User's
Manual

CMZ700S
Gyrocompass
User's Manual

IM 80B10M-11E

YOKOGAWA
Yokogawa Denshikiki Co.,Ltd.

IM 80B10M-11E
8th Edition

CMZ700S Gyrocompass User's Manual

IM80B10M-11E 8th Edition

CONTENTS

Introduction

This instruction manual describes the functions and handling procedures of the CMZ700 Gyrocompass. Before using the gyrocompass carefully read this manual to get a clear understanding on proper use.

Notice

- **The information contained in this manual is subject to change without prior notice for the reason of improvement in the performance and functions of the gyrocompass system.**
- **All efforts have been made to ensure accuracy in the preparation of this manual. However, should any errors come to your attention or any questions arise, please inform the head office of Yokogawa Denshikiki Co., Ltd. or your nearest sales representative office listed on the back cover of this manual.**
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Important Cautions

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

⚠ **DANGER** **This symbol indicates that a failure to observe the given instructions may result in a fatal hazard critical to the handling personnel.**

⚠ **WARNING** **This symbol indicates that a failure to observe the instructions may result in death or serious injury to the personnel.**

⚠ **CAUTION** **This symbol indicates that a failure to observe the instructions may result in personal injury or damage to the product.**

⚠ DANGER

Risk of Mercury

- Do not allow mercury to come into contact with skin. If contact does occur, thoroughly wash the affected area with clean water immediately.
- If mercury is accidentally spilled, it should be drawn off with a syringe or the like and kept in a glass bottle.

⚠ WARNING

Risk of Electric Shock

- Turn off the power before carrying out any wiring.

⚠ CAUTION

Do not perform an insulation resistance test using a megohmmeter except on the ship's power terminals. Performing such a test may cause a failure in the gyro system.

Precautions in handling the gyrosphere

- Hold the gyrosphere firmly with both hands so as not to subject it to any shock.

- Do not drop the gyrosphere. Dropping the gyrosphere may result in damage to the internal mechanism or lead to personal injury.
- Do not disassemble the gyrosphere.

Precautions in handling the container

- Hold the container firmly with both hands.
- Do not drop it. Dropping the gyrosphere may result in damage to the internal mechanism or lead to personal injury.

Polishing of the slip ring is prohibited

- Carry out cleaning by wiping dirt off the slip ring with ethyl alcohol or ligroin.

1 SUMMARY

This chapter briefly describes operating procedures that are regarded as essential to the operation of the CMZ700S Gyrocompass.

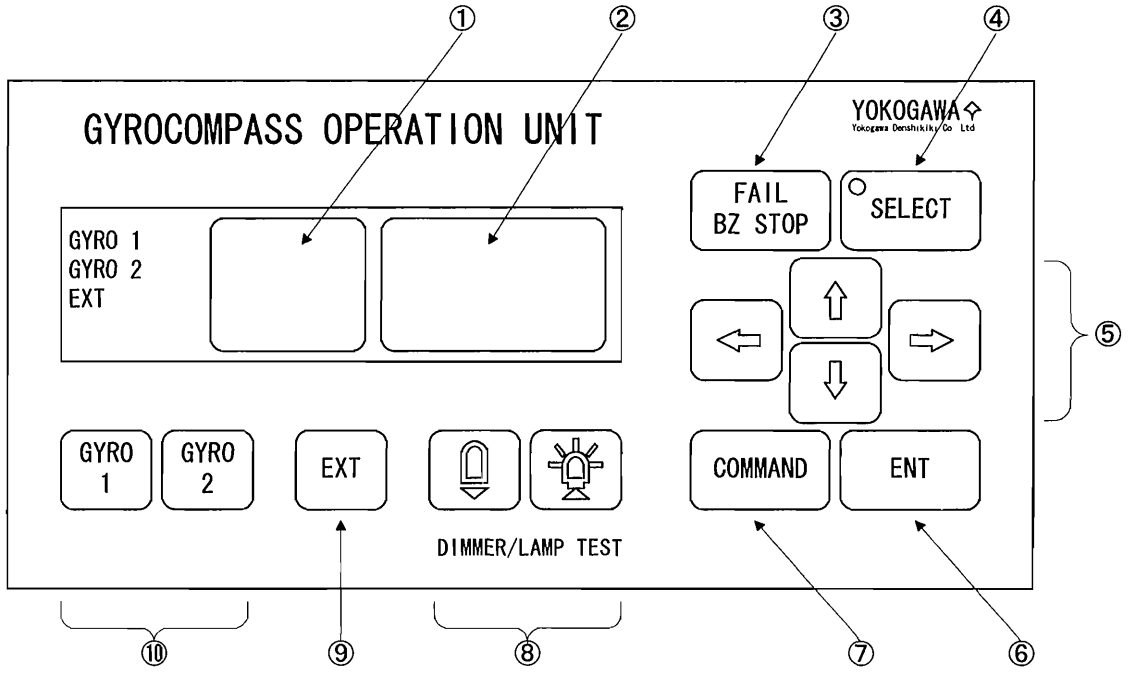
For details, see Chapter 2 and subsequent chapters. Use Chapter 1 as a simplified manual.

(1) Components and Functions of The Operation Unit
(2) Handling precautions
(3) Startup and stoppage
(4) Command Code List
(5) Advice for Specific Situations
(6) Definition of Terms

1.1 Components and Functions of C.Operation Unit

Name	Functions and Operations
① Heading display	Displays a compass heading and system status.
② Data display	Indicates displays corresponding to menus and each command code.
③ Alarm lamp and buzzer stop key	Displays alarm statuses for the gyrocompass system. If pressed when an alarm is generated, the alarm buzzer is stopped.
④ Select LED and Select key	Displays and selects the operating initiative (C. operation unit or M. operation unit). When LED is lit, this unit can be operated. When LED goes off, M. operation unit can be operated.
⑤ Arrow keys	Carry out selection of commands and data and switching of displays.
⑥ ENT key	Enters and sets commands and data.
⑦ COMMAND key	If pressed when in normal mode, the display switches from the data display to the MAIN MENU. If pressed when the display is in access mode, the display returns to normal mode.
⑧ Dimmer key	Adjusts brightness of the displays of this unit. In addition, if this key is pressed in combination with the ENT key, contrast of the LCD can be adjusted. If both keys are simultaneously pressed, a lamp test is performed.
⑨ External heading selector key	Changes the output heading to that of the external heading (bow heading input from external heading sensor).
⑩ Gyro heading selector key	If GYRO1 key is pressed, the output heading is changed to the gyro heading (true heading of the master compass). GYRO2 key is not used..

If key ④, ⑨ or ⑩ is to be operated, keep the key pressed for at least two seconds.



1.2 Handling Precautions

1.2.1 Startup of Gyrocompass

(1) Startup the gyrocompass at least 5 hours before the ship's departure.

(2) After startup, do not touch the internal unit of the master compass. Otherwise the equipment may be damaged or an error generated.

1.2.2 Handling in Cold Districts

Since the master compass container containing the gyrocompass is filled with liquid, if a gyrocompass is to be stopped in a cold district where the ambient temperature is -3°C or less it should therefore be handled as shown below.

(1) In the case where it is stopped for a period of a few days or less:

Wrap the master compass in a blanket or the like to provide heat insulation.

(2) In the case of a prolonged stopping period (a week or more):

Drain the liquid completely.

1.2.3 External Heading Out Put

External heading can use with the mastercompass'amplifier unit.

Turn on the main power of the master compass (MKM022) in case of using external heading.

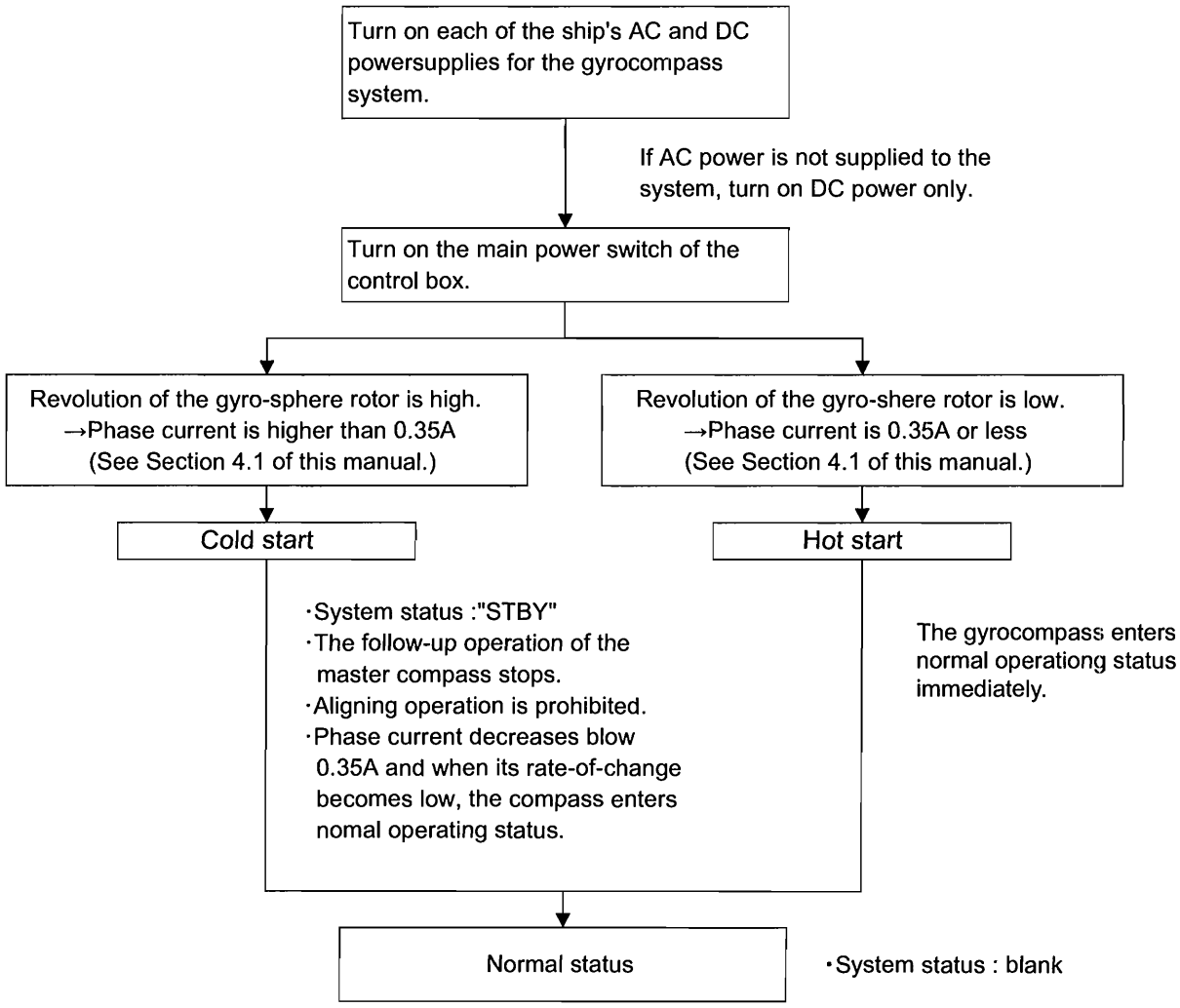
CAUTION

Polishing the slip ring is prohibited

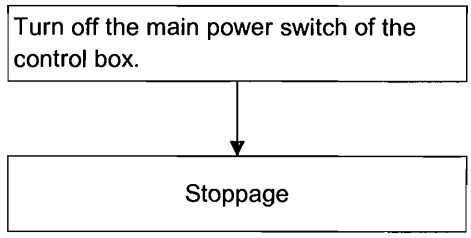
- Carry out cleaning by wiping dirt off the slip ring with ethyl alcohol or ligroin.

1.3 Startup and Stoppage

(1) Procedure for Gyrocompass System Startup



(2) Procedure for Gyrocompass System Stoppage



1.4 Command Code List

Call-up codes for various data displays/settings in the CMZ700 gyrocompass system are assigned to the predetermined numbers (command codes).

This section describes the command codes and their functions and whether they can be executed or not during stand-by period.

Classification	Command Code	Execution during Standby	Function Item	Page
Display Function		○	Ture heading, compass heading and system status display (normal mode)	4-5
	10	○	True heading and value of speed error correction display	4-9
	11	○	Heading deviation display	4-10
	12	○	Turn rate display	4-10
	13	○	Total running time, gyrosphere running time and the time after startup display	4-11
	14	○	Dimmer rank display	4-11
	15	○	Gyrosphere phase current display	4-12
	16	○	Backup battery voltage display	4-12
	17	○	Deviation voltage display	4-12
	19	○	Software version number display	4-12
Setting Function	20	○	External azimuth input selection	4-14
	21	×	Speed setting for speed error correction	4-15
	22	×	Latitude setting for speed error correction	4-15
	23	×	Automatic alignment of master compass	4-16
	24	×	Manual alignment of master compass	4-16
	26	○	Displaying/resetting cause of master compass alarm	5-4
	27	○	Displaying/resetting cause of C.operation unit alarm	5-4
	28	○	Deviation alarm setting	4-17
	29	○	Startup timer setting	4-18
Maintenance Function	30	○	Permission for maintenance function	6-20
	31	○	Outputting simulated DAC signals	6-21
	32	○	Manual drive of master compass	6-22
	33	○	Manual drive of repeater compass	6-22
	34	○	Resetting gyrosphere running time	6-23
	36	○	Initialization of backup memory	6-23
	37	○	Correcting master compass installation error	6-24
	38	○	Setting the master compass follow-up gain	6-25
	39	○	Error log display	6-25
Generation Function	40	×	Permission for generation function	6-31
	41	×	Setting the follow-up speed for stepper signal.	6-32
	42	×	Setting communication protocol of output port	6-32
	43	×	Setting format of output port	6-33
	44	×	Setting communication protocol of input port	6-38
	45	×	Setting format of input port	6-38

"○" means that execution is permitted during standby.
"×" means that execution is not permitted during standby.

1.5 Advice for Specific Situations

(1) If it is suspected that there is an error in a heading shown by a repeater compass or an autopilot:

① Check the settings for the ship's speed and latitude for correcting speed-error using command codes 21 and 22. If they are not correct, correct the values.

(See 4.7.2 of this manual.)

② Set the ship's speed to zero and check that indications on the master compass and repeater compass are the same. If they are not, align the indications of the repeater compass and master compass.

(See 4.7.3 of this manual.)

(2) If an abnormal sounds can be heard from the master compass:

① Continue to operate the gyro system if there are no errors in indications of the master and repeater compasses.

② When there are errors in indications of the master and repeater compasses, use the external azimuth selector switch to set the operation of the system so that the azimuth sensor is selected to "external azimuth."

(See 4.3 of this manual.)

* In either case, replace the gyrosphere as soon as possible.

(3) If you desire to know the gyrosphere running time:

This can be displayed using the command code 13. However, a correct value cannot be obtained unless the running time was reset when the gyrosphere was replaced.

(See 4.6.4 of this manual.)

(4) If you desire to know the phase current of the gyrosphere:

This can be displayed using the command code 15.

(See 4.6.6 of this manual.)

(5) If you desire to implement automatic re-startup using the timer:

The timer can be set using the command code 29.

(See 4.7.6 of this manual.)

1.6 Definition of Terms

This section describes the definition of terms used in this manual.

Compass heading	The heading detected by the master compass
True heading	The heading obtained by subtracting the value of the speed error correction from the compass heading
Value of speed-error correction	The error calculated from the ship's heading, speed and latitude
Output heading	A heading output to external connected device (such as repeater compasses). Either the gyro heading or external sensor heading should be selected.
Gyro heading	True heading
External sensor heading	A heading to be input from external heading sensors (such as magnet compass/GPS compass and the like)

2. OVERVIEW

2.1 General

The CMZ700 Gyrocompass fully conforms to the technical requirements of the IMO resolution A.424 (XI), gyrocompass performance standards, as well as to JIS F9602, Class A standards. The anti-vibration structure has been strengthened and improvement of the follow-up performance has been achieved, leading to increased rigidity of the gyrocompass in all types of ships, from small to large.

(1) High North-seeking Accuracy

High north-seeking accuracy is achieved because of the following configuration: The gyrosphere, the heart of the gyrocompass, is supported in a container filled with liquid, which prevents disturbance from affecting the center pin. In addition, two gyro-rotors rotate at a high speed and work with each other to cancel out errors due to the rolling, pitching and yawing of a ship.

(2) Excellent Vibration Resistance and Shock Resistance

The gyrocompass is designed to disperse forces due to vibration and shock by the inclusion of liquid in the container to support the gyrosphere. In addition, the container is protected from vibration and shock with a diaphragm-shaped rubber vibration-isolator and bellows damper. The diaphragm-shaped rubber vibration-isolator has universal joints as a countermeasure against the affect of attitude change due to rolling, pitching and yawing. This configuration produces excellent resistance against vibration and shock.

(3) Improvement of Follow-up Performance

A follow-up speed of 30 °/s has been realized by reducing the size and weight of the container. This has made smooth follow-up without delay possible in response to sudden turning as is characteristic with small ships.

(4) Digitalization of Master Compass Heading

The display of the master compass heading has been changed to digital. This increases the ease of reading a heading.

(5) Digitalization of Repeater Compass Signal

Electromagnetic wave noise is suppressed to a minimum by expressing the repeater compass signal in a digital form and having the driving circuit for the compass motor on the repeater compass side.

(6) Automatic Speed-error Correcting Function

Speed-error is corrected automatically by entering the ship's speed signal and latitude signal respectively from the log and GPS or the like. The amount of latitude change in the case where there is no latitude signal input is estimated from a calculation of the ship's speed and heading. In a basic system, this function is implemented in the remote unit.

(7) Functions for Various Displays and Settings

Various types of gyrocompass information can be displayed and set on the master compass operation unit and remote unit.

(8) Preparation of Outputs Corresponding to Every Requirement

In addition to the digital heading signal output for the repeater compass, the stepper heading signal output, digital signal output (IEC61162-1), analog heading, quadrant, and angular turning velocity signal output are equipped as standard.

(9) Onboard Battery Drive

Compass running by the onboard battery is available as standard.

(10) Built-in Startup Timer

The restart time of the timer can be set from 1 to 99 hours.

(11) Heading Output Using External Azimuth Sensor Signal

Using the heading signal from the external azimuth sensor (GPS compass, magnet compass, etc.) signals can be output to externally connected units such as repeater compasses or a radar.

2.2 Performance and Specifications

2.2.1 Power Supply

Main power supply: 24 V DC +30 %, -10 %
100 to 230 V AC ± 10 %, 50/60 Hz ± 5 %, single phase (optional)

Power consumption (24 V DC)

At startup	Approx. 3.2 A + 0.35 A * number of repeater compasses
Steady sate	Approx. 1.8 A + 0.35 A * number of repeater compasses

Power consumption (100 V AC)

At startup	Approx. 90 VA + 10 VA * number of repeater compasses
Steady state	Approx. 52 VA + 10 VA * number of repeater compasses

Alarm Power supply (24 V DC)
Approx. 0.1 A (annunciator unit, optional)

2.2.2 Input Signal

(1) Ship's speed signal for speed-error correction: 1 circuit (optional)
- Signal form: 200 pulses/n mile, or serial IEC61162-1
- Unit to be connected: Electromagnetic log, Doppler log, and the like

(2) Latitude signal for speed-error correction: 1 circuit (optional)
- Signal form: Serial IEC61162-1
- Unit to be connected: GPS or the like

(3) Heading signal for backup: 1 circuit
- Signal form: Serial IEC61162-1
- Unit to be connected: GPS compass, magnet compass, and the like

(4) Alarm buzzer stop signal: 1 circuit, contact

2.2.3 Output Signal

(1) Repeater compass signal: 3 circuits
- Signal form: Serial IEC61162-1 sentence
- Unit to be connected: Repeater compasses

(2) Stepper heading signal: 1 circuit, capacity 0.3 A
9 loops via optional distribution unit
- Signal form: 24 V DC, 3-bit gray code, 1/6 degree/step
- Unit to be connected: Radar, ARPA, INMARSAT etc.

(3) Serial heading/rate-of-turn signal: 3 circuits, individual generation possible
- Signal form: Serial IEC61162-1
- Unit to be connected: Autopilot, multi-display, etc.

(4) Analog heading and quadrant signals: 1 circuit each (optional)

	Signal form:	0 to 5 V DC
	Unit to be connected:	Course recorder, evaluation/measuring units, etc.
(5)	Analog rate-of-turn signal:	3 circuits, individual range setting possible
	Signal form:	0 to 5 V DC; 30, 100, and 300 °/min
	Unit to be connected:	Rate-of-turn meter etc.
(6)	Volt-free signal:	1 circuit, contact
	Signal form:	"Open" or "closed" when no voltage is applied
(7)	Gyro failure signal:	1 circuit, contact
	Signal form:	"Open" or "closed" when gyro fails
(8)	Heading selection signal:	1 circuit, contact
	Signal form:	"Open" or "closed" when gyro is selected

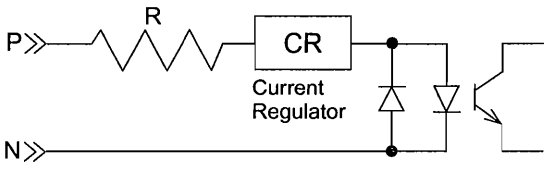
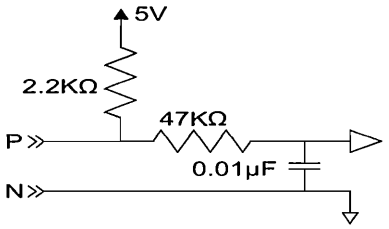
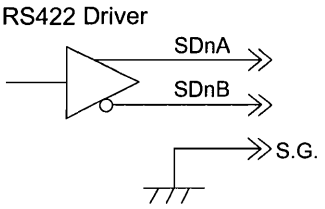
2.2.4 Settling Time and Accuracy

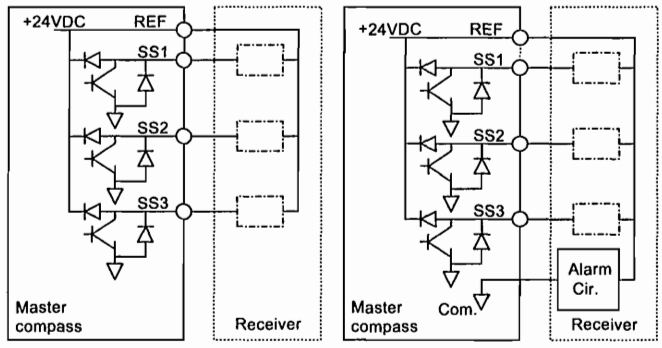
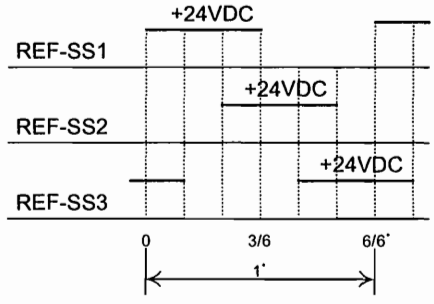
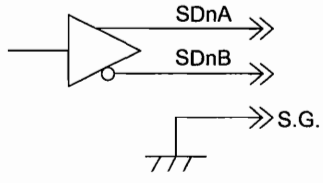
(1)	Settling time:	Within 6 hours (The gyro can actually be used after about 2 hours from start.)
(2)	North-pointing accuracy:	Within ± 0.25 °/cos Φ (Φ being the latitude at that location)
(3)	Follow-up accuracy:	0.1 ° or less
(4)	Maximum follow-up speed:	30 °/s

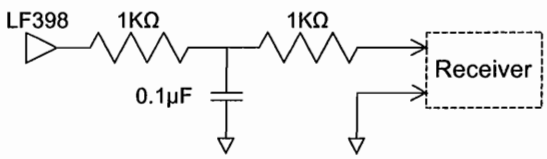
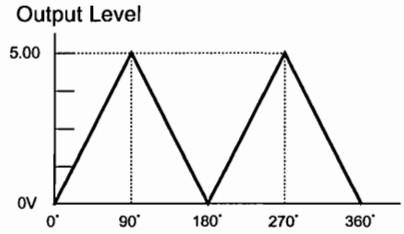
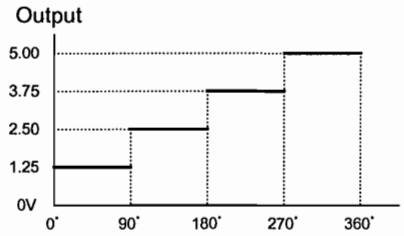
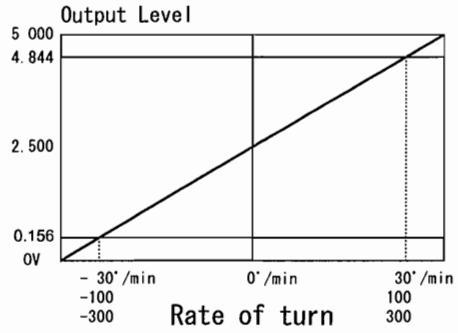
2.2.5 Environmental Specifications (normal operating conditions)

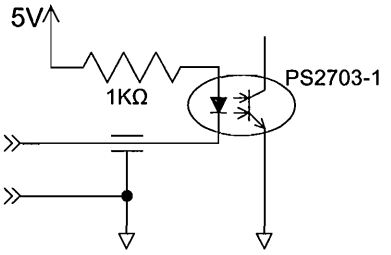
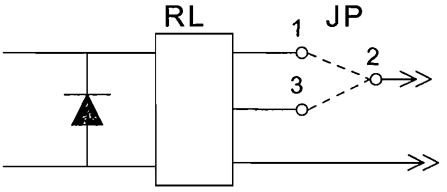
(1)	Allowable roll and pitch:	40 ° for both rolling and pitching
(2)	Allowable vibration:	1.5 mm p-p or less for 5 to 8 Hz
		0.35 mm p-p or less for 8 to 25 Hz
		0.1 mm p-p or less for 25 to 50 Hz
(3)	Operating temperature range:	- 15 °C to + 55 °C

2.2.6 External Input/Output Signal Specifications and Circuits

Signal Name	Abbreviation	Circuit/signal Specifications
Serial signal input	RDAM RDBM	 • Number of connectable circuits: 1 or 3 (remote unit used) • Data contents: Heading, ship's speed (optional) and latitude (optional) • Receiving circuit: Photo-coupler • Transmission format: Start-stop serial signal • Transmission rate: To be selected from 2400/4800/9600 bps. • Data format: See Subsection 6.4.6
Ship's speed pulse input		 • Number of connectable circuits: 1 • Pulse rate: 200 pulses/n mile • Signal format: Open collector (photo-coupler) or volt-free contact • Applied voltage: 5 V DC • Current value: 2 mA (in ON state) • Saturation voltage: 0.4 V DC or less (for transistor contact)
Repeater compass heading output	SD1AR SD1BR SD2AR SD2BR SD3AR SD3BR SG	 • Number of connectable circuits: 3 • Transmission system: RS422 (use a driver circuit equivalent to RS422A or RS485) • Transmission format: Start-stop serial signal • Transmission rate: 4800 bps • Transmission period: 50 ms • Character configuration: Start bit 1, Data bit 8, Stop bit 1, and Parity None • Data format: IEC61162-1

Signal Name	Abbreviation	Circuit/signal Specifications
Stepper heading output	REF SS3 SS2 SS1 COM	< 4 wiring > Control circuit < 5 wiring > Control circuit  Signal format  • Number of connectable circuits: 1 or 9 (optional) • COM: 0 V (circuit GND) • REF output voltage: 24 V DC, 35 V DC (optional) • REF output current: 0.3 A max., 1 A max. (optional) • Output form: Open collector output (24 V DC 3-bit gray code) • Source current: each 0.15 A max.
Serial signal output	SD1A SD1B SD2A SD2B SD3A SD3B SG	RS422 Driver  • Number of connectable circuits: 3 • Transmission system: RS422 (use a driver circuit equivalent to RS422A or RS485) • Transmission format: Start-stop serial signal • Transmission rate: To be selected from 2400/4800/9600 bps. • Transmission period: See Subsection 6.4.4 • Data format: See Subsection 6.4.4

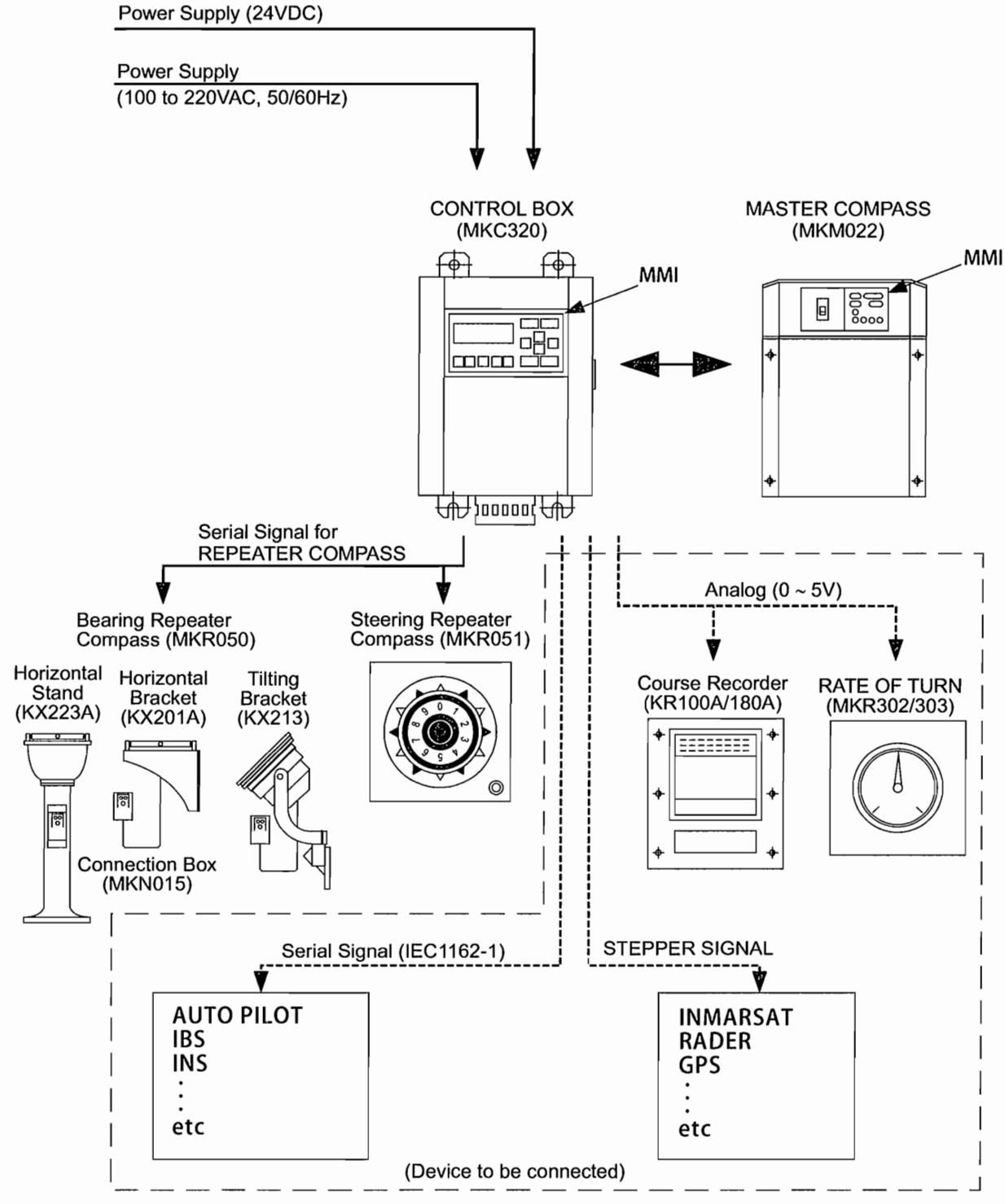
Signal Name	Abbreviation	Circuit/signal Specifications
Analog heading quadrant signal output	HDG QUD COM	 Signal format  Heading signal  Quadrant signal
Analog rate-of-turn output	ROT1 ROT2 ROT3 COM	Signal format  • Number of connectable circuits: 3 • COM: 0 V (circuit GND) • Output voltage: 0 to + 5 V DC • Output resolution: 2.5 mV • Output impedance: 2 kΩ max. • Recommended input impedance of connected unit: 500 kΩ min. • Output accuracy: ±1 % (at 25 °C)

Signal Name	Abbreviation	Circuit/signal Specifications
Buzzer stop contact input	BSP BSN	 • Contact closed: At buzzer stop • Connecting switch (contact) rating: 24 V DC, 0.05 A min.
Heading selection contact output	GM GMC	 • Jumper-1 and -2 short-circuited: Contact OFF when gyro selected • Jumper-2 and -3 short-circuited: Contact ON when gyro selected
Gyro failure contact output	GF GFC	• Jumper-1 and -2 short-circuited: Contact ON when gyro fails • Jumper-2 and -3 short-circuited: Contact OFF when gyro fails
No gyro voltage contact output	NV NVC	• Jumper-1 and -2 short-circuited: Contact OFF when there is no voltage • Jumper-2 and -3 short-circuited: Contact ON when there is no voltage

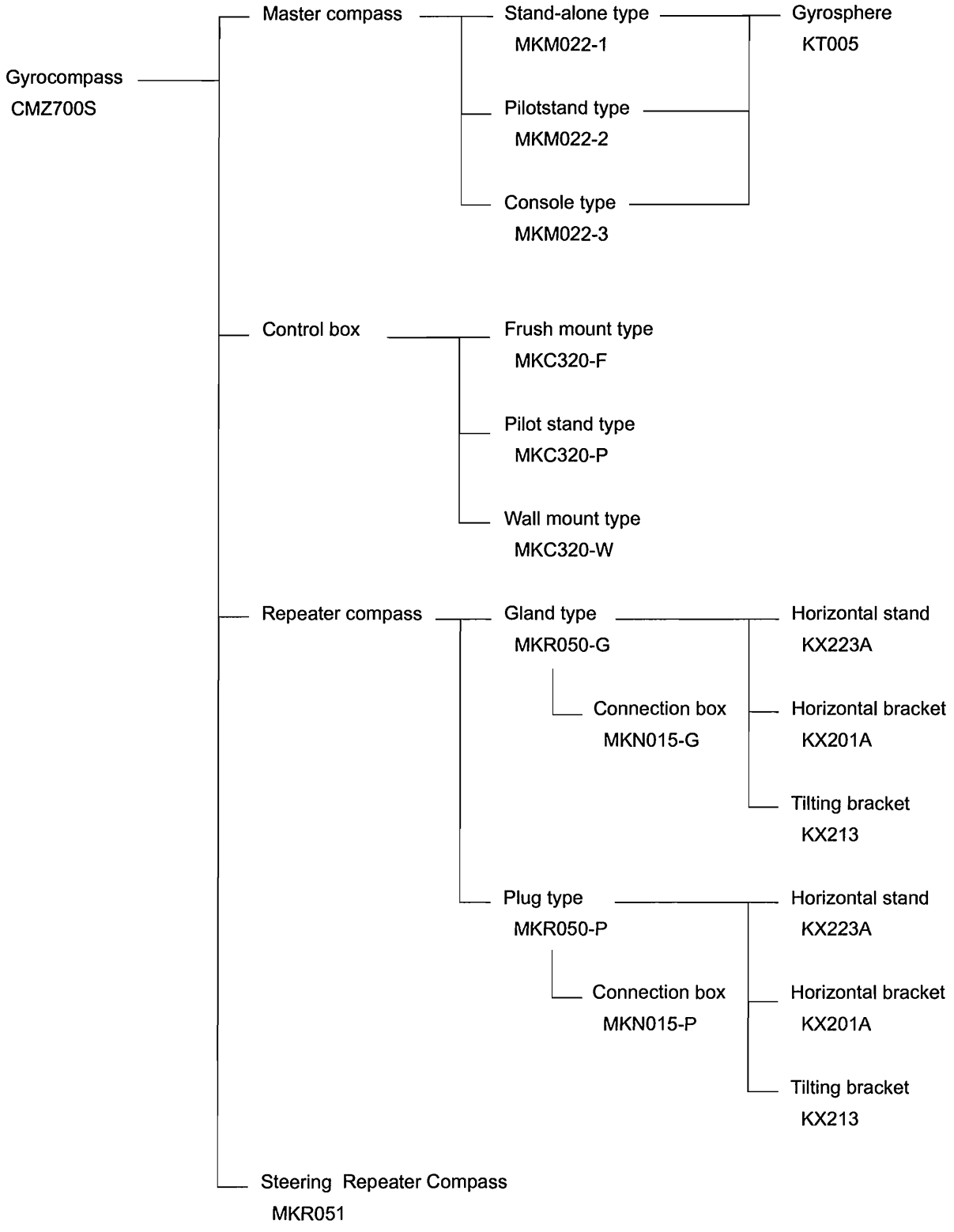
3. HARDWARE

3.1 System Configuration

CMZ700S
Stand-alone type



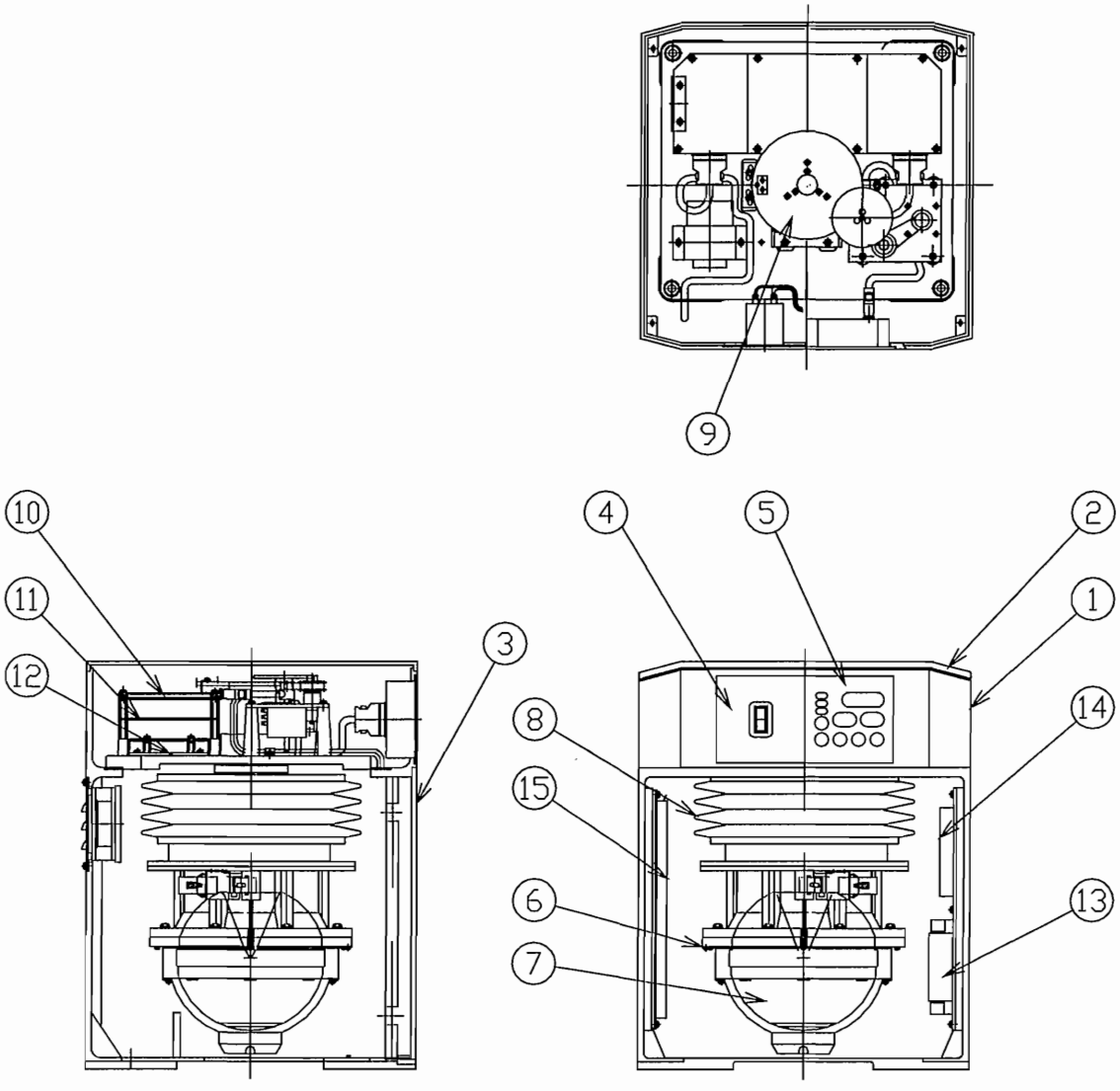
3.2 Component Models



3.3 Component Names and Functions

(1)Master Compass (MKM022)

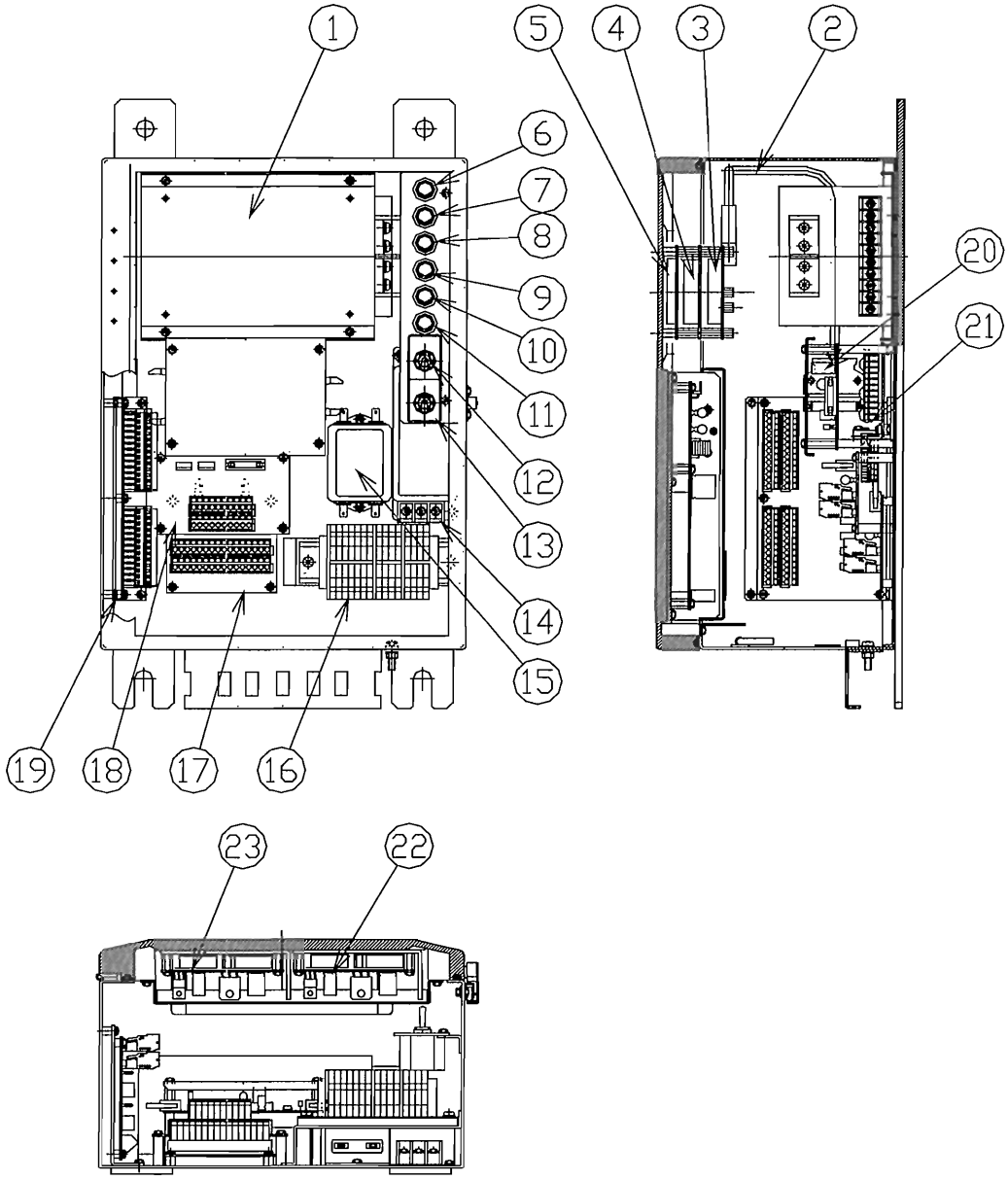
The components of the master compass and their functions are summarized below.
(For details of exchange parts, refer to Appendix-4 Components List.)



No	Name	Function
1	Case	Protects the internal unit.
2	Cover	Protects the follow-up mechanism.
3	Front cover	Protects the follow-up mechanism.
4	Switch unit	For turning on or off the main power supply.
5	M.operation unit	The components of the control panel and their functions are summarized below.
6	Container Assy	Contains the gyrosphere.
7	Gyrosphere	Contains the rotator.
8	Dumper Assy	Protects the Container Assy and Gyrosphere.
9	Follow-up mechanism	Provides a follow-up function by means of a stepping motor and gear mechanism.
10	Main Assy	Main control board.
11	Inverter Assy	For control. Produce power source for Gyrosphere drive.
12	PS1,PS2 Assy	Supplies power to individual units.
13	Noise filter	Suppresses noise.
14	Terminal board	For analog signal output.
15	Terminal board	For serial signal and stepper output.

(2-1) Control Box (MKC320-F,W)

The components of the control box and their functions are summarized below.

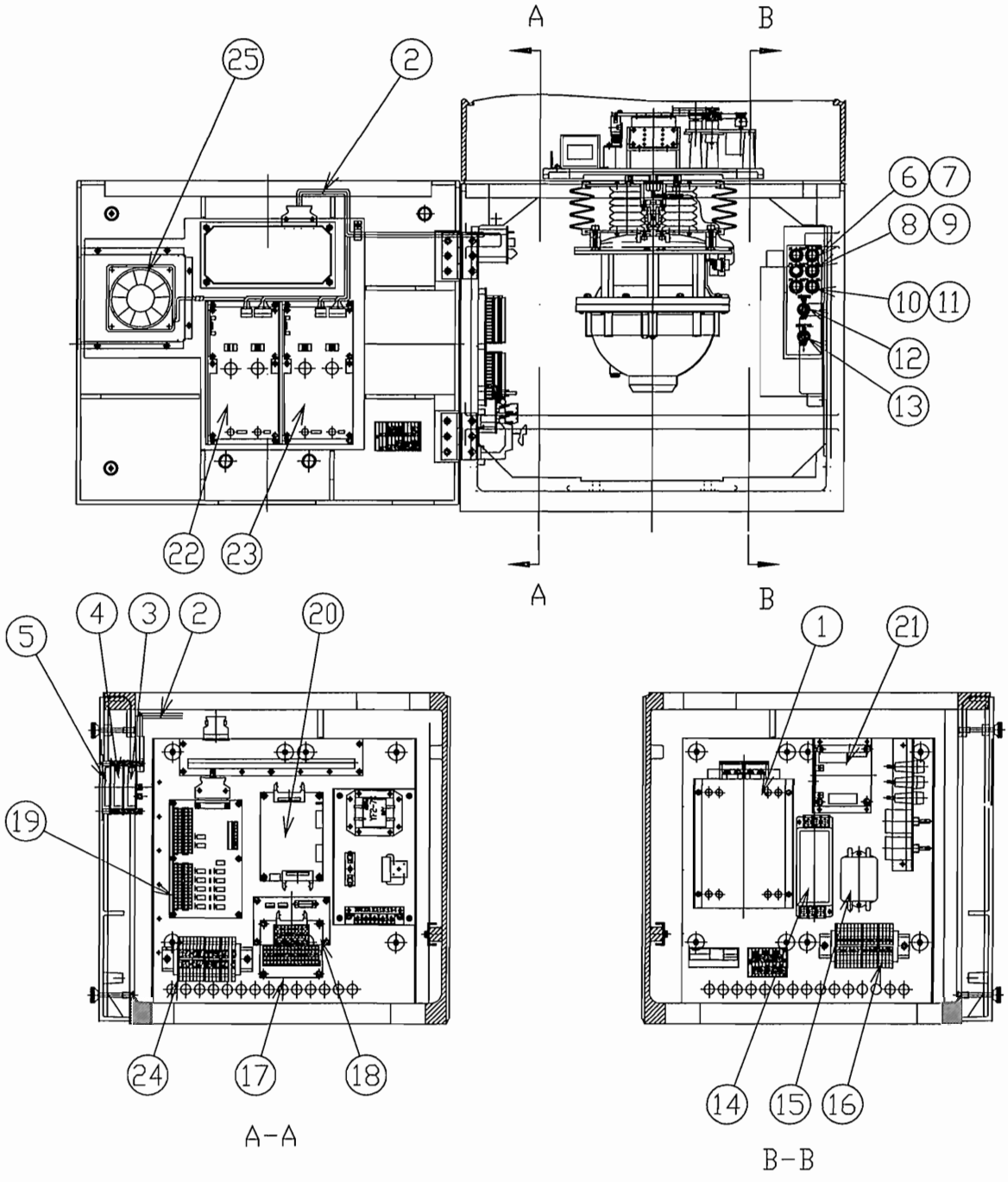


No	Name	Function
1	AC/DC POWER SUPPLY	Supplies power to individual units.
2	CABLE ASSY	Connect The C.operation and C.ope TB assy.
3	POWER ASSY	It is supplied to individual units.
4	MAIN ASSY	Main control board.
5	DISPLAY ASSY	Display heading and etc, monitor. Alarm LED is lit or blinks when an error is detected.
6	FUSE (15 A/2 A)*	Protect the power supply circuit.
7	FUSE (15 A/2 A)*	Protect the power supply circuit.
8	FUSE (10 A)	Protect the power supply circuit.
9	FUSE (10 A)	Protect the power supply circuit.
10	FUSE (2 A)	Protect the power supply circuit.
11	FUSE (2 A)	Protect the power supply circuit.
12	SWITCH	Main control switch.
13	SWITCH	Out put power supply switch.
14	NOISE FILTER	Suppresses noise to Input power supply.
15	NOISE FILTER	Suppresses noise to Input power supply.
16	TERMINAL ASSY	For external connection.
17	R.TB ASSY	Supply the repeater signal.
18	S.TB ASSY	Supply the stepping signal.
19	C.OPE TB ASSY	For connecting the C.operation unit.
20	R.DISTRIBUTION ASSY	Distribute the repeater compass signal.
21	BUCK UP ASSY	For backup DC 24 V power supply . If AC power supply is shut down ,output DC 24 V power supply is supplied for the gyro compass system with this assy.
22	PS ASSY (option)	Supplies power to the stepping signal (35 V).
23	PS ASSY	Supplies power to the repeater compass (24 V).

* with DC BACKUP : 15 A without DC BACKUP : 2 A

(2-2) Control Box (MKC320-P)

The components of the control box and their functions are summarized below.

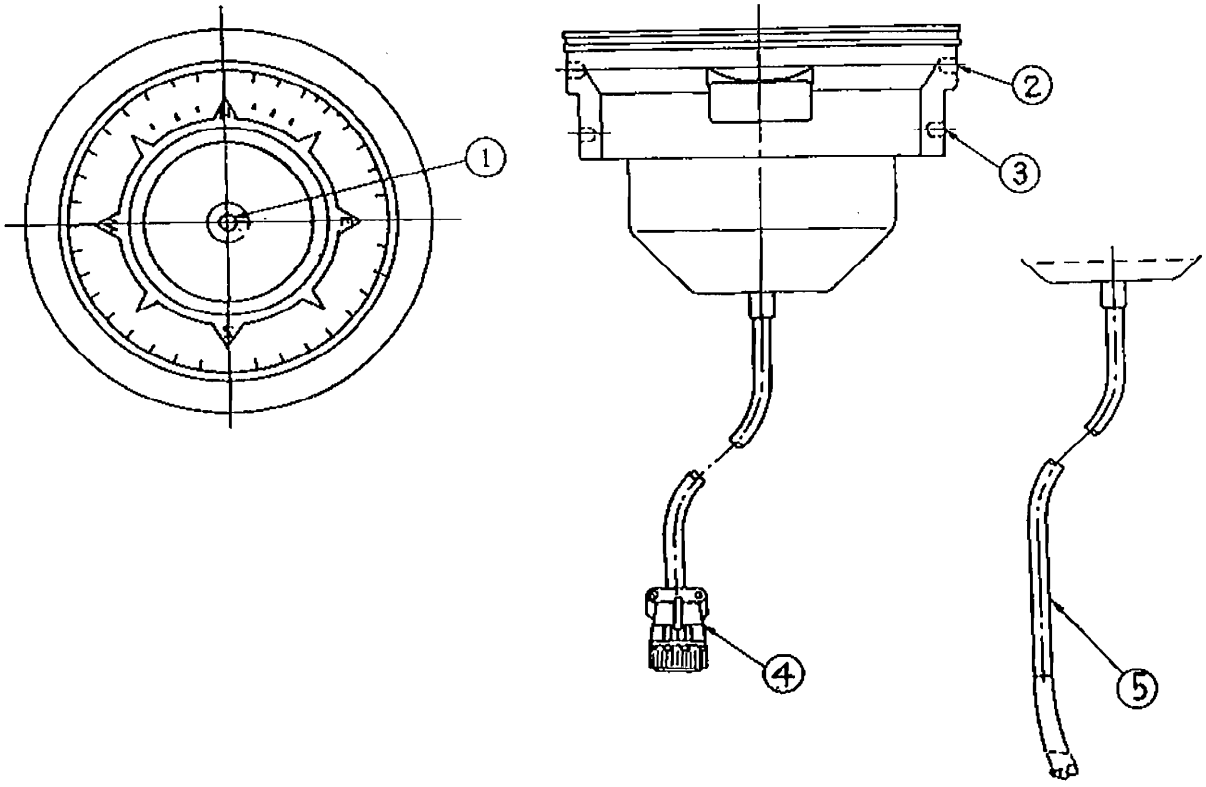


No	Name	Function
1	AC/DC POWER SUPPLY	Supplies power to individual units.
2	CABLE ASSY	Connect The C.operation and C.ope TB assy.
3	POWER ASSY	It is supplied to individual units.
4	MAIN ASSY	Main control board.
5	DISPLAY ASSY	Display heading and etc, monitor. Alarm LED is lit or blinks when an error is detected.
6	FUSE (15 A/2 A)*	Protect the power supply circuit.
7	FUSE (15 A/2 A)*	Protect the power supply circuit.
8	FUSE (10 A)	Protect the power supply circuit.
9	FUSE (10 A)	Protect the power supply circuit.
10	FUSE (2 A)	Protect the power supply circuit.
11	FUSE (2 A)	Protect the power supply circuit.
12	SWITCH	Power switch.
13	SWITCH	Out put power supply switch.
14	NOISE FILTER	Suppresses noise to Input power supply.
15	NOISE FILTER	Suppresses noise to Input power supply.
16	TERMINAL ASSY	For external connection.
17	R.TB ASSY	Supply the repeater signal.
18	S.TB ASSY	Supply the stepping signal.
19	C.OPE TB ASSY	For connecting the C.operation unit.
20	R.DISTRIBUTION ASSY	Distribute the repeater compass signal.
21	BUCK UP ASSY	For backup DC 24 V power supply . If AC power supply is shut down, output DC 24 V power supply is supplied for the gyro compass system with this assy.
22	PS ASSY (option)	Supplies power to the stepping signal (35 V).
23	PS ASSY	Supplies power to the repeater compass (24 V).
24	TERMINAL ASSY	For external connection.
25	FAN MOTOR	Ventilation. For the gyrocompass.

* with DC BACKUP : 15 A without DC BACKUP : 2 A

(3)Repeater Compass (MKR050-G or -P)

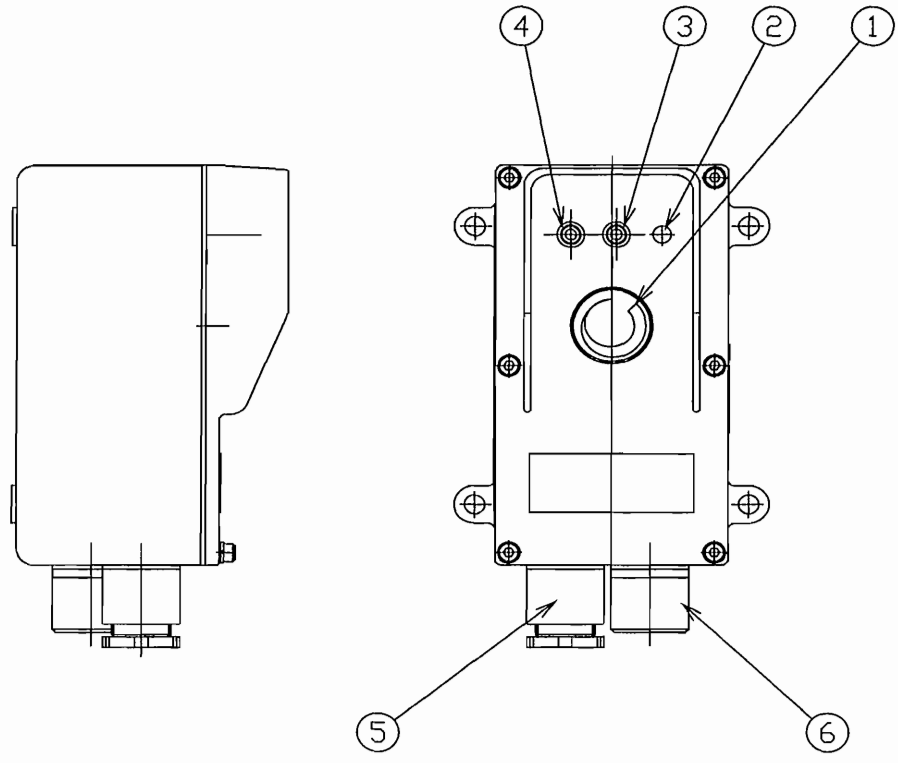
The components of the repeater compass and their functions are summarized below.



No	Name	Function
1	Shadow pin mounting hole	For installing the shadow pin which measures the azimuth of a target.
2	Mounting hole (for a horizontal stand or bracket)	Allows the repeater compass to be attached to the gimbal ring on a horizontal stand or bracket.
3	Mounting hole (for a tilting bracket)	Allows the repeater compass to be attached to a tilting bracket.
4	Connector	For connection to a connection box. (for the MKN015-P)
5	Cable	Connects the repeater compass to a connection box. (for the MKN015-P or -G)

(4)Connection Box (MKN015-P or -G)

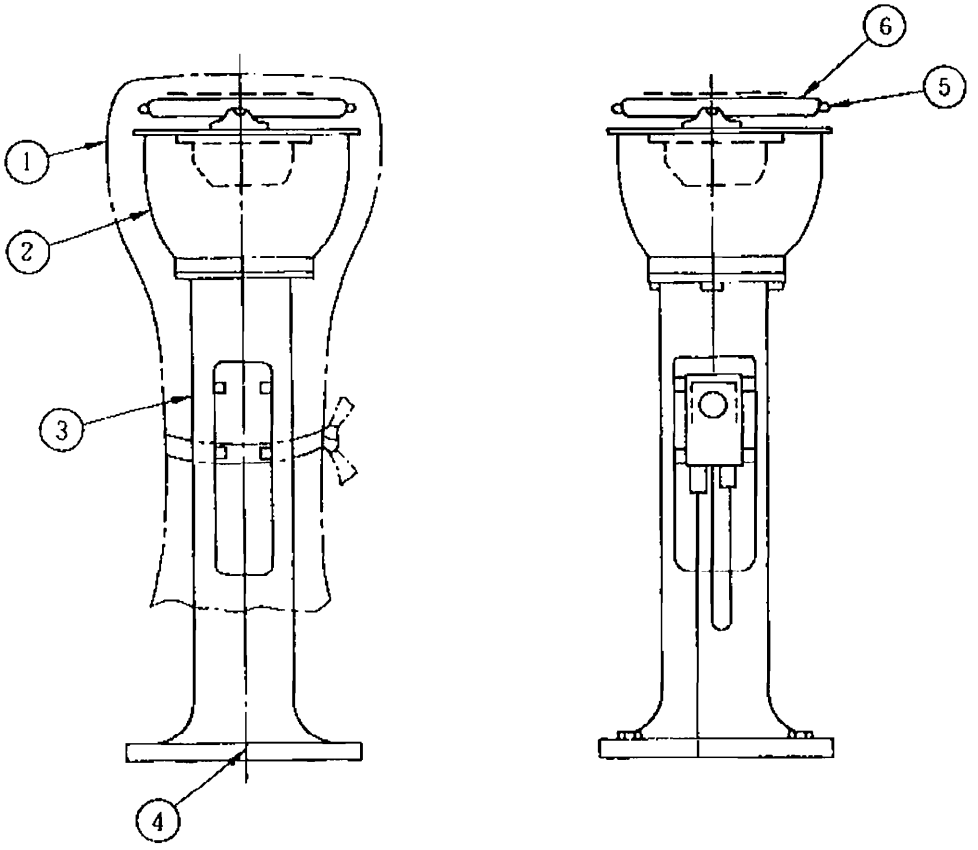
The components of the connection box and their functions are summarized below.



No	Name	Function
1	Dimmer	Controls the illumination intensity of the repeater compass card.
2	Zero adjustment switch	Used when there has been a shift in the value indicated by the repeater compass.
3	Run indicator lamp (green)	This LED blinks when zero adjustment is being carried out. Normally it is lit.
4	Fail indicator lamp (red)	This LED is lit or blinks when an error is detected. Normally it is off.
5	Connector	For an input cable clamp.
6	Gland	For a repeater compass cable clamp.

(5)Horizontal Stand (KX223A)

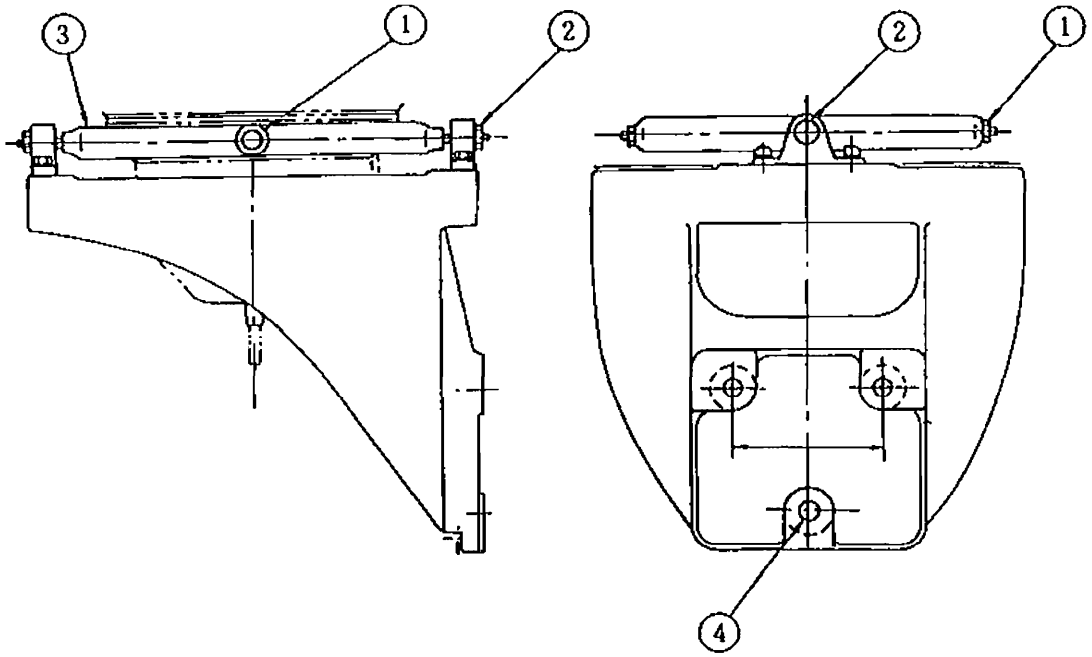
The components of the horizontal stand and their functions are summarized below.



No	Name	Function
1	Cover	
2	Support	
3	Stand	
4	Base line	Allows the horizontal stand to be aligned with the bow-to-stern line of the ship.
5	Repeater mounting shaft	For installing a repeater compass (keeps the repeater compass horizontal).
6	Gimbal ring	Keeps the repeater compass horizontal.

(6)Horizontal Bracket (KX201A)

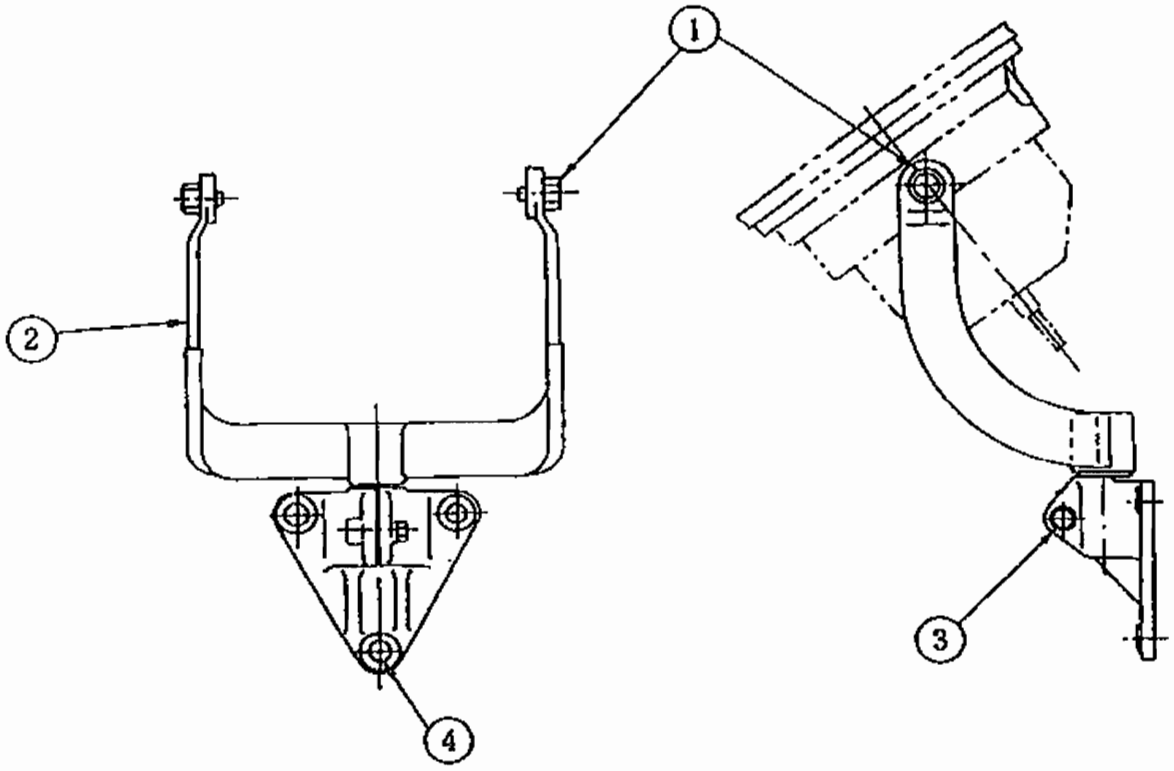
The components of the horizontal bracket and their functions are summarized below.



No	Name	Function
1	Repeater mounting shaft	For installing a repeater compass (keeps the repeater compass horizontal).
2	Gimbal bearing	Keeps the repeater compass horizontal.
3	Gimbal ring	Keeps the repeater compass horizontal.
4	Mounting hole	For mounting a horizontal bracket to the ship.

(7)Tilting Bracket (KX213)

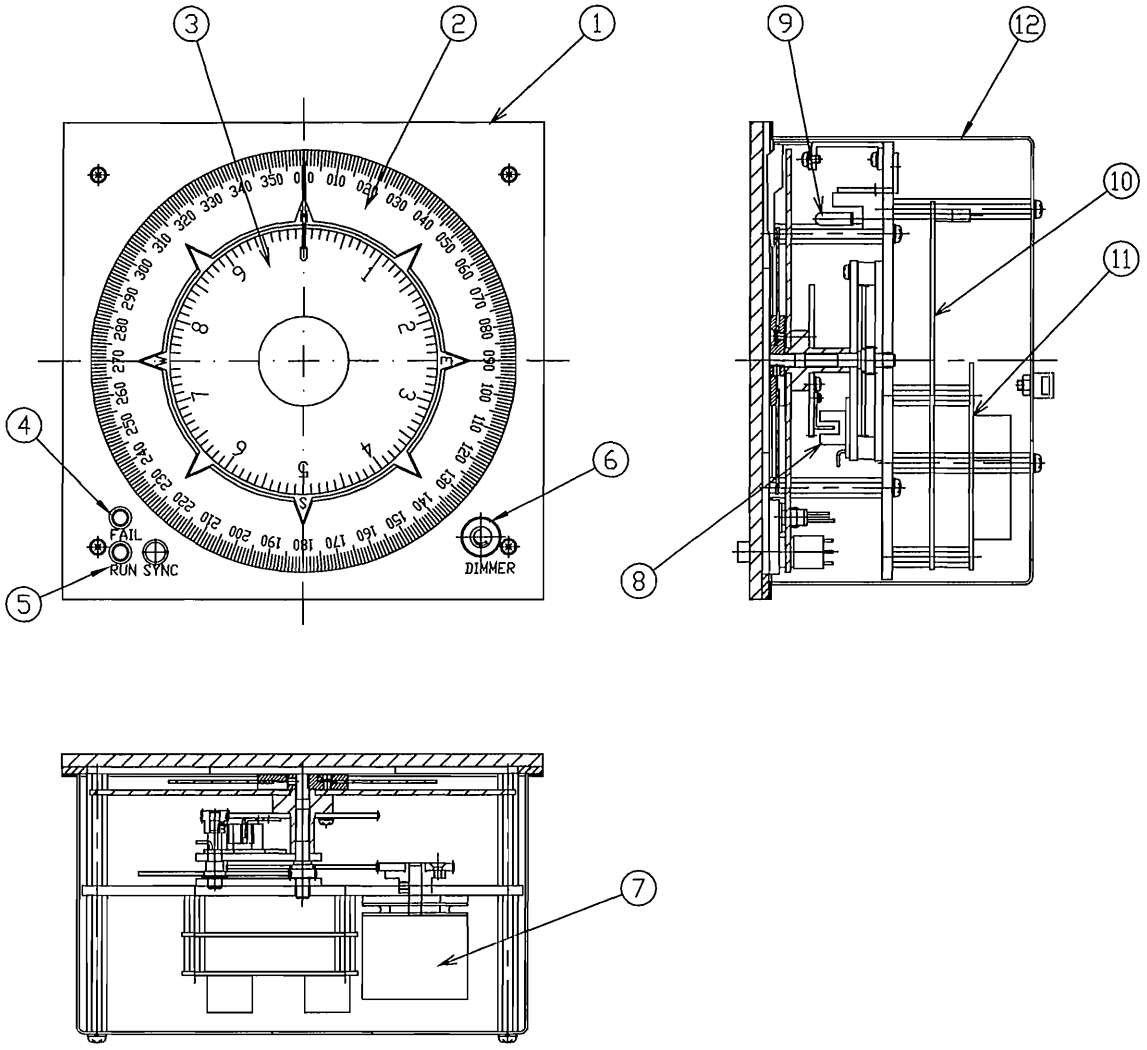
The components of the tilting bracket and their functions are summarized below.



No	Name	Function
1	Repeater mounting bolt	For installing a repeater compass and adjusting its tilting angle.
2	Arm	For supporting a repeater compass and adjusting its tilting angle.
3	Arm fastening bolt	For Fastening an arm and adjusting its horizontal position.
4	Mounting hole	For mounting a tilting bracket to the ship.

(8)Steering Repeater Compass (MKR051)

The components of the steering repeater compass and their functions are summarized below.

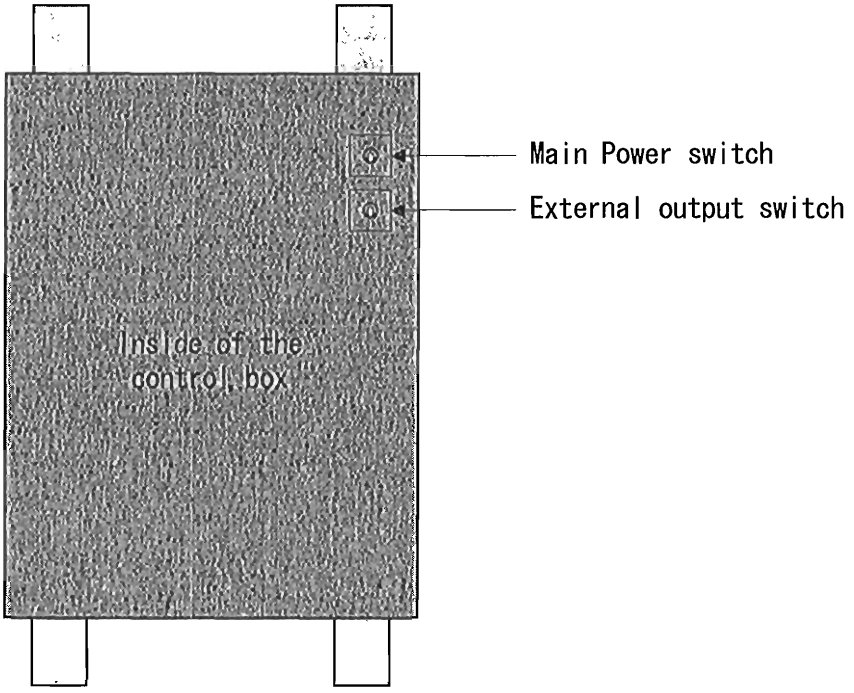


No	Name	Function
1	Front panel	For panel mount fitting.
2	Scale (360°/rev)	Heading scale card.
3	Scale (10°/rev)	Heading scale card.
4	Fail indicator lamp (red)	This LED is lit or blinks when an error is detected. Normally it is off.
5	Run indicator lamp (green)	This LED blinks when zero adjustment is being carried out. Normally it is lit.
6	Dimmer	Controls the illumination intensity of the repeater compass card.
7	Motor	Drive the heading scale card.
8	Photo sensor	Adjust the repeater compass card to 0 (zero) point.
9	Lamp	Light up the repeater compass card.
10	RPT CPU Assy	Input a heading signal and control motor drive.
11	RPT TB Assy	In put and out put Terminal board.
12	Box	Protects the internal unit.

4. OPERATION

4.1 Startup and Stoppage

The gyrocompass system is started up or stopped by operating the main power switch in the control box.



4.1.1 Startup

Start up the gyrocompass at least 5 hours before performing normal operation.

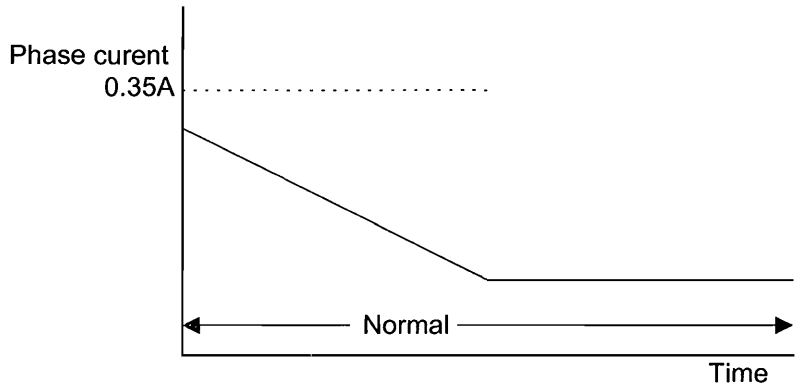
After the power switch is turned on, the gyrocompass system is started up at either hot start or cold start depending on the condition of the gyrosphere.

If the gyro rotor is rotating at a high enough speed to detect the heading, hot start begins, however, if it is rotating at a speed that is too low to detect the heading, cold start begins.

The rotating status of the gyro rotor is determined by monitoring the phase current.

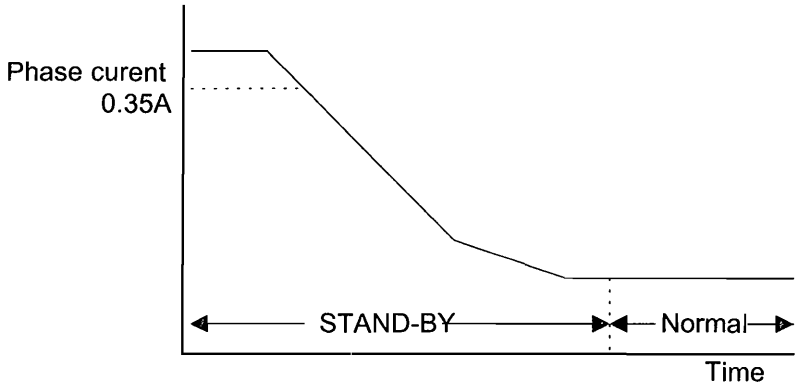
(1) Hot start

Hot start begins if the value of the phase current immediately after turning on the power is 0.35 A or less and follow-up of master compass, signal input/output, and indicator lamps are normal.



(2) Cold start

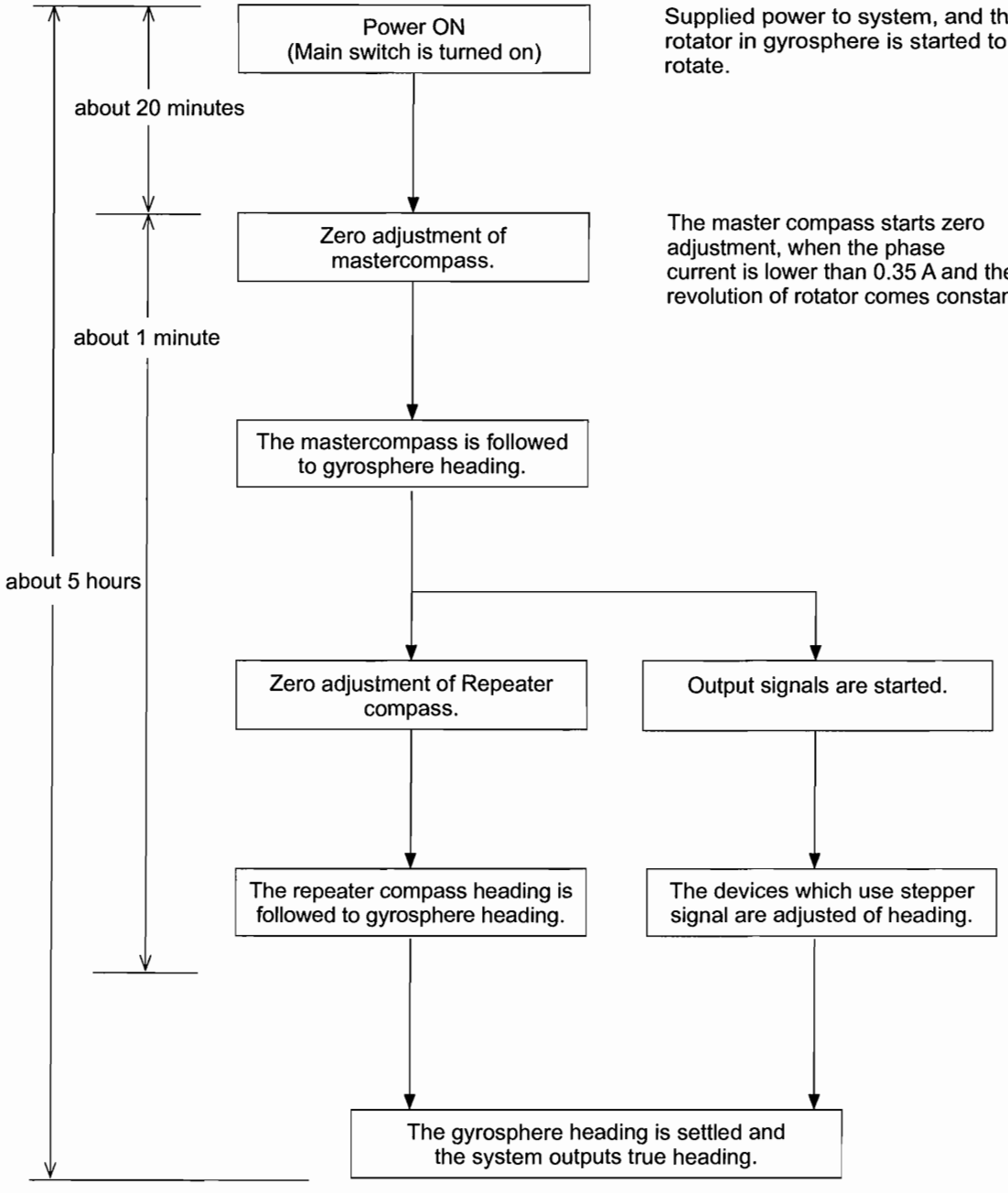
Cold start begins if the value of the phase current immediately after turning on the power is higher than 0.35 A. The stand-by state continues until the phase current drops and the rate of change in the phase current drops below a specified level. Normal operation will start when these requirements are met. During stand-by, functions of master compass automatic aligning and manual aligning cannot be carried out. After about 2 hours, the heading indication settles and the gyrocompass is ready for operation.



4.1.2 Stoppage

When the main power switch is turned off, all power is cut.

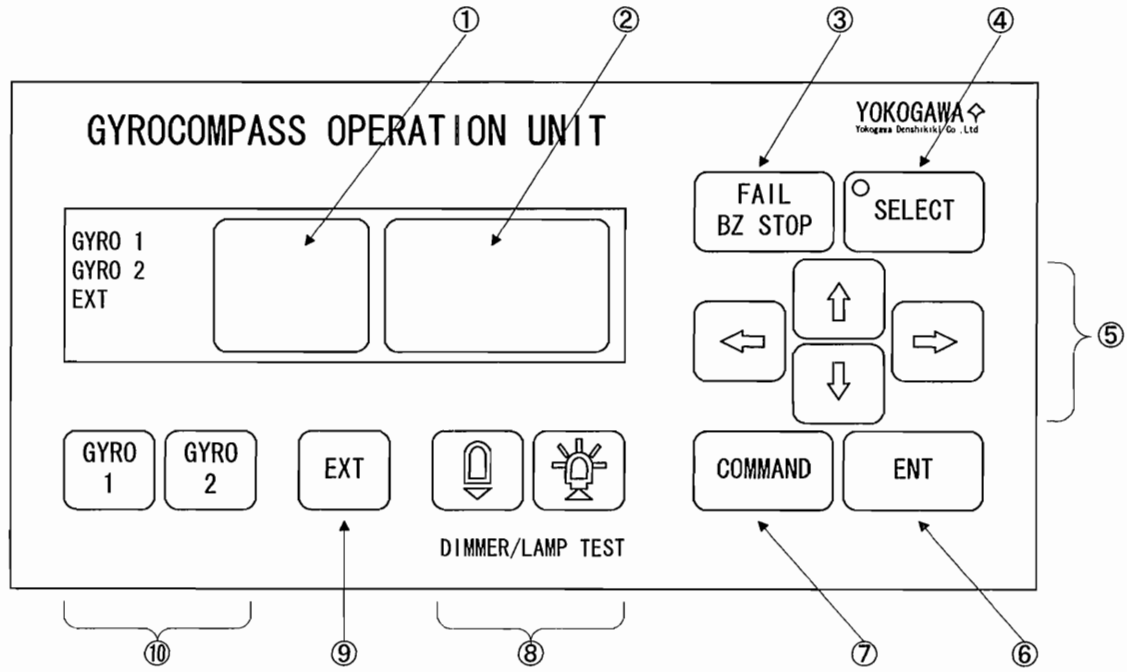
Startup Sequence



4.2 Functions and Operations of The C.Operation unit

Name	Functions and Operations
① Heading display	Displays a compass heading and system status.
② Data display	Indicates displays corresponding to menus and each command code.
③ Alarm lamp and buzzer stop key	Displays alarm statuses for the gyrocompass system. If pressed when an alarm is generated, the alarm buzzer is stopped.
④ Select LED and Select key	Displays and selects the operating initiative (C. operation unit or M. operation unit). keep the key pressed for at least two seconds When LED is lit, this unit can be operated. When LED goes off, M. operation unit can be operated.
⑤ Arrow keys	Carry out selection of commands and data and switching of displays.
⑥ ENT key	Enters and sets commands and data.
⑦ COMMAND key	If pressed when in normal mode, the display switches from the data display to the MAIN MENU. If pressed when the display is in access mode, the display returns to normal mode.
⑧ Dimmer key	Adjusts brightness of the displays of this unit. In addition, if this key is pressed in combination with the ENT key, contrast of the LCD can be adjusted. If both keys are simultaneously pressed, a lamp test is performed.
⑨ External heading selector key	Changes the output heading to that of the external heading (bow heading input from external heading sensor). keep the key pressed for at least two seconds
⑩ Gyro heading selector key	If GYRO1 key is pressed, the output heading is changed to the gyro heading (true heading of the master compass). GYRO2 key is not used.. keep the key pressed for at least two seconds

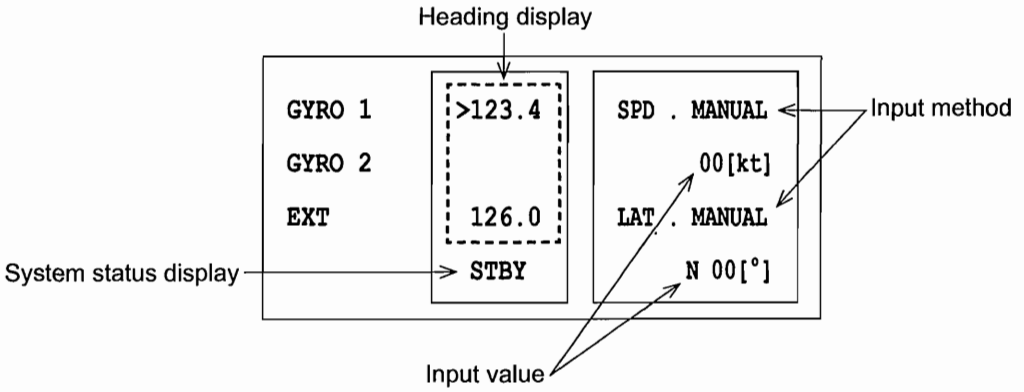
If key ④, ⑨ or ⑩ is to be operated, keep the key pressed for at least two seconds.



4.3 Display of Normal Mode

Displays of the C. operation unit at startup (normal mode) will be described below.

The heading display indicates true headings of each heading sensor and system status, and the data display indicates input method and input value of ship's speed and ship's position (the figure on the right is an example of this display).



(1) Heading display

The true heading of the master compass is displayed in the first line (GYRO 1) and the true heading of external heading sensor is displayed in the third line (EXT) of the heading display.

The display is blank for heading values not connected to this C. operation unit.

The true heading whose heading value is ineffective is displayed with "---.-". (i.e. signal input error.)

For the heading sensor that is selected, ">" is displayed immediately before the true heading.

To switch to another heading sensor, press the external heading selector key or the gyro heading selector key (cannot be selected to an unconnected compass).

(2) System status display

The gyro system status is displayed in the bottom line of the heading display. The system status at normal running is not shown and the display is blank.

System Status

STBY	Displayed when the master compass is in stand-by status.
HDG FLT	Displayed when there is a failure with the heading sensor that is selected.
PWR FLT	Displayed when there is a failure of the AC power supply to the system equipped with the DC backup system. **This indication is held even if an AC power supply recovers. Indication disappears when a COMMAND key is pushed.**

(3) Input method

There are displayed the method of input for speed and latitude.

MANUAL	The value is set manually.
AUTO	The value is input from external sensor.

(4) Input value

The values to correct the speed error is displayed.

4.4 Accessing Menus

The following is a description of accessing menus.

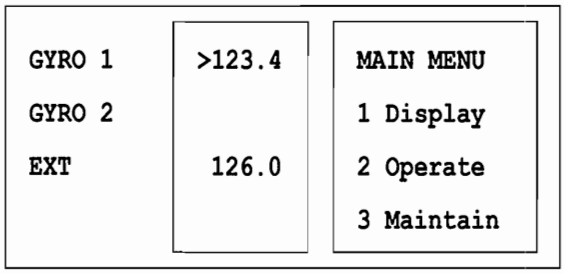
The heading display continues to display system status and the data display indicates the menus.

(1) Rough classification menu

If the command key is pressed when in normal mode, the MAIN MENU appears in the data display (the figure on the right).

The item that is selected blinks. (The blinking part is called the cursor.)

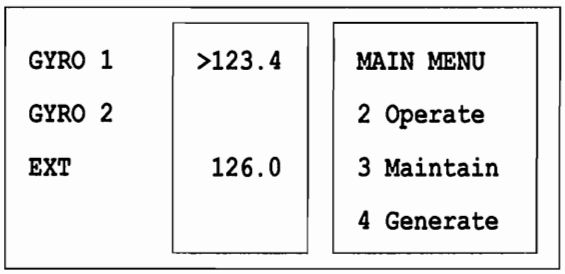
Select an item by moving the position of the cursor with the up and down arrow keys.



If the down arrow key is pressed when the cursor resides in the bottom line, the displayed menu shows the next page.

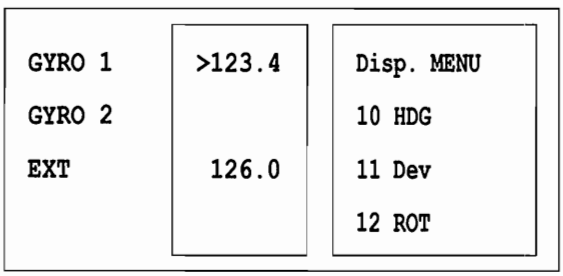
If the up arrow key is pressed when the cursor resides in the top line, the displayed menu shows the preceding page.

To return to normal mode from the display thus accessed, press the COMMAND key.

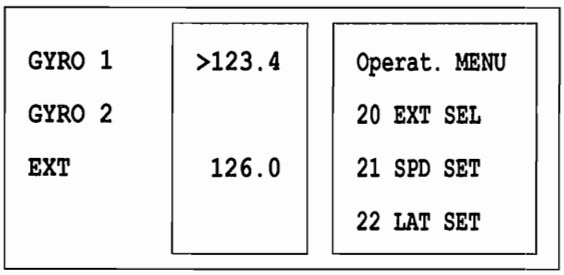


(2) Medium classification menu

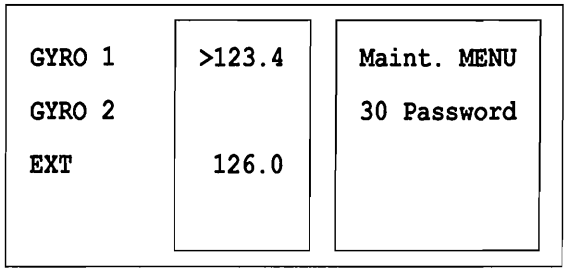
Select "1 Display" from the MAIN MENU and press the ENT key. The MAIN MENU switches to the Disp. MENU (as shown in the figure on the right).



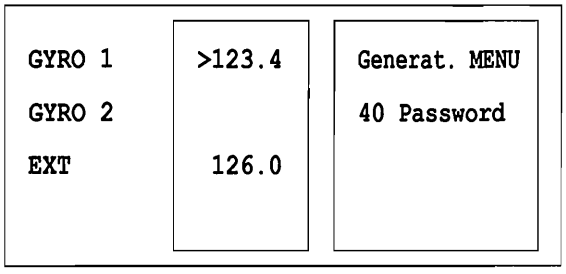
Select "2 Operate" from the MAIN MENU and press the ENT key. The MAIN MENU switches to the Operat. MENU (as shown in the figure on the right).



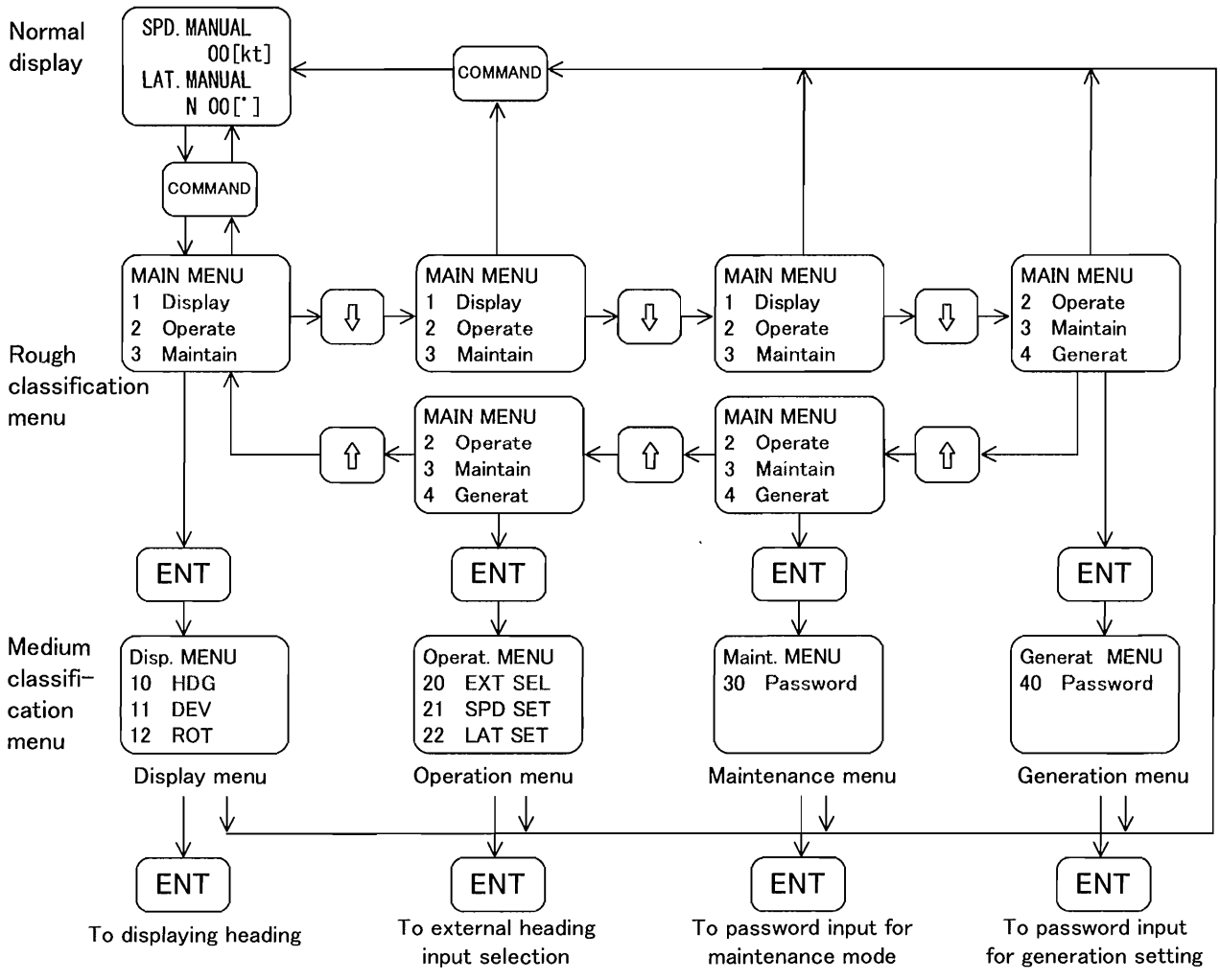
Select "3 Maintain" from the MAIN MENU and press the ENT key. The MAIN MENU switches to the Maint. MENU (as shown in the figure on the right).



Select "4 Generate" from the MAIN MENU and press the ENT key. The MAIN MENU switches to the Generat. MENU (as shown in the figure on the right).



☐ Flow of accessing menus



4.5 Command Functions

Each command code and their functions and whether or not they can be executed when in standby state are described below.

Classification	Command Code	Execution during Standby	Function Item	Page
Display Function		o	True heading, compass heading and system status display (normal mode)	4-5
	10	o	True heading and value of speed error correction display	4-9
	11	o	Heading deviation display	4-10
	12	o	Turn rate display	4-10
	13	o	Total running time, gyrosphere running time and the time after startup display	4-11
	14	o	Dimmer rank display	4-11
	15	o	Gyrosphere phase current display	4-12
	16	o	Backup battery voltage display	4-12
	17	o	Deviation voltage display	4-12
	19	o	Software version number display	4-12
Setting Function	20	o	External azimuth input selection	4-14
	21	×	Speed setting for speed error correction	4-15
	22	×	Latitude setting for speed error correction	4-15
	23	×	Automatic alignment of master compass	4-16
	24	×	Manual alignment of master compass	4-16
	26	o	Displaying/resetting cause of master compass alarm	5-4
	27	o	Displaying/resetting cause of C.operation unit alarm	5-4
	28	o	Deviation alarm setting	4-17
	29	o	Startup timer setting	4-18
Maintenance Function	30	o	Permission for maintenance function	6-20
	31	o	Outputting simulated DAC signals	6-21
	32	o	Manual drive of master compass	6-22
	33	o	Manual drive of repeater compass	6-22
	34	o	Resetting gyrosphere running time	6-23
	36	o	Initialization of backup memory	6-23
	37	o	Correcting master compass installation error	6-24
	38	o	Setting the master compass follow-up gain	6-25
	39	o	Error log display	6-25
Generation Function	40	×	Permission for generation function	6-31
	41	×	Setting the follow-up speed for stepper signal.	6-32
	42	×	Setting communication protocol of output port	6-32
	43	×	Setting format of output port	6-33
	44	×	Setting communication protocol of input port	6-38
	45	×	Setting format of input port	6-38

"o" means that execution is permitted during standby.
"×" means that execution is not permitted during standby.

4.6 Display Functions

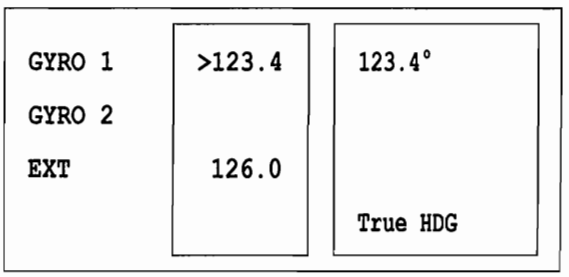
This section describes how to display various information.

The following 9 items can be displayed.

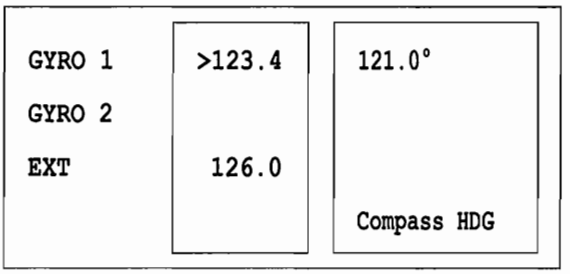
1	Heading display	Displays true heading , compass heading and value of speed error correction.
2	Heading deviation display	Displays heading deviation of gyro heading from external azimuth.
3	Turn rate display	Displays turn rate on a degrees/second or degrees/minute basis.
4	Running time display	Displays the total running time, gyrosphere running time and running time after startup.
5	Dimmer rank display	Displays a dimmer rank and adjusts the contrast.
6	Gyrosphere phase current display	Displays the gyrosphere phase current.
7	Backup battery voltage display	Displays the backup battery voltage.
8	Deviation voltage display	Displays a deviation voltage.
9	Software version number display	Displays the software version number.

4.6.1 Displaying Heading

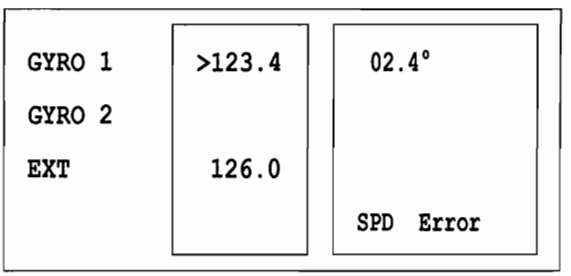
Selecting "10 HDG" from the Disp. MENU and pressing the ENT key switches to the display showing the heading.



Pressing the right and left arrow keys switches the display between true heading, compass heading and the value of speed error correction.



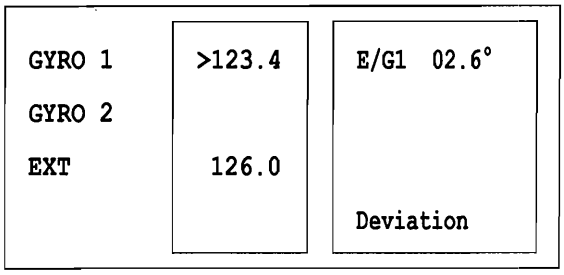
The upper, middle and lower figure on the right is an example of displaying the true heading (True HDG), compass heading (Compass HDG) and the value of speed error correction (SPD Error).



4.6.2 Displaying Heading Deviation

Selecting "11 Dev" from the Disp. MENU and pressing the ENT key switches to the display showing the heading deviation.

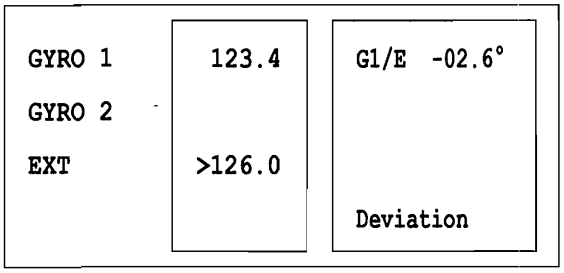
Deviation values of each heading sensor based on the heading currently being output are displayed.



The upper figure on the right shows an example of displaying the heading deviation of the external heading sensor based on the gyro heading.

(Heading deviation) =

(External heading) - (Gyro heading)



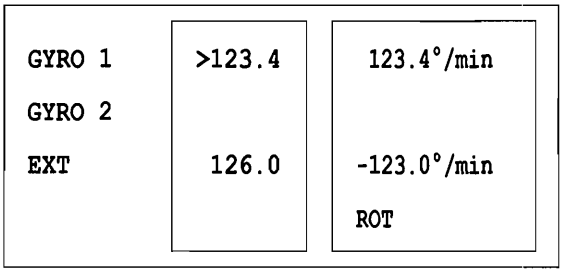
The lower figure on the right shows an example of displaying the heading deviation of the gyro-heading sensor based on the external heading.

(Heading deviation) =

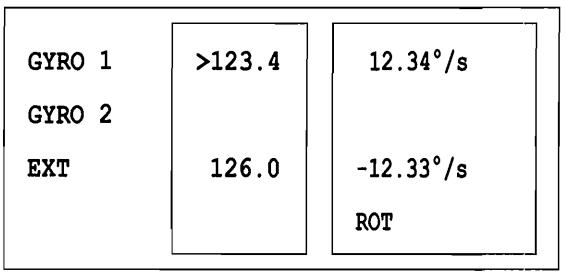
(Gyro heading) - (External heading)

4.6.3 Displaying Rate of Turn

Selecting "12 ROT" from the Disp. MENU and pressing the ENT key switches to the display showing the rate of turn.



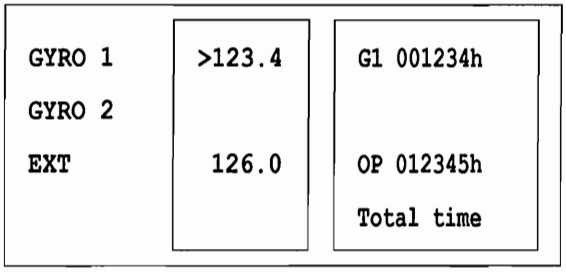
If the right and left arrow keys are pressed, the display for rate of turn units can be changed from degrees/minute to degrees/second.



The upper figure on the right shows an example of displaying a rate of turn in degrees/minute and the lower figure on the right, an example of displaying a rate of turn in degrees/second.

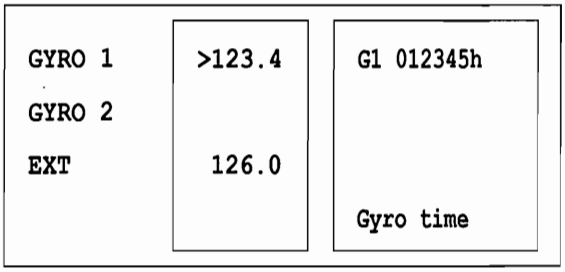
4.6.4 Displaying Running Time

Selecting "13 Run Time" from the Disp. MENU and pressing the ENT key switches to the display showing the running time.

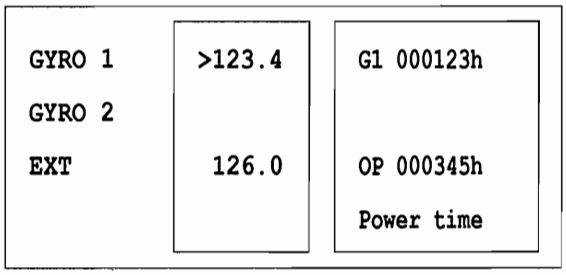


The first line (G1) indicates the master compass running time and the third line (OP) the C. operation unit running time.

If the right and left arrow keys are pressed, the display can be switched between the total running time, gyrosphere running time, and time after startup.

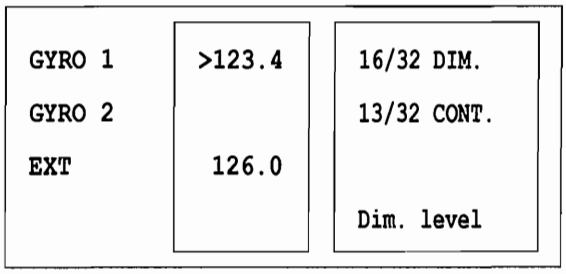


The upper, middle and lower figures on the right show examples of displaying total running time (Total time), gyrosphere running time (Gyro time) and the time after startup (Power time) respectively.



4.6.5 Displaying Dimmer Rank

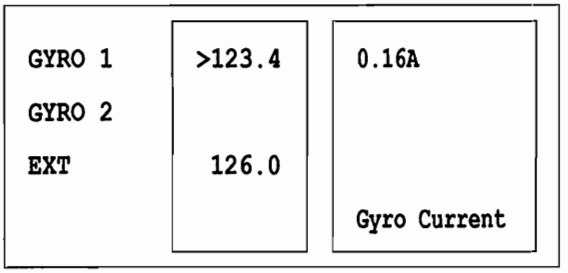
Selecting "14 Dim. level" from the Disp. MENU and pressing the ENT key switches to the display showing the dimmer rank (as shown in the figure on the right).



4.6.6 Displaying Gyrosphere Phase Current

Selecting "15 G.Current" from the Disp. MENU and pressing the ENT key switches to the display showing the gyrosphere phase current (as shown in the figure on the right).

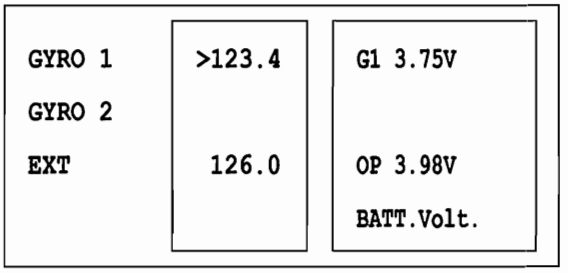
The normal value is in the range from 0.15 A to 0.35 A.



4.6.7 Displaying Backup Battery Voltage

Selecting "16 BT.Volt" from the Disp. MENU and pressing the ENT key switches to the display showing the backup battery voltage (as shown in the figure on the right).

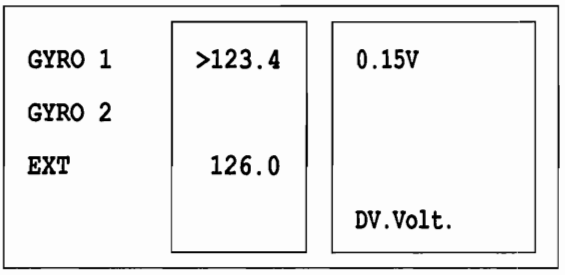
The normal value is in the range from 2.5 V to 4.0 V.



4.6.8 Displaying Deviation Voltage

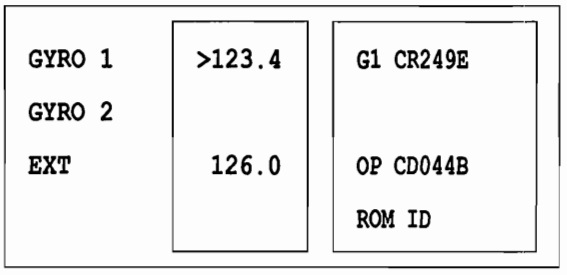
Selecting "17 DV.Volt" from the Disp. MENU and pressing the ENT key switches to the display showing the deviation voltage (as shown in the figure on the right).

The normal value is in the range from - 0.4 V to 0.4 V.

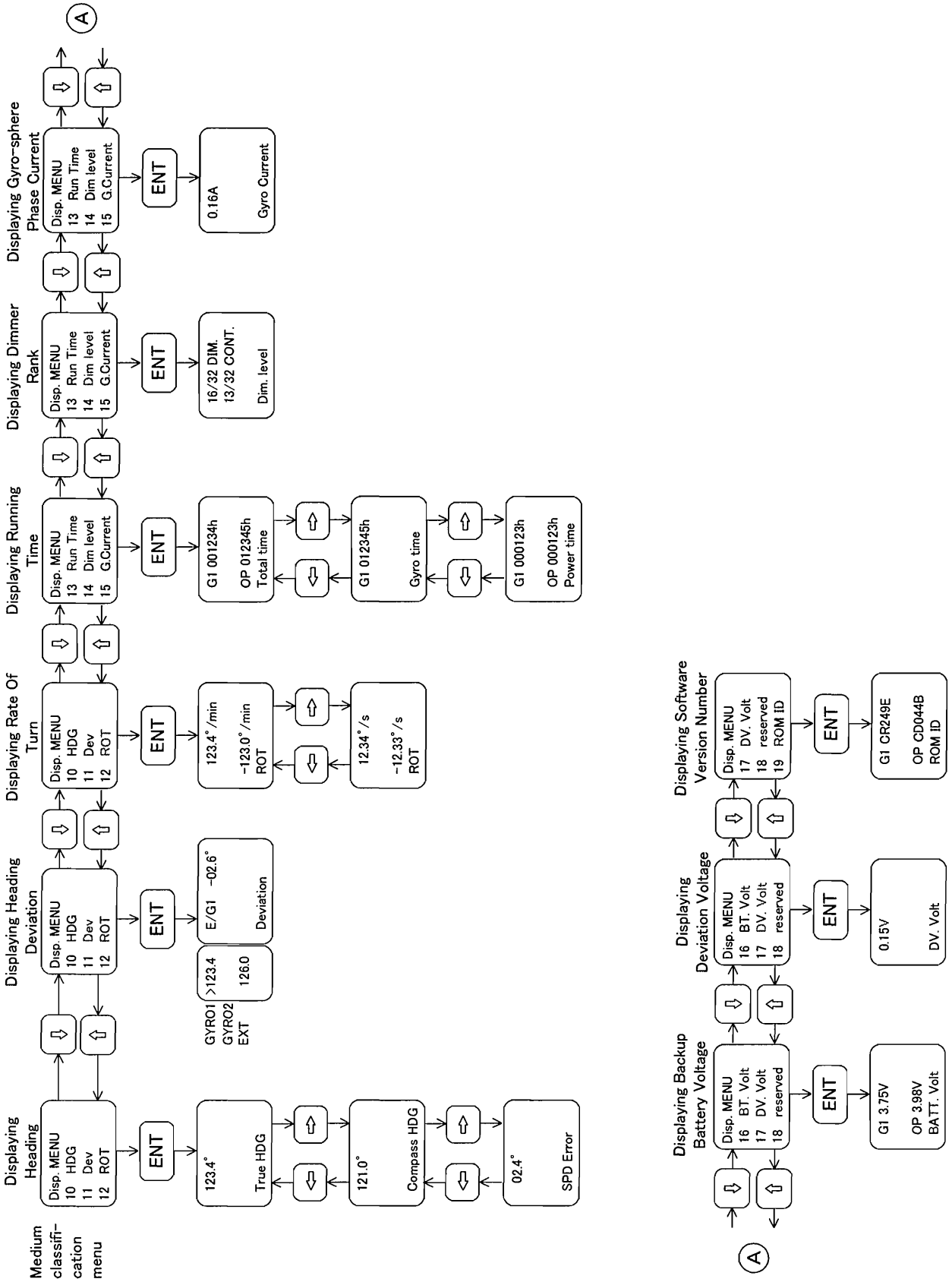


4.6.9 Displaying Software Version Number

Selecting "19 ROM ID" from the Disp. MENU and pressing the ENT key switches to the display showing the software version number (as shown in the figure on the right).



☐Flow of accessing Display function



4.7 Setting Functions

This section describes how to set the functions that are regarded as essential for running the gyrocompass.

The setting functions include the following six types.

- External heading input selection
- Speed-error correction
- Automatic master compass alignment
- Manual master compass alignment
- Deviation alarm setting
- Startup timer setting

4.7.1 External Heading Input Selection

C. operation unit has 3 input ports for the serial signal and all port can be connected the heading sensors. This menu executes the status display of each port and the selection of external heading sensor that display as EXT.

The example of connected external heading sensor and the selecting procedure are as follows.

☐ The example of connected external heading sensor

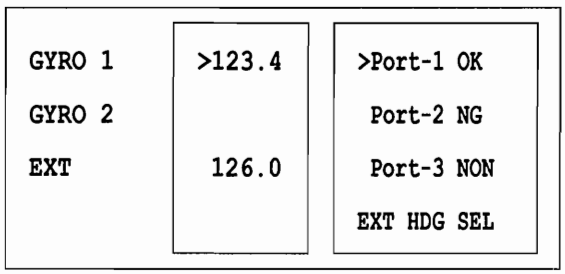
Port 1 : Magnetic compass (TMC unit)

Port 2 : Transmitting heading device

Port 3 : disconnected

☐ The selecting procedure

Selecting "20 EXT SEL" from the Operat. MENU and pressing the ENT key switches to the display showing the external heading input selection.



External heading input information for external heading input ports 1 to 3 is displayed (as shown in the figure on the right).

External heading input information

NON	Without external heading input setting
OK	With external heading input setting; External heading input information is being normally input.
NG	With external heading input setting; External heading input information failure is being generated.

For the port used as the external heading, ">" is displayed immediately before "Port-."

In order to change input ports, move the ">" to the targeted port by pressing the up or down arrow key and press the ENT key. The display blinks, signaling the need to validate the change.

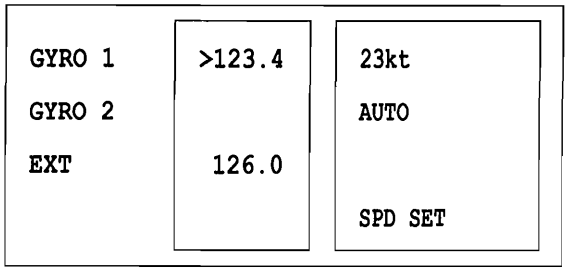
If the ENT key is pressed again, blinking stops and the input port is changed. However, the port cannot be changed without setting the external heading input.

4.7.2 Speed Error Correction

(1) Setting the Ship's Speed (procedure for setting correction in the speed-error of the ship's speed)

Selecting "21 SPD SET" from the Operat. MENU and pressing the ENT key switches to the display showing speed-error correction speed input.

The figure on the right shows an example of displaying ship's speed of 23 knots (kt) with automatic input.



To select automatic or manual input, press the ENT key. Both AUTO and MANUAL blink. Then, with the up or down key select either AUTO or MANUAL and press the ENT key.

If AUTO is selected, the automatic ship's speed input becomes valid.

If MANUAL is selected, the tens digit of the ship's speed blinks, allowing for a value between 00 to 99 kt to be entered for the ship's speed by manual.

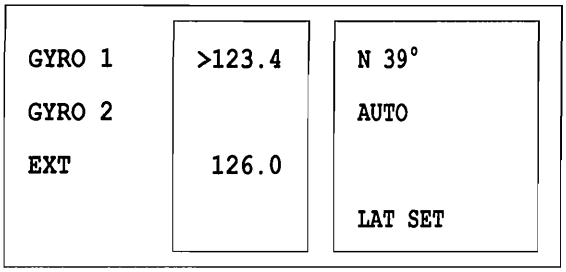
Press the right or left arrow key to change the place of input and press the up or down arrow key to change the numeric value.

After entering ship's speed press the ENT key. The input value blinks, signaling the need to validate the change. If the ENT key is pressed again, blinking stops and the input value is changed.

(2) Setting the Ship's Position (procedure for setting the latitude for correcting speed-error)

Selecting "22 LAT SET" from the Operat. MENU and pressing the ENT key switches to the display showing the speed-error correcting latitude input.

The figure on the right shows an example of displaying the latitude of 39 °N.



To select automatic or manual input, press the ENT key. Both AUTO and MANUAL blink. Then, with the up or down key select either AUTO or MANUAL and press the ENT key.

If AUTO is selected, the automatic latitude input becomes valid.

If MANUAL is selected, the character N or S blinks allowing for a value between 00 to 70 degrees N or S to be entered for the ship's latitude by manual.

Press the right or left arrow key to change the place of input and press the up or down arrow key to change the numeric value.

After entering the latitude press the ENT key. The input value blinks, signaling the need to validate the change. If the ENT key is pressed again, blinking stops and the input value is changed.

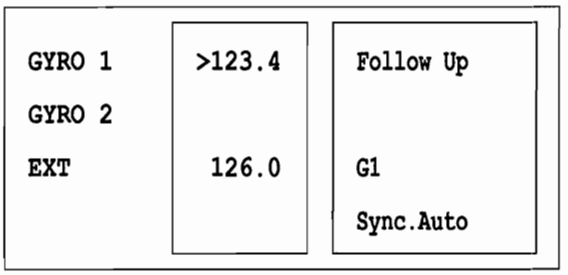
Determine the true heading by calculating the value for speed-error-correction from the values of speed and latitude.

True heading (deg) = (Compass heading) - (Value of speed-error-correction)

$$\text{Value of speed-error-correction (deg)} = \frac{\text{ship's speed (kt)}}{5\pi} \times \frac{\cos(\text{Compass heading})}{\cos(\text{Latitude})}$$

4.7.3 Automatic Master Compass Alignment

Selecting "23 Sync.Auto" from the Operat. MENU and pressing the ENT key switches the display showing automatic master compass alignment (as shown in the figure on the right).



"Follow Up" is displayed, signifying that the master compass is following up the gyrosphere.

If the ENT key is pressed when in this state, the "Ready" display appears showing standby for automatic alignment.

If the ENT key is again pressed, the "Running" display appears showing that automatic alignment is being carried out. (The master compass starts automatic alignment.)

If automatic alignment finishes normally, the "Success" display appears. However if it finishes due to a failure, the "Error" display appears. If a failure occurs, execute master compass alignment manually.

4.7.4 Manual Master Compass Alignment

If automatic master compass alignment cannot be executed, it is necessary to adjust the compass heading to the container heading. There are relative value alignment and absolute value alignment as the adjustment method.

<<Note>>Please make zero degree the speed error correction value by setting ship's speed 0 kt by using code "21" when you execute this adjustment.

(1) Relative value alignment

The error of the observation bearing that was measured by the gyrocompass is entered as the input value. (Input range : - 180 ° to + 180°)

Input value = (true reading through astronomical observation) - (compass reading)

Easterly : "-", Westerly : "+"

For example, if compass reading is "050.0" and the true reading through astronomical observation is "020.0", the input value is "- 30".

This method may be effective in case of sailing because the standard of absolute heading can be not obtained.

(2) Absolute value alignment

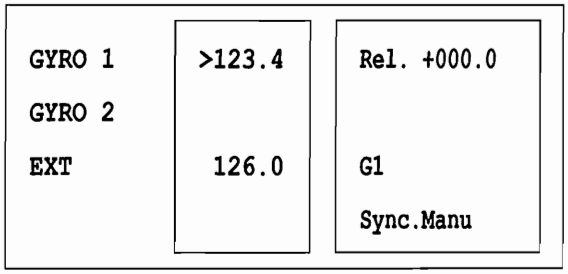
By inputting present absolute heading the compass heading is adjusted to the value.

Input value = (true heading)

This method may be effective in the dock, because the standard of absolute heading can be obtained.

☐ Operation procedure

Selecting "24 Sync.Manu" from the Operat. MENU and pressing the ENT key, switches to the display showing the manual master compass alignment (as shown in the figure on the right).



If the ENT key is pressed, "Rel." blinks allowing for a heading (absolute value: ±180.0 degrees; relative value: 000.0 to 359.9 degrees) to be entered.

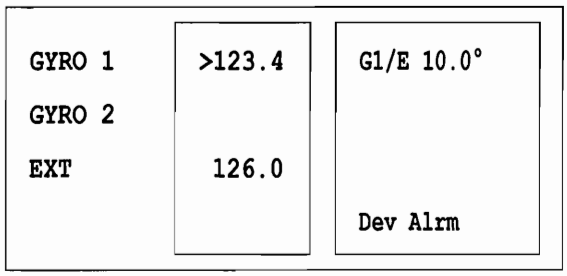
Press the right or left arrow key to change the place of input and press the up or down arrow key to select the absolute value of alignment (Abs.) or relative value of alignment (Rel.) and to change the numeric value.

After entering the heading press the ENT key. The input value blinks, signaling the need to validate the change. If the ENT key is pressed again, blinking stops and the input value is changed.

4.7.5 Setting Deviation Alarm

Selecting "28 Dev Alrm." from the Operat. MENU and pressing the ENT key switches to the display showing the deviation alarm setting.

The figure on the right shows an example of the deviation limit value to generate a deviation alarm (difference of master compass heading from external input heading) being at 10.0 degrees.



If the ENT key is pressed, the tens place of the deviation alarm limit value blinks to allow the value to be entered.

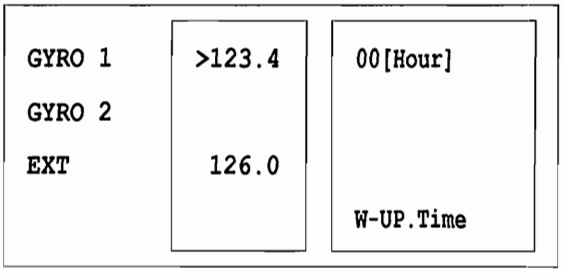
Press the right or left arrow key to change the place of input and press the up or down arrow key to change the numeric value.

After entering the limit value press the ENT key. Then the input value blinks, signaling the need to validate the change. If the ENT key is pressed again, blinking stops and the input value is changed.

In addition, if the limit value is set to "00.0," a deviation alarm is not generated.

4.7.6 Setting Startup Timer

Selecting "29 W-UP.Time" from the Operat. MENU and pressing the ENT key switches to the display showing the startup timer setting (as shown in the figure on the right).

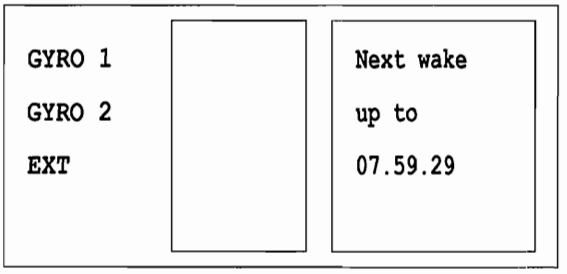


If the ENT key is pressed, the tens place of the startup time blinks to allow a startup time between 00 to 99 hours to be entered.

Press the right or left arrow key to change the place of input and press the up or down arrow key to change the numeric values.

After entering the time press the ENT key. The input value blinks, signaling the need to validate the input.

If the ENT key is again pressed, the system goes into timer mode and the power supply to the gyrosphere is stopped.



In timer mode the time until restart is displayed (as shown in the figure on the right).

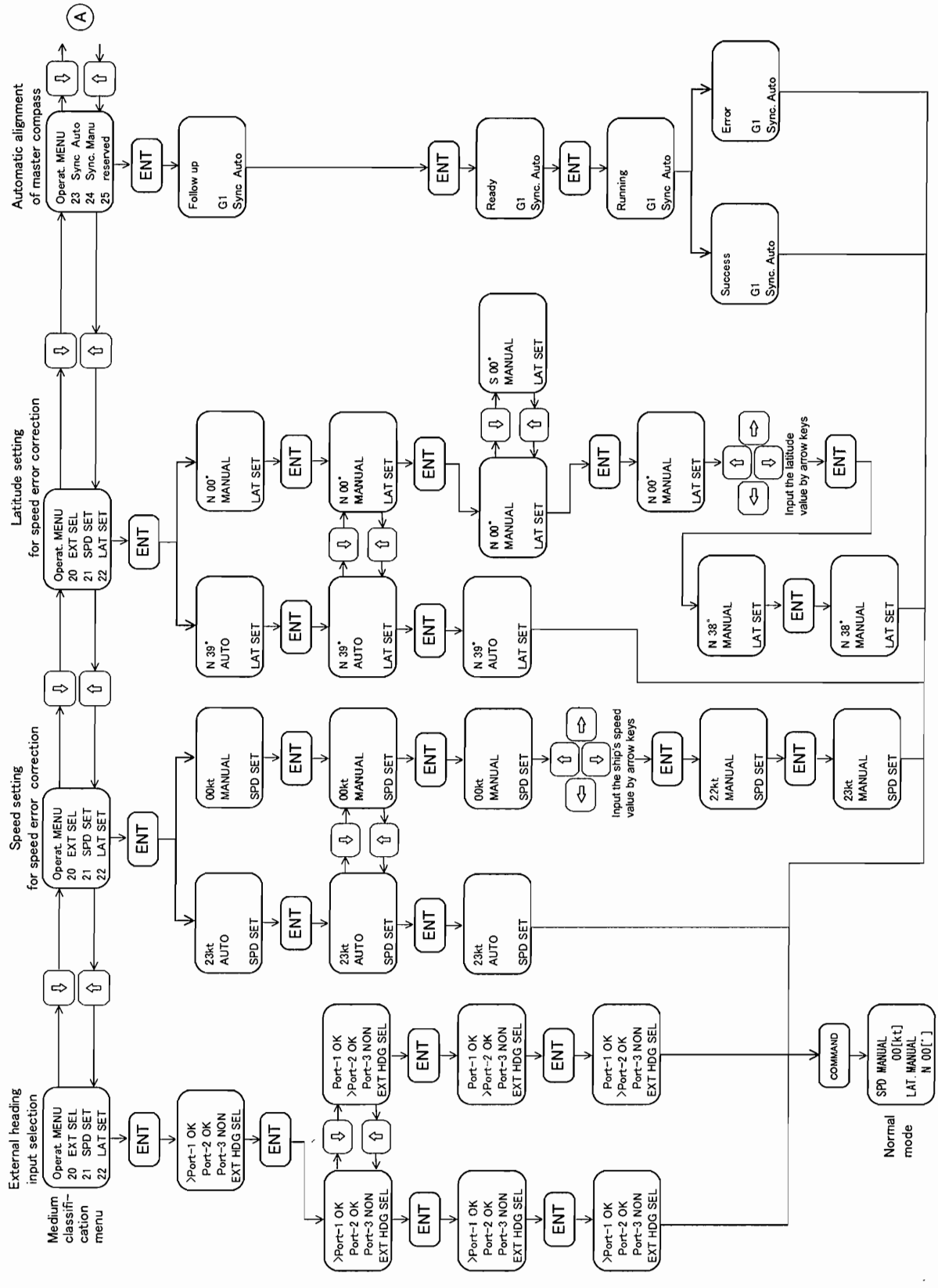
If the ENT key is pressed when in timer mode, the timer is reset and the system can be immediately started.

In addition, the system is normally started up at the heading that was selected when the power switch was turned off, however, the output heading if the system is started up using the timer function, becomes the gyro heading.

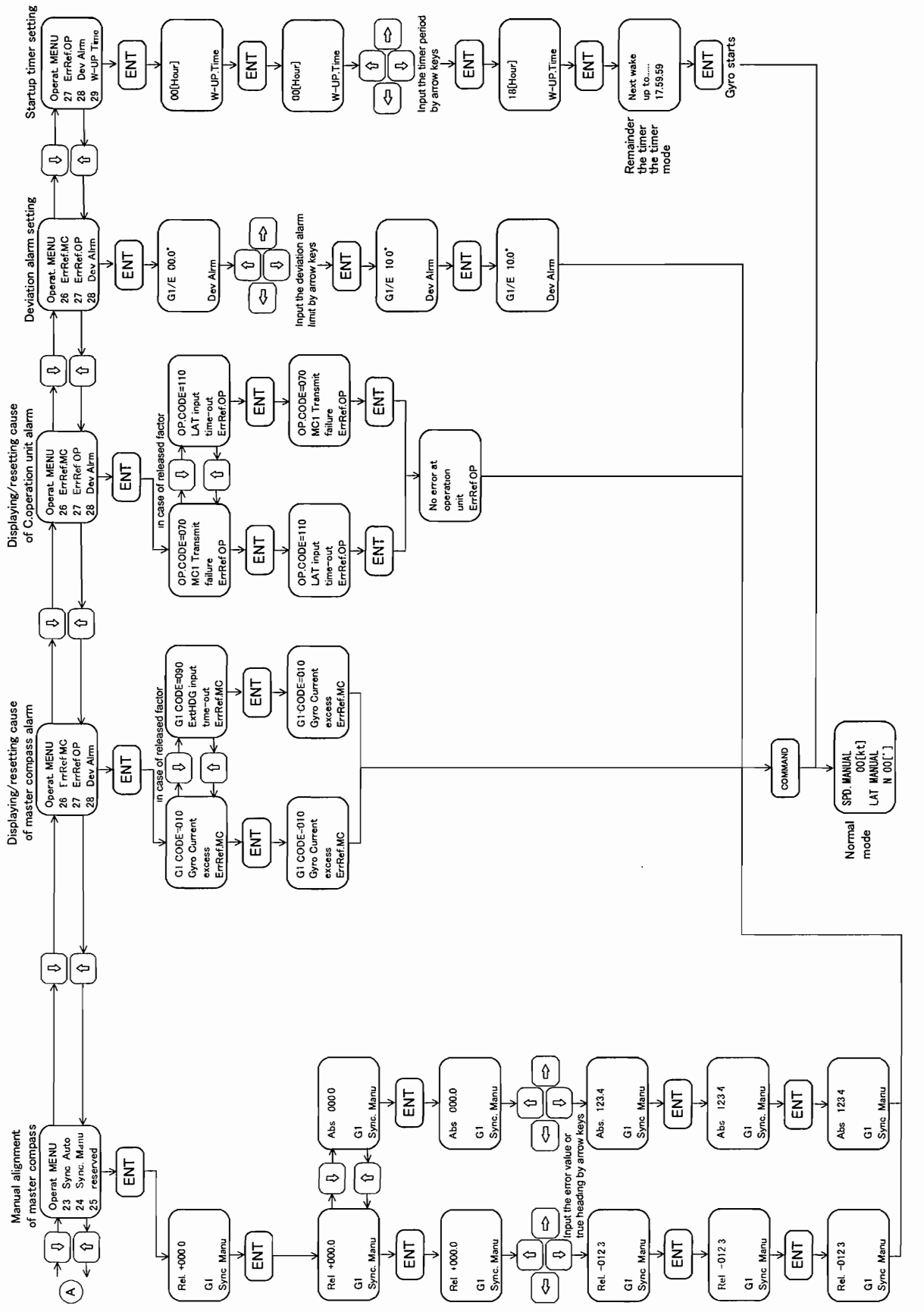
<<Note>> Don't cut off DC power supply for gyro system during timer mode.

If the startup time is set to "00", the system goes into "timer mode" for one minute and the power supply to the gyrosphere is stopped.

☐Flow-① of accessing Operation function



☐Flow-②of accessing Operation function



4.8 Procedures for Operating Repeater Compass

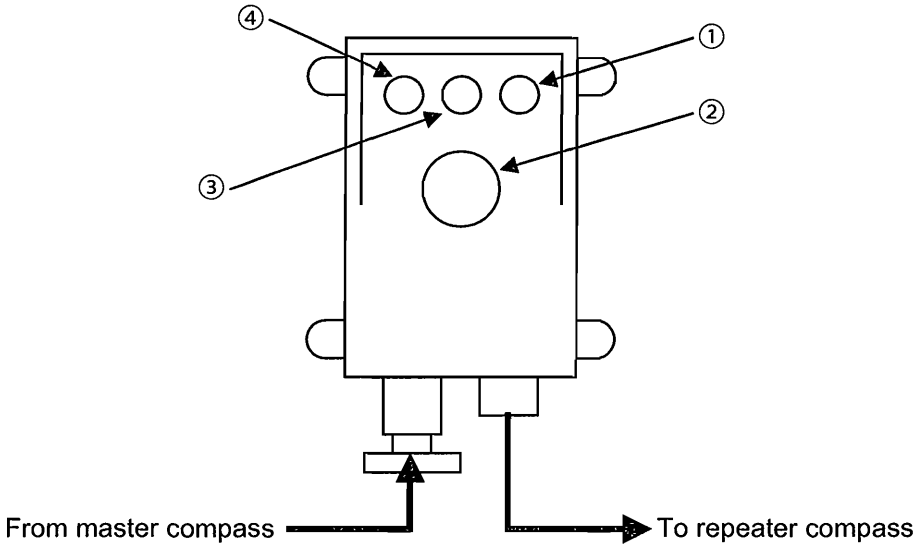
4.8.1 Basic Operation

The repeater compasses receive a serial signal from the master compass, and the compass cards turn so as to indicate the true heading.

If power is supplied from the master compass, the compass cards turn and zero adjustment is carried out. If this occurs, the run indicator lamp blink. When the pointers align with zero on the compass cards, the run indicator lamp stop blinking and remain lit.

If a heading signal is sent from the master compass using a serial signal, the compass cards turn and display the same value as that displayed by the master compass.

4.8.2 Connection Box



① **Zero adjustment switch**

Used when there has been a shift in the value indicated by the repeater compass.

② **Dimmer**

Turning this dial adjusts the illumination of the compass card, and fail indicator and run indicator lamps.

③ **Run indicator lamp (green)**

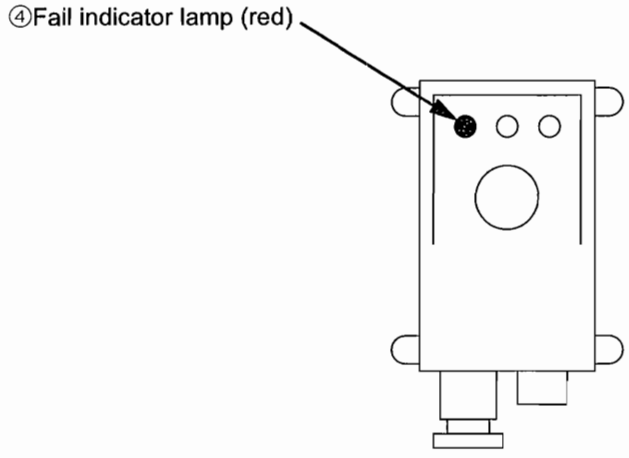
This lamp blinks when zero adjustment is being carried out. Normally it is lit.

④ **Fail indicator lamp (red)**

This lamp is lit or blinks when an error is detected. Normally it is off.

4.8.3 Repeater Compass Error Contents and Countermeasures

This section describes error contents when fail indicator lamp turns on or blinks and countermeasures.



Fail indicator lamp condition		Error contents	Causes	Countermeasure
Light off ○		Normal		
Light on ●		CPUI RAM failure or ROM failure	Broken down CPU board in connection box	Exchange CPU board
blink	Light on one time per 1.6 seconds.	Null point detection failure	Broken down optical sensor inside of repeater compass	Exchange optical sensor (It is possible to adjust null point by manually)
	●○○●○○●○○ 1.6sec		The snapping of a wire for Optical sensor	Restore connection (It is possible to adjust null point by manually)
	Light on two times per 1.6 seconds.	Communication failure between master compass and repeater compass	•Not connected signal wire •Thesnapping of signal wire •Connected signal wire inversely	Restore connection
	●●○●●○●●○			

●: Light on ○: Light off

4.8.4 Procedure for Null Point Adjustment of Repeater Compass

It is possible to adjust null point by manually when null point detection failure is occurred.

The procedure is as follows:

(1) Push Zero adjustment switch more than 2 seconds.

(The repeater compass card will turn round and stop after 5 seconds.)

At this time Fail indicator lamp shows null point detection failure.

(2) Push Zero adjustment switch. (The repeater compass card will turn round rapidly)

(3) Push Zero adjustment switch when the outer repeater compass card (360 degrees/revolution) value go below 10 degrees. (Rough adjustment)

The compass card will turn round slowly.

(4) Push Zero adjustment switch when the compass needle agree with the 0 scale of inner repeater compass card.

After about 3 seconds the Fail indicator lamp will be turned off and the repeater compass shows same heading as master compass heading. (Fine adjustment)

If you failed manual null point adjustment, try again the above procedure.

5. MAINTENANCE AND INSPECTION

Implement the following procedures of the daily inspection and regular inspection to maintain the gyrocompass in a state of normal working order:

5.1 Daily Inspection

	Inspection Item	Inspection Contents and Procedure	Recommended Inspection Interval
1	Gyrosphere drive current	Check that the current is within the range 0.15 A to 0.35 A by executing the command code "15" using the master compass operation unit or the remote unit.	Once/day (at an arrival)
2	Repeater compass alignment	Check that the heading of each repeater compass agrees with that of the master compass. (*1)	Once/departure
3	Ship's speed value Latitude value	Check that there are no errors in ship's speed and latitude by executing the command codes "21" and "22" in the master compass operation unit or the remote unit.	Once/day
4	Azimuth error	Check that there is no azimuth error using astronomical or physical target observation.	Once/day

(*1)

Check the readings of the repeater compass card when the ship's speed is set to "0." If a speed-error correction is performed, the master compass card reading will not agree with the repeater compass card reading.

5.2 Regular Inspection

Perform the following maintenance once a year.

Only technicians of the Service department of Yokogawa Denshikiki Co., Ltd. are authorized to implement the operations and other work described in this chapter. However, if for some reason the service department of Yokogawa Denshikiki Co., Ltd. permits you to perform these operations, be sure to follow the instructions described in this chapter.

	Inspection Item	Procedure
1	Gyrosphere	• Cleaning of mercury pot • Cleaning of lower electrode • Cleaning of follow-up electrode
2	Container	• Cleaning of inside surface • Cleaning of center pin (Exercise care when handling.) • Cleaning of lower electrode • Cleaning of follow-up electrode
3	Liquid Mercury Insulator	• Replace

(Note) For disassembling and assembling procedures, see Chapter 6, Section 6.2.

5.3 Troubleshooting

This section describes the checking procedure for error contents when an alarm is generated and countermeasures.

5.3.1 Display That Appears When an Alarm is Generated

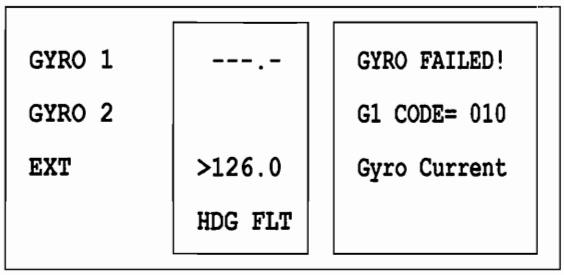
When an alarm is generated, the alarm lamp lights up and the buzzer stop key blinks with the buzzer sounds. Pressing the buzzer-stop key stops the buzzer.

The alarm lamp goes out if the alarm is reset, but continues to light up if the alarm continues.

The data display indicates the error code and the cause of the alarm. (The figure on the right shows an example.)

If there are two or more alarm causes, they are displayed one by one.

If the command key is pressed, the screen returns to normal mode.



<<Note>>

If the heading data is not obtained due to the cause of the alarm, the heading display indicates "---.-" such as above figure. In this case, we recommend that the available heading sensor be selected as the output heading.

When the heading sensor is changed from the present output heading to the available heading, the output heading value jumps to the selected heading value. Therefore, steering mode of autopilot should be change to manual mode if output heading is changed.

The list of error codes is shown on the next page.

5.3.2 List of Error Code

Main Group		Sub Group	
Error Code	**Error Contents**	**Error Code**	**Error Contents**
010's	Gyrosphere failure	010	350 mA or more for 20 min. (40 min. for startup)
020's	Inverter failure (Phase current shutdown)	020	50 mA or less for 3 seconds, without inverter output voltage
		021	50 mA or less for 3 seconds, with inverter output voltage
030's	Memory failure	030	ROM failure (check sum error)
		031	RAM failure (read/write error)
040's	Backup battery voltage failure	040	Backup battery voltage failure
050's	Follow-up failure	050	Deviation of 0.5° or more continues for 12 seconds or more.
060's	Operation panel switch failure	060	Continuously ON for 60 seconds or more
070's	Communication failure between C. operation unit and master compass	070	Communication error
		071	Abnormal data
080's	Master compass alignment failure	080	Zero detection failure
090's	External heading input failure	090	Time-out
		091	Over-run error occurred 3 times successively
		092	Framing error occurred 3 times successively
		093	Parity error occurred 3 times successively
		094	Check sum error occurred 3 times successively
		095	Abnormal data for 10 seconds or more
100's	Ship's speed input failure	100	Time-out
		101	Over-run error occurred 3 times successively
		102	Framing error occurred 3 times successively
		103	Parity error occurred 3 times successively
		104	Check sum error occurred 3 times successively
		105	Abnormal data for 10 seconds or more
110's	Ship's position input failure	110	Time-out
		111	Over-run error occurred 3 times successively
		112	Framing error occurred 3 times successively
		113	Parity error occurred 3 times successively
		114	Check sum error occurred 3 times successively
		115	Abnormal data for 10 seconds or more
120's	Speed error correction failure	120	Speed error correction failed.
150's	Deviation alarm	151	Abnormal GYRO-EXT heading deviation

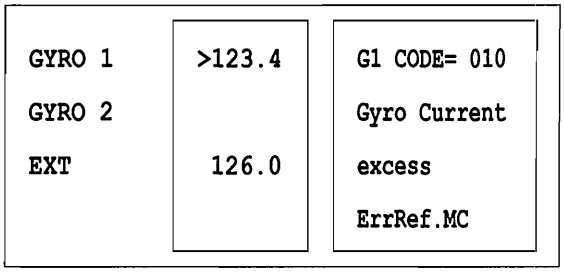
5.3.3 Displaying Alarm Causes

When an alarm is generated, carry out the following procedure to check the error contents:

(1) Displaying/resetting master compass alarm causes

Selecting "26 ErrRef.MC" from the Operat. MENU and pressing the ENT key switches to the display showing the cause of the master compass alarm.

The figure on the right shows an example of a display when a gyrosphere failure is generated in the master-compass.



If there is an alarm occurring, the corresponding error code is displayed on the first line and the error contents on the second and third lines.

If the first line of the display blinks, it means that the cause of the alarm has not yet been recovered; if it is not blinking the cause has already been recovered.

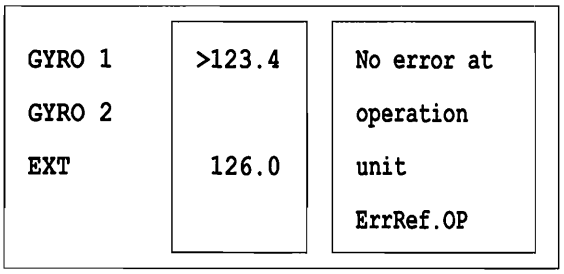
If there are two or more causes of an alarm, the other causes of the alarm are displayed by pressing the right or left arrow key.

When the cause of an alarm has already been recovered, pressing the ENT key cancels the display.

(2) Displaying/resetting operation unit alarm causes

Selecting "27 ErrRef.OP" from the Operat. MENU and pressing the ENT key switches to the display showing the cause of C.operation unit alarm.

The figure on the right shows an example of a display when no alarm cause in C.operation unit is shown.



If there is an alarm occurring, the corresponding error code is displayed on the first line and the error contents on the second and third lines.

If the first line of the display blinks, it means that the cause of the alarm has not yet been recovered; if it is not blinking the cause has already been recovered.

If there are two or more causes of an alarm, the other causes of the alarm are displayed by pressing the right or left arrow key.

When the cause of an alarm has already been recovered, pressing the ENT key cancels the display.

5.3.4 Possible Causes and Countermeasures

Error Code	Error Contents	Possible Cause	Countermeasure
010	Gyrosphere failure Phase current of 350 mA or more continued for 20 min. or more. (40 min. for startup)	Gyrosphere fails and there is a flow of excessive current.	Replace the gyrosphere.
020	Inverter failure Phase current of 50 mA or less continued for 3 seconds. (no inverter output voltage)	•Power unit (inverter section) failure •Wiring failure	•Check the output of power unit. •Check wiring and connection.
021	Inverter failure Phase current of 50 mA or less continued for 3 seconds. (with inverter output oltage)	•No phase current flow due to gyrosphere failure. •Wiring failure	•Replace the gyrosphere. •Check wiring and connection.
030	Memory failure ROM check sum failure is generated.	Memory element failure	Replace the main-assembly unit.
031	Memory failure RAM read/write failure is generated.	Memory element failure	Replace the main-assembly unit.
040	Backup battery voltage failure. Voltage of memory backup battery falls to 2.5 V or less.	Memory backup battery dissipation	Replace the main-assembly unit.
050	Follow-up failure Deviation of 0.5° or more is generated for 12 seconds or more.	•Follow-up mechanism failure •Motor drive circuit failure •Wiring failure	•Replace the main-assembly unit. •Replace the follow-up mechanism. •Replace the container. •Check wiring and connections.
060	Switch failure ON continuously for 60 seconds or more	Failure of the operation unit in the master compass	Replace the operation unit in the master compass.
070	Communication failure	Wiring failure between the operation unit and the master compass	Check wiring and connection.
071	Abnormal data	Failure in transmission from the connection unit occurred 3 times successively.	Check the connection unit.
080	Automatic master compass alignment failure (Null point detection failure)	Faulty zero point sensor section	Check/replace the zero point detection sensor. Perform manual alignment using command code 24.
090	Time-out Transmission from the external azimuth input unit stopped for 10 seconds.	Faulty wiring between the control box and the unit to be connected.	Check wiring and connection.
091	Over-run error	Failure in transmission from the unit to be connected occurred 3 times successively.	Check the units to be connected.
092	Framing error		
093	Parity error		
094	Check sum error		
095	Abnormal data	Abnormal data from the unit to be connected continued for 10 seconds or more.	

Error Code	Error Contents	Possible Cause	Countermeasure
100	Time-out Transmission from the ship's speed input unit stopped for 10 seconds.	Faulty wiring between the control box and the unit to be connected.	Check wiring and connection.
101	Over-run error	Failure in transmission from the unit to be connected occurred 3 times successively.	Check the units to be connected.
102	Framing error		
103	Parity error		
104	Check sum error		
105	Abnormal data	Abnormal data from the unit to be connected continued for 10 seconds or more.	
110	Time-out Transmission from the ship's position input unit stopped for 10 seconds.	Faulty wiring between the control box and the unit to be connected.	Check wiring and connection.
111	Over-run error	Failure in transmission from the unit to be connected occurred 3 times successively.	Check the units to be connected.
112	Framing error		
113	Parity error		
114	Check sum error		
115	Abnormal data	Abnormal data from the external input unit continued for 10 seconds or more.	
120	Speed error correction failure	A ship's speed input failure or a ship's latitude input failure is generated.	• Check wiring and connection. • Check the units to be connected.
151	Deviation alarm	The heading difference between gyro heading and external azimuth exceeded the alarm value.	Check the master compass and external azimuth input unit.

6. INSTALLATION PROCEDURES

Only technicians of the Service department of Yokogawa Denshikiki Co., Ltd. are authorized to implement the operations and other work described in this chapter. However, if for some reason the service department of Yokogawa Denshikiki Co., Ltd. permits you to perform these operations, be sure to follow the instructions described in this chapter.

6.1 Precautions during Installation

Exercise care with the following items when installing a gyrocompass.

6.1.1 Vibration Measures

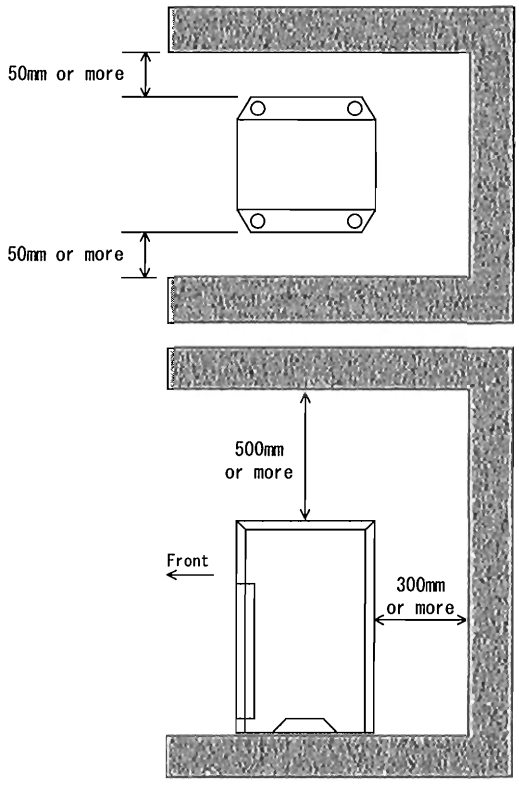
The floors on which the master compass and the horizontal stands are installed, and the walls on which the remote unit, horizontal brackets, tilted brackets, course recorder, digital repeater compass, etc. are installed, should be reinforced against vibrations from the hull.

6.1.2 Parallelism of Lubber's Lines

Install the master compass, repeater compasses for the horizontal stand and repeater compasses for the horizontal bracket so that their lubber's lines are parallel with ship's fore-and-aft line. Since the accuracy of the parallelism of these lines is the basis of heading measurement, adjust them to within an accuracy of ± 0.5 °.

6.1.3 Service Area

Ensure that the dimensions of the running, operating and maintenance area of the master-compass are as specified below.



6.1.4 Limitation for Using Insulation Tester

To prevent the deterioration of electronic components, do not use an insulation tester to perform an insulation inspection or perform a withstanding voltage inspection on the master compass, remote unit and connection boxes.

6.2 Installing and Removing the Gyrosphere

This subsection describes the procedure for installing the gyrosphere in and removing it from master compass.

6.2.1 Precautions during Removal

(1) The gyrosphere should not be removed from the master compass until at least 1.5 hours has elapsed since the power has been turned.

(2) Make sure that the surrounding area of the master compass is clean, there is ample lighting and prepare all required equipment and tools before beginning work. To avoid damaging the nuts and bolts, be sure to use the correct tools such as drivers and wrenches for each part.

(3) Be sure to do the following to ensure proper reinstallation of the gyrosphere:

- Provide mating marks to the required portions before disassembly.
- Temporarily reinsert the bolts into the correct holes.
- Place the disassembled parts in the correct order on a piece of clean paper or cloth.
- If wires are to be disconnected, keep a record of the color of each wire and attach labels to them to ensure correct reconnection.

(4) Do not remove any part that does not need to be disassembled.

(5) Never disassemble the gyrosphere.

⚠ DANGER

Risk of Mercury

- **Do not allow mercury to come into contact with skin. If contact does occur, thoroughly wash the affected area with clean water immediately.**
- **If mercury is accidentally spilled, it should be drawn off with a syringe or the like and kept in a glass bottle.**

CAUTION

Precautions in handling the gyrosphere

- Hold the gyrosphere firmly with both hands so as not to subject it to any shock.
- Do not drop the gyrosphere. Dropping the gyrosphere may result in damage to the internal mechanism or lead to personal injury.
- Do not disassemble the gyrosphere.

Precautions in handling the container

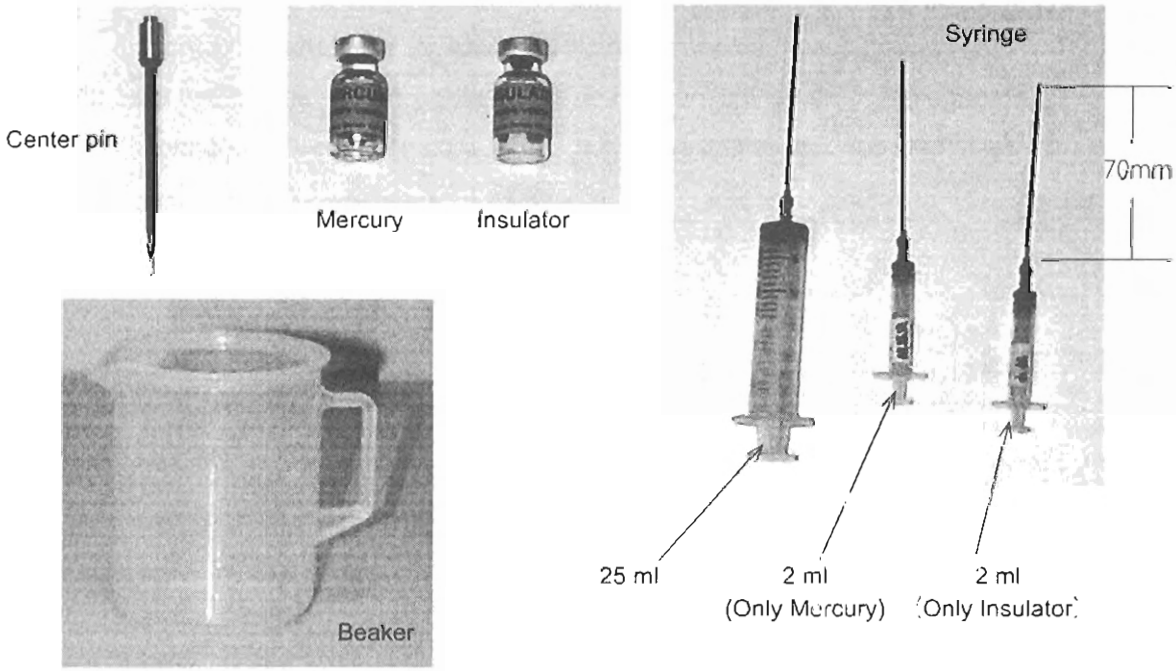
- Hold the container firmly with both hands.
- Do not drop it. Dropping the gyrosphere may result in damage to the internal mechanism or lead to personal injury.

6.2.2 Installing the Gyrosphere

If the gyrosphere is to be installed in the container, exercise care not to subject it to shock when handling.

(1) Equipment and tools to be prepared

Prepare a gyrosphere, center pin, mercury, insulator, syringe, beaker, funnel, liquid, and No.2 Phillips screwdriver.



(2) Installing the gyrosphere and attaching the container to the master compass

Installation of the gyrosphere in the container should be carried out on a flat surface and care should be taken not to knock the container over.

Caution
Comply with the below process.
If it doesn't comply with the process, it doesn't move normally, and it causes a trouble.

① Cleaning..

Confirm that oil doesn't stick to the gyrosphere (upper, lower and following electrode) and. top of the centerpin. If oil sticks, get rid of it with gauze contain ethyl alcohol.

② Confirm that the drain screw in the lower container is tight and then put the gyrosphere in the lower container.

③ Pour in the mercury.

④ Pour 500 ml of liquid into a beaker, and then slowly pour it from the beaker into upper the gyrosphere until overflow. (Liquid is used by 650 ml in total)

⑤ Attach the upper container to the lower containers.

⑥ Pour the liquid into the container.

⑦ Insert the center pin and put the cap on.

⑧ Pour in the insulator.

⑨ Seal the vent hole.

⑩ Connect the wire to the center pin.

⑪ Connect the connector.

The above is a brief description on how to install the gyrosphere in the container.

The following describes how to attach the container to the master compass.

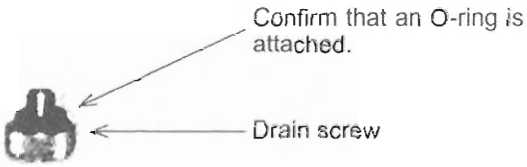
⑫ Engage the container into position on the master compass and tighten the bolts.

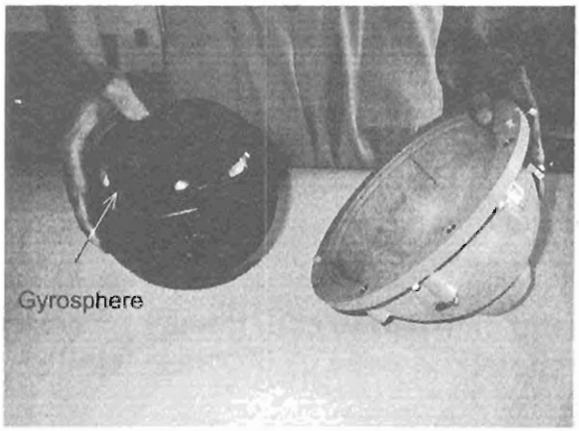
⑬ Fasten the connectors that connect the master compass to the container.

① Cleaning

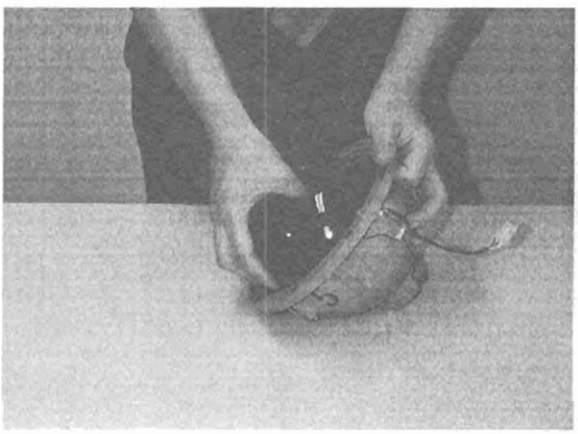
Confirm that oil doesn't stick to the gyrosphere (upper, lower and following electrode) and. top of the centerpin. If oil sticks, get rid of it with gauze contain ethyl alcohol.

② Confirm that the drain screw in the lower container is tight and then put the gyrosphere





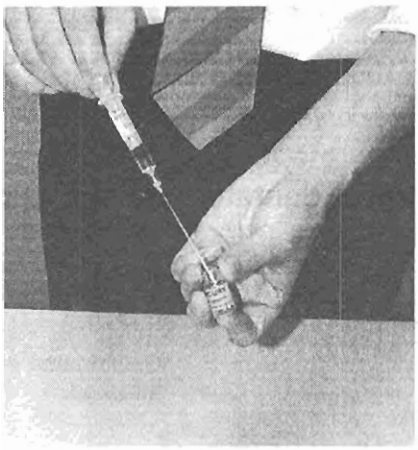
Hold the gyrosphere as shown in the photo, and with the container tilted, place it into the container. Hold the sphere on the opposite side of the gold line.
Do not tilt the gyrosphere beyond the required limit (30°).



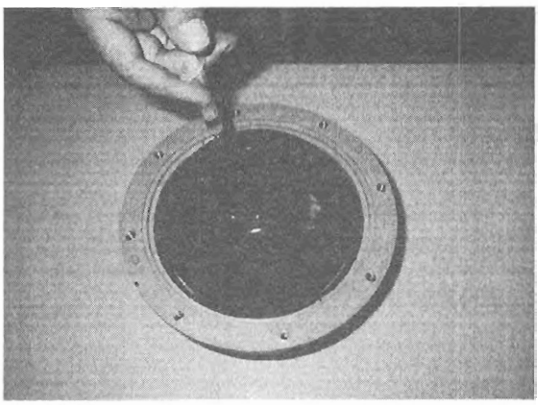
After placing the gyrosphere in the container, position the container and sphere horizontally.

③ Pour in the mercury

Remove the aluminum seal with a pair of long nose pliers or a pair of diagonal cutting nippers, or the like.

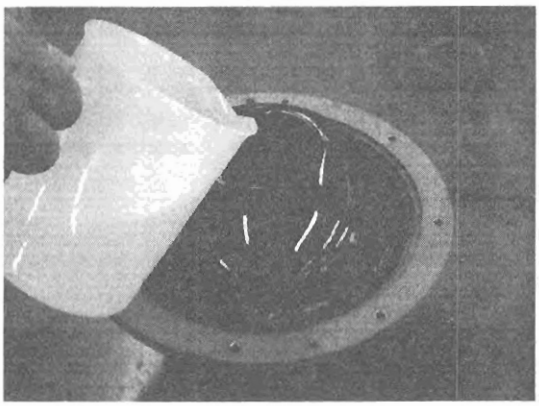


Fill a syringe (small ,the length 70mm of the needle.) with mercury (0.3 ml).
Be very careful not to spill any of the mercury.
Use separate syringes for mercury and insulator.

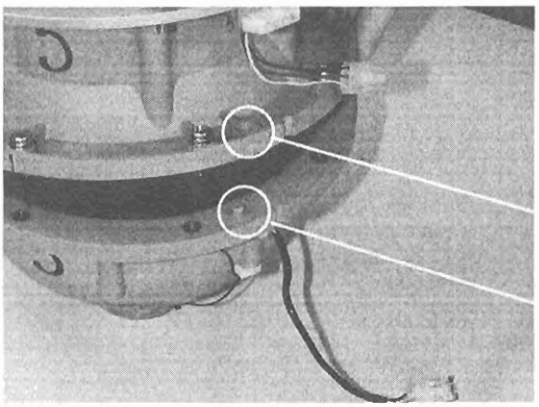


Put the needle of the syringe at the bottom of the gyrosphere upper electrode, and pour mercury quietly.

④ **Pour 500 ml of liquid into a beaker, and then slowly pour it from the beaker into upper the gyrosphere until overflow (Liquid is used by 650 ml in total)**



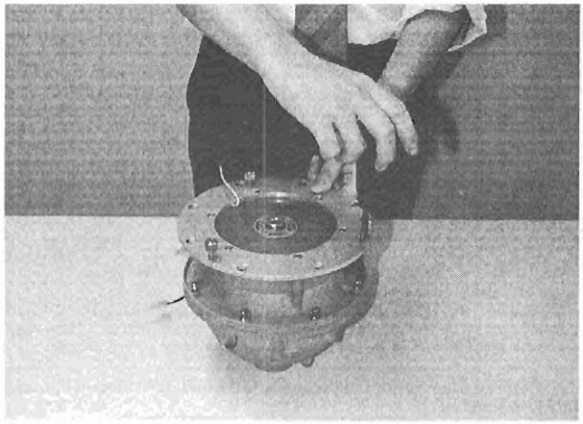
⑤ **Attach the upper and lower containers to each other**



Confirm that there is an O-ring the upper container, then align the knock-pin and fit both the upper and lower containers to each other.

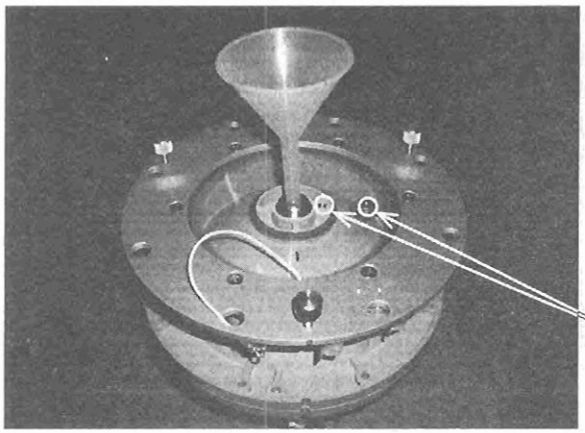
Hole

Pin



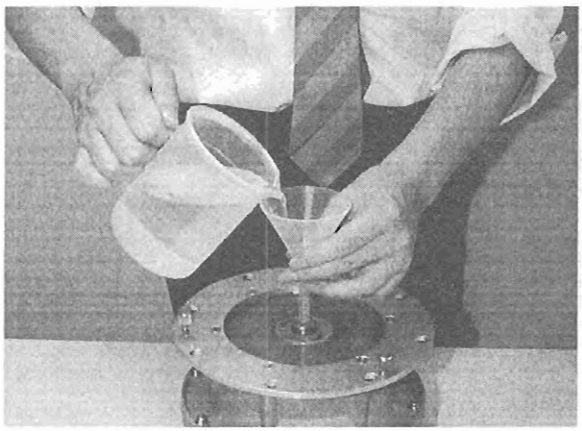
Fit the upper and lower containers to each other by tightening the bolts (8 places).

⑥ Pour the liquid into the container after put off two Vent hole screws

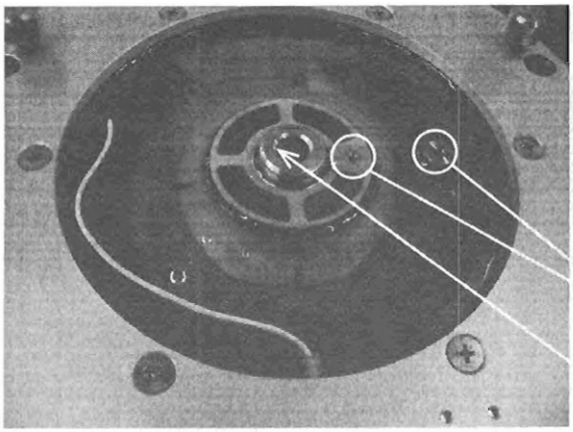


Insert the funnel into the hole of the center pin after put off two Vent hole screws.

Two vent hole screws

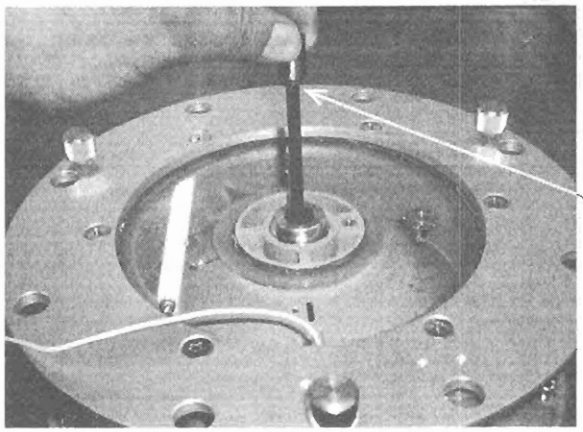


Pour liquid slowly from the beaker into the funnel until it begins to overflow from the vent hole.
(Liquid is used by 650 ml in total)

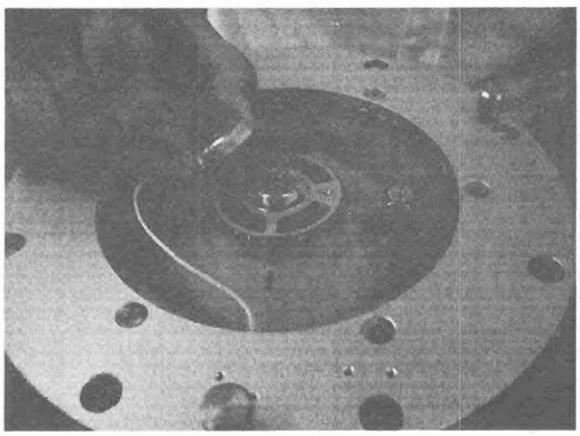


If any liquid overflows from the vent hole, wipe it off with a rag.
Wipe off a surface inside the upper part .

⑦ Insert the center pin and put the cap on



Confirm that there is an O-ring on the center pin and then insert the center pin.

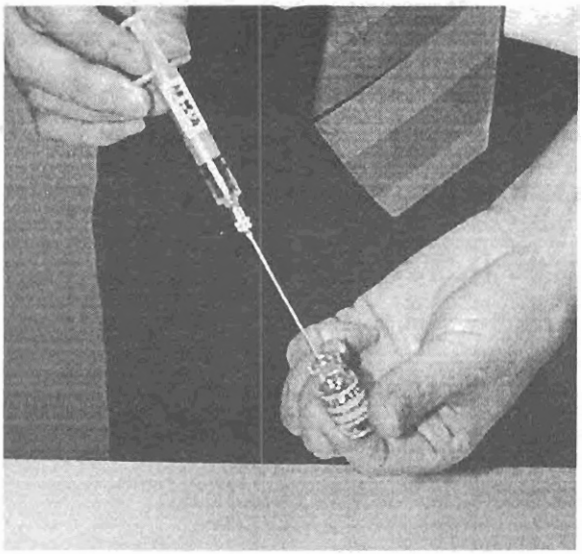


Put the cap on.

⑧ Pour in the insulator

Insulator

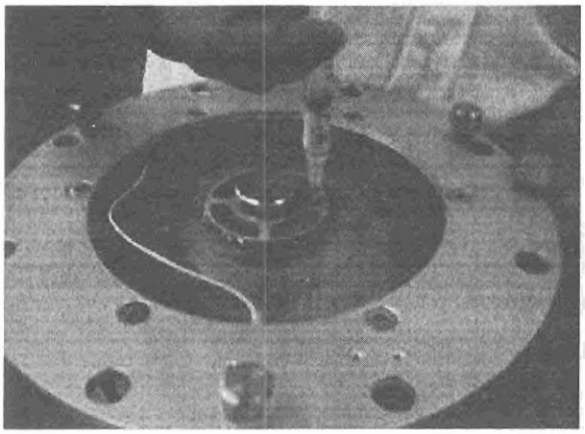
Remove the aluminum seal with a pair of long nose pliers or a pair of diagonal cutting nippers, or the like.



Fill a syringe (small ,the length 70mm of the needle.) with insulator (1 ml).

Be careful not to spill any of the insulator.

Use separate syringes for mercury and insulator.



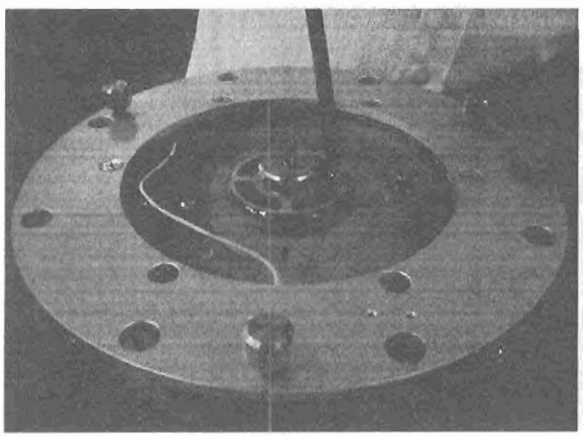
Use the syringe to insert the insulator into the vent hole.

Insert a needle in the air hole to the root. This time., the tip of the needle is to be careful not to push down the gyrosphere .

Wipe off any liquid that overflows from the vent hole with a rag.

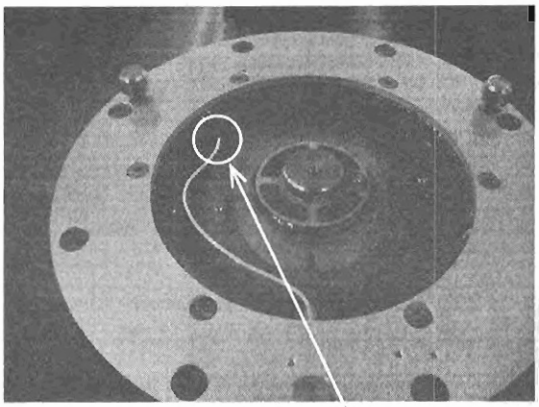
If liquid does not overflow from the vent hole, use a syringe (large, 25 ml) to gently insert some more liquid into the vent hole.

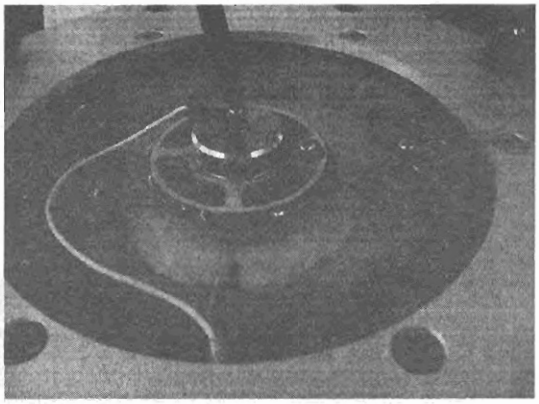
⑨ Seal the vent hole



Seal the vent hole with two seal washers and screws.

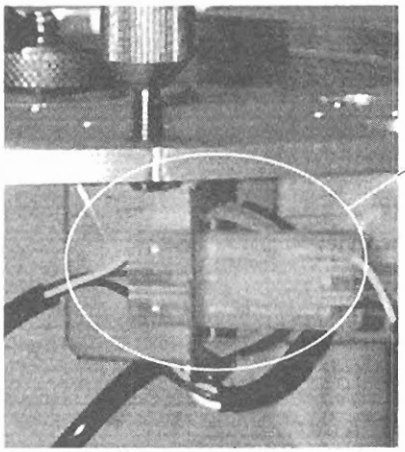
⑩ Connect the wire to the center pin





Connect this terminal to the top of the center pin.

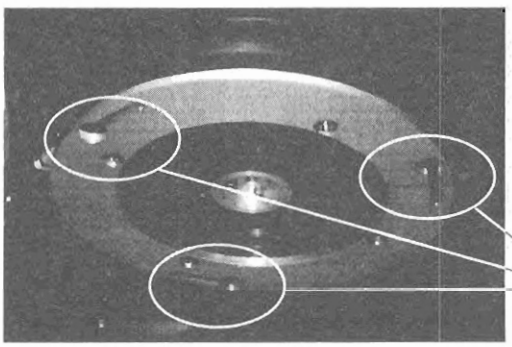
⑪ Connect the connectors



Fasten the connectors (three terminals) that connect the upper and lower containers.

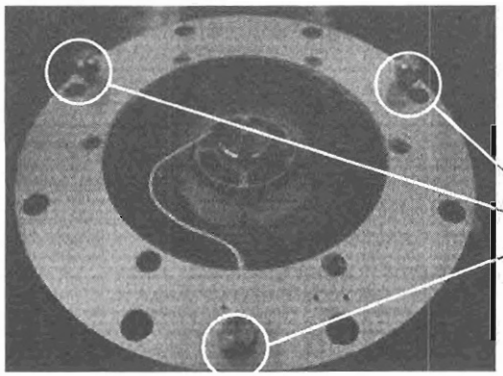
Then, place the container in which the gyrosphere is installed into the master compass.

⑫ Engage the container into position on the master compass and tighten the bolts

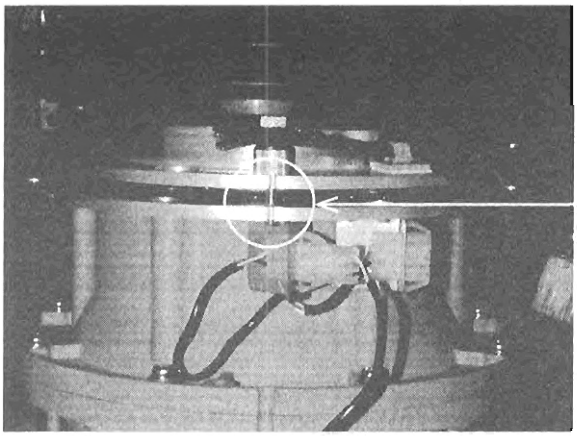


Places where the container is to be engaged to the master compass.

Insert the container bolts from the underside and tighten them in a clockwise direction.

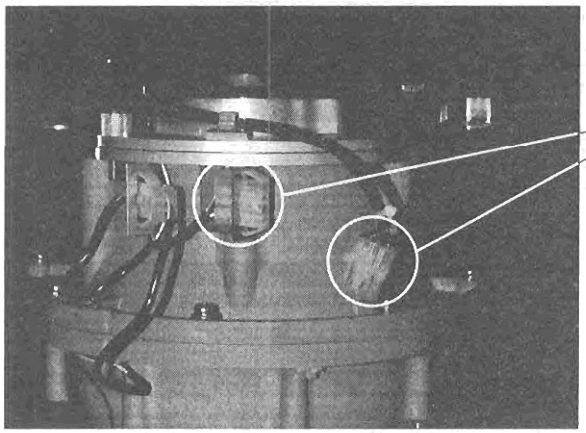


Container bolts

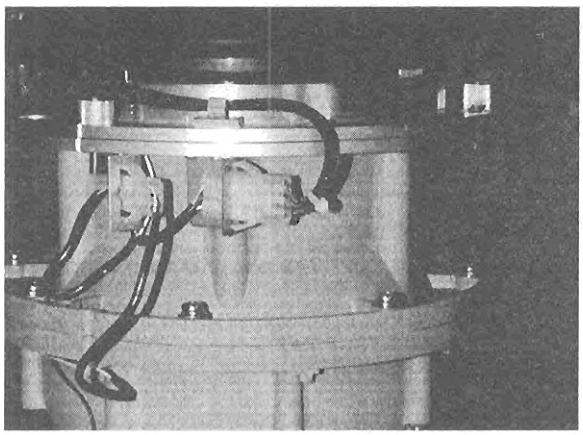


Align the mating marks when engaging the container. Then tighten the container bolts.

⑬ Fasten the connectors that connect the master compass to the container



Connect the 4-terminal connectors.



The container hanging bolts have been tightened and the connectors have been connected.

6.2.3 Removing the Gyrosphere

If the gyrosphere is to be removed from the container, first turn off power and leave it for at least 1.5 hours.

(1) Equipment and tools to be prepared

Beaker, No.2 Phillips screwdriver, syringe (Large) and a bottle for waste liquid

Beaker

(2) Removal of the container from the master compass and take-out of the gyrosphere

① Remove the connectors connecting the master compass and the container.

② Loosen the container bolts and remove the container from the master compass.

The above describes the procedure for taking out the container from the master compass.

The following describes the procedure for removing the gyrosphere from the container.

③ Remove the screw from the vent hole.

④ Remove the wire connected to the center pin.

⑤ Remove the cap from the center pin.

⑥ Pull out the center pin.

⑦ Place the beaker under the drain and remove the drain screw.

⑧ Disengage the connectors that connect the upper and lower containers.

⑨ Remove the bolts that fasten the upper and lower containers together.

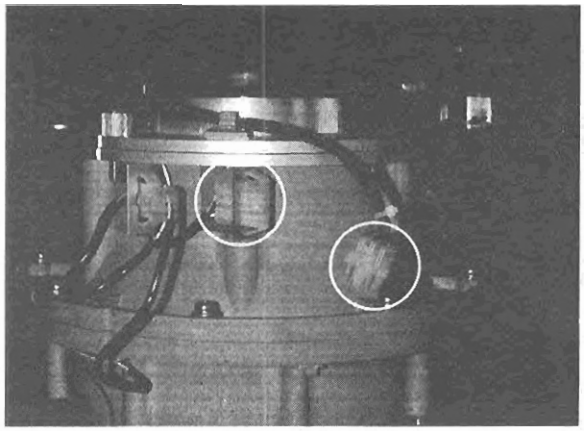
⑩ Remove the upper container.

⑪ Remove the supporting liquid from within the funnel-shaped portion.

⑫ Take the gyrosphere out of the lower container.

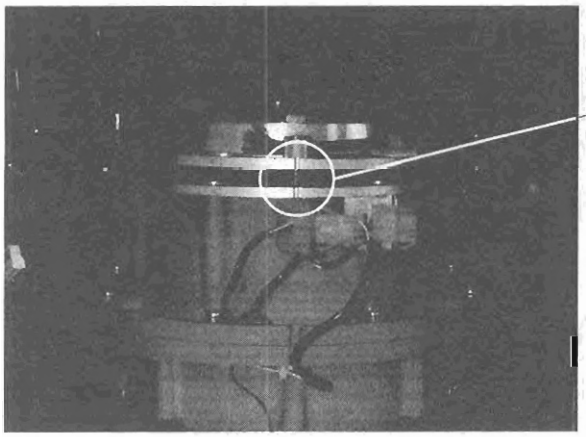
Removing the container from the master compass:

① Remove the connectors connecting the master compass and the container



Disengage the connectors (4 terminals).

② Loosen the container bolts and remove the container from the master compass

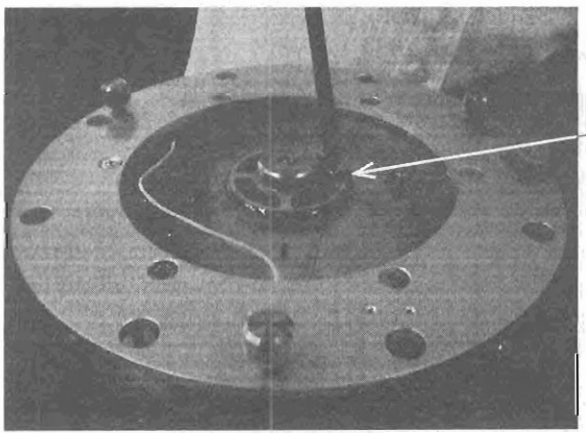


Loosen the three container bolts by turning them in a counterclockwise direction and remove the container. Be careful not to let the container hit the floor.

Take the gyrosphere out of the container.

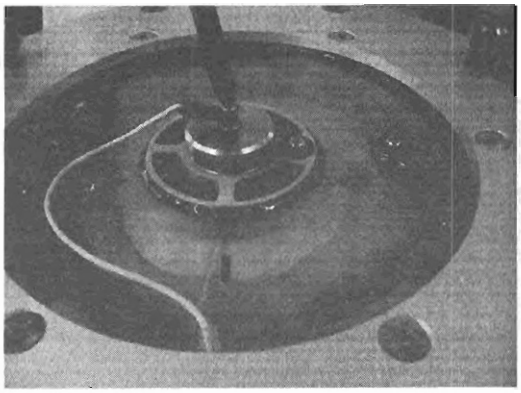
When taking the gyrosphere out of the container, work on a flat surface and ensure that the container does not fall over.

③ Remove the screw from the vent hole



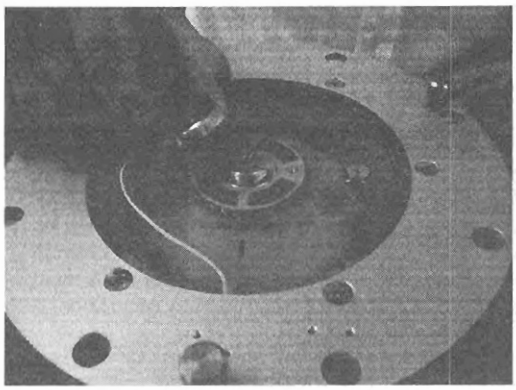
Resin washer and screw

④ Remove the wire connected to the center pin



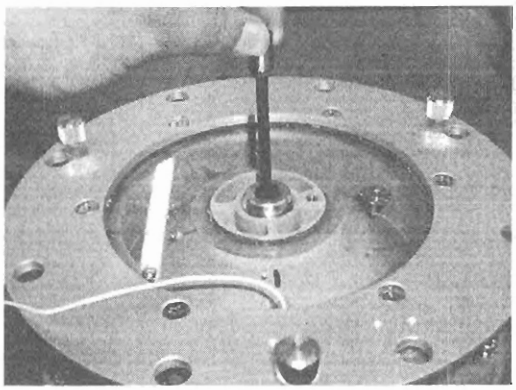
Remove the screw using a screwdriver.

⑤ Remove the cap from the center pin



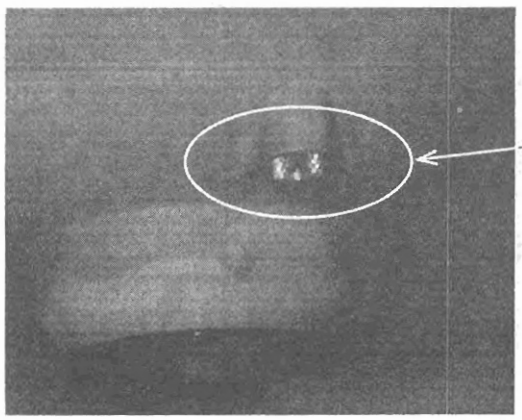
Turn the cap of the center pin to remove it.

⑥ Pull out the center pin

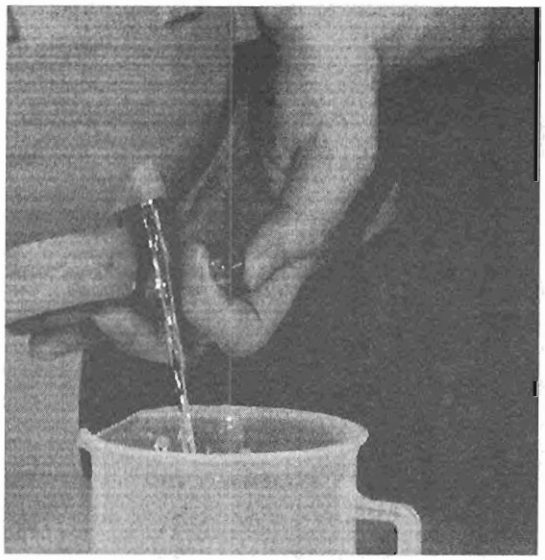


An easy way to pull out the center pin is to insert the screw that is used to connect the wire to the center pin to the pin and use the screw head to draw out the pin.

⑦ Place the beaker under the drain and remove the drain screw



The drain screw is located on the lower container.



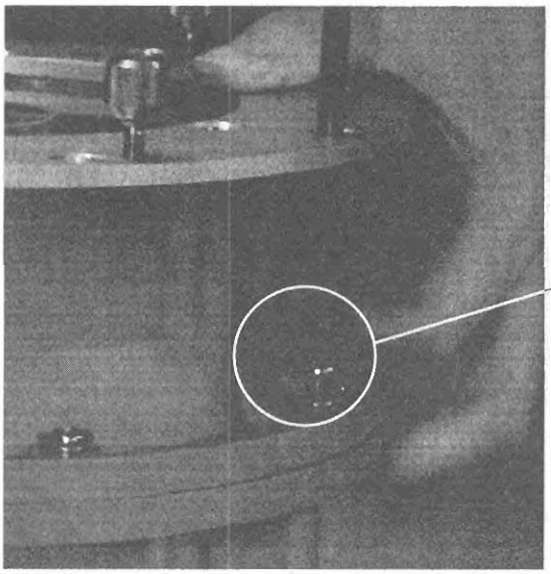
Drain all the supporting liquid from the drain hole while holding the container as horizontally as possible.

After draining, reinsert the screw in the drain hole.

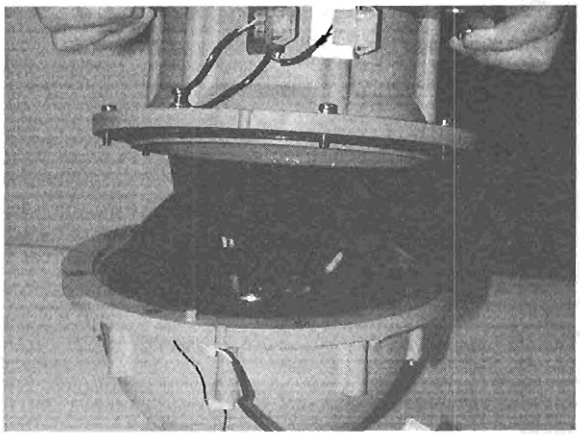
⑧ Disengage the connectors that connect the upper and lower containers

Disengage the connectors (three terminals).

⑨ Remove the bolts that fasten the upper and lower containers together

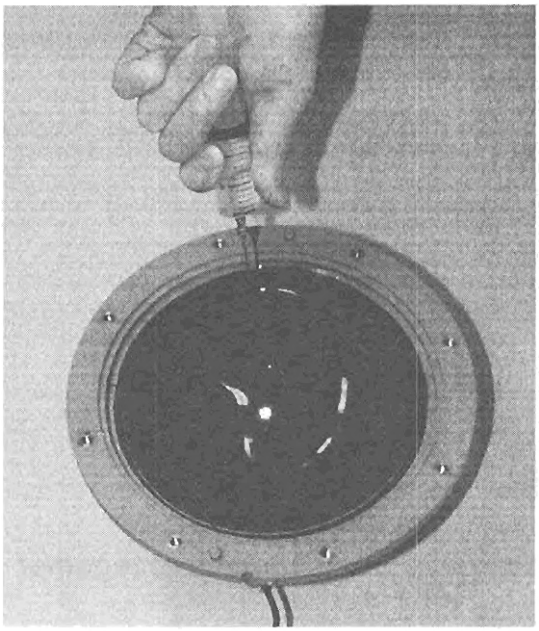


⑩ Remove the upper container



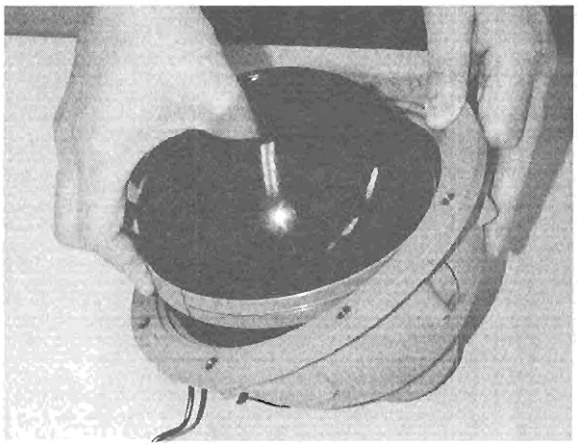
Lift up the upper container to remove it.

⑪ Remove the supporting liquid from within the funnel-shaped portion



Remove the supporting liquid, insulator and mercury from the funnel-shaped portion with a syringe (large).
(Remove all liquids.)

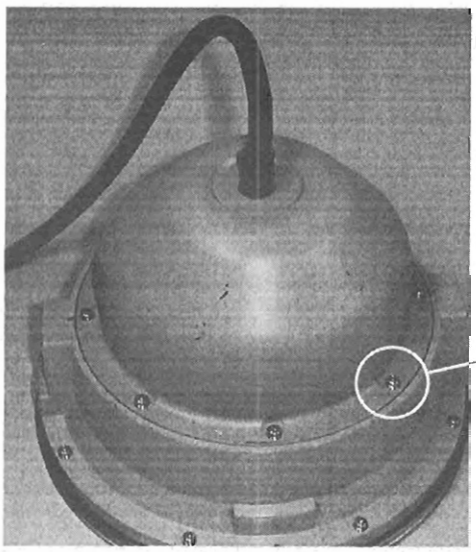
⑫ Take the gyrosphere out of the lower container



When taking out the gyrosphere, hold the side in a location with no gold line on it.

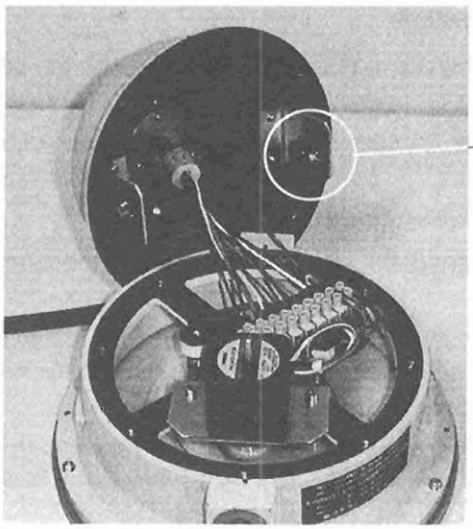
Place the removed gyrosphere onto a gyrosphere stand.

6.2.4 Replacement of Lamps in the Repeater Compass



(1) Place the repeater compass on a stand with the repeater card face down and draw alignment marks on the lower cover and the body.

(2) Remove the eight mounting bolts from the lower cover.



(3) Raise the lower cover to separate it from the body.

(4) Hold the lower cover in this position while replacing the illuminating lamp or lamps.

(5) Align the alignment marks, and then tighten the eight bolts.

Avoid disassembling the repeater compass any further. When these procedures are to be carried out aboard a ship, close attention must be paid so that reassembling is carried out correctly. If these procedures cannot be carried out aboard, contact your nearest service agent of Yokogawa Denshikiki Co., Ltd.

6.2.5 Procedure for Aligning Repeater Compass Indication

The repeater compass indication is automatically aligned with the master compass indication when the power is turned on. In general, no other alignment is required. However, it is advisable to check the master compass display and the repeater compass indication before departing from a port to avoid possible accident. If the master compass display and the repeater compass indication match, alignment of indication is not necessary.

(1) Procedure using the zero adjustment switch

If the repeater compass indication shifts from the master compass display, use the zero adjustment switch to align the indication. Press this switch for 3 seconds or more. The repeater compass card turns and the zero of the compass card is aligned with the pointer to correct the shift. Then, the repeater compass follows up the received value.

(2) Procedure in the case where the zero point photo-sensor fails

If an error due to zero point photo-sensor failure is generated, use the procedure described below to align the indication.

① When an error is generated, the compass card stops.

② By pressing the zero adjustment switch with the compass card stopped state, the compass card begins to revolve the high speed (30 °/s).

③ When the pointer is near the zero point of the compass card, press the zero adjustment switch.

④ The speed of the turning compass card decreases (0.5 °/s).

⑤ At the instant when the pointer aligns with the zero of the compass card, press the zero adjustment switch. The compass card stops turning.

⑥ If the zero adjustment switch is not pressed within 5 seconds, the compass follows up the received value. If it is pressed within 5 seconds, the state of the compass changes returns to ②.

*** If the switch is not pressed when it is in the turning state of ② or ④ the compass card stops. If the zero adjustment switch is pressed when it is stopped, the compass goes to state ② and turns at the high speed.**

6.2.6 Preparation of Supporting Liquid

Approximately 650 mL of supporting liquid are used in the master compass unit, and further 1 L of supporting liquid are provided for spare. Contact Yokogawa for further supplies. Supporting liquid should always be supplied by Yokogawa, but in unavoidable circumstances, you may prepare supporting liquid as follows:

Distilled water	1.8 L
Glycerin	145 mL
Benzoic acid	3.2 g

Put the each material in distilled water at the specified rate. Heat the mixture up to 80 to 90 °C until the benzoic acid dissolves in the solution.

Note : If the specific gravity of the prepared liquid deviates from the value shown below, add glycerin or distilled water to make fine adjustment.

Temperature	Specific Gravity
15 °C	1.0230 ± 0.001
20 °C	1.0220 ± 0.001
25 °C	1.0208 ± 0.001
30 °C	1.0193 ± 0.001

6.3 Maintenance Function

This section describes the functions used for maintenance. When command codes of 30's in the command functions are to be used, enable the maintenance functions as shown in section 6.3.1.

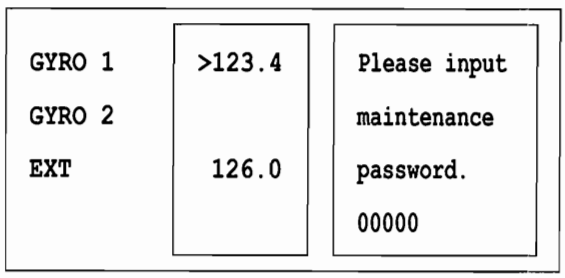
Only technicians of the service department of Yokogawa Denshikiki Co., Ltd. are authorized to implement the operations and other work described in this section. However, if for some reason the service department of Yokogawa Denshikiki Co., Ltd. permits you to perform these operations, be sure to follow the instructions described in this section.

The maintenance functions include the following:

- Permission for maintenance function
- Outputting simulated DAC signals
- Manual drive of master compass (One-way-turning)
- Manual drive of repeater compass (One-way-turning)
- Resetting gyrosphere runtime
- Initializing backup memory
- Correcting master compass installation-error
- Setting master compass follow-up gain
- Displaying error log

6.3.1 Permission for Maintenance Function

Selecting "30 Password" from the Maint. MENU and pressing the ENT key switches to the display for entering a password (as shown in the upper figure on the right).

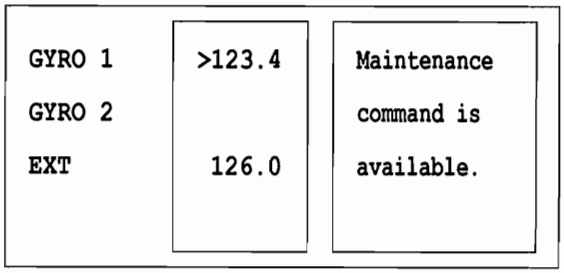


Press the ENT key again. The ones digit of "00000" blinks, prompting you to enter a password.

Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the correct password "xxxxx", press the ENT key. All the digits blink for confirmation.

Press the ENT key again. If the password is correctly entered, the maintenance functions are enabled (as shown in the lower figure on the right).



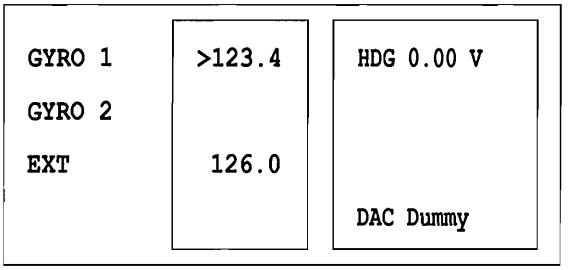
The maintenance functions are disabled by default whenever the power is turned on, or a wrong password is entered.

Ask your nearest service agent of Yokogawa Denshikiki Co., Ltd. to implement the operation above.

6.3.2 Simulated DAC Output

This function varies simulated analog output signals.

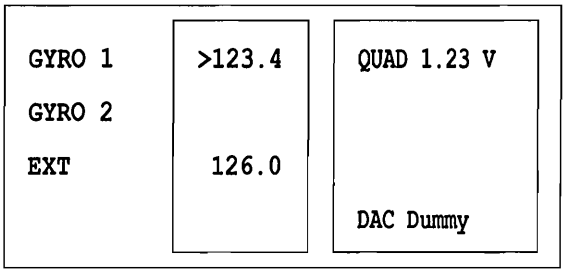
Selecting "31 DAC Dummy" from the Maint. MENU and pressing the ENT key switches to the display showing the simulated DAC signal setting (as shown in the upper figure on the right).



Press the ENT key again. The HDG blinks and an analog signal can be selected.

Press the upper and lower arrow keys to select a channel from HDG (heading), QUAD (quadrant), ROT1 (rate of turn), ROT2, and ROT3, then the ENT key. The channel stops blinking and the ones digit of the output voltage level blinks.

Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.



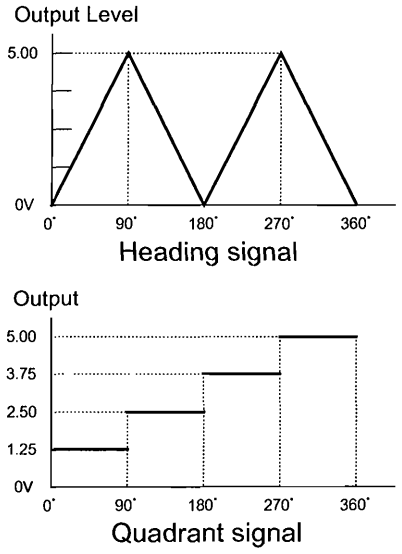
After entering the voltage level, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The voltage level stops blinking and finally changes to the value you set.

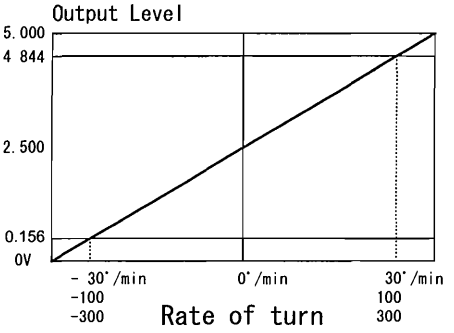
The lower figure on the right shows an example of setting the simulated output of 1.23 V for the quadrant signal of the master compass.

The following graphs show the output span for each analog output.

☐Heading (HDG) and quadrant (QUAD)



☐Rates of turn (ROT1, ROT2, and ROT3)



6.3.3 One-way Turning of the Master Compass

This function turns the master-compass at a specified speed to check its follow-up mechanism.

Selecting "32 Rotate MC" from the Maint. MENU and pressing the ENT key switches to the display showing the angular speed setting of "00" degree/sec.

Press the ENT key again, then the "00" blinks. Press the upper and lower arrow keys to change the angular speed as follows:

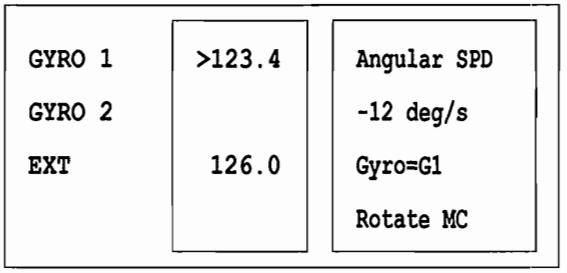
Pressing the upper arrow key repeatedly:

Accelerates the speed clockwise: 00 → 01 → 02 → 03 → 04 → 05 → 06 → 12 → 18 → 24 → 30
Decelerates the speed counterclockwise: -30 → -24 → -18 → -12 → -06 → -05 → -04 → -03 → -02 → -01 → 00

Pressing the lower arrow key repeatedly:

Accelerates the speed counterclockwise: 00 → - 01 → - 02 → -03 → -04 → -05 → -06 → -12 → -18 → -24 → -30
Decelerates the speed clockwise: 30 → 24 → 18 → 12 → 06 → 05 → 04 → 03 → 02 → 01 → 00

The figure on the right shows an example of displaying the angular speed of - 12 degrees/sec.



6.3.4 One-way Turning of the Repeater Compass

This function turns the repeater-compass at a specified speed to check its follow-up mechanism.

Selecting "33 Rotate RC" from the Maint. MENU and pressing the ENT key switches to the display showing the angular speed setting of "00" degree/sec.

Press the ENT key again, then the "00" blinks. Press the upper and lower arrow keys to change the angular speed as follows:

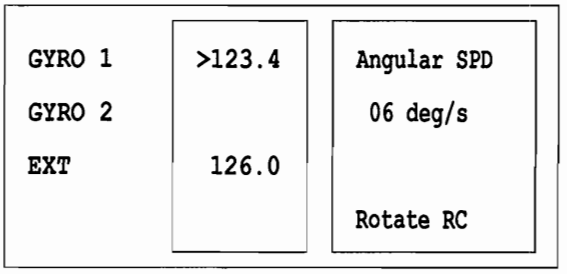
Pressing the upper arrow key repeatedly:

Accelerates the speed clockwise: 00 → 01 → 02 → 03 → 04 → 05 → 06 → 12 → 18 → 24 → 30
Decelerates the speed counterclockwise: -30 → -24 → -18 → -12 → -06 → -05 → -04 → -03 → -02 → -01 → 00

Pressing the lower arrow key repeatedly:

Accelerates the speed counterclockwise: 00 → - 01 → - 02 → -03 → -04 → -05 → -06 → -12 →- 18 → -24 → -30
Decelerates the speed clockwise: 30 → 24 → 18 → 12 → 06 →05 → 04 → 03 → 02 → 01 → 00

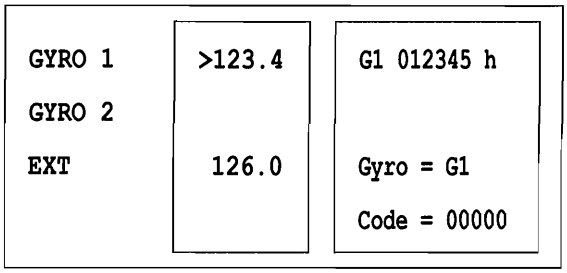
The figure on the right shows an example of displaying the angular speed of 6 degrees/sec.



6.3.5 Resetting Gyrosphere Running Time

Use this function to reset the running time (hours) of the gyrosphere to zero when replacing the gyrosphere. This operation is required to grasp the accurate running time of the gyrosphere for adequate maintenance scheduling.

Selecting "34 Reset RT" from the Maint. MENU and pressing the ENT key switches to the display for entering a password.



Press the ENT key again. The ones digit of "00000" blinks, prompting you to enter a password.

Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the correct password "xxxxx", press the ENT key. All the digits blink for confirmation.

Press the ENT key again. If the password is correctly entered, the running time is reset to zero.

When a wrong password is entered, the ones digit of "00000" blinks again, prompting you to reenter a password.

Ask your nearest service agent of Yokogawa Denshikiki Co., Ltd. to implement the operation above.

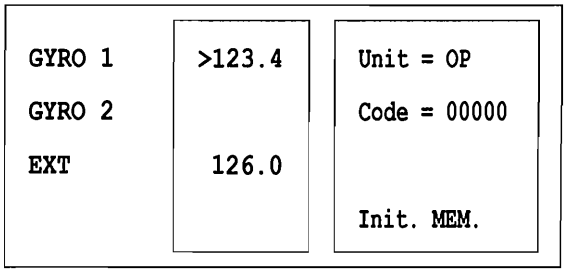
6.3.6 Initialization of Backup Memory

Use this function to reset all the function settings.

Caution!

DO NOT perform the following operation unless instructed by an authorized service technician of Yokogawa Denshikiki Co., Ltd.

Selecting "36 Init. MEM" from the Maint. MENU and pressing the ENT key switches to the display for entering a password.



Press the ENT key again. The OP blinks and a target unit can be selected.

Press the upper and lower arrow keys to select the unit from OP (C operation unit) and G1 (master compass), then the ENT key. The unit stops blinking and the ones digit of "00000" blinks.

Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the correct password "xxxxx", press the ENT key. All the digits blink for confirmation.

Press the ENT key again. If the password is correctly entered, the backup memory is initialized when the power is turned on next time.

When a wrong password is entered, the ones digit of "00000" blinks again, prompting you to reenter a password.

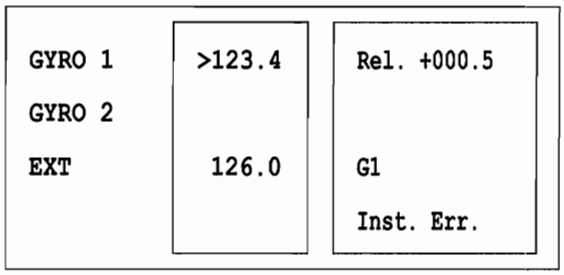
Ask your nearest service agent of Yokogawa Denshikiki Co., Ltd. to implement the operation above.

6.3.7 Correction of the Master Compass Installation Error

This section describes the procedure for correcting the error caused when the gyrocompass is not installed in such a way that the lubber line of the master compass is precisely aligned parallel with the ship's fore-and-aft line.

Selecting "37 Inst. Err" from the Maint. MENU and pressing the ENT key switches to the display showing the current correction setting.

There are two correction procedures: relative value correction and absolute value correction. The figure on the right shows the current setting of 0.5°.



① Relative value correction

The procedure uses the compass heading error as the amount of correction.

Example:

0.56 (Amount of error correction) = 42.56 (true heading through astronomical observation) - 42.00 (compass heading)

Note: When setting the relative value of correction repeatedly, first reset the current setting to zero in order to avoid setting the wrong value.

The amount of correction for master compass installation error is determined from the difference between the compass heading detected by a reading when the master compass is settled and an accurate true heading obtained through astronomical observation.

Perform these measurements when there is no change in the heading, such as when the ship is docked.

② Absolute value correction

If the absolute true heading can be obtained, such as when the ship is docked, set it as the compass heading.

Pressing the COMMAND key returns the operation mode to normal.

Example:

(Input value) = (absolute true heading when the ship is docked)

Whenever performing error correction, be sure to record the amount of correction in the maintenance record book.

In the example of display above, press the ENT key, then Rel. (relative value correction) blinks.

Press the right and left arrow keys to change the blinking digit: correction procedure → sign (for absolute correction only) → the hundreds digit → the tens digit → the ones digit → the first decimal place

Press the upper and lower arrow keys to select the correction procedure from Rel. (relative) and Abs. (absolute), or to change the numeric value.

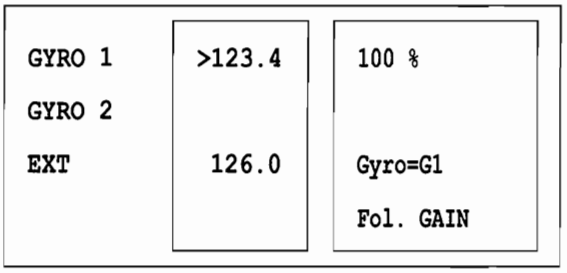
After entering the amount of correction, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The blinking stops and the correction method and the amount is finally set.

The value for difference correction is limited to ±10 degrees, even if a value that exceeds this is entered. Adjust the lubber line of the master compass so that the difference between it and the true heading is within ±10 degrees, before.

6.3.8 Setting the Master Compass Follow-up Gain

Adjust the master compass follow-up gain when there is a deadband in the follow-up actions and thus follow-up is not smooth or when hunting occurs because the gain is too high.



Selecting "38 Fol. GAIN" from the Maint. MENU and pressing the ENT key switches to the display showing the current setting of follow-up gain.

Press the ENT key again, then the follow-up gain blinks.

Pressing the upper arrow key increases the gain by 10 % (max. 200 %).

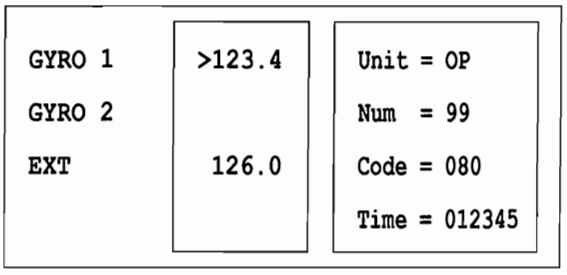
Pressing the lower arrow key decreases the gain by 10 % (min. 50 %).

After entering the gain value, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The follow-up gain finally changes to the value you set.

6.3.9 Error Log Display

Up to 100 data entries can be recorded and displayed in the error log.



Selecting "39 Err. LOG" from the Maint. MENU and pressing the ENT key switches to the error log display.

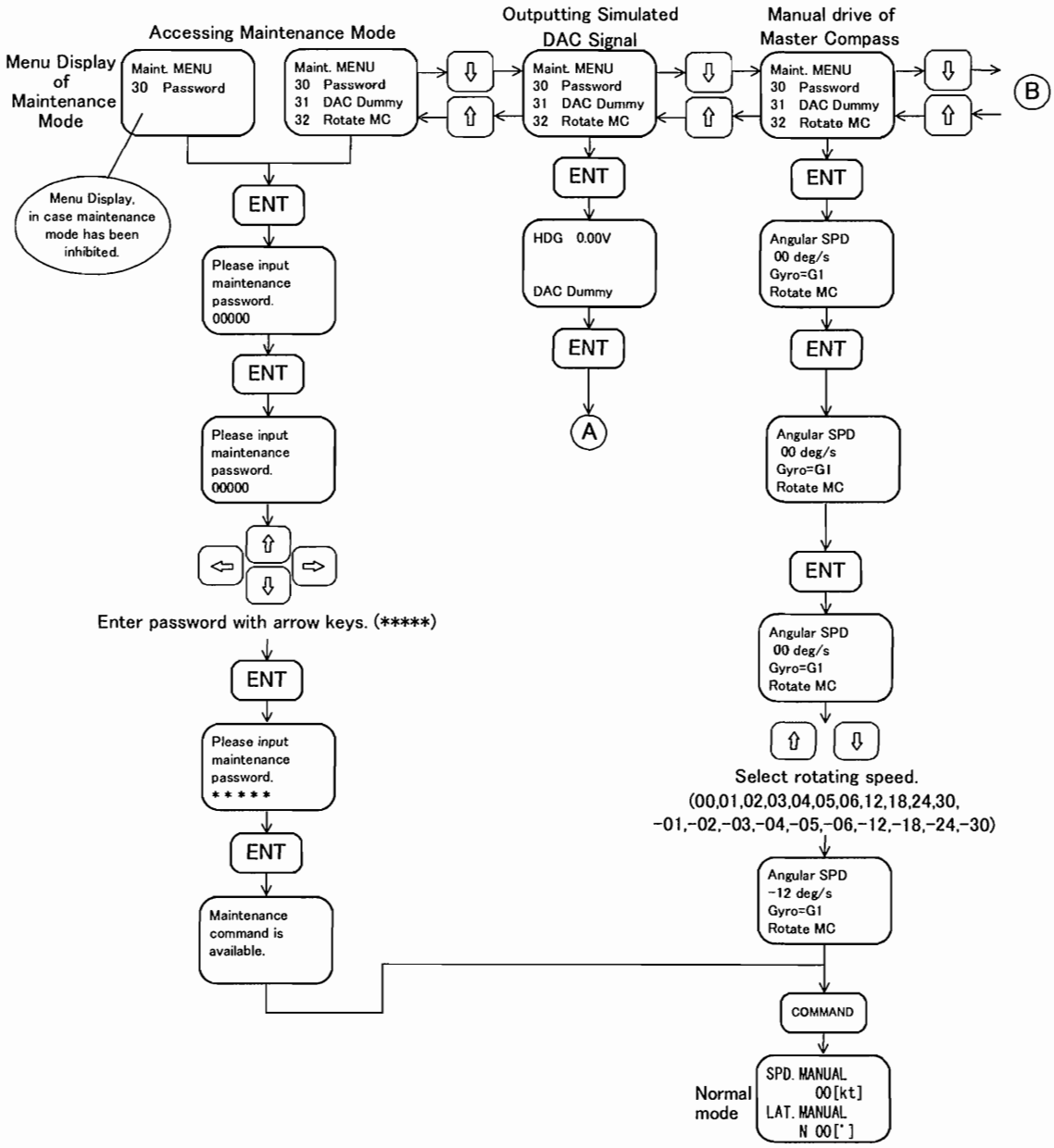
Press the ENT key again. The OP blinks and a target unit can be selected.

Press the upper and lower arrow keys to select the unit from OP (C operation unit) and G1 (master compass), then the ENT key. The latest error log of the selected unit is displayed.

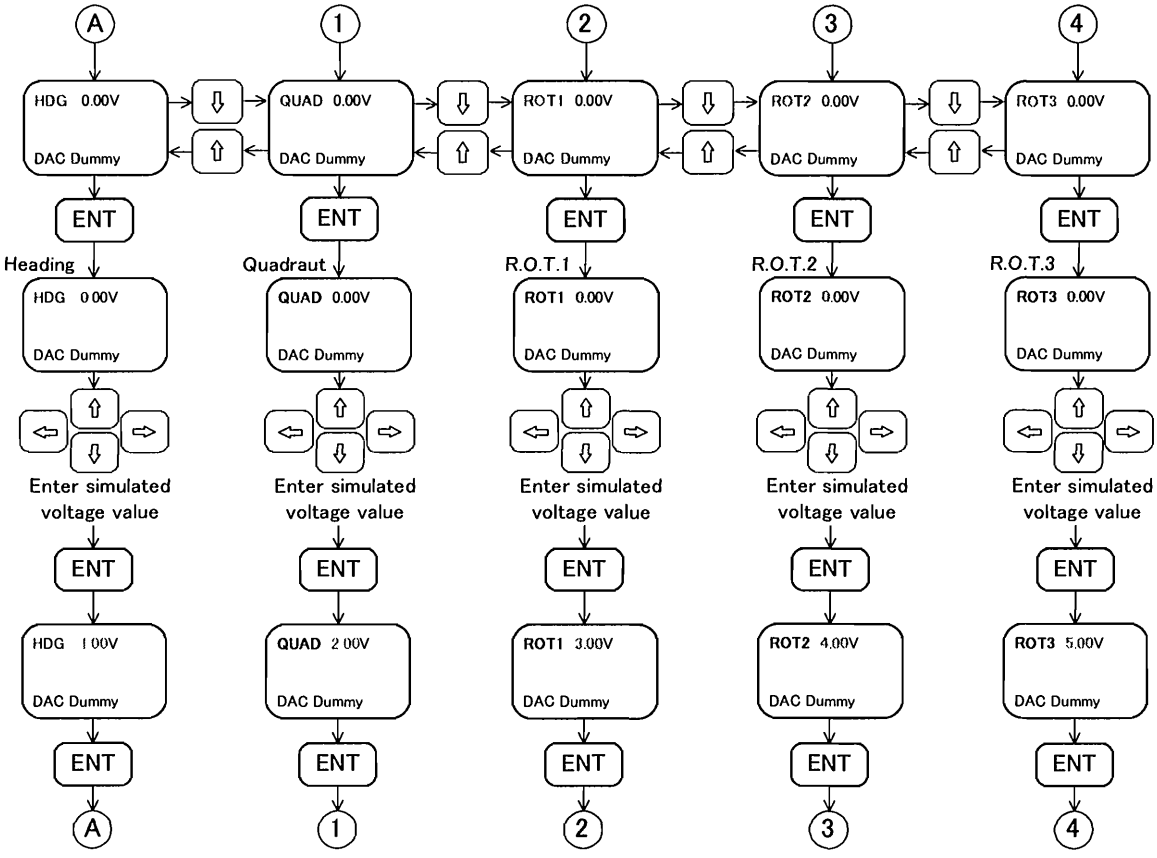
The second line indicates the error number (00 to 99), the third line the error code, and the fourth line the time of occurrence.

If the error number is 1 or more, or more than one error has occurred, pressing the lower arrow key displays the immediately preceding error log, and pressing the upper arrow key displays the immediately following error log. A larger error number corresponds to a later error.

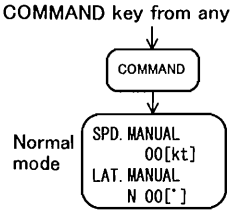
☐ Operation Flow Sheet of Maintenance Function (1/5)



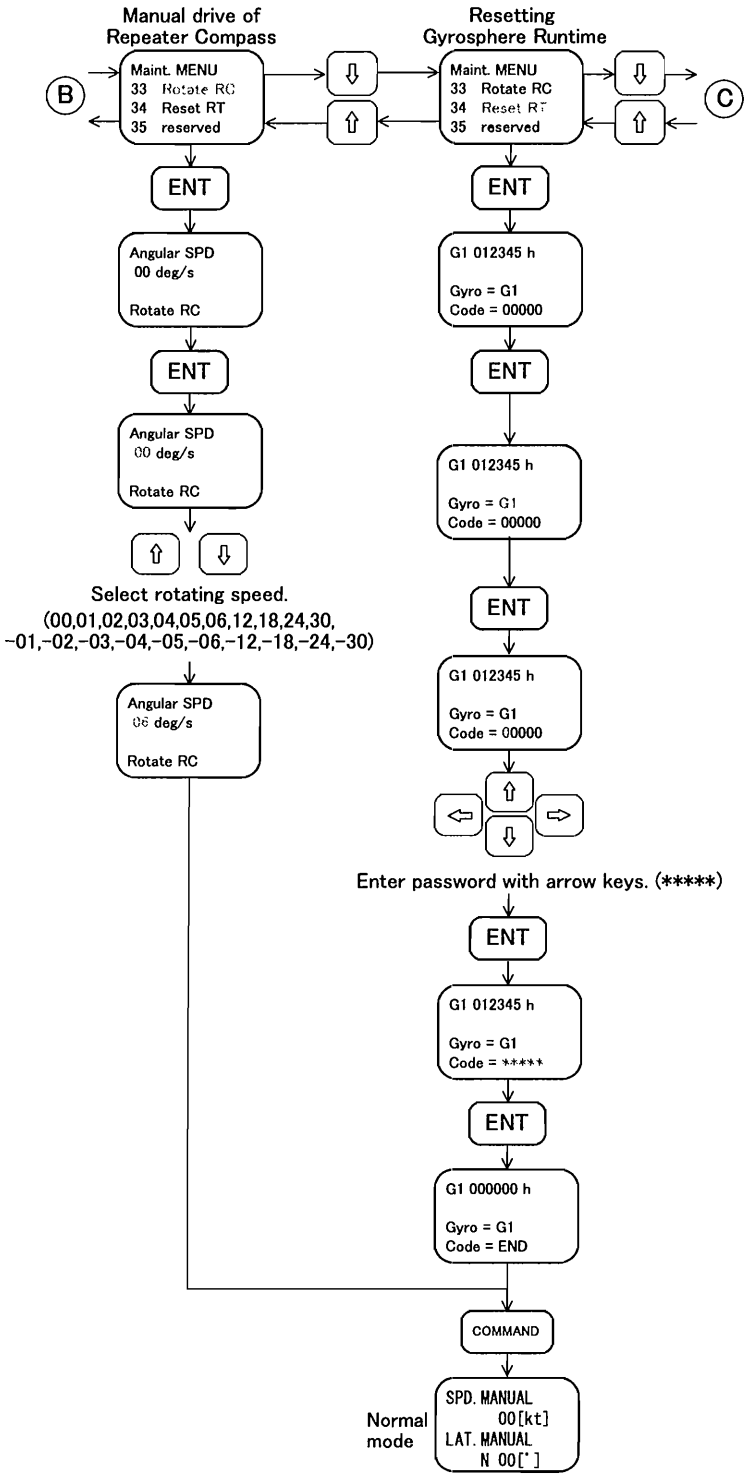
☐ **Operation Flow Sheet of Maintenance Function (2/5)**



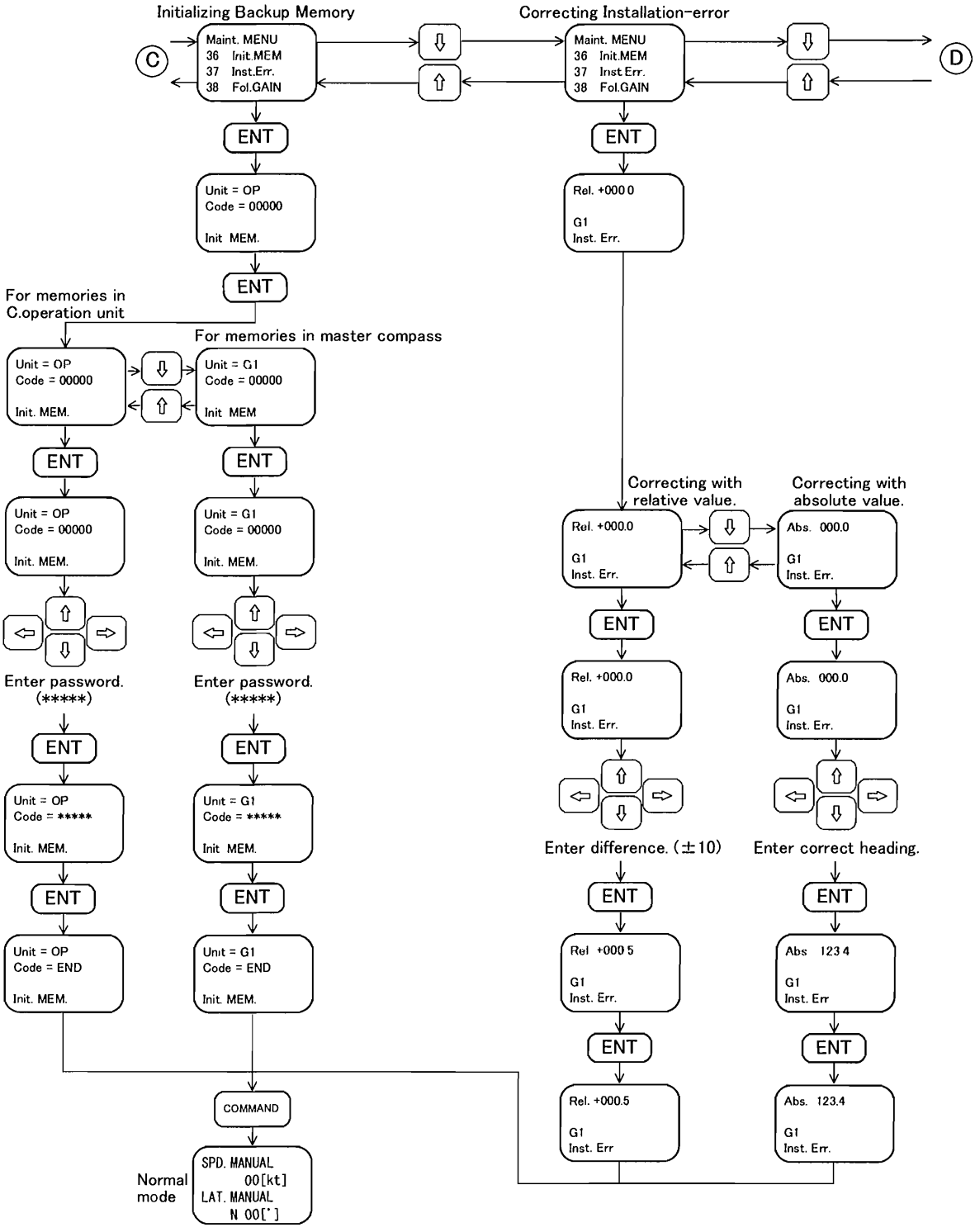
To go to Normal Display press COMMAND key from any screen.



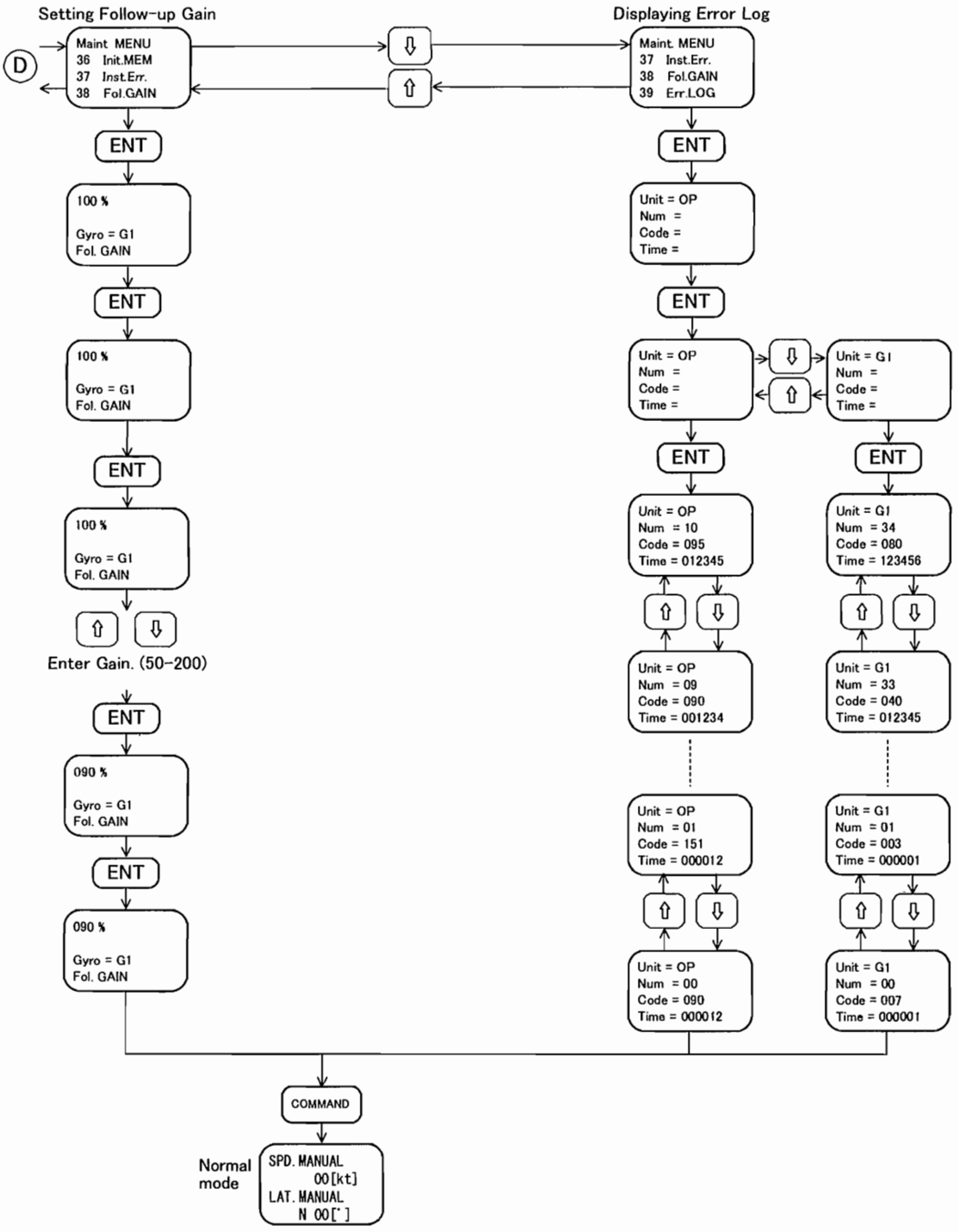
☐Operation Flow Sheet of Maintenance Function (3/5)



☐Operation Flow Sheet of Maintenance Function (4/5)



☐Operation Flow Sheet of Maintenance Function (5/5)



6.4 Generation Function

This section describes the functions that facilitate communication with input/output devices connected to the CMZ700. The generation functions are divided into two groups: command functions with codes of 40's and settings with the dip switches. When command codes of 40's in the command functions are to be used, enable the generation functions as shown in section 6.4.1.

Ask your nearest service agent of Yokogawa Denshikiki Co., Ltd. to implement the operation above.

The generation functions include the following:

- Permission for generation function
- Setting the follow-up speed for stepper signal
- Setting communication protocol of output port
- Setting format of output port
- Setting communication protocol of input port
- Setting format of input port

6.4.1 Permission for Generation Function

Selecting "40 Password" from the Generat. MENU and pressing the ENT key switches to the display for entering a password (as shown in the upper figure on the right).

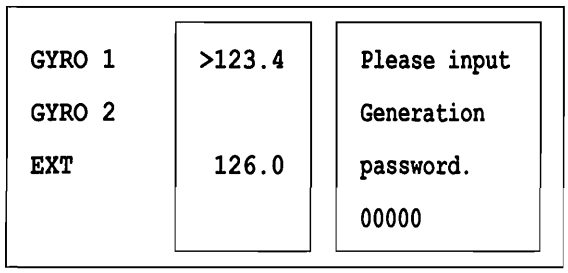
Press the ENT key again. The ones digit of "00000" blinks, prompting you to enter a password.

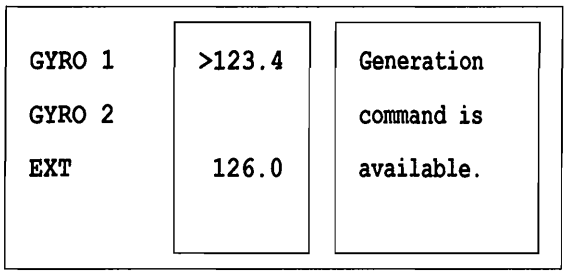
Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the correct password "xxxxx", press the ENT key. All the digits blink for confirmation.

Press the ENT key again. If the password is correctly entered, the generation functions are enabled (as shown in the lower figure on the right).

The generation functions are disabled by default whenever the power is turned on, or a wrong password is entered.

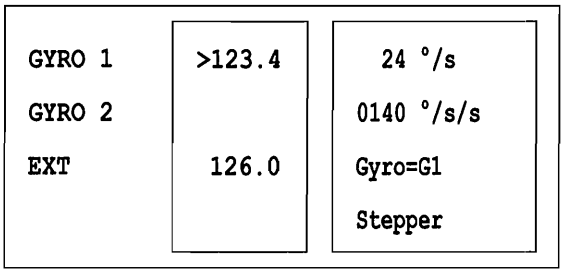




6.4.2 Setting the Follow-up Speed for Stepper Signal

Selecting "41 Stepper" from the Generat. MENU and pressing the ENT key switches to the display showing the current settings for the maximum follow-up angular speed on line 1, and the maximum follow-up angular acceleration on line 2.

The figure on the right shows the standard settings.



Press the ENT key again. The tens digit of the angular speed blinks.

Press the right and left arrow keys to change the blinking digit and press the upper and lower arrow keys to change the numeric value.

After entering the angular speed (00 to 99), press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The angular speed stops blinking and the thousands digit of the angular acceleration blinks.

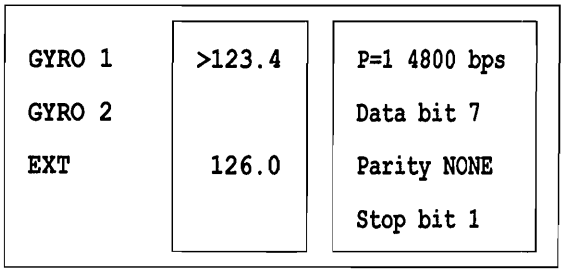
Enter the angular acceleration (0000 to 9999) in the same way and press the ENT key. All the digits blink for confirmation.

Press the ENT key once more. The angular acceleration stops blinking and the settings finally change to the values you set.

6.4.3 Setting Communication Protocol for Serial Output Ports

The gyrocompass system has four serial output ports, and a different communication protocol can be set for each.

Selecting "42 Out Port" from the Generat. MENU and pressing the ENT key switches to the display for selecting a port number (as shown in the figure on the right).



Press the ENT key again. The port number "1" blinks.

Press the upper and lower arrow keys to change the port number (1 to 4). The current settings of communication protocol for the port are displayed.

After selecting the port, press the ENT key. The port number stops blinking and the baud rate blinks.

Press the upper and lower arrow keys to change the baud rate (2400, 4800, or 9600).

After selecting the baud rate, press the ENT key. The baud rate stops blinking and the data length blinks.

Press the upper and lower arrow keys to change the data length (7 or 8 bits).

After selecting the data length, press the ENT key. The data length stops blinking and the parity blinks.

Press the upper and lower arrow keys to change the parity (None, odd, or even).

After selecting the parity, press the ENT key. The parity stops blinking and the stop bit blinks.

Press the upper and lower arrow keys to change the stop bit (1 or 2 bits).

After selecting the stop bit, press the ENT key. The port number blinks for confirmation.

Press the ENT key once more. The port number stops blinking and the communication protocol settings finally change to the values you set.

6.4.4 Setting Communication Formats for Serial Output Ports

Up to three communication formats can be set for each serial output port for whether the gyro heading or the external azimuth is selected, as follows:

Port	Output Heading	Record
Port 1	Gyro heading (GYRO)	Record 1
		Record 2
		Record 3
	External azimuth (EXT)	Record 1
		Record 2
		Record 3

There are two types of format settings: ready-made formats and new formats.

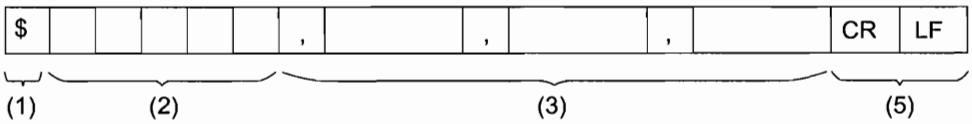
With the ready-made formats, one of the following formats can be set for each record.

Data	Ready-made Format
Heading (HDG)	$HEHDT
Rate of turn (ROT)	$HEROT
Heading/Rate of turn (HDG/ROT)	$HEHRC

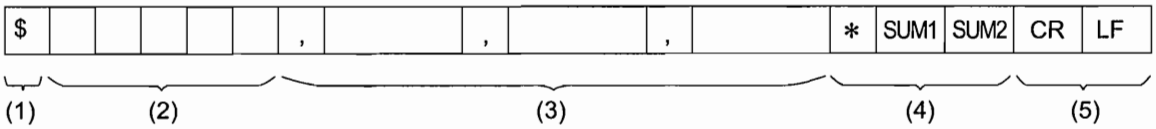
With the new formats, the heading, the rate of turn, or the heading/rate of turn can be set for each record according to the following basic format:

□Basic Format

• Without check sum



• With check sum



(1) Header : $ (fixed)

(2) Identification : Set five uppercase letters.

(3) Data : Set how many commas (,) the heading and the rate of turn come after (starting positions), and the total number of data items. The heading data can be followed by T (True) or M (Magnet), and the rate of turn by A (Yes, valid, clear warning flag) or V (No, invalid, clear warning flag). And the following represents data formats for the heading and the rate of turn.

Heading aaa.a In units of degrees, fixed to 4 digits (e.g. "001.2" as 1.2 degrees).

Rate of turn: In units of degrees/min or degrees/sec.

Degrees/min:

abbb.b • "a" represents direction: "–" as port and " " (blank)

• as starboard. The numeral part "bbb.b" is fixed to 4 digits.

Degrees/sec:

abb.bb
- "a" represents direction: "–" as port and " " (blank) as starboard.
- The numeral part "bb.bb" is fixed to 4 digits.

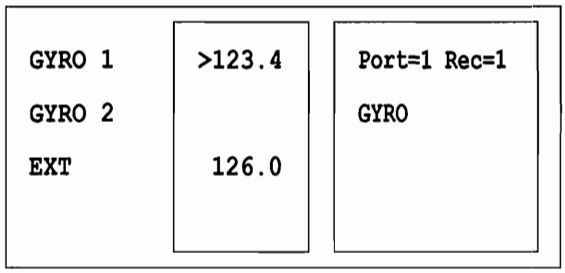
(4) Check sum : Select with or without.

(5) Terminator : CR - LF (fixed).

- Transmission period : Can be set to 100 to 2000 ms.
- A/V status : Follows the rate of turn data. It is A whenever the gyro heading is selected for the output heading, and V when the external azimuth is selected and the external azimuth input is erroneous.

The following describes how to set the communication formats for serial output ports.

Selecting "43 Out Form" from the Generat. MENU and pressing the ENT key switches to the display for setting the communication formats for serial output ports (as shown in the upper figure on the right).

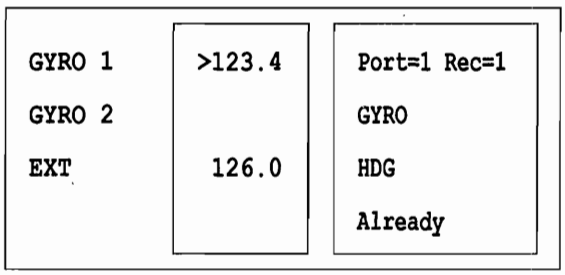


① Selecting the output port, record number, and types

Press the ENT key, then the port "1" blinks.

Press the upper and lower arrow keys to select the port number (1 to 4), and press the ENT key. The port number stops blinking and the record "1" blinks.

Press the upper and lower arrow keys to select the record number (1 to 3), and press the ENT key. The record number stops blinking and the output heading "GYRO" blinks.



Press the upper and lower arrow keys to select the output heading (GYRO or EXT), and press the ENT key. The output heading stops blinking and the selected output port, record number, and output heading blink on line 3 (as shown in the lower figure on the right).

Press the upper and lower arrow keys to select the data type (HDG, ROT, HDG/ROT, or NONE), and press the ENT key. When NONE is selected here, no data is output for the selected port, record number, or output heading. When other type is selected, then Already/New blinks on line 4.

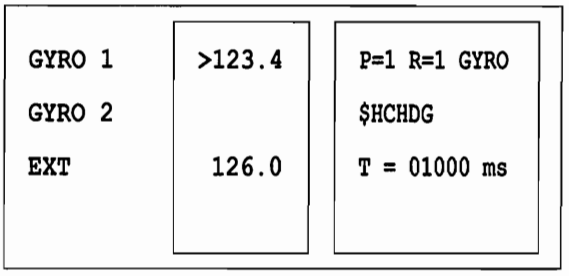
Press the upper and lower arrow keys to select the type of format, and press the ENT key. When Already is selected here, then go to ② Selecting a ready-made format. When New is selected, then go to ③ Creating a new format.

② Selecting a ready-made format

The display shows the current settings (as shown in the figure on the right) and the current ready-made format blinks.

Press the upper and lower arrow keys to select a format. The selectable ready-made formats depend on the data type. See the table on page 6-33.

After selecting a ready-made format, press the ENT key. The format stops blinking and the ten thousands digit of current communication period blinks.



Press the right and left arrow keys to change the blinking digit (ten thousands, thousands, or hundreds), and press the upper and lower arrow keys to change the numeric value.

After entering the communication period, press the ENT key. All the digits blink for confirmation.

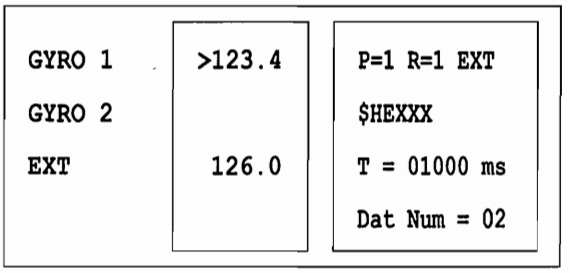
Press the ENT key again. The output port, record number, and output heading finally change to the selected settings.

③ Creating a new format

The display shows the current settings (as shown in the figure on the right) and the second leftmost character of the header blinks.

Press the right and left arrow keys to change the blinking character (except for $), and press the upper and lower arrow keys to change the letter (A to Z, cyclic).

After entering the header, press the ENT key. All the characters blink for confirmation.



Press the ENT key again. The header stops blinking and the ten thousands digit of current communication period blinks.

Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the communication period, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The communication period stops blinking and the tens digit of the number of data items (Dat Num) blinks.

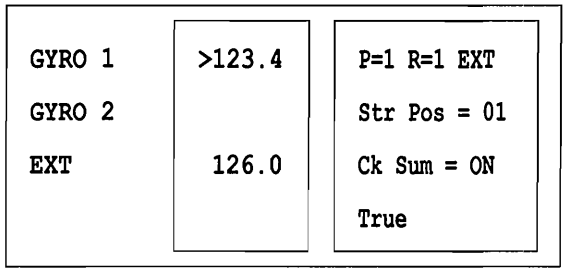
Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the number of data items, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The display shows the current settings for the selected data type.

Example of creating an HDG format

The figure on the right shows an example of selecting HDG for the data type.



The tens digit of the starting position (Str Pos) blinks. Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the starting position, press the ENT key. All the digits blink for confirmation.

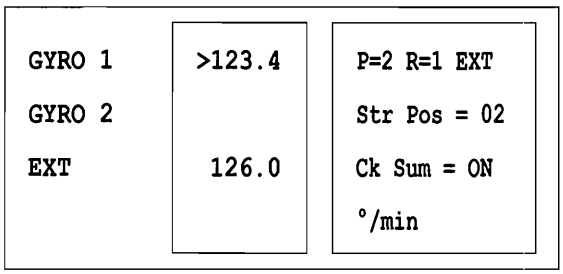
Press the ENT key again. The starting position stops blinking and the designation for use of the check sum (Ck Sum) blinks. Press the upper and lower arrow keys to select on/off.

After selecting the check sum, press the ENT key. The check sum stops blinking and the True/Magnetic blinks.

Press the upper and lower arrow keys to select True, Magnetic, or None, and press the ENT key. The new format (heading) for the selected output port, record number, and output heading is finally confirmed.

Example of creating an ROT format

The upper figure on the right shows an example of selecting ROT for the data type.



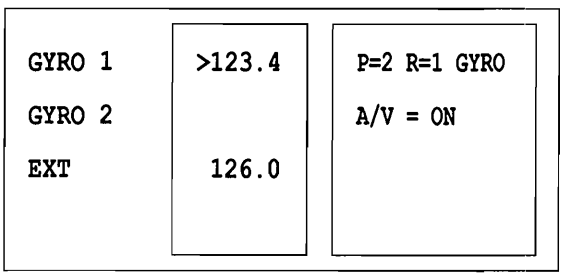
The tens digit of the starting position (Str Pos) blinks. Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.

After entering the starting position, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The starting position stops blinking and the designation for use of the check sum blinks. Press the upper and lower arrow keys to select on/off.

After selecting the check sum, press the ENT key. The check sum stops blinking and the unit blinks.

Press the upper and lower arrow keys to select a unit (degrees/min or degrees/sec), and press the ENT key. The designation for use of the A/V status blinks as shown in the lower figure on the right.

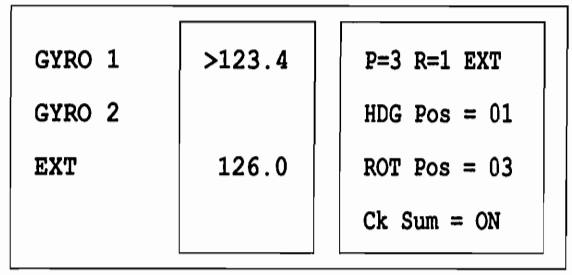


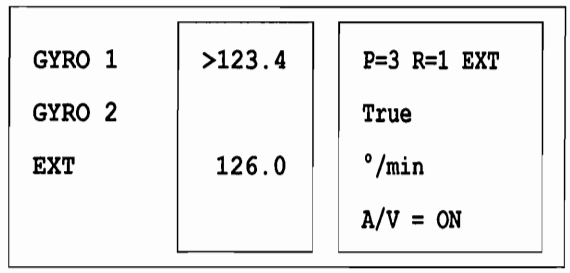
Press the upper and lower arrow keys to select on/off, and press the ENT key. The new format (rate of turn) for the selected output port, record number, and output heading is finally confirmed.

Example of creating a HDG/ROT format

The upper figure on the right is an example of selecting HDG/ROT for the data type. The display shows the current settings of starting positions of the heading (HDG Pos) and the rate of turn (ROT Pos), and the designation for use of the check sum. Set all the items as in the case of the HDG and ROT.

After selecting the check sum, the display changes as shown in the lower figure on the right. Set all the items likewise. When all of the settings are completed, the new format (heading/rate of turn) for the selected output port, record number, and output heading is finally confirmed.

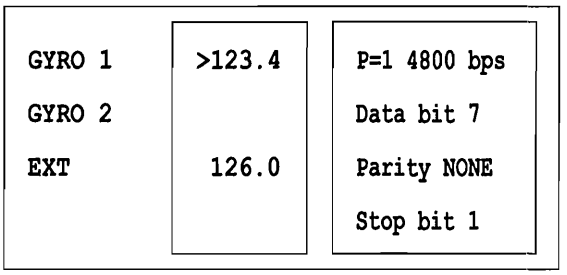




6.4.5 Setting Communication Protocol for Serial Input Ports

The gyrocompass system has three serial input ports and a different communication protocol can be set for each.

Selecting "44 In Port" from the Generat. MENU and pressing the ENT key switches to the display for selecting a port number (as shown in the figure on the right).



Press the ENT key again. The port number "1" blinks.

Press the upper and lower arrow keys to change the port number (1 to 3). The current settings of communication protocol for the port are displayed.

After selecting the port, press the ENT key. The port number stops blinking and the baud rate blinks.

Press the upper and lower arrow keys to change the baud rate (2400, 4800, or 9600).

After selecting the baud rate, press the ENT key. The baud rate stops blinking and the data length blinks.

Press the upper and lower arrow keys to change the data length (7 or 8 bits).

After selecting the data length, press the ENT key. The data length stops blinking and the parity blinks.

Press the upper and lower arrow keys to change the parity (None, odd, or even).

After selecting the parity, press the ENT key. The parity stops blinking and the stop bit blinks.

Press the upper and lower arrow keys to change the stop bit (1 or 2 bits).

After selecting the stop bit, press the ENT key. The port number blinks for confirmation.

Press the ENT key once more. The port number stops blinking and the communication protocol settings finally change to the values you set.

6.4.6 Setting Communication Formats for Serial Input Ports

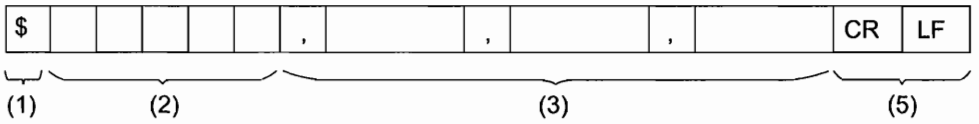
Each of ship's speed (one input), latitude (one input), and heading (three inputs) can be freely assigned to three ports.

There are two types of format settings: ready-made formats (see the table below) and new formats (according to the basic format below).

Data	Ready-made Format
Ship's speed (SPD)	$VMVSD $VDVBW ,$VMVBW $GPVHW , $VDVHW $GPVTG , $VDVTG
Latitude (POS)	$GPGLL $GPGGA
Heading (HDG)	$HCHRC, $HEHRC $HCHDM ,$HCHDG $GPVTG ,$GPVHW $GPHDT

☐Setting new format

• Without check sum



• With check sum

(1) Header : $ (fixed)

(2) Identification : Set five uppercase letters.

(3) Data : Set how many commas (,) the ship's speed, latitude, and heading come after (starting positions). Thus, each data must follow a comma, and the number and the order of data items must never be changed. Data must be represented as follows:

Ship's speed	a.a	•In units of Kt or Km/h.
		•The decimal point and decimals may either be displayed or not. Variable length.
Latitude	aabb.cc, d	•"aa" represents degrees and "bb.cc" minutes. The "aabb" part is fixed to 4 digits.
		•For "d", either "N" (north latitude) or "S" (south latitude) is displayed.
Heading	a.a	•In units of degrees.
		•The decimal point and decimals may either be displayed or not. Variable length.

(4) Check sum : Select with or without.

The check sum is obtained by performing the Exclusive OR operation on the bits between $ and * exclusive, dividing it into the upper and lower four bits, and converting each group into ASCII code characters SUM1 and SUM2.

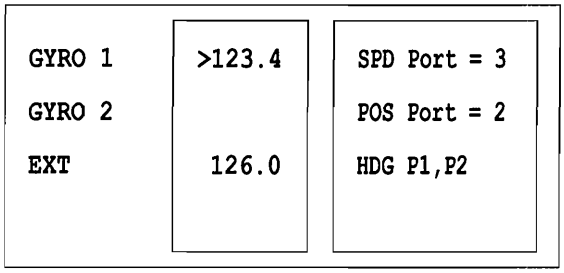
(5) Terminator : CR – LF (fixed).

Transmission period

Can be set to 0 to 20000 ms in 100-ms increments. If the normal data transfer stops for a period ten times the communication period setting, the gyrocompass system issues an alarm for a communication port failure (time-out). If the communication period is set to zero, it does not monitor the time-out.

The following describes how to set the communication formats for serial input ports.

Selecting "45 In Form" from the Generat. MENU and pressing the ENT key switches to the display showing the current settings for the communication formats for serial output ports. The figure on the right is an example of setting the ship's speed to port 3, the ship's position (latitude) to port 2, and the heading to ports 1 and 2.



Press the ENT key, then the ship's speed input port (SPD) blinks.

Press the upper and lower arrow keys to select the port (1 to 3, P, or "-"). Select P for the ship's speed pulse input and "-" if there is no input for the ship's speed. After selecting the port, press the ENT key. The ship's speed input port stops blinking and the ship's position input port (POS) blinks.

Press the upper and lower arrow keys to select the port (1 to 3, or "-"). Choose "-" if there is no input for the ship's position. After selecting the port, press the ENT key. The ship's position input port stops blinking and SPD blinks.

Press the upper and lower arrow keys to change the blinking item and select the data type (SPD, POS, or HDG).

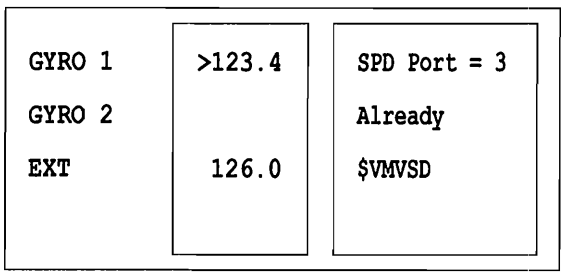
When selecting SPD (for the input ports 1 to 3 only) and pressing the ENT key, then go to ① Creating a ship's speed format.

When selecting POS (for the input ports 1 to 3 only) and pressing the ENT key, then go to ② Creating a ship's position format.

When selecting HDG and pressing the ENT key, then go to ③ Setting serial input ports for heading.

① Creating a ship's speed format

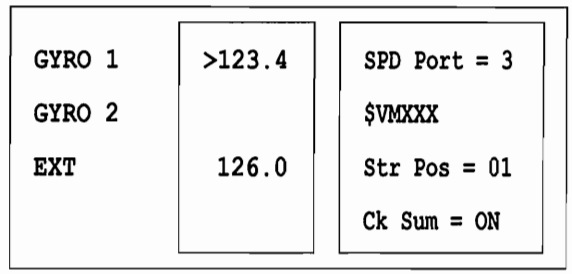
The figure on the right shows an example of selecting SPD for the data type.



Already/New blinks. Press the upper and lower arrow keys to select the type of format, and press the ENT key.

When Already is selected here, the current ready-made format blinks on line 3. Press the upper and lower arrow keys to select a ready-made format and press the ENT key. The selected format is finally confirmed.

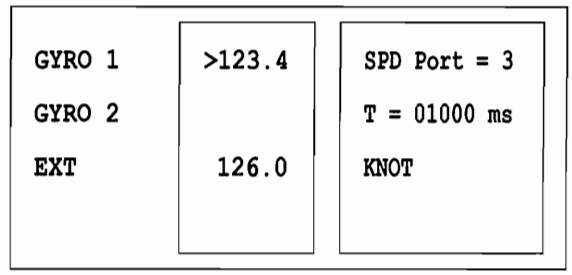
When New is selected, the display changes as shown in the upper figure on the right.



The second leftmost character of the header blinks. Press the right and left arrow keys to change the blinking character (except for $), and press the upper and lower arrow keys to change the letter (A to Z, cyclic).

After entering the header, press the ENT key. All the characters blink for confirmation.

Press the ENT key again. The header stops blinking and the tens digit of the starting position (Str Pos) blinks. Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.



After entering the starting position, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The starting position stops blinking and the designation for use of the check sum (Ck Sum) blinks. Press the upper and lower arrow keys to select on/off.

After selecting the check sum, press the ENT key. The display changes as shown in the lower figure on the right.

The ten thousands digit of current communication period blinks. Press the right and left arrow keys to change the blinking digit (ten thousands, thousands, or hundreds), and press the upper and lower arrow keys to change the numeric value.

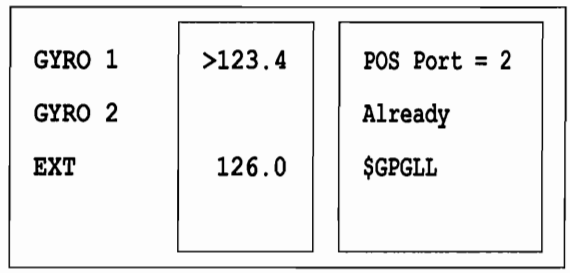
After entering the communication period, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The blinking stops and the unit blinks.

Press the upper and lower arrow keys to select a unit (KNOT or Km/h), and press the ENT key. The new format of ship's speed is finally confirmed.

② Creating a ship's position format

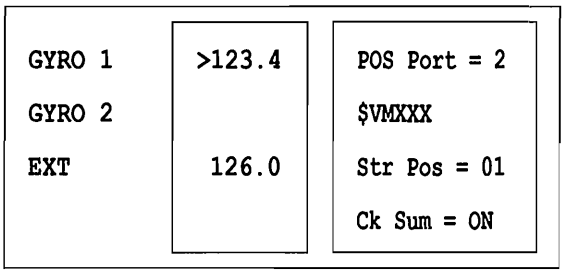
The figure on the right shows an example of selecting POS for the data type.



Already/New blinks. Press the upper and lower arrow keys to select the type of format, and press the ENT key.

When Already is selected here, the current ready-made format blinks on line 3. Press the upper and lower arrow keys to select a ready-made format and press the ENT key. The selected format is finally confirmed.

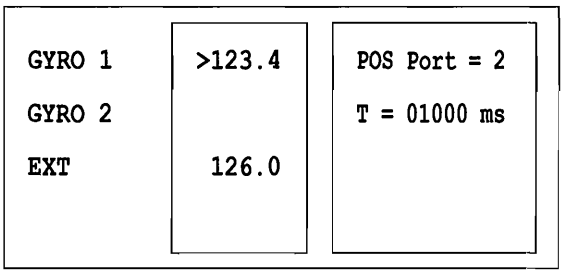
When New is selected, the display changes as shown in the upper figure on the right.



The second leftmost character of the header blinks. Press the right and left arrow keys to change the blinking character (except for $), and press the upper and lower arrow keys to change the letter (A to Z, cyclic).

After entering the header, press the ENT key. All the characters blink for confirmation.

Press the ENT key again. The header stops blinking and the tens digit of the starting position (Str Pos) blinks. Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.



After entering the starting position, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The starting position stops blinking and the designation for use of the check sum (Ck Sum) blinks. Press the upper and lower arrow keys to select on/off.

After selecting the check sum, press the ENT key. The display changes as shown in the lower figure on the right.

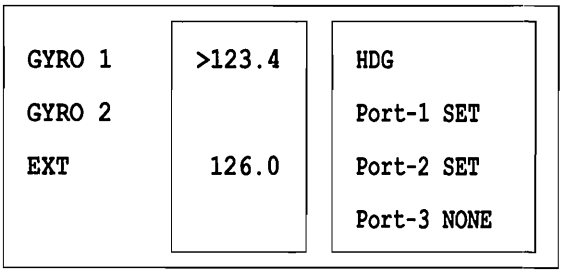
The ten thousands digit of current communication period blinks. Press the right and left arrow keys to change the blinking digit (ten thousands, thousands, or hundreds), and press the upper and lower arrow keys to change the numeric value.

After entering the communication period, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The new format of ship's position is finally confirmed.

③ Setting serial input ports for heading

The upper figure on the right shows an example of selecting HDG for the data type.



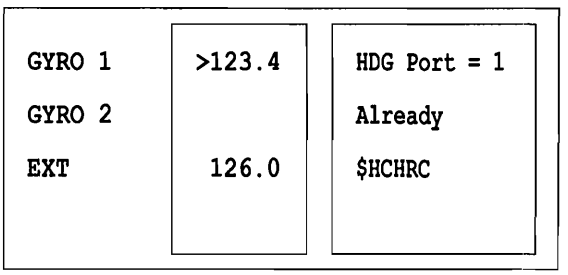
The display shows whether the heading is input to the serial ports 1 to 3. Either SET (yes) or NONE (no) is displayed.

The heading input status for port 1 blinks. Press the upper and lower arrow keys to select SET or NONE.

After selecting the heading input status for port 1, press the ENT key. The setting is finally confirmed.

Set the heading input status for ports 2 and 3 likewise.

When all the ports are set for the heading input status, the display shows "Port = 1" and the number blinks.



Press the upper and lower arrow keys to select an input port (1 to 3) and press the ENT key. The display changes as shown in the lower figure on the right.

Already/New blinks. Press the upper and lower arrow keys to select the type of format, and press the ENT key.

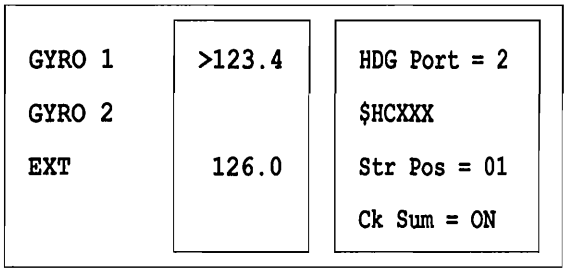
When Already is selected here, the current ready-made format blinks on line 3. Press the upper and lower arrow keys to select a ready-made format and press the ENT key. The selected format is finally confirmed.

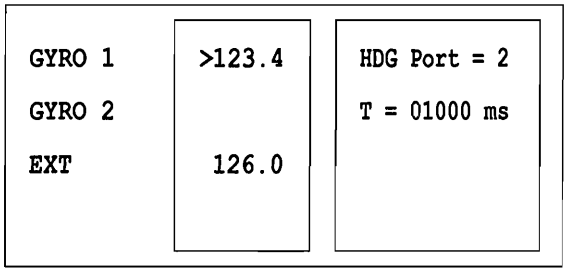
When New is selected, the display changes as shown in the upper figure on the right.

The second leftmost character of the header blinks. Press the right and left arrow keys to change the blinking character (except for $), and press the upper and lower arrow keys to change the letter (A to Z, cyclic).

After entering the header, press the ENT key. All the characters blink for confirmation.

Press the ENT key again. The header stops blinking and the tens digit of the starting position (Str Pos) blinks. Press the right and left arrow keys to change the blinking digit, and press the upper and lower arrow keys to change the numeric value.





After entering the starting position, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The starting position stops blinking and the designation for use of the check sum (Ck Sum) blinks. Press the upper and lower arrow keys to select on/off.

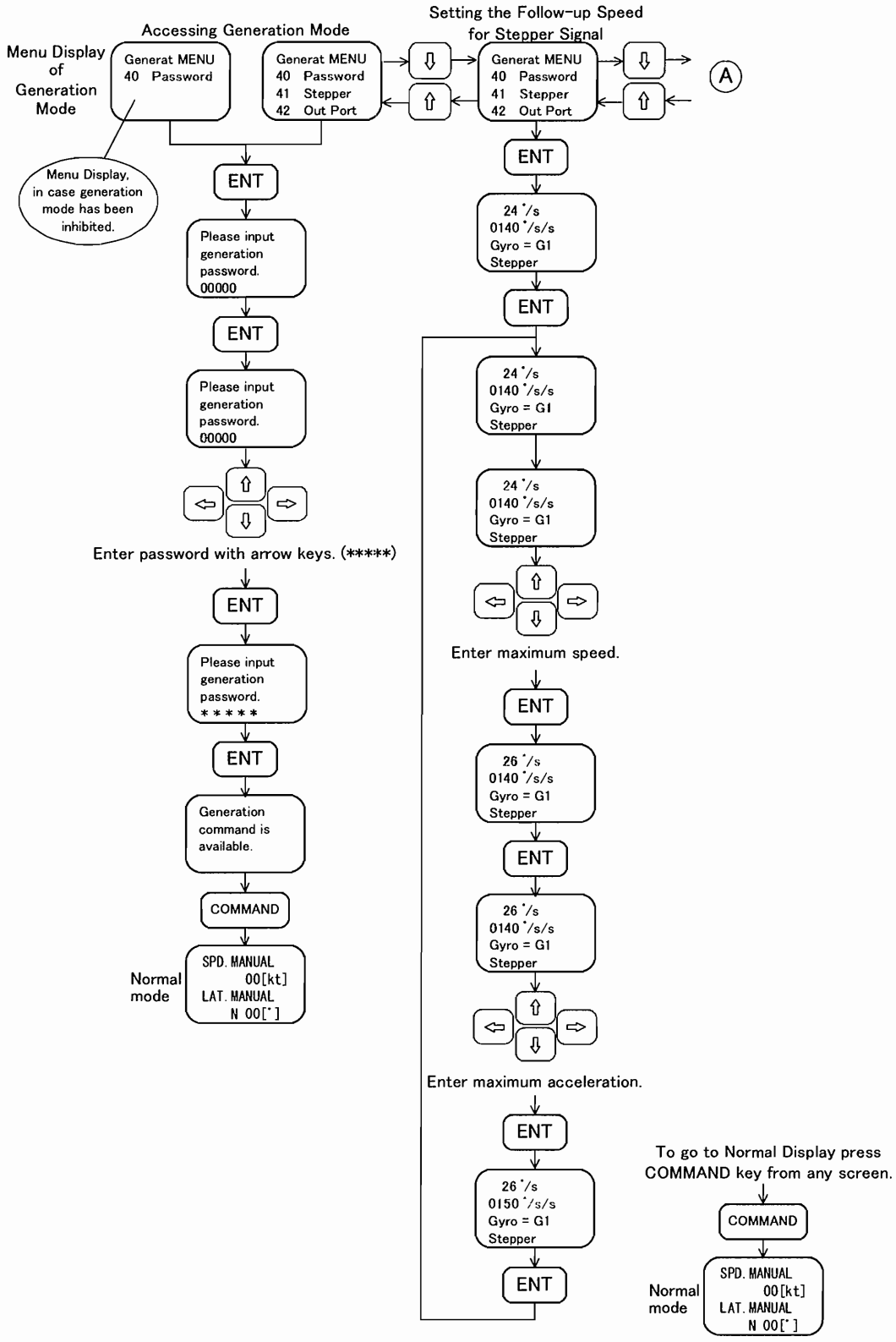
After selecting the check sum, press the ENT key. The display changes as shown in the lower figure on the right.

The ten thousands digit of current communication period blinks. Press the right and left arrow keys to change the blinking digit (ten thousands, thousands, or hundreds), and press the upper and lower arrow keys to change the numeric value.

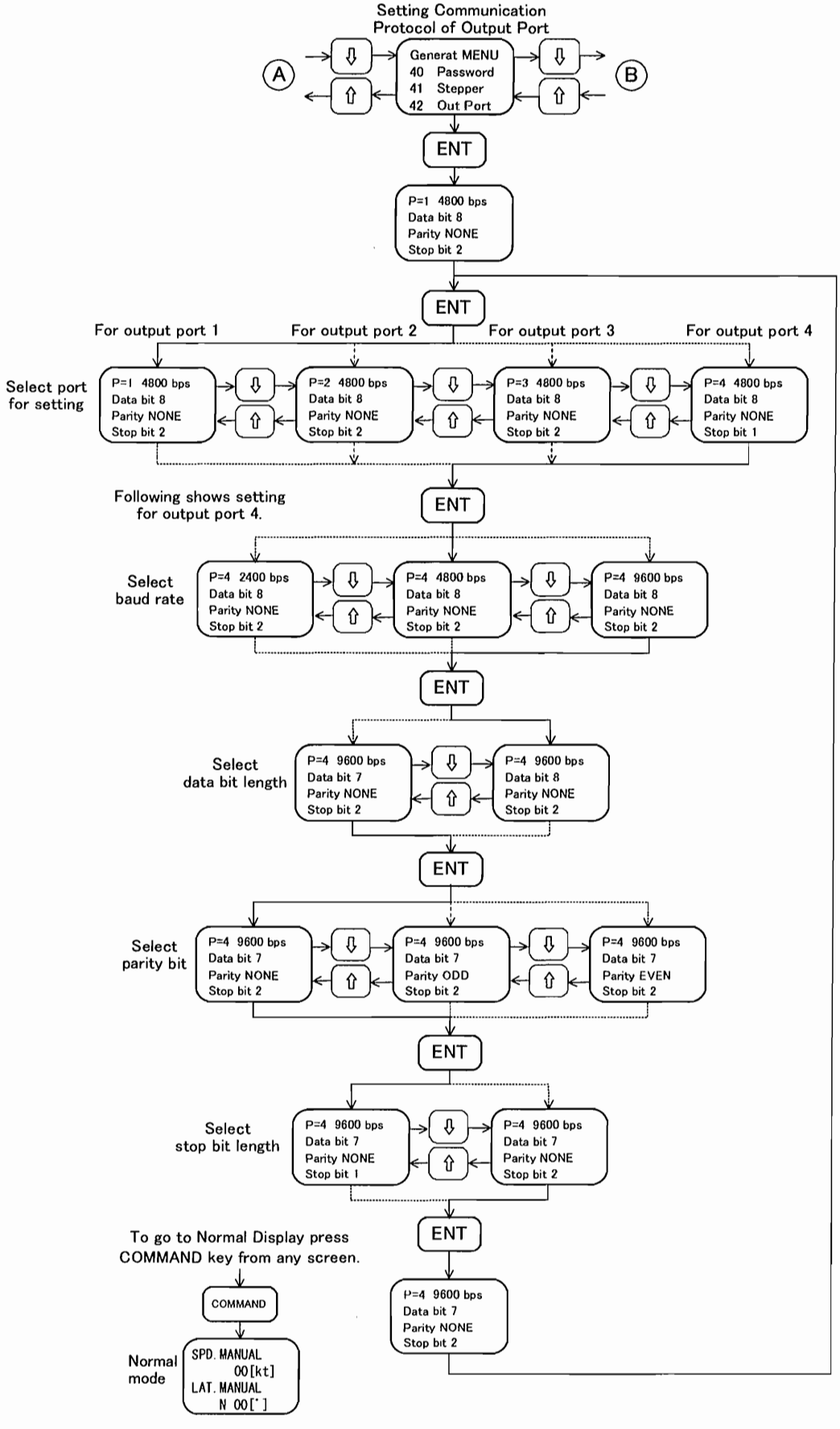
After entering the communication period, press the ENT key. All the digits blink for confirmation.

Press the ENT key again. The new format of heading is finally confirmed.

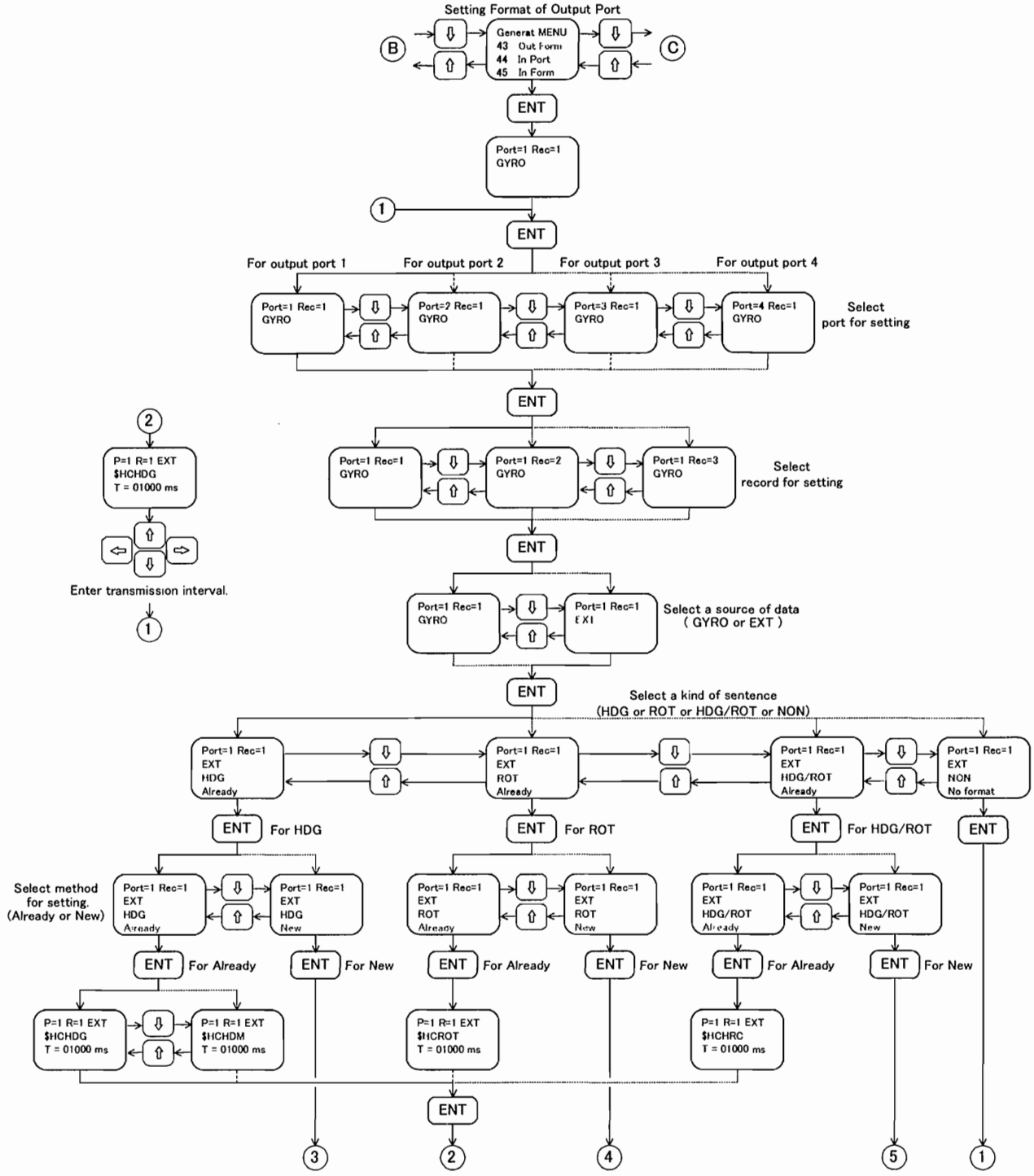
☐Operation Flow Sheet of Generation Function (1/9)



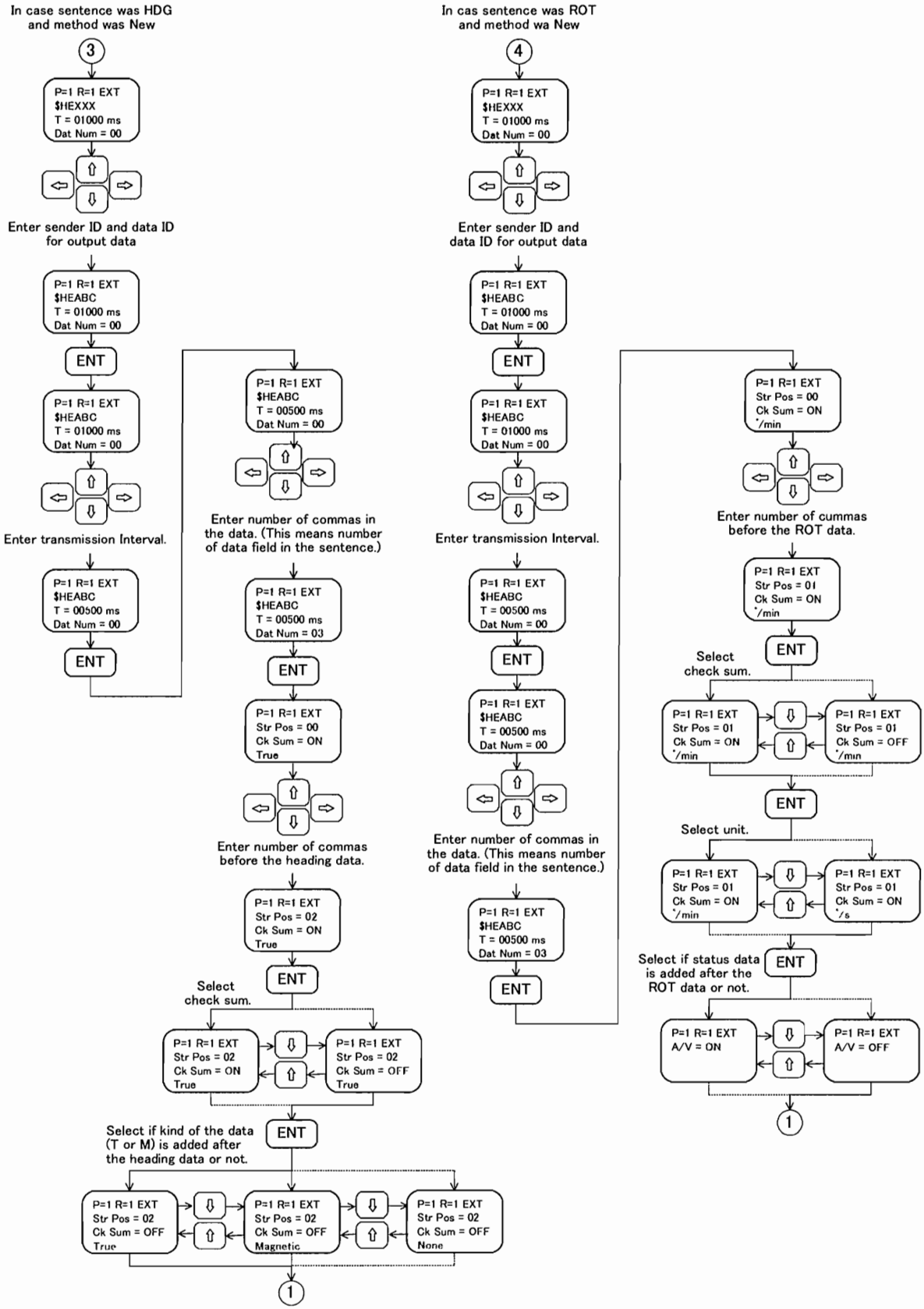
□Operation Flow Sheet of Generation Function (2/9)



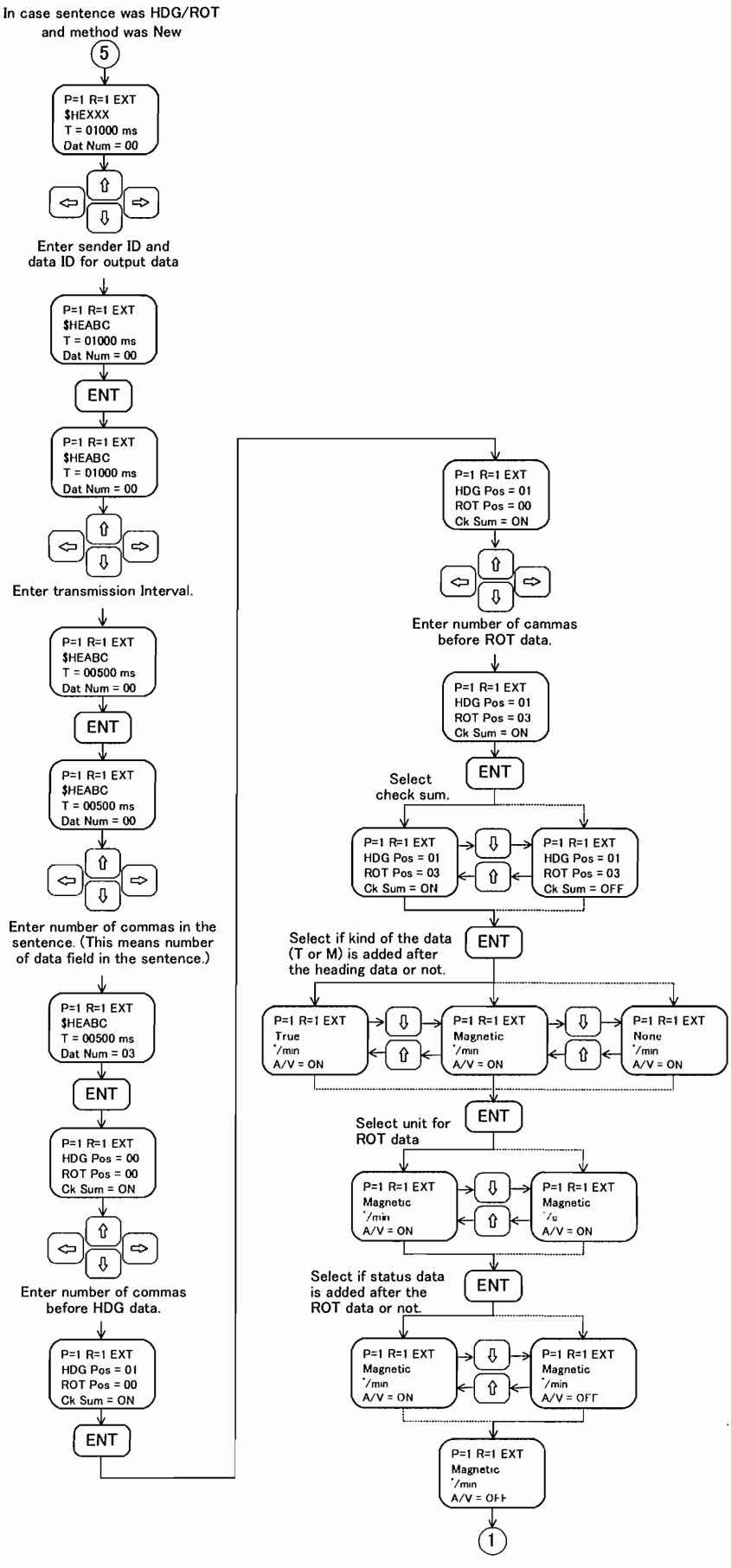
☐Operation Flow Sheet of Generation Function (3/9)



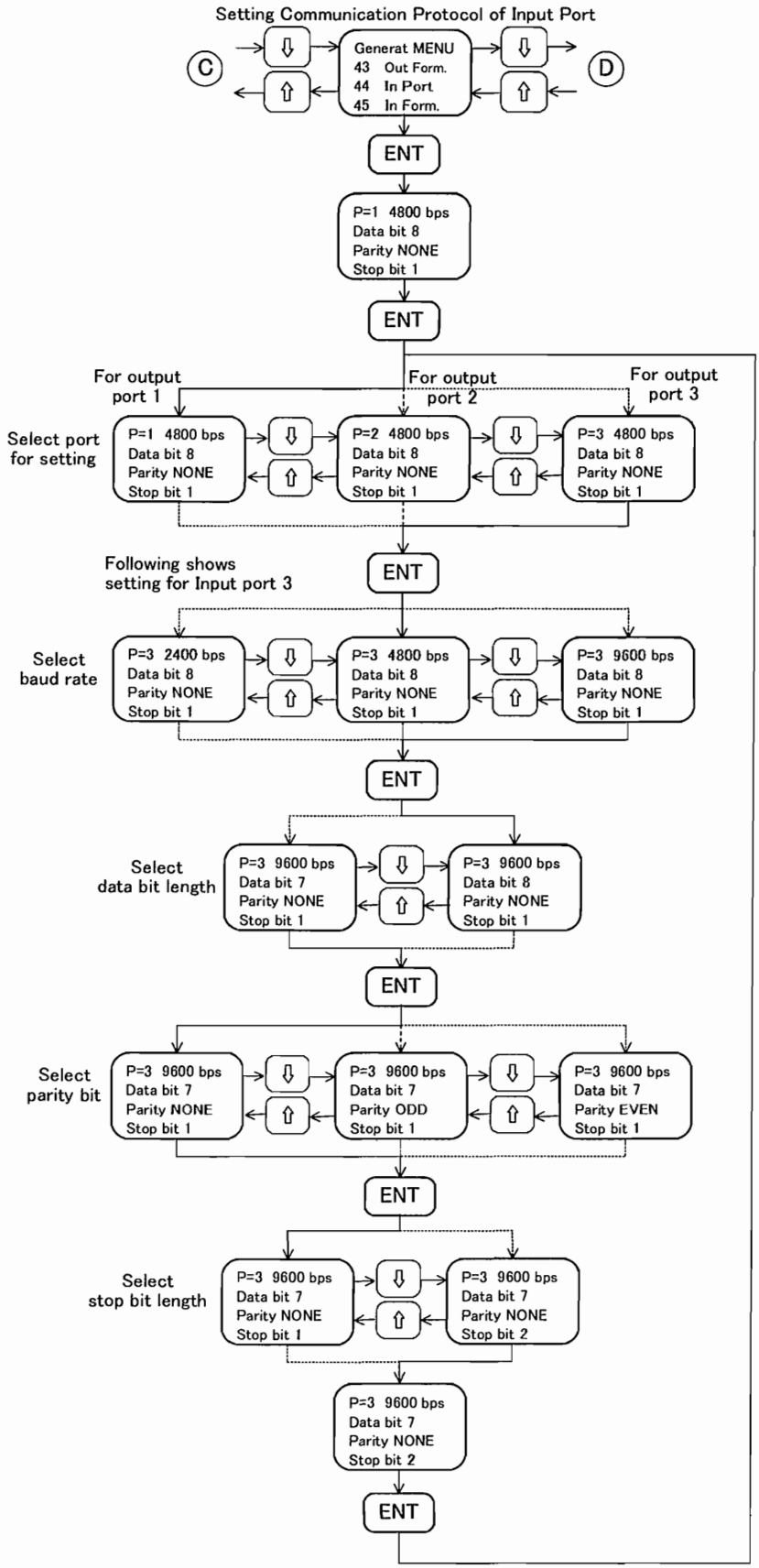
☐Operation Flow Sheet of Generation Function (4/9)



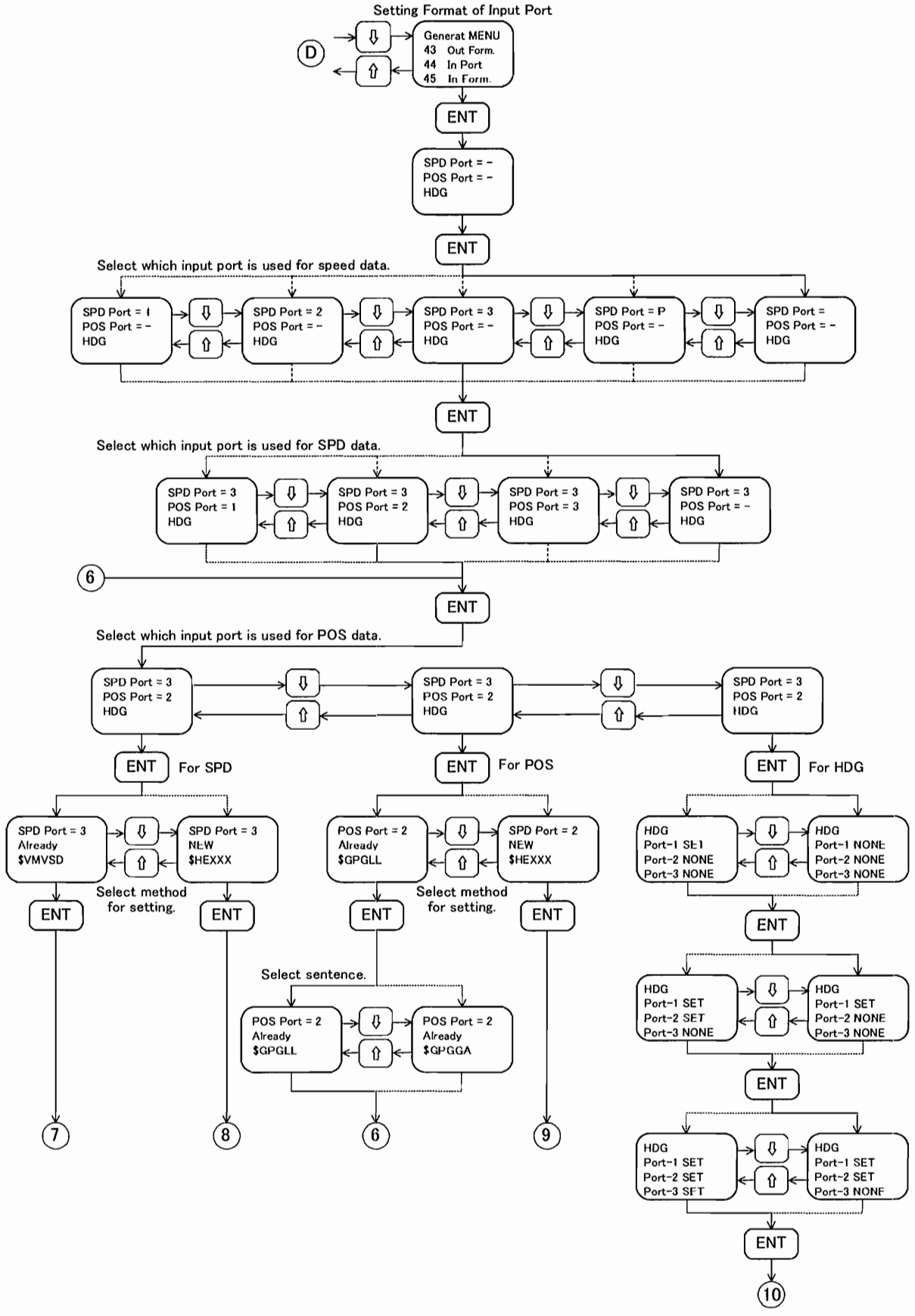
☐Operation Flow Sheet of Generation Function (5/9)



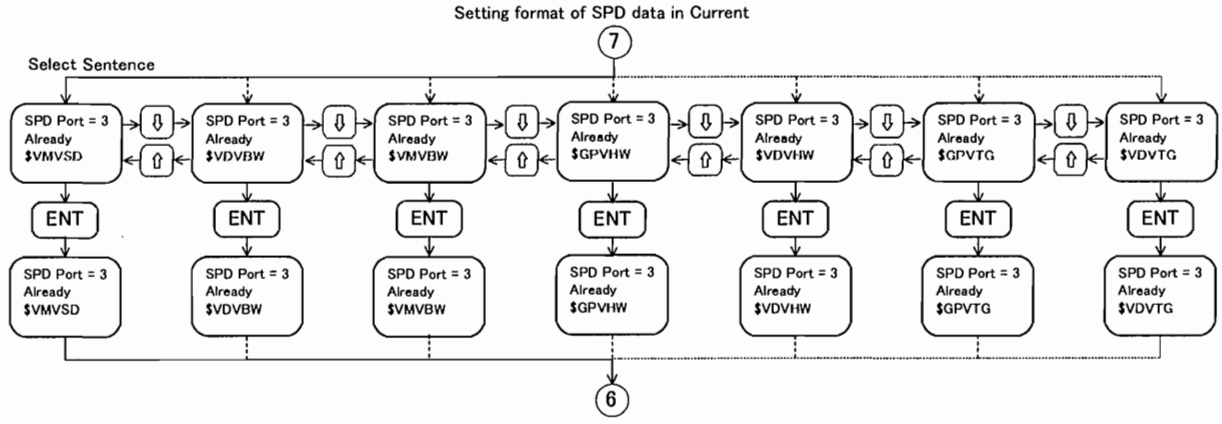
□Operation Flow Sheet of Generation Function (6/9)

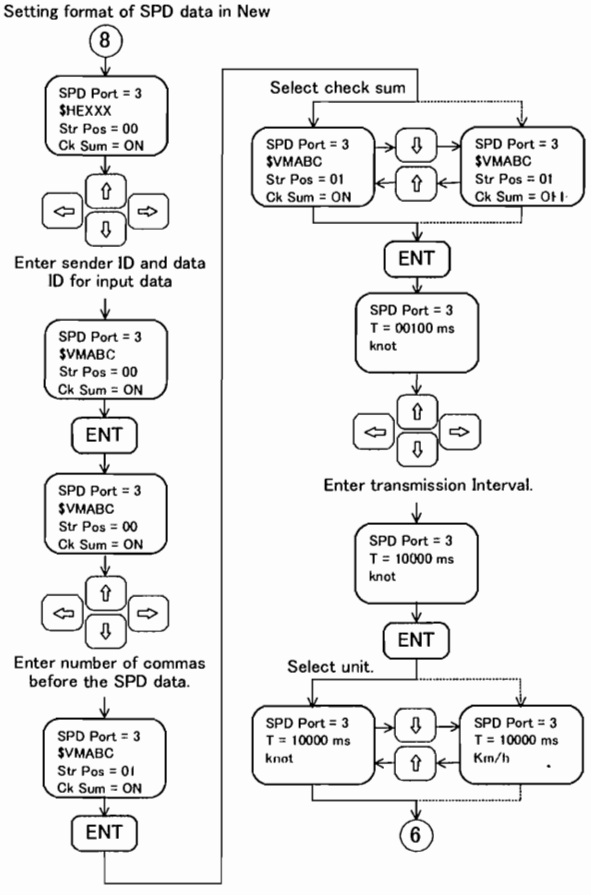


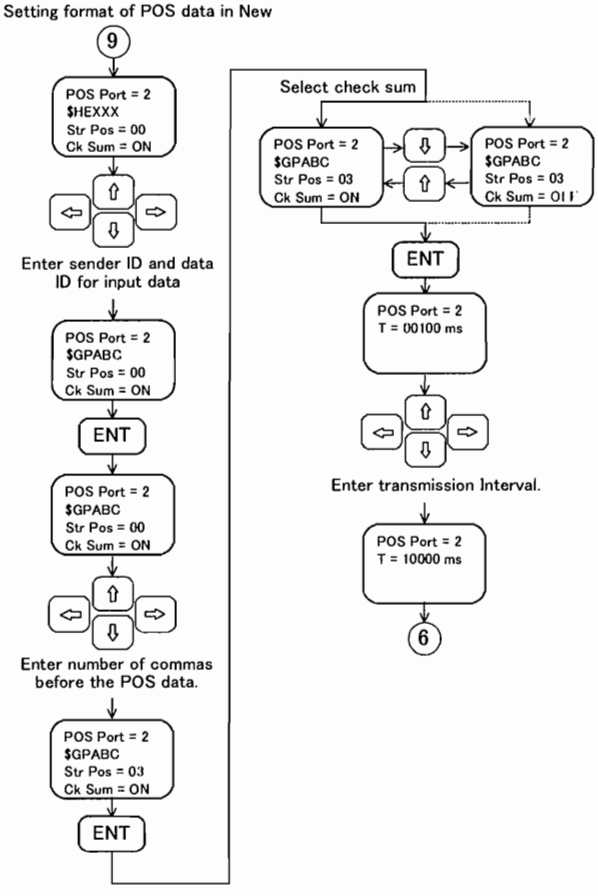
☐Operation Flow Sheet of Generation Function (7/9)



☐Operation Flow Sheet of Generation Function (8/9)







☐Operation Flow Sheet of Generation Function (9/9)