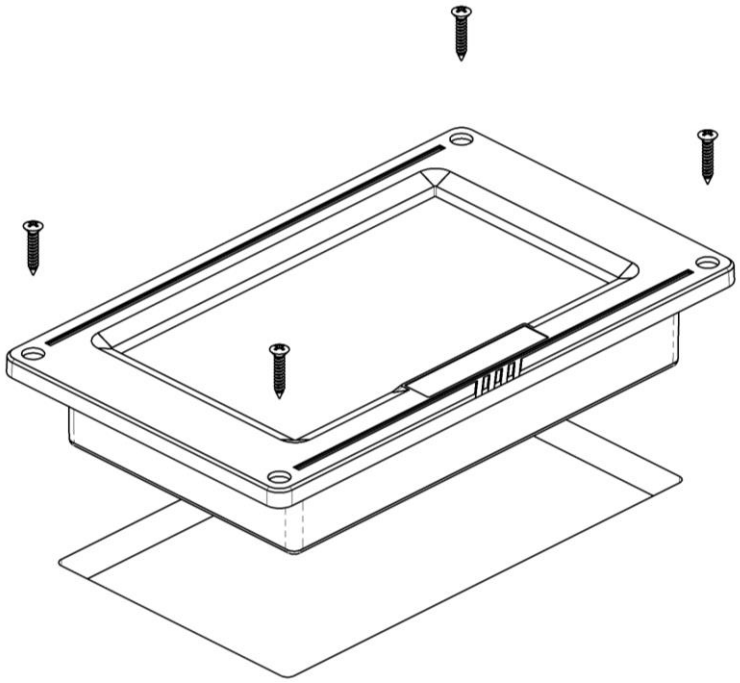

Figure 1: Mounting Vitals to the Dash

4.3.1 Mounting Template

The mounting and cutout dimensions for Vitals is included below. Note that this example is not to scale. A scale mounting template is included within each box and available on the Vitals product page (http://www.kobelt.com/products/6700/) of the Kobelt website for download.

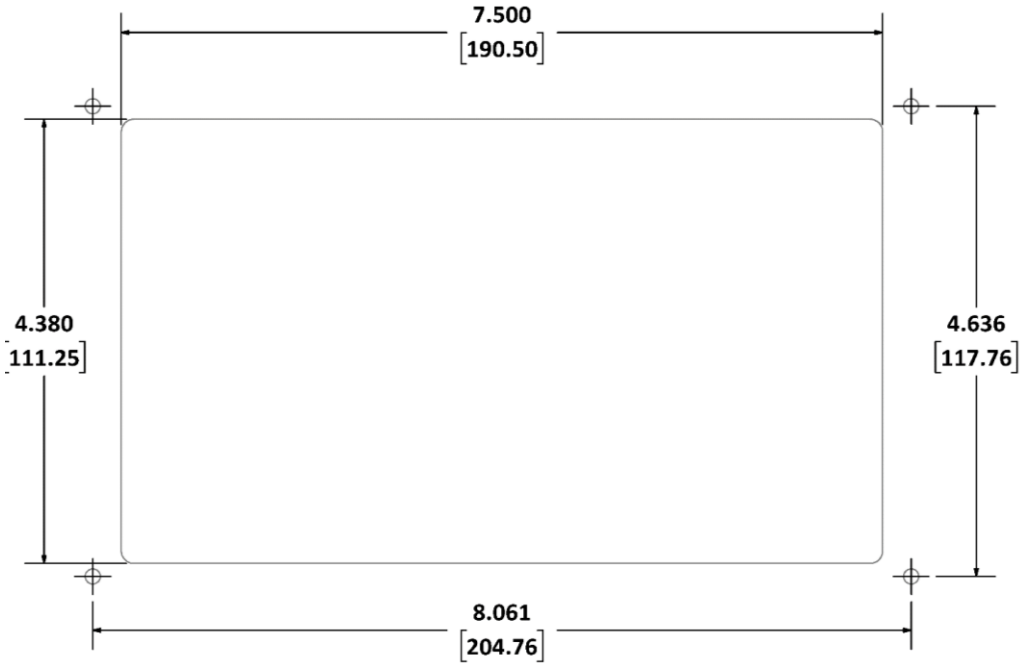

Figure 2: Mounting and Cutout Dimensions for Vitals

4.4 CONNECTING THE ELECTRICAL

The back panel of Vitals contains all the electrical connections to interface with on-board equipment. Cables are required to connect all the required instruments to the appropriate connectors on the backside of the unit. Cables are supplied separately and are available through a Vitals dealer or local marine installer.

4.4.1 Electrical Connectors

Connectors are indicated as ① to ⑪. Connections to ① and ② are required for basic operation. All other connections are optional and based on the users' specific installation needs.

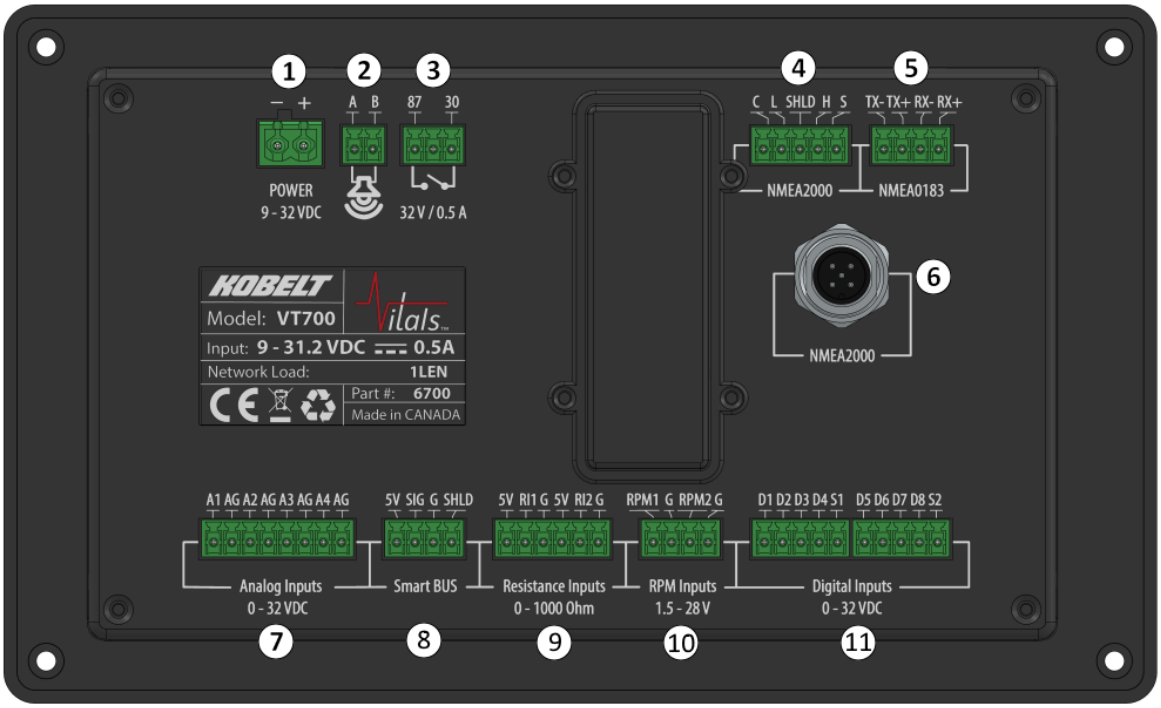

Figure 3:Vitals Back Panel Visual Overview

Table 1: Vitals Back Panel Connectors

NO.	NAME
1	Power Connector
2	Speaker Connector
3	Relay Output Connector
4	NMEA 2000 Terminal Connector
5	NMEA0183 Connector
6	NMEA 2000 M12 Connector
7	Analog Inputs Connector
8	SmartBus Connector
9	Resistance Inputs Connector
10	RPM Inputs Connector
11	Digital Inputs Connector

4.4.1.1 Power Connector

This connector must be used to provide DC power to the system. Vitals accepts 9-32 VDC. The positive (+) and negative (-) terminals are clearly marked on the product. The product is equipped with reverse polarity protection. While reversing the polarity will not harm the unit, it will not work until proper polarity power is connected to the device.

Table 2: Power Connector

①	Power Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	-	Power	Primary Power Connection, Negative (COM)
2	+	Power	Primary Power Connection, Positive (9 – 32 VDC)

4.4.1.2 Speaker Connector

The Speaker Connector is used to add audio capability to the product. Vitals accepts a 4 or 8 Ohm, 2 W external speakers. Connection is polarity agnostic and is labeled **A** and **B** for clarity only.

Table 3: Speaker Connector

②	Speaker Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	A	Signal	Speaker Signal Output A
2	B	Signal	Speaker Signal Output B

NOTICE	Vitals does not have an internal speaker. Audible alarms will only sound if there is an external speaker connected to the device.

4.4.1.3 Relay Output Connector

The Relay Output Connector is used to trigger external devices, such as a secondary buzzer, or strobe light. This connector supports a maximum of 32 VDC and can control up to a 400mA load. Connect the power source to terminal marked ***30*** and the load to the terminal marked ***87***.

Table 4: Relay Output Connector

③	Relay Output Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	87	Signal	Relay, Negative Contact (-)
2	--	N/A	No Connection
3	30	Signal	Relay, Positive Contact (+)

NOTICE	***DO NOT*** exceed the listed power requirements, or the internal components may become damaged.

⚠CAUTION	Check the polarity before applying power. Incorrect polarity can damage Vitals and connected devices.

4.4.1.4 NMEA 2000 Terminal Block Connector

The NMEA 2000 Terminal Connector is used if the users' NMEA 2000 network utilizes terminal strip type connections.

NOTICE	***DO NOT*** connect both of the NMEA 2000 ports at the same time. Connections are internally shared.

Table 5: NMEA 2000 Terminal Connector

④	NMEA 2000 Terminal Block Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	C	Power	NET-C, Power Supply Common
2	L	Comms	NET-L, CAN Low, or Network Signal Low
3	SHLD	Shield	SHIELD, Network Shield
4	H	Comms	NET-H, CAN High or Network Signal High
5	S	Power	NET-S, Power Supply Positive

4.4.1.5 NMEA0183 Connector

NMEA0183 Connector is used if Vitals is being connected to another NMEA0183 device. By default, the NMEA0183 port is set up for the standard NMEA0183 baud rate of 4800 baud. Note that the NMEA0183 port is not enabled by default. It must be enabled in the NMEA0183 settings within Vitals.

Table 6: NMEA0183 Connector

⑤	NMEA0183 Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	Tx-	Comms	Transmit negative pin, connect to Rx- on the other NMEA0183 system
2	Tx+	Comms	Transmit positive pin, connect to Rx+ on the other NMEA0183 system
3	Rx-	Comms	Receive negative pin, connect to Tx- on the other NMEA0183 system
4	Rx+	Comms	Receive positive pin, connect to Tx+ on the other NMEA0183 system

NOTICE	***DO NOT*** short any pins within the NMEA 2000 Terminal Connector, or the NMEA0183 Connector together. Doing this may cause internal damage that will not be covered by the manufacturer warranty. This port is NMEA0183 port and it is not intended to connect to PC serial RS232 ports.

4.4.1.6 NMEA 2000 M12 Connector

The NMEA 2000 M12 Connector is used to directly connect to standard NMEA 2000 networks based on circular connector cabling standards. The connect on the back of the unit contains the following pin-out. The signals are directly connected to their corresponding signals of the NMEA 2000 Terminal Connector.

NOTICE	***DO NOT*** connect both of the NMEA 2000 ports at the same time**.** Connections are internally shared.

Table 7: NMEA 2000 M12 Connector

⑥	NMEA 2000 M12 Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	SHIELD	Power	NMEA 2000 Shield Connection
2	NET-S	Power	NMEA 2000 Power Supply Positive (Isolated from V+ on Vitals)
3	NET-C	Power	NMEA 2000 Ground (Isolated from V- on Vitals)
4	NET-H	Comms	NMEA 2000 CAN High Signal
5	NET-L	Comms	NMEA 2000 CAN Low Signal

4.4.1.7 Analog Inputs Connector

The Analog Inputs Connector is used to measure from 0 VDC to +30 VDC. These inputs cannot be used to measure negative voltages. The precision is to two decimal places, about 1/100V. The analog inputs have high input impedance. It is unlikely that they affect the signals being measured. Note that all AG analog ground inputs are connected internally. It is not required, or recommended, to connect more than one of these ground terminals together if the sensors are also grounded on their ends.

Table 8: Analog Inputs Connector

⑦	Analog Inputs Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	A1	Input	Analog Input, Signal 1
2	AG	Power	Analog Ground (connected internally to Power Supply Negative)
3	A2	Input	Analog Input, Signal 2
4	AG	Power	Analog Ground (connected internally to Power Supply Negative)
5	A3	Input	Analog Input, Signal 3
6	AG	Power	Analog Ground (connected internally to Power Supply Negative)
7	A4	Input	Analog Input, Signal 4
8	AG	Power	Analog Ground (connected internally to Power Supply Negative)

NOTICE	***DO NOT*** connect these ports to AC voltages because this will cause internal damage to the product and it will not be covered by the manufacturer's warranty.

4.4.1.8 SmartBus Connector

The SmartBus Connector is used to connect to external sensors and accessories available from Kobelt.

Table 9: SmartBus Connector

⑧	SmartBus Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	5V	Power	Power to SmartBus devices or hubs
2	SIG	Comms	Data communications from SmartBus devices or hub
3	G	Power	Power ground to SmartBus devices or hubs
4	SHLD	Power	Cable shield connection point

NOTICE	***DO NOT*** short the 5V to ground. If done, Vitals will restart automatically. If the short still exists, there will be no 5V present on the 5V line. Remove the short-circuit, then switch off the breaker to Vitals to power it off. Power Vitals on again in 10 seconds, allowing the internal protection on the 5V line to reset.

4.4.1.9 Resistance Inputs Connector

The Resistance inputs are used to measure resistance sensors, or low voltage analog signals.

Table 10: Resistance Inputs Connector

⑨	Resistance Inputs Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	5V	Power	5V Power Connection for Sensors
2	RI1	Input	Analog Signal 1 from resistive sensor
3	G	Power	Common Power Connection for Sensors
4	5V	Power	5V Power Connection for Sensors
5	RI2	Input	Analog Signal 2 from resistive sensor
6	G	Power	Common Power Connection for Sensors

NOTICE	Using the Resistance Inputs to measure low-voltage analog signals requires changes to an internal jumper in the product.

4.4.1.10 RPM Inputs Connector

The RPM inputs is used to connect to RPM signals. Vitals RPM inputs are configured to handle different types of RPM output sources/sensors with signal from 5V - 30V in a frequency range from 5Hz - 20kHz.

Table 11: RPM Inputs Connector

⑩	RPM Inputs Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	RPM1	Input	Input for Engine #1
2	G	Power	Ground for RPM1
3	RPM2	Input	Input for Engine #2
4	G	Power	Ground for RPM2

4.4.1.11 Digital Inputs Connector

The Digital Inputs Connector is used to connect to any DC system that has an on/off switch.

Table 12: Digital Inputs Connector

⑪	Digital Inputs Connector		
Pin #	**Pin Designator**	**Pin Type**	**Function**
1	D1	Input	Digital input #1
2	D2	Input	Digital input #2
3	D3	Input	Digital input #3
4	D4	Input	Digital input #4
5	S1*	Reference	External Reference for D1 to D4
6	D5	Input	Digital input #5
7	D6	Input	Digital input #6
8	D7	Input	Digital input #7
9	D8	Input	Digital input #8
10	S2*	Reference	External Reference for D5 to D8

*If set to VDC, digital inputs need to short to GND (LOW). If set to GND, then switches need to go to VDC (HIGH).

NOTICE	If the input voltage drops below 7 VDC the input will not be triggered or will shut off if previously triggered.

4.4.2 Configuring Electrical Connections

Vitals can be configured in many ways, for a minimal installation power and speaker connections are required. An external strobe or alarm panel connection is also recommended.

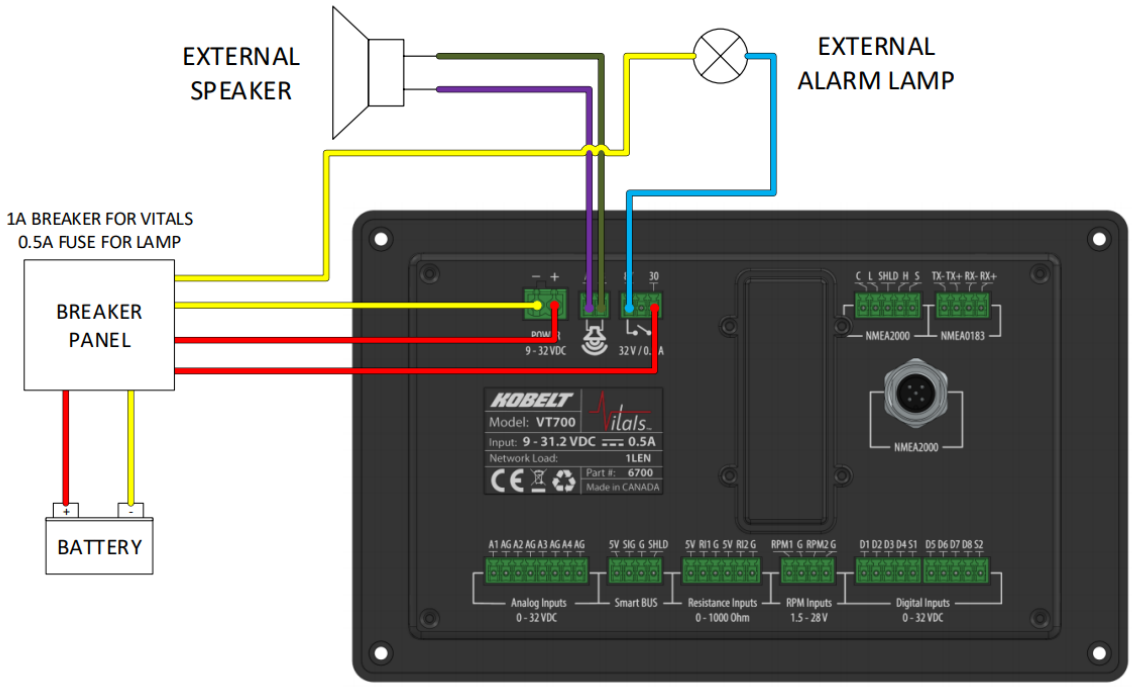

Figure 4: Connecting to vessel's power, external speaker and Solid State Relay (SSR) output

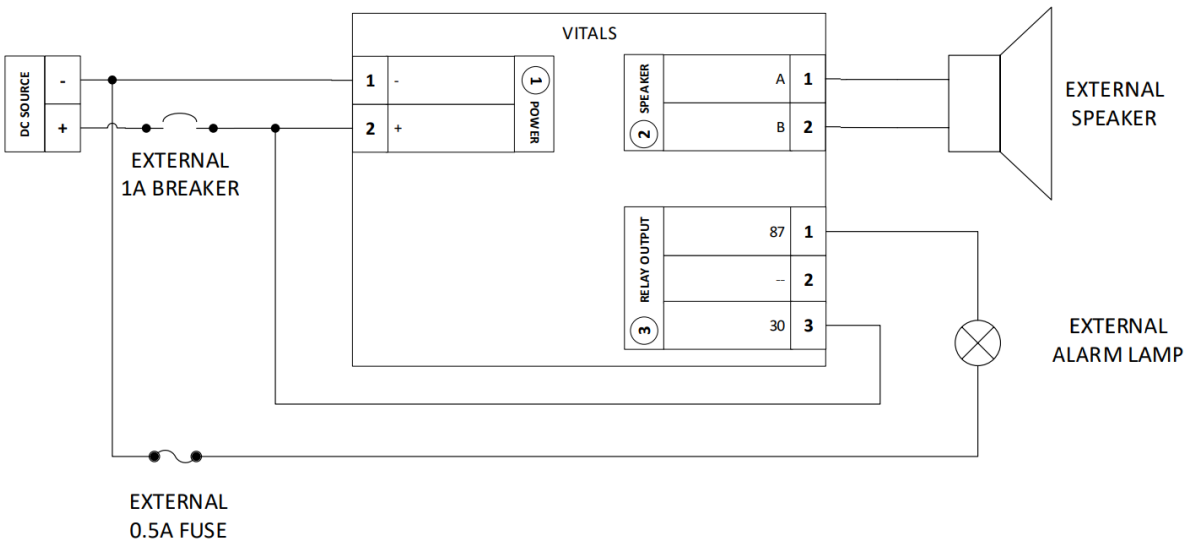

Figure 5: Schematic Overview

4.4.3 Connecting to the Vessel's Power

Vitals will accept DC power with any voltage between 9 and 32 VDC. Route power cables to the unit from a 1A breaker or fuse at your DC panel. Observe the proper polarity. The unit is equipped with reverse polarity protection, and reversing the polarity will not harm the unit, but it will not work until proper polarity power is connected to the product.

4.4.3.1 Cabling Recommendations

The installer should ensure that their circuits conform to ABYC recommendations and/or other applicable local electrical codes. Ensure that the electrical cables used are sized properly to prevent unreasonable voltage drop. Follow recommended wiring practices and standards as per relevant local codes.

Table 13: Vitals DC Power Cable Run Information

12V or 24V DC System - Acceptable Loss 3%			
Cable Run		Matched mm² Cable Size Required	Matched AWG Cable Size Required
Meters	Feet		
2	6	0.5mm²	22AWG
3	10	0.5mm²	22 AWG
4	13	0.5mm²	20 AWG
5	16	1.0mm²	18 AWG
6	20	1.0mm²	18 AWG
8	26	1.5mm²	16 AWG
10	33	1.5mm²	16 AWG

Table 14: DC Power Cable Current Rating Information

USA Wire & Cable Size	EU Metric MM2 Size	Recommended Max Ampere Rating
AWG	mm²	Amps
30	0.05	0.5
28	0.08	0.8
26	0.13	1
24	0.20	2
22	0.32	3
20	0.52	5
18	0.82	7
16	1.3	10

4.4.3.2 Application Example

Connect a DC supply to Vitals such as a 12/24V battery using a 1A external breaker as shown in the figure below.

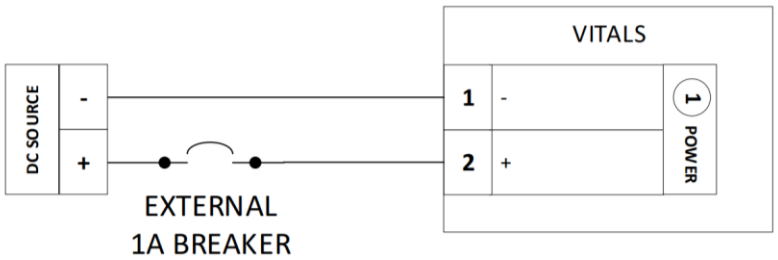

Figure 6: DC Power Connection

4.4.4 Connecting to an External Speaker

A speaker is required. Kobelt offers a suitable speaker for order to use with Vitals (Kobelt P/N: 6001-2207). Vitals provides a 2.8 W audio output for the external speaker.

Figure 7: Accessory Speaker

NOTICE	The external speaker must have an impedance of 4-8 Ohms with power rating of 2.8 Watts maximum. Please observe proper speaker impedance for best performance. Lower than 2.8 Watt power rated speakers will work as well.

4.4.4.1 Cabling Recommendations

The speaker offered by Kobelt comes with a 10ft 18AWG pigtail. If more length is required, twisted-pair 18 AWG cable is recommended.

Follow recommended wiring practices and standards as per relevant local codes.

4.4.4.2 Application Example

Connect the external speaker as shown in Figure 8. The polarity of the connections does not matter.

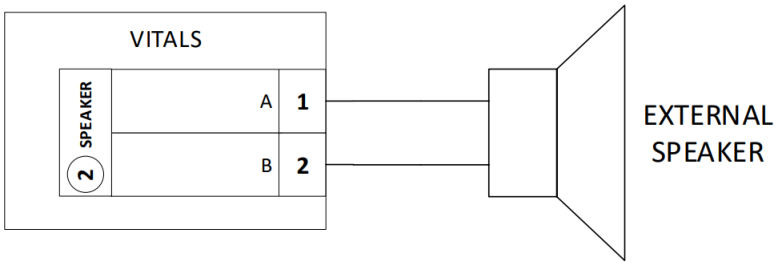

Figure 8: Example External Speaker Connection

4.4.5 Connecting the Alarm Output

Vitals provides one alarm output for activating an external device when warning or alarm conditions are triggered by any of the configured inputs. The alarm output is a normally open (NO) relay dry contact. When a warning or alarm condition is triggered, the relay contact closes.

If you have a powered external device (siren, strobe light, etc.), connect the source voltage up to 60 VDC to the relay connector contact marked ***30*** and the power terminal of the external device to the contact marked ***87***. Make sure that you provide ground to your external device from the same power source connected to the relay connector. Relay connections and power sources may be separate from the primary power source of Vitals, as the relay contacts are isolated.

4.4.5.1 Cabling Recommendations

Assess cabling based on your application requirements.

Follow recommended wiring practices and standards as per relevant local codes.

4.4.5.2 Application Example

If you have an external 12V alarm lamp that you would like to trigger on warnings/alarms, it may be connected as shown in Figure 9 below. This configuration is applicable for any device with supply voltages up to 32VDC and current <400mA.

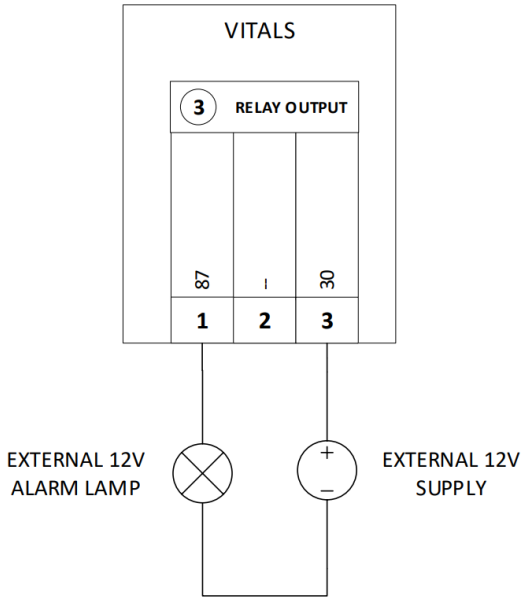

Figure 9: Example Relay Output Connection, Alarm Lamp

4.4.6 Connecting to a NMEA 2000 network

Vitals provides 2 methods to connect to pre-existing NMEA 2000 network on-board the vessel: M12 and legacy device connections.

4.4.6.1 Cabling Recommendations

Kobelt recommends the use of NMEA 2000 approved cabling as specified by the National Marine Electronics Association (NMEA).

Follow recommended wiring practices and standards as per relevant local codes.

4.4.6.2 Application Example

Use the proper T connector and insert it into the network backbone. Take a new network drop to Vitals with an appropriate length standard NMEA 2000 cable and attach it to the 5-pin round connector on Vitals. The cable length to any of the devices on the NMEA 2000 network should not exceed 6 meters (approx. 20 feet).

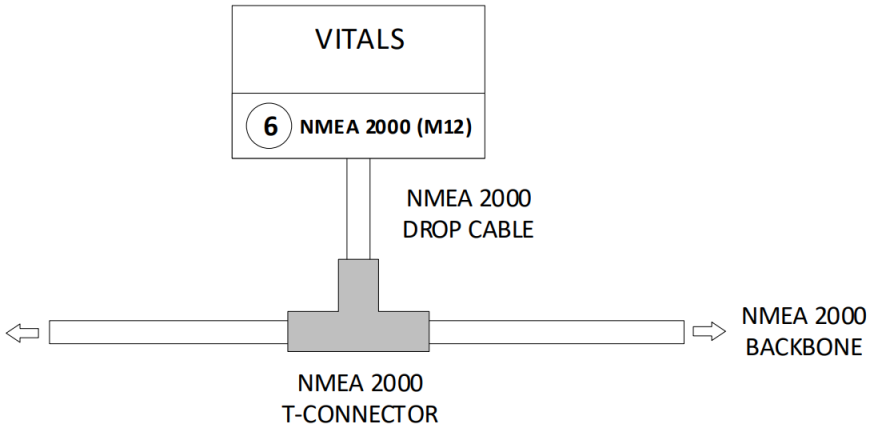

Figure 10: NMEA 2000 Network Connection, M12 Connector

4.4.7 Connecting to a NMEA 0183 device

Vitals provides NMEA 0183, Ver.2.0+ compatibility.

4.4.7.1 Cabling Recommendations

Shielded cable is recommended.

Follow recommended wiring practices and standards as per relevant local codes.

4.4.7.2 Application Examples

The electrical standard that is used is EIA-422.

4.4.7.2.1 Connecting to an NMEA 0183 Device with Tx/Rx Markings

- Connect ***Tx+*** on Vitals device or **Rx+** on the other NMEA0183 device
- Connect ***Tx-*** on Vitals device to **Rx-** on the other NMEA0183 device
- Connect ***Rx+*** on Vitals device to **Tx-** on the other NMEA0183 device
- Connect ***Rx-*** on Vitals device to **Tx+** on the other NMEA0183 device

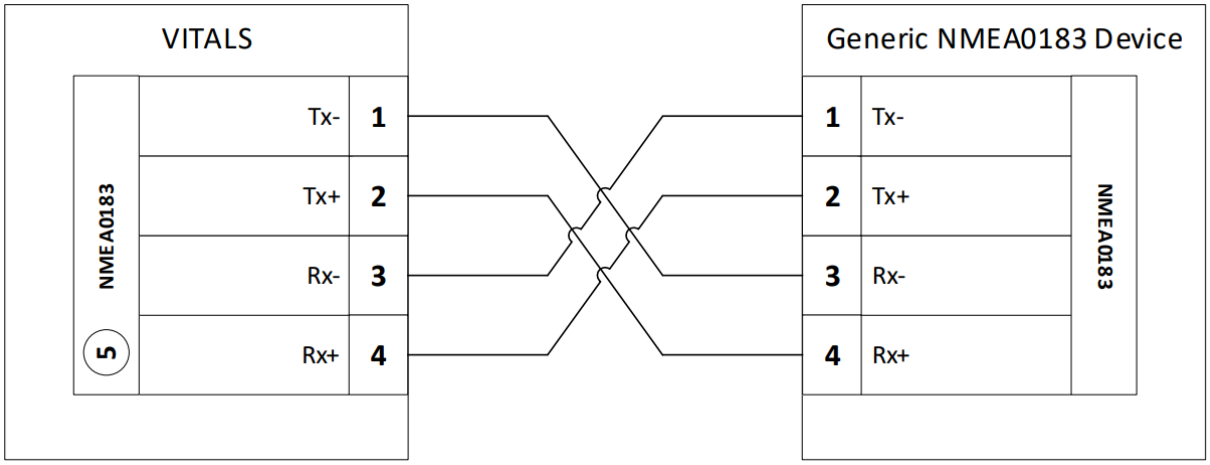

Figure 11: NMEA0183 Connection to Generic NMEA0183 Device with Tx/Rx Markings

4.4.7.2.2 Connecting to an NMEA 0183 Device with Talker/Listener Markings

On some devices the connections are marked as A and B:

- ***Talker A*** - Data-H
- ***Talker B*** - Data-L
- ***Listener A*** - Data-H
- ***Listener B*** - Data-L

In this is the case:

- Connect ***Tx+*** on Vitals to ***Listener B*** on the other NMEA0183 device
- Connect ***Tx-*** on Vitals to ***Listener A*** on the other NMEA0183 device
- Connect ***Rx+*** on Vitals to ***Talker B*** on the other NMEA0183 device
- Connect ***Rx-*** on Vitals to ***Talker A*** on the other NMEA0183 device

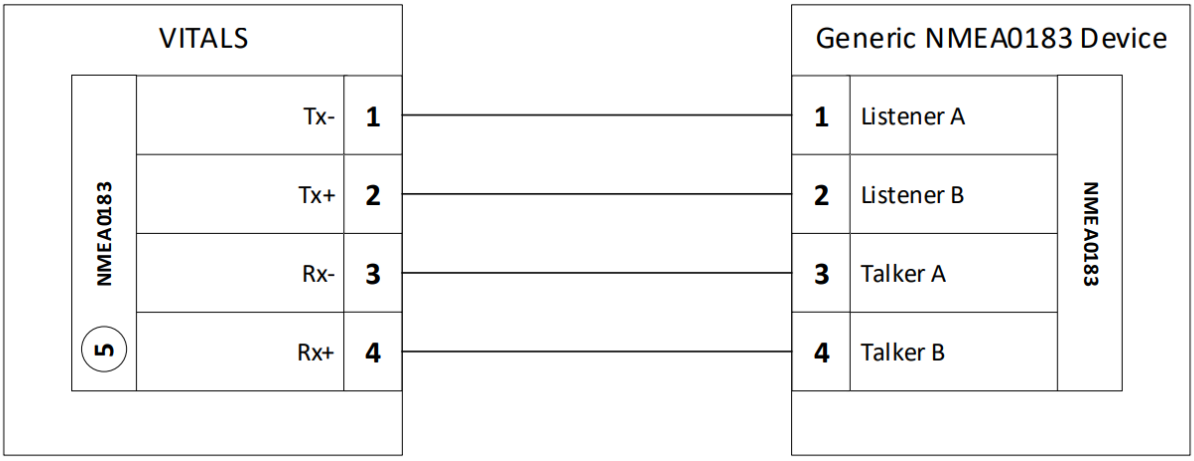

Figure 12: NMEA0183 Connection to Generic NMEA0183 Device with Talker/Listener Markings

4.4.8 Connecting the analog inputs

Vitals has four analog inputs that can measure DC voltages from 0-30V. There are many ways to utilize these analog inputs as the measured voltage from a sensor or gauge can be assigned to any Data Type, calibrated, and presented on the screen as RPM, temperature, pressure, etc.

Engine temperature measurement is a good example. A conventional analog engine temperature gauge maps a voltage from a sensor to a pointer position on the gauge. As the voltage changes, the pointer on the gauge moves with it. The gauge is calibrated for the voltage change and displays the temperature in degrees.

Vitals allows the display of electronic gauges in a similar way; the process is as follows:

1. Vitals measures the voltage of a sensor with one of the available analog inputs
2. The signal is calibrated to convert the measured voltage into the actual value based on calibration points
3. The gauge displays the value in the correct format, based on the data type you would like to measure (degrees C or F for temperature, Litres or Gallons for volume, PSI or kg/cm2 for pressure, etc.)
4. The final configured gauge will appear similar to an analog gauge, but with the added warning and alarm features of Vitals.

4.4.8.1 Cabling Recommendations

Consider grounding during installation. Ensure that there are no large ground loops.

Follow recommended wiring practices and standards as per relevant local codes.

NOTICE	Always check that the Analog inputs are connected to the correct stud on the back of any installed Gauges. Confirm the terminal markings and wiring on the back of any gauges with the manufacturer manual. Do not depend on color codes, check your boat connections as they may have been installed differently.

⚠ CAUTION	**DO NOT** connect the ***AG*** terminals of the analog port to any positive wires or signals. Use them to connect only to ships negative terminal or wire.

4.4.8.2 Application Examples

The ***A1***, ***A2***, ***A3***, and ***A4*** terminals on the Analog Input Connector can be connected to the positive voltage signals to be monitored. The ***AG*** terminals on the Analog Input Connector are all connected internally to a common ground.

NOTICE	The inputs are ***NOT*** isolated and can only be connected to sensors that have a common ground.

4.4.8.2.1 Connecting to an Existing Analog Gauge

Vitals can be wired in parallel with existing gauges so that the information can be displayed on the existing gauge and within Vitals. The gauge is typically connected directly to an analog sensor, Vitals can be connected in parallel with the gauge.

To connect Vitals to an existing analog gauge, first identify the signal and ground terminals of the gauge.

1. Connect an available analog input connector terminal ***A1***-***A4*** to the signal terminal of the gauge.
2. Connect the associated ***AG*** terminal of the analog input connector to the ground terminal of the gauge.
3. Repeat the connection to the other Gauges on the remaining available analog inputs, as desired.

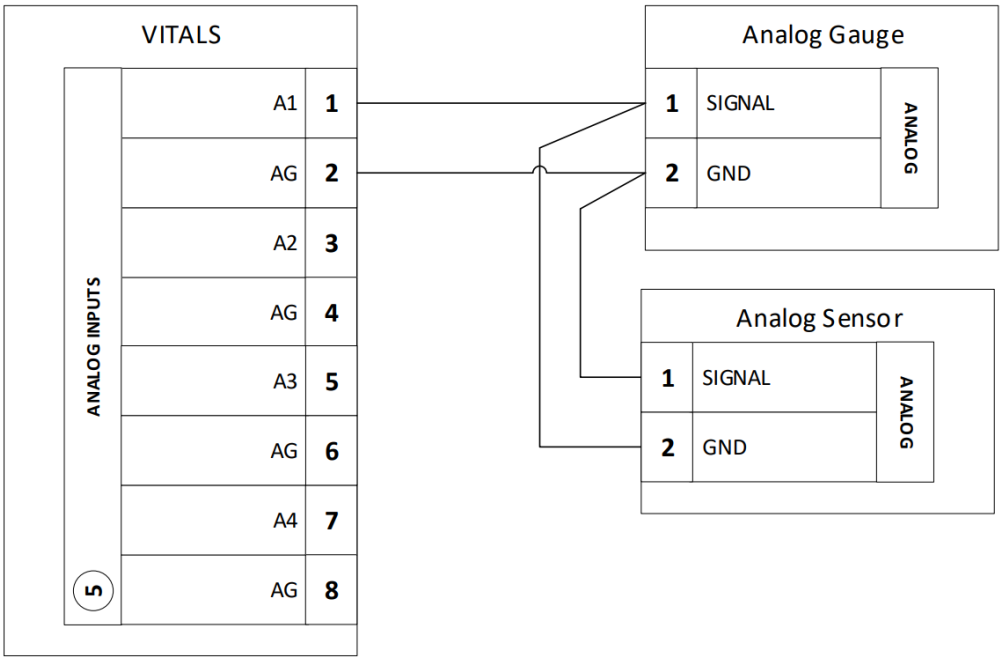

Figure 13: Connecting to an existing analog gauge

4.4.8.2.2 Connecting to a New Analog Sensor

To connect Vitals to a new analog sensor, first identify the signal and ground terminals of the sensor.

1. Connect an available analog input connector terminal ***A1***-***A4*** to the signal terminal of the sensor.
2. Connect the associated ***AG*** terminal of the analog input connector to the ground terminal of the sensor.
3. Repeat the connection to the other sensors on the remaining available analog inputs, as desired.

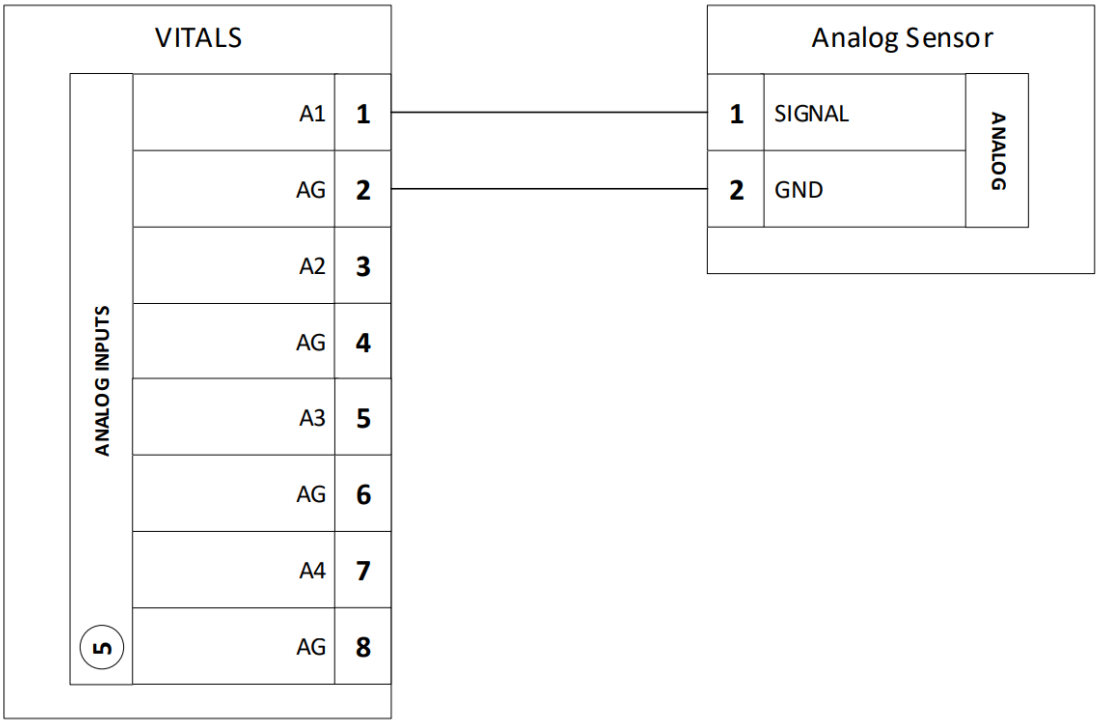

Figure 14: Connecting to a new analog sensor

4.4.9 Connecting the SmartBus

To connect multiple devices to the SmartBus one needs to run SmartBus cabling throughout the boat. All SmartBus devices will be branched off the main cabling at any location on the boat.

4.4.9.1 Cabling Recommendations

The recommended cable is the Alpha Wire 75020 BK002 cable (Kobelt P/N: 6014-0424). Be sure to keep consistent with using the same pairs in all bus segments.

If using the recommended Alpha Wire cable, use the blue and blue/white wire pair for the ground and signal, respectively. The orange conductor should be used for +5V. The blue and blue/white wire pair has the tightest winding and lowest noise sensitivity.

Make sure to use the same cable for the sensor network backbone and follow the same colour code. Do not extend the temperature sensor cable more than 10 feet (3 meters) total length. If you are extending the cable on the temperature probe, shorten the original non-twisted pair cable to the shortest reasonable length if possible and extend to the desired length with the twisted pair cable as previously described.

- Do not mix different cables on the bus
- When untwisting cable pairs for installation, make the untwisted sections as short as possible
- Do not make sharp bends or kinks in the cable. The radius of bends should be larger than 1” (2.54cm)
- Do not route the cables close to sources of EMI such as electrical motors, pumps, etc.
- Handle all cables carefully during installation. Do not step on the cable or pinch it tight with cable ties.

Follow recommended wiring practices and standards as per relevant local codes.

NOTICE	Properly wired SmartBus should be capable of lengths of 30m/100feet. Use high quality twisted pair cable, as recommended. Install it following good wiring practices. Leave the unused pairs unterminated. Follow the preferred topology as described in the sections below.

SmartBus Hubs (Kobelt P/N: 6700-0200) are also available to simplify cabling. When using hubs, the SmartBus sensors are connected to the hub directly with locking Molex connectors. If replacing the connectors be sure to use the appropriate Molex connectors, contacts, and crimping tools provided below.

- 3-Pin, Connector Housing (Molex: 50-57-9403)
- Contacts, 22-24AWG, Tin (Molex: 16-02-0102)
- Hand Crimp Tool (Mole: 0640160201)

NOTICE	Crimps should be performed following manufacturer recommendations.

4.4.9.2 Bus Topology

The sensors must be attached to the bus on separate terminal connectors.

See the following interconnection diagrams for reference:

4.4.9.3 Linear Topology

The SmartBus is a 3conductor wire, starting from the master and extending to the farthest slave device. Other slaves are attached to SmartBus with insignificant (< 3m) branches or "stubs."

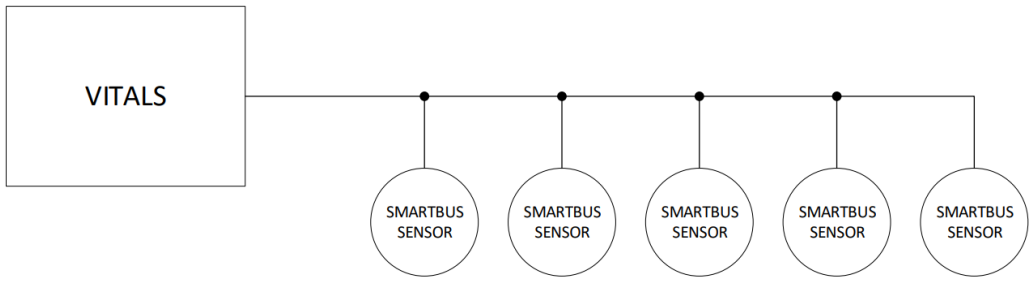

Figure 15: Linear topology.

4.4.9.4 Stub Topology

The SmartBus is a single main line, starting at the master and extending to the farthest slave. Other slaves are attached to the main line through branches or stubs 3m or less in length.

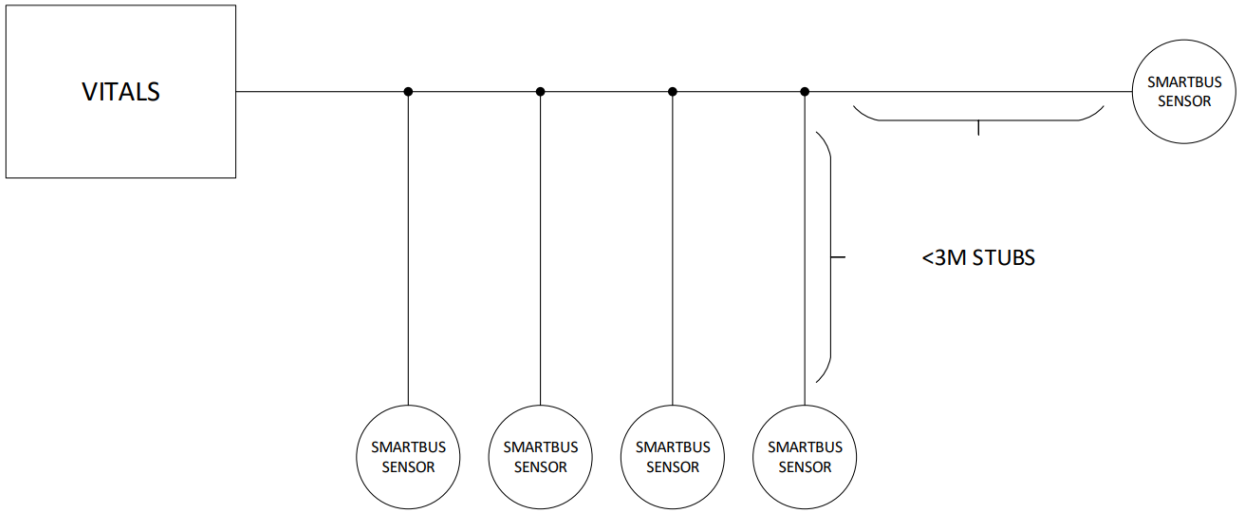

Figure 16: Stubbed topology.

4.4.9.5 Star Topology

In star topology, the SmartBus is split at or near the master end and extends in multiple branches of varying lengths. There are slave devices along, or at the ends of, the branches

Testing has shown that star-type network topologies (i.e., those with several branches diverging from the master) are unreliable. The junction of various branches presents highly mismatched impedances; reflections from the end of one branch can travel distances equal to nearly the length of the network (rather than the radius) and cause data errors. For this reason, the star topology is not recommended, and no guarantees can be made about their performance.

NOTICE	Star topology is not recommended to be used in installations.

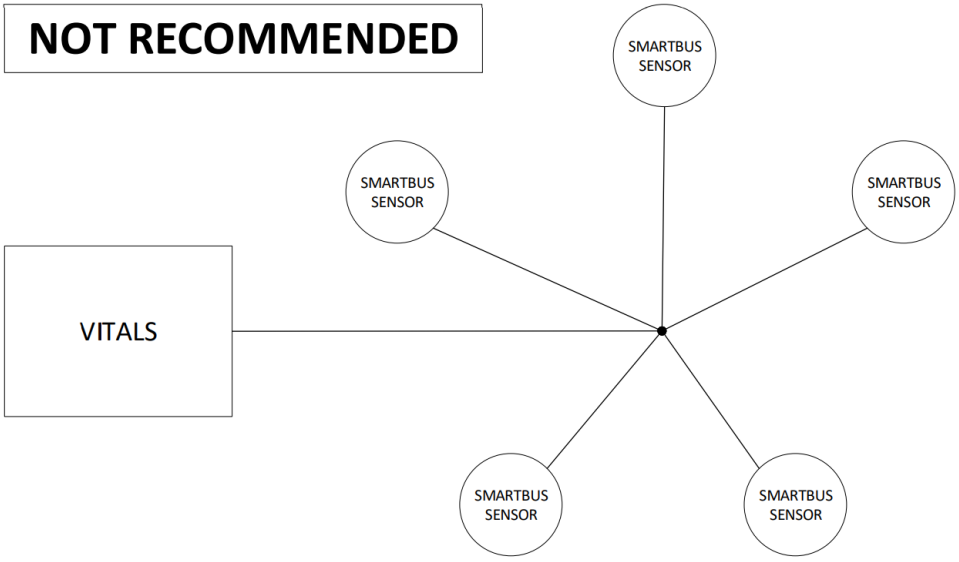

Figure 17: Star topology

4.4.10 Application Example

Vitals can be connected using either hubs or terminal strips. Hubs greatly simplify the wiring and have built-in filtering to reduce noise on the network. Consider using hubs especially if your installation is electrically noisy.

4.4.10.1 With Hubs

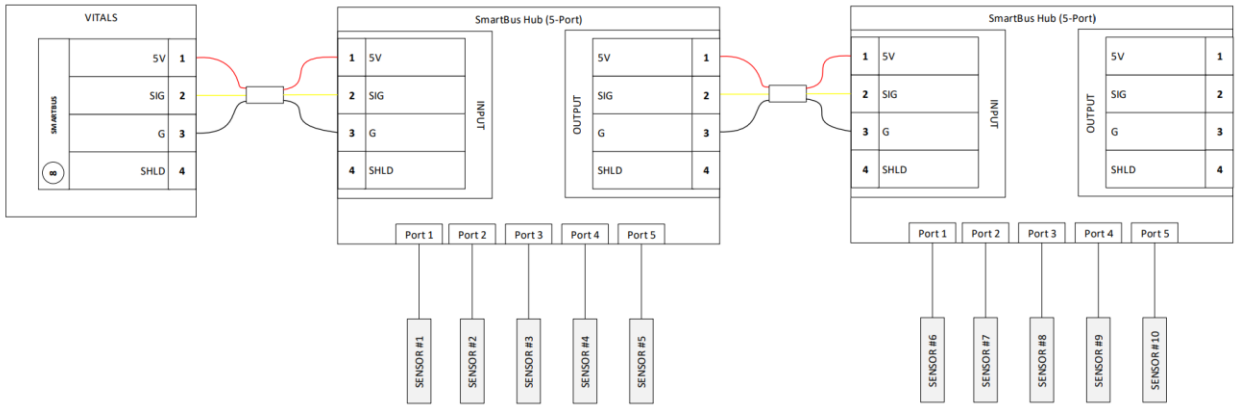

Figure 18: SmartBus sensor connection using hubs

4.4.10.2 No Hubs

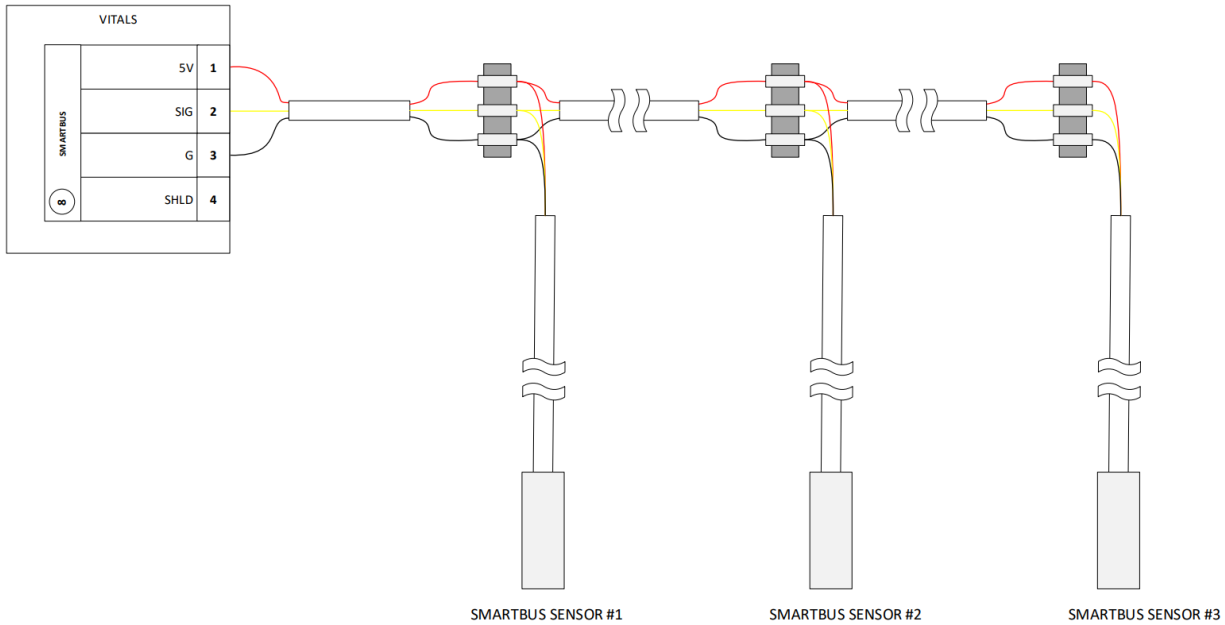

Figure 19: SmartBus sensor connection using terminals (Linear or Stubbed configuration)

4.4.11 Connecting to the Resistive Inputs

Vitals comes with the two resistive inputs configured from the factory to measure directly resistance of resistive sensors. These resistive inputs can also be configured as auxiliary analog inputs with a reduced voltage input range.

The ***RI1*** and ***RI2*** terminals can be used as indicated below on without reconfiguring the unit.

NOTICE	All Vitals units have the jumpers on the printed circuit board installed to “Resistance” measurement as factory configuration.

4.4.11.1 Cabling Recommendations

Follow recommended wiring practices and standards as per relevant local codes.

4.4.11.2 Application Example

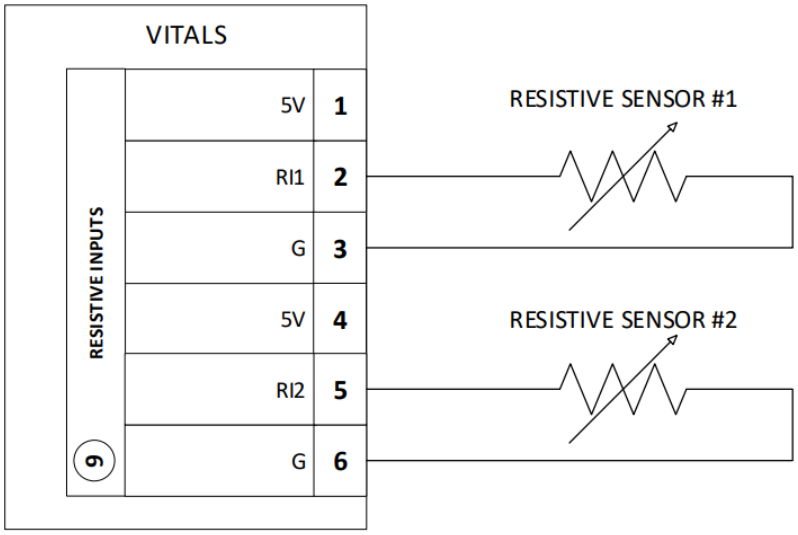

Figure 20: Direct connection to resistive sensors

4.4.12 Connecting to the Engine Speed Inputs (RPM)

Vitals is equipped with two frequency measuring inputs suited to measure engine RPM signals. Vitals accepts AC and pulse sources that have amplitudes between 5V and 30V and frequencies from 5 Hz to 20 kHz.

RPM inputs can be connected to signals from the following sources:

- The engine's existing tachometer Gauge if not cable driven
- An output from alternator's terminal. Vitals can measure RPM from the terminal marked ***W***, ***R*** or ***AC***. Such terminal is found on most marine alternators. These terminals generally output an unrectified AC voltage, the frequency of which is proportional to the engine speed, multiplied of the number of alternator poles and by the belt pulleys ratio
- A pulse generator connected to the old RPM cable drive
- A low voltage magnetic pickup sensor reading off of the flywheel
- Primary engine ignition coil winding
- Dedicated tachometer outputs

NOTICE	Not all of the inputs listed will be available or compatible with Vitals. Check the source of the vessel to ensure that it is in the 5-30V range required and that it is proportional to the engine RPM. This may change depending on if you are using a gasoline or diesel engine.

Section 5.5 of the Owners' Operation Manual explains how to configure and calibrate gauges for RPM inputs.

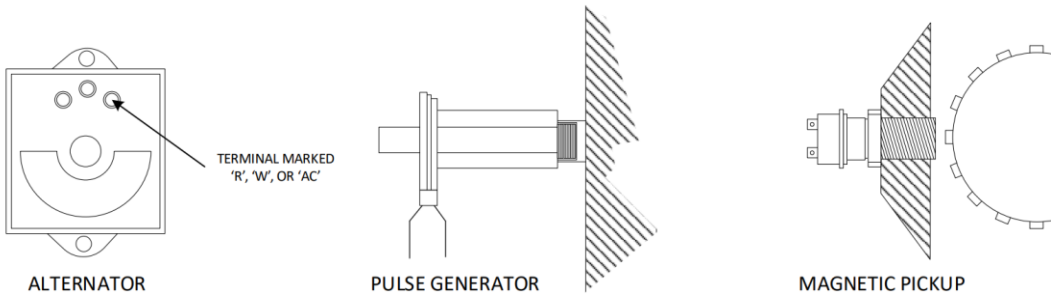

Figure 21: Common RPM sources

4.4.12.1 Cabling Recommendation

Shielded cabling is recommended. Follow recommended wiring practices and standards as per relevant local codes.

4.4.12.2 Application Example

If you have an RPM Gauge on your vessel, you may connect the RPM input of Vitals to the existing gauge as shown on the picture above. Connect the ***RPM1*** terminal on Vitals to the signal connection on the gauge and the ground terminal ***G*** to the ground connection on the Gauge.

NOTICE	The two ground terminals on the RPM Inputs connector are isolated from the common ground of Vitals and must be connected to the ground connector of the Gauge/Sensor in order for the RPM sensing to work.

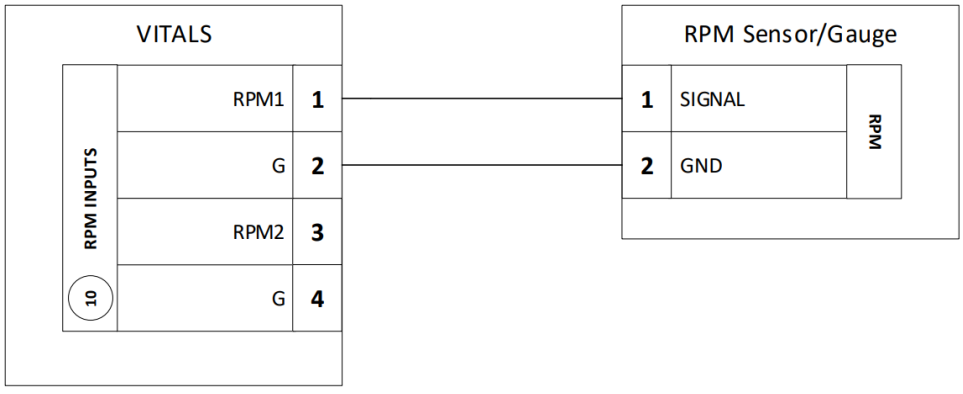

Figure 22: Connect to Existing Electronic RPM Gauge/Sensor

4.4.13 Connecting to Digital Inputs

The digital inputs can be configured to be triggered either by connecting the input to positive voltage, referred to as “Active High”, or by connecting to ground, referred to as “Active Low”. The digital inputs on Vitals are configured from the factory as “Active High” and it will trigger by positive DC voltage between 5 V and 30 V. This is the most common use as majority of the switches on the boat interrupt the battery power to the load.

The reference can be set using terminals ***S1*** and ***S2***. Terminal ***S1*** controls the reference for ***D1***-***D4***, ***S2*** controls the reference for ***D5***-***D8***. If set to VDC (HIGH), digital inputs need to short to GND (LOW). If set to GND (LOW), then switches need to go to VDC (HIGH).

4.4.13.1 Cabling Recommendations

If the ground connection is shared throughout the vessel, including the ground to Vitals, all that is needed to activate a digital input is to connect it on the load side of the switch for the device being monitored. Make sure that the reference terminals, ***S1*** or ***S2***, are connected to the appropriate reference.

Follow recommended wiring practices and standards as per relevant local codes.

4.4.13.2 Application Example

The following diagram shows an example where a bilge pump is monitored by Vitals. In this example, the vessel has a secondary battery for the bilge pump, an automatic float switch, and a manual bilge toggle. In this configuration, the bilge pump is triggered either by the manual switch or, when switched in auto mode, by the float switch. This causes the bilge pump to turn on and activates the digital input on Vitals. When using another power source, the grounds must be connected.

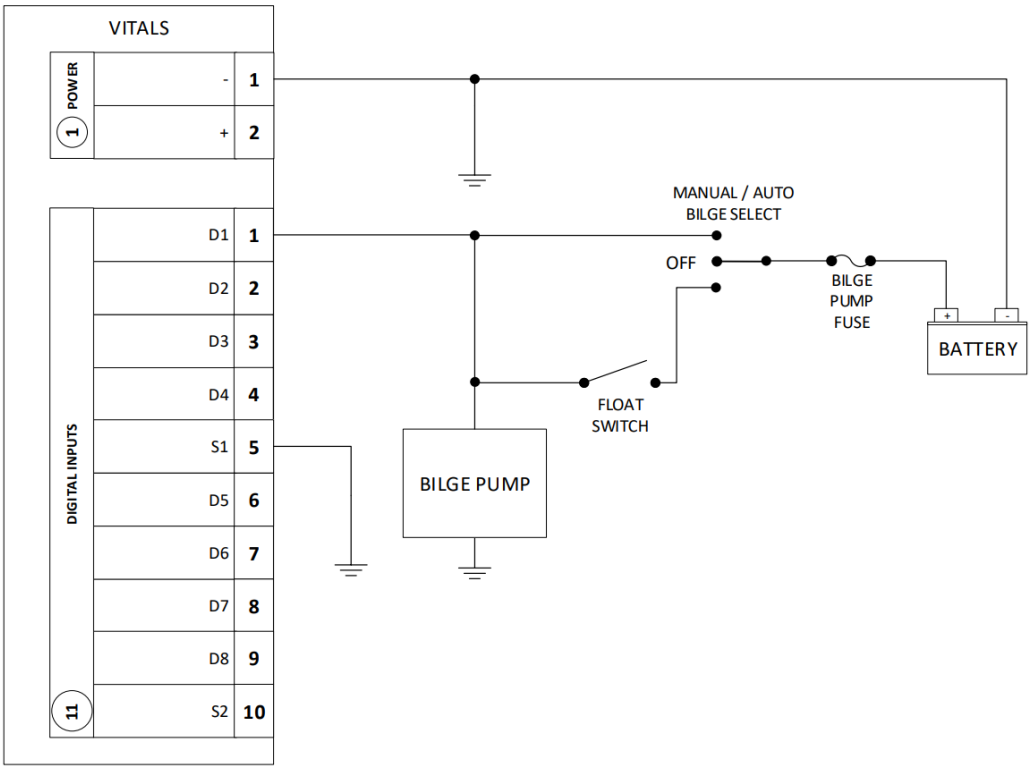

Figure 23: Connecting single wire digital input to bilge pump arrangement

5 APPENDIX A: RECORD OF CONNECTIONS

The following table can be used to plan and record the external sensors connected to Vitals.

Table 15: Record of Connectors table

IO Name	IO Limits	Externally Connected Sensor Notes
Speaker	*4-8 Ohm, <2.8 Watts*	
Relay	*32 V / 0.5 A, NO*	
NMEA 2000 (M12)	*9-32 VDC*	
NMEA 2000	*9-32 VDC*	
NMEA0183	*Version 2.0+*	
Analog Input 1	*0-32 VDC*	
Analog Input 2	*0-32 VDC*	
Analog Input 3	*0-32 VDC*	
Analog Input 4	*0-32 VDC*	
Resistance Input 1	*0-1000 Ohm*	
Resistance Input 2	*0-1000 Ohm*	
RPM Input 1	*1.5-28 V*	
RPM Input 2	*1.5-28 V*	
Digital Input 1	*0-32 VDC*	
Digital Input 2	*0-32 VDC*	
Digital Input 3	*0-32 VDC*	
Digital Input 4	*0-32 VDC*	
Digital Reference 1	*VDC / GND*	
Digital Input 5	*0-32 VDC*	
Digital Input 6	*0-32 VDC*	
Digital Input 7	*0-32 VDC*	
Digital Input 8	*0-32 VDC*	

IO Name	IO Limits	Externally Connected Sensor Notes
Digital Reference 2	*VDC / GND*	
SmartBus – Sensor 1	*Temperature*	
SmartBus – Sensor 2	*Temperature*	
SmartBus – Sensor 3	*Temperature*	
SmartBus – Sensor 4	*Temperature*	
SmartBus – Sensor 5	*Temperature*	
SmartBus – Sensor 6	*Temperature*	
SmartBus – Sensor 7	*Temperature*	
SmartBus – Sensor 8	*Temperature*	
SmartBus – Sensor 9	*Temperature*	
SmartBus – Sensor 10	*Temperature*	
SmartBus – Sensor 11	*Temperature*	
SmartBus – Sensor 12	*Temperature*	

6 APPENDIX B: MARINE WIRING COLOUR CODE

The following AC and DC Marine Wire Code colours are recommended for installations:

Table 16: Standard DC Marine Wiring

Colour		Purpose	Application
	Red	DC Positive	Positive Mains or Batteries
	Black	DC Negative	Negative Mains or Batteries
	Yellow		
	Green	DC Ground	Bonding Wires/System ***(Note: Not for COM or NEG from batteries)***
	Green w/ Yellow Stripe		
	Light Blue	Oil Pressure Sender	Oil Pressure Gauge Sender
	Dark Blue	Gauge Lighting	Fuse or Switch to Lights
	Purple	Ignition	Ignition switch to starter coil
		Instrument Feed	Distribution Panel to Instruments
	Yellow w/ Red Stripe	Neutral Safety	Neutral Safety Connection
		Starting Circuit	Solenoid starting switch
	Tan	Water Temperature Sender	Water Temperature Gauge Sender
	Pink	Fuel Sender	Fuel Gauge Sender
	Gray	Tachometer Sender	Tachometer Gauge Sender
		Navigation Lights	Fuse or Switch to Lights
	Orange	Accessory Feed	Ammeter to Alternator/Generator Output/Accessory Fuses & Switches
		Common Feed	Distribution Panel to Accessory Switch
	Brown	Pumps	Fuse or Switch to Pumps
		Alternator Charge Light	Generator, Alternator, Auxiliary Terminal to Light/Regulator
		Generator Armature	Generator Armature to Regulator
	Brown w/ Yellow Stripe	Bilge Blowers	Fuse or Switch to Bilge Blower
	Green w/ Stripe (other than Yellow)	Tilt Down	Tilt Circuit
		Trim In	Trim Circuit
	Blue w/ Stripe	Tilt Up	Tilt Circuit
		Trim Out	Trim Circuit

Table 17: Standard AC Marine Wiring

Colour		Purpose	Application
	Black	AC Hot	Mains Hot Line
	White	AC Neutral	Mains Neutral
	Green	AC Ground	Ground Bonding Wires/System
	Green w/ Yellow Stripe		