Kobelt 6300-0100-1

Steering Controller

Owner's Operation, Installation & Maintenance Manual

NOTES:

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

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1 INTRODUCTION

1.1 CONTACT

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This document is intended to clearly present comprehensive product data and provide technical information to assist the end user in design applications. 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, without notice, any technical information contained within this document.

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

This device is only intended for use by persons trained in operating marine systems.

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 Kobelt products.

1.3 COPYRIGHTS & TRADEMARKS

2 SAFETY

2.1 SAFETY ALERTS

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

⚠ 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 NOTICE TO INSTALLER

Disregarding the following safety measures can result in an accident, causing severe injury to personnel and damage to material assets.

- Only use the product as directed in this manual.
- Never put the product into service if there is evidence of visible damage.
- Never put the product into service before fully completing installation and commissioning.
- Do not carry out any modifications to the product.
- Only use authentic Kobelt spare parts.
- Observe all local regulations, directives, and laws during the installation of this product.
- All installation, commissioning, and maintenance work must be conducted by qualified personnel. (For the purpose of this manual, qualified personnel are people who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications necessary for their occupation.)
- Observe all specifications in this manual. If these guidelines are not followed and damage occurs, the warranty will be voided.

2.3 PRODUCT HAZARDS

⚠WARNING	**Equipment Starts Automatically:** The Kobelt Steering Controller valve outputs are controlled remotely and/or through a control loop. They may be driven unintentionally through improper closed loop feedback and or unintentional operator commands. Ensure all power sources are disconnected or locked out prior to performing system maintenance or repair.
⚠WARNING	**Disconnect Power:** Turn off power at distribution panel before beginning installation to protect installer from electrical hazards.
⚠WARNING	**Voltage and Power Compatibility:** Confirm that the power and voltage requirements of the system are compatible. Ensure that the voltage drops from cabling is within the specifications of the product. If voltage drops are excessive the system could fail due to low voltage conditions resulting in abnormal behavior and or loss of function.
⚠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.

2.4 SCOPE

This manual covers the installation, configuration, operation, and maintenance of the Kobelt 6300-0100-1 enhanced version steering controller only. Instructions on the 6300-0200-1 steering station or digital helm can be found in their respective manuals (MNL-6300-0200 and MNL-6301-0100). Instructions on the basic version of the Kobelt digital steering system can be found in manual MNL-002. Information on electric and hydraulic systems present on the vessel requires knowledge not covered within this document.

Information of any Autopilot interfacing to the Kobelt Steering System is not covered within this manual.

⚠WARNING	The Kobelt Steering System is designed to connect to a correctly installed and commissioned hydro-mechanical steering gear.

3 TERMINOLOGY AND DEFINITIONS

Before proceeding with the configuration and operation of the Kobelt Steering System, it is important for the user to become familiar with the terminology and basic functions used throughout this manual.

Station	Physical locations around the vessel where steering controls are located. Some common station locations include: • the Main Bridge, • the Fly Bridge, • a bow or aft station, • port or starboard wing stations, • the Engine Room.
FFU	Full follow up. A mode of control where the controller will move the rudder to the **Rudder Order** position from the FFU lever
NFU	Non-follow up. A mode of control which moves the rudder in the **Jog Order** direction for as long as the NFU lever is engaged
RFU	Rudder feedback unit. An angular position measurement device, connected to the rudder to provide a **Rudder Angle** signal to the controller.
RAI	Rudder angle indicator. Receives a signal from an RFU to display to the operator the current **Rudder Angle**
ROI	Rudder order indicator. Receives a signal from an FFU to display to the operator the current **Rudder Order**
SBW	Steer-by-wire. An electronic helm wheel. Also referred to as 'Smart Helm'
PID	Proportional-integral-derivative. A control method employed for rudder positional control.
CAN	Controller Area Network. A digital communication protocol employed by the Kobelt steering controller.

4 PRODUCT DESCRIPTION

4.1 SYSTEM OVERVIEW

The Kobelt Steering System is a configurable, electro-hydraulic steering control system for marine vessels. The system is comprised of a minimum of one steering controller and one to six steering stations. The system is interconnected by the KNet network for communications and power. The Kobelt steering system controls one or two directional solenoid valves for a single rudder, or two independent rudders. The valve outputs may be configured as on-off type, or proportional control. A steering station can interface with any combination of;

a. one or two NFU jog lever inputs,
   - either as twin independent or redundant single speed inputs
   - one two-speed input

b. one or two FFU lever inputs, and/or
   - either as twin independent or redundant inputs

c. one SBW helm Wheel.

Commands are accepted at the steering station that is in control and transmitted digitally to the steering controller to act upon. The steering controller takes the command and moves the steering gear to the desired position or in the desired direction. An RFU is used by the controller to measure the rudder angle so that it can continually position the rudder to the desired rudder order during full follow up operations. Non-follow up commands are acted upon without the benefit of the rudder angle in single rudder applications. Additionally, an integrated autopilot interface can take control signals from an autopilot to control the valves in the commanded direction.

The Kobelt steering system is capable of;

a. Position control of one (1) rudder or mechanically coupled rudders with;
   - Variable-speed control via a proportional valve, with redundancy, or
   - Single-speed control via solenoid valve, with redundancy, or
   - Two-speed control via two solenoid valves, without redundancy.

b. Position control of two (2) independent rudders with;
   - Variable-speed control via two proportional solenoid valves
   - Single-speed control via two on-off solenoid valves
   - Electronic tie bar capability.

c. Up to six (6) Steering Stations, each with a control panel and one or more input devices.
   - Stations and controller communicate over our KNet Network
   - Based on, but not compatible with, the NMEA 2000 standard.

⚠WARNING	The System is not NMEA 2000 compatible and needs to be isolated from any onboard NMEA 2000 network.

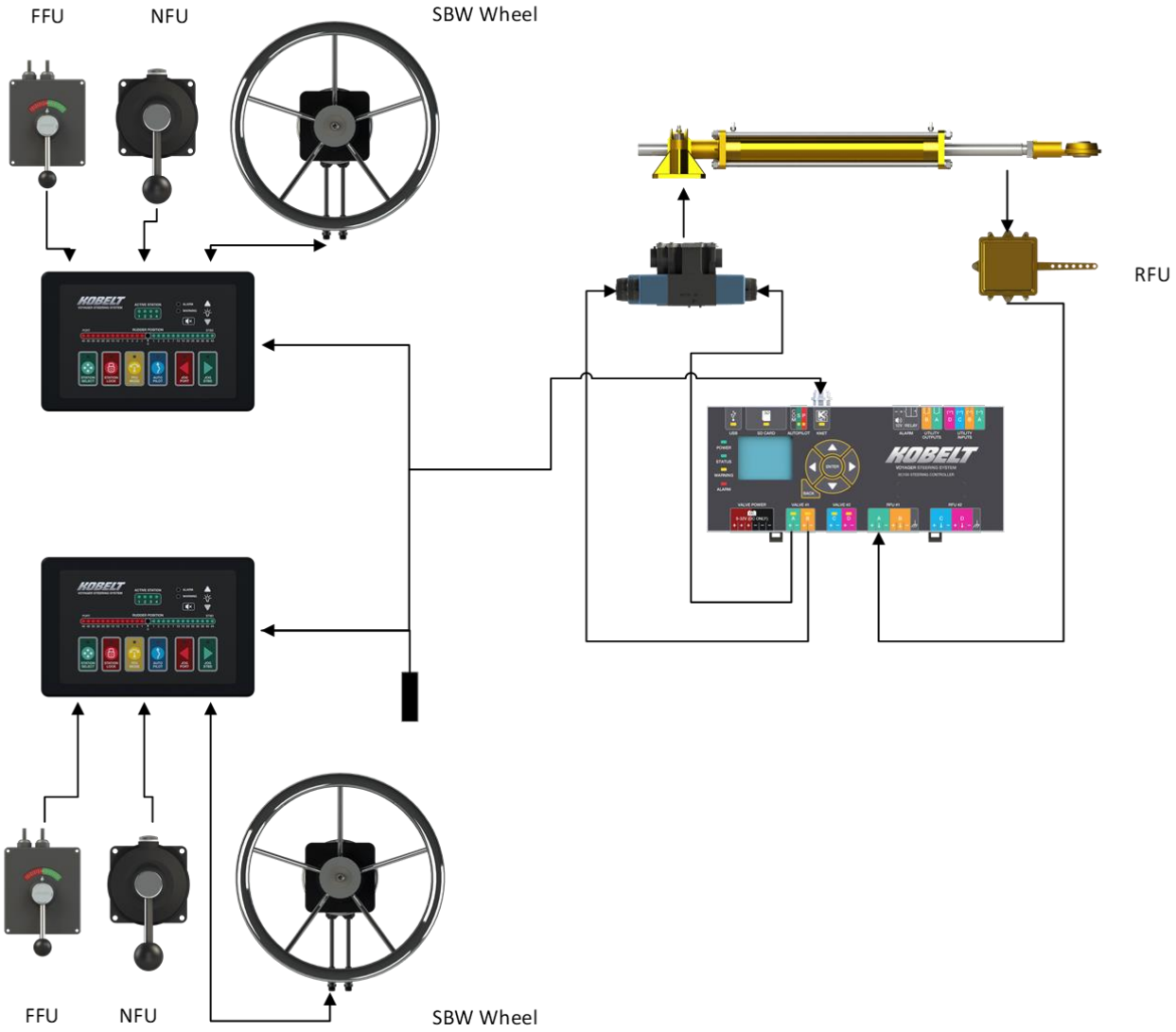


Figure 1: Single Rudder Steering System Block Diagram (Simplified)

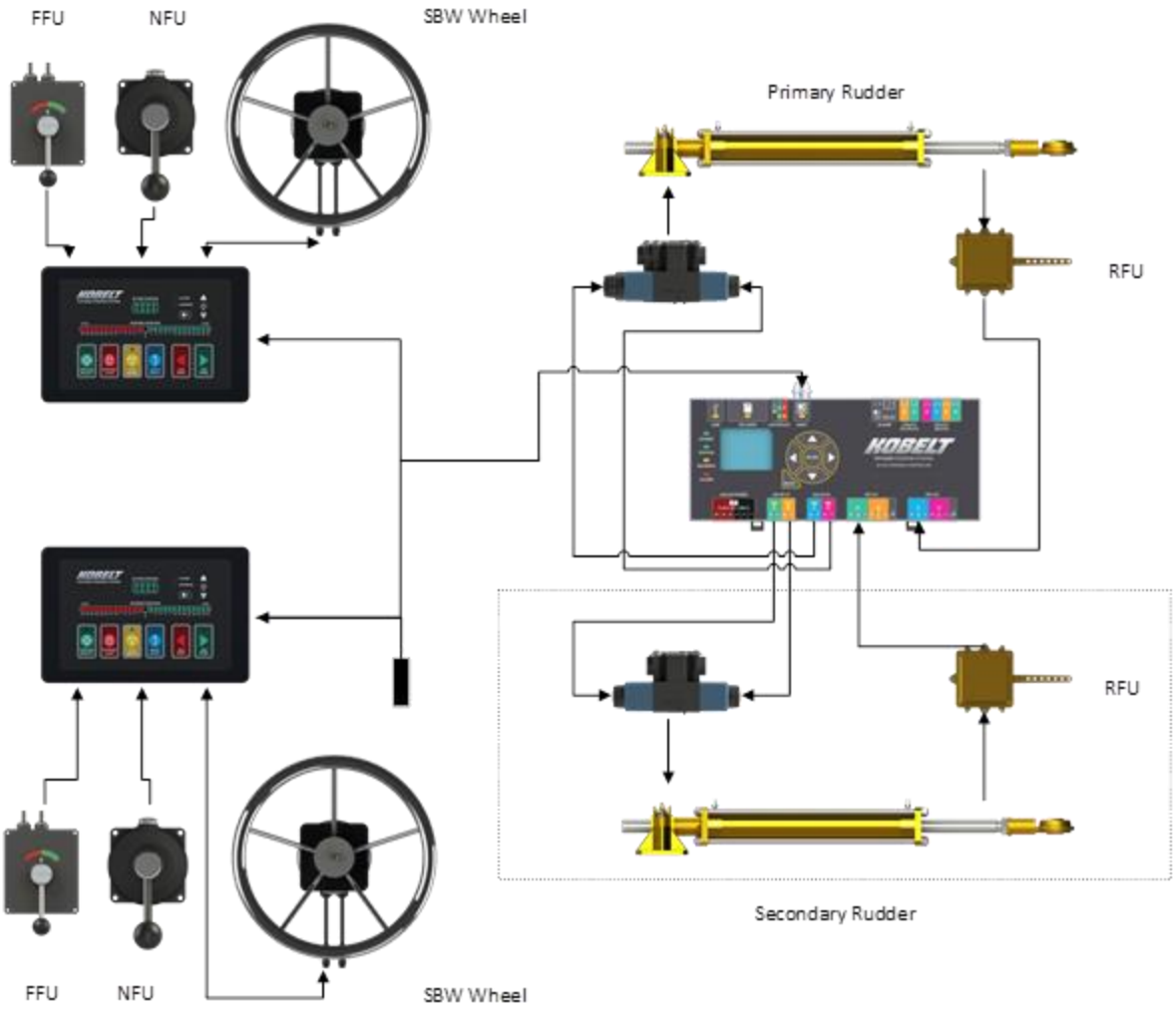


Figure 2:Dual Rudder Steering System Block Diagram (Simplified)

4.2 CONTROLLER OVERVIEW

The figure below identifies the key features of the steering controller referenced in this manual.

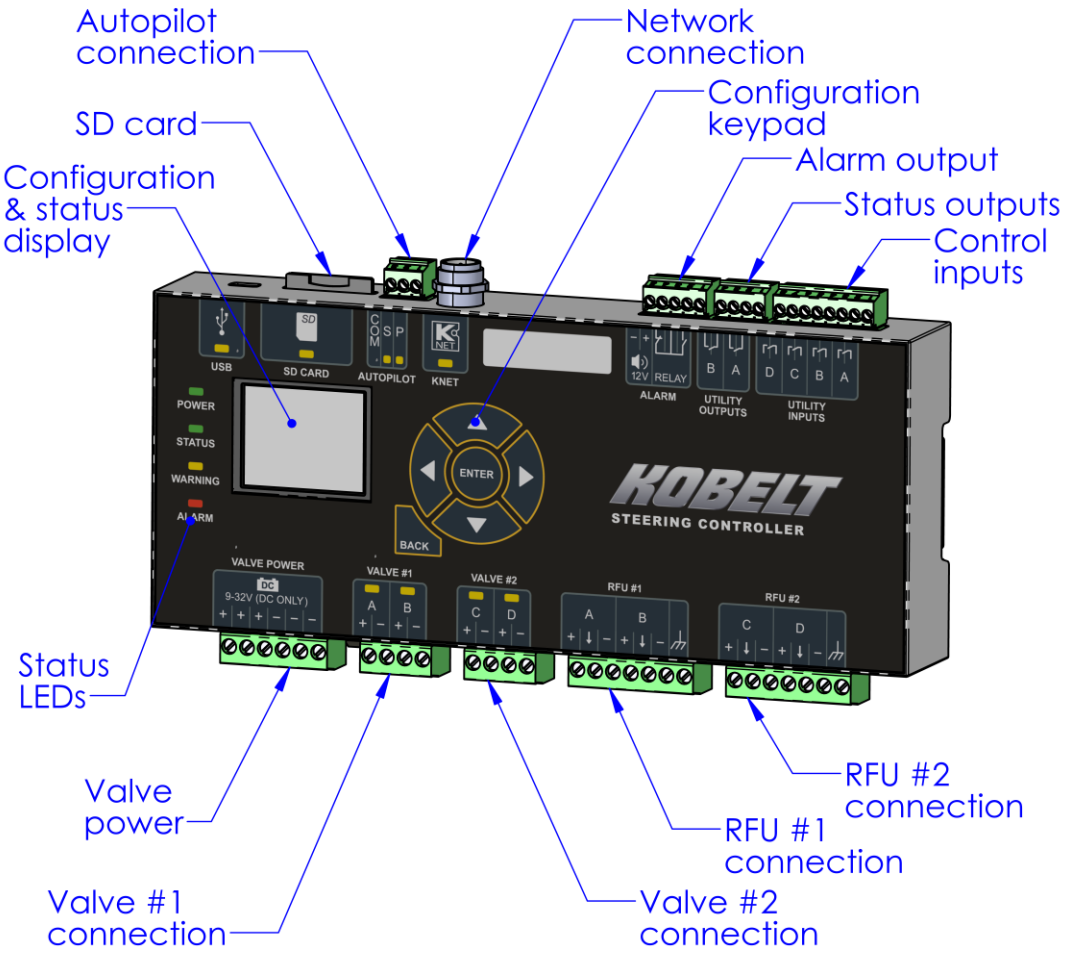


Figure 3: Controller Overview

4.3 TECHNICAL SPECIFICATIONS

Table 1: Technical Specifications Controller and Head

ELECTRICAL	
OPERATING VOLTAGE	10-24Vdc
OPERATING CURRENT	Max 0.2A (at 24VDC)
VALVE OPERATING VOLTAGE	12-32VDC
VALVE OPERATING CURRENT	0-3.0A (Per Terminal)
REVERSE POLARITY PROTECTION	Yes
COMPASS SAFE DISTANCE	N/A
CONNECTORS	1x KNET (NMEA Micro-C) 2x Analog Input Banks, 2 Channels/Bank 1x Digital Input Banks, 4 Channels 1x Digital Output Bank, 2 Channels 1x Autopilot input bank 2x Valve control outputs,
MECHANICAL	
PHYSICAL DIMENSIONS (L x W x H)	212.5 mm x 111.5 mm x 32.2 mm [8.37” x 4.39” x 1.27”]
MOUNTING DIMENSIONS (L x W)	DIN rail mounted (minimum 152 mm [6”] lg)
PRODUCT WEIGHT	0.3 kg [0.68 lbs]
SHIPPING DIMENSIONS (L x W x H)	275 mm x 170 mm x 100 mm [10 7/8” x 7” x 3 7/8”]
ENVIRONMENTAL	
ENVIRONMENTAL CATEGORY	ENV2 / Class A / protected
OPERATING TEMPERATURE	-15°C to 55C [5°F to 131°F]
STORAGE TEMPERATURE	-20°C to 60°C [-4°F to 140°F]
OPERATING HUMIDITY	95 % (Non-Condensing) 95% Max.
STORAGE HUMIDITY	98 % (Non-Condensing) 95% Max.
VIBRATION RESISTANCE	0.7 g
IP RATING	IP20

5 INSTALLATION

5.1 RECEIPT

Upon receipt of the device ensure that the model number and serial number are noted in the table on page 2 of this manual. The serial number can be found in the location noted at right.

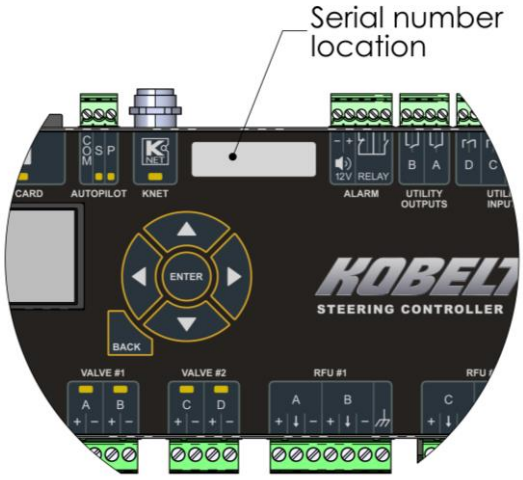


Figure 4: Serial Number

5.2 MECHANICAL

The location of the controller unit must satisfy the following conditions:

- Vibrations not to exceed rated vibration resistance (see table 1)
- Ambient temperatures not to exceed rated temperature (see table 1)
- Do not install in areas exposed to moisture
- Do not install near high-power devices

Distances should be within 10m [32.7 ft] to the solenoid valves to reduce voltage drop. If a voltage RFU is used, the location of the controller should be within 18m [58.87ft] of the RFU to reduce electrical noise induced on the signal wires. 4-20mA RFUs' are less susceptible to noise.

The controller must be installed inside a suitable enclosure to meet the ingress requirements of the area. For reference, the ingress requirements for machinery rooms are IP44 (minimum), and IP56 for exposed locations

The controller is rail mounted on 35mm DIN rail as shown at right.

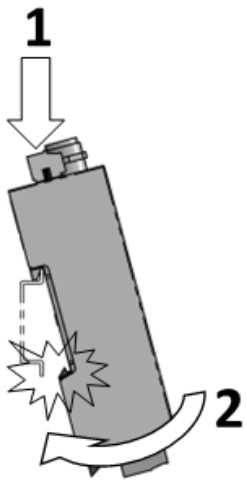


Figure 5: Rail Mounting

5.3 ELECTRICAL

The top and bottom sides of the Controller contain the electrical connections for wiring the steering system and should be allotted extra space for ease of wiring within the enclosure. The graphics on the front of the controller identifies each connector (see diagram below).

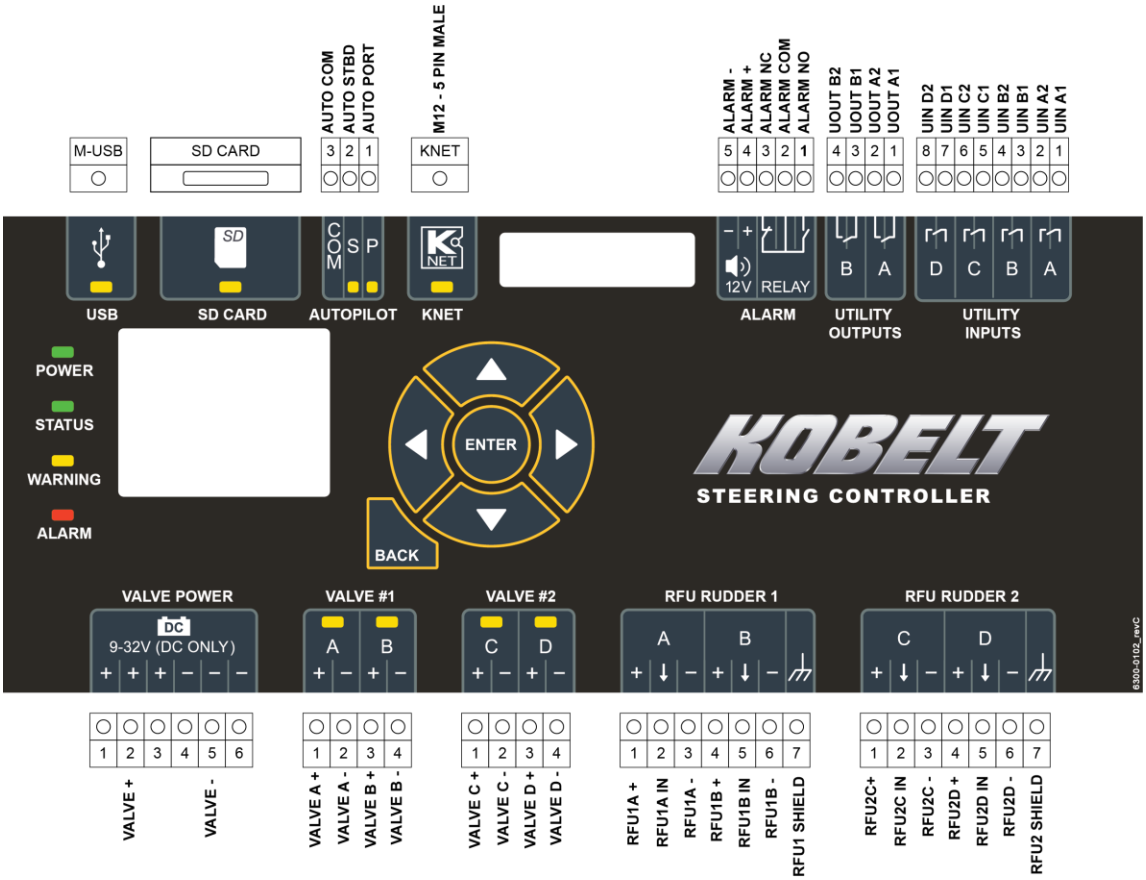


Figure 6: Steering Controller Connectors

⚠WARNING	Each system is required to have the ability to override the control system with a local backup. This can be accomplished by switching control over the steering valves to an NFU jog switch connected directly to the solenoids thereby giving manual control over the valves.

NOTICE	Redundant power for the steering system is recommended.

5.3.1 KNET Connection

5.3.1.1 Cable Selection

The controller is supplied with a standard 5 pin – M12 connector for making the network connection to the stations and other devices. The system cabling must be sized for the current loads and lengths. Inadequate gauge cable may result in excessive voltage drop and unreliable operation. The cable must be 4-conductor twisted-pair wire, individually shielded preferably with an overall shield. Reference the table below for a summary of NMEA cable data.

Table 2: NMEA Cable Properties

	Light Cable (Micro/Drop)	Mid(Backbone)	Heavy Cable (Mini)
Signal Wire Gauge	24 AWG	20 AWG	18 AWG
Power Wire Gauge	22 AWG	16 AWG	15 AWG
Power Wire Resistance	5.7 Ohms/100m (328 ft)	1.7 Ohms/100m (328 ft)	1.6 Ohms/100m (328 ft)

Maximum Current	6 Amps	14 Amps	14-16 Amps

It is possible to use Mini sized wiring with Mini to Micro/Mid reducers at the devices. This will allow a better power distribution.

Standard Micro/Mid connectors are specified for smaller wire gauge than what is specified for the backbone cable. Running larger gauge wire will reduce total impedance. This is an important consideration when running backbone cables.

Contact Kobelt sales for connector components.

NOTICE	Do not use Light Cable (Micro) for back bone connections. The resistance of the wire is too high for all but minimal installations.

5.3.1.2 KNET Pinout

Connector Type: 5-pin M12, A-Keyed, Male

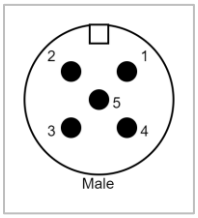


Figure 7: KNet Male Connector Pinout for The Controller

Table 3: KNet Network Connector

Pin #	Pin Designator	Pin Type	Function
1	KNET_SHLD	-	KNet Shield Pin
2	KNET+	Power	KNet Power Supply Positive, 12VDC or 24VDC nominal
3	KNET-	Power	KNet Power Supply Common, COM
4	KNET-H	I/O	KNet CAN High Signal
5	KNET-L	I/O	KNet CAN Low Signal

NOTICE	For resilient systems a redundant KNet cabling is recommended in case of cable damage that may occur.

5.3.1.3 Network Design

Please observe the following network design rules:

- The network backbone needs to be in line type. i.e., No Star Topologies.
- The maximum drop or off-line connection length is 6m(19.8ft)
- Vessels larger than 40m(130ft) should use Mini, instead of micro cabling. Alternatively, use power drops closer to the stations. Doing this reduces the voltage drop on the power lines.
- Terminations need to be at each end of the backbone run.

The network design is dependent upon the voltage supplied at each station. With the voltage drop along the backbone wiring it can take several calculations to design the network properly.

⚠CAUTION	If the main power source is 24Vdc, and with sufficient voltage drop in the network it is possible for the steering station to drop below its operating voltage and experience a station brown out.

- For the best power distribution, over long networks, it is recommended to use isolated power drops at each individual station, this will ensure the correct operating voltage is available at each station and guarantee that any station will not lose power due to voltage drops during periods of large current draw.

NOTICE	For 12Vd.c., any station with a SBW wheel will require an isolated power drop

- Refer to the current requirements of the steering stations with and without an electric steering wheel, and the wiring specifications.

Table 4: KNet Network Properties

Network Characteristic Summary	
Network Architecture	• Bus wiring configuration using 4-conductor twisted-pair wire to carry power to operate the interface and data signals. • Linear Network with end terminations and multiple short length drop cables connecting the backbone cable to individual nodes.
Network Operation	• Network access: Carrier Sense/Multiple Access/Collision Arbitration using CAN (Controller Are Network) • Multi-master network operation (No central control node) • Self-Configuring • Special Network tools, desirable for diagnostic purposes, are not necessary for operation
Network Size	• Physical nodes: Up to 7 devices • Length: Up to 100m(328ft) for mid-cabling, and 250m(820ft) for mini cabling. • Total drop length maximum 14m(46ft) • The network is grounded at a single location and isolated from the hull of the vessel.

5.3.2 Valve Connections

The steering controller is supplied with three sets of terminals dedicated to the steering valves. The first set is the valve power supply, independent from the controller power supply. There are also two sets of terminals for either;

a) Single rudder with two speed on/off solenoid valves, or
b) Twin independent single speed or proportional control rudders, or
c) Primary valve and secondary redundant valve

NOTICE	When using a mechanical tie bar in two rudder application the steering system treats this as a single rudder when configuring the valve outputs.

The system has configurable virtual end-stops that will prevent the rudder from being driven past these end-stop angles when using the smart helm or FFU levers. Jog commands will ignore the virtual end-stops and continue to drive the valve. The system should be installed with hard-wired travel limit switches, usually equipped with the RFU, to shut off the steering valves before the rudder hits the hard stops.

5.3.2.1 Valve Power Connector

Connector Type: 6-pin 5mm Pluggable Terminal Block

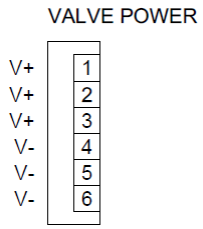


Figure 8: Electrical Connector for Valve Power

- Power supply input for all four coil drivers (Valve #1 and #2)
- Power can come from any supply suitable for driving the solenoid valves. Note that:
  - Valve power is isolated from KNet power supply, and they do not need to share a ground
  - Valve supply voltage may be different than the KNet supply voltage, to a maximum of 24Vd.c.
  - The valve power supply voltage is governed by the steering valve coil voltage.
- Only two of the pins are required for connection to the power source.
  - The remaining four pins provide convenient, redundant, and reliable termination points when wiring 3-wire valves with common return wires.

NOTICE	To meet IEC 60945 EMC regulations, the valve power connector needs to be routed through an EMC filter. Failure to use a filter may result in radio frequencies to be generated by the system.

Table 5: Valve Power Connector

Pin #	Pin Name	Membrane Symbol	Pin Type	Function
1	VALVE+	+	Power	Valve Power Supply Positive, 12VDC or 24VDC nominal
2	VALVE+	+	Power	
3	VALVE+	+	Power	
4	VALVE-	-	Power	Valve Power Supply Negative
5	VALVE-	-	Power	
6	VALVE-	-	Power	

5.3.2.2 Valve #1 Connector

Connector Type: 4-pin 5mm Pluggable Terminal Block

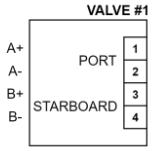


Figure 9: Electrical Connector for Valve #1 (Channels A/B)

Table 6: Valve #1 Connector

Pin #	Pin Designator	Membrane Symbol	Pin Type	Function
1	Coil A+	+	Output	Valve #1, CHA, Positive Output
2	Coil A-	-	Output	Valve #1, CHA, Negative Output
3	Coil B+	+	Output	Valve #1, CHB, Positive Output
4	Coil B-	-	Output	Valve #1, CHB, Negative Output

Ensure that coil A terminals are assigned to the port side steering solenoid.

5.3.2.3 Valve #2 Connector

Connector Type: 4-pin 5mm Pluggable Terminal Block

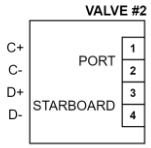


Figure 10: Electrical Connector for Valve #2 (Channels C/D)

Table 7: Valve #2 Connector

Pin #	Pin Designator	Membrane Symbol	Pin Type	Function
1	Coil C+	+	Output	Valve #2, CHC, Positive Output
2	Coil C-	-	Output	Valve #2, CHC, Negative Output
3	Coil +	+	Output	Valve #2, CHD, Positive Output
4	Coil D-	-	Output	Valve #2, CHD, Negative Output

Ensure that coil C terminals are assigned to the port side steering solenoid.

When using the two-solenoid with single rudder configuration, the first set of solenoids are used for low-speed operation, and both sets are used for high-speed operation. 'Low speed' turns on Valve 1, coil A or B, depending on the desired direction. 'High speed' turns on both valves 1 and 2 in the desired direction.

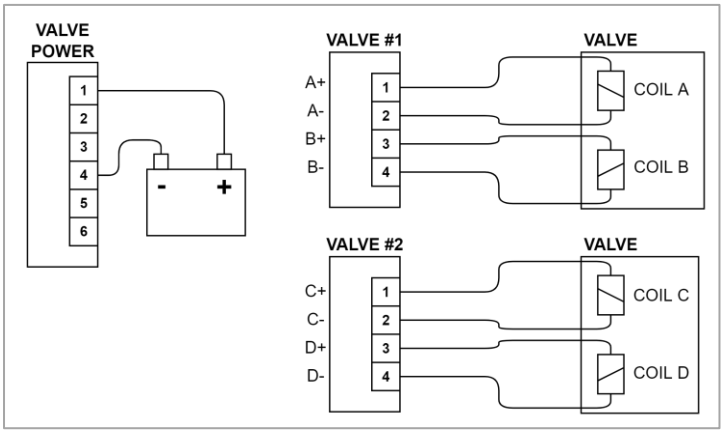


Figure 11: Valve Wiring for Solenoid Valves (4-Wire)

5.3.2.4 Alternate Wiring Schemes

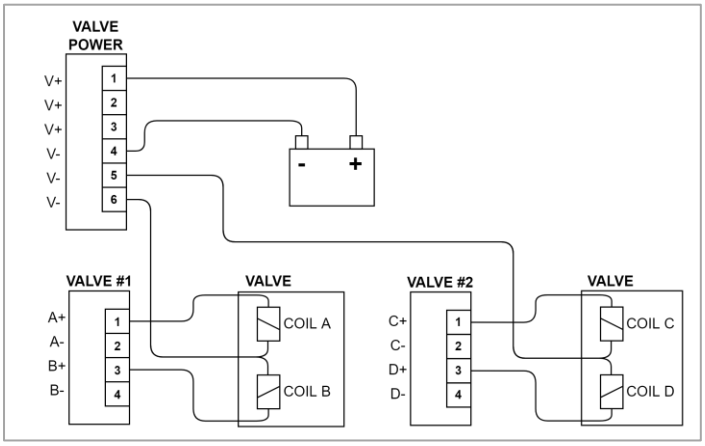


Figure 12: Valve Wiring for Solenoid Valves (Common Negative)

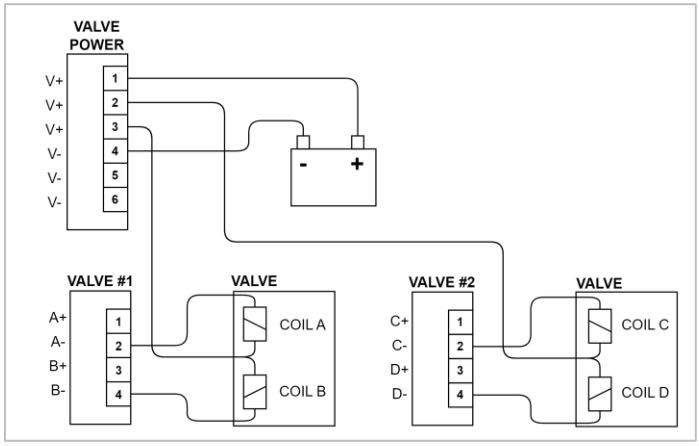


Figure 13: Valve Wiring for Solenoid Valves (Common Positive)

5.3.3 RFU Connections

The steering controller is supplied with two sets of terminals, labelled "**RFU rudder 1**" and "**RFU rudder 2**", along the bottom side dedicated to the rudder feedback units. The controller permits connection of one RFU with redundant potentiometers per rudder.

Wire single potentiometer RFUs to the terminals labeled A & C only.

A single-rudder vessel (or a multiple-rudder vessel with mechanical tie-bars) requires just one Rudder Feedback Unit. A dual rudder vessel requires 2 Rudder Feedback Units.

The steering system can be configured to interface with the following types of RFUs;

a. 1K potentiometer
b. 10K potentiometer
c. 0.5 to 4.5 voltage output
d. 4-20 mA current output

Use of a 4-20 mA RFU requires an external voltage supply greater than 18VDC

5.3.3.1 RFU #1 Connector (Channels A/B)

Connector Type: 7-pin 5mm Pluggable Terminal Block

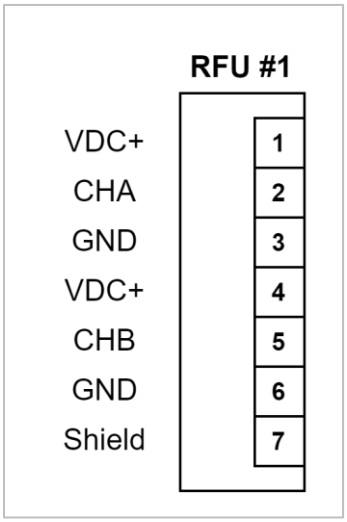


Figure 14: Electrical Connector for RFU #1

Table 8: RFU #1 Connector

Pin #	Pin Designator	Membrane Symbol	Pin Type	Function
1	RFU1A+	+	Power	Voltage power for CH A
2	RFU1A_IN	↓	Input	Voltage/current input for CH A
3	RFU1A-	-	Power	GND for CH A
4	RFU1B+	+	Power	Voltage power for CH B
5	RFU1B_IN	↓	Input	Not used (future support)
6	RFU1B-	-	Power	GND for CH B
7	RFU1_SHLD	⏚	Power	Shield

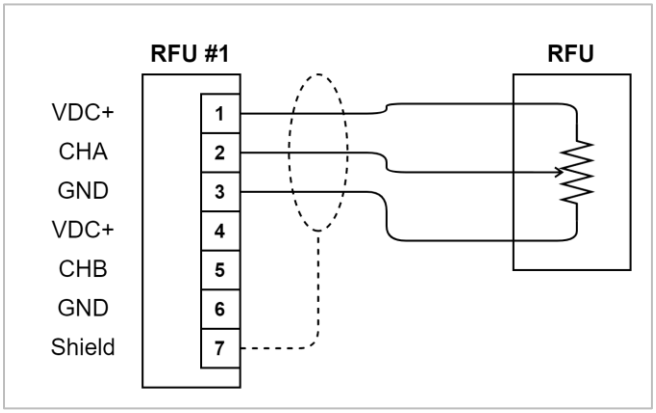


Figure 15: RFU Wiring for 1 Rudder with 1 Potentiometer Sensor

5.3.3.2 RFU #2 Connector (Channels C/D)

Connector Type: 7-pin 5mm Pluggable Terminal Block

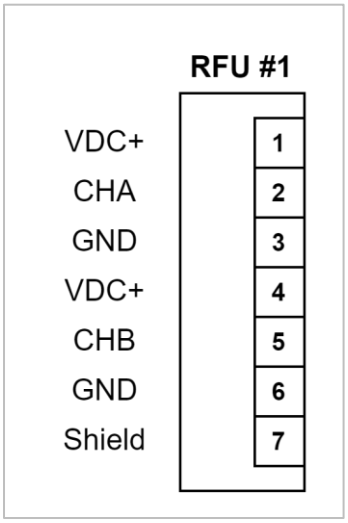


Figure 16: Electrical Connector for RFU #2

Table 9: RFU #2 Connector

Pin #	Pin Designator	Membrane Symbol	Pin Type	Function
1	RFU2C+	+	Power	Voltage power for CH C
2	RFU2C_IN	↓	Input	Voltage/current input for CH C
3	RFU2C-	-	Power	GND for CH C
4	RFU2D+	+	Power	Voltage power for CH D
5	RFU2D_IN	↓	Input	Not used (future support)
6	RFU2D-	-	Power	GND for CH D
7	RFU2_SHLD	⏚	Power	Shield

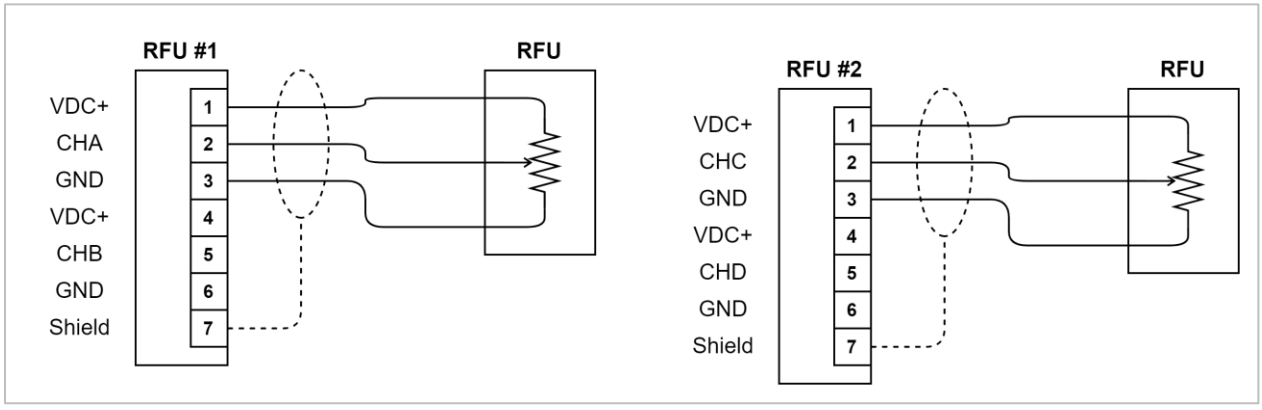


Figure 17: RFU Wiring for 2 Rudders with 2 Potentiometer Sensors

5.3.3.3 Current Output RFUs

Single Rudder with 1 Current Sensor

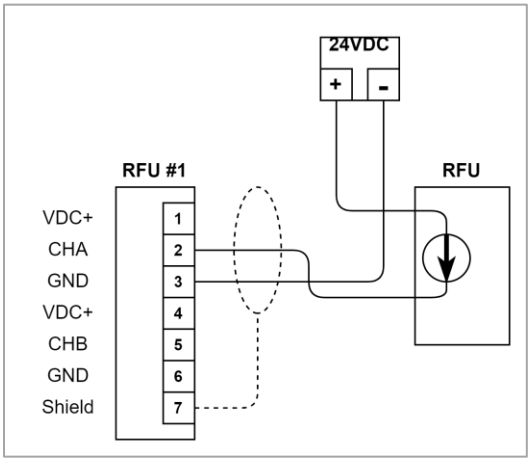


Figure 18: RFU Wiring for 1 Rudder with 1 Current Sensor

RFU 1, ChA	RFU 1, ChB	RFU 2, ChC	RFU 2, ChD
Current Mode	*Not used*	*Not used*	*Not used*

Dual Rudder with 2 Current Sensors

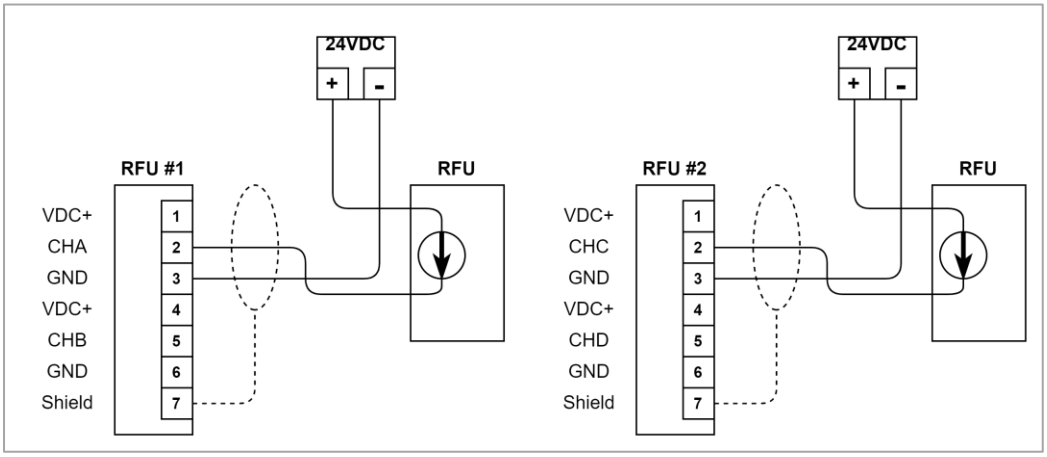


Figure 19: RFU Wiring for 2 Rudders with 2 Current Sensors

RFU 1, ChA	RFU 1, ChB	RFU 2, ChC	RFU 2, ChD
Current Mode	*Not used*	Current Mode	*Not used*

Note: The DEIF RTA 602 unit has built-in calibration, a zeroing feature and polarity switch, using various combinations of additional “Setup” wires. This Calibration should be done before the Controller’s calibration. The DEIF’s default configuration should be acceptable in nearly every case.

5.3.4 Autopilot Connection

The Kobelt steering system routes autopilot signals through the controller to permit an integrated dodge function from a either a jog lever or SBW wheel at the steering stations. Only non-follow up, jog type autopilots are permissible. The controller can accept the following types of autopilot outputs;

a. Sourcing
b. Sinking
c. Reversing pump

5.3.4.1 Autopilot Connector

Connector Type: 3-pin 3.5mm Pluggable Terminal Block (Phoenix Contact)

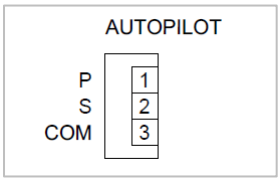


Figure 20: Electrical Connector for Autopilot Interface

Table 10: Autopilot Connector

Pin #	Pin Designator	Membrane Symbol	Pin Type	Function
1	AUTO_P	P	Input	Autopilot port input
2	AUTO_S	S	Input	Autopilot starboard input
3	AUTO_COM	COM	Power	Autopilot input common

5.3.4.2 Sourcing Connections

The COM terminal is connected to V- or 0Vdc, or

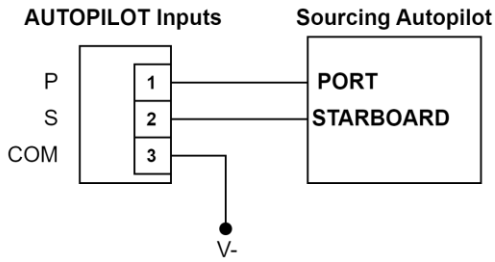


Figure 21: Sourcing Autopilot Wiring

5.3.4.3 Sinking Connections

The COM terminal is connected to V+. i.e. VBAT or 24Vdc

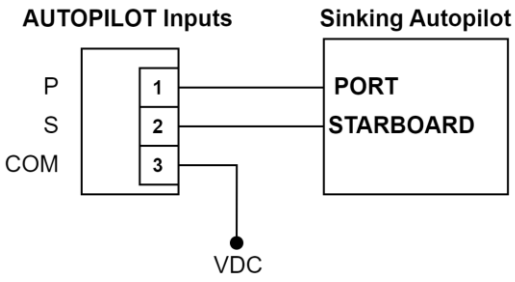


Figure 22: Sinking Autopilot Wiring

5.3.4.4 Reversing Pump Connection

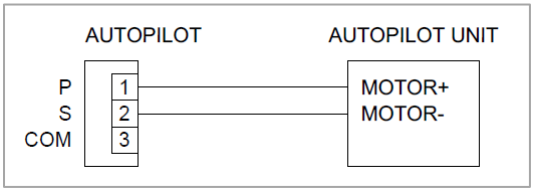


Figure 23: Reversing Pump Autopilot Wiring

5.3.5 Alarm Output Connection

The Kobelt steering controller has a set of alarm outputs along the top side for;

a. Form C alarm relay output
b. Transistor type buzzer output

The alarm relay works on the fail-safe principle: the relay is energized when the controller is healthy (not in an alarmed state). Use the N.O. (normally open) contact for connection to the alarm system.

NOTICE	Connect the relay output to external system through the NO-COM on the alarm connector.

Alarm Buzzer:

- A standard 12VDC External Alarm Buzzer can be connected to the system.
- B+ and B- supply regulated 12 VDC to the external alarm buzzer.
- The current is internally limited to 100mA.

5.3.5.1 Alarm Output Connector

Connector Type: 5-pin 3.5mm Pluggable Terminal Block

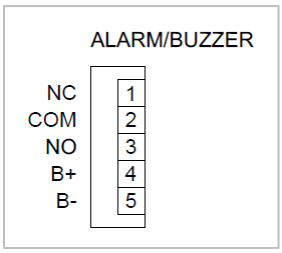


Figure 24: Alarm Buzzer & Relay Connector

Table 11: Alarm Output Connector

Pin #	Pin Name	Pin Type	Function
1	ALRM_NC	Output	Dry contact normally closed (connected to COM in alarmed state)
2	ALRM_COM	--	Dry contact common
3	ALRM_NO	Output	Dry contact normally open (Connected to COM in normal operation)
4	ALRM_B+	Output	Buzzer output positive
5	ALRM_B-	Power	Buzzer output negative

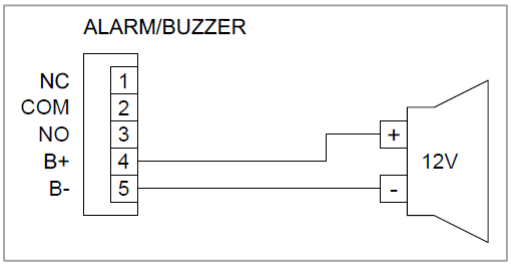


Figure 25: Wiring of External Buzzer

5.3.6 Utility Input Connection

The steering controller has a set of four digital inputs used to signal different conditions. Connect to the inputs in accordance with the table below when required. The inputs are sourcing connections and are activated by shorting each pair of pins. Inputs must be controlled by dry contacts devices.

Table 12: Utility Input Connector

Pin #	Name	Function	Notes
1 & 2	Input A	Backup HPU switchover	Use this input to signal when to switch to a backup set of steering valves.
3 & 4	Input B	Local control indication[1]	Connect to a switch contact on the local control switch.
5 & 6	Input C	Not used	reserved for future use
7 & 8	Input D	Not used	reserved for future use

Note 1: For autopilots not routed through the steering controller, use this input to indicate when the vessel is under autopilot control.

Input Connector Type: 8-pin 3.5mm Pluggable Terminal Block.

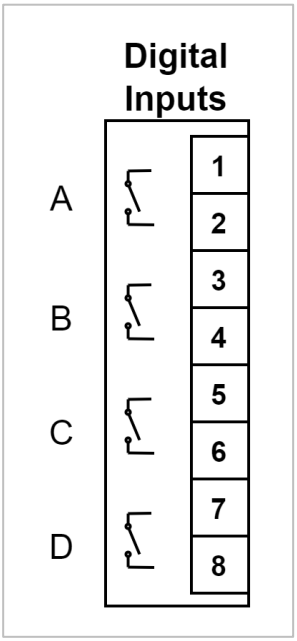


Figure 26: Digital Inputs

5.3.7 Utility Output Connection

The steering controller has two relay outputs used to signal different conditions. Connect to the outputs in accordance with the table below when required.

Table 13: Utility Input Connector

Pin #	Name	Function	Notes
1 & 2	Output A	Controller health	Relay is closed when the controller is not faulted and able to perform
3 & 4	Output B	Autopilot mode	Relay is closed when the autopilot mode has been enabled in the steering controller

Output Connector Type: 4-pin 3.5mm Pluggable Terminal Block. These are general purpose Relay outputs that are reserved for future use.

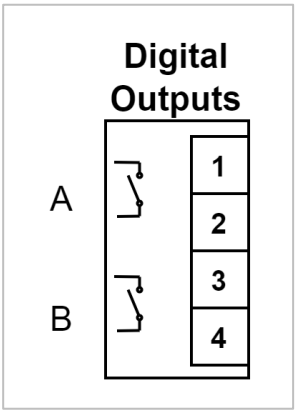


Figure 27: Digital Outputs

5.3.8 EMC installation guidelines

5.3.8.1 Power Line Filter

To conform to EMC Standards in IEC60945, a power Line filter must be installed on to the main power supply line of the system as well as to the main power supply line of the valve. Kobelt recommends Schaffner EMC power line filters. The size of filter must be selected based on the expected maximum current draw of the system. The FN2010 series have rated currents ranging from 1A to 60A. Some recommended part numbers are listed in the table below.

Table 14: Power Line Filters

Schaffner Part Number	Maximum current Draw (A)
FN2010-1-06	1
FN2010-3-06	3
FN2010-6-06	6
FN2010-10-06	10
FN2010-12-06	12
FN2010-16-06	16
FN2010-20-06	20

The installation of the power line filter shall be placed in between the main power supply line and the system load. The “Line” terminals shall be connected to the main power supply line and the “Load” terminals shall be connected to system load, the “PE” terminal shall be connected to the bonding of the ship as indicated in Figure 28 below. The same topology will also be followed for connecting the valve power supply.

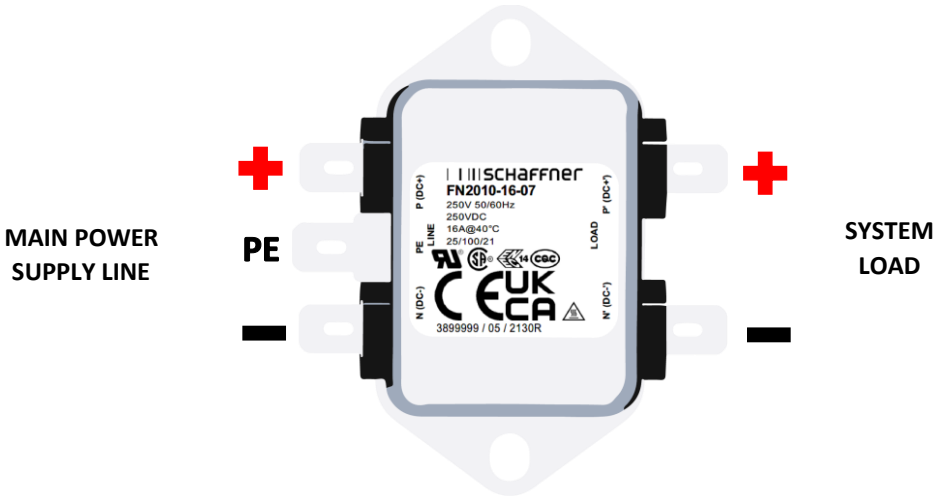


Figure 28: Schaffner Powe Liner Filter

5.3.8.2 Shielding and grounding methods

Shielded cables shall be utilized when connecting to the Kobelt Steering Controller and steering stations. The cable shield shall be grounded at the controller and from there bonded with the vessel to ensure proper EMC compliance.

NOTICE	The user is responsible for implementing the above recommendations. Failure to do so will result in the system not complying with IEC 60945 EMC regulations.

5.3.8.3 Cable Routing

In areas of extreme EMC interference, care should be taken in arranging the cabling of the Kobelt Steering system to maintain proper system performance.

To achieve adequate system performance from the rudder feedback readings, the cable lengths should be kept to a minimum. RFU cable lengths should not exceed 100ft and it is recommended to keep them below 50ft. In areas of high EMC interference care should be taken to ensure the RFU cable is less susceptible to interference. This means routing the cable further away from the potential noise source and making sure the proper shielded cable is used. Please ensure that the rudder feedback readings are stable with a maximum oscillation of +-2 degrees on the Controllers angle readout. If a stationary rudder has an angle oscillating greater than 4 degrees check the cable routing and shielding method. It may be required to switch to 4-20mA feedback unit to ensure proper system performance.

6 COMMISSIONING

6.1 CONFIGURATION

Prior to commissioning and operating the steering system, the controller must be configured for the steering topology of the vessel.

⚠WARNING	System configuration must be completed prior to commissioning the vessel and calibration. If reference menu pictures do not match, please download the latest manual version at www.kobelt.com.

The system should be configured to match the physical hardware attached to the Mighty Helmsman steering system. After completion Kobelt recommends saving the configuration to the SD card.

6.1.1 Navigating the controller screens

Use the Keypad on the controller to navigate through the Controller HMI.

The figure at right displays the controller keypad. Press the ENTER and BACK keys to traverse into and out of the menu structure. The UP and DOWN arrows are used to move up and down through specific MENUS options, the highlighted option is the current selection. When the option has been located press ENTER to either enter that SUBMENU or select the item.

Navigation through the menus is accomplished by pressing the arrow, the BACK and ENTER buttons.

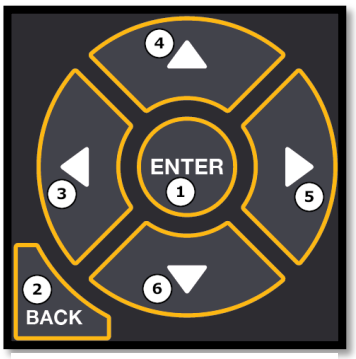


Figure 29: Controller HMI Buttons

NOTICE	The screen will go dark after 5 minutes of non-use. To wake up the screen press the BACK button.

Table 15 HMI Keypad Overview

#	Name	Description
1	ENTER	Used to accept a setting or to enter the password screen
2	BACK	Go to the previous screen
3	LEFT ARROW	Go to the previous status screen
4	UP ARROW	Up one menu item or increase value
5	RIGHT ARROW	Go to the next status screen
6	DOWN ARROW	Down one menu item or decrease value

When editing a numeric parameter, the ARROW keys can be used to adjust the value. UP ARROW will increase the parameter value. DOWN ARROW will reduce the parameter value. LEFT ARROW while editing a parameter will decrease the parameter by a larger step size. RIGHT ARROW will increase the parameter value at a larger step size

There is a series of monitoring screens that provide information on various components in the system and are accessed by pressing the UO and DOWN ARROW keys on the navigating buttons.

The configuration screens that allow configuration and calibration of this system and components are accessed through a password screen. Below is a diagram displaying the layout of the controller menu choices available.

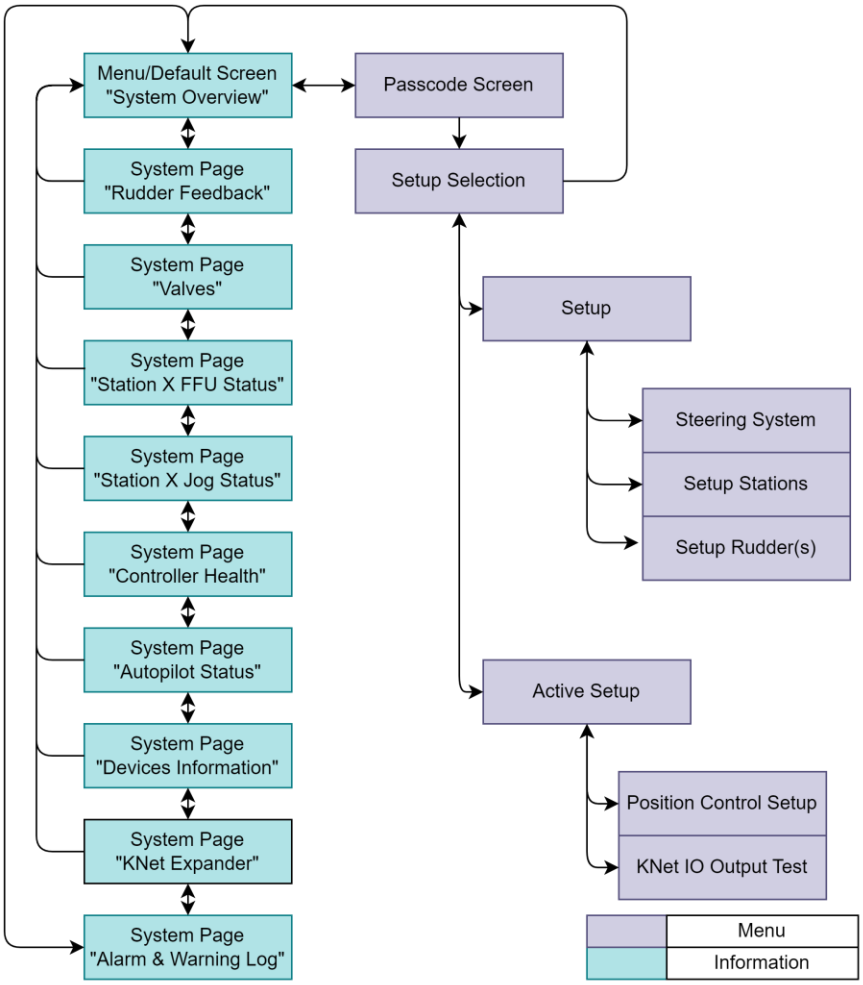


Figure 30: Root Menu Structure

6.1.2 Menu Structure

The 'Home' screen is the first screen in the set of monitoring screens. Pressing enter from the 'Home' screen will call the passcode screen. The menu structure is accessed after successfully entering the passcode.

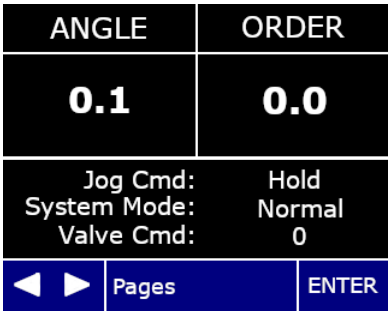


Figure 31: Home Screen

6.1.2.1 Passcode

Use the navigation keys to move the cursor to the correct passcode keys and press ENTER to select. The factory default pass code is 0000. To protect the steering system against unauthorized changes to the configuration table, the pass code must be changed to a secure code. Ensure that this code is recorded and protected.

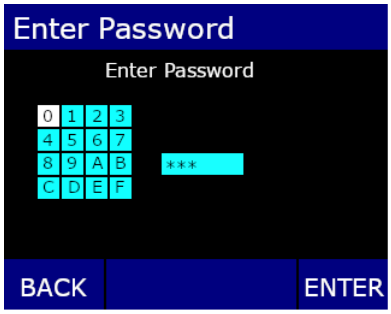


Figure 32: Password Select

6.1.2.2 Landing Screen

Upon successful submission of the system passcode, the user will be given a selection of three options. Start with configuring the system by selecting 'Setup' and pressing ENTER.

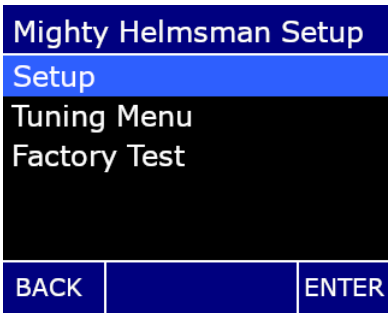


Figure 33: Config Landing Screen

6.1.2.3 Setup Screen

The configuration parameters are grouped into three main sections:

1. Steering system
2. Steering stations
3. Rudders

Start the configuration process by selecting 'Steering System'.

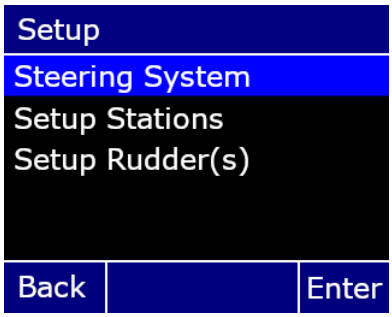


Figure 34: Setup screen

6.1.3 Steering System Setup

The diagram below is an overview of the steering system configuration layout.

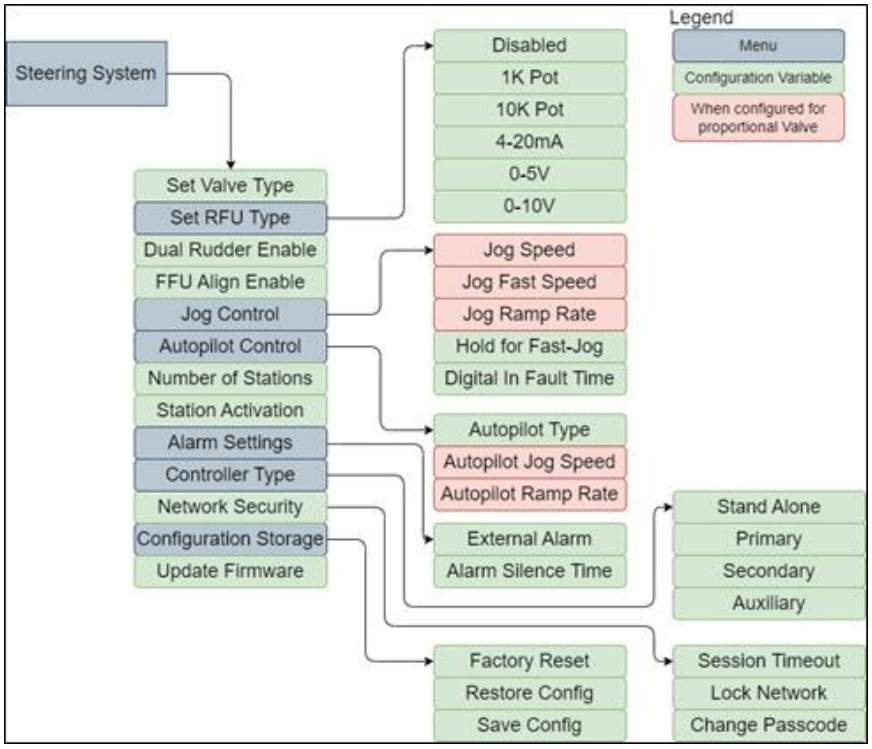


Figure 35: Steering System Configuration Menu Overview

6.1.3.1 Set Valve Type

The first configuration item to set is the valve type. Select between a single speed on/off directional valve, two on/off directional valves for two speed operation or a proportional directional valve.

Scroll to the desired valve type and press enter.

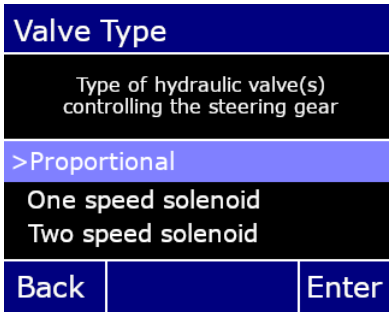


Figure 36: Valve Configuration Screen

6.1.3.2 Set RFU Type

The type of RFU must be set for the system to operate correctly. Scroll between the different options and press enter.

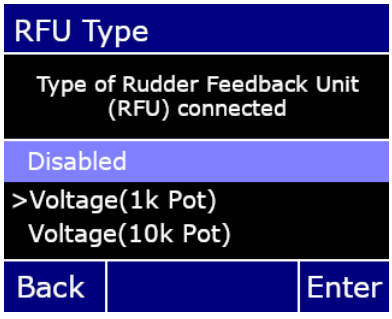


Figure 37: Set RFU Type

6.1.3.3 Dual Rudder Enable

If it is desired to have independent rudder control on two rudder vessels, the Dual Rudder parameter must be set to 'Enable'.

NOTICE	Do not enable dual rudder functionality for twin rudder vessels that will always operate synchronously.

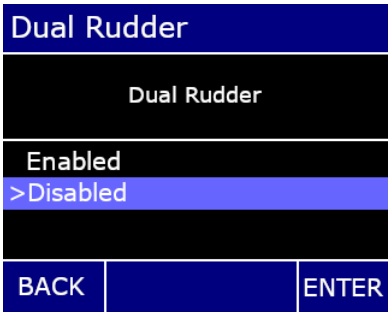


Figure 38: Dual Rudder Enable

6.1.3.4 FFU Align Enable

Setting the Lever Alignment parameter to 'Enabled' will force the operator to align the FFU lever(s) with the current rudder position whenever entering FFU Mode.

6.1.3.5 Jog Control Settings

This set of parameters determines the system's response to the operator's jog commands. The first three parameters are only relevant for proportional valve types. If the valve type has been set to single or two-speed, then these parameters are not available to edit.

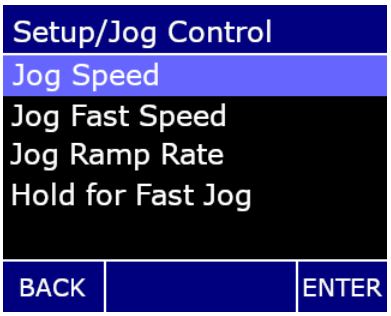


Figure 39: Jog Control Settings

The parameters have the following effect:

a. Jog Speed — sets the percentage of full valve output for the first jog speed
b. Jog Fast Speed — sets the percentage of full valve output for the fast jog speed
c. Jog Ramp rate — Sets the rate at which the valve output increases from the off condition
d. Hold for Fast Jog — Sets how long the jog lever must be engaged before the system transitions to fast speed. This feature can also be disabled.
e. Jog Fault Time — Sets how long the jog lever must be engaged before the system trips a failed jog lever fault.

6.1.3.6 Autopilot Settings

When routing an autopilot through the steering controller the parameters in this group must be set correctly to specify the interaction with the controller.

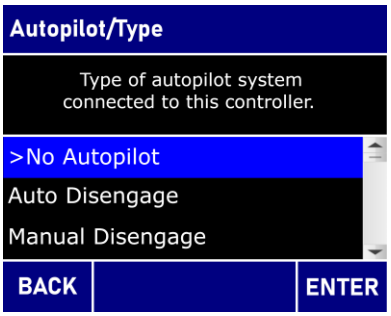


Figure 40: Set Autopilot Type

The parameters have the following effect:

a. Autopilot Type — Set to 'No Autopilot' if there is no autopilot or the autopilot is not routed through the steering controller otherwise chose one of the three other modes. Reference the table below for a summary of the behaviors.
b. Jog Speed — sets the percentage of full valve output for the jog speed
c. Ramp rate — Sets the rate at which the valve output increases from the off condition

The second and third parameters are only relevant for proportional valve types. If the valve type has been set to single or two-speed, then these parameters are not available to edit.

Table 16: Autopilot Disengagement Settings

Autopilot Disengagement	Description of Operation
Auto Disengage	The steering system's Autopilot Mode will be cancelled as soon as a helm wheel, jog lever or FFU lever is operated.
Manual Disengage	The Autopilot Mode button must be pressed to turn off the steering system's Autopilot Mode. All steering commands from the helm wheel, jog lever or FFU lever are ignored until this occurs.
Always Live	The steering system's Autopilot Mode will NOT be cancelled when the helm wheel, jog lever or FFU lever is operated. The steering controller will execute the steering commands from the operator and then resume following autopilot commands after thirty seconds. This setting is to permit fluid dodge capability when under autopilot control.

NOTICE	For cases where the autopilot is not routed through the steering controller, ensure that Digital input B should be closed with a dry contact to eliminate any faults generated on the Kobelt steering system.

6.1.3.7 Number of Stations

The number of steering stations on the vessel must be set in this parameter. Only include the Kobelt digital steering stations: Do not include manual steering stations.

6.1.3.8 Station Activation

There are two ways to transfer control between stations:

a. Single Station selecting a mode of steering at a different station will transfer control
b. Auto Transfer Operating a helm wheel, jog lever or FFU lever will transfer control

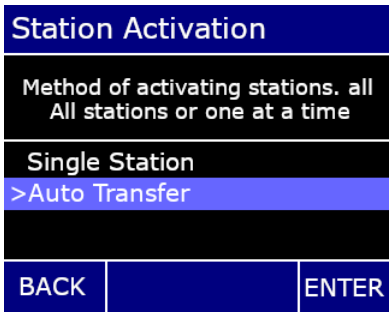


Figure 41: Station Activation

6.1.3.9 Alarm Settings

If the steering system is to interface with an alarm management system set the External Alarm parameter to 'Enabled'. When set to 'Enabled' the steering controller;

a. will not sound alarms
b. the alarm LED and relay will only latch loop alarms
c. the acknowledge button will have no effect

For small, non-commercial vessels, setting the parameter to 'Disabled' will provide the user with some basic alarm management such as;

a. alarm and warning conditions will latch until acknowledged
b. alarms will sound and flash an alarm LED until acknowledged
c. uncleared alarms will rearm after a configurable timeout period

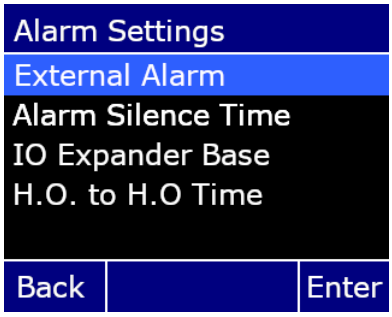


Figure 42: Alert Menu

The H.O.-to-H.O. Time parameter is used to configure the rudder lock alarm. When set to zero, the vessel must have pressure switches plumbed into both ports of one cylinder per rudder. Conversely, entering the time

required to move the rudder from one extreme to the other will arm the Rudder Lock fault. If a solenoid is energized for a length of time greater than this parameter value, the alarm will trip.

NOTICE	The Rudder Lock alarm will require the 6300-0300 I/O expansion module to signal the fault.

6.1.3.10 Controller Purpose

If the steering controller is to be used with a redundant / backup controller, one must be set to 'Primary' and the other to 'Secondary', otherwise leave as 'stand Alone'.

NOTICE	When configuring redundant controllers, all parameters except the Controller Purpose parameter must be identical between the two controllers.

⚠WARNING	Failure to ensure identical configurations will result in unpredictable control behavior.

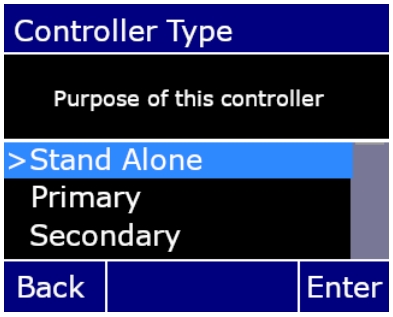


Figure 43: Controller Purpose

6.1.3.11 Network Security

The Kobelt digital steering controller has several security features that allow it to meet ISA 62443-4-2, security level 1. Maintaining this level of security requires setting the time out session, enabling the network lock and periodically changing the passcode. Only enable the Network lock after all the stations have been installed and connected.

NOTICE	Meeting the ISA 62443-4-2 security level 1 requires the steering controller and stations to be connected to 'trusted' networks only.

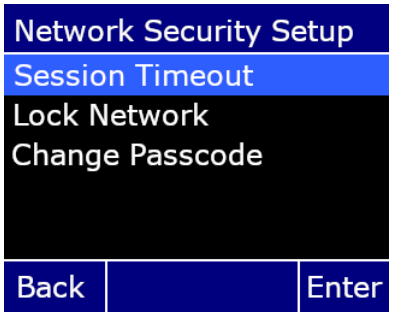


Figure 44: Network Security Setup

6.1.3.12 Configuration Management

Use these commands to save the configuration settings to the SD card, restore the controller from a previously saved set of parameters or reset the steering system to the factory defaults.

⚠WARNING	When making any changes to the configuration through a Factory Reset or Restore Configuration. The system should be validated while at dock to ensure that the loaded parameters function correctly with the installed system.

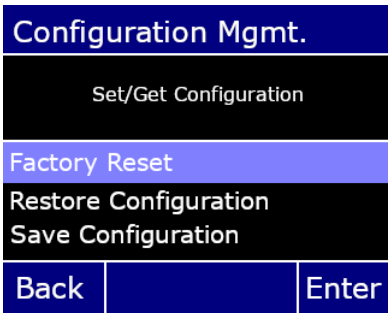


Figure 45: Configuration Management Screen

Factory Reset	Pressing reset will change all the Kobelt Steering System parameters to the factory defaults. After pressing the Enter button, there are two layers of confirmation screens. Press ENTER twice to accept the warnings.

Restore Configuration	Selecting this function allows system parameters to be loaded from a configuration file on the SD card. Before restoring the configuration, please make sure the SD card is inserted properly. After selecting the Restore Configuration and pressing the Enter button, there is one layer of confirmation screen before a saved configuration is restored.
Save Configuration	The Save Configuration allows for the saving of system parameters into a configuration file on a SD card. Before saving the configuration, please make sure the SD card is inserted properly. After selecting the **Save Configuration** option and pressing the **Enter** button, there is one layer of confirmation screen before saving the configuration. See notice below for further details.

NOTICE	The controller automatically names the file as Configuration1.bin. It is up to the user to rename the file to prevent over writing.

After performing a Factory Reset, Restore Configuration, or Save Configuration, a screen will show if the operation succeeded or failed. If failure occurs, make sure that the SD card is fully inserted and that there is a valid configuration file for the firmware version of the system.

⚠WARNING	Ensure that a copy of the configuration parameters is securely saved after the system has been successfully commissioned. These values will be required when installing a new controller.

6.1.4 Station Setup

The diagram at right is an overview of the steering station configuration layout.

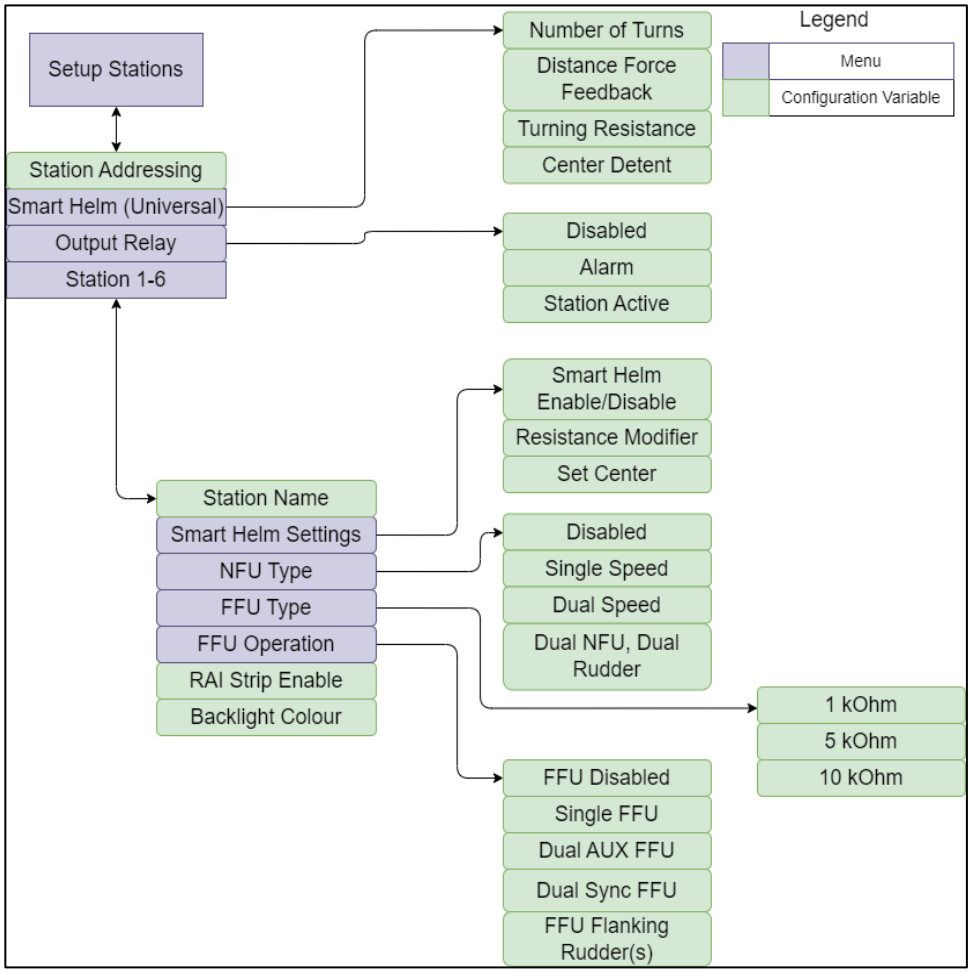


Figure 46: Station Configuration Menu Structure

6.1.4.1 Station Addressing

The first step in configuring the stations is locating and addressing the stations. In this step the station number will be allocated to a physical steering station. Follow the steps below:

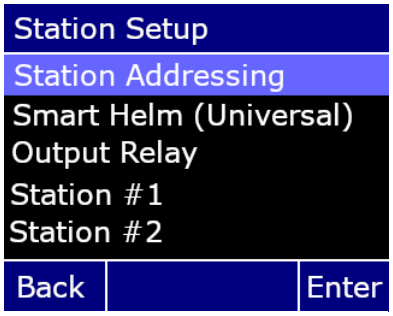


Figure 47: Connected Stations Screen

Step 1: Select 'Station Addressing'

Step 2: Scroll through the list of connected stations. As each station is highlighted the physical station will flash its RAI strip lights, illuminate all the station ID lights and flash the station ID currently allocated.

Step 3: Continue to scroll through the list until the station at the bridge is located. Assign this station 'Station #1'

⚠WARNING	Ensure to assign Station #1 ID to the master station. It is the only station that can override the station locks.

Step 4: Address the other physical stations as desired and make note of their locations.

6.1.4.2 Smart Helm Settings

There is a set of digital helm parameters that are applied to all steering stations. Set these parameters before configuring each station.

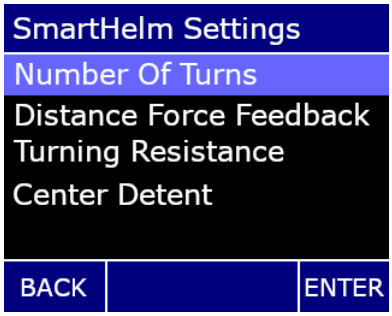


Figure 48: Smart Helm Settings

Number of Turns	Set the number of turns, between 1 and 8, to move the rudder from one extreme to the other.
Distance-Force Feedback	This feature simulates helm pumps by increasing the helm resistance as the Rudder Order gets ahead of the Rudder Angle. A setting of 10 provides the maximum resistance.
Turning Resistance	This parameter sets the base turning resistance. A setting of 30 provides the maximum resistance.
Center Detent	The center detent can be either; a. Disabled b. Soft c. Medium d. Hard

6.1.4.3 Station Relay Setting

The stations have a relay that can be configured to be either

a. Disabled
b. Alarm indicating
c. Station active indicating

6.1.4.4 Station Configuration

Each steering station on the vessel may have different devices connected to it and must be configured separately. Start with the first station and complete each one present.

⚠WARNING	Ensure the station ID as configured matches the physical station. Failure to do so will result in unpredictable or unreliable steering control.

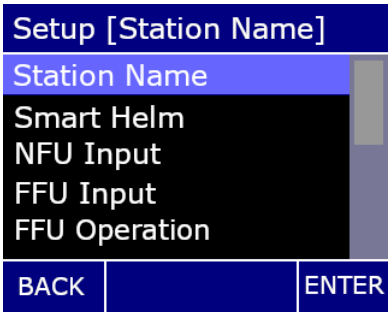


Figure 49: Station Setup Screen

6.1.4.5 Station Name

The user can select a name for each station to indicate its physical location. Select from one of the options below. The default value is "Station".

- Station
- Main Bridge
- Fly Bridge
- Port Wing
- Stbd Wing
- Port Aft
- Stbd Aft

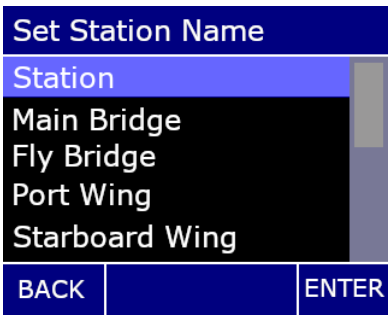


Figure 50: Station Name Setting

6.1.4.6 Smart Helm Settings

Select this menu item to;

a. specify whether the selected station has a smart helm
b. Adjust the turning resistance for the selected station
c. Set the center detent to the current wheel position

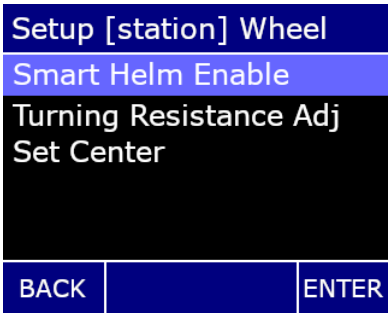


Figure 51: smart Helm Settings

6.1.4.7 NFU Input

The user must specify what type of NFU jog lever the selected station has.

1. Select 'Disabled' if there is no jog lever CONNECTED to the steering station.
2. Select '1 Speed' if using single speed jog levers such as the Kobelt 7170 jog lever

NOTICE	Select '1 speed' if using two single speed jog levers for redundancy.

3. Select '2 Speed' if using two speed jog levers such as the Kobelt 7196 jog lever.
4. Select 'Dual 1 Speed' if using two separate jog levers for twin independent rudder control.

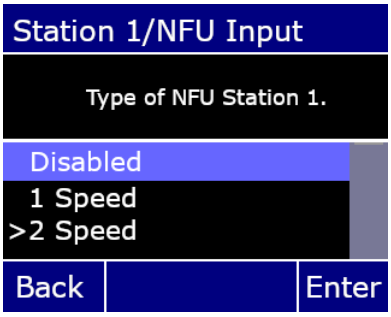


Figure 52: NFU Input Screen

6.1.4.8 FFU Input

The user must specify what type of potentiometer their FFU has.

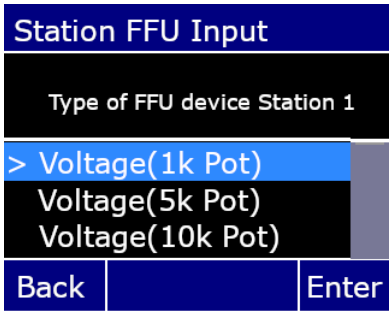


Figure 53: FFU Input Screen

6.1.4.9 FFU Operation

The user must specify what type of FFU jog lever the selected station has.

1. Select 'Disabled' if there is no FFU lever CONNECTED to the steering station.
2. Select 'Single FFU' if the vessel is not using independent rudder control

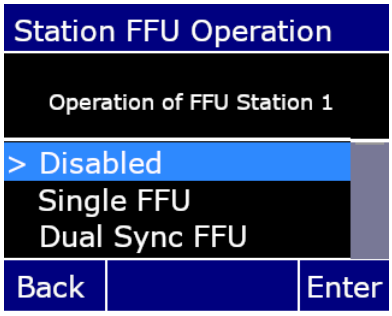


Figure 54: FFU Operation Screen

NOTICE	Select 'Single FFU' if using a two potentiometer FFU lever for redundancy.

3. Select 'Dual Sync FFU' if the vessel is using independent rudder control.
4. Select 'Dual Aux FFU' if using a separate FFU device such as the Kobelt 7176 Walk-about control head.

⚠CAUTION	When selecting 'Dual Aux FFU' ensure that the FFU stations are within sight of the steering panel.

5. Select 'FFU Flanking' for vessels equipped with a set of flanking rudders.

6.1.4.10 LED Strip Style

Use this screen to turn off the LED rudder angle indicator (RAI) strip. Default is on.

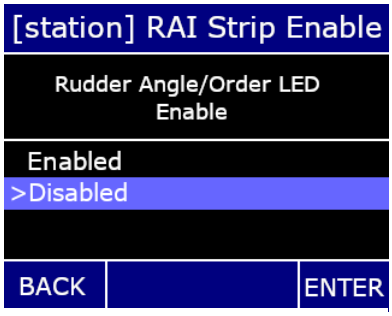


Figure 55: LED Strip Enable Screen

6.1.4.11 Station Backlight Colour

The steering station backlight can be either set to;

- 'Disabled' to turn the LED backlight off
- 'White', or
- 'Red'

The default setting is white.

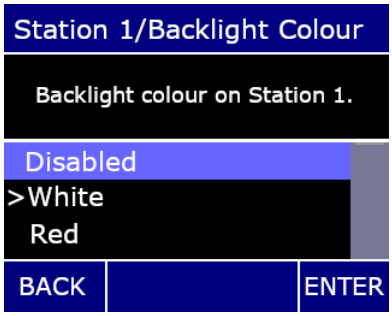


Figure 56: Station Backlight Screen

6.1.5 Rudder Setup

The diagram below is an overview of the rudder configuration menu structure:

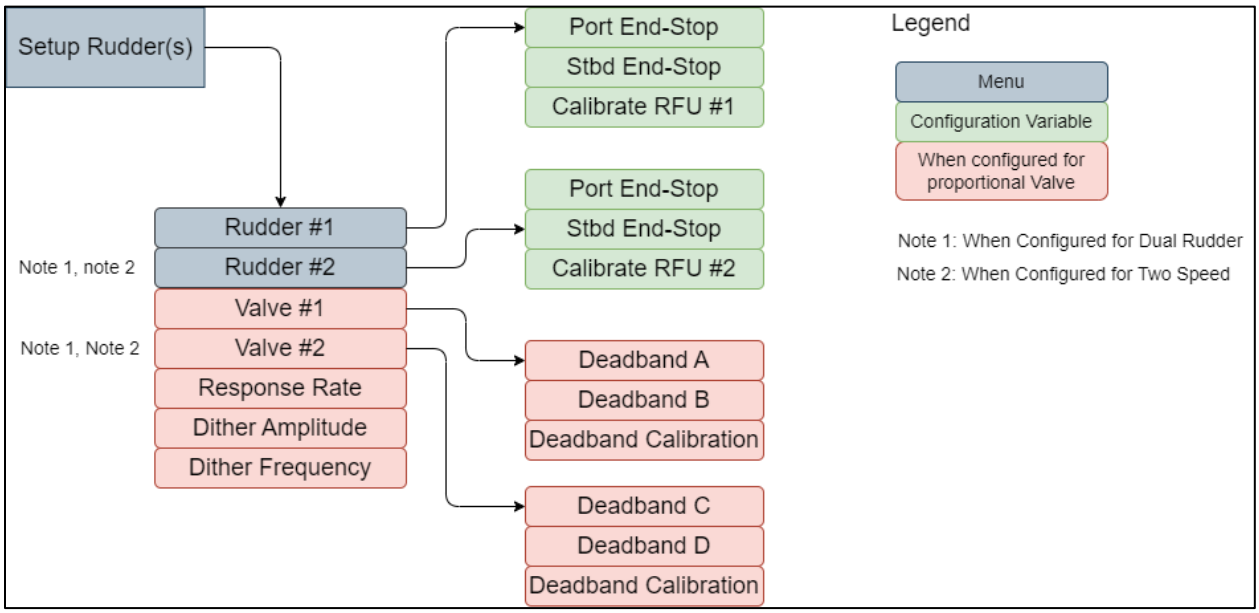


Figure 57: Rudder Setup Menu Structure

6.1.5.1 Rudder #1

Select 'Rudder #1' to configure the virtual end stops. The rudder calibration procedure will be described in the Calibration section.

Set the port and starboard virtual end stops. These must be set at an angle that is less than the hard end stops and the RFU travel limit switches.

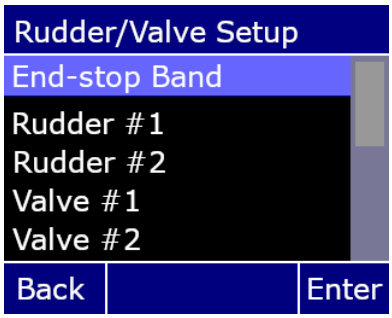


Figure 58: Rudder Setup Screen

NOTICE	The gap between Virtual end-stop and physical end-stop should be as small as practical, and not larger than 5 degrees

NOTICE	Rudder #2, and Valve #2 are only available when Dual Rudder is enabled.

6.1.5.2 Valve #1

If the vessel is using proportional type steering valves, the valve specific settings must be set for the controller to perform optimally. In this menu the following valve parameters can be set:

- Dead band for each side
- Valve slew rate (command response rate)
- Dither amplitude
- Dither frequency

Note that the steering controller can determine the valve deadband automatically. See the Calibration section of this manual.

Selecting the optimal slew rate may be an iterative process. Vessels with fast rudders will work better with low slew rates whereas slow rudders will benefit from having higher valve responsiveness.

Dither amplitude is the magnitude of the superimposed signal. If a dither amplitude of 5% is selected, then the super imposed signal will oscillate around the main valve output signal by a max of 2.5%.

Dither frequency is the frequency at which the imposed dither signal will oscillate. The default value is 0hz, which means no dither is applied to the output signal. Dither should be added to optimize valve responsiveness. For example, the dither frequency to 10hz and dither amplitude is 5% and the valve driver is at 50% duty cycle, then valve will oscillate between 45% and 55% at 10 times a second. The average signal will be 50% but the dither will keep the valve in constant motion reducing the chance of sticking.

NOTICE	Dither is a superimposed frequency on the valve output signal. This can help smooth out valve motion by reducing the valve sticking. If the rudder appears to get stuck or have jittery motion, try implementing dither.

Determining the optimum dither amplitude and frequency may require an iterative process.

NOTICE	Valve #1 and #2 settings are only required when the Valve Type is set to Proportional

6.2 CALIBRATION

Once the steering system has been properly configured for the vessel, the system must be calibrated.

⚠WARNING	Calibration of the system should be performed while dockside. Upon completion of calibration all systems should be tested to ensure proper function. Calibration at sea should only be performed in the event of an emergency or by trained personnel.
⚠CAUTION	Calibration and Adjustment should only be performed once wiring of the system has been validated.

After wiring has been checked and validated, power on the system, including the steering HPU and run through all the applicable calibration items. In this step the installer will;

a. Allow the controller to measure the valve deadband for each coil
b. Allow the controller to map the RFU hard-over port, midship and hard-over starboard outputs
c. Allow the controller to map the FFU lever hard-over port, midship and hard-over starboard outputs

6.2.1 Valve Calibration

Prior to calibrating the valve, ensure that the vessel has a proportional valve and that the appropriate parameter has been set (see section 6.1.3.1).

NOTICE	Only proportional valves require a deadband setting. Ensure that the 'Valve Type' system parameter has been set to 'Proportional'

6.2.1.1.1 Automatic Valve Dead-band Calibration

Navigate to the valve dead-band calibration menu in the rudder group of menus and select automatic calibration. The automatic calibration takes 30-60 seconds, and the valve LED indicates which valve is being driven to find the dead-band. The system will adjust the output to each of the coils gradually until it detects a movement in the rudder from the RFU reading.

NOTICE	The valve dither amplitude and frequency must be set prior to deadband calibration for accurate results.

It is recommended after automatic calibration to confirm the valve dead-band values.

6.2.1.1.2 Manual Dead-band Entry

This setting allows applying a specific dead-band to each valve output denoted by the letters A-B-C-D. This setting adjusts the minimum valve output required to start moving the.

To determine this setting manually;

- Set the deadband for all coils to 0
- Set the jog parameter (Jog Settings Screen) to 10 percent in the Jog Settings menu
- Move the rudder with the Jog buttons on the station port and starboard
- If the rudder does not move, then the value is higher.
- If it moves, then decrease it until operating the jog buttons does not move the rudder.
- This can be done coarsely at starting at 10% and adding 10 percent until movement of the rudder us detected
- When rudder movement is detected, decrease it by 5%.
- If the rudder still moves, decrease it by 2%, or if the rudder does not move, increase it by 3%.
- The value for port or starboard movement can be different.
- Record these numbers for input into the Deadband settings

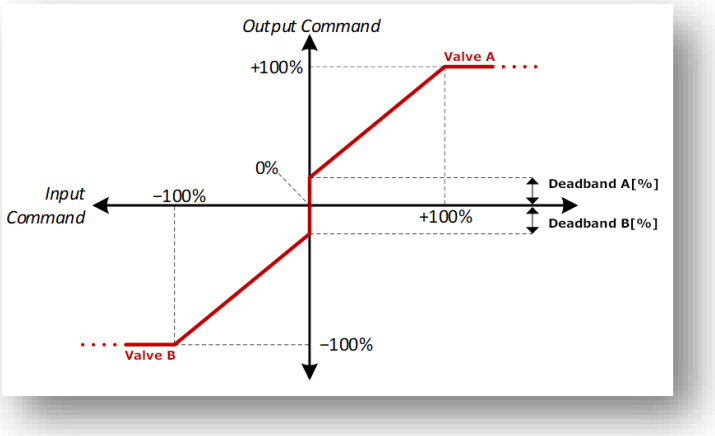


Figure 59:Valve Dead-band Graph

NOTICE	Poor dead-band calibration can result in poor system performance.

6.2.2 RFU Calibration

After the valves have been calibrated move on to calibrating the RFUs.

⚠WARNING	The Port and Starboard end stops should be in place and the RFU travel limit switches wired and tested before RFU calibration is performed.

The RFU (rudder feedback unit) must be calibrated before operation of the vessel. The RFU requires a three-point calibration: one at the port end-stop, another at dead center and the last at the starboard end-stop. Navigate to the "Calibrate RFU" by following the menu sequence below:

- Main Monitoring Screen -> Passcode -> Setup Selection Screen -> Setup -> Setup Rudder (s) -> Rudder #1

Following the instructions given from the top of the Calibrate RFU screen. Pressing the LEFT or RIGHT arrow key on the Controller will move the rudder to the required angle. Pressing the UP or DOWN arrow key changes the rudder speed, and the ENTER button confirms the angle. Press the BACK button to go back to the previous screen. The calibration task is performed as follows:

Step 1: Move the rudder to the center position. Monitor the rudder actual position on a properly calibrated RAI. Press ENTER to accept the reading.

Step 2: Move the rudder to the port side virtual end stop. Press ENTER to accept the reading.

Step 3: Move the rudder to the starboard side virtual end stop. Press ENTER to accept the reading.

If no calibration errors are detected, then the RFU calibration is complete.

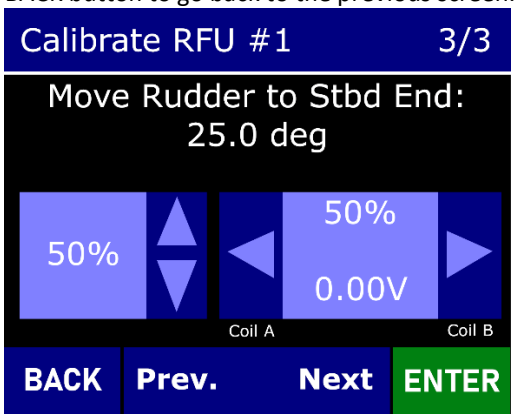


Figure 60: RFU Calibration Wizard

- Pressing the BACK button for 5 seconds any time during calibration takes you out of the RFU calibration entirely.
- The RFU can be re-calibrated by repeating the above steps. If the BACK key is pressed while calibrating a new position will be stored on pressing ENTER again.

NOTICE	The RFU Calibration is from configured Port End-stop to configured Starboard end-stop. Any error in configuring the end-stops, or in this calibration will cause an error in the steering system controls.

6.2.3 FFU Calibration

See manual MNL-6300-0200 for instructions on calibrating the FFU lever(s).

6.3 TUNING

The third step in the commission process is to tune the position control of the rudder. The 'Active Setup' menu gives the user access to a set of parameters necessary for fine tuning the behaviour of the control system while the controls are live. To perform this process, enter configuration mode in the controller by following the menu sequence below:

- Main Monitoring Screen -> Passcode -> Setup Selection Screen -> Tuning Menu

Before allowing access to this menu, a caution message is displayed, acknowledge the inherent risk when modifying Parameters:

⚠WARNING	System tuning should only be performed by qualified personnel. Contact an installation representative to assist as required.

Once in the Active Setup Menu, the operator can edit the parameters needed to tune the control of the vessel such as Position Control Setup.

6.3.1 Active Menu Overview

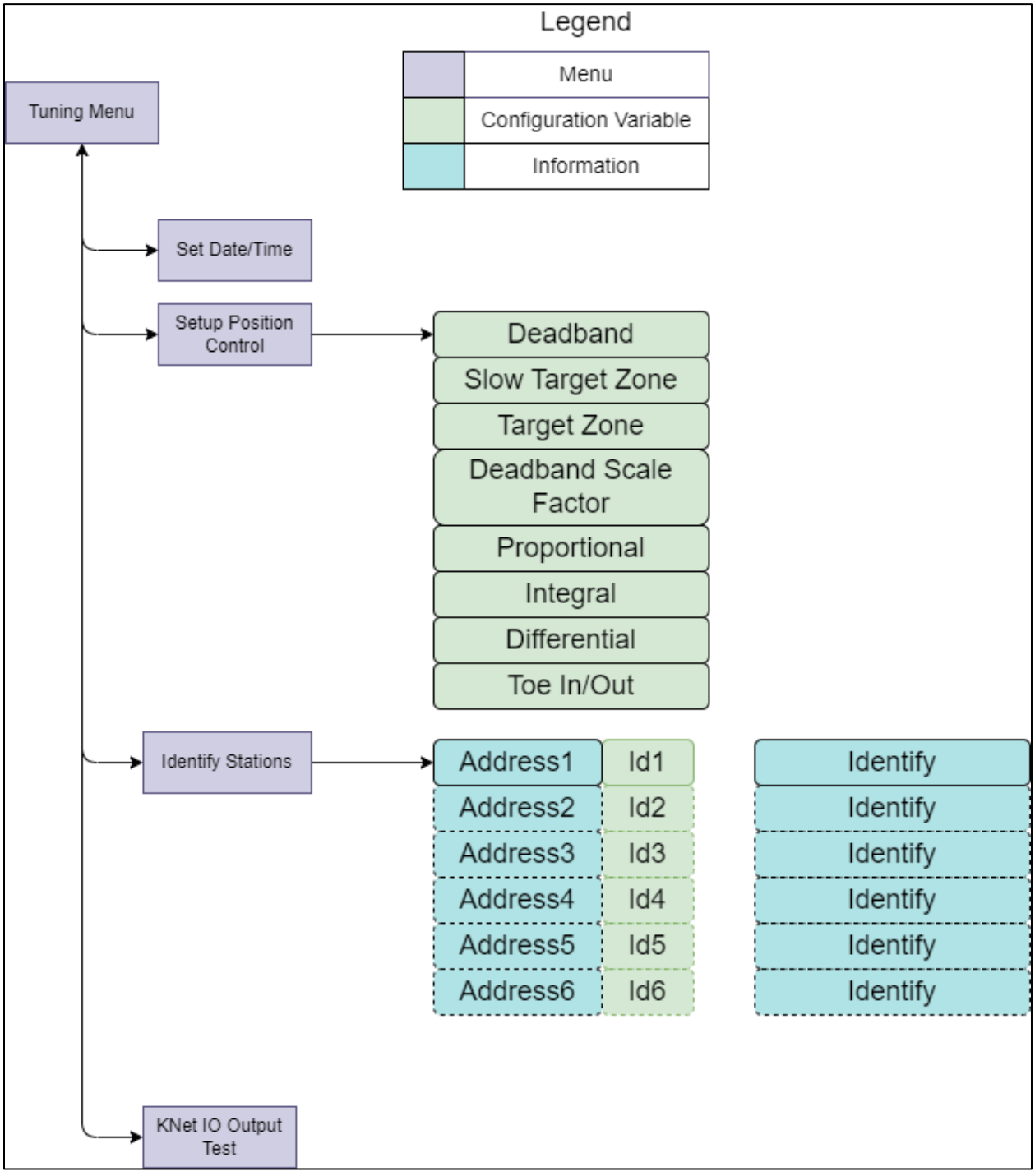


Figure 61: Active Menu Overview

6.3.2 Set Date and Time

The controller uses the internal clock to properly log alarms and events. The time and date will initially need to be set for the desired time zone. Use the UP and DOWN arrow keys to change the numbers and press the ENTER

button to confirm the change for each digit and go to the next digit, or the BACK button to go back to the previous digit.

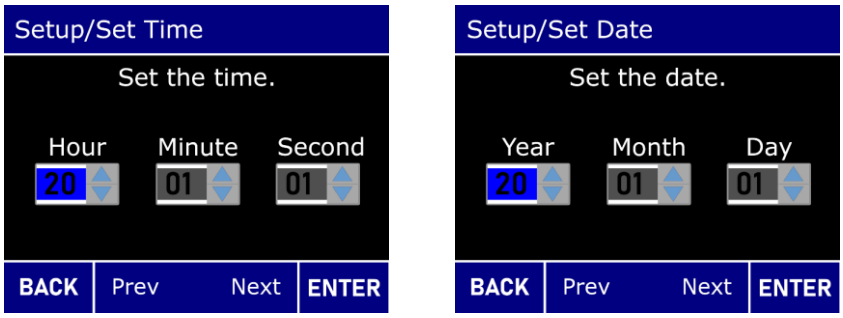


Figure 62: Set Date/Time Screen

6.3.3 Position Control Parameters

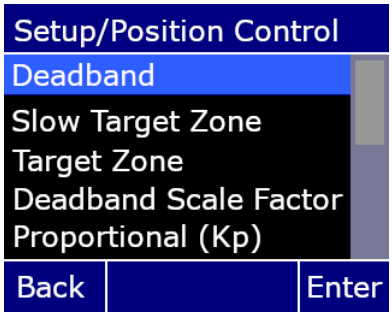


Figure 63: Position Control Menu

This set of parameters determines the system's response to rudder orders. Only the first three parameters are relevant for on/off valve types. If the valve type has been set to proportional, then the last three parameters are also available to edit.

The parameters have the following effect:

a.	Dead-band	sets the amount of tolerable rudder deviation before the controller corrects the position
b.	Slow target zone	sets the rudder proximity (in degrees) from the rudder order when the high-speed solenoid valve is turned off.
c.	Target Zone	Sets the desired positional accuracy (in degrees) of the rudder. Faster rudders will require a larger target zone to prevent overshoot.
d.	Proportional gain	Sets the magnitude of the system's response to the current rudder deviation.
e.	Integral gain	Sets the system's response to the accumulated error and allows the system to drive out rudder deviation errors.
f.	Derivative gain	Sets the system's response to changes in the rudder deviation. Most systems can be set to 0.

The system tuning process should be started with conservative values and then further adjusted during function testing when the vessel is in motion.

- For on/off type solenoid valves start with the dead-band and target zones set large.
- For proportional type solenoid valves leave the proportional, integral and derivative gains at default (20, 0 & 0).

NOTICE	Ensure that the dead-band and target zone are set to a level that does not cause the system to cycle, or hunt after reaching the correct position.

NOTICE	Fast dead-band parameter only applies to systems that have a two-speed solenoid setup.

6.3.4 Toe-in

The steering controller permits offsetting the two rudders by up to +/-5 degrees. Select the 'Toe-in-out' parameter from the Setup Position Control menu. Start with a small angle and then increment during sea trials.

NOTICE	Toe-in/out angles are made in reference to the port rudder and, therefore, toe-in angles are positive.

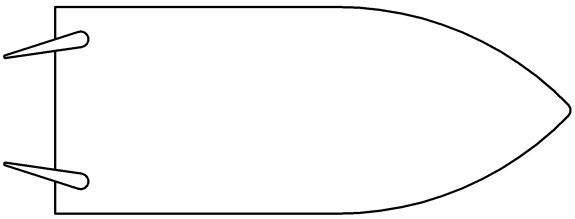


Figure 65: Toe-in Position

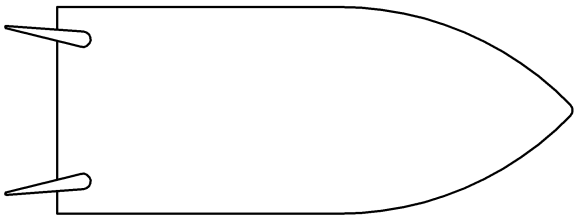


Figure 64: Toe-out Position

6.4 Functional Test

Before commencing with sea trials, a series of basic function tests must be performed to ensure proper rudder movement. Follow the test steps below.

⚠WARNING	The Function Test should be carried out while the vessel is still at dock and before it is taken out to sea and after installation has been completed.

6.4.1 Steering Controls

Reference manual MNL-6300-0200 for function testing the steering controls.

6.4.2 Autopilot

For vessels equipped with an autopilot routed through the steering system confirm that jog commands from the autopilot move the rudder in the correct direction.

6.4.3 Station Addressing

Confirm that the master station is assigned station ID #1. Set the station locks from another station and then go to the master station and confirm that they can be removed.

6.4.4 Sea Trials

Prior to putting the vessel into service, complete the commissioning process with sea trials.

⚠CAUTION	Do not put the vessel into service until the steering system has been tested.

During the sea trials the positional control parameters will be tuned to ensure acceptable responsiveness and accuracy without introducing rudder oscillations.

For vessels with on/off steering valves; gradually reduce the deadband and target zone until the rudder begins to oscillate. Reduce to the last stable setting.

For vessels equipped with proportional steering valves;

1. Increase the proportional gain until the rudder begins to oscillate then reduce to stabilize
2. Increase the integral gain until the rudder begins to oscillate
3. Decrease the proportional gain until the rudder stabilizes
4. Increase the derivative gain until the rudder begins to oscillate then reduce to stabilize

NOTICE	The positioning control gains are influenced by the selected valve slew rate. Ensure that the position control is tuned after making any changes to the valve slew rate.

After the positioning gains have been set, gradually reduce the deadband and target zone until the rudder begins to oscillate. Reduce to the last stable setting.

7 OPERATION

The controller operates autonomously and therefore has no operator interface. Reference the steering station manual, document number MNL-6300-0200 for instruction on operating the Kobelt digital steering system.

⚠WARNING	Before exiting local control mode, return the rudder to midship and ensure all FFU lever positions are at center. Failure to do so, may result in unexpected rudder movement.

7.1 LOCAL CONTROL

All vessels must either have redundant steering controllers or a manual backup system. For vessels with local or manual control, a status input should be wired back to the controller (see section 5.3.6).

If the steering control system needs to be bypassed due to some condition, the status input from the local control switch, wired back to utility input B on the controller will notify the controller to disable certain fault conditions. Energizing this input eliminates false conditions while in emergency backup.

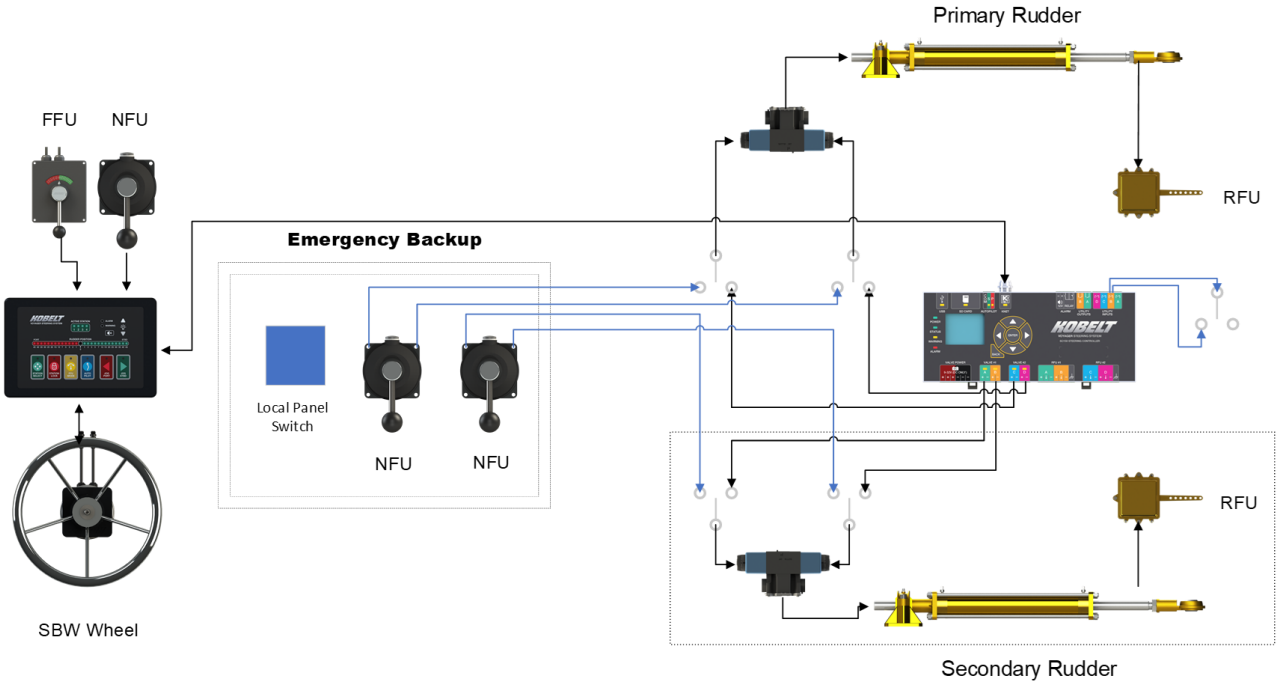


Figure 66: System with Local Emergency Backup Control

8 MAINTENANCE

8.1 CHANGING PASSCODE

ISA 62443-4-2 recommends changing the passcode periodically. The change the passcode, enter Configuration Mode by following the menu sequence below:

- *Main Monitoring Screen -> Passcode -> Setup Selection Screen -> Setup -> Steering System -> Network Security -> Change Passcode*

In this screen enter the current passcode. After entering the fourth character, the user is prompted to enter a new passcode. After entering the fourth character, the user is prompted to enter the new passcode again. If the two entries are equivalent, then the controller will store the new passcode and display a 'Success' screen.

8.2 PASSCODE RECOVERY

The system passcode can be recovered by requesting a temporary passcode from sales@kobelt.com and include the **MCU serial number** and **hardware version** with the request. The MCU serial number can be found on the Device Version screen (see section 9.1.8). Kobelt will return a 4-digit code that must be entered in the passcode screen. Upon successful entry of this code, a new password must immediately be chosen. Enter the new passcode twice and when complete, record the new passcode in a secure place.

8.3 SD CARD

The SD Card is used to store configuration parameters, this feature should be used when the operator and or installer is making changes to ensure that they have an operational return point.

The SD Card will also log system data time stamped to the internal clock time. This feature is intended for helping the operator pinpoint potential errors in configuration or setup.

NOTICE	The SD Card will log data time stamped based on the real time clock. The clock should be periodically checked for drift to ensure the time stamp is still within desired tolerance levels.
NOTICE	Supports SDHC/XC cards and up to 64 GB (Requires Special Formatting), these can be purchased from Kobelt. Off the shelf 32GB cards with FAT32 formatting will work without special formatting
NOTICE	Inserting an SD card during operation requires the system to be power cycled to successfully mount the card. This means that the logging, saving, and restoring configuration features won't work when a new card is inserted until the system is re-booted.

8.4 REAL TIME CLOCK

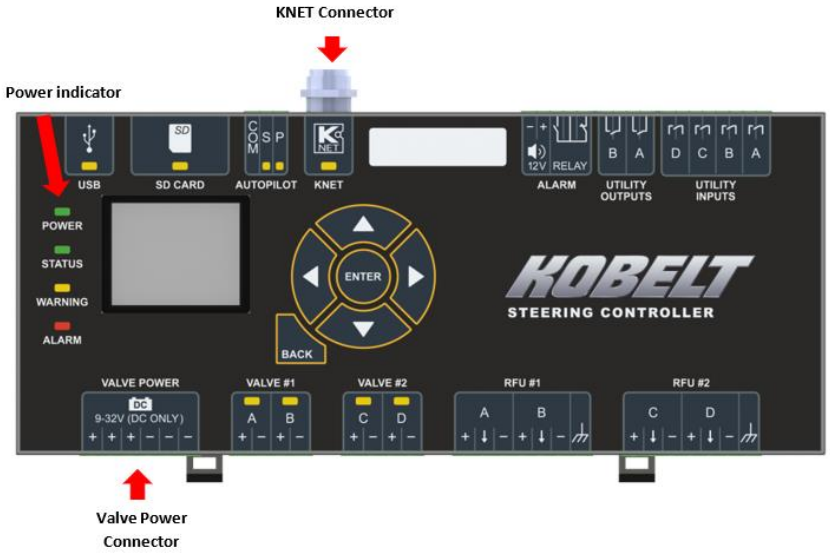
The Kobelt Steering Controller has a real time clock that will continuously run from an internal battery. The real time clock is used to properly log alarms and events. The clock will need to be checked periodically and corrected if necessary.

8.5 BATTERY REPLACEMENT

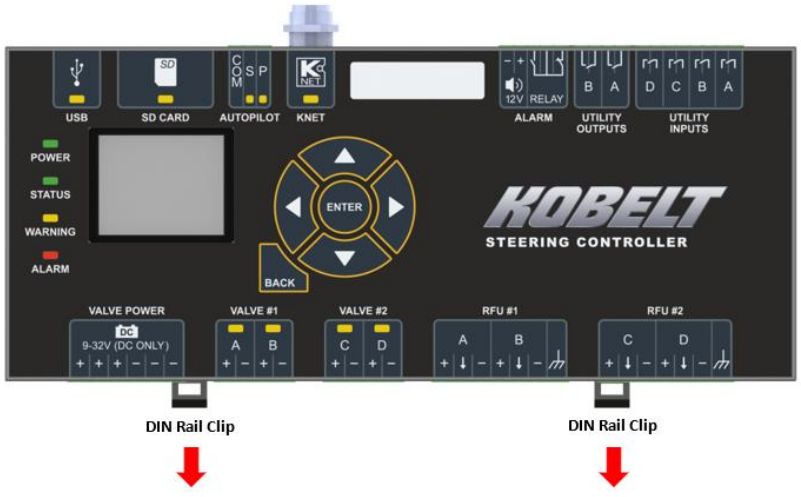
The Kobelt steering controller has an internal, CR2032 battery on the device. This battery is required for the real time clock to keep track of time when control power has been removed. The battery will require replacement on approximately a yearly basis. The Kobelt steering controller will issue a caution when the battery is low and then issue a warning when the battery needs to be replaced. The system will still operate at 100% steering functionality should the battery fail; however the logged alarms and data will lose its timing information.

Follow the steps below to replace the battery:

1. Turn off the power to the system. If this is not possible remove the connector labeled "KNET" (NMEA2000 Micro-C) and then remove the "VALVE POWER" connectors.
2. Check to ensure that the system is no longer powered, indicated by the "POWER" led indicator.

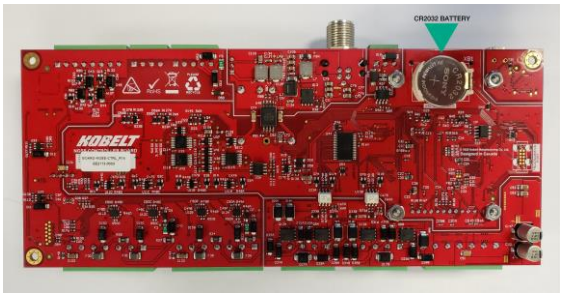


3. Remove all the connectors on the device.
4. Unclip the din rail mounts from the controller and remove it from the din rail. Pull the clips downward to release the device from the din rail.



5. Remove the din rail clips from the housing
6. Ensure that you are properly ground at this point to guarantee no unwanted Electrostatic discharge onto the device.
7. Open the controller box backing making sure to start with the side with the "KNET" Connector and labeled "TOP" on the housing. making sure to pull the back plate off slowly trying to keep both top and bottom as level as possible.

8. Once the back plate is off and the PCB board is exposed, electrically ground yourself and then simply replace the battery with a new CR2032. Removal of the low battery can be done by levering one end of the battery.



9. Ensure that the four LCD screen nuts are still securely fastened.
10. Replace the backplate of the enclosure onto the device slowly while maintaining a consistent level between both clipped sides when putting it back on.
11. Re-insert the din rail clips onto the device.
12. Mount the controller back into its intended position on the din rail
13. Put the connectors back onto the device leaving the power connectors last.
14. Plug in the power connectors “KNET” and “VALVE POWER” and turn on the device.
15. Navigate to the setup screen and re-enter the current date and time of the device.
16. Upon completion of replacing the battery the battery the system should perform a functional test of the steering, to ensure no failures have occurred during the battery replacement procedure.

8.6 Update Firmware

The firmware for the steering system can be updated via the SD card. Insert the SD card with the updated firmware into the card slot (see Figure 3). Navigate to the Configuration Management screen:

Main Monitoring Screen -> Passcode -> Setup Selection Screen -> Setup -> Steering System -> Update Firmware

A list of eligible files will be displayed on the screen. Select the desired version and press **ENTER**. The controller will update the firmware for all of the connected stations and controller. The process will take several seconds.

8.7 Reset Configuration

If desired or required, the controller configuration parameters can be reset to the factory default settings. To perform this function, navigate to the Configuration Storage screen:

Main Monitoring Screen -> Passcode -> Setup Selection Screen -> Setup -> Steering System -> Configuration Storage

and select **Reset**. Acknowledge the warning screens to continue.

8.8 Restore Configuration

If desired or required, the controller configuration parameters can be restored to a previous configuration. To perform this function, navigate to the Configuration Storage screen:

Main Monitoring Screen -> Passcode -> Setup Selection Screen -> Setup -> Steering System -> Configuration Storage

and select **Restore**. Scroll down the list of available configuration files and select the desired restore point. Press **Enter** and acknowledge the warning screens to continue.

8.9 USB PORT

The USB port has read access only and is intended for qualified technician use only.

Connector Type: Mini USB Female B

Figure 67: Mini USB Female B Connector

8.10 PREVENTATIVE MAINTENANCE

- Every Sailing
  - Functionally test every NFU Jog Lever.
  - Functionally test every FFU lever.
  - Review alarm log
- Quarterly
  - Check clock setting
- Once per year
  - Replace internal CR2032 Battery then set the current time.

8.11 RECOMMENDED SPARE PARTS

As a minimum Kobelt recommends the following spare parts are on-hand:

Table 17: Recommended Spares

RECOMMENDED SPARES		
QTY	**ITEM**	**KOBELT PART #**
1	Male Network Terminator	6015-1011
1	Female Network Terminator	6015-1012
1	CR2032 Coin Battery	9870-0001

To purchase spare parts Contact Kobelt for list of parts numbers available

9 TROUBLESHOOTING

In the event of an abnormal operation or an alarm alert, check the error message in the fault log. The top alert on the list is the most current alarm. Navigate to the alarm of interest and press enter for more detailed information. The fault message will provide a clue to locate and rectify the problem. The monitoring screens should be used in conjunction with the fault messaging as a troubleshooting tool.

If it is not possible to locate or eliminate the problem using this section, or if the fault is still present, switch off the device and contact Kobelt Manufacturing Co. Ltd. technical support department.

⚠WARNING	The user must not attempt to repair the unit themselves. It is strongly recommended that any required service work on a Kobelt unit be performed by a factory authorized service representative. Please contact the nearest Kobelt authorized distributor for assistance. Any repairs performed by 3rd party may null and void any warranty or type approvals

9.1 MONITORING SCREENS

The controller has a set of eleven open-access monitoring screens that are available to assess the steering system.

9.1.1 Main Monitoring Screen

This is the root monitor screen and first screen after system power ON and Splash screen. The information displayed is:

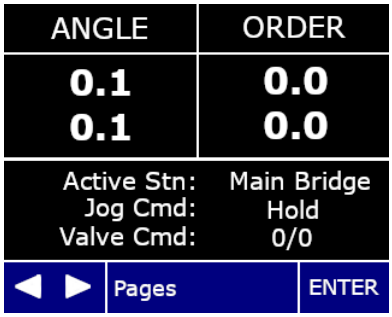


Figure 68: Main Monitoring Screen

- Angle – Angle reading from the RFU source.
  - This will show a " – " if there is a fault with the RFU reading
- Order – Order from the FFU or wheel input.
  - This will be blank when the system does not have an order.
  - This is blank if the system is not using an FFU lever or the smart helm.
- Jog Cmd – current status of the jog lever as determined by the controller:
  - Hold
  - Port
  - Starboard
  - Port Fast
  - Stbd Fast
- Valve Cmd – Percentage driving the valves.
  - One number indicates one proportional or on/off solenoid valve. Two numbers separated by a '/' indicates two valve operation.
  - A negative value is driving port and a positive number is driving starboard.

9.1.2 Rudder Feedback Screen

Two Rudder Feedback screens are available to view the RFU output.

- Angle – The determined angle from the RFU in degrees.
- Norm – The normalized angle (in percent) from the Port to Starboard end stops. Value is from 0 – 100 %.
- Supply – displays the RFU potentiometer power supply.

If there is more than 1 RFU, pressing the up or down buttons on the controller will cycle through the rudder feedback units

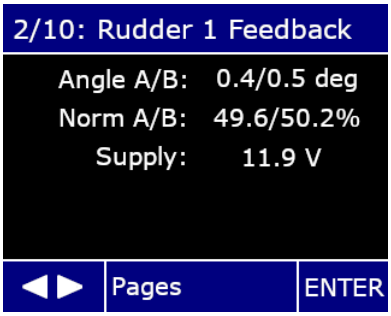


Figure 69: Rudder Feedback Screen

9.1.3 Valves Screen

One valve screen is available to view the steering valves status.

- Coil A/B – The percentage of the valve A/B driven duty between dead-band and maximum 100%.
- Valve 1 Amps – The measured current driving the on/off or proportional solenoid.
- Coil C/D – The percentage of the valve C/D driven duty between dead-band and maximum 100%.
- Valve 2 Amps – The measured current driving the on/off or proportional solenoid.

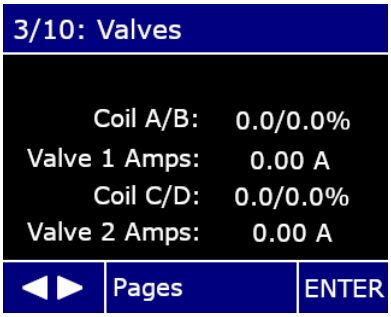


Figure 70: Valve Status Screen

9.1.4 FFU Status Screen

A FFU status screen per station is available for viewing. Pressing the RIGHT or LEFT arrow keys will cycle through the connected stations.

- Supply – Voltage reading from the FFU and the Supply voltage to the FFU on the station being displayed.
- Order A/B – The current FFU reading at the noted station
- Volts A/B – the current FFU unprocessed signal at the noted station

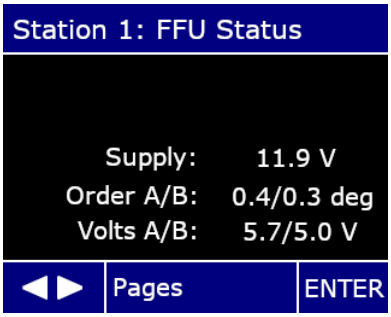


Figure 71: FFU Status Screen

9.1.5 Input Status Screen

The input status screen provides information on the state of the jog inputs and membrane switches of each station. There is a screen for each of the connected stations.

- The names of any button pressed
- Supply – current voltage of the digital input supply.
- NFU A/B/C/D – Individual input signals from the digital input port. A '1' indicates that a jog switch is closed.

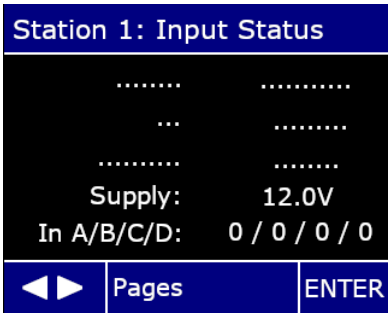


Figure 72: Input Status Screen

9.1.6 Controller Health Screen

The controller health screen displays some key operating values. Pressing the LEFT or RIGHT arrow keys will cycle through the connected stations as well.

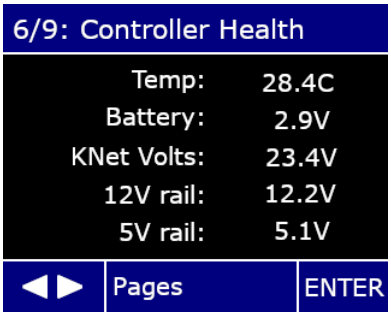


Figure 73: Controller Health Screen

- Temp – Temperature reading on the Voyager controller of the ambient temperature inside the case.
- Battery – The RTC (real time clock) battery voltage level.
- KNet Volts – The voltage reading of KNET connector voltage level.
- 12V rail – The voltage generated for the internal 12V rail on the circuit board.
- 5V rail – The voltage generated for the internal 5V rail on the circuit board.

9.1.7 Autopilot Status Screen

The status of a connected autopilot can be monitored from this screen.

- AP Mode – If Autopilot Mode is Enabled, Disabled or Standby.
- AP Cmd – The current Autopilot command.
- AP Interface – The configured autopilot interface mode
  - Always live.
- AP P/S – The direction of Autopilot command, port or starboard.

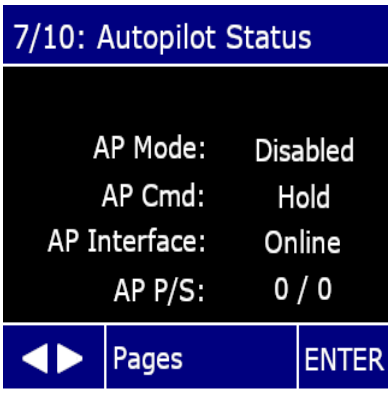


Figure 74: Autopilot Status Screen

9.1.8 Device Version Screen

The information presented on this screen may be requested by the factory to resolve technical issues. Pressing the LEFT or RIGHT arrow keys will cycle through the connected stations as well.

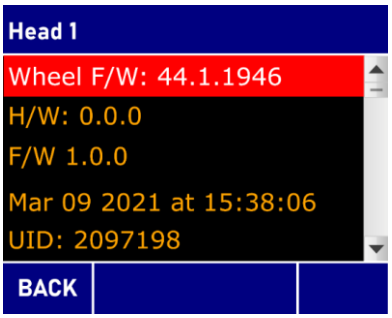


Figure 75: Device Version Screen

- Controller – Firmware/Hardware information
  - H/W: The hardware version of the Controller, “0” as the initial version.
  - F/W: The firmware version of the Controller and time that the F/W was compiled.
  - UID: The unique ID of the micro-controller on the device.
- Head – Firmware/Hardware information
  - Wheel F/W: The firmware version of the SBW wheel connecting to this Head.
  - H/W: The hardware version of this Head, “0” as the initial version.
  - F/W: The firmware version of this Head and time that the F/W was compiled.
  - UID: The unique ID of the micro-controller on the device.

9.1.9 KNet IO Status Screen

If the Kobelt 6300-0300 I/O Module is connected for interfacing with the 6511-APS10 steering alarm panel, this screen can be used to monitor the state of the inputs and outputs. This screen is available when the External Alarm parameter is enabled.

  - Output 1 – Deviation Fault. The rudder is moving slow or not at all to a given order

- Output 2 – Loop Fault.
  - RFU fault
  - NFU Fault
  - SBW Wheel
  - Valve Current Fault
- Output 3 – Control System Fault
  - Over Temperature
  - Internal Voltage fault
  - KNet Power Fault
  - Flash or configuration fault

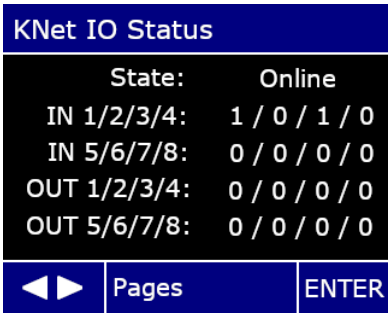


Figure 76: I/O Module Status

- Output 4 - Communications Fault
  - There is a communications fault with any configured station.
- Output 5 - Hydraulic Lock - Input 1 and 2, or 3 and 4, are energized at the same time
  - Input 1 and 2 should be connected to Pressure Switches on Valve 1
  - Input 3 and 4 should be connected to Pressure Switches on Valve 2

9.1.10 Fault Log

- The Fault Log Screen is a list of faults that have been detected recently. It displays any alarm that occurs, even if the fault condition has already been removed.
- Scrollable list up to **30** of the most recent Alarms and or Warnings
- Gives an overview of the alarm, warning or caution, with alarm name/type
- Sorted in reverse chronological order (newest first)
- Each row of the list shows a single Fault, with the following elements:
  - A letter to indicate the severity:
    - A for Alarms
    - W for Warnings
    - C for Cautions

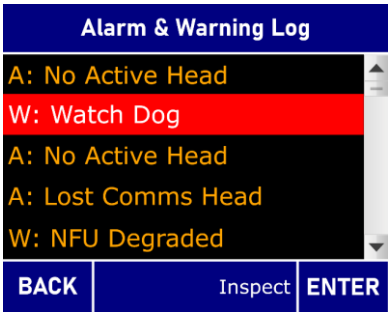


Figure 77: Fault Log Screen

- The fault name indicates the location with a number at the end
  - For controller alarms, number 1 indicates the primary controller and 2 the secondary.
  - For steering station alarms, the number indicates which steering station ID number.
- Upon entering the screen, the first entry in the log (if any) is selected
  - Up/Down Arrow Keys moves the active selection up and down the list
  - Enter Key – Switches to Fault Inspector Screen to view timing details about selected list entry, see detail in the next section
  - Back Key – Return to Main Menu Screen

9.1.11 Fault Detail Screens

The Fault Detail Screen shows details about the selected alarms, warnings or caution. It is accessed by pressing the Enter button to select a fault in the Fault Log Screen.

- The title of the screen will state Warning/Alarm/Caution Information, and the order 1/30, 2/30, 3/30…30/30.
- The details for the alarm or warning, is given on this screen:
  - Date and time that the alarm or fault occurred, first row.
  - Date and time that the alarm was acknowledged, second row.

  - Date and time that the fault cleared, third row. This may have occurred on power up.
- A letter to indicate the severity:
  - 'W' for Warnings
  - 'C' for Cautions
  - 'A' for Alarms
- The Right and Left arrows will go to the next or previous Fault.
- Back key will take the user back to the Fault Log screen.
- Enter key will take the user to acknowledge the Fault.

Figure 78: Fault Detail Screen

9.2 FAULT RESOLUTION

Table 18: Common Troubleshooting Problems

Problem (Issue Encountered)	Cause (What it Means)	Corrective Action (What to Do)
Product does not turn on	Blown fuse or circuit breaker Wiring is not correct	1. Replace external fuse. Replace internal fuse. Reset circuit breaker. 2. Check wiring diagram and ensure that all connections are correct.
Alerts not showing up on the fault log screen	The real time clock is not correct.	1. Set the clock to the current time 2. Check the battery voltage. Replace if necessary
No Active Head (Communication Fault)	No Head is in control of the system.	3. Check wiring diagram for KNET and ensure that all connections are correct. 4. Press the Station Select button from any station.
Valve Failure (Loop Failure)	1. Valve is open-circuit. 2. Valve current is too high.	Check wiring diagram for the valve(s) and ensure that all connections are correct.
Hydraulic Lock	Rudder not moving due to unresponsive valve or both cylinder ports pressurized.	Test steering valves Check plumbing Inspect bypass vale block
Rudder Deviation Alarm	The Rudder Deviation fault is an alarm that alerts the operator when the system is not controlling the rudder adequately (or cannot verify that it is controlling the rudder)	Inspect RFUs Test PID gains Check valve slew rate
RFU Failure (Loop Fault)	1. RFU supply voltage is shorted. 2. RFU supply voltage is wire break.	Check wiring diagram for the RFU and ensure that all connections are correct.
Controller Internal Failure (Control System Failure)	The Steering Controller has an internal fault. High temperature or voltage failure	Examine Controller health screen to identify what condition is present. Voltage issues may be due to a low voltage at the device. Temperature problems could be due to extreme environmental conditions: too close to heat generating devices. Consider a different location, or provide ventilation at the device.

Station x SBW wheel Input Failure (Loop Failure)	The communication problem between the Head and SBW wheel	Check Wheel connection between the station and the wheel. Replace drop cable or Y connector.
Station x FFU Input Failure (Loop Failure)	1. The FFU lever is wire break. 2. The supply of the FFU lever is shorted.	Check wiring diagram for the FFU lever and ensure that all connections are correct.
Station x NFU Input Failure (Loop Failure)	The supply of the NFU lever is shorted.	Check wiring diagram for the NFU lever and ensure that all connections are correct.
Controller Comms to Head x Lost (Communication Failure)	Controller cannot communicate with the Head.	Check wiring diagram for KNET and ensure that all connections are correct.
Invalid Autopilot Input	The steering system receives the autopilot command port and starboard at the same time.	Test autopilot outputs
Battery Failure	The battery voltage on the Controller is too low.	Replace CR2032 battery.

10 WARRANTY

Kobelt Manufacturing Co. Ltd. (“Kobelt”) warrants the Products and Parts manufactured by Kobelt to be free from defects in workmanship or material and that said products are designed mechanically and functionally to perform to specifications.

This warranty is effective providing:

- The equipment is used within the intended operating conditions and in accordance with Kobelt recommendations
- The equipment is installed according to equipment diagrams, specifications, and recommendations which Kobelt has provided

This warranty becomes invalid if the factory supplied serial number has been removed or altered on the product. This warranty does not cover cosmetic damage or damage caused by an act of God, accident, misuse, abuse, negligence, or modification of any part of the product. This warranty does not cover damage due to improper operation or maintenance, connection to inappropriate equipment or attempted repair by anyone other than an authorized Kobelt representative.

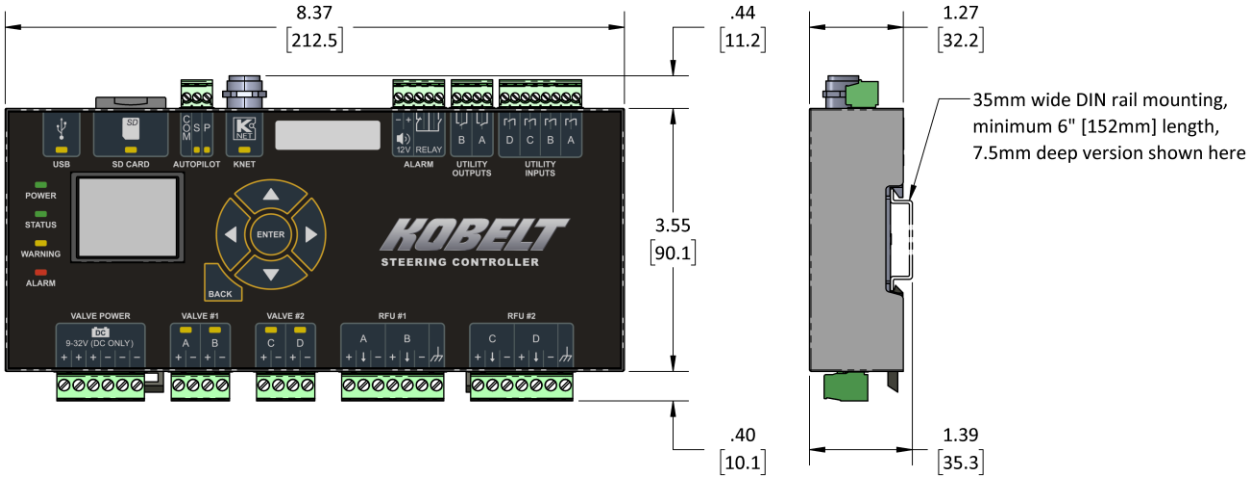
Upon identification of a potential issue or defect with a Kobelt Product or Part, the Warranty Applicant (“Applicant”) must immediately contact Kobelt and describe the issue in writing, by letter, fax, email or other electronic conveyance. Kobelt will then assess the cause of the defect and determine warranty applicability and appropriate remediation.

If any part is found to be defective, Kobelt will replace said part FOB the Kobelt factory provided that any such defective part is returned by the Buyer with freight and applicable forwarding charges prepaid by the Buyer. Kobelt’s sole obligation to the Applicant will be to repair or replace the defective part with same or similar product, to a maximum value of the list price of the product or part. The Kobelt warranty does not cover labour charges, travel, or any other associated expenses.

All Products and Parts manufactured by Kobelt, are subject to a warranty against manufacturer’s defects in materials or workmanship for a period of two (2) years from the date of purchase.

Kobelt will be responsible for all Products or Parts sold by Kobelt but manufactured by 3rd party manufacturing companies. However, these products and parts are subject to applicable 3rd party warranties and may not be the same as the Kobelt warranty.

APPENDIX A: INSTALLATION DIMENSIONS



APPENDIX B: PINOUT