ELECTROMAGNETIC LOG
EML500 Series
User's Manual

IM 80B80T10E

IM 80B80T10E
21th Edition

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EML 500 Series
User's Manual

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FOREWORD

A Brief Word Before Use

Thank you very much for purchasing our EML500 Series Electromagnetic Log.

This instruction manual describes the functions of the Electromagnetic Log and how to use it. Before using this equipment, please read the manual carefully for correct operation.

Notice

The contents of this manual are subject to change without prior notice.

- If any question arises or errors are found, or if there is any information missing from the manual, please inform the company or your nearest sales office or representative. Their addresses may be found on the back cover of this manual.
- No part of this manual may be reproduced in any form without our written permission.

Exemption from Responsibility

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

Important Cautions

The following symbols concerning safety can be found on the equipment and in this manual:

WARNING
This symbol indicates that the operator must refer to an explanation in the instruction manual in order to avoid the risk of injury to personnel or death.

CAUTION
This symbol indicates that the operator must refer to an explanation in the instruction manual in order to prevent damage to the equipment.

WARNING **Electrical shock**

- To avoid electrical shock, turn off the power before making wiring connections.

■ Removal of Measurement Rod

- To remove the measurement rod, Pull it all the way up and close the seawater valve.

  Then remove the rod.

- If the rod is removed before closing the valve, seawater will spew out through the valve.
- To remove the chain, fully close the valve (for the HS,HV, and FA models).

  Then remove the chain.

CAUTION

- Do not use a megger for inspection purposes except for on-board power supply terminals. Otherwise, the equipment may be damaged.
- Do not use a megger for sensor inspections. Otherwise, the sensor may be damaged.
- Do not drop the measurement rod or allow any mechanical shock at the tip of the rod. Otherwise, the rod may be damaged.

1. INTRODUCTION

This chapter briefly describes the minimum information necessary to operate the EML500 Electromagnetic Log. You can use this chapter as a quick-reference manual covering the following items:

(1) Components on the operation / display panel and their functions

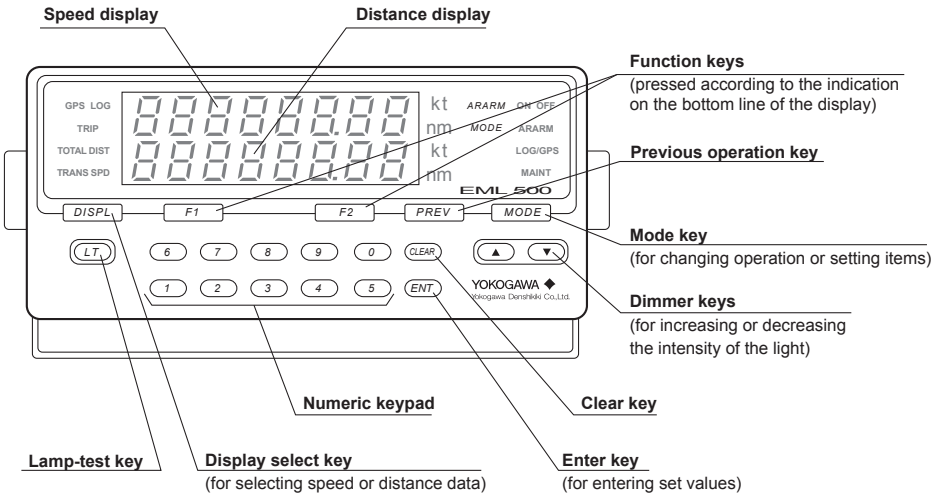
(2) Starting and stopping

(3) Summary of functions

For further details, refer to the subsequent chapters.

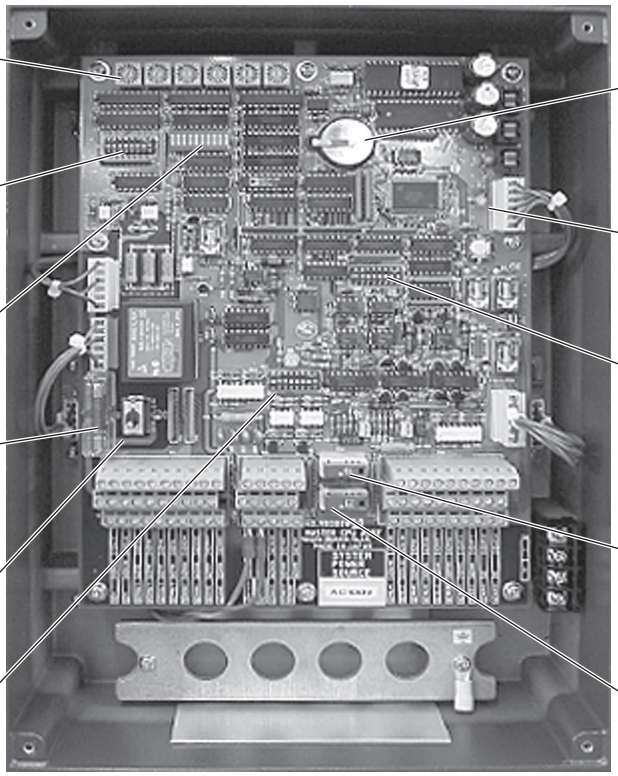
1.1 Components and Their Functions

(1) Master indicator



(2) Master Unit

The operation panel on the master unit is shown below, with its cover removed.



WARNING **Electrical shock**

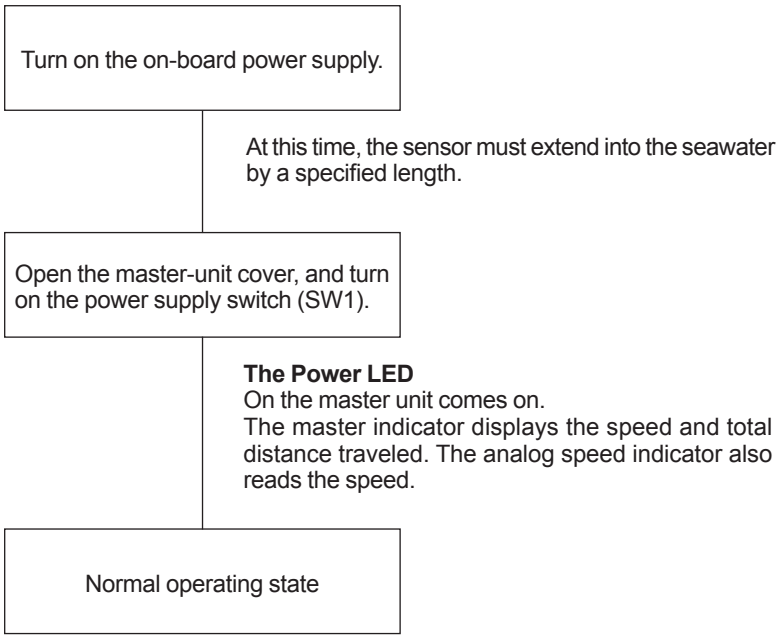
To avoid electrical shock, turn off the power before making wiring connections.

CAUTION

Do not use a megger for inspection purposes except for on-board power supply terminals. Otherwise, the equipment may be damaged.

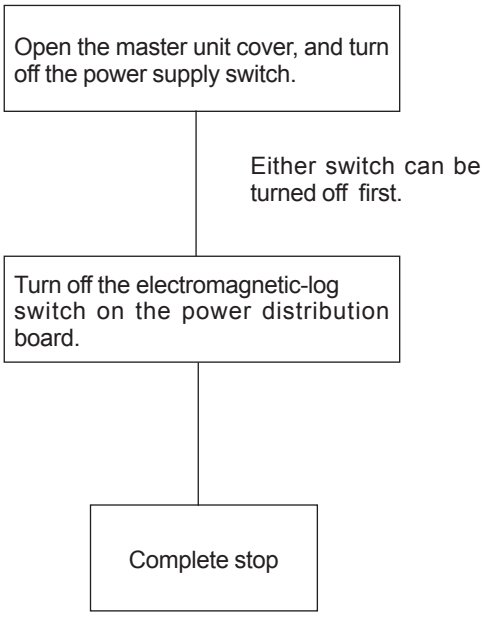
1.2 Starting and Stopping

(1) Starting



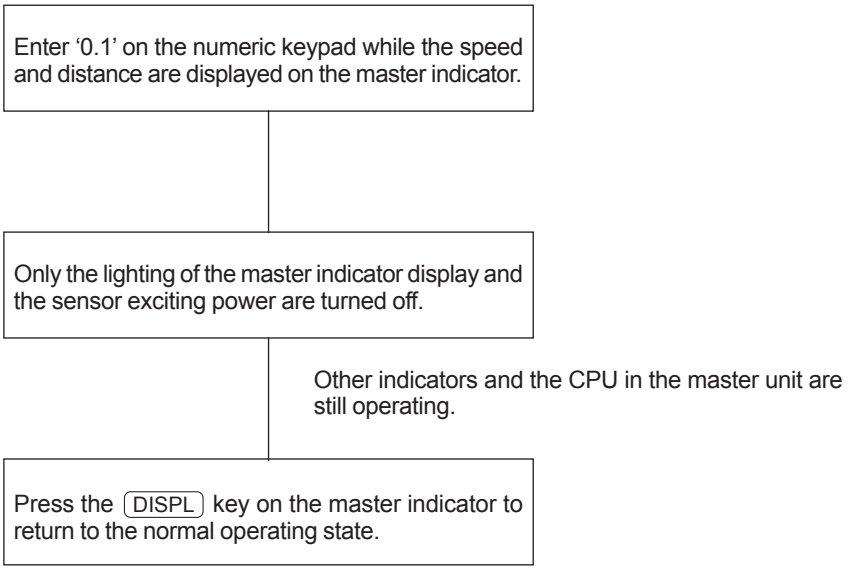
(2) Stopping

① Complete Stopping



② Partial Stopping (power-off for protecting the sensor)

The Power can be partially turned off if the sensor is replaced or pulled up and kept in the seawater valve for a while.



1.3 Summary of Functions

Classification			Function	page
Indication	Master indicator	LOG	Displays the speed and total distance	4-6
			Displays the trip and total distance	4-6
			Displays the longitudinal and transverse speeds (dual-axis sensor system)	4-6
			Displays the resultant speed direction of moving ship (dual-axis sensor system)	4-6
		GPS	Displays the speed and total distance (when backed up by the GPS)	4-6
			Displays the trip and total distance (when backed up by the GPS)	4-6
	Speed indicator	Single-axis	Indicator the longitudinal speed by a needle pointing to the reading	3-6
		Dual-axis	Indicates the resultant speed and direction of a moving ship by a needle pointing to the reading (dual-axis)	3-6
			Indicates the longitudinal to transverse speed by a needle pointing to the reading (dual-axis)	3-6
Setting	Master indicator		Test function	4-8
			Alarm speed setting	4-9
			GPS speed selection	4-9
			Error code display mode	6-26
Maintenance	Master indicator		Zero adjustment	6-6
			Sensitivity adjustment	6-7
			Span adjustment	6-8
			Response-speed setting	6-2
			Milepost	6-9
			Display / alteration / deletion of milepost data	6-13
			Display / alteration of the linearizer table	6-14
			Selection of intermediate error compensation factor	6-24
			Switching of the voltage output range	6-18
			Setting of the GPS interface	6-16
			Selection of sub-maintenance mode	6-24
			Switch status display mode	6-25
			Voltage check mode	6-25
			Fixed voltage output mode	6-26

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2. OVERVIEW

2.1 General

The EML 500 series of electromagnetic logs successfully meets the performance requirements prescribed by IMO resolution A478 (XII), and has been approved by the Ministry of Land,Infrastructure and Transport Japan (approval no.:3795).

The EML500 features:

(1) Versatile external interfaces

· Pulse output (photocoupler / contact)

· Digital output (NMEA0183)

· Analog speed output (0V DC to 5V DC)

· Alarm contact and interface with the GPS

(2) High reliability

The use of highly integrated circuits, such as microprocessors, provides excellent reliability due to a reduction in parts and the elimination of moving parts.

(3) Master indicator for displaying the speed and distance

(4) Variety of sensors available to meet various installation requirements.

A dual-axis sensor can measure not only the longitudinal speed, but also the transverse speed.

(5) Built-in self-diagnostic function

2.2 Principle

The principle of electromagnetic logs is based on Faraday's law of electromagnetic induction.

An electromotive force is induced in a conductor whenever there is relative motion between the conductor and magnetic field.

The directions of the magnetic field, motion and induced emf are at right angles or perpendicular to each other.

If the magnetic field is fixed, the magnitude of the induced emf is proportional to the speed of the motion (see Figure "Principle").

Therefore, either the conductor or magnetic field must move to induce an electromotive force.

In the case of electromagnetic logs, the magnetic field moves along with the ship while the seawater (the conductor) remains stationary.

There is a coil in the sensor at the top of the measurement rod, and this coil is energized to establish a magnetic field around the sensor. As the ship moves, an emf is induced which is then detected by a pair of electrodes at the tip of the sensor (see Figure "Flattened Sensor Structure").

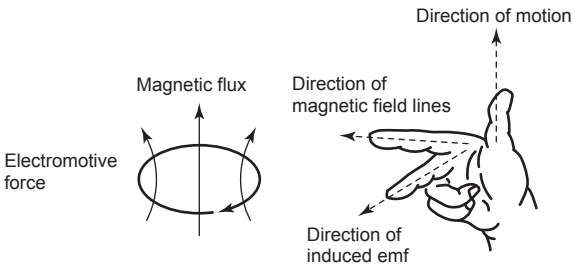


Figure Principle

Here an induced emf can be obtained from the formula below.

$e = B \cdot V \cdot D \cdot 10^{-4}$ Volt

where

B = Flux density (Tesla)

V = Speed (cm/s)

D = Distance between electrodes (cm)

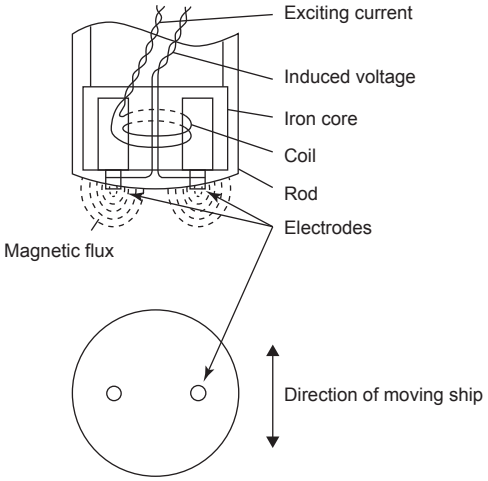


Figure Flattened Sensor Structure

2.3 Performance and Specifications

(1) Power supply

Power supply voltage:	100 / 110 / 115 V AC ±10 % (50 / 60 Hz ±6 %)
	200 / 220 V AC ±10 % (50 /60 Hz ±6 %)
	(can be selected by changing the jumper setting in the power supply unit.)
Power consumption:	80 VA
Insulation resistance:	at least 10MΩ using 500V megger (excluding electronic circuits)
Withstanding voltage:	1500 V AC for 1 min (excluding electronic circuits)

(2) Measuring Range

Speed:	-4 kt to 20 kt.
	-5kt to 25 kt.
(*1: Additional engineering is required concerning the installation of the sensor.)	-8 kt to 40 kt.
	-7 kt to 35 kt.
	-10 kt to 50 kt. (*1)
	-13 kt to 65 kt. (*1)
Transverse speed:	0 kt to ± 6.5 kt.
Distance:	0 nm to 9999.99 nm
Direction of ship movement:	0 to 359 deg., clockwise from the bow-to-stern line (fixed to 0 deg if the resultant speed is 0.5 kt or less)

(3) Measuring Accuracy

Speed:	± 0.15 kt. with respect to standard signal inputs (± 0.25 kt. or less if the measuring range is above 40 kt.)
Distance:	± 0.05 nm/h or ± 1.0% max., whichever is larger
Direction of ship movement:	deg max = ±2.5 deg

(4) Response Speed

Variable up to 2 min for a 0 to FS-step input (0% to 90% response)

(5) Milepost Adjustment

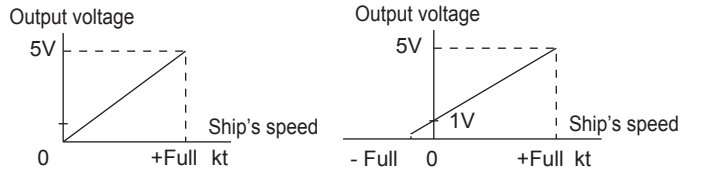
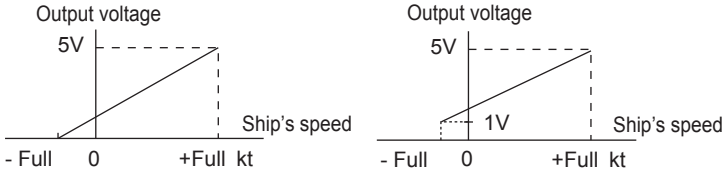
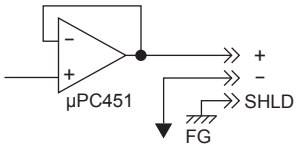
Break point of linearize :	in 5 kt. increments
Sensitivity (span) adjustment range :	× 1.8 to × 0.6 (specified in 0.1 increments)

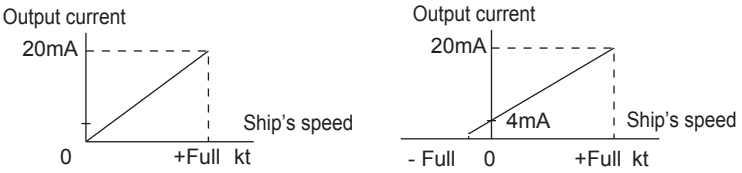
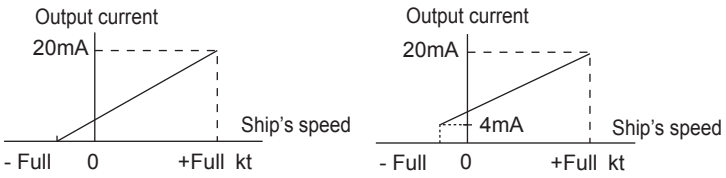
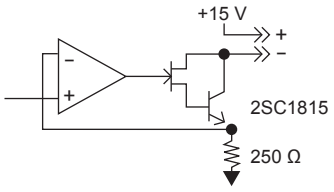
(6) External Output Signal Accuracy

Analog signal (voltage / current):	0.2 % max. of the full span
Distance pulse:	same as the measuring accuracy
Speed limit detection:	same as the measuring accuracy

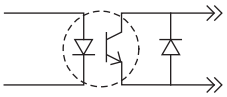
(7) Output Signals

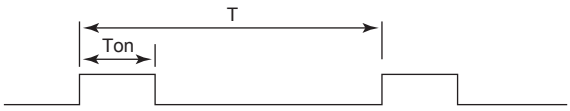
① analog speed output : 6 circuits

(i) Voltage output	Number of circuits :	2
	Output level:	Either 0 V to 5V or 1 V to 5V can be selected. One output type can be selected from the following four types. Procedure of selection vide 6.3.3.
		(a)  (b) 
	Output circuit :	Non - isolating method Load resistance of kΩ max = 5 kΩ
		

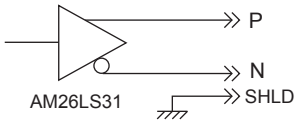
(ii) Current output	Number of circuits :	4
	Output level:	Either 0 mA to 20mA or 4 mA to 20 mA can to be selected. One output type can be selected from the following four types. Procedure of selection vide 6.3.3.
		(a)  (b) 
	Output circuit :	Non - isolating method Load resistance of Ω max = 250 Ω
		

② Distance pulse output : 10 circuits

(i) Photocoupler output	Number of circuits:	8
	Output capacity:	voltage between terminals .....V max = 24 V
		Sink current ..... mA max = 5 mA
		Dark current ..... μA max = 50 μA (at 24V between terminals).
	Output circuit :	 TLP621-4
	Pulse weight :	200 pulses / nm (fixed)
(ii) Relay output	Number of circuits :	2
	Contact capacity :	rated load (resistance load) ..... 30 V DC; 1 A 30 V AC; 0.5 A
		Minimum applicable load ..... 10 mV DC; 10μA
		Chattering ..... ms max = 1 ms
	Pulse weight:	200 pulses / nm (fixed)

Output -pulse characteristics :	 Ton : 100 ±1.25 ms (fixed) T : Varies depending on the ship's speed		
	At Ton :	Photocoupler output	Continuity between terminals
		Relay output	"Open" or "Close" contact (normally "Open") Can be specified by setting dip switch SW9-1 (off : closed; on : open)

③ digital speed output : 2 circuits (as per NMEA0183)

Output circuit		
	Conforms to EIA RS422A	
	Output current at H level :	-20 mA
	Output current at L level :	20 mA

④ Alarm contact : 4 circuit

(i)

State of contact	Setting alarm speed (master indicator)	Dip SW9-2 (master unit)	
'close' in the Speed limit	Hi	ON	Standard
	Lo	OFF	
'Open' in the Speed limit	Hi	OFF	
	Lo	ON	

(Note) For setting Hi and Lo, refer to 4.4.1

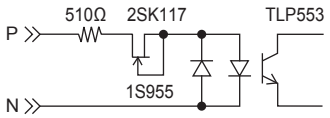
(ii)

State of contact	Setting of JP1,2			
'Close' at the occurrence of on error	short between 2 and 3	●	●	3
		●	●	2
		□	□	1
'Open' at the occurrence of on error	short between 1 and 2	○	○	3
		●	●	2
		■	■	1

(Note) Fix dip switch 9 to OFF

Error detection	A/D converter error	
	Communication errors	· GPS input error · Communication error between the master unit and master indicator
	Excess of the speed sensor input range	

(8) Input Signal: 1 circuit (for back up by GPS)

① Digital signal	
Input circuit:	Isolated by photocoupler
	

(9) Ambient Conditions

Temperature:	-15°C to +55 °C (when operating)
	-20 °C to +60 °C (when not operating)
Humidity :	up to 95 % RH (no condensation)
Vibration :	5 Hz to 12.5 Hz ..... ±1.6 mm
	12.5 Hz to 25 Hz ..... ± 0.38 mm
	25 Hz to 50 Hz ..... ± 0.1 mm
Waterproofing :	IP 22
	Junction box ..... IP 55
	Sensor unit ..... 0.5 MPa for submerged section and IP 55 for the upper section
Power line noise :	There must be no noise when a pulse of 100 / 400 nsec and 1500 V is applied for three minutes.
Insulation resistance :	at least 10MΩ, using a 500 V megger (excluding the sensor and electronic circuits)
Withstanding voltage :	1500 V AC, for 1 minute (excluding the sensor and electronic circuits)

2.4 Handling Precautions

(1) If there are contaminants or microorganisms adhering to bottom of the ship or the tip of the measurement rod (electrodes), the indicated speed may be lower than the actual speed. The bottom of the ship should always be kept clean. For cleaning and inspection, refer to Section 5.2 in Chapter 5.

(2) When closing the seawater valve, first pull up the measurement rod as far as the attached chain allows.

(3) If the ship is at anchor, pull the measurement rod all the way up and close the seawater valve.

(4) If the ship will remain in port for a log time, remove the chain and keep the measurement rod on board.

(5) The “FWD” marking on the measurement rod must face in the direction of the bow.

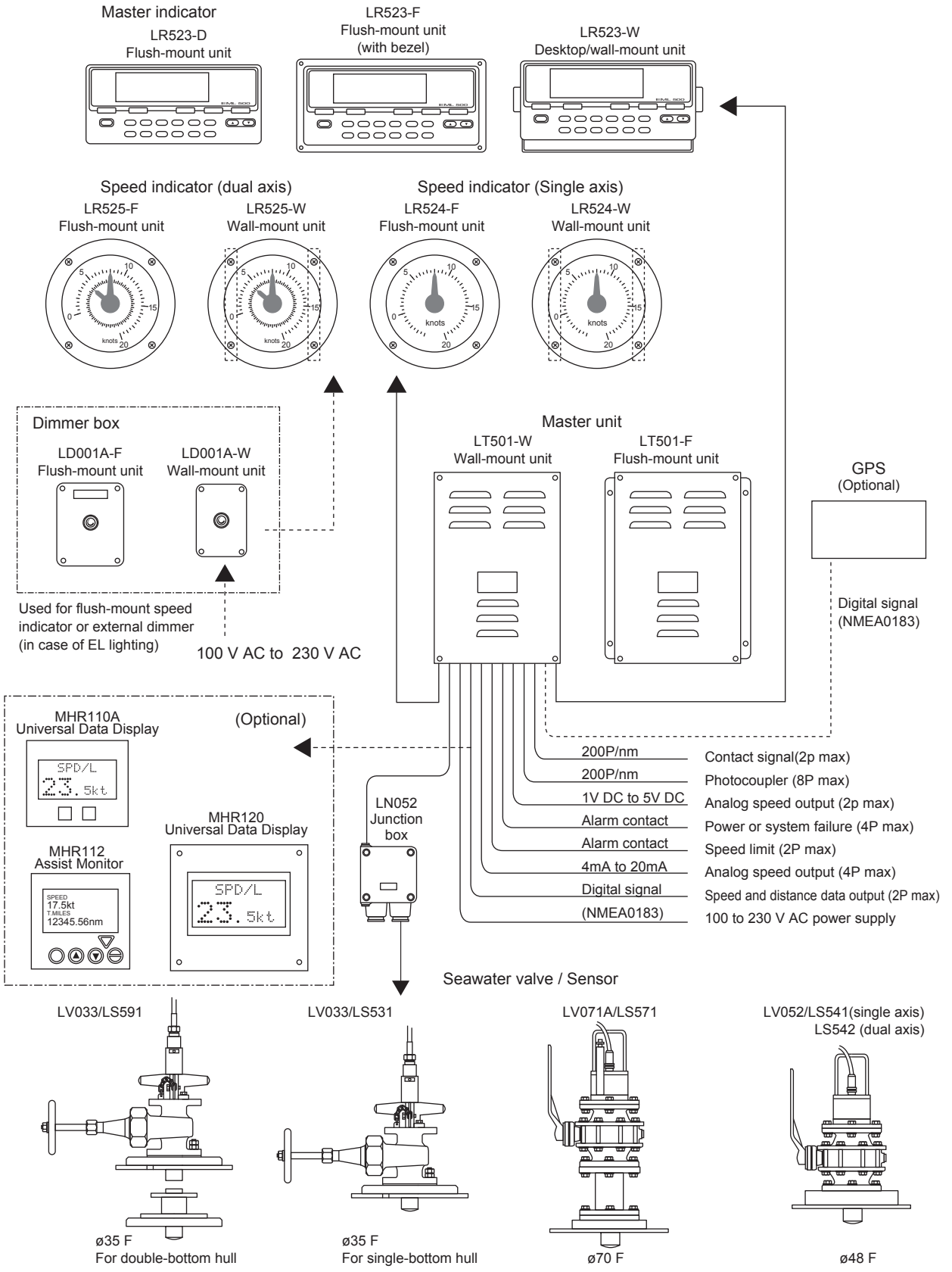
Otherwise, the detected speeds will be lower than the actual ones.

(6) The tip of the measurement rod is fragile. Handle it very carefully.

(7) Even when the ship is at anchor, a slight speed may be indicated if the water is flowing past.

3. Components

3.1 System Configuration



3.2 Component Models

Product Name and Models \ System type			EML500-							Remarks
			HS1	HD1	HV1	RD1	FA1	HV2	FA2	
Master unit		LT501	○	○	○	○	○	○	○	
Master indicator		LR523	○	○	○	○	○	○	○	
speed indicator (single-axis)		LR524	○	○	○	○	○			
Speed indicator (dual-axis)		LR525						○	○	
Dimmer box		LD001A	○	○	○	○	○	○	○	
Junction box		LN052	○	○	○	○	○	○	○	
Sensor Unit	Sensor	LS531	○							35 mm dia.,with cable
		LS501		○		○				Only sensor element 35 mm in dia.
		LS571			○					70 mm dia.; single-axis
		LS541					○			48 mm dia.; single-axis
		LS542							○	48 mm dia.; dual-axis
		LS572						○		70 mm dia.; dual-axis
	Measurement rod	LS592				○				Not including the sensor
		LS591		○						Not including the sensor
	Sensor cable	LS503		○	○	○	○	○	○	
	Seawater value	LV033	○	○						For sensors 35 mm in dia.
		LV071A			○			○		For sensors 70 mm in dia.
		LV052					○		○	For sensors 48 mm in dia (inclu-deing the dual-axis sensor)
		LV031				○				For sensors 35 mm in dia
	Seawater value flange	LV904		○		○				LV701=LV904+LV905
	Protection tube	LV905		○						
		LV903				○				
	Mouting plate for seawater valve	LV902				Δ				
		LV902A-1_	Δ							
		LV902A-2_		Δ						
		LV902A-3_		Δ						
		LV902A-4_			Δ			Δ		
		LV902A-5_			Δ			Δ		
		LV910					Δ		Δ	
	Zinc plate	LV901-1_		Δ		Δ				
		LV901-2_	Δ							
		LV931-3_			Δ(*1)			Δ(*1)		*1:For the flush-mounted unit (unnecessary for a protruding unit)
Sensor installation		Installation type	Single bottom hull	Double bottom hull	Single bottom hull	double bottom hull	Single bottom hull	Single bottom hull	single bottom hull	
		Standard length of protrusion	50 mm	50 mm	7 or 50 mm	50 mm	7 or 50 mm	7 or 50 mm	7 or 50 mm	

Note: Items marked with a "Δ" are ordered from the ship builder as standard

3.3 Components and Their Functions

3.3.1 Sensor Unit

A variety of sensor units are available depending on the installation conditions, but all of them consist of the following components:

(1) Sensor (with built-in amplifier)

Detects the ship's speed in the water, and transmits the data to the master unit. If an emf is induced by the relative motion between the water flow (the ship's speed in the water) and the magnetic field established by the coil, a voltage proportional to the ship's speed is detected at the electrodes located at the tip of the sensor. This voltage is then fed to the built-in amplifier, converted into a current signal (0 mA to 20 mA) proportional to the speed, and finally output.

(2) seawater valve

Holds the sensor and prevents seawater from spurting out when the sensor is removed.

(3) Mounting plate: LV902 and LV910 (for sensors 48 mm in dia.)

This is welded onto the bottom of the ship's hull to allow the seawater valve to be installed. The mounting plate is ordered from the shipbuilder as standard. For sensors installed through the double-bottom hull of a ship, the mounting plate for the seawater valve flange is also included.

(4) Protection tube : LV905

This is watertight tubing for sensors which are installed through the double-bottom hull of a ship. the tubing is made of brass (BS) or stainless steel (SUS304) depending on the class of the ship.

Brass (BS) ..... NK, LR, DNV

Stainless steel (SUS304) .....ABS

(5) Seawater valve flange : LV904

This is used for supporting the bottom of the protection tube for sensors which are installed through the double bottom hull of a ship. The flange has a structure which allows the protection tube to slide in consideration of variations in the distance between the two bottom plates. The seawater valve flange is made of bronze casting (BC3).

(6) Zinc plate: LV901

Protects the sensor unit from corrosion. The zinc plate is ordered from the shipbuilder as standard.

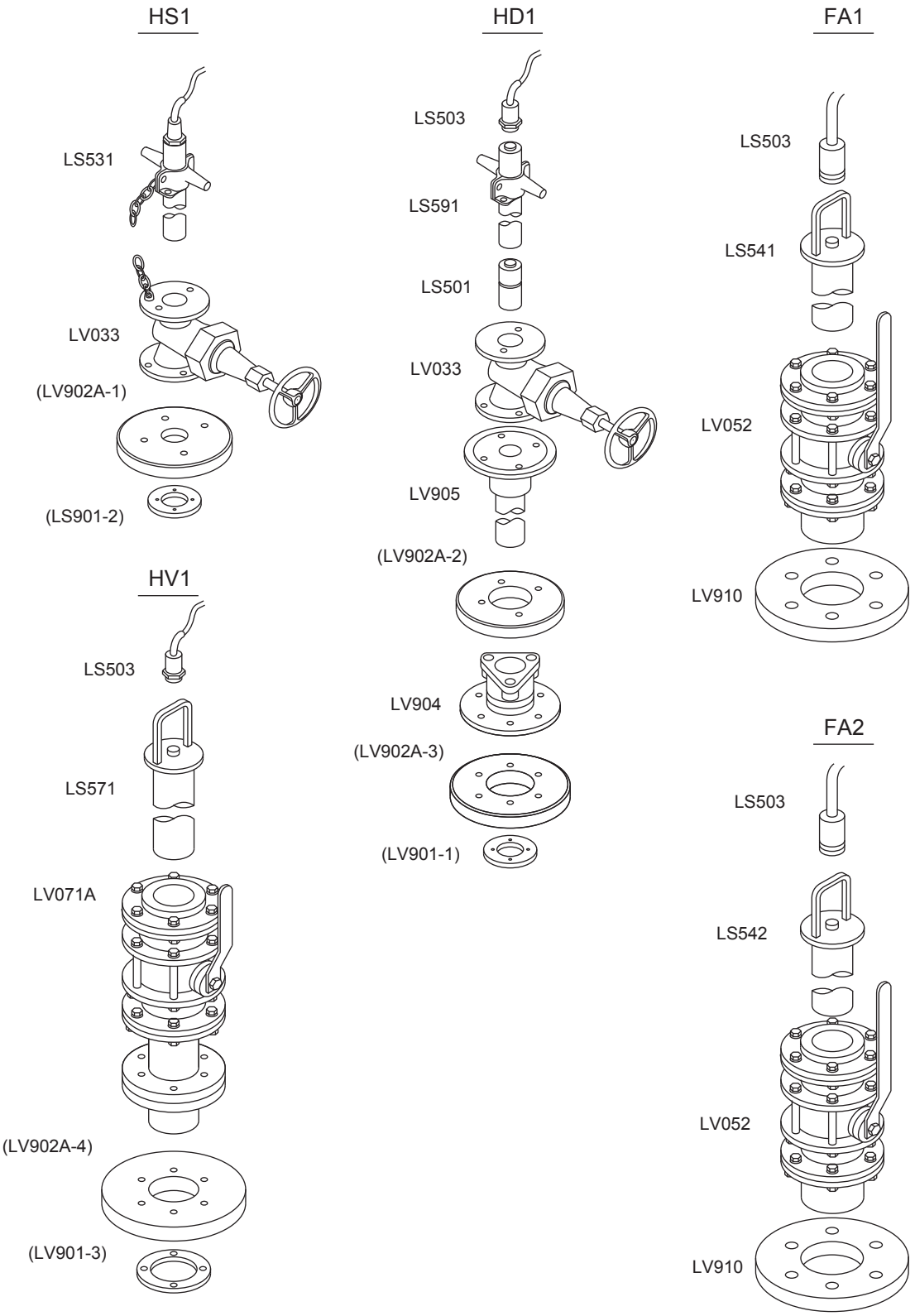


Figure Sensor Unit Structure

NOTE

The items in parentheses are ordered from the shipbuilder as standard.

3.3.2 Junction box : LN052

This is a repeater junction box placed between the sensor and master unit. This allows the cable supplied to the shipbuilder to be connected to the EML500 cable.

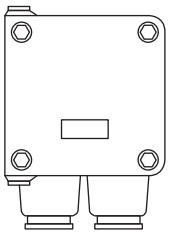


Figure Junction box (LN052)

3.3.3 Master Unit : LT501

Supplies the power (24 V and ±15 V) to the amplifier in the sensor ,and receives speed data signals from the sensor. After adjusting the data, the master unit then transmits the speed and distance to external devices in various signal forms. For operation of the master unit , refer to Section 1.2 in Chapter 1 and Sections 4.1 in Chapter 4.

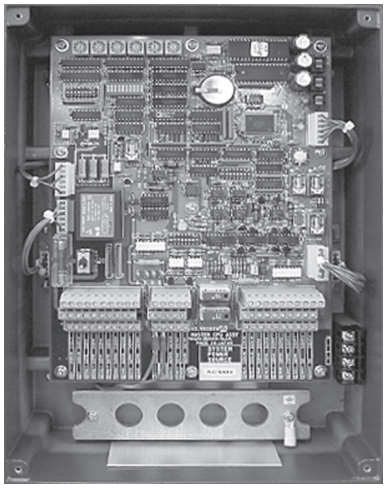


Figure Master Unit (LT501)

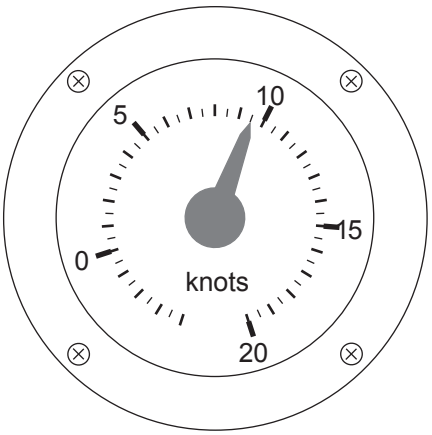
3.3.4 Master Indicator : LR523

Receives digital signals from the master unit, and displays the speed and distance. Both the display and operation panel are on the front of the master indicator. Set data are sent to the master unit in the form of digital signals, and placed in the memory. The LED display allows speed and distance data to be read clearly even in direct sunlight. The dimmer keys control the intensity of the light (▲ -brighter; ▼ -dimmer). For details, refer to Chapter 4.

Figure Master Indicator (LR523)

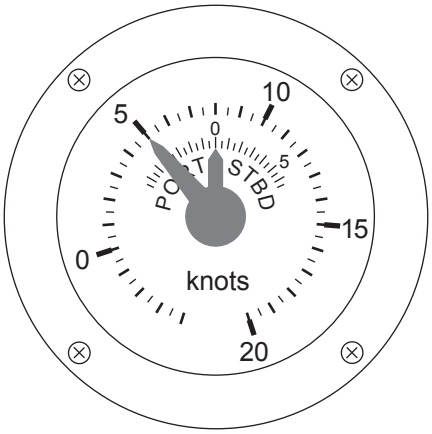
3.3.5 Speed Indicator : LR524 (single-indication) and LR525 (dual-indication)

This is a large analog indicator with an outside diameter of 180 mm. EL-plate lighting is employed, and two types of dimmers, a built-in dimmer (for wall-mounted models only) and an external dimmer (LD001A), are available. This indicator receives digital signals from the master unit, and reads the analog speed by using the pulse motor.

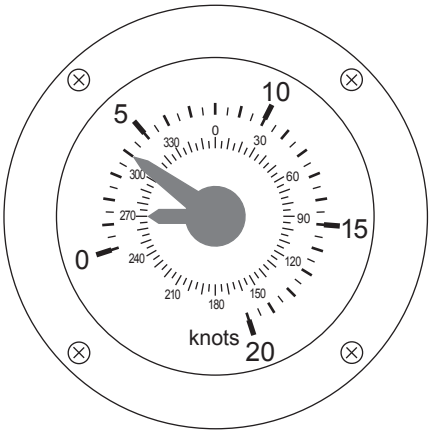


Longitudinal speed

Figure Speed Indicator LR524 (single-indication)



Lonfitudinal and transverse speeds



Resultant speed and direction of ship movement

Figure Two Examples of Speed Indicator LR525 (dual-indication)

4. OPERATION

4.1 Starting and Stopping

4.1.1 Starting

① If the sensor is kept in the seawater valve, allow it to protrude from the ship by a specified length.

② Turn on the electromagnetic-log switch on the power distribution board.

③ Open the master unit cover, and turn on the power supply switch. Now the entire system is supplied with power and ready to operate.

④ Adjust the intensity of the light on the master indicator.

4.1.2 Display at Start-up

① The master indicator display the speed and total distance traveled.

② To reset the trip distance, first press the [DISPL] key. This indicates the trip distance on the top line of the display and “RESET” on the bottom line of the display . Next, press the [F 1] key to reset the trip distance.

③ To reset the total distance, press the [CLEAR], [CLEAR], [ENT] to the order during the indication “Speed, Total distance traveled”.

④ If the [DISPL] key is pressed again in a dual -axis sensor system, the transverse speed appears on the bottom line of the display. If the [DISPL] key is pressed once more, the resultant speed and direction appear on the display. That is, the data items on the display change in the following order each time the [DISPL] key is pressed : speed and distance → trip distance → transverse speed → resultant speed and direction → return to speed and distance.

4.1.3 Stopping

① Turn off the electromagnetic-log switch on the power distribution board. it does not matter if the power supply switch on the master unit is left on.

NOTE

If this EML500 instrument will not be used for at least three months, pull up the sensor and close the seawater valve.

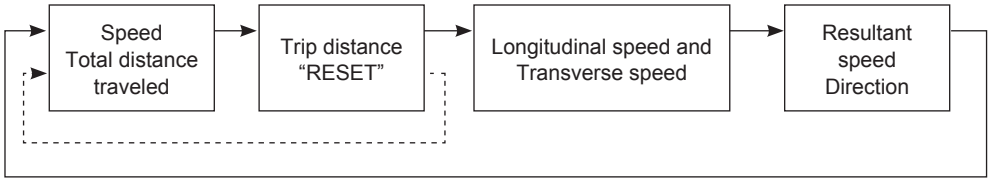
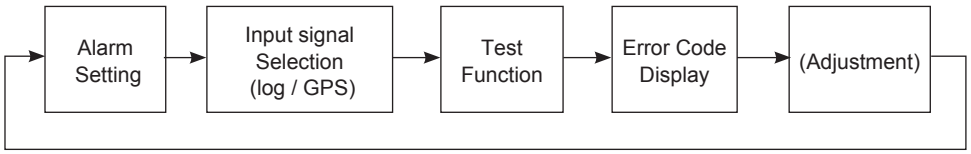
CAUTION

■ Removal of Measurement Rod

- To remove the measurement rod, pull it all the way up and close the seawater valve. Then remove the rod.
- If the rod is removed before closing the valve, seawater will spew out through the valve.
- To remove the chain, fully close the valve (for the HS, HV, and FA models). Then remove the chain.

4.2 Functions of Master Indicator Components

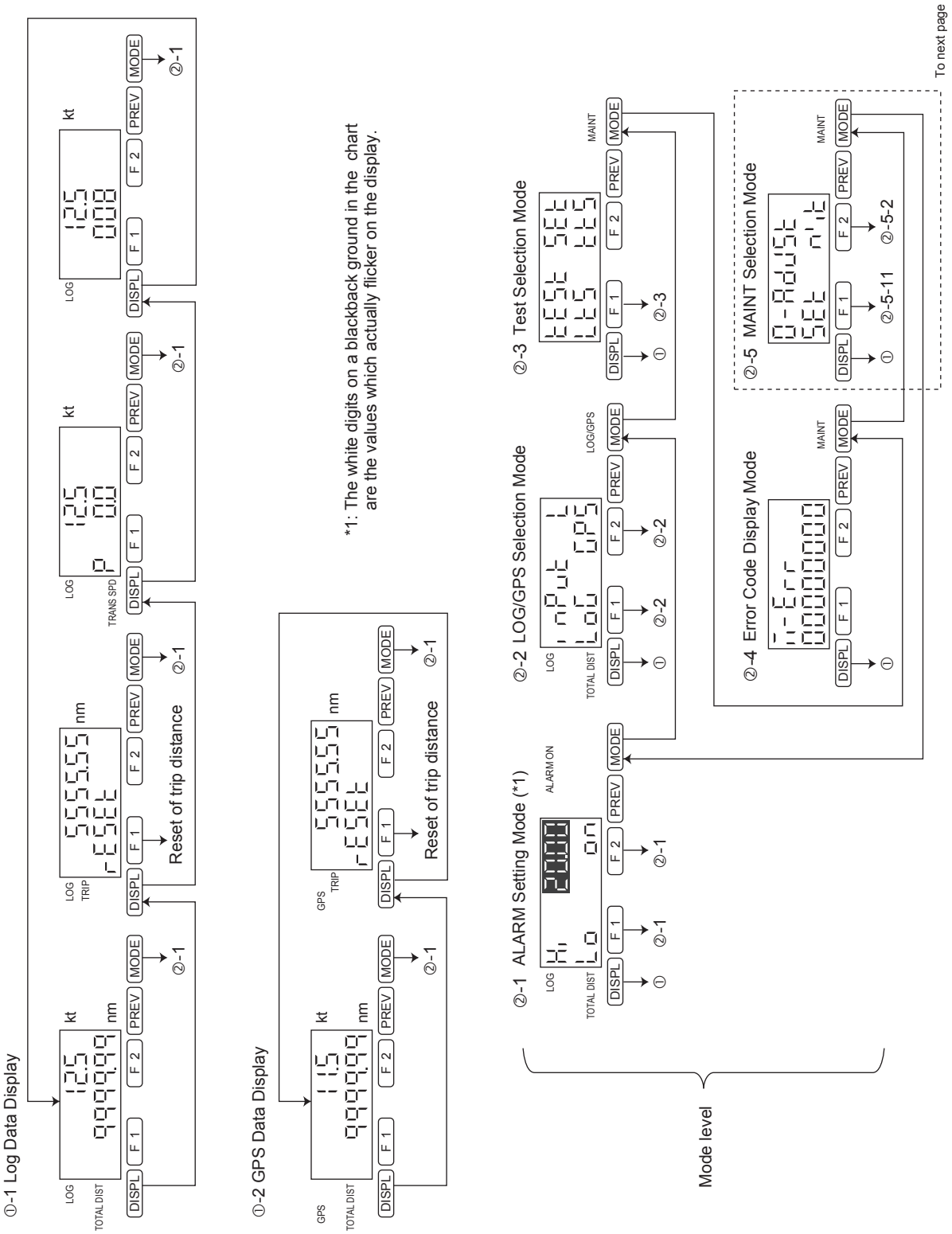
The functions of the switches and keys on the master indicator are summarized below.

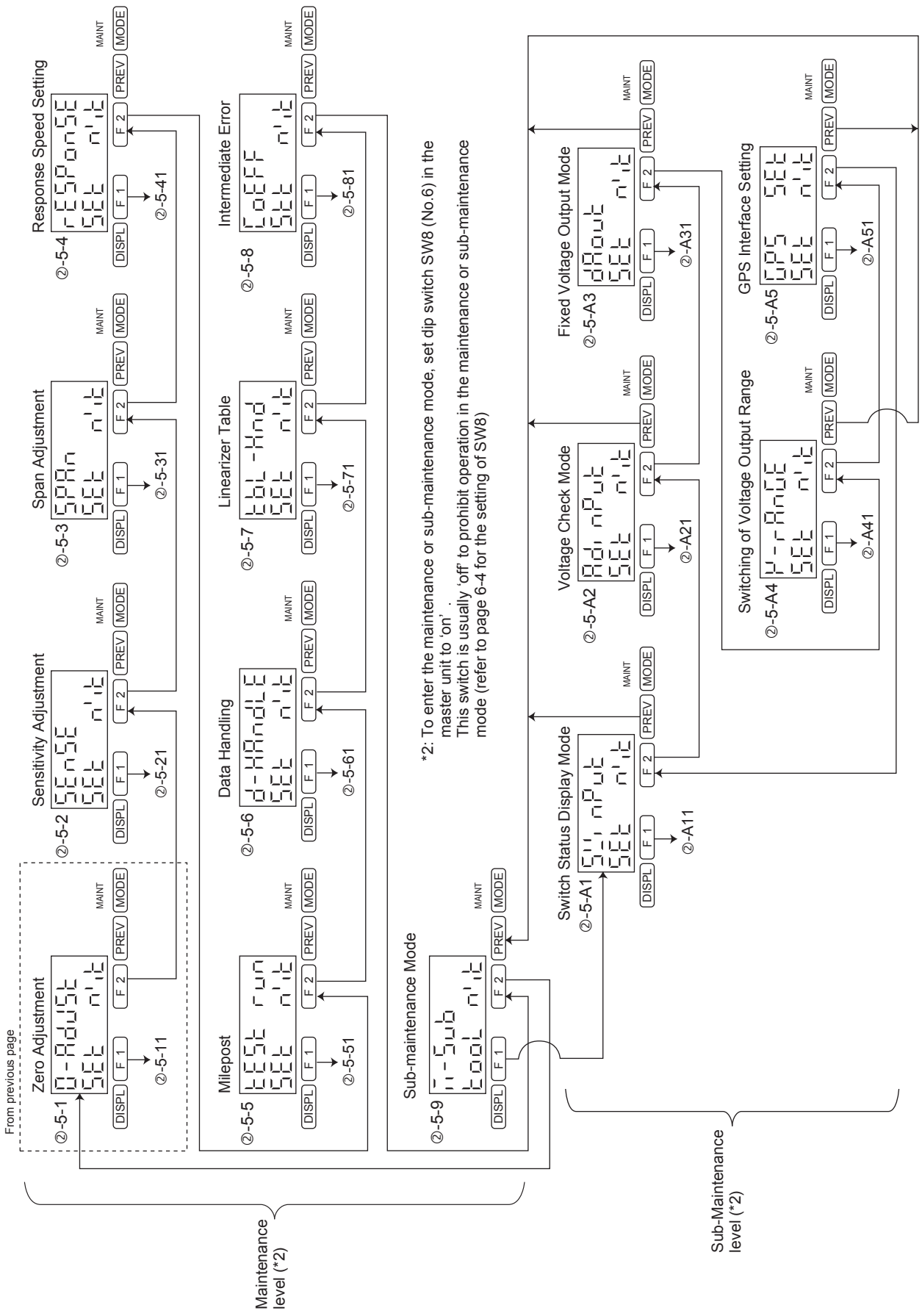
Switch / key	Function
DISPL	Switching of data items on the display  The items on the display switch to the next items each time the **DISPL** key is pressed.
MODE	Switching of operation mode  The operation mode switches to the next one each time the **MODE** key is pressed.
F 1 F 2	A function displayed on the bottom line of the display can be selected by pressing either the **F1** or **F2** key.
PREV	Pressing this key moves the operation sequence one step back.
▲ ▼	These keys control the intensity of the light as follows: ▲ Brighter ▼ Dimmer
LT	Pressing this key starts the lamp test by turning on all lamps. Press this key again to return to the state immediately before the lamp test.
0 to 9	These are used for entering data.

4.3 Operational Functions

Perform the necessary operations using the operation panel on the master indicator .

4.3.1 Basic Operation Flowchart




From previous page
Zero Adjustment
②-5-1
②-5-11
Sensitivity Adjustment
②-5-2
②-5-21
Span Adjustment
②-5-3
②-5-31
Response Speed Setting
②-5-4
②-5-41
Milepost
②-5-5
②-5-51
Data Handling
②-5-6
②-5-61
Linearizer Table
②-5-7
②-5-71
Intermediate Error
②-5-8
②-5-81
Sub-maintenance Mode
②-5-9
Switch Status Display Mode
②-5-A1
②-A11
Voltage Check Mode
②-5-A2
②-A21
Fixed Voltage Output Mode
②-5-A3
②-A31
Switching of Voltage Output Range
②-5-A4
②-A41
GPS Interface Setting
②-5-A5
②-A51
DISPL
F 1
F 2
PREV
MODE
MAINT
*2: To enter the maintenance or sub-maintenance mode, set dip switch SW8 (No.6) in the master unit to 'on'.
This switch is usually 'off' to prohibit operation in the maintenance or sub-maintenance mode (refer to page 6-4 for the setting of SW8)
Maintenance level (*2)
Sub-Maintenance level (*2)

4.3.2 Fundamentals of Operation

① **Entry from the numeric keypad**

New data can be entered from the numeric keypad while the value on the display is flickering. The entry of a new value is set when the (ENT) key is pressed and the flickering stops. To change the value again, press the (CLEAR) key. The value on the display starts flickering, and prompts you to enter a new value.

② **Switching of the display on the mode level**

As shown in the basic operation flowchart, the display in one mode is switched to another mode each time the [MODE] key is pressed.

③ **Switching of the display on the maintenance level**

As shown in the basic operation flowchart, the maintenance display is switched to the next one each time the [F 2] (“NXT”) key is pressed.

④ **Switching of the display on the sub-maintenance level**

As shown in the basic operation flowchart, the sub-maintenance display is switched to the next one each time the [F 2] key is pressed.

⑤ **Pressing the [DISPL] key allows the display to return to ①-1 or ①-2 from any level**

⑥ **Level movement [MODE] key**

If the [MODE] key is pressed on the maintenance level and the sub-maintenance level, the display returns to the ②-1.

⑦ **Level movement [PREV] key**

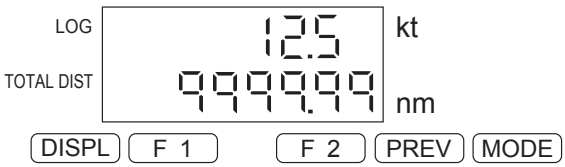
If the [PREV] key is pressed within a mode, the display returns to the initial state in that mode.

If the [PREV] key is pressed on the maintenance level and the sub-maintenance level, the display returns to the ②-5-1.

4.3.3 Switching the display

The following 4 types of displays appear one after the other in this order, a→ b → c → d→ a, each time the DISPL key is pressed. In a single-axis sensor system, (c) and (d) are not displayed.

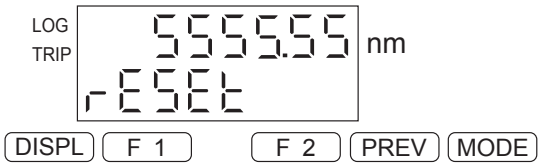
(a) Speed and total distance traveled



← Speed

← Total distance traveled

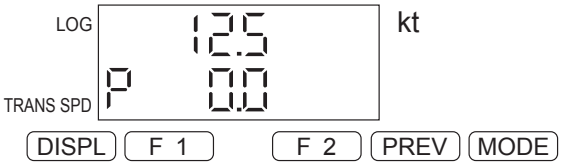
(b) Trip distance



← Trip distance

← Indicates that the F 1 key works as a reset switch

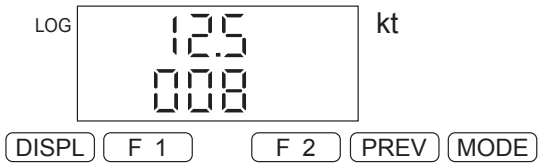
(c) Longitudinal and transverse speeds (dual-axis sensor system)



← Longitudinal speed

← Transverse speed (S: right P: left)

(d) Resultant speed and direction (dual-axis sensor system)

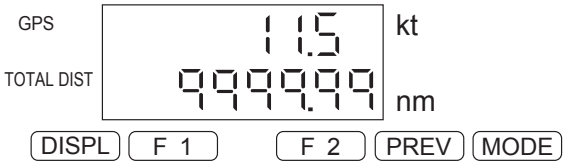


← Resultant speed

← Direction

If GPS signals are received as input, the following items are displayed:

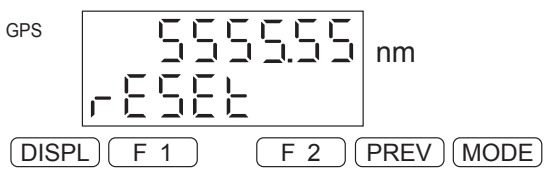
(a) Displays the speed and total distance (When backed up by the GPS)



← Speed

← Total distance traveled

(b) Displays the trip and total distance (when backed up by the GPS)



← Trip distance

← Indicates that the F 1 key works as a reset switch.

NOTE

If the all displays filcker, it shows that some errors occur in P6-26

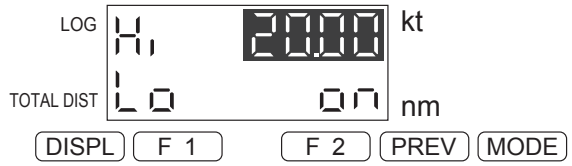
Check it the troubleshooting to show in P5-2, the flickers stop if the error is sollved

4.3.4 LOG / GPS Selection

If the GPS is connected, either a GPS input or electromagetic-log input can be selected.

Press the [MODE] key, and the follwing display appears :

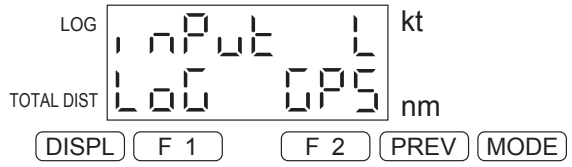
(turn on No3 of SW8 of the master unit if the GPS is connected.)



← Speed

← Low-Speed alarm (on / off)

Press the [MODE] key again. The display changes as follows :



← Input signal : LOG

← LOG / GPS

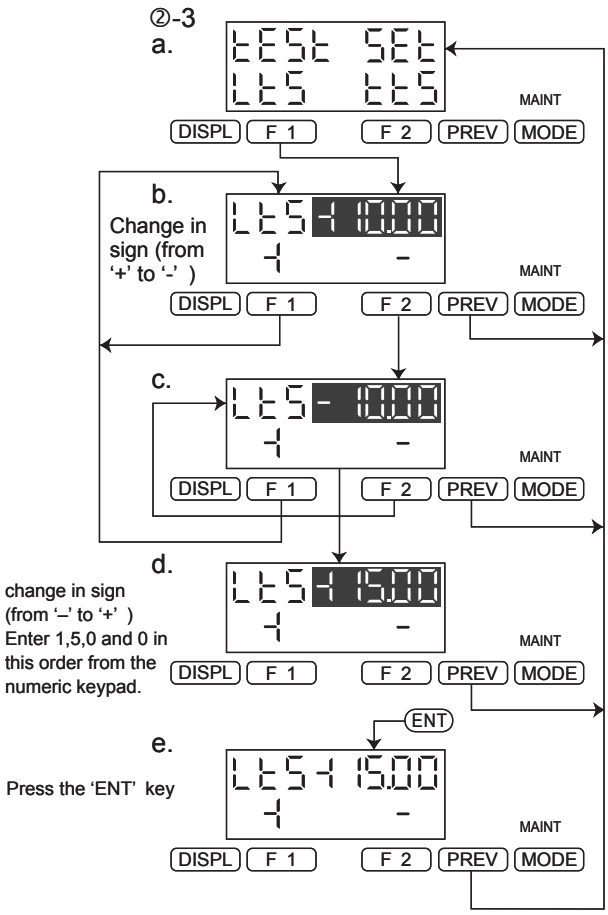
Press the [F 1] key to select the log input or press the [F 2] key to select the GPS input . Then press the [DISPL] key to return to the speed and distance display.

NOTE

It doesn't change to the GPS mode if GPS isn't connected or normal signal more than 10 seconds isn't made of GPS.

4.3.5 Test Function

Data can be output to indicators and external devices on a test basis if the speed data are set from the operation panel on the master indicator.



Operate the MODE key, and indicate figure ②-3 to do the test function.

In a single-axis sensor system, however, 'TTS' (transverse speed test output) is not available. To select 'LTS' (longitudinal speed test output), press the F 1 key while the display is **a**. The Display then chages to that marked **b**. The value on this display flickers.

The operation flow on the left gives an example of setteing the ouput at + 15.00 kt.

To do this, first set the sign by pressing the F 1 key ('+') or F 2 key ('-'). Next, enter the output value using the numeric keypad. Confirm the value that has just been entered, and then press the ENT key. This stops the flickering (see the display marked e), and the set speed is output.

To set the transverse speed (TTS), press the F 2 key while the display is at **a**, and then use the same procedure as that for the logitudinal speed setting.

NOTE

Push the MODE key, and change the mode to cancel the function.

The test data which on the serial output signal format is only longitudinal water speed.

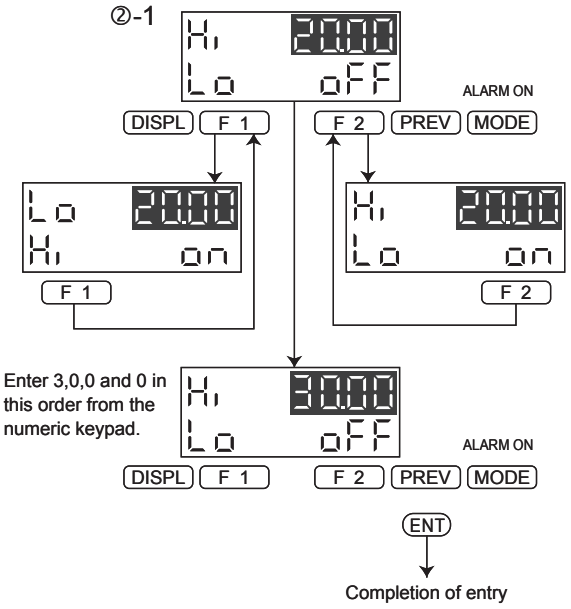
4.3.6 Resetting the total distance function

To reset the total distance, press the CLEAR, CLEAR, ENT to the order during the indication "Speed, Total distance traveled".

4.4 Setting function

4.4.1 Speed Alarm Setting

Alarm setting (on or off) and the setting of a limit speed can be done as follows:



To select the alarm setting mode, press the MODE key while the display is at ①**-1** or ①**-2**.(see page 4-3) This allows the alarm setting display (②**-1**) to appear. This display alternates between "Hi" and "Lo" each time the F 1 key is pressed if "Hi" is set at the beginning of the top line, the alarm speed is used as the high-limit value.

If "Lo" is set, the alarm speed is used as the low - limit value .

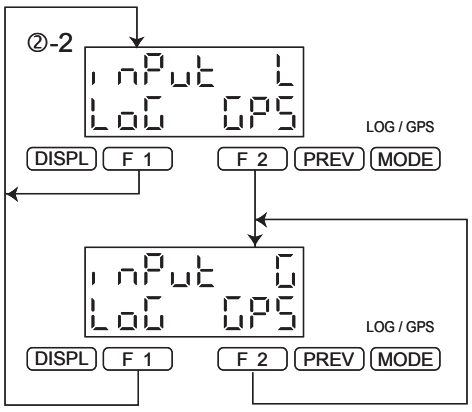
The indication "on" on the bottom line of the display changed to "off" if the F 2 key is pressed. This on/off setting determines whether the speed alarm is employed or not. There "on" and "off" settings are displayed alternately each time the F 2 key is pressed . At the same time, another on/off indication appears accordingly in the mode LED section.

The alarm-limit speed can be changed using the numeric keypad while the set value is flickering on the display. the flickering is indicated by the white digits on the black back ground in the figure on the left.

(The figure on the left shows the case in which the high-limit speed is set to '30.00 kt')

4.4.2 GPS Input Selection

If the GPS is connected, the EML500 can receive speed signals from it. GPS input is to be selected in such a case as sensor failure.



To select the Log-Sensor input, press the F 1 key. The letter "L" appears on the far right of the top line of the display. In addition, "LOG" appears in the title LED section.

To select GPS input, press the F 2 key. The letter "G" appears on the far left of the top line of the display. In addition, "GPS" appears in the title LED section.

It can be used turning on SW8-No3 of the master unit LT501, P1-2, P6-4 reference.

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5. MAINTENANCE

The EML500 has been strictly adjusted during the production process. Furthermore, the use of highly integrated circuits has eliminated moving parts; thus ensuring greater reliability. However, daily inspection and periodic maintenance are necessary for accurate and stable operation of the system.

5.1 Daily Inspection

Inspection Item	Description
Dimmer	Check the dimmer function.
Speed indicator	Check that the reading of the speed indicator is identical to the speed on the master indicator.
Distance display	Check the displayed distance with respect to the speed display.
Error indicator	Check that there is no error indicated in the master unit.
Lamp test	Do the lamp test to check the lighting of the LEDs.

5.2 Periodic Inspection

Inspection Item	Description	Frequency of Inspection
Sensor	Check for contamination on the electrodes in the sensor, and clean it off.	Once every three months
	Check the wiring connections.	Every year
	Check the connector.	Every year
Master indicator	Check the display and individual LEDs.	Once every 6 months
	Check the speed using test output	Once every 6 months
Speed indicator	Check the lighting.	Once every 6 months

Note: Refer to Section 6.4(1) for cleaning the electrode.

CAUTION

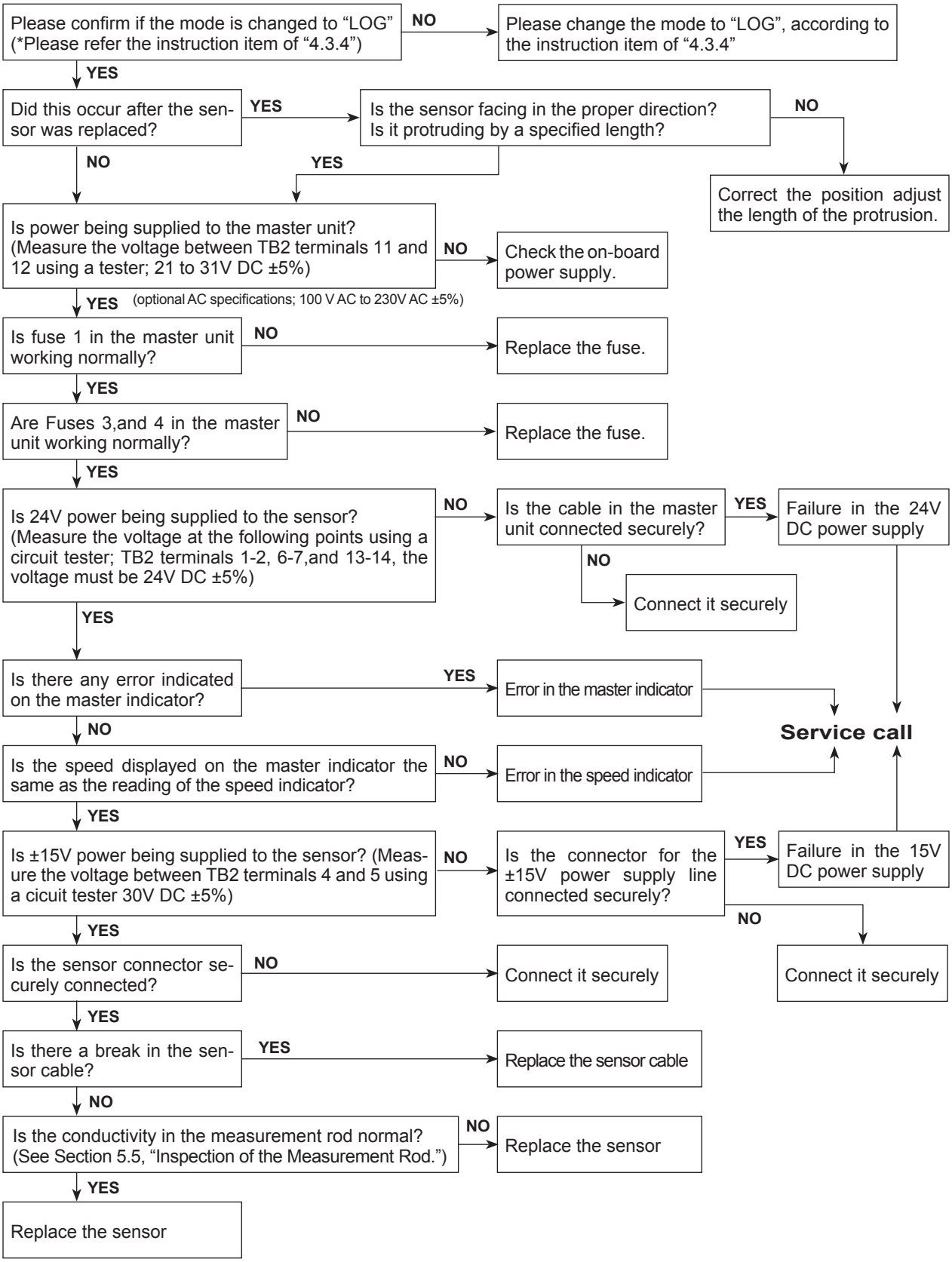
Do not use a megger for inspection purposes except for on board power supply terminals. Otherwise, the equipment may be damaged.

NOTE

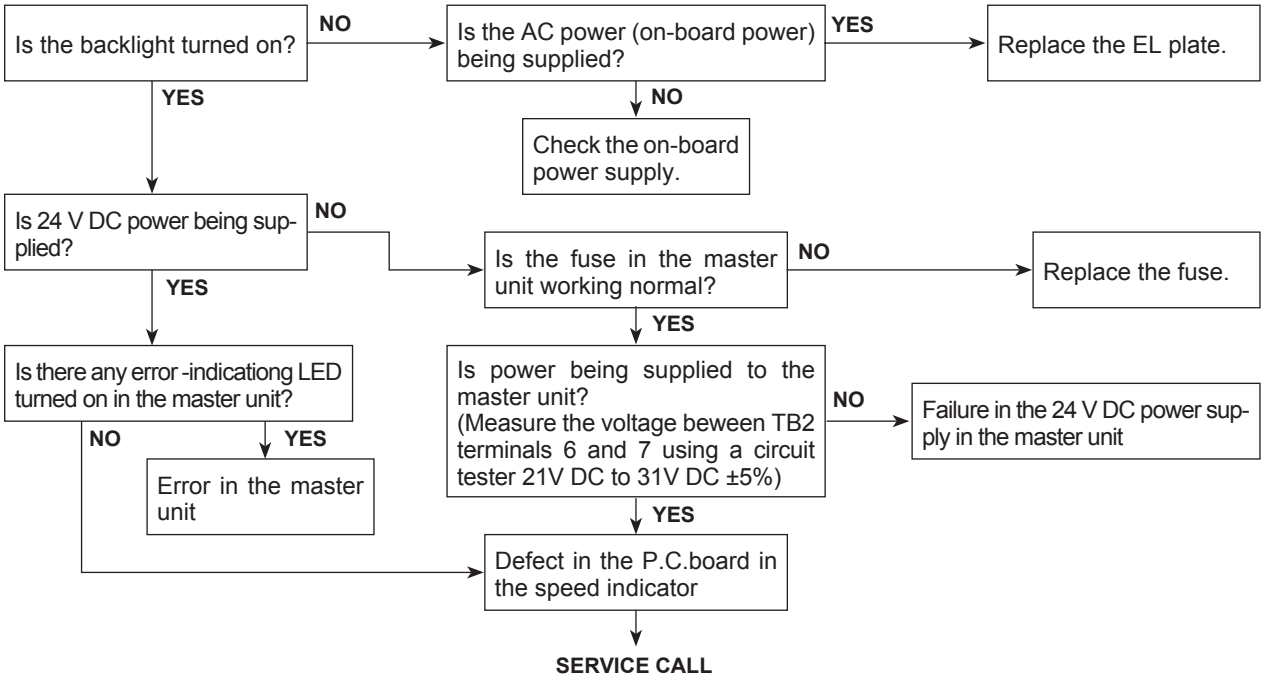
If there are contaminants or microorganisms adhering to or around the sensor electrode, the speed cannot be measured accurately. The tip of the sensor must be kept clean.

5.3 Troubleshooting

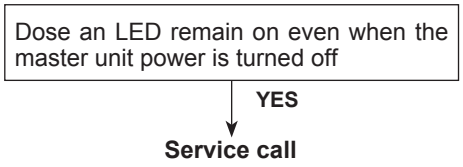
(1) If the analog speed indicator does not move, with the pointer indication "0 kt" in the minus scale direction or full scale direction.



(2) Speed Indicator (LR524, LR525)



(3) Errors in the Master Indicator



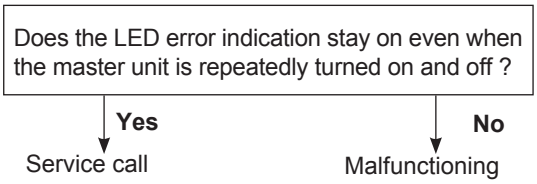
If an error occurs in the master indicator, the corresponding error code automatically appears on the display as shown on the following page.

- If two or more errors occur simultaneously, their codes are displayed in a combined manner.
- The display returns to the previous state (the state immediately before the error indication) as soon as the error or errors are removed.

Error code	Error	Action
Err 00000001	Checksum error in ROM	Replace the unit.
Err 00000010	Read / write error in RAM	Replace the unit.
Err 00000100	Error in communication hardware	Replace the unit.
Err 00001000	Communication checksum error	Replace the unit or check the master unit.
Err 00010000	Communication time-out error	Replace the unit or check the master unit.
n-Err 00100000	GPS communication error	Check the status of GPS communication.

(An error is occurring if the error indication and normal display automatically fluctuate back and forth over a short interval.)

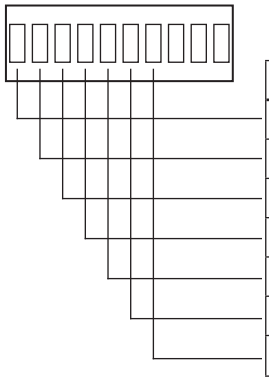
(4) LED Error Indication for Master Unit



Errors in the master unit can be identified.

The types of errors are shown in the table below.

Errors in the master unit are indicated by the LEDs of the MDS1 (refer to Page 1-2)



Error	Action
ROM error	Replace the master unit.
RAM error	Replace the master unit.
Speed input error (sensor input error)	Replace the sensor.
Communication error 1 (related to the master indicator)	Refer to Section 6.3
Communication error 2 (related to GPS)	Refer to Section 6.6
Voltage drop of memory backup battery	Replace the battery. (*1)

*1: The setting stored in the memory are deleted when the battery is replaced. After battery replacement, re-enter the data (refer to the nest page for details).

5.4 Replacing the Master Unit Battery

If low voltage in the memory backup battery is indicated by the corresponding LED on the master unit error indicator, replace it in the following manner:

NOTE

The data in memory will be lost when the battery is removed from the master unit.

Therefore, be sure to record the necessary data (shown below) before starting the replacement.

Data Type	Operation After Replacement
Zero adjustment data	Re-adjust the data according to item (1) in Section 6.4
Sensitivity adjustment data	Re-adjust the data according to item (2) in Section 6.4
Span adjustment data	Re-adjust the data according to item (3) in Section 6.4
Milepost data	Re-enter the data according to Subsection 6.5.3
Response speed data	Re-enter the data according to Section 6.2
Alarm speed data	Re-enter the data according to Subsection 4.4.1
GPS format data	Re-set the data according to Section 6.6.
voltage output range data	Re-select the data according to Section 6.7

● Replacement Method

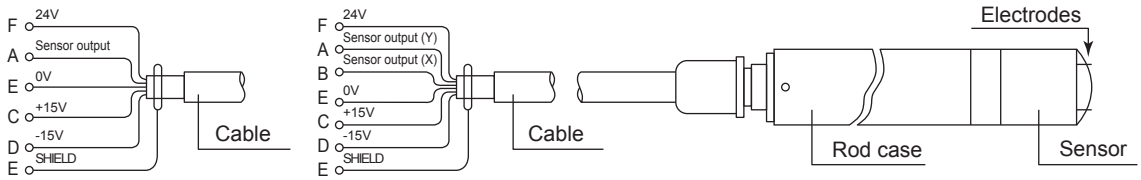
Turn off the power supply switch. Wait 1 minute, and then remove the battery from the master unit. Next, insert a new battery, while pressing the '+' contact on the battery holder.

5.5 Inspection of the Measurement Rod

CAUTION
Do not use a megger for inspection purposes except for on-board power supply terminals. Otherwise, the equipment may be damaged.

Remove the measurement rod from the sewater valve.

(1) Cable, Rod Case, and Sensor

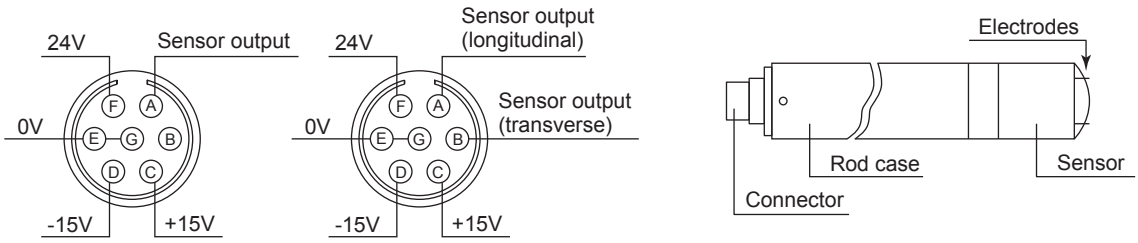


Single - indication
(HS1 / HD1 / HV1/ FA1 / RD1)

Dual - indication
(HV2 / FA2)

(2) Rod Case and Sensor

Cross-section of Connector



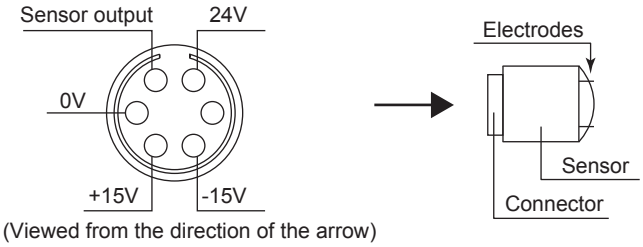
Single - indication
(HS1 / HD1 / HV1 / FA1 / RD1)

Dual - indication
(HV2 / FA2)

(3) Sensor

The connector on the sensor has the same pin arrangement as the connector at the end of the rod.

Cross-section of Connector (HD1, RS1, RD1)



(Viewed from the direction of the arrow)

● Continuity check

NOTE

Use a digital multimeter for a continuity check.

Tester Polarity / Terminals	G, E : NEGATIVE	G, E : POSITIVE
E-A (0V - sensor output)	O.L	O.L
E-B (*1)	O.L	O.L
E-C (0V - +15V)	6kΩ min	6 kΩ min
E-D (0V- -15V)	1.2MΩ min	10MΩ min
E-F (0V - 24V)	5MΩ min	3MΩ min

*1: For dual-indication model only

Between the electrode and rod case (on the right) : MΩ min = 1MΩ

Between the electrode and rod case (on the left) : MΩ min = 1MΩ

Between G and rod case (metal part of the sensor) : 0Ω

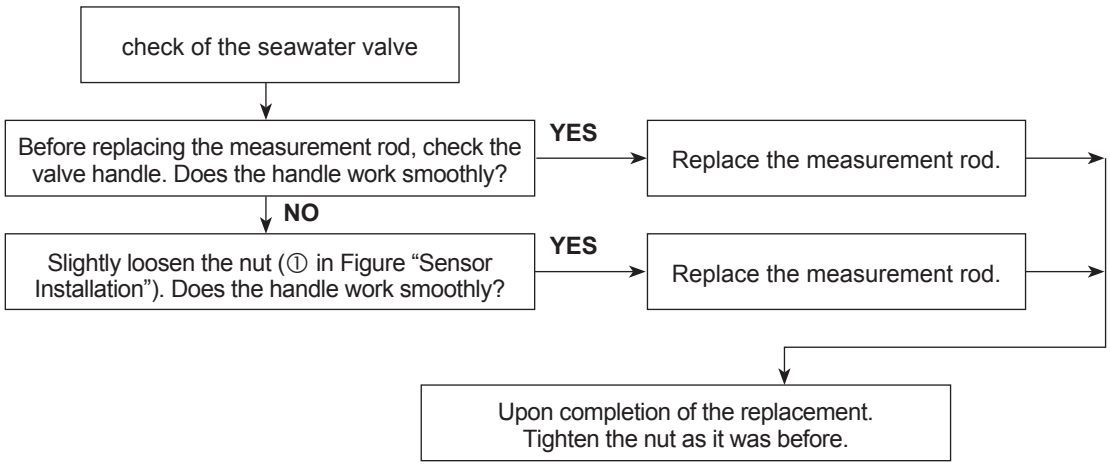
For dual-axis sensor.

Between the electrode and case (longitudinally) : MΩ min = 1MΩ

Between the electrode and rod case (transversely) : MΩ min = 1MΩ

The purpose of this check is for confirmation if sea water entered (or did not enter) in Sensor.
Though the measured data should be a little different by makers and kinds of tester,
If the data is over 6Ω, there will be no problem.
Concerning the operating check of Sensor Checker (Extra-sold: QY001) should be used.

5.6 Inspection of the Seawater Valve



5.6.1 Precautions in Replacing the Sensor

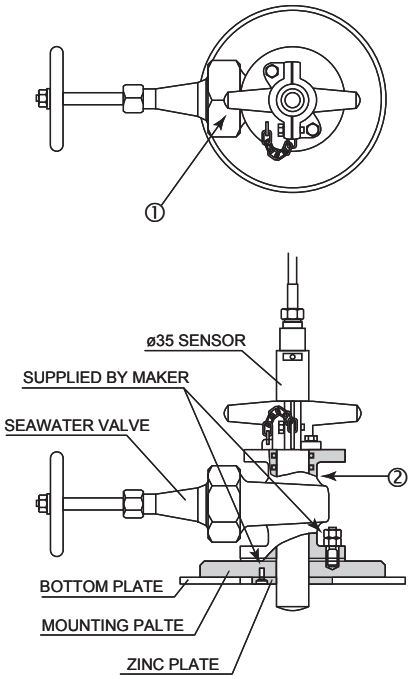


Figure Sensor Installation

(1) Before making a replacement, check the handle operation.

(2) Place a spare sensor on the seawater valve (② in Figure “Sensor Installation”). Pull up the currently used sensor to almost the same height as the spare sensor, and turn the handle to close the seawater valve. Then, Remove the sensor and replace it.

CAUTION

■ Removal of Measurement Rod

- To remove the measurement rod, pull it all the way up and close the seawater valve. Then remove the rod.
- If the rod is removed before closing the valve, seawater will spew out through the valve.
- To remove the chain, fully close the valve (for the HS, HV, and FA models). Then remove the chain.

5.6.2 Precautions in Installing the Sensor

NOTE

(1) Install the sensor with its heading mark aligned with the heading of the ship. The direction of the bow is indicated by the dot mark in the sensor.

(2) To prevent the sensor from being stuck, apply a lubricant before inserting it into the sewater valve. In this case, do not use an excessive amount of lubricant. If there is lubricant on the electrodes at the top of the sensor, an indication error may occur.

CAUTION

Do not drop the measurement rod or allow any mechanical shock at the tip of the rod. Otherwise, the rod may be damaged.

6. INSTALLATION

CAUTION

Do not use a megger for inspection purposes except for on-board power supply terminals. Otherwise, the equipment may be damaged.

6.1 Precautions on Installation

6.1.1 Seawater Valve and Measurement Rod

(1) Install the sensor near the bow-to-stern line and pivoting point.

(2) The bottom of the ship's hull must be flat and smooth.

(3) There must be no water inlet or outlet disturbing the flow of water near the sensor.

(4) There must be not protrusions in the area around the sensor on the bottom of the ship's hull : 5m toward the bow; 2.5 m to the right and left; 2.5 m toward the stern.

(5) (a) Confirm the sensitive unit should be projected by 50 mm (30 mm for HS1) from ship's bottom after installation of sea valve while the vessel. (at Ø35 sensor)

(b) Following maintenance space should be kept to pull out the rod meter. The length of rodmeter + 450 mm from the top of tank. (at a double bottom)

(c) When pull out the rod meter, do not remove the chain setting until the sea valve is closed perfectly. Confirm maintenance space to pull out the rod meter. (at Ø35, Ø48, Ø70 sensor)

(6) Align the bow mark on the measurement rod with the bow.

(7) Do not apply a lubricant or oil to the electrodes. This may cause an error.

6.1.2 Junction Box

(1) Allow for a length of between the measurement rod and junction box long enough for the measurement rod to be pulled up easily during maintenance.

(2) Use the supplied cable between the measurement rod and junction box.

6.1.3 Master Unit

(1) Install the master unit where operation and maintenance can be performed easily (the main power switch is on the master unit).

(2) Connect the ground terminal of the case to the ship.

(3) Do not use a megger except when checking the on-board power supply terminals.

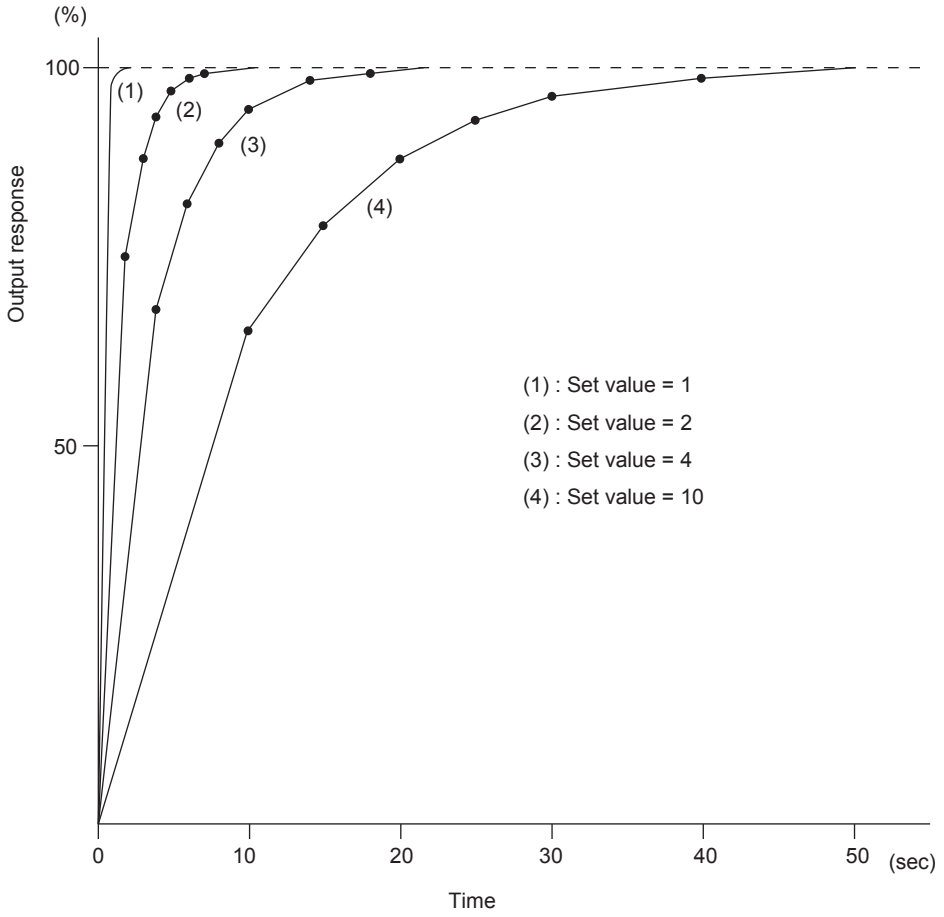
6.1.4 Indicator

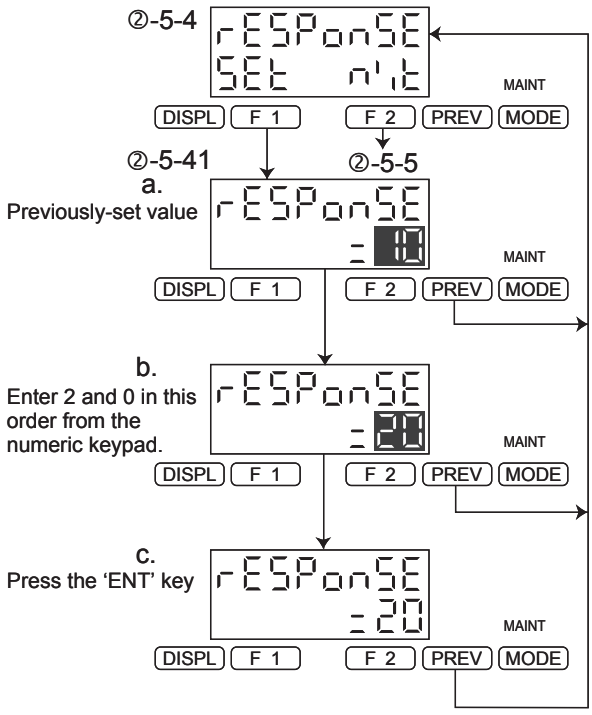
(1) General — Install the indicator where it can be seen clearly.

(2) LR522 — Connect to TB1-11, 12, set output.
Refer to 6.3.3 for the setting of output.

6.2 Response-speed Setting

Determine the response speed according to the performance of the ship. The relationship between the set value and actual output response is as follows :





Default	: 5
Recommended values	
For ships at 20 kt or 25 kt.	: 5
For ships at 35 kt or 40 kt.	: 3
For ships at 50 kt or 65 kt.	: 2

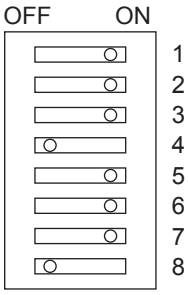
Press the F 1 key at ②**-5-4** to select the response speed setting .The display then changes to that marked **a**. Here, the previously-set value is flickering on the display.

The operation flow on the left gives an example of setting '20'. To do this, first enter 2 and 0 using the numeric keypad. Confirm that the values has just been entered, and then press the ENT key. This stops the flickering (see the display marked **c**), and completes the setting of the new value (at time constant 20 seconds).

Setting range : 1 to 20

6.3 Parameter Settings

6.3.1 Master Indicator



Mode Setting switch

(The figure on the left is the factory setting.)

·Mode setting ..... Dip switch (DSW1)

Various parameters can be set with a combination of the on (right) and off (left) positions of the eight bits (No.1 to No.8) of the dip switch.

·Master indicator

(1) No.1 ..... Not used.

(2) No.2 ..... Not used.

(3) No.3 ..... Not used.

(4) No.4 ..... Baud rate **ON** ..... 9600 bps

OFF ..... 4800 bps (factory setting)

(5) No.5 ..... Not used.

(6) No.6 ..... Not used.

(7) No.7 ..... Not used.

(8) No.8 .....LR221 Connection **ON** ..... no connection

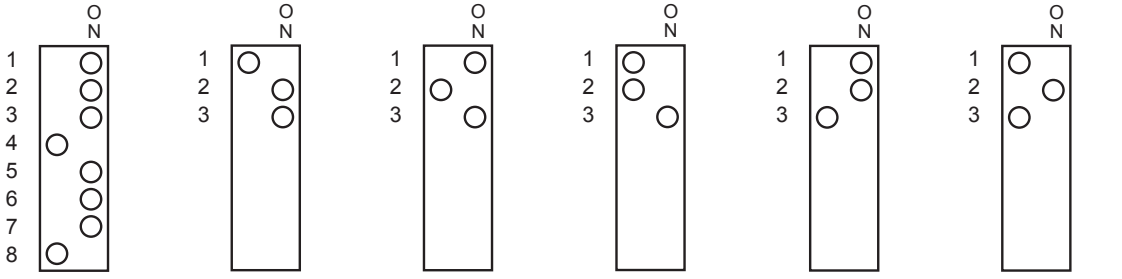
OFF ..... connection (factory setting)

6.3.2 Analog Indicator

(1) No.1 / No.2 / No.3 ..... Speed rage setting (DSW1)

Various speed ranges can be set based on the combinations of the on and off positions of these switch bits as shown below.

- 4kt to 20 kt **- 5 kt to 25 kt** **- 7 kt to 35 kt** **- 8 kt to 40 kt** **-10 kt to 50 kt** **-13 kt to 65 kt**



(2) No.4 ..... baud rate **ON** .....9600 bps **OFF** ..... 4800 bps (factory setting)

(3) No.5 .... Not used.

(4) No.6 ..... Selection of single -axis or dual-axis

ON ..... single-axis **OFF** ..... dual-axis

(5) No.7 ..... Selection of dual indication data

ON ..... Resultant speed and direction of ship movement

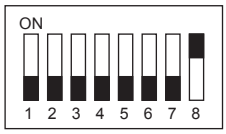
OFF ..... Longitudinal and transverse speeds

(6) No.8 ..... LR221 Connection

ON ..... no connection **OFF** ..... connection (factory setting)

6.3.3 Master Unit

● SW8 Function setting



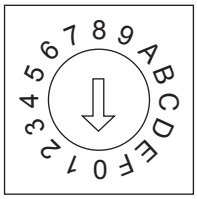
Set the No.6 switch to 'ON' to enter the maintenance or sub-maintenance mode. In normal operation, this switch must be off to protect data in the memory:

SW No.	ON	OFF	Remarks
1	Not used	Fixed	
2	Dual-axis	Single-axis	Type of sensor
3	Connection	No connection	GPS sensor
4	Ground speed	Water speed	Water speed field data
5	Version 2.3	Version 2.0	NMEA0183
6	Maintenance	Normal	Operation Mode
7	Reset	Working	Memorized Data
8	Connection	No connection	LR221

NOTE

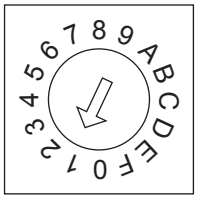
When set the switch No.7 to ON and turn the power switch ON, all adjustment and distance data is initialized.

● SW 3 Range setting



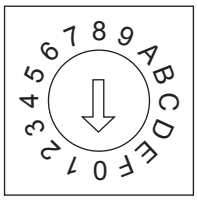
SW No.	Range
0	20 kt
1	25 kt
2	35 kt
3	40 kt
4	50 kt
5	65 kt
6	20 kt
.	↓
F	

● SW 2 baud rate setting (between the master indicator and speed indicator)



SW No.	Baud rate	
0	9600 bps	
1	4800 bps	(Factory setting)
2		
.		
F		

● SW4 Analog output setting



Procedure of selection vide 6.7

SW No.	Analog output
0	(a) of 2-3 (7) ①
1	(b) of 2-3 (7) ①

● SW11 Output setting of TB1-11,12

When connection the indicator LR522, set SW11

SW No.	LR522	
	NOT CONNECT	CONNECT
1	OFF	ON
2	ON	OFF
3	ON	OFF
4	OFF	OFF
5	OFF	ON
6	OFF	ON
7	OFF	OFF
8	ON	OFF

6.4 Adjustments

(1) Zero Adjustment (Maintenance Mode)

A zero adjustment corrects a zero-point drift which may occur in a circuit other than the one in the sensor. To make a zero adjustment, there mast be no water flowing in the direction to be detected. Therefore, make the adjustment :

· with the sensor placed in a bucket of water, or

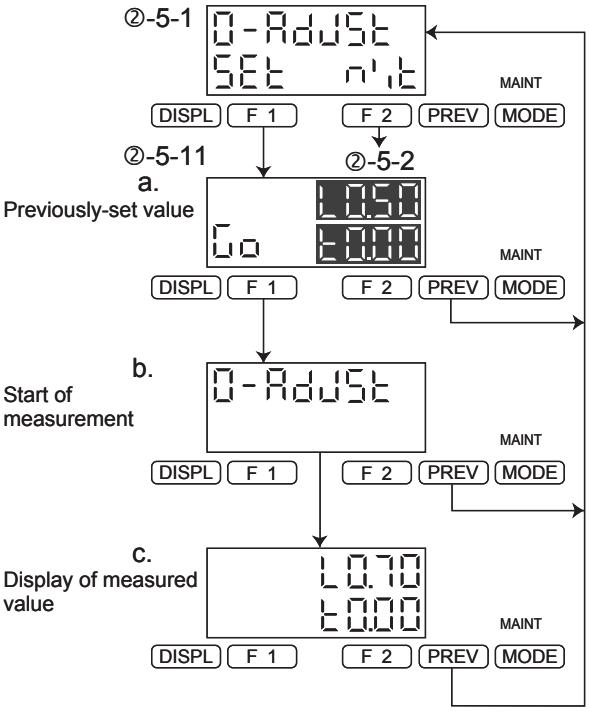
· with the ship at anchor and no water flowing around the sensor.

Furthermore,

· Lightly polish the electrodes in the sensor with the water-resistant sandpaper (at last #600) dampened in water.

· Place the sensor in a bucket of water. Hold the sensor so that its electrodes are in the middle of the bucket: do not let the electrodes come into contact with the bottom of the bucket.

The adjustment procedure is shown in the figure below.



This is the initial display (②**-5-1**) of the maintenance mode. Press the F 1 key at ②**-5-1** to select zero-adjustment. The display then changes to that marked **a**.

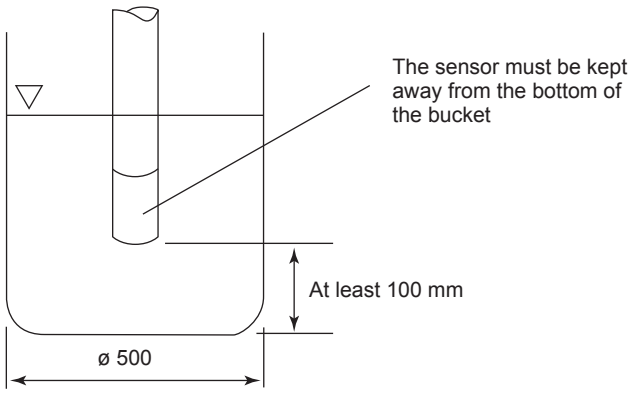
The values high-lighted in reverse video here are the zero-adjustment data that were the latest set. To make a new zero adjustment, press the F 1 key ('GO'). The display changes to that marked **b**, and then further changes to that marked **c** after approximately 20 seconds. On this display, the new zero-adjustment data are displayed.

Press the ENT key to enter the data.

Press the PREV key when the data are not entered.

At ②**-5-1**, press the F 2 key (NXT) to advance to sensitivity adjustment (②**-5-2**).

(Refer to page 6-7 for details on sensitivity adjustment.)



(2) Sensitivity Adjustment (Maintenance Mode)

The differences in sensitivity among sensors can be adjusted with this function. If the accuracy of the reading changes when the sensor is replaced, make a sensitivity adjustment.

The sensitivity adjustment value can be obtained from the following expression :

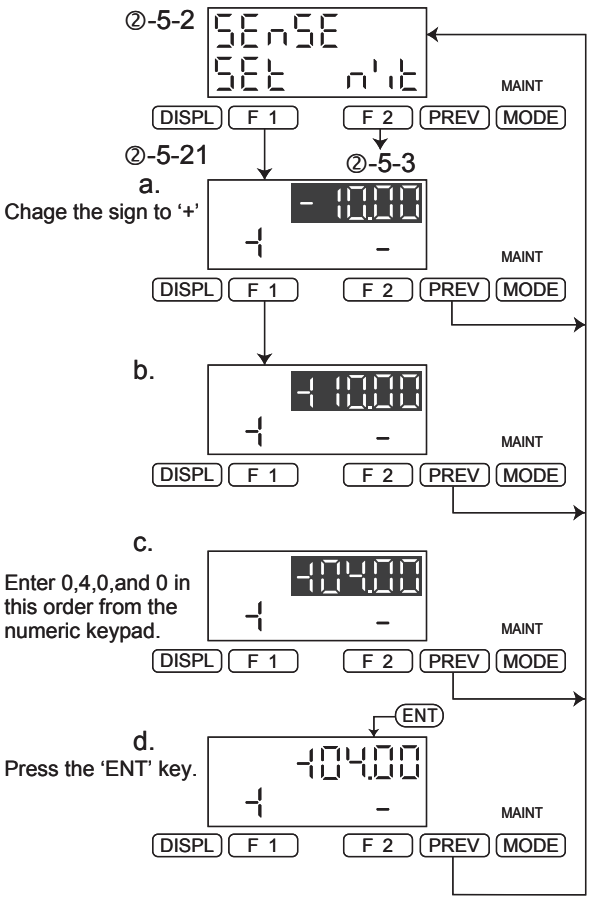
$$\text{Set value} = \frac{SPD1}{SPD2}(SS1 + 100) - 100$$

SPD1 : Intended speed

SPD2 : Current speed

SS1: Current set value

The adjustment procedure is shown in the figure below .



Press the F 1 key at ②**-5-2** to select sensitivity adjustment. The display then changes to that marked **a** . The value highlighted in reverse video here is the adjustment data that were the latest set.

To change it to '+4.00%' for example, first press the F 1 key to change the sign to '+' (see the display marked **b**). Next, enter 0 , 4 , 0 , and 0 using the numeric keypad.

Confirm the entered value, and then press the ENT key. This stops the flickering and completes the setting of '+4.00%' (see the display marked **d**).

To set a minus value, press the F 2 key ('-') while the display is at **a**, and enter the value using the numeric keypad.

(3) Span Adjustment (Maintenance Mode)

If an error in the speed is proportional to the actual speed, it can be adjusted by multiplying the speed by a certain coefficient (the span-adjustment value). This adjustment is made to minimize a discrepancy between the displayed speed and actual speed before a milepost measurement is made.

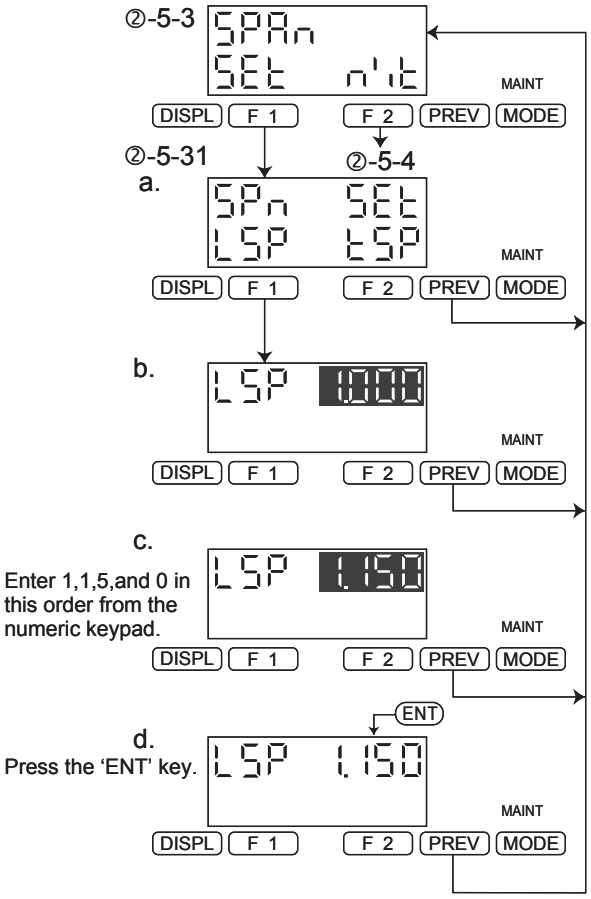
NOTE

Span-adjustment data have an effect on milepost data.

Therefore, do not change the value after a milepost measurement.

A span adjustment is also necessary if the speed error has become larger due to contaminants adhering to the bottom of the ship after many years of service.

The adjustment procedure is shown in the figure below.



At ②**-5-3**, press the F 1 key to select span adjustment. The display then changes to that marked **a**. In a single-axis sensor system , however, 'TSP' (transverse span) does not appear on the display.

To select 'LSP' (Longitudinal span), press the F 1 key while the display is at **a**.

The display then changes to that marked **b**.

The value highlighted in reverse video here is the adjustment data that were the latest set.

To change it to '1.15 times' for example, enter 1 , 1 , 5 , and 0 using the numeric keypad (see the display marked **c**).

Confirm the entered value, then press the ENT key. This stops the Flickering and completes the setting (see the display marked **d**).

Setting range : 0.600 to 1.800

To set 'TSP', press the F 2 key while the display is at **a**, and then use the same procedure as that for 'LSP'.

6.5 Milepost Measurement (Maintenance Mode)

In actual navigation, the flow of water detected by the sensor in the measurement rod depends on the installation position of the sensor, type of ship, length of the protruding sensor, draft, and the ship's speed. Therefore, to obtain more accurate data, it is necessary to compare the indicated speed with the actual one, and correct any discrepancy between them.

The actual speed can be measured when the ship is sailing on calm water over a certain distance. In this case, however, the tide and wind can affect the speed . To eliminate these factors, the ship makes a round trip between mileposts. For accurate measurement, preliminary sailing is also necessary to minimize any variations in the speed, and the ship must take the correct course between mileposts.

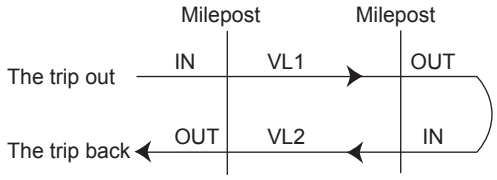
In milepost calibration, the ship makes a round trip (2 one-way trips) or a round trip plus another on-way trip (3 one-way trips) to obtain a set of data which serves as the unit of measurement. The mean values of the actual speed and log speed are calculated based on these milepost measurement data.

(1) One round trip

Measurement for a round trip is recommended if the influence from the tide and wind is constant with respect to the time.

Mean log speed /mean actual speed : VL

$$VL = \frac{VL1+VL2}{2}$$



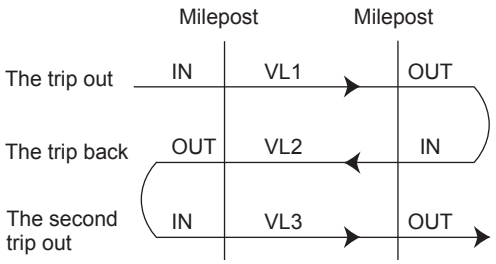
Round-trip measurement

(2) One and a half round trips

Measurement for three one-way trips is recommended if the influence from the tide and wind is changing along with the time.

Mean Log speed / mean actual speed : VL

$$VL = \frac{VL1 + 2 \times VL2 + VL3}{4}$$

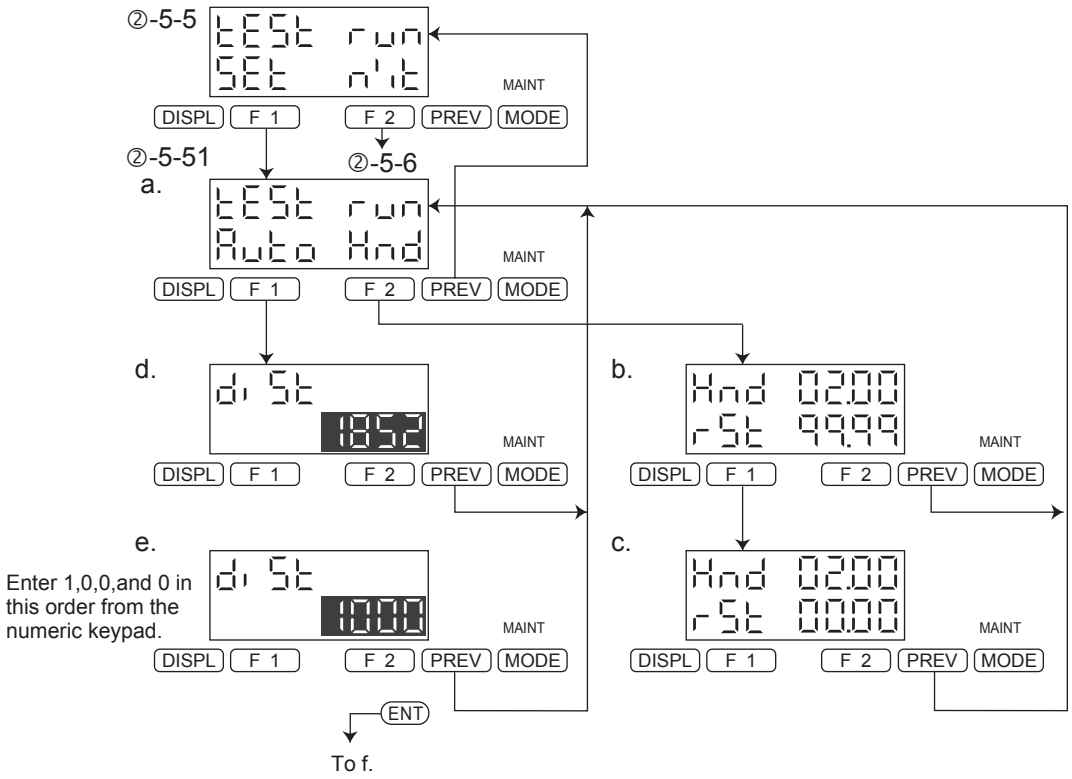


One-and-a-harf-round-trip measurement

6.5.1 Automatic Milepost measurement

In this measurement, the actual speed in automatically calculated based on the travel time and the distance between mileposts which has been set in advance. To obtain the log speed, the speed detected by the sensor is automatically averaged. Milepost measurement is usually performed in the automatic mode. The operation flow is shown in the figures on the following pages.

At ②**-5-5**, press the F 1 key to select the milepost mode. The display then change to that marked **a**.



● Manual milepost mode

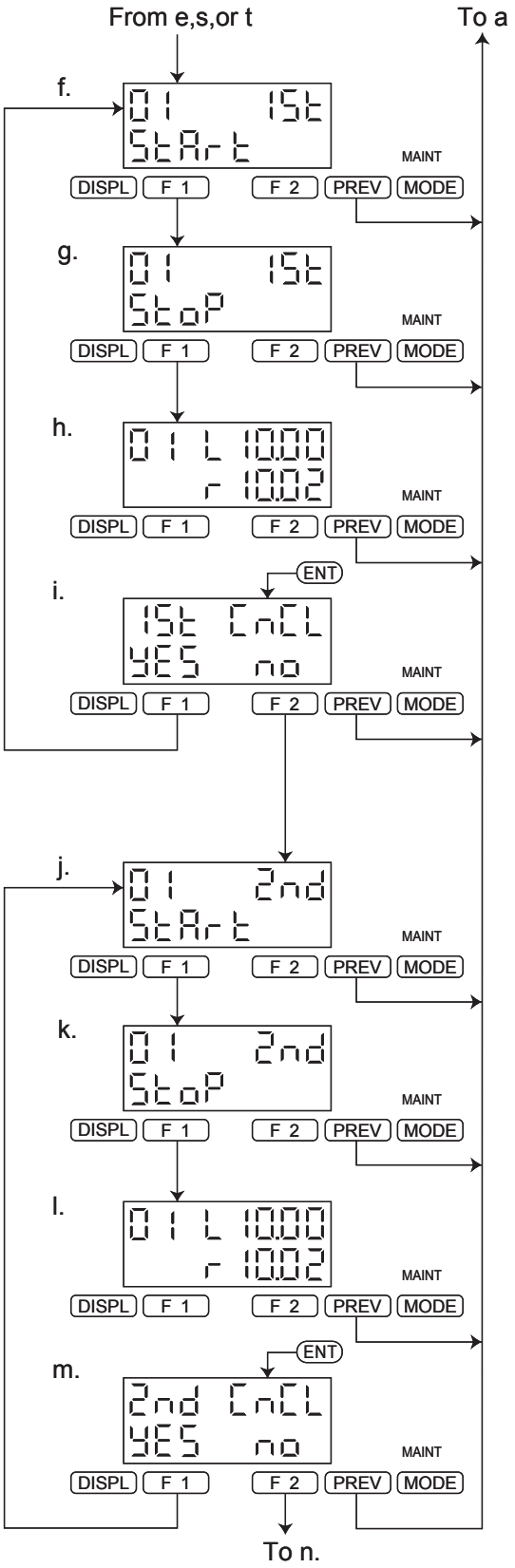
Press the F 2 key (HND) while the display is at **a** to select the manual mode. The display then changes to that marked **b**. The values on this display are the log speed (without intermediate-error and span adjustments) and the distance.

If the F 1 key is pressed while the display is at **b**, the distance is reset and the display changes to that marked **c** (this distance is different from the total distance and trip distance; therefore, the resetting of this distance has no effect on them).

● Automatic milepost mode

Press the F 1 key (AUTO) while the display is at **a** to select the automatic mode. The display then changes to that marked **d**. The value highlighted in reverse video here is the distance that was the latest set . To change it to '1000 m' for example, enter 1, 0, 0, and 0 using the numeric keypad. Confirm the entered value, and then press the ENT key. This allows the display to advance to **f** on the following page.

Note that the operations at **a** to **i** are for obtaining data on the first trip out (1ST).



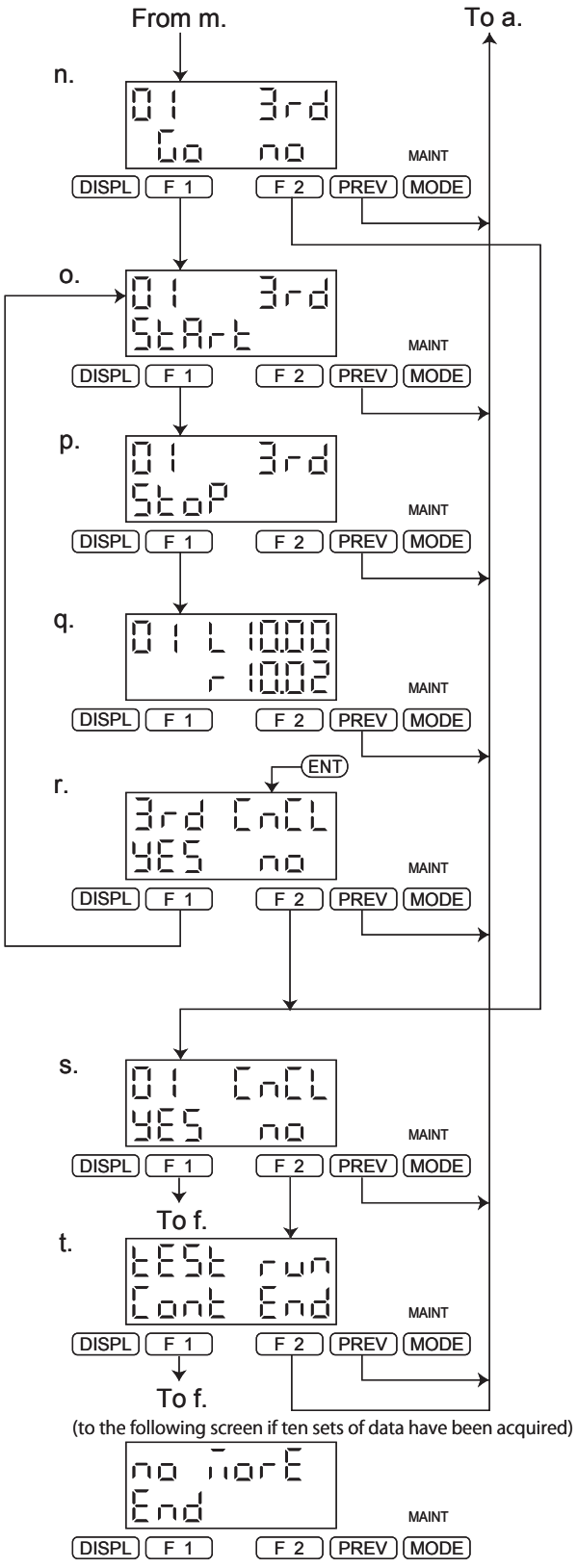
At **f**, press the F 1 key (START) when the first trip out starts. The display then changes to that marked **g**. Next, press the F 1 key (STOP) when the trip out is finished. This allows the display to change to that marked **h**. Here, the log speed (L) and real speed (R) that have just been obtained are displayed.

If the ENT key is pressed at **h**, the display marked **i** appears. This display asks whether the obtained data on the trip out are to be cancelled or not. To cancel them and restart the trip out, press the F 1 key (YES) . The display then returns to **f**.

To validate the obtained data and proceed to the trip back (2ND), press the F 2 key (NO) while the display is at **i**. This allows the display to advance to **j** (the operations for the trip back start from here).

The operations and display at **j** to **m** are the same as those for the trip out (**f** to **i**).

If the F 2 key is pressed while the display is at **m** (after the completion of the trip back), the display changes to that marked **n** as shown on the following page.



The screen advances to Step **n**. Here, whether a third trip out (3RD) is to be made (GO) or not (NO) is selected. If the F 1 key is pressed to select GO, the screen advances to Step **o**. (operations for the third trip out are activated from here). The operations and screens in Steps **o**. to **r**. are the same as those in Steps **f**. to **i**. (the first trip out).

If the F 2 key is pressed to select NO in Step **n**. or the same key is pressed in Step **r**., the screen advances to Step **s**. Here, whether the set of data that has been saved up to the second or third trip out is deleted (YES) or not (NO) is selected.

Press the F 1 key to delete the existing data and acquire new data. The Screen reverts to Step **f**. to acquire new set of data . If the F 2 key is pressed, the new set of data is saved, and the screen advances to Step **t**.

To acquire another set of data, press the F 1 key (CONT). To finish the milepost measurement, press the F 2 key (END). The screen then returns to Step **a**.

NOTE

If the DISPL or PREV key is pressed to go back to a previous step rather than selecting END in Step **t**., all the milepost data that has been saved will be lost.

6.5.2 Manual milepost Measurement

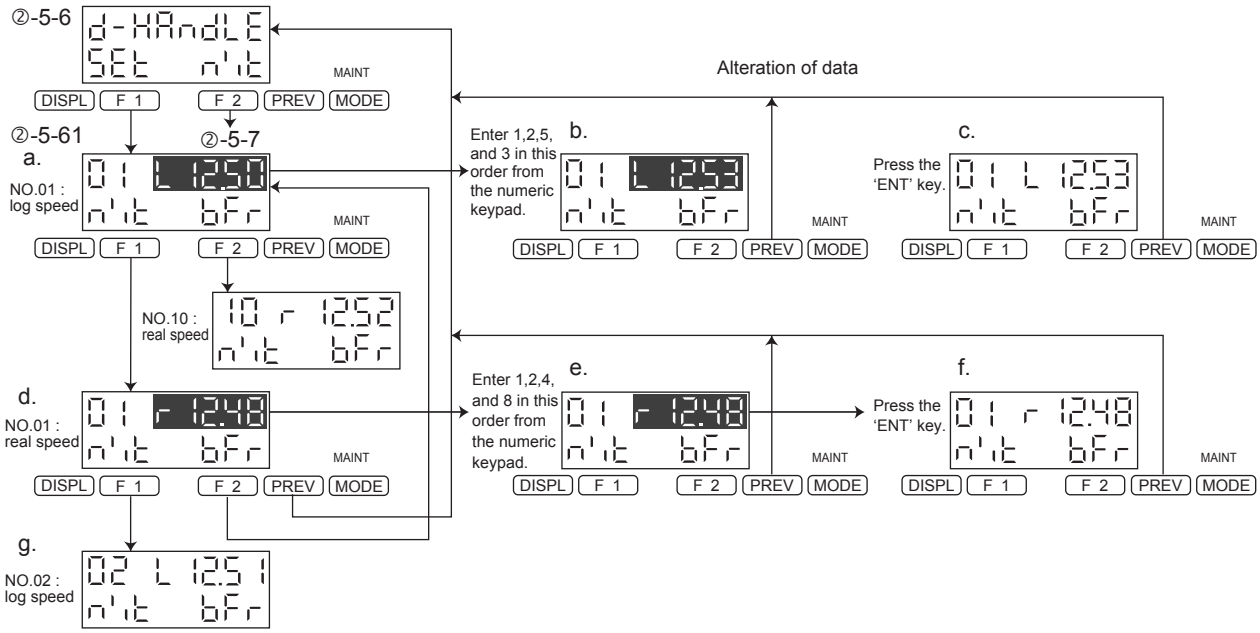
In the manual milepost mode, no data can be set or entered; only the log speed is displayed without intermediate error compensation. This mode is used to backup automatic milepost measurement. If the D-GPS or another speed indicator is available during milepost measurement, the speed obtained by the GPS or the indicator can be used as the real speed, instead of the real speed calculated based on the distance and time.

Record the log speed displayed in this mode, and also record a reading of the GPS (or another speed indicator) as the real speed at the same time. Repeat this operation to obtain enough data. After milepost measurement has been completed, enter these data to improve the milepost measurement (for data entry, refer to Subsection 6.5.3, "Display / Alteration / Deletion of Milepost Data"). Refer to Subsection 6.5.1 for details on the operation.

6.5.3 Display / Alteration / Deletion of Milepost Data (Maintenance Mode)

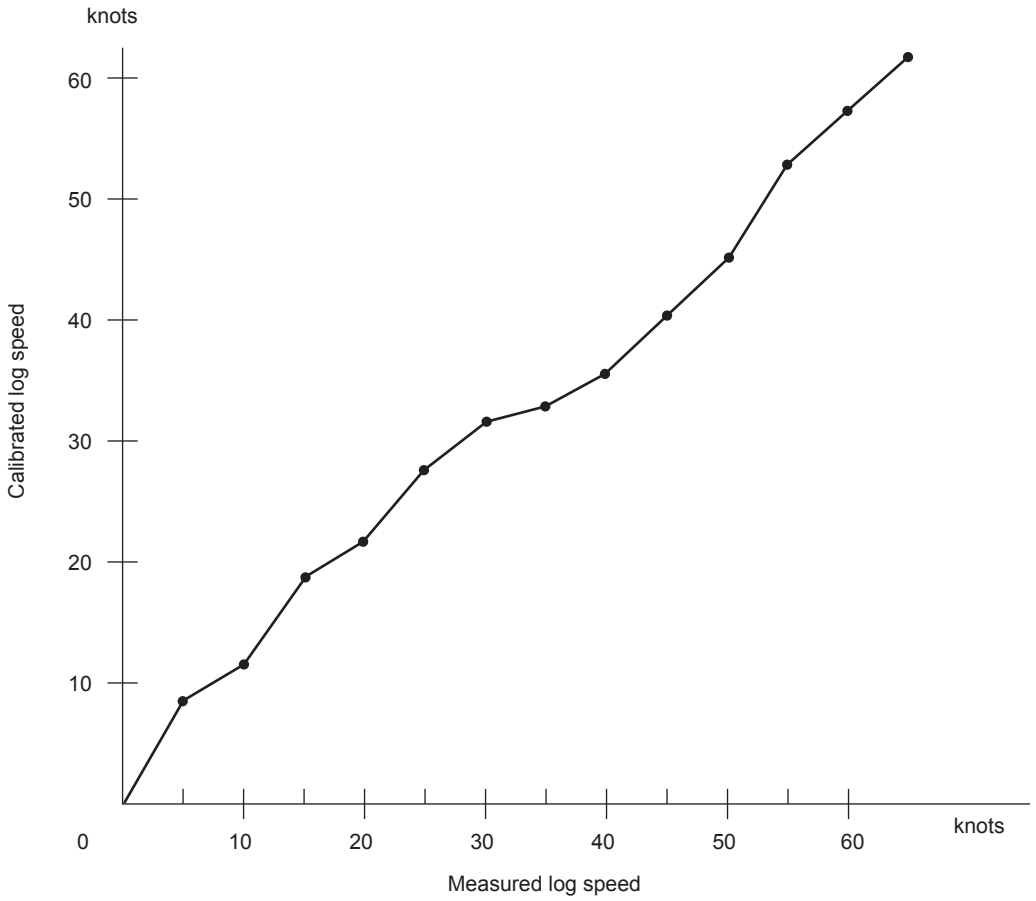
Milepost data can be displayed, altered, added, or deleted as follows:

At ②**-5-6**, press the [F 1] key to select the data handling mode. The display then changes to that marked **a**. While the display is at **a** to **g**. pressing the [F 1] key (NXT) or [F 2] key (BFR) changes the displayed items in the order shown in the following figure. (The number at the beginning of the top line of the display is the data group number. An "L" on the top line means log speed, and "r" means the real speed.)



6.5.4 Dsiplay and Alteration of Linearizer Table (Maintenance Mode)

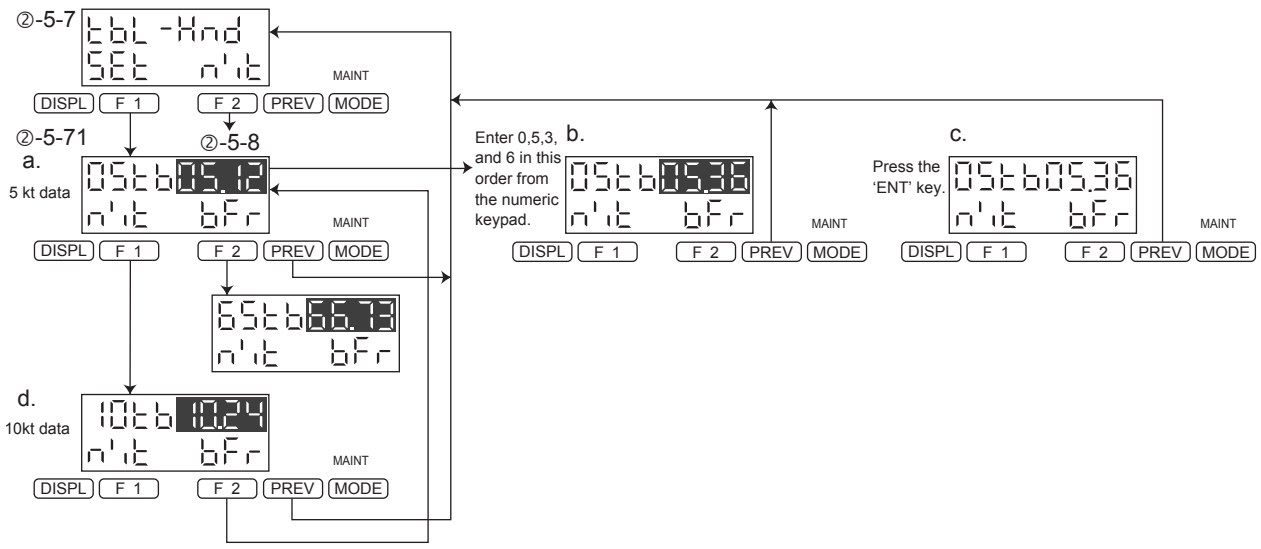
After milepost measurement has been completed, all sets of obtained data are used to calculate the linearizer. In an actual situation, speed errors are corrected according to the linearizer which is represented as line graph (in 5-kt. increments on the measured log speed axis) as shown below.



The calibration curve is listed as a linearizer table as shown below.

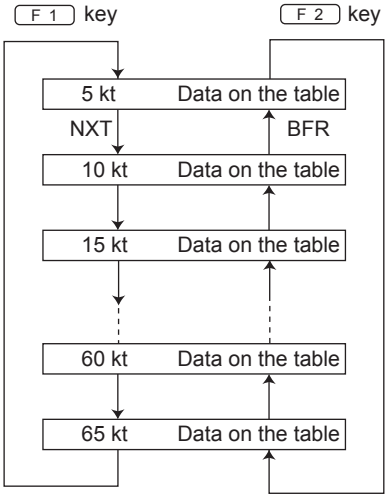
Measured log speed	Calibrated log speed
5 knot	XX.XX knot
10	XX.XX
15	XX.XX
20	XX.XX
25	XX.XX
30	XX.XX
35	XX.XX
40	XX.XX
45	XX.XX
50	XX.XX
55	XX.XX
60	XX.XX
65	XX.XX

The linearizer table can be displayed and modified as follows:



At ②**-5-7**, press the F 1 key to select the linearizer handling mode. The display then changes to that marked **a**.

While the display is at **a** to **d**, pressing the F 1 key (NXT) or F 2 key (BFR) changes the displayed items in the order shown in the figure below. (The number at the beginning of the top line of the display means the log speed level in the linearizer table.)



(i) Modification of data

Press either the F 1 key (NXT) or F 2 key (BFR) until the data to be modified appear on the display. Enter a new value using the numeric keypad. Confirm the entered value, and then press the ENT key. Modification of the data has now been completed.

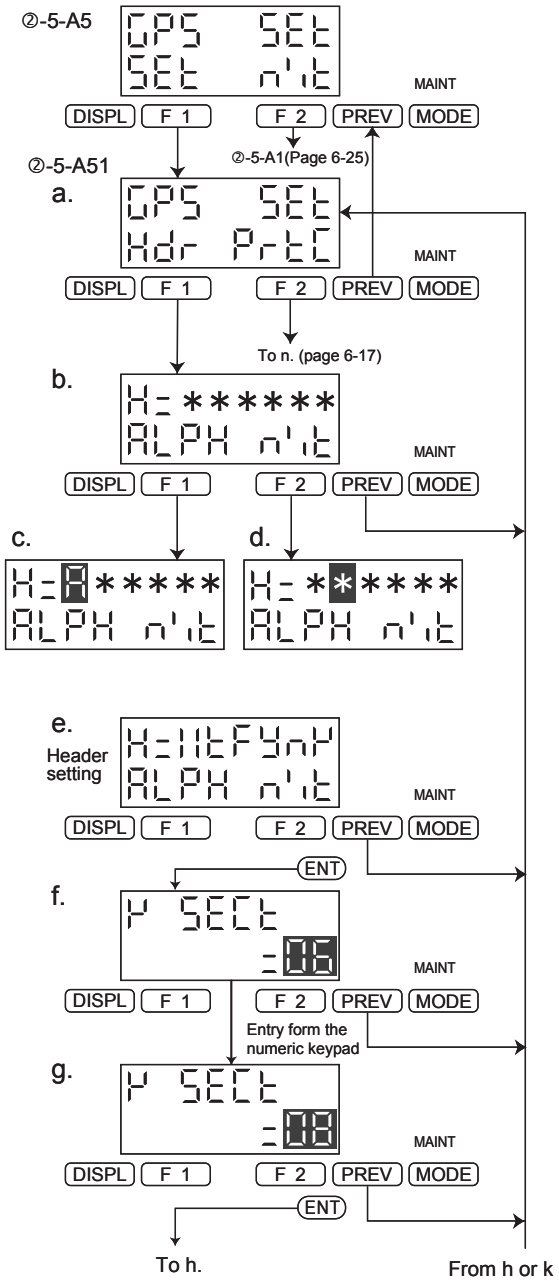
(ii) Confirmation of data

To confirm (refer to) data, press either the F 1 key (NXT) or F 2 key (BFR) until the required data appear on the display.

6.6 GPS Interface Setting

If the GPS is connected to back up the EML500, the communication format of the EML500 must agree with that of the GPS. Set the following items in accordance with the GPS to enable the interface between them:

Header:	up to 6 characters
Speed data position:	number of commas (i.e., the speed data are placed after a specified number of commas)
Checksum data :	used / not used
Terminator :	CR,LF/C0h
Baud rate :	9600/4800/2400
Stop bits :	1 / 1.5 / 2
Parity :	Odd / Even / None
Character length :	7 / 8



The setting procedure is shown in the figures on the following pages.

At ②**-5-A5**, press the F 1 key to select the GPS interface setting. The display then changes to that marked **a**.

Pressing the PREV key at **a** allows the display to return to ②**-5-A5**. If the F 1 key is pressed while the display is at **a**, the format setting mode is selected. If the F 2 key is pressed instead, the protocol setting mode is selected and the display advances to **n** (See page 6-17).

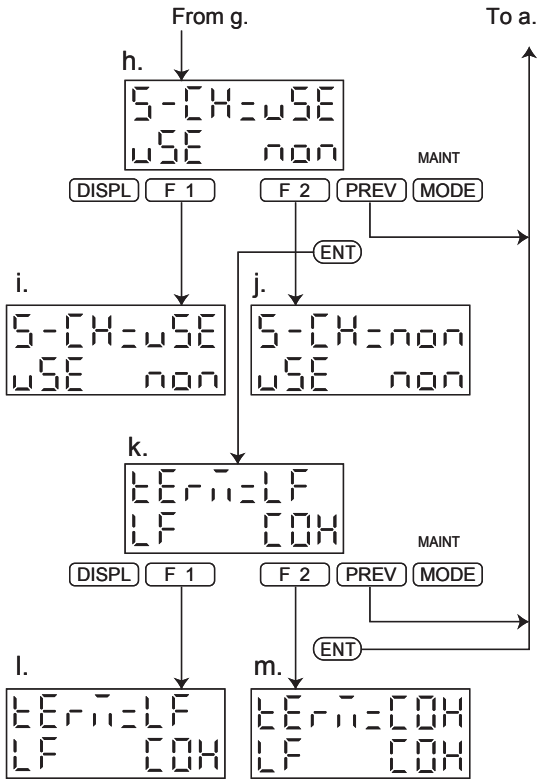
The asterisks "******" in the figure indicate the current header data. Each time the F 1 key (ALPH) is pressed, A to Z , ($), A. (C0h), Z. (0Dh, 0Ah = CR, LF), and a blank space appear one after the other in the space highlighted in reverse video (see the display marked **c**).

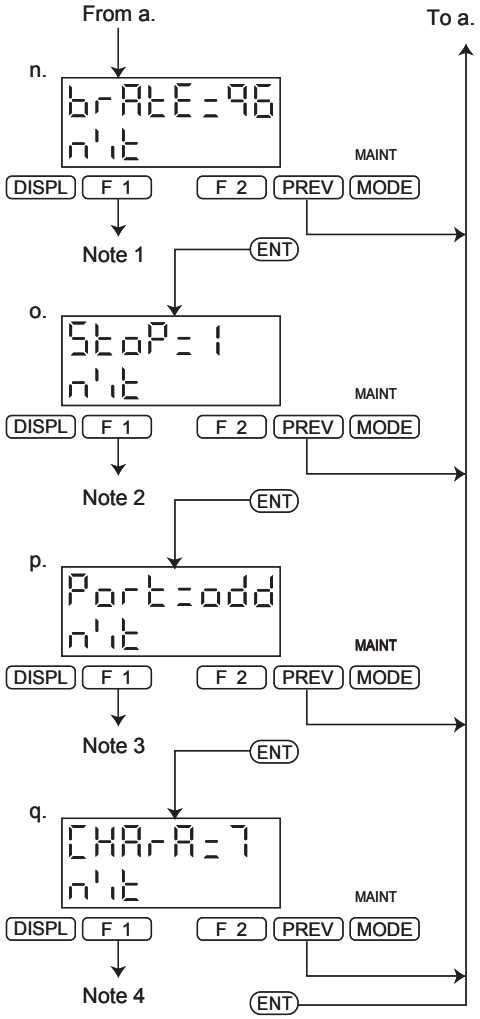
If the F 2 key (NXT) is pressed while the display is at **b**, the position of the inverse video highlight moves right one space (see the display marked **d**).

Enter a header, confirm it, and then press the ENT key. The display changes to that marked **f**.

While the display is at **f**, set the number of commas (,) that are placed before the speed data. The setting range is from 1 to 99 .

Enter a value using the numeric keypad, and then press the ENT key. The display then changes to that marked **h**.





The display marked **h** asks whether cheksum is used or not. Press the F 1 key (USE) to select the use of checksum. The display them changes to that marked **i**.

If the F 2 key (NON) is pressed, checksum is not used and the display changes to that marked **j**.

Pressing the ENT key while the display is at **h**, **i**, or **j** allows the display to advance to **k**.

To select CR,LF as a terminator, press the F 1 key (LF) while the display is at **k**.

The display then changes to that marked **l**. To select code C0h as a terminator, press the F 2 key (C0h) instead. The display then changes to that marked **m**.

Pressing the PREV key while the display is at **b** to **m** allows the display to return to **a**.

At **n**, set the baud rate.

Note 1: the values '96','48',and '24' appear one after the other in this order (96,48,24,96,48,....) each time the F 1 key (NXT) is pressed.

96:9600; 48:4800; 24:2400

Pressing the ENT key allows the display to advance to **o**.

At **o**, set the number of stop bits.

Note: 2 The values '1', '15', and '2' appear one after the other in this order (1,15,2,1,15,.....) each time the F 1 key (NXT) is pressed.

15: 1.5 bits

Pressing the ENT key allows the display to advance to **p**.

At **p**, set the parity bits.

Note 3: The values 'ODD','EVN,' and 'NON' appear one after the other in this order (ODD, EVN, NON, ODD, EVN.....) each time the F 1 key (NXT) is pressed.

ODD : odd; EVN : even; NON : none

Pressing the ENT key allows the display to advance to **q**.

At **q**, set the character length.

Note 4: The values '7' and '8' appear alternately (7,8,7,8,.....) each time the F 1 key (NXT) is pressed.

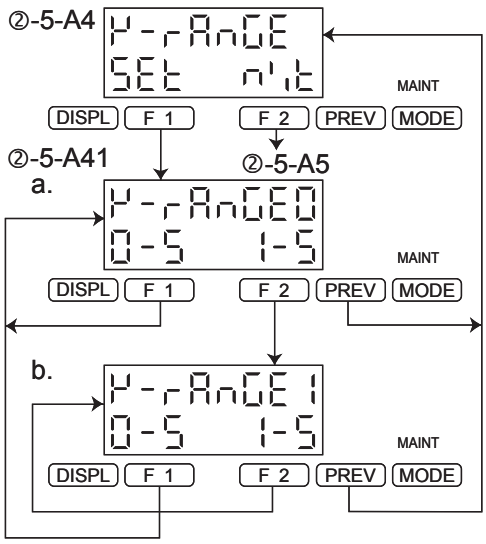
Pressing the ENT key allows the display to return to **a**.

If the PREV key is pressed while the display is at **n** to **q**, the display returns to **a**.

6.7 Switching of Voltage Output Range

Before switching of voltage output range, it is necessary to set the digital switch No.4. (Vide 6.3.3)

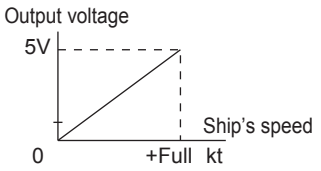
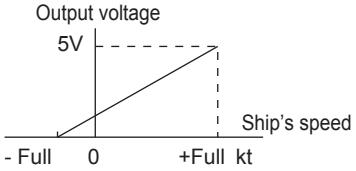
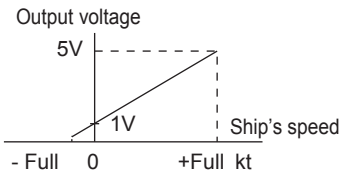
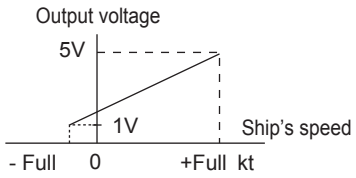
The operation procedure is illustrated in the figure below.



At ②**-5-A4**, press the F 1 key to select the voltage output range setting, the display then changes to that marked **a**.

The value selected at **a** is '0V to 5V' to change it to ' 1V to 5V', press the F 2 key. The display then changes to that marked **b**.

If the F 1 key is pressed at **b**, the display returns to **a** where '0V to 5V' is selected.

Setting of Master indicator ②-5-A41 a.	**Setting of digital SW4**	
	0	1
F1		
F2		

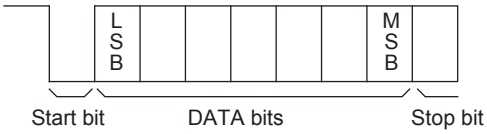
NOTE

Current output is selected automatically as follows.

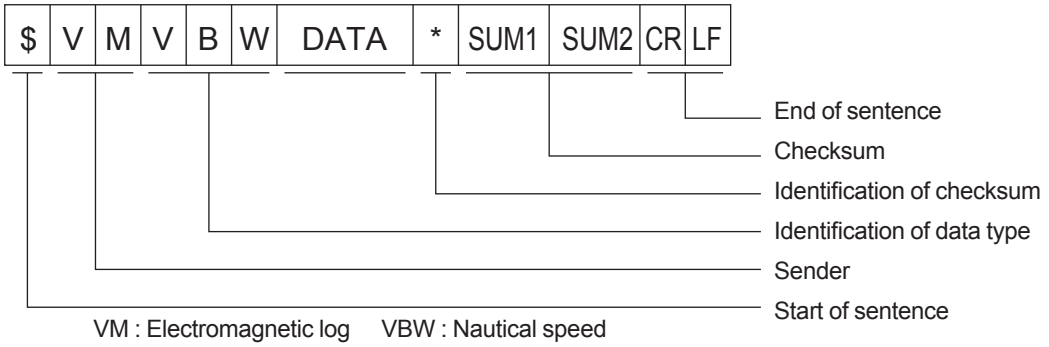
When selecting 0V to 5V output, current output is set 0 mA to 20 mA.

When selection 1V to 5V output, current output is set 4 mA to 20 mA.

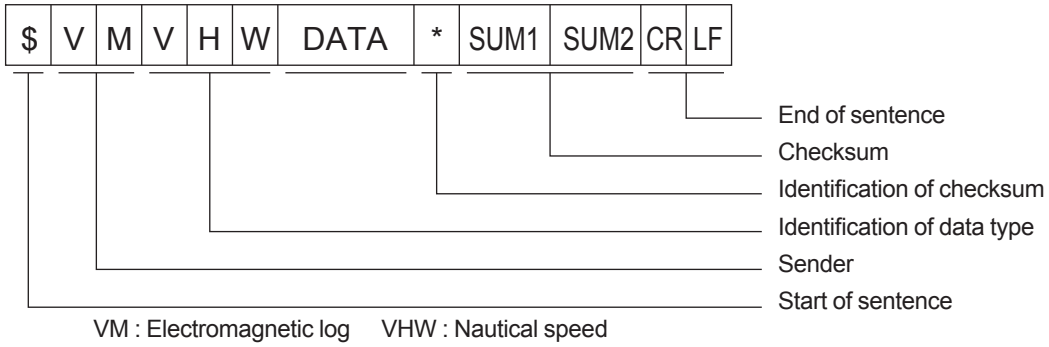
6.8 Serial Output Signal Format

Transmission type :	Start-stop synchronization	
Baud rate :	9600 / 4800 / 2400 bps as per GPS interface setting	
Transmission distance :	1.2 Km	
Transmission period:	1 second (fixed)	
Character format :	Start bit	1
	Data bit	7 / 8 bit as per the GPS interface setting
	Stop bit	1 / 1.5 / 2 bit as per the GPS interface setting
	Parity	non / odd / even as per the GPS interface setting
		

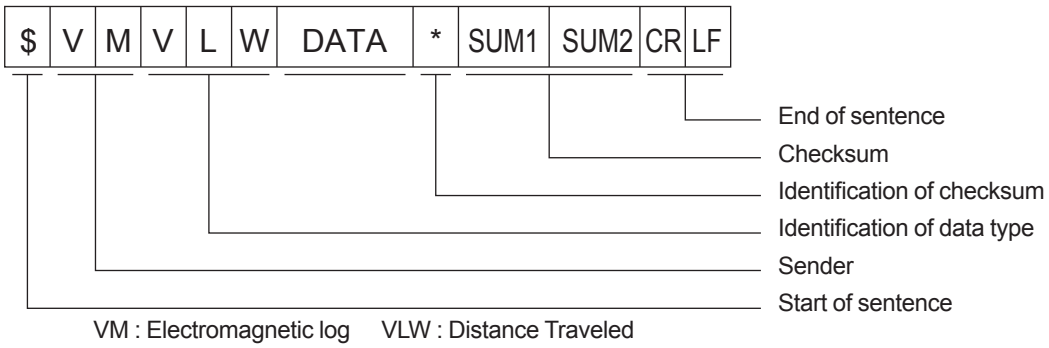
Data format (conforms to NMEA0183)



VM : Electromagnetic log VBW : Nautical speed



VM : Electromagnetic log VHW : Nautical speed



VM : Electromagnetic log VLW : Distance Traveled

· Checksum

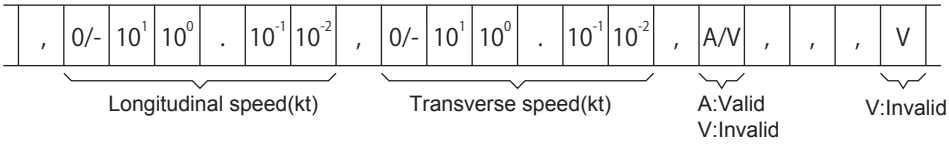
The characters in the area from next "$" to immediately "*" are EXCLUSIVEORed (on a bit-by-bit basis), and then the result is divided into two groups: the upper 4 bit and the lower 4 bit. These two groups (SUM1 and SUM2) are further converted into ASCII, and used as checksum data.

■ Format of the data section

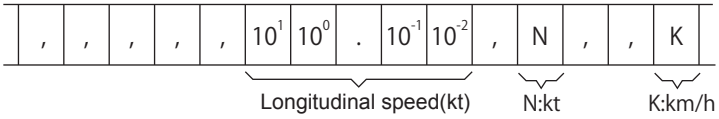
1. NMEA0183 Version 2.0 format

● EML input (dual-axis system)

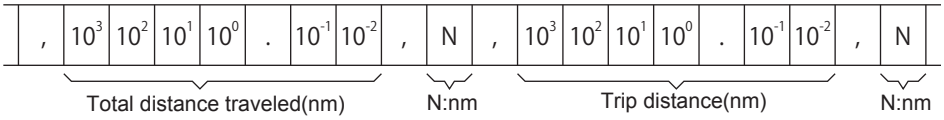
·VBW data



·VHW data (Only 'kt' value data is available)

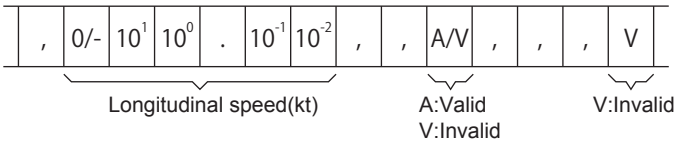


·VLW data



● EML input (single-axis system)

·VBW data



·VHW data

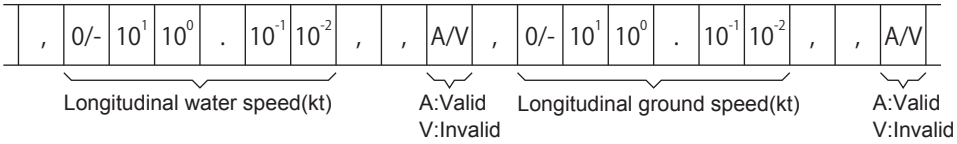
The same EML input (dual-axix system)

·VLW data

The same EML input (dual-axis system)

● GPS input

·VBW data



When set the Dip switch 8-4 to 'ON' , Longitudinal ground speed data is set on this field.

·VHW data

The same EML input (dual-axis system)

·VLW data

The same EML input (dual-axis system)

In the case of system error detection (*1)

·VBW data

,	,	,	V	,	,	,	V

·VHW data

,	,	,	,	,	,	N	,	,	K

·VLW data

,	,	N	,	,	N

*1: Whenever the A/D conversion error is detected, system error will occur, in case of the EML input.

Whenever the Communication error No.2 (with the GPS) is detected, system error will occur, in case of the GPS input.

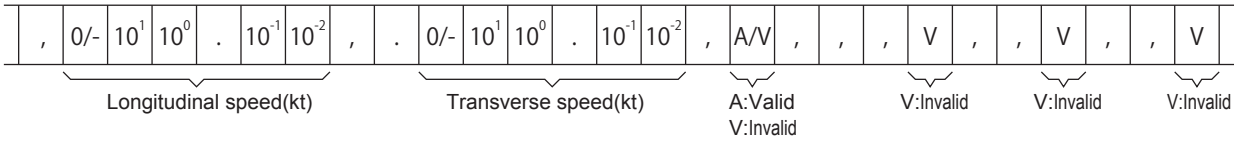
(In this case, the input mode will be changed the EML input automatically.)

Whenever the any factor is detected, ROM error, RAM error, system error will occur, in all cases.

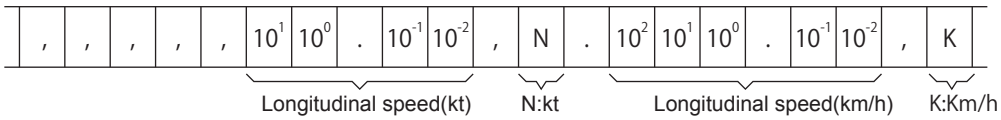
2. NMEA0183 Version 2.3 format

● EML input (dual-axis system)

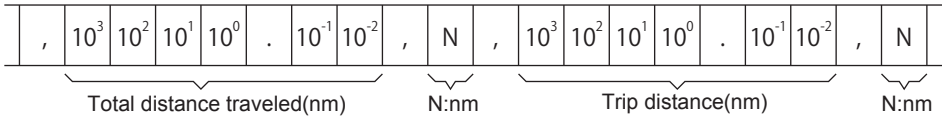
·VBW data



·VHW data

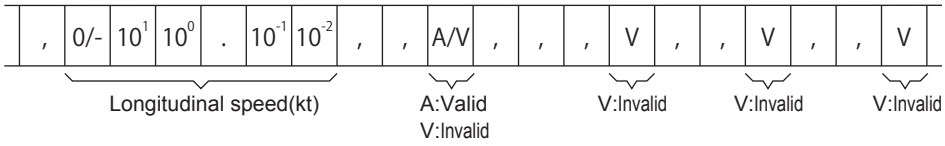


·VLW data



● EML input (single-axis system)

·VBW data



·VHW data

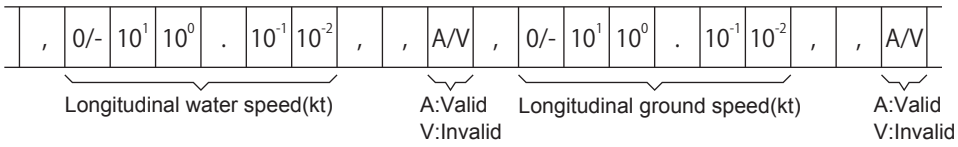
The same EML input (dual-axis system)

·VLW data

The same EML input (dual-axis system)

● GPS input

·VBW data



When set the Dip switch 8-4 to 'ON' , Longitudinal ground speed data is set on this field.

·VHW data

The same EML input (dual-axis system)

·VLW data

The same EML input (dual-axis system)

In the case of system error detection (*1)

·VBW data

,	,	,	V	,	,	,	V	,	,	V	,	,	V

·VHW data

,	,	,	,	,	,	,	,

·VLW data

,	,	,	,

*1: Whenever the A/D conversion error is detected, system error will occur, in case of the EML input.

Whenever the Communication error No.2 (with the GPS) is detected, system error will occur, in case of the GPS input.

(In this case, the input mode will be changed the EML input automatically.)

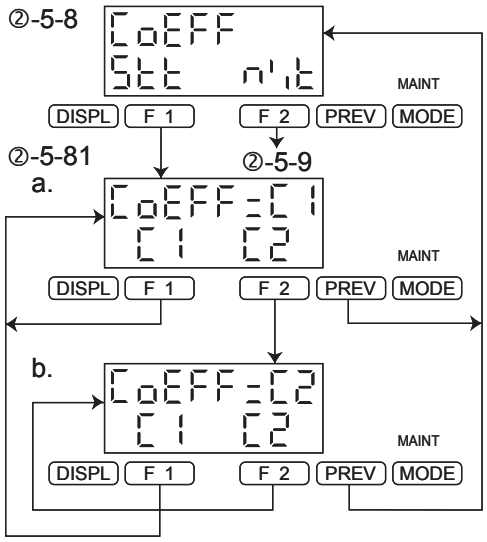
Whenever the any factor is detected, ROM error, RAM error, system error will occur, in all cases.

6.9 Maintenance Functions

6.9.1 Intermediate Error Compensation Factor (Maintenance Mode)

Two linearizer tables are available for intermediate error compensation, and either can be selected in this mode. Therefore, compensation based on the newest linearizer table of compensation based on the previous linearizer table can be done selectively if the compensation coefficient is changed alternately each time milepost measurement is done.

The selective use of these linearizer tables is also useful for ships whose speeds differ when they are fully loaded.



The operation procedure is shown below.

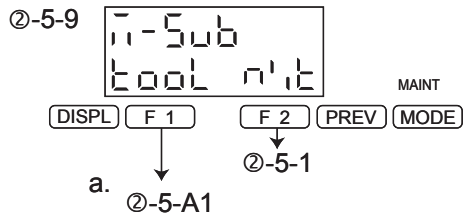
At ②**-5-8**, press the F 1 key to enter the mode for selecting a coefficient. The display then changes to that marked **a**.

At **a**, the display indicates that coefficient 1 (C1) is currently selected. To select coefficient 2 (C2) instead, press the F 2 key while the display is at **a**. The display then change to that marked **b** where coefficient 2 (C2) is selected.

6.9.2 Sub-maintenance Mode

Select the sub-maintenance mode to perform the switch status display, voltage check, fixed voltage output, or GPS interface setting .

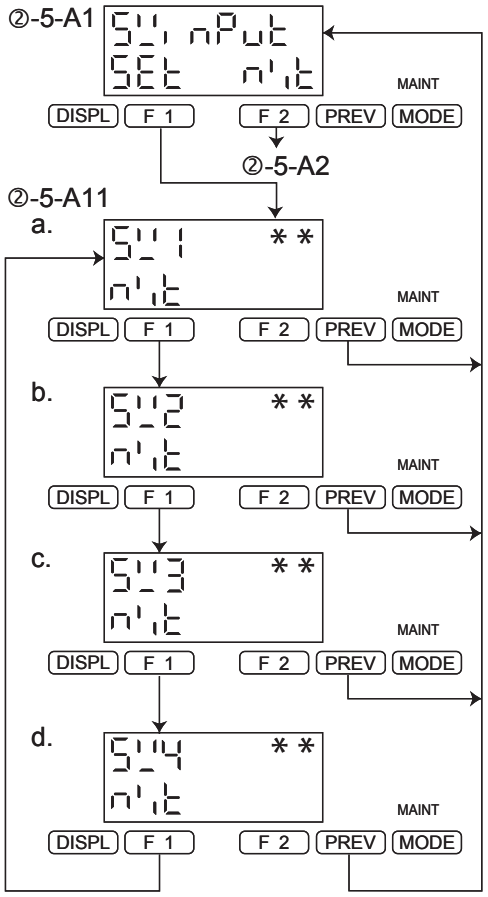
The operation procedure is shown below.



This is the entrance to the sub-maintenance mode.

At ②**-5-9**, press the F 1 key to select the sub-maintenance mode. The display then advances to ②**-5-A1**.

6.9.3 Switch Status Display Mode (Sub-maintenance Mode)



The switch status display is used to see if hardware switch inputs are correct as specified.

The operation procedure is shown below:

At ②**-5-A1**, press the F 1 key to select the switch status display function. The display then changes to that marked **a**.

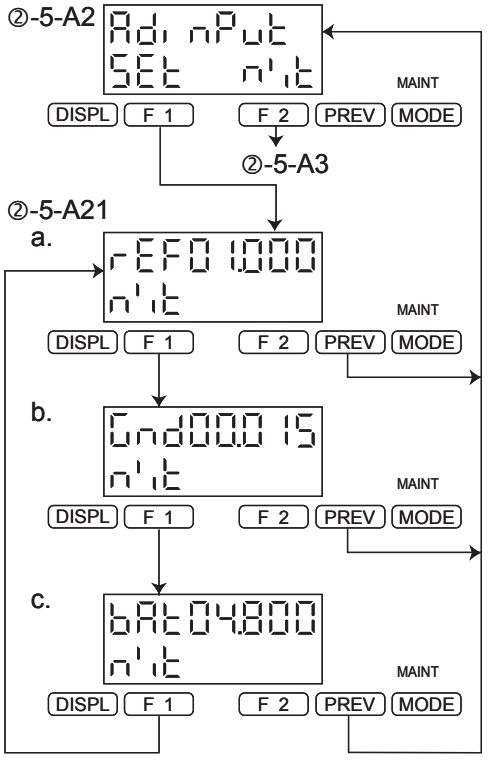
The asterisks "**" on the display mean the switch status is represented as a hexadecimal value (2 digits).

Pressing the F 1 key (NXT) at **a** to **d** causes the next switch status to appear on the display as shown in the figure on the left.

The correspondence between the displayed SW number and the actual SW number on the board is as follows:

Display	Board
SW1	SW 8
SW 2	SW3, SW 2
SW 3	SW 5, SW 4
SW 4	SW 7, SW 6

6.9.4 Voltage Check Mode (Sub-maintenance Mode)



The voltage at several points along the hardware is checked in this mode.

The operation procedure is shown below.

At ②**-5-A2**, press the F 1 key to select the voltage check mode. The display then change to that marked **a**.

At **a** to **c**, pressing the F 1 key (NXT) causes the next voltage value to appear on the display as shown in the figure on the left. The following are the items that are displayed:

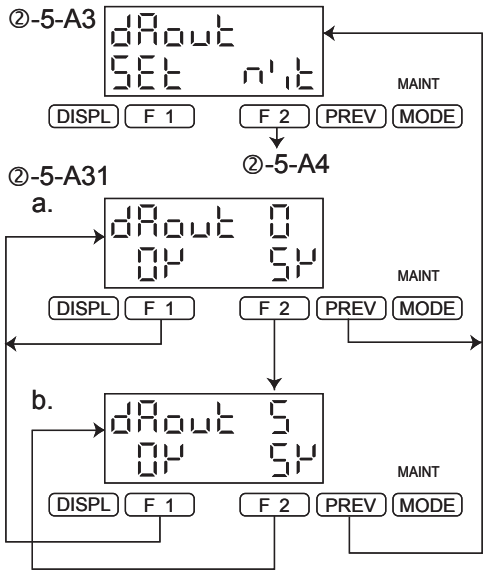
		Standard value
REF:	Reference voltage for A/D converter	4.500 min
GND:	Ground level in the master unit	0.500 max
BAT:	RAM backup battery voltage	2.100 min

6.9.5 Fixed voltage Output Mode (Sub-maintenance Mode)

External devices which receive voltage or output from the master unit can undergo zero or span adjustment in this mode as required. Select a 0V output to fix the voltage and current output to 0V and 0 mA, respectively (to 1V and 4mA if '1V to 5V' has been selected as the voltage output range).

Select a 5V output to fix the voltage and current outputs to 5V and 20 mA, respectively. Leaving this mode allows the voltage and current output to return to the ordinary state where the voltage and current output are proportional to the speed.

The operation procedure is shown in the figure on the following page.



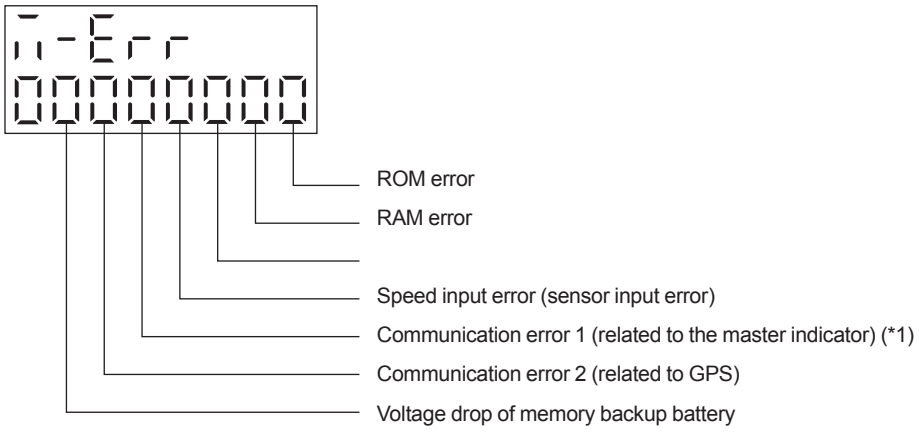
At ②**-5-A3**, press the F 1 key to select the fixed voltage output mode. The display then changes to that marked **a**.

To select the 5V output press the F 2 key while the display is at **a**. The display then changes to that marked **b**, and a fixed voltage of 5V is output. If the F 1 key is pressed while the display is at **b**, the display returns to **a** and a fixed voltage of 0V is output.

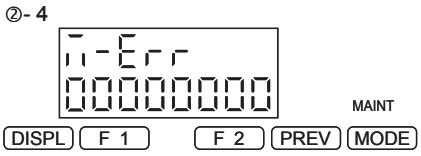
6.10 Error Code Display Mode (Sub-maintenance Mode)

In this mode, LED error indications for the master unit in item (4) of Section 5.3 are as shown below:

LED error indications on the master unit's MDS 1



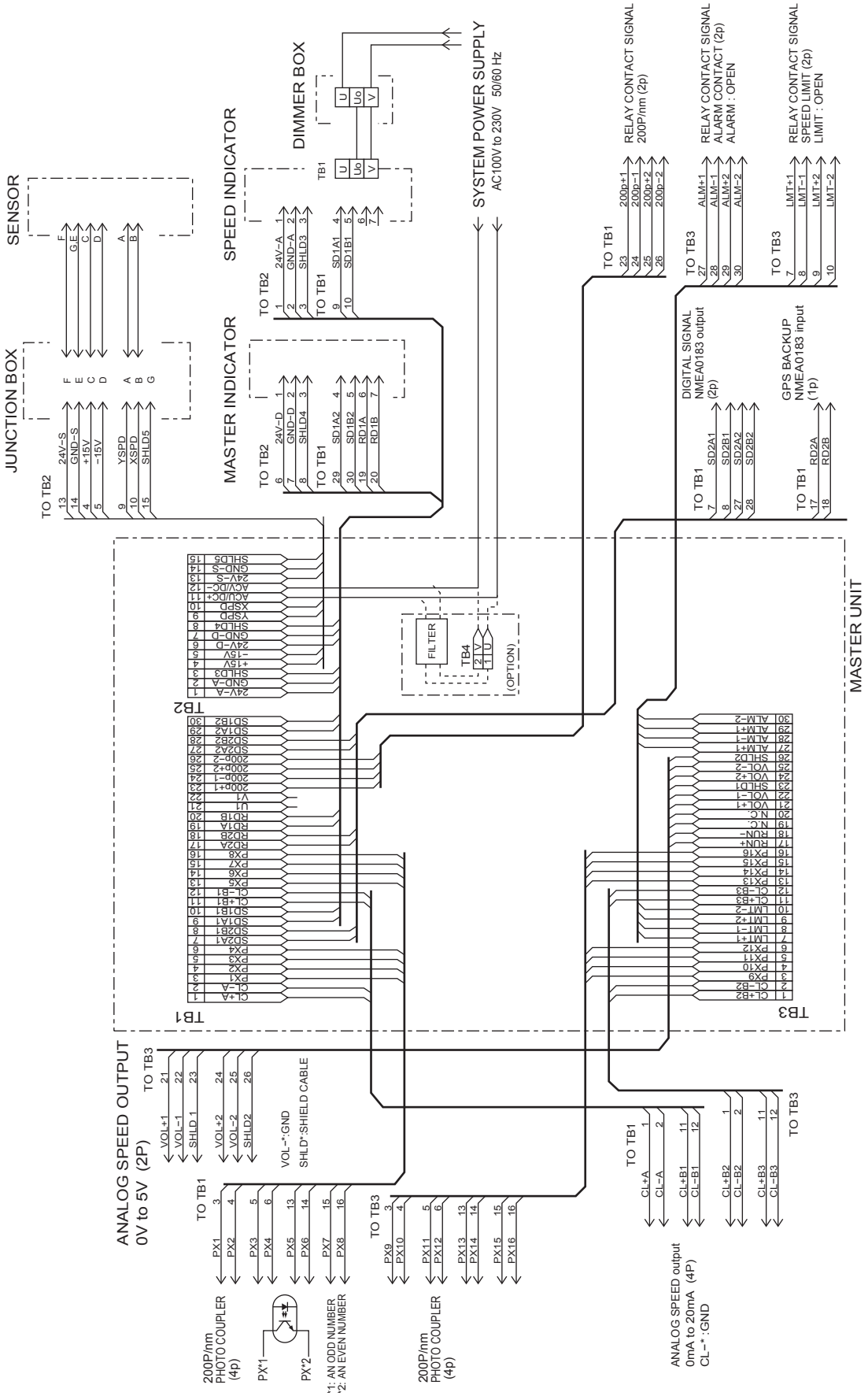
*1: Error information from the Master unit usually becomes “M-Err” in the LED display of the Master indicator, and it becomes “Err” only for “communication error 1”



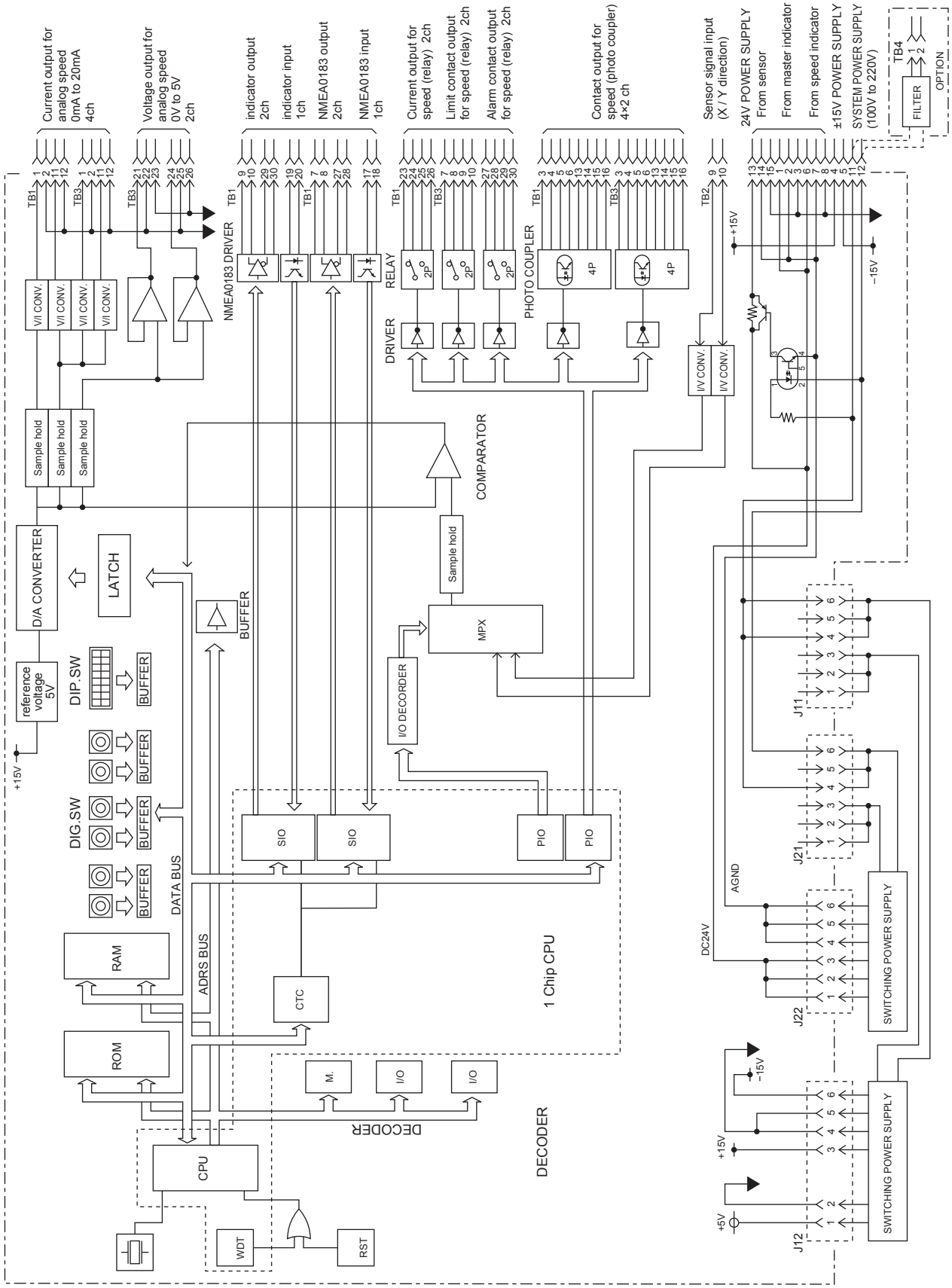
In the Error Code Display Mode, the screen in ②**-4** appears.

Refer to item (4) of Section 5.3 for errors and error codes.

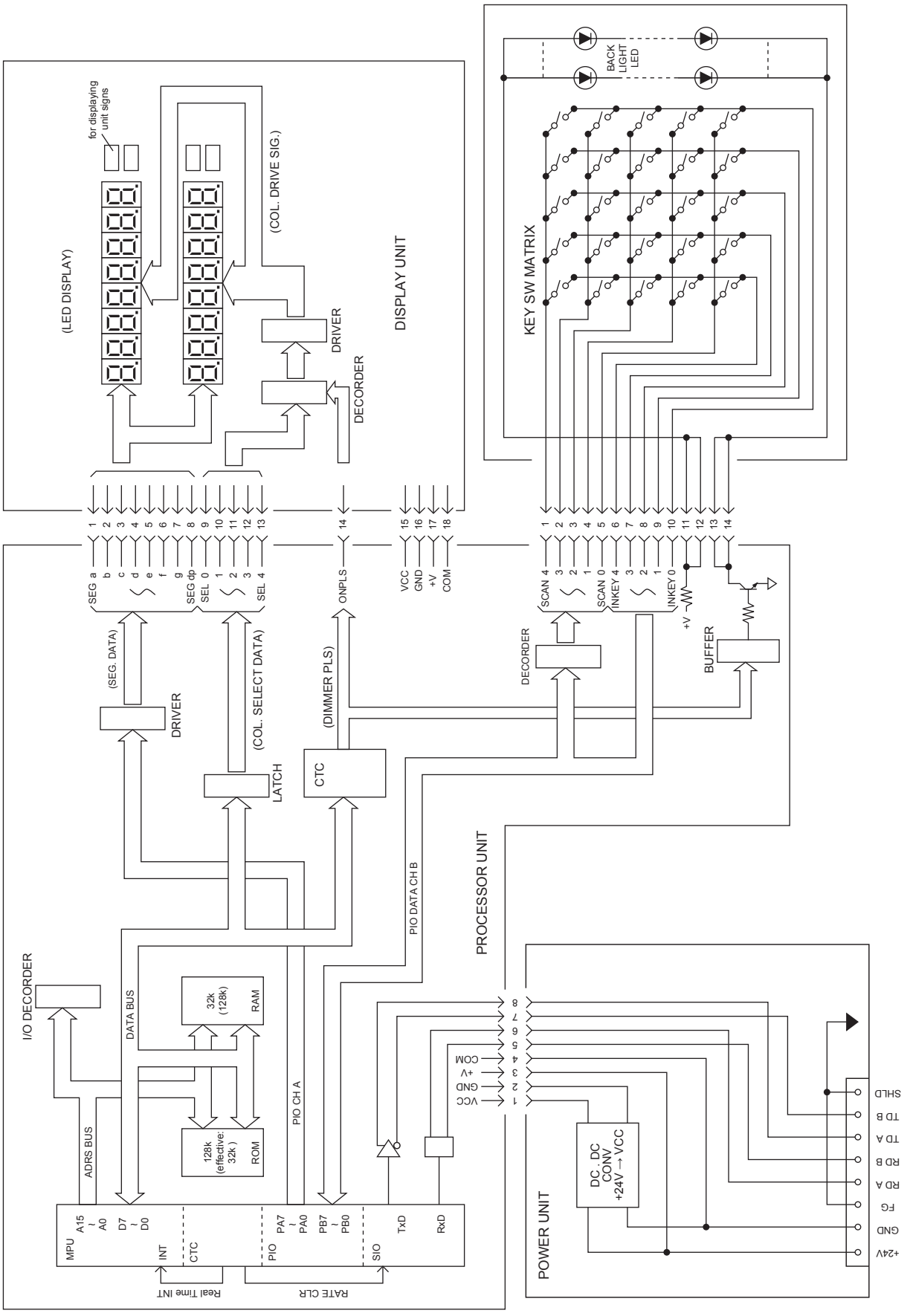
Appendix 1: EML 500 Circuit diagram



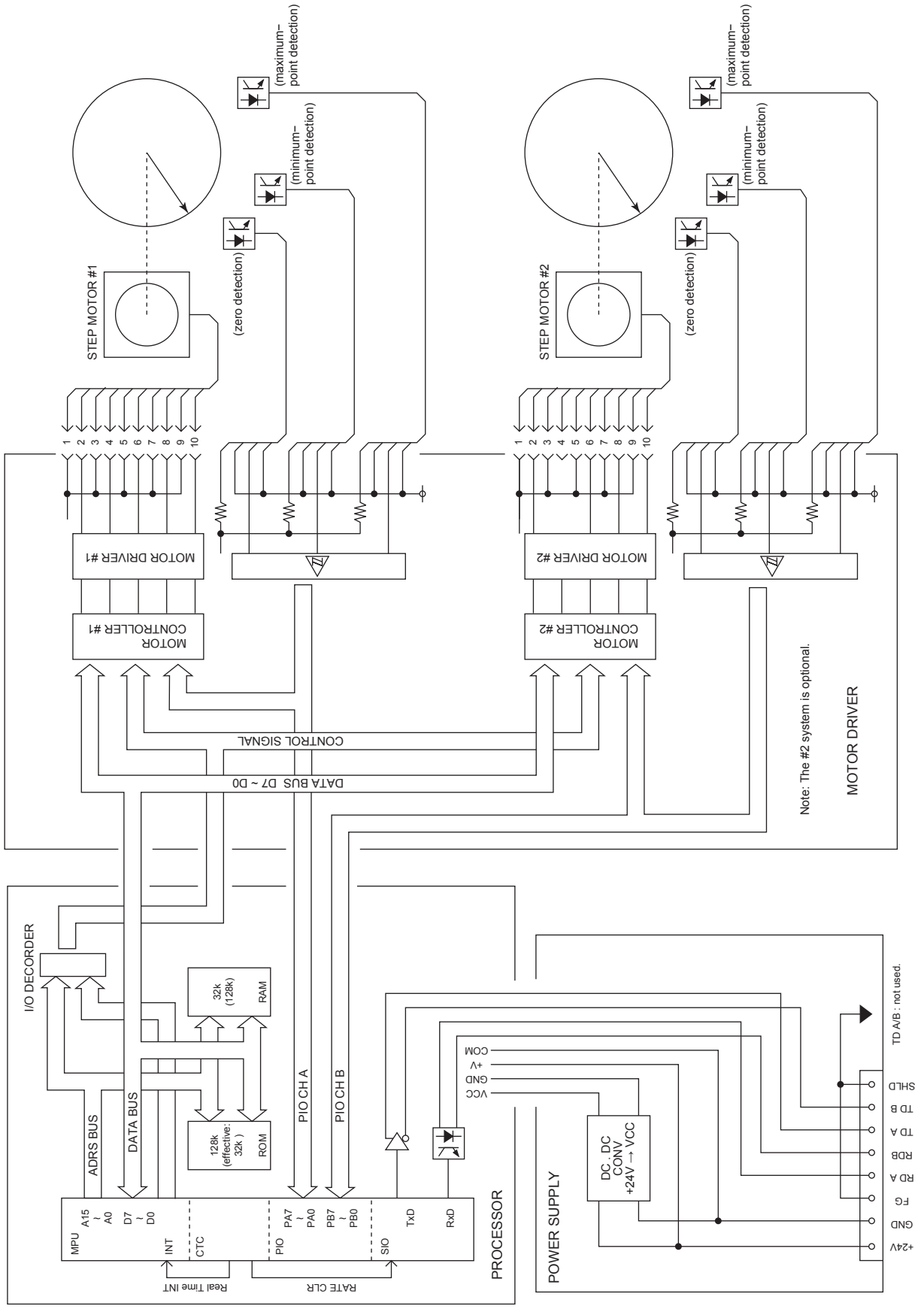
Appendix 2 : Master Unit Block Diagram



Appendix 3: Master Indicator Block Diagram



Appendix 4: Speed Indicator Block Diagram



Appendix 5 : List of Components

1. Master Unit (LT501)

No.	Component	Part Number
1	Master CPU unit	V8308 WA
2	Swithing powaer supply : 24V OUTPUT (For 100V AC to 220V AC specifications)	5T164A194-02
3	Switching power supply : +5V and ±15V (For 100V AC to 220V AC specifications)	5T164A193-01
4	CABLE ASSY J11	V8308CY
5	CABLE ASSY J12	V8308CZ
6	CABLE ASSY J21	V8308DG
7	CABLE ASSY J22	V8308DH
8	FUSE FU3; 1A	A1309EF
9	FUSE FU4; 2A	A1311EF

2. Master Indicator (LR523)

No.	Component	Part Number
1	Display	V8308WD
2	Processor	V8308WB
3	Power supply	V8303WC
4	Sheet key unit	V8308AC

3. Speed Indicator (LR524)

No.	Component	Part Number
1	M.D.U. assembly	V8308WE for CE V8308CQ
2	Step motor assembly	V8308YA
3	EL plate	5T153A014-01
4	Dimmer (AC 100 V)	5T162B015-01 (with 5T161W168-04)
5	Dimmer (AC 220 V)	5T162B015-01 (with RNC32B223J)

4. Dual-indication Speed Indicator (LR525)

No.	Component	Part Number
1	M.D.U. assembly	V8308WE
2	M.D.U. II assembly	V8308WG
3	P.S.U. assembly	V8308WH
4	EL plate	5T153A014-01

<When equipped with built -in dimmer>

5	Dimmer (100 V AC)	5T162B015-01 (with 5T161W168-04)
6	Dimmer (220 V AC)	5T162B015-01 (with RNC32B223J)

5. Dimmer Box (LD001A)

No.	Component	Part Number
1	Variable resistor	5T162B015-01
2	Terminal board	5T171A040-01

6. Junction Box (LN052)

No.	Component	Part Number
1	Terminal Box	5T118N008 Note: The gland size and color are to be specified.

7. Sensor 35 mm in dia. (LS531)

No.	Component	Part Number
1	Sensor assembly	FE0-LS531-01

8. Sensor 35 mm in dia. (LS501)

No.	Component	Part Number
1	Sensor assembly	FE0-LS501-01

9. Single-indication 48 mm in dia. (LS541)

No.	Component	Part Number
1	Sensor assembly	FE0-LS541-01
2	Handle	EL23023④

10. Dual-indication Sensor 48 mm in dia. (LS542)

No.	Component	Part Number
1	Sensor assembly	FE0-LS542-01
2	Handle	EL23023④

11. Sensor 70 mm in dia. (LS571)

No.	Component	Part Number
1	Sensor assembly	FE0-LS571-01
2	Handle	5T411C015-01

12. Sensor 70 mm in dia. (LS572)

No.	Component	Part Number
1	Sensor assembly	FE0-LS572-01
2	Handle	5T411C015-01

13. Sensor Cable (LS503)

No.	Component	Part Number
1	Cable assembly	FE0-LS503

14. Seawater Valve (LV033)

No.	Component	Part Number
1	O-ring	5T101Z005-35
2	Seawater valve	5T800C010

15. Seawater Valve (LV071A)

No.	Component	Part Number
1	O-ring	5T101Z005-61
2	Seawater Valve	5T800C008-02

16. Seawater Valve (LV052)

No.	Component	Part Number
1	O-ring	5T101Z005-50
2	Seawater valve	FE1-LS052-01

17. Seawater Valve (LV031)

No.	Component	Part Number
1	O-ring	5T101Z005-32
2	Seawater valve	5T800C002

Appendix 6: Installation and Adjustment Certificate

After installing and adjusting the EML500 system, please fill in the Installation and Adjustment Certificate on the following page, and return a copy to Yokogawa Denshikiki Co.,Ltd. (keep the original on the ship). The warranty period starts when Yokogawa Denshikiki receives a copy of the certificate.

Installation and Adjustment Certificate

1/2

YDK No.:

Yokogawa Denshikiki Co.,Ltd. Electromagnetic Log Model: EML 500-

Name of ship :

Installation and Adjustment Period : From to

Owner of ship :

Installed and adjusted at :

Dockyard / Ship No.:

The person in charge :

Ship type / Net tonnage

The company in charge:

On-board power supply :

Delivery date of the ship :

G. P. manufacturer / Model

Date of navigation test

GPS manufacturer / Model

Installation and wiring have been confirmed, and final adjustments have been completed as follows:

LOG No.:

Speed range from- kt to kt.

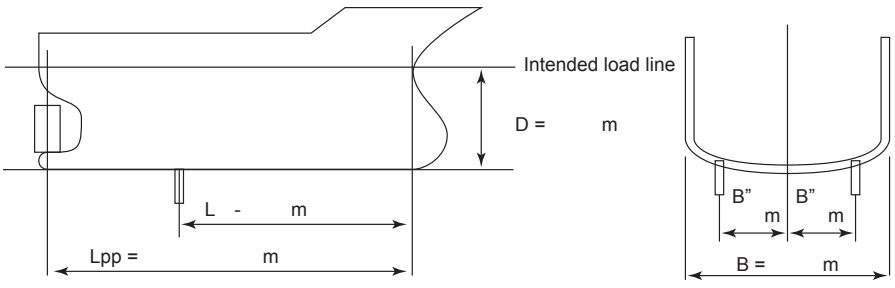
Dual-indication log : ☐ Longitudinal and transverse speed ☐ Resultant speed and direction of ship movement

Length of measurement rod : L= mm, L1 = mm

Sensor installation : ☐ Single bottom ☐ Double bottom

Sensor dia.: ☐ Ø35 ☐ Ø48 ☐ Ø70 ☐ Other (mm)

Sensor Protrusion : ☐ 50 mm ☐ 7 mm ☐ Other (mm)



Nautical speed : kt

Intermediate error compensation factor : ☐ C1 ☐ C2

Alarm speed setting: ☐ HI ☐ LO kt

GPS format setting

· Header (up to 6 characters) : _____

· Speed data position (number of commas) : _____

· Checksum data : ☐ Used ☐ Not used

· Terminator : ☐ LF ☐ C0h

· Baud rate : ☐ 9600 ☐ 4800 ☐ 2400

· Stop bits: ☐ 1 ☐ 1.5 ☐ 2

· Parity : ☐ Odd ☐ Even ☐ None

Character length : ☐ 7 ☐ 8

Analog voltage (current) ouput range: ☐ 0V to 5V (0mA to 20mA) ☐ 1V to 5V (4mA to 20mA)

Zero adjustment value : kt

Sensitivity adjustment value : %

Span setting : LSP times , TSP times (transverse direction for dual-axis log)

Response speed setting:

Linearizer table data

0	C1	C2
5	kt.	kt.
10		
15		
20		
25		
30		
35		
40		
45		
50		
55		
60		
65		

This is to certificate that the installation and adjustments have been compleated as shown above.

Date (Signed by captain);

(Signed by dockyard foreman);

Appendix 7: Calibration and Measurement Record

EML500 Series

RECORD OF ELECTROMAGNETIC LOG CALIBRATION AND MEASUREMENT

LOG No. _____ DATE _____

SHIPYARD _____

VESSEL		PLACE		DEPTH OF SEA		DRAFT		
						FORE	AFT	MEAN
WATHER		SEA CONDITION		TIME OF DAY				

FINAL CONFIRMATION DATA

RUN. NO.	MAIN ENGINE LOAD	MAIN ENGINE ENG. PRM	MAIN ENGINE AVE. PRM	TIME REQUIRED TRUE m/s	TIME REQUIRED LOG m/s	SPEED TRUE kt	SPEED LOG kt	SPEED AVERAGE SPEED TRUE kt	SPEED AVERAGE SPEED LOG kt	SPEED ERROR kt	SPEED ERROR %	WIND SPEED & DIRECTION m/s	COURSE	REMARKS

SIGNATURE _____ SERVECE ENGINEER _____

Appendix 8: Contrast of digital display and character for Master Indicator

Contrast table

Chracter	Display	Character	Display	Character	Display
A		Q		0	
B		R		1	
C		S		2	
D		T		3	
E		U		4	
F		V		5	
G		W		6	
H		X		7	
I		Y		8	
J		Z		9	
K					
L		-			
M		+			
N		=			
O		$			
P					

- Illustration

Display	Character	Display	Character
rESEt	RESET	SEnSE	SENSE
Hi	HI	SPAn	SPAN
Lo	LO	rESPonSE	RESPONSE
on	ON	CoEFF	COEFFICIENT
oFF	OFF	d-HAndLE	DATA-HANDLE
inPut	INPUT	tESt run	TEST RUN
LoG	LOG	n-Sub	MAINTENANCE-SUB
GPS	GPS	tooL	TOOL
0-AdJSt	0- ADJST	Go	GO
SEt	SET	LSP	LONGITUDINAL SPAN
n'it	NEXT	tSP	TRANSVERSE SPAN
Auto	AUTO	StArt	START
Hnd	HAND	StoP	STOP
d.St	DISTANCE	CnCL	CANCEL
rSt	RESET	Cont	CONTINUE
1St	1ST	End	END
2nd	2ND	bFr	BEFORE
3rd	3RD	LtS	LONGITUDINAL TEST
YES	YES	ttS	TRANSVERSE TEST
no	NO	SW	SWITCH
Ad	ADC	n-Err	MASTER ERR
dA	DAC	dSP	DISPLAY
out	OUT	rEF	REFERENCE
V-rAnGE	V-RANGE	Gnd	GROUND
Hdr	HEADER	bAt	BATTERY
PrtC	PCOL	tErn	TERMINATOR
ALPH	ALPHABET	LF	LF
SECt	SECTION	brAtE	BAUD RATE
S-CH	SUM CHECK	Prt	PRT
uSE	USE	CHArA	CHARACTER
non	NON	odd	ODD
		EVE	EVEN

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  EML 500 Series User's Manual
- Manual No. : IM 80B80T10E

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■ Inquiries
For inquiries about the content of this manual, please visit the following URL. Also visit the Yokogawa Denshikiki website at the following address for information on this product.
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