

# **PT900 Autopilot system User's Manual**

IM 80B20T01E

IM 80B20T01E

8th Edition

---

---

**Blank Page**

---

---

# PT900 Autopilot system User's Manual

IM 80B20T01E 8th Edition

## Contents

Foreword.....	vi
Precautions for Installation .....	xi
Precautions for Operation .....	xii
<b>1. Outline .....</b>	<b>1-1</b>
1.1 Features of PT900 .....	1-1
1.2 About Autopilot system.....	1-1
1.3 Composition and Type of system.....	1-3
1.3.1 PT900D.....	1-3
1.3.2 PT900A.....	1-3
1.3.3 PT900A PLUS .....	1-3
1.4 Interface .....	1-5
1.4.1 Input signals.....	1-5
1.4.2 Output signals.....	1-5
1.5 Summary of operation .....	1-6
1.5.1 Checking items before power ON.....	1-6
1.5.2 How to startup and shut down.....	1-6
1.5.3 How to select the Steering mode.....	1-6
1.5.4 [HOME] Screen.....	1-7
1.5.5 How to start the Heading Control (AUTO mode) .....	1-8
1.5.6 How to start the Manual steering (HAND mode) .....	1-8
1.5.7 How to start the Manual steering (MAN mode).....	1-8
1.5.8 How to start the Non-Follow-Up steering (NFU mode) .....	1-8
1.6 Summary of Alert .....	1-9
1.6.1 Alert indication.....	1-10
1.6.2 How to acknowledge the alert.....	1-10
1.6.3 How to check the alert factor.....	1-11
1.7 Maintenance and Inspection .....	1-12
1.7.1 Daily and Regular inspection by user .....	1-12
1.7.2 Regular maintenance.....	1-13
1.8 Terms, definitions and abbreviations .....	1-14
<b>2. System configuration .....</b>	<b>2-1</b>

---

2.1	System configuration and Type and code.....	2-1
2.2	Individual Units and Their Functions.....	2-4
2.2.1	CONTROL STAND [MPM190].....	2-4
2.2.2	STEERING REPEATER COMPASS [MKR056] .....	2-5
2.2.3	SYSTEM SELECTOR [MPH790].....	2-6
2.2.4	MODE SELECTOR [MPH791].....	2-6
2.2.5	AP CDU (AUTOPILOT CONTROL & DISPLAY UNIT) [MPH490] .....	2-7
2.2.6	HAND STEERING UNIT [MPB390] .....	2-8
2.2.7	NFU LEVER [MPB391].....	2-9
2.2.8	ANNUNCIATOR UNIT [MPH690] .....	2-10
2.2.9	NAV I/F UNIT [MPT590] .....	2-11
2.2.10	MAIN CONTROL UNIT (MCU) [MPH291] .....	2-11
3.	Operation.....	3-1
3.1	Operation .....	3-1
3.1.1	Checking items before power ON.....	3-1
3.1.2	How to startup and shut down.....	3-1
3.2	Manual steering .....	3-2
3.3	Auto steering .....	3-3
3.3.1	Preparation for Auto steering .....	3-3
3.3.2	Start Auto steering.....	3-5
3.3.3	Mode selection of Auto steering.....	3-5
3.3.4	Course change during AUTO/CRS mode.....	3-7
3.4	NFU steering.....	3-8
4.	Function and operation .....	4-1
4.1	MENU Tree .....	4-1
4.2	Basic operations .....	4-2
4.2.1	Touch panel operation .....	4-2
4.2.2	KEY SWITCH and COURSE SETTING DIAL operation.....	4-5
4.3	Screen indications .....	4-7
4.3.1	[HOME] screen .....	4-7
4.3.2	[Full Screen] screen.....	4-17
4.3.3	[MENU] screen .....	4-19
4.4	Brilliance/contrast adjustment.....	4-21
4.4.1	How to transition to [1 Brilliance/contrast] screen .....	4-21
4.4.2	[1 Brilliance/contrast] screen.....	4-21
4.5	Alert indications .....	4-23
4.5.1	Alert indications.....	4-23
4.5.2	[2 Alert List] screen .....	4-24
4.5.3	[2-1 Equipment status log] screen .....	4-30

---

---

<b>4.6</b>	<b>Monitoring function</b> .....	<b>4-32</b>
4.6.1	[3 Monitor] screen.....	4-32
4.6.2	[3-1 Heading & Rudder angle graph] screen (PT900A / A Plus).....	4-33
4.6.3	[3-2 Cross track distance] screen (Option).....	4-34
4.6.4	[3-4 Sensor & Measurement] screen.....	4-35
4.6.4.1	[3-4-1 Sensor data] screen .....	4-36
4.6.4.2	[3-4-2 Calculate data] screen .....	4-39
4.6.4.3	[3-4-3 Rudder angle data] screen .....	4-40
4.6.5	[3-5 Software version] screen.....	4-41
<b>4.7</b>	<b>Setting functions</b> .....	<b>4-42</b>
4.7.1	[4 Setting] screen.....	4-42
4.7.2	[4-1 Alert] screen.....	4-43
4.7.3	[4-2 Display customize] screen.....	4-47
4.7.4	[4-3 Control] screen .....	4-49
4.7.5	[4-4 Parameter] screen .....	4-58
4.7.6	[4-5 Forwarding distance(TCS)] screen (Option) .....	4-59
4.7.6.1	[4-5-1 Radius/Speed range] screen (Option) .....	4-61
4.7.6.2	[4-5-2 Forwarding distance(full)] screen (Option).....	4-62
4.7.6.3	[4-5-3 Forwarding distance(middle)] screen (Option).....	4-63
4.7.6.4	[4-5-4 Forwarding distance(ballast)] screen (Option).....	4-64
4.7.7	[4-6 Adjust touch screen] screen .....	4-65
4.7.8	[4-7 Date and time] screen .....	4-66
4.7.9	[4-8 Backup/Restore] screen.....	4-68
4.7.10	[4-9 Maintenance] screen .....	4-71
<b>4.8</b>	<b>Key switches operation</b> .....	<b>4-72</b>
<b>4.9</b>	<b>Lamp, buzzer and LCD test</b> .....	<b>4-74</b>
4.9.1	Lamp and buzzer test on SYSTEM SELECTOR / MODE SELECTOR / ANNUNCIATOR UNIT 4-74	
4.9.2	Lamp, buzzer and LCD test on AP CDU.....	4-75
<b>5.</b>	<b>Troubleshooting</b> .....	<b>5-1</b>
5.1	Trouble and measures on AP CDU .....	5-1
5.2	Alert .....	5-2
5.2.1	Alert indication.....	5-3
5.2.2	Alert confirmation.....	5-4
5.2.3	Alert acknowledgement.....	5-5
5.2.4	Alert factor and measures.....	5-6
5.2.5	Alert and Important indication code list .....	5-6
5.3	Trouble and measures on STEERING REPEATER COMPASS.....	5-23

---

---

5.3.1	Error indication .....	5-23
5.4	Trouble and measures on MODE SELECTOR.....	5-23
5.4.1	MODE SELECTOR trouble during AUTO/CRS/TRACK mode.....	5-23
5.4.2	MODE SELECTOR trouble during MAN mode.....	5-23
5.5	AC power failure.....	5-24
5.5.1	One of AC power failure during single S/G pump operation.....	5-24
5.5.2	One of AC power failure during parallel S/G pumps operation .....	5-24
<b>6.</b>	<b>Specifications .....</b>	<b>6-1</b>
6.1	Performance and Specifications .....	6-1
6.1.1	Power Supply .....	6-1
6.1.2	Environmental specifications (under normal conditions).....	6-1
6.1.3	Input signal.....	6-2
6.1.4	Output signal.....	6-2
6.1.5	External input / output signal specifications and circuits.....	6-3
6.2	Serial input/output data sentence .....	6-6
6.3	Default settings .....	6-7
6.4	Outlines .....	6-8
<b>7.</b>	<b>Maintenance and Inspection.....</b>	<b>7-1</b>
7.1	Daily and Regular inspection by user.....	7-1
7.2	Regular maintenance.....	7-2
<b>Annex-1</b>	<b>Basic autopilot action .....</b>	<b>1</b>
1.1	Steering for Fuel Saving.....	1
1.2	Adaptive Autopilot Control Algorithm .....	1
1.3	Changes in Weather Conditions and Adaptive Autopilot.....	2
1.4	Basic Behavior of BNAAC (Economy mode in PT900A, and A-PLUS).....	4
1.5	BNAAC and Changes in Weather Conditions .....	4
1.6	Basic Behavior of Course Control Algorithm (Option) .....	5
<b>Annex-2</b>	<b>Circuit Diagram.....</b>	<b>7</b>
2.1	Power Circuit Diagram.....	7
2.2	Signal Circuit Diagram (Follow-up steering).....	8
2.3	Signal Circuit Diagram (Non-follow-up steering: N2 system) .....	9
2.4	Signal Circuit Diagram (Non-follow-up steering: Y2 system).....	10
2.5	Alert circuit (1/2).....	11
2.6	Alert circuit (2/2).....	12
2.7	Interface circuit (NAV I/F UNIT MPT590).....	13
<b>Annex-3</b>	<b>Components list .....</b>	<b>14</b>
3.1	STEERING REPEATER COMPASS [MKR056].....	14
3.2	SYSTEM SELECTOR [MPH790].....	15
3.3	MODE SELECTOR [MPH791].....	15

---

---

3.4	AUTOPILOT CONTROL & DISPLAY UNIT [MPH490] .....	16
3.5	HAND STEERING UNIT [MPB390] .....	17
3.6	NFU LEVER [MPB391] .....	18
3.7	ANNUNCIATOR UNIT [MPH690] .....	18
3.8	NAV I/F UNIT [MPT590] .....	19
3.9	MAIN CONTROL UNIT (MCU) [MPH291] .....	20
<b>Annex-4 Serial signal format .....</b>		<b>22</b>
4.1	Basic format.....	22
4.2	Existing format .....	23
<b>Annex-5 Display Specifications.....</b>		<b>34</b>
5.1	Mechanical specifications .....	34
5.2	Optical characteristic.....	34

---

## Foreword

Thank you for purchasing the YOKOGAWA Denshikiki PT900 Autopilot system. This manual shows the functions, operating procedures, and the handling precautions of the PT900. To ensure the correct operation of PT900, please read this manual thoroughly before beginning operation.

### ■ Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA Denshikiki dealer.
- Copying or reproducing all or any part of the contents of this manual without the permission of YOKOGAWA Denshikiki Co., Ltd. is strictly prohibited.

### ■ Trademarks

- All the brands or names of YOKOGAWA Denshikiki's products used in this manual are either trademarks or registered trademarks of YOKOGAWA Denshikiki Co.,Ltd.
- For purposes of this manual, the TM and ® symbols do not accompany their respective trademark names or registered trademark names.
- Company and product names that appear in this manual are trademarks or registered trademarks of their respective holders.

### ■ Safety Precautions

The general safety precautions described here must be observed during all phases of operation.

#### ● About This Manual

- This manual should be read by the end user.
  - Read this manual thoroughly and have a clear understanding of the product before operation.
  - This manual describes the functions of the product. YOKOGAWA Denshikiki does not guarantee that the product will suit a particular purpose of the user.
  - Under absolutely no circumstances may the contents of this manual be transcribed or copied, in part or in whole, without permission.
  - The contents of this manual are subject to change without prior notice.
  - Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors or omissions, please contact your nearest YOKOGAWA Denshikiki dealer.
-



---

## ● Precautions Related to the Protection, Safety, and Alteration of the Product

The following safety symbols are used on the product and in this manual.



**"Handle with care." To avoid injury and damage to the instrument, the operator must refer to the explanation in the manual.**



**"Risk of Electric Shock"**



**Protective ground terminal**



**AC**



**"High temperature" To avoid injury caused by hot surface, do not touch locations where this symbol appears.**

- For the protection and safe use of the product and the system controlled by it, be sure to follow the instructions and precautions on safety that are stated in this manual whenever you handle the product. Take special note that if you handle the product in a manner that violates these instructions, the protection functionality of the product may be damaged or impaired. In such cases, YOKOGAWA Denshikiki does not guarantee the quality, performance, function, and safety of the product.
  - When installing protection and/or safety circuits such as lightning protection devices and equipment for the product and control system or designing or installing separate protection and/or safety circuits for fool-proof design and fail-safe design of the processes and lines that use the product and the control system, the user should implement these using additional devices and equipment.
  - If you are replacing parts or consumable items of the product, make sure to use parts specified by YOKOGAWA Denshikiki.
  - Do not modify this product.
-



- **Power Supply**  
Ensure that the source voltage matches the voltage of the power supply before turning ON the power.
  - **Protective Grounding**  
Make sure to connect the protective grounding to prevent electric shock before turning ON the power.
  - **Necessity of Protective Grounding**  
Never cut off the internal or external protective earth wire or disconnect the wiring of the protective earth terminal. Doing so invalidates the protective functions of the instrument and poses a potential shock hazard.
  - **Defect of Protective Grounding**  
Do not operate the instrument if the protective earth or fuse might be defective. Make sure to check them before operation.
  - **Do Not Operate in an Explosive Atmosphere**  
Do not operate the instrument in the presence of flammable liquids or vapors. Operation in such environments constitutes a safety hazard.
  - **Do Not Remove Covers**  
The cover should be removed by YOKOGAWA Denshikiki's qualified personnel only. Opening the cover is dangerous, because some areas inside the instrument have high voltages.
  - **External Connection**  
Connect the protective grounding before connecting to the item under measurement or to an external control unit.
  - **Damage to the Protective Structure**  
Operating the unit in a manner not described in this manual may damage its protective structure.
  - **Do not allow this device to get wet**  
Do not operate with wet hands. Doing so might cause electric shock. Do not allow water to enter inside this device. Doing so might cause fire or malfunction.
-

### ■ Notes about maintenance and inspection

- Regular inspection is recommended to keep this system good condition.
- Do not detach the unit cover without the instruction of service engineer.
- Contact your nearest service agent when the inspection which is not permitted in this manual is needed.

### ■ Notes about abnormal circumstances

- When abnormal allophone or abnormal smell is generated from this product, turn off the power supply.
- Do not keep using the system , if dealing methods are unknown when the system is under abnormal condition.
- Contact your nearest service or sales agent to repair the system.
- When there is some instruction about the method of trouble shooting from service department of Yokogawa Denshikiki Co., Ltd. , obey the instructions and work.

### ■ Notes about disposal of the products

When this product is scrapped , follow the regulations specifi ed by each country.

---

## ■ Exemption from Responsibility

- YOKOGAWA Denshikiki makes no warranties regarding the product except those stated in the WARRANTY that is provided separately.
- YOKOGAWA Denshikiki assumes no liability to any party for any loss or damage, direct or indirect, caused by the user or any unpredictable defect of the product.

## ■ Handling Precautions

- Use care when cleaning the unit, especially any plastic parts. When cleaning, wipe using a dry soft cloth. Do not use chemicals such as benzene or thinner, since these may cause discoloring and deformation.
- Keep electrically charged objects away from the signal terminals. This may damage the unit.
- Do not apply volatile chemicals. Do not allow rubber and vinyl products to remain in contact with the unit for long periods of time. This may damage the unit.
- When not in use, make sure to turn OFF the power switch.
- If there are any symptoms of trouble such as strange odors or smoke coming from the unit, immediately turn OFF the power switch and the power supply source. Then, contact your nearest YOKOGAWA Denshikiki dealer.
- Do not perform an insulation resistance test using a mega ohmmeter. Doing so causes malfunction.

## ■ How to Use This Manual



The following markings are used in this manual.

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION".

### WARNING

---

Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

---

### CAUTION

---

Calls attentions to actions or conditions that could cause light injury to the user or damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

---

### Note

---

Call attention to the information that is important for proper operation of the instrument.

---

---

## Precautions for Installation

---



### RISK OF ELECTRICAL SHOCK

Turn off the power supply before starting the wiring.

#### ■ Precautions on installation position

In case the TRACK CONTROL SYSTEM is installed as the option, each one of following override facility shall be installed around the conning position to comply with IEC62065 Ed.2.

- MODE SELECTOR (MPH791)
- SYSTEM SELECTOR (MPH790) & NFU LEVER (MPB391)
- TAKE-OVER UNIT (MPH793) & NFU LEVER (MPB391)
- TAKE-OVER UNIT (MPH793) & DIAL STEERING UNIT (MPB394)
- NFU OVRD OPERATION UNIT (MPH795) & NFU LEVER (MPB391)
- FU OVRD OPERATION UNIT (MPH794) & DIAL STEERING UNIT (MPB394)
- manual steering change-over device which is provided by steering gear or azimuth thruster manufacturer

#### ■ Baseline of CONTROL STAND (MPM190)

The baseline of CONTROL STAND (MPM190) which has master gyrocompass shall be parallel to the fore-and-aft line. The accuracy of baseline is within +/-0.5degrees from fore-and-aft line.

#### ■ Service area

Keep the service area around the CONTROL STAND (MPM190) for usual operation, ventilation and maintenance.

In case PT900 is installed in the bridge center console, please keep enough space. See 6.4

---

---

## Precautions for Operation

---



### WARNING

#### ■ MODE SELECTOR (MPH791)

- Before you change the steering mode from AUTO to MAN, please set the steering wheel to the midship position.
- If there is a large difference between the actual rudder angle and steering wheel position before changing the steering mode, the rudder may be steered excessively.

#### ■ Alarm

- Change-over to NFU mode immediately when PT900 detects any "ALARM".
  - Following alarms appear, switch-over S/G pump or stop abnormal S/G pump in parallel operation.
    - Servo loop failure
    - Rudder angle feedback signal failure
    - MCU(ADAPT) time out
- 



### CAUTION

- Do not execute the megger test except the on-board power supply terminals. A megger test may damage the instrument.
  - While you maneuver the vessel with NFU lever, watch the rudder angle indicator to avoid the rudder steered up to the mechanical limit.
-

# 1. Outline

PT900 fully conforms to the IMO MSC64(67) Annex3, Heading Control System performance standards, and provides the economical efficiency, safety, usability, extensibility.

PT900 can be adapted from small vessels to large vessels.

## 1.1 Features of PT900

- Economical efficiency  
The economical efficiency is improved by Batch Noise Adaptive Autopilot Control (BNAAC) and course control function (Option).
  
- Visibility and usability  
The visibility and usability is improved by using 7 inch color LCD and touch panel. This interface will make instinctive operation.
  
- Easy scalability  
Each unit interfaces with CAN-bus network. Thus, the system is scalable easily by CAN-bus network.
  
- Interface with external equipment  
PT900 has 3 heading sensor input ports (IEC61162-1/2) and interfaces with external navigational equipment (ECDIS, BAMS, BNWAS, etc.).

## 1.2 About Autopilot system

Autopilot is a system which controls the ship's heading based on the heading sensor input like a gyrocompass, magnet compass or THD (Transmitting Heading Device) by activating the rudder. So the autopilot means the Heading Control System (HCS).

PT900 basically consists of the following units. This user's manual is intended for the basic configuration. The other option units are shown in the other manual.

- CONTROL STAND (MPM190)  
CONTROL STAND is a stand-alone steering stand that we supplied. Each human-machine interface can be installed on the upper panel. Each board and terminal can be installed inside the CONTROL STAND.
  
  - STEERING REPEATER COMPASS (MKR056)  
STEERING REPEATER COMPASS is powered and receives serial signals from the
-

gyrocompass system. It drives the repeater compass card to indicate the current heading of the vessel.

- **AUTOPILOT CONTROL & DISPLAY UNIT : AP CDU (MPH490)**  
AP CDU is a human-machine interface which indicates the navigational information on 7 inch LCD. AP CDU is not only indication but also calculation of rudder order during AUTO steering mode.
  
- **HAND STEERING UNIT (MPB390)**  
HAND STEERING UNIT indicates and commands the order rudder angle during MAN steering mode.
  
- **NFU LEVER (MPB391)**  
NFU LEVER activates the rudder actuator directly during Non-Follow-Up steering mode.
  
- **SYSTEM SELECTOR (MPH790)**  
SYSTEM SELECTOR selects the system in operation. SYSTEM SELECTOR also selects the steering mode of Follow-Up or Non-Follow-Up.
  
- **MODE SELECTOR (MPH791)**  
MODE SELECTOR selects the steering mode during Follow-Up steering. Selectable modes are auto steering "AUTO" or manual steering "MAN".
  
- **NAV I/F UNIT (MPT590)**  
NAV I/F is connected with various external navigational equipment. It has input and output ports for external navigational equipment.
  
- **ANNUNCIATOR UNIT (MPH690)**  
ANNUNCIATOR UNIT is alert indicator unit. It mainly monitors the power supply for Steering gear Control System, steering gear condition and PT900 operation condition. It provides the audible and visible alerts.
  
- **MAIN CONTROL UNIT : MCU (MPH291)**  
MAIN CONTROL UNIT mainly controls the steering system. It controls the steering mode and rudder order output etc.

For detail of system configuration, refer to Section 2 "System configuration".

---



## 1.3 Composition and Type of system

PT900 series has 3 types of models. Each model has a different controller.

You can check which controller is installed on your vessel at AP CDU [Control Mode] button in [HOME] screen.

### 1.3.1 PT900D

PT900D is Heading Control System (HCS) based on the digital PID controlling method.

You can check “PID” indication at AP CDU [Control Mode] button.

This controller selects the PID gain automatically by inputting the vessel’s speed manually.

You can set the fine adjustment of PID gain.

### 1.3.2 PT900A

PT900A is HCS based on the adaptive PID controlling method.

You can check “Adaptive” indication at AP CDU [Control Mode] button.

This controller selects the PID gain automatically according to the vessel’s motion characteristics which is changed by ship’s speed and ship’s draft etc.

Batch Noise Adaptive Autopilot Control (BNAAC) function is activated while operation mode is “Economy”.

### 1.3.3 PT900A PLUS

PT900A PLUS is HCS with more economical efficiency control.

You can check “Adaptive Plus” indication at AP CDU [Control Mode] button.

Batch Noise Adaptive Autopilot Control (BNAAC) function is activated during any operation mode (i.e. Precision-1, Precision-2 and Economy).

---

		Controller Type		
Function		PT900D	PT900A	PT900A PLUS
Controller		PID controller	Adaptive PID controller	Economical efficiency controller
Steering mode Note.1	AUTO	O	O	O
	CRS	X	Option	Option
	TRACK	Option	Option	Option
Noise adaptation	BNAAC	X	Operation mode is "Economy".	O
Turn mode	P-D	O	O	O
	Rate	X	O	O
	Radius	X	O	O
Ship speed input	Manual	O	O	O
	Serial	X	O	O
	Pulse	X	O	O
Monitoring	Heading & rudder angle graph screen	X	O	O
	AP Performance screen	X	X	O

Note.1 "AUTO" mode is Heading Control System.

"CRS" mode is Course Control System. It is an optional function. GPS shall be connected with PT900.

"TRACK" mode is Track Control System. It is an optional function. ECDIS shall be connected with PT900.

## 1.4 Interface

PT900 receives the ship's heading and speed from each sensor and sends the control data to other navigational equipment (VDR, ECDIS etc.).

### 1.4.1 Input signals

PT900 receives the following signals from external navigational equipment.

Input signal	Navigational equipment	Signal type
Ship's heading 1	Gyrocompass/Magnetic compass	IEC61162-1/-2
Ship's heading 2	Gyrocompass/Magnetic compass/THD	IEC61162-1/-2
Ship's heading 3	THD	IEC61162-2
Ship's speed	Electromagnetic log/Doppler log	IEC61162-1, Pulse signal
Time(UTC), position, COG and SOG etc.	GPS	IEC61162-1
Track control command, etc.	ECDIS, INS	IEC61162-1/-2
Alert command, etc.	BAMS	IEC61162-1
Buzzer stop		Dry contact

### 1.4.2 Output signals

PT900 sends the following signals to external navigational equipment.

Output signal	Navigational equipment	Signal type
Track control data etc.	ECDIS	IEC61162-1/-2
Alert data, etc.	BAMS	IEC61162-1/-2
Control data, rudder angle, etc.	VDR	IEC61162-1
Autopilot activate, Watch timer reset	BNWAS	Dry contact
Buzzer stop		Dry contact

## 1.5 Summary of operation

This chapter shows the outline of PT900 operation.

### 1.5.1 Checking items before power ON

Check if the following items are normal before you turn on PT900.

- (1) Check that the steering gear is ready to operate.
- (2) Check that CONTROL & POWER BOX is turned on. Check also that the test switch of the CONTROL & POWER BOX is set to "NOR" (Normal).
- (3) Check that "PWR ON" indication of ANNUNCIATOR UNIT is on.
- (4) Check that STEERING REPEATER COMPASS shows correct heading.
- (5) Check that HAND STEERING UNIT is set to midship position.

### 1.5.2 How to startup and shut down

SYSTEM SELECTOR has the following 2 functions;

- Power ON/OFF of PT900
- Select the system in operation

Select "NO.1" or "NO.2" position of SYSTEM SELECTOR to startup PT900.

Steering mode is same one that PT900 was turned off.

Select "OFF" position of SYSTEM SELECTOR to shut down PT900.

### 1.5.3 How to select the Steering mode

Steering mode which is same as the last one is selected when PT900 is turned on.

NFU mode is selected by SYSTEM SELECTOR, MAN/AUTO mode is selected by MODE SELECTOR, AUTO/CRS mode is selected by AP CDU. TRACK mode is only selectable by ECDIS operation.

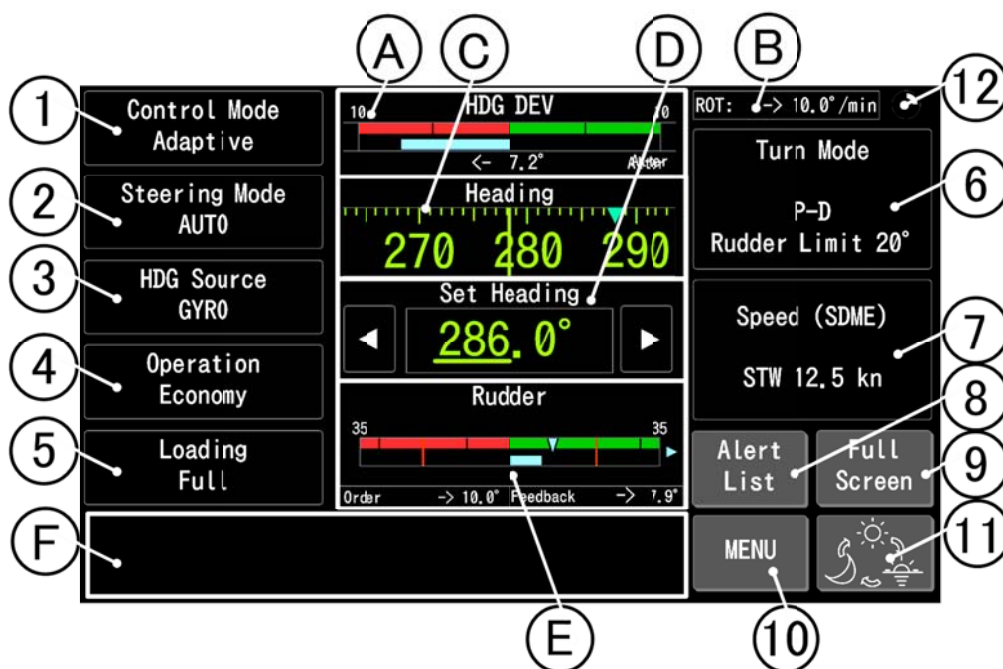
When you change the steering mode, the buzzer on AP CDU sounds to inform the navigator.

SYSTEM SELECTOR	MODE SELECTOR	AP CDU Steering Mode	Steering mode	Remark
NO.1/NO.2	AUTO	AUTO	Heading control is selected.	
		CRS	Course control is selected.	Option
		TRACK	Track control is in control.	Option
	MAN	—	FU HAND wheel is	
NFU	—	—	NFU LEVER operation is selected.	

### 1.5.4 [HOME] Screen

Below figure shows the [HOME] screen of AP CDU. [HOME] screen indicates the navigation information and each setting.

See 4.3.1



- |                      |                     |                       |
|----------------------|---------------------|-----------------------|
| A: Heading deviation | 1: Control mode     | 7: Speed              |
| B: Rate of turn      | 2: Steering mode    | 8: Alert button       |
| C: Heading           | 3: Selected compass | 9: Full screen button |
| D: Set Heading       | 4: Operation mode   | 10: MENU button       |
| E: Rudder angle      | 5: Draft mode       | 11: Display mode      |
| F: Guidance area     | 6: Turn mode        | 12: Spinner           |

### 1.5.5 How to start the Heading Control (AUTO mode)

- (1) Select “NO.1” or “NO.2” position of SYSTEM SELECTOR.
- (2) Press “AUTO” key on MODE SELECTOR.
- (3) Current ship’s heading is set as the preset heading and heading control starts.
- (4) After you select the turn mode (P-D, Rate<sup>°</sup>/min, “°/τ” or Radius) on [HOME] screen, you can change the set course.
- (5) Set course can be changed by set course dial or touchscreen.

### 1.5.6 How to start the Manual steering (HAND mode)

- (1) Select “NO.1” or “NO.2” position of SYSTEM SELECTOR.
- (2) Press “AUTO” key on MODE SELECTOR.
- (3) After you edit the planned route on ECDIS, track control starts on ECDIS side operation. Steering mode on PT900 is automatically changed from AUTO to TRACK mode.
- (4) Track control can be finished by long tap of [Steering Mode] button on [HOME] screen except ECDIS side operation.

### 1.5.7 How to start the Manual steering (MAN mode)

- (1) Select “NO.1” or “NO.2” position of SYSTEM SELECTOR.
- (2) Press “MAN” key on MODE SELECTOR.
- (3) You can steer the rudder by manual
- (4) Order rudder angle can be changed by HAND STEERING UNIT.

### 1.5.8 How to start the Non-Follow-Up steering (NFU mode)

- (1) Select “NFU” position of SYSTEM SELECTOR.
- (2) Manual steering by NFU LEVER is available.
- (3) Rudder is steered while NFU LEVER is turned.



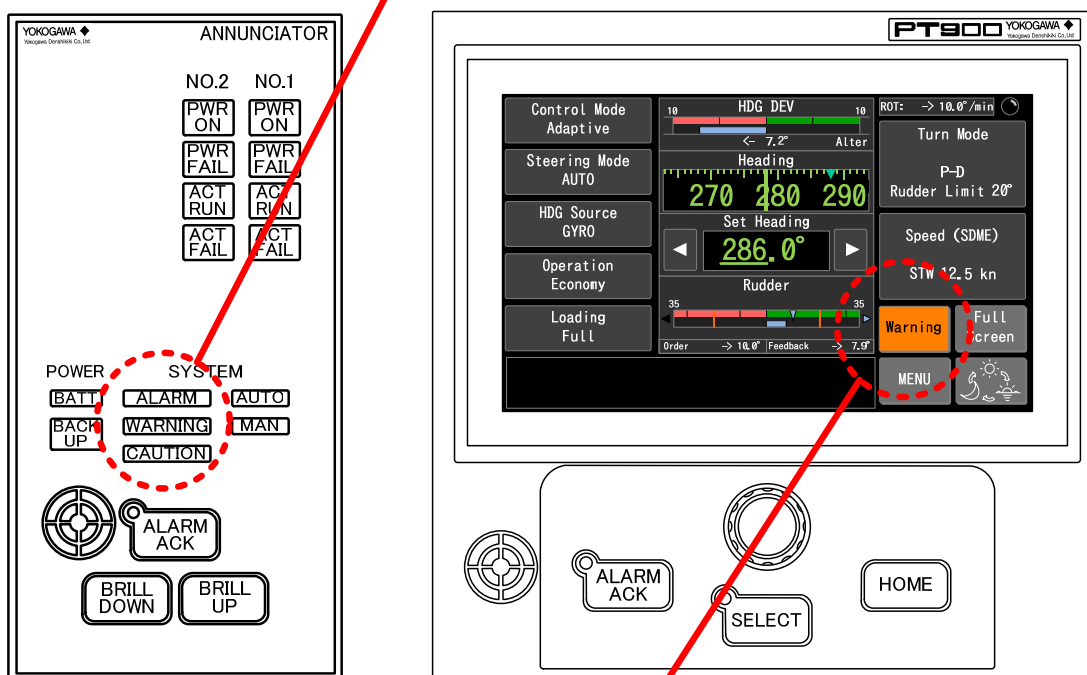
- While you maneuver the vessel with NFU LEVER, watch the rudder angle indicator to avoid the rudder steered up to the mechanical limit.
-

## 1.6 Summary of Alert

In case that PT900 detects any trouble, audible and visible alerts are generated at AP CDU and ANNUNCIATOR UNIT shown in the figure below.

This information is categorized as “Alert” having three priorities (Alarm, Warning and Caution) and “Important indication”.

Alert indication (ALARM/WARNING/CAUTION)



Alert indication (Alarm/Warning/Caution), Important indication (IND)

● Alert

Priorities	Definition (IMO resolution A.1021(26))
Alarm	An alarm is a high priority of an alert. Condition requiring immediate attention and action, to maintain the safe navigation and operation of the ship.
Warning	Condition requiring no immediate attention or action. Warnings are presented for precautionary reasons to bring awareness of changed conditions which are not immediately hazardous, but may become so when no action is taken.
Caution	Lowest priority of an alert. Awareness of a condition which does not warrant an alarm or warning condition, but still requires attention out of the ordinary consideration of the situation or of given information.

- Important indication

The following information is categorized in this classification.

- Problem not to influence function that is used now directly
- Abnormality of the system that is not selected
- Abnormality of sensor input that is not used

The problem included in this classification does not influence a used function directly now. However, like the case when a alert occurred, please perform correspondence according to displayed guidance.

### 1.6.1 Alert indication

In case that PT900 detects any trouble, audible and visible alerts are generated at AP CDU and ANNUNCIATOR UNIT. Buzzer sounds according to the alert priority.

- Alert buzzer

Buzzer sounding changes depending on alert priority.

Alarm	Sounding short sound at 3 times every 7 seconds.
Warning	Sounding short sound at 2 times.
Caution	No soundings
Important indication	No soundings

### 1.6.2 How to acknowledge the alert

You can acknowledge the alert at AP CDU or ANNUNCIATOR UNIT.

- AP CDU

By pressing the ALARM ACK key or tapping the [ACK] button on [2 Alert List] screen, you can acknowledge the alert and stop the buzzer.

- In case the alerts are rectified, the indications are removed.
- In case the alerts are not rectified, the indications changes from blinking to lighting.

- ANNUNCIATOR UNIT

By pressing the ALARM ACK key, you can acknowledge the steering gear alert mainly and stop the buzzer.

- In case the alerts are rectified, the indications are removed.
  - In case the alerts are not rectified, the indications changes from blinking to lighting.
-

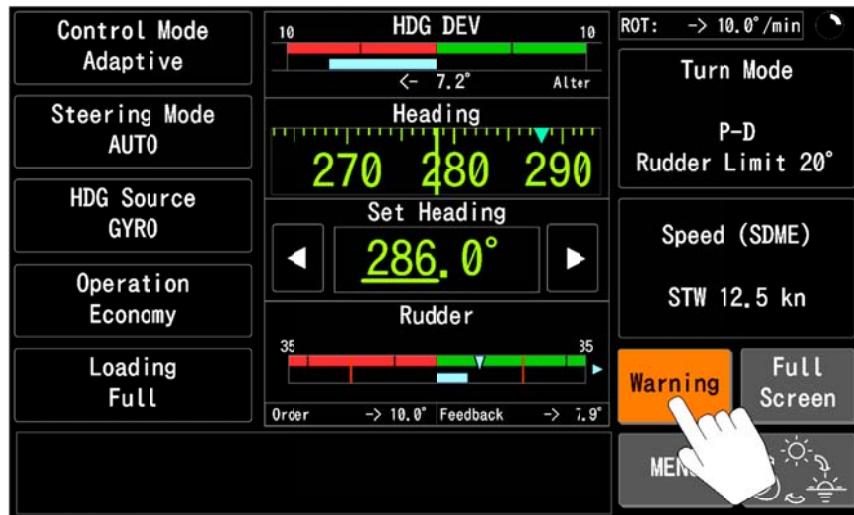


### 1.6.3 How to check the alert factor

You can check the alert factors on [2 Alert List] screen of AP CDU.

By tapping the [Alert] button on [HOME] screen, the screen changes from [HOME] screen to [2 Alert List] screen.

See 4.5



## 1.7 Maintenance and Inspection

Please inspect the following items according to the following procedures for safe-operation. Refer to the steering gear equipment's instruction manual for daily and regular inspection of steering gear equipment. (i.e. CONTROL & POWER BOX and  $\mu$ -TRANSMITTER)

### 1.7.1 Daily and Regular inspection by user

Inspection item and recommended interval are shown in the table below.

Inspection item	Inspection Contents and Procedure	Interval
Manual steering (FU)	Press "MAN" key on MODE SELECTOR and steer the HAND STEERING UNIT to check if the rudder is steered correctly.	Once/day
Manual steering (NFU)	Select "NFU" at SYSTEM SELECTOR and lean the NFU LEVER to check if the rudder is steered correctly.	Once/day
Auto steering	Press "AUTO" key on MODE SELECTOR and change the set heading (1 to 2 degrees from current heading) by the course setting dial. Check if the rudder is steered correctly.	Once/day
Remote steering (FU or NFU)	Change the steering mode to "Remote steering", and check if the rudder is steered correctly.	Once/day
System changeover	Check the above 4 items to another system and check if both systems work correctly.	Once/day
SYSTEM SELECTOR	Check if the SYSTEM SEECTOR works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.1	Once/week
MODE SELECTOR	Check if the MODE SEECTOR works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.1	Once/week
ANNUNCIATOR UNIT	Check if the ANNUNCIATOR UNIT works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.1	Once/week
AP CDU (Lamp test)	Check if the AP CDU works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.2	Once/week
AP CDU (Touch panel)	Tap the touch panel and check if the touch panel responses correctly.	Once/week
Ship's heading input	Check the heading indication on AP CDU and the steering repeater if both values are same. In case PT900 is connected 2 or 3 heading sources, elect the other heading source and check if AP CDU heading indication is same as the source of heading sensor.	Once/week

Inspection item	Inspection Contents and Procedure	Interval
MAIN CONTROL UNIT	Check if the RL8 of MAN TERMINAL BD which is installed on the baseplate of MAIN CONTROL UNIT is excited one time when you select "NO.1" or "NO.2" at SYSTEM SELECTOR.	Once/half year
Screw, Fixing parts	Check the terminals and fixing screw if they are loose. If the screw or connected cables are loose, retighten them.	Once/half year

### 1.7.2 Regular maintenance

Execute regularly the following maintenance once a year.

#### Note

Please contact our Service Department for general inspection.

Inspection item	Procedure
HAND STEERING UNIT	There is a click to recognize the center position of hand wheel. Please distribute the grease for the click of center. The type of grease is EPONEX GREASE NO.2 produced by IDEMITSU KOSAN Co., Ltd. Do not distribute the other parts.
HAND STEERING UNIT	Check the tension of timing belt inside HAND STEERING UNIT.
MAIN CONTROL UNIT	Check if the RL8 of MAN TERMINAL BD which is installed on the baseplate of MAIN CONTROL UNIT is excited one time when you select "NO.1" or "NO.2" at SYSTEM SELECTOR.

## 1.8 Terms, definitions and abbreviations

For the purposes of this manual, the following terms and abbreviations apply.

Terms	Definition
ACK	Acknowledge
ACT	Actuator
AP	AutoPilot
AUTO	Automatic
BAMS	Bridge Alert Management System
BATT	Battery
BG	BNAAC Gain
BNAAC	Batch Noise Adaptive Autopilot Controller
BNWAS	Bridge Navigational Watch Alarm System
BRILL	Brilliance
CAN-bus	Controller Area Network
COMM error	Communication error
CRS	Course
DEV	Deviation
ECDIS	Electronic Chart Display and Information System
ECOP	E-Course Pilot
FB	Feed Back rudder
FU	Follow-Up control
FWD DIST	Forwarding distance
HAND	Hand steering
HCS	Heading Control System
IND	Indication
Kn	Knot
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LOG	Speed Log
MAG	Magnetic
MAN	Manual
NAV	Navigation
NM	Nautical miles
NFU	Non Follow-Up

---

Terms	Definition
ORD	Order
OVRD	Override control
PWR	Power
PORT	Port
P-D	Proportional-Derivative Controller
PID	Proportional-Integral-Derivative Controller
RAD	Radius
ROT	Rate Of Turn
RUDD LIM	Rudder Limit
SDME	Speed and Distance Measuring Equipment
STBD	Starboard
SEL	Select
S/G	Steering Gear
S-JOY	Steering Joystick Controller
SOG	Speed Over the Ground
SPD	Speed
STA	Status
STW	Speed Through the Water
SYNC	Synchronize
TCS	Track Control System
TMC	Transmitting Magnetic Compass
THD	Transmitting Heading Device
WOL	Wheel Over Line
XTD	Cross Track Distance
XTE	Cross Track Error

---

---

Blank Page

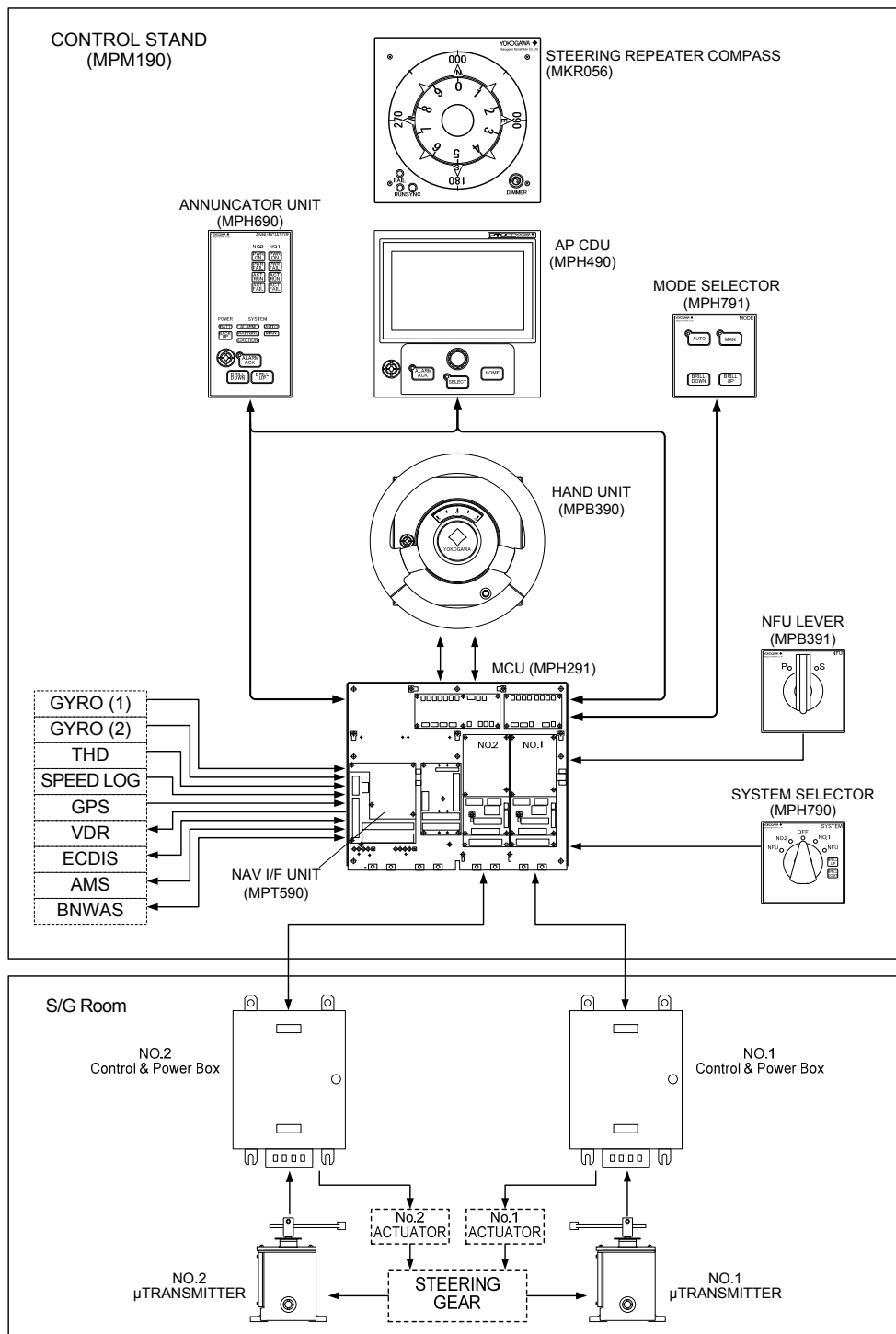
---



## 2. System configuration

### 2.1 System configuration and Type and code

- PT900 System configuration



● Type and code

PT900□-□-□-□□

① ② ③ ④⑤

①Control system

A PLUS	PT900A PLUS Adaptive control (Fully BNAAC function applied)
A	PT900A Adaptive control (BNAAC is activated during ECONOMY mode)
D	PT900D PID control

②System style

S	Stand-alone steering stand
K	Stand built-in CMZ900 Gyro compass
P	Panel mounting type (Console mounting type)
Q	INS concept type (Control stand and Console mounting)

③Type of steering gear control (□ = Number of Pumps)

N□	Direct activation of solenoid valves on steering gear pump unit
N□F	Direct activation of solenoid valves on steering gear pump unit
J□	Hydraulic power unit for JANNEY steering gear
H□	Hydraulic power unit
K□T	Torque motor control steering gear
Y□	Torque motor control steering gear
Y□A	Torque motor control steering gear
T□	Proportional solenoid valve control steering gear
ANA□	Analog control

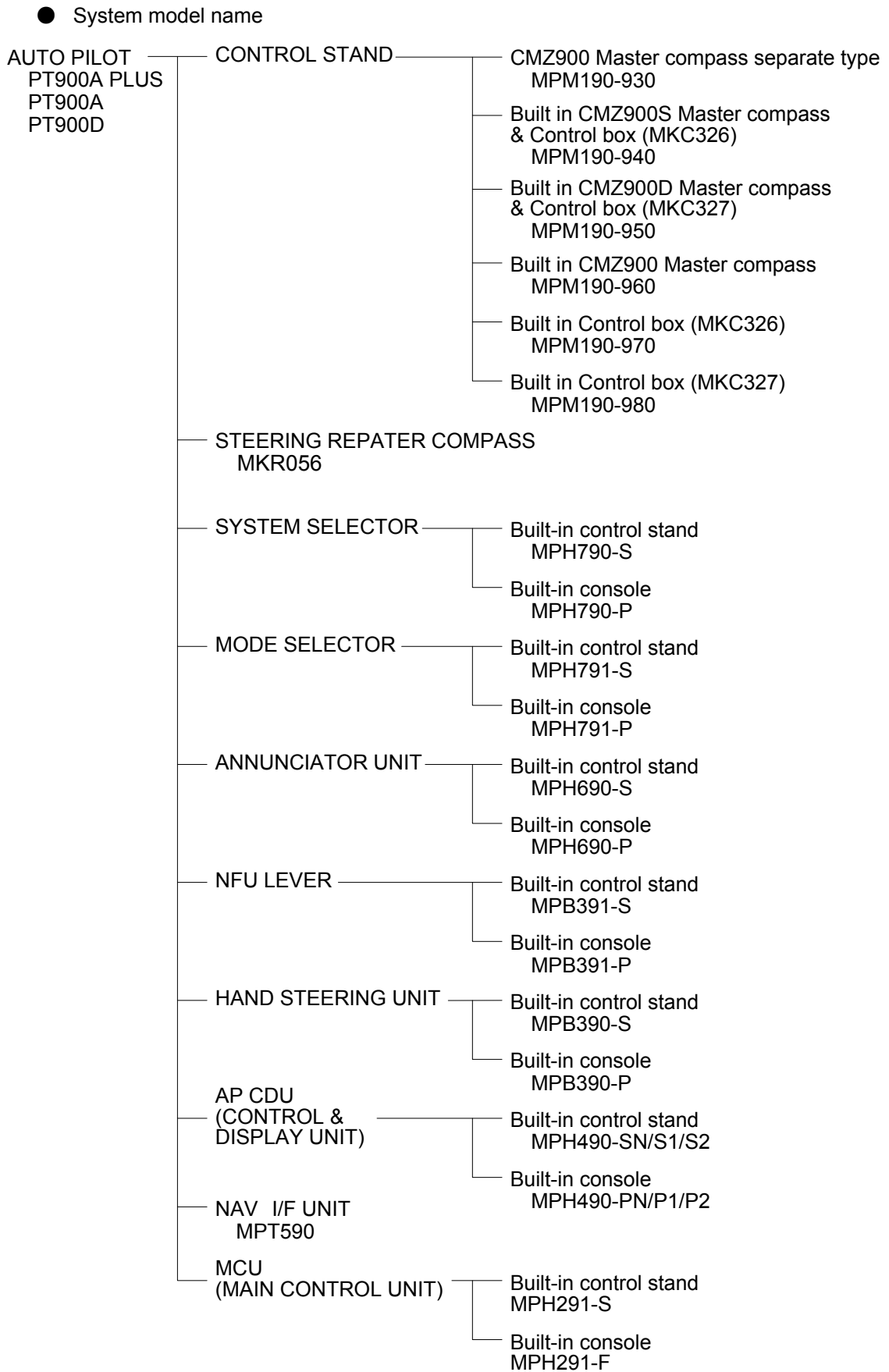
④Systems

1	1 system (N□,ANA□)
2	2 systems

⑤Rudder

S	1 rudder
T	2 rudders

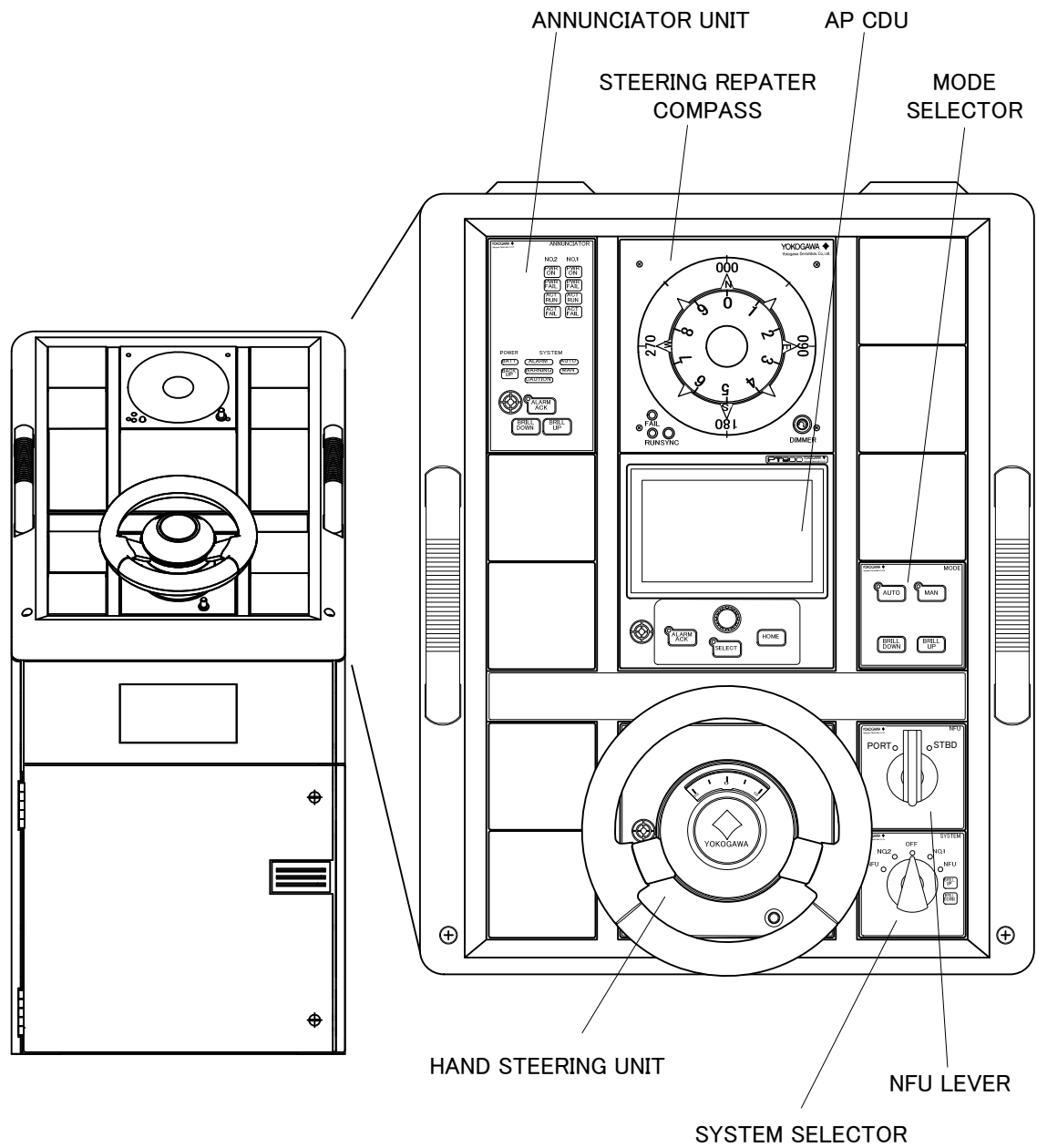




## 2.2 Individual Units and Their Functions

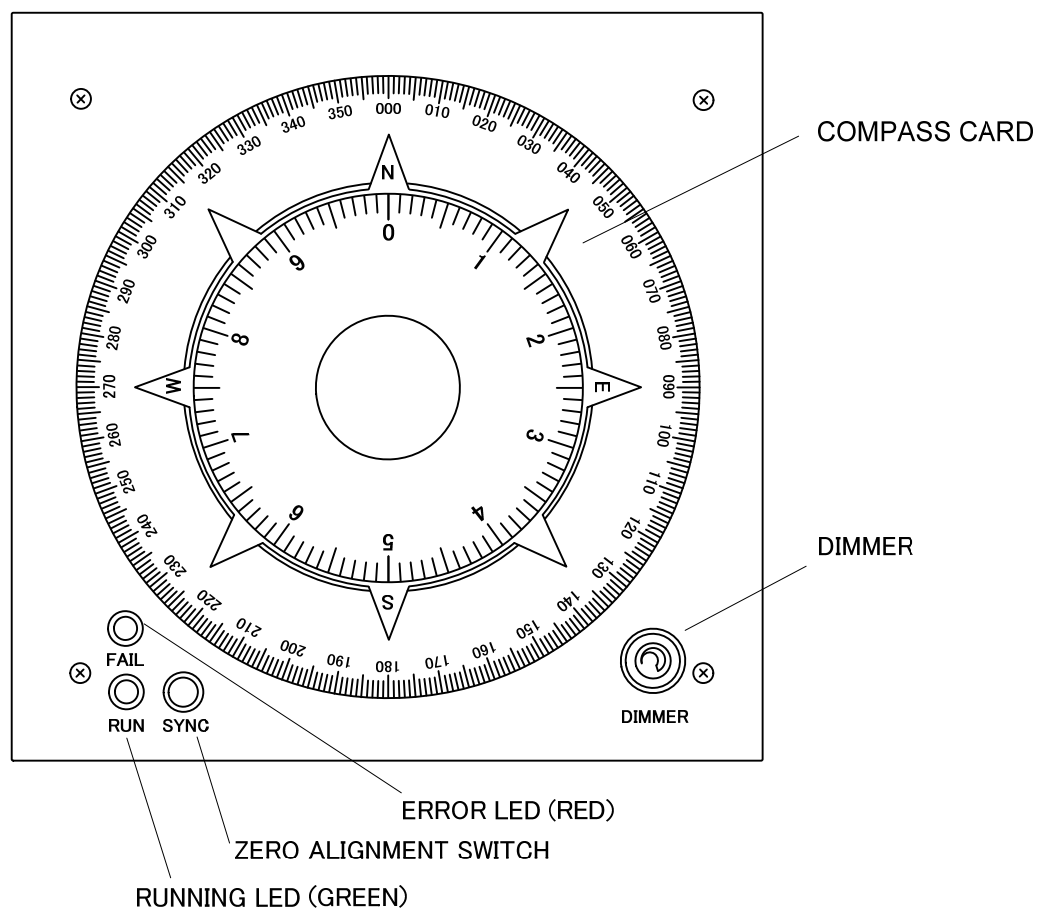
### 2.2.1 CONTROL STAND [MPM190]

CONTROL STAND is a stand-alone steering stand that we supplied. Each human-machine interface can be installed on the upper panel. Each boards and terminals (NAV I/F and MCU, etc.) can be installed inside the CONTROL STAND. Gyro master compass also can be installed inside the CONTROL STAND.



## 2.2.2 STEERING REPEATER COMPASS [MKR056]

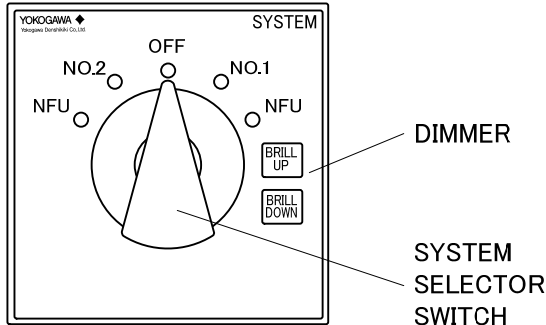
STEERING REPEATER COMPASS is powered and receives serial signals from the gyrocompass system. It drives the compass card to indicate the current heading of the vessel. At the time of being supplied the power source, STEERING REPEATER COMPASS starts zero adjustment. RUNNING LED blinks during zero adjustment. It changes from blinking to lighting after zero adjustment.



Operation / Indication	Function
COMPASS CARD	It indicates the ship's heading.
ERROR LED (red)	It blinks or lights when STEERING REPEATER COMPASS detects any error.
RUNNING LED (green)	It blinks during zero adjustment. It lights while STEERING REPEATER COMPASS works normally.
ZERO ALIGNMENT SWITCH	There is any deviation between other repeater compasses, push it and align the indication.
Dimmer	It adjusts the brightness of backlight and LEDs.

### 2.2.3 SYSTEM SELECTOR [MPH790]

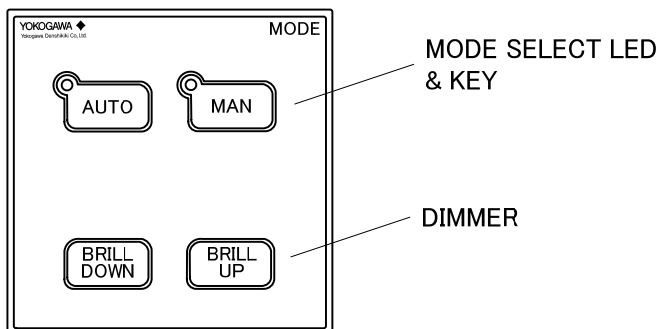
SYSTEM SELECTOR selects the system in operation. SYSTEM SELECTOR also selects the steering mode of Follow-Up or Non-Follow-Up.



Operation / Indication	Function
OFF	Shut down of PT900
NO.1	Startup of PT900 and selection of NO.1 system
NO.2	Startup of PT900 and selection of NO.2 system
NFU	Startup of PT900 and selection of NFU steering mode
BRILL DOWN key	Decrease of the brightness
BRILL UP key	Increase of the brightness

### 2.2.4 MODE SELECTOR [MPH791]

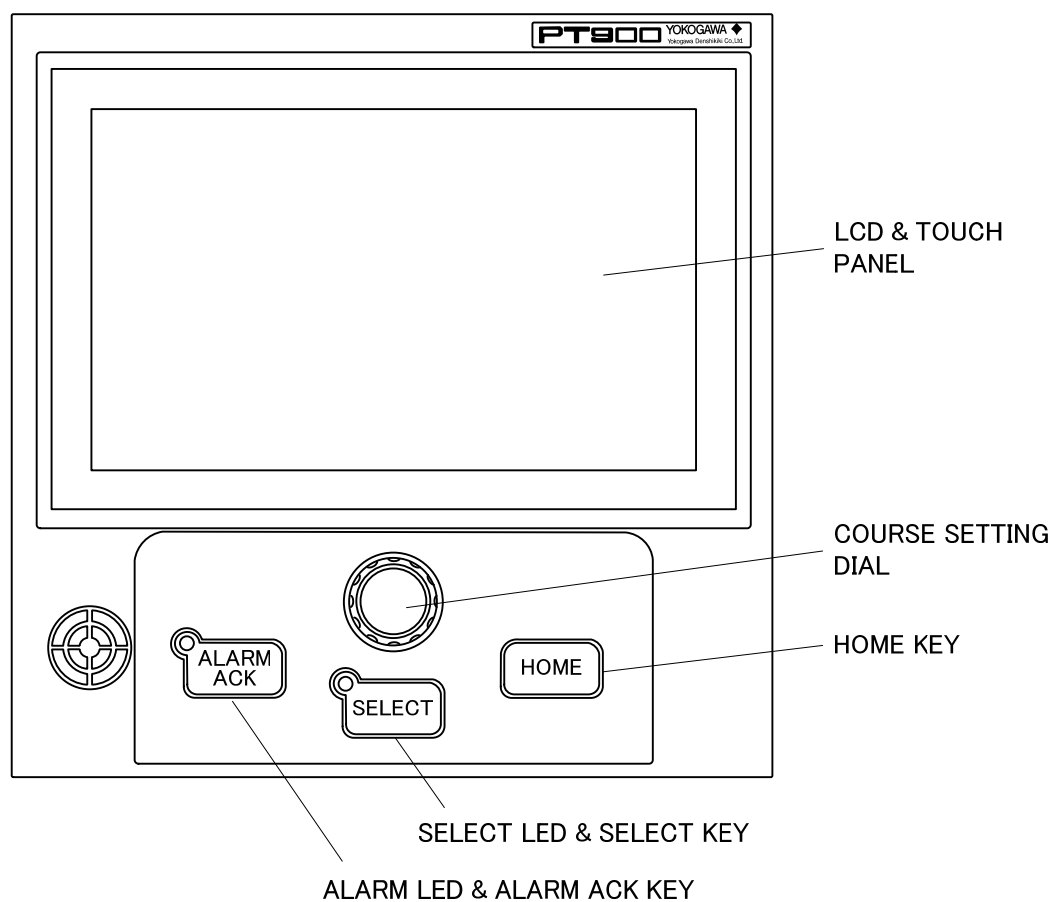
MODE SELECTOR selects the steering mode during Follow-Up steering. Selectable modes are auto steering "AUTO" or manual steering "MAN".



Operation / Indication	Function
AUTO key	It lights during AUTO steering mode.
MAN key	It lights during manual steering mode.
BRILL DOWN key	Decrease of the brightness
BRILL UP key	Increase of the brightness

## 2.2.5 AP CDU (AUTOPILOT CONTROL & DISPLAY UNIT) [MPH490]

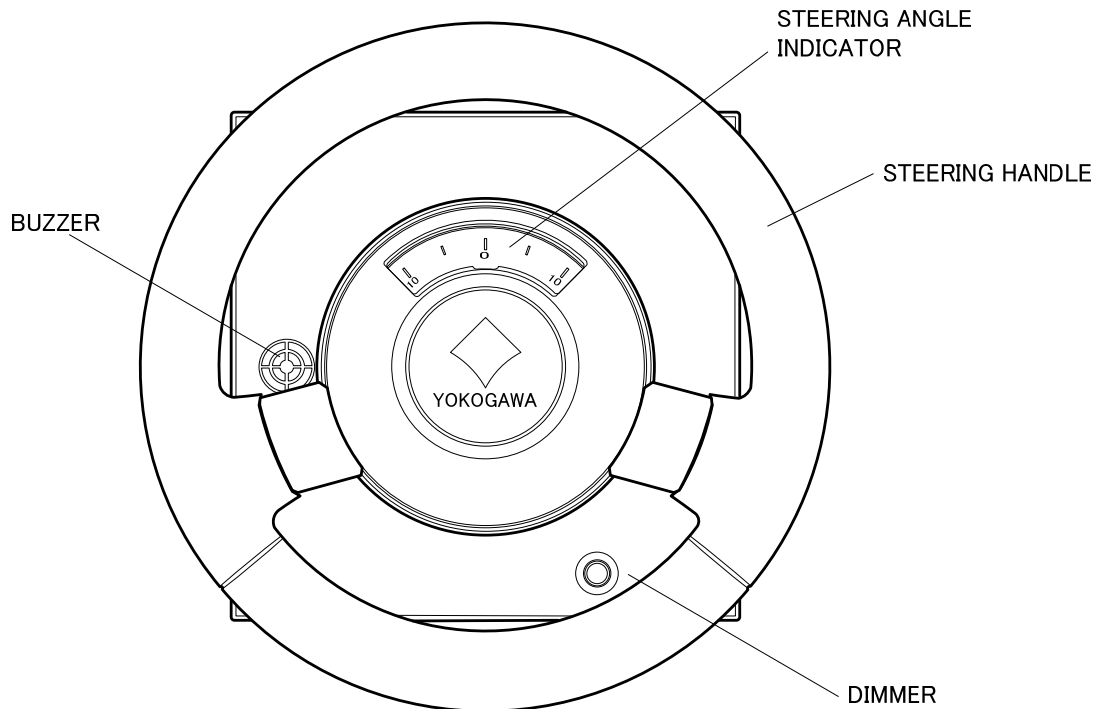
AP CDU is a human-machine interface which indicates the navigational information on 7 inch LCD. AP CDU is not only indication but also calculation of rudder order during AUTO steering mode.



Operation / Indication	Function
LCD	It indicates the various data and settings.
TOUCH PANEL	You can operate it by tapping screen.
COURSE SETTING DIAL	It can set the "Set heading" during AUTO mode or "Set course" during CRS mode. This dial works by pushing and rotating it.
ALARM ACK key	To press it stops the buzzer in the event of an alert and allows the alert item to be acknowledged. LED (red) blinks or lights while the alert appears.
SELECT key	To press it selects this AP CDU in case 2 or more AP CDUs are installed. LED (green) lights while this AP CDU is selected.
HOME key	To press it transitions to [HOME] screen.
Buzzer	Buzzer sounds for any alert or steering mode change.

### 2.2.6 HAND STEERING UNIT [MPB390]

HAND STEERING UNIT indicates and commands the order rudder angle during MAN steering mode.

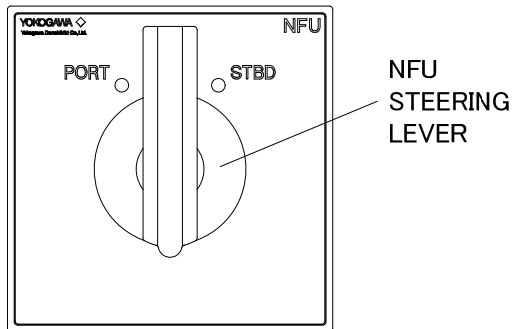


Operation / Indication	Function
STEERING HANDLE	It inputs order rudder angle during MAN mode.
STEERING ANGLE INDICATOR	It indicates the order rudder angle during MAN mode.
DIMMER	It adjusts the brightness of STEERING ANGLE INDICATOR backlight. It does not work while the central dimmer control (see 4.4.2) is on. Rotate the dimmer knob to counterclockwise fully to escape from central dimmer control and to adjust the brightness individually. Adjust the brightness of the steering angle indicator. Then rotate knob to clockwise to adjust the brightness.
BUZZER	It sounds when wheel-off center alert appears. (Option)

### 2.2.7 NFU LEVER [MPB391]

NFU LEVER is self-returning lever switch to activate the rudder actuator directly during Non-Follow-Up steering mode.

NFU LEVER is available while SYSTEM SELECTOR is set to NFU position.



Operation / Indication	Function
NFU STEERING LEVER	It activates the rudder actuator directly.



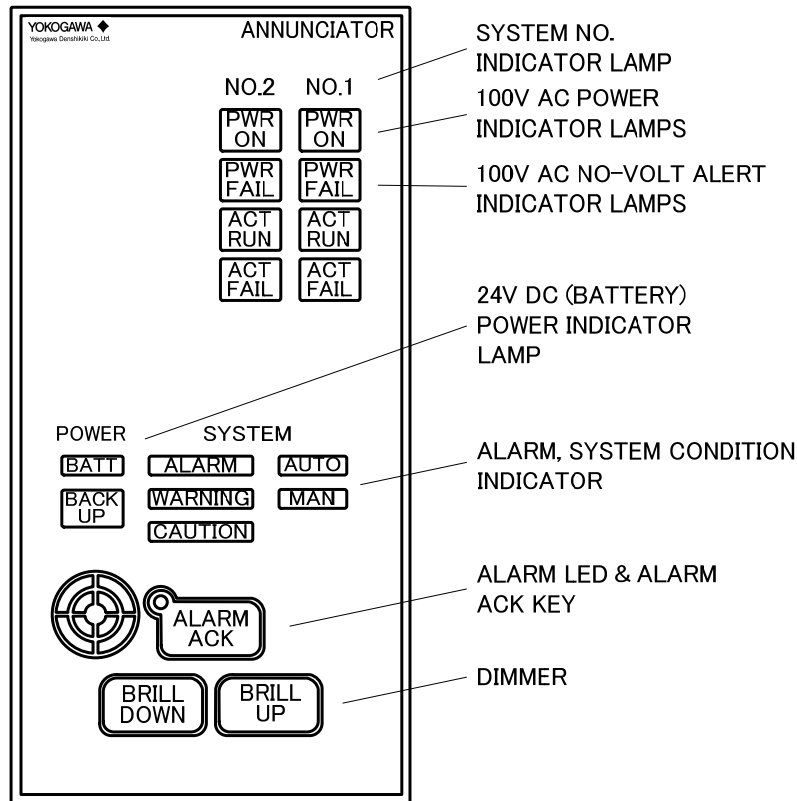
While you maneuver the vessel with NFU lever, watch the rudder angle indicator to avoid the rudder steered up to the mechanical limit.

**2.2.8 ANNUNCIATOR UNIT [MPH690]**

ANNUNCIATOR UNIT is alert indicator unit. It mainly monitors the power supply for Steering gear Control System, steering gear condition and PT900 operation condition. It provides the audible and visible alerts.

The arrangement of indicator lamp depends on the specification of the vessel.

(Following figure is an example of two steering gear pumps type)



Operation / Indication	Function
PWR ON	100V AC power supply indicator lamps (green)
PWR FAIL	100V AC no-volt alert indicator lamps (red)
ACT RUN	Actuator run indicator lamps (green)
ACT FAIL	Actuator failure alert indicator lamps (red)
BATT	24V DC (ship's battery) power supply indicator lamp (green)
BACKUP	24V DC (backup) power supply indicator lamp (green) Note) This 24V DC is provided from AC power source.
ALARM	ALARM lamp (red)
WARNING	WARNING lamp (orange)
CAUTION	CAUTION lamp (yellow)
AUTO	Auto steering status indicator lamp (green)
MAN	Manual steering status indicator lamp (green)



Operation / Indication	Function
ALARM ACK key	To press it stops the buzzer in the event of an alert and allows the alert item to be acknowledged. LED (red) blinks or lights while the alert appears.
BRILL DOWN key	Decrease of the brightness
BRILL UP key	Increase of the brightness
Buzzer	Buzzer sounds for any alert.

**2.2.9 NAV I/F UNIT [MPT590]**

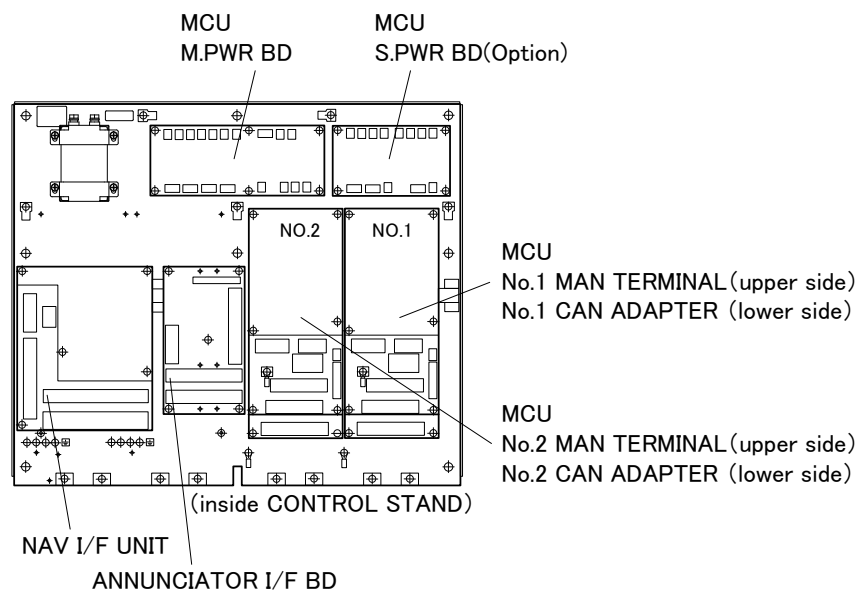
NAV I/F is connected with various external navigational equipment. It has input and output ports for external navigational equipment.

- NAV I/F receives the sensor data from each sensor like gyrocompass, speed log and so on. It distributes these sensor data to other PT900 equipment with CAN-bus line.
- NAV I/F sends alert information and control status to the external equipment like BAMS VDR and so on.

**2.2.10 MAIN CONTROL UNIT (MCU) [MPH291]**

MAIN CONTROL UNIT mainly controls the steering system. It controls the steering mode and rudder order output etc.

- MAIN CONTROL UNIT receives the digital signal of rudder order from HAND STEERING UNIT or AP CUD and it converts and outputs as the analog signal to CONTROL & POWER BOX installed in steering gear room.
- MAIN CONTROL UNIT receives analog signal of actual rudder angle and contact status signal of steering gear from CONTROL & POWER BOX. It converts and distributes them to other PT900 equipment with CAN-bus line.





**RISK OF ELECTRICAL SHOCK**

Turn off the power supply before starting the wiring.

---



Do not execute the megger test except the on-board power supply terminals.  
A megger test may damage the instrument.

---

## 3. Operation

This chapter shows the operation method and procedure of PT900.

### 3.1 Operation

#### 3.1.1 Checking items before power ON

Check if the following items are normal before you turn on PT900.

- (1) Check that the steering gear is ready to operate.
- (2) Check that CONTROL & POWER BOX is turned on. Check also that the test switch of the CONTROL & POWER BOX is set to "NOR" (Normal).
- (3) Check that "PWR ON" indication of ANNUNCIATOR UNIT is on.
- (4) Check that STEERING REPEATER COMPASS shows correct heading.
- (5) Check that HAND STEERING UNIT is set to midship position.

#### 3.1.2 How to startup and shut down

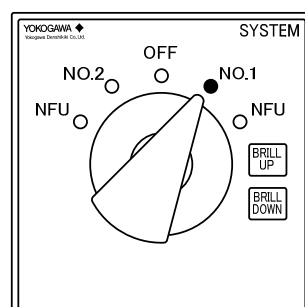
SYSTEM SELECTOR has the following 2 functions;

- Power ON/OFF of PT900
- Select the system in operation

Select "NO.1" or "NO.2" position of SYSTEM SELECTOR to startup PT900.

Steering mode is same one that PT900 was turned off.

Select "OFF" position of SYSTEM SELECTOR to shut down PT900.



## 3.2 Manual steering

Press the “MAN” key on MODE SELECTOR, and you can steer the rudder by Follow-Up with HAND STEERING UNIT.

You can use the [Set Heading] on [HOME] screen of AP CDU as COURSE REMINDER during “MAN” mode.

**WARNING**

- Before you change the steering mode from AUTO to MAN, please set the steering wheel to the midship position.
  - If there is a large difference between the actual rudder angle and steering wheel position before changing the steering mode, the rudder may be steered excessively.
-

## 3.3 Auto steering

Press the “AUTO” key on MODE SELECTOR, and you can steer the rudder automatically with AP CDU. That means that the heading control starts.

### 3.3.1 Preparation for Auto steering

Take the following process before starting Auto steering.

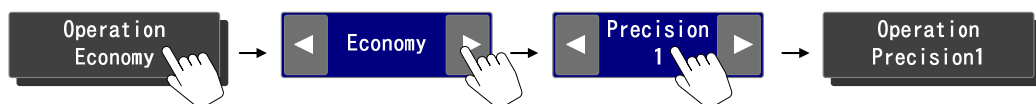
#### 3.3.1.1 OPERATION MODE setting

Select OPERATION MODE according to the navigating area, weather and sea conditions.

OPERATION MODE	Description
Economy	“Economy” is for fuel saving steering in the open sea area.
Precision 1	“Precision 1” steers more frequently to decrease the HDG DEV and yawing during AUTO mode than “Economy” does.
Precision 2	“Precision 2” steers more frequently to decrease the HDG DEV and yawing during AUTO mode than “Precision 1” does.

- (1) Tap [Operation] button on [HOME] screen to set OPERATION MODE.
- (2) Tap the arrow button to select OPERATION MODE.
- (3) Tap the operation indication space to fix OPERATION MODE.

The example of OPERATION MODE changing from “Economy” to “Precision 1” is shown in figure below.



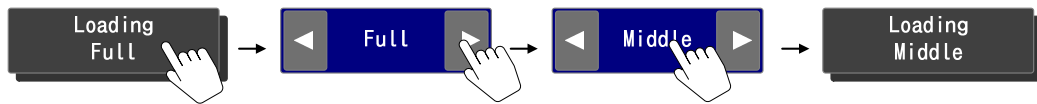
### 3.3.1.2 DRAFT MODE setting

Select DRAFT MODE according to the vessel's loading condition.

DRAFT MODE	Description
Full	"Full" is 80 to 100% of designed full load draft.
Middle	"Middle" is 55 to 80% of designed full load draft.
Ballast	"Ballast" is less than 55% of designed full load draft.

- (1) Tap [Loading] button on [HOME] screen to set DRAFT MODE.
- (2) Tap the arrow button to select DRAFT MODE.
- (3) Tap the loading indication space to fix DRAFT MODE.

The example of DRAFT MODE changing from "Full" to "Middle" is shown in figure below.



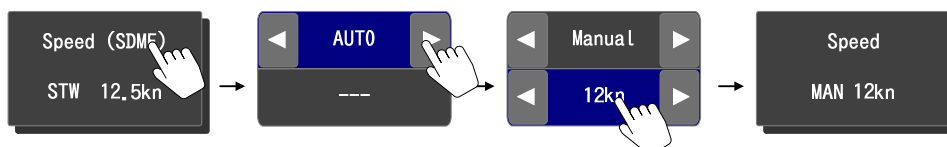
### 3.3.1.3 SPEED setting

Select the input method of current ship's speed. SDME is an abbreviation of "Speed and Distance Measuring Equipment".

Speed	Description
AUTO (A or A-PLUS)	PT900A or PT900A Plus receives speed sensor data from electromagnetic log, doppler log and so on. Setting "AUTO" means that these controllers update speed data automatically according to the sensor data. Speed through the water (STW) is more important for heading control than speed over the ground (SOG). So they usually use STW. But in case STW becomes unavailable, they use SOG data of VBW sentence. STW or SOG is indicated to show which speed source is being used.
Manual	Setting "Manual" is used for PT900D or PT900A/PT900A Plus with speed sensor error to input ship's speed manually. Setting range of "Manual" is from 1 to 65kn.

- (1) Tap [Speed] button on [HOME] screen.
- (2) Tap the arrow button to select "AUTO" or "Manual".
- (3) In case you select "Manual", set adequate ship's speed in the lower column

The example of speed setting change from "AUTO" to "Manual" is shown in figure below.



### 3.3.2 Start Auto steering

Press the “AUTO” key on MODE SELECTOR, and you can steer the rudder automatically with AP CDU. Buzzer sounds to inform the change of steering mode.

Current heading is applied as “Set Heading” which you change the steering mode from “MAN” to “AUTO”. First decimal place of “Set Heading” is rounded off.

### 3.3.3 Mode selection of Auto steering

There are 3 modes as auto steering, Heading/Course/Track control. Selected mode is indicated on [HOME] screen [Steering Mode] section of AP CDU. The difference of these auto steering is shown in table below.

Auto steering	Description	Remarks
AUTO	“AUTO” means heading control. “AUTO” keeps ship’s heading based on the “Set Heading”.	Standard
CRS	“CRS” means course control. “CRS” keeps ship’s course based on the virtual course. AP CDU plans virtual course automatically based on the “Set Course”.	Option
TRACK	“TRACK” means track control. “TRACK” keeps ship’s position based on the preplanned route on ECDIS.	Option

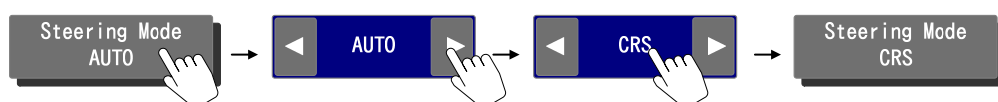
#### 3.3.3.1 AUTO mode

Press the “AUTO” key on MODE SELECTOR, and you can steer the rudder automatically with “AUTO” mode. Buzzer sounds to inform the change of steering mode.

#### 3.3.3.2 CRS mode (Option)

“CRS” mode is optional auto steering mode. PT900 connected with GPS has this mode.

- (1) Tap [Steering Mode] button on [HOME] screen.
- (2) Tap the arrow button to select “CRS”.
- (3) Tap the steering mode indication space to fix.
- (4) Buzzer sounds to inform the change of steering mode.



### **3.3.3.3 TRACK mode (Option)**

“TRACK” mode is optional auto steering mode. PT900 connected with ECDIS has this mode.

“TRACK” mode can be automatically selected by the operation of ECDIS with buzzer sound.

Please refer to the user manual of ECDIS about how to start.

How to end “TRACK” mode and the steering mode at that time is as follows:

- Press “MAN” key on MODE SELECTOR, and “TRACK” mode is ended to be switched to “MAN” mode.
- Select “NFU” in SYSTEM SELECTOR, and “TRACK” mode is ended to be switched to “NFU” mode.

Sailing on straight leg

- In case you stop track control on ECDIS operation, current heading is set as “Set Heading” and heading control starts.
- In case you stop track control by long tap of [Steering Mode] on [HOME] screen of AP CDU, heading control starts. Current heading is set as “Set Heading”.

Sailing on curved track

- In case you stop track control on ECDIS operation, heading control starts after the turn is completed. Next leg is set as “Set Heading”.
- In case you stop track control by long tap of [Steering Mode] on [HOME] screen of AP CDU, heading control starts after the turn is completed. Next leg is set as “Set Heading”.

Buzzer sounds to inform the change of steering mode after above operation,

Track control uses following parameters which are set on

- PT900 : OPERATION mode, DRAFT mode, Ship’s speed
- ECDIS : Turn radius, Channel limit

Especially, forwarding distance is based on DRAFT mode, Ship’s speed and Turn radius.

Please refer to 4.7.6 about the setting of forwarding distance.

---



### 3.3.4 Course change during AUTO/CRS mode

After you select the TURN mode, vessel can turn automatically by changing the [Set Heading] or [Set Course] during AUTO or CRS mode.

#### 3.3.4.1 TURN MODE setting

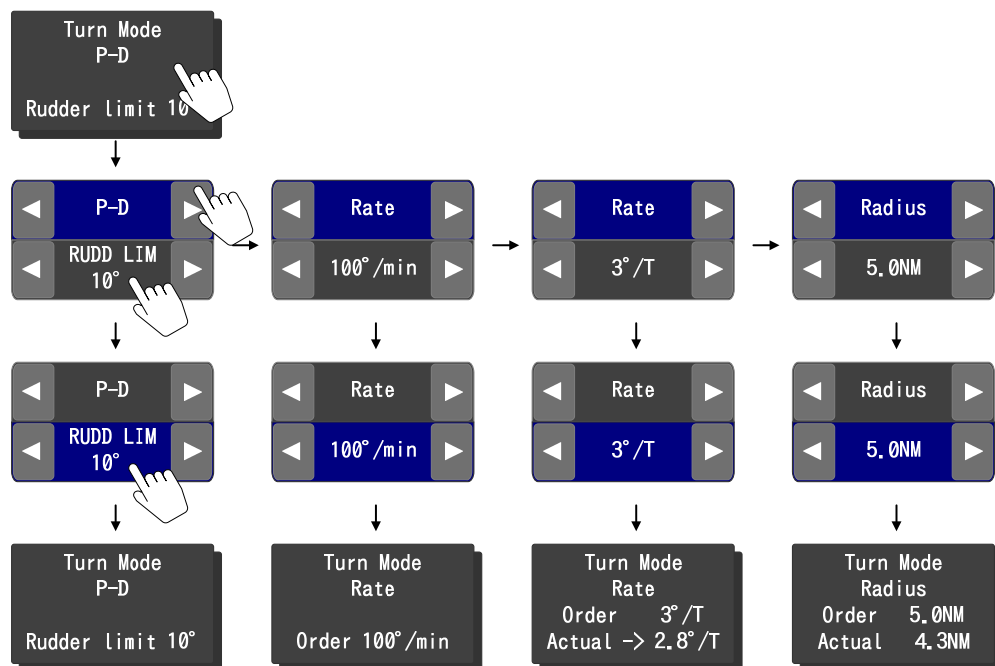
There are 3 TURN MODES for auto course change. Select TURN MODE before changing [Set Heading] or [Set Course]. Rudder is steered within setting during "P-D" control.

TURN MODE	Function	Setting range	Rudder limit
P-D	"P-D" mode can turn the vessel in shortest time. This mode is useful in ocean going.	Rudder limit 2~35 degree	Manual setting
Rate Note1	"Rate" mode can turn the vessel with constant ROT. This mode use ship's speed and length of itself. $\tau$ is time which vessel takes to go own length.	Turn rate 1~200°/min or 1~25°/ $\tau$	---
Radius Note1	"Radius" mode can turn the vessel with set radius.	Radius 0.1~10.0NM	---

Note1: "Rate" mode and "Radius" mode is selectable on PT900A and PT900A Plus.

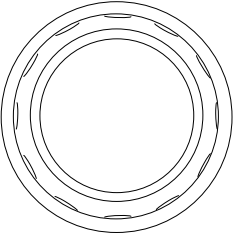


- (1) Tap [Turn Mode] button on [HOME] screen to set TURN MODE.
- (2) Tap the arrow button to select TURN MODE.
- (3) Tap the turn mode indication space to fix TURN MODE.

The figure shows the example of selecting each TURN MODE.



### 3.3.4.2 Set Heading / Set Course

You can change [Set Heading] / [Set Course] during AUTO/CRS mode.

[Set Heading] / [Set Course] change		Operation
Name	Outline	
COURSE SETTING DIAL		<ul style="list-style-type: none"> <li>Press and rotate it to the clockwise, and [Set Heading] / [Set Course] increases.</li> <li>Press and rotate it to the counterclockwise, and [Set Heading] / [Set Course] decreases.</li> <li>Press for 2 seconds, and setting digit changes.</li> </ul>
TOUCH PANEL		<ul style="list-style-type: none"> <li>Tap the right side arrow key, and [Set Heading] / [Set Course] increases.</li> <li>Tap the left side arrow key, and [Set Heading] / [Set Course] decreases.</li> <li>Tap the value, and setting digit changes.</li> </ul>
SELECT KEY Note1		<ul style="list-style-type: none"> <li>Current heading is set as [Set Heading] / [Set Course] during AUTO/CRS mode.</li> <li>First decimal place of "Set Heading" is rounded off.</li> </ul>

Note1: In case the vessel has two or more AP CDUs and SELECT LED is off, operation right changes to itself by pressing SELECT KEY. See 4.2.2.1

## 3.4 NFU steering

Select "NFU" on SYSTEM SELECTOR, and you can steer the rudder with NFU LEVER.

- NFU LEVER is a self-return on-off cam switch.



- While you maneuver the vessel with NFU lever, watch the rudder angle indicator to avoid the rudder steered up to the mechanical limit.

---

Blank Page

---



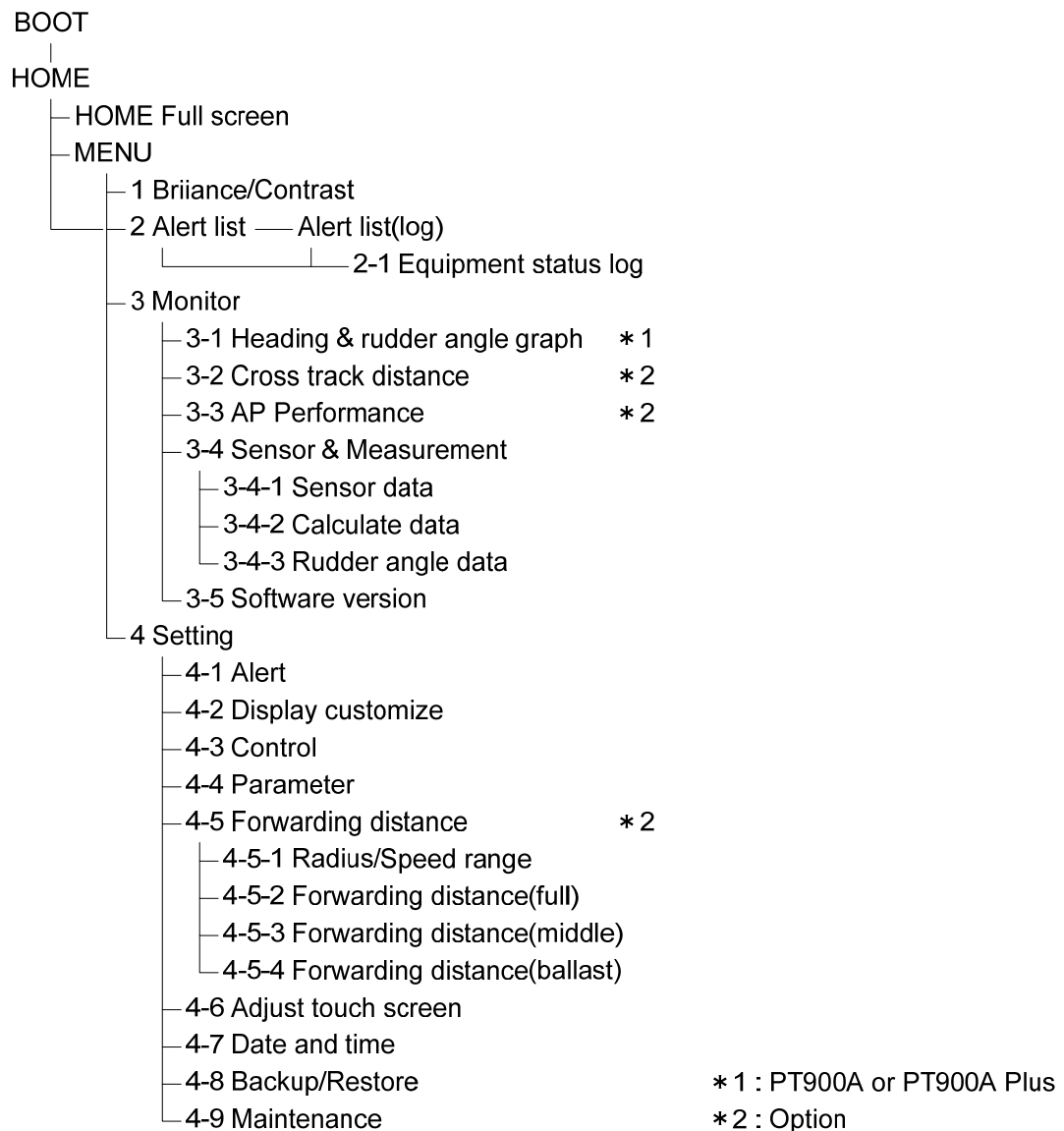
## 4. Function and operation

This chapter shows the Autopilot Control & Display Unit (AP CDU) functions.

### 4.1 MENU Tree

The figure above shows the screen transition of AP CDU.

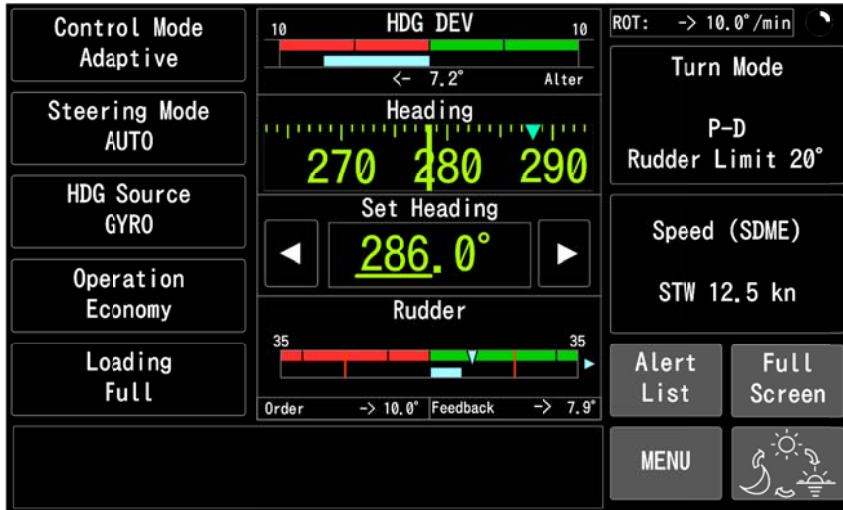
The numbers in front of the screen name show the depth of hierarchy. They are always indicated on the top left corner of the screen.



## 4.2 Basic operations

### 4.2.1 Touch panel operation

You can operate AP CDU with touch panel. To tap the button on screen provides screen transition and change of settings.

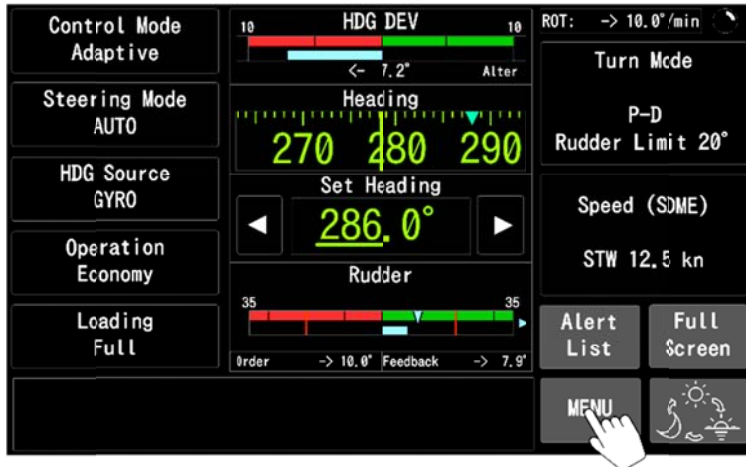


#### 4.2.1.1 Screen transitions

Screen transition is provided by tapping the following respective buttons.

Button	Function
Alert List	It is indicated on [HOME] screen. It provides screen transition to [2 Alert List] screen.
Full Screen	It is indicated on [HOME] screen. It provides screen transition to [Full screen] screen.
MENU	It is always indicated on screen except [MENU] screen. It provides screen transition to [MENU] screen.
Home	It is always indicated on screen except [HOME] screen. It provides screen transition to [HOME] screen.
Back	It is indicated on screen which is 2 or more depth of hierarchy. It provides screen transition to previous screen.
Prev Page	It is indicated on screen which has some pages in one screen like [2-1 Equipment status log] or [3-5 Software version] screen. It provides screen transition to previous page.
Next Page	It is indicated on screen which has some pages in one screen like [2-1 Equipment status log] or [3-5 Software version] screen. It provides screen transition to next page.

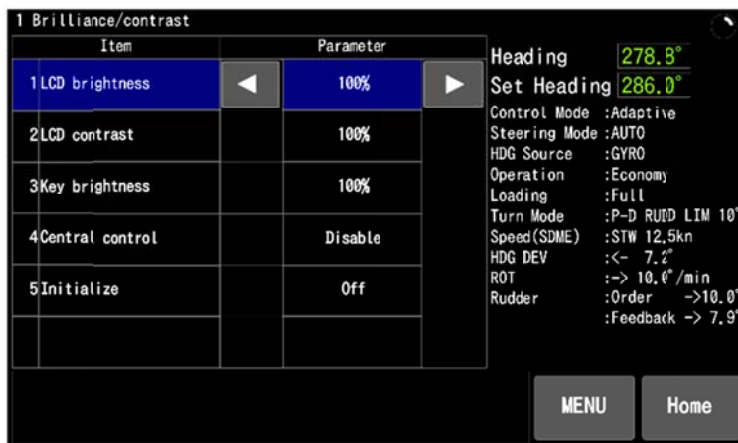
- Example of screen transition from [HOME] screen to [1 Brilliance/contrast] screen



(1) Tap [MENU] button.



(2) Select "1 Brilliance/contrast" from MENU list.

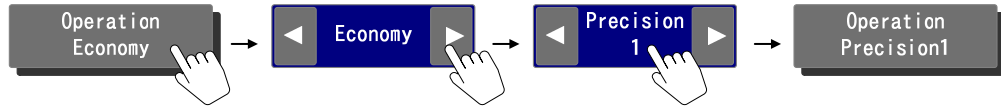


(3) [1 Brilliance/contrast] screen appears.

### 4.2.1.2 Setting change by touch panel operations

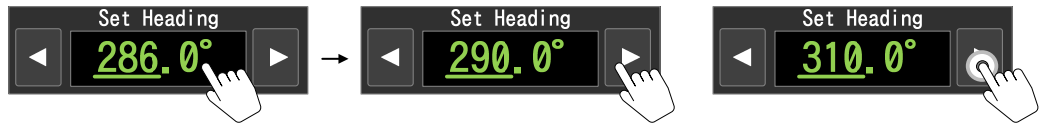
- Example of OPERATION mode change

- (1) Tap [Operation] button on [HOME] screen to set OPERATION MODE.
- (2) Tap the arrow button to select OPERATION MODE.
- (3) Tap the operation indication space to fix OPERATION MODE.



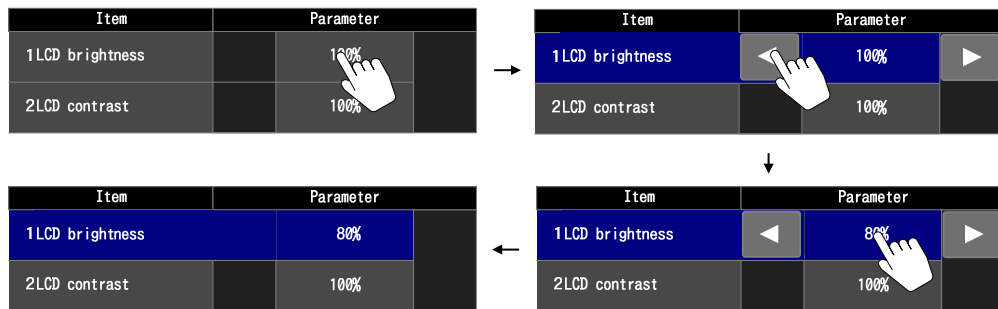
- Example of [Set Heading] change

- (1) Tap [Set Heading] value on [HOME] screen.
- (2) Tap the right side arrow button, and [Set Heading] increases.  
Tap the left side arrow button, and [Set Heading] decreases.  
(Long tap of arrow button changes [Set Heading] value quickly.)
- (3) Change of [Set Heading] value applies immediately to heading control.



- Example of LCD brilliance change

- (1) Tap [MENU] button on [HOME] screen to transition to [MENU] screen.
- (2) Tap the value directly to change the value.
- (3) Tap the arrow button to set the adequate value.
- (4) Tap the value directly to fix the value.




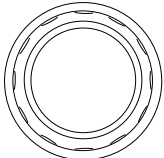




## 4.2.2 KEY SWITCH and COURSE SETTING DIAL operation

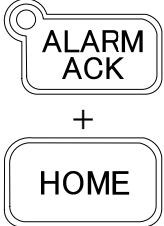



Function of KEY SWITCH and COURSE SETTING DIAL of AP CDU depends on the condition and operation.

### 4.2.2.1 NORMAL operation

Outline	AP CDU condition	Operation	Function
	SELECT LED is off because other installed AP CDU has operation right.	Press 1 time	SELECT LED lights to indicate this AP CDU has operation right.
	SELECT LED is on and steering mode is AUTO or CRS.	Press 1 time	Set the current heading as [Set Heading].
	There are unacknowledged alerts with buzzer sound.	Press 1 time	Buzzer becomes silent.
	There are unacknowledged alerts with silenced buzzer.	Press 1 time	The highest priority alert is acknowledged.
	Normal condition	Press 1 time	Return to [HOME] screen.
		Press for 2 seconds	Transition to [1 Brilliance/contrast] screen.
	Normal condition	Press and rotate	Change the [Set Heading].
		Press for 2 seconds	Setting digit of [Set Heading] is changed. (1 degree / 0.1 degree)

### 4.2.2.2 KEY SWITCH operation

In case any trouble of touch panel appears on AP CDU, switch KEY operation shown below.

Outline	AP CDU condition	Operate	Function
	NORMAL operation	Press for 3 seconds	Changeover from NORMAL operation to KEY SWITCH operation. See 4.8
	KEY SWITCH operation	Press 1 time	Changeover from KEY SWITCH operation to NORMAL operation.
	NORMAL operation	Press 1 time	Same as 4.2.2.1
	KEY SWITCH operation	Press 1 time	Enter the each command.
	NORMAL operation	Press 1 time	Same as 4.2.2.1
	KEY SWITCH operation	Press 1 time	Move the highlight selection to left or upper side.
	NORMAL operation	Press 1 time	Same as 4.2.2.1
	KEY SWITCH operation	Press 1 time	Move the highlight selection to right or lower side.



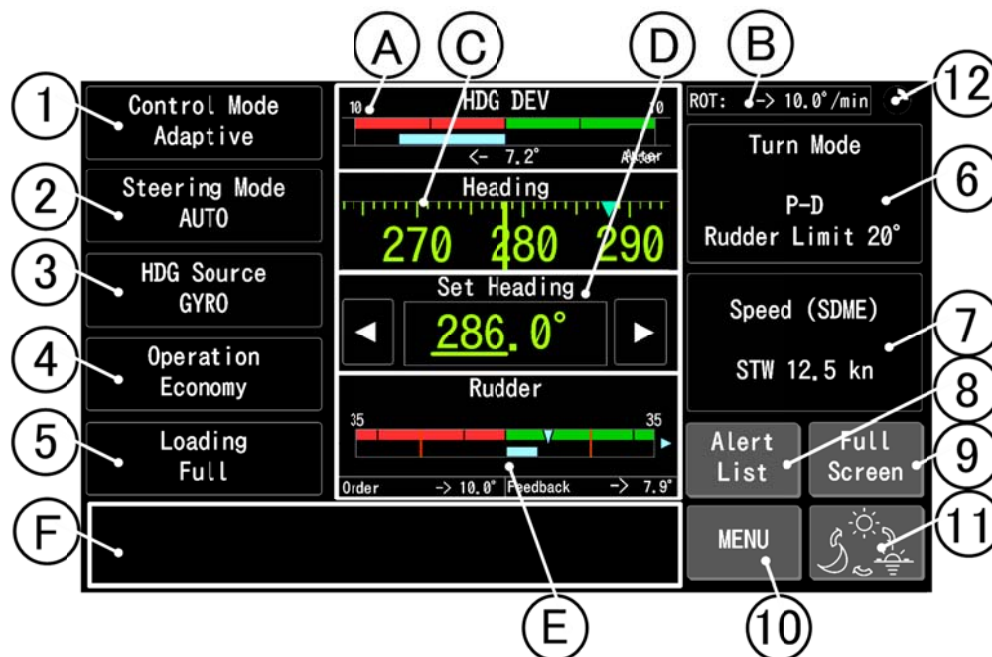
In case any trouble of touch panel appears on AP CDU, switch KEY SWITCH operation immediately.

### 4.3 Screen indications

#### 4.3.1 [HOME] screen

[HOME] screen indicates various sensor data and changes each setting.

Operable buttons are gray color and inoperable buttons are charcoal gray color.



- Ⓐ Heading deviation      Ⓑ Rate Of Turn

Indication pattern depends on the steering mode as following table.

Indication range of heading deviation, course deviation and rate of turn can be set on [4-2 Display customize] screen. See 4.7.3

Steering mode		Ⓐ	Ⓑ
AUTO TRACK	Heading deviation		ROT: XX.X°/min
CRS	Course deviation		ROT: XX.X°/min
MAN NFU	Rate of turn		HDG DEV: XX.X°

In case heading – set heading is plus, “->” is displayed.

In case heading – set heading is minus, “<-” is displayed.

“Alter” is indicated while vessel turns during AUTO/CRS/ TRACK mode.

“Steady” is indicated while vessel goes straight during AUTO/CRS/ TRACK mode.

© Heading

The indication pattern depends on the steering mode as following table.

Format of heading can be set on [4-2 Display customize] screen. See 4.7.3

Steering mode	Format	
	Digital (Numeric)	Tape repeater
AUTO TRACK MAN NFU		 "▼" Set Heading
CRS		 "▼" Set Course " " COG

④ Set Heading/Set Course

The indication pattern depends on the steering mode as following table.

Steering mode	Format	
AUTO TRACK		
	Underline length changes according to the setting digit.	
CRS		
	Underline length changes according to the setting digit.	
MAN NFU		
	You can input the set heading as COURSE REMINDER not to forget it during MAN or NFU mode. <span style="float: right;">Note1</span>	

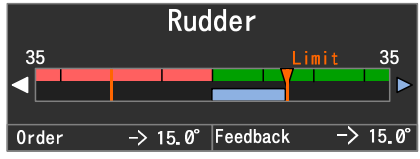


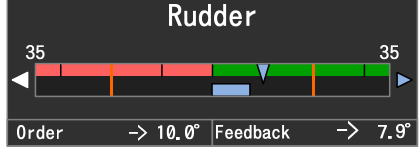


Note1: ON/OFF setting of COURSE REMINDER function is set in [4-9-8 Others] screen.

Default setting is ON.

Ⓔ Rudder angle

Order and feedback rudder angle are indicated on here.

Indication range of graph can be set on [4-2 Display customize] screen. See 4.7.3

Steering mode	Format	Symbol
AUTO or CRS mode with P-D turn		 Rudder limit
		 Rudder Order: While this mark reaches to the rudder limit, the symbol changes to orange and "Limit" appears.
Other mode		 Rudder moving direction: Symbol of rudder turning side changes to blue.
		

Ⓕ Guidance area








Guidance is indicated here while the particular alerts appear or AP CDU is KEY SWITCH operation mode.























In case the guidance appears with any alert, follow the guidance immediately.

① Control mode






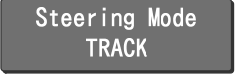

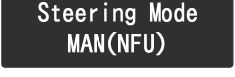
You can select controller with [Control Mode] button on [HOME] screen. There are 3 types of controller and one AP CDU can have maximum two controllers. Combination of controller depends on the specification of each vessel. See 1.3 for more information about controller.

Combination of controller	Indication / Selection
ADAPTIVE PLUS x 1	 (Not selectable)
ADAPTIVE x 1	 (Not selectable)
PID x 1	 (Not selectable)
ADAPTIVE PLUS x 2	   

Combination of controller	Indication / Selection	
ADAPTIVE x 2	 	 
PID x 2	 	 
ADAPTIVE PLUS x 1 ADAPTIVE x 1	 	 
ADAPTIVE PLUS x 1 PID x 1	 	 
ADAPTIVE x 1 PID x 1	 	 

② Steering mode

You can select steering mode with [Steering Mode] button on [HOME] screen. Steering mode is also selectable with SYSTEM SELECTOR and MODE SELECTOR. You can select especially AUTO or CRS mode with this button. Selectable steering mode depends on the specification of each vessel. See 1.5.3 for more information about steering mode.

Steering mode	Indication / Selection		
AUTO CRS (Option) TRACK (Option)	 	 	  Note1
HAND	 Note2		
NFU	 Note3		

Note1: It is indicated when you select TRACK mode with ECDIS side operation.


See 3.3.3.3 to changeover TRACK mode.

Note2: It is indicated when you select MAN mode with MODE SELECTOR.


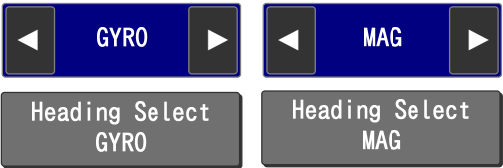
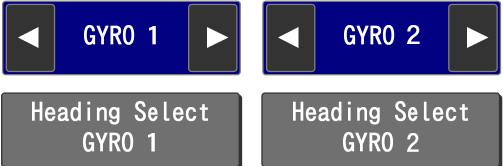

In case MODE SELECTOR is out of work, HAND mode can be selected with this button. See 5.4

Note3: It is indicated when you select NFU mode with SYSTEM SELECTOR.

③ Selected compass

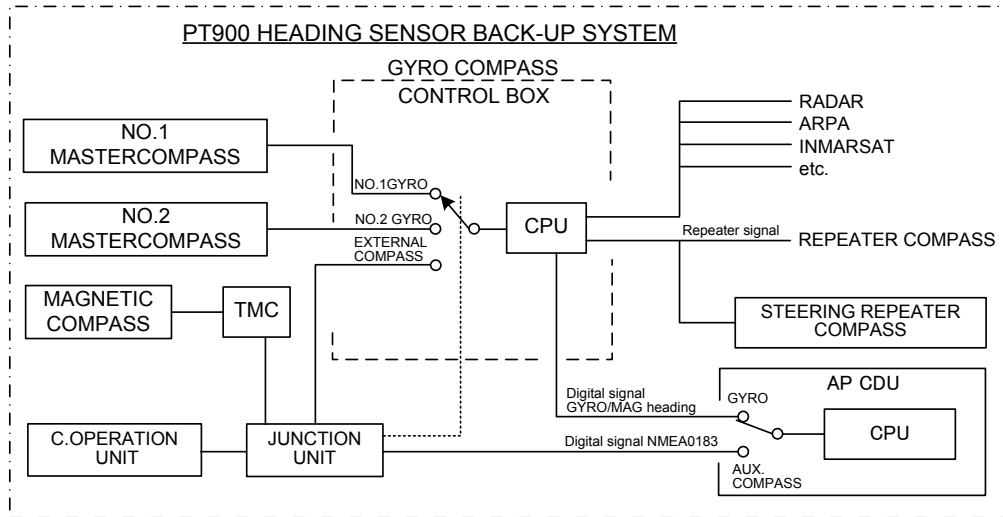
You can select compass source with [Heading Select] button on [HOME] screen. Selected compass heading is indicated on  without any moving average filtering shown in this manual 4.7.4.9~11

Maximum three compasses are connectable to PT900 and that depends on the specification of each vessel.

Connected Compass	Indication / Selection
GYRO	
GYRO and TMC	
GYRO1 and GYRO2	
GYRO1 GYRO2 THD	



PT900 receives compass heading as GYRO1 which you select at gyrocompass system side. Please select GYRO1 to correspond with the selection of gyrocompass system side. Refer the figure above.



④ OPERATION mode

You can select OPERATION mode with [Operation] button on [HOME] screen.

See 3.3.1.1 for more information about OPERATION mode.

OPERATION mode	Indication / Selection		
Economy			
Precision 1			
Precision 2			

⑤ DRAFT mode

You can select DRAFT mode with [Loading] button on [HOME] screen.

See 3.3.1.2 for more information about DRAFT mode.

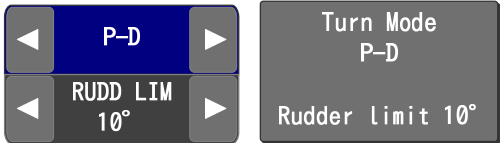


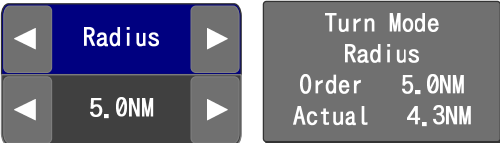
DRAFT mode	Indication / Selection		
Full			
Middle			
Ballast			



## ⑥ TURN mode

You can select TURN mode with [Turn Mode] button on [HOME] screen.

See 3.3.4.1 for more information about TURN mode.


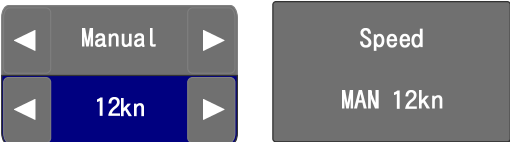
TURN mode	Indication / Selection	Setting value
P-D control		Rudder limit 2~35°
Rate control		Turn rate 1~200°/min Note1
		Turn rate 1~25°/τ Note1
Radius control		Radius 0.1~10.0NM Note1

Note1: Maximum rate of turn and minimum radius are set on [4-9-7-2 Safety] by our authorized agent engineer according to each vessel's own maneuverability.

## ⑦ SPEED

You can select speed input mode with [Speed] button on [HOME] screen.

See 3.3.1.3 for more information about speed setting.

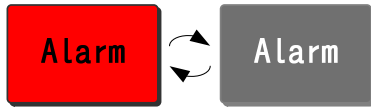
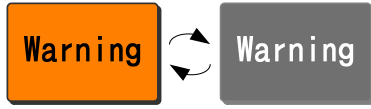





Speed setting	Indicate / Select	Setting value
AUTO		---
Manual		1~65kn Note1

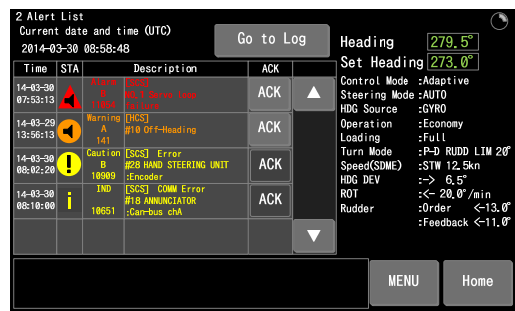
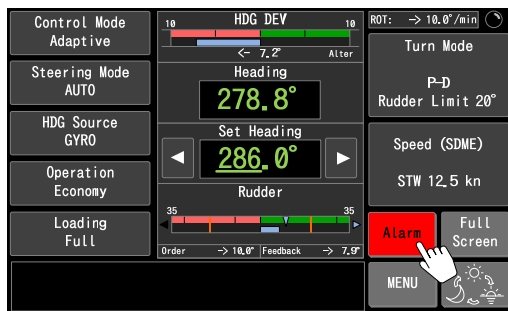
Note1: Maximum speed is set on [4-9-7-2 Safety] by our authorized agent engineer according to each vessel's own specification.

⑧ ALERT

[Alert] button shows the alert condition and transitions to [2 Alert List] screen.

See 4.5.2 for more information about [2 Alert List] screen.

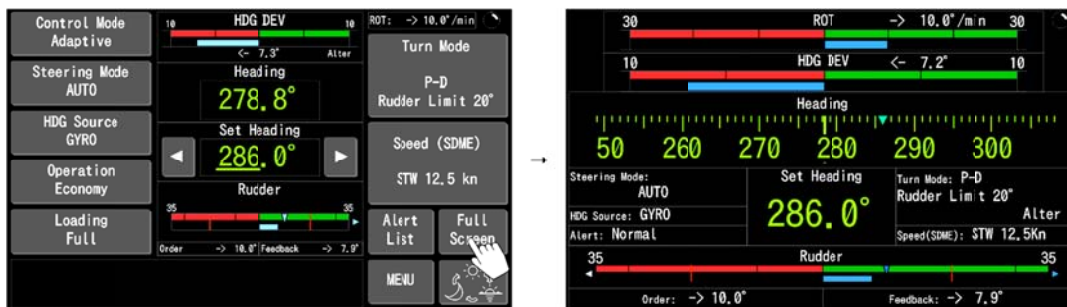
Alert Priority	Alert condition	Format	Priority
Alarm	Active - unacknowledged or Rectified- unacknowledged	 Blinking every 1 sec	High      ↓      Low
Warning	Active - unacknowledged or Rectified- unacknowledged	 Blinking every 1 sec	
Alarm	Active - acknowledged		
Warning	Active - acknowledged		
Caution	Active		
Important indication	Active		
Normal	Normal / Rectified		Low



⑨ Full Screen

[Full Screen] button transitions to [Full Screen] screen.

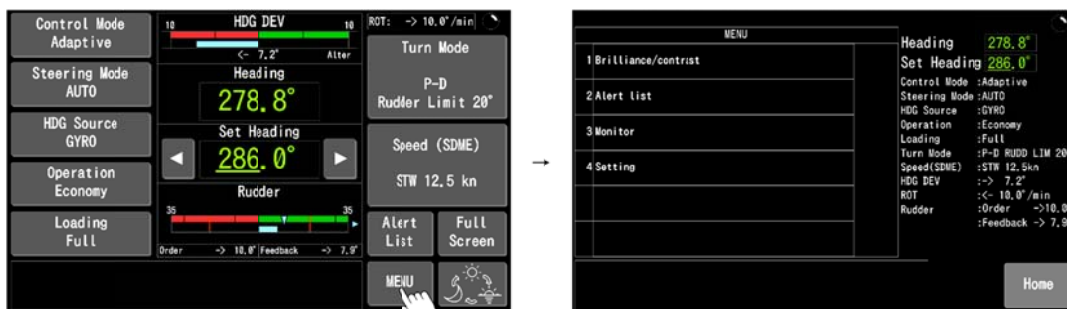
See 4.3.2 for more information about [Full Screen] screen.



⑩ MENU

[MENU] button transitions to [MENU] screen.

See 4.3.3 for more information about [MENU] screen.



⑪ Display mode

There are 3 types of screen display mode as [Day], [Dusk] and [Night].

These modes are changed whenever you tap this button. Tone change applies to all screens.

Dimmer of other PT900 equipment is synchronized if you set [1 Brilliance/contrast] screen [Central control] item to “Enable”.

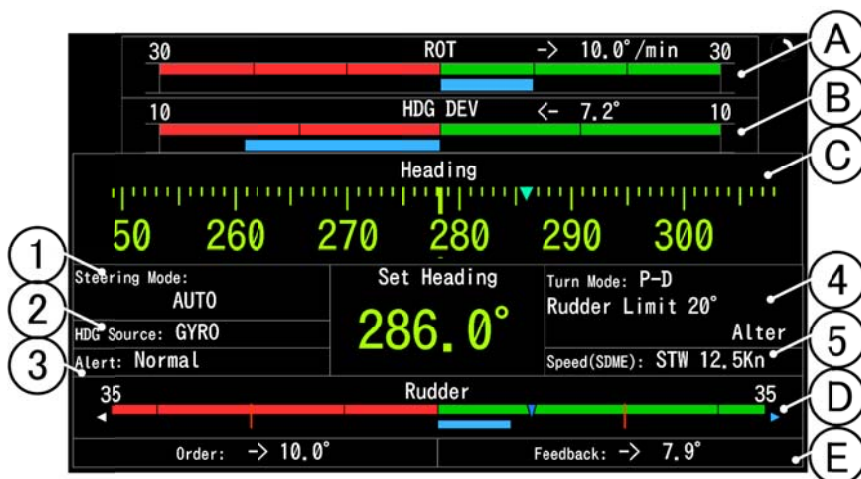


⑫ Spinner

Spinner is indicated on upper-right corner of all screens. AP CDU may have any trouble while spinner stops. In that case, please set SYSTEM SELECTOR “OFF” to restart PT900.

### 4.3.2 [Full Screen] screen

Essential data for navigation are indicated on [Full Screen] screen. You cannot change any settings on this screen. No screen can be transitioned from this screen except [HOME] screen. You can return [HOME] screen by pressing "HOME" key or long tap of screen.



**A** Rate of turn

Rate of turn data based on the selected compass is displayed on here.

**B** Heading deviation

Heading deviation is displayed on here.

In case heading – set heading is plus, “->” is displayed.

In case heading – set heading is minus, “<-” is displayed.

**C** Heading

The indication pattern depends on the steering mode as following table.


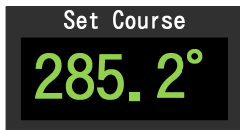
Format of heading can be set on [4-2 Display customize] screen. See 4.7.3

Steering mode	Format	
	Digital (Numeric)	Tape repeater
AUTO TRACK MAN NFU		 "▼" Set Heading
CRS		 "▼" Set Course "  " COG

④ Set Heading / Set Course

The indication pattern depends on the steering mode as following table.

You cannot change set heading and set course by tapping on this screen. Use course setting dial on AP CDU to change them.

Steering mode	Format	Steering mode	Format
AUTO TRACK MAN NFU		CRS	

⑤ Rudder angle

Order and feedback rudder angle are indicated on here.

Format is same as [HOME] screen.

① Steering mode

Steering mode is indicated on here.

Format is same as [HOME] screen.

② Selected compass

Selected compass is indicated on here.

Format is same as [HOME] screen.

③ Alert

Alert condition is indicated on here.

“Normal” appears while there is no alert. The highest priority alert and its number appear while there is any alert. [2 Alert List] screen cannot be transitioned from this screen even if you tap here. So you have to return to [HOME] screen once to check the detail of alert.

**Alert : Alarm XXXXX**

**Alert : Warning XXXXX**

**Alert : Caution XXXXX**

**Indication : XXXXX**

**Alert : Normal**

## ④ Turn mode

Turn mode is indicated on here.

Format is same as [HOME] screen.

“Alter” is indicated while vessel turns during AUTO/CRS/TRACK mode.

“Steady” is indicated while vessel goes straight during AUTO/CRS/TRACK mode.

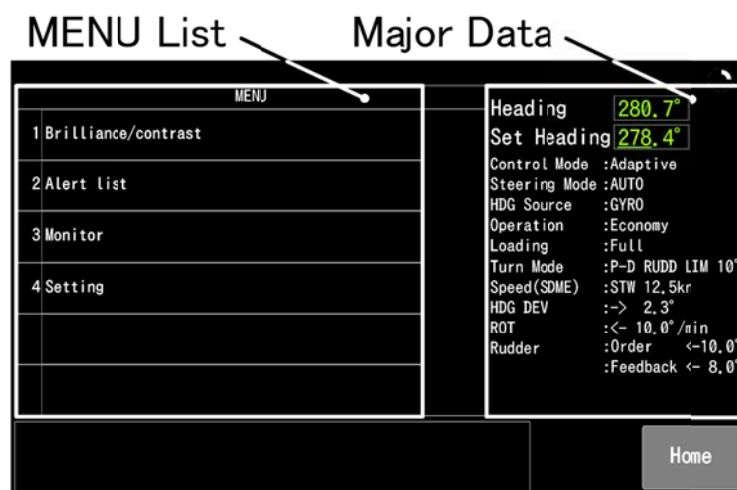
## ⑤ Speed

Ship's speed is indicated on here.

Format is same as [HOME] screen.

## 4.3.3 [MENU] screen

[MENU] screen shows items to transition to each setting screen.



## ● MENU List

Touch the item area to transition to each setting menu.

Item	Function	Remark
1 Brilliance/contrast	Transition to [1 Brilliance/contrast] screen.	4.4.2
2 Alert list	Transition to [2 Alert list] screen.	4.5.1
3 Monitor	Transition to [3 Monitor] screen.	4.6
4 Setting	Transition to [4 Setting] screen.	4.7

- Major Data

Major Data is always indicated on right side of any screen to check navigational data whenever screen transitions from [HOME] screen or [Full Screen] screen.

Item	Format
Heading	
Set Heading	
Control Mode	Adaptive Plus / Adaptive / PID
Steering Mode	AUTO / CRS / TRACK / MAN / NFU
HDG Source	GYRO1 / GYRO2 / THD
Operation	Economy / Precision1 / Precision2
Loading	Full / Middle / Ballast
Turn Mode	P-D RUDD LIM XX° Rate ORD XXX°/min RAD ORD X.XNM
Speed	-9.9~99.9kn
HDG DEV	< -180.0° ~ - > 180.0°
ROT	< -1999.9 ~ - > 999.9°/min
Rudder Order	< -199.9° ~ - > 99.9°
Rudder Feedback	< -199.9° ~ - > 99.9°



## 4.4 Brilliance/contrast adjustment

### 4.4.1 How to transition to [1 Brilliance/contrast] screen

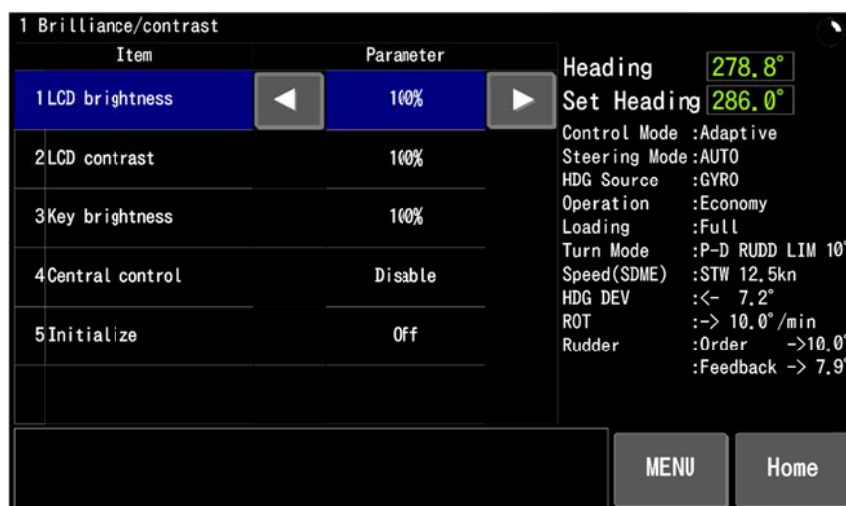
There are 2 methods to transition to [1 Brilliance/contrast] screen.

- Tap [MENU] button on [HOME] screen and tap [1 Brilliance/contrast] button in MENU List.
- Press [HOME] key for 2 seconds.

### 4.4.2 [1 Brilliance/contrast] screen

[1 Brilliance/contrast] screen consists of 5 items shown in figure and table below.

You can adjust the brilliance and contrast of AP CDU on this screen.



#### ● Setting items

[1 LED brightness], [2 LCD contrast] and [3 Key brightness] affect the current display mode which you select from [Day], [Dusk] and [Night] on [HOME] scree.

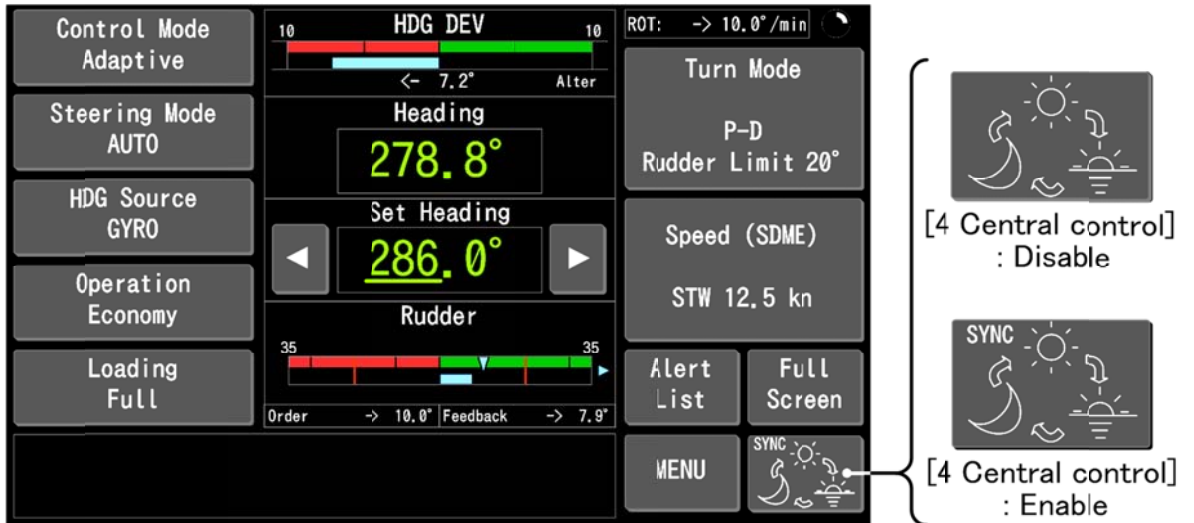
Setting value is preserved automatically.

Item	Function	Default	Setting range
1 LCD brightness	LCD brilliance (Day)	80%	1~100%
	LCD brilliance (Dusk)	80%	1~100%
	LCD brilliance (Night)	80%	1~100%
2 LCD contrast	LCD contrast (Day)	50%	1~100%
	LCD contrast (Dusk)	50%	1~100%
	LCD contrast (Night)	50%	1~100%

Item	Function	Default	Setting range
3 Key brightness	LCD brilliance (Day)	80%	0~100%
	LCD brilliance (Dusk)	40%	0~100%
	LCD brilliance (Night)	20%	0~100%
4 Central control	Brilliance Central control	Disable	Disable/Enable
5 Initialize	Initialize the brilliance/contrast	Off	Off/On

Display mode selection from Day, Dusk and Night affects all unit of PT900 as central dimmer control in case you set [4 Central control] "Enable".

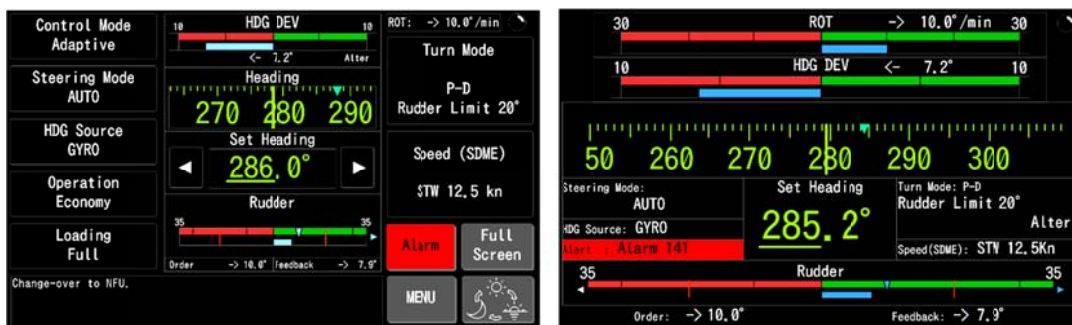
"SYNC" is indicated on display mode button while [4 Central control] is "Enable".



## 4.5 Alert indications

### 4.5.1 Alert indications

Alert condition is indicated on the Home screen, Home Full screen and LED on the ALARM ACK key as follows;



Alert Priority	Alert condition	[HOME] screen	[Full Screen] screen	ALARM ACK key	priority	
Alarm	Active - unacknowledged or Rectified-unacknowledged	Blink every 1 sec	Blink every 1 sec		High	
Warning	Active - unacknowledged or Rectified-unacknowledged	Blink every 1 sec	Blink every 1 sec	LED Blink every 1 sec		
Alarm	Active - acknowledged			LED Light	↓	
Warning	Active - acknowledged					
Caution	Active					
Important indication	Active					
Normal	Normal / Rectified			LED off		Low

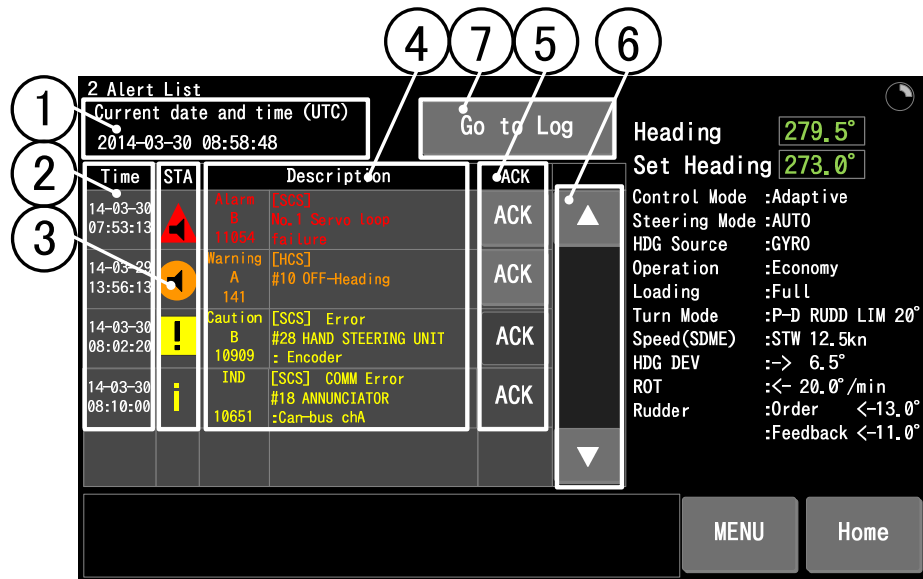
## 4.5.2 [2 Alert List] screen

[2 Alert List] screen indicates past and present alerts. Alert history is preserved automatically. It is kept even if SYSTEM SELECTER is set OFF.

### 4.5.2.1 Contents of [2 Alert List] screen

[2 Alert List] screen indicates current alert condition.

You can acknowledge the alert on this screen.



① Current date and time

Date and time (UTC) is indicated on here. Clock of PT900 is set on [4-7 Date and time] screen. See 4.7.8

② Time

Time when each alert appeared (including alert priority change) is indicated on here. It is not the time when you silenced or acknowledged the alert.

Tapping here transitions to [2-1 Equipment status log] screen which displays equipment status when alert appeared. See 4.5.3

③ STA

Announcement state of the alert is indicated on here. These icons are defined in IEC62288 Ed.2

④ Description

“Alert Priority”, “Alert Category” and “Alert Number” are indicated with alert name. These characters are based on the alert priority.

See 1.6 for more information about “Alert Priority”.

There are 3 categories as “Alert Category” shown below.



● Description of Alert category

Category	Function	Place of alert acknowledgement
A	Category A alerts specified as alerts where information at a task station directly assigned to the function generating the alert is necessary, as decision support for the evaluation of the alert-related condition	Equipment which generated the alert.
B	Category B alerts are Specified as alerts where no additional information for decision support is necessary besides the information which can be presented at the CAM-HMI.	Equipment which generated the alert. or BAMS
C	Category C alerts are specified as alerts that cannot be acknowledged on the bridge but for which information is required about the status and treatment of the alerts, e.g., certain alerts from the engine.	—

⑤ ACK

State that the alert has been already acknowledged or not is indicated on here.

Acknowledge button is combined here.

	Unacknowledged alert is gray color.
	Acknowledged alert is charcoal gray color.




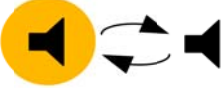
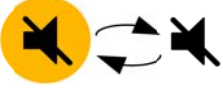
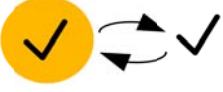




⑥ Slide button

Alert list can be shifted by these buttons in case 6 or more alerts appear.


⑦ “Go to Log” button

Tapping here transitions to [2 Alert List (log)] screen.

● Detail of Announcement state icons

Alert Priority	Announcement state	Icon	Description Character color	Priority
Alarm	Active - unacknowledged	 Blink every 1 sec	Character color: Red	High
	Active - silenced alarm	 Blink every 1 sec		
	Rectified - unacknowledged	 Blink every 1 sec		
Warning	Active - unacknowledged	 Blink every 1 sec	Character color: Orange	
	Active - silenced alarm	 Blink every 1 sec		
	Rectified - unacknowledged	 Blink every 1 sec		
Alarm	Active - acknowledged		Character color: Red	
	Active – responsibility transferred			
Warning	Active - acknowledged		Character color: Orange	
	Active – responsibility transferred			

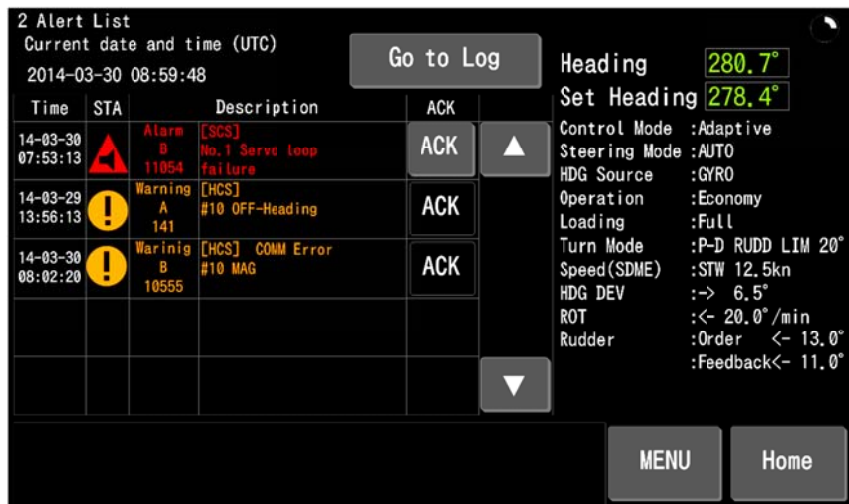
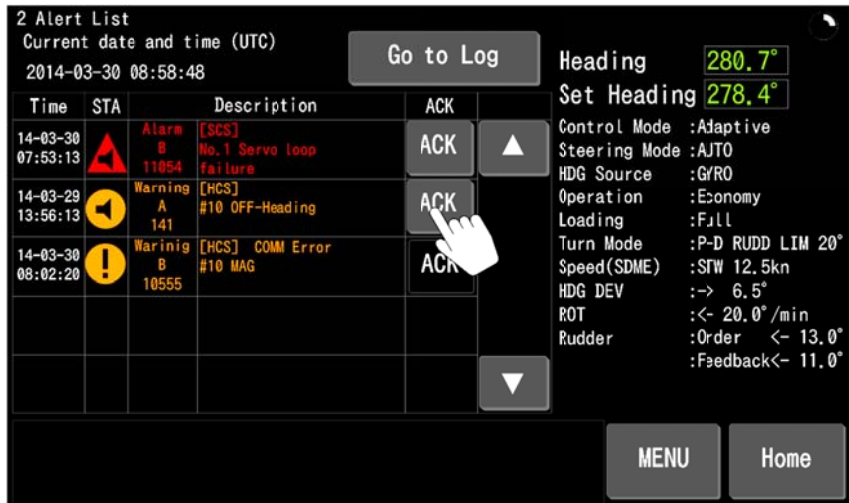
---

Alert Priority	Announcement state	Icon	Description Character color	Priority
Caution	Active – acknowledged warning		Character color: Yellow	
Important indication	Active		Character color: Yellow	
Normal	Normal / Rectified	Blank	Character: None	Low

---

#### 4.5.2.2 Operation of [2 Alert List] screen

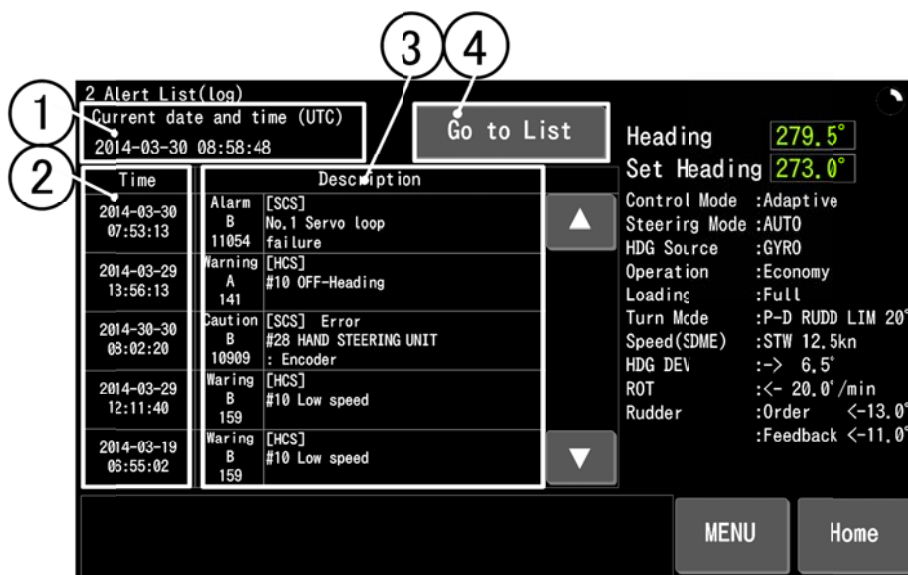
- Alerts are listed in order of high priority.
- Tap ACK button to acknowledge the alert content.
- Indications of icon and ACK button are changed by above operation. Alerts are sorted in order of high priority again.
- Tap "Go to Log" button to transition to [2 Alert List (log)] screen. You can check alert history on there.





### 4.5.2.3 Contents list of Alert list(log) screen

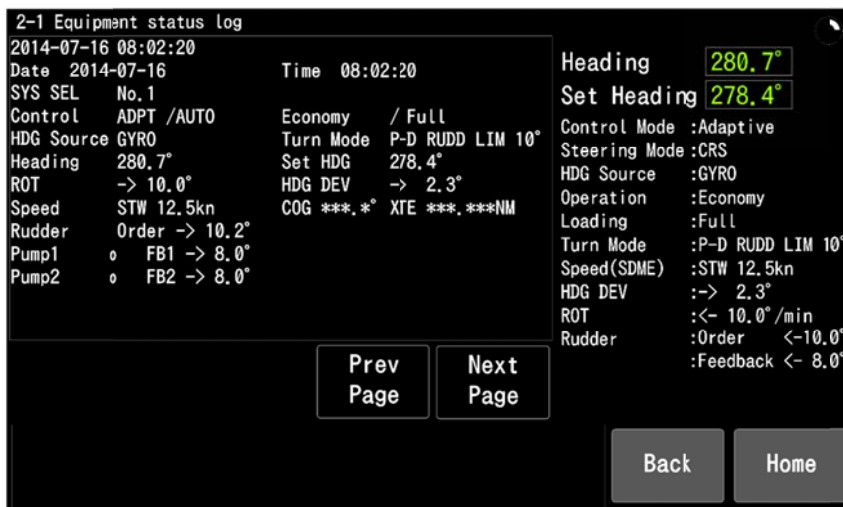
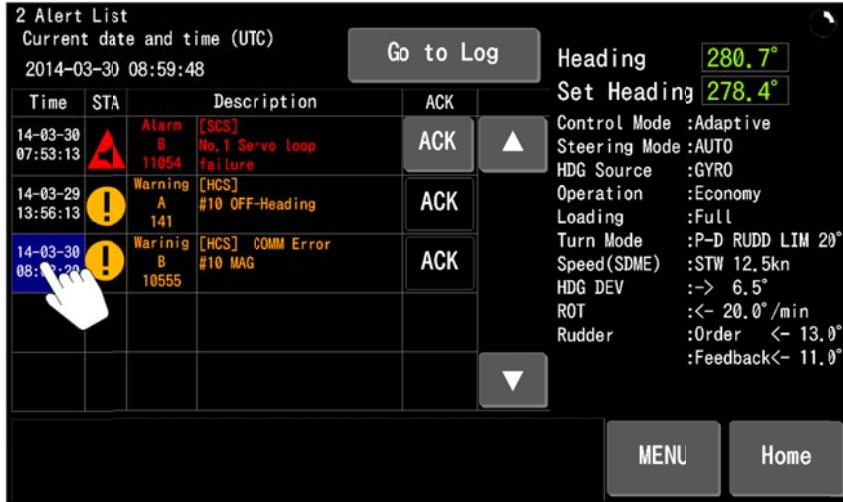
[2 Alert List (log)] screen indicates the alert history. Storage number of alerts is maximum 1000. These are overwritten sequentially.



- ① Current date and time  
Date and time (UTC) is indicated on here. Clock of PT900 is set on [4-7 Date and time] screen. See 4.7.8
- ② Time  
Time when each alert appeared (including alert priority change) is indicated on here. It is not the time when you silenced or acknowledged the alert.  
Tapping here transitions to [2-1 Equipment status log] screen which displays equipment status when alert appeared. See 4.5.3
- ③ Description  
“Alert Priority”, “Alert Category” and “Alert Number” are indicated with alert name. These characters are based on the alert priority.  
See 1.6 for more information about “Alert Priority”.  
There are 3 categories as “Alert Category” shown below.
- ④ “Go to List” button  
Tapping here transitions to [2 Alert List] screen.

### 4.5.3 [2-1 Equipment status log] screen

Tapping "Time" on [2 Alert List] screen or [2 Alert List (log)] screen transitions to [2-1 Equipment status log] screen which displays date/time, "Major Data" and steering gear pump status when alert appeared. Tapping "Prev Page" / "Next Page" transitions before / after 1 second when alert appeared.



● Description of indicated items

Item	Description	Indication examples
Date	Date	YYYY-MM-DD
Time	Time	HH:MM:SS
SYS SEL	SYSTEM SELECTOR position	NO.1 / NO.2 / NFU
Control	Controller status	<u>①</u> / <u>②</u> <u>③</u> / <u>④</u> ①Control mode : A Plus / ADPT / PID ②Steering mode : AUTO / CRS / TRACK ③Operation : Economy / Precision1 / Precision2 ④Loading : Full / Middle / Ballast
HDG Source	Selected compass	GYRO / GYRO1 / GYRO2 / MAG / THD
Turn Mode	Turn mode	P-D RUDD LIM XX° Rate ORD XXX°/min RAD ORD X.XNM
Heading	Ship's heading	000.0~359.9°
Set HDG	Set heading /Course	000.0~359.9°
ROT	Rate of turn	< -999.9 ~ - > 999.9°/min
HDG DEV	Heading deviation	< -999.9 ~ - > 999.9°
Speed	Ship's speed	-9.9~99.9kn
COG	Course over the ground	000.0~359.9°      Note1
XTE	Cross Track Error	< -9.999 ~ - > 9.999NM      Note2
Rudder Order	Rudder order angle	< -99.9° ~ - > 99.9°
Pump "n"	Operating S/G pump number	o/x ("o"=Run "x"=Stop)
FB "n"	Actual rudder from Operating S/G pump system	< -99.9° ~ - > 99.9°

Note1: It is indicated while PT900 receives VTG sentence.

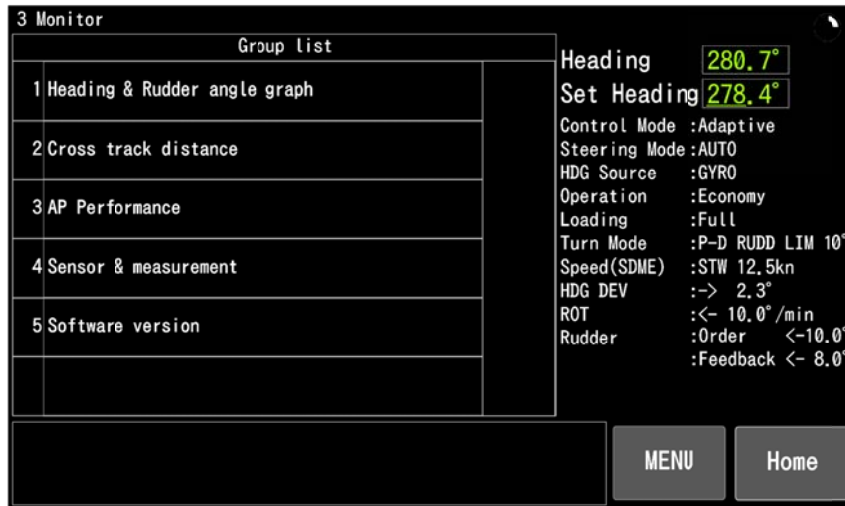
Note2: It is indicated while PT900 receives XTE sentence or is CRS mode.

## 4.6 Monitoring function

### 4.6.1 [3 Monitor] screen

[3 Monitor] screen consists of 5 items shown in figure and table below.

Tap each item to check each monitoring item.

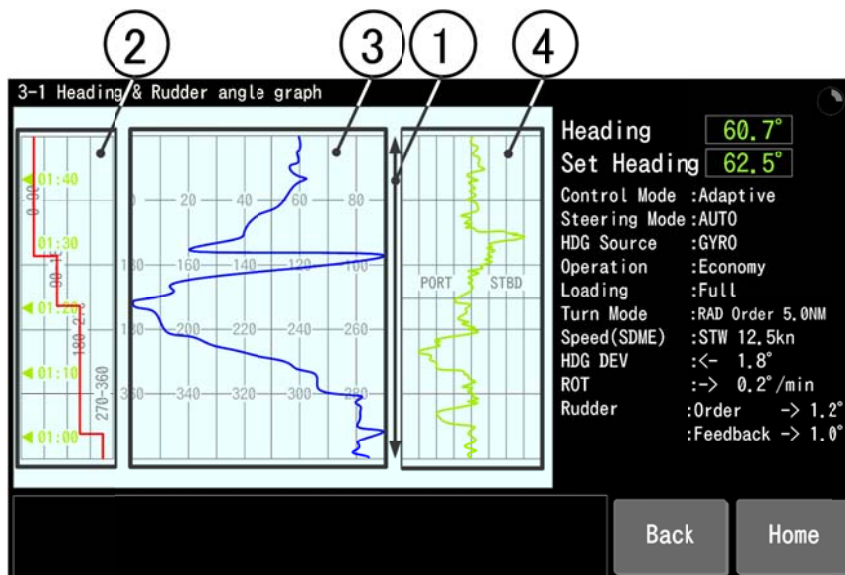


#### ● Description for Group list

Item	Description	Remark
1 Heading & Rudder angle graph	Display of the ship's heading and actual rudder angle	4.6.2
2 Cross track distance	Display of the cross track distance under course control	4.6.3
3 AP Performance	Display of the course deviation, rudder angle and speed etc.	
4 Sensor & Measurement	Display of the controllability	4.6.4
5 Software version	Display of the software version.	4.6.5

#### 4.6.2 [3-1 Heading & Rudder angle graph] screen (PT900A / A Plus)

[3-1 Heading & Rudder angle graph] screen shows the graphs of ship's heading and rudder angle. These graphs are indication only (Not saved).



① Time axis

Vertical axis of the graph is 60 minutes fixed time axis. Thus 1 scale is about 12 minutes. The latest data is described on the upper side of graph. Time stamp is written every 10 minutes.

② Quadrant

Quadrant of ship's heading is indicated on this area.

③ Heading

Ship's heading is indicated on this area.

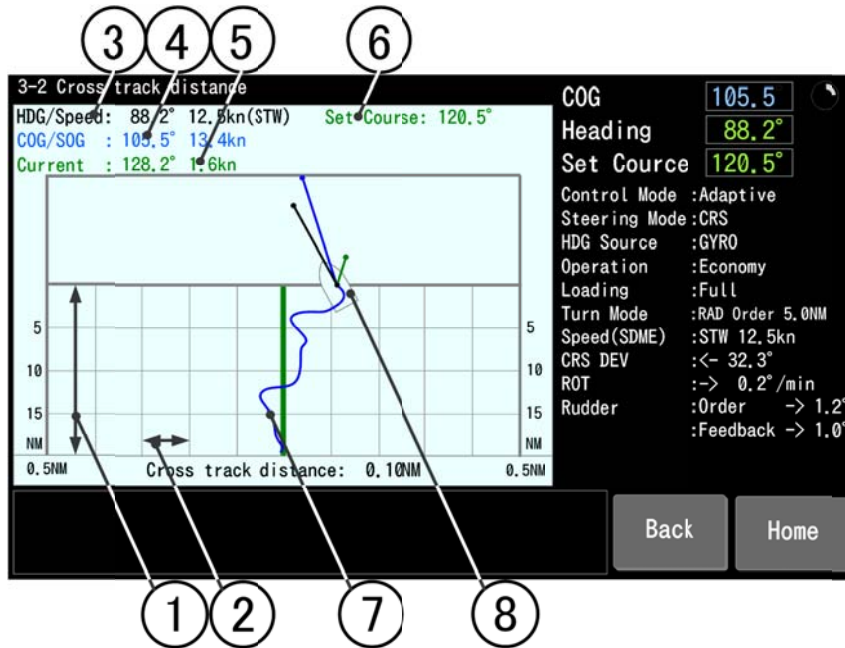
④ Rudder angle

Feedback actual rudder angle is indicated on this area. There are 2 types of indication range, P40-0-S40 degrees and P80-0-S80 degrees. That is set on [4-9-2-5 Rudder control] screen by our factory or service agent engineer.

In case the vessel has twin rudder, one side of rudder is indicated. You can select on [4-2 Display customize] screen which rudder is indicated.



### 4.6.3 [3-2 Cross track distance] screen (Option)

[3-2 Cross track distance] screen shows the chart of ship's control condition during CRS mode. This chart is course-up mode only.



● Description of chart area

Item	Display range	Remark	
① Longitudinal distance (NM)	About 1.25 times of the ship's navigation speed	Navigation speed (Vs) is set on [4-4 Parameter] screen. (Ex: Vs = 15kn, Long. Distance(NM) = 15x1.25 = 20)	
② Cross track distance(XTD) (NM)	0.1 / 0.2 / 0.5 / 1.0NM	Display range is set on [4-2 Display customize] screen. See 4.7.3	
③ HDG	000.0~359.9°	● (Black)	Symbol represents the vector of ship's heading and STW.
Speed	-9.9~99.9kn		
④ COG	000.0~359.9°	● (Blue)	Symbol represents the vector of COG and SOG.
SOG	0.0~99.9kn		
⑤ Current	000.0~359.9° 0.0~99.9kn	● (Green)	Symbol represents the vector of Current.
⑥ Set Course	000.0~359.9°	(Green)	This line represents the vertical course. It is indicated on the center of chart.

	Item	Display range	Remark	
⑦	Cross track distance	0.00~9.99NM	 (Blue)	This line represents the difference between ship's position and vertical course. It becomes ship's track.
⑧	Own Ship	—	 (Cyan)	Symbol represents the heading direction and own position from vertical course.

#### 4.6.4 [3-4 Sensor & Measurement] screen

[3-4 Sensor & Measurement] screen consists of 3 items shown in figure and table below.

Tap each item to transition to each screen.



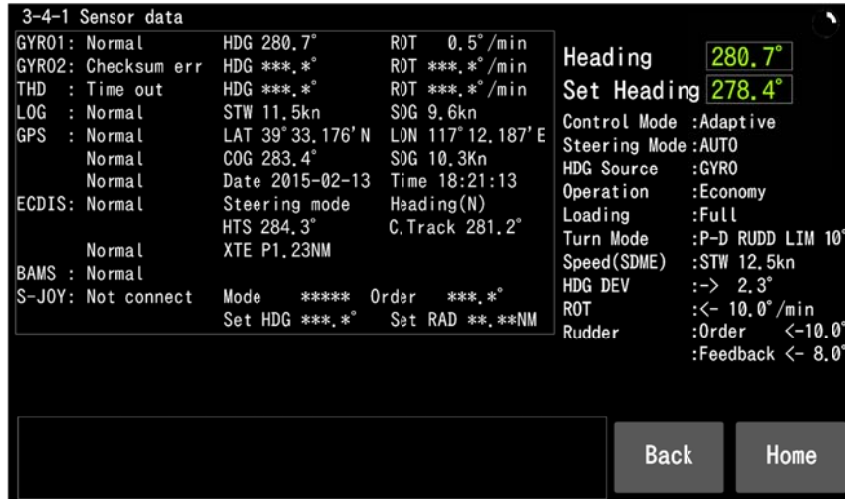
#### ● Description for Group list

Item	Description	Remark
1 Sensor data	Display of the all connected sensor status and data	4.6.4.1
2 Calculate data	Display of the performance index	4.6.4.2
3 Rudder data	Display of the S/G pump status and rudder angle	4.6.4.3

#### 4.6.4.1 [3-4-1 Sensor data] screen

[3-4-1 Sensor data] screen shows the interface condition connected to PT900.

Connected equipment depends on the vessel's specification.



#### ● Description of display items

Unit name	Interface condition	Displayed data	Format	Remark
GYRO1	Either of them is indicated.	HDG	000.0~359.9°	
		ROT	< -999.9~ - > 999.9°/min	
GYRO2		HDG	000.0~359.9°	
		ROT	< -999.9~ - > 999.9°/min	
THD	<ul style="list-style-type: none"> <li>• Time out</li> <li>• Hard err</li> </ul>	HDG	000.0~359.9°	
		ROT	< -999.9~ - > 999.9°/min	
LOG	<ul style="list-style-type: none"> <li>• Format err</li> <li>• Checksum err</li> </ul>	STW	-99.9~99.9kn	
		SOG	-99.9~99.9kn	
GPS	<ul style="list-style-type: none"> <li>• Data err</li> <li>• Invalid data</li> <li>• Normal</li> <li>• Not connect</li> </ul>	LAT	90°00.000'N~90°00.000'S	
		LON	180°00.000'E~180°00.000'W	
		COG	000.0~359.9°	
		SOG	00.0~99.9kn	
	Note1			



Unit name	Interface condition	Displayed data	Format	Remark
ECDIS	Either of them is indicated. • Time out • Hard err • Format err	Steering mode	Manual / NFU / Rudder / Heading / Track	
		HTS	000.0~359.9°	Heading to steer
		C.Track	000.0~359.9°	Commanded track
		XTE	< -9.99 ~ - > 9.99NM	
BAMS	• Checksum err	—	—	
S-JOY	• Data err • Invalid data • Normal • Not connect  Note1	Mode	TRACK / HEADING / RADIUS P-TURN / RUDDER / COURSE	
		Order	< -99.9° ~ - > 99.9°	For RUDDER mode
		Set HDG	000.0~359.9°	For HEADING / RADIUS / P-TURN mode
		Set RAD	0.10~10.00NM	For RADIUS / P-TURN mode

Note1:

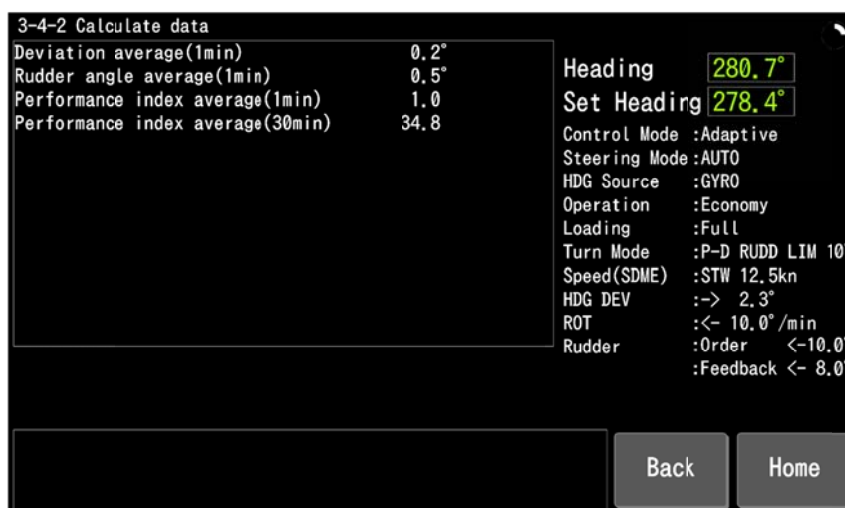
Interface condition	Description
Time out	"Time out" is indicated while PT900 receives no signal due to the disconnection of cable or sensor off.
Hard err	"Hard err" is indicated while baud rate error, data bit error, parity error, reverse connection and so on. PT900 receives something but does not recognize as sentence.
Format err	"Format err" is indicated while <ul style="list-style-type: none"><li>• Talker ID is not correct.</li><li>• There is invalid data in data field of sentence.</li><li>• Field which should not be NULL is NULL.</li></ul> and so on
Checksum err	"Checksum err" is indicated while checksum is not correct.
Data err	"Data err" is indicated in same condition of "Format err".
Invalid data	"Data err" is indicated while PT900 receives some sentences whose status is "V".
Normal	"Normal" is indicated while PT900 receives correctly.
Not connect	"Not connect" is indicated while "Not connect" is selected on [4-9-1 Interface] screen.

#### 4.6.4.2 [3-4-2 Calculate data] screen

[3-4-2 Calculate data] screen shows the validity of control by using average of heading deviation, rudder angle or performance index. Performance index average is calculated from heading deviation and rudder angle though these values are indicated on either steering mode. Fundamentally refer these values in AUTO/CRS/TRACK mode.

Larger heading deviation or rudder angle becomes, larger performance index average becomes. So performance index average tends to become large in following conditions.

- Just after course change in AUTO/CRS mode
- Operation mode is Precision2 in rough sea.
- Channel limit is narrow in TRACK mode.
- There is a difference between heading and the value of course reminder in MAN mode.

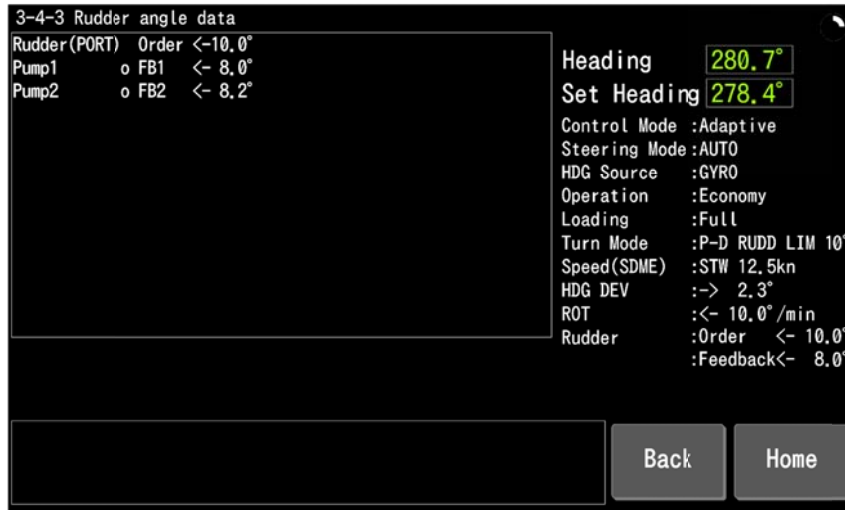


#### ● Description of display items

Item	Format	Remark
Deviation average (1min)	0.0~359.9°	Heading deviation average (absolute value)
Rudder angle average (1min)	0.0°~99.9°	Rudder angle average (absolute value)
Performance index average (1min)	0.0~999.9	
Performance index average (30min)	0.0~999.9	

#### 4.6.4.3 [3-4-3 Rudder angle data] screen

[3-4-3 Rudder angle data] screen shows the steering gear pump running status and order/feedback rudder angle. These data are sent from CONTROL & POWER BOX installed in steering gear room.

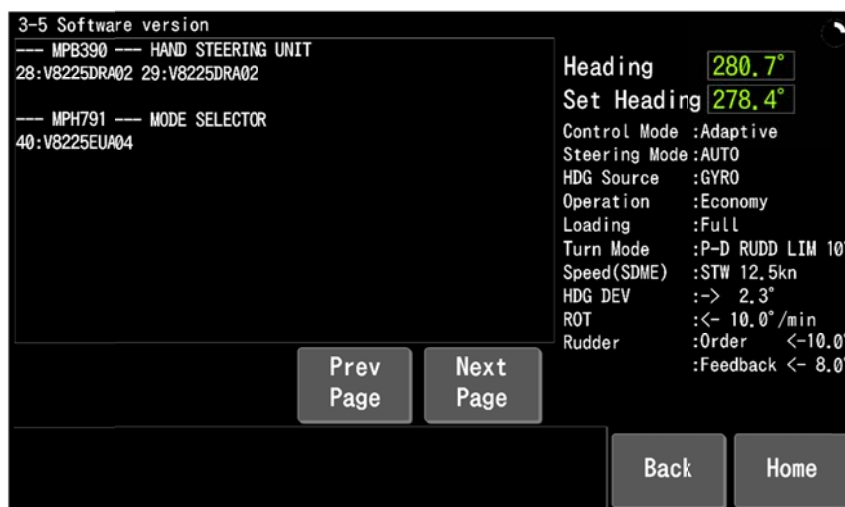


#### ● Description of display items

Item	Format	Remark
Rudder Order	<-99.9°~>99.9°	Rudder order average
Pump n	o/x	No. n Steering gear pump operation condition "o"=Run "x"=Stop
FB n	<-99.9°~>99.9°	No. n Actual rudder angle

### 4.6.5 [3-5 Software version] screen

[3-5 Software version] screen shows the software version of each unit of PT900 which has CPU. The unit of PT900 depends on the vessel's specification. In case plural number of units are installed, these are distinguished by unit ID (③).



#### ● Description of display items

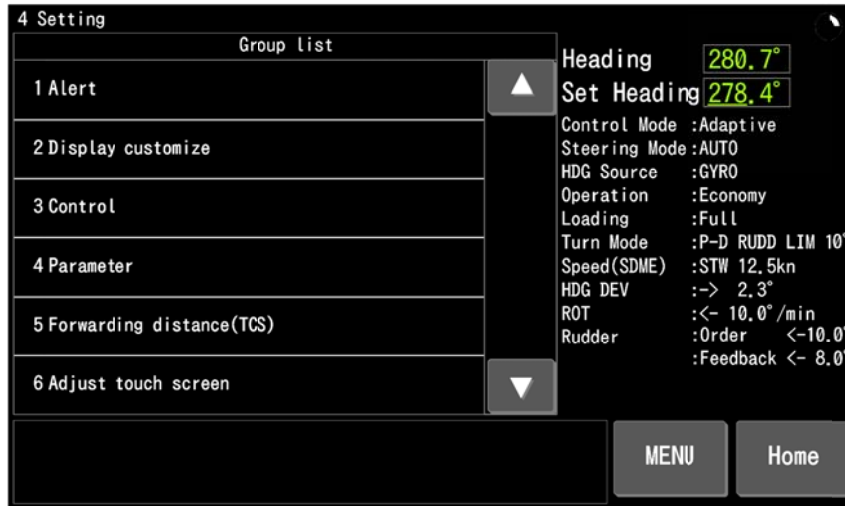
Format	Description
--- MPH490 --- AP CDU	① Unit type      ② Unit name
①                  ②	③ Unit ID        ④ Software No.
08:V8225HV A 01	⑤ Software version (A to Z)
③    ④    ⑤    ⑥	⑥ Software revision (01 to 99)

## 4.7 Setting functions

### 4.7.1 [4 Setting] screen

[4 Setting] screen consists of 9 items shown in figure and table below.

Tap each item to transition to each setting screen.



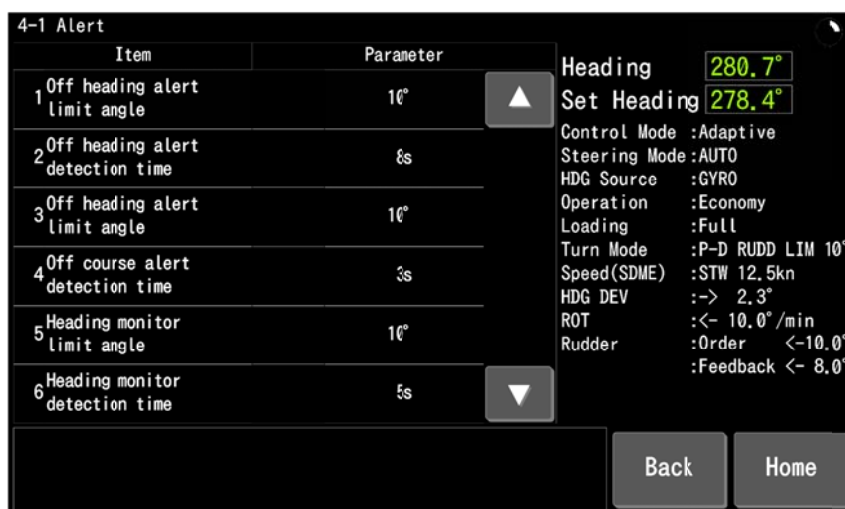
#### ● Description of Group list

Item	Description	Remark
1 Alert	Setting of alert functions and monitor threshold range	4.7.2
2 Display customize	Setting of display on [HOME] screen and [Full screen] screen	4.7.3
3 Control	Setting of control functions	4.7.4
4 Parameter	Setting of vessel's parameter	4.7.5
5 Forwarding distance	Setting of Forwarding distance for TRACK mode	4.7.6
6 Adjust touch screen	Adjustment of touch panel	4.7.7
7 Date and time	Setting of Date and time	4.7.8
8 Backup/Restore	Setting data backup and restore	4.7.9
9 Maintenance	Setting menu for service engineer This menu is locked for general user.	4.7.10

## 4.7.2 [4-1 Alert] screen

[4-1 Alert] screen consists of 9 items shown in figure and table below.

You can set the detection values (thresholds) and detection time for each alert on this screen.



### ● Description of item

Item	Default value	Setting range	Description
1 Off heading alert limit angle	10	2~45 deg	Detection angle and time for off heading (course deviation) alert are set. See 4.7.2.1
2 Off heading alert detection time	8	2~20 sec	
3 Off course alert limit angle	10	1~90 deg	Detection angle and time for off course (course deviation based on the unselected compass) alert are set. See 4.7.2.2
4 Off course alert detection time	3	1~120 sec	
5 Heading monitor alert limit angle	10	1~45 deg	Detection angle and time for heading monitor (Deviation between two compasses) alert are set. See 4.7.2.3
6 Heading monitor alert detection time	5	1~20 sec	
7 Limit of low speed	Disable	Disable, 1~35kn	Limit value of low speed alert is set. See 4.7.2.4
8 ROT limit error: limit ROT	Disable	Disable, 1~100 deg/min	Detection rate and time for ROT limit error alert are set. See 4.7.2.5
9 ROT limit error: detection time	5	1~10 sec	

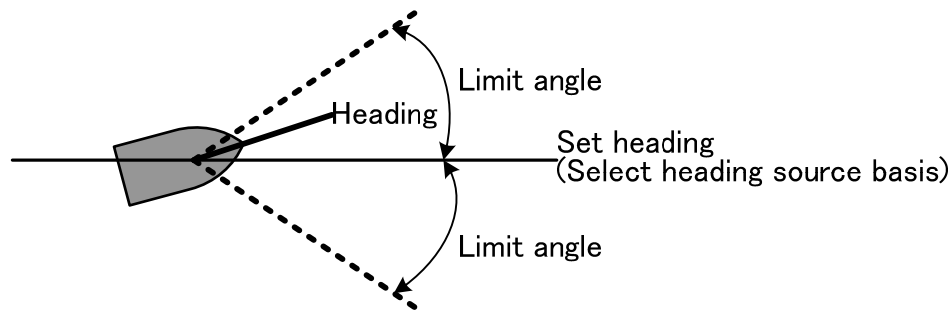
### 4.7.2.1 Off heading alert

Off heading alert monitors the difference between set heading and selected compass heading during AUTO/TRACK mode and “Steady” control that means the vessel is in course keeping. Off heading alert appears in case the deviation which is over the detection angle lasts for detection time.

Following are some examples of cause of off heading alert.

IMO MSC64 (67) Annex3 requires to detect off heading alert on heading control system.

- Oblique angle is generated by tide or current in “Steady” control.
- Heading is not kept correctly due to any trouble of steering gear in “Steady” control.



Simulation method of off heading alert is below.

#### Note

Rudder may be steered excessively by this simulation. So please execute this while the vessel is in port or at anchor.

- In case the heading source for PT900 is only 1 gyrocompass.
  - (1) Set the detection angle and detection time to a minimum on [4-1 Alert] screen.
  - (2) Select AUTO mode on MODE SELECTOR and check whether “Steady” is indicated.
  - (3) Change the setting digit of “Set heading” to a first decimal place.
  - (4) Increase or decrease just 2.5degree from current “Set heading”.
  - (5) Indication changes from “Steady” to “Alter” for few seconds and returns to “Steady” again in few seconds.
  - (6) Off heading alert appears.
- In case 1 gyrocompass and 1 magnetic compass are connected to PT900
  - (1) Select AUTO mode on MODE SELECTOR while magnetic compass is in use.
  - (2) Check whether “Steady” is indicated.
  - (3) Make difference of magnetic compass heading intentionally by using screwdriver.



### 4.7.2.2 Off course alert

#### Note

Off course alert can be detected on PT900 which is connected 2 or more compasses.

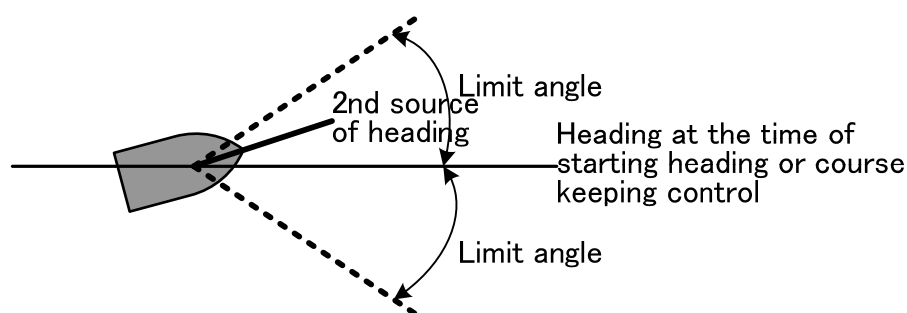
Off course alert monitors the difference between unselected compass heading when vessel starts course keeping and unselected compass current heading during AUTO/CRS/TRACK mode. Off course alert appears in case the deviation which is over the detection angle lasts for detection time.

Yokogawa's authorized service engineer selects whether PT900 detects off course alert or not on [4-9-3-1 Monitor] screen. Default value (Factory value) is set not to detect off course alert because this alert is optional function which uses 2 compasses.

"GYRO2" is unselected compass when "GYRO1" is in use. "THD" is unselected compass when "GYRO2" is in use. You can select which compass is used on [HOME] screen. See 4.3.1

Following are some examples of cause of off course alert.

- Oblique angle is generated by tide or current in "Steady" control.
- Heading is not kept correctly due to any trouble of steering gear in "Steady" control.
- Heading is kept based on the compass with trouble in "Steady" control.
- Unselected compass has some trouble in "Steady" control.



Simulation method of off heading alert is below.

- In case 1 gyrocompass and 1 magnetic compass are connected to PT900
  - (1) Select AUTO mode on MODE SELECTOR while gyrocompass is in use.
  - (2) Check whether "Steady" is indicated.
  - (3) Make difference of magnetic compass heading intentionally by using screwdriver.

### 4.7.2.3 Heading monitor

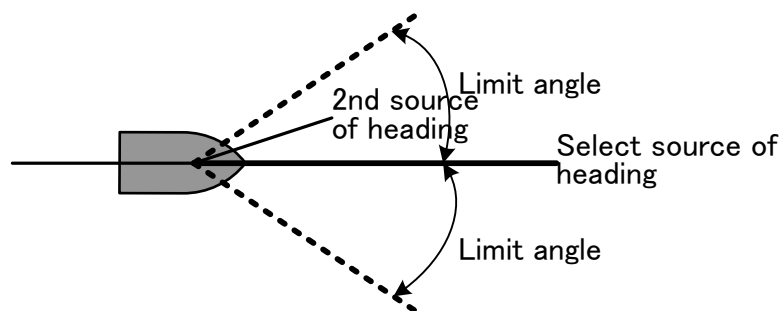
#### Note

Off course alert can be detected on PT900 which is connected 2 or more compasses.

Heading monitor alert monitors the difference between selected compass heading and unselected compass heading during all steering mode. Heading monitor alert appears in case the deviation which is over the detection angle lasts for detection time.

Yokogawa's authorized service engineer selects whether PT900 detects heading monitor alert or not on [4-9-3-1 Monitor] screen. Default value (Factory value) is set not to detect heading monitor alert because this alert is optional function which uses 2 compasses.

Heading monitor alert is fundamentally detected in gyrocompass system side in case Yokogawa's gyrocompass is connected to PT900.



### 4.7.2.4 Low speed alert

Low speed alert appears when ship's speed is less than detection time for more 10seconds in AUTO/CRS/TRACK mode. Lift of rudder is reduced while ship's speed is low. In that case, PT900 may not provide performance sufficiently.

Default value (Factory value) is set not to detect low speed alert because this alert is optional function.

### 4.7.2.5 Rate of turn (ROT) limit alert

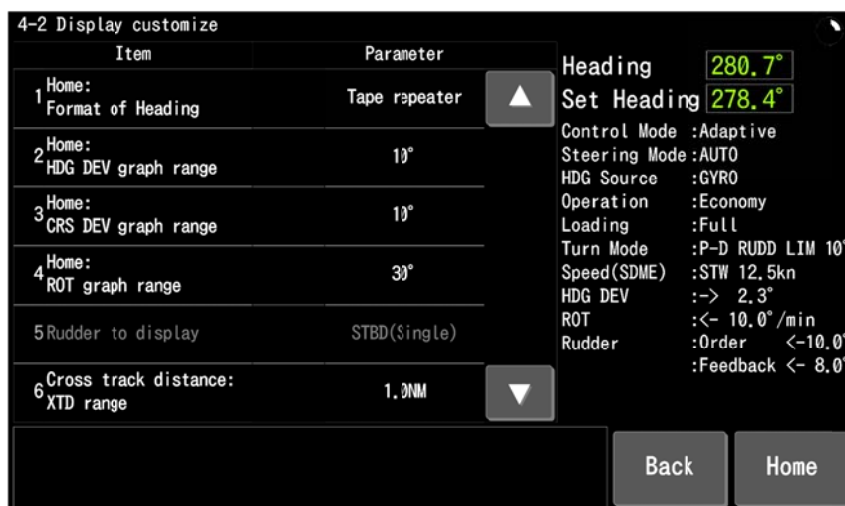
ROT limit alert monitors the rate of turn of selected compass in AUTO/CRS/TRACK mode and "Stable" control. ROT limit alert appears in case current ROT which is over the detection rate lasts for detection time. The purpose of this alert is unexpected yawing due to the tide or current in "Stable" control.

Default value (Factory value) is set not to detect ROT limit alert because this alert is optional function.

### 4.7.3 [4-2 Display customize] screen

[4-2 Display customize] screen consists of 7 items shown in figure and table below.

You can select indication pattern or format of [HOME] screen, [Full screen] screen and [3-2 Cross track distance] screen.



#### ● Description of items

Item	Default	Setting range	Description
1 Home: Format of heading	Tape repeater	Numeric/ Tape repeater	Setting of heading indication format on [HOME] screen. See 4.3.1
2 Home: HDG DEV graph range	10	5/10/15/20/25/ 30/35/40/45 deg	Setting of heading deviation bar-graph range on [HOME] screen. See 4.3.1
3 Home: CRS DEV graph range	10	5/10 deg	Setting of course deviation bar-graph range on [HOME] screen. See 4.3.1
4 Home: ROT graph range	30	30/60/90/120/ 180/300 deg/min	Setting of ROT bar-graph range on [HOME] screen. See 4.3.1
5 HDG and rudder graph: Rudder to display	STBD (Single)	PORT/ STBD(Single)	Setting of rudder indication range on [3-1 Heading & Rudder angle graph] screen. See 4.6.2

---

Item	Default	Setting range	Description
6 Cross track distance: XTD range	1.0	0.1/0.2/0.5/1.0 NM	Setting of XTD range on [3-2 Cross track distance] screen. See 4.6.3
7 AP Performance: Speed graph range	20	20/30kn	Setting of [3-3 AP Performance] screen.

Note1: [5 HDG and rudder graph: Rudder to display] item on [4-2 Display customize] screen is adjustable when [5 Number of rudder] item is set to "Twin" on [4-3 Control] screen.

---

#### 4.7.4 [4-3 Control] screen

[4-3 Control] screen consists of 23 items shown in figure and table below.

These values depend on the specification of the vessel and are set in the factory. The document “AUTOPILOT PT900 SYSTEM SETTING PARAMETER LIST” which was delivered with FINAL DRAWING shows the details.



#### ● Description of items

Item	Default	Setting range	Description
1 Command rudder angle of the alarm occurs	Midship	Keeping/ Midship	Setting of rudder frozen position in the event of alarm appearance See 4.7.4.1
2 Counter rudder angle limit	Off	Off/On	Setting of counter rudder angle limit in P-D turn mode See 4.7.4.2
3 Rough seas steering mode	Off	Off/On	Application of Rough sea steering mode See 4.7.4.3
4 Helm adjustment in steering mode switch	0°	Auto/0°/S1° /S2°/S3°/S4° /S5°/P5°/P4° /P3°/P2°/P1°	Compensation of integral-rudder at switching from MAN mode to AUTO mode See 4.7.4.4
5 Number of rudders	Single	Single/ Twin	Setting on number of rudders See 4.7.4.5
6 Course deviation limit function	Enable	Disable/ Enable	Setting of Heading deviation limit See 4.7.4.6

Item	Default	Setting range	Description
7 Steering gear deadband compensation	Disable	Disable/ Enable	Application of steering gear deadband See 4.7.4.7
8 Exponential smoothing time for ship speed	16	1~30	Time constant setting for exponential smoothing of ship speed See 4.7.4.8
9 Ch1 compass moving average time	Disable	Disable, 1~30sec	Time constant setting for moving average of Ch1 compass See 4.7.4.9
10 Ch2 compass moving average time	Disable	Disable, 1~30sec	Time constant setting for moving average of Ch2 compass See 4.7.4.10
11 THD moving average time	14s	Disable, 1~30sec	Time constant setting for moving average of THD See 4.7.4.11
12 HC moving average time	14s	Disable, 1~30sec	Time constant setting for moving average of magnetic compass See 4.7.4.12
13 Rudder order moving average time	Disable	Disable, 1~7sec	Time constant setting for moving average of rudder order See 4.7.4.13
14 Filter time constant for ch1 compass(ROT)	Disable	Disable, 1~15sec	Time constant setting for filter of Ch1 compass's ROT See 4.7.4.14
15 Filter time constant for ch2 compass(ROT)	Disable	Disable, 1~15sec	Time constant setting for filter of Ch2 compass's ROT See 4.7.4.15
16 Filter time constant for THD(ROT)	Disable	Disable, 1~15sec	Time constant setting for filter of THD's ROT See 4.7.4.16
17 Deviation correction of external compass	0°	-90~90	Correction for heading deviation of external compass See 4.7.4.17
18 ECOP Gain	500	100~5000	ECOP gain See 4.7.4.18

Item	Default	Setting range	Description
19 ECOP Average time	30	2~300sec	ECOP moving average time See 4.7.4.19
20 DRIFT comp. Average times	30	2~300sec	Time constant setting for moving average of Drift compensation (For course keeping). See 4.7.4.20
21 Reserved	—	—	
22 Hand mode selectable	Off	Off/On	Application of HAND mode selection by AP CDU. See 4.7.4.21
23 BG adjustment	0	-3.0~3.0	BNAAC gain adjustment. See 4.7.4.22

#### 4.7.4.1 Command rudder angle of the alarm occurs

You can select the rudder frozen position in case alarm except servo loop error appears in AUTO/CRS/TRACK mode.

Midship: Rudder is steered to midship position.

Keeping: Rudder is frozen at the current position.

Vessel keeps current course in case alarm appears during going straight.

Vessel keeps turning in case alarm appears during turn.

#### Note

---

Select "Keeping" in case the vessel has TRACK mode to satisfy the requirement of track control system.

---

#### 4.7.4.2 Counter rudder angle limit

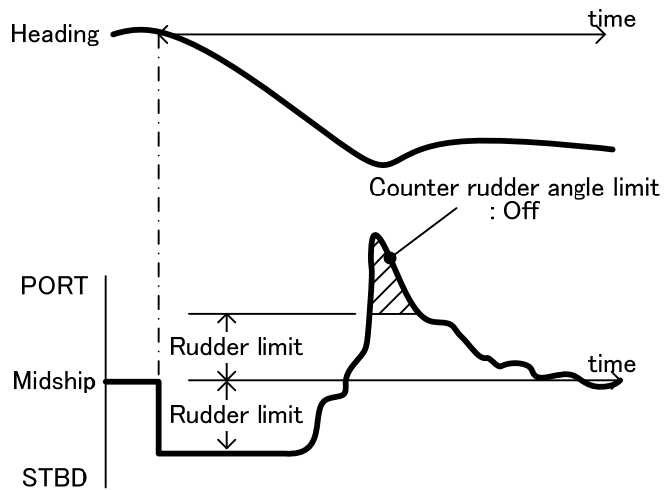
At the end of P-D turn in AUTO mode, rudder is steered to the opposite side of turning direction to decrease ROT. This steering is counter rudder.

Off: Rudder is steered adequately to reduce ROT.

On: Rudder is steered within rudder limit setting to reduce ROT.

#### Note

This setting is reset to "Off" on every restart of PT900



#### 4.7.4.3 Rough seas steering mode

Steering gear may be activated frequently due to the yawing in rough seas. These steering may result in the fatigue of steering gear. So we recommend using this mode in rough seas though yawing tends to increase.

Off: Apply "Rough seas steering mode"

On: Not apply "Rough seas steering mode"



#### 4.7.4.4 Helm adjustment in steering mode switch

Vessel needs to be steered with constant rudder angle to go straight in seas with steady tide, current and winds. Especially in MAN mode, you have to steer HAND STEERING UNIT.

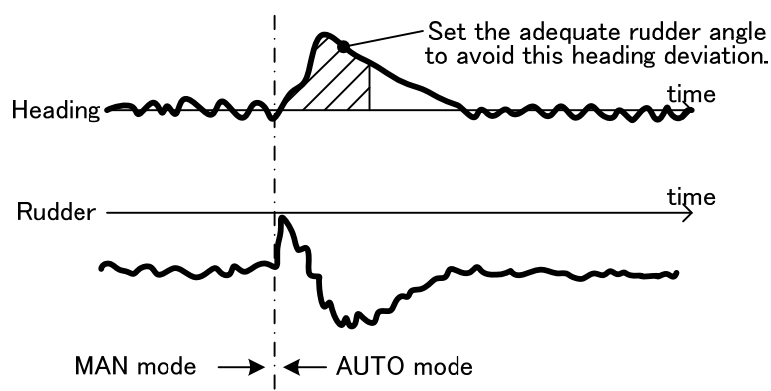
In above situation, rudder may be steered excessively by switching steering mode from MAN mode to AUTO mode shown in figure below.

You can set adequate counter rudder angle to avoid rudder activation by setting this function.

0°: Counter rudder angle during MAN mode does not apply to the beginning of AUTO mode.

Auto: Counter rudder angle during MAN mode applies automatically to the beginning of AUTO mode.

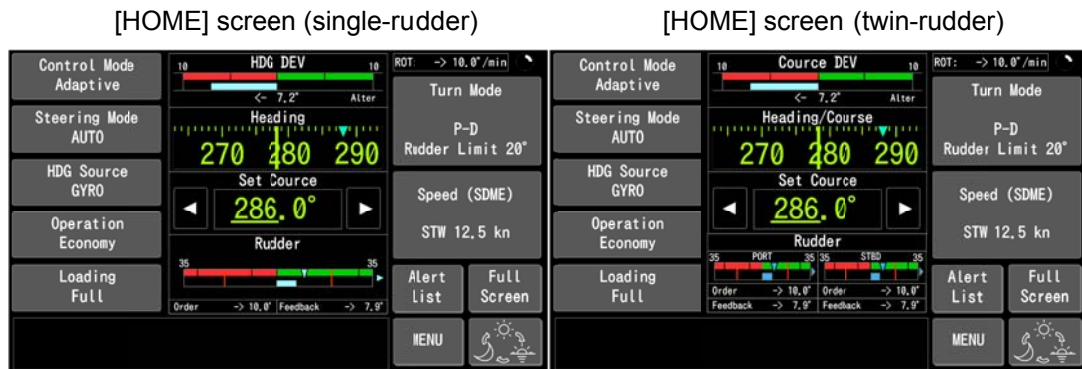
P5°~S5°: Counter rudder angle during MAN mode applies manually to the beginning of AUTO mode.



#### 4.7.4.5 Number of rudders

You can select the number of rudders, “Single” or “Twin”.

This setting applies to the indication and control. Following figure shows the difference of [HOME] screen.



#### 4.7.4.6 Course deviation limit function

Sudden change of disturbance by passing the island or estuary may make large heading deviation in “Steady” control. This function enhances the proportional gain temporarily against the above situation. The basis of heading deviation depends on operation mode and rough seas mode.

Enable: Function is effective.

Disable: Function is in effective.

#### 4.7.4.7 Steering gear deadband compensation

Yawing or steering angle may become large in AUTO/CRS/TRACK mode due to the steering gear with large deadband. This function can compensate the deadband of steering gear.

Enable: Function is effective.

Disable: Function is in effective.

#### 4.7.4.8 Exponential smoothing time for ship speed

This function is for the exponential smoothing time constant of speed sensor. Smoothed speed data is used for control. Non-smoothed speed data is indicated on AP CDU in case PT900 receives speed data as serial signal. Smoothed speed data is indicated on AP CDU in case PT900 receives speed data as pulse signal.

#### **4.7.4.9 Ch1 compass moving average time**

You can set the time constant for moving average of heading data from compass connected to Ch1 port of PT900. Smoothed heading data is used for control. Non-smoothed heading data is indicated on AP CDU.

#### **4.7.4.10 Ch2 compass moving average time**

You can set the time constant for moving average of heading data from compass connected to Ch2 port of PT900. Smoothed heading data is used for control. Non-smoothed heading data is indicated on AP CDU.

#### **Note**

---

Setting applies when Ch2 port of PT900 has second compass.

---

#### **4.7.4.11 THD heading's moving average time**

You can set the time constant for moving average of heading data from compass connected to THD port of PT900. Smoothed heading data is used for control. Non-smoothed heading data is indicated on AP CDU.

#### **Note**

---

Setting applies when THD port of PT900 has THD.

---

#### **4.7.4.12 Magnetic compass moving average time**

In case talker ID of heading data from Ch1, Ch2 or THD port is HC which represents magnetic compass, this time constant applies prior to each port setting. Example is shown below. Ch2 compass moving average time is "Disable". HC moving average time is "14s". In case THD (magnetic method) is connected to Ch2 compass port, heading data is smoothed with 14sec time constant.

#### **4.7.4.13 Rudder order angle moving average time**

You can set the time constant for moving average of rudder order signal.

#### **4.7.4.14 Ch1 Compass ROT filter moving average time**

You can set the time constant for moving average of ROT data which means the value of data field of \$\*\*ROT sentence from compass connected to Ch1 port of PT900. This setting is useful for the gyrocompass based on the rate sensor.

---

#### **4.7.4.15 Ch2 Compass ROT filter moving average time**

You can set the time constant for moving average of ROT data which means the value of data field of \$\*\*ROT sentence from compass connected to Ch2 port of PT900. This setting is useful for the gyrocompass based on the rate sensor.

#### **4.7.4.16 THD heading's ROT filter moving average time**

You can set the time constant for moving average of ROT data which means the value of data field of \$\*\*ROT sentence from compass connected to Ch2 port of PT900. This setting is useful for the GPS compass.

#### **4.7.4.17 Deviation correcting of external compass**

You can correct the deviation manually in case Ch2 compass has deviation from Ch1 compass. This setting is useful for the heading sensor which sends heading data based on the magnetic north.

#### **4.7.4.18 ECOP Gain (Option)**

You can set the gain used during CRS mode. This gain affect to the correction due to the XTD during CRS mode.

- Larger value makes accurate control to the virtual course line.  
(Rudder is activated frequently to control the vessel more accurate.)
- Smaller value makes moderate control to the virtual course line.  
(Rudder is not activated so frequently to control the vessel more economically.)

#### **4.7.4.19 ECOP Average time (Option)**

You can set the time constant for moving average which are used during CRS mode.

- Larger value makes moderate control to the excessive tide or current.  
Vessel returns to the virtual course line gradually.
- Smaller value makes accurate control to the excessive tide or current.  
Vessel returns to the virtual course line smoothly.

#### **4.7.4.20 DRIFT comp. Average time**

You can set the average time which are used for drift correction during TRACK mode and going straight. Set large value in case vessel is yawing due to the change of COG.

---

#### 4.7.4.21 Activation of HAND mode selection by AP CDU

MAN mode is usually selected with “MAN” key on MODE SELECTOR. You can select MAN mode on [HOME] screen of AP CDU in case MODE SELECTOR is out of work due to the trouble.

Disable: MAN mode cannot be selected on AP CDU.

Enable: MAN mode can be selected on AP CDU.



#### 4.7.4.22 BG adjustment

BG is abbreviation of BNAAC Gain.

You can adjust fine setting of BNAAC function which is applied during Economy mode for PT900A or all operation modes for PT900A Plus.

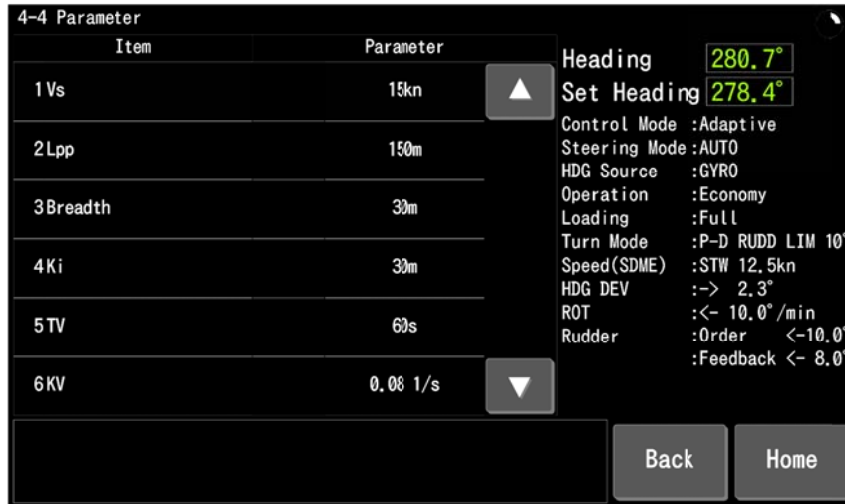
- Larger value makes accurate control by reducing heading deviation.  
(Rudder is activated frequently to reduce heading deviation.)
- Smaller value makes economical control by reducing the rudder activation.  
(Rudder is not activated so frequently that the heading deviation may get large.)

#### 4.7.5 [4-4 Parameter] screen

[4-4 Parameter] screen consists of 13 items shown in figure and table below.

You can input the ship's particular, each values and gains on [4-4 Parameter] screen.

These values depend on the specification of the vessel and are set in the factory. The document "AUTOPILOT PT900 SYSTEM SETTING PARAMETER LIST" which was delivered with FINAL DRAWING shows the details.



#### ● Description of items

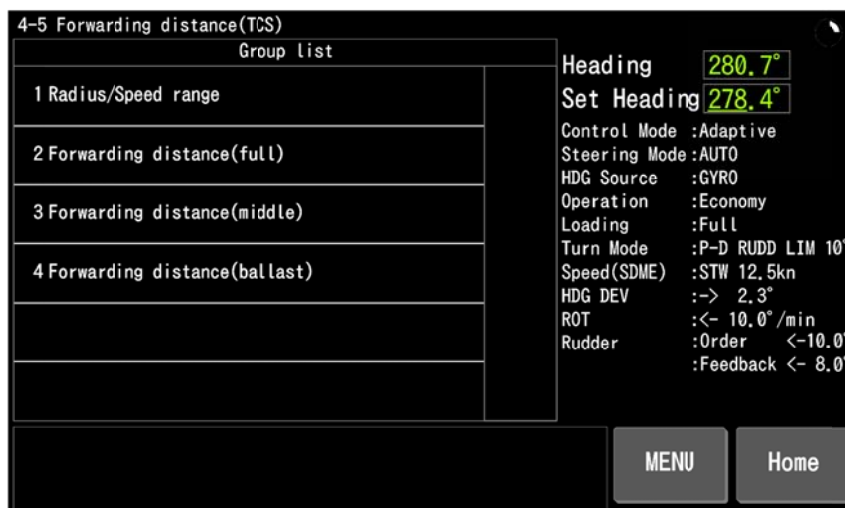
Item	Description	
1 Vs	Navigation speed (1~65kn)	
2 Lpp	Length between perpendicular (10~400m)	
3 Breadth	Moulded breadth (1~99m)	
4 Ki	Initial setting value of static gain	
5 TV	Setting value of time constant	
6 KV	Setting value of static gain	
7 MQ	Kalman filter noise covariance matrix multiplier	Note1
8 Gd	Derivative gain multiplier	Note1
9 Gp	Proportional gain multiplier	Note1
10 Gi	Integral gain multiplier	
11 INIT	Calculation result (Stable/Unstable) from ship's particulars	
12 IDENT	Identification state	
13 RESULT	Identification result	

Note1: BNAAC function which is applied during Economy mode for PT900A or all operation modes for PT900A Plus does not use these values.

#### 4.7.6 [4-5 Forwarding distance(TCS)] screen (Option)

##### Note

[4-5 Forwarding distance(TCS)] screen is adjustable in case the vessel has track control system as optional function.



##### ● Description of Group list

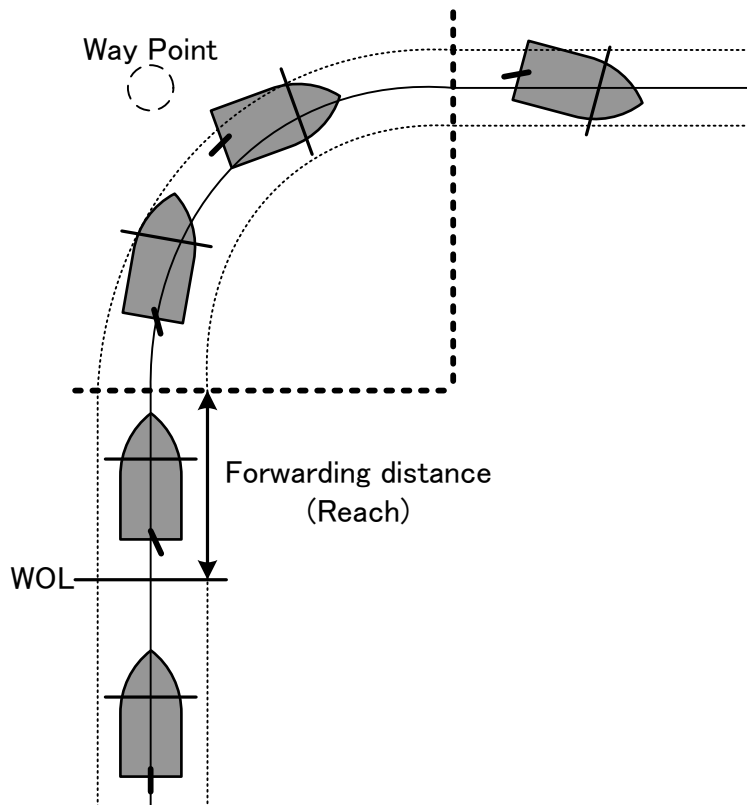
Item	Description
1 Radius/Speed range	Setting of turn radius and speed as a basis of FWD DIST table. See 4.7.6.1
2 Forwarding distance (full)	Setting of FWD DIST on each turn radius and speed while draft mode is "Full".
3 Forwarding distance (middle)	Setting of FWD DIST on each turn radius and speed while draft mode is "Middle".
4 Forwarding distance (ballast)	Setting of FWD DIST on each turn radius and speed while draft mode is "Ballast".

● Description of FWD DIST

FWD DIST is the distance between WOL (Wheel Over Line) and start of curved track. Its length depends on the ship's speed, turn radius and loading condition. PT900 has tables whose vertical axis is ship's speed and horizontal axis is turn radius on each draft mode.

Factory setting of all FWD DIST is 0.100NM. Yokogawa's authorized service engineer adjusts it according to the vessel's particular in sea trial. But it is hard for service engineer to adjust in all draft modes completely. So user has to adjust FWD DIST eventually. Adjustment points are shown below. Please adjust it in calm sea.

- Vessel overshoots from the center of the channel...  
FWD DIST is short. Add the distance which vessel overshoots to current FWD DIST.  
Change the value of cell which is equivalent to current draft mode, turn radius and ship's speed.
- Vessel undershoots from the center of the channel...  
FWD DIST is long. Decrease the distance which vessel undershoots to current FWD DIST. Change the value of cell which is equivalent to current draft mode, turn radius and ship's speed. Proportional gain used in TRACK mode may not be correct. Please contact our Service Department to readjust it.

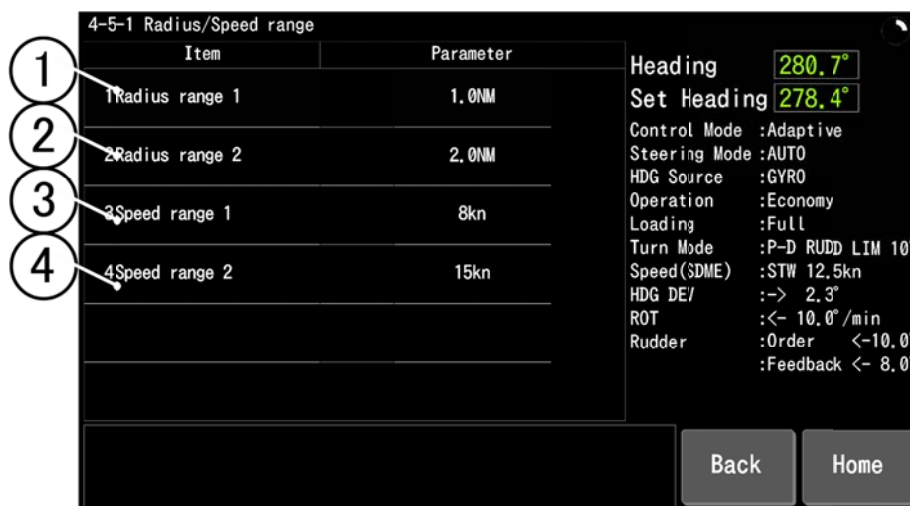




### 4.7.6.1 [4-5-1 Radius/Speed range] screen (Option)

You can define the rows and columns basis of FWD DIST table which is used on [4-5-2/3/4 Forwarding distance (full/middle/ballast)] screens.

Specifically, ①~④ of figure is equivalent to ①~④ of table below.



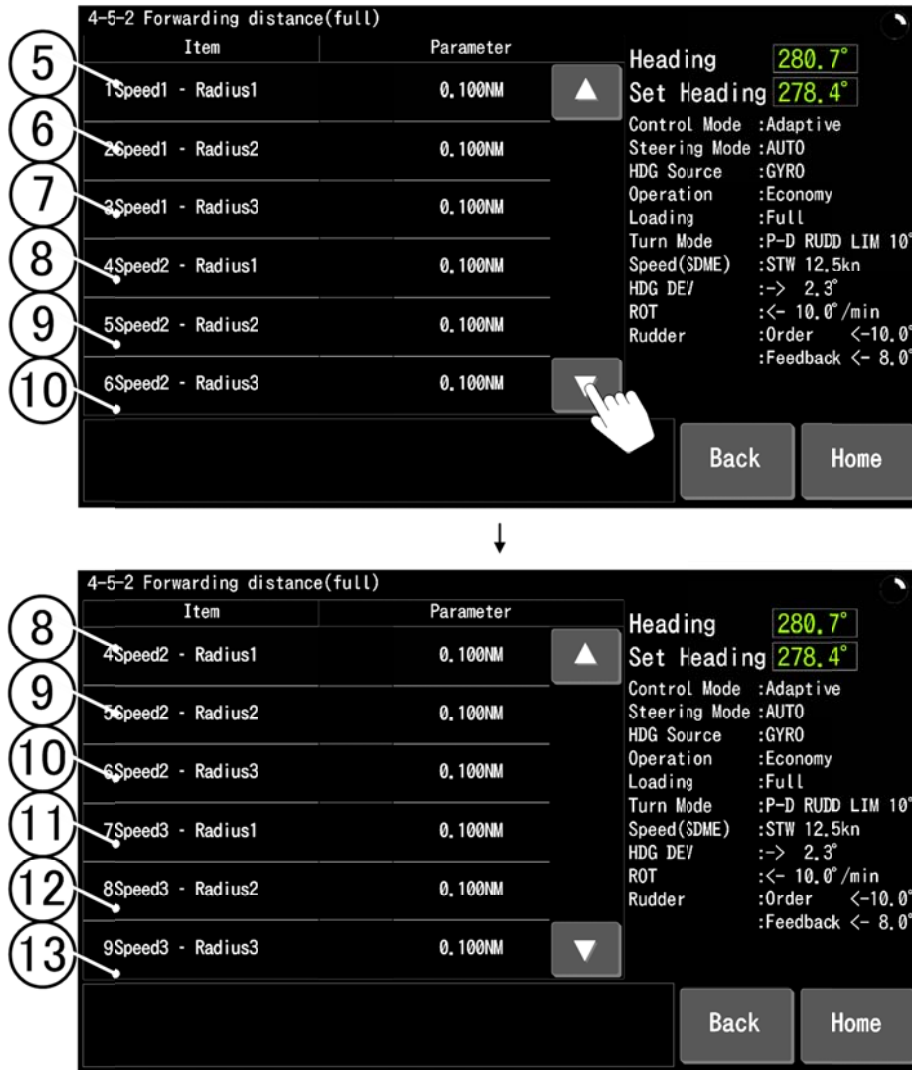
● Description of FWD DIST table

FWD DIST [NM] (Draft mode = ***)		Turn radius		
		① ~	① ~ ②	② ~
Speed	~ ③	***	***	***
	③ ~ ④	***	***	***
	④ ~	***	***	***

4.7.6.2 [4-5-2 Forwarding distance(full)] screen (Option)

You can define the FWD DIST on each turn radius and ship's speed while loading condition is Full mode.

Specifically, ⑤~⑬ of figure is equivalent to ⑤~⑬ of table below.



● Description of FWD DIST table for Full mode

FWD DIST [NM] (Draft mode = Full)		Turn radius		
		① ~	① ~ ②	② ~
Speed	~ ③	⑤	⑥	⑦
	③ ~ ④	⑧	⑨	⑩
	④ ~	⑪	⑫	⑬

### 4.7.6.3 [4-5-3 Forwarding distance(middle)] screen (Option)

You can define the FWD DIST on each turn radius and ship's speed while loading condition is Middle mode.

Specifically, ⑭~⑳ of figure is equivalent to ⑭~㉓ of table below.



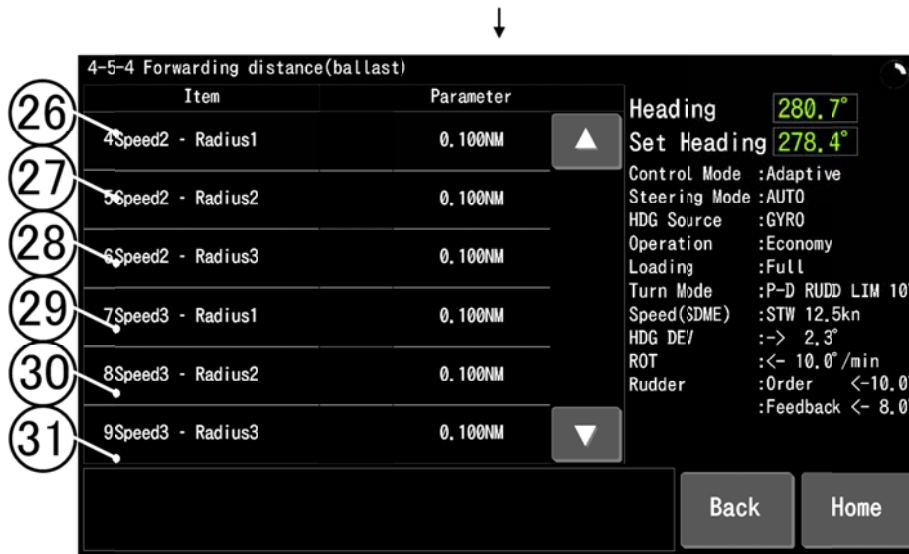
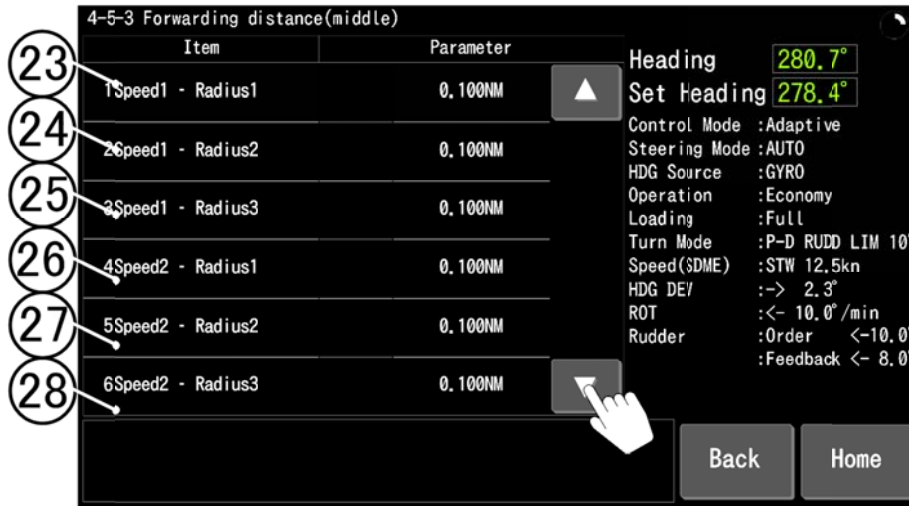
● Description of FWD DIST table for Middle mode

FWD DIST [NM] (Draft mode = Middle)		Turn radius		
		① ~	① ~ ②	② ~
Speed	~ ③	⑭	⑮	⑯
	③ ~ ④	⑰	⑱	⑲
	④ ~	⑳	㉑	㉒

4.7.6.4 [4-5-4 Forwarding distance(ballast)] screen (Option)

You can define the FWD DIST on each turn radius and ship's speed while loading condition is Ballast mode.

Specifically, ㉓~㉑ of figure is equivalent to ㉓~㉑ of table below.



● Description of FWD DIST table for Ballast mode

FWD DIST [NM] (Draft mode = Ballast)		Turn radius		
		① ~	① ~ ②	② ~
Speed	~ ③	㉓	㉔	㉕
	③ ~ ④	㉖	㉗	㉘
	④ ~	㉙	㉚	㉛

### 4.7.7 [4-6 Adjust touch screen] screen

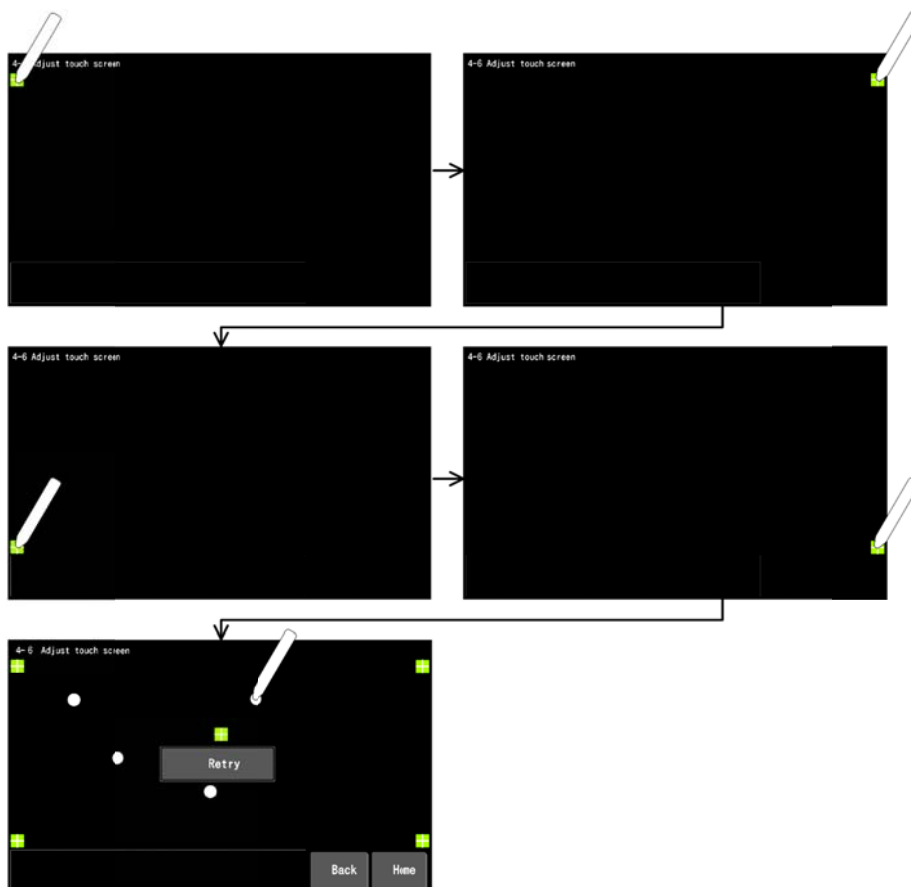
You can adjust touch panel screen of AP CDU.

Tap “+” in order which indicated on each corner.

#### Note

Execute this adjustment in case there is a gap between tapping position and selected position.

- (1) Tap “+” indicated on upper-left corner of screen.
- (2) “+” position will change to upper-right corner when AP CDU recognizes the above operation.
- (3) Similarly, tap “+” in order.
- (4) [Retry] button appears after you tap “+” on every corner.
- (5) Check whether there is gap between tapping position and selected position.
- (6) Tap [Back] button or [Home] button to transition to [4-6 Adjust touch screen] screen if there is no gap.
- (7) Tap [Retry] button to readjust if there is gap.



#### 4.7.8 [4-7 Date and time] screen

You can adjust internal time of PT900.

---

#### Note

Internal time of PT900 is included in ALF and ARC sentences which sent to BAMS. ACN sentence sent from BAMS also has data of date and time. You should set internal time based on the UTC to correspond the time between PT900 and BAMS.

---

---

#### Note

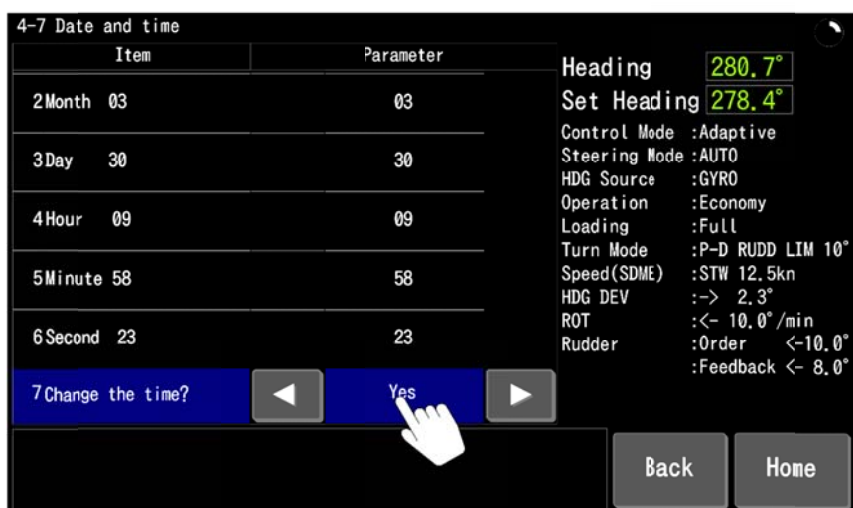
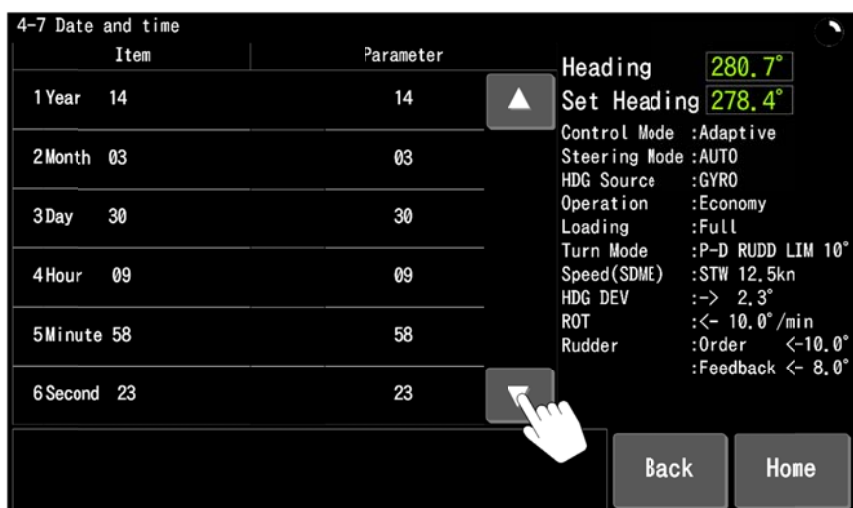
Readjust the date and time in case there is a difference between internal time and actual time. Real time clock IC which stores the internal time is reset in case SYSTEM SELECTOR is set to "OFF" position for 1 week.

---

Settings are applied after you input each items and tap "Yes" on [7 Change the time?] item.

Internal time is adjusted automatically in case all of followings are satisfied.

- AP CDU has CRS mode as steering mode and GPS is connected to PT900.
  - ZDA sentence is included in sentences from GPS and "Enable" is selected on [4-9-1-5 Input ZDA sentence] screen.
-



● Description for setting items

Item	Default	Range	Description
1 Year	Current value	0~99	Year (The last 2 digits of the year)
2 Month	Current value	1~12	Month
3 Day	Current value	1~31	Day
4 Hour	Current value	0~23	Hour
5 Minute	Current value	0~59	Minute
6 Second	Current value	0~59	Second
7 Change the time?	No	Yes/No	Update date and time data

#### 4.7.9 [4-8 Backup/Restore] screen

You can execute “Backup” and “Restore” operation manually of each setting data on [4-8 Backup/Restore] screen.

“Backup” means to save the setting data and

“Restore” means to read out the saved setting data.

There are 3 files as “No.1” ~ “No.3” with which you can do “Backup” or “Restore” of setting data. There is a “Restore” file as “Initial value” separately with which you can initialize the setting data. “Initial value” file has the setting data when Yokogawa’s authorized service engineer rigged.

Figure shows that

Yokogawa’s authorized service engineer did “Backup” operation in March 8, 2014.

User did “Backup” operation on “No.1” file in August 13, 2014.

User did “Backup” operation on “No.3” file in October 12, 2014.

User has not done any “Backup” operation on “No.2” file. “No.2” file does not have any setting data. So user cannot do “Restore” operation.

You can use these files for each officer, draft and forward and backward route and so on.

The screenshot displays the '4-8 Backup/Restore' interface. It features a table with columns for 'Backup No.', 'Backup', 'Last update(UT)', and 'Restore'. The table lists four entries: No. 1 (2014-08-13 18:30:45), No. 2 (\*\*\*), No. 3 (2014-10-12 09:23:11), and Initial value (2014-03-08 15:43:23). To the right of the table, system parameters are listed, including Heading (280.7°), Set Heading (278.4°), Control Mode (Adaptive), Steering Mode (AUTO), HDG Source (GYRO), Operation (Economy), Loading (Full), Turn Mode (P-D RUDD LIM 10°), Speed (SDME) (STW 12.5kn), HDG DEV (-> 2.3°), ROT (<- 10.0°/min), and Rudder (Order <-10.0°, Feedback <- 8.0°). At the bottom right, there are 'Back' and 'Home' buttons.

Backup No.	Backup	Last update(UT)	Restore
No. 1	Backup	2014-08-13 18:30:45	Restore
No. 2	Backup	***	Restore
No. 3	Backup	2014-10-12 09:23:11	Restore
Initial value		2014-03-08 15:43:23	Restore

Heading: 280.7°  
Set Heading: 278.4°  
Control Mode: Adaptive  
Steering Mode: AUTO  
HDG Source: GYRO  
Operation: Economy  
Loading: Full  
Turn Mode: P-D RUDD LIM 10°  
Speed (SDME): STW 12.5kn  
HDG DEV: -> 2.3°  
ROT: <- 10.0°/min  
Rudder: Order <-10.0°  
:Feedback <- 8.0°

Back Home



#### 4.7.9.1 Backup/Restore items

Setting data are stored automatically in a constant period without “Backup” operation.

PT900 holds them even if SYSTEM SELECTOR is sets to “OFF” position. And PT900 starts with last settings which stored automatically.

There is a difference of setting data which can be stored automatically or manually.

Please refer the table below.

Screen	Automatic Backup/Restore	Manual Backup/Restore
[HOME] screen	O	X
[1 Brilliance/contrast] screen	O	O
[4-1 Alert] screen	O	O
[4-2 Display customize] screen	O	O
[4-3 Control] screen	O	O
[4-4 Parameter] screen	O	O
[4-5 Forwarding distance] screen	O	O
[4-6 Adjust touch screen] screen	O	X

Internal time of PT900 is stored in real time clock IC.

### 4.7.9.2 How to “Backup”

Setting data are stored by tapping “Backup” button. You can store maximum 3 kinds of settings to 3 files at the same time. You can also overwrite the stored data by tapping “Backup” button.

Date and time (UTC) are indicated between “Backup” button and “Restore” button when you stored the setting data. “\*\*\*” means no data are stored.

4-8 Backup/Restore			
Backup No.		Last update(UTC)	
No. 1	Backup	2014-08-13 18:30:45	Restore
No. 2	Backup	***	Restore
No. 3	Backup	2014-10-12 09:23:11	Restore
Initial value		2014-03-08 15:43:23	Restore

Heading 280.7°  
 Set Heading 278.4°  
 Control Mode :Adaptive  
 Steering Mode :AUTO  
 HDG Source :GYRO  
 Operation :Economy  
 Loading :Full  
 Turn Mode :P-D RUDD LIM 10°  
 Speed(SDME) :STW 12.5kn  
 HDG DEV :-> 2.3°  
 ROT :<- 10.0°/min  
 Rudder :Order <-10.0°  
 :Feedback <- 8.0°

Back Home

### 4.7.9.3 How to “Restore”

Setting data are read out by tapping “Restore” button and apply immediately.

You can read out maximum 4 kinds of settings as 3 user settings and initial setting.

#### Note

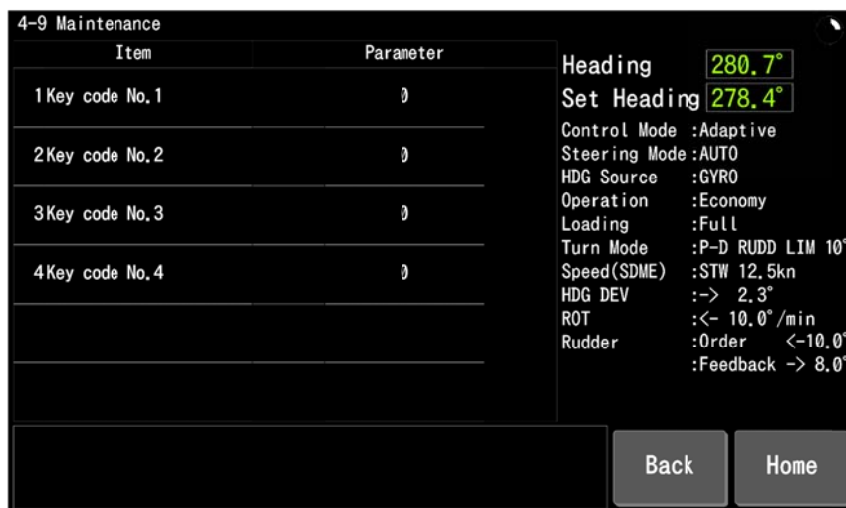
Setting data are applied immediately by pressing “Restore” button. Data concerning the control are also changed. So please execute “Restore” operation while the vessel is in port or at anchor.

#### 4.7.10 [4-9 Maintenance] screen

##### Note

[4-9 Maintenance] screen is access restriction screen for general user.

Yokogawa's authorized service engineer can access and operate this screen.



## 4.8 Key switches operation

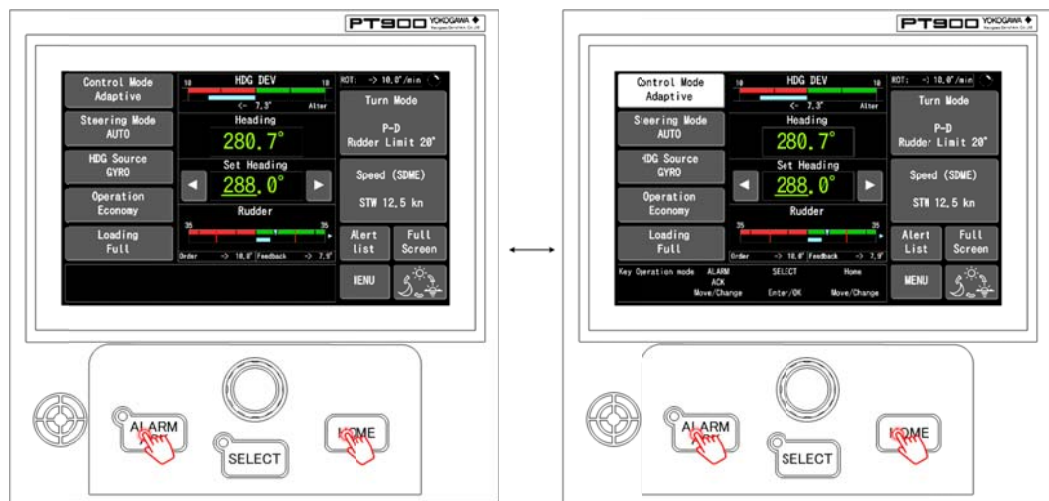
You can operate AP CDU with key switches in case touch panel is out of work.

Guidance area of [HOME] screen shows the functions of each key on AP CDU during key operation mode.

- How to change to key switches operation mode

You can change from touch panel operation mode to key switches operation mode and vice versa by long press of both “HOME” key and “ALARM ACK” key on AP CDU.

Switching of touch screen/key switches operation mode is possible at any screens.

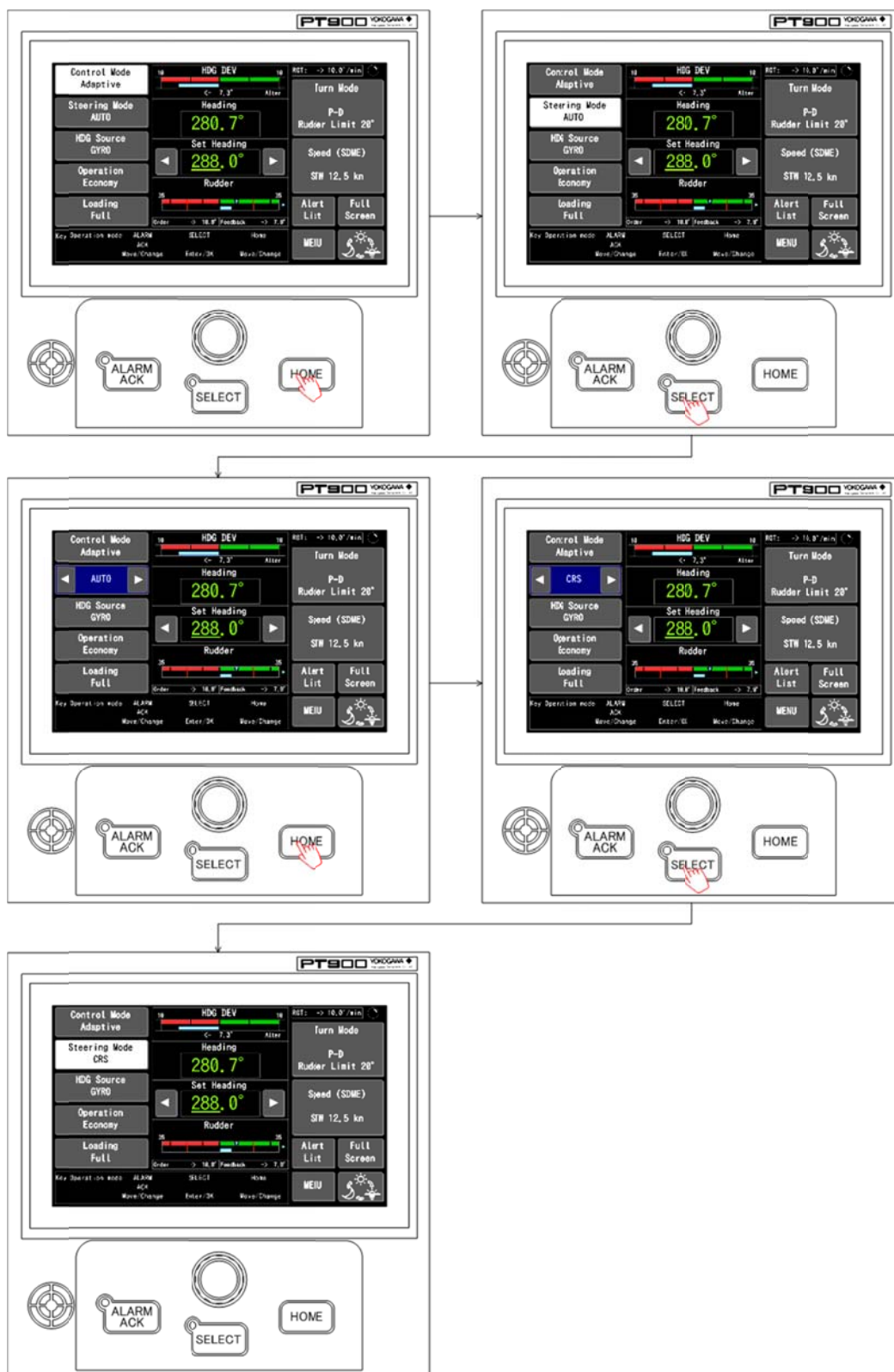


- Key switches operation

“ALARM ACK” / “SELECT” / “HOME” key have following functions during key switches operation. Selected position is indicated inversely.

Key	In selecting operation	In setting operation
ALARM ACK	Shift the selected position upper side	Change data (Down / Before)
SELECT	Select (transition to setting operation)	Enter (Set the value and return to selection opera)
HOME	Shift the selected position lower side	Change data (Up / Next)

Figure shows how to change the steering mode from AUTO to TRACK in key switches operation.



## 4.9 Lamp, buzzer and LCD test

Lamp and buzzer test method on SYSTEM SELECTOR, MODE SELECTOR and ANNUNCIATOR UNIT is shown in this chapter.

You can check the followings by this test

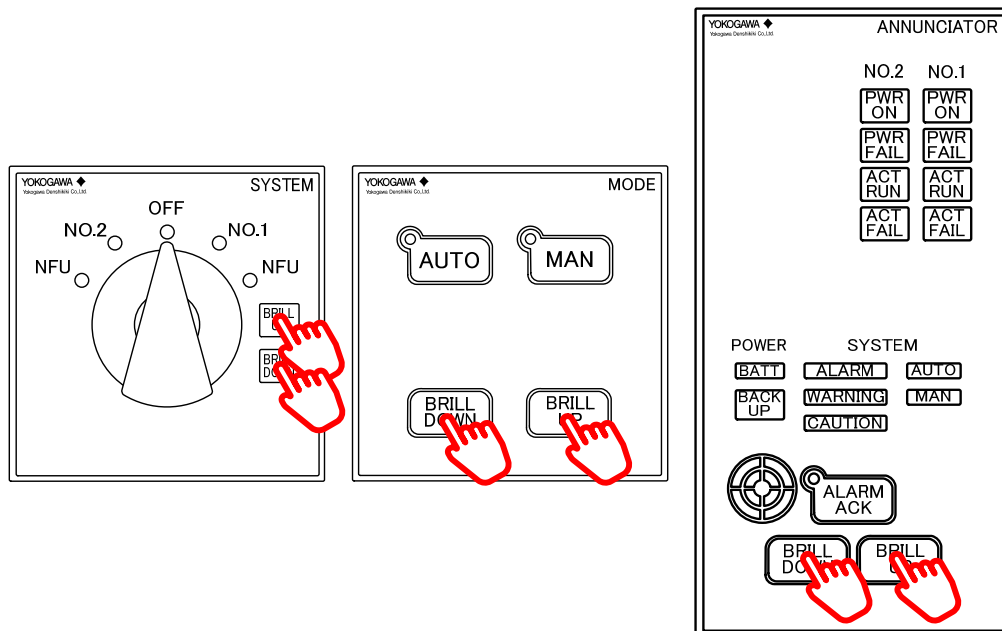
- CPU works correctly.
- Lamps light correctly.
- Buzzer sounds correctly.
- Keys work correctly.

### 4.9.1 Lamp and buzzer test on SYSTEM SELECTOR / MODE SELECTOR / ANNUNCIATOR UNIT

You can check lamp and buzzer test by pressing both “BRILL UP” key and “BRILL DOWN” key on SYSTEM SELECTOR, MODE SELECTOR and ANNUNCIATOR UNIT.

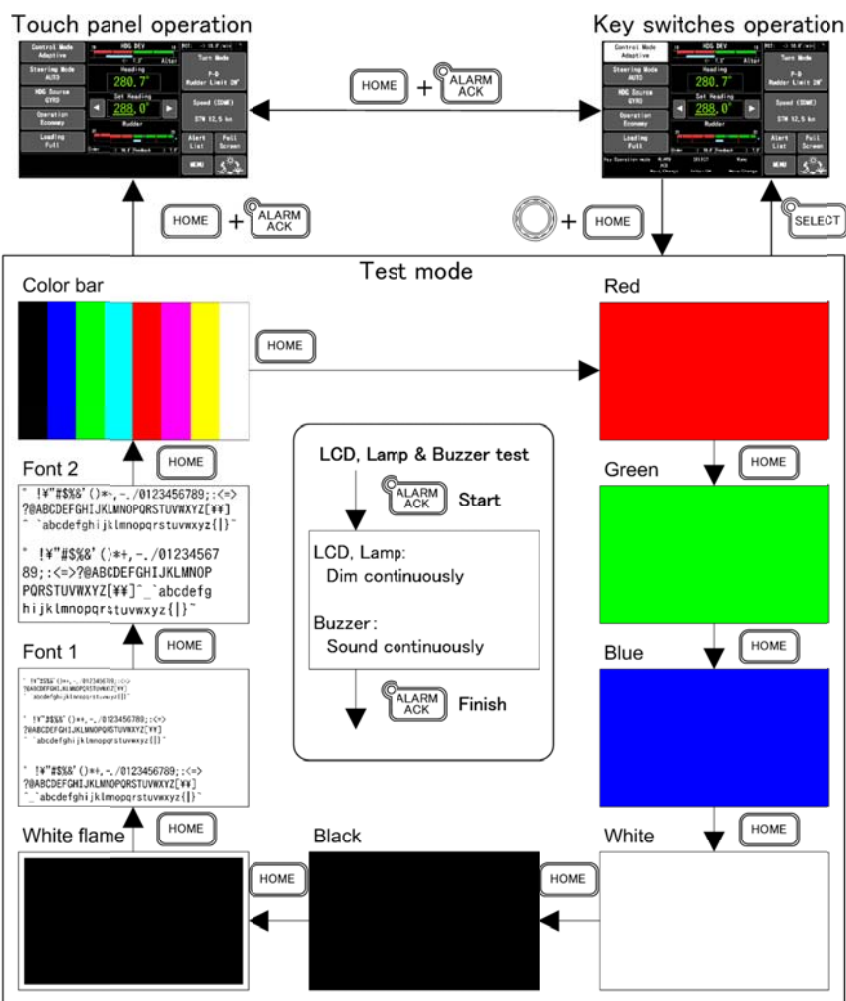
All lamps light and buzzer sounds during pressing these keys.

ANNUNCIATOR UNIT only has buzzer in these units.



### 4.9.2 Lamp, buzzer and LCD test on AP CDU

- Start of test
  - (1) Press and hold both “HOME” key and “ALARM ACK” key to change to key switches operation.
  - (2) Press and hold both “HOME” key and COURSE SETTING DIAL to transition to test mode.
- End of test
  - Press the “SELECT” key to finish the test mode and return to the key switches operation.
  - or
  - Press and hold the both “HOME” key and “ALARM ACK” key to finish the test mode and to return to the touch panel operation.







## 5. Troubleshooting

### 5.1 Trouble and measures on AP CDU

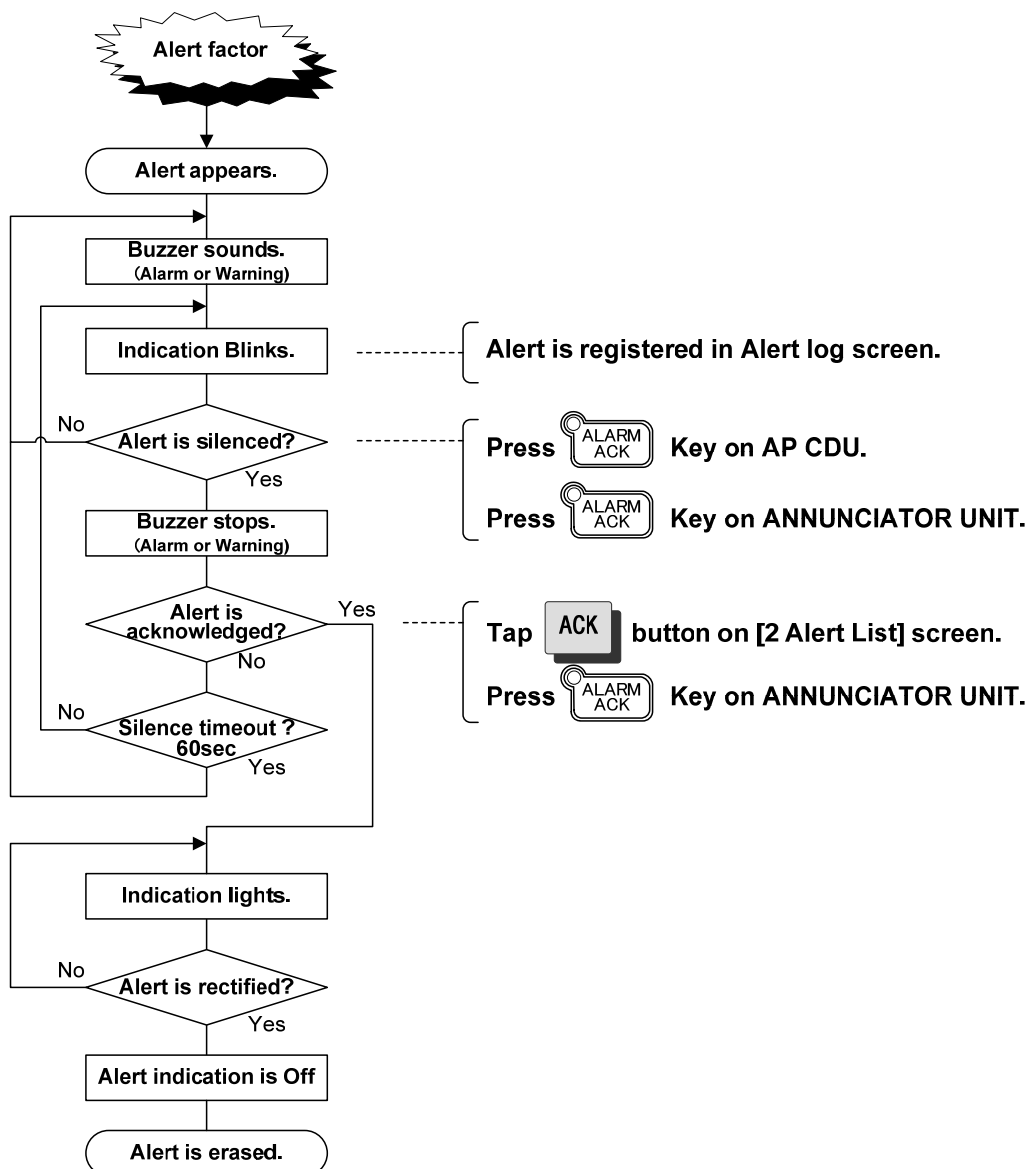
- The tapping position and reaction position are misaligned on AP CDU.  
→Adjust the touch screen position. See 4.7.7
  
  - The touch screen does not respond or AP CDU screen works without any tapping.  
→Change to KEY SWITCH OPERATION mode. See 4.8  
Contact Yokogawa's service agent or service department because it might be caused by the touch panel problem or interface problem.
  
  - Nothing is displayed on LCD of AP CDU.  
Nothing might seem to be displayed when the display mode is "Night" during daytime.  
→Touch the bottom-right corner of LCD and check if the screen color changes or not.  
If there is no changes, contact Yokogawa's service agent or service department because LCD might have any problem.
  
  - Set heading does not change with COURSE SETTING DIAL.  
→Change set heading with touch panel operation on [HOME] screen. See.4.3.1  
Contact Yokogawa's service agent or service department because COURSE SETTING DIAL might have any problem.
  
  - There is time difference between current time and Alert list.  
→Adjust the time on [4-7 Date and time] screen. See 4.7.8
-

## 5.2 Alert

The alert (or important indication) appears when PT900 detects some problem like CPU fail or communication fail and so on. This chapter shows how to check the alert contents and how to acknowledge them.

Figure shows the flow of alert handling.

(There is no buzzer sound and necessary of acknowledgement for caution alert and important indication.)





### ■ Alarm

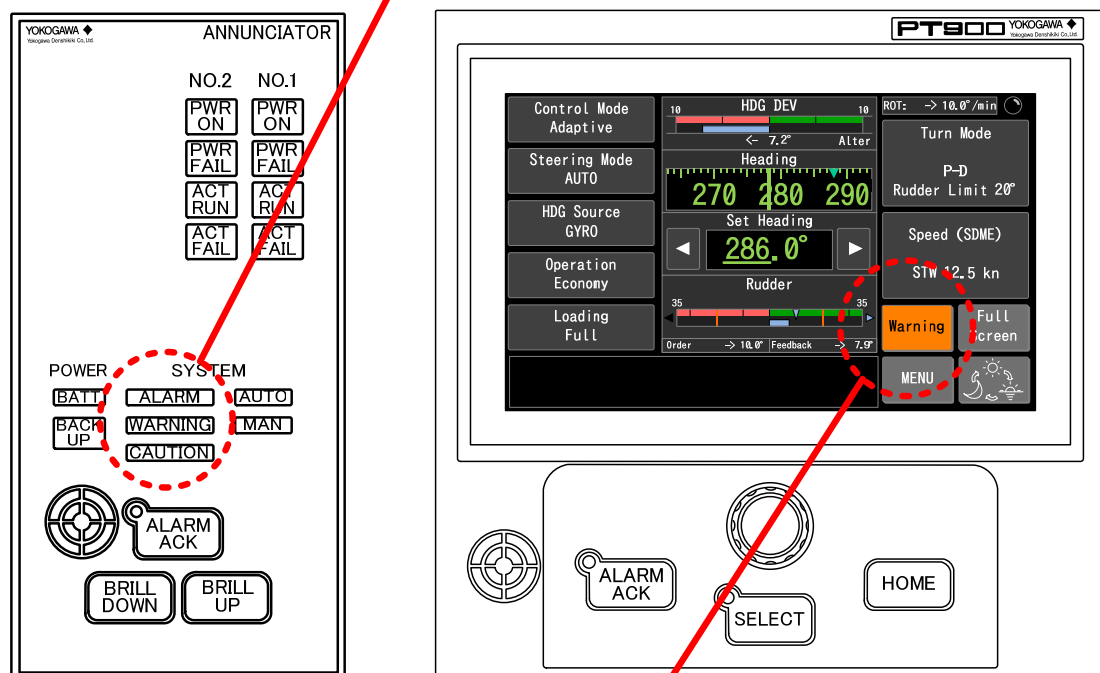
- Change-over to NFU mode immediately when PT900 detects any "ALARM".
- Following alarms appear, switch-over S/G pump or stop abnormal S/G pump in parallel operation.
  - Servo loop failure
  - Rudder angle feedback signal failure
  - MCU(ADAPT) time out

#### 5.2.1 Alert indication

In case that PT900 detects any trouble, audible and visible alerts are generated at AP CDU and ANNUNCIATOR UNIT shown in the figure below.

This information is categorized as "Alert" having three priorities (Alarm, Warning and Caution) and "Important indication".

Alert indication (ALARM/WARNING/CAUTION)



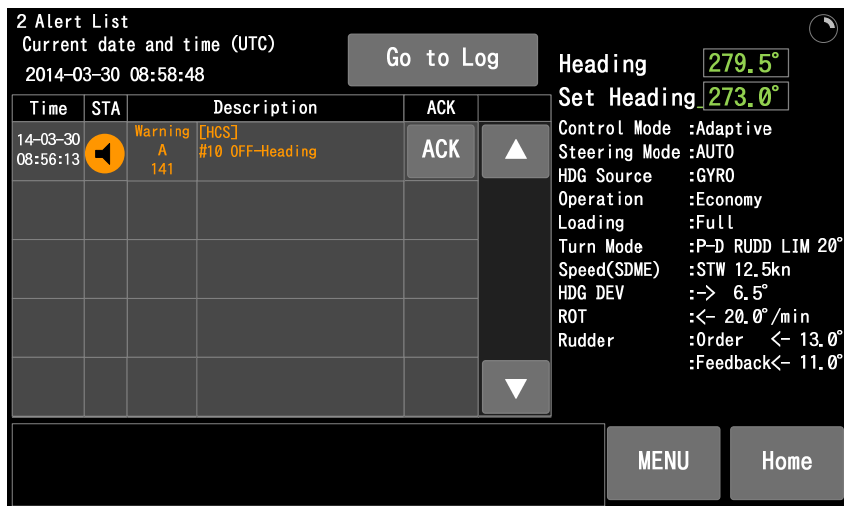
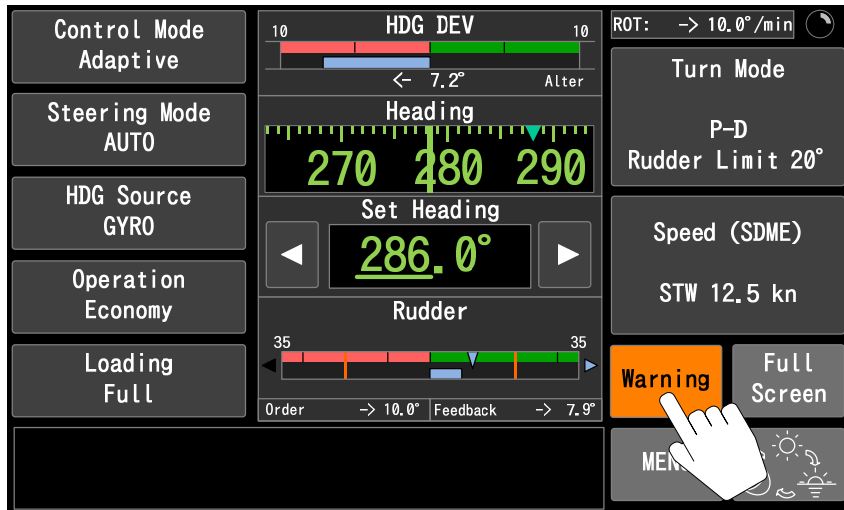
Alert indication (Alarm/Warning/Caution), Important indication (IND)

### 5.2.2 Alert confirmation

You can check the alert factors on [2 Alert List] screen of AP CDU.




By tapping the [Alert] button on [HOME] screen, the screen transitions from [HOME] screen to [2 Alert List] screen. See 4.5

More detail of each alert is shown in 5.2.5



### 5.2.3 Alert acknowledgement

You can acknowledge the alert by tapping “ACK” button on [2 Alert List] screen or pressing “ALARM ACK” key at AP CDU. You can also acknowledge it by pressing “ALARM ACK” key at ANNUNCIATOR UNIT. Announcement state will be changed according to the current alert status. See 4.5

Unit	Button / Key	Function
AP CDU		One alert which is indicated on left side of this button is acknowledged by tapping this.
		The highest priority alert is acknowledged by pressing this.
ANNUNCIATOR UNIT		The highest priority alert is acknowledged by pressing this.

### 5.2.4 Alert factor and measures

Please refer the alert and important indication list shown below to estimate the alert factor.

In case the alert or important indication with guidance appears, follow the guidance.

Please contact Yokogawa's service agent or service department if you cannot rectify by yourself.

### 5.2.5 Alert and Important indication code list

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
10400	---	[HCS] #08 Program start	---	(IND)	---	System starting status	
10401	1	[HCS] COMM Error #08 AP CDU :Can-bus address	---	(IND)	---	No.1 AP CDU detected the overlapped CAN-bus address	
	2	[HCS] COMM Error #08 AP CDU :Can-bus chA	---	(IND)	---	No.1 AP CDU detected CAN-bus ch-A Transmission error.	
	3	[HCS] COMM Error #08 AP CDU :Can-bus chB	---	(IND)	---	No.1 AP CDU detected CAN-bus ch-B Transmission error.	
	4	[HCS] COMM Error #08 AP CDU :Can-bus data(MPU)	B	Warning	In use and Auto steering	No.1 AP CDU could not receive the data from MPU for 3 seconds or longer.	
			---	(IND)	"Not in use" Or "In use and Manual steering"		
	5	[HCS] COMM Error #08 AP CDU :Can-bus data(MCU)	B	Warning	In use and Auto steering	No.1 AP CDU could not receive the data from MCU (MAN TERM) for 3 seconds or longer.	
---			(IND)	"Not in use" Or "In use and Manual steering"			
6	[HCS] COMM Error #08 AP CDU :Can-bus data(NAV)	B	Warning	In use and Auto steering	No.1 AP CDU could not receive the data from NAV I/F for 3 seconds or longer.		
		---	(IND)	"Not in use" Or "In use and Manual steering"			

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	7	[HCS] Time out #08 AP CDU	B	Warning	In use and Auto steering	No.1 AP CDU could not receive the data from No.2 AP CDU for 3 seconds or longer.	
			---	(IND)	"Not in use" Or "In use and Manual steering"		
10402	---	[HCS] COMM Error #08 GYRO	---	(IND)	Manual steering	No.1 AP CDU could not receive the valid heading data or the signal from port Ch-1 for 3 seconds or longer during manual steering.	Keep Current heading source.
10403	---	[HCS] COMM Error #08 MAG	---	(IND)	Manual steering	No.1 AP CDU could not receive the valid heading data or the signal from port Ch-2 for 3 seconds or longer during manual steering.	Keep Current heading source.
10404	---	[HCS] COMM Error #08 THD	---	(IND)	Manual steering	No.1 AP CDU could not receive the valid heading data or the signal from THD port for 3 seconds or longer during manual steering.	Keep Current heading source.
10405	---	[HCS] COMM Error #08 Speed	---	(IND)	Manual steering	No.1 AP CDU could not receive the valid speed data or the signal from speed port for 10 seconds or longer during manual steering..	
10406	1	[HCS] Error #08 AP CDU :Backup data	---	(IND)	---	No.1 AP CDU detected own back-up data error.	
	2	[HCS] Error #08 AP CDU :Key	B	Warning	In use and Auto steering	No.1 AP CDU detected the key pressing status for 60 seconds or longer.	
			---	(IND)	"Not in use" Or "In use and Manual steering"		
3	[HCS] Error #08 AP CDU :Dial	B	Warning	In use and Auto steering	No.1 AP CDU detected the dial pressing status for 60 seconds or longer.		
		---	(IND)	"Not in use" Or "In use and Manual steering"			

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance	
	4	[HCS] Error #08 AP CDU :Touch panel	B	Warning	In use and Auto steering	No.1 AP CDU detected the touch panel pressing status for 60 seconds or longer.		
			---	(IND)	"Not in use" Or "In use and Manual steering"			
10407	---	[HCS] #08 GYRO HDG CORR	B	Caution	Auto steering	No.1 AP CDU could not receive the valid heading correction data or the signal from port Ch-1 for 3 seconds or longer.		
10551	1	[HCS] COMM Error #10 AP CDU(MPU) :Can-bus address	---	(IND)	---	No.1 MPU detected the overlapped CAN-bus address		
	2	[HCS] COMM Error #10 AP CDU(MPU) :Can-bus chA	---	(IND)		No.1 MPU detected CAN-bus ch-A Transmission error.		
	3	[HCS] COMM Error #10 AP CDU(MPU) :Can-bus chB	---	(IND)	---	No.1 MPU detected CAN-bus ch-B Transmission error.		
	4		[HCS] COMM Error #10 AP CDU(MPU) :Can-bus data(CDU)	B	Alarm	In use and Auto steering	No.1 MPU could not receive the data from AP CDU for 3 seconds or longer during automatic steering.	Change-over to Manual steering.
				---	(IND)	"Not in use" Or "In use and Manual steering"	No.1 MPU could not receive the data from AP CDU for 3 seconds or longer during manual steering.	
5		[HCS] COMM Error #10 AP CDU(MPU) :Can-bus data(MCU)	B	Alarm	In use and Auto steering	No.1 MPU could not receive the data from MCU(MAN TERM) for 3 seconds or longer during automatic steering.	Change-over to Manual steering.	
			---	(IND)	"Not in use" Or "In use and Manual steering"	No.1 MPU could not receive the data from MCU(MAN TERM) for 3 seconds or longer during manual steering.		
10552	---	[HCS] Time out #10 AP CDU(MPU)	B	Alarm	Auto steering	No.1 AP CDU detected the timeout of No.1 MPU status.	Change-over to Manual steering.	
			---	(IND)	"Not in use" Or "In use and Manual steering"		Keep Current steering.	
10553	---	[HCS] Error #10 AP CDU(MPU) :Backup data	---	(IND)	---	No.1 MPU detected own back-up data error.		



No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
10554	---	[HCS] COMM Error #10 GYRO	B	Alarm	In use and Auto steering	No.1 MPU could not receive the valid heading data or the signal from port Ch-1 for 3 seconds or longer during automatic steering..	Change-over to Manual steering and select the other heading source.
			---	(IND)	Not in use and Auto steering		Keep Current heading source.
10555	---	[HCS] COMM Error #10 MAG	B	Alarm	In use and Auto steering	No.1 MPU could not receive the valid heading data or the signal from port Ch-2 for 3 seconds or longer during automatic steering..	Change-over to Manual steering and select the other heading source.
			---	(IND)	Not in use and Auto steering		Keep Current heading source.
10556	---	[HCS] COMM Error #10 THD	B	Alarm	In use and Auto steering	No.1 MPU could not receive the valid heading data or the signal from THD port for 3 seconds or longer during automatic steering.	Change-over to Manual steering and select the other heading source.
			---	(IND)	Not in use and Auto steering		Keep Current heading source.
10557	---	[HCS] COMM Error #10 Speed	B	Warning	In use and Auto steering	No.1 MPU could not receive the valid speed data or the signal from speed port for 10 seconds or longer during automatic steering.	Select Manual speed input.
			---	(IND)	Not in use and Auto steering		
10558	---	[TCS] COMM Error #10 ECDIS	---	(IND)	---	No.1 MPU could not receive the valid ECDIS data or the signal from ECDIS port for 10 seconds or longer during the other than TRACK mode.	Track control is unavailable.
10559	---	[HCS] COMM Error #10 GPS	B	Warning	CRS mode	No.1 MPU could not receive the valid GPS data or the signal from GPS port for 10 seconds or longer during CRS mode.	Course control is unavailable.
			---	(IND)	Other than CRS mode		Course control is unavailable.

5-10

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
10560	---	[HCS] COMM Error #10 S-JOY(I/O UNIT)	B	Warning	In use	No.1 MPU could not receive the valid S-JOY data or the signal from S-JOY(I/O UNIT) port for 10 seconds or longer.	
			---	(IND)	Not in use		
10561	---	[HCS] COMM Error #10 S-JOY(OP UNIT)	B	Warning	In use	No.1 MPU received S-JOY(OP) UNIT failure status from S-JOY(I/O UNIT).	
			---	(IND)	Not in use		
10562	---	[HCS] #10 Off course	B	Warning	Auto steering	No.1 MPU detects an alert if the deviation between heading and set heading by the 2nd compass remains over the set limit value for n-seconds or longer during automatic steering. (Limit: 1 to 90 deg., Detection time:1 to 120s)	
141	1	[HCS] #10 Off-heading	A	Warning	Auto steering	No.1 MPU detects an alert if the deviation between heading and set heading by the selected compass remains over the set limit value for n-seconds or longer during automatic steering. (Limit: 2 to 45 deg., Detection time:2 to 20s)	
10571	---	[HCS] #10 Low speed	B	Warning	AUTO/CRS mode	No.1 MPU detects an alert if the ship's speed blows the set limit value for 10 seconds or longer during automatic steering except TRACK mode. (Limit: Disable or 1to 35kn)	
159	1	[TCS] #10 Low speed	B	Warning	TRACK mode	No.1 MPU detects an alert if the ship's speed blows the set limit value for 10 seconds or longer during TRACK mode. (Limit: Disable or 1to 35kn)	
142	1	[HCS] #10 Heading difference	B	Warning	AUTO/CRS mode	No.1 MPU detects an alert if the deviation between the selected heading and the 2nd compass remains over the set limit value for n-seconds or longer during the other than TRACK mode. (Limit: 1 to 45deg., 1-20s)	
			---	(IND)	Manual steering		

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
155	1	[TCS] #10 Heading difference	A	Warning	TRACK mode	No.1 MPU detects an alert if the deviation between the selected heading and the 2nd compass remains over the set limit value for n-seconds or longer during TRACK mode. (Limit: 1 to 45deg., 1-20s)	
10567	---	[HCS] #10 Heading ROT difference	B	Warning	Auto steering	No.1 MPU detects an alert if the ROT deviation between No.1 the selected heading and the 2nd compass remains over the set limit value for n-seconds or longer during automatic steering. (Limit: Disable or 1to 20 deg/min., 1 to 10s)	
10568	---	[HCS] #10 Heading jump large	B	Warning	Auto steering	No.1 MPU detects an alert if deviation between the selected heading and the 2nd compass is 2deg. or more when selected heading sensor signal has been lost during automatic steering. (This monitoring function is activated when Automatic heading change-over function is applied.)	
10569	---	[HCS] #10 ROT limit exceeded	B	Warning	Auto steering	No.1 MPU detects an alert if ROT value is beyond the preset limit and detection time during automatic steering. (This monitoring function is activated during course keeping mode.) (Limit: 10 to 100deg./min., 1 to 10s)	
10570	---	[HCS] #10 Heading monitor impossible	B	Caution	Auto steering	Heading Monitor - function is enabled by system setting, but it is unavailable due to one of heading source failure.	
10651	1	[SCS] COMM Error #18 ANNUNCIATOR :Can-bus address	---	(IND)	---	ANNUNCIATOR detected the overlapped CAN-bus address.	
	2	[SCS] COMM Error #18 ANNUNCIATOR :Can-bus chA	---	(IND)	---	ANNUNCIATOR detected CAN-bus ch-A Transmission error.	
	3	[SCS] COMM Error #18 ANNUNCIATOR :Can-bus chB	---	(IND)	---	ANNUNCIATOR detected CAN-bus ch-B Transmission error.	

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	4	[SCS] COMM Error #18 ANNUNCIATOR :Can-bus data	B	Warning	---	ANNUNCIATOR could not receive the data from MCU(MAN TERM) for 3 seconds or longer.	
10652	---	[SCS] Time out #18 ANNUNCIATOR	B	Warning	---	No.1 AP CDU detected the timeout of ANNUNCIATOR status.	
10653	1	[SCS] Error #18 ANNUNCIATOR :Backup data	---	(IND)	---	ANNUNCIATOR detected own back-up data error.	
	2	[SCS] Error #18 ANNUNCIATOR :Key	B	Caution	---	ANNUNCIATOR detected the key pressing status for 60 seconds or longer.	
10660	---	[SCS] #18 No.1 AC power failure	B	Alarm	---	ANNUNCIATOR detected No.1 AC power failure condition.	
10661	---	[SCS] #18 No.1 Pump over load	B	Alarm	---	ANNUNCIATOR detected the over-load condition of No.1 pump unit.	Change-over System to the other side.
10662	---	[SCS] #18 No.1 Pump oil low pressure	B	Alarm	---	ANNUNCIATOR detected the low pressure condition of No.1 pump unit.	Change-over System to the other side.
10663	---	[SCS] #18 No.1 Tank oil low level	B	Alarm	---	ANNUNCIATOR detected the low oil level condition of No.1 pump unit.	Change-over System to the other side.
10664	---	[SCS] #18 No.1 Actuator failure	B	Alarm	---	ANNUNCIATOR detected the actuator follow-up failure condition of No.1 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10665	---	[SCS] #18 No.1 Hydrolock	B	Alarm	---	ANNUNCIATOR detected the hydraulic locking alarm condition of No.1 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10670	---	[SCS] #18 No.2 AC power failure	B	Alarm	---	ANNUNCIATOR detected No.2 AC power failure condition.	
10671	---	[SCS] #18 No.2 Pump over load	B	Alarm	---	ANNUNCIATOR detected the over-load condition of No.2 pump unit.	Change-over System to the other side.
10672	---	[SCS] #18 No.2 Pump oil low pressure	B	Alarm	---	ANNUNCIATOR detected the low pressure condition of No.2 pump unit.	Change-over System to the other side.
10673	---	[SCS] #18 No.2 Tank oil low level	B	Alarm	---	ANNUNCIATOR detected the low oil level condition of No.2 pump unit.	Change-over System to the other side.
10674	---	[SCS] #18 No.2 Actuator failure	B	Alarm	---	ANNUNCIATOR detected the actuator follow-up failure condition of No.2 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10675	---	[SCS] #18 No.2 Hydrolock	B	Alarm	---	ANNUNCIATOR detected the hydraulic locking alarm condition of No.2 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
10680	---	[SCS] #18 No.3 AC power failure	B	Alarm	---	ANNUNCIATOR detected No.3 AC power failure condition.	
10681	---	[SCS] #18 No.3 Pump over load	B	Alarm	---	ANNUNCIATOR detected the over-load condition of No.3 pump unit.	Change-over System to the other side.
10682	---	[SCS] #18 No.3 Pump oil low pressure	B	Alarm	---	ANNUNCIATOR detected the low pressure condition of No.3 pump unit.	Change-over System to the other side.
10683	---	[SCS] #18 No.3 Tank oil low level	B	Alarm	---	ANNUNCIATOR detected the low oil level condition of No.3 pump unit.	Change-over System to the other side.
10684	---	[SCS] #18 No.3 Actuator failure	B	Alarm	---	ANNUNCIATOR detected the actuator follow-up failure condition of No.3 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10685	---	[SCS] #18 No.3 Hydrolock	B	Alarm	---	ANNUNCIATOR detected the hydraulic locking alarm condition of No.3 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10690	---	[SCS] #18 No.4 AC power failure	B	Alarm	---	ANNUNCIATOR detected No.4 AC power failure condition.	
10691	---	[SCS] #18 No.4 Pump over load	B	Alarm	---	ANNUNCIATOR detected the over-load condition of No.4 pump unit.	Change-over System to the other side.
10692	---	[SCS] #18 No.4 Pump oil low pressure	B	Alarm	---	ANNUNCIATOR detected the low pressure condition of No.4 pump unit.	Change-over System to the other side.
10693	---	[SCS] #18 No.4 Tank oil low level	B	Alarm	---	ANNUNCIATOR detected the low oil level condition of No.4 pump unit.	Change-over System to the other side.
10694	---	[SCS] #18 No.4 Actuator failure	B	Alarm	---	ANNUNCIATOR detected the actuator follow-up failure condition of No.4 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10695	---	[SCS] #18 No.4 Hydrolock	B	Alarm	---	ANNUNCIATOR detected the hydraulic locking alarm condition of No.4 Control & Power Box.	Stop abnormal S/G pump and start reserve S/G pump.
10666	---	[SCS] Error #18 No.1 Rudder angle feedback signal	B	Alarm	---	ANNUNCIATOR detected the feed-back signal fail condition of No.1 Control & Power Box.	Change-over to NFU.
10676	---	[SCS] Error #18 No.2 Rudder angle feedback signal	B	Alarm	---	ANNUNCIATOR detected the feed-back signal fail condition of No.2 Control & Power Box.	Change-over to NFU.
10686	---	[SCS] Error #18 No.3 Rudder angle feedback signal	B	Alarm	---	ANNUNCIATOR detected the feed-back signal fail condition of No.3 Control & Power Box.	Change-over to NFU.

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
10696	---	[SCS] Error #18 No.4 Rudder angle feedback signal	B	Alarm	---	ANNUNCIATOR detected the feed-back signal fail condition of No.4 Control & Power Box.	Change-over to NFU.
140	1	[HCS] Error #18 Power failure	B	Alarm	Auto steering	ANNUNCIATOR detected HCS power failure condition.	
10751	1	[HCS] COMM Error #20 NAV I/F :Can-bus address	---	(IND)		NAV I/F detected the overlapped CAN-bus address.	
	2	[HCS] COMM Error #20 NAV I/F :Can-bus chA	---	(IND)	---	NAV I/F detected CAN-bus ch-A Transmission error.	
	3	[HCS] COMM Error #20 NAV I/F :Can-bus chB	---	(IND)	---	NAV I/F detected CAN-bus ch-B Transmission error.	
	4	[HCS] COMM Error #20 NAV I/F :Can-bus data	B	Warning	Auto steering	NAV I/F could not receive the data from MCU(MAN TERM) for 3 seconds or longer.	
		---	(IND)	Manual steering			
10752	---	[HCS] Time out #20 NAV I/F	B	Warning	Auto steering	No.1 AP CDU detected the timeout of NAV I/F status during automatic steering.	
			---	(IND)	Manual steering	No.1 AP CDU detected the timeout of NAV I/F status during manual steering.	Automatic steering is unavailable.
10753	---	[HCS] Error #20 NAV I/F :Backup data	---	(IND)	---	NAV I/F detected own back-up data error.	
10754	---	[HCS] COMM Error #20 BAMS	---	(IND)		NAV I/F detected the timeout of BAMS signal.	
10851	1	[SCS] COMM Error #28 MCU(TERM) :Can-bus address	---	(IND)	---	No.1 MAN TERM detected the overlapped CAN-bus address.	
	2	[SCS] COMM Error #28 MCU(TERM) :Can-bus chA(W/H)	---	(IND)		No.1 MAN TERM detected CAN-bus ch-A Transmission error.	
	3	[SCS] COMM Error #28 MCU(TERM) :Can-bus chB(W/H)	---	(IND)	---	No.1 MAN TERM detected CAN-bus ch-B Transmission error.	
	4	[SCS] COMM Error #28 MCU(TERM) :Can-bus chC(S/G)	---	(IND)	---	No.1 MAN TERM detected CAN-bus ch-C Transmission error.	
	5	[SCS] COMM Error #28 MCU(TERM) :Can-bus chD(S/G)	---	(IND)	---	No.1 MAN TERM detected CAN-bus ch-D Transmission error.	

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	6	[SCS] COMM Error #28 MCU(TERM) :Can-bus data(W/H)	B	Alarm	Selected	No.1 MCU(MAN TERM) could not receive the data from AP CDU for 3 seconds or longer.	Change-over to Manual steering.
			---	(IND)	Unselected		Keep Current system
	7	[SCS] COMM Error #28 MCU(TERM) :Can-bus data(S/G)	B	Alarm	Selected	No.1 MCU(MAN TERM) could not receive the data from No.1 CAN ADPT for 3 seconds or longer.	Change-over to NFU.
			---	(IND)	Unselected		Keep Current system
10852	---	[SCS] Time out #28 MCU(TERM)	B	Alarm	Selected	No.1 AP CDU detected the timeout of No.1 MAN TERM status.	Change-over to NFU.
			---	(IND)	Unselected		Keep Current system
10853	---	[SCS] Error #28 MCU(TERM) :Backup data	---	(IND)	---	No.1 MAN TERM. detected own back-up data error.	
10854	1	[SCS] Error #28 SYSTEM SELECTOR :Selection signal	B	Warning	---	No.1 MAN TERM. Could not receive the status of SYSTEM SELECTOR.	
	2	[SCS] Error #28 SYSTEM SELECTOR :Key	B	Caution	---	No.1 MAN TERM. detected the key pressing status of SYSTEM SELECTOR for 60 seconds or longer.	
10855	---	[SCS] Error #28 OVRD TERMINAL :Take-over selection	B	Caution	---	No.1 MAN TERM. detected the take-over status failure.	
10858	---	[SCS] #28 Pump all rest	B	Caution	---	No.1 MAN TERM. detected the rest condition of all operational signals from the Control and Power Box.	
10859	1	[SCS] COMM Error #28 HAND STEERING UNIT	B	Alarm	Selected (HAND mode)	No.1 MAN TERM. detected the invalid data or loss of signal from HAND UNIT during HAND mode.	Change-over System to the other side.
			B	Warning	Unselected (HAND mode) or Selected (FU/NFU)		
			---	(IND)	Auto Steering and DP/JOY		Keep Current system

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	2	[SCS] Error #28 HAND STEERING UNIT :Encoder	B	Alarm	Selected (HAND mode)	No.1 HAND CPU detected the invalid data or loss of signal from HAND UNIT during HAND mode.	Change-over System to the other side.
			B	Warning	Unselected (HAND mode) or Selected (FU/NFU)		
			---	(IND)	Auto Steering and DP/JOY		Keep Current system
10860	---	[HCS] #28 WHEEL OFF CENTER	B	Caution	Auto steering	No.1 MAN TERM. detected that HAND UNIT is rotated 3deg or more from midship position during automatic steering.	
10861	---	[HCS] #28 AC/DC Power failure	B	Caution	Auto steering	No.1 MAN TERM. detected loss of DC power from AC/DC converter.	
10862	---	[HCS] #28 AC/DC(sub) Power failure	B	Caution	Auto steering	No.1 MAN TERM. detected loss of DC power from sub AC/DC converter.	
10863	---	[HCS] #28 Common DC power failure	B	Caution	Auto steering	No.1 MAN TERM. detected loss of common DC power from M.PWR board.	
10901	1	[SCS] COMM Error #29 MCU(TERM) :Can-bus address	---	(IND)	---	No.2 MAN TERM detected the overlapped CAN-bus address.	
	2	[SCS] COMM Error #29 MCU(TERM) :Can-bus chA(W/H)	---	(IND)	---	No.2 MAN TERM detected CAN-bus ch-A Transmission error.	
	3	[SCS] COMM Error #29 MCU(TERM) :Can-bus chB(W/H)	---	(IND)	---	No.2 MAN TERM detected CAN-bus ch-B Transmission error.	
	4	[SCS] COMM Error #29 MCU(TERM) :Can-bus chC(S/G)	---	(IND)	---	No.2 MAN TERM detected CAN-bus ch-C Transmission error.	
	5	[SCS] COMM Error #29 MCU(TERM) :Can-bus chD(S/G)	---	(IND)	---	No.2 MAN TERM detected CAN-bus ch-D Transmission error.	
	6		[SCS] COMM Error #29 MCU(TERM) :Can-bus data(W/H)	B	Alarm	Selected (Auto steering)	No.2 MCU(MAN TERM) could not receive the data from AP CDU for 3 seconds or longer.
---				(IND)	Unselected	Keep Current system	



No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	7	[SCS] COMM Error #29 MCU(TERM) :Can-bus data(S/G)	B	Alarm	Selected (FU)	No.2 MCU(MAN TERM) could not receive the data from No.2 CAN ADPT for 3 seconds or longer.	Change-over to NFU.
			---	(IND)	Unselected		Keep Current system
10902	---	[SCS] Time out #29 MCU(TERM)	B	Alarm	Selected (FU)	No.1 AP CDU detected the timeout of No.2 MAN TERM status.	Change-over to NFU.
			---	(IND)	Unselected		Keep Current system
10903	---	[SCS] Error #29 MCU(TERM) :Backup data	---	(IND)	---	No.2 MAN TERM. Detected own back-up data error.	
10904	1	[SCS] Error #29 SYSTEM SELECTOR :Selection signal	B	Warning	---	No.2 MAN TERM. Could not receive the status of SYSTEM SELECTOR.	
	2	[SCS] Error #29 SYSTEM SELECTOR :Key	B	Caution	---	No.2 MAN TERM. detected the key pressing status of SYSTEM SELECTOR for 60 seconds or longer.	
10905	---	[SCS] Error #29 OVRD TERMINAL :Take-over selection	B	Caution	---	No.2 MAN TERM. detected the take-over status failure.	
10908	---	[SCS] #29 Pump all rest	B	Caution	---	No.2 MAN TERM. detected the rest condition of all operational signals from the Control and Power Box.	
10909	1	[SCS] COMM Error #29 HAND STEERING UNIT	B	Alarm	Selected (HAND mode)	No.2 MAN TERM. detected the invalid data or loss of signal from HAND UNIT during HAND mode.	Change-over System to the other side.
			B	Warning	Unselected (HAND mode) or Selected (FU/NFU)		
			---	(IND)	Auto Steering and DP/JOY		Keep Current system
10909	2	[SCS] Error #29 HAND STEERING UNIT :Encoder	B	Alarm	Selected (HAND mode)	No.2 HAND CPU detected the invalid data or loss of signal from HAND UNIT during HAND mode.	Change-over System to the other side.
			B	Warning	Unselected (HAND mode) or Selected (FU/NFU)		
			---	(IND)	Auto Steering and DP/JOY		Keep Current system

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
10910	---	[HCS] #29 WHEEL OFF CENTER	B	Caution	Auto steering	No.2 MAN TERM. detected that HAND UNIT is rotated 3deg or more from midship position during automatic steering.	
10911	---	[HCS] #29 AC/DC Power failure	B	Caution	Auto steering	No.2 MAN TERM. detected loss of DC power from AC/DC converter.	
10912	---	[HCS] #29 AC/DC(sub) Power failure	B	Caution	Auto steering	No.2 MAN TERM. detected loss of DC power from sub AC/DC converter.	
10913	---	[HCS] #29 Common DC power failure	B	Caution	Auto steering	No.1 MAN TERM. detected loss of common DC power from M.PWR board.	
11051	1	[SCS] COMM Error #30 MCU(ADPT) :Can-bus address	---	(IND)	---	No.1 CAN ADPT detected the overlapped CAN-bus address.	
	2	[SCS] COMM Error #30 MCU(ADPT) :Can-bus chC	---	(IND)	---	No.1 CAN ADPT detected CAN-bus ch-C Transmission error.	
	3	[SCS] COMM Error #30 MCU(ADPT) :Can-bus chD	---	(IND)	---	No.1 CAN ADPT detected CAN-bus ch-D Transmission error.	
	4	[SCS] COMM Error #30 MCU(ADPT) :Can-bus data	B	Alarm	FU	No.1 MCU(MAN TERM) could not receive the data from No.1 CAN ADPT for 3 seconds or longer.	Change-over to NFU.
			---	(IND)	NFU		
11052	---	[SCS] Time out #30 MCU(ADPT)	B	Alarm	FU	No.1 AP CDU detected the timeout of No.1 CAN ADPT status.	Change-over to NFU.
11052	---	[SCS] Time out #30 MCU(ADPT)	---	(IND)	NFU	No.1 AP CDU detected the timeout of No.1 CAN ADPT status.	
11053	1	[SCS] Error #30 MCU(ADPT) :Backup data	---	(IND)	---	No.1 CAN ADPT detected own back-up data error.	
	2	[SCS] Error #30 MCU(ADPT) :DC power failure	B	Alarm	FU	No.1 CAN ADPT detected the internal power supply failure.	Change-over to NFU.
			---	(IND)	NFU		
11054	1	[SCS] No.1 Servo loop failure	B	Alarm	FU	CAN ADPT detected the servo loop failure.	Change-over to NFU.
	2	[SCS] No.2 Servo loop failure	B	Alarm	FU	This alarm is issued if the difference between the rudder order and feed back rudder angle is approx. 5	Change-over to NFU.

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	3	[SCS] No.3 Servo loop failure	B	Alarm	FU	degree or more and, the follow up time does not finish within the alarm detection time that is defined by rudder deviation.	Change-over to NFU.
	4	[SCS] No.4 Servo loop failure	B	Alarm	FU		Change-over to NFU.
11055	---	[SCS] #30 MCU(ADPT) Registration failure	---	(IND)	---	No.1 CAN ADPT detected registration failure.	
11056	---	[SCS] #30 MCU(ADPT) DAC Adjustment failure	B	Alarm	FU	No.1 CAN ADPT detected abnormality of the adjustment data (D/A conversion).	
			---	(IND)	NFU		
11057	---	[SCS] Error #30 MCU(ADPT) :Rudder erroneous	B	Alarm	FU	No.1 CAN ADPT detected rudder command loop-back signal failure.(Option)	Change-over to NFU.
11101	1	[SCS] COMM Error #31 MCU(ADPT) :Can-bus address	---	(IND)	---	No.1 CAN ADPT detected rudder command loop-back signal failure.(Option)	
	2	[SCS] COMM Error #31 MCU(ADPT) :Can-bus chC	---	(IND)	---	No.2 CAN ADPT detected CAN-bus ch-C Transmission error.	
	3	[SCS] COMM Error #31 MCU(ADPT) :Can-bus chD	---	(IND)	---	No.2 CAN ADPT detected CAN-bus ch-D Transmission error.	
	4	[SCS] COMM Error #31 MCU(ADPT) :Can-bus data	B	Alarm	FU	No.1 MCU(MAN TERM) could not receive the data from No.2 CAN ADPT for 3 seconds or longer.	Change-over to NFU.
---	(IND)	NFU					
11102	---	[SCS] Time out #31 MCU(ADPT)	B	Alarm	FU	No.1 AP CDU detected the timeout of No.2 CAN ADPT status.	Change-over to NFU.
			---	(IND)	NFU		
11103	1	[SCS] Error #31 MCU(ADPT) :Backup data	---	(IND)	---	No.2 CAN ADPT detected own back-up data error.	
	2	[SCS] Error #31 MCU(ADPT) :DC power failure	B	Alarm	FU	No.2 CAN ADPT detected the internal power supply failure.	Change-over to NFU.
---	(IND)	NFU					
11105	---	[SCS] #31 MCU(ADPT) Registration failure	---	(IND)	---	No.2 CAN ADPT detected registration failure.	

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
11106	---	[SCS] #31 MCU(ADPT) DAC Adjustment failure	B	Alarm	FU	No.2 CAN ADPT detected abnormality of the adjustment data (D/A conversion).	
			---	(IND)	NFU		
11107	---	[SCS] Error #31 MCU(ADPT) :Rudder erroneous	B	Alarm	FU	No.2 CAN ADPT detected rudder command loop-back signal failure. (Option)	Change-over to NFU.
11151	1	[SCS] COMM Error #32 MCU(ADPT) :Can-bus address	---	(IND)	---	No.3 CAN ADPT detected the overlapped CAN-bus address.	
	2	[SCS] COMM Error #32 MCU(ADPT) :Can-bus chC	---	(IND)	---	No.3 CAN ADPT detected CAN-bus ch-C Transmission error.	
	3	[SCS] COMM Error #32 MCU(ADPT) :Can-bus chD	---	(IND)	---	No.3 CAN ADPT detected CAN-bus ch-D Transmission error.	
	4	[SCS] COMM Error #32 MCU(ADPT) :Can-bus data	B	Alarm	FU	No.2 MCU(MAN TERM) could not receive the data from No.3 CAN ADPT for 3 seconds or longer.	Change-over to NFU.
---			(IND)	NFU			
11152	---	[SCS] Time out #32 MCU(ADPT)	B	Alarm	FU	No.1 AP CDU detected the timeout of No.3 CAN ADPT status.	Change-over to NFU.
			---	(IND)	NFU		
11153	1	[SCS] Error #32 MCU(ADPT) :Backup data	---	(IND)	---	No.3 CAN ADPT detected own back-up data error.	
	2	[SCS] Error #32 MCU(ADPT) :DC power failure	B	Alarm	FU	No.3 CAN ADPT detected the internal power supply failure.	Change-over to NFU.
---			(IND)	NFU			
11155	---	[SCS] #32 MCU(ADPT) Registration failure	---	(IND)	---	No.3 CAN ADPT detected registration failure	
11156	---	[SCS] #32 MCU(ADPT) DAC Adjustment failure	B	Alarm	FU	No.3 CAN ADPT detected abnormality of the adjustment data (D/A conversion).	
			---	(IND)	NFU		
11157	---	[SCS] Error #32 MCU(ADPT) :Rudder erroneous	B	Alarm	FU	No.2 CAN ADPT detected rudder command loop-back signal failure. (Option)	Change-over to NFU.
11201	1	[SCS] COMM Error #33 MCU(ADPT) :Can-bus address	---	(IND)	---	No.4 CAN ADPT detected the overlapped CAN-bus address.	

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	2	[SCS] COMM Error #33 MCU(ADPT) :Can-bus chC	---	(IND)	---	No.4 CAN ADPT detected CAN-bus ch-C Transmission error.	
	3	[SCS] COMM Error #33 MCU(ADPT) :Can-bus chD	---	(IND)	---	No.4 CAN ADPT detected CAN-bus ch-D Transmission error.	
	4	[SCS] COMM Error #33 MCU(ADPT) :Can-bus data	B	Alarm	FU	No.2 MCU(MAN TERM) could not receive the data from No.4 CAN ADPT for 3 seconds or longer.	Change-over to NFU.
---			(IND)	NFU			
11202	---	[SCS] Time out #33 MCU(ADPT)	B	Alarm	FU	No.1 AP CDU detected the timeout of No.4 CAN ADPT status.	Change-over to NFU.
			---	(IND)	NFU		
11203	1	[SCS] Error #33 MCU(ADPT) :Backup data	---	(IND)	---	No.4 CAN ADPT detected own back-up data error.	
	2	[SCS] Error #33 MCU(ADPT) :DC power failure	B	Alarm	FU	No.4 CAN ADPT detected the internal power supply failure.	Change-over to NFU.
---	(IND)	NFU					
11205	---	[SCS] #33 MCU(ADPT) Registration failure	---	(IND)	---	No.4 CAN ADPT detected registration failure.	
11206	---	[SCS] #33 MCU(ADPT) DAC Adjustment failure	B	Alarm	FU	No.4 CAN ADPT detected abnormality of the adjustment data (D/A conversion).	
			---	(IND)	NFU		
11207	---	[SCS] Error #33 MCU(ADPT) :Rudder erroneous	B	Alarm	FU	No.4 CAN ADPT detected rudder command loop-back signal failure. (Option)	Change-over to NFU.
11451	1	[SCS] COMM Error #40 MODE SEL :Can-bus address	---	(IND)	---	MODE SELECTOR detected the overlapped CAN-bus address.	
	2	[SCS] COMM Error #40 MODE SEL :Can-bus chC	---	(IND)	---	MODE SELECTOR detected CAN-bus ch-C Transmission error.	
	3	[SCS] COMM Error #40 MODE SEL :Can-bus chD	---	(IND)	---	MODE SELECTOR detected CAN-bus ch-D Transmission error.	

No.	Ins.	Message	Cat.	Priority	Status	Description	Guidance
	4	[SCS] COMM Error #40 MODE SEL :Can-bus data	B	Warning	FU	MODE SELECTOR could not receive the data from MCU for 3 seconds or longer.	Select Steering mode by AP CDU.
			---	(IND)	NFU		
11452	---	[SCS] Time out #40 MODE SEL	B	Warning	FU	No.1 AP CDU detected the timeout of MODE SELECTOR status.	Select Steering mode by AP CDU.
			---	(IND)	NFU		
11453	1	[SCS] Error #40 MODE SEL :Backup data	---	(IND)	---	MODE SELECTOR detected own back-up data error.	
	2	[SCS] Error #40 MODE SEL :Key	B	Warning	FU	MODE SELECTOR detected the key pressing status for 60 seconds or longer.	Select Steering mode by AP CDU.
---	(IND)	NFU					

## Notation

Cat.	alert category
Ins.	alert instance
IND	Important indication
In use	The device (or data source) is selected.
Not in use	The device (or data source) is not selected.
Selected	The system is selected by SYSTEM SELECTOR
Unselected	The system is not selected by SYSTEM SELECTOR

## **5.3 Trouble and measures on STEERING REPEATER COMPASS**

### **5.3.1 Error indication**

In case STEERING REPEATER COMPASS detects any alert, error LED blinks or lights. Please refer the user's manual of gyrocompass.

## **5.4 Trouble and measures on MODE SELECTOR**

### **5.4.1 MODE SELECTOR trouble during AUTO/CRS/TRACK mode**

There is no effect and PT900 continues current control even if any trouble appears on MODE SELECTOR during AUTO/CRS/TRACK mode.

Change-over methods of steering mode without MODE SELECTOR are shown below.

- Non-Follow-Up steering (NFU mode)

You can steer with NFU LEVER by selecting "NFU" with SYSTEM SELECTOR.

- Follow-Up steering (MAN mode)

There are two ways to change-over the steering mode from AUTO mode to MAN mode.

(1) Steer the HAND STEERING UNIT more than 3 degrees during AUTO mode, and steering mode is changed to MAN mode automatically. This function works while MODE SELECTOR has any trouble.

(2) Select "Enable" of [22 HAND mode selectable] item on [4-3 Control] screen at AP CDU, and you can select MAN mode on [HOME] screen.

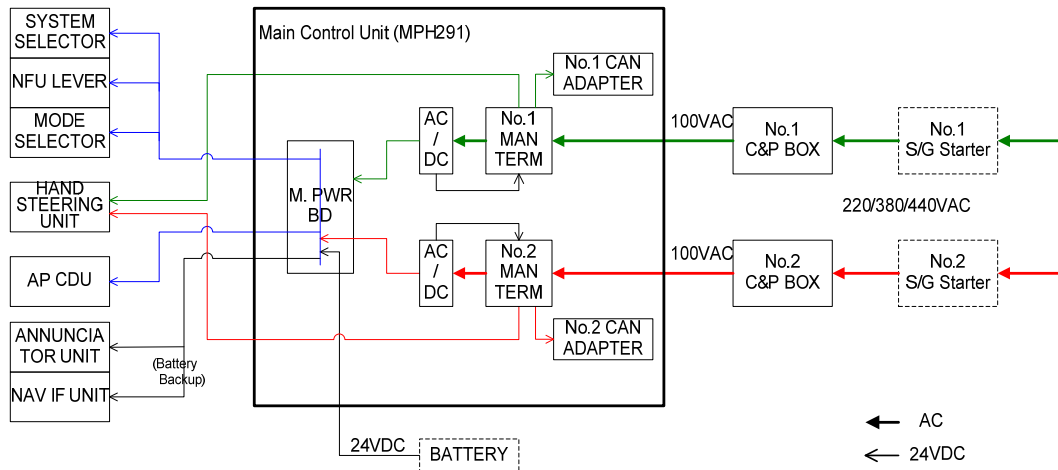
### **5.4.2 MODE SELECTOR trouble during MAN mode**

There is no effect and you can steer with HAND STEERING UNIT even if any trouble appears on MODE SELECTOR during MAN mode. You can select AUTO mode on [HOME] screen of AP CDU.

---

## 5.5 AC power failure

PT900 is powered by CONTROL & POWER BOX which installed in steering gear room. Moreover CONTROL & POWER BOX is powered by steering gear starter which is provided by steering gear manufacture.



### 5.5.1 One of AC power failure during single S/G pump operation

Power fail of S/G pump under single running results in the loss of rudder control. You have to start running another side of S/G pump immediately.

ANNUNCIATOR UNIT which is powered by ship's battery can detect and indicate AC power failure as "PWE FAIL" with buzzer sound.

### 5.5.2 One of AC power failure during parallel S/G pumps operation

One power fail of S/G pump under parallel running does not result in the loss of rudder control. You can steer the rudder though rudder turning speed becomes half.

ANNUNCIATOR indicates "PWR FAIL" and AP CDU indicates "No.x AC power failure" with buzzer sound. Keep the current condition and recover the AC power to S/G pump starter immediately.



---

Blank Page

---



## 6. Specifications

### 6.1 Performance and Specifications

#### 6.1.1 Power Supply

The specification of power supply depends on the specification of each vessel.

The tables below show the standard arrangement of PT900.

Item	Specifications
Main power supply	220/380/440V AC 50/60Hz
Backup power supply	24V DC
Power consumption (AC)	300VA (Max.) It depends on the steering gear specification.
Power Circulation (24V DC)	0.5A (In normal)

#### 6.1.2 Environmental specifications (under normal conditions)

Item	Specification	
Power supply variation	AC power supply	Voltage: $\pm 10\%$ , Frequency: $\pm 5\%$
	Ship's battery power supply	-25% to +30%
Temperature	-15°C to +55°C	
Humidity	0 to 95% R.H (No condensation)	
Vibration	2.0 to 13.2Hz: 2mm p-p / 13.2 to 100Hz: 7m/s <sup>2</sup>	
Protection	IP22 (Surface)	

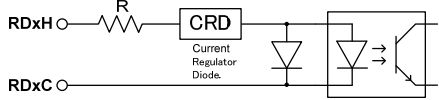
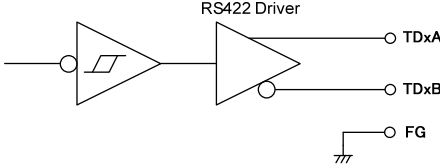
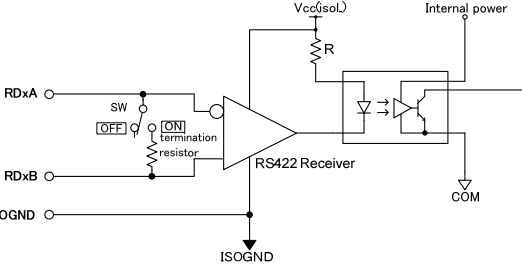
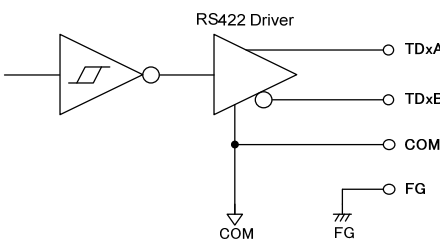
### 6.1.3 Input signal

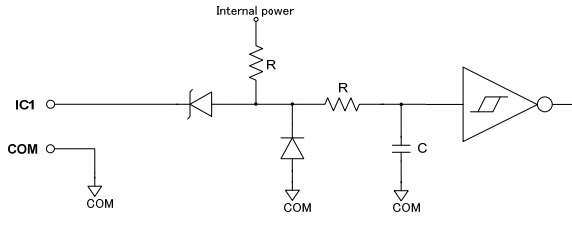
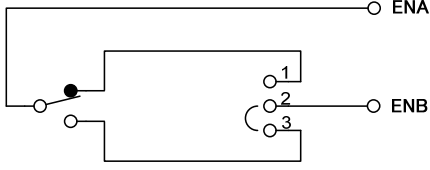
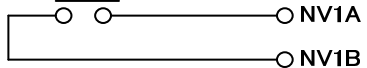
Input signal	No. of circuits	Signal specification
Ship's heading, Rate of turn	2 circuits	IEC61162-1 or IEC61162-2
Ship's heading, Rate of turn	1 circuit	IEC61162-2
Ship's speed	1 circuit	IEC61162-1 or 100 to 900 pulse/NM (100 Pulse step)
GPS (Position, COG, SOG and Time)	1 circuit	IEC61162-1
ECDIS	1 circuit	IEC61162-1 or IEC61162-2
BAMS	1 circuit	IEC61162-1 or IEC61162-2
Alert buzzer stop signal	1 circuit	Contact

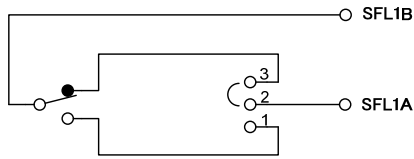
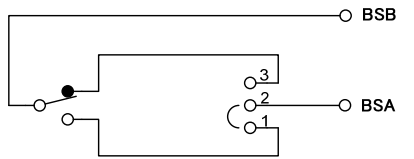
### 6.1.4 Output signal

Output signal	No. of circuits	Signal specification
ECDIS	1 circuit	IEC61162-1 or IEC61162-2
BAMS	1 circuit	IEC61162-1 or IEC61162-2
VDR, MHR110A, MHR120, MDR290(YOKOGAWA products)	4 circuits	IEC61162-1 or IEC61162-2
BNWAS: Enable	1 circuit	Contact
BNWAS: Watch timer Reset	1 circuit	Contact
Power fail	2 circuits	Contact
Actuator fail (From CONTROL & POWER BOX)	2 circuits	Contact
System fail	2 circuits	Contact
Off heading alert	2 circuits	Contact
Alert buzzer stop signal	1 circuit	Contact

### 6.1.5 External input / output signal specifications and circuits

Circuit name	Abbreviation	Circuit / Signal specification
IEC61162-1 Input	RDxH RDxC  (x=Number)	 <p>no-voltage contact input Input circuit : Photo-coupler Transmission format : Start-stop serial signal Transmission rate: 4800bps</p>
IEC61162-1 Output	TDxA TDxB FG  (x=Number)	 <p>Output circuit: RS485/RS422 Transceiver Transmission format : Start-stop serial signal Transmission rate: 4800bps</p>
IEC61162-2 Input	RDxA RDxB ISOGND  (x=Number)	 <p>Input circuit : RS422 Receiver Transmission format : Start-stop serial signal Transmission rate : 38400bps</p>
IEC61162-2 Output	TDxA TDxB COM FG  (x=Number)	 <p>Output circuit: RS485/RS422 Transceiver Transmission format : Start-stop serial signal Transmission rate : 38400bps</p>

Circuit name	Abbreviation	Circuit / Signal specification															
Ship's speed Pulse signal	IC1 COM	 <p>                         Input circuit : CMOS                          Withstanding voltage : 32VDC Max                          Pulse rate : 200 Pulse/NM                     </p>															
BNWAS Contact output	ENA ENB  RSTA RSTB	 <p>                         Output circuit : no-voltage contact                          Contact rating : 24VDC 0.5A                     </p> <table border="1"> <thead> <tr> <th>State</th> <th>JP1-2</th> <th>JP2-3(Normal)</th> </tr> </thead> <tbody> <tr> <td>Power off</td> <td>Close</td> <td>Open</td> </tr> <tr> <td>Non Active</td> <td>Close</td> <td>Open</td> </tr> <tr> <td>Active</td> <td>Open</td> <td>Close</td> </tr> <tr> <td>CPU fail</td> <td>Close</td> <td>Open</td> </tr> </tbody> </table>	State	JP1-2	JP2-3(Normal)	Power off	Close	Open	Non Active	Close	Open	Active	Open	Close	CPU fail	Close	Open
State	JP1-2	JP2-3(Normal)															
Power off	Close	Open															
Non Active	Close	Open															
Active	Open	Close															
CPU fail	Close	Open															
Power fail Contact output	NV1A NV1B  NV2A NV2B	 <p>                         Output circuit : no-voltage contact                          Contact rating : 24VDC 0.5A                     </p> <table border="1"> <thead> <tr> <th>Power</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>On</td> <td>Close</td> </tr> <tr> <td>Off</td> <td>Open</td> </tr> </tbody> </table>	Power	Output	On	Close	Off	Open									
Power	Output																
On	Close																
Off	Open																

Circuit name	Abbreviation	Circuit / Signal specification															
System fail Contact output	SFL1A SFL1B  SFL2A SFL2B	 <p>Output circuit : no-voltage contact Contact rating : 24VDC 0.5A</p>															
Off heading alert Contact output	CRS1A CRS1B  CRS2A CRS2B	<table border="1"> <thead> <tr> <th>State</th> <th>JP1-2</th> <th>JP2-3(Normal)</th> </tr> </thead> <tbody> <tr> <td>Power off</td> <td>Open</td> <td>Close</td> </tr> <tr> <td>Normal</td> <td>Open</td> <td>Close</td> </tr> <tr> <td>Fail</td> <td>Close</td> <td>Open</td> </tr> <tr> <td>CPU Fail</td> <td colspan="2">Before state holding</td> </tr> </tbody> </table>	State	JP1-2	JP2-3(Normal)	Power off	Open	Close	Normal	Open	Close	Fail	Close	Open	CPU Fail	Before state holding	
State	JP1-2	JP2-3(Normal)															
Power off	Open	Close															
Normal	Open	Close															
Fail	Close	Open															
CPU Fail	Before state holding																
Alert buzzer stop Contact output	BSA BSB	 <p>Output circuit : no-voltage contact Contact rating : 24VDC 0.5A</p> <table border="1"> <thead> <tr> <th>State</th> <th>JP1-2(Normal)</th> <th>JP2-3</th> </tr> </thead> <tbody> <tr> <td>Power off</td> <td>Open</td> <td>Close</td> </tr> <tr> <td>Normal</td> <td>Open</td> <td>Close</td> </tr> <tr> <td>Fail</td> <td>Close</td> <td>Open</td> </tr> <tr> <td>CPU Fail</td> <td>Open</td> <td>Close</td> </tr> </tbody> </table>	State	JP1-2(Normal)	JP2-3	Power off	Open	Close	Normal	Open	Close	Fail	Close	Open	CPU Fail	Open	Close
State	JP1-2(Normal)	JP2-3															
Power off	Open	Close															
Normal	Open	Close															
Fail	Close	Open															
CPU Fail	Open	Close															

## 6.2 Serial input/output data sentence

Input/output	Sentence	Standard	Data	Interval
Input	HRC	Proprietary sentence	Heading / Rate of turn	-
	HDM	IEC61162-1/-2	Heading	-
	HDT	IEC61162-1/-2	Heading	-
	HDG	IEC61162-1/-2	Heading	-
	THS	IEC61162-1/-2	Heading	-
	ROT	IEC61162-1/-2	Rate of turn	-
	VMVSD	Proprietary sentence	Ship's speed	-
	VHW	IEC61162-1	Ship's speed	-
	VBW	IEC61162-1	Ship's speed	-
	VTG	IEC61162-1	Ship's speed	-
	VDR	IEC61162-1/-2	Set & Drift	-
	ZDA	IEC61162-1	Date and Time	-
	GGA	IEC61162-1	Ship's position	-
	XTE	IEC61162-1/-2	Cross track error	-
	HSC	IEC61162-1/-2	Heading steering command	-
	HTC	IEC61162-1/-2	Heading/track control command	-
	ACM	IEC61162-1/-2	Alert : Command	-
HBT	IEC61162-1/-2	Alert : Heartbeat supervision	-	
Output	HTD	IEC61162-1/-2	Heading/track control data	1sec
	RSA	IEC61162-1/-2	Rudder angle (Feedback, Actual rudder)	1sec
	ROR	IEC61162-1/-2	Rudder angle (Order)	1sec
	ALF	IEC61162-1/-2	Alert : Alert sentence	Event
	ALC	IEC61162-1/-2	Alert : Cyclic alert list	10sec
	ARC	IEC61162-1/-2	Alert : Alert command refused	Event
	HBT	IEC61162-1/-2	Alert : Heartbeat supervision	60sec



## 6.3 Default settings

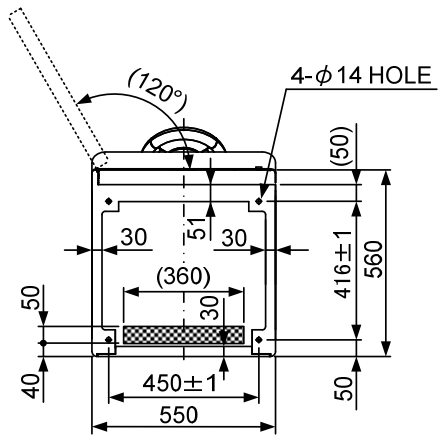
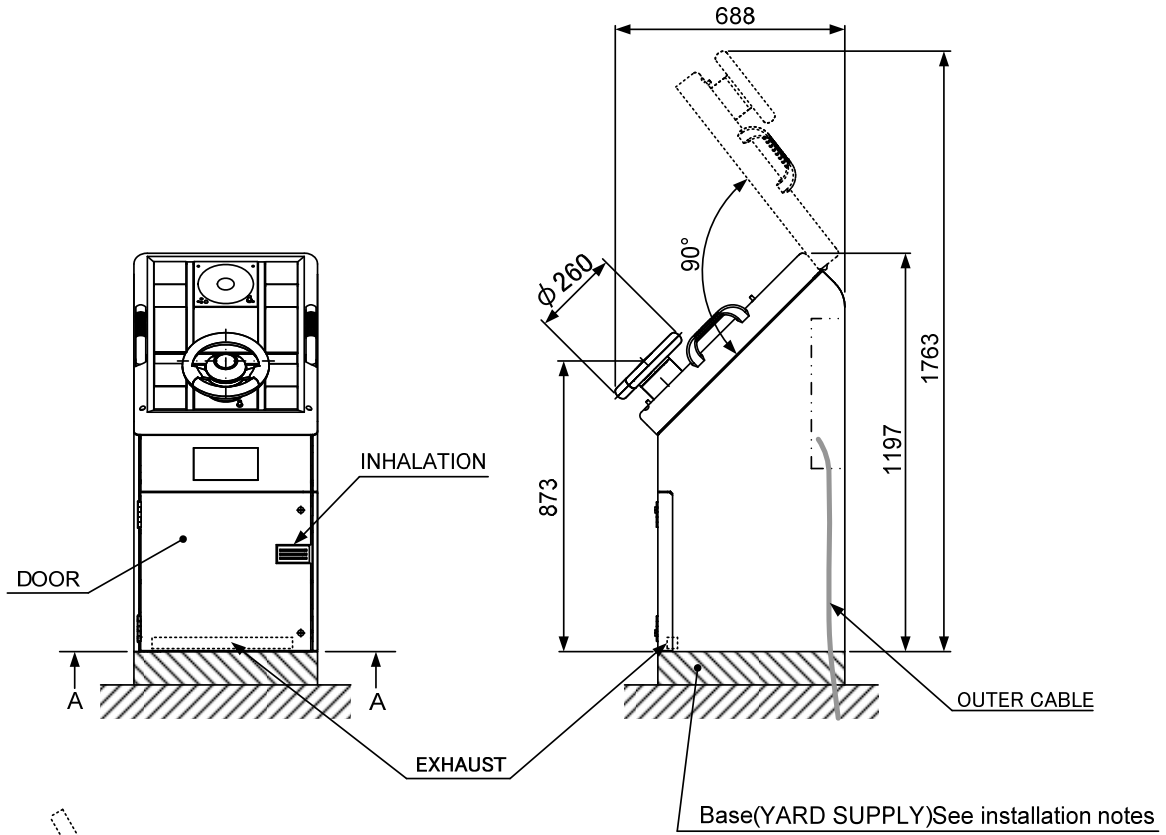
Default settings that means our factory settings is shown the table below.

- AUTOPILOT CONTROL & DISPLAY UNIT

Screen	Setting items	Default value
[HOME]	Control Mode	Setting by system configuration
	Steering Mode	HAND
	Heading Select	GYRO
	Operation	Economy
	Loading	Full
	Turn Mode	P-D
	Speed	AUTO (PT900D: Manual)
	Display mode	Day
[1 Brilliance/contrast]	See. 4.4.2	See. 4.4.2
[2 Alert List]	See. 4.7.2	See. 4.7.2
[4-2 Display customize]	See. 4.7.3	See. 4.7.3
[4-3 Control]	See. 4.7.4	See. 4.7.4
[4-4 Parameter]	See. 4.7.5	See. 4.7.5
[4-5 Forward Distance]	See. 4.7.6	See. 4.7.6

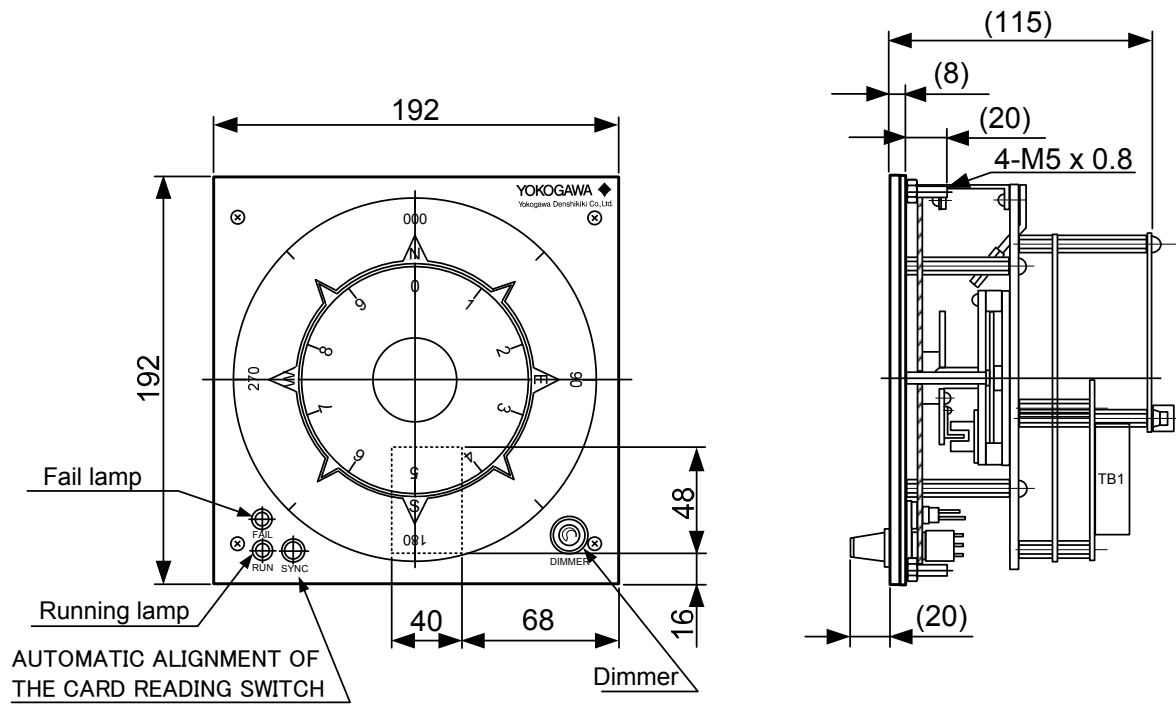
## 6.4 Outlines

- CONTROL STAND [MPM190]

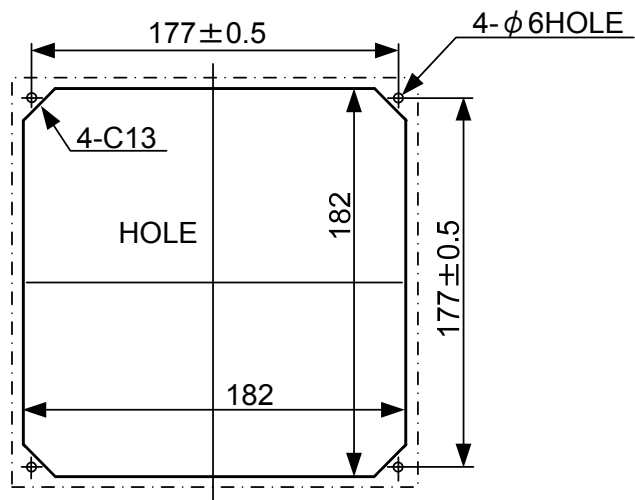


FIXING DIMENSION (Section A-A)

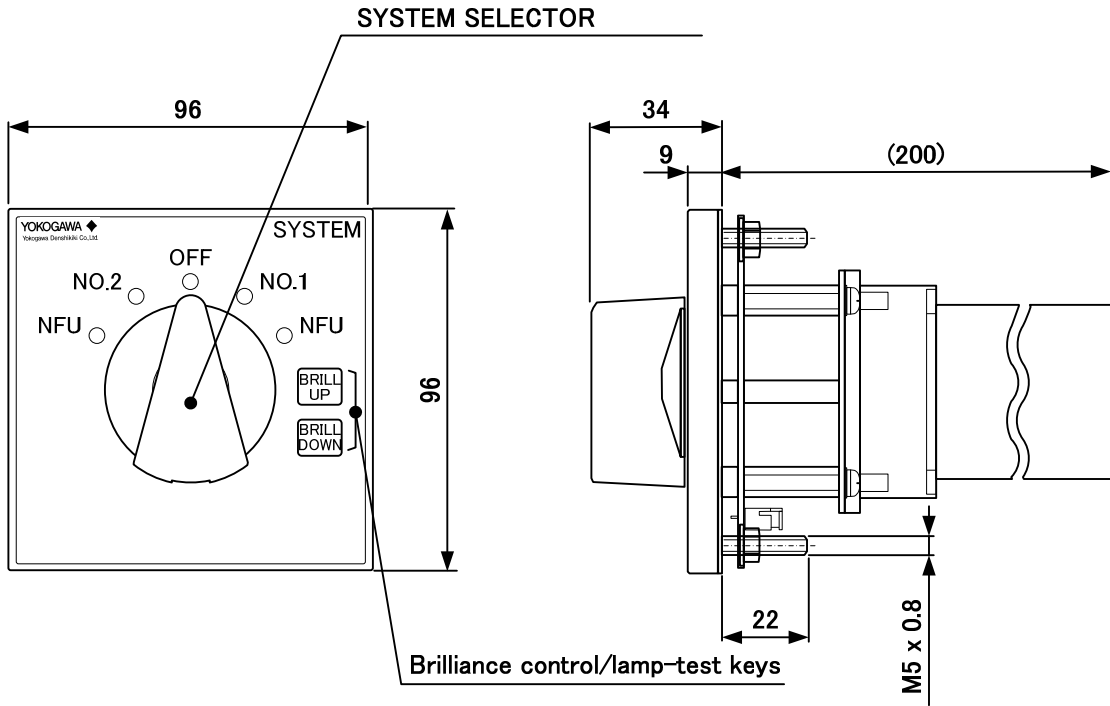
● STEERING REPEATER COMPASS [MKR056]



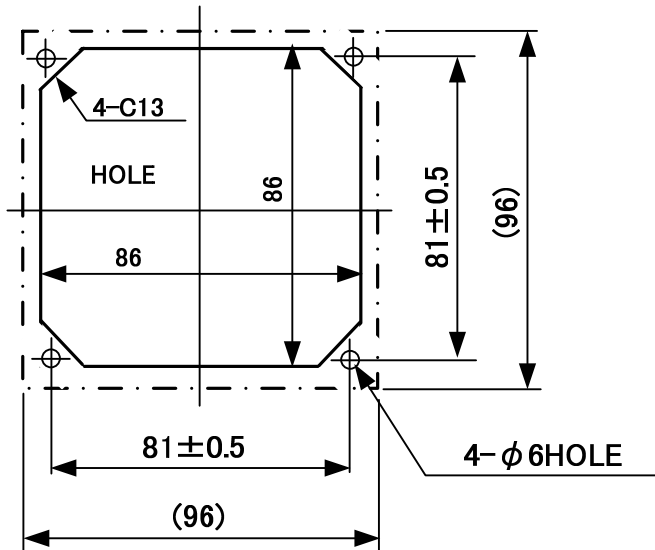
PANEL CUT



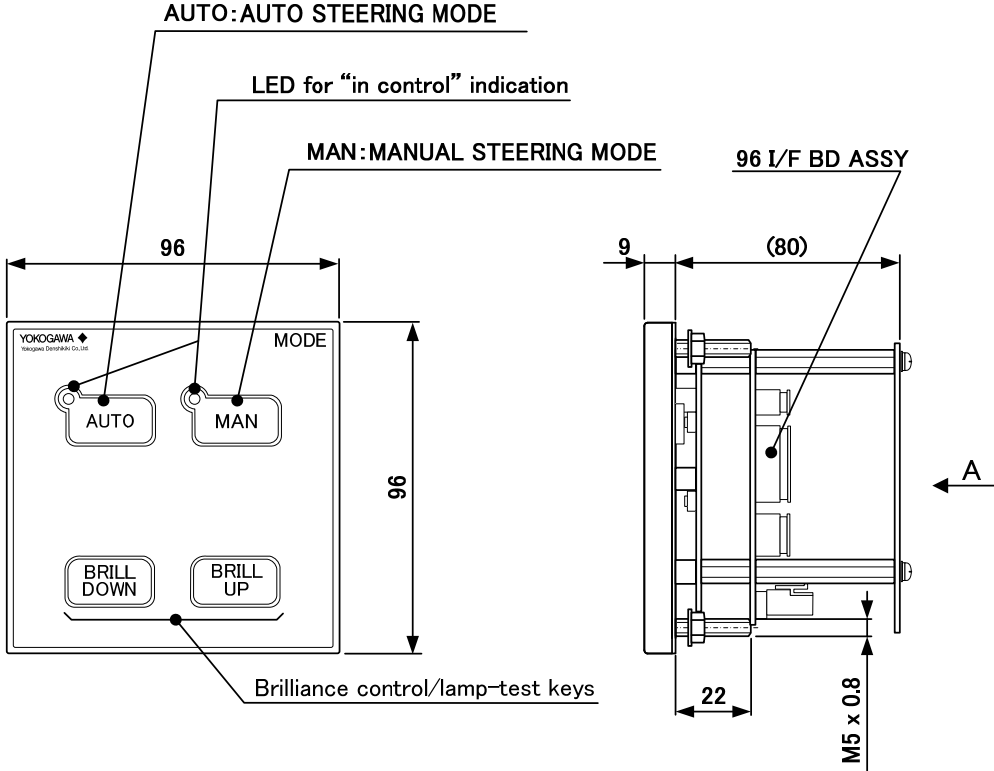
● SYSTEM SELECTOR [MPH790]



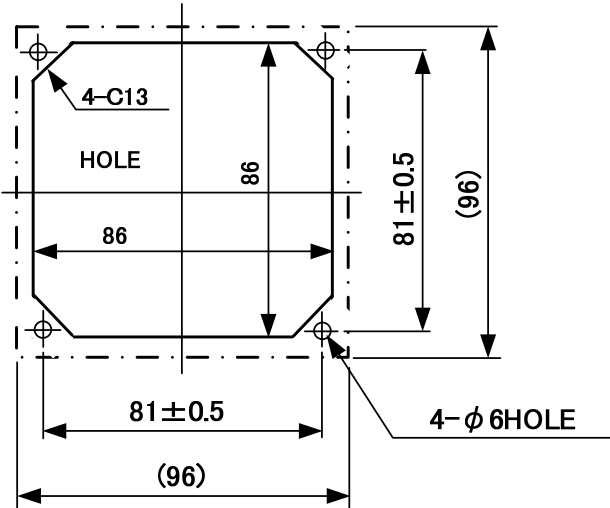
**PANEL CUT**



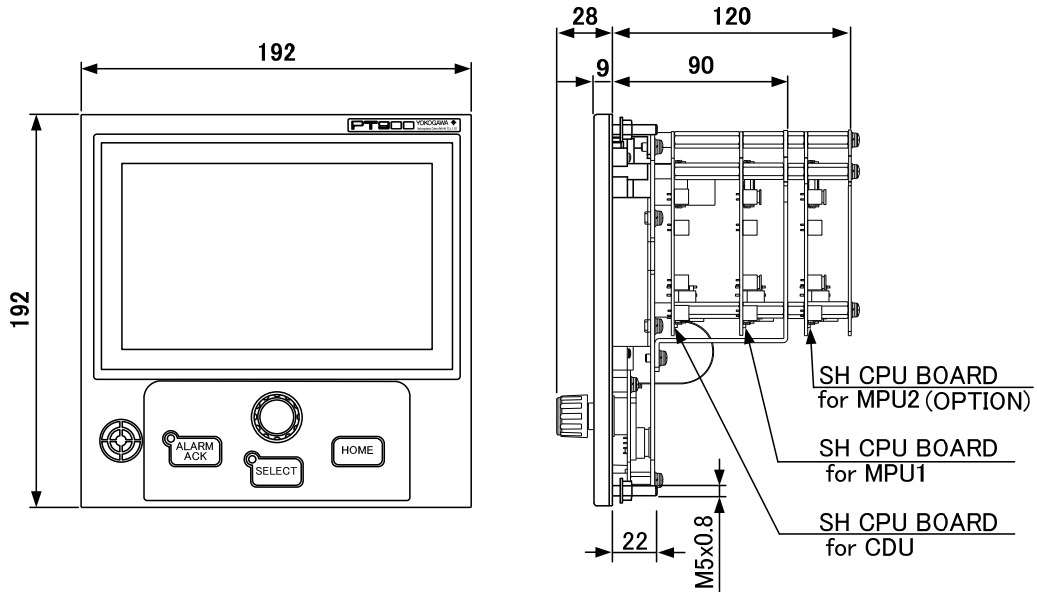
● MODE SELECTOR [MPH791]



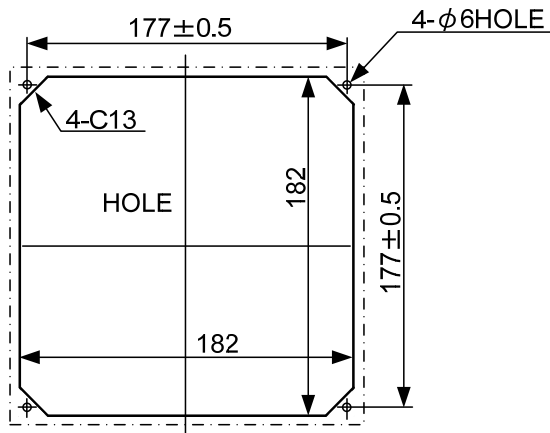
PANEL CUT



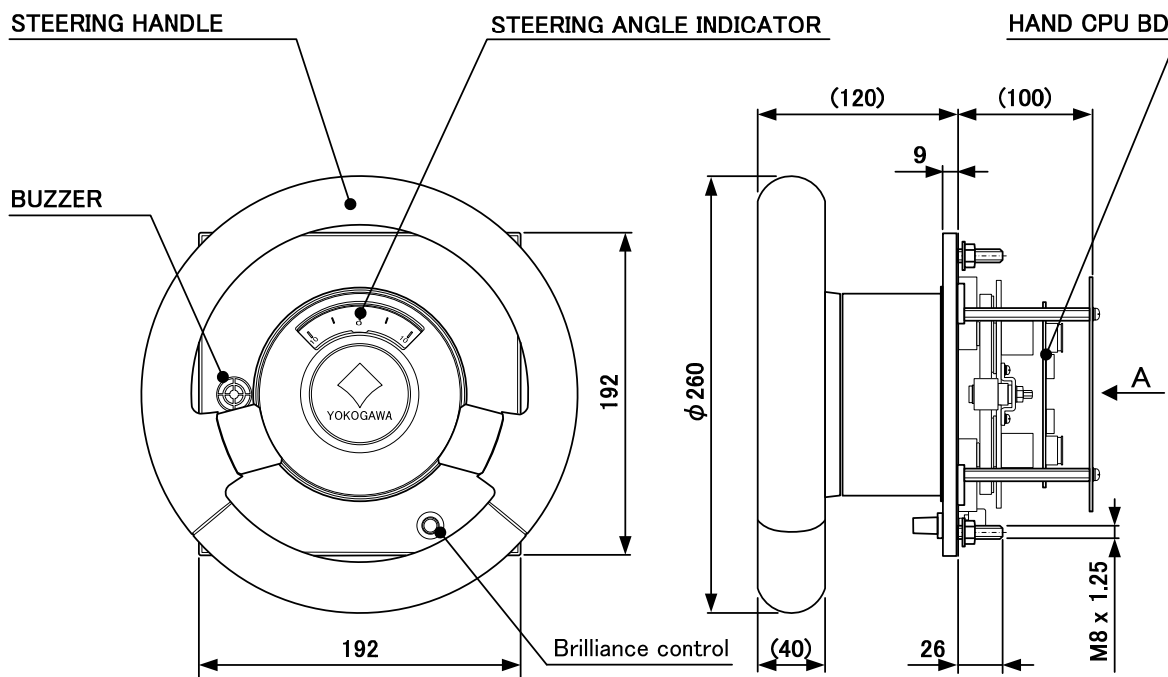
● AUTOPILOT CONTROL & DISPLAY UNIT (AP CDU) [MPH490]



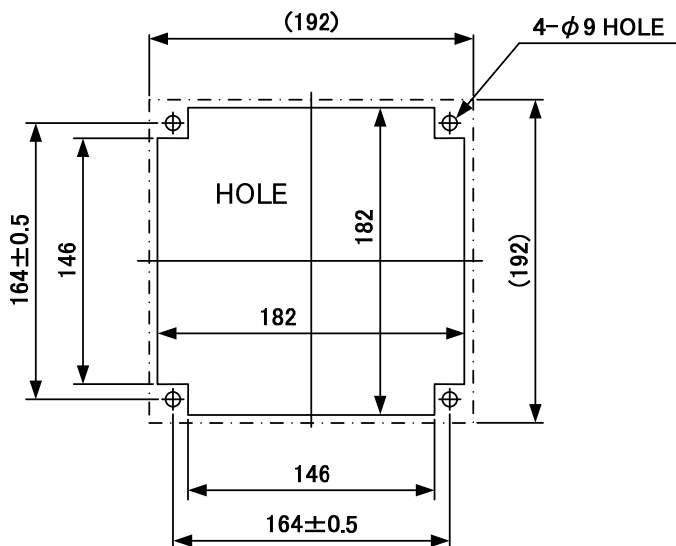
PANEL CUT



● HAND STEERING UNIT [MPB390]

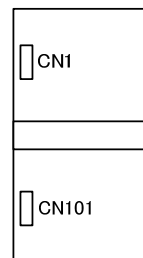


PANEL CUT

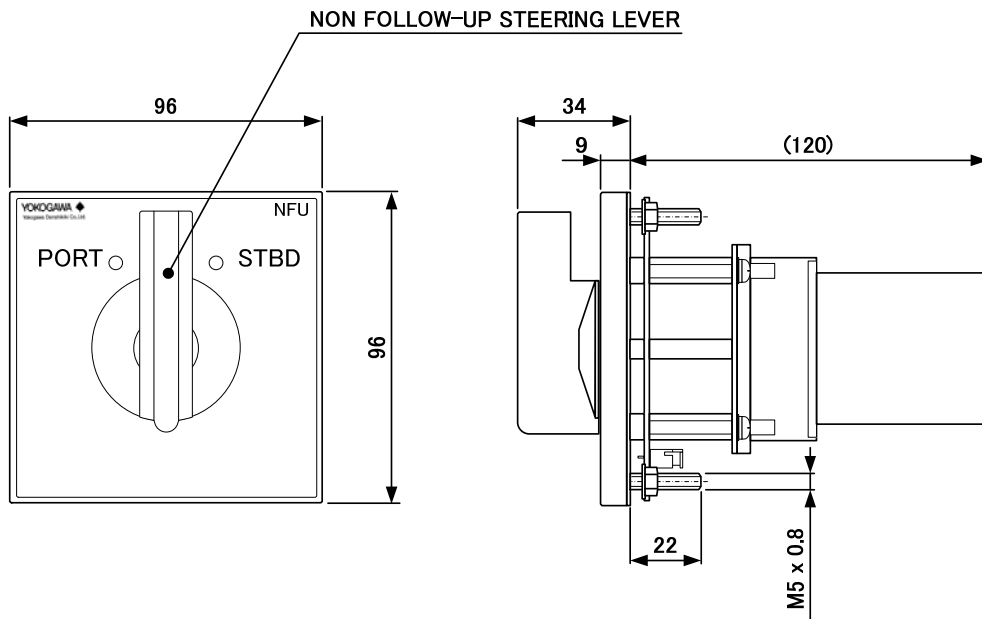


View A

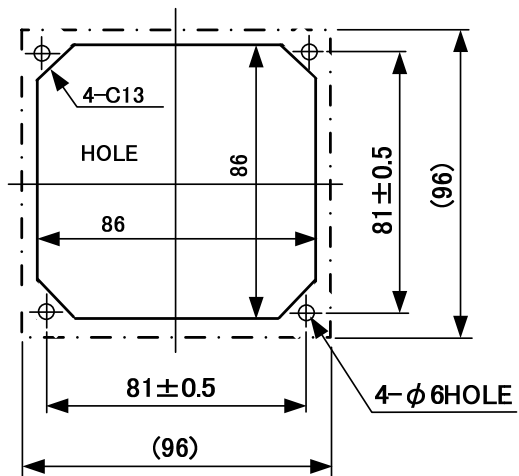
HAND CPU BD connector layout



● NFU LEVER [MPB391]

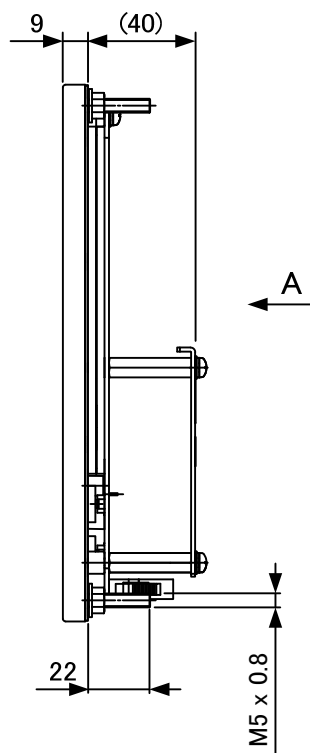
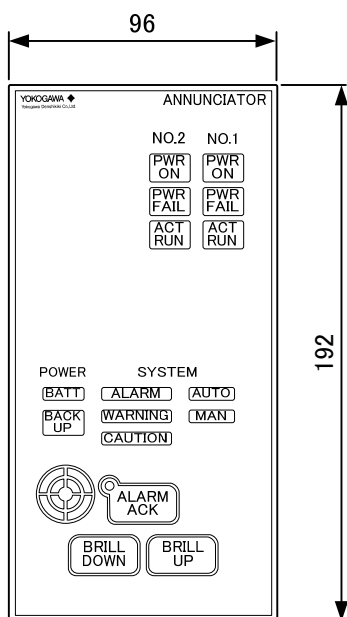


PANEL CUT

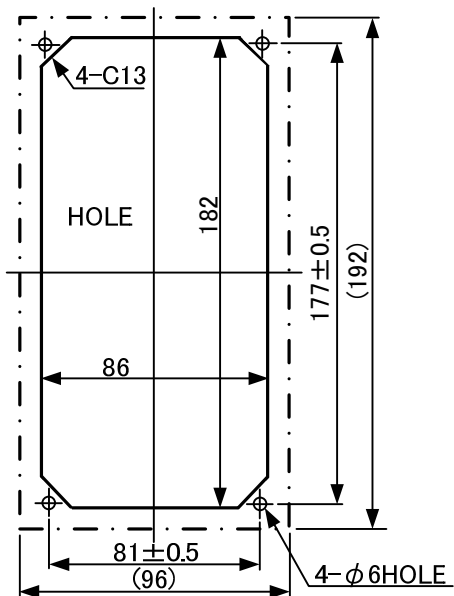




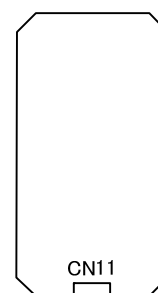
● ANNUNCIATOR UNIT [MPH690]



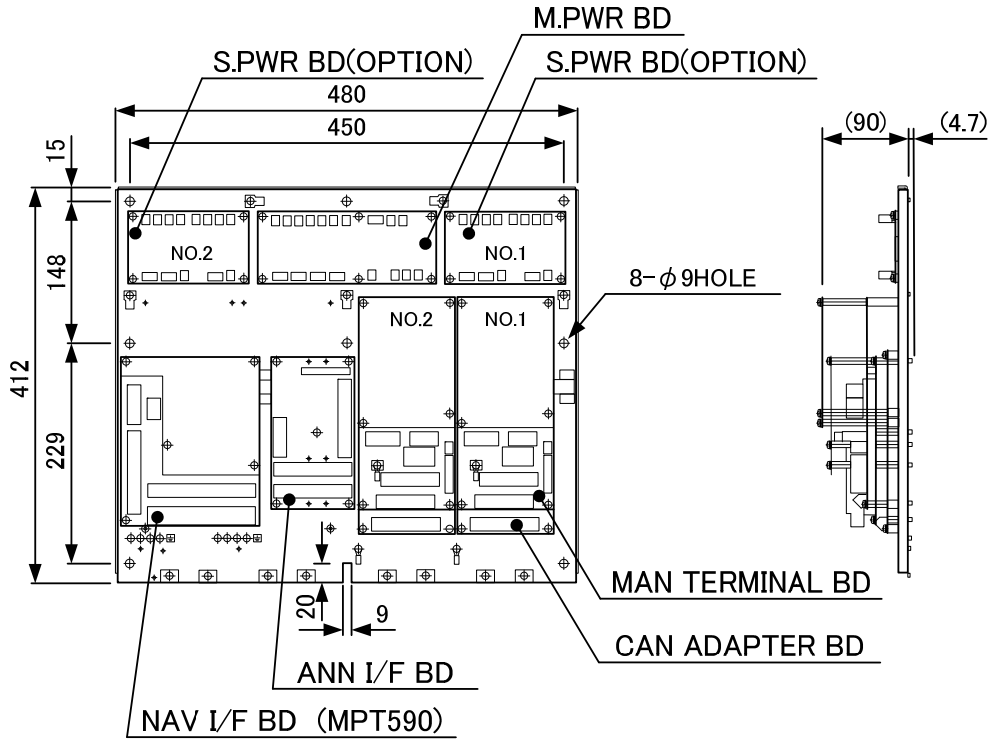
PANEL CUT



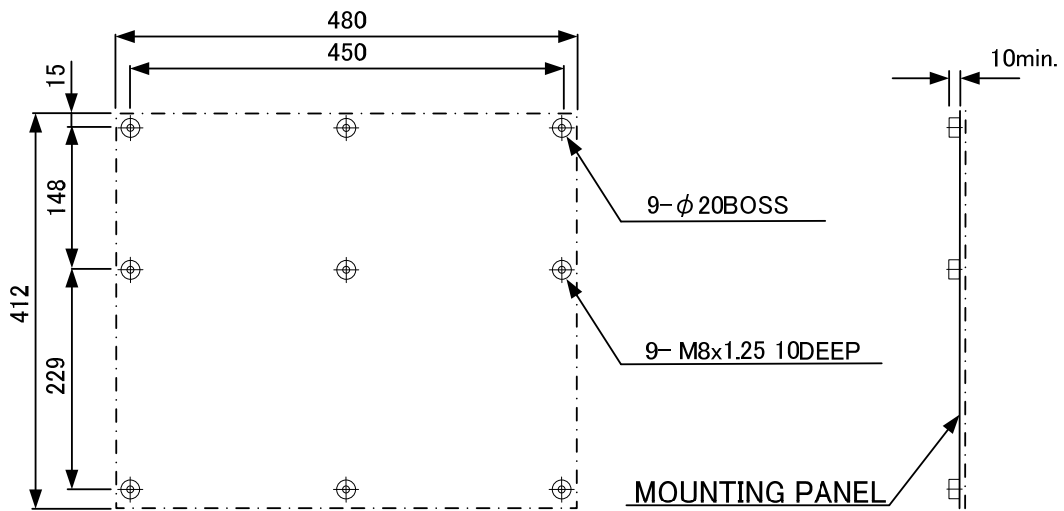
View A



- NAV I/F UNIT [MPT590]
- MAIN CONTROL UNIT (MCU) [MPH291]



MOUNTING ARRANGEMENT



## 7. Maintenance and Inspection

Please inspect the following items according to the following procedures for safe-operation. Refer to the steering gear equipment's instruction manual for daily and regular inspection of steering gear equipment. (i.e. CONTROL & POWER BOX and  $\mu$ -TRANSMITTER)

### 7.1 Daily and Regular inspection by user

Inspection item and recommended interval are shown in the table below.

Inspection item	Inspection Contents and Procedure	Interval
Manual steering (FU)	Press "MAN" key on MODE SELECTOR and steer the HAND STEERING UNIT to check if the rudder is steered correctly.	Once/day
Manual steering (NFU)	Select "NFU" at SYSTEM SELECTOR and lean the NFU LEVER to check if the rudder is steered correctly.	Once/day
Auto steering	Press "AUTO" key on MODE SELECTOR and change the set heading (1 to 2 degrees from current heading) by the course setting dial. Check if the rudder is steered correctly.	Once/day
Remote steering (FU or NFU)	Change the steering mode to "Remote steering", and check if the rudder is steered correctly.	Once/day
System changeover	Check the above 4 items to another system and check if both systems work correctly.	Once/day
SYSTEM SELECTOR	Check if the SYSTEM SEECTOR works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.1	Once/week
MODE SELECTOR	Check if the MODE SEECTOR works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.1	Once/week
ANNUNCIATOR UNIT	Check if the ANNUNCIATOR UNIT works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.1	Once/week
AP CDU (Lamp test)	Check if the AP CDU works correctly. Press BRILL DOWN/UP key together for lamp test. See 4.9.2	Once/week
AP CDU (Touch panel)	Tap the touch panel and check if the touch panel responses correctly.	Once/week

Inspection item	Inspection Contents and Procedure	Interval
Ship's heading input	Check the heading indication on AP CDU and the steering repeater if both values are same. In case PT900 is connected 2 or 3 heading sources, elect the other heading source and check if AP CDU heading indication is same as the source of heading sensor.	Once/week
MAIN CONTROL UNIT	Check if the RL8 of MAN TERMINAL BD which is installed on the baseplate of MAIN CONTROL UNIT is excited one time when you select "NO.1" or "NO.2" at SYSTEM SELECTOR.	Once/half year
Screw, Fixing parts	Check the terminals and fixing screw if they are loose. If the screw or connected cables are loose, retighten them.	Once/half year

## 7.2 Regular maintenance

Execute regularly the following maintenance once a year.

### Note

Please contact our Service Department for general inspection.

Inspection item	Procedure
HAND STEERING UNIT	There is a click to recognize the center position of hand wheel. Please distribute the grease for the click of center. The type of grease is EPONEX GREASE NO.2 produced by IDEMITSU KOSAN Co., Ltd. Do not distribute the other parts.
HAND STEERING UNIT	Check the tension of timing belt inside HAND STEERING UNIT
MAIN CONTROL UNIT	Check if the RL8 of MAN TERMINAL BD which is installed on the baseplate of MAIN CONTROL UNIT is excited one time when you select "NO.1" or "NO.2" at SYSTEM SELECTOR.

## Annex-1 Basic autopilot action

Fig. 1-1 shows an overview of adaptive control.

### 1.1 Steering for Fuel Saving

The basic of fuel saving in steering is to minimize sea water reaction when the rudder is activated. When rudder movement occurs, the increased reaction of sea water results in an increase in the load on the engine, causing the engine speed to drop. The governor prevents the engine speed from decreasing, thereby ensuring constant control. This results in increased fuel consumption. To put it another way, the ship speed decreases when the reaction increases. These facts indicate that economical steering of the ship is ensured by navigation along the set course with minimal rudder movement.

Each ship has its own dynamic characteristics. The response time of a ship varies depending on these characteristics. The ship will not respond if the rudder is moved quickly beyond its capacity limit. This limit is called the response limit of a ship. The dynamic characteristics vary with the load, trim and ship speed. This requires compensation based on correct information of these factors.

Yawing detected by the gyroscope is caused by two factors: the dynamic characteristics of the ship and the noise from waves or the like. From a fuel-saving viewpoint, it is not recommended that the rudder be activated in response to high-frequency noise in excess of the response limit of the ship. Furthermore, it is not recommended that the rudder be moved resulting in great changes in rudder angle control.

### 1.2 Adaptive Autopilot Control Algorithm

Fuel saving is ensured by the effective removal of noise and minimized rudder movement based on correct information on the dynamic characteristics of the ship, as discussed above.

The PT900A Adaptive Autopilot is provided with a built-in extended Kalman filter and optimal controller.

#### (1) Kalman filter

Statistic concepts are extensively used for more accurate extraction of information obtained from the input containing irregular noise. Recently, Kalman filters have come to be used to pick up in-formation on the dynamic characteristics of a ship from its yawing detected by a gyrocompass.

The Kalman filter is used to estimate the rate of turn resulting from operation of the rudder to some extent by effective removal of the included noise from the gyrocompass output.

The Kalman filter has dynamic characteristics incorporated as a model. This model is turned when the actual rudder angle is given. Operation of this model and the rate of turn measured by the gyrocompass are different. This difference is statistically processed to estimate the rate of turn of the ship caused by rudder movement.

---

## **(2) Extended Kalman filter**

As mentioned in the above discussion of the Kalman filter, it has dynamic characteristics incorporated as a model. It was also explained that this model must be changed according to the load, trim and ship speed. The extended Kalman filter has a noise removal function and a function to create a model and to retain its changes.

The function of detecting changes in the model and creating a new model is referred to as "identification". Normally, to identify the dynamic characteristics of a ship, a Z-test is conducted to create a model.

The PT900A Adaptive Autopilot obtains the initial value of the ship model indicating the dynamic characteristics of the ship from its particulars at the time of installation, and stores such information in the adaptive controller. Identification is carried out based on maneuvering by reading the hull parameters when leaving the harbor, and the model is updated.

## **(3) Optimal controller**

Ship yawing as estimated by the extended Kalman filter is input into the optimal controller, and a rudder angle command is transmitted to ensure that the rate of turn will be put on the correct course.

According to the current control theory, "the controlled object is placed under optimal control if some evaluation criteria are provided and optimized."

As evaluation criteria, the PT900A Adaptive Autopilot provides optimal control on the basis of fuel-saving evaluation criteria using the heading deviation, rate of turn and rudder angle as functions. Controller parameters are automatically determined from the hull model corrected for ship speed and the above mentioned evaluation functions, thereby eliminating the need for hand setting work as in a conventional autopilot.

## **1.3 Changes in Weather Conditions and Adaptive Autopilot**

The above discussion is based on the assumption that the ship is cruising on a calm noiseless sea. When the sea is rough, the noise from waves or the like will increase, having an increased impact on the turn of the ship. This degrades the estimated heading accuracy of the Kalman filter.

Under this condition, however, the controller operates in such a way as to minimize the rudder angle, so it provides the following advantages over a conventional autopilot using weather adjustment:

- Improved fuel saving properties despite worsening weather conditions
- Increased yawing

The problem is found in the balance between fuel saving and maneuverability.

The PT900A Adaptive Autopilot has an economy mode, course-staying mode and rough-seas steering mode available for selection according to the particular requirements. If maneuverability is degraded, select the course-staying mode.

When economy mode is selected, the autopilot uses BNAAC algorithm which is described as follows.

---

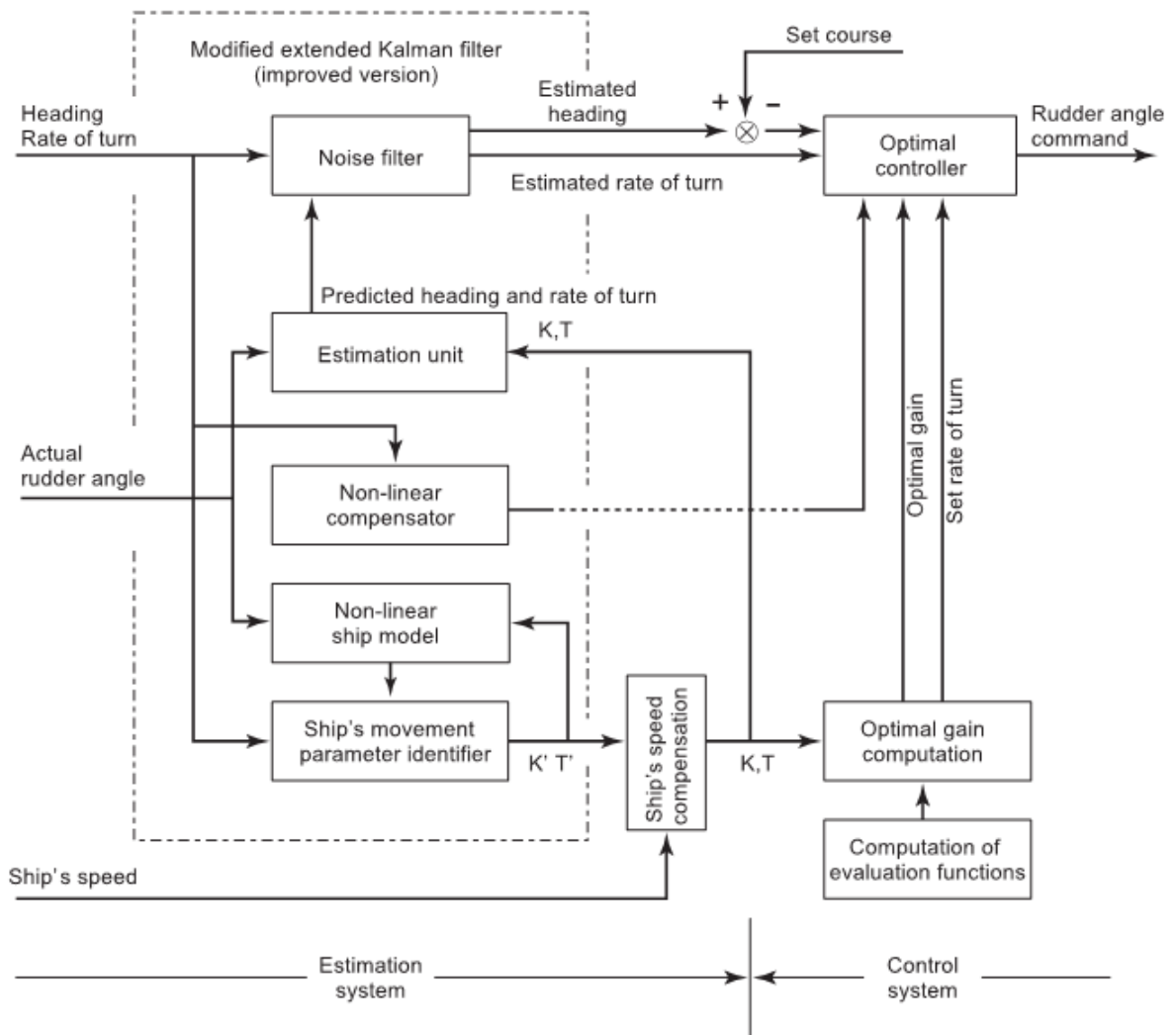


Fig.1-1 Adaptive Autopilot Control Block Diagram

## 1.4 Basic Behavior of BNAAC (Economy mode in PT900A, and A-PLUS)

The “BNAAC” is an abbreviation of “Batch Noise Adaptive Autopilot Controller”.

Fig. 1-2 shows an overview of the “BNAAC”.

The important function of “BNAAC” can be roughly divided into two functions.

- Updating of Ship’s Model
- Update of Optimal Gain

### (1) Updating of Ship’s Model

#### aa. Ship’s Basic Model

This model which expresses characteristics of the ship is quite the same as PT900A autopilot.

#### bb. Model Identifier (Disturbance Model)

Disturbance caused by the wind and the wave is extracted by subtracting the actual deviation and the estimated value of disturbance from ship’s basic model.

This disturbance data is collected for 400 seconds, and the disturbance model is produced with this data.

#### cc. Current Ship’s Model

In this function, ship’s basic model and disturbance model is composed by mathematical combination method. As a result, current ship’s model is generated.

This model expresses “how the ship moves by the rudder under current sea condition”.

### (2) Update of Optimal Gain

This function is computation of optimal rudder gain by current ship’s model.

Performance index works evaluation of the previous rudder control. It is used as the index to calculate the optimal rudder gain.

The optimal rudder controller which is calculated by “Performance index and Gain controller” can achieve fuel saving.

## 1.5 BNAAC and Changes in Weather Conditions

BNAAC can calculate optimal rudder angle by using accurate disturbance model under various sea conditions. If sea condition worsens remarkably, select the course-staying mode like the conventional Adaptive AUTOPILOT.

---



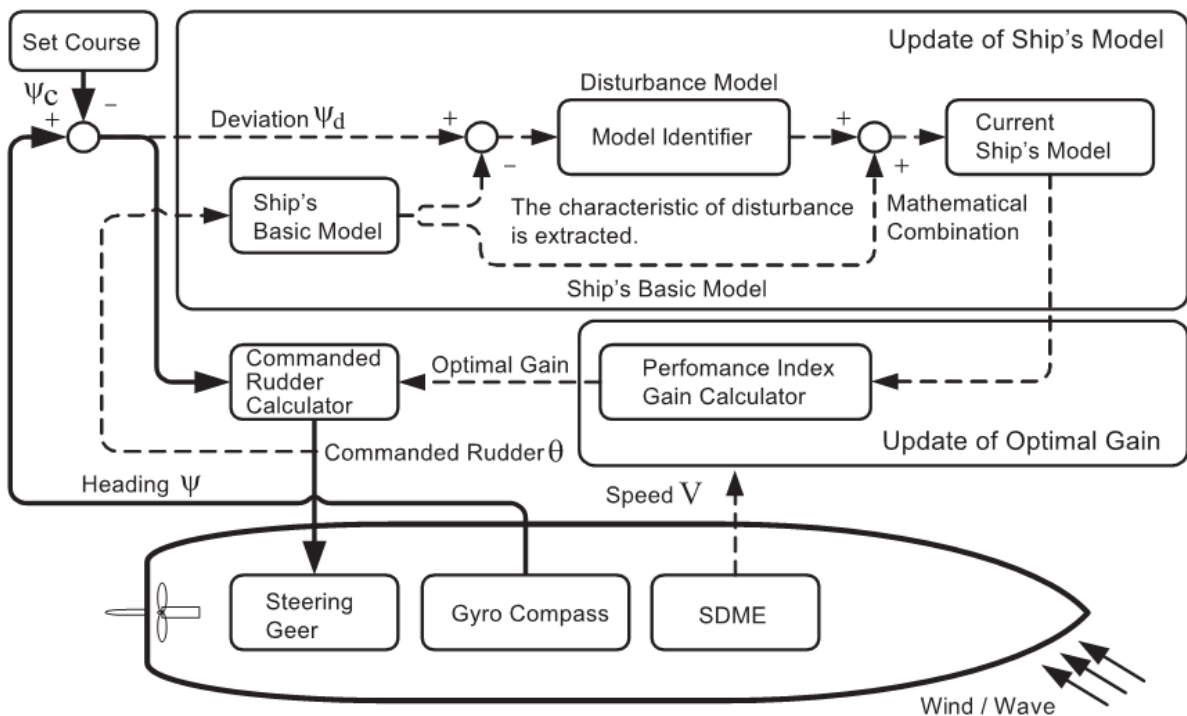


Fig.1-2 Overview of the “BNAAC”

## 1.6 Basic Behavior of Course Control Algorithm (Option)

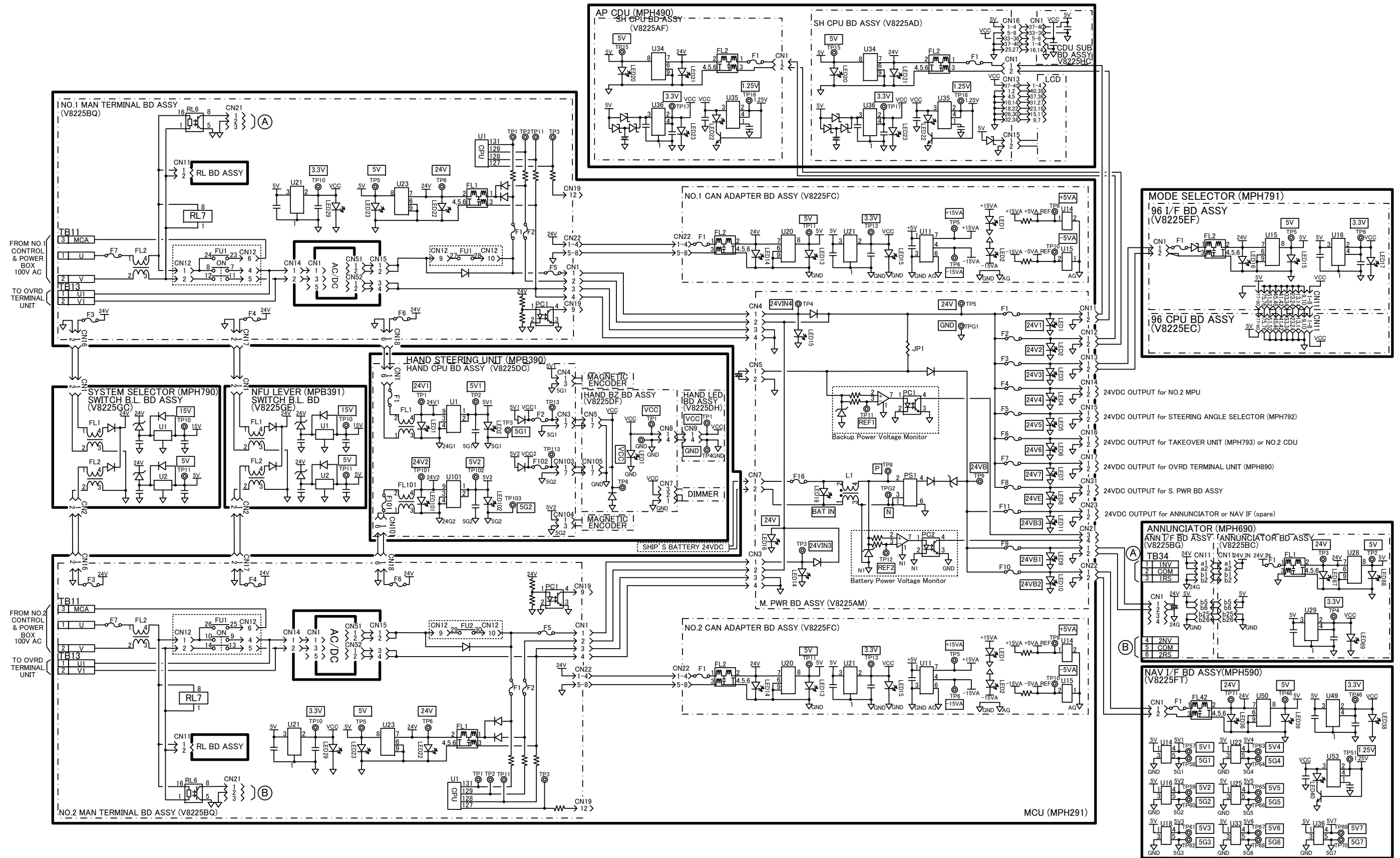
Course control receives GGA (vessel position signal) and VTG (SOG signal) from GPS receiver, and controls the course by implementing automated navigation.

Course control draws virtual course line and virtual destination far-off on it, measures XTD (Cross Track Distance) caused by tidal current and wind-wave, controls the vessel's course to follow on the line, and guides her to the destination with a shorter track of distance.

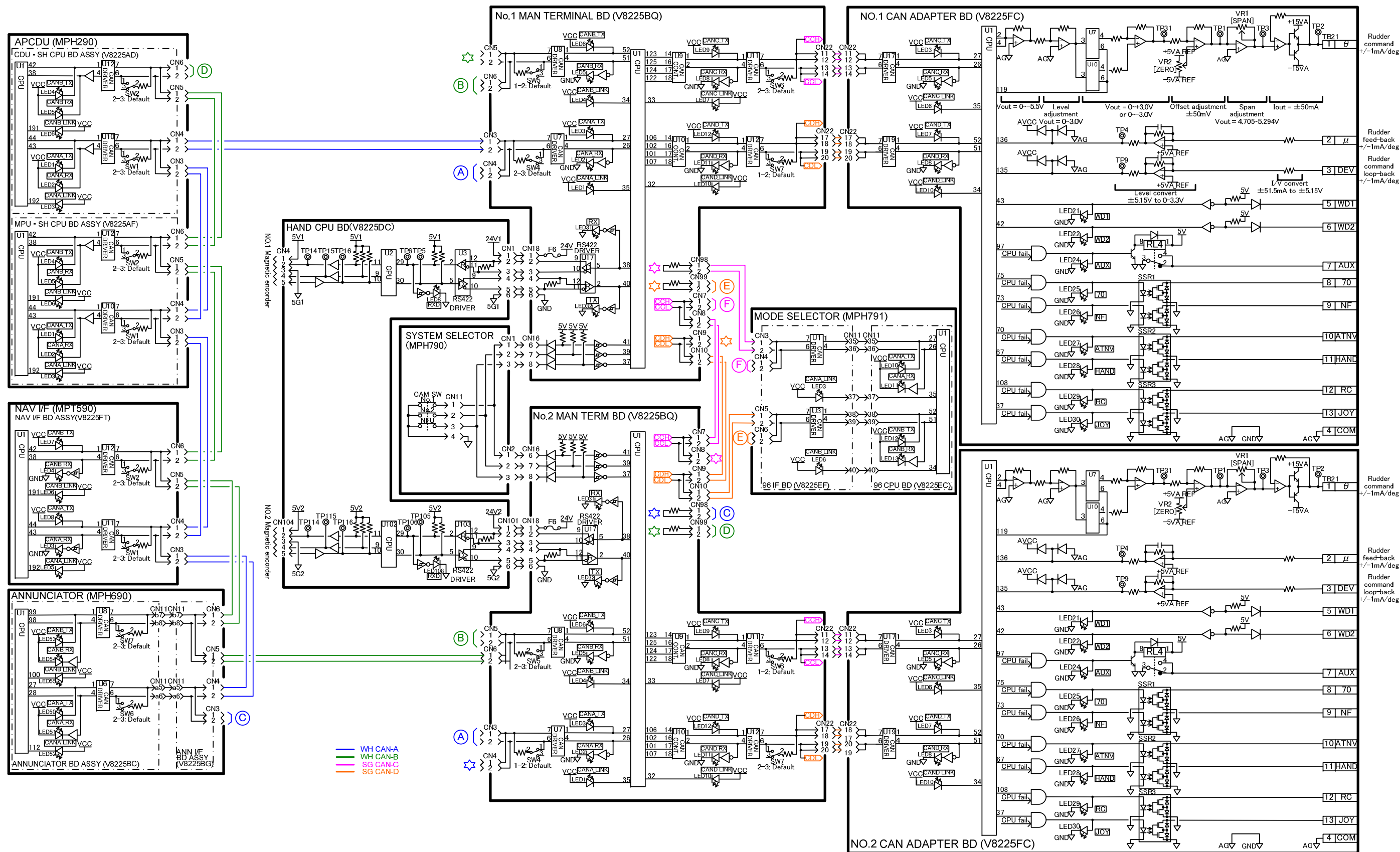


# Annex-2 Circuit Diagram

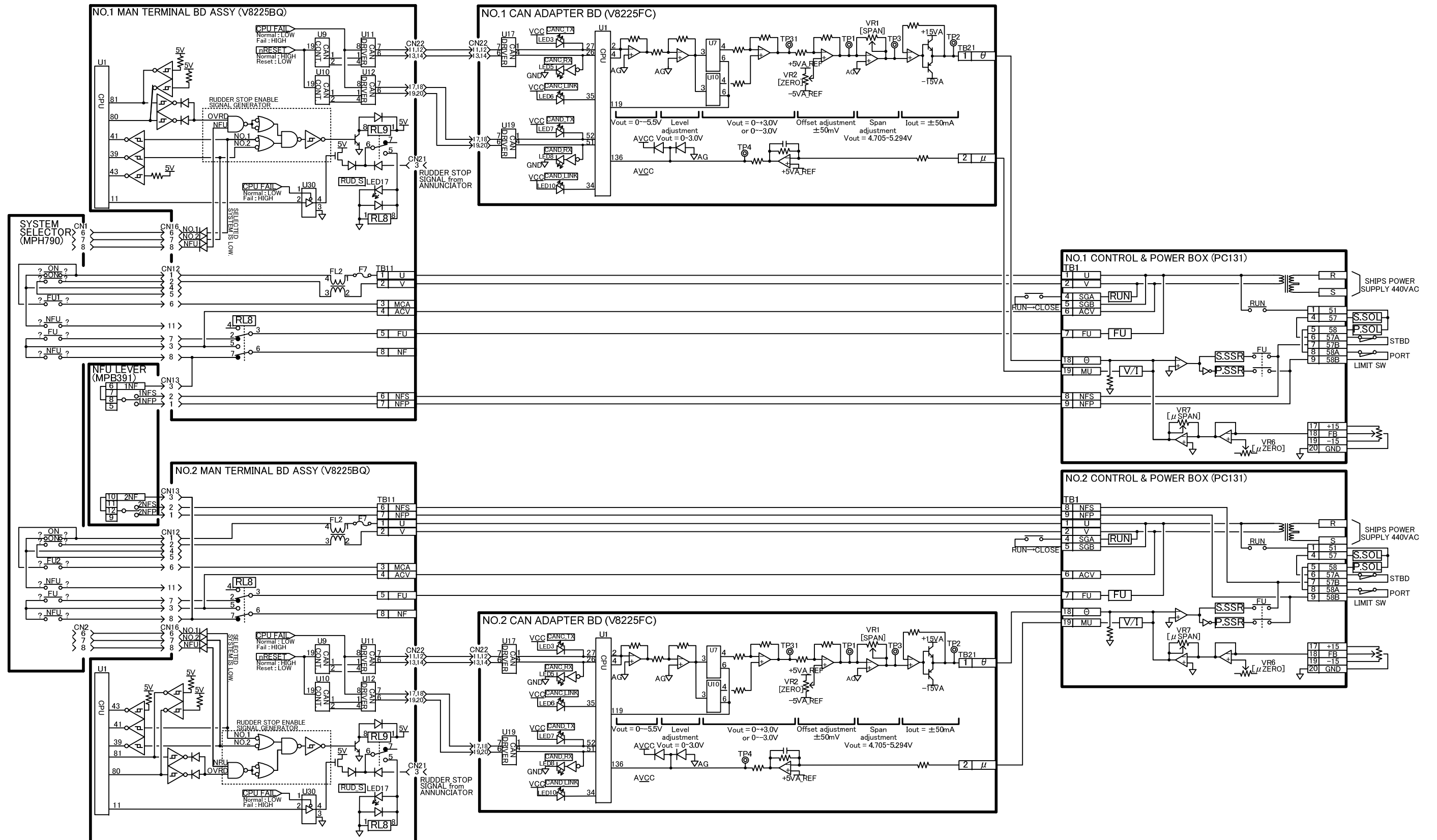
## 2.1 Power Circuit Diagram



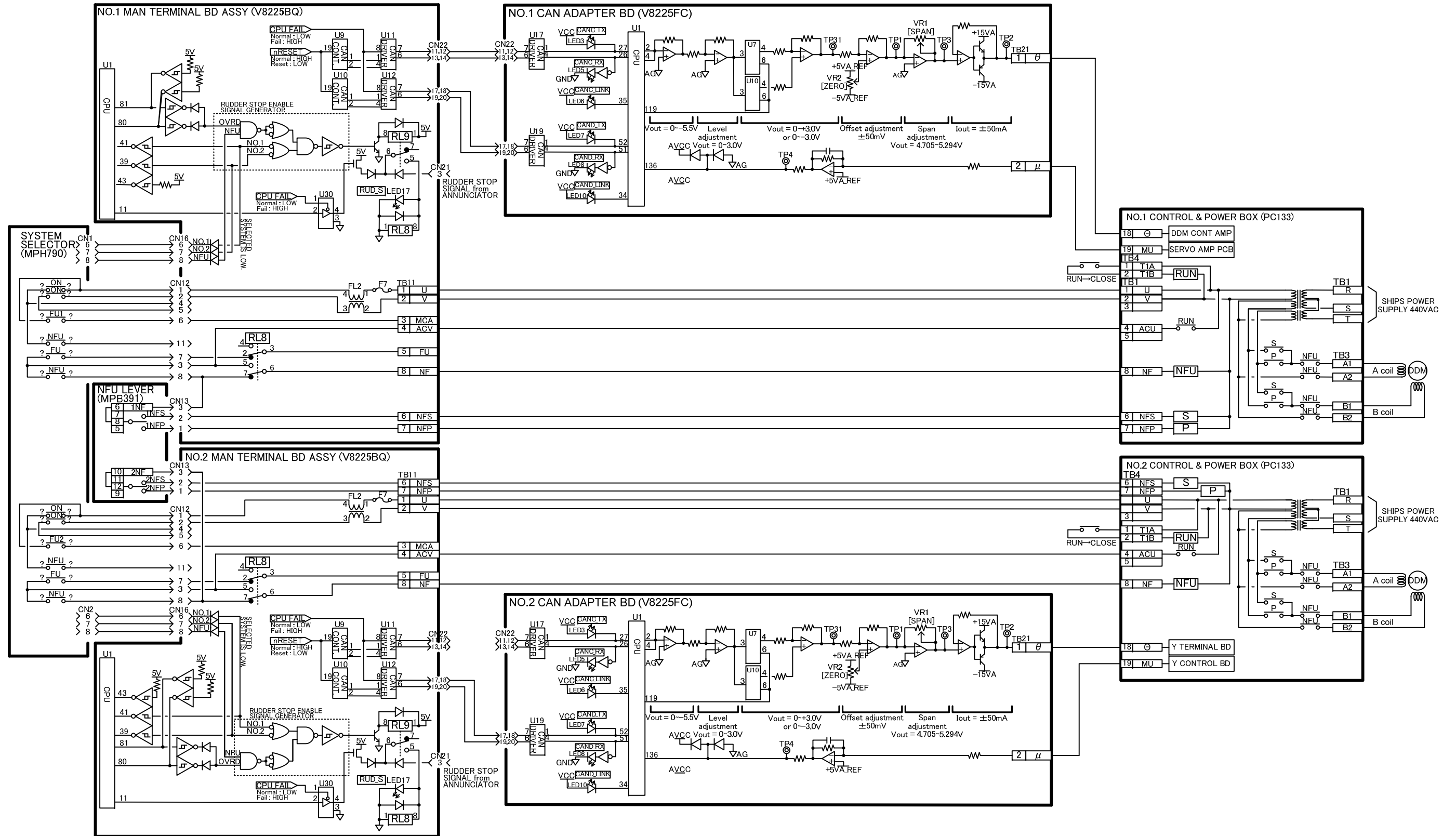
## 2.2 Signal Circuit Diagram (Follow-up steering)



### 2.3 Signal Circuit Diagram (Non-follow-up steering:N2 system)

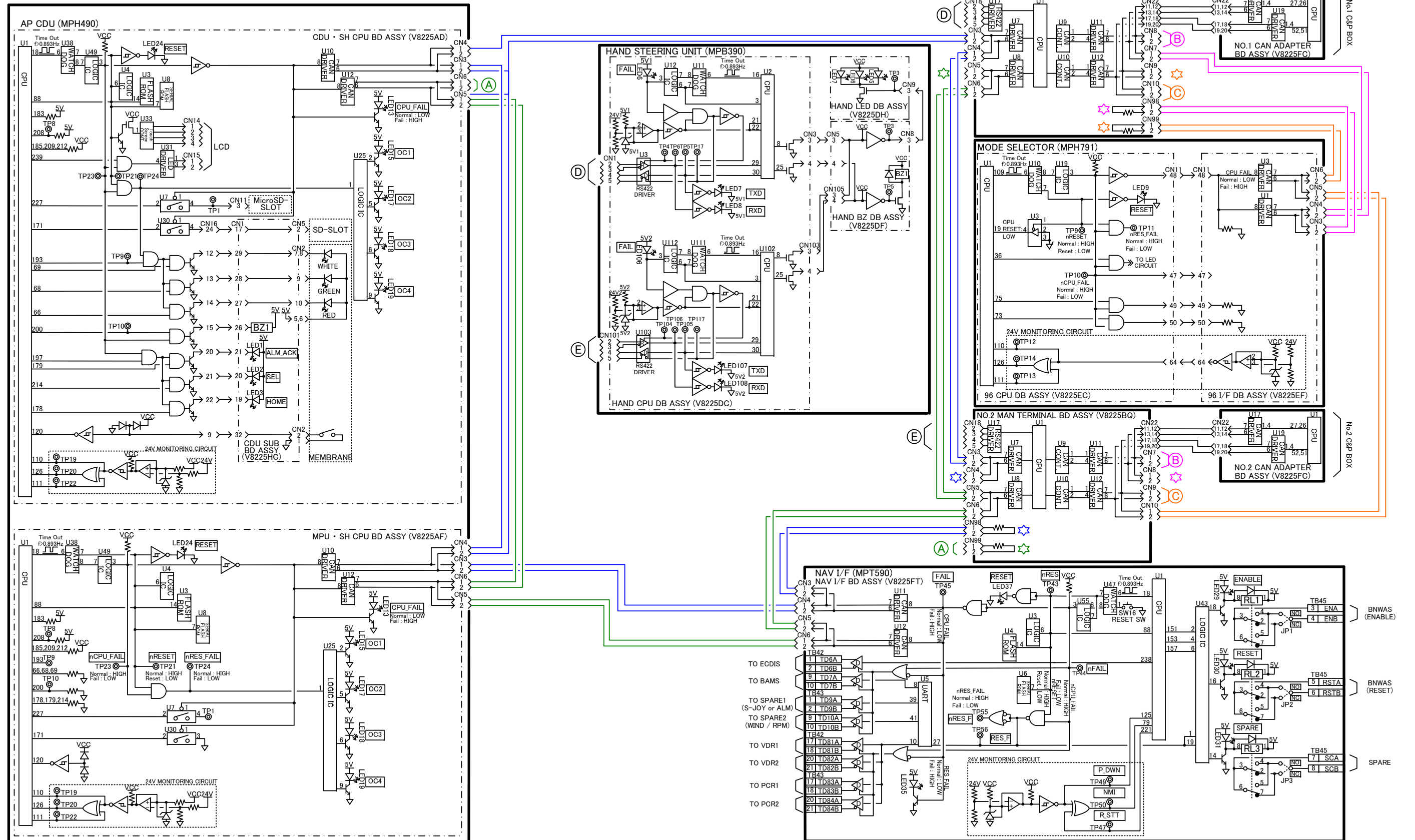


### 2.4 Signal Circuit Diagram (Non-follow-up steering: Y2 system)

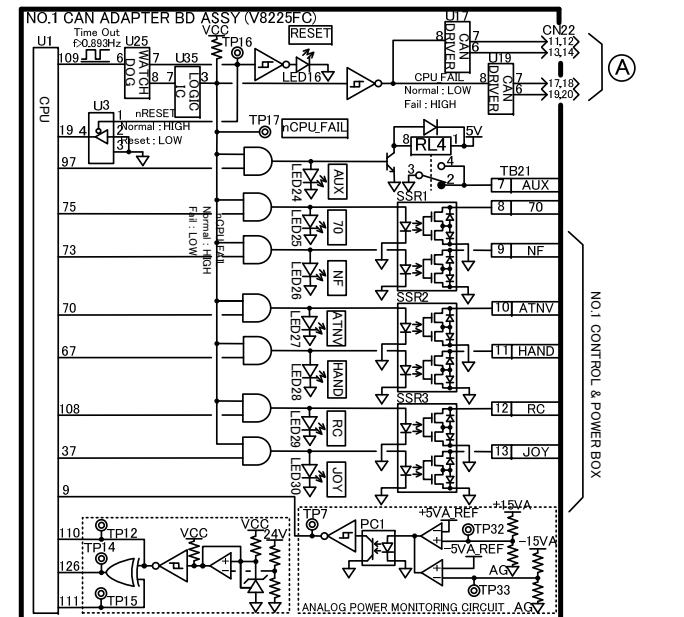
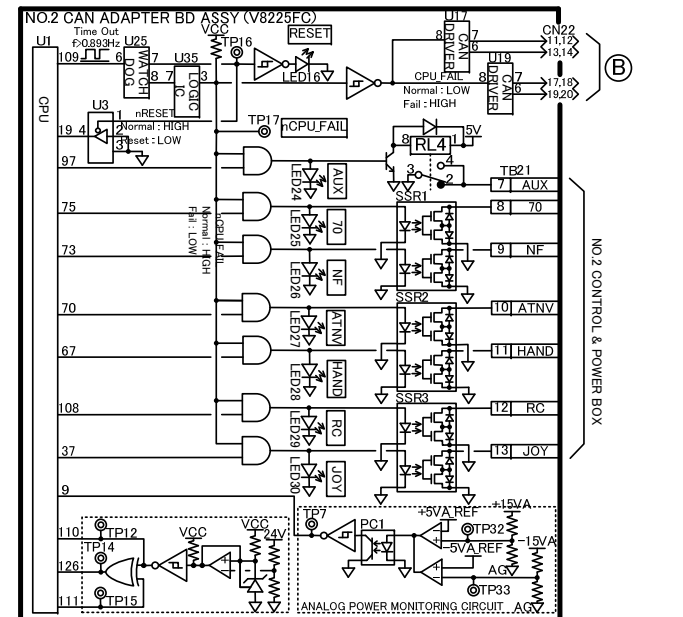
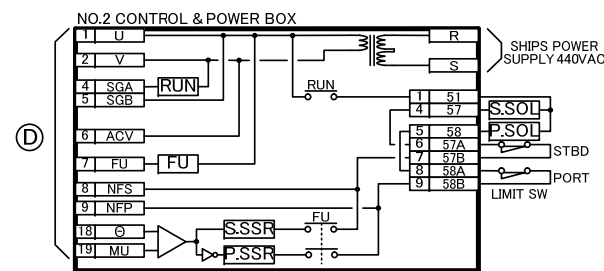
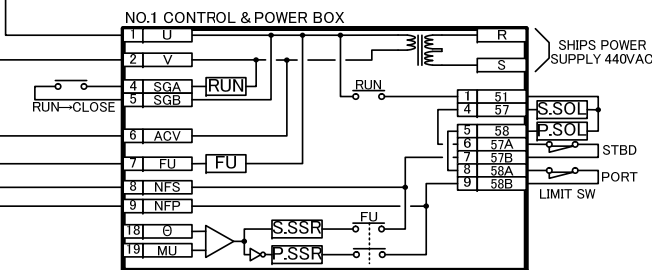
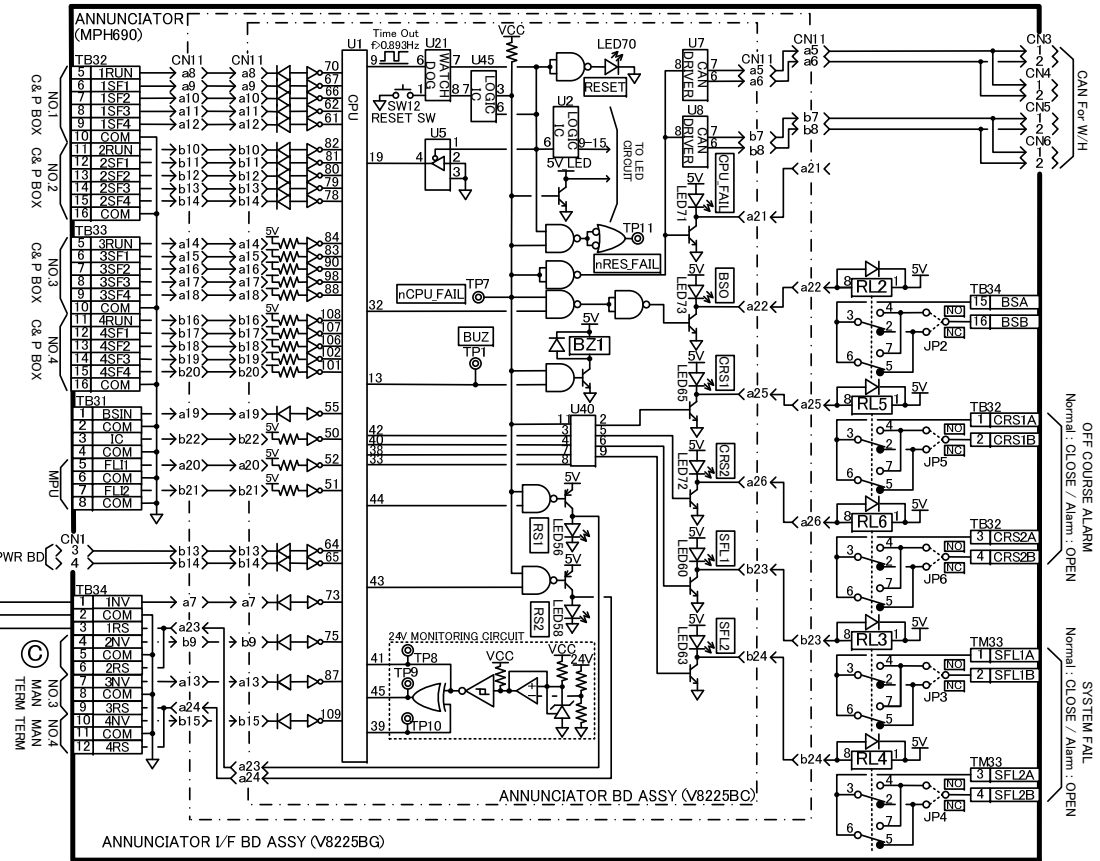
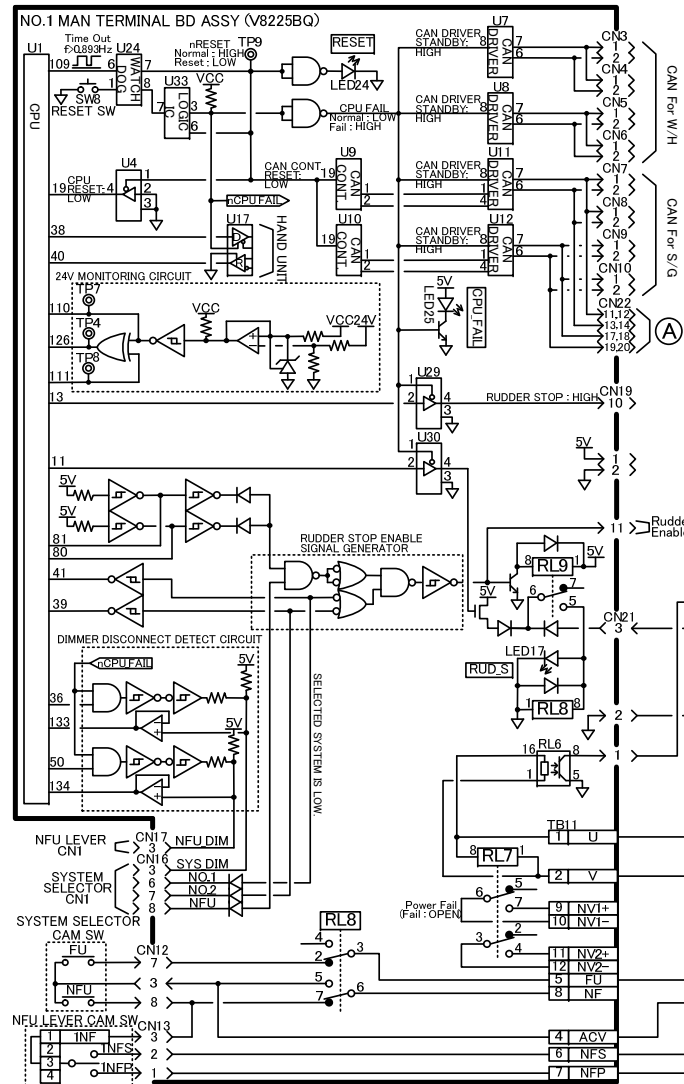
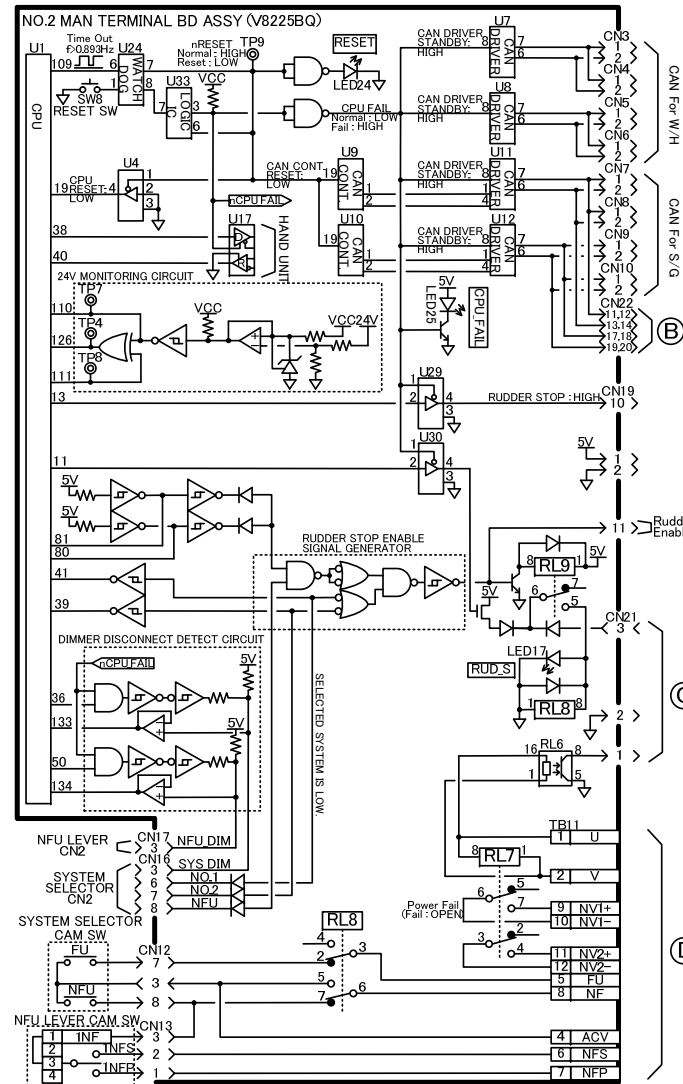


### 2.5 Alert circuit (1/2)

- WH CAN-A
- WH CAN-B
- SG CAN-C
- SG CAN-D

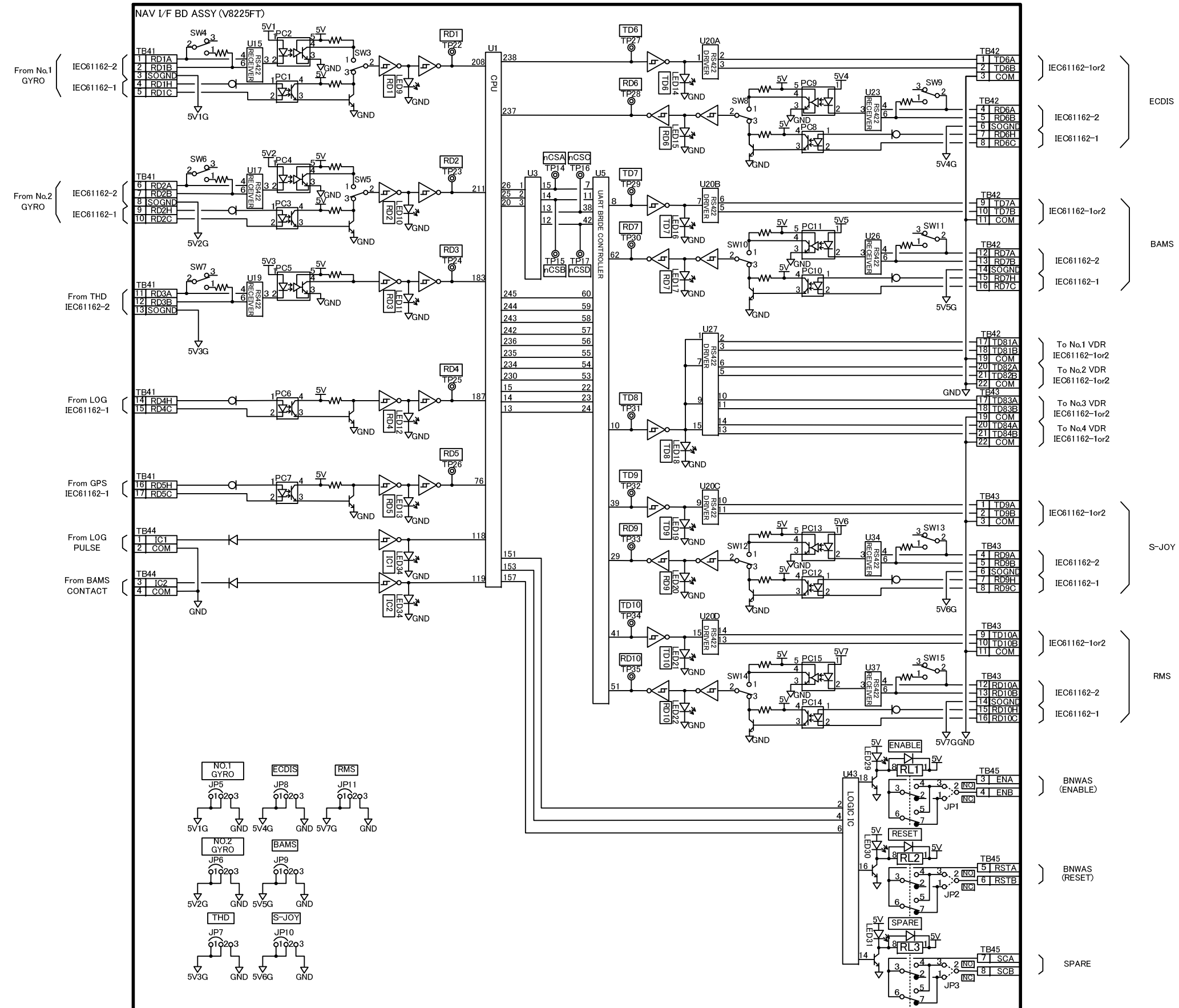


### 2.6 Alert circuit (2/2)





## 2.7 Interface circuit (NAV I/F UNIT MPT590)



JUMPER SETTING TABLE

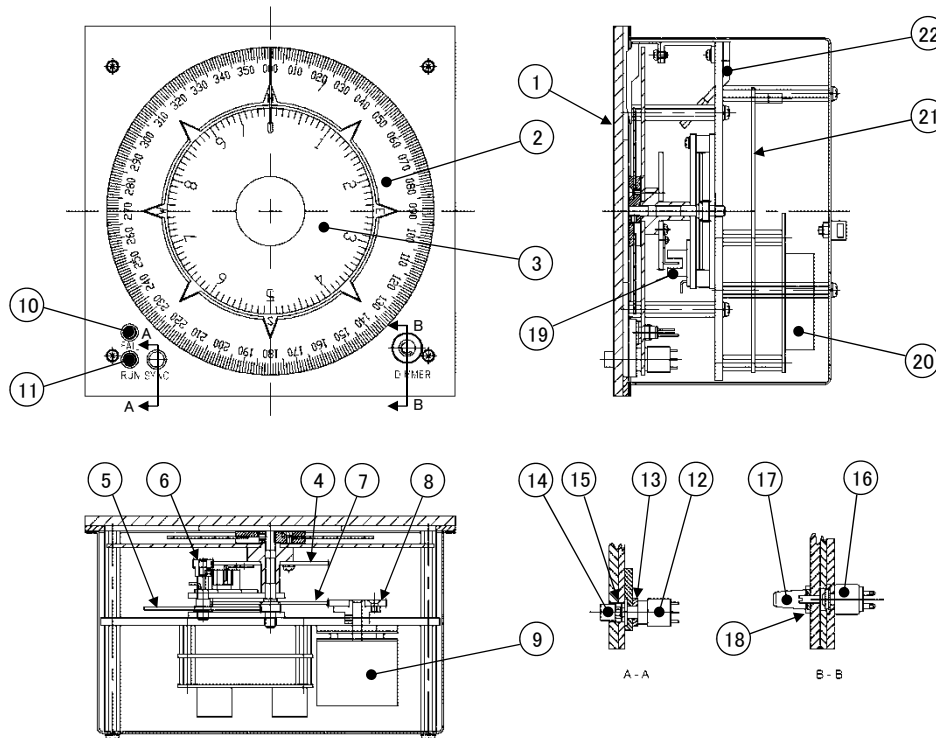
		1-2	2-3
JP1	Contact output	normal open	normal close
JP2	Contact output	normal open	normal close
JP3	Contact output	normal open	normal close
JP5	ch1	IEC	ITU
JP6	ch2	IEC	ITU
JP7	ch3	IEC	ITU
JP8	ch6	IEC	ITU
JP9	ch7	IEC	ITU
JP10	ch9	IEC	ITU
JP11	ch10	IEC	ITU

SWITCH SETTING TABLE

		1-2	2-3
SW1	CAN_A	termination	default
SW2	CAN_B	termination	default
SW3	ch1_baud rate	38400bps	4800bps
SW4	ch1_terminator	termination	default
SW5	ch2_baud rate	38400bps	4800bps
SW6	ch2_terminator	termination	default
SW7	ch3_terminator	termination	default
SW8	ch6_baud rate	38400bps	4800bps
SW9	ch6_terminator	termination	default
SW10	ch7_baud rate	38400bps	4800bps
SW11	ch7_terminator	termination	default
SW12	ch9_baud rate	38400bps	4800bps
SW13	ch9_terminator	termination	default
SW14	ch10_baud rate	38400bps	4800bps
SW15	ch10_terminator	termination	default
SW16	CPU reset	normal = OFF	reset = ON

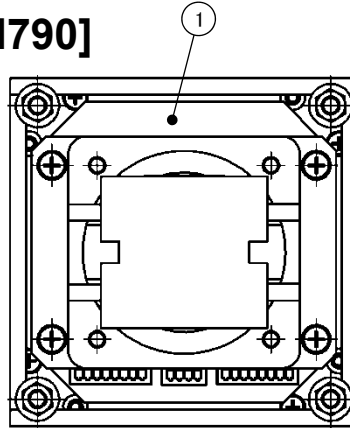
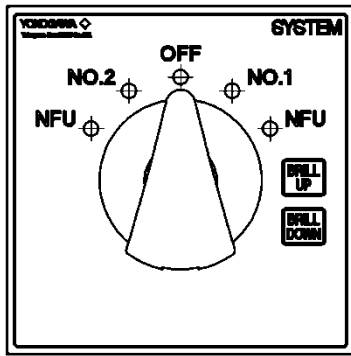
## Annex-3 Components list

### 3.1 STEERING REPEATER COMPASS [MKR056]



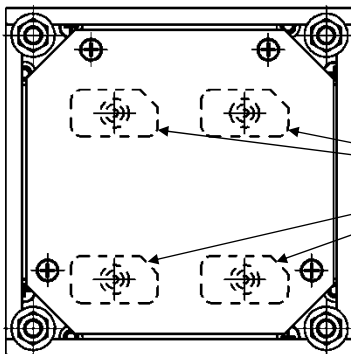
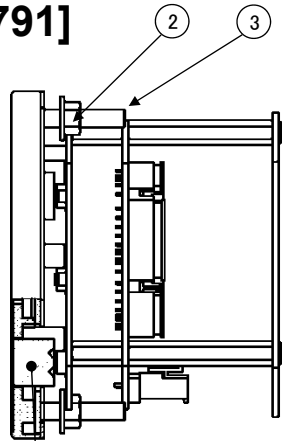
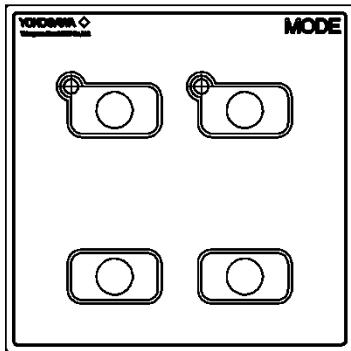
NO	PARTS NAME	PART NO.	NO	PARTS NAME	PART NO.
1	FRONT PANEL	V8118BA(□192) V8118BC(□144)	13	COLLAR	V8118BS
2	SCALE (36X)	V8219FV	14	BUTTON	5T124A104-02
3	SCALE (1X)	V8118DE	15	O RING	5T101Z005-09
4	GEAR	V8114HV	16	RESISTOR	5T162A167-01
5	GEAR	V8114HL	17	KNOB	5T124A043-02
6	GEAR	1G422A549-01	18	CPLLAR	5T108F032-07
7	GEAR	V8114HN	19	PHOTO SENSOR ASSY	V8114UX
8	GEAR	V8114RR	20	RPT TB ASSY	V8114SQ
9	MOTOR	5T165A165-01	21	RPT CPU BD ASY	V8114SN
10	FAIL INDICATOR LAMP(RED)	5T166F082-03	22	LED BD ASSY	V8116VH
11	FAIL INDICATOR LAMP (GREEN)	5T162F082-04			
12	SWITCH	5T154A272-01			

### 3.2 SYSTEM SELECTOR [MPH790]



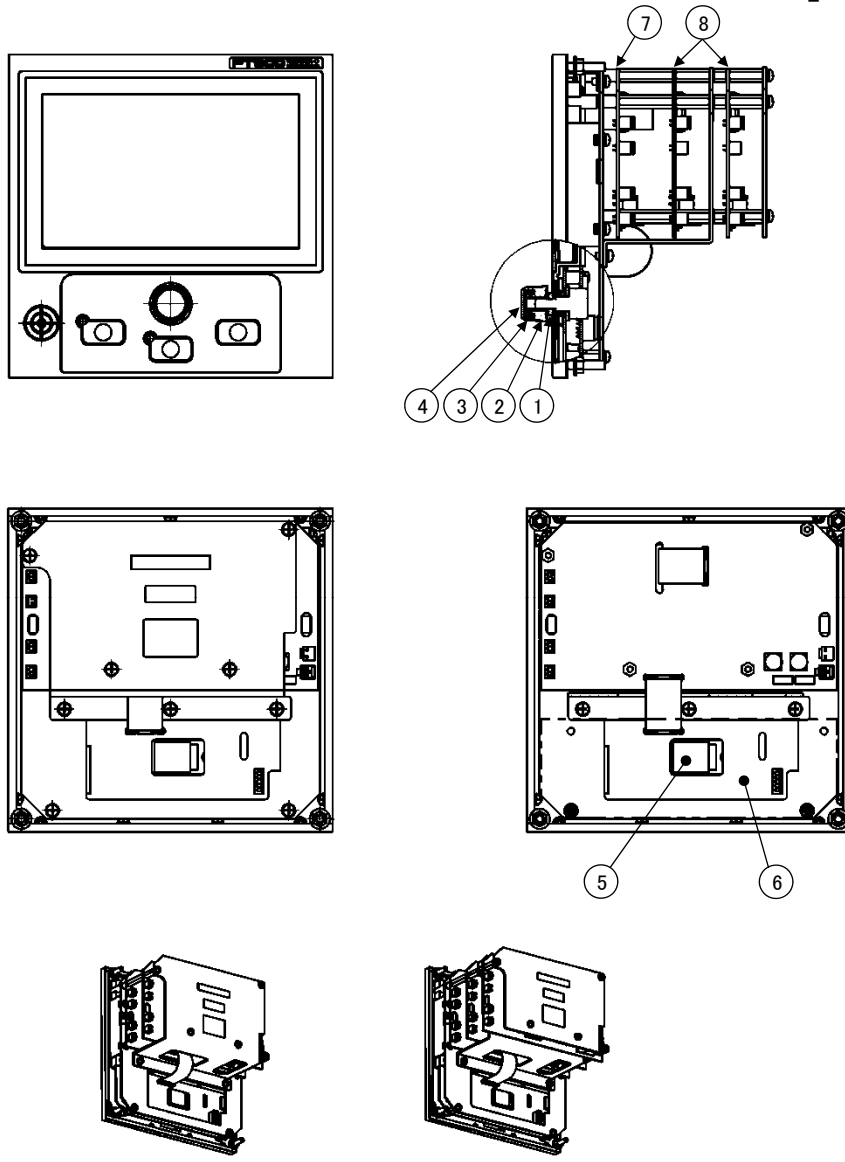
NO	PARTS NAME	PART NO.
1	SWITCH B.L. BD ASSY	V8225GC

### 3.3 MODE SELECTOR [MPH791]



NO	PARTS NAME	PART NO.
1	GUM BUTTON	V8225UG
2	96 CPU BD ASSY	V8225EC
3	96 I/F BD ASSY	V8225EF

### 3.4 AUTOPILOT CONTROL & DISPLAY UNIT [MPH490]

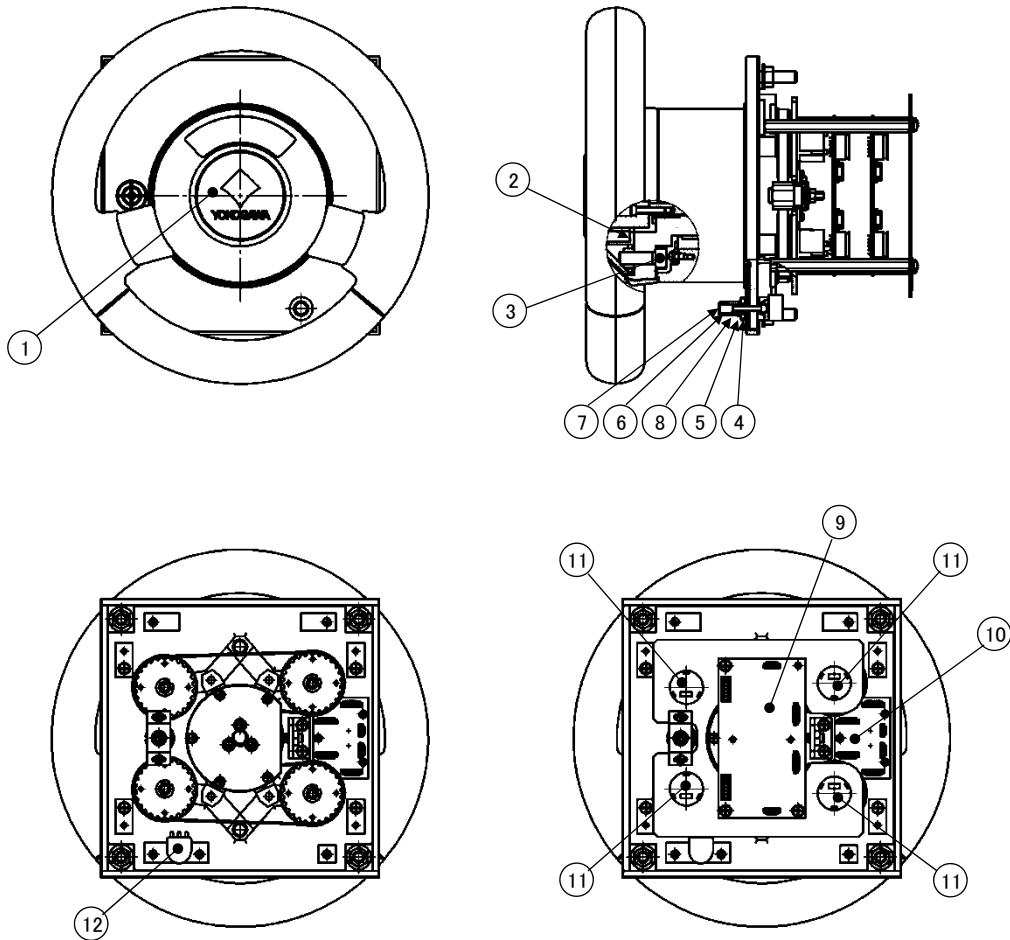


Autopilot controller X 1

Autopilot controller X 2

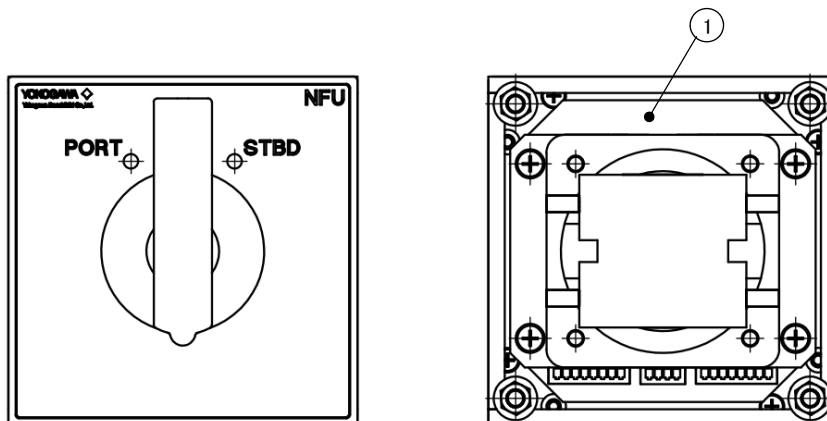
NO	PARTS NAME	PART NO.
1	RING GASKET	V8225SH
2	POM WASHER	V8810VD
3	KNOB	V8810VB
4	CAP	V8810VC
5	ENCODER ASSY	V8225HD
6	CDU SUB BD ASSY	V8225HC
7	SH CPU BD ASSY	V8225AD
8	SH CPU BD ASSY	V8225AF/V8225AG/V8225AH

### 3.5 HAND STEERING UNIT [MPB390]



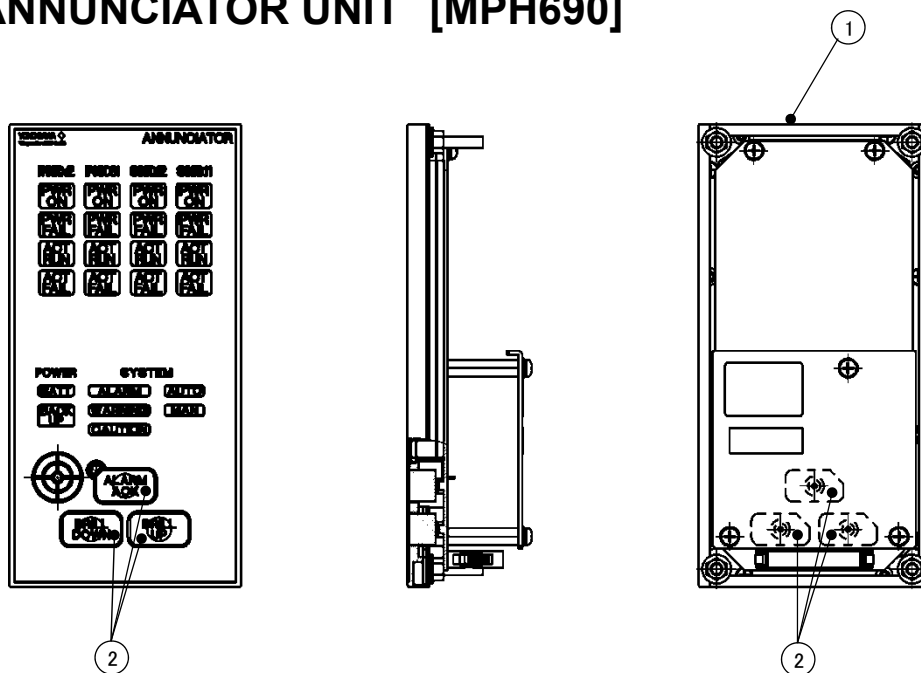
NO	PARTS NAME	PART NO.
1	BRAND EMBLEM ASSY	V8225NB
2	HAND LED BD ASSY	V8225DH
3	BUMPER RUBBER	V8225NC
4	O RING	5T101Z005-01
5	SPACER	5T108F032-04
6	KNOB	5T124A043-02
7	CAP	5T114A018-02
8	NUT COVER	5T124A089-01
9	HAND CPU BD ASSY	V8225DC
10	HAND BZ BD ASSY	V8225DE
11	ENCODER	A1250MM
12	VR ASSY	V8225DP

### 3.6 NFU LEVER [MPB391]



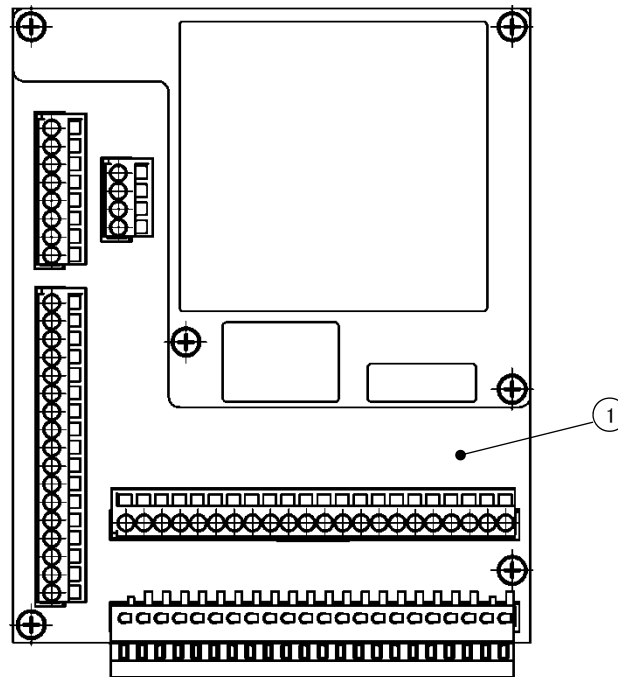
NO	PARTS NAME	PART NO.
1	SWITCH B.L. BD ASSY	V8225GE

### 3.7 ANNUNCIATOR UNIT [MPH690]



NO	PARTS NAME	PART NO.
1	ANNUNCIATOR BD ASSY	V8225BC/V8225BE
2	GUM BUTTON	V8225UE

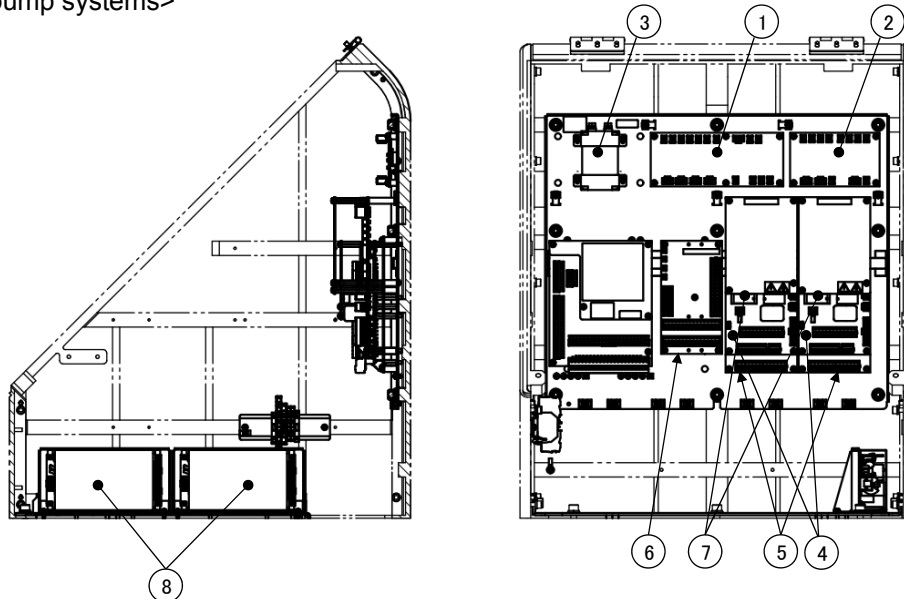
### 3.8 NAV I/F UNIT [MPT590]



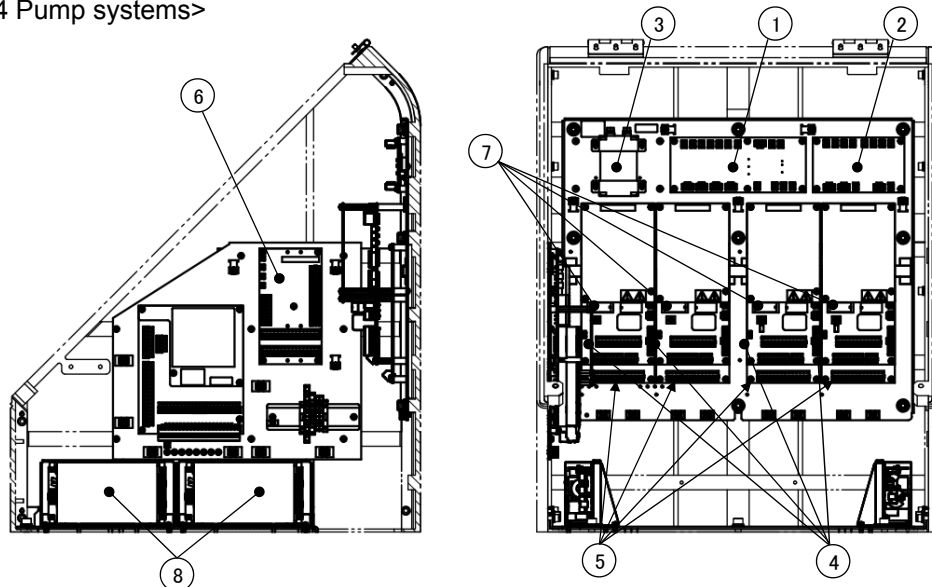
NO	PARTS NAME	PART NO.
1	NAV I/F BD ASSY	V8225FT

### 3.9 MAIN CONTROL UNIT (MCU) [MPH291]

<2 pump systems>



<4 Pump systems>



NO	PARTS NAME	PART NO.
1	M.PWR BD ASSY	V8225AM
2	S.PWR BD ASSY	V8225AS
3	CAPACITOR ASSY	V8225VZ
4	MAN TERMINAL BD ASSY	V8225BQ/V8225BU/V8225BS
5	CAN ADAPTER BD ASSY	V8225FC/V8225FF
6	ANN. I/F BD ASSY	V8225BG
7	RELAY	V8821BS
8	POWER SUPPLY	A1701UP





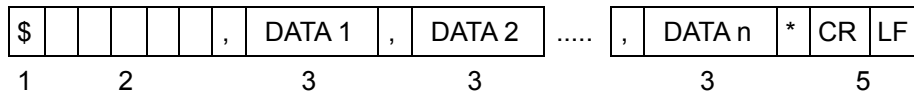
## Annex-4 Serial signal format

### 4.1 Basic format

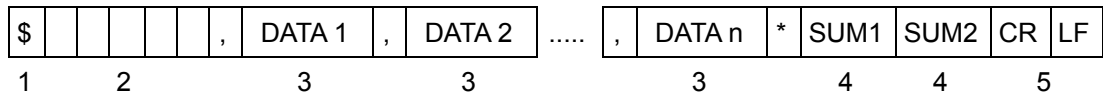
The basic serial signal formats are shown below.

All transmitted and received data shall be interpreted as ASCII characters.

- No Checksum



- Use Checksum



1	Start of sentence	\$
2	Address field	This field serves to define the sentence. The first two characters are the talker identifier. The other three characters are the data identifier.
3	Data field	This field is described with regular format data. Each data is delimited by “,”.
4	Check-sum field	Check-sum value
5	<CR><LF> Terminator	End of sentence

## 4.2 Existing format

PT900 has several regular data format to communicate with external equipment.

### Regular data format

Data Type	Input	Output	Interval	Remark
Heading	HRC/HDM/HDT/HDG/THS	-	-	
Rate of turn	ROT	-	-	
Heading / Rate of turn	HRC	-	-	
Speed	VMVSD/VHW/VBW/VTG	-	-	
Current	VDR	-	-	
Date and Time	ZDA	-	-	
Position	GGA	-	-	
Cross track error	XTE	-	-	
Heading steering command	HSC	-	-	
Heading/track control command	HTC	-	-	
Heading/track control data	-	HTD	1sec	
Rudder angle	-	RSA/ROR	1sec	
Alert, Alert list, Alert command	ACN/HBT	ALF	Event	See Note1
		ALC	10sec	
		ARC	Event	
		HBT	60sec	

## Note 1

Talker ID to be used changes by a current steerage mode and the function that alert that is exchanged in sentences belongs to.

Sentence	Talker ID	Content
ALF	\$TCALF	<ul style="list-style-type: none"> <li>• Notice of the state of the alert that is related to the Track Control.</li> <li>• During TRACK mode, this sentence is transmitted when the state of the alert that is related to the track control changed.</li> </ul>
	\$AGALF	<ul style="list-style-type: none"> <li>• Notice of the state of the alert that is related to the Heading Control.</li> <li>• During TRACK/AUTO/CRS mode, this sentence is transmitted when the state of the alert that is related to the heading control changed.</li> </ul>
	\$SGALF	<ul style="list-style-type: none"> <li>• Notice of the state of the alert that is related to the Steering gear Control and Manual steering.</li> <li>• During all mode, this sentence is transmitted when the state of the alert that is related to the Steering gear Control changed.</li> </ul>
ALC	\$TCALC	<ul style="list-style-type: none"> <li>• Notice of the alert list that is related to the Track Control.</li> <li>• This sentence is transmitted to any mode periodically, but contents become always empty other than TRACK modes (i.e., this means Track Control function is off)</li> </ul>
	\$AGALC	<ul style="list-style-type: none"> <li>• Notice of the alert list that is related to the Heading Control.</li> <li>• This sentence is transmitted to any mode periodically, but contents become always empty other than TRACK/AUTO/CRS modes (i.e., this means Heading Control function is off)</li> </ul>
	\$SGALC	<ul style="list-style-type: none"> <li>• Notice of the alert list that is related to the Steering gear Control and/or Manual steering.</li> <li>• This sentence is transmitted to any mode periodically.</li> </ul>
ARC	\$TCARC	<ul style="list-style-type: none"> <li>• Notice of the refusal of the command of the alert communication that is related to Track Control.</li> <li>• During TRACK mode, when a command of the alert communication that is related to Track Control is not accepted, this sentence is transmitted.</li> </ul>
	\$AGARC	<ul style="list-style-type: none"> <li>• Notice of the refusal of the command of the alert communication that is related to Heading Control.</li> <li>• During TRACK/AUTO/CRS mode, when a command of the alert communication that is related to Track Control is not accepted, this sentence is transmitted.</li> </ul>
	\$SCARC	<ul style="list-style-type: none"> <li>• Notice of the refusal of the command of the alert communication that is related to Steering gear Control and/or Manual steering.</li> <li>• During all mode, when a command of the alert communication that is related to Steering gear Control and/or Manual steering is not accepted, this sentence is transmitted.</li> </ul>

Sentence	Talker ID	Content
HBT	\$TCHBT	• During TRACK mode, this sentence is transmitted periodically.
	\$AGHBT	• During AUTO/CRS mode, this sentence is transmitted periodically.
	\$SGHBT	• During Manual steering, this sentence is transmitted periodically.

Status	Details of the transmitted sentence and talker ID			
	ALF	ALC	ARC	HBT
TRACK mode	<ul style="list-style-type: none"> <li>•\$TCALF</li> <li>•\$AGALF</li> <li>•\$SGALF</li> </ul>	<ul style="list-style-type: none"> <li>•\$TCALC</li> <li>•\$AGALC</li> <li>•\$SGALC</li> </ul>	<ul style="list-style-type: none"> <li>•\$TCARC</li> <li>•\$AGARC</li> <li>•\$SCARC</li> </ul>	\$TCHBT
AUTO/CRS mode	<ul style="list-style-type: none"> <li>•\$AGALF</li> <li>•\$SGALF</li> </ul>	<ul style="list-style-type: none"> <li>•\$TCALC (empty)</li> <li>•\$AGALC,</li> <li>•\$SGALC</li> </ul>	<ul style="list-style-type: none"> <li>•\$AGARC</li> <li>•\$SCARC</li> </ul>	\$AGHBT
Manual steering	\$SGALF	<ul style="list-style-type: none"> <li>•\$TCALC (empty)</li> <li>•\$AGALC (empty)</li> <li>•\$SGALC</li> </ul>	\$SCARC	\$SGHBT

---

- HRC

\$HCHRCxxxx,xxxx\*hh <CR><LF>

1 2

- 1 Heading (Decimal point is omitted. xxx.xx -> xxxxx)
- 2 Turn rate (Decimal point is omitted. -/ x.x -> -/ xxx)

- HDM

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

1 1

- 1 Magnetic sensor heading, degrees

- HDT

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

1 1

- 2 Heading, degrees true

- HDG

\$--HDG, x.x, x.x, a, x.x, a\*hh<CR><LF>

1 2 2 3 3

- 1 Magnetic sensor heading, degrees
- 2 Magnetic deviation, degrees E/W
- 3 Magnetic variation, degrees E/W

- THS

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

1 2

- 1 Heading, degrees true
- 2 Mode indicator

- ROT

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

1 2

- 1 Rate of turn, °/min, "-" = bow turns to port
  - 2 Status: A = data valid, V = data invalid
-

●VMVSD

\$VMVSD-/ x x x, x x x x x x\*hh<CR><LF>

1 2

- 1 Y-SPEED-/ x x, x[knot]
- 2 Cruising distance x x x x, x x[Nautical Mile]

●VHW

\$--VHW, x.x, T, x.x, M, x.x, N, x.x, K\*hh<CR><LF>

1 1 2 2 3 3 4 4

- 1 Heading, degrees true
- 2 Heading, degrees magnetic
- 3 Speed, knots
- 4 Speed, km/h

●VBW

\$--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
- 2 Transverse water speed, knots
- 3 Status: water speed, A = data valid, V = data invalid
- 4 Longitudinal ground speed, knots
- 5 Transverse ground speed, knots
- 6 Status, ground speed, A = data valid, V = data invalid
- 7 Stern transverse water speed, knots
- 8 Status: stern water speed, A = data valid, V = data invalid
- 9 Stern transverse ground speed, knots
- 10 Status: stern ground speed, A = data valid, V = data invalid

●VTG

\$--VTG, x.x, T, x.x, M, x.x, N, x.x, K,a\*hh<CR><LF>

1 1 2 2 3 3 4 4 5

- 1 Course over ground, degrees true
  - 2 Course over ground, degrees magnetic
  - 3 Speed over ground, knots
  - 4 Speed over ground, km/h
  - 5 Mode indicator
-

## •VDR

\$--VDR, x.x, T, x.x, M, x.x, N\*hh<CR><LF>

1 1 2 2 3 3

- 1 Direction, degrees true
- 2 Direction, degrees magnetic
- 3 Current speed, knots

## •ZDA

\$--ZDA, hhmmss.ss, xx, xx, xxxx, xx, xx\*hh<CR><LF>

1 2 3 4 5 6

- 1 UTC
- 2 Day, 01 to 31 (UTC)
- 3 Month, 01 to 12 (UTC)
- 4 Year (UTC)
- 5 Local zone hours, 00 h to  $\pm 13$  h
- 6 Local zone minutes, 00 to +59

## •GGA

\$--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 2 3 3 4 5 6 7 8 9 10 11 12

- 1 UTC of position
- 2 Latitude N/S
- 3 Longitude E/W
- 4 GPS quality indicator
- 5 Number of satellites in use, 00-12, may be different from the number in view
- 6 Horizontal dilution of precision
- 7 Antenna altitude above/below mean sea level (geoid)
- 8 Units of antenna altitude, m
- 9 Geoidal separation
- 10 Units of geoidal separation, m
- 11 Age of differential GPS data
- 12 Differential reference station ID, 0000-1023



•XTE

\$--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
- 4 Direction to steer, L/R
- 5 Units, nautical miles
- 6 Mode indicator

•HSC

\$--HSC, x.x, T, x.x, M,a\*hh<CR><LF>

1 1 2 2 3

- 1 Commanded heading, degrees true
- 2 Commanded heading, degrees magnetic
- 3 Sentence status flag

•HTC

\$--HTC,A,x.x,a,a,x.x,x.x,x.x,x.x,x.x,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 Override, A = in use, V = not in use
  - 2 Commanded rudder angle, degrees
  - 3 Commanded rudder direction, L/R = port/starboard
  - 4 Selected steering mode
  - 5 Turn mode, R = radius controlled, T = turn rate controlled,  
N = turn is not controlled
  - 6 Commanded rudder limit, degrees (unsigned)
  - 7 Commanded off-heading limit, degrees (unsigned)
  - 8 Commanded radius of turn for heading changes, n.miles
  - 9 Commanded rate of turn for heading changes, °/min
  - 10 Commanded heading-to-steer,degrees
  - 11 Commanded off-track limit n.miles (unsigned)
  - 12 Commanded track
  - 13 Heading reference in use, T/M
  - 14 Sentence status
-

---

•HTD

\$--HTD,A,x.x,a,a,x.x,x.x,x.x,x.x,x.x,x.x,a,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, A = in use, V = not in use
- 2 Commanded rudder angle, degrees
- 3 Commanded rudder direction, L/R = port/starboard
- 4 Selected steering mode
- 5 Turn mode, R = radius controlled, T = turn rate controlled,  
N = turn is not controlled
- 6 Commanded rudder limit, degrees (unsigned)
- 7 Commanded off-heading limit, degrees (unsigned)
- 8 Commanded radius of turn for heading changes, n.miles
- 9 Commanded rate of turn for heading changes, °/min
- 10 Commanded heading-to-steer,degrees
- 11 Commanded off-track limit n.miles (unsigned)
- 12 Commanded track
- 13 Heading reference in use, T/M
- 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, A =within limits, V=limit reached or exceeded
- 17 Vessel heading, degrees

•RSA

\$--RSA, x.x, A, x.x, A\*hh<CR><LF>

1 1 2 2

- 1 Starboard (or single) rudder sensor Status A = valid, V = data invalid
- 2 Port rudder sensor Status A = valid, V = data invalid

•ROR

\$--ROR,x.x,A,x.x,A,a\*hh<CR><LF>

1 1 2 3 4

- 1 Starboard (or single) rudder order Status A = valid,V = data invalid
  - 2 Status A = data valid, V = data invalid
  - 3 Port rudder order
  - 4 Command source location, B=Bridge, P=Port wing, S=Starboard wing,  
C=Engine control room, E=Engine side / local  
W=Wing (port or starboard not specified)
-

**•ACN**

\$--ACN,hhmmss.ss, aaa, x.x, x.x, c, a\*hh <CR><LF>

1 2 3 4 5 6

- 1 Time
- 2 Manufacturer mnemonic code (YDK or NULL: Not defined)
- 3 Alert Identifier
- 4 Alert Instance, 1 to 999999
- 5 Alert command, A, Q, O or S
- 6 Sentence status flag

**•ALF**

\$--ALF, x, x, x, hhmmss.ss, a, a, a, aaa, x.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 to 2
- 2 Sentence number, 1 to 2
- 3 Sequential message identifier, 0 to 9
- 4 Time of last change
- 5 Alert category, A, B or C
- 6 Alert priority, E, A, W or C
- 7 Alert state, A, S, N, O, U or V
- 8 Manufacturer mnemonic code (YDK or NULL: Not defined)
- 9 Alert identifier
- 10 Alert instance, 1 to 999999
- 11 Revision counter, 1 to 99
- 12 Escalation counter, 0 to 9
- 13 Alert text

**•ALC**

\$--ALC, xx, xx, xx, x.x, aaa, x.x ,x.x ,x.x,.....,aaa, x.x, x.x, x.x\*hh <CR><LF>

1 2 3 4 5 6 7 8 9 10

- 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
  - 5 Manufacturer mnemonic code Alert entry 1 (YDK or NULL: Not defined)
  - 6 Alert identifier Alert entry 1
  - 7 Alert instance Alert entry 1
  - 8 Revision counter Alert entry 1
  - 9 Additional Alert entries
  - 10 Alert entry *n*
-

## ●ARC

\$--ARC, hhmmss.ss, aaa, x.x, x.x, c\*hh <CR><LF>

1 2 3 4 5

- 1 Time
- 2 Manufacturer mnemonic code (YDK or NULL: Not defined)
- 3 Alert identifier
- 4 Alert instance, 1 to 999999
- 5 Refused alert command, A, Q, O or S

## ●HBT

\$--HBT,x.x,A,x\*hh<cr><lf>

1 2 3

- 1 Configured repeat interval
  - 2 Equipment status
  - 3 Sequential sentence identifier
-

Blank Page

---

## Annex-5 Display Specifications

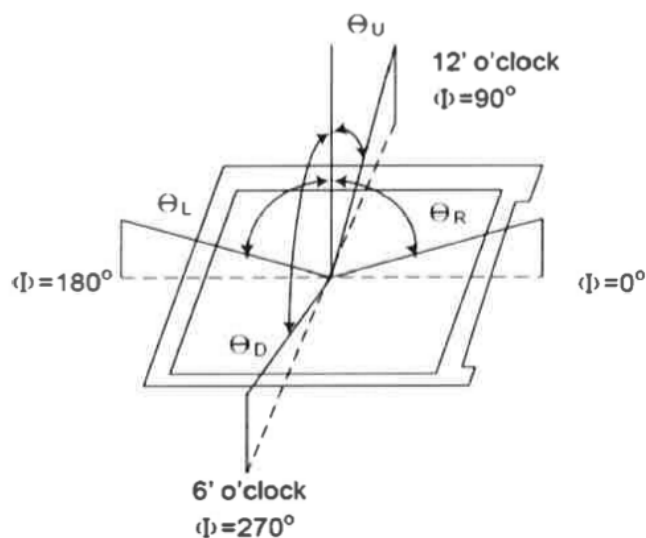
The following table shows the LCD specifications of AP CDU.

### 5.1 Mechanical specifications

Item	Specification	Unit
Screen Size	7.0	inch
Display Resolution	800(H) x 480(V)	pixel
Active Area	152.4(H) x 91.44(V)	mm
Outline Dimensions	166.6(W) x 109.4(H) x 10.0(D)	mm
Display Mode	Normally white mode/ Transmissive	-
Pixel Arrangement	R,G,B Vertical stripe	-
Pixel Size	0.1905(H) x 0.1905(V)	mm
Surface Treatment	Anti glare and Hard Coating(3H)	-
Display Color	262,144	-
Input Interface	Digital RGB(6bits/each color) Data Transfer	-

### 5.2 Optical characteristic

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark	
Brightness	B	-	(800)	(1000)	-	cd/m <sup>2</sup>		
Contrast ratio	CR	Optimum viewing angle	(350)	(400)	-	-	Ta=25°C	
Viewing angle	Horizontal	$\theta_R$	CR $\geq$ 10	55	65	-	deg.	Ta=25°C
		$\theta_L$		55	65	-	deg.	
	Vertical	$\theta_U$		45	55	-	deg.	
		$\theta_D$		55	65	-	deg.	



Blank Page

---

## **PT900 Autopilot system User's Manual**

Manual No. : IM80B20T01E

November, 2014 1st Edition

December, 2014 2nd Edition

January, 2015 3rd Edition

May, 2015 4th Edition

August, 2015 5th Edition

October, 2015 6th Edition

January, 2016 7th Edition

April, 2016 8th Edition

---



Blank Page

---