

Installation Manual

AUTOPILOT

Model NAVpilot-1000

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**FURUNO ELECTRIC CO., LTD.**www.furuno.com

FURUNO ELECTRIC CO., LTD.

9-52 Ashihara-cho,
Nishinomiya, 662-8580, JAPAN

• FURUNO Authorized Distributor/Dealer

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SAFETY INSTRUCTIONS

Follow the safety instructions listed below and throughout this manual to prevent damage to your equipment or vessel and to prevent harm to the operator or other personnel on-board. The results of failing to follow the instructions and guidelines outlined herein are listed below.

 WARNING	Indicates a condition that can cause death or serious injury if not avoided.
 CAUTION	Indicates a condition that can cause minor or moderate injury if not avoided.

 Prohibitive Action	 Warning, Caution	 Mandatory Action
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 WARNING	
	ELECTRICAL SHOCK HAZARD Do not open the equipment unless totally familiar with electrical circuits and service manual. Only qualified personnel are allowed to work inside the equipment.
	Do not allow any units to get wet by waves, spray or heavy rain in inclement weather. Electrical fire and/or electrical shock can result.
	Turn off the power at the mains switchboard before beginning the installation. Fire, electrical shock or serious injury can result if the power is left on or is applied while the equipment is being installed.
	When connecting a geomagnetism detection type heading sensor, correct magnetic field deviation. If an autopilot is used without the compensation, unexpected course change may occur.
	Input the correct ship's speed data. The NAVpilot cannot control the rudder properly if the incorrect ship's speed is input.

 WARNING	
	The processor unit must be connected to the power supply through a breaker (local supply). The breaker must be installed at a location where it can be easily operated in an emergency. If the rudder is unintentionally moved or auto steering cannot be canceled, do as follows to stop the autopilot. <ul style="list-style-type: none"> • For analog steering system: Use the steering control changeover feature of the steering system to stop the auto steering, then turn the breaker off. • For solenoid steering system: Turn the breaker off.
	Install a control unit equipped with the STBY key, or an "auto steering cancel button" (local supply) at the helm and all steering stations, to disable rudder control by the autopilot in an emergency. An accident may result if the auto steering cannot be canceled immediately. To enable auto steering cancellation from an auto steering cancel button, set [In Port 1] (or [In Port 2], [In Port 3], [In Port 4]) to [Go STBY] on the [Universal Port] menu. See section 3.6.15.



CAUTION



Confirm that the power supply voltage is compatible with the voltage rating of the equipment.

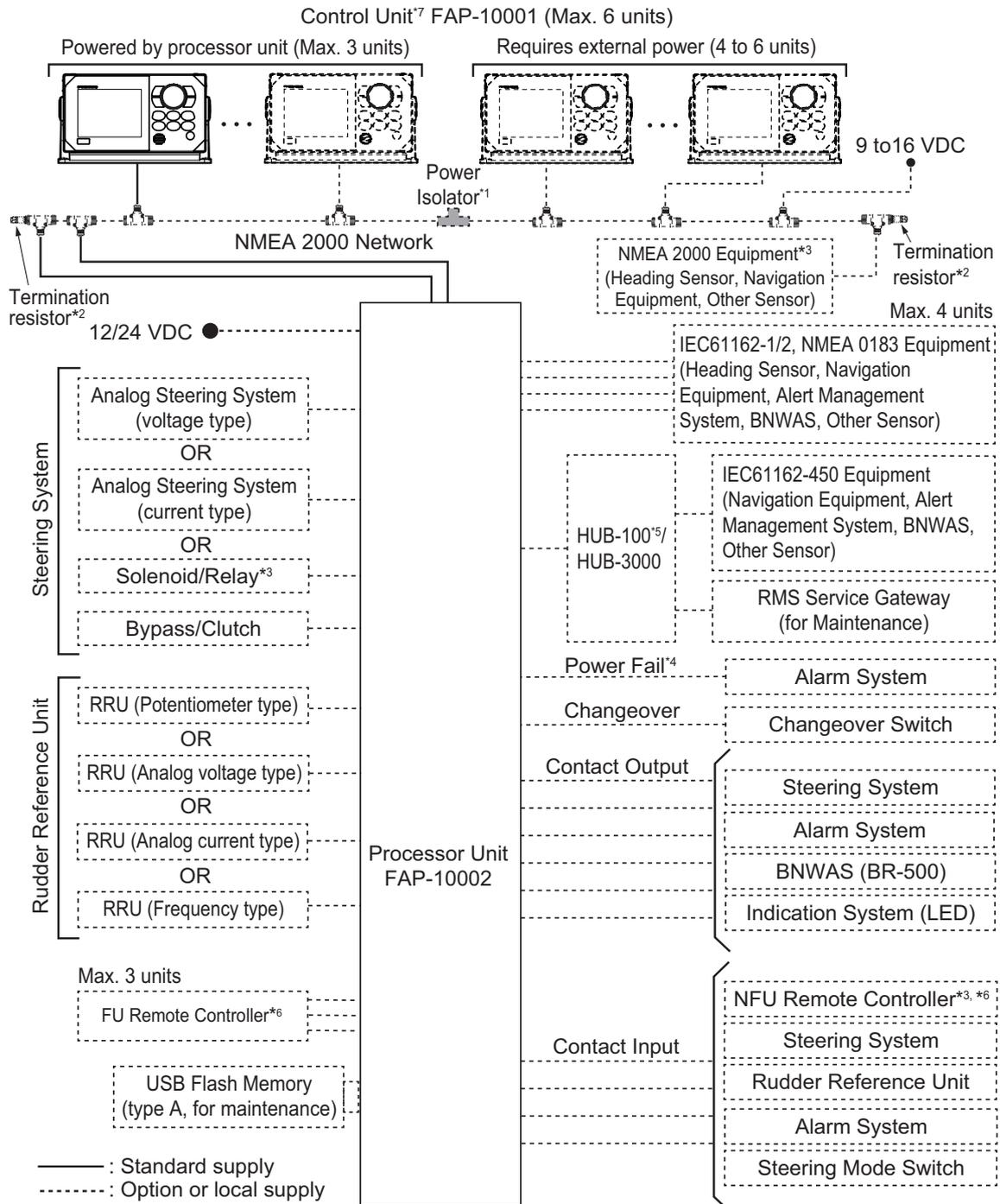
Connection to the wrong power supply can cause fire or damage the equipment.



Observe the following compass safe distances to prevent interference to a magnetic compass:

Unit	Standard compass	Steering compass
Control Unit FAP-10001	0.40 m	0.40 m
Processor Unit FAP-10002	5.20 m	3.40 m

SYSTEM CONFIGURATION



*1: When four or more control units are connected, connect the power isolator to the NMEA 2000 network and provide the external power supply to the backbone.
 *2: Termination resistors must be installed at both ends of the backbone.
 *3: Available only for the non-IMO type.
 *4: For the IMO type, power fail signal must be connected to an external alarm system in accordance with ISO 11674. For details of wiring, see section 2.1.10.
 *5: HUB-100 can only be used for IEC61162-450 Ed.1 compliant network.

Category of units

Processor unit	Protected from the weather.
Control unit	Protected from the weather.

*6: Available only when the RRU is installed.
 *7: If your ship does not need SOLAS certification, the control unit can be connected directly to the processor unit without connecting via the NMEA 2000 backbone, using the optional cable assembly (type: FRU-LMT-18-SINGLE). For details, see section 2.1.5.

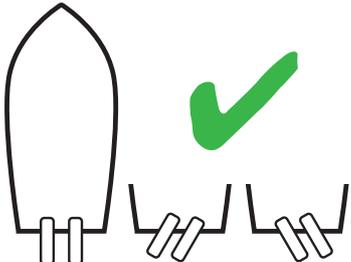
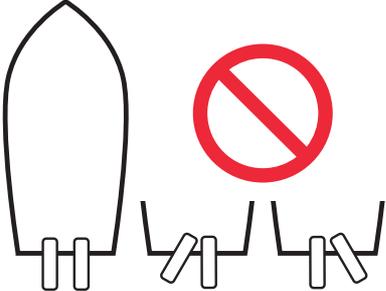
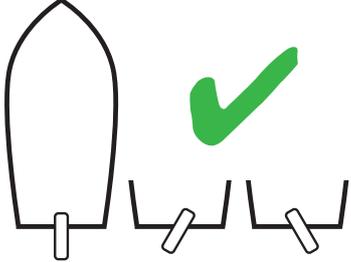
Compatible external equipment

The following table shows the external equipment that have been verified for use with the NAVpilot.

Equipment	Manufacturer	Model	Remarks
FU Remote Controller	Jastram	JAS-LC1-FFU	
NFU Remote Controller	Jastram	JAS-LC1-NFU	Not compatible with active switch
RRU (Analog Current Type)	DEIF	RTA602	
RRU (Frequency Type)	SIMRAD	RF-45X	For frequency type RRU, RF-45X is only compatible.

Compatible boat/steering type

The NAVpilot-1000 is designed for use in 100 m or smaller boats with following boat/steering types.

Supported			NOT supported		
Inboard	Stern Drive	Water Jet	Outboard	Sailboat	Azimuth Drive
Single rudder drive with single-rudder or multi-rudders (single control)			Independently controlled/moved multiple rudder drives		
					
					

EQUIPMENT LISTS

Standard supply

Name	Type	Code No.	Qty	Remarks
Control Unit	FAP-10001	—	1	
Processor Unit	FAP-10002	—	1	
Installation Materials	CP64-03601	001-645-260	1	For control unit
	CP64-03700	000-042-877	1	For processor unit
Spare Parts	SP64-01801	001-645-250	1	For control unit
	SP64-01901	001-645-270	1	For processor unit

Optional supply

Name	Type	Code No.	Qty	Remarks
Control Unit	FAP-10001	—		
Junction Box	FI-5002	—		For CAN bus connection
Rudder Reference Unit	FAP-6112-200	—		
Cable Assembly (NMEA 2000 Cable)	FRU-NMEA-PFF-010	001-507-010	1 m	With micro type connector (one side: female connector)
	FRU-NMEA-PFF-020	001-507-030	2 m	
	FRU-NMEA-PFF-060	001-507-040	6 m	
	FRU-NMEA-PMMFF-010	001-533-060	1 m	With micro type connectors (one side: female connector, other side: male connector)
	FRU-NMEA-PMMFF-020	001-533-070	2 m	
	FRU-NMEA-PMMFF-060	001-533-080	6 m	
Cable Assembly	FRU-LMT-18-SINGLE	001-674-660	15 m	For direct connection between the control unit and processor unit
Connector (Power Isolator)	FRU-N2K-PO-ISO	001-651-160		
Micro T-Connector	FRU-MM1MF1MF1001	001-507-050		
Termination Resistor (Micro)	FRU-MM1000000001	001-507-070		Male connector
	FRU-MF000000001	001-507-060		Female connector
Installation Materials	CP03-28900 (10M)	000-082-658	10 m	LAN cable
	CP03-28910 (20M)	000-082-659	20 m	
	CP03-28920 (30M)	000-082-660	30 m	

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1. MOUNTING

The installer of this equipment must be familiar with the hydraulic system and have the experience of installing the ship's steering equipment.

NOTICE

Do not apply paint, anti-corrosive sealant or contact spray to coating or plastic parts of the equipment.

Those items contain organic solvents that can damage coating and plastic parts, especially plastic connectors.

1.1 Control Unit

The control unit can be mounted on a desktop or flush mounted in a console.

Mounting consideration

Select a mounting location, keeping in mind the following points:

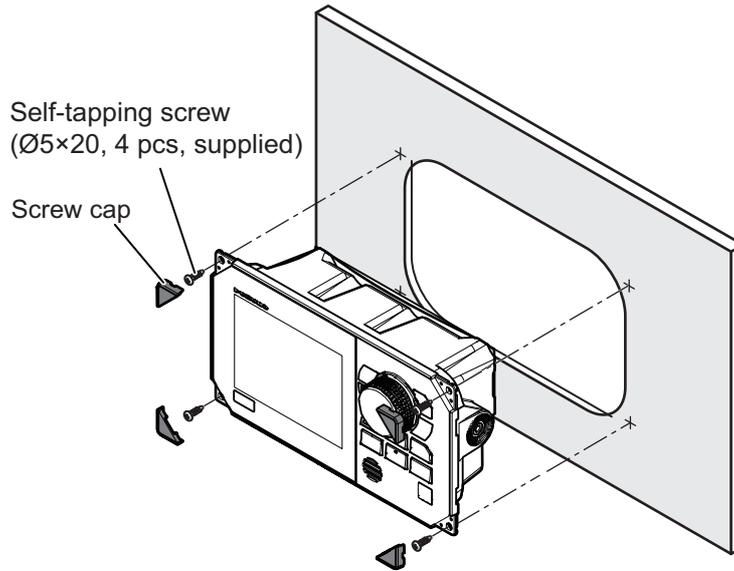
- Select a location where the unit can easily be operated.
- Do not install the unit under "Plexiglas" or other types of shielding material. Plexiglas can trap heat and moisture or magnify sunlight on the surface of the display.
- Locate the unit away from exhaust pipes and ventilators.
- The mounting location should be well ventilated.
- Select a location where shock and vibration are minimal.
- Leave sufficient space for maintenance and service, referring to the outline drawings at the back of this manual.
- Select a mounting location considering the length of the cables to be connected to the unit.
- A magnetic compass will be affected if the unit is placed too close to the magnetic compass. Observe the compass safe distances at the front of this manual to prevent interference to a magnetic compass.

1. MOUNTING

1.1.1 Flush mount

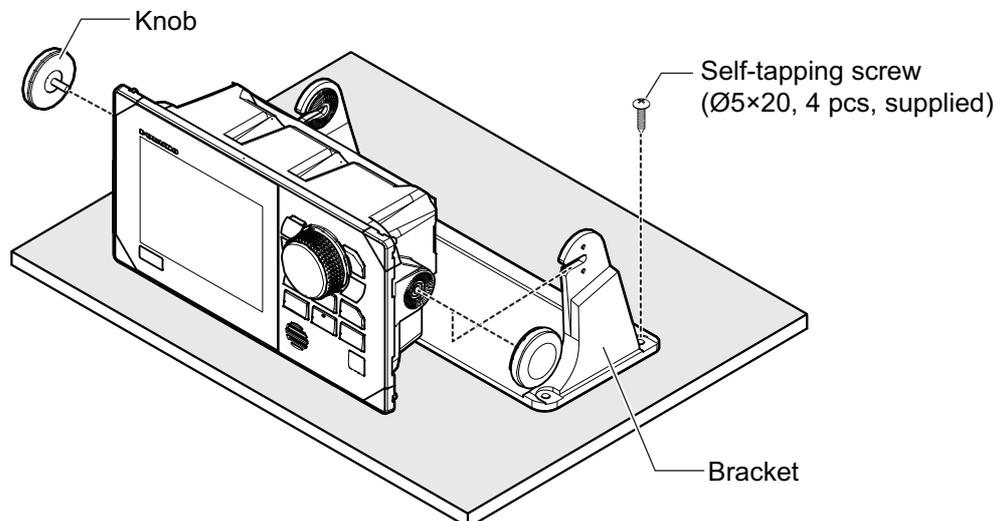
Select a flat mounting location, and install the unit as shown below.

1. Make a mounting hole in the mounting location and four pilot holes for self-tapping screws, using the supplied mounting template.
2. Remove four screw caps from the control unit.
3. Feed the cables through the mounting hole, then connect the cables to the unit.
4. Set the unit into the mounting hole, then secure the unit using four self-tapping screws ($\phi 5 \times 20$, supplied).
5. Reattach four screw caps.



1.1.2 Desktop mount

1. Secure the bracket to the mounting location, using four self-tapping screws ($\phi 5 \times 20$, supplied).
2. Fasten two knobs to the control unit loosely.
3. Connect the cables to the unit.
4. Set the unit in the bracket, then fasten the knobs.



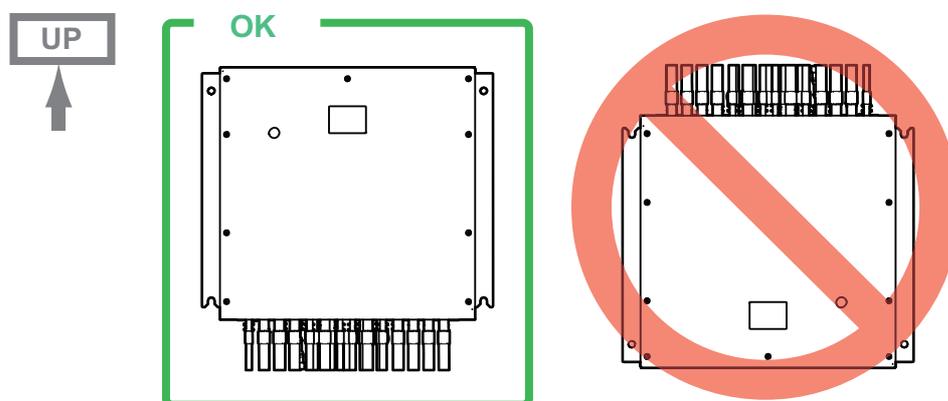
1.2 Processor Unit

The processor unit can be installed on a deck or bulkhead.

Mounting consideration

Select a mounting location, keeping in mind the following points:

- Locate the unit away from direct sunlight.
- Locate the unit away from places subject to water splash and rain.
- Locate the unit away from exhaust pipes and ventilators.
- The mounting location should be well ventilated.
- Select a location where the shock and vibration are minimal.
- For the installation on a bulkhead, make sure the mounting location is strong enough to support the unit under the pitching and rolling normally found on the boat.
- Leave sufficient space for maintenance and service, referring to the outline drawings at the back of this manual.
- Select a mounting location considering the length of the cables to be connected to the unit.
- A magnetic compass will be affected if the unit is placed too close to the magnetic compass. Observe the compass safe distances at the front of this manual to prevent interference to a magnetic compass.
- For installation on a bulkhead, secure the unit so that the cables face downward.

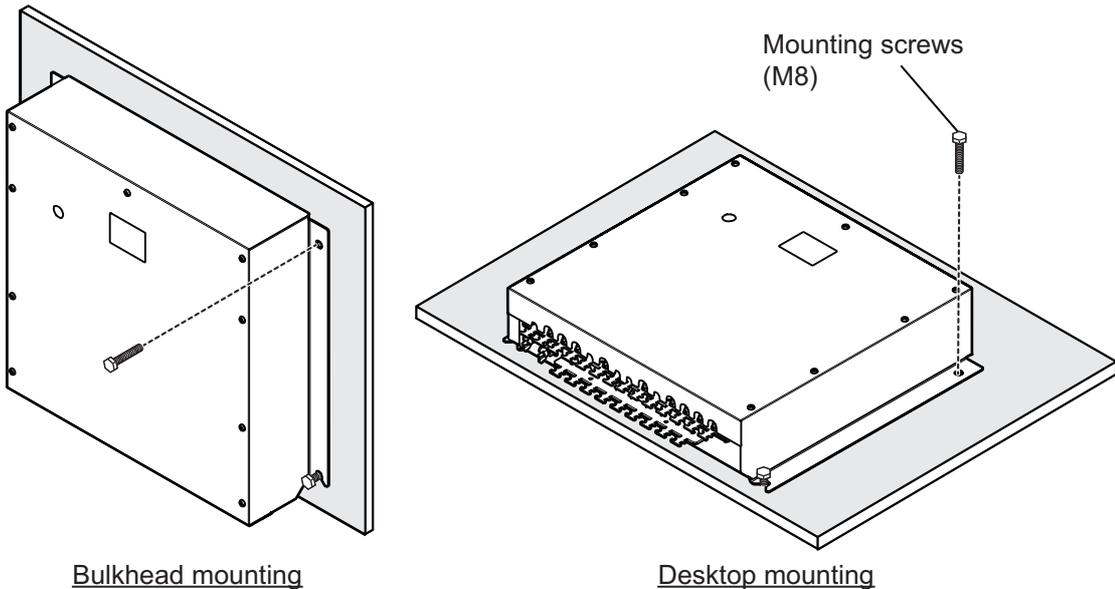


1. MOUNTING

1.2.1 Mounting

Mount the unit on a bulkhead or desktop.

1. Drill four pilot holes in the bulkhead for mounting screws (M8 bolts).
2. Screw two mounting screws (local supply) into the lower pilot holes. Leave 5 mm of thread visible.
3. Set the notches of the unit onto the screws inserted at step 2.
4. Screw two mounting screws (local supply) into the upper fixing holes.
5. Fasten all screws tightly to secure the unit in place.



1.3 Rudder Reference Unit

1.3.1 Compatible rudder reference unit

The following types of rudder reference units (RRU) can be used with the NAVpilot-1000:

Sensor type	Connect to	Remarks
Potentiometer type (1 to 10 k Ω)	TB102	<ul style="list-style-type: none">• Maximum cable length is 20 m.
Voltage output type (minimum range: 0 to 5V, maximum range: -10 to 10 V)	TB103	<ul style="list-style-type: none">• Maximum cable length is 100 m.• External power supply to the RRU is required.
Current output type (4 to 20 mA)		
Frequency output type (1600 to 5200 Hz)	TB213	<ul style="list-style-type: none">• Maximum cable length is 100 m.• NAVpilot supplies the power (12 V) to the RRU.

Note: For the non-IMO type, the NAVpilot can operate without the RRU, if the ship's steering system is analog drive. Note that course-keeping performance may decline compared to with RRU. Also, the rudder angle indicator and FU/NFU remote control cannot be used.

The following table shows the RRUUs that have been tested and are compatible for operation with the NAVpilot-1000.

Manufacturer	Model	Remarks
FURUNO	FAP-6112-200	Option
DEIF	RTA 602	Analog current type
SIMRAD	RF45X	Frequency type

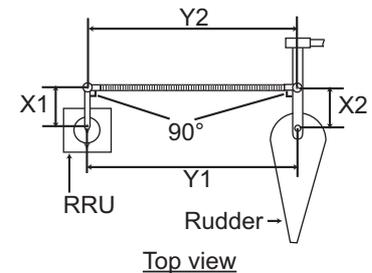
1.3.2 Notice for mounting

The RRU must be fastened to the rudder as shown in the figure to the right, where the following conditions are met, to properly transmit the rudder angle to the NAVpilot-1000:

$$X1 = X2$$

$$Y1 = Y2$$

For details of mounting instructions, see the installation manual of the RRU.



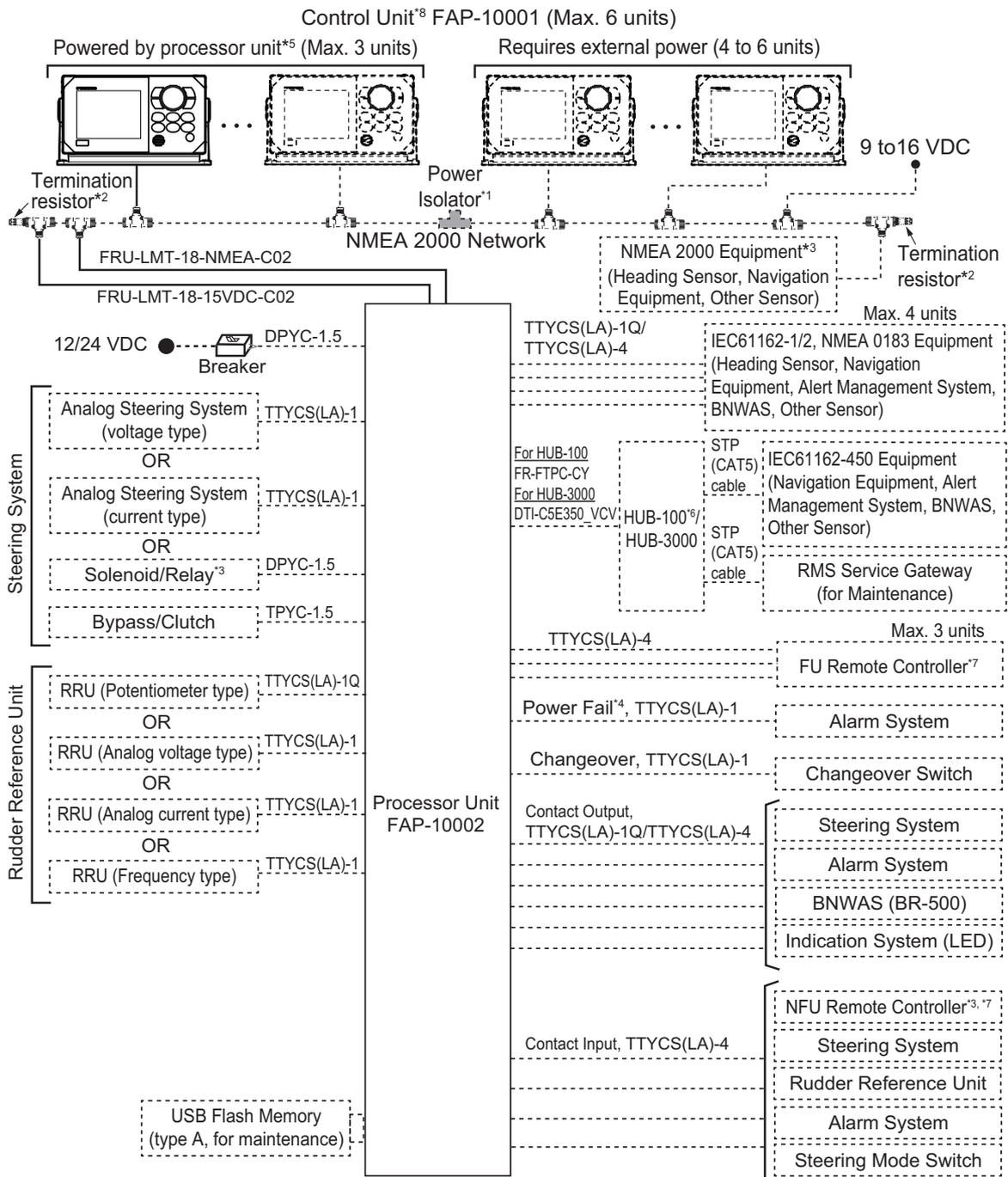
After the installation, set the auto/manual rudder limit and perform the rudder calibration with the vessel on the water, referring to section 3.4.2. Note that it is required to complete the settings on the [Rudder Drive Setup] menu to perform the rudder calibration.

1. MOUNTING

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2. WIRING

The following illustration shows the general connection of the NAVpilot-1000. For detailed information, see the interconnection diagram at the back of this manual.



^{*1}: When four or more control units are connected, connect the power isolator to the NMEA 2000 network and provide the external power supply to the backbone.
^{*2}: Termination resistors must be installed at both ends of the backbone.
^{*3}: Available only for the non-IMO type.
^{*4}: For the IMO type, power fail signal must be connected to an external alarm system in accordance with ISO 11674. For details of wiring, see section 2.1.10.

^{*5}: When the control unit is powered by the processor unit, the total cable length of the drop and backbone cables between control unit and processor unit must be 30 m or less. If exceeds 30 m, the control unit may not work properly due to the voltage drop.
^{*6}: HUB-100 can only be used for IEC61162-450 Ed.1 compliant network.
^{*7}: Available only when the RRU is installed.
^{*8}: If your ship does not need SOLAS certification, the control unit can be connected directly to the processor unit without connecting via the NMEA 2000 backbone, using the optional cable assembly (type: FRU-LMT-18-SINGLE). For details, see section 2.1.5.

Emergency stop method

An emergency stop method is required for the NAVpilot, so that you stop the auto steering in an emergency, such as when the rudder is unintentionally moved or auto steering cannot be canceled. Prepare one of the following emergency stop methods, depending on the type of the steering system.

- **For analog steering system:** The steering system must have a steering control changeover feature*. Also, connect the processor unit with the power supply through a breaker (local supply).
*: Ask the manufacturer of the steering system.
- **For solenoid steering system:** Connect the processor unit with the power supply through a breaker (local supply).

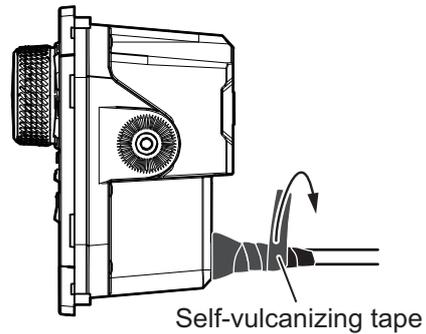
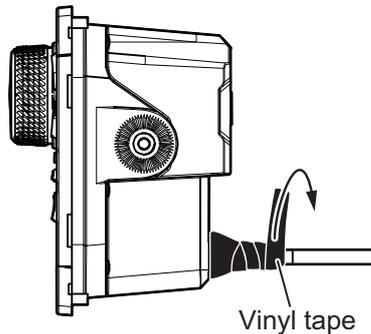
Note: Breaker must be installed at a location where it can be easily operated in an emergency.

How to secure and waterproof the cable connections

The connector at the rear of the control unit and all cable connections should be waterproofed and secured after making connections.

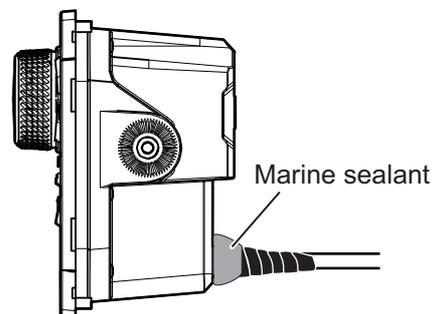
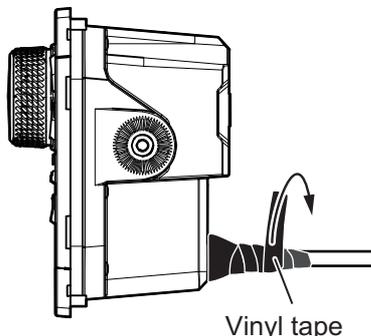
To waterproof and secure each connection, refer to the following procedure.

- **Securing and waterproofing the connector at the rear of the control unit**
 - 1) Wrap the connector with vinyl tape.
 - 2) Wrap self-vulcanizing tape over the vinyl tape.



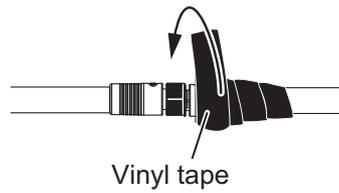
- 3) Wrap vinyl tape over the self-vulcanizing tape.

- 4) Apply a marine sealant around the base of the connector.

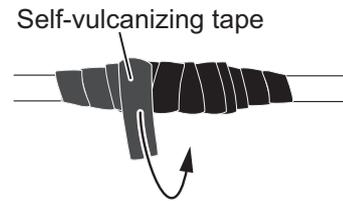


- Securing and waterproofing connections

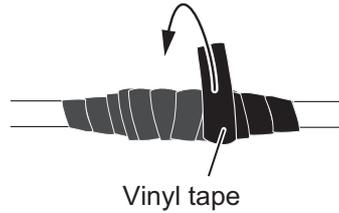
1) Wrap the connector with vinyl tape.



2) Wrap self-vulcanizing tape over the vinyl tape.



3) Wrap vinyl tape over the self-vulcanizing tape.

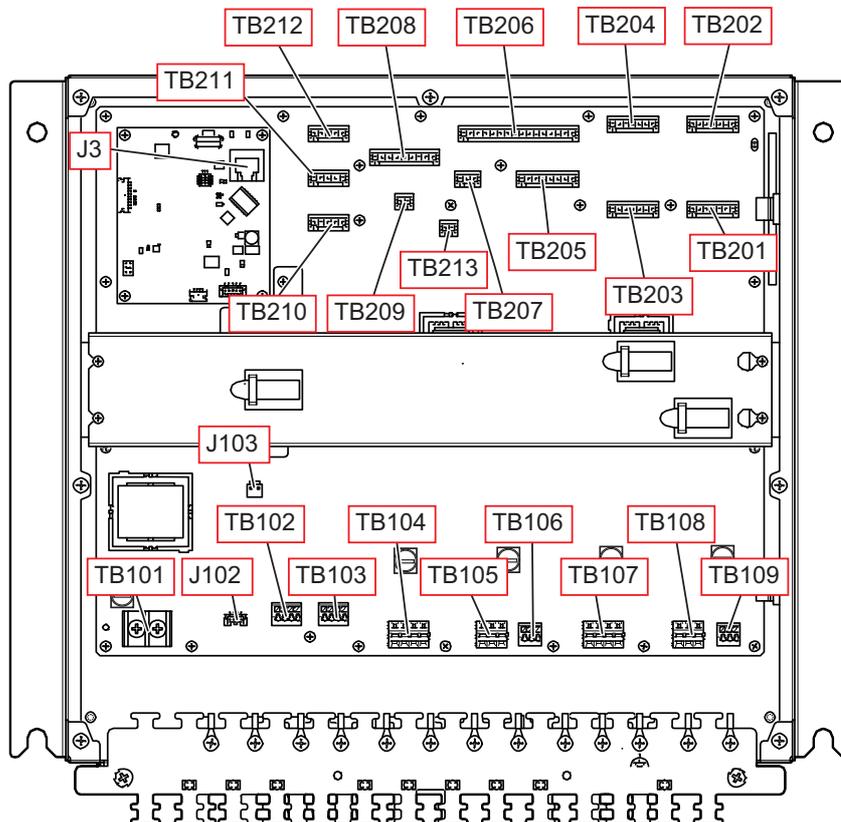


2.1 Processor Unit

2.1.1 Location of connectors and terminal blocks

Remove the cover from the processor unit to access the plug-in terminal blocks. Fabricate the cables referring to the section 2.1.2, then connect the cables.

Note: For details about pin assignment of each terminal block, see the interconnection diagram at the end of this manual.

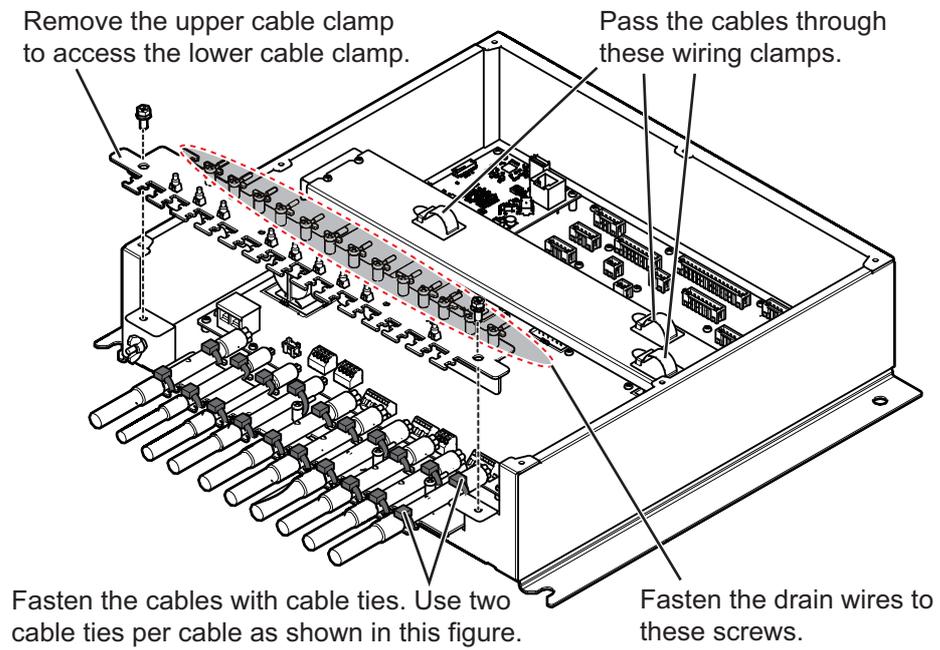


2. WIRING

Terminal block/Connector		Used for...	Cable
J3	IEC61162-450	Input/output for IEC61162-450	LAN cable (FR-FTPC-CY)
J102	NMEA 2000	Connect to NMEA 2000 backbone via drop cable.	NMEA 2000 cable, cable assembly (option, FRU-LMT-18-SINGLE)
J103	15V_P	Power supply to the control units.	Power cable, cable assembly (option, FRU-LMT-18-SINGLE)
TB101	DC IN	Input for power supply (12/24 VDC)	DPYC-1.5
TB102	RRU POT.	Input for rudder feedback potentiometer	TTYCS(LA)-1Q
TB103	RRU ANALOG	Input for analog (voltage/current) rudder feedback	TTYCS(LA)-1
TB104	RUDDER SOLENOID	Connect to steering system solenoid.	DPYC-1.5
TB105	RUDDER BYPASS/CLUTCH	Connect to steering system relay/bypass clutch.	TPYC-1.5
TB106	RUDDER ANALOG	Connect to analog steering system.	TTYCS(LA)-1
TB107	No use.	-	-
TB108	No use.	-	-
TB109	No use.	-	-
TB201	IEC61162-1/2 NMEA 0183 PORT1	Input/output for IEC61162-1/2 and NMEA 0183	For IEC61162-1 (NMEA 0183): TTYCS(LA)-1Q
TB202	IEC61162-1/2 NMEA 0183 PORT2		
TB203	IEC61162-1/2 NMEA 0183 PORT3		For IEC61162-2: TTYCS(LA)-4
TB204	IEC61162-1/2 NMEA 0183 PORT4		
TB205	UNIVERSAL OUTPUT PORT1 - PORT2	Output for contact signal (steering system, alarm system, BNWAS, indication system (LED))	TTYCS(LA)-1Q
TB206	UNIVERSAL OUTPUT PORT3 - PORT6		TTYCS(LA)-4
TB207	POWER FAIL	Connect to external alarm system.	TTYCS(LA)-1
TB208	UNIVERSAL INPUT PORT1 - PORT4	Input for contact signal (NFU remote controller, steering system, rudder reference unit, alarm system, steering mode switch)	TTYCS(LA)-4
TB209	CHANGEOVER SWITCH	Connect to changeover switch.	TTYCS(LA)-1
TB210	FU PORT1	Connect to FU remote controller.	TTYCS(LA)-4
TB211	FU PORT2		TTYCS(LA)-4
TB212	FU PORT3		TTYCS(LA)-4
TB213	RRU FREQUENCY	Connect to frequency type RRU.	TTYCS(LA)-1

How to fasten the cables

Fasten the cables to the cable clamp with cable ties (local supply). Use two cable ties per one cable as shown in the following figure. To access the lower cable clamp, unfasten two screws to remove the upper cable clamp.



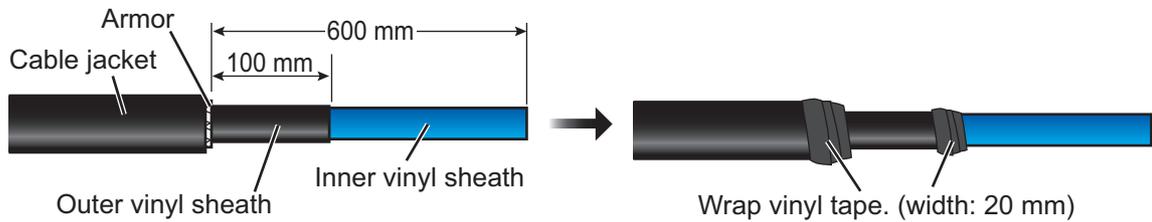
2. WIRING

2.1.2 Cable fabrication

FR-FTPC-CY (LAN cable)

Fabricate the LAN cable, referring to the following figure. After fabricating the cable, attach the modular connector.

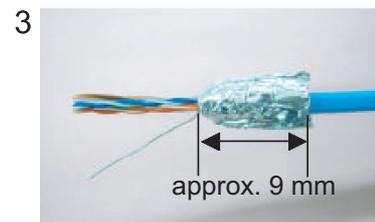
Note: This equipment can use either straight or crossover cables.



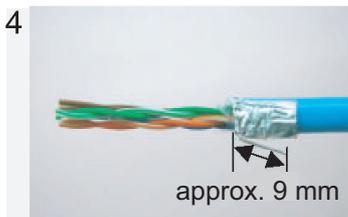
1 Expose inner vinyl sheath.



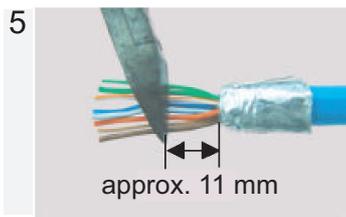
2 Remove the inner vinyl sheath by approx. 25 mm. Be careful not to damage inner shield and cores.



3 Fold back the shield, wrap it onto the inner vinyl sheath and cut it, leaving approx. 9 mm.



4 Fold back drain wire and cut it, leaving approx. 9 mm.



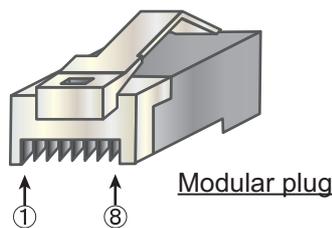
5 Straighten and flatten the cores in colored order and cut them, leaving approx. 11 mm.



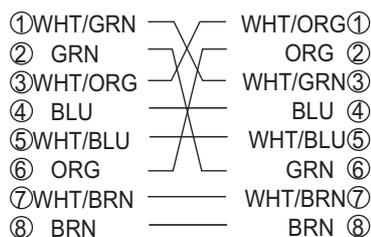
6 Insert the cable into the modular plug so that the folded part of the shield enters into the plug housing. The drain wire should be located on the tab side of the jack.



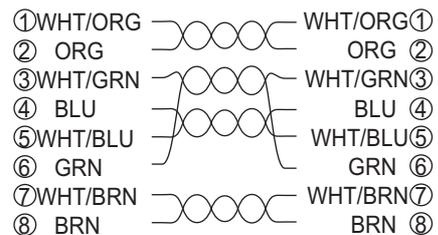
7 Using special crimping tool MPT5-8AS (PANDUIT CORP.), crimp the modular plug. Finally, check the plug visually.



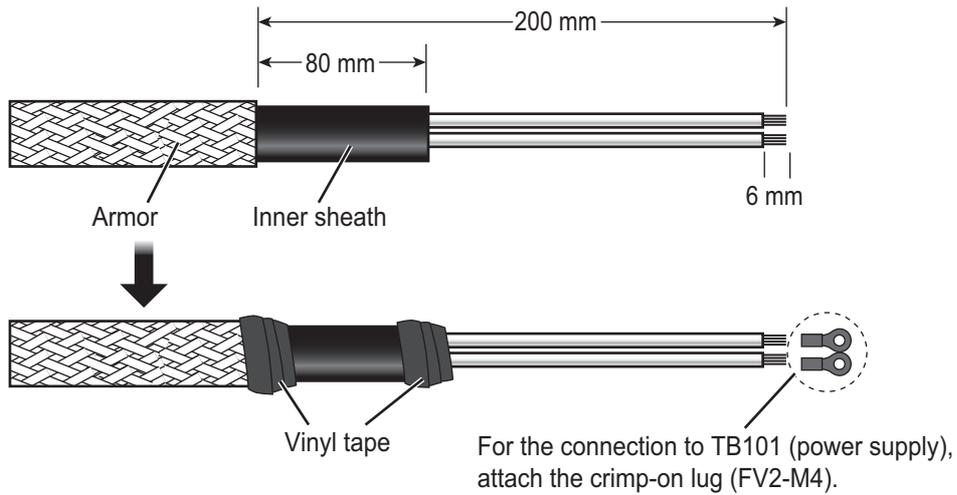
[Crossover cable]



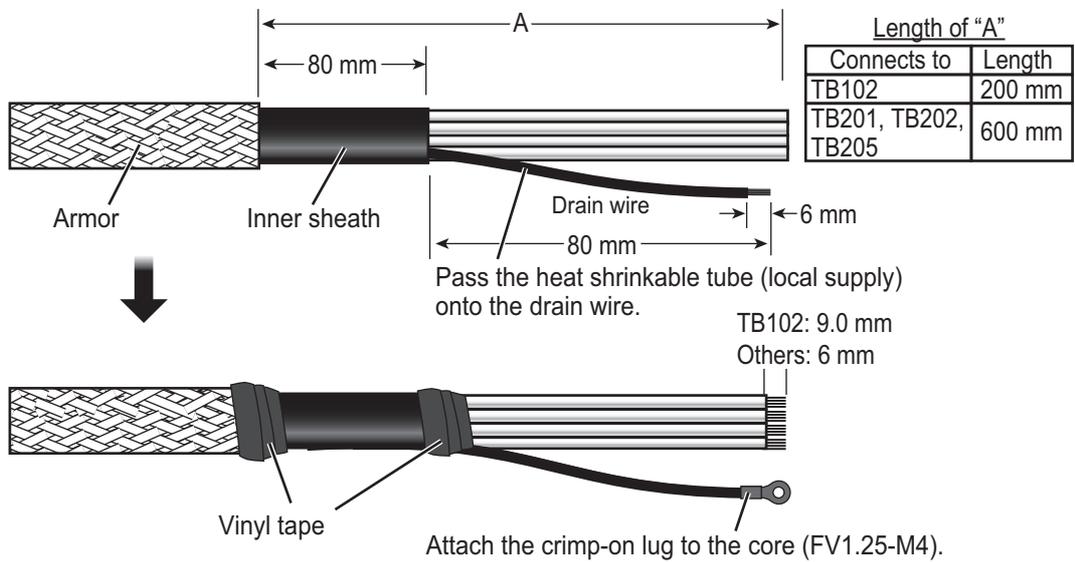
[Straight cable]



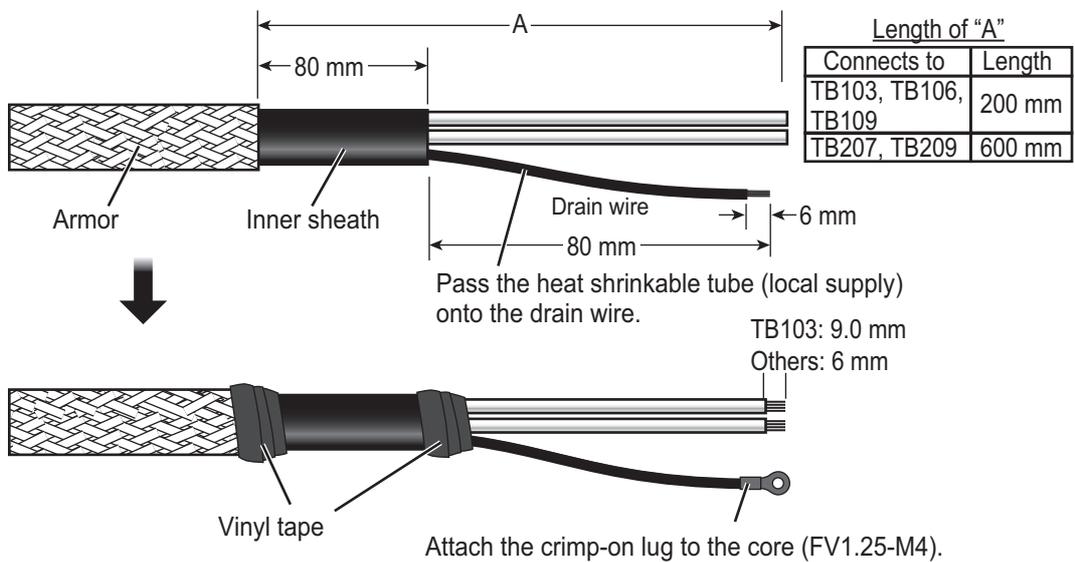
DPYC-1.5



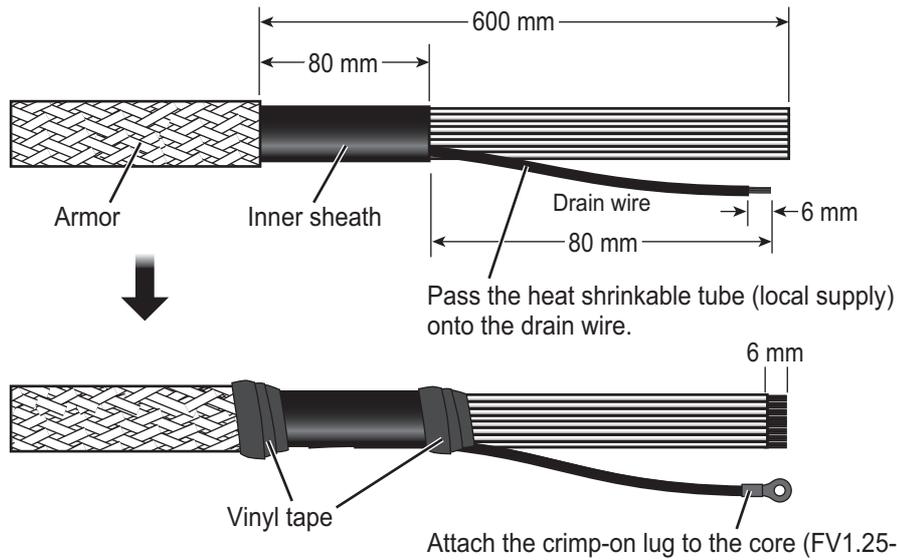
TTYCS(LA)-1Q



TTYCS(LA)-1



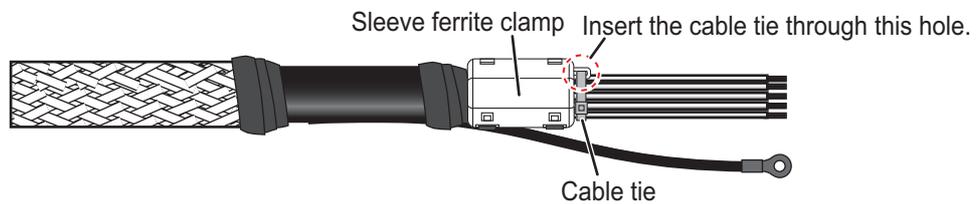
TTYCS(LA)-4



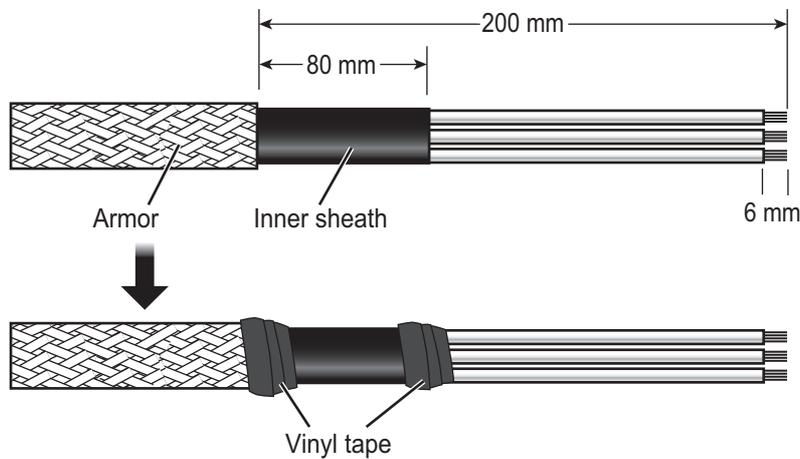
Note 1: For the IEC61162-2 and FU remote controller connections, cut the cores of no.6 to no.8 pins at the inner sheath end.

Connector	Signal	Cable	Remarks
TB201/TB202/ TB203/TB204	IEC61162-1 (NMEA0183)	TTYCS(LA)-1Q	Not required to cut the core.
	IEC61162-2	TTYCS(LA)-4	Cut the cores of no.6 to no.8 pins.
TB210/TB211/TB212	FU remote controller	TTYCS(LA)-4	

Note 2: For IEC61162-2 connection, attach the supplied sleeve ferrite clamp (GRFC-8) to the cores and bind them using the cable tie (CV-100N).



TPYC-1.5



How to connect cores for each type of wiring connector

Terminal opener

Core

Twist

Push downward.

Procedure

1. Twist the conductor.
2. Insert terminal opener and push.
3. Insert the conductor in the hole. Be careful not to pinch the sheath.
4. Release terminal opener.
5. Pull the core to confirm it is correctly inserted.

Terminal opener

Core

Twist

Push

Procedure

1. Twist the conductor.
2. Insert terminal opener and push.
3. Insert the conductor in the hole. Be careful not to pinch the sheath.
4. Release terminal opener.
5. Pull the core to confirm it is correctly inserted.

Core

Twist

Push downward.

Procedure

1. Twist the conductor.
2. Insert terminal opener or flat head screwdriver and push.
3. Insert the conductor in the hole. Be careful not to pinch the sheath.
4. Release terminal opener or flat head screwdriver.
5. Pull the core to confirm it is correctly inserted.

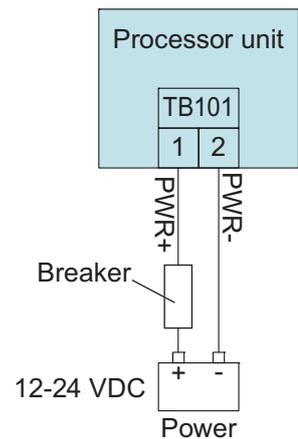
2.1.3 Power supply

Connect the ship's mains (12/24 VDC) to TB101 of the processor unit. For the connection, use the DPYC-1.5 cable. Connect through a breaker (local supply) whose rated current is 5 A, to turn the power off and stop the Autopilot in case of an emergency.

Note: Breaker must be installed at a location where it can be easily operated in an emergency.

TB101 (Ship's Main)

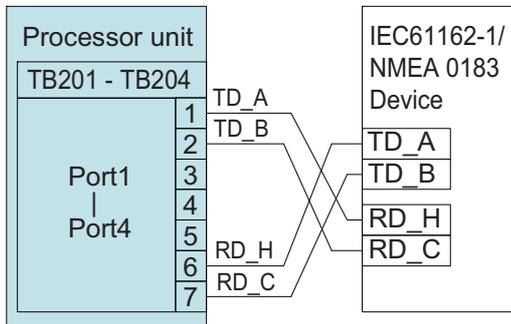
Pin No.	Signal	I/O	Signal Level
1	DC_P	In	12 to 24 VDC (10.8 to 31.2 VDC)
2	DC_N	In	0 V



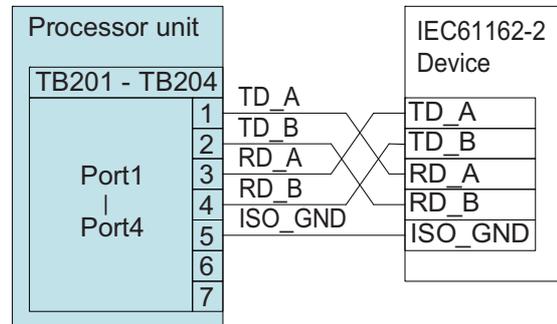
2.1.4 IEC61162-1/2 (NMEA 0183) devices

A maximum of four IEC61162-1/2 (NMEA 0183) devices can be connected to the NAVpilot. To connect the IEC61162-1/2 devices, use TB201 to TB204.

IEC-61162-1 (NMEA 0183) connection



IEC-61162-2 connection



TB201/TB202/TB203/TB204 (IEC61162-1/2, NMEA 0183)

Pin No.	Signal	I/O	Pin No.	Signal	I/O	Description	Remarks
TB201			TB202				
1	TD1-A	Out	1	TD2-A	Out	RS485	IEC61162-1/2
2	TD1-B	Out	2	TD2-B	Out		Only IEC61162-2
3	RD1-A	In	3	RD2-A	In		
4	RD1-B	In	4	RD2-B	In		
5	ISOGND	-	5	ISOGND	-	GND	Isolated GND
6	RD1-H	In	6	RD2-H	In	NMEA 0183 input level	Only IEC61162-1
7	RD1-C	In	7	RD2-C	In		
TB203			TB204				
1	TD3-A	Out	1	TD4-A	Out	RS485	IEC61162-1/2
2	TD3-B	Out	2	TD4-B	Out		Only IEC61162-2
3	RD3-A	In	3	RD4-A	In		
4	RD3-B	In	4	RD4-B	In		
5	ISOGND	-	5	ISOGND	-	GND	Isolated GND
6	RD3-H	In	6	RD4-H	In	NMEA 0183 input level	Only IEC61162-1
7	RD3-C	In	7	RD4-C	In		

How to terminate COM ports (For IEC 61162-1/2 signal)

When the output/input signal used is IEC61162-2 format, terminate at the DIP switch (S1, S2) as required. The DIP switch is located inside the processor unit.

COM port	DIP switch setting
COM1 (TB201)/COM2 (TB202)	Set S1 to ON, to turn the termination ON.
COM3 (TB203)/COM4 (TB204)	Set S2 to ON, to turn the termination ON.

Note 1: Incorrect termination may cause communication errors.

Note 2: When using the COM ports as IEC61162-1 or the COM ports are not used, termination must be OFF (default setting: OFF).

2.1.5 NMEA 2000 (CAN bus) devices

To connect with NMEA 2000 (CAN bus) devices, connect the processor unit (J102/J103) to the NMEA 2000 network backbone. J102 is used for NMEA 2000 signal communication, and J103 is used for the power supply to the control units (max. 3 units).

J102 (NMEA 2000)

Pin No.	Signal	I/O	Signal Level	Description
1	NET_S	In	9.0 V to 16.0 V	Power input from NMEA 2000
2	NET_C	In	0 V	GND
3	NET_H	In/out	1.5 V to 3.5 V	NMEA 2000 signal
4	NET_L	In/out	1.5 V to 3.5 V	

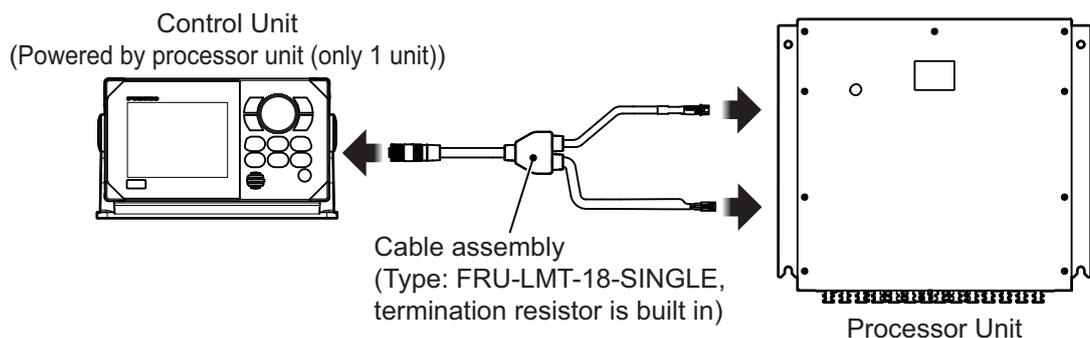
J103 (15V_P)

Pin No.	Signal	I/O	Signal Level	Description
1	+15V	Out	15 V \pm 5%, 3 A max	Connect to NET_S
2	GND	Out	0 V	Connect to NET_C

Connection with the control unit

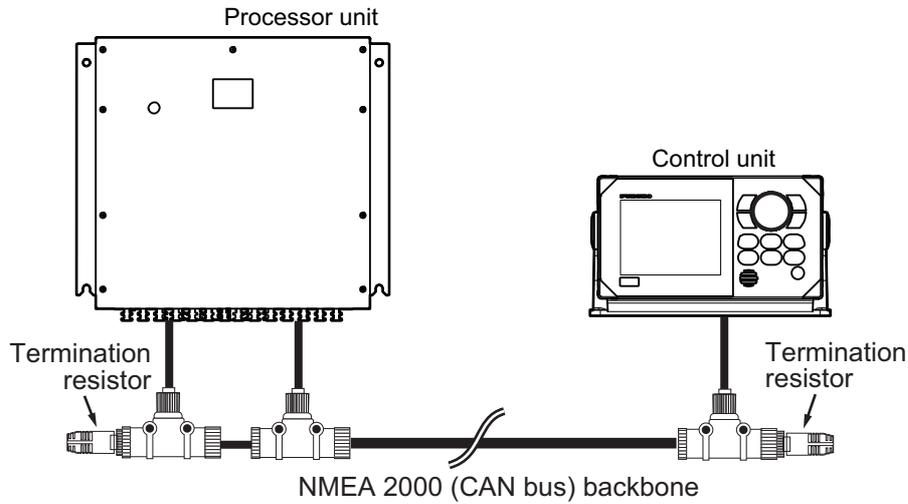
A maximum of six control units can be connected to the processor unit, through the NMEA 2000 (CAN bus) network. The processor unit can supply the power to up to three control units. If four or more control units or other NMEA 2000 sensors are connected, a power isolator and external power supply to the NMEA 2000 network are required. For details, see section 2.2.

If your ship does not need SOLAS certification, the optional cable assembly (type: FRU-LMT-18-SINGLE) can be used. This allows you to connect the control unit and processor unit directly without connecting via the NMEA 2000 backbone. In this case, note that only one control unit can be connected and NMEA 2000 equipment cannot be connected to the NAVpilot.



Termination resistors for NMEA 2000 (CAN bus) network

Termination resistors are required to close off the NMEA 2000 (CAN bus) network ends, completing the network.



The following optional termination resistors are available:

Name	Type	Code No.	Remarks
Termination Resistor (Micro)	FRU-MM1000000001	001-507-070	Male connector
	FRU-MF000000001	001-507-060	Female connector

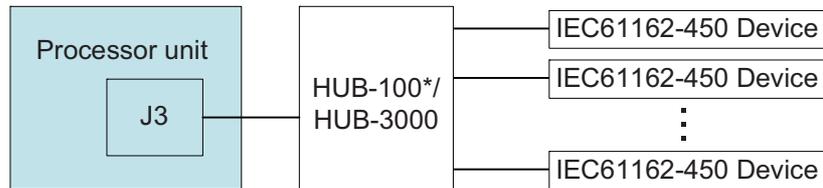
What is CAN bus?

CAN bus is a communication protocol (NMEA 2000 compliant) that shares multiple data and signals through a single backbone cable. You can simply connect any CAN bus devices onto the backbone cable to expand your network on-board. With CAN bus, IDs are assigned to all the devices in the network, and the status of each sensor in the network can be detected. All the CAN bus devices can be incorporated into the CAN bus network.

For technical personnel: See “Furuno CAN bus Network Design Guide” (TIE-00170) for details about CAN bus network.

2.1.6 IEC61162-450 devices

Connect the IEC61162-450 devices to the processor unit, through HUB-100. For the IEC61162-450 connections, use J3 port (RJ-45 connector) on the processor unit.



*: HUB-100 can be used only for IEC61162-450 Ed.1 compliant network.

J3 (IEC61162-450)

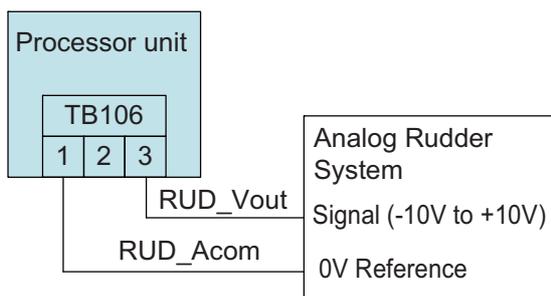
Pin No.	Signal	I/O	Signal level	Description
1	LAN_TXD_P	Out	+3.3 V	Ethernet TX Data (+)
2	LAN_TXD_N	Out	+3.3 V	Ethernet TX Data (-)
3	LAN_RXD_P	In	+3.3 V	Ethernet RX Data (+)
4	-	-	-	-
5	-	-	-	-
6	LAN_RXD_N	In	+3.3 V	Ethernet RX Data (-)
7	-	-	-	-
8	GND	-	GND	-
-	Shield	-	Shield	-

2.1.7 Steering system connections

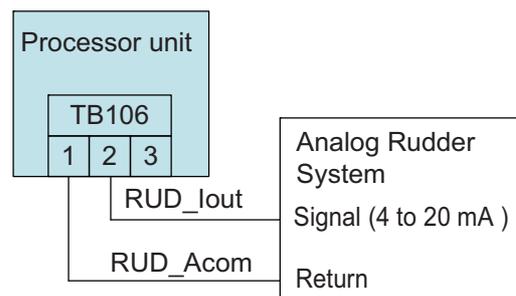
Analog steering system

The NAVpilot outputs an analog signal to the steering system to control the rudder steering. Use TB106 to connect with the analog steering system.

• Voltage type



• Current type



TB106 (Analog IF)

Pin No.	Signal	I/O	Characteristics	Description
1	RUD_A_Com	-	<ul style="list-style-type: none"> Voltage: common Current: return 	-
2	RUD_Iout	Out	<ul style="list-style-type: none"> Controlling range: 4 to 20 mA 	4 to 20 mA current loop, variable output range For analog current output
3	RUD_Vout	Out	<ul style="list-style-type: none"> Controlling range: -10 to +10 V Rated current: 5 mA 	Differential voltage output, variable output range For analog voltage output

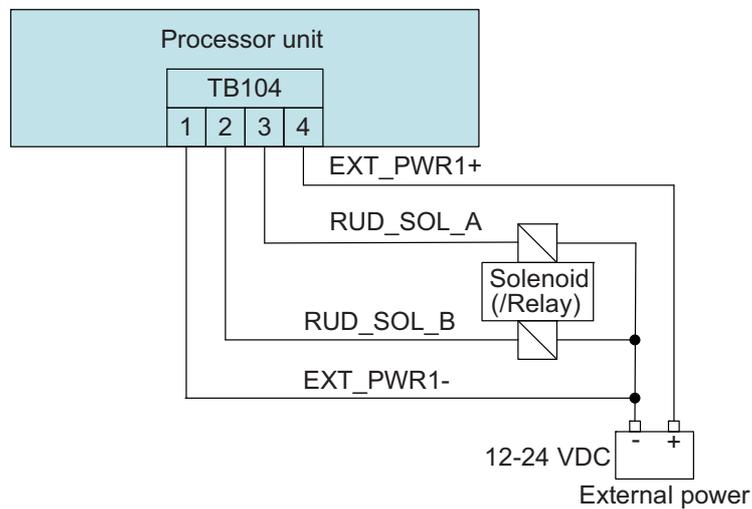
Solenoid valve

The NAVpilot controls the solenoid or relay to control the hydraulic direction for rudder steering. Use TB104 to connect with the solenoid valve or relay. The NAVpilot is only compatible with a common negative solenoid.

TB104 (Solenoid IF)

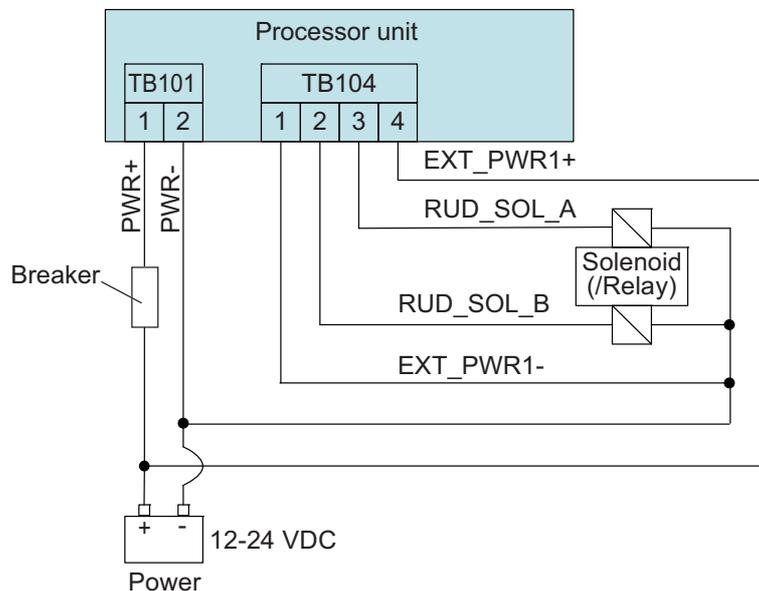
Pin No.	Signal	I/O	Characteristics	Description
1	EXT_PWR1-	-	-	Counter-electromotive force suppression
2	RUD_SOL_A	Out	Rated current: Max. 3A	Isolated ON/OFF control, operated by external power supply
3	RUD_SOL_B	Out	Rated current: Max. 3A	
4	EXT_PWR1+	In	External power supply: 12 to 24 VDC (10.8 to 31.2 V)	-

- Isolated solenoid valve

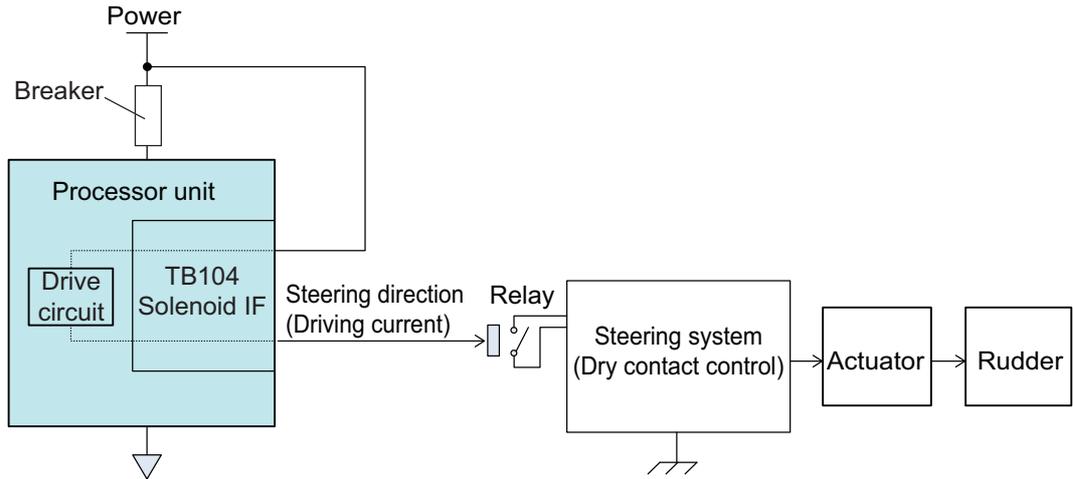


- Non-isolated solenoid valve

Note: When a non-isolated solenoid is used, TB104 must be connected with the power source that is branched from the power source line of the processor unit.



- Dry contact type steering system (relay)



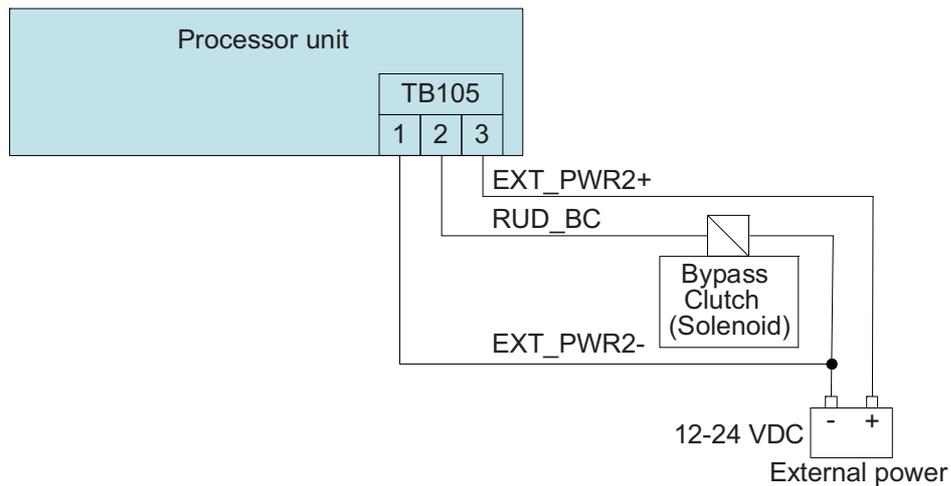
Bypass clutch signal

When the NAVpilot needs to control the bypass valve or relay separate from the solenoid connection, to control the steering system, use the bypass clutch interface (TB105).

TB105 (Bypass clutch)

Pin No.	Signal	I/O	Characteristics	Description
1	EXT_PWR2-	-	-	-
2	RUD_BC	Out	Rated current: Max. 3A	Isolated B/C control, operated by external power supply
3	EXT_PWR2+	In	External power supply: 12 to 24 VDC (10.8 to 31.2 V)	-

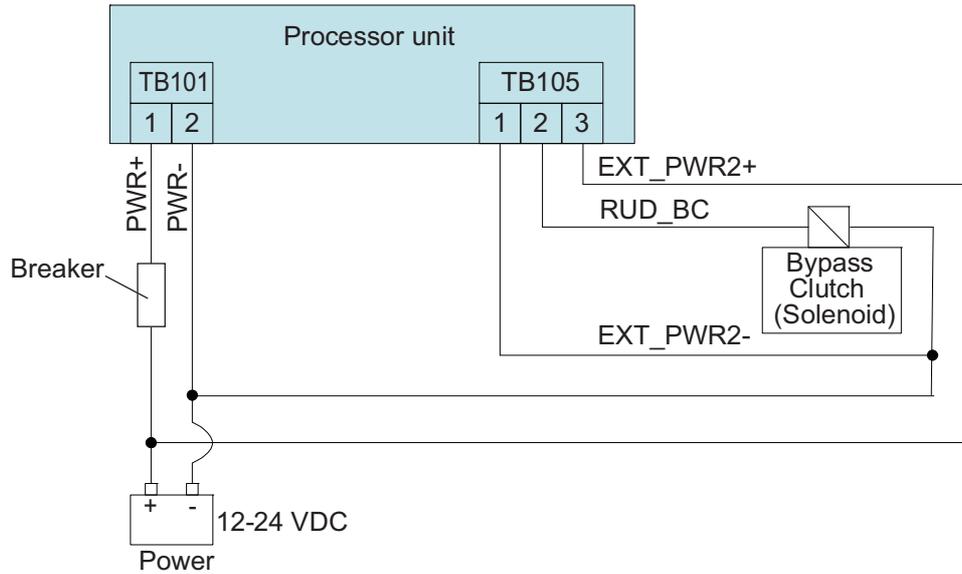
- Isolated solenoid type



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- Non-isolated solenoid type

Note: When a non-isolated solenoid is used, TB105 must be connected with the power source that is branched from the power source line of the processor unit.



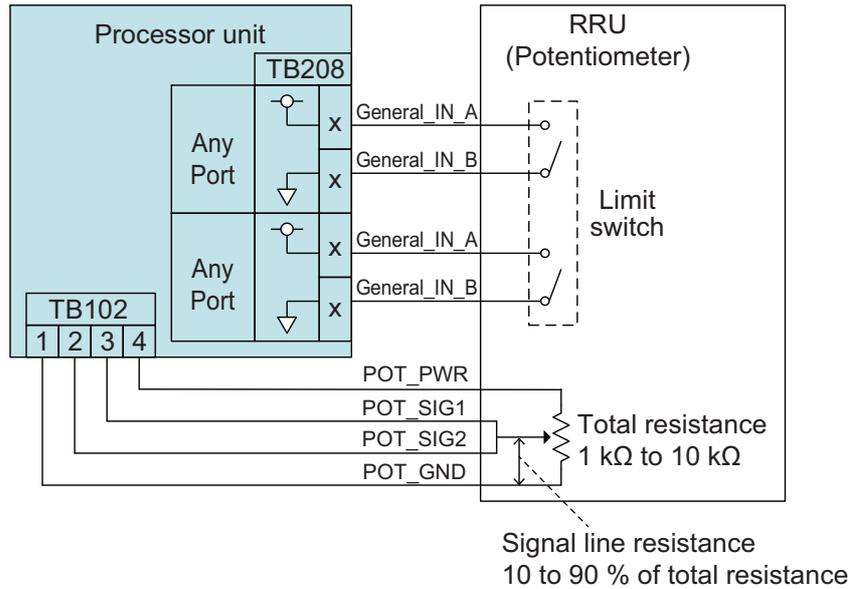
2.1.8 Rudder reference unit connections

The following types of rudder reference units (RRU) can be used with the NAVpilot-1000:

Sensor type	Connect to	Remarks
Potentiometer type (1 to 10 kΩ)	TB102	<ul style="list-style-type: none"> • Maximum cable length is 20 m.
Voltage output type (minimum range: 0 to 5V, maximum range: -10 to 10 V)	TB103	<ul style="list-style-type: none"> • Maximum cable length is 100 m. • External power supply to the RRU is required.
Current output type (4 to 20 mA)		
Frequency output type (1600 to 5200 Hz)	TB213	<ul style="list-style-type: none"> • Maximum cable length is 100 m. • NAVpilot supplies the power (12 V) to the RRU.

Note: For the non-IMO type, the NAVpilot can operate without the RRU, if the ship's steering system is analog drive. Note that course-keeping performance may decline compared to with RRU. Also, the rudder angle indicator and FU/NFU remote control cannot be used.

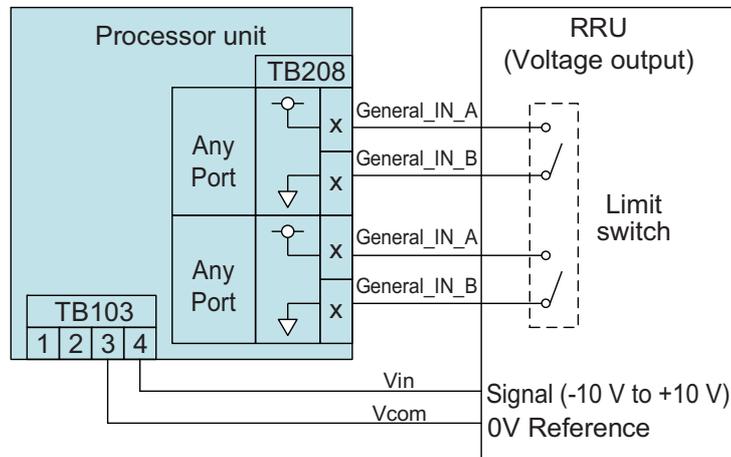
• Potentiometer type



TB102 (RRU POT.)

Pin No.	Signal	I/O	Characteristics	Description
1	POT_GND	-	-	GND
2	POT_SIG2	In	-	Signal input from potentiometer
3	POT_SIG1	In	-	
4	POT_PWR	Out	+12 VDC	Power supply to potentiometer

• Voltage output type

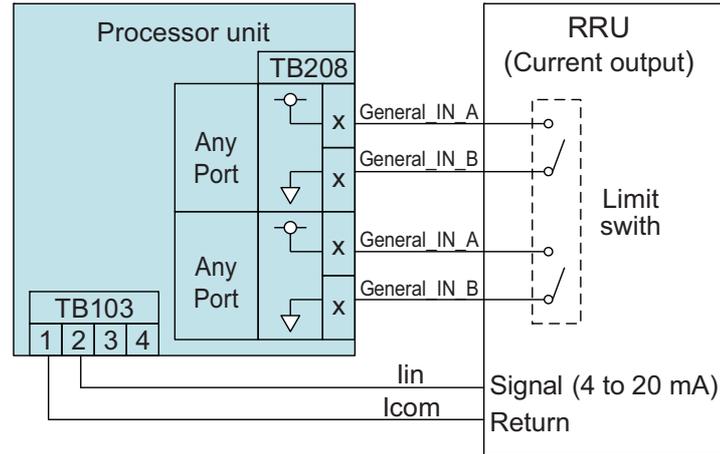


TB103 (RRU ANALOG.)

Pin No.	Signal	I/O	Characteristics	Description
1	Icom	In	Current input (4 to 20 mA current loop)	Return (current)
2	Iin	In		Current input signal
3	Vcom	In	Voltage input (minimum range: 0 V to 5 V, maximum range: -10 V to +10 V)	Common (voltage)
4	Vin	In		Voltage input signal

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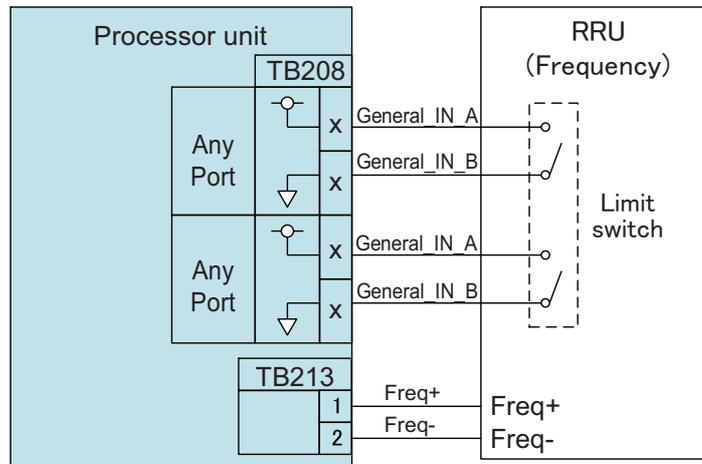
- Current output type



TB103 (RRU ANALOG.)

Pin No.	Signal	I/O	Characteristics	Description
1	Icom	In	Current input	Return (current)
2	Iin	In	(4 to 20 mA current loop)	Current input signal
3	Vcom	In	Voltage input	Common (voltage)
4	Vin	In	(minimum range: 0 V to 5 V, maximum range: -10 V to +10 V)	Voltage input signal

- Frequency type



TB213 (RRU FREQUENCY.)

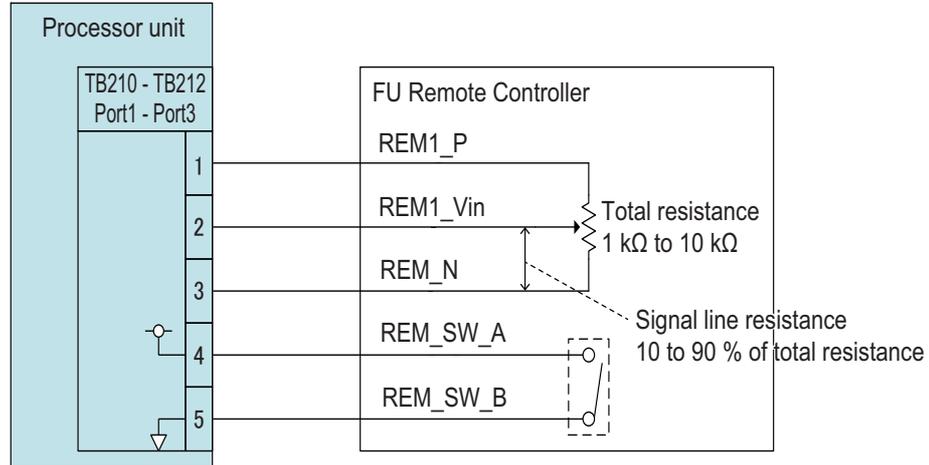
Pin No.	Signal	I/O	Characteristics	Description
1	FRQ+	Out	+12 VDC	Power supply to frequency type RRU
2	Freq-	In	Switching current input (frequency: 1600 to 5200 Hz)	Switching current return input from frequency RRU

2.1.9 Connection to FU remote controller

The following FU (follow up) remote controller is available with the NAVpilot-1000. A maximum of three remote controllers can be connected.

Note: The RRU must be installed to use the FU remote controller.

Type	Signal IF of remote controller	Active switch
FU remote controller	Potentiometer (1 kΩ to 10 kΩ)	With active switch
		Without active switch



TB210/TB211/TB212 (FU Remote Controller IF.)

Pin No.	Signal	I/O	Characteristics	Description
TB210				
1	REM1_PWR	Out	+5 VDC	Power supply to remote controller
2	REM1_Vin	In	-	FU signal
3	GND	-	-	-
4	REM1_SW_A	In	Dry contact input	Used for active switch
5	REM1_SW_B	In		
TB211				
1	REM2_PWR	Out	+5 VDC	Power supply to remote controller
2	REM2_Vin	In	-	FU signal
3	GND	-	-	-
4	REM2_SW_A	In	Dry contact input	Used for active switch
5	REM2_SW_B	In		
TB212				
1	REM3_PWR	Out	+5 VDC	Power supply to remote controller
2	REM3_Vin	In	-	FU signal
3	GND	-	-	-
4	REM3_SW_A	In	Dry contact input	Used for active switch
5	REM3_SW_B	In		

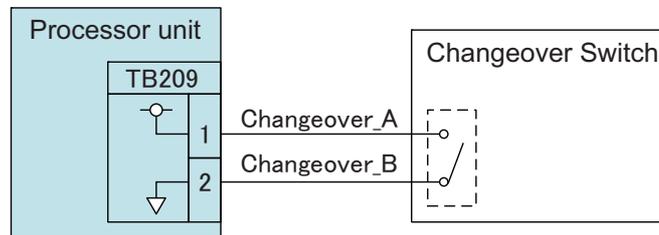
2.1.10 Connection to external I/O

Dedicated port

- Changeover switch connection (TB209)
 The changeover switch switches between the auto steering and manual steering. Set the switch to OFF to get full control of the boat with the NAVpilot. The ON position provides only the STBY mode functions (manual steering). The changeover switch is required by the regulations for the HCS (Refer to IMO resolution MSC 64. sec 4).
 Use TB209 to connect with the changeover switch.

TB209 (Changeover)

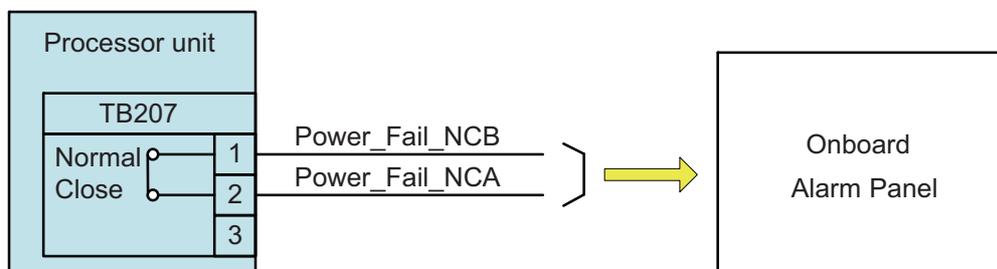
Pin No.	Signal	I/O	Characteristics	Description
1	Changeover_A	In	Dry contact input	<ul style="list-style-type: none"> ON: Disengage mode (manual steering) ON → OFF: AUTO mode
2	Changeover_B	In		



- Power fail signal (TB207)
 The NAVpilot outputs the power fail signal when the input voltage has failed from TB207. Connect with an external alarm system.
Note: For the IMO type, power fail signal must be connected to an external alarm system in accordance with ISO 11674.

TB207 (Power Fail)

Pin No.	Signal	I/O	Characteristics	Description
1	PowerFail_A	Out	<ul style="list-style-type: none"> Dry contact output Load current: 100 mA or less Load voltage: 12 to 24 V (10.8 to 31.2 V) 	<ul style="list-style-type: none"> Open: Power fail Close: Normal state
2	PowerFail_B	Out		
3	NC	-		



Universal purpose port

The NAVpilot has contact input/output ports (TB205/TB206/TB208) that can be software programmed for various purposes like interface to handshake signal, rudder angle limit switch, NFU remote controller, central alarm panel, BNWAS, steering switch, indicator equipment. For how to select the command of function for the Universal purpose port, see section 3.6.15.

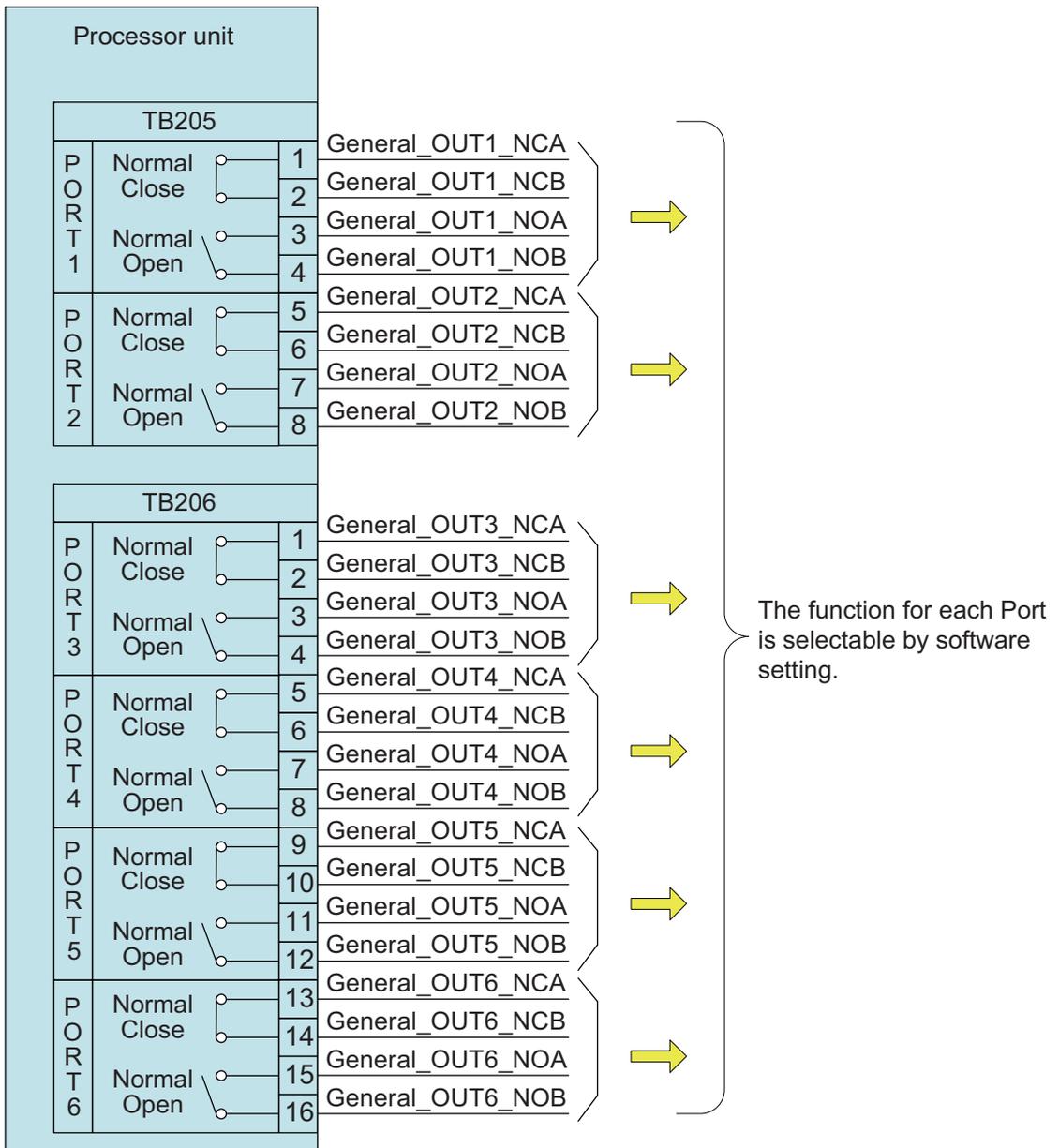
TB205 (Universal Output 1 and 2)

Pin No.	Signal	I/O	Characteristics	Description
1	General_OUT1_NCA	Out	<ul style="list-style-type: none"> • Dry contact output (Normally open/close) • Load current: 100 mA or less • Load voltage: 12 to 24 V (10.8 to 31.2 V) 	Universal output 1
2	General_OUT1_NCB	Out		
3	General_OUT1_NOA	Out		
4	General_OUT1_NOB	Out		
5	General_OUT2_NCA	Out	<ul style="list-style-type: none"> • Dry contact output (Normally open/close) • Load current: 100 mA or less • Load voltage: 12 to 24 V (10.8 to 31.2 V) 	Universal output 2
6	General_OUT2_NCB	Out		
7	General_OUT2_NOA	Out		
8	General_OUT2_NOB	Out		

TB206 (Universal Output 3 to 6)

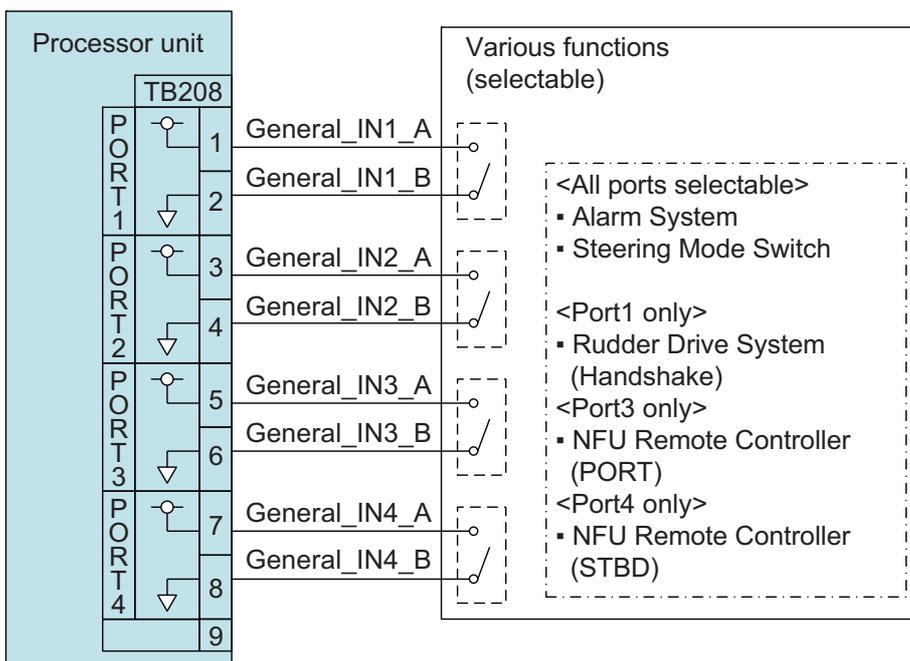
Pin No.	Signal	I/O	Characteristics	Description
1	General_OUT3_NCA	Out	<ul style="list-style-type: none"> • Dry contact output (Normally open/close) • Load current: 100 mA or less • Load voltage: 12 to 24 V (10.8 to 31.2 V) 	Universal output 3
2	General_OUT3_NCB	Out		
3	General_OUT3_NOA	Out		
4	General_OUT3_NOB	Out		
5	General_OUT4_NCA	Out	<ul style="list-style-type: none"> • Dry contact output (Normally open/close) • Load current: 100 mA or less • Load voltage: 12 to 24 V (10.8 to 31.2 V) 	Universal output 4
6	General_OUT4_NCB	Out		
7	General_OUT4_NOA	Out		
8	General_OUT4_NOB	Out		
9	General_OUT5_NCA	Out	<ul style="list-style-type: none"> • Dry contact output (Normally open/close) • Load current: 100 mA or less • Load voltage: 12 to 24 V (10.8 to 31.2 V) 	Universal output 5
10	General_OUT5_NCB	Out		
11	General_OUT5_NOA	Out		
12	General_OUT5_NOB	Out		
13	General_OUT6_NCA	Out	<ul style="list-style-type: none"> • Dry contact output (Normally open/close) • Load current: 100 mA or less • Load voltage: 12 to 24 V (10.8 to 31.2 V) 	Universal output 6
14	General_OUT6_NCB	Out		
15	General_OUT6_NOA	Out		
16	General_OUT6_NOB	Out		

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TB208 (Universal Input 1 to 4)

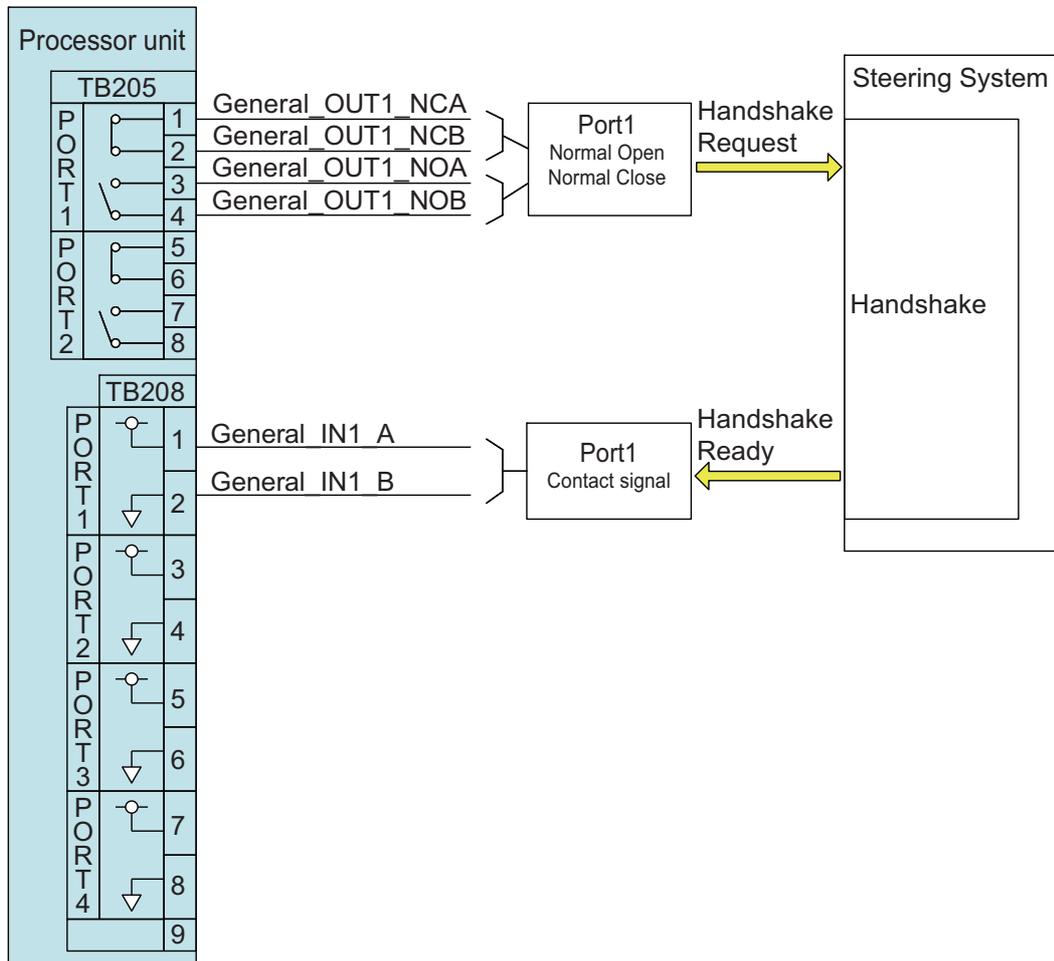
Pin No.	Signal	I/O	Characteristics	Description
1	General_IN1_A	In	Dry contact input	Universal input 1
2	General_IN1_B	In		
3	General_IN2_A	In	Dry contact input	Universal input 2
4	General_IN2_B	In		
5	General_IN3_A	In	Dry contact input	Universal input 3
6	General_IN3_B	In		
7	General_IN4_A	In	Dry contact input	Universal input 4
8	General_IN4_B	In		
9	NC	In	-	-



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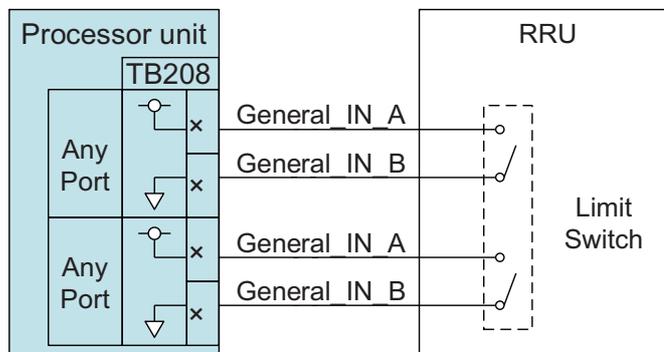
- Handshake signal

When the computer system controls the rudder, the NAVpilot must be get the rudder control authority from the system. In this case, connect the system to the Universal Input (TB208) and Output (TB205) ports to receive/transmit the control authority, using the handshake signal.



- Rudder angle limit switch connection

When the RRU has the rudder angle limit switch, connect the signal from the limit switch to the Universal Input port (TB208). The NAVpilot stops the rudder steering and shows a message when the rudder reaches the rudder limit.

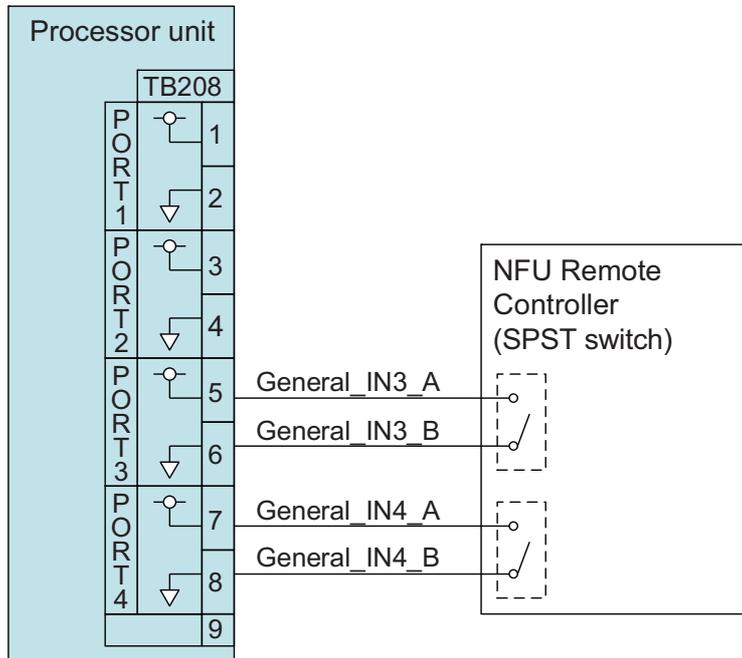


- NFU remote controller connection

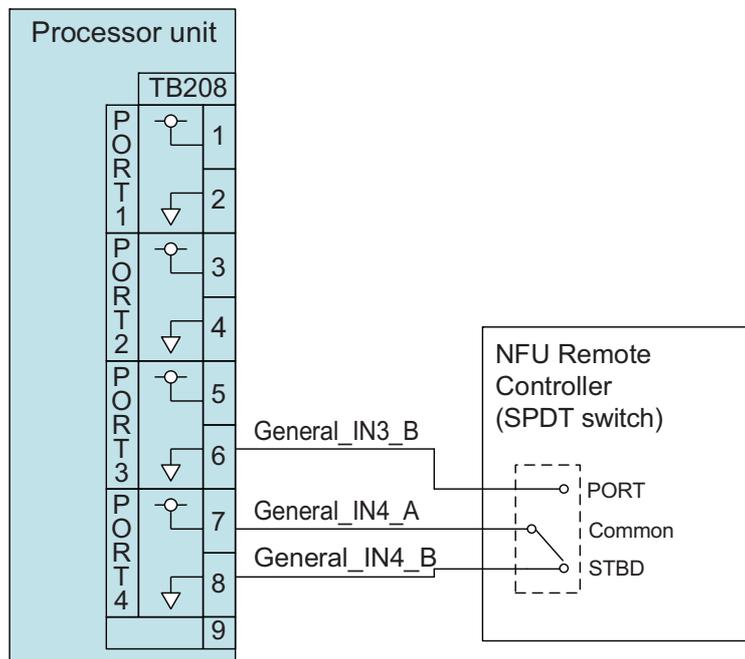
To connect with the NFU (Non-Follow UP) remote controller, use the Universal Input port (TB208).

Note: The RRU must be installed to use the NFU remote controller.

- SPST switch



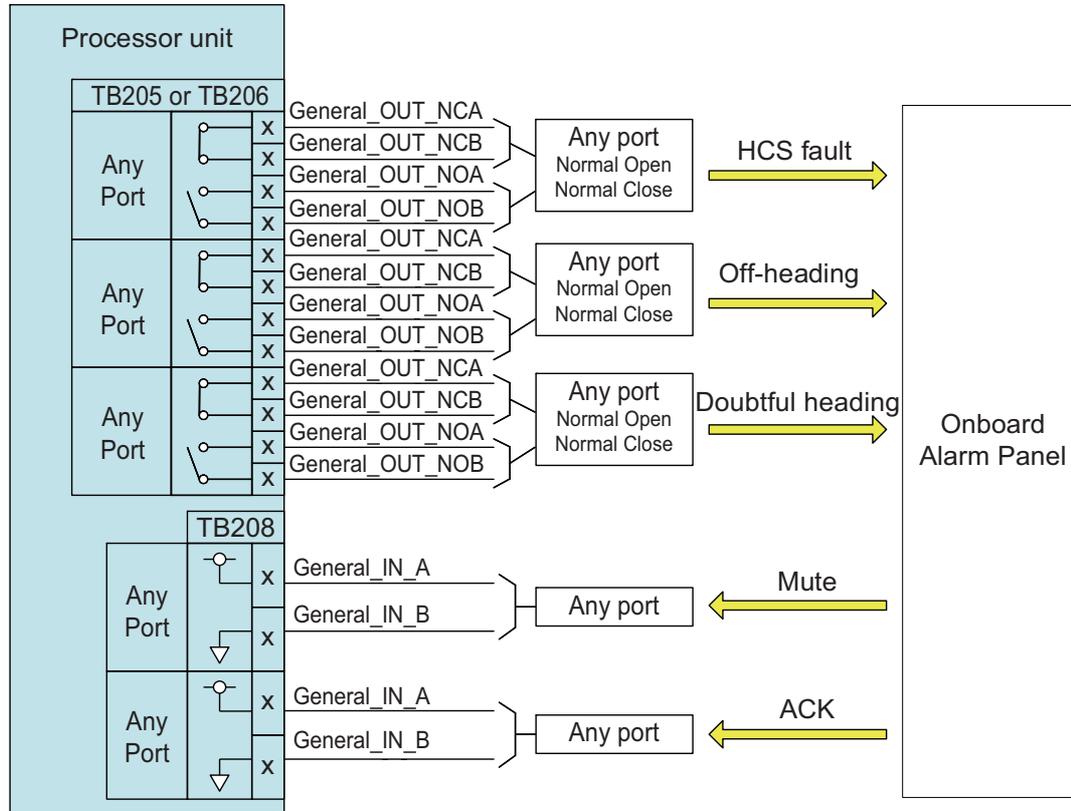
- SPDT switch



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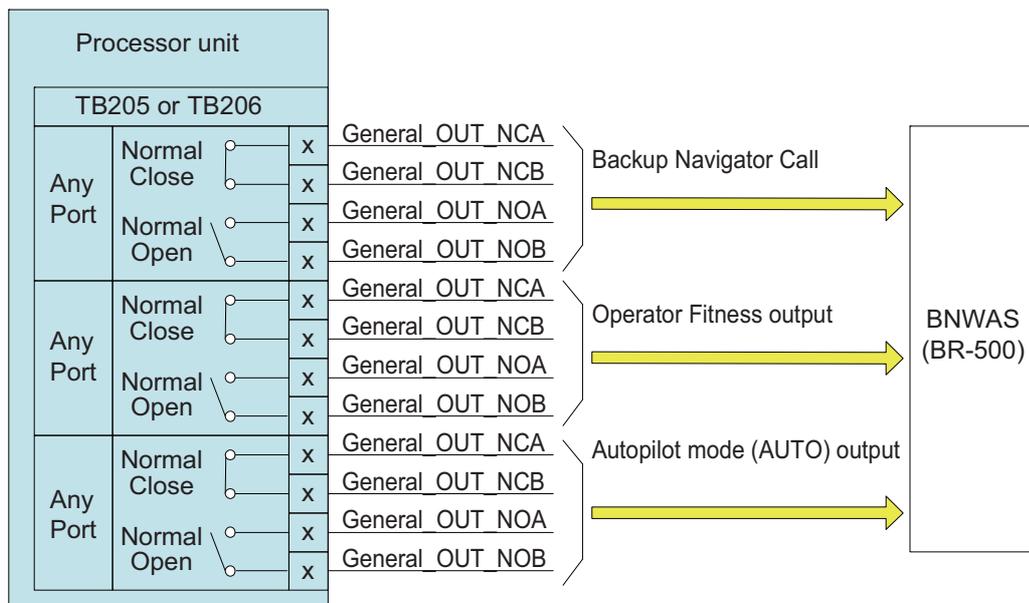
- Central alarm panel with direct I/O interface

The NAVpilot can output the HCS fault, off heading and heading monitor alarm signal to the central alarm panel. To connect with the alarm panel, use TB205/TB206 (Universal Output) and TB208 (Universal Input).



- BNWAS connection

The NAVpilot can output the backup navigator call, operator fitness and autopilot mode signal to the BNWAS (Bridge Navigation Watch Alarm System) connection. To connect with the BNWAS, use the Universal Output (TB205/TB206) port.



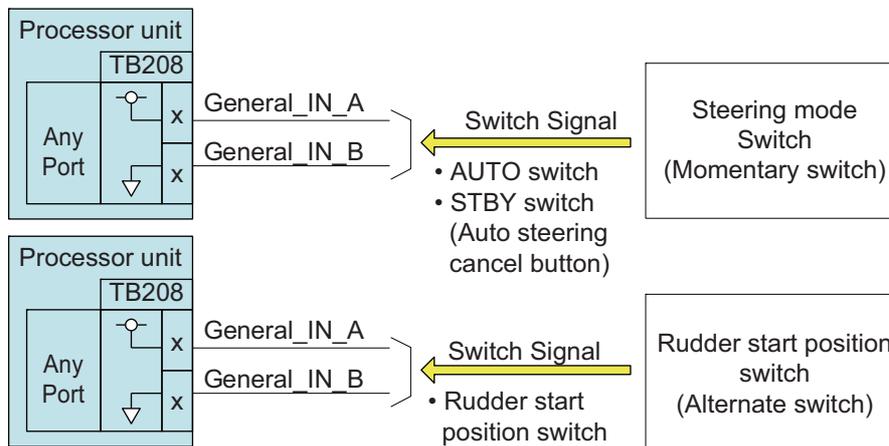
• Steering mode switch/rudder start position switch connection

To connect the steering mode switch and rudder start position switch, use the Universal Input port (TB208).

Note 1: Install a control unit equipped with the **STBY** key, or an “auto steering cancel button” (STBY switch) at the helm and all steering stations, to disable rudder control by the autopilot in an emergency. Install the button where it can be easily operated.

Note 2: To use the steering mode switch, initial setting must be completed. See chapter 3.

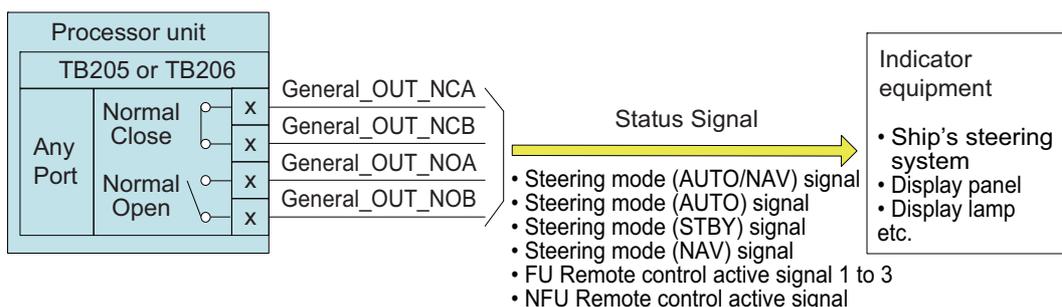
Switch	Explanation	Signal interface
Steering mode switch	The switch, when operated, puts the NAVpilot in the AUTO/STBY mode.	Contact output, Momentary switch
Rudder start position switch	The switch, when operated, switches the rudder position to start auto steering. Turn the switch on to start auto steering from the rudder position when auto steering is activated. Turn the switch off to start auto steering when the rudder is centered. This function is not available when the RRU is not installed.	Contact output, Alternate switch



• Indicator equipment connection

To show the steering status of the NAVpilot, connect the indicator equipment to the Universal Output port (TB205/TB206).

Steering status output from NAVpilot	Connected to	Signal interface
<ul style="list-style-type: none"> Steering mode (AUTO/NAV) signal Steering mode (AUTO) signal Steering mode (STBY) signal Steering mode (NAV) signal FU remote control active signal 1 to 3 NFU remote control active signal 	<ul style="list-style-type: none"> Ship's steering system Display panel Display lamp etc. 	<ul style="list-style-type: none"> Contact input Load current: Max. 100 mA



2.1.11 Auto steering cancel button

Install a control unit equipped with the **STBY** key, or an “auto steering cancel button” (local supply) at the helm and all steering stations, to disable rudder control by the autopilot in an emergency. Install the button where it can be easily operated.

Do the following to install the auto steering cancel button:

- 1) Connect a momentary switch (local supply) to the Universal Input port (TB208) of the processor unit, referring to page 2-27.
- 2) Change the setting of the Universal Input port to [Go STBY]. See section 3.6.15.

When the auto steering cancel button is pressed, autopilot rudder control is disabled and the steering mode changes to the STBY mode (manual steering).

2.2 Control Unit

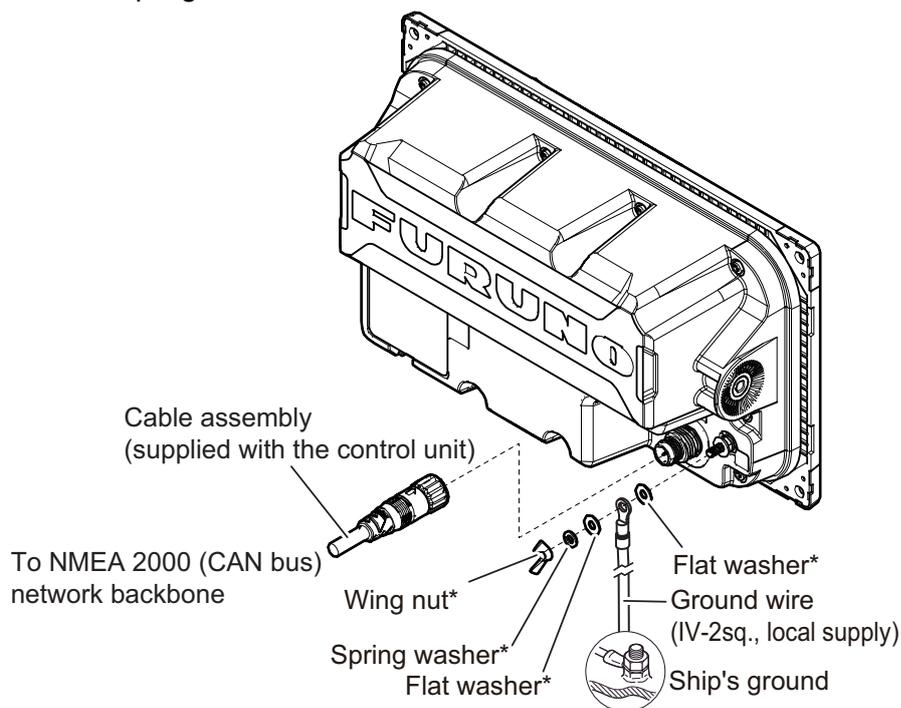
The control unit is part of a network, connected via a NMEA 2000 (CAN bus) backbone. A maximum of six control units can be connected in the same network.

If your ship does not need SOLAS certification, the optional cable assembly (type: FRU-LMT-18-SINGLE) can be used. This allows you to connect the control unit and processor unit directly without connecting via the NMEA 2000 backbone. For details, see page 2-11.

Connection

Using the supplied cable assembly, connect the control unit to the NMEA 2000 (CAN bus) network backbone. The control unit must be on the same network as the processor unit.

To ground the unit, fasten a ground wire (IV-2sq., local supply) between its ground terminal and the ship’s ground.

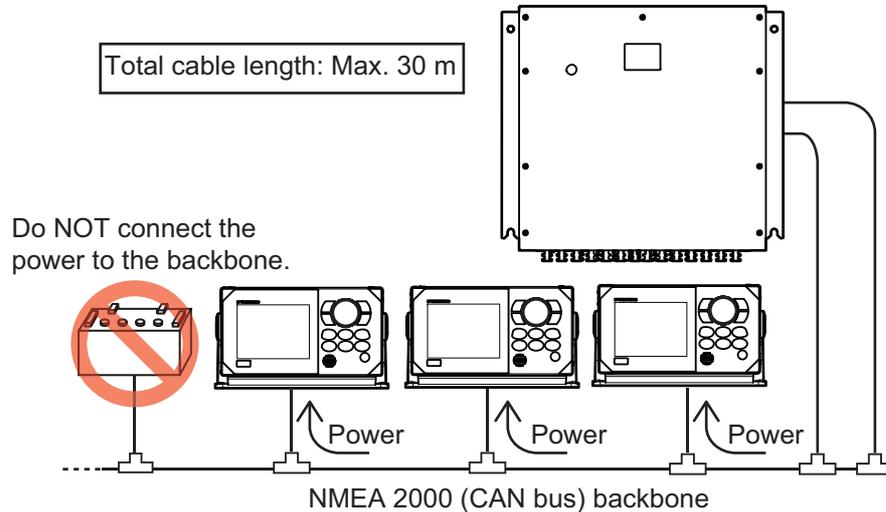


*: Pre-attached to the unit.

Power supply

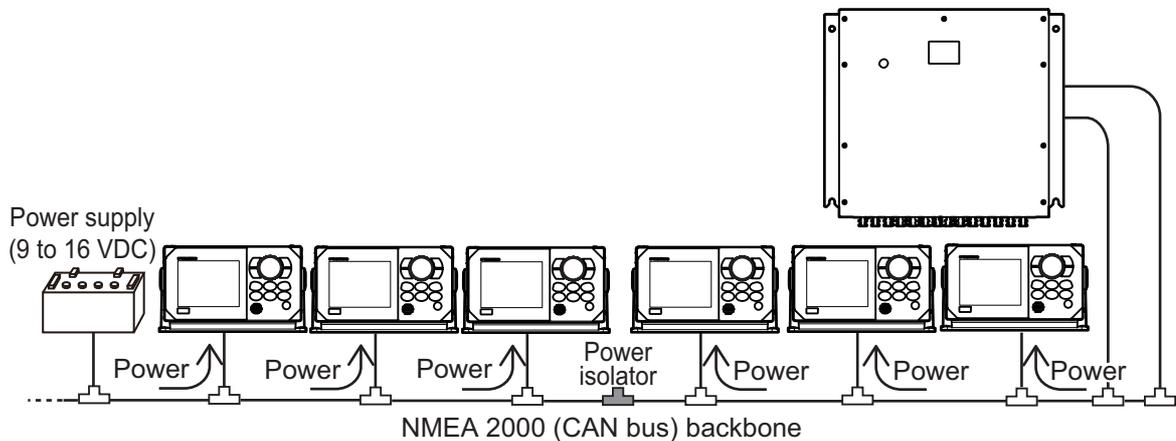
- Three or less control units are connected: Power is supplied from the processor unit through the NMEA 2000 (CAN bus) network. Do NOT connect the external power supply or other NMEA 2000 sensors to the NMEA 2000 backbone.

Note: The total cable length of the drop and backbone cables between the control unit and processor unit must be 30 m or less. If exceeds 30 m, the control unit may not work properly due to the voltage drop.



- Four or more control units or other NMEA 2000 sensors are connected: Connect the power isolator to the NMEA 2000 (CAN bus) network and provide the external power supply to the backbone.

Note: If the power isolator is not connected, power failure occurs due to the collision of the power supply, and "CAN-bus PWR fail" alert occurs.

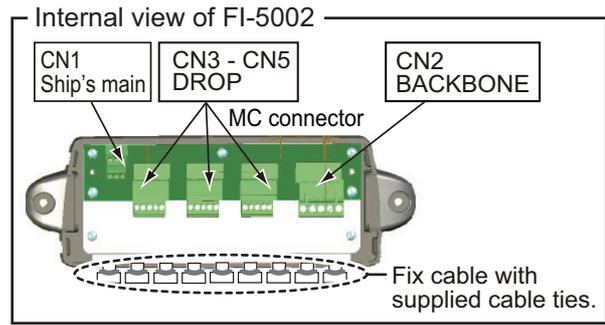


2.3 Junction Box (Option)

The optional junction box FI-5002 has two backbone ports and allows up to six NMEA 2000 (CAN bus) devices to be networked together. The FI-5002 is available for connecting between the processor unit and control unit.

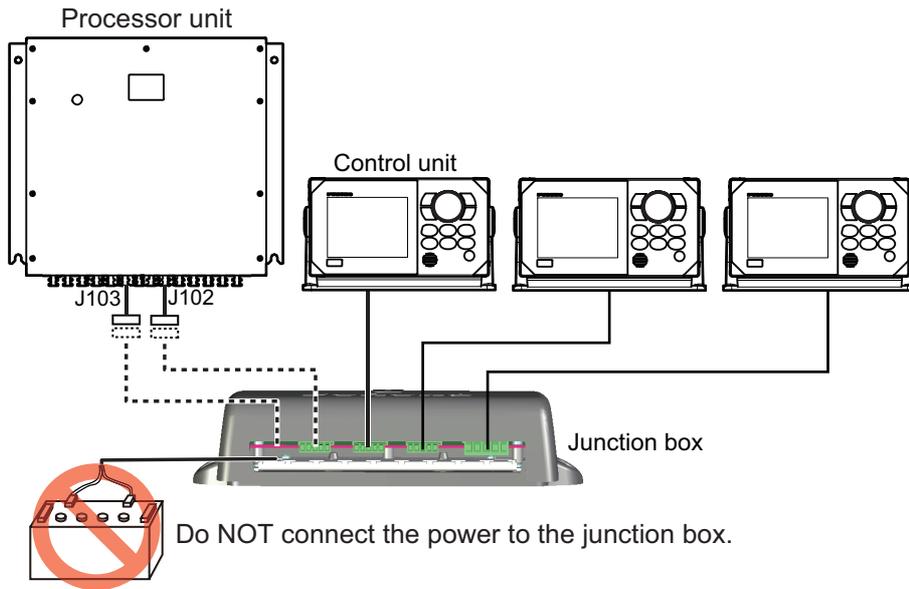
When using the FI-5002 to connect between the processor unit and control unit, fabricate the drop cable, then connect the cable to the FI-5002 internal MC connectors (CN3 to CN5).

For details about the FI-5002 installation, refer to the installation instructions (C72-00702) supplied with the FI-5002.



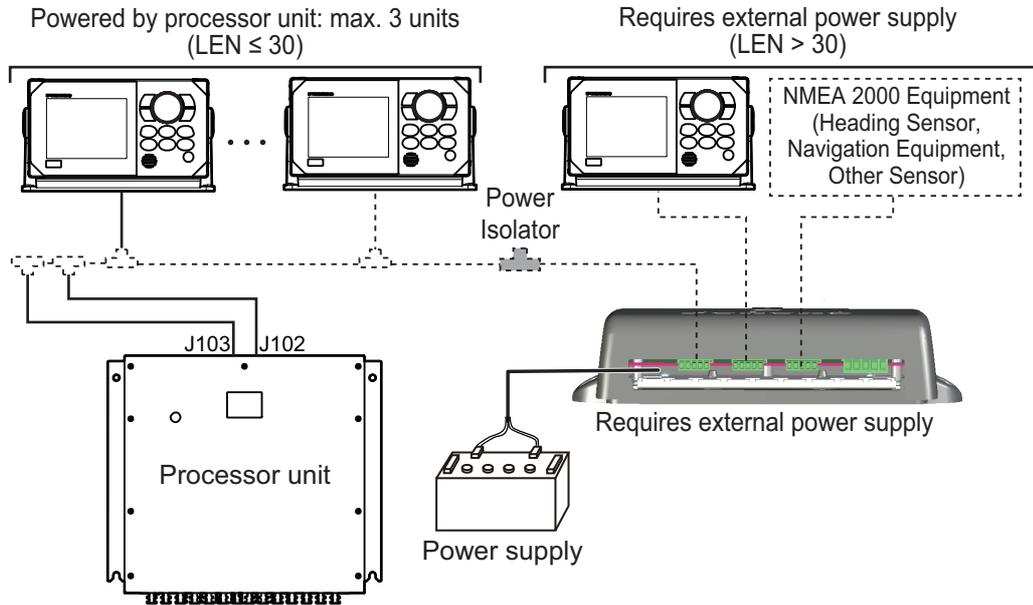
Three or less control units and processor unit are connected

The power port (CN1) of the junction box should be connected to the processor unit (J103). External power supply is not required.



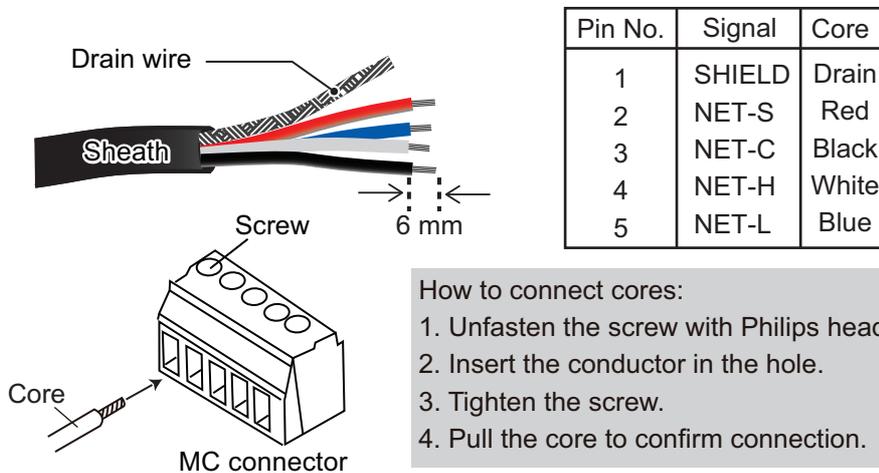
Four or more control units or external NMEA 2000 network are connected

Connect the power isolator between the NMEA 2000 network of the NAVpilot and junction box and provide the external power supply to the junction box.



2.3.1 How to fabricate the drop cable

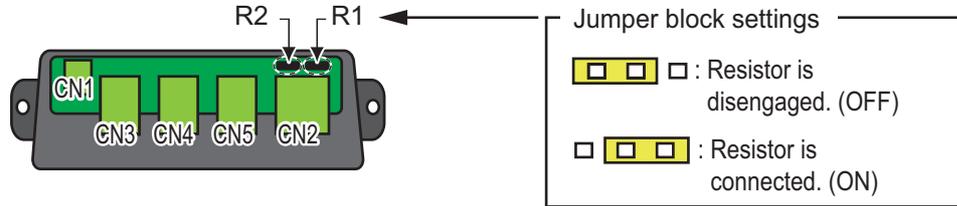
The drop cable, which is supplied with the control unit, has connectors at both cable ends. Cut off the connector at the junction box end and fabricate the cable as shown in the following figure to connect the MC connector.



2.3.2 Termination resistor in the FI-5002

The FI-5002 has two termination resistors (R1 and R2). The resistors are set in the following manner:

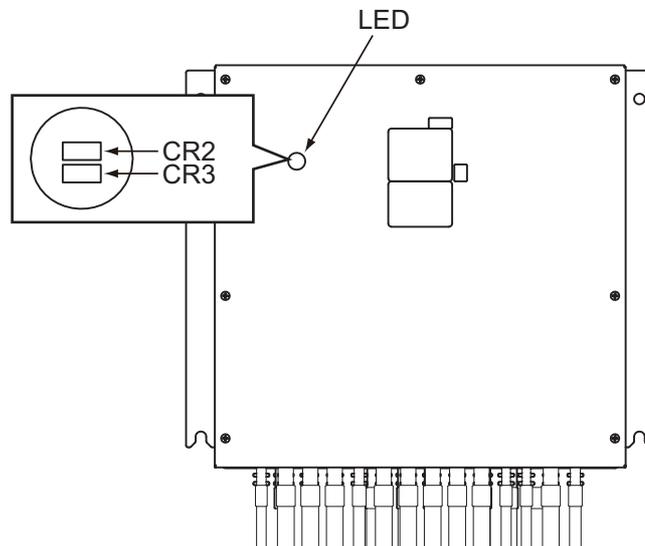
- When no backbone cable is connected, R1 and R2 are set to ON position.
- When one backbone cable is connected, either R1 or R2 is set to ON position.
- When two backbone cables are connected, R1 and R2 are set to OFF position.



2.4 Operation Check (LED Indication)

After mounting and wiring are completed, press the power key (⏻) on the control unit to turn the system on. The LEDs (CR2/CR3) on the processor unit light or flash according to the equipment state, as described in the following table.

LED state		Meaning
CR2 (orange)	CR3 (orange)	
ON	Flashes at 1 second intervals 30 seconds after turning the system on.	Normal operation
ON	Flashes at 3 seconds intervals	
ON	OFF	CPU board error (software startup error)
ON	ON	
Flashes 1 to 4 times at 1 second intervals after the LED goes off for 3 seconds.	ON	



3. INITIAL SETTING

This chapter shows you how to enter initial settings. The first time the system is powered, the initial setting wizard appears. After completing the settings in the initial setting wizard, set up the [Installation Menu].

Note: [Installation Menu] can be opened from the STBY mode, by pressing the knob three times while holding down the **MENU/ESC** key.

The general initial setting flow is as follows:

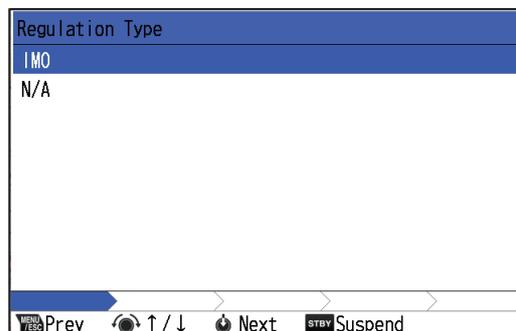
- 1) **Initial Setting Wizard:** Mandatory settings, basic setup for selecting the regulation type and display unit. See section 3.1.
- 2) **Own Ship Information Setting:** Mandatory settings, enter own ship information (ship's width/length, cruising speed, etc.). See section 3.2.
- 3) **Data Source Settings:** Mandatory settings, select the data source for the heading, STW, SOG, position, navigation and alert data. See section 3.3.
- 4) **Rudder Drive Settings:** Mandatory settings, set up the rudder drive information. See section 3.4.
- 5) **Sea Trial Settings:** Necessary settings, perform the zigzag cruising test and set the rudder center position. See section 3.5.
- 6) **Other Installation Setup:** Optional settings, universal port setup (operator fitness, etc.), remote controller setup, etc. See section 3.6.

3.1 Initial Setting Wizard

After mounting and wiring are completed, press the power key (⏻) to turn the system on. The first time the system is powered, the initial setting wizard appears.

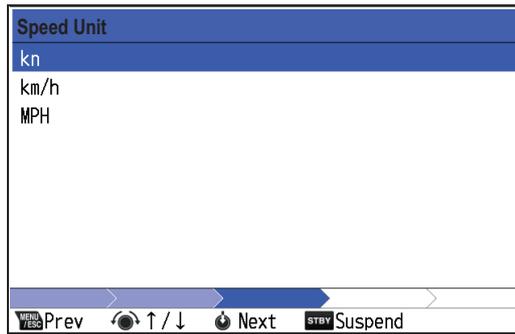
Follow the procedure below to set up the wizard.

1. Press the power key (⏻) on the control unit to turn the system on.
The initial setting wizard starts and the regulation type selection screen appears.



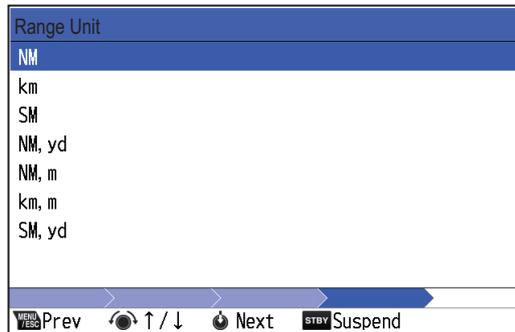
3. INITIAL SETTING

2. Select [IMO] (IMO type) or [N/A] (non-IMO type).
If your ship needs SOLAS certification, select [IMO]. After selection, the speed unit selection screen appears.



3. Select the appropriate unit of measurement for the ship's speed.
 - [kn]: knot
 - [km/h]: kilometers per hour
 - [MPH]: miles per hour

After selection, the range unit selection screen appears.

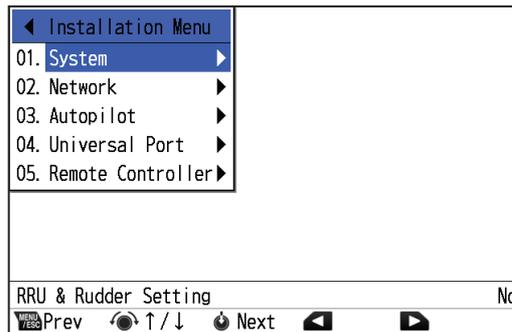


4. Select the appropriate unit of measurement for the distance.
 - [NM]: nautical miles
 - [SM]: statute miles
 - [NM, m]: nautical miles, meters
 - [SM, yd]: statute miles, yards
 - [km]: kilometers
 - [NM, yd]: nautical miles, yards
 - [km, m]: kilometers, meters

After selection, the operation mode selection screen appears.



- Select [Installation] to open [Installation Menu].



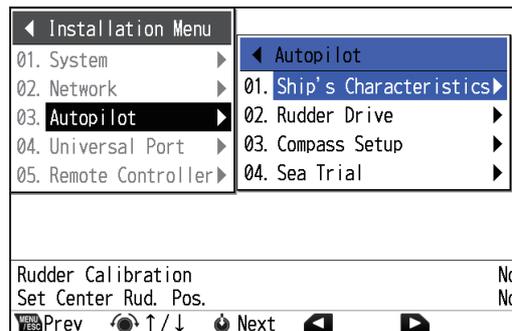
Note: [Simulator] and [Slide Show] are not used in normal operation.

- Follow the procedures in the remaining sections of this chapter to set up the NAVpilot.

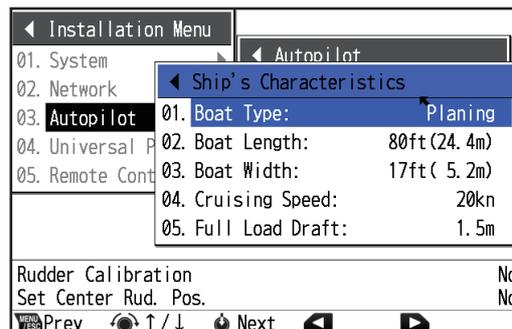
3.2 Own Ship Information Setting

Enter own ship information (ship's width/length, cruising speed, etc.) as follows:

- Select [Autopilot] from the [Installation Menu].



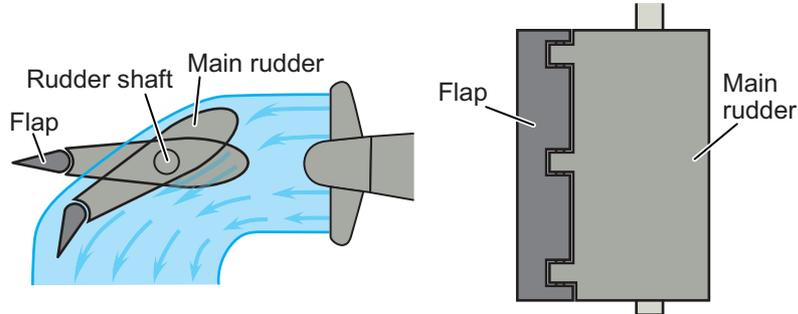
- Select [Ship's Characteristics] from the [Autopilot] menu.



- Select [Boat Type], then select your boat type.
 - [Planing]: Fast patrol boats
 - [Displacement]: Fishing boats, work boats, houseboats
 - [Waterjet]: Water jet propulsion boats
- Select [Boat Length], then set the ship's length, calculated from the bow-tip to the stern, along the center of the vessel.
- Select [Boat Width], then set the ship's width, calculated from the port-side to star-board-side of the widest section of the vessel.
- Select [Cruising Speed], then set the cruising speed of your boat.

3. INITIAL SETTING

7. Select [Full Load Draft], then set the distance between ship's hull and the full load draft line, in meters.
8. Select [Flap Rudder], then select [Yes] or [No].
Select [Yes] if your ship uses a flap rudder. A flap rudder is a rudder with a movable plate, called a "flap," which is attached to the aft end of the rudder plate. The maneuvering performance is higher than a normal rudder.



9. Press the **MENU/ESC** key twice to go back to [Installation Menu].

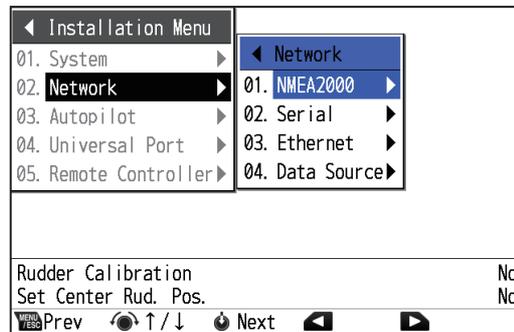
Note: If the following menu items are changed, a confirmation message appears. Note that all work profiles are restored to the default settings to apply any setting.

- [Boat Length]
- [Boat Width]
- [Cruising Speed]
- [Full Load Draft]
- [Flap Rudder]

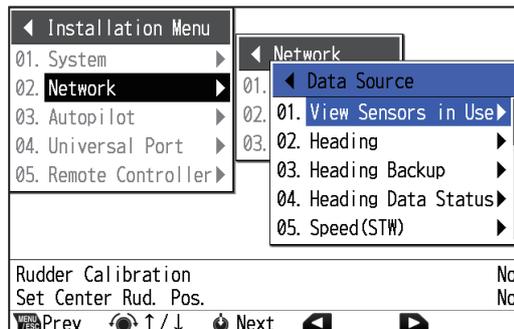
3.3 Data Source Settings

Select the data source for the heading, STW, SOG, position, navigation and alert data as follows:

1. Select [Network] from the [Installation Menu].



2. Select [Data Source] from the [Network] menu.



3. Select [Heading].
4. Set up the following items.
 - [Source]: Select the port that is connected with the data source among Port1 to Port4, Ethernet, NMEA 2000*.



Note: You cannot use the serial port whose baud rate is set to “4800 bps” as the input port for the alert source. For how to set up the baud rate of the serial port, see section 3.6.8.

- [Ethernet SFI]: Enter the SFI (system function ID) of the data source. This menu is active when [Source] is set to [Ethernet].
 - [NMEA2000 Device]: Select the NMEA 2000 device of the data source. This menu is active when [Source] is set to [NMEA2000].
- *: Shown only for the non-IMO type.
5. Select the data source for other data similarly.
 6. Press the **MENU/ESC** key twice to go back to the [Installation Menu].

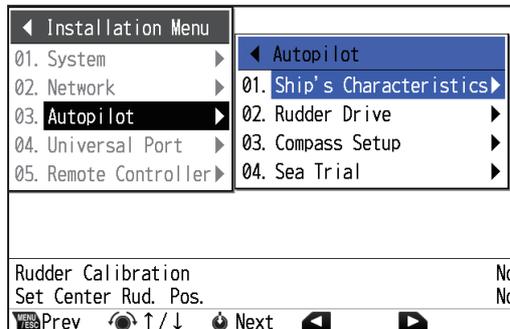
3.4 Rudder Drive Settings

3.4.1 Rudder drive setup

The setup procedure changes according to ship's steering system type (bang-bang control/analog control).

For bang-bang control type

1. Select [Autopilot] from the [Installation Menu].



2. Select [Rudder Drive] from the [Autopilot] menu.

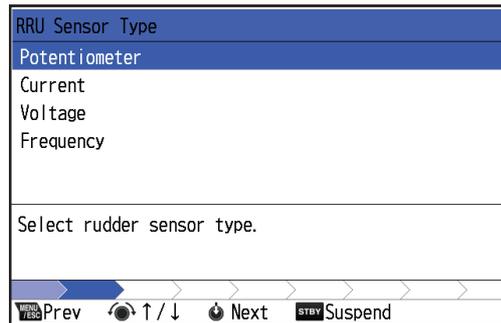


3. INITIAL SETTING

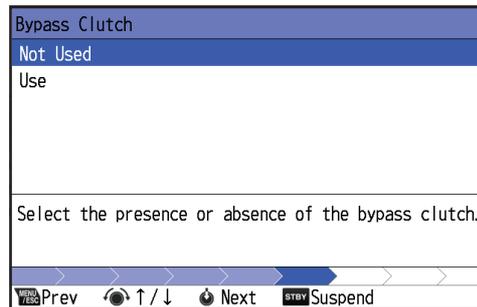
3. Select [Rudder Drive Setup] from the [Rudder Drive] menu to show the drive type selection screen.



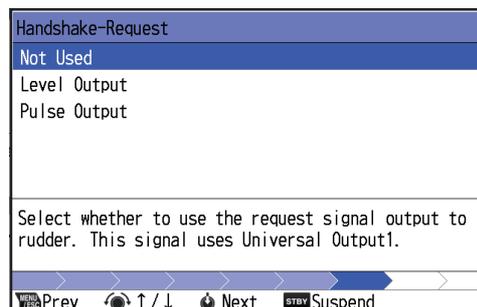
4. Select [Bang-Bang] to show the RRU sensor type selection screen.



5. Select the sensor type of your rudder reference unit to show the bypass clutch setting screen.



6. Select the presence or absence of the bypass clutch to show the handshake (request) signal setting screen.



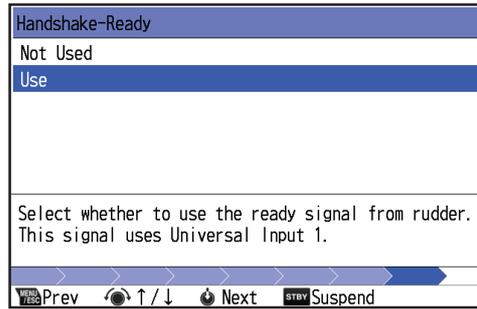
7. Select the handshake request signal type that is output from the NAVpilot to the rudder control system. Select an appropriate type, depending on the computer system that controls the rudder. If the handshake signal is not required, select [Not Used].

Note: The handshake request signal must be connected to Universal Output 1 (TB205).

- [Level Output]: Contact signal is output when the autopilot requests steering system control.

- [Pulse Output]: Contact signal is output for 1 second when the autopilot requests steering system control.

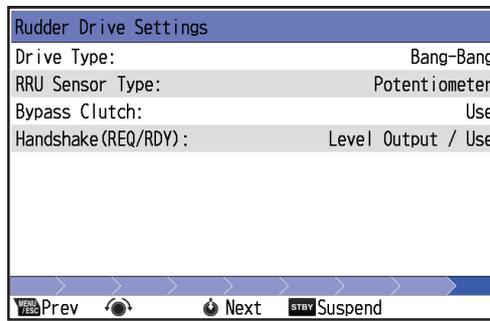
After selection, the handshake (ready) signal setting screen appears.



8. Select whether to use the handshake ready signal, which is output from the rudder control system to the NAVpilot.

Note: The handshake ready signal must be connected to Universal Input 1 (TB208).

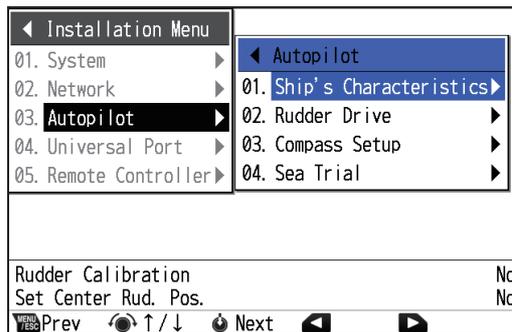
After selection, the setting confirmation window appears.



9. Confirm the setting, then push the knob to close the window and go back to the [Rudder Drive] menu.
10. Perform the rudder calibration, referring to "Auto rudder calibration (with RRU)" on page 3-10.

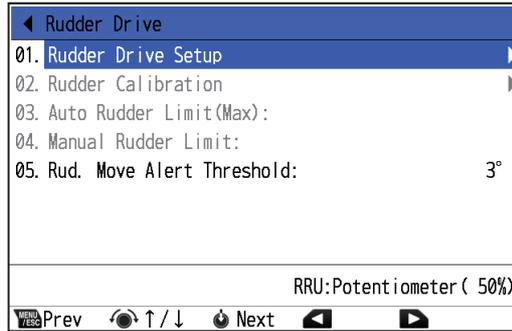
For analog control type

1. Select [Autopilot] from the [Installation Menu].



3. INITIAL SETTING

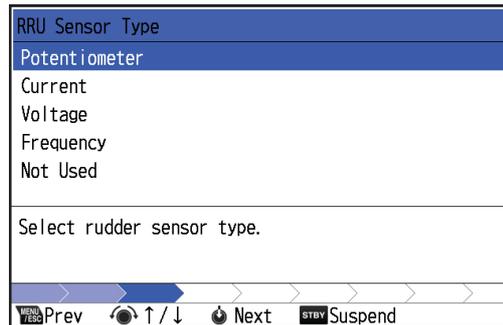
2. Select [Rudder Drive] from the [Autopilot] menu.



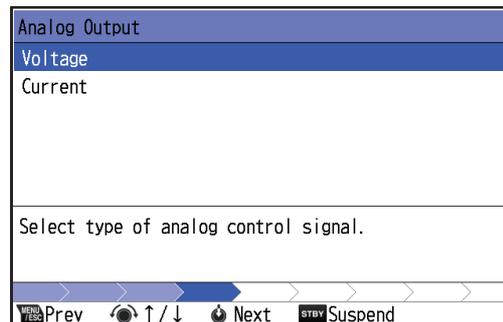
3. Select [Rudder Drive Setup] from the [Rudder Drive] menu to show the drive type selection screen.



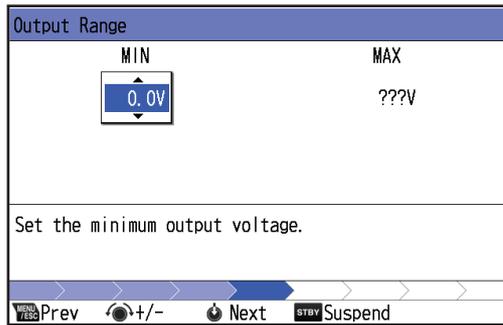
4. Select [Analog] to show the RRU sensor type selection screen.



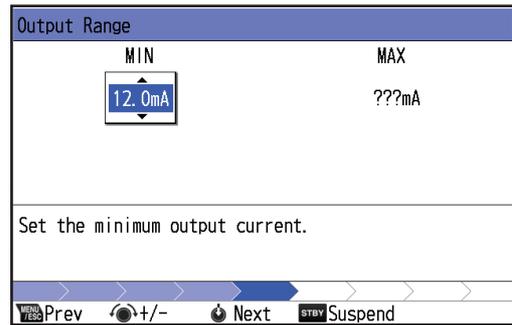
5. Select the sensor type of your rudder reference unit to show the analog output setting screen.



6. Select the type of analog control signal for the rudder steering system. Minimum/maximum output range screen appears.

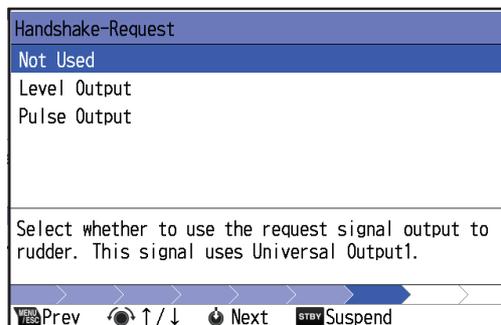


When [Voltage] is selected



When [Current] is selected

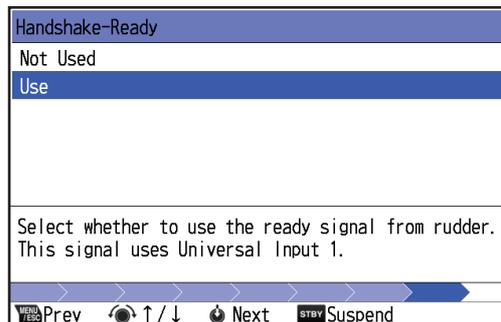
7. Rotate the knob to adjust the minimum output voltage (or current), then push the knob.
8. Rotate the knob to adjust the maximum output voltage (or current), then push the knob.
After setting, the handshake (request) signal setting screen appears.



9. Select the handshake request signal type that is output from the NAVpilot to the rudder control system. Select an appropriate type, depending on the computer system that controls the rudder. If the handshake signal is not required, select [Not Used].

Note: The handshake request signal must be connected to Universal Output 1 (TB205).

After setting, the handshake (ready) signal setting screen appears.

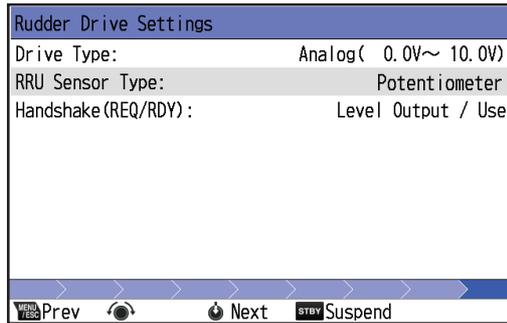


10. Select whether to use the handshake ready signal, which is output from the rudder control system to the NAVpilot.

Note: The handshake ready signal must be connected to Universal Input 1 (TB208).

3. INITIAL SETTING

After selection, the setting confirmation window appears.



11. Confirm the setting, then push the knob to close the window and go back to the [Rudder Drive] menu.
12. Perform the rudder calibration, referring to "Auto rudder calibration (with RRU)" on page 3-10 or "Rudder calibration (without RRU)" on page 3-12.

3.4.2 Rudder calibration

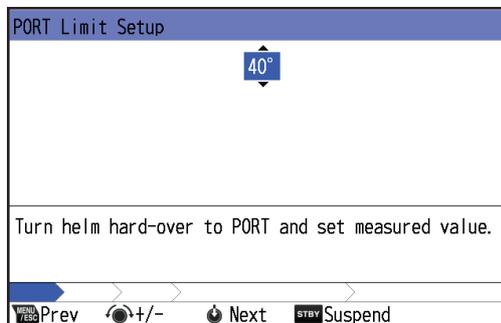
Set the auto/manual rudder limit and perform the rudder calibration as follows:

Note 1: Complete the settings on the [Rudder Drive Setup] menu to perform the rudder calibration.

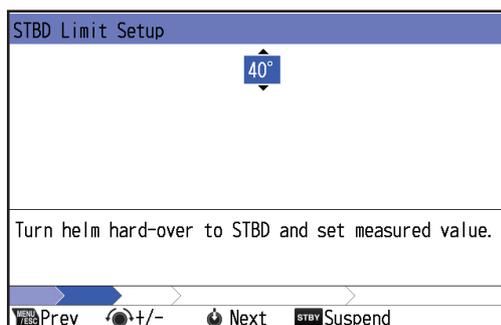
Note 2: The rudder calibration must be performed with the vessel on the water.

Auto rudder calibration (with RRU)

1. Select [Rudder Calibration] from the [Rudder Drive] menu to show the PORT limit angle setting screen.

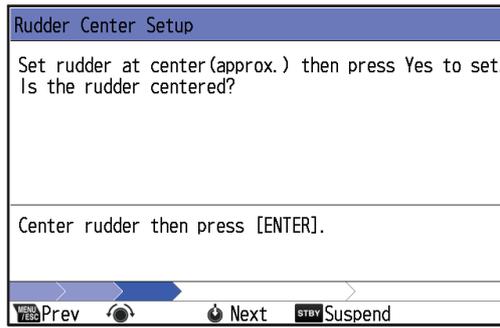


2. Turn the helm hard-over to port, then measure the rudder angle using an onboard rudder angle indicator.
3. Rotate the knob to enter the value measured at step 2, then push the knob. The STBD limit angle setting screen appears.



4. Turn the helm hard-over to starboard, then measure the rudder angle.

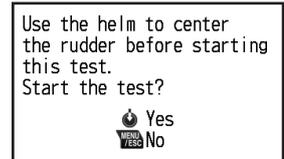
- Rotate the knob to enter the value measured at step 4, then push the knob. The rudder center setup screen appears.



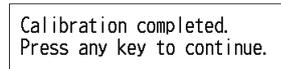
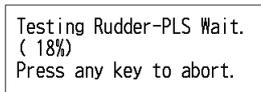
- Center the rudder, then push the knob. The confirmation message shown to the right appears.

Note: The error message appears in the following conditions.

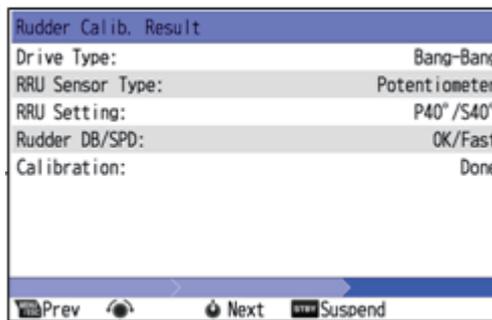
- The values for [PORT Limit Setup], [STBD Limit Setup], or [Rudder Center Setup] are not entered correctly.
- The RRU is not properly positioned relative to the rudder. For mounting considerations, see section 1.3.2



- Confirm that the rudder is centered, then push the knob to start the auto rudder calibration. The message shown below-left appears while performing the auto calibration. After completing the calibration, the confirmation message shown below right appears.



- Push the knob to close the confirmation message, then push the knob again to show the calibration result window.



Note: If the auto rudder calibration failed, “Calibration” shows “Fault” on the result window. Retry the auto rudder calibration.

- Push the knob to close the result window and go back to the [Rudder Drive] menu.

3. INITIAL SETTING

Rudder calibration (without RRU)

1. Turn the helm to center the rudder.
2. Select [Rudder Calibration] from the [Rudder Drive] menu.

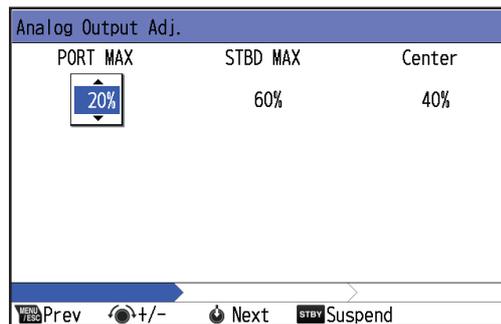
The message shown right appears.

Note: The NAVpilot outputs analog voltage (or current) to the rudder drive after pressing the knob. Note that the ship's rudder moves.

Use the helm to center the rudder before starting this test. When the test is started, the rudder analog voltage/current is output. Start the test?



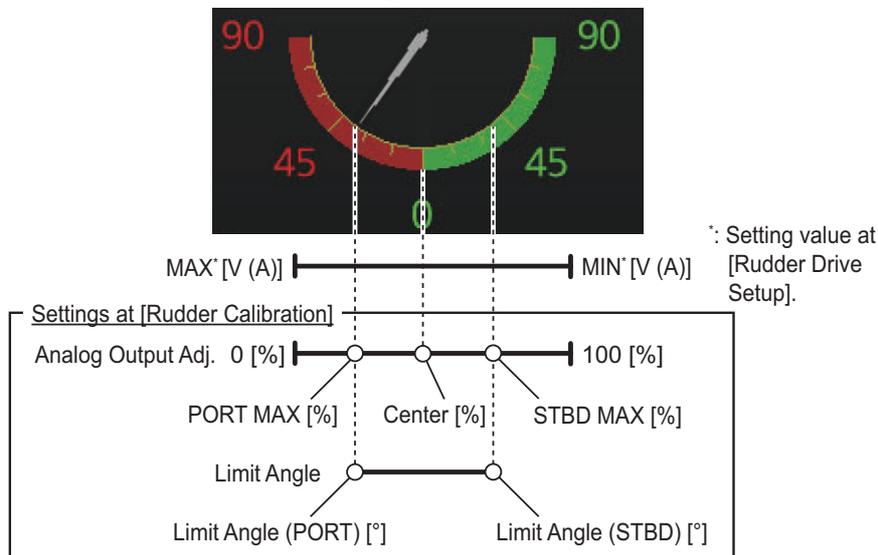
3. Confirm that the rudder is centered, then push the knob. The analog output adjustment screen appears. The NAVpilot outputs analog voltage (or current) depending on the highlighted value on the screen.



4. Set up [PORT MAX], [STBD MAX] and [Center], referring to the rudder angle indicator.

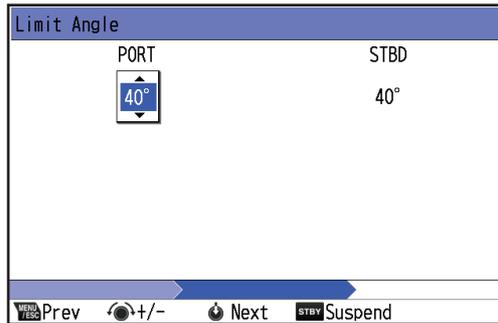
Adjust the analog output value in percentage. When set to "0%", the minimum value set at [Rudder Drive Setup] is output, and when set to "100%", the maximum value is output. When you rotate the knob and change the analog output value, the ship's rudder moves according to the value.

Example when the maximum rudder angle is "35°"



- [PORT MAX]: Rotate the knob to adjust the value so that the rudder is hard-over to port, referring to the rudder angle indicator, then push the knob.
- [STBD MAX]: Rotate the knob to adjust the value so that the rudder is hard-over to starboard, referring to the rudder angle indicator, then push the knob.
- [Center]: Rotate the knob to adjust the value so that the rudder is centered, referring to the rudder angle indicator, then push the knob.

After setting, the limit angle setup screen appears.

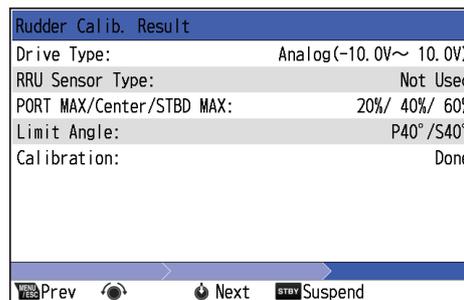


5. Set up the limit angles for [PORT] and [STBD].
 - [PORT]: Rotate the knob to set the maximum rudder angle to port when [PORT MAX] was adjusted, then push the knob.
 - [STBD]: Rotate the knob to set the maximum rudder angle to starboard when [STBD MAX] was adjusted, then push the knob.

After setting, the NAVpilot starts the calibration and the message shown right appears after completing the calibration.

Calibration completed.
Press any key to continue.

6. Push the knob to close the message and open the result window.



7. Push the knob to close the result window and go back to the [Rudder Drive] menu.

3.4.3 Auto rudder limit settings

Determine the maximum rudder movement in degrees from the mid position while auto steering by the NAVpilot. The rudder angle set here is used for the maximum value for [Auto Rudder Limit] on the user menu.

Note 1: Complete the settings on the [Rudder Drive Setup] (see section 3.4.1) and [Rudder Calibration] (see section 3.4.2) to set the auto rudder limit.

Note 2: The value for [Auto Rudder Limit] is automatically set to 5° lower than the [STBD Limit Setup]/[PORT Limit Setup] value set at auto rudder calibration.

1. Select [Auto Rudder Limit] from the [Rudder Drive] menu.
2. Set the rudder limit angle while auto steering by the NAVpilot.

3.4.4 Manual rudder limit settings

Determine the maximum rudder movement in degrees from the mid position in the remote (FU and NFU), FU or NFU modes. Do not set the limit higher than the rudder limit. It is recommended to set the manual rudder limit equal to or greater than the auto rudder limit. If the manual rudder limit is set lower than the auto one, the rudder may be returned to center position too quickly when the vessel is making automatic turns.

3. INITIAL SETTING

Note 1: Complete the settings on the [Rudder Drive Setup] (see section 3.4.1) and [Rudder Calibration] (see section 3.4.2) to set the manual rudder limit.

Note 2: You cannot change the settings when [RRU Sensor Type] is [Not Used].

Note 3: The value for [Manual Rudder Limit] is automatically set to 5° lower than the [STBD Limit Setup]/[PORT Limit Setup] value set at auto rudder calibration.

1. Select [Manual Rudder Limit] from the [Rudder Drive] menu.
2. Set the maximum rudder angle in the remote (FU and NFU), FU or NFU modes.
3. Press the **MENU/ESC** key to go back to [Installation Menu].

3.5 Sea Trial Settings

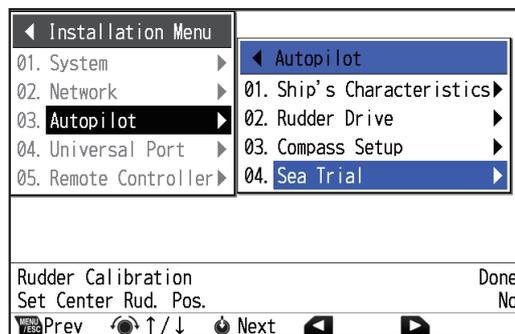
Auto Tuning

Perform the zigzag cruising test in a normal cruising speed to automatically adjust the rudder gain, counter rudder and rate of turn. Move the vessel to a safe area before doing this test.

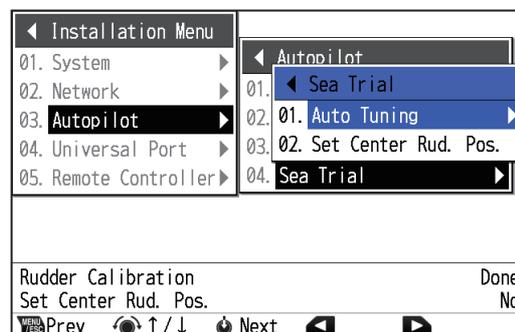
Note 1: The following test must be performed when the vessel is in the ballasted condition.

Note 2: The following test must be performed under calm or moderate sea conditions.

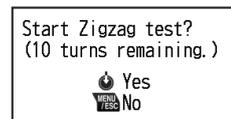
1. Move the vessel to a safe area with no obstructions around.
2. Select [Autopilot] from the [Installation Menu].



3. Select [Sea Trial] from the [Autopilot] menu.



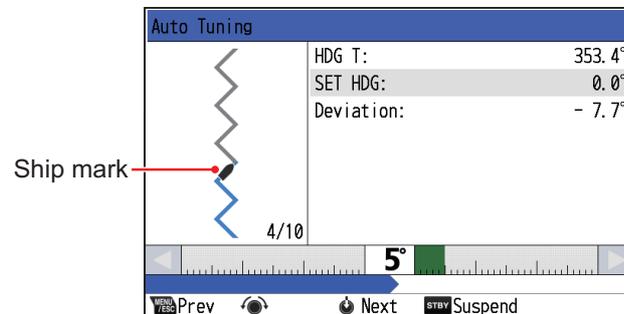
4. Select [Auto Tuning] from the [Sea Trial] menu. The confirmation message to the right appears.
Note: [Auto Tuning] appears on the [Sea Trial] menu only when [Boat Length] is set to 60 ft (18.3 m) or more.



5. Confirm that your surroundings are safe, then push the knob to start the test.
Note: Be careful to ensure the safety around your vessel during test.

The NAVpilot starts 10 zigzag turns, at a rudder angle of 5 degrees and a deviation of 5 degrees*. During the test, the ship mark, which indicates own ship's course movement, appears. To abort the test, press the knob, **MENU/ESC**, **AUTO**, **STBY** or **NAV** key.

*: Note that the deviation may exceed ± 5 degrees depending on ship's characteristics.



After completing the test, a message appears.

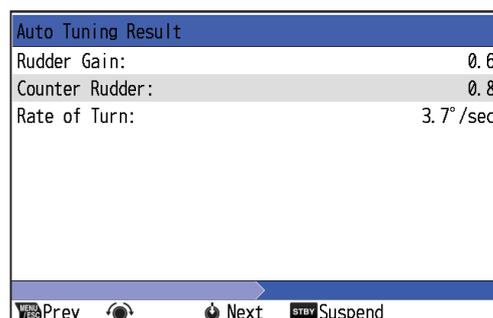
Now calculating ship's parameters.
Please wait a moment.



Auto Tuning complete.
Press any key to continue.

Note: If the heading signal or communication with the RRU is lost, the message "Auto Tuning Failed" appears. Rectify the current alert(s), then retry the auto tuning.

Push the knob to show the test result.



[Rudder Gain], [Counter Rud.], [Rate Of Turn] and [Radius Of Turn] values calculated by this test are applied to the current work profile settings. For details about the work profile function, see the Operator's Manual.

6. Push the knob to close the test result.
7. Press the **MENU/ESC** key several times to close the menu.

Set up Rudder Center Position

Do as follows to set the rudder center position.

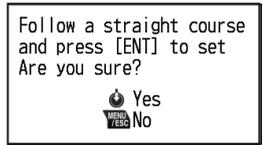
Note 1: The following setup must be performed under calm or moderate sea conditions.

Note 2: The following setup is not available when [RRU Sensor Type] is set to [Not Used].

1. Move the vessel to a safe area with no obstructions around.
2. Select [Autopilot] from the [Installation Menu].
3. Select [Sea Trial] from the [Autopilot] menu.

3. INITIAL SETTING

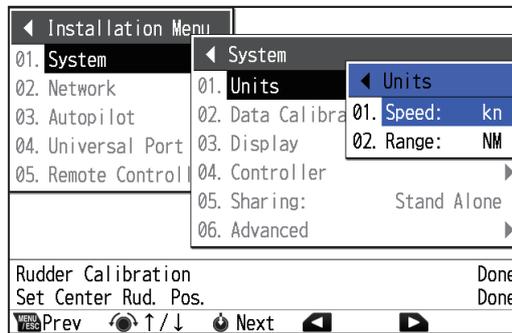
4. Select [Set Center Rud. Pos.] from the [Sea Trial] menu.
The message to the right appears.
5. Confirm that your surroundings are safe, then run the boat at your normal cruising speed.
6. When the ship runs straight, push the knob to complete the setting.
7. Press the **MENU/ESC** key several times to close the menu.



3.6 Other [Installation Menu] Items

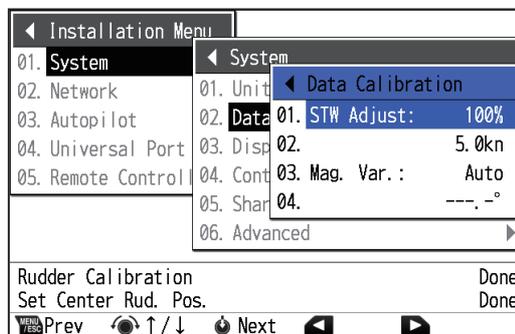
This section presents an overview of the menu items on the [Installation Menu] not previously described.

3.6.1 [Installation Menu] > [System] > [Units] menu



Menu item	Description
[Speed Unit]	Select the unit of measurement for ship's speed. <ul style="list-style-type: none"> • [kn]: knot • [km/h]: kilometers per hour • [MPH]: miles per hour
[Range Unit]	Select the unit of measurement for distance. <ul style="list-style-type: none"> • [NM]: nautical miles • [SM]: statute miles • [NM, m]: nautical miles, meters • [SM, yd]: statute miles, yards • [km]: kilometers • [NM, yd]: nautical miles, yards • [km, m]: kilometers, meters

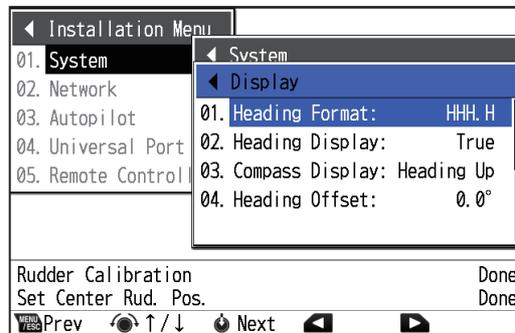
3.6.2 [Installation Menu] > [System] > [Data Calibration] menu



Menu item	Description
[STW Adjust]	Apply an offset to the STW data. Enter 99% or below when the indication is higher than the actual value; 101% or more when it is lower than the actual value. If the indication on the display shows the current value, keep the setting at "100%".

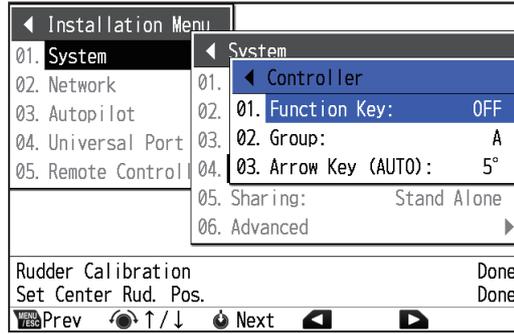
Menu item	Description
[Mag. Var.]	<p>With a magnetic heading sensor (PG-700, etc.), magnetic variation information is necessary to display true heading data. In almost all cases, a GPS will be connected to the NAVpilot and the GPS will send this variation information to the NAVpilot automatically. Therefore, set [Mag. Var.] to [Auto]. In special cases where a manual variation is required, you may input these values manually.</p> <p>Note that this selection is only effective when [Heading Display] is set to [True] on the [Display] menu. When [Heading Display] is set to [True] on the [Display] menu, the NAVpilot will display true heading information even though the NAVpilot may be connected to a magnetic heading sensor. This is very valuable when connecting a FURUNO FAR-21×7 series radar to the NAVpilot because these radars can not be set for magnetic heading input and the “Waypoint Lollipop” will only align properly when true heading is used.</p>

3.6.3 [Installation Menu] > [System] > [Display] menu



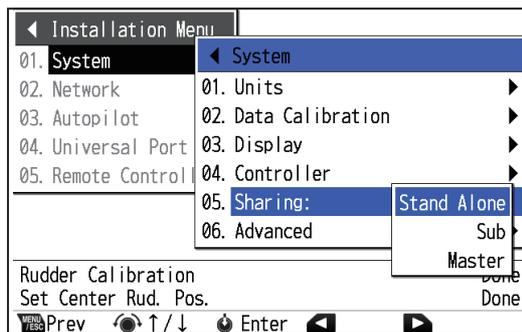
Menu item	Description
[Heading Format]	<p>Select how to show the heading indication.</p> <ul style="list-style-type: none"> • [HHH.H]: 000.0° to 359.9° • [HHH]: 000° to 359°
[Heading Display]	<p>Select how to show heading, true or magnetic.</p> <ul style="list-style-type: none"> • [Magnetic]: Use magnetic heading. • [True]: Use true heading.
[Compass Display]	<p>Select the orientation mode for the compass display.</p> <ul style="list-style-type: none"> • [Heading Up]: The compass rotates to keep the ship's heading (gray pointer) at the top of the display. • [Course Up]: The compass rotates to keep the set course (blue pointer) at the top of the display.
[Time Offset]	<p>Enter the time difference between local time and UTC time to display the local lime.</p> <p>Setting range: -14:00 to +14:00</p>

3.6.4 [Installation Menu] > [System] > [Controller] menu



Menu item	Description
[Function Key]	Select the function of the knob on the control unit when pushed while displaying the normal screen. <ul style="list-style-type: none"> • [OFF]: No function assigned. • [STBY]: Switches to STBY mode (manual steering). • [AP]: Switches between the AUTO (auto steering) and STBY modes.
[Group]	The language and brilliance settings are shared within a group of control units. If these settings are adjusted for one unit in the group, all other units in the same group are also adjusted, however FURUNO multi function display (MFD) settings are not adjusted. There are three groupings available: [A], [B] and [C]. Select an appropriate group to assign a group to a control unit.
[Arrow Key (Auto)]	Set the heading angle increment of arrow keys when pressed in the AUTO mode. <ul style="list-style-type: none"> • [5°]: The arrow key adjusts the heading in 5° increments. • [10°]: The arrow key adjusts the heading in 10° increments. • [Manual]: Select degree of turn from 1° to 45°.

3.6.5 [Installation Menu] > [System] > [Sharing] menu



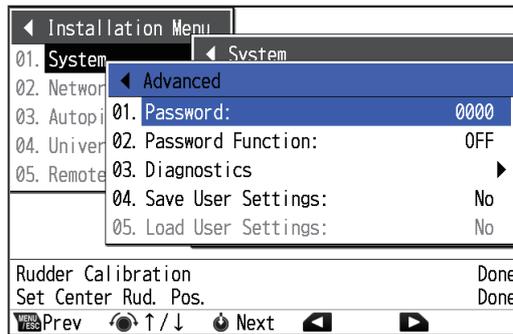
The following installation settings, made on a master unit within the network, are passed onto the sub units on the same network.

- Data source settings on the [Data Source] menu (see section 3.6.10)
- Speed and range unit setting on the [Units] menu (see section 3.6.1)
- [Heading Display] setting on the [Display] menu (see section 3.6.3)
- [Time Offset] setting on the [Display] menu (see section 3.6.3)
- [Mag. Var.] setting on the [Data Calibration] menu (see section 3.6.2)
- [STW Adjust] setting on the [Data Calibration] menu (see section 3.6.2)

Select the appropriate sharing level from the following options.

- [Stand Alone]: Disables sharing of settings.
- [Sub]: Assign the control unit as a sub unit.
- [Master]: This unit's settings are passed to all sub units. Where a FURUNO multi function display (MFD) is in the same network, the MFD is automatically assigned as the [Master] and this option is not available.

3.6.6 [Installation Menu] > [System] > [Advanced] menu

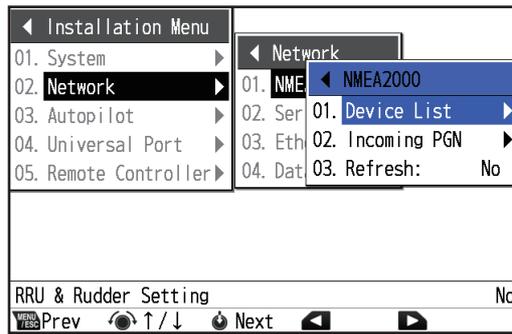


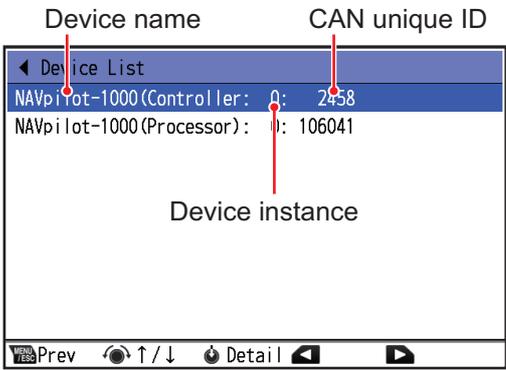
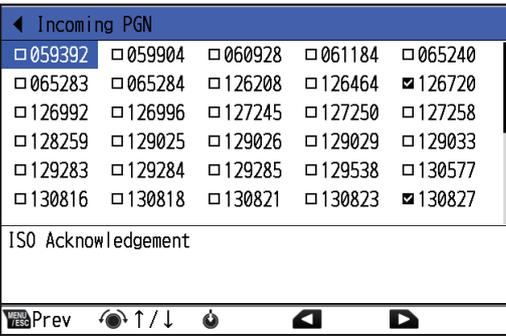
Menu item	Description
[Password]	Set the password for the password lock function.
[Password Function]	<p>Activate or deactivate the password lock function. When [ON] is selected, the display is automatically changed to the Autopilot screen and key lock icon () appears. When you try to open the following menu while this function is active, the password window appears. To unlock, enter the password that is set at [Password].</p> <ul style="list-style-type: none"> • [User Menu] • [Parameter Menu] • [Auto Option Setup] menu • [NAV Option Setup] menu • [Installation Menu] • [Work Profile] menu • [Turn Option Setup] menu
[Diagnostics]	<p>Perform various diagnostics on the NAVpilot system.</p> <ul style="list-style-type: none"> • [Processor Unit]: Checks the processor unit for correct operation. • [Control Unit]: Checks the control unit for correct operation. • [Keyboard Test]: Checks the key panel on the control unit. Press each key. The related on-screen location fills in blue if the key is operating normally. To abort the test, press the MENU/ESC key three times. • [Screen Test]: Checks the control unit for correct presentation of color tones. Press the STBD key () to cycle through the screens in following order. The PORT key () cycles through the screens in reverse order. Test start screen → White → Black → Red → Green → Blue → Multi-hue RGB → Gray → Test start screen → White → ... To abort the test, press the MENU/ESC. • [Rudder Test]: Checks various aspects of the rudder and controls. • [Rudder Information]*: Shows the information about the rudder installation settings. <p>*: Shown only when [RRU Sensor Type] is set to [Not Used].</p>

3. INITIAL SETTING

Menu item	Description
[MP Menu]	<p>This menu is used to activate remote access from external equipment and operate this equipment remotely. Do not use this menu, unless otherwise specifically directed. System reboot is required to apply the setting. If you change the setting, the following message appears. Select [Yes] to reboot the system.</p> <div data-bbox="767 409 1254 551" style="border: 1px solid black; padding: 5px; text-align: center;"> <p>A reboot is required if you change the settings. Are you sure?</p> <p>Yes No</p> <p>Enter ←/→ <small>MENU</small> YES Cancel</p> </div>
[Syslog Output Dest]	Set the destination IP address to output the syslog.
[System Data Monitor]	<div data-bbox="647 611 914 835" style="border: 1px dashed red; padding: 5px;"> <p>Rudder: -10.0V~ 10.0V Input Voltage: 24.0V</p> <p>DRK PROFILE STW 5.0</p> <p>PROF. 1</p> </div> <p>[System Data Monitor] window</p> <p>Select [ON] to display the [System Data Monitor] window on the normal screen. The information on the window depends on the installation settings. Note: When [ON] is selected, the Autopilot main screen is fixed to digital format, regardless of the setting of the [Screen Display].</p>
[Simulation]	Activate or deactivate the simulation mode. DO NOT select the option other than [OFF]. The options other than [OFF] are intended for use in service or promotion purposes.
[Factory Default]	<ul style="list-style-type: none"> • <u>IMO type operation</u> Select the item to be restored to factory default settings. The system reboot is required to restore factory default settings. <ul style="list-style-type: none"> • [No]: Cancel restoring the factory default settings. • [ALL]: Restore all default settings. • [IP Address for Type Approval]: Do NOT select this option. • <u>Non-IMO type operation</u> Select [Yes] to restore all settings to factory default settings. The system is automatically restarted after selecting [Yes]. <p>After selecting item, a confirmation message appears. Select [Yes] to restore factory default. To cancel, select [No]. After selecting [Yes], the NAVpilot reboots automatically and restores factory defaults.</p>

3.6.7 [Installation Menu] > [Network] > [NMEA2000] menu (non-IMO type only)



Menu item	Description
[Device List]	Shows a list of devices connected to the same NMEA 2000/CAN bus network as the NAVpilot. 
[Incoming PGN List]	Shows a list of PGNs that the NAVpilot is capable of receiving. PGNs that are being received are marked with a check mark. 
[Refresh]	Refreshes the items displayed in the [Device List] and [Incoming PGN List]. Refresh the lists when devices are added or removed from the same NMEA 2000 network. To refresh the lists, select [Refresh] and push the knob. Then, select [Yes] and push the knob.

Input PGNs for processor unit

PGN	Description
059392	ISO Acknowledgment
059904	ISO Request
060160	ISO Transport Protocol, Data Transfer
060416	ISO Transport Protocol, Connection Management - BAM group function
060928	ISO Address Claim
061184	Self Test Group Function

3. INITIAL SETTING

PGN	Description
065240	ISO Commanded Address
065283	Magnetic Compass Control Status
065284	Magnetic Compass Status
126208	NMEA - Request group function
	NMEA - Command group function
	NMEA - Acknowledge group function
126464	PGN List - Transmit PGN's group function
126720	Free Format
	Memory Clear Group Function
	Reset Memory Group Function
	GMM Message
	Coop Message
	Auto Pilot System Setup Information
126992	System Time
126996	Product Information
127250	Vessel heading
127258	Magnetic Variation
128259	Speed, Water referenced
129025	Position, Rapid Update
129026	COG & SOG, Rapid Update
129029	GNSS Position Data
129033	Local Time Offset
129283	Cross Track Error
129284	Navigation Data
129285	Navigation - Route/WP Information
130306	Wind Data
130577	Direction Data
130816	Self Test Report
130818	Heading & Attitude Sensor Control Status
130827	NAVpilot General Message
	NAVpilot Dodge
130841	N2K System Setup Information

Output PGNs for processor unit

PGN	Description	Transmission Rate
059392	ISO Acknowledgment	—
059904	ISO Request	—
060928	ISO Address Claim	—
061184	FURUNO Proprietary PGN	—
126208	NMEA - Request group function	—
	NMEA - Command group function	—
	NMEA - Acknowledge group function	—
126464	PGN List - Transmit PGN's group function	—
	PGN List - Received PGN's group function	—
126720	Free Fromat	—
	Memory Clear Group Function	—
	Reset Group Function	—

PGN	Description	Transmission Rate
126720	Auto Pilot Setting	—
	GMM Message	—
	Auto Pilot Coop Message	—
	Auto Pilot System Setup Information	—
	NAVpilot Alert Display Data (Alert Database)	—
	NAVpilot Alert Display Data (Alert Status)	—
	NAVpilot Alert Display Data (Alert List/Log Data)	—
	NAVpilot Alert Display Data (Alert List/Log Detail Data)	—
126993	Heartbeat	60000 msec
126996	Product Information	—
126998	Configuration Information	—
127245	Rudder	100 msec
127237	Heading/Track Control	250 msec
130816	Self Test Report	—
130822	Unit Division Code	—
130823	Browser Control Status	—
130827	NAVpilot General Message (Alive Message)	—
	NAVpilot Alert Data (DATA)	1000 msec
	NAVpilot Display Data (1 sec Cycle)	1000 msec
	NAVpilot Display Data (100 msec Cycle)	100 msec
130841	N2K System Setup Information	—

Input PGNs for control unit

PGN	Description
059392	ISO Acknowledgment
059904	ISO Request
060160	ISO Transport Protocol, Data Transfer
060416	ISO Transport Protocol, Connection Management - BAM group function
060928	ISO Address Claim
061184	Self Test Group Function
065240	ISO Commanded Address
126208	NMEA - Request group function
	NMEA - Command group function
	NMEA - Acknowledge group function
126720	Free Format
	Memory Group Function
	Reset Memory Group Function
	Auto Pilot Setting
	GMM Message
	Auto Pilot Coop Message
	Auto Pilot System Setup Information
	NAVpilot Alert Display Data (Alert Database)
	NAVpilot Alert Display Data (Alert Status)
	NAVpilot Alert Display Data (Alert List/Log Data)
NAVpilot Alert Display Data (Alert List/Log Detail Data)	
126996	Product Information
130816	Self Test Report
130823	Browser Control Status

3. INITIAL SETTING

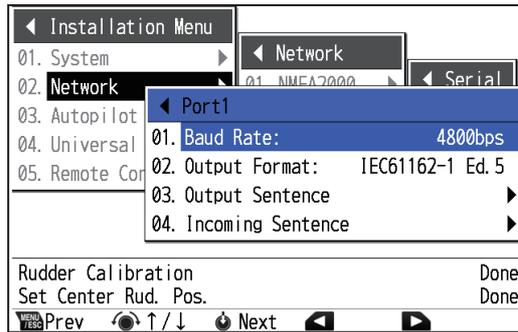
PGN	Description
130827	NAVpilot Display Data (100 msec Cycle)
	NAVpilot General Message
	NAVpilot Display Data (1 sec Cycle)
	NAVpilot Group Setting

Output PGNs for control unit

PGN	Description	Transmission Rate
059392	ISO Acknowledgment	—
059904	ISO Request	—
060928	ISO Address Claim	—
061184	Self Test Group Function	—
126208	NMEA - Request group function	—
	NMEA - Command group function	—
	NMEA - Acknowledge group function	—
126464	PGN List - Transmit PGN's group function	—
	PGN List - Received PGN's group function	—
126720	Free Format	—
	Memory Clear Group Function	—
	Reset Group Function	—
	GMM Message	—
	Auto Pilot Coop Message	—
	Auto Pilot System Setup Information	—
126993	Heartbeat	60000 msec
126996	Product Information	—
126998	Configuration Information	—
130816	Self Test Report	—
130822	Unit Division Code	—
130823	Browser Control Status	—
130827	NAVpilot General Message	—
	NAVpilot Dodge	—
	NAVpilot Alert Display Data (Alert Status)	—
	NAVpilot Group Setting	—

3.6.8 [Installation Menu] > [Network] > [Serial] menu

The [Serial] menu sets the interface for each serial port.



Menu item	Description
[Baud Rate]	Select a baud rate (4800 or 38400 bps). Note: You cannot use the serial port whose baud rate is set to “4800 bps” as the input port for the alert source.
[Output Format]*	Select a NMEA format among IEC61162-1 Ed.5, Ed.4, Ed.3, NMEA 0183 Ver 2.0, Ver 1.5.
[Output Sentence]*	Shows a list of sentences that the NAVpilot is capable of transmitting. You can turn on or off the output sentences on this window. <div data-bbox="778 972 1283 1294" data-label="Image"> </div> <p>Note: If the load rate for the serial port exceeds 100%, an error message appears. Adjust output sentences so that the load rate does not exceed 100%. The load rate is shown on the bottom of the [Output Sentence] window.</p>
[Incoming Data]	Shows a list of sentences that the NAVpilot is capable of receiving. Sentences that are being received are marked with a check mark. <div data-bbox="778 1576 1283 1904" data-label="Image"> </div>

*: Shown only for the non-IMO type. For the IMO type, the output format is fixed to IEC61162-1/2 Ed.5.

3. INITIAL SETTING

Input sentences (PORT 1 to PORT 4)

- IMO type: IEC61162-1/2 Ed.3/4/5 format sentences.
- Non-IMO type: NMEA 0183 version 1.5/2.0/3.0/4.0 format sentences.

Data	Sentence Priority
Time and Date	ZDA
Position	GNS > GGA > RMC > GLL
Waypoint (non-IMO type only)	APB > RMB > BWR > BWC > BOD > AAM
Cross Track Error	XTE ^{*2} > APB > RMB
Speed (SOG)	VTG > RMC
COG	VTG > RMC
Speed (STW)	VBW > VHW
Heading ^{*1} (True)	THS > HDT > HDG
Heading ^{*1} (Magnetic)	HDG > HDM ^{*3}
Heading, Deviation & Variation	HDG > RMC
Wind Direction & Speed (True)	MWV > VWT ^{*3}
Wind Direction & Speed (Relative)	MWV > VWR ^{*3}
Heading Correction	HCR
Acknowledge Alarm	ACN
Heartbeat Supervision Report	HBT

*1: Recommended transmission rate is "100 ms".

*2: The XTE (Cross Track Error) resolution of the nav data source must be 0.001 NM or more precise. If not, the NAVpilot steering performance may be reduced.

*3: For IEC61162-450 connection, cannot be received.

Output sentences (PORT 1 to PORT 4)

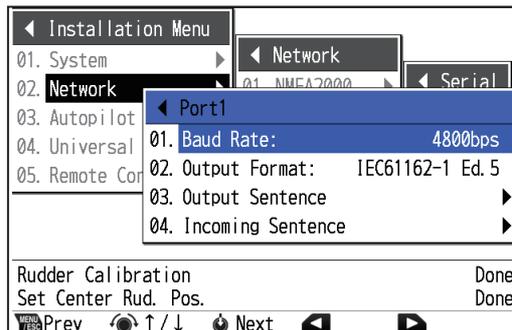
For the non-IMO type, you can select output format from the [Installation] menu (IEC61162-1/2 Ed.3/4/5 or NMEA 0183 version 1.5/2.0) and turn on/off each sentence. For details, see section 3.6.8 or section 3.6.9.

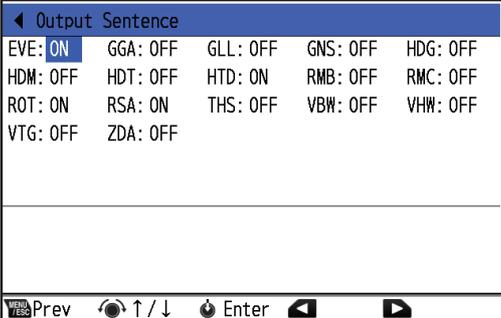
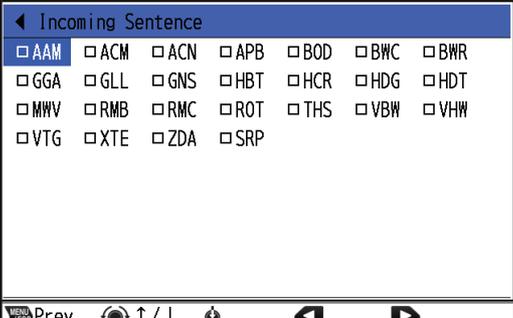
Data	Sentence	Transmission Rate
Heading (True)	THS ^{*3} , HDT ^{*3} , HDG ^{*3}	1 sec
Heading (Magnetic)	HDG ^{*3} , HDM ^{*1, *3}	1 sec
Time and Date	ZDA ^{*3}	1 sec
Position	GNS ^{*2, *3} , GGA ^{*3} , RMC ^{*3} , GLL ^{*3}	1 sec
Waypoint	RMB ^{*3}	1 sec
Speed (SOG)	VTG ^{*3} , RMC ^{*3}	1 sec
COG	VTG ^{*3} , RMC ^{*3}	1 sec
Speed (STW)	VBW ^{*3} , VHW ^{*3}	1 sec
Alert	ALC, ALF, ARC, HBT	ALC: 30 sec, HBT: 25 sec ALF, ARC: N/A
Alert (BNWAS)	ALR ^{*4}	-
Operator Fitness	EVE ^{*5}	6 sec
Heading Control	HTD ^{*5}	1 sec
Rate of Turn	ROT ^{*3}	1 sec
Rudder	RSA ^{*5}	1 sec

- *1. For IEC61162-450 connection, cannot be transmitted.
- *2. Fixed at through-out signal regardless of output format. Used only for remote display.
- *3. Available only for the non-IMO type.
- *4. Output when “Lost HDG control” or “HCS fault” alert is not acknowledged for 30 seconds.
- *5. For IMO type: Continuous output.

3.6.9 [Installation Menu] > [Network] > [Ethernet] menu

The [Ethernet] menu sets the interface for the LAN port.



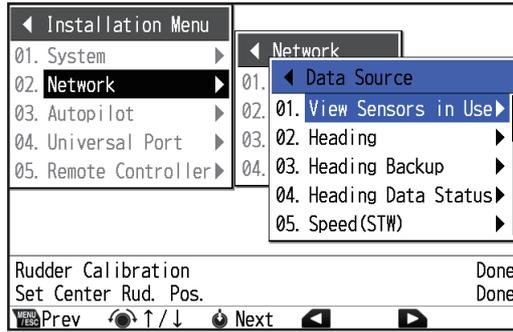
Menu item	Description
[Output Sentence]*	<p>Shows a list of sentences that the NAVpilot is capable of transmitting. You can turn sentence output on or off on this window.</p> 
[Incoming Data]	<p>Shows a list of sentence that the NAVpilot is capable of receiving. Sentences that are being received are marked with a check mark.</p> 

3. INITIAL SETTING

Menu item	Description																								
[Network Address]	<div data-bbox="833 210 1201 338" style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p style="text-align: left; margin: 0;">◀ Network Address</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">01. IP Address:</td> <td style="text-align: right;">172.31.16.141</td> </tr> <tr> <td>02. Subnet Mask:</td> <td style="text-align: right;">255.255.0.0</td> </tr> <tr> <td>03. Default Gateway:</td> <td style="text-align: right;">0.0.0.0</td> </tr> </table> </div> <p>Set the IP address, subnet mask and default gateway of the NAVpilot. The default setting is as follows.</p> <ul style="list-style-type: none"> • [IP Address]: 172.31.16.141 • [Subnet Mask]: 255.255.0.0 • [Default Gateway]: 0.0.0.0 <p>Setting range for the IP address, subnet mask and default gateway is “000.000.000.000” to “255.255.255.255”.</p> <p>Note: Do NOT use the same IP address as other network equipment.</p>	01. IP Address:	172.31.16.141	02. Subnet Mask:	255.255.0.0	03. Default Gateway:	0.0.0.0																		
01. IP Address:	172.31.16.141																								
02. Subnet Mask:	255.255.0.0																								
03. Default Gateway:	0.0.0.0																								
[Ethernet SFI]	<p>Set the SFI (system function ID) of the NAVpilot. The talker of the device is alphanumeric, two characters followed by four numerals.</p> <ul style="list-style-type: none"> • Default setting: AG0001 • Setting range: AA0001 to ZZ9998 <p>Note: The SFI is a unique ID to distinguish the shipboard equipment. Therefore, do NOT use the same SFI as other network equipment.</p>																								
[Multicast IP Address]	<p>Set the multicast IP address of the NAVpilot.</p> <ul style="list-style-type: none"> • Default setting: 239.192.0.4 • Setting range: 239.192.0.1 to 239.192.0.16 																								
[Receive Group]	<p>Select [ON] to receive the following data signals:</p> <ul style="list-style-type: none"> • [MISC]: Other equipment data (engine sensor, etc.) • [SATD]: Satellite data • [NAVD]: Navigation data • [TIME]: Time • [PROP]: Data specified by manufacturer <div data-bbox="1209 1099 1385 1283" style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: left; margin: 0;">◀ Receive Group</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%;">01. MISC:</td> <td style="text-align: right;">ON</td> </tr> <tr> <td>02. SATD:</td> <td style="text-align: right;">ON</td> </tr> <tr> <td>03. NAVD:</td> <td style="text-align: right;">ON</td> </tr> <tr> <td>04. TIME:</td> <td style="text-align: right;">ON</td> </tr> <tr> <td>05. PROP:</td> <td style="text-align: right;">ON</td> </tr> </table> </div>	01. MISC:	ON	02. SATD:	ON	03. NAVD:	ON	04. TIME:	ON	05. PROP:	ON														
01. MISC:	ON																								
02. SATD:	ON																								
03. NAVD:	ON																								
04. TIME:	ON																								
05. PROP:	ON																								
[Ethernet Error Counter]	<p>Displays the number of LAN-related errors since the power has been turned on.</p> <div data-bbox="759 1375 1275 1709" style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: left; margin: 0;">◀ Ethernet Error Counter</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 85%;">Ethernet Error</th> <th style="width: 10%;">Counter</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Incorrect Sentence</td> <td style="text-align: right;">000</td> </tr> <tr> <td>2</td> <td>TAG Block Framing Error</td> <td style="text-align: right;">000</td> </tr> <tr> <td>3</td> <td>TAG Syntax Error</td> <td style="text-align: right;">000</td> </tr> <tr> <td>4</td> <td>TAG Block Checksum Error</td> <td style="text-align: right;">000</td> </tr> <tr> <td>5</td> <td>Incorrect TAG Block</td> <td style="text-align: right;">000</td> </tr> <tr> <td>6</td> <td>Invalid Header</td> <td style="text-align: right;">000</td> </tr> <tr> <td>7</td> <td>UDP Checksum Error</td> <td style="text-align: right;">000</td> </tr> </tbody> </table> <p style="font-size: small; margin-top: 5px;"> MENU Prev ↑/↓ ↺ ↻ </p> </div>		Ethernet Error	Counter	1	Incorrect Sentence	000	2	TAG Block Framing Error	000	3	TAG Syntax Error	000	4	TAG Block Checksum Error	000	5	Incorrect TAG Block	000	6	Invalid Header	000	7	UDP Checksum Error	000
	Ethernet Error	Counter																							
1	Incorrect Sentence	000																							
2	TAG Block Framing Error	000																							
3	TAG Syntax Error	000																							
4	TAG Block Checksum Error	000																							
5	Incorrect TAG Block	000																							
6	Invalid Header	000																							
7	UDP Checksum Error	000																							

*: Shown only for the non-IMO type.

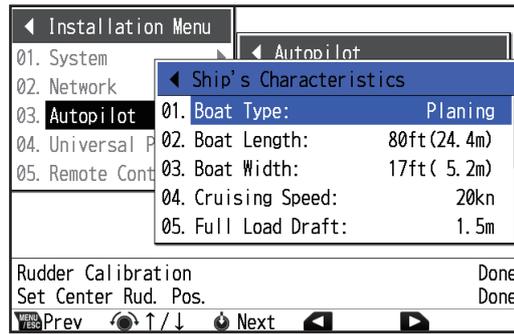
3.6.10 [Installation Menu] > [Network] > [Data Source] menu



Menu item	Description																					
[View Sensors in Use]	<p>Opens the [View Sensors in Use] display and shows a list of the sensors currently used as data sources. Dashed lines "-----" indicate that either there is no connection, or the sensor is not currently active.</p> <p>The screenshot shows the following data in the 'View Sensors in Use' display:</p> <table border="1"> <thead> <tr> <th>Data</th> <th>Talker</th> <th>SFI</th> </tr> </thead> <tbody> <tr> <td>Heading:</td> <td>Port1</td> <td>HE</td> </tr> <tr> <td>Speed (STW):</td> <td>Port2</td> <td>VD</td> </tr> <tr> <td>Speed (SOG):</td> <td>Ethernet:</td> <td>VD0001</td> </tr> <tr> <td>Position:</td> <td>Ethernet:</td> <td>GP0001</td> </tr> <tr> <td>NAV Data:</td> <td>NMEA2000:</td> <td>NAVpilot: U: 2458</td> </tr> <tr> <td>Alert:</td> <td>-----</td> <td>-----</td> </tr> </tbody> </table>	Data	Talker	SFI	Heading:	Port1	HE	Speed (STW):	Port2	VD	Speed (SOG):	Ethernet:	VD0001	Position:	Ethernet:	GP0001	NAV Data:	NMEA2000:	NAVpilot: U: 2458	Alert:	-----	-----
Data	Talker	SFI																				
Heading:	Port1	HE																				
Speed (STW):	Port2	VD																				
Speed (SOG):	Ethernet:	VD0001																				
Position:	Ethernet:	GP0001																				
NAV Data:	NMEA2000:	NAVpilot: U: 2458																				
Alert:	-----	-----																				
[Heading Data Status]	Shows the status for heading data.																					
[Heading]	See section 3.3.																					
[Heading Backup]																						
[Speed (STW)]																						
[Speed (STW) Backup]																						
[Speed (SOG)]																						
[Speed (SOG) Backup]																						
[Position]																						
[Position Backup]																						
[NAV Data]	See section 3.3.																					
[Alert]																						

3. INITIAL SETTING

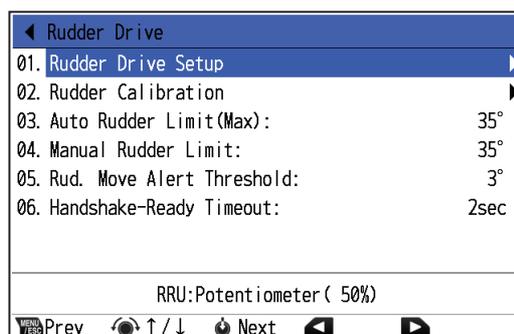
3.6.11 [Installation Menu] > [Autopilot] > [Ship's Characteristics] menu



Menu item	Description
[Boat Type]	See section 3.2.
[Boat Length]*	
[Boat Width]*	
[Cruising Speed]*	
[Full Load Draft]*	
[Flap Rudder]*	
[Turn Type]	<p>Select whether to use the rate of turn or radius of turn for turn control by the NAVpilot. To control the vessel so that the turn radius is constant regardless of ship's speed, select [Turn Radius].</p> <ul style="list-style-type: none"> • [Turn Rate]: Use the rate of turn for turn control by the NAVpilot. • [Turn Radius]: Use the radius of turn for turn control by the NAVpilot.
[Regulation Type]	<p>If your ship needs SOLAS certification, select [IMO] (IMO type). If not, select [N/A] (non-IMO type).</p> <p>When this setting is changed, the following message appears. Select [OK] to restore all settings to factory defaults.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>If this setting is changed from N/A to IMO, all settings will be restored to factory defaults. Are you sure?</p> <p style="text-align: center;">OK Cancel</p> <p style="text-align: center;"> Enter ←/→ Cancel </p> </div>

*: If changed, a confirmation message appears. Note that all work profiles are restored to the default settings to apply the setting.

3.6.12 [Installation Menu] > [Autopilot] > [Rudder Drive] menu



Menu item	Description
[Rudder Drive Setup]	See section 3.4.1.
[Rudder Calibration]	See section 3.4.2.
[Auto Rudder Limit (Max)] ^{*1}	See section 3.4.3.
[Manual Rudder Limit] ^{*1, *2}	See section 3.4.4.
[Rud. Move Alert Threshold]	Adjust the threshold for the rudder movement alert (HCS fault alert). If the rudder angle does not change greater than the value set here while auto steering by the NAVpilot, the system determines that the rudder is not moving and the HCS fault alert occurs.
[Rudder Dead Band] ^{*1, *3}	You can set the rudder dead band automatically or manually. For manual setting, select [Manual] and do as follows: 1) Rotate the knob to select the current dead band value, then push the knob. 2) Adjust the dead band value, then push the knob.
[Rudder Speed] ^{*1, *4}	Adjust the rudder speed. If the rudder speed is too slow or too fast, the vessel may not be controlled properly.
[Handshake-Ready Timeout] ^{*5}	Adjust the timeout threshold for the handshake-ready signal. If the handshake signal response could not be obtained from the steering system for the time set here, the system alert occurs.

*1: Activated after completing [Rudder Drive Setup] and [Rudder Calibration] setup.

*2: Not shown when [RRU Sensor Type] is set to [Not Used].

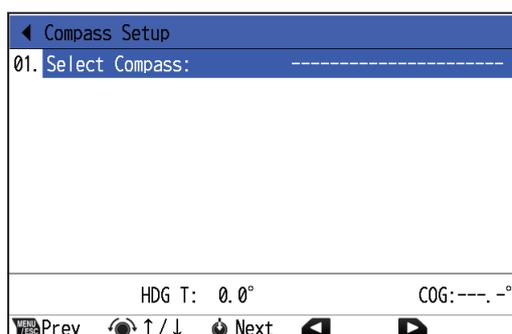
*3: Shown when [Drive Type] is set to [Bang-Bang].

*4: Shown when [RRU Sensor Type] is set to [Not Used].

*5: Shown when [Handshake-Ready] is set to [Used] at rudder drive setup.

3.6.13 [Installation Menu] > [Autopilot] > [Compass Setup] menu

The [Compass Setup] menu calibrates the connected heading sensor.



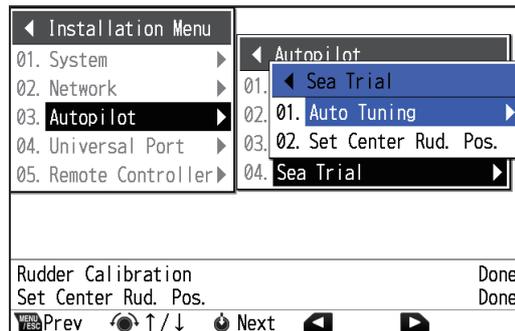
Menu item	Description
[Select Compass]	Select the heading sensor to set up.
[Compass Information]	Show the information (model name, software version, etc.) of the sensor that is selected at [Select Compass].

3. INITIAL SETTING

Menu item	Description
Menu items shown when the PG-700 is selected at [Select Compass].	
[Compass Calib.]	Select the calibration mode. <ul style="list-style-type: none"> [Auto]: The boat turns to starboard three or four full circles for calibration. Note that the boat will turn to starboard with the degree set at [Manual Rudder Limit] on the [Rudder Drive] menu. Note: [Auto] is not shown when [RRU Sensor Type] is set to [Not Used]. [Manual]: Use the helm to turn the boat to port or starboard for three or four full circles in speed of about one minute/circle to perform the calibration.
[Compass Offset]	If the heading data shown on the display differs from the indication of the heading sensor, apply an offset at [Compass Offset]. This offset is applied to the heading sensor data. For example, if the indication on the control unit shows 125° though the heading sensor reading is 120°, enter "5°".
[Compass Clear]	Select [Yes] to restore the sensor's factory defaults. For recalibrating the heading sensor.
[Restart PG-700]	Select [Yes] to restart the PG-700. Turn the steering mode to the STBY mode before restarting the PG-700.

3.6.14 [Installation Menu] > [Autopilot] > [Sea Trial] menu

Note: Settings on this menu require taking the vessel on a short sea trial. This requires the vessel to leave the dock.

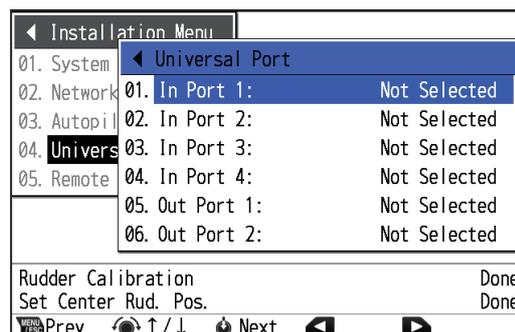


Menu item	Description
[Auto Tuning] ^{*1}	See section 3.5.
[Set Center Rud. Pos.] ^{*2}	

*1: Shown when [Boat Length] is 60 ft (18.3 m) or more.

*2: Not shown when [RRU Sensor Type] is set to [Not Used].

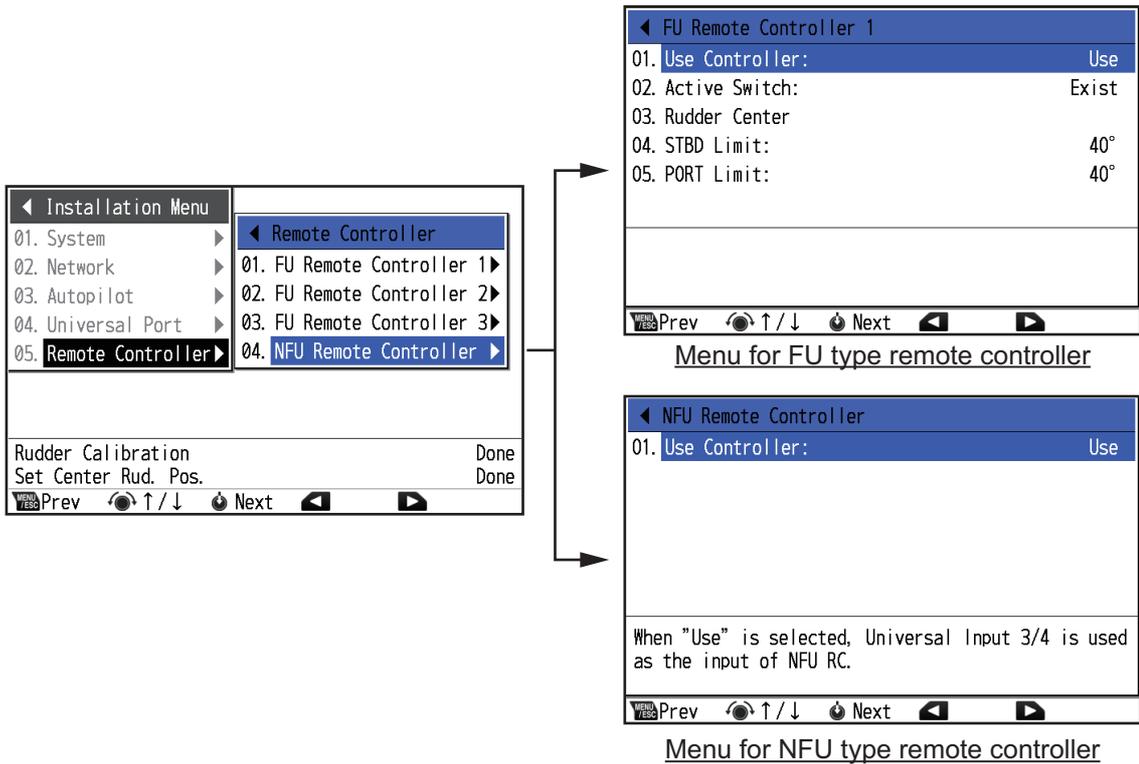
3.6.15 [Installation Menu] > [Universal Port] menu



Menu item	Description
[In Port 1] to [In Port 4]	<p>Select the command of function for the Universal Input port. This command or function assigned to the switch box connected to the GENERAL IN port.</p> <ul style="list-style-type: none"> • [Not Selected]: The port is disabled. • [Go AUTO]: The switch, when operated, puts the NAVpilot in the AUTO mode. • [Go STBY]: The switch, when operated, puts the NAVpilot in the STBY mode. • [Rudder Start Position]^{*1}: The switch, when operated, switches the rudder position to start auto steering. Turn the switch on to start auto steering from the rudder position when auto steering is activated. Turn the switch off to start auto steering when the rudder is centered. • [Rudder Limit Switch (P)]^{*1}/[Rudder Limit Switch (S)]^{*1}: Select when the RRU has a rudder angle limit switch. The NAVpilot stops the rudder steering and shows a message when the rudder reaches the rudder limit and the limit switch is pressed. • [Alert ACK]^{*2}: The switch, when operated, acknowledges alerts generated by the NAVpilot. • [Alert Mute]^{*2}: The switch, when operated, temporarily silences the buzzer. <p>^{*1}: Not shown when [RRU Sensor Type] is set to [Not Used]. ^{*2}: Shown only for the non-IMO type.</p> <p>Note 1: [In Port 1] is available when [Handshake-Ready] on the [Rudder Drive Setup] wizard is set to [Not Used]. Note 2: [In Port 3] and [In Port 4] are available when [Use Controller] for [NFU Remote Controller] is set to [Not Used].</p>
[Out Port 1] to [Out Port 6]	<p>Select the action that triggers contact output signal from the Universal Output port. The contact output signal can be set to NC (normally closed) or NO (normally open) output by wiring to the Universal Output port. For detailed information, see the pin assignment table on page 2-21.</p> <ul style="list-style-type: none"> • [Not Selected]: The port is disabled. • [AUTO/NAV Mode][*]: While the NAVpilot is in the AUTO or NAV mode. • [AUTO Mode]: While the NAVpilot is in the AUTO mode. • [STBY Mode]: While the NAVpilot is in the STBY mode. • [NAV Mode][*]: While the NAVpilot is in the NAV mode. • [FU Remote Controller1] to [FU Remote Controller3]: The FU remote controller is operated. • [NFU Remote Controller1][*]: The NFU remote controller is operated. • [Backup Navigator Call]: The NAVpilot loses the heading signal and the alert is not acknowledged for 30 seconds. • [Operator Fitness]: A key or knob on the control unit is pressed. • [HCS Fault Alert]: The NAVpilot generates “HCS fault” or “Lost HDG control” alert. • [Off Heading Alert]: The NAVpilot generates “Off Heading” alert. <p>[*]: Shown only for the non-IMO type.</p> <p>Note: [Out Port 1] is available when [Handshake-Request] on the [Rudder Drive Setup] wizard is set to [Not Used].</p>

3.6.16 [Installation Menu] > [Remote Controller] menu

Note: The RRU must be installed to use the FU and NFU remote controllers.



Menu item	Description
[Use Controller]	Select [Use] when the remote controller is connected. If not connected, select [Not Used]. <ul style="list-style-type: none"> • FU type: Connect the remote controller to TB210, TB211 or TB212. • NFU type: Connect the remote controller to universal input 3 and 4. When [Use Controller] for [NFU Remote Controller] is set to [Use], [In Port 3] and [In Port 4] on the [Universal Port] menu cannot be changed.
[Active Switch]*	Select [Exist] when a remote controller has an active switch. If not, select [Not Exist].
[Rudder Center Setup]*	Set the rudder center position. When this menu item is selected, the following message appears. Center the lever and turn the helm so that the rudder is centered, then push the knob. <div style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>Set rudder at center (approx.) then press Yes to set. Is the rudder centered?</p> <p style="text-align: center;"> <input type="radio"/> Yes <input type="radio"/> No </p> </div>
[STBD Limit Setup]*	Set the starboard rudder limit. Turn the lever hard-over to starboard and measure the rudder angle, then enter the measured value.
[PORT Limit Setup]*	Set the port rudder limit. Turn the lever hard-over to port and measure the rudder angle, then enter the measured value.

*: Not shown for the NFU type remote controller.

APPX. 1 JIS CABLE GUIDE

Cables listed in the manual are usually shown as Japanese Industrial Standard (JIS). Use the following guide to locate an equivalent cable locally.

JIS cable names may have up to 6 alphabetical characters, followed by a dash and a numerical value (example: DPYC-2.5).

For core types D and T, the numerical designation indicates the *cross-sectional Area (mm²)* of the core wire(s) in the cable.

For core types M and TT, the numerical designation indicates the *number of core wires* in the cable.

1. Core Type

D: Double core power line

T: Triple core power line

M: Multi core

TT: Twisted pair communications
(1Q=quad cable)

2. Insulation Type

P: Ethylene Propylene Rubber

3. Sheath Type

Y: PVC (Vinyl)

4. Armor Type

C: Steel

5. Sheath Type

Y: Anticorrosive vinyl sheath

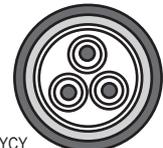
6. Shielding Type

SLA: All cores in one shield, plastic tape w/aluminum tape

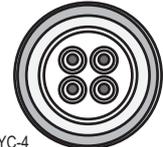
-SLA: Individually shielded cores, plastic tape w/aluminum tape



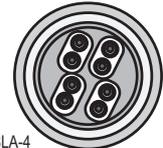
DPYCY



TPYCY



MPYC-4



TTYCSLA-4

EX: ¹ ³ ⁴ ⁵ ⁶
TTYCYSLA - 4
 Designation type | # of twisted pairs

EX: ¹ ² ³ ⁴
MPYC - 4
 Designation type | # of cores

The following reference table lists gives the measurements of JIS cables commonly used with Furuno products:

Type	Area	Core Diameter	Cable Diameter	Type	Area	Core Diameter	Cable Diameter
DPYC-1.5	1.5mm ²	1.56mm	11.7mm	TTYCSLA-1	0.75mm ²	1.11mm	9.4mm
DPYC-2.5	2.5mm ²	2.01mm	12.8mm	TTYCSLA-1T	0.75mm ²	1.11mm	10.1mm
DPYC-4	4.0mm ²	2.55mm	13.9mm	TTYCSLA-1Q	0.75mm ²	1.11mm	10.8mm
DPYC-6	6.0mm ²	3.12mm	15.2mm	TTYCSLA-4	0.75mm ²	1.11mm	15.7mm
DPYC-10	10.0mm ²	4.05mm	17.1mm	TTYCY-1	0.75mm ²	1.11mm	11.0mm
DPYCY-1.5	1.5mm ²	1.56mm	13.7mm	TTYCY-1T	0.75mm ²	1.11mm	11.7mm
DPYCY-2.5	2.5mm ²	2.01mm	14.8mm	TTYCY-1Q	0.75mm ²	1.11mm	12.6mm
DPYCY-4	4.0mm ²	2.55mm	15.9mm	TTYCY-4	0.75mm ²	1.11mm	17.7mm
MPYC-2	1.0mm ²	1.29mm	10.0mm	TTYCY-4SLA	0.75mm ²	1.11mm	19.5mm
MPYC-4	1.0mm ²	1.29mm	11.2mm	TTYCYSLA-1	0.75mm ²	1.11mm	11.2mm
MPYC-7	1.0mm ²	1.29mm	13.2mm	TTYCYSLA-4	0.75mm ²	1.11mm	17.9mm
MPYC-12	1.0mm ²	1.29mm	16.8mm	TTPYCSLA-1	0.75mm ²	1.11mm	9.2mm
TPYC-1.5	1.5mm ²	1.56mm	12.5mm	TTPYCSLA-1T	0.75mm ²	1.11mm	9.8mm
TPYC-2.5	2.5mm ²	2.01mm	13.5mm	TTPYCSLA-1Q	0.75mm ²	1.11mm	10.5mm
TPYC-4	4.0mm ²	2.55mm	14.7mm	TTPYCSLA-4	0.75mm ²	1.11mm	15.3mm
TPYCY-1.5	1.5mm ²	1.56mm	14.5mm				
TPYCY-2.5	2.5mm ²	2.01mm	15.5mm				
TPYCY-4	4.0mm ²	2.55mm	16.9mm				

APPX. 2 DIGITAL INTERFACE

Digital Interface

• **Input sentences:**

AAM, ACN, APB, BOD, BWC, BWR, GGA, GLL, GNS, HBT, HCR, HDG, HDM^{*1}, HDT, MWV, RMB, RMC, ROT, THS, VBW, VHW, VTG, VWR^{*1}, VWT^{*1}, XTE^{*2}, ZDA

• **Output sentences:**

ALC, ALF, ALR, ARC, EVE, GGA^{*3}, GLL^{*3}, GNS^{*3}, HBT, HDG^{*3}, HDM^{*3}, HDT^{*3}, HTD, RMB^{*3}, RMC^{*3}, ROT^{*3}, RSA, THS^{*3}, VBW^{*3}, VHW^{*3}, VTG^{*3}, ZDA^{*3}

*1: Available only for IEC61162-1/2.

*2: The XTE (Cross Track Error) resolution of the nav data source must be 0.001 NM or more precise. If not, the NAVpilot steering performance may be reduced.

*3: Available only for the non-IMO type.

Data Sentences

Input sentences

AAM - Waypoint arrival alarm

```
$--AAM,A,A,x.x,N,c--c*hh<CR><LF>
  1 2 3 4 5
```

1. Status (A=Arrival circle entered, V=Not arrived)
2. Status (A=Perpendicular passed at waypoint, V=Not arrived)
3. Arrival circle radius (0.000 to 9.999)
4. Units of radius, nautical miles (N)
5. Waypoint ID (Max. 30 characters)

ACN - Alert command

```
$--ACN,hhmss.ss,aaa,x.x,x.x,ca,a*hh<CR><LF>
  1      2 3 4 5 6
```

1. Time (No use)
2. Manufacturer mnemonic code (null, FEC)
3. Alert Identifier (0 to 9999999)
4. Alert Instance (0 to 999999, null)
5. Alert command (A=acknowledge, Q=request/repeat information, O=responsibility transfer, S=silence)
6. Sentence status flag (C)

APB - Heading/track controller (autopilot) sentence B

\$--APB,A,A,x.x,a,N,A,A,x.x,a,c--c,x.x,a,x.x,a,a*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

1. Status (A=Data valid V=LORAN-C blink or SNR warning
 V=general warning flag for other navigation systems
 when a reliable fix is not available)
2. Status (A=OK or no use V=LORAN-C cycle lock warning flag)
3. Magnitude of XTE (0.000 to 100.000)
4. Direction to steer L/R (L, R)
5. XTD units (N=nautical miles)
6. Status (A=arrival circle entered, V=arrival circle not passed, null)
7. Status (A=perpendicular passed at waypoint, V=perpendicular not entered, null)
8. Bearing origin to destination (No use)
9. M/T (No use)
10. Destination waypoint ID (Max. 30 characters)
11. Bearing, present position to destination (0.0 to 359.9)
12. M/T (M=Magnetic, T=True)
13. Heading to steer to destination waypoint (No use)
14. M/T (No use)
15. Mode indicator (A=Autonomous mode D=differential mode S=Simulator mode,
 N=Data not valid, null)

BOD - Bearing origin to destination

\$--BOD,x.x,T,x.x,M,c--c,c--c*hh<CR><LF>
 1 2 3 4 5 6

1. Bearing, degrees (0.0 to 359.9)
2. True (T)
3. Bearing, degrees (0.0 to 359.9)
4. Magnetic (M)
5. Destination waypoint ID (Max. 30 characters)
6. Origin waypoint ID (Max. 30 characters)

BWC - Bearing and distance to waypoint - Great circle

\$--BWC,hhmmss.ss,IIII.II, a,IIII.II,a,yyy.y,T, yyy.y,M,yyy.y,N,c--c,a*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of observation (No use)
2. Waypoint latitude (0000.0000 to 9000.0000)
3. N/S (N, S)
4. Waypoint longitude (00000.0000 to 18000.0000)
5. E/W (E, W)
6. Bearing, degrees true (0.0 to 359.9)
7. Unit (T)
8. Bearing, degrees (0.0 to 359.9)
9. Unit (M)
10. Distance, nautical miles (0.000 to 10000.000)
11. Unit (N)
12. Waypoint ID (Max. 30 characters)
13. Mode Indicator (A=Autonomous D=Differential S=Simulator N=Data not valid, null)

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BWR - Bearing and distance to waypoint - Rhumb line

\$--BWR,hhmmss.ss,llll.ll,a,llll.ll,a,yyy.y,T,yyy.y,M,yyy.y,N,c--c,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of observation (No use)
2. Waypoint latitude (0000.0000 to 9000.0000)
3. N/S (N, S)
4. Waypoint longitude (00000.0000 to 18000.0000)
5. E/W (E, W)
6. Bearing, degrees true (0.0 to 359.9)
7. Unit (T)
8. Bearing, degrees magnetic (0.0 to 359.9)
9. Unit (M)
10. Distance, nautical miles (0.000 to 10000.000)
11. Unit (N)
12. Waypoint ID (Max. 30 characters)
13. Mode Indicator (A=Autonomous D=Differential S=Simulator N=Data not valid, null)

GGA - Global positioning system fix data

\$--GGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13 14

1. UTC of position (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Latitude (0000.00000 to 9000.00000)
3. N/S (N, S)
4. Longitude (0000.00000 to 18000.00000)
5. E/W (E, W)
6. GPS quality indicator (1 to 8)
7. Number of satellites in use (00 to 99)
8. Horizontal dilution of precision (0.00 to 999.99)
9. Antenna altitude, m (-999.99 to 9999.99)
10. Unit (M)
11. Geoidal separation (-999.99 to 9999.99)
12. Unit (M)
13. Age of differential GPS data (0 to 999)
14. Differential reference station ID (0000 to 1023)

GLL - Geographic position, latitude/longitude

\$--GLL,llll.ll,a,yyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>
1 2 3 4 5 6 7

1. Latitude (0000.0000 to 9000.0000)
2. N/S (N, S)
3. Longitude (00000.0000 to 18000.0000)
4. E/W (E, W)
5. UTC of position (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
6. Status (A=data valid, V=data invalid)
7. Mode indicator (A=Autonomous, D=Differential, S=Simulator, null)

GNS - GNSS fix data

\$--GNS, hhmmss.ss, llll.ll, a, yyyyy.yy, a, c--c, xx, x.x, x.x, x.x, x.x, x.x, x.x, a*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of position (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Latitude (0000.0000 to 9000.0000)
3. N/S (N, S)
4. Longitude (00000.0000 to 18000.0000)
5. E/W (E, W)
6. Mode indicator (A=Autonomous, D=Differential, E=Estimated Mode, F=Float RTK, M=Manual Input Mode, N=No fix, P=Precise, R=Real Time Kinematic, S=Simulator Mode, null)
7. Total number of satellite in use (00 to 99)
8. HDOP (0.00 to 999.99)
9. Antenna altitude, meters (-999.99 to 9999.99)
10. Geoidal separation (-999.99 to 9999.99)
11. Age of differential data (0 to 999)
12. Differential reference station ID (0000 to 1023)
13. Navigational status indicator (S=Safe, C=Caution, U=Unsafe, V=Not valid, null)

HBT - Heartbeat supervision sentence

\$--HBT, x.x, A, x*hh<CR><LF>
 1 2 3

1. Configured repeat interval (1 to 99, null)
2. Equipment status (A=Normal)
3. Sequential sentence identifier (0 to 9)

HCR - Heading Correction Report

\$**HCR, x.x, a, a, x.x*hh<CR><LF>
 1 2 3 4

1. Heading, degrees true(0.00 to 359.9)
2. Mode indicator (A=Autonomous)
3. Correction state (A=Both Speed/latitude and dynamic correction included in heading, D=Dynamic correction included in heading, S=Speed/latitude correction included in heading, N=No correction included in heading, V=Not available, reporting device does not know about correction state)
4. Correction value (-180.0 to 180.0, null)

HDG - Heading, deviation and variation

\$--HDG, x.x, x.x, a, x.x, a*hh<CR><LF>
 1 2 3 4 5

1. Magnetic sensor heading, degrees (0.00 to 359.99)
2. Magnetic deviation, degrees (0.0 to 180.0)
3. E/W (E, W)
4. Magnetic variation, degrees (0.0 to 180.0)
5. E/W (E, W)

HDM - Heading, Magnetic

\$--HDM, x.x, M*hh<CR><LF>
 1 2

1. Heading, degrees (0.00 to 359.99)
2. Magnetic (M)

HDT - Heading, true

\$--HDT, xxx.x, T*hh<CR><LF>
 1 2

1. Heading, degrees (0.00 to 359.99)
2. True (T)

APPX. 2 DIGITAL INTERFACE

MWV - Wind Speed & Angle

\$--MWV,x.x,a,x.x,a,A*hh<CR><LF>
1 2 3 4 5

1. Wind angle, degrees (0.00 to 359.9)
2. Reference (R=Relative, T=Theoretical)
3. Wind speed (0.0 to 999.9)
4. Wind speed units (K=km/h M=m/s N=knots)
5. Status (A=Valid)

RMB - Recommended minimum navigation information

\$--RMB,A,x.x,a,c--c,c--c,llll.ll,a,yyyy.yy,a,x.x,x.x,x.x,A,a*hh <CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13 14

1. Data status (A=data valid, V=navigation receiver warning)
2. Cross track error - nautical miles (0.000 to 100.000)
3. Direction to steer (L, R)
4. Origin waypoint ID (Max. 30 characters)
5. Destination waypoint ID (Max. 30 characters)
6. Destination waypoint latitude (0000.0000 to 9000.0000)
7. N/S (N, S)
8. Destination waypoint longitude (0000.0000 to 18000.0000)
9. E/W (E, W)
10. Range to destination, nautical miles (0.000 to 10000.000)
11. Bearing to destination, degrees true (0.0 to 359.9)
12. Destination closing velocity, knots (-99.9 to 99.9)
13. Arrival status (A=Arrival circle entered or perpendicular passed, V=not entered/passed)
14. Mode indicator (A= Autonomous, D= Differential mode, S= Simulator, N=Data not valid, null)

RMC - Recommended minimum specific GPS/TRANSIT data

\$--RMC,hhmmss.ss,A,llll.ll,a,yyyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a,a*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of position fix (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Status (A=data valid, V=navigation receiver warning)
3. Latitude (0000.0000 to 9000.0000)
4. N/S (N, S)
5. Longitude (00000.0000 to 18000.0000)
6. E/W (E, W)
7. Speed over ground, knots (0.00 to 999.9)
8. Course over ground, degrees true (0.0 to 359.9)
9. Date (No use)
10. Magnetic variation, degrees (0.0 to 180.0)
11. E/W (E, W)
12. Mode indicator (A= Autonomous mode, D= Differential mode, F=Float RTK, P=Precise, R=Real time kinematic, S= Simulator, null)
13. Navigational status indication (S=Safe, C=Caution, U=Unsafe, V=Navigational status not valid, null)

ROT - Rate Of Turn

\$--ROT,x.x,A*hh<CR><LF>
1 2

1. Rate of turn, deg/min, "-"=bow turns to port (-9999.9 to 9999.9)
2. Status (A=data valid)

THS - True heading and status

\$--THS,x.x,a*hh<CR><LF>
1 2

1. Heading, degrees True (0.00 to 359.99)
2. Mode indicator (A=Autonomous)

VBW - Dual ground/water speed

\$--VBW,x,x,x,x,A,x,x,x,x,A,x,x,A,x,x,A*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10

1. Longitudinal water speed, knots (-999.99 to 999.99)
2. Transverse water speed, knots (-999.99 to 999.99, null)
3. Status: water speed (A=data valid)
4. Longitudinal ground speed, knots (-999.99 to 999.99)
5. Transverse ground speed, knots (-999.99 to 999.99, null)
6. Status: ground speed (A=data valid)
7. Stern transverse water speed, knots (-999.99 to 999.99)
8. Status: stern water speed (A=data valid)
9. Stern transverse ground speed, knots (-999.99 to 999.99)
10. Status: stern ground speed (A=data valid)

VHW - Water speed and headings

\$--VHW,x,x,T,x,x,M,x,x,N,x,x,K*hh <CR><LF>
 1 2 3 4 5 6 7 8

1. Heading, degrees (No use)
2. T=True (No use)
3. Heading, degrees (No use)
4. M=Magnetic (No use)
5. Speed (-999.9 to 999.9)
6. N=Knots (fixed)
7. Speed (-999.9 to 999.9)
8. K=km/h (fixed)

VTG - Course over ground and ground speed

\$--VTG,x,x,T,x,x,M,x,x,N,x,x,K,a*hh <CR><LF>
 1 2 3 4 5 6 7 8 9

1. Course over ground, degrees (0.0 to 359.9)
2. T=True (fixed)
3. Course over ground, degrees (0.0 to 359.9)
4. M=Magnetic (fixed)
5. Speed over ground, knots (0.00 to 999.9)
6. N=Knots (fixed)
7. Speed over ground, km/h (0.00 to 999.9)
8. K=km/h (fixed)
9. Mode indicator (A=Autonomous, D=Differential, S=Simulator, P=Precision, null)

VWR - Relative (Apparent) Wind Speed and Angle

\$--VWR,x,x,a,x,x,N,x,x,M,x,x,K*hh<CR><LF>
 1 2 3 4 5 6 7 8

1. Measured wind angle relative to the vessel, degrees (0.0 to 180.0)
2. L/R (L=Left semicircle, R=Right semicircle)
3. Velocity, knots (0.0 to 999.9)
4. Unit (N, fixed)
5. Velocity (0.0 to 999.9)
6. Unit (M, fixed)
7. Velocity, km/h (0.0 to 999.9)
8. Unit (K, fixed)

APPX. 2 DIGITAL INTERFACE

VWT - True Wind Speed and Angle

\$**VWT,x.x,a,x.x,N,x.x,M,x.x,K*hh<CR><LF>
1 2 3 4 5 6 7 8

1. Measured wind angle relative to the vessel, degrees (0.0 to 180.0)
2. L/R (L=Left semicircle, R=Right semicircle)
3. Velocity, knots (0.0 to 999.9)
4. Unit (N, fixed)
5. Velocity (0.0 to 999.9)
6. Unit (M, fixed)
7. Velocity, km/h (0.0 to 999.9)
8. Unit (K, fixed)

XTE - Cross-track error, measured

\$--XTE,A,A,x.x,a,N,a*hh<CR><LF>
1 2 3 4 5 6

1. Status (A=Data valid V=LORAN-C blink or SNR warning
V=general warning flag for other navigation systems when a reliable fix is not available)
2. Status (A=data valid, V=Loran-C cycle lock warning flag)
3. Magnitude of cross-track error (0.000 to 100.000)
4. Direction to steer, L/R (L, R)
5. Units, nautical miles (N)
6. Mode indicator (A=Autonomous mode, D=Differential mode, S=Simulator mode, N=Data not valid, null)

ZDA - Time and date

\$--ZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>
1 2 3 4 5 6

1. UTC (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Day (UTC) (01 to 31)
3. Month (UTC) (01 to 12)
4. Year (UTC) (1986 to 2046)
5. Local zone, hours (-14 to 14)
6. Local zone, minutes (00 to 59)

Output sentences

ALC - Cyclic alert list

\$AGALC,xx,xx,xx,x.x,aaa,x.x,x.x,x.x,"""*hh<CR><LF>
1 2 3 4 5 6 7 8 9

1. Total number of sentences for this message (01 to 99)
2. Sentence number (01 to 99)
3. Sequential message identifier (00 to 99)
4. Number of alert entries (0 to n)
5. Manufacturer mnemonic code (FEC, null)
6. Alert identifier (000 to 9999999)
7. Alert instance (0 to 999999, null)
8. Revision counter (1 to 99)
9. Additional alert entries (see Note)

Note: Alert entry 0 to n: Each alert entry consists of

- Manufacturer Identifier (see ALF Manufacturer)
- Alert Identifier (see ALF Alert identifier)
- Alert instance (see ALF instance)
- Revision counter (see ALF revision counter)

Each entry identifies a certain alert with a certain state.

It is not allowed that an alert entry is split between two ALC sentences.

ALF - Alert sentence

\$AGALF,x,x,x,hhmmss.ss,a,a,a,aaa,x,x,x,x,x,x,c--c*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13

1. Total number of ALF sentences for this message (1, 2)
2. Sentence number (1, 2)
3. Sequential message identifier (0 to 9)
4. Time of last change (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99, null when #2 is 2)
5. Alert category (A=Alert category A, B=Alert category B, C=Alert category C, null when #2 is 2)
6. Alert priority (A=Alarm, W=Warning, C=Caution, null when #2 is 2)
7. Alert state (A=Acknowledged, S=Silence, O=Active-responsibility transferred, U=Rectified-unacknowledged, V=Not acknowledged, N=Normal state, null when #2 is 2)
8. Manufacturer mnemonic code (FEC, null)
9. Alert identifier (000 to 9999999)
10. Alert instance (0 to 999999)
11. Revision counter (1 to 99)
12. Escalation counter (0 to 9)
13. Alert text (max. 16 characters, null)

ALR - Set alarm state

\$AGALR,hhmmss.ss,xxx,A,A,c--c*hh<CR><LF>
 1 2 3 4 5

1. Time of alarm condition change, UTC (null)
2. Unique alarm number (identifier) at alarm source (260)
3. Alarm condition (A=threshold exceeded)
4. Alarm acknowledge state (A=acknowledged, V=not acknowledged)
5. Alarm description text (Emergency Call)

ARC - Alert command refused

\$AGARC,hhmmss.ss,aaa,x,x,x,x,c*hh<CR><LF>
 1 2 3 4 5

1. Release time of the alert command refused (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Used for proprietary alerts, defined by the manufacturer (FEC, null)
3. The alert identifier (000 to 9999999)
4. The alert instance (0 to 999999)
5. Refused alert command (A=acknowledge, Q=request/repeat information, O=responsibility transfer, S=silence)

EVE - General event message

\$AGEVE,hhmmss.ss,c--c,c--c*hh<CR><LF>
 1 2 3

1. Event time (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Tag code used for identification of source of event (AA0001 to ZZ9998)
3. Event description (OPERATION)

Note: This sentence is output after input has been detected from either the control unit.

APPX. 2 DIGITAL INTERFACE

GGA - Global positioning system fix data

\$AGGGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10 11 12 13 14

1. UTC of position (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Latitude (0000.00000 to 9000.00000)
3. N/S (N, S)
4. Longitude (0000.00000 to 18000.00000)
5. E/W (E, W)
6. GPS quality indicator (0 to 5, 8)
7. Number of satellites in use (00 to 99)
8. Horizontal dilution of precision (0.00 to 999.99)
9. Antenna altitude, m (-1000 to 9999)
10. Unit (M)
11. Geoidal separation (-1000 to 9999)
12. Unit (M)
13. Age of differential GPS data (0 to 99)
14. Differential reference station ID (0000 to 1023)

GLL - Geographic position, latitude/longitude

\$AGLL,lll.ll,a,yyyy.yy,a,hhmmss.ss,A,a*hh<CR><LF>
1 2 3 4 5 6 7

1. Latitude (0000.0000 to 9000.0000)
2. N/S (N, S)
3. Longitude (00000.0000 to 18000.0000)
4. E/W (E, W)
5. UTC of position (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
6. Status (A=data valid, V=data invalid)
7. Mode indicator (A=Autonomous, D=Differential, S=Simulator, null)

GNS - GNSS fix data

Note: Outputs received data as it is.

HBT - Heartbeat supervision sentence

\$AGHBT,x.x,A,x*hh<CR><LF>
1 2 3

1. Configured repeat interval (30)
2. Equipment status (A=Normal, V=System fail)
3. Sequential sentence identifier (0 to 9)

HDG - Heading, deviation and variation

\$--HDG,x.x,x.x,a,x.x,a*hh<CR><LF>
1 2 3 4 5

1. Magnetic sensor heading, degrees (0.00 to 359.99)
2. Magnetic deviation, degrees (null)
3. E/W (null)
4. Magnetic variation, degrees (0.0 to 180.0, null)
5. E/W (E, W)

HDM - See "HDM - Heading, Magnetic" on page AP-5.

HDT - See "HDT - Heading, true" on page AP-5.

HTD - Heading/Track Control Data

\$AGHTD,A,x.x,a,a,a,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,a,A,A,x.x*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

1. Override (V=Not in use)
2. Commanded rudder angle, degrees (0.0 to 180.00, null)
3. Commanded rudder direction (L/R=Port/starboard, null)
4. Selected steering mode (M=Manual steering, S=Stand-alone (heading control))
5. Turn mode (R=Radius controlled, T=Turn rate controlled, N=Turn is not controlled)
6. Commanded rudder limit, degrees (unsigned) (0.0 to 99.9)
7. Commanded off-heading limit, degrees (unsigned) (0.0 to 359.9)
8. Commanded radius of turn for heading changes, n.miles (0.0 to 9999.99, null)
9. Commanded rate of turn to heading changes, deg/min (-9999.99 to 9999.99, null)
10. Commanded heading-to-steer, degrees (null)
11. Commanded off-track limit, n.miles (unsigned) (null)
12. Commanded track, degrees (null)
13. Heading reference in use, T/M (T, M, null)
14. Rudder status (A=Within limits, V=Limit reached or exceeded)
15. Off-heading status (A=Within limits, V=Limit reached or exceeded)
16. Off-track status (null)
17. Vessel heading, degrees (0.0 to 359.9, null)

RMB - Recommended minimum navigation information

\$AGRMB,A,x.x,a,c--c,c--c,llll.ll,a,yyyy.yy,a,x.x,x.x,x.x,A,a*hh <CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13 14

1. Data status (A=data valid, V=navigation receiver warning)
2. Cross track error - nautical miles (0.000 to 100.000)
3. Direction to steer (L, R)
4. Origin waypoint ID (First 4 characters of origin waypoint)
5. Destination waypoint ID (First 4 characters of destination waypoint)
6. Destination waypoint latitude (0000.0000 to 9000.0000)
7. N/S (N, S)
8. Destination waypoint longitude (0000.0000 to 18000.0000)
9. E/W (E, W)
10. Range to destination, nautical miles (0.000 to 10000.000)
11. Bearing to destination, degrees true (0.0 to 359.9)
12. Destination closing velocity, knots (-99.9 to 99.9)
13. Arrival status (A=Arrival circle entered or perpendicular passed, V=not entered/passed)
14. Mode indicator (A= Autonomous, D=Differential mode, S= Simulator, N=Data not valid, null)

RMC - Recommended minimum specific GPS/TRANSIT data

\$AGRMC,hhmmss.ss,A,llll.ll,a,yyyyyy.yy,a,x.x,x.x,xxxxxx,x.x,a,a*hh<CR><LF>
 1 2 3 4 5 6 7 8 9 10 11 12 13

1. UTC of position fix (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Status (A=data valid, V=navigation receiver warning)
3. Latitude (0000.0000 to 9000.0000)
4. N/S (N, S)
5. Longitude (00000.0000 to 18000.0000)
6. E/W (E, W)
7. Speed over ground (0.0 to 9999.9)
8. Course over ground, degrees true (0.0 to 359.9)
9. Date (null)
10. Magnetic variation, degrees (0.0 to 180.0, null)
11. E/W (E, W, null)
12. Mode indicator (A= Autonomous mode, D=Differential mode, F=Float RTK, P=Precise, R=Real time kinematic, S= Simulator, null)
13. Navigational status indication (S=Safe, C=Caution, U=Unsafe, V=Navigational status not valid)

ROT - See "ROT - Rate Of Turn" on page AP-6.

APPX. 2 DIGITAL INTERFACE

RSA - Rudder sensor angle

\$AGRSA,x.x,A,x.x,A*hh<CR><LF>
1 2 3 4

1. Starboard(or single) rudder sensor data (-180 to 180.0, null)
2. Starboard(or single) rudder sensor status (A=Valid, V=Data invalid)
3. Port rudder sensor data (null)
4. Port rudder sensor status (V=Data invalid)

THS - See "THS - True heading and status" on page AP-6.

VBW - Dual ground/water speed

\$AGVBW,x.x,x.x,A,x.x,x.x,A,x.x,A,x.x,A*hh<CR><LF>
1 2 3 4 5 6 7 8 9 10

1. Longitudinal water speed, knots (-999.99 to 999.99, null)
2. Transverse water speed, knots (-999.99 to 999.99, null)
3. Status: water speed (A=data valid, V=data invalid)
4. Longitudinal ground speed, knots (-999.99 to 999.99, null)
5. Transverse ground speed, knots (-999.99 to 999.99, null)
6. Status: ground speed (A=data valid, V=data invalid)
7. Stern transverse water speed, knots (-999.99 to 999.99, null)
8. Status: stern water speed (A=data valid, V=data invalid)
9. Stern transverse ground speed, knots (-999.99 to 999.99, null)
10. Status: stern ground speed (A=data valid, V=data invalid)

VHW - Water speed and headings

\$AGVHW,x.x,T,x.x,M,x.x,N,x.x,K*hh <CR><LF>
1 2 3 4 5 6 7 8

1. Heading, degrees (0.0 to 359.9, null)
2. T=True (T)
3. Heading, degrees (0.0 to 359.9, null)
4. M=Magnetic (M)
5. Speed (-999.9 to 999.9)
6. N=Knots (N)
7. Speed (-999.9 to 999.9)
8. K=km/h (K)

VTG - See "VTG - Course over ground and ground speed" on page AP-7.

ZDA - Time and date

\$AGZDA,hhmmss.ss,xx,xx,xxxx,xx,xx*hh<CR><LF>
1 2 3 4 5 6

1. UTC (hh=00 to 23, mm=00 to 59, ss.ss=00.00 to 59.99)
2. Day (UTC) (01 to 31)
3. Month (UTC) (01 to 12)
4. Year (UTC) (0000 to 9999)
5. Local zone, hours (-14 to 14)
6. Local zone, minutes (00, 59)

Alert Interface

This equipment has the following alert interface types and quantities to communicate with the CAM-HMI:

- IEC61162-1/2 (4 ports)
- IEC61162-450 (1 port)

ALF, ALC, ARC and HBT sentences are used for alert handling.

APPX. 3 ALERT LIST

Alerts which are not acknowledged within the specified time limit are repeated as warning level, with the exception of the Alert “Off-heading”. The Alert “Off-heading” is escalated from warning level to alarm level if the alert is not acknowledged within the time limit.

The table below lists the possible alerts for this autopilot. Each alert is listed with priority and category.

Alert ID/ Instance ID	Alert title	Alert Message	Priority & Category	Mode in which alert is generated
3061-1	HCS fault	System power fail. Switch to Manual.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: Input power voltage of the processor unit is out of threshold. Remedy: Turn the system off and check the power supply voltage to the NAVpilot.			
3061-2	HCS fault	Rudder drive circuit error. Switch to MAN.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: A malfunction is detected in the rudder drive unit. Remedy: Turn the system off and request service from your local dealer.			
3061-3	HCS fault	Rudder not moving. Switch to Manual.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: The rudder angle did not follow the rudder order from the NAVpilot. Remedy: If the problem recurs, request service from your local dealer.			
3061-4	HCS fault	Rud. angle HW limit reached. Switch to MAN.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: The rudder angle reached its hardware limit. Remedy: Stop using the NAVpilot and check the rudder angle, status of the rudder, or hardware limit switch.			
3061-5	HCS fault	Rudder angle limit exceeded. Switch to MAN.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: Input rudder angle is outside operable threshold. Remedy: Check the connection to, and status of, the rudder angle sensor. If the problem recurs, request service from your local dealer.			
3061-6	HCS fault	Rudder ready signal error. Switch to MAN.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: The handshake signal response could not be obtained from the steering system. Remedy: Check connection to, and status of, the steering system.			
3061-7	HCS fault	CAN-bus power fail. Switch to Manual.	Alarm Cat: B	AUTO Advanced AUTO NAV
	Meaning: Power supply to the CAN bus network is outside operable threshold. Remedy: Check the voltage from the power supply to the CAN bus network.			

APPX. 3 ALERT LIST

Alert ID/ Instance ID	Alert title	Alert Message	Priority & Category	Mode in which alert is generated
3061-8	HCS fault	Lost all disp unit comm. Switch to Manual.	Alarm Cat: B	AUTO Advanced AUTO NAV
	<p>Meaning: Communication error between the processor unit and control unit. Remedy: Check the connection between the processor unit and control unit.</p>			
3007-1	Lost HDG control	Lost heading signal. Switch to Manual.	Alarm Cat: B	AUTO Advanced AUTO NAV Auto Tuning
	<p>Meaning: The NAVpilot has stopped controlling the rudder due to no heading signal. Remedy: Check connection to, and status of, the heading sensor.</p>			
3007-2	Lost HDG control	HDG data change too large. Switch to MAN.	Alarm Cat: B	AUTO Advanced AUTO NAV Auto Tuning
	<p>Meaning: A sudden change in the heading data was detected. Remedy: Check the status of the heading sensor.</p>			
3059-1	HCS unavailable	No heading signal.	Caution Cat: B	STBY DISENGAGED FU/NFU RC-FU/RC-NFU
	<p>Meaning: The NAVpilot can not use automatic rudder control due to no heading signal. Remedy: Check connection to, and status of, the heading sensor.</p>			
3059-2	HCS unavailable	Rudder drive circuit error.	Caution Cat: B	STBY DISENGAGED Rudder Calibration
	<p>Meaning: A malfunction is detected in the rudder drive unit. Remedy: Turn the system off and request service from your local dealer.</p>			
3059-3	HCS unavailable	Lost all display unit commu- nications.	Caution Cat: B	STBY DISENGAGED Rudder Calibration
	<p>Meaning: Communication error between processor unit and the last control unit. Remedy: Check the connection between the processor unit and control unit. To rectify the alert, a system reboot is required.</p>			
3024	Off-heading	Yawing is too large. Switch to Manual.	Alarm Cat: B	AUTO Advanced AUTO NAV Auto Tuning
	<p>Meaning: Heading deviation is outside operable threshold. Remedy: Check that the control parameters (ex. Rudder Gain/Rud. Counter) are appropriate. If the effect of disturbance is significant, consider switching to manual steering.</p>			
3025	Off-heading	Yawing is too large. Switch to Manual.	Warning Cat: B	AUTO Advanced AUTO NAV Auto Tuning
	<p>Meaning: Heading deviation is outside operable threshold. Remedy: Check that the control parameters (ex. Rudder Gain/Rud. Counter) are appropriate. If the effect of disturbance is significant, consider switching to manual steering.</p>			
3012-1	Doubtful heading	Deviation between two HDG sensors exceeded.	Warning Cat: B	AUTO Advanced AUTO NAV
	<p>Meaning: Heading deviation between the main and backup source are outside operable threshold. Remedy: Check the connections to, and status of, the heading sensors.</p>			

Alert ID/ Instance ID	Alert title	Alert Message	Priority & Category	Mode in which alert is generated
3012-2	Doubtful heading	Loss one of two HDG sensors.	Warning Cat: B	AUTO Advanced AUTO NAV
	Meaning: The one of the two heading sensors was lost. Remedy: Check the connections to, and status of, the heading sensors.			
3065	Low speed	Ship's speed is too low for HDG control.	Warning Cat: B	AUTO Advanced AUTO NAV
	Meaning: Speed input is too low for automatic steering control. Remedy: Accelerate the ship's speed to at least 0.3 kn.			
3113	HDG in fallback	HDG lost. Automatic switched to Backup.	Caution Cat: B	STBY DISENGAGED Rudder Calibration
	Meaning: The source of heading data has changed. Remedy: Check the connections to, and status of, heading sensor, or select the appropriate sensor from [Sensor Select].			
3156	No SPD adaptive	Speed adaptive control is not available.	Caution Cat: B	AUTO Advanced AUTO NAV
	Meaning: There is no speed data input. Remedy: Check the connections to, and status of, the speed sensor. It is also possible to set a manual speed temporarily.			
0800001	Lost one disp	Lost communication with one display unit.	Caution Cat: B	AUTO Advanced AUTO NAV STBY DISENGAGED FU/NFU RC-FU/RC-NFU Auto Tuning Rudder Calibration
	Meaning: Communication error between processor unit and a control unit. Remedy: Check the connection between the processor unit and control unit.			
0800002*	Doubtful NAV data	NAV mode parameter error.	Warning Cat: B	NAV
	Meaning: There is no NAV data input. Remedy: Check the status of the sensor used as NAV data source.			
0800003*	Doubtful Mag HDG	No compass adjustment data.	Caution Cat: B	AUTO Advanced AUTO NAV Auto Tuning
	Meaning: Compass setting is incomplete or an error in the settings was detected. Remedy: Check and complete compass offsets from [Compass Setup] menu.			
0800004-1	Lost RUD control	System power fail. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	Meaning: Input power voltage of the processor unit is out of threshold. Remedy: Turn the system off and check the power supply voltage to the NAVpilot.			
0800004-2	Lost RUD control	Rudder drive circuit error. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	Meaning: A malfunction is detected in the rudder drive unit. Remedy: Turn the system off and request service from your local dealer.			

APPX. 3 ALERT LIST

Alert ID/ Instance ID	Alert title	Alert Message	Priority & Category	Mode in which alert is generated
0800004-3	Lost RUD control	Rudder not moving. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	<p>Meaning: Rudder is not responding to the rudder drive. Remedy: Check connections between rudder drive and rudder. If the problem persists, request service from your local dealer.</p>			
0800004-4	Lost RUD control	Rudder angle HW limit reached. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	<p>Meaning: The rudder angle reached its hardware limit. Remedy: Stop using the NAVpilot and check the rudder angle, status of the rudder, or the hardware limit switch.</p>			
0800004-5	Lost RUD control	Rudder angle limit exceeded. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	<p>Meaning: Input rudder angle is outside operable threshold. Remedy: Stop using the NAVpilot and check the connections to, and status of, the rudder sensor. If the problem recurs, request service from your local dealer.</p>			
0800004-6	Lost RUD control	Rudder ready signal error. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	<p>Meaning: The handshake signal response could not be obtained from the steering system. Remedy: Check connection to, and status of, the steering system.</p>			
0800004-7	Lost RUD control	CAN-bus power fail. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	<p>Meaning: Power supply to the CAN bus network is outside operable threshold. Remedy: Check the voltage of the power supply to the CAN bus network.</p>			
0800004-8	Lost RUD control	Lost all disp unit comm. Take helm.	Warning Cat: B	FU/NFU RC-FU/RC-NFU Auto Tuning
	<p>Meaning: Communication error between processor unit and control unit. Remedy: Check the connection between the processor unit and control unit.</p>			
0800005	Lost RC control	Remote control signal error. Take helm.	Warning Cat: B	RC-FU
	<p>Meaning: Remote control signal is outside operable threshold. Remedy: Check connection to, and status of, the remote controller.</p>			
0800006	RC unavailable	Remote controller not available.	Caution Cat: B	AUTO Advanced AUTO NAV STBY DISENGAGED FU/NFU
	<p>Meaning: Remote controller is unavailable. This message is displayed when the switch is turned on in a steering mode that has a higher priority than the remote controller. Remedy: Switch to STBY mode.</p>			
0800007	Lost position	Last position sensor lost. Check source.	Warning Cat: B	Advanced AUTO
	<p>Meaning: There is no position data input. Remedy: Check the connection to, and status of, the position sensor.</p>			

Alert ID/ Instance ID	Alert title	Alert Message	Priority & Category	Mode in which alert is generated
0800008-1*	Lost NAV control	Last NAV data sensor lost. Switch to MAN.	Alarm Cat: B	NAV
	Meaning: There is no NAV data input. Remedy: Check the status of the sensor used as NAV data source.			
0800008-2*	Lost NAV control	Degradation of NAV data quality.	Alarm Cat: B	NAV
	Meaning: NAV data quality is degraded. Remedy: Check the status of the sensor used as NAV data source.			
0800009	POS in fallback	POS lost. Automatic switched to Backup.	Caution Cat: B	STBY DISENGAGED
	Meaning: The data source for positioning changed. Remedy: Check the connections to, and status of, the position sensor.			
0800010	SPD in fallback	SPD lost. Automatic switched to Backup.	Caution Cat: B	STBY DISENGAGED
	Meaning: The data source for speed (SOG/STW) changed. Remedy: Check the connections to, and status of, speed sensor.			
0800011	System PWR fail	System power fail. Check power supply.	Caution Cat: B	STBY DISENGAGED Rudder Calibration
	Meaning: Input power voltage of the processor unit is outside operable threshold. Remedy: Turn the system off and check the power supply voltage to the NAVpilot.			
0800012	CAN-bus PWR fail	CAN-bus power fail. Check power supply.	Caution Cat: B	STBY DISENGAGED Rudder Calibration
	Meaning: Power supply to the CAN bus network is outside operable threshold. Remedy: Check the power supply voltage to the CAN bus network. If four or more control units are connected without the power isolator, this alert may occur repeatedly. Have a qualified technician check the power connection. To rectify the alert, a system reboot is required.			

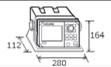
*: Shown only for the non-IMO type.

PACKING LIST

64BD-X-9851 -0 1/1

FAP-10001

A-1

NAME	UNIT	OUTLINE	DESCRIPTION/CODE No.	Q'TY
ユニット UNIT				
操作部 CONTROL UNIT			FAP-10001 000-042-874-00	1
予備品 SPARE PARTS				
予備品 SPARE PARTS			SP64-01801 001-645-250-00	1
工事材料 INSTALLATION MATERIALS				
工事材料 INSTALLATION MATERIALS			CP64-03601 001-645-260-00	1
図書 DOCUMENT				
フラッシュマウント型紙 FLUSH MOUNTING TEMPLATE			E72-02101-* 000-199-025-1*	1

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

CN

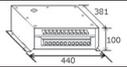
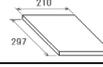
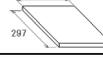
C7289-Z01-A

PACKING LIST

64BD-X-9852 -2 1/1

NAVPILOT-1000-N

A-2

NAME	UNIT	OUTLINE	DESCRIPTION/CODE No.	Q'TY
ユニット UNIT				
制御部 PROCESSOR UNIT			FAP-10002 000-042-876-00	1
予備品 SPARE PARTS				
予備品 SPARE PARTS			SP64-01901 001-645-270-00	1
工事材料 INSTALLATION MATERIALS				
ケーブル組品 CABLE ASSEMBLY		L=2000	FRU-LMT-18-NMEA-C02 000-200-727-10	1
ケーブル組品 CABLE ASSEMBLY		L=2100	FRU-LMT-18-15VDC-C02 000-200-728-10	1
ケーブル組品(NMEA) CABLE ASSEMBLY		L=6M	FRU-NMEA-PMFF-060 001-533-080-00	1
工事材料 INSTALLATION MATERIALS			CP64-03701 001-645-280-00	1
図書 DOCUMENT				
取扱説明書(英) OPERATOR'S MANUAL (EN)			OME-72890-* 000-199-018-1*	1
装備要領書(英) INSTALLATION MANUAL (EN)			IME-72890-* 000-199-023-1*	1

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

CN

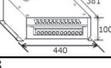
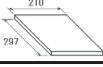
C7289-Z02-C

PACKING LIST

64BD-X-9853 -2 1/1

NAVPILOT-1000-A

A-3

NAME	UNIT	OUTLINE	DESCRIPTION/CODE No.	Q'TY
ユニット UNIT				
操作部箱詰品 CONTROL UNIT COMPLETE SET			FAP-10001 000-042-873-00	1
制御部 PROCESSOR UNIT			FAP-10002 000-042-876-00	1
予備品 SPARE PARTS				
予備品 SPARE PARTS			SP64-01901 001-645-270-00	1
工事材料 INSTALLATION MATERIALS				
ケーブル組品(NMEA) CABLE ASSEMBLY		L=6M	FRU-NMEA-PMFF-060 001-533-080-00	1
ケーブル組品 CABLE ASSEMBLY		L=2100	FRU-LMT-18-15VDC-C02 000-200-728-10	1
ケーブル組品 CABLE ASSEMBLY		L=2000	FRU-LMT-18-NMEA-C02 000-200-727-10	1
工事材料 INSTALLATION MATERIALS			CP64-03701 001-645-280-00	1
図書 DOCUMENT				
取扱説明書(英) OPERATOR'S MANUAL (EN)			OME-72890-* 000-199-018-1*	1
装備要領書(英) INSTALLATION MANUAL (EN)			IME-72890-* 000-199-023-1*	1

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

CN

C7289-Z03-C

FURUNO

CODE NO. 001-645-260-00 64BD-X-9401 -1
TYPE CP64-03601 1/1

番号 NO.	名称 NAME	略図 OUTLINE	型名/規格 DESCRIPTIONS	数量 Q'TY	用途/備考 REMARKS
1	ボンド接着剤 BINDER TAPPING SCREW		5X20 SUS304 CODE NO. 000-163-915-10	4	
2	注意ラベル LABEL		110 64-032-1121-0 CODE NO. 100-444-290-10	1	
3	注意ラベル(E) LABEL		110 130 64-032-1122-0 CODE NO. 100-444-280-10	1	
4	注意ラベル(C) LABEL		110 64-032-1123-0 CODE NO. 100-444-290-10	1	
5	ラベル貼付要領 LABEL ATTACHING GUIDE		210 297 C72-02301-* CODE NO. 000-200-658-1*	1	

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

FURUNO ELECTRIC CO., LTD.

CN

C7289-M01-B

FURUNO

CODE NO.	001-645-280-00	648D-X-9402-1
TYPE	CP64-03701	1/1

工事材料表		INSTALLATION MATERIALS	
番号	名称	略図	型名/規格
NO.	NAME	OUTLINE	DESCRIPTIONS
1	ケーブルタイ CABLE TIE		CV-100N CODE NO. 000-162-188-10
2	EMIシブ SLEEVE FERRITE CLAMP		GRFC-8 CODE NO. 000-199-317-10
3	コネクタ MICRO T-CONNECTOR		FRU-MM1MF1001 CODE NO. 000-194-633-10
4	コネクタ TERMINATION RESISTOR (MICRO)		FRU-MM100000001 CODE NO. 000-194-634-10
5	コネクタ TERMINATION RESISTOR (MICRO)		FRU-MF000000001 CODE NO. 000-194-635-10
6	圧着端子 CRIMP-ON LUG		FV2-M K CODE NO. 000-157-229-11
7	圧着端子 CRIMP-ON LUG		FV1.25-M (LF) K CODE NO. 000-166-741-11
8	ケーブルタイ CABLE TIE		CV-150N CODE NO. 000-162-188-10

(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

FURUNO ELECTRIC CO., LTD. CN

C7289-M02-B

FURUNO

CODE NO.	001-645-250-00	648D-X-9301-0 1/1
TYPE	SP64-01801	BOX NO. P

SHIP NO.	SPARE PARTS LIST FOR	U S E			SETS PER VESSEL		
ITEM NO.	NAME OF PART	OUTLINE	DWG. NO. OR TYPE NO.	QUANTITY			REMARKS/CODE NO.
				WORKING	PER SET	PER VES	
1	ガラス管 GLASS TUBE FUSE		F08B-A 250V 2A PBF	1	1	1	000-157-497-10

MFR'S NAME	FURUNO ELECTRIC CO., LTD.	DWG NO.	C7289-P01-A CN	1/1
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(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

FURUNO

CODE NO.	001-645-270-00	648D-X-9302-0 1/1
TYPE	SP64-01901	BOX NO. P

SHIP NO.	SPARE PARTS LIST FOR	U S E			SETS PER VESSEL		
ITEM NO.	NAME OF PART	OUTLINE	DWG. NO. OR TYPE NO.	QUANTITY			REMARKS/CODE NO.
				WORKING	PER SET	PER VES	
1	ガラス管 GLASS TUBE FUSE		F08B-A 250V 5A PBF	1	1	4	000-157-570-10
2	ガラス管 GLASS TUBE FUSE		F08B-S 250V 10A PBF	1	1	1	000-157-495-10

MFR'S NAME	FURUNO ELECTRIC CO., LTD.	DWG NO.	C7289-P02-A CN	1/1
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(略図の寸法は、参考値です。 DIMENSIONS IN DRAWING FOR REFERENCE ONLY.)

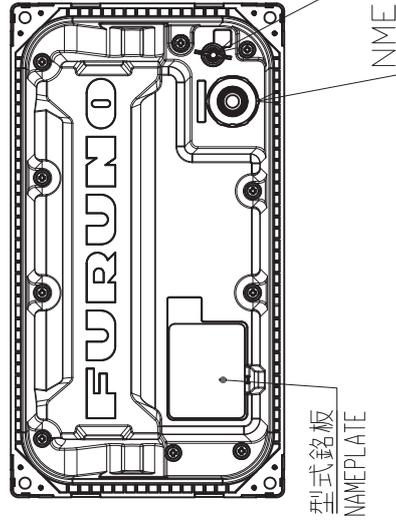
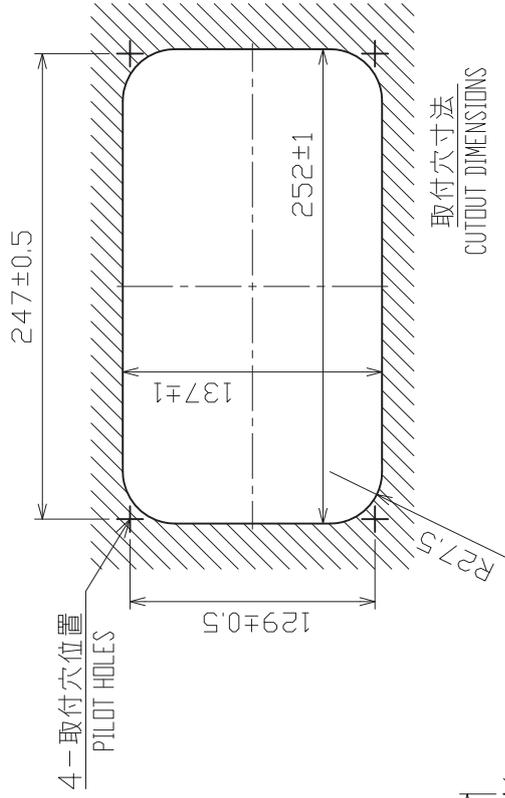
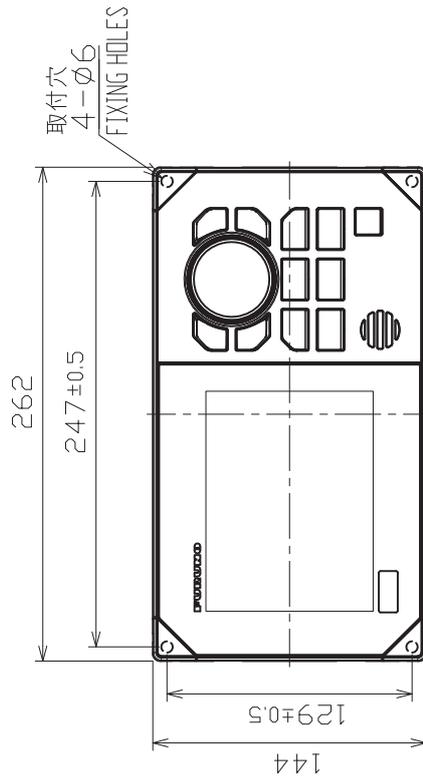
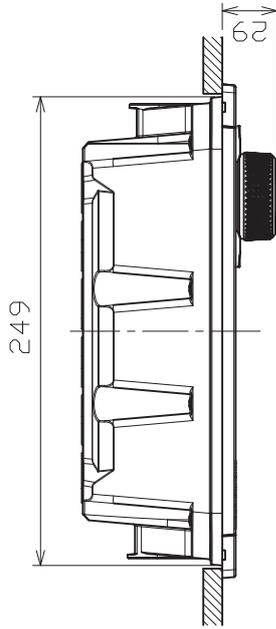
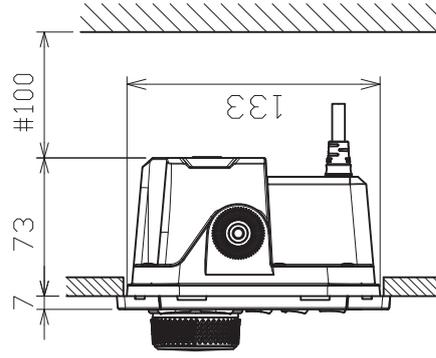


表 1 TABLE 1

寸法区分 (mm) DIMENSION	公差 (mm) TOLERANCE
L ≤ 50	±1.5
50 < L ≤ 100	±2.5
100 < L ≤ 500	±3



注 記

- 1) 指定外の寸法公差は表 1 による。
- 2) #印寸法は最小サービスクリアランスとする。
- 3) 取付用ネジはバイネジ呼び径 5 × 2.0 を使用のこと。

NOTE

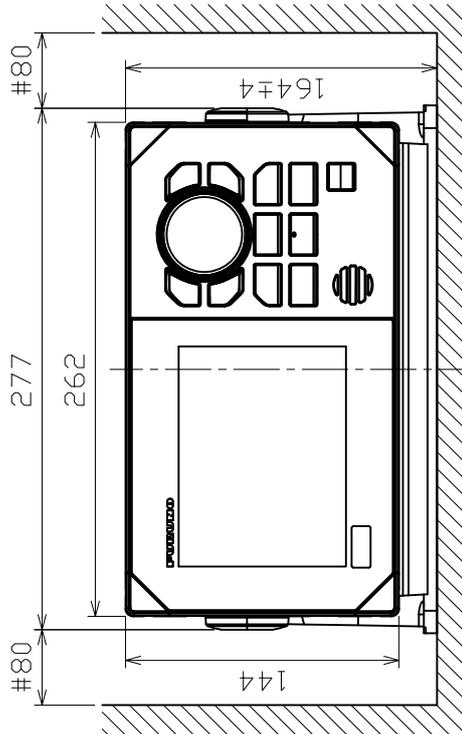
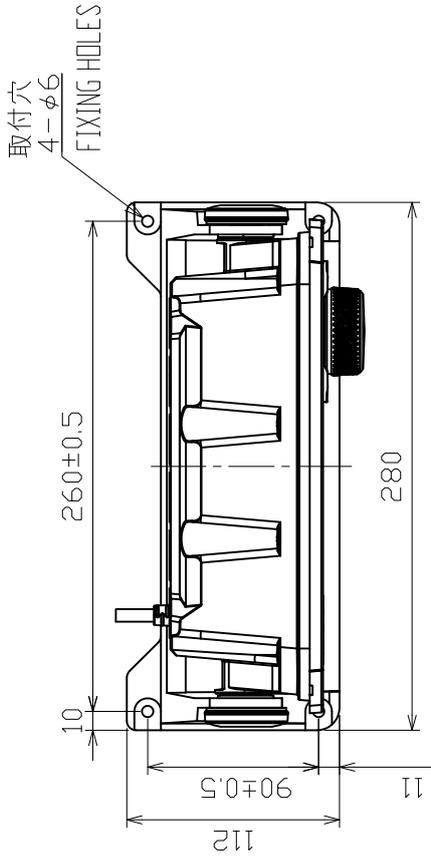
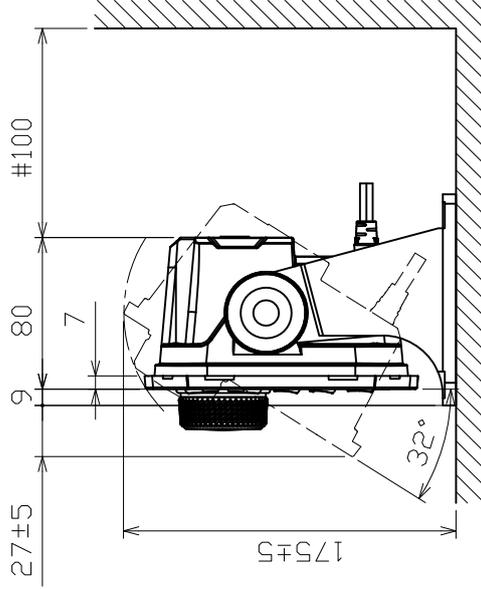
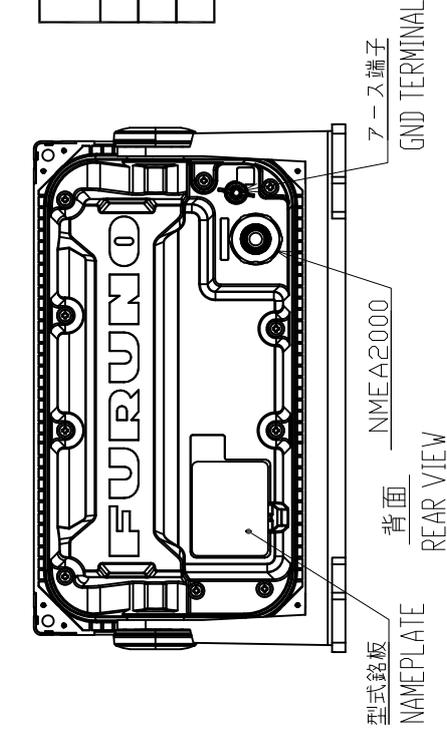
1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. #-MINIMUM SERVICE CLEARANCE.
3. USE TAPPING SCREWS Ø5x2.0 FOR FIXING THE UNIT.

DRAWN	30/Jun/2023	I. YAMASAKI	TITLE	FAP-10001
CHECKED	30/Jun/2023	H. MAKI	名称	操作部 (埋込装備)
APPROVED	29/Sep/2023	H. MAKI	外寸図	
SCALE	1/4	MASS	NAME	CONTROL UNIT (FLUSH MOUNT)
FIG. No.	C7289-G01-A	REV. No.	REF. No.	64-035-100G-4

NAME	CONTROL UNIT (FLUSH MOUNT)
OUTLINE DRAWING	

表1 TABLE 1

寸法区分 (mm) DIMENSION	公差 (mm) TOLERANCE
L ≤ 50	±1.5
50 < L ≤ 100	±2.5
100 < L ≤ 500	±3



注記

- 1) 指定外の寸法公差は表1による。
- 2) #印寸法は最小サービスマウントとする。
- 3) 取付用ネジはバインドットピンネジ呼び径5×20を使用のこと。

NOTE

1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
2. # MINIMUM SERVICE CLEARANCE.
3. USE TAPPING SCREWS φ5x20 FOR FIXING THE UNIT.

DRAWN	30/Jun/2023	I. YAMASAKI	TITLE	FAP-10001
CHECKED	30/Jun/2023	H. MAKI	名称	操作部 (卓上装備)
APPROVED	25/Sep/2023	H. MAKI	外寸図	
SCALE	1/4	1.2	NAME	CONTROL UNIT (TABLETOP MOUNT)
FIG.No.	C7289-G02-A		REF.No.	64-035-110G-3

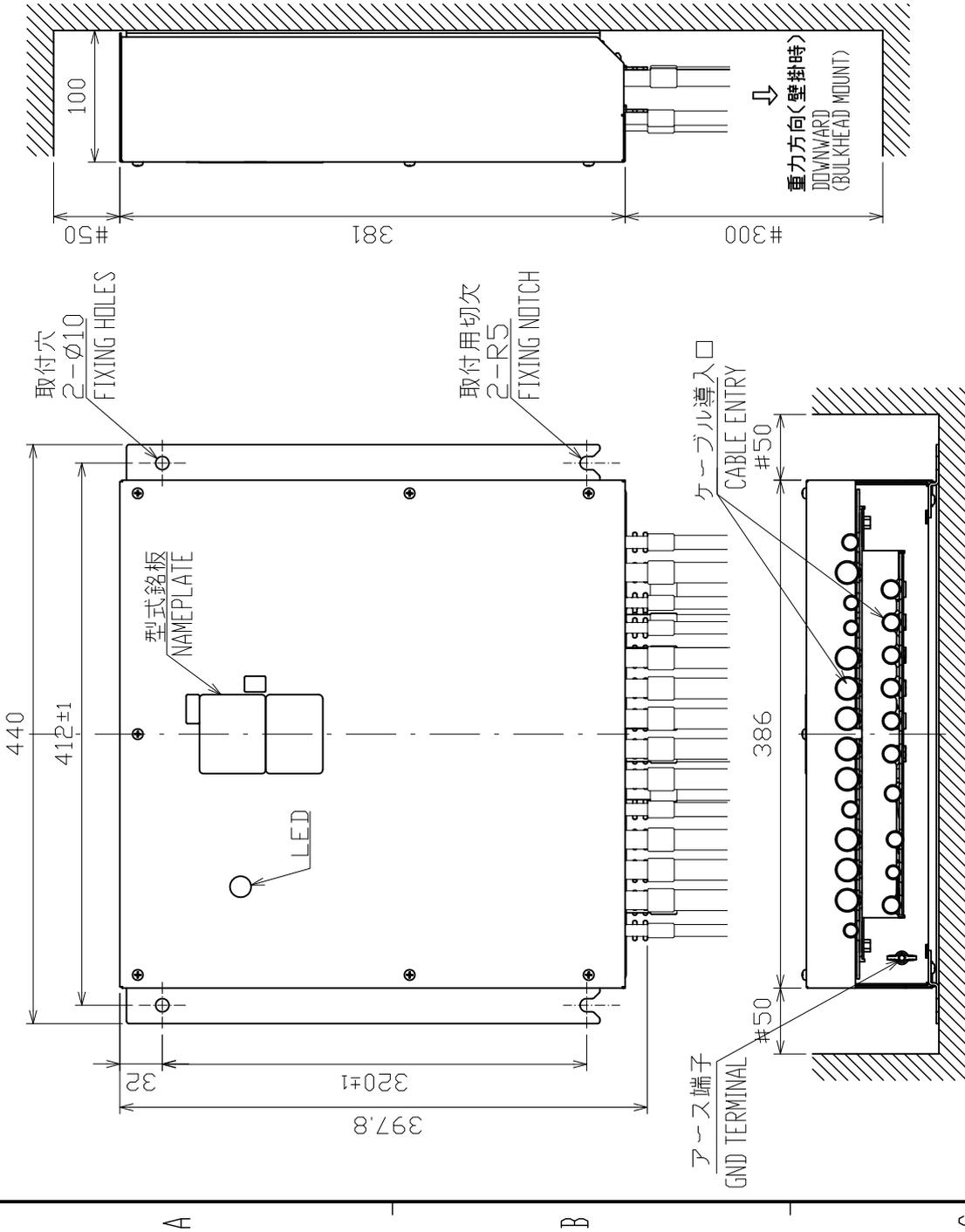


表1 TABLE 1

寸法区分 (mm) DIMENSION	公差 (mm) TOLERANCE
L ≤ 50	±1.5
50 < L ≤ 100	±2.5
100 < L ≤ 500	±3

DRAWN	I.YAMASAKI	TITLE	FAP-10002
CHECKED	I.YAMASAKI	名称	制御部(卓上・壁掛装備)
APPROVED	H.MAKI	外寸図	
	25/Sep/2023 H.MAKI	NAME	PROCESSOR UNIT (TABLETOP/BULKHEAD MOUNT)
SCALE	1/5	REF.No.	64-035-300G-3
DWG.No.	C7289-G03-A		OUTLINE DRAWING

- 注記
- 1) 指定外の寸法公差は表1による。
 - 2) 印寸法は最小サービス空間寸法とする。
 - 3) 取付用ネジはM8ボルトを使用のこと。
- NOTE
1. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
 2. #-MINIMUM SERVICE CLEARANCE.
 3. USE M8 BOLTS FOR FIXING THE UNIT.

