

FURUNO

OPERATOR'S MANUAL

INTEGRATED HEADING SENSOR

MODEL PG-1000



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NISHINOMIYA, JAPAN

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·Your Local Agent/Dealer

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PG-1000



* 00080805700 *



SAFETY INSTRUCTIONS

Safety Information for the Installer



WARNING

Turn off the power at the mains switchboard before beginning the installation.
Post a sign near the switch to indicate it should not be turned on while the equipment is being installed.

Fire or electrical shock can result if the power is left on or is applied while the equipment is being installed.



CAUTION

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

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

Use the supplied power cable.

Use of a wrong power cable can cause fire or equipment damage.

Maintain the compass safe distance.

Standard compass	Steering compass
0.5 m	0.4 m

Safety Information for the Operator



WARNING

Do not disassemble or modify the equipment.

Fire, electrical shock or serious injury can result.

Turn off the power immediately if water leaks into the equipment or the equipment is emitting smoke or fire.

Continued use of the equipment can cause fire or electrical shock.

Do not place liquid-filled containers on the top of the equipment.

Fire or electrical shock can result if a liquid spills into the equipment.



CAUTION

Turns off the autopilot before selecting output data format.

The autopilot may turn the rudder suddenly.

Turns off the autopilot before aligning heading.

The autopilot may turn the rudder suddenly.

FOREWORD

A Word to PG-1000 Owners

Congratulations on your choice of the FURUNO PG-1000 Integrated Heading Sensor. We are confident you will see why the FURUNO name has become synonymous with quality and reliability.

For over 40 years FURUNO Electric Company has enjoyed an enviable reputation for innovative and dependable marine electronics equipment. This dedication to excellence is furthered by our extensive global network of agents and dealers.

Your heading sensor is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless operated and maintained properly. Please carefully read and follow the recommended procedures for installation, operation and maintenance.

We would appreciate hearing from you, the end-user, about whether we are achieving our purposes.

Thank you for considering and purchasing FURUNO equipment.

Features

- The PG-1000 uses a magnetic sensor and a vibrating gyroscope to find bearing.
- Automatic correction of magnetic variation
- Can convert magnetic bearing data to true bearing data (requires navaid connection).

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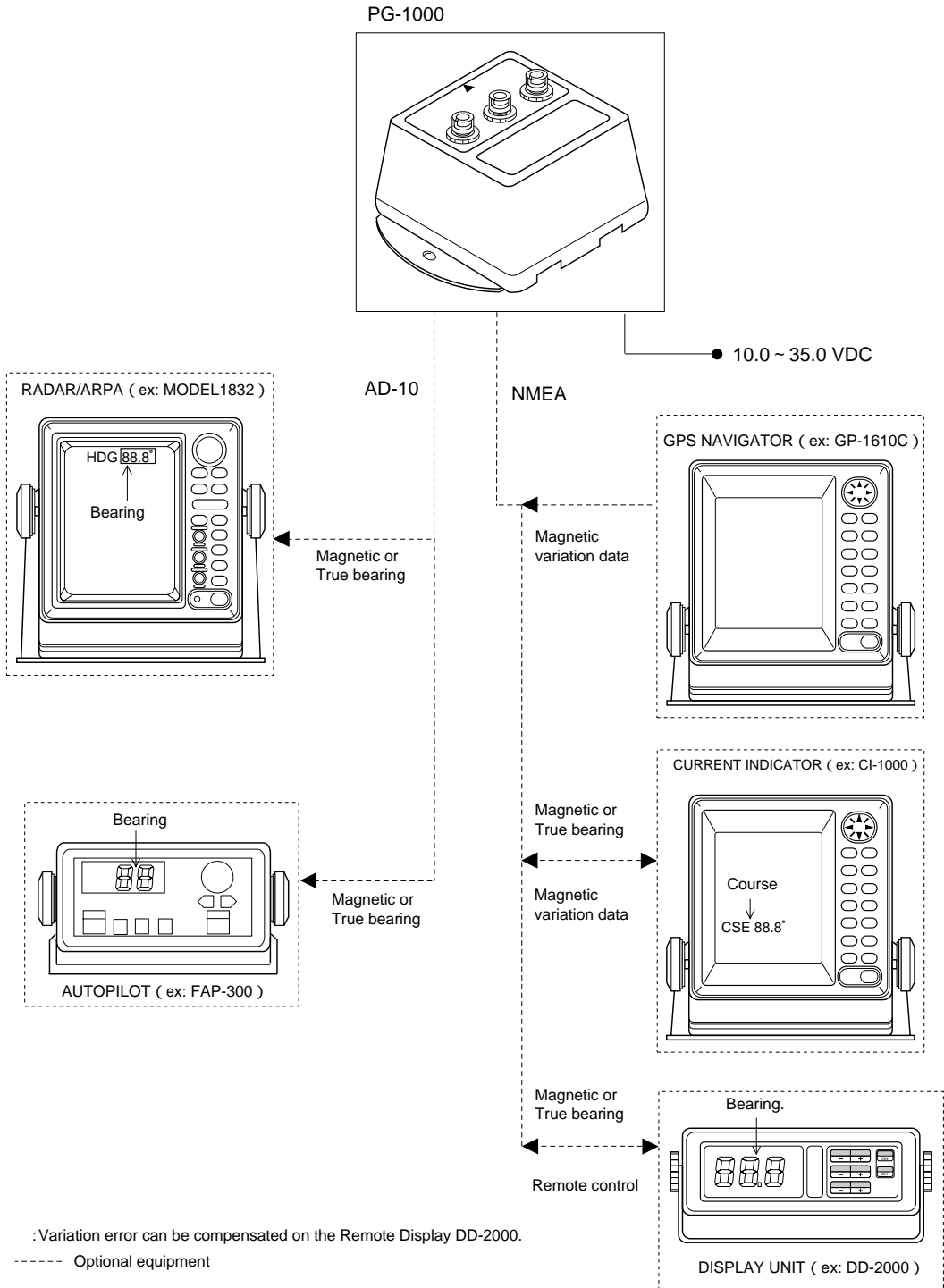
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SYSTEM CONFIGURATION



1. INSTALLATION

1.1 Equipment List

Complete set

No.	Name	Type	Code No.	Qty	Remarks
1	Sensor	PG-1000-E	—————	1	
2	Installation Materials	CP64-02000	000-040-433	1	Refer to table below.

Installation materials (CP64-02000)

No.	Name	Type	Code No.	Qty	Remarks
1	Tapping screw	4x16 SUS304	000-802-080	2	
2	Flat washer	M4 SUS304	000-864-126	2	
3	Power cable	22S0019	000-109-000	1	
4	Cable assy.	MJ-A6SPF0007-100	000-125-237	1	

Optional equipment

No.	Name	Type	Code No.	Qty	Remarks
1	Signal cable	MJ-A6SPF0003-050	000-117-603	1	w/connector, 5m (for AD-10)
2	Cable assy.	MJ-A6SPF0007-100	000-125-237	1	6p-6p, 10m (for AD-10)
		MJ-A6SPF0012-100	000-133-817	1	6p-6p, 10m (for NMEA)

1.2 Selecting Mounting Location

The PG-1000 must be mounted horizontally.

When selecting a mounting location, keep in mind the following points:

- The ambient temperature must be between -15°C and 55°C.
- Vibration at the mounting location should be minimal.
- Install the sensor as far as possible from power cable, engine, steel fuel tank, steel water tank, bilge pump, anchor and anchor chain, antenna and antenna cable for the radio equipment, steel mast, steel mast support and steel keel.
- Leave sufficient space around the sensor for maintenance.
- Select a location where the LEDs can be easily viewed.
- Install the sensor close to the boat's center of gravity.
- Align the arrow mark on the top of the sensor parallel with the ship's bow.

1. Tentatively select the mounting location.

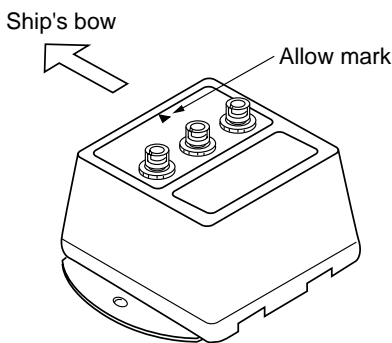


Figure 1 PG-1000

2. Connect the PG-1000 to the battery as shown below.

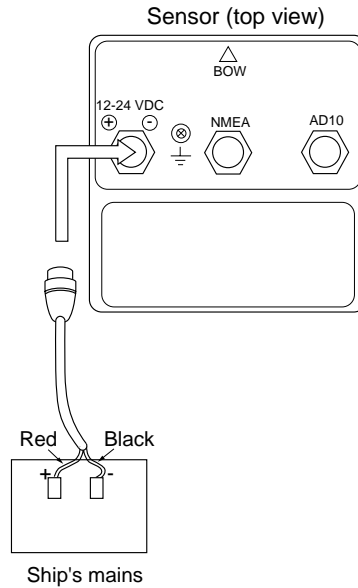


Figure 2 Battery connections to PG-1000

3. Turn the ship's mains switch on.

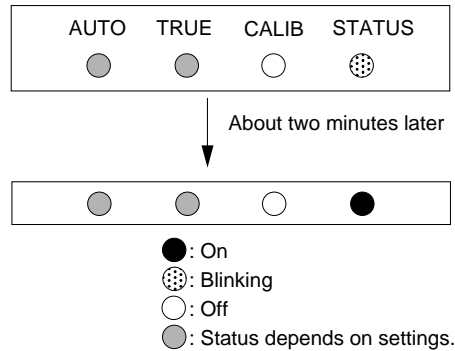


Figure 3 LEDs at power on

4. Confirm that the STATUS LED blinks. Two minutes later it will light. If STATUS LED doesn't blink and then light, suspect error. Reset power.

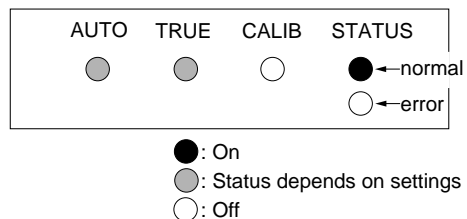


Figure 4

5. Press the [AUTO] and [+] keys together more than two seconds.

After the TRUE, CALIB and STATUS LEDs light and AUTO LED blinks, rotate the equipment 360° slowly, keeping it upright. If three LEDs are lighting, the mounting location is suitable.

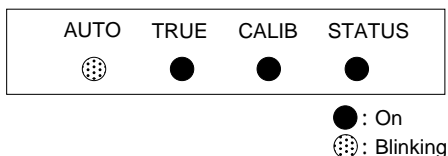


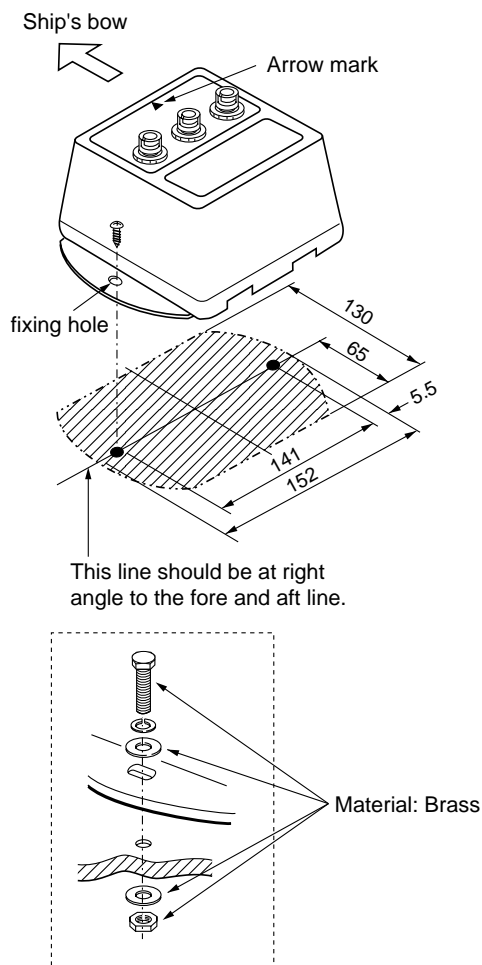
Figure 5

If one or more LED is off, the mounting location is not suitable. Try to change the location, and do step 5 again.

6. Press the [AUTO] and [TRUE] keys together to return to the normal mode. The STATUS LED blinks while the equipment is being calibrated and lights when the calibration is completed (return to normal mode). Do not operate the equipment while the LED is blinking; calibration will be incomplete.

1.3 Mounting

1. Fix the sensor by using screws and washers (supplied). The size of the fixing hole is $\varnothing 4.5$.



All dimensions in millimeters.
For added support, use nuts, bolts and washers instead of woodscrews.
Secure sufficient space around the sensor for maintenance and checking.

Figure 6 Mounting the PG-1000

Note: Do not overtighten the screws (or bolts); the sensor may crack.

Checking for inclination

The following checks if the PG-1000 is mounted horizontally.

1. Press the [TRUE] and [+] keys more than two seconds.

When the inclination is within $\pm 5^\circ$, STATUS LED lights and TRUE LED blinks.

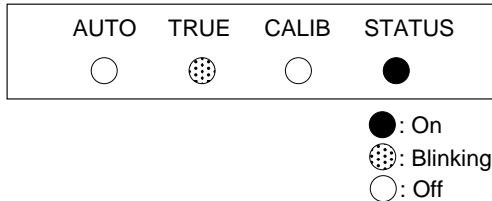


Figure 7 LED status when inclination is within $\pm 5^\circ$

If STATUS LED is off, the inclination is over $\pm 5^\circ$. In this case, relocate the sensor to where inclination becomes within $\pm 5^\circ$.

2. Press the [AUTO] and [TRUE] keys more than two seconds to return to the normal mode. The STATUS LED blinks while the equipment is being calibrated and lights when the calibration is completed (return to normal mode). Do not operate the equipment while the LED is blinking; calibration will be incomplete.

1.4 Connections

Connect cables as shown in the Figure 8.

Leave sufficient slack in cables for maintenance and checking ease. If cables run outside the bridge run them through conduit to protect them from corrosion.

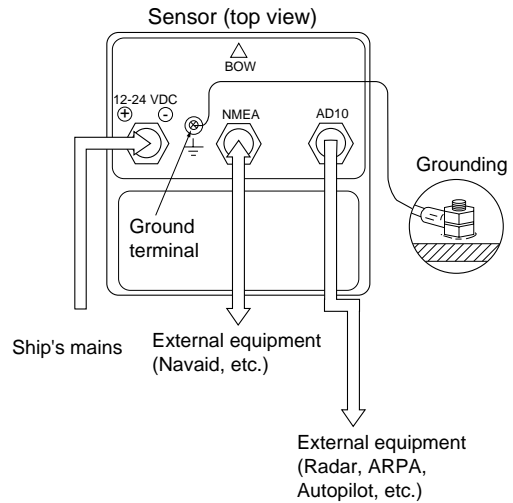


Figure 8 Connections

Grounding

Ground the PG-1000 as follows to prevent interference:

- The ground wire should be as short as possible.
- The ground wire should be about 1.25 sq and not contain steel.
- Use only a closed end lug.

	CAUTION
	Ground the equipment to prevent loss of sensitivity.

Connection of external equipment

NMEA: Connect with the equipment which has NMEA format input/output terminal.

Output: HDG, HDT, HDM, HCC
 Input: RMC or VTG

AD-10: Connect with the equipment which has AD-10 format input terminal; for example, radar, ARPA, autopilot, etc.

Note: Cover unused connector(s) with the rubber cap (supplied).

1.5 Magnetic Field Distortion Compensation

The PG-1000 contains a circuit which automatically compensates for magnetic field distortion aboard the boat, which causes heading data output error.

1. Find a calm and clear area without current, wind, swell or waves.
2. Turn the boat clockwise or counterclockwise in a circle. Take about two minutes to complete the circle at about 3 kts. While turning the boat, go to step 3.

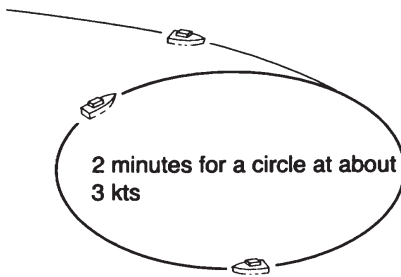
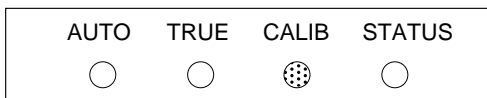


Figure 9

Notes: Speed higher than 3 kts may cause large error after the compensation

3. Press [AUTO] and [TRUE] keys together more than two seconds. The CALIB LED blinks.



●: Blinking
○: Off

Figure 10 LED status during compensation

Note: You can return to normal operation at any time by pressing the [TRUE] key.

4. Continue turning the boat in a circle (three to five times) until a result appears.

The compensation result is shown by the LEDs. When compensation is successful, all LEDs light. Wait 30 seconds for the sensor to return to normal operation automatically, or press the [TRUE] key to return manually.

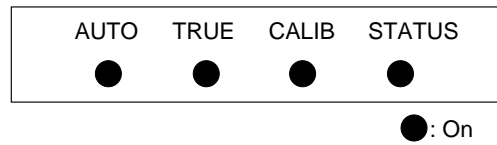


Figure 11 LED status at successful compensation

Note 1: Do not turn off the ship's mains during the compensation. Data may be corrupted.

Note 2: You may restart compensation at anytime during compensation or while the compensation results are displayed, by pressing [AUTO] key. After pressing the key the AUTO LED lights for two seconds.

Note 3: Continue turning the boat even if the CALIB LED status changes from blinking to lighting. Keys are inoperative when the CALIB LED is lighting.

Note 4: The sensor does not output heading data during the compensation (Program Ver. 3 and after).

5. Anchor the boat at the pier to check sensor bearing against a known point (for example, lighthouse).

If there is bearing error, see "1.6 Heading Alignment".

If some LED does not light, change sensor location and repeat step 2 through 4.

If automatic compensation failed at step 4, the compensation result is shown in LEDs. This continues until you press any key to clear the display. (Turning off the power at switch board will not clear the LED display.)

Note: Bearing output is done with the status before the automatic compensation.

Failure of automatic compensation may be caused by the factors mentioned in the table below. Try the compensation again referring to the table.

Causes	Results of compensation				Remedy
	AUTO	TRUE	CALIB	STATUS	
Above range of magnetic sensor	●	●	●	⊗	Follow the procedure in above from step 2 after the replacement of unit.
Magnetic field distortion	●	●	⊗	⊗	Follow the procedure in above from step 2 after the replacement of unit.
Turning error	●	⊗	⊗	⊗	Follow the procedure in above from step 2.

● : On
 ⊗ : Blinking

Note: Compensation can also be done at Remote Display DD-2000. See the Operator's Manual for the DC-2000.

1.6 Heading Alignment

Heading alignment is required when sensor bearing is different from actual bearing.

This alignment must be done using magnetic bearing (default setting).

⚠ CAUTION

Turn off the autopilot before aligning heading.

The autopilot may turn the rudder suddenly.

Procedure

1. Press the [-] and [+] keys together more than two seconds. All LEDs go off.

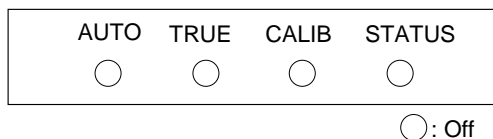


Figure 13

Note: Complete the next step within 10 seconds, otherwise normal operation is restored.

2. Set difference between sensor bearing (output) and actual bearing with the [+] or [-] key. For example, the bearing output by the sensor is 70° and the actual bearing is 75°. Therefore, the difference is +5°. Press the [+] key five times to set +5°. Each time the [+] key is pressed the LEDs light as shown in Figure 14.

	AUTO	TRUE	CALIB	STATUS
+1°	●	○	○	○
+2°	●	●	○	○
+3°	●	●	●	○
+4°	●	●	●	●
+5°	○	○	○	○
+6°	●	○	○	○
+7°	●	●	○	○
⋮				
Repeat				

● : On
 ○ : Off

Figure 14 LED state and pressing of [+] key

1.7 Setting Output Data

Setting output interval

The default setting is 100 ms.

1. Disconnect the power connector from the sensor.
2. Reattach the connector to the sensor while pressing the [+] key. The PG-1000 is powered on, and the current output interval is shown by the LEDs.

	AUTO	TRUE	CALIB	STATUS
100ms	●	○	○	○
200ms	●	●	○	○
1s	●	●	●	○
2s	●	●	●	●

● : On
 ○ : Off

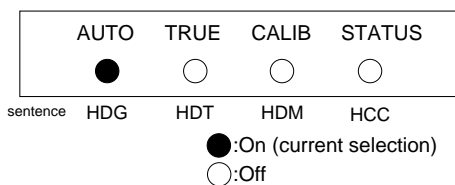
Figure 15 LED state and output interval

3. Press the [+] or [-] key to change interval.
4. Press the [AUTO] and [TRUE] keys together more than two seconds to return to the normal mode. The STATUS LED blinks while the equipment is being calibrated and lights when the calibration is completed (return to normal mode). Do not operate the equipment while the LED is blinking; calibration will be incomplete.

Setting the output sentence(s)

Select which type(s) of bearing to output.
The default setting is HDG.

1. Disconnect the power connector from the sensor.
2. Reattach the connector to the sensor while pressing the [-] key. The PG-1000 is powered on, and LED(s) light to show which output sentence(s) is being output.



HDG : Magnetic bearing /
 Magnetic variation value
 HDT : True bearing
 HDM : Magnetic bearing
 HCC : Magnetic bearing

Figure 16 LED and output sentence

3. Press key(s) corresponding to sentence(s) to output. For example, press the [TRUE] key to output HDT.

Note 1: Several sentences may be output simultaneously. However, delay may result when the output interval is 100 ms or 200 ms.

Note 2: "HDT" outputs true bearing data. However, if variation data is not input from the navaid, magnetic bearing will be output.

2. BASIC OPERATION

2.1 Controls and Indications

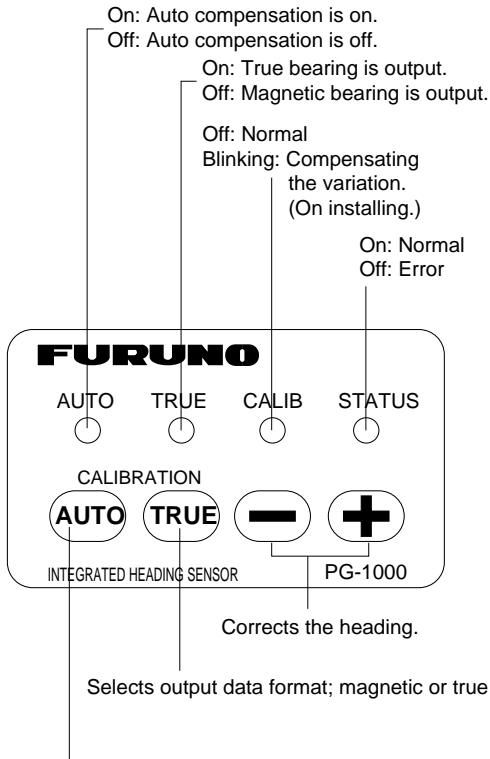


Figure 17 Front panel of PG-1000

2.2 Turning the Power On/Off

Power to the equipment may be turned on/off at the mains switchboard.

1. Turn the mains switch on.

STATUS LED blinks. About two minutes later it lights. Bearing is now reliable.

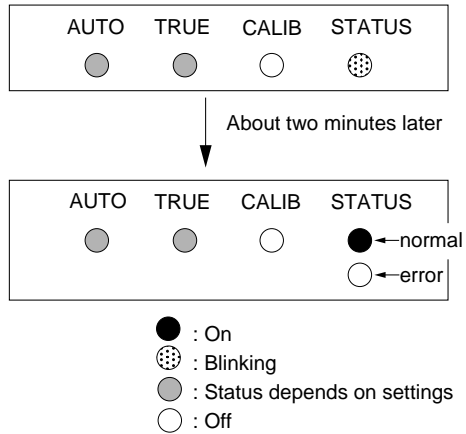


Figure 18 LED state at power on

Note: You may leave port after the STATUS LED begins lighting (not blinking).

2.3 Automatic Distortion Compensation

Magnetic field distortion can be automatically compensated as follows:

Note: This function is only effective after compensating for magnetic field distortion (refer to page 5).

1. Press the [AUTO] key more than two seconds to light the AUTO LED.

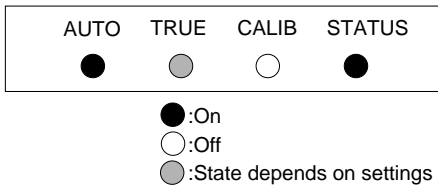


Figure 19

2. To cancel automatic compensation, press the [AUTO] key more than two second to turn off the AUTO LED.

Note 1: Turn off this function when your boat is near a steel ship or iron bridge, since they affect sensor performance.

Note 2: Compensate distortion whenever you feel error is excessive.

2.4 Selecting Output Data Format

The PG-1000 can output magnetic bearing data or true bearing data (requires magnetic variation data from navigation aid). The default setting is magnetic bearing (AD-10 format).

⚠ CAUTION

Turns off the autopilot before selecting output data format.

The autopilot may turn the rudder suddenly.

1. Connect navaid to PG-1000.

NMEA format RMC or VTG data input is required.

2. Set up magnetic variation (manual or automatic) at the navaid.
3. Press the [TRUE] key more than two seconds.

The TRUE LED blinks. It lights when receiving data from the navaid.

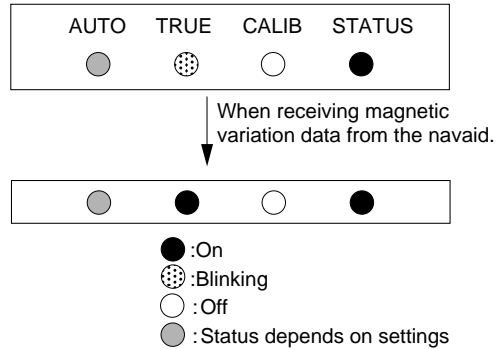


Figure 20

Note: If no variation data is received within 90 seconds after pressing the key, the TRUE LED goes off and the PG-1000 will output magnetic bearing data.

4. To return to magnetic bearing output, press the [TRUE] key more than two seconds to turn off the TRUE LED.

Note 1: If the PG-1000 stops receiving magnetic variation data while outputting true bearing, the TRUE LED stops lighting and blinks. The last used variation data is used.

Note 2: Magnetic variation cannot be compensated manually at the PG-1000. Therefore, if you desire true bearing output but do not have a navigation aid, you may enter appropriate variation as shown in 1.6 Heading Alignment on page 6.

Note 3: HDM and HCC sentence are magnetic bearing output sentences. HDG sentence must be changed to true bearing at the equipment connected, by using the magnetic bearing and magnetic variation data in the sentence.

3. MAINTENANCE & TROUBLESHOOTING

3.1 Maintenance

Regular maintenance is important for good performance. Regularly check the following:

- The equipment may be cleaned with a soft cloth. Do not use chemical cleaners to clean the equipment; they can remove paint and markings.
- Check that all connections are tight.
- Check the ground terminal for corrosion. Clean if necessary.

3.2 Troubleshooting

The table below provides simple troubleshooting procedures which the user can follow to restore normal operation. If normal operation cannot be restored do not check inside the equipment; there are no user-serviceable parts inside. Any repair work should be referred to a qualified technician.

Symptom	Remedy
Unit cannot be powered.	<ul style="list-style-type: none">•Check power connector.•Check the ship's mains.
LEDs do not light.	<ul style="list-style-type: none">•Check power connector.•Do the self-test. (Refer to the next page.)
Bearing data error.	<ul style="list-style-type: none">•Do the self-test. (Refer to the next page.)
The bearing data is not output to external equipment.	<ul style="list-style-type: none">•Check connections.•Do the self-test. (Refer to the next page.)

3.3 Self-test

The PG-1000 has a self-test which checks the circuit board and keys for proper operation.

LED/KEY/ROM/RAM test

1. Disconnect the power cable from the equipment.
2. While pressing the [AUTO] key, reattach the power cable.

The test sequence is as below.

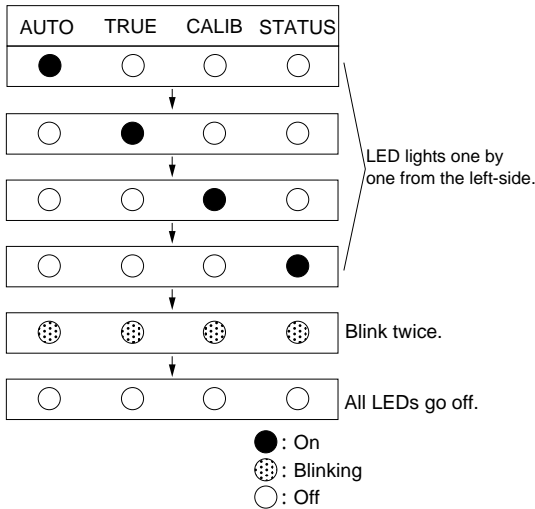


Figure 21 Sequence of LED test

3. Press each key one by one.

LED corresponding to the key lights if the key is normal.

[AUTO] key: AUTO LED
 [TRUE] key: TRUE LED
 [-] key: CALIB LED
 [+] key: STATUS LED

4. Press the [AUTO] and [TRUE] keys together more than two seconds after checking all keys. Then, the ROM and RAM are checked.

AUTO LED lights: RAM is normal.

TRUE LED lights: ROM is normal.

5. Press the [AUTO] and [TRUE] keys together more than two seconds to escape from the test. The STATUS LED blinks while the equipment is being calibrated and lights when the calibration is completed (return to normal mode). Do not operate the equipment while the LED is blinking; calibration will be incomplete.

EEPROM/Sensor/NMEA test

This test checks the EEPROM, sensor and NMEA data. All default settings (navigation setting, output sentence, output interval, etc.) are restored at the completion of the test.

1. Disconnect the power cable off from the equipment.
2. While pressing the [TRUE] key, reattach the cable. After all LEDs light, the test proceeds in the sequence shown below.

When the equipment finds error, LEDs do not light.

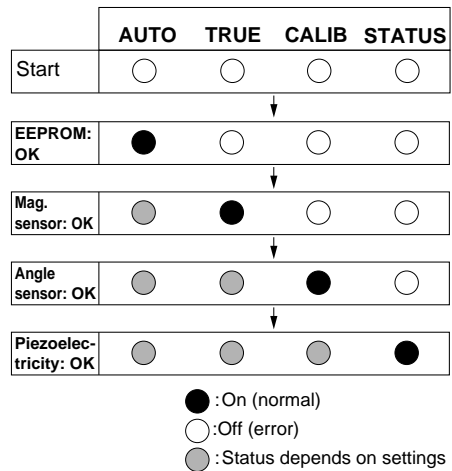


Figure 22 EEPROM/Sensor/NMEA test sequence

- Press the [AUTO] and [TRUE] keys more than two seconds.

All LEDs go off. Three seconds later all LEDs blink twice if NMEA data is normal.

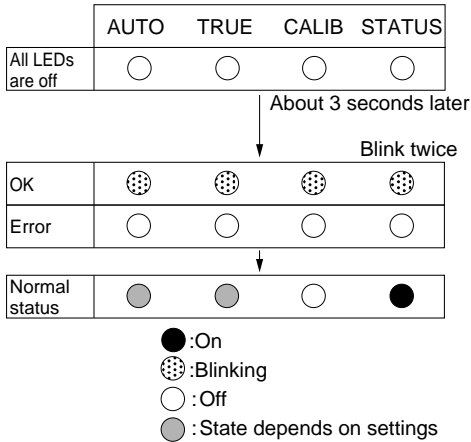


Figure 23 NMEA check sequence

Note: NMEA test requires a special connector.

Displaying program version no.

When the equipment is powered on, the program no., denoted by LEDs in binary notation, is shown about 1 second.

For example, LED state shown below means the program no. is 5.

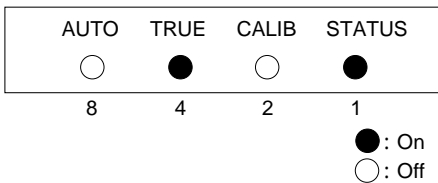


Figure 24 LED state and program version no.

SPECIFICATIONS OF INTEGRATED HEADING SENSOR PG-1000

The FURUNO Integrated Heading Sensor PG-1000 converts detected terrestrial magnetism into digital coded bearing data in AD-10 format. The digital bearing data may be output to equipment such as GPS navigator, autopilot and such indicator.

1. GENERAL

- (1) Bearing Accuracy Within 1°
- (2) Bearing Resolution 0.1°
- (3) Magnetic Field Range 5 to 200 μ T
- (4) Auto stabilizer ON/OFF selected
- (5) I/O Port Input: 1 port
 Output: 2 ports, 1 port output enables 3 equipment driven.
- (6) Input Data Following data (either one) required for true heading data output
 IEC61162-1 (NMEA0183 Ver.2.0)
 \$--RMC, \$--VTG
- (7) Output Data AD-10 FURUNO format
 IEC61162-1 (NMEA0183 Ver.2.0)
 \$HCHDG,XXX.X,,,<CR><LF>
 \$HCHDM,XXX.X,M<CR><LF>
 \$HCHCC,XXX.X,<CR><LF>
 \$HCHDT,XXX.X,T<CR><LF>
- (8) Tracking Speed AD-10 formatted: 25 ms fixed
 IEC61162-1 (NMEA0183): 1 s, 2 s, 100 ms or 200 ms selected

2. POWER SOURCE

- (1) Power Supply 10 to 35 VDC, 0.3 A

3. ENVIRONMENTAL CONDITION

- (1) Temperature -15°C to +55°C
- (2) Relative Humidity 90 %
- (3) Waterproofing IEC529 IPX5

4. COATING COLOR

- (1) Chassis N3.0 (Gray)

表 1 TABLE 1

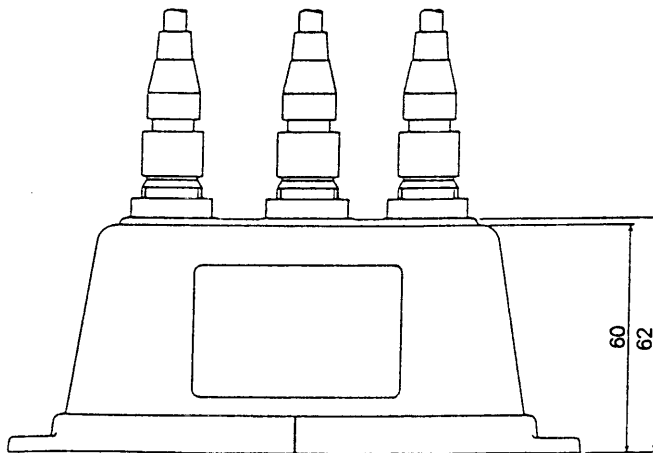
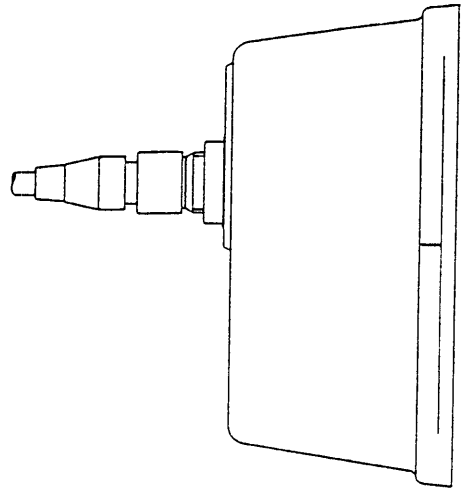
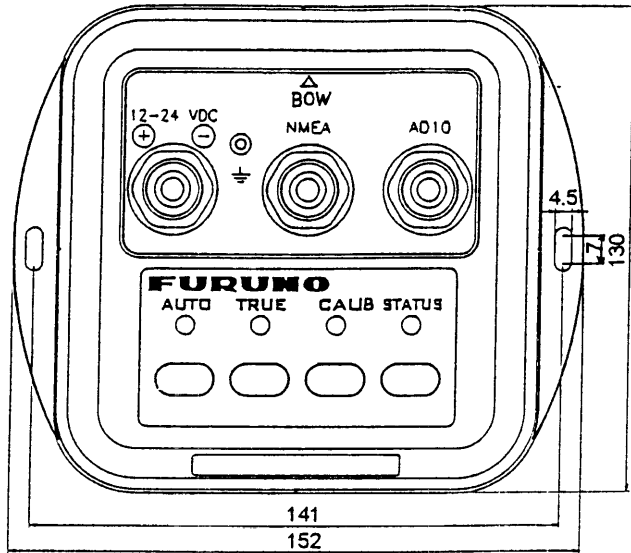
範囲 DIMENSIONS	公差 TOL
$L \leq 50$	$\pm 1 \text{ mm}$
$50 < L \leq 100$	$\pm 2 \text{ mm}$
$100 < L \leq 500$	$\pm 3 \text{ mm}$
$500 < L \leq 1000$	$\pm 4 \text{ mm}$
$1000 < L \leq 2000$	$\pm 5 \text{ mm}$
$2000 < L \leq 4000$	$\pm 7 \text{ mm}$
$4000 < L \leq 8000$	$\pm 10 \text{ mm}$
$8000 < L$	$\pm 15 \text{ mm}$

A

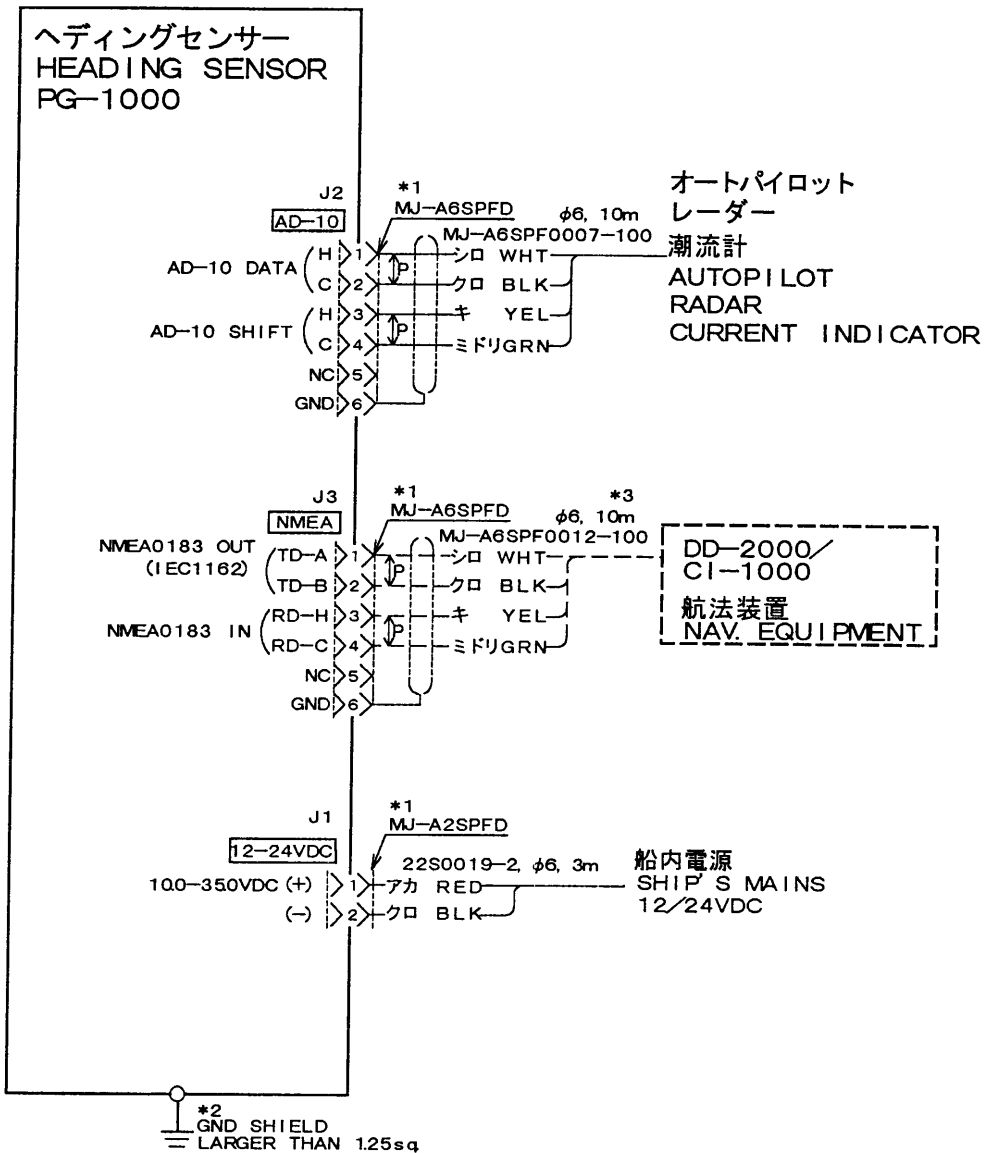
B

C

D



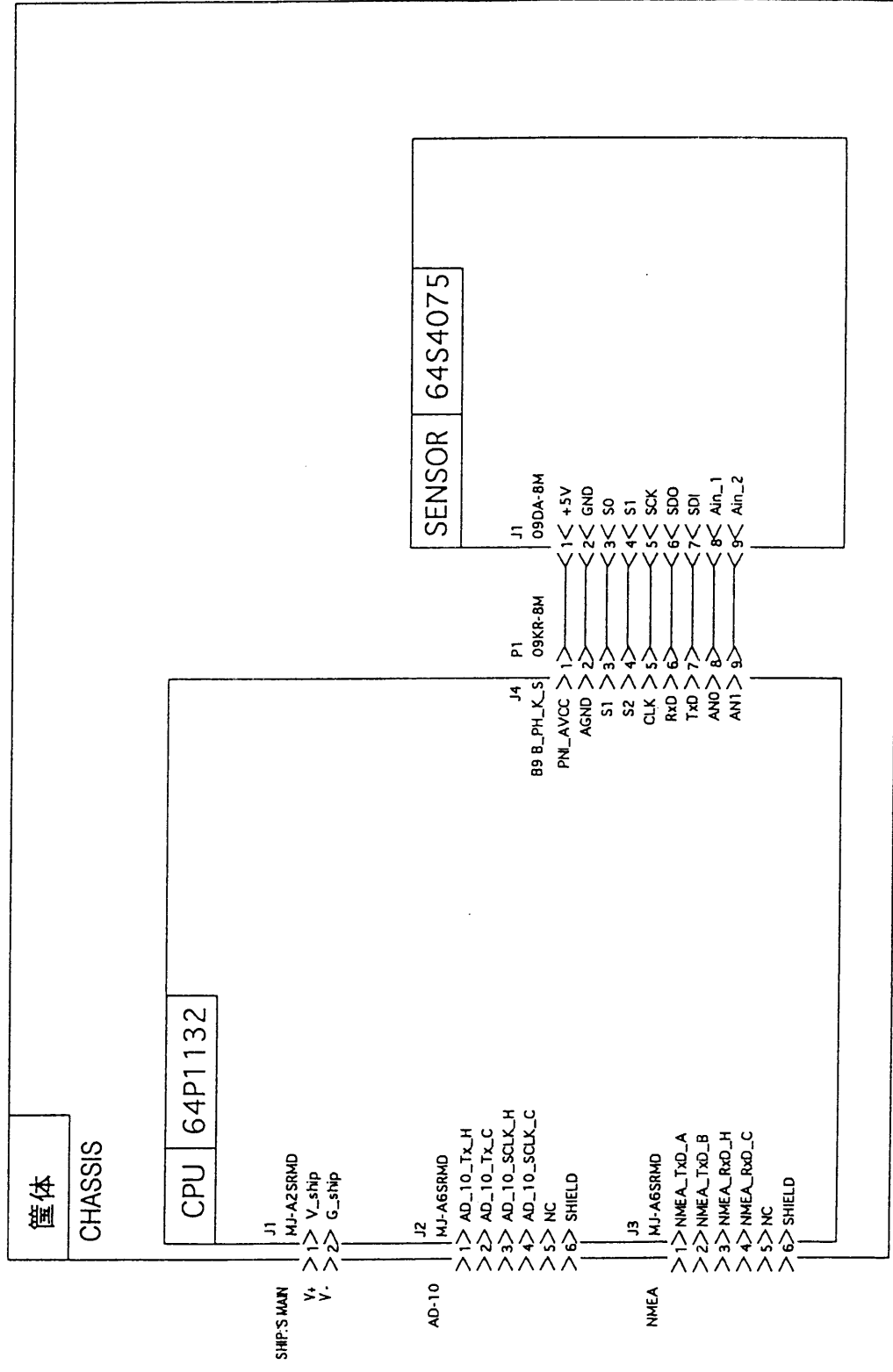
DRAWN July 4 '97 I. YAMASAKI		TITLE PG-1000/C-2100
CHECKED July 4 '97 K. Kusunoki		名称 ヘディングセンサー
APPROVED July 4 '97 K. Kusunoki		外寸図
SCALE 1/2 MASS 0.35 kg		NAME HEADING SENSOR
DWGN No. C7246-G01-A		OUTLINE DRAWING



- 注 記
*1. 工場にて取付済み
*2. 現地支給
*3. オプション

NOTE
*1. FITTED AT FACTORY.
*2. LOCAL SUPPLY.
*3. OPTIONAL SUPPLY.

DRAWN	July 23 '97 T. YAMASAKI	TITLE	PG-1000
CHECKED	July 23 '97 K. MURAMOTO	名称	ハイブリッドヘディングセンサー
APPROVED	July 23 '97 M. YAMAGUCHI		相互結線図
SCALE	MASS kg	NAME	INTEGRATED HEADING SENSOR
DWGN _a	C7246-C01-B		INTERCONNECTION DIAGRAM



DRAWN July 23 '97 YAMASAKI	TYPE PG-1000
CHECKED July 23 '97 K. KUBOYAMA	名称 ハイブリッドヘッドダイナミックセンサー
APPROVED July 23 '97 H. YAMAGUCHI	回路図
SCALE 1/1000	NAME HYBRID HEADING SENSOR(GENERAL)
DWG NO. C7246-K01-B	APPLICABLE TO; (MODEL)
	BLOCK NO.
	64-022-5010-0
	SCHEMATIC DIAGRAM