

# FURUNO

## OPERATOR'S MANUAL

INTEGRATED HEADING SENSOR    PG-500  
FLUXGATE HEADING SENSOR    C-500

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**FURUNO ELECTRIC CO., LTD.**  
NISHINOMIYA, JAPAN

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# 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 damage the equipment.

**Use the supplied power cable.**

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

**Maintain the compass safe distance to prevent deviation to a magnetic compass.**

Standard compass	Steering compass
0.3 m	0.3 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

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## **A Word to PG-500/C-500 Owners**

Congratulations on your choice of the FURUNO PG-500 Integrated Heading Sensor, C-500 Fluxgate Heading Sensor. We are confident you will see why the FURUNO name has become synonymous with quality and reliability.

For over 50 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 sales and service.

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 installed, operated and maintained properly. Please carefully read and follow the recommended procedures for installation, operation and maintenance.

We would appreciate hearing from you about whether we are achieving our purposes.

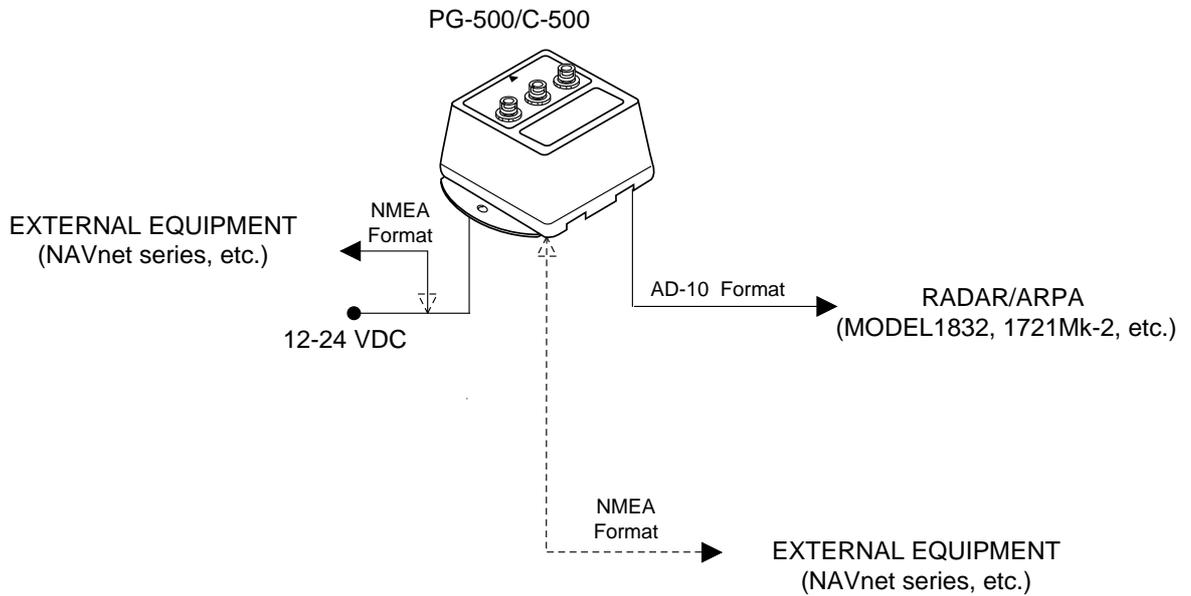
Thank you for choosing FURUNO equipment.

## **Features**

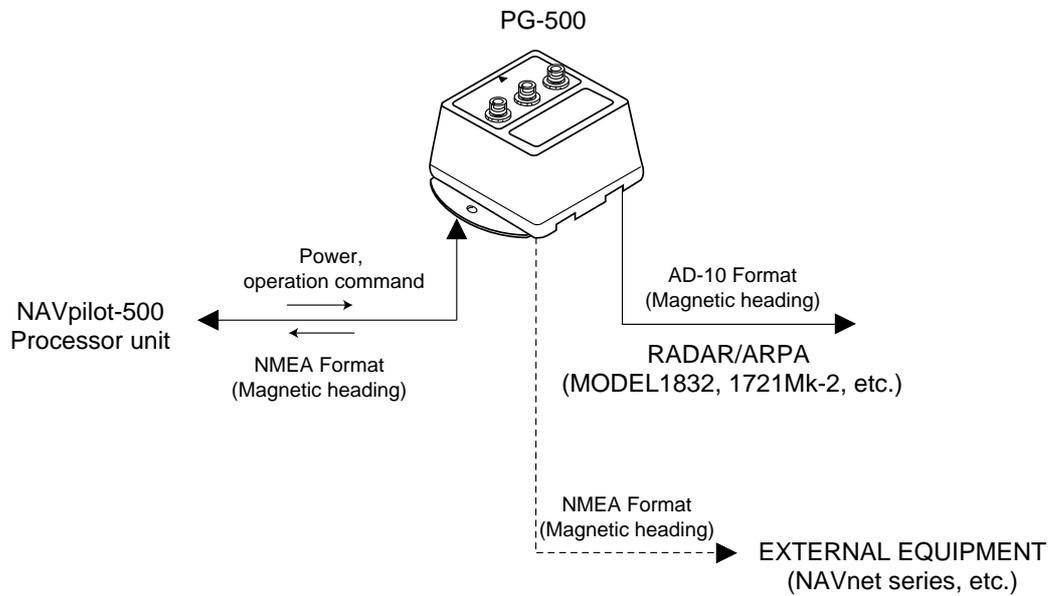
- The PG-500 uses a fluxgate magnetic sensor in conjunction with a solid-state angular rate heading.
- The C-500 uses a fluxgate magnetic sensor.
- The PG-500/C-500 can correct magnetic deviation automatically.
- The PG-500/C-500 can convert magnetic heading to true heading (requires FURUNO GPS Navigator).

# SYSTEM CONFIGURATION

## Standard connection



## Connection with NAVpilot-500



# EQUIPMENT LIST

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## Standard set

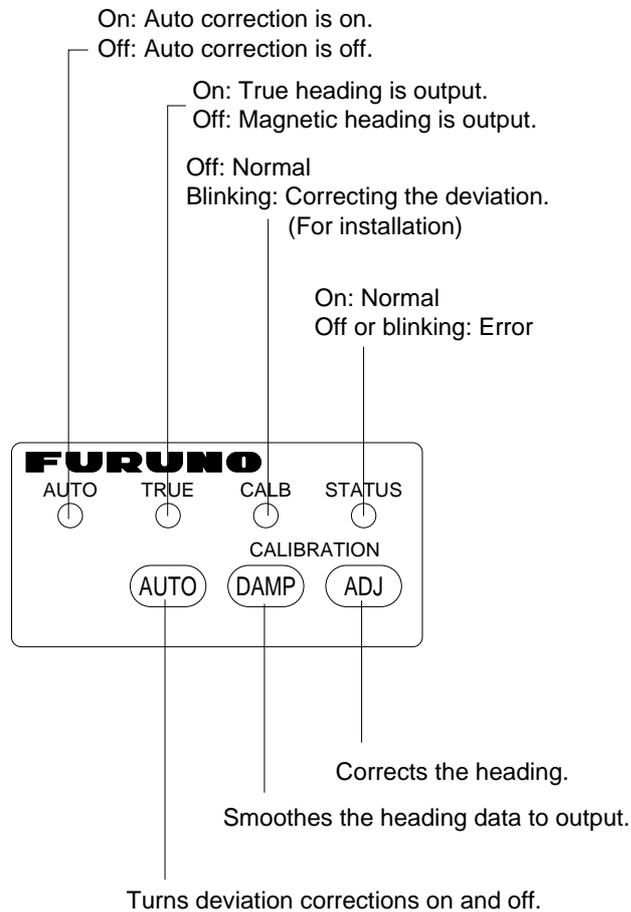
Name	Type	Qty	Remarks
Sensor	PG-500-E	1	Fluxgate and rate sensor
	C-500-E		Fluxgate sensor
Installation Materials	CP64-02100	1 set	Refer to the packing list at the back of this manual.
Spare Parts	SP64-01301	1 set	Fuse (Type: FGMB 1A 125V, Code No.: 000-114-805)

## Option

Name	Type	Code No.	Qty	Remarks
Cable assy.	MJ-A6SPF0003-050	000-117-603	1	6P connector, 5 m (for AD-10 format, NMEA)
	MJ-A6SPF0007-100	000-125-237	1	6P-6P, 10 m (for AD-10 format)
	MJ-A7SPF0006-100	000-143-578	1	7P-7P, 10 m (for NMEA/Power)
	MJ-A7SPF/SRMD-100	000-144-534	1	For extension. 7P-7P, 10 m

# 1. OPERATION

## 1.1 Controls and Indications



*Front panel of sensor*

## 1.2 Turning the Power On/Off

Power to the sensor may be turned on or off at the mains switchboard.

Turn the mains switch on.  
The sensor checks the program version, LED, ROM, RAM and deviation status in that order for proper operation.

### Program version

The program version, denoted by the LEDs in binary notation, is shown. For example, the LED state shown on the next page means the program version is "1.03".

### ROM, RAM check

AUTO LED lights: ROM is normal.  
TRUE LED lights: RAM is normal.  
(CALB and STATUS LEDs are always lit.)

### Deviation status

All LEDs blink twice when the calibration is completed.

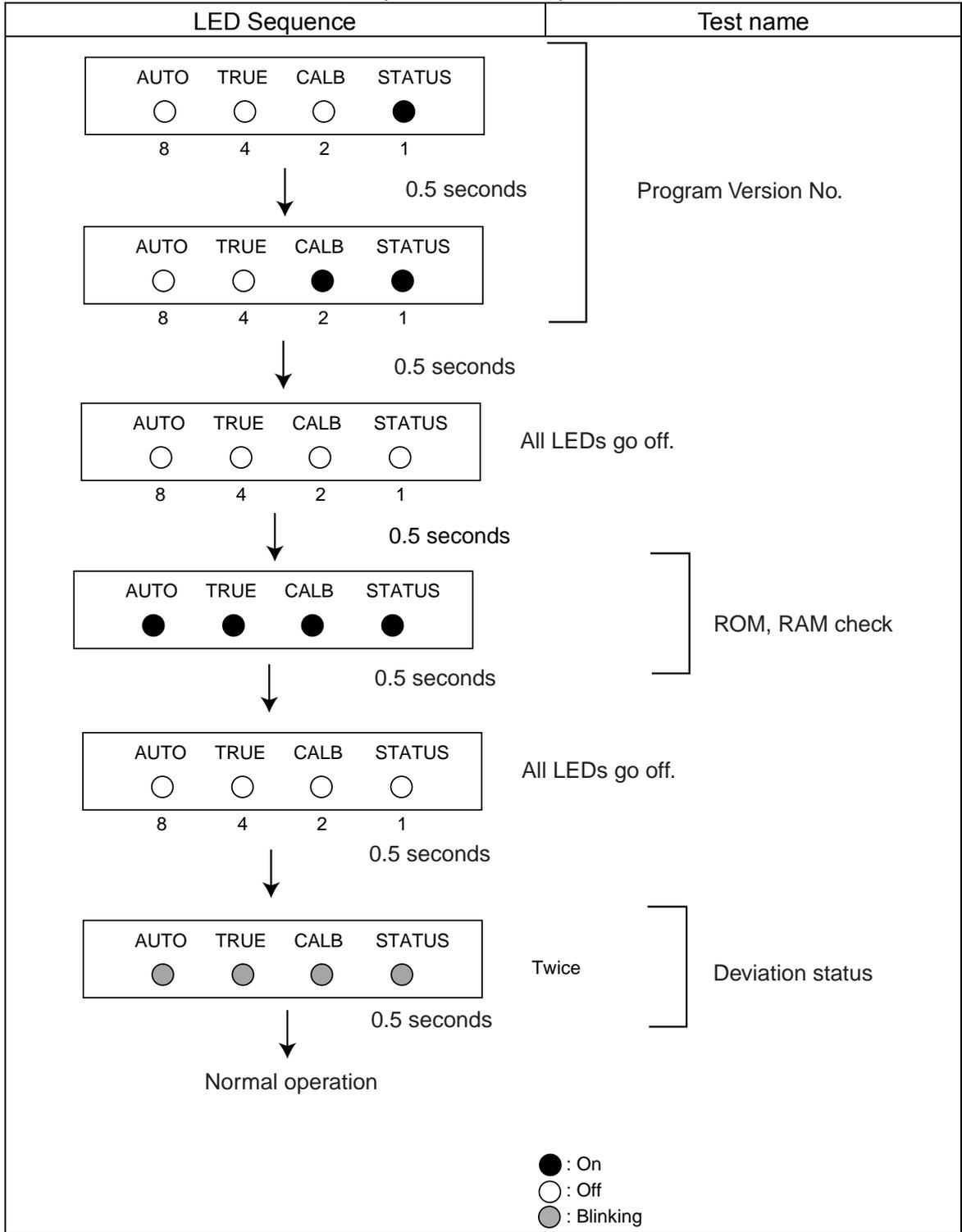
After the diagnostic tests are completed;

- C-500 outputs heading data and the STATUS LED lights immediately.
- PG-500 calculates the rate sensor offset. The STATUS LED blinks during the calculation, which takes about two minutes. When the STATUS LED lights, bearing is reliable.

**Note:** Confirm that the STATUS LED is lit (not blinking) before leaving port.

1. OPERATION

*Sequence of Start up test*

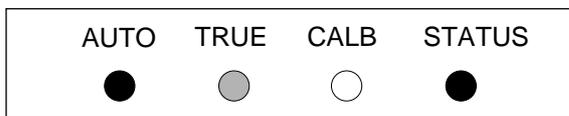


### 1.3 Automatic Distortion Compensation

Magnetic field distortion on your vessel has been compensated at the installation. When the magnetic field distortion changes, it can be compensated automatically as follows.

**Note:** This function is only effective after compensating for magnetic field distortion. (Refer to page 10.)

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



- : On
- : Off
- (grey) : State depends on settings

*Auto compensation*

The STATUS LED lights during the automatic distortion compensation functions.

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

**Note 1:** Do not conduct this procedure when your boat is near a steel ship or iron bridge, since they affect sensor performance.

**Note 2:** Correct distortion whenever you feel heading error is excessive.

### 1.4 Damping Control

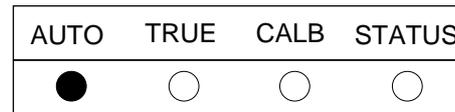
The damping control determines how sensitively the sensor responds to change of ship's heading. When the damping value is large, the sensor responds smoothly but a small boat may wander after the turning. Use a small damping value as possible.

**Note:** When connecting with the autopilot NAVpilot-500, use the default damping setting (PG-500: damping 1, C-500: damping 2).

1. Press the [DAMP] key more than two seconds.

All LEDs go off, and then the current damping setting is shown by the LEDs.

2. Press the [DAMP] key to change the damping setting in the sequence of damping 1→2→3→4→1→...



Damping 1



Damping 2



Damping 3



Damping 4

- : On
- : Off

*Damping LED state*

If three seconds passes with no operation, the damping setting is fixed, and the damping control mode is terminated.

## 1.5 Selecting Output Data Format

The sensor can output true or magnetic heading. The default setting is magnetic, in AD-10 format.

### CAUTION

**Turn off the autopilot before selecting output data format.**

The autopilot may turn the rudder suddenly.

To output true heading, do the following:

1. Connect Furuno GPS Navigator which can output data sentence RMC or VTG.
2. Set up magnetic variation (manual or automatic) at the GPS Navigator.  
When RMC or VTG is input to the sensor, the TRUE LED lights and then true heading is output to other equipment.
4. To return to magnetic heading output, disconnect the GPS Navigator.

**Note 1:** If the TRUE LED does not light within 90 seconds, check the navigator setting and cable connection.

**Note 2:** If the sensor stops receiving magnetic variation data while outputting true heading, the TRUE LED stops lighting and blinks. The last-used variation data is used.

**Note 3:** Magnetic variation cannot be corrected manually at the sensor. Therefore, if you desire true heading output but do not have a navigation aid, you may enter appropriate variation as shown in 3.4 Heading Alignment on page 11. HDM sentence, however, cannot be changed to true heading. For HDG sentence, it can be changed to true heading at the equipment connected, by using the magnetic heading and magnetic variation data in the sentence.

# 2. MAINTENANCE & TROUBLESHOOTING

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## 2.1 Maintenance

Regular maintenance is important to maintain intended performance over a long period. Regularly check the following:

- Clean the component with a soft cloth. Do not use chemical cleaners; they can remove paint and markings.
- Make sure all connections are tight.
- Check the ground terminal for corrosion. Clean if necessary.

## 2.2 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.

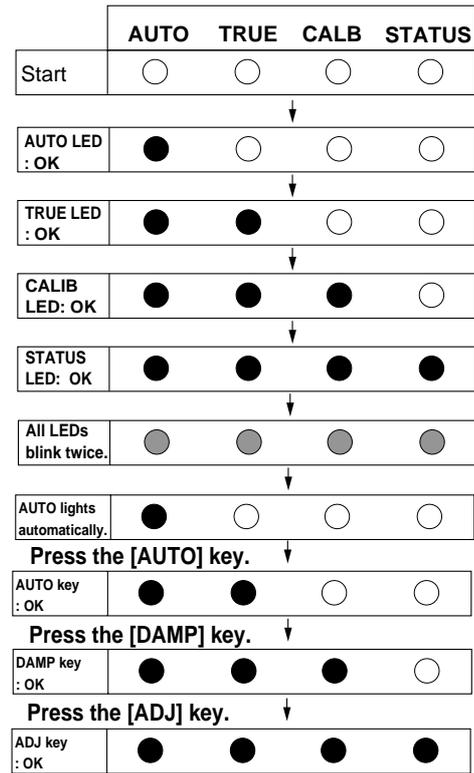
Symptom	Remedy
Unit cannot be powered.	<ul style="list-style-type: none"><li>• Check power connector.</li><li>• Check the ship's mains.</li><li>• Check the fuse.</li></ul>
LEDs do not light.	<ul style="list-style-type: none"><li>• Check power connector.</li><li>• Do the diagnostic test. (Refer to the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

## 2.3 Diagnostic Test

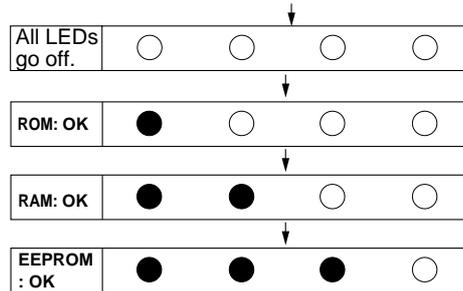
This equipment has a diagnostic test which checks the LED, key operation, ROM, RAM, EEPROM, magnetic sensor, rate sensor (PG-500 only) and loop back for proper operation. Do this test after dismantling the sensor.

1. Disconnect the power cable from the equipment.
2. While pressing the [AUTO] and [DAMP] keys together, reattach the power cable.
3. Release the [AUTO] and [DAMP] keys when the AUTO LED lights.

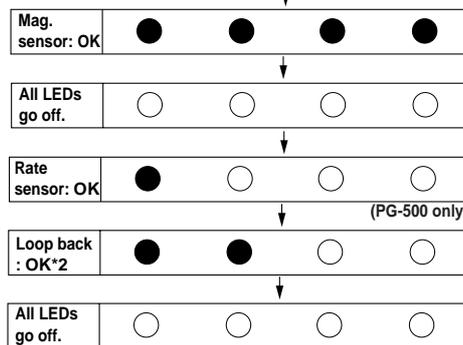
Then, the test is executed in the sequence shown in the right column.



Press the [AUTO] and [DAMP] keys together again.



Turn the sensor more than 180° until STATUS LED lights.\*1



Normal operation  
 ● : On (normal)    ○ : Off (error)    ● : Blink

Sequence of diagnostic test

\*1: If STATUS LED does not light (NG), this test cannot be carried out. Contact your dealer.

Also, if the sensor is not turned within one minute after the EEPROM test, the test is carried out with the "Mag sensor" is NG.

\*2: The loop back test requires a special test connector. It is skipped when the test connector is not connected.

## 2.4 Error Status

When error is detected, all LEDs go off and then the STATUS LED blinks or goes off depending on error type as shown in the table below.

LED status	Meaning	Remarks
STATUS LED blinks slowly.	Magnetic deviation error	
STATUS LED blinks quickly.	EEPROM error	
STATUS LED goes off.	Other than the above.	Appropriate LED blinks. CALIB LED: Rate sensor error TRUE: Cable of the magnetic sensor is cut.

## 2.5 Clearing the Memory

The memory can be cleared to start afresh with default settings.

1. Disconnect the power cable from the equipment.
2. Reattach the cable while pressing the [AUTO] and [ADJ] keys together.

After the memory has been cleared, the sensor returns to the normal mode.

If the memory could not be cleared, the STATUS LED blinks quickly.

# 3. INSTALLATION

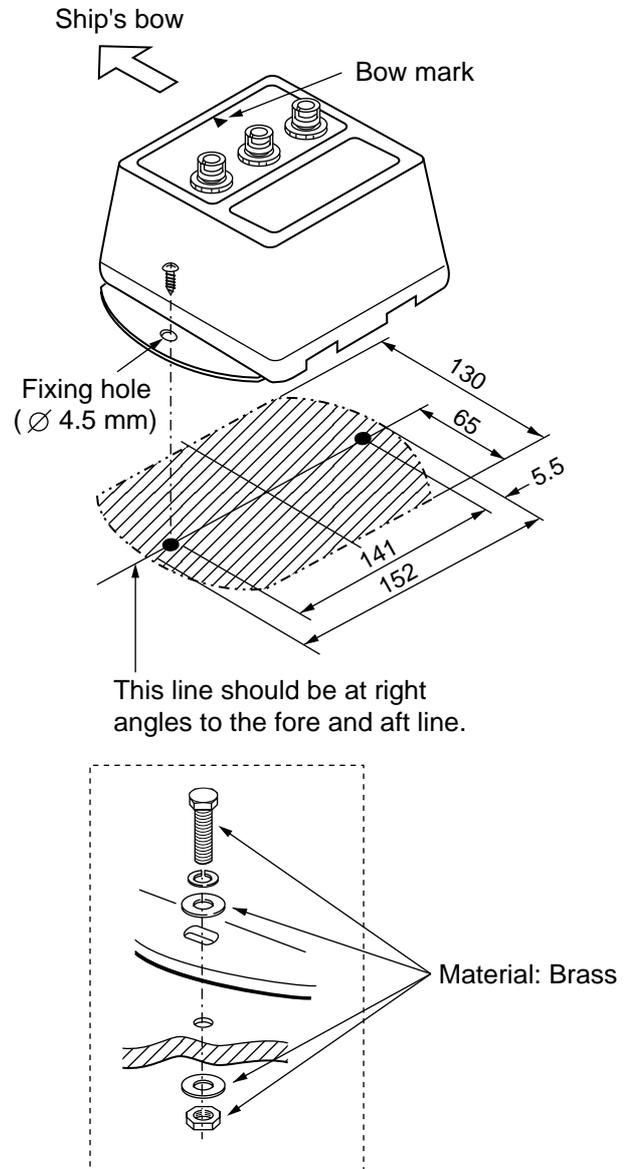
## 3.1 Mounting

This sensor must be mounted indoors on the horizontal plane.

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

- Vibration at the mounting location should be minimal.
- Install the sensor as far as possible from power cables and ferrous materials.
- Install the sensor near the ship's center of gravity.
- Align the bow mark with the ship's bow on the fore-and-aft-line.

Fix the sensor by using tapping screws (supplied).



- All dimensions in mm.
- For added support, use M4 nuts, bolts and washers instead of tapping screws.
- Secure sufficient clearance around the sensor for maintenance and checking.

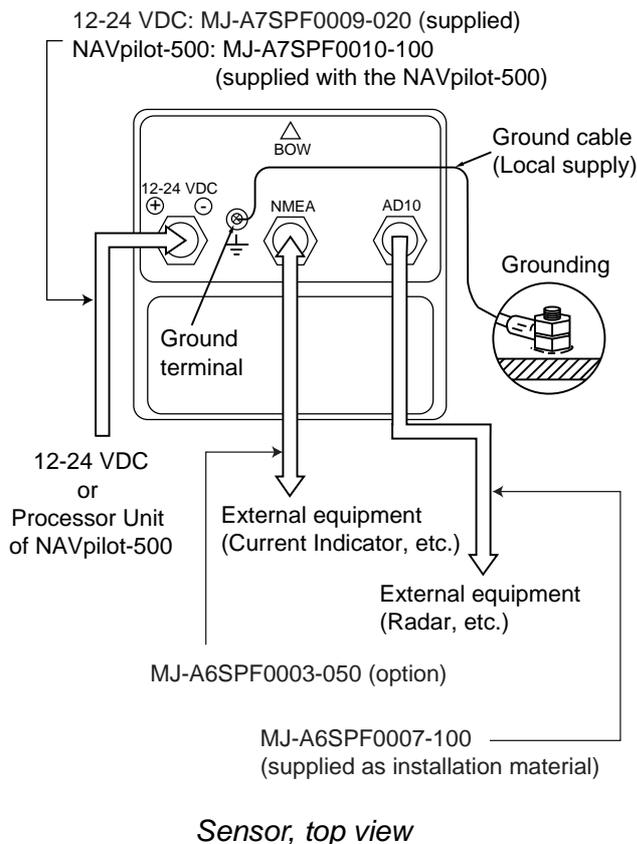
*Mounting the sensor*

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

## 3.2 Connections

Connect cables as shown below. 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.

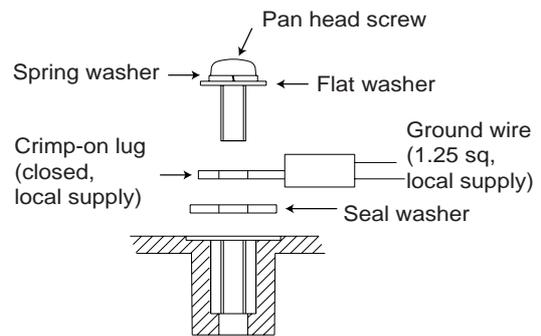
**Note:** The NMEA port (the mid position) can receive and send data. However, when connecting with the NAVpilot-500 or RD-30, the NMEA port is for output only.



## Grounding

Ground the equipment as follows to prevent loss of sensitivity:

- 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.



*Ground terminal, sectional view*

## Connection of external equipment

**NMEA:** Digital interface NMEA format input/output terminal.

**Output:** HDG, HDT, HDM (Magnetic Heading)

**Input\*:** RMC or VTG

**AD-10:** Outputs heading information in AD-10 format.

**12-24VDC:** Power input, Digital interface NMEA format input/output terminal

**Output:** HDG, HDT, HDM (Magnetic Heading)

**Input\*:** RMC or VTG

**\*Only one port can be for Input.**

**Note:** Cover unused connector(s) with the rubber cap (supplied) to prevent ingress of water.

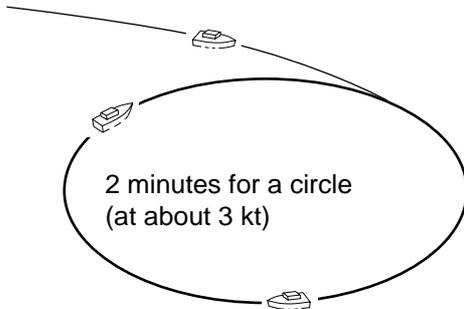
### 3. INSTALLATION

## 3.3 Correcting Magnetic Field Distortion

The magnetic field around the sensor is subject to change with the ship structure, engines, electronic equipment or any ferrous materials in the vicinity.

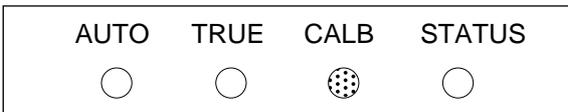
The equipment contains an automatic magnetic field distortion correction facility. Do the following to correct magnetic field distortion on calm water.

1. Steer the boat clockwise or counterclockwise in a circular course. Take about two minutes to complete the circle (at about 3 kt). While turning the boat, go to step 2.



**Note:** Complete circle within 2 minutes, otherwise large error may result.

2. Press [ADJ] and [DAMP] keys together more than two seconds. The CALB LED blinks.



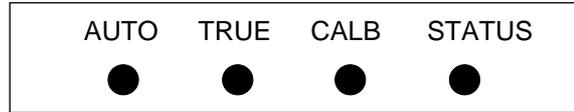
⦿: Blinking  
○: Off

*LED status during compensation*

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

3. Continue turning the boat in a circle (three to five times) until a result is shown with the LEDs.  
When correction is successful, all LEDs

light. Wait 30 seconds for the sensor to return to normal operation, or press any key for quick return.



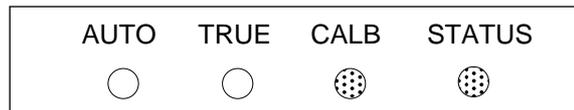
●: On

*LED status at successful correction*

- Note 1:** Do not turn off the power supply during the correction. Data may be corrupted.
- Note 2:** Continue turning the boat even if the CALB LED status changes from blinking to lighting. Keys are inoperative when the CALB LED is lighting.
- Note 3:** The sensor does not output heading data during the correction.

4. Anchor the boat at the pier to check sensor heading to a known point (for example, lighthouse).  
If there is error, see "3.4 Heading Alignment."  
If some LED does not light, change sensor location and repeat step 2 through 4.

If the correction failed, the LED status is as shown below. This continues until you press any key to clear the display. (Turning off the power at switchboard will not clear the LED display.) Try the correction again.



⦿: Blinking  
○: Off

*LED status, compensation failed*

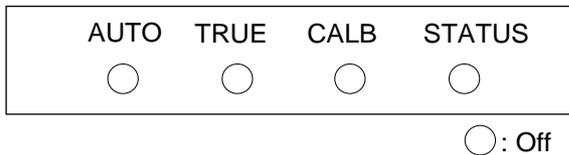
### 3.4 Heading Alignment

Heading alignment is required when sensor heading is different from actual heading. This alignment must be done using magnetic heading (default setting).

 <b>CAUTION</b>
<p><b>Turn off the autopilot before aligning heading.</b></p> <p>The autopilot may turn the rudder suddenly.</p>

**Procedure**

1. Press the [ADJ] key more than two seconds. All LEDs go off.



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

2. Set difference between sensor heading (output) and actual heading with the [DAMP] key for “+” or [ADJ] key for “-”. For example, the heading output by the sensor is 70° and the actual heading is 75°. Therefore, the difference is +5°. Press the [DAMP] key five times to set +5°. Each time the [DAMP] key is pressed, the LEDs light as shown below.

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

●: On  
○: Off

*LED state and pressing of [DAMP] key*

When pressing the [ADJ] key, the above sequence begins from the STATUS LED side.

### 3. INSTALLATION

## 3.5 Setting Output Data

### Setting output interval

The default setting is 200 ms.

Refer to the table shown on the next page for proper setting.

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

	AUTO	TRUE	CALB	STATUS
1 s	●	○	○	○
200 ms	●	●	○	○
100 ms	●	●	●	○
25 ms	●	●	●	●

● : On  
○ : Off

#### LED state and output interval

If step 2 was not completed satisfactorily, the STATUS LED blinks quickly. Try step 2 again.

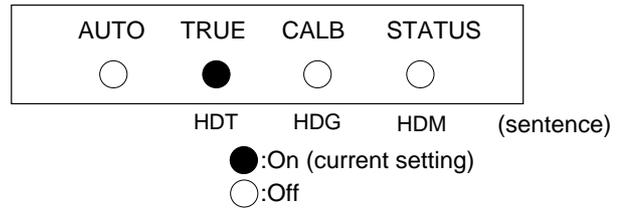
3. Press the [DAMP] key to change interval.

The sensor returns to the normal mode if there is no operation for three seconds.

### Setting the output sentence(s)

Select which type(s) of heading data 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 [ADJ] key. The equipment is powered on, and LED(s) light to show which output sentence(s) is being output.



HDT : True heading  
HDM : Magnetic heading  
HDG : Magnetic heading & Magnetic variation value

AUTO LED has no function.

#### LED and output sentence

3. Press key corresponding to sentence to output.

Sentence	Key
HDT	[AUTO]
HDG	[DAMP]
HDM	[ADJ]

To cancel output, press the same key again.

**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 heading data. However, if variation data is not input from the GPS navigator, magnetic bearing will be output.

The equipment returns to the normal mode if there is no operation for three seconds.

### 3.6 Setting Baud Rate

Set the baud rate of external equipment.  
The default setting is 4800 bps.

When connecting with the NAVpilot-500, use the default setting (4800 bps).

1. Disconnect the power connector from the sensor.
2. Reattach the connector to the sensor while pressing the [AUTO] key. The sensor is powered on, and the current baud rate is shown by the LEDs.
3. Press the [AUTO] key to change the baud rate as appropriate.

	AUTO	TRUE	CALB	STATUS
4800	●	○	○	○
9600	●	●	○	○
19200	●	●	●	○
38400	●	●	●	●

●: On  
○: Off

*LED and baud rate*

If baud rate could not be set, the STATUS LED blinks quickly. Try again.

The sensor returns to the normal mode if there is no operation for three seconds.

*Relation baud rate and output interval*

Baud rate	Output interval	Available sentences
4800	25	No output
	100	Up to two sentences can be output.
	200	Up to three sentences can be output.
	1000	
9600	25	HDT or HDM
	100	Up to three sentences can be output.
	200	
	1000	
19200	25	Up to two sentences can be output.
	100	Up to three sentences can be output.
	200	
	1000	
38400	25	Up to three sentences can be output.
	100	
	200	
	1000	

**Note:** When an error message occurs, the above sentences may be changed.

# SPECIFICATIONS OF INTEGRATED HEADING SENSOR PG-500

## 1 GENERAL

- |     |                    |  |
|-----|--------------------|--|
| 1.1 | Heading Accuracy   | 1.0°rms (horizontal)<br>1.5°rms (within 30°)                                     |
| 1.2 | Display resolution | 0.1°   |
| 1.3 | Follow-up          | 30°/s rate-of turn   |
| 1.4 | I/O Port           | Input: 1 port<br>Output: 2 ports (one port drives 3 outputs)                     |
| 1.5 | Interface          |  |
|     | Output             | FURUNO AD-10 format<br>IEC 61162-1 (NMEA 0183 Ver2.0)<br>HDG, HDT, HDM           |
|     | Input              | IEC 61162-1 (NMEA 0183 Ver1.5/2.0)<br>RMC, VTG                                   |
| 1.6 | Data Update        | AD-10 formatted: 25 ms<br>IEC 61162-1 (NMEA 0183): 100ms, 200 ms or 1 s selected |

## 2 POWER SUPPLY

12-24 VDC: 0.12-0.03 A

## 3 ENVIRONMENTAL CONDITION

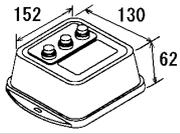
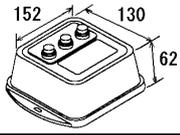
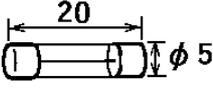
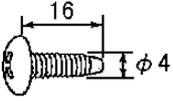
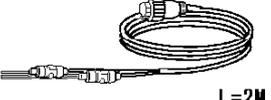
- |     |                     |   |
|-----|---------------------|---|
| 3.1 | Ambient Temperature | -15°C to +55°C                          |
| 3.2 | Relative Humidity   | 95% at 40°C                             |
| 3.3 | Waterproof          | IP5 (IEC 60529), CFR-46 (USCG standard) |
| 3.4 | Vibration           | IEC 60945                               |

## 4 COLOR

N3.0

# PACKING LIST

## PG-500/C-500

NAME	OUTLINE	DESCRIPTION/CODE	Q'TY
<b>ユニット UNIT</b>			
ハイブリッド heading センサー INTEGRATED HEADING SENSOR		PG-500 000-040-467	1 (*1)
Fluxgate heading センサー FLUXGATE HEADING SENSOR		C-500 000-040-468	1 (*1)
<b>予備品 SPARE PARTS SP64-01301</b>			
ヒューズ FUSE		FGMB 1A 125V 000-114-805	2
<b>工事材料 INSTALLATION MATERIALS CP64-02101</b>			
+トラスタップ スクリュー +TAPPING SCREW		4X16 SUS304 1ヶ 000-802-080	2
<b>その他工材 OTHER INSTALLATION MATERIALS</b>			
ケーブル組品MJ CABLE ASSY.		MJ-A6SPF0007-100 000-125-237	1
ケーブル組品MJ CABLE ASSY.		MJ-A7SPF0009-020 000-145-612	1

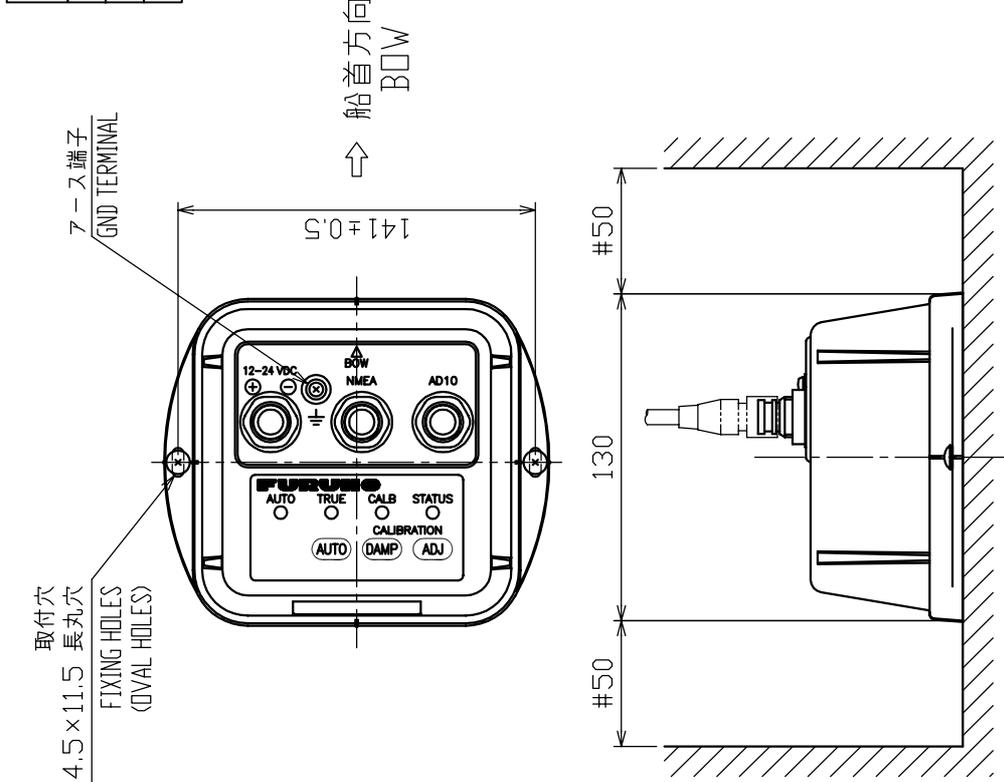
(\*1)のユニットは仕様により決定されます。

(\*1)UNIT HAS BEEN DETERMINED BY SPECIFICATION.

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

表 1 TABLE 1

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



注 記

- 1) #印寸法は最小サービス空間寸法とする。
- 2) 指定外の寸法公差は表1による。
- 3) 取付用ネジは+トラスタップピンネジ呼び径4×16を使用のこと。

NOTE

1. # MINIMUM SERVICE CLEARANCE.
2. TABLE 1 INDICATES TOLERANCE OF DIMENSIONS WHICH IS NOT SPECIFIED.
3. USE SELF-TAPPING SCREWS 4X16 FOR FIXING THE UNIT.

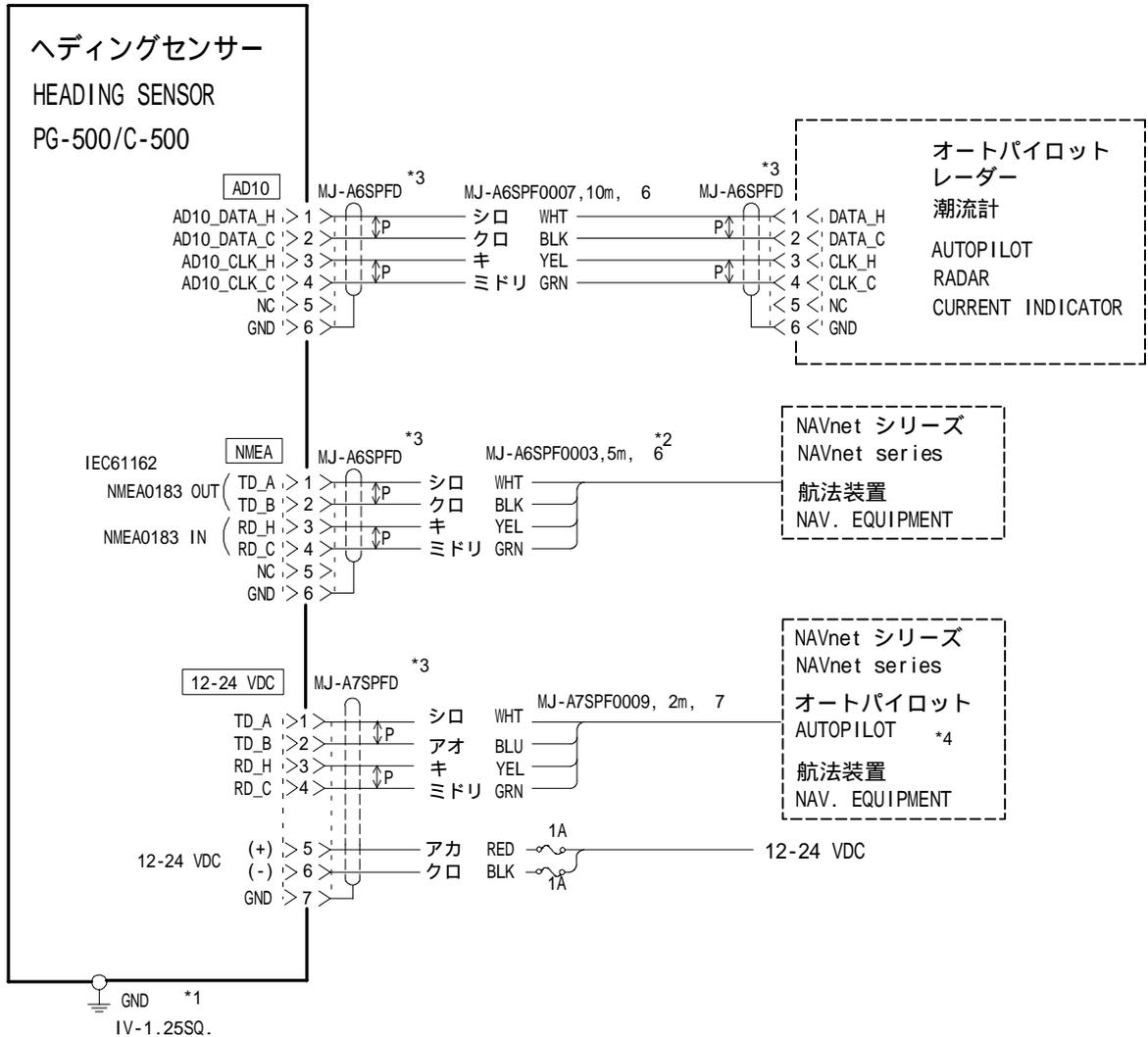
DRAWN	MAY 27 '04 E. MIYOSHI	TITLE	PG-500/C-500
CHECKED	TAKAHASHI, I	名称	ハイブリッド Heading センサー / Heading センサー
APPROVED	Y. Hatai	外寸図	
SCALE	1/3 MASS 0.3 kg	NAME	INTEGRATED HEADING SENSOR/HEADING SENSOR
DWG No.	C7255-001-B		OUTLINE DRAWING

A

B

C

D



**注記**

- \* 1 ) 造船所手配。
- \* 2 ) オプション。
- \* 3 ) 工場にて取付済み。
- \* 4 ) NAVpilot-500を接続する場合、相互結線図はNAVpilot-500の装備要領書を参照 (PG-500のみ)。

**NOTE**

- \*1. SHIPYARD SUPPLY.
- \*2. OPTION.
- \*3. FITTED AT FACTORY.
- \*4. WHEN NAVpilot-500 IS CONNECTED TO PG-500, REFER TO INTERCONNECTION DIAGRAM IN INSTALLATION MANUAL OF NAVpilot-500.

DRAWN Aug. 27, '04 E. MIYOSHI		TITLE PG-500/C-500
CHECKED TAKAHASHI.T		名称 ハイブリッド Heading センサー / Heading センサー
APPROVED Y. Hatai		相互結線図
SCALE MASS kg		NAME INTEGRATED HEADING SENSOR/HEADING SENSOR
DWG. No. C7255-C01-C		INTERCONNECTION DIAGRAM

© **FURUNO ELECTRIC CO., LTD.**

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

Telephone : 0798-65-2111

Fax : 0798-65-4200

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Your Local Agent/Dealer

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