

9-2. Recording data and data processing

9-2-1. Calculation of current velocity

This current meter Model:MTC-2, generates one impeller's pulse at the rate of 1/2 revolution of impeller. The intergrated numbers of impeller's pulse are recorded on cassette tape during the measuring period.

Calculate the current velocity according with the formula 9-1 and 9-2.

Pulse number of revolution P 1
Pulse number of reversion P 2 (Practically P2 is zero)
Measuring time T 1 (minute)

$$\text{Mean revolution number (N)} = \frac{P 1 - P 2}{2 \times 60 \times T 1} \quad \dots\dots \text{Formula 9-1}$$

From the impeller's certification, $V = A N + B$

$$\text{Mean current velocity} = A N + B \text{ m/sec.} \quad \dots\dots \text{Formula 9-2}$$

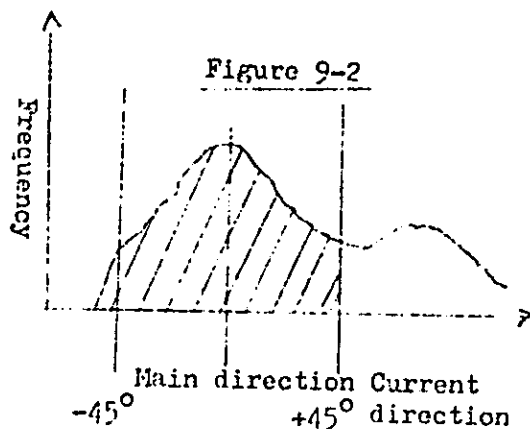
9-2-2. Calculation of current direction

The data of current direction will be sampled by every impeller's pulse and draw up a frequency graph on memory as fugure 9-2.

After measuring, the highest frequency of direction is main current direction.

The range ± 45 degree against the main current direction will be calculated as the mean current direction by load shedding method.

Impeller's pulse (PD) for the calculation of current direction in CH 12 of recording data are shown by part of an oblique line in figure 9-2.



On the other side, total pulse number (PT) are added revolution and reversion of impeller's pulse. As a standard of dispersion of current direction, the difference between PT and PD is shown the impeller's pulse which is out of place from ± 45 degree of mean current direction.

9-2-3. Data processing

Reading method from the recorded data of cassette tape is a following ways.

- (A). Write the indicated value by displaying the current velocity and direction with data out mode.

- (B). Print the result of current direction and velocity with optional teletype writer and optional tape reader (Model:CTR-1). In this case, connection way is shown in clause 11.
- (C). Connect the optional tape reader (Model:CTR-1) with user's computer. CTR-1 is equipped with interface RS-232-C, it can read out the recorded cassette tape by simple command of computer.
- (D). A tape translation unit is available to enable customers to read the data from the cassette tape into their own data processing facility with the optional CMP-MT convertor (Model:COV-1).

10. Maintenance

10-1. Dispatch of abnormal condition

Table 2 shows the message. Shoot the trouble according with the following contents.

TABLE 1 MESSAGES

Message number	Contents of trouble	Proceeding
8000	It means a start of check mode	
8002	CMT does not start normally	Repeat the action to insert the tape fully or replace it again.
8003	Unrecordable into CMT normally	Clean the head of CMT with an attached head cleaner.
8004	Under charging of battery	Recharge the battery well.
8005	Discharge of battery completely	Recharge the battery well.
8006	Trouble of data memory	Need to change control board at our factory.
8007	Trouble of program memory	Need to change control board at our factory.
8008	Remained record in CMT	See the clause of check mode.
8888	Finish of check mode action	
9000	Start of measuring mode action	
9001	Abnormal institution of measuring period and interval	Reset to meet the stipulations.
9009	Abnormal finish of measuring	Data was already recorded normally, switch off a power source.
9999	Finish of measuring mode action	
7000	Start of data-out-mode action	
7777	Finish of data-out-mode action	

10-1-1. In case of no indication for the revolution number of impeller

- (A). Connector of non-contact switch plug in well into its receptacle?
- (B). The distance between the metal plate of impeller and non-contact switch is too off?
- (C). Supplied the source power into the non-contact switch circuit?

10-1-2. In case of no indication for a compass direction

- (A). Connector of magnet compass plug in well into its receptacle?
- (B). Supplied the source power into the magnet compass circuit?

10-1-3. In case of early consumption of battery during the measuring period

Finish the check mode action and display the value 8888 on display board. With holding the indicated value 8888, turn the mode switch into the measuring mode then turn off a power switch.

If the indicated value 8888 on display board, disappears within two or three seconds, the circuit board will not work normally, the indicated value 8888 on display board will fade and disappear the value gradually.

10-2. Storage of magnetic tape and recording unit

10-2-1. Instruction for cassette tape handling

- (A). Generally, magnetic tapes are very sensitive to dust and dirt. Following precautions apply whenever handling the cassette.
- (B). Cassette tape shall be stored always in a container (case) when not used even for a short time.
- (C). Cassette tape shall be removed from the magnetic tape recorder after being fully wound up to the clear leader.
- (D). Keep the cassette out dusty operational environment as much as possible.
- (E). Since the magnetic coating side of the cassette tape (except for the clear leader) is exposed to the out side through the open area of the cassette half, any contact with dirty or dusty things such as fingers, shall be avoided to protect the tape from the drop-outs which would be caused by such contact.
- (F). Do not apply any excessive force to the cassette such as placing heavy things on it, dropping the cassette to the floor, or distorting the cassette half, which may damage the cassette half and/or the tape edge. The cassette tapes shall be so packaged that they will not suffer from any strong impact nor vibration during transportation.
- (G). Never place the recorded cassette near a strong magnetic field, which will damage the recorded data. Also never expose the cassette to direct sunshine, micro waves or radiated heat waves.

10-2-2. Cassette sides and write enable plugs

The two sides of a cassette are named A and B respectively. The cassette commercially available have these two sides labelled. When a cassette is inserted A side up, only the first track is available for data recording/reproducing.

For writing new data with erasing of the original data, use the cassette with these write enable plugs. The attachment of the write enable plug is confirmed by a micro switch (File protect switch) of the magnetic tape unit. When these plugs are removed no data can be written into the cassette and the original data in the cassette are protected from a careless erasure.

For the cassette for data reading only, the plugs shall be removed to protect the recorded data.

Also the write enable plugs are durable for many insertions and removals.

Following figure 10-1 shows the relation ship between A/B sides and tracks.

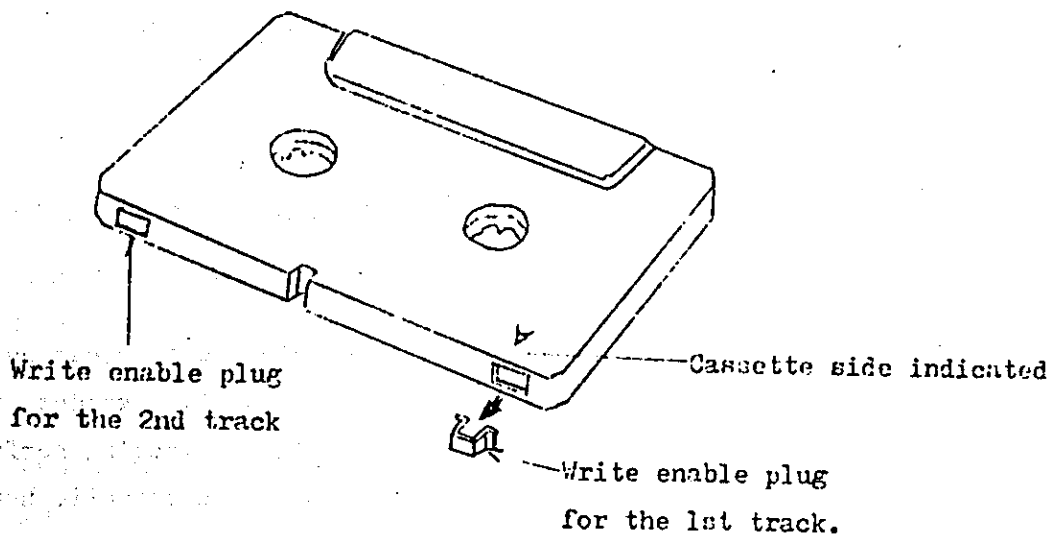


Figure 10-1 Write enable plugs of cassette

10-2-3. Cleaning of the magnetic tape unit

A. Cleaning aids

1. Cotton swab or cotton cloth such as gauze which is not fluffy.
2. Cleaning liquid, trichlorethane type.

Following cleaner kit is available for the cleaning of the magnetic tape unit.

Cleaner kit: TZ-350 (TEAC. P/N 17930220-00)

Cotton swabs, gauze and cleaner liquid are packaged in a kit.

B. Cleaning procedure

1. Remove the pocket cover and cassette tape. Push the cover in the direction indicated by an arrow in figure 10-2 (in the direction to the head), unhook the bottom side of the cover by pulling it in the direction indicated by an arrow in figure 10-3. The pocket may be open or closed when you remove the cover. Because the easiness depends on the type of installation of the magnetic tape unit, i. e., horizontal, vertical or etc. Figure 10-3 shows the cover removing method for the open-condition of the pocket.

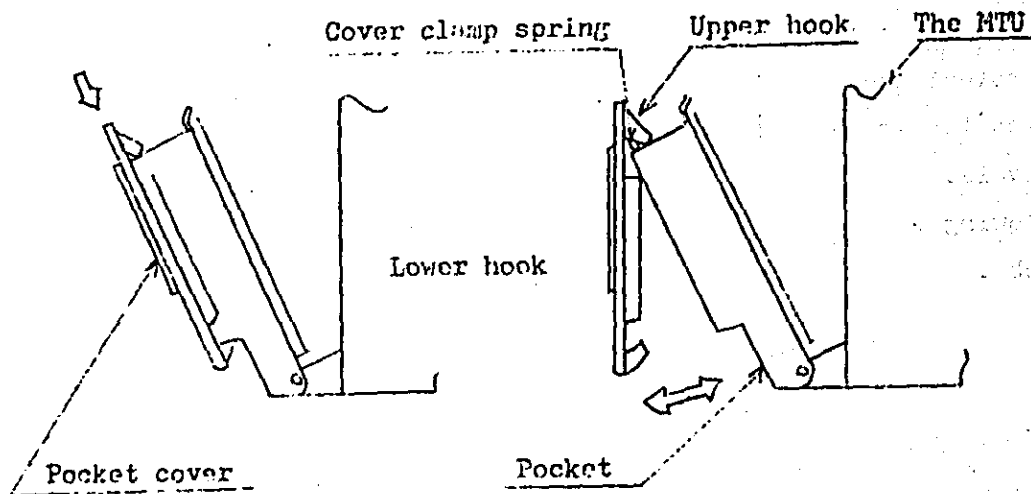


Figure 10-2

Figure 10-3

Removal and attachment of the pocket cover

2. Clean the head surface with a wet swab or cloth with cleaning liquid. In the same way, the surface of the two tape guides and encoder shall be cleaned carefully. Since the contacting surface of these parts with the tape are less dusty than the magnetic head surface, the cleaning cycle of these parts may be two or three times longer than that of the magnetic head.

Be careful not to apply excessive cleaning liquid. Clean the encoder and left side tape guide (also used as a marker sensor) carefully not to apply excessive force on them. Manual rotation of the encoder will make the cleaning easier.

3. Often cleaning of two guide pins and other surface of the mechanical construction are required. For cleaning of these, do not use the

cleaning liquid. A dry cloth is recommended. Be careful not to leave any lint around the lamp window of the left side guide pin.

4. Install the pocket cover to the magnetic tape unit. Hook the upper side of the cover to the cover clamp springs which are located at the top of pocket. (See Fig. 10-3) Be careful not to install the cover in the wrong direction.

Depressing the cover toward the magnetic head, push and lock it to the pocket as shown in figure 10-3 by an arrow.

Remember to check that both upper and lower hooks are securely fixed to the cover clamp spring.

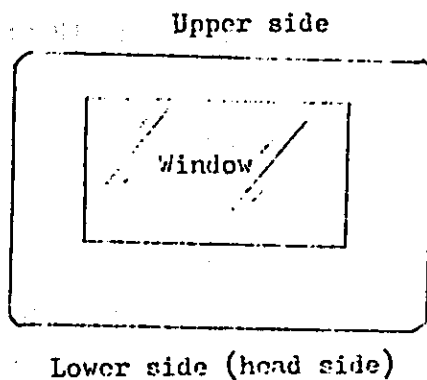


Figure 10-4
Pocket cover

11. Interfacing with the teletype writer

Interfacing with the teletype writer is as following specifications.

Transfer format	20 mA current loop method
Transfer speed	110 baud
Number of stop bit	2 bit
Number of data bit	8 bit
Number of start bit	1 bit
Connector	9 pins (receptacle) of D-sub type Model:HDF-9s (Hirose Electric Co.,)

Jumper connection

Name of pin signal

No. 1. Open	No. 5. Open
2. Open	6. Transmit return
3. Receive signal	7. Transmit signal
4. Receive return	8. Open
	9. Open

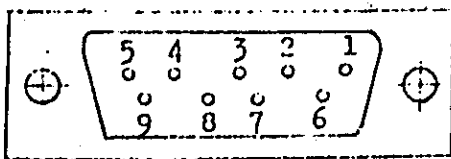


Figure 11-1

12. Change of axis for impeller

Axis for impeller is made of plastic for the protection of electrolytic corrosion.

Head of impeller's axis are made of stainless steel (SUS 304).

In case of electrolytic corrosion or abrasion happend on the head of impeller's axis, change them immediately.

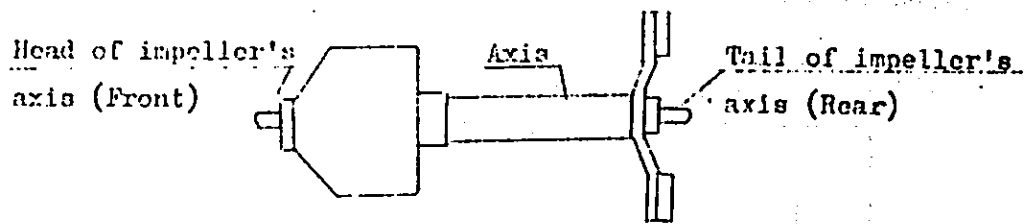


Figure 10-5

Front side of head is left tapped screw and rear is right tapped screw. Pay attention, in case of change the heads of impeller's axis, do not clamp heads so tighten.

13. Teletype writer (T.T.Y.) Interface Circuit

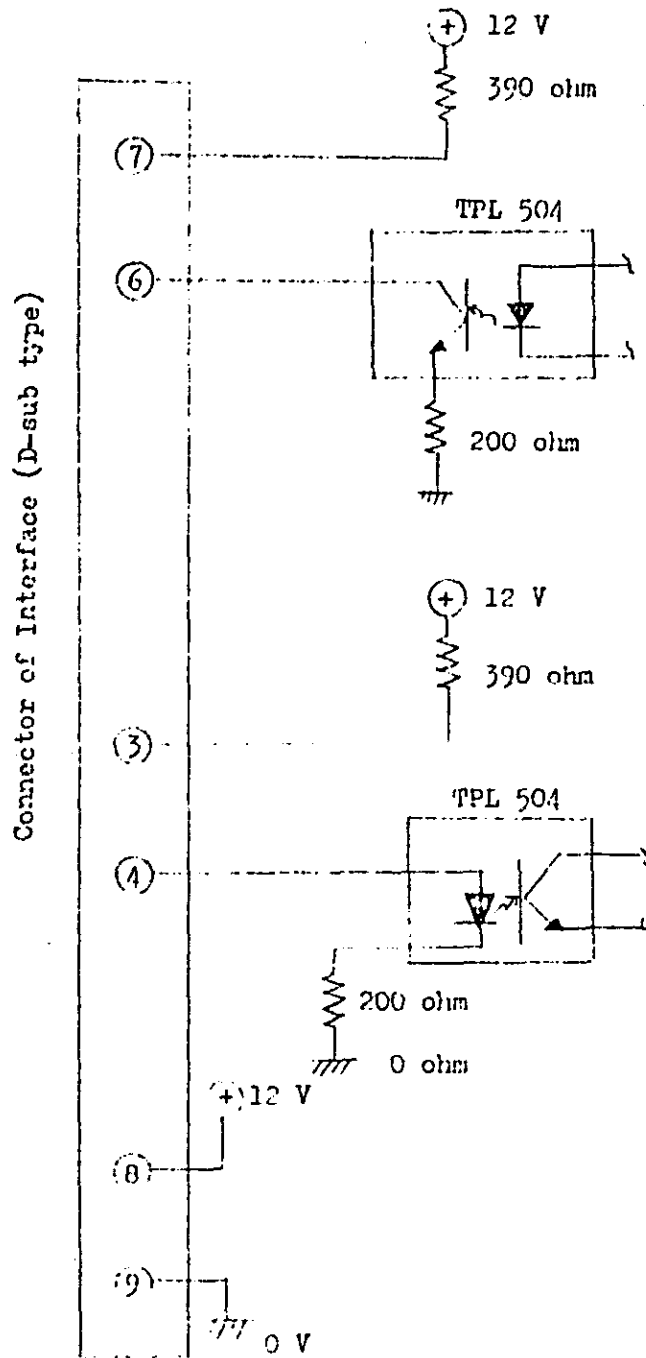


Figure 11-2

14. Example of teletype writer output data

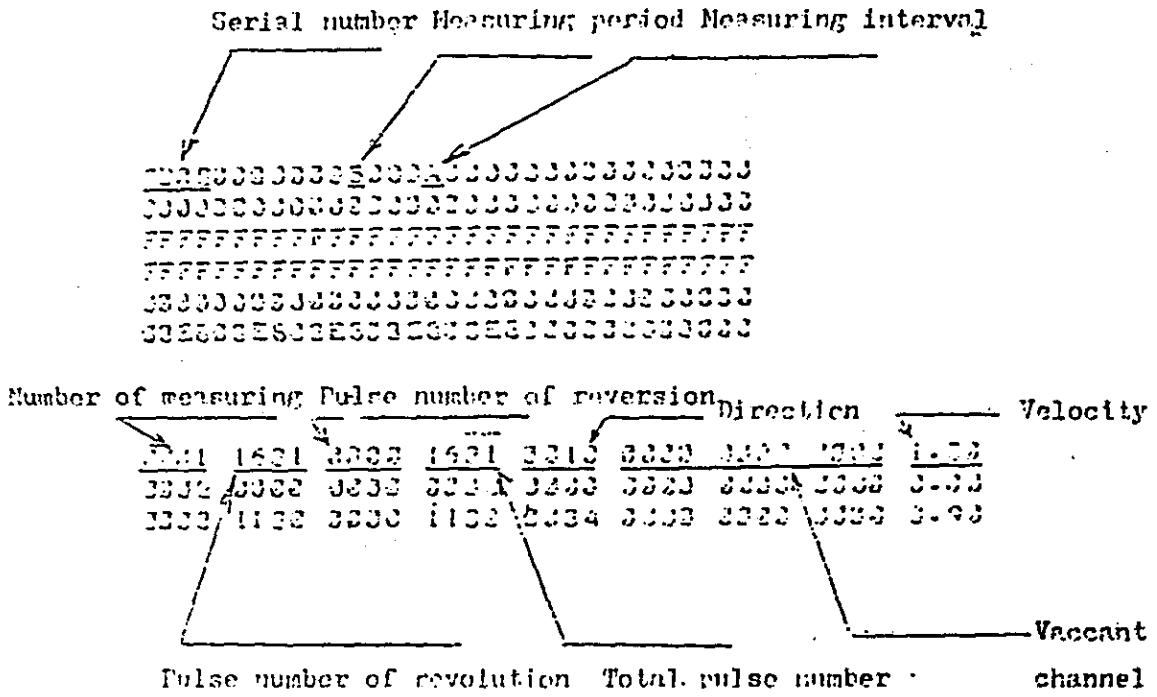


Figure 12-1

15. Maximum measuring period (without water temperature) Model: MTC-2

Maximum measuring period

Mean current velocity Measuring period/Measuring interval (Minute)

m/sec.	1/2	1/5	2/10	1/15	2/20
0.2	16.2	32.1	33.8	57.1	49.7
0.4	13.9	28.3	29.7	52.9	45.1
0.5	12.9	26.8	28.0	51.1	43.1
0.6	12.1	25.4	26.5	49.3	41.2
0.8	10.8	23.0	23.9	46.2	38.0
1.0	9.7	21.0	21.7	43.5	35.3
1.2	8.8	19.3	20.0	41.0	32.9
1.4	8.0	17.9	18.4	38.8	30.9
1.5	7.8	17.3	17.8	37.8	30.0
1.6	7.4	16.7	17.1	36.9	28.9
1.8	6.9	15.6	16.0	35.1	27.3
2.0	6.5	14.7	15.0	33.5	25.9
2.5	5.5	12.7	13.0	30.0	22.8
3.0	4.9	11.3	11.5	27.2	20.4
3.5	4.3	10.1	10.3	24.9	18.5
4.0	3.9	9.1	9.3	22.9	16.9

measuring time/day 720 288 144 96 72

Magnetic tape life (Days) 10 26 52 79 105

6. Water-Temperature

16-1. Preface

This water-temperature is established on Self Recording Current Meter, Model:MTC-2.

Measuring data of water-temperature will be recorded on magnetic cassette tape as well as current direction and velocity.

16-2. Component

This water-temperature consists of followings.

- | | |
|-----------------------|-------|
| 1). Detector | 1 pc. |
| 2). Measuring circuit | 1 pc. |
| 3). P-ROM | 1 pc. |

16-3. Specification

- | | |
|--------------------------------|--------------------------|
| 1). Detector | Platinum Resistance type |
| 2). Resolution | 0.1 °C |
| 3). Accuracy | ± 0.1 °C |
| 4). Measuring range | - 5.0 to 30.0 °C |
| 5). Time constant (90 % value) | Under 8 seconds |

16-4. Operation

16-4-1. Detector check mode

Turn the select switch No. 1 to set the position "7", LCD will display the value `0NNN` on display board. The reading way of display value (4 figures) as temperature is the number of lower three figures shows the water-temperature. Top number shows the limit of plus or minus temperature as followings.

Case	Display of LCD	Reading temperature
1). General	<code>0 N N N</code> (+)	<code>N N . N °C</code>
2). In case of + 5 °C	<code>0 0 5 0</code> (+)	<code>+ 5 . 0 °C</code>
3). In case of - 5 °C	<code>1 0 5 0</code>	<code>- 5 . 0 °C</code>

16-4-2. Measure mode

The temperature will be sampling just before the end of each measuring period, then records its value as the water-temperature.

16-4-3. Data out mode

The contents which display on LCD is displayed only current direction and velocity, therefore, no displaying for the water-temperature.

But, output to the teletype writer (T.T.Y.) can print the same values as the displayed contents by check mode.

ATTENTION: Detail contents of general handling is written on page 8 to 10.

16-4-4. Maintenance and cleaning

Maintenance and cleaning of this instrument is as follows,

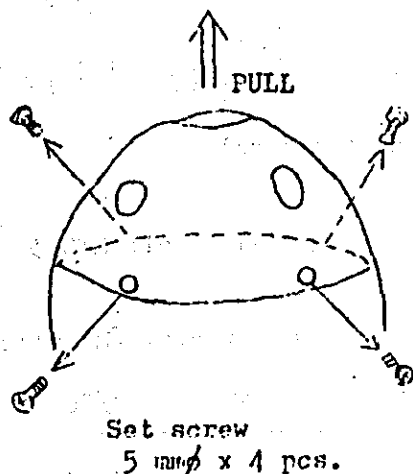


Figure A

1. Pull out an impeller.
2. Unscrew four pieces of bolt and pull the head cover up as figure A.
3. Unscrew the protector of water-temperature by an arrow and pull it out.
4. Clean the detector and protector with a wet swab or cloth with fresh water. In this time, do not shock against the detector.
5. Clean out the surface of fringe for non-contact switch and protector such as sea-grows.

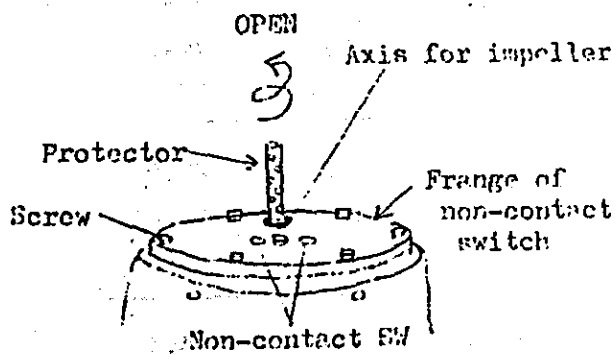


Figure B

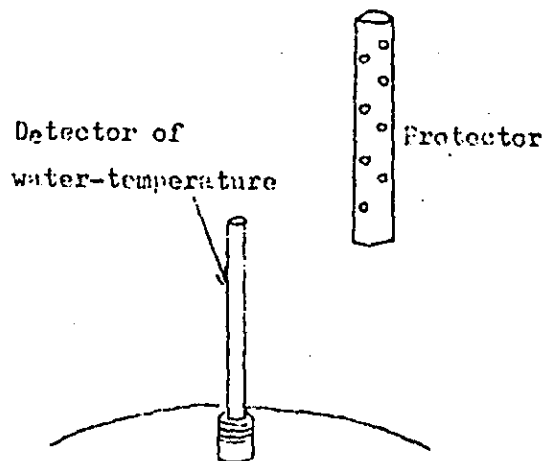


Figure C

16-5. Example of teletype writer out put data with water-temperature

Serial number Measuring interval

Measuring period

```

0001 00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000
00000000000000000000000000000000

```

Coefficient: Coefficient No. 2

No. 1

No. of measuring	Pulse number of reversion	Direction	Velocity
0001 0002	0000 0112	0000 0112	0000 0112
0002 0003	0112 0112	0112 0112	0112 0112
0003 0004	0112 0112	0112 0112	0112 0112
Pulse number of revolution	Total pulse number	Water- temperature	Vacant channel

16-6. Maximum measuring period (with water temperature) Model: MTC-3

Mean current velocity Meter/sec.	Measuring period/Measuring interval (Minute)				
	1/2	1/5	2/10	1/15	2/20
0.2	2.7	20.1	21.7	43.5	35.3
0.4	2.8	17.3	17.9	41.0	32.9
0.5	2.4	18.6	17.2	42.9	31.8
0.6	2.1	17.9	18.4	38.8	30.8
0.8	7.5	16.7	17.1	36.9	28.9
1.0	6.9	15.6	16.0	35.1	27.3
1.2	6.5	14.7	15.0	33.5	25.9
1.4	6.1	13.9	14.1	32.0	24.6
1.5	5.9	13.4	13.7	31.3	23.9
1.6	5.7	13.1	13.4	30.7	23.4
1.8	5.4	12.4	12.7	29.4	22.3
2.0	5.1	11.8	12.0	28.3	21.3
2.5	4.5	10.5	10.7	25.8	19.2
3.0	4.1	9.5	9.7	23.7	17.5
3.5	3.7	8.7	8.8	21.9	16.1
4.0	3.4	8.0	8.1	20.1	14.8
Measuring time/day	720	288	144	96	72
Magnetic tape life (days)	10	26	52	79	105

APPENDIX 8

INSTRUCTION MANUAL
OF
DIRECT READING FLOW DIRECTION CURRENT
METER PRINTER

(DCM-PRT-III)

KYOWA SHOKO CO., LTD

TOKYO

DIRECT READING FLOW DIRECTION CURRENT METER

PRINTER

DCM-PRT-III

INSTRUCTION MANUAL

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- 11-2 Printer
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1. GENERAL

This apparatus is used connected with the detector of the direct reading flow direction current meter, a product of KYOWA SHOKO, LTD. Flow detection data and flow velocity data obtained by the detector are subjected to arithmetic operation performed by the microcomputer built in the apparatus. The result is displayed and printed in the printer.

- (a) Year, month, day, hour, and minute of observation are displayed and printed in the printer.
- (b) Average flow velocity and average flow direction are computed.
- (c) Flow velocity display and print can be made either in m/s or knot.
- (d) Build-in battery, external DC 12V power supply, and commercial AC 100V can be used as power source.
- (e) With RS-232C interface provided and I/O function, online processing with computer, etc. is possible.
(Option)
- (f) With analog voltage output function incorporated, analog record can be obtained by connecting the recorder. (Option)

2. COMPONENT PARTS

Detector	1 set w/cable 50m
DCM printer	1 set
Impeller	2 ea
Weight	1 ea 7kg
Shackle	1 ea 8mm
Ink ribbon	2 ea (1 ea already set)
Recording paper	1 ea 58mm
Chart bobbin	1 ea
Fuse	5 ea 2A
Battery cord	2 m
AC cord	2 m
Battery	1 ea 6V AH X 2 incorporated
Containing wooden box	1 ea
Tools	
Driver large (-)	1 ea
Driver large (+)	1 ea
Driver medium(+)	1 ea
Adjustable wrench	1 ea 200mm
Single ended wrench	1 ea 14mm
Pliers	1 ea small
Inspection sheet	2 copies One for each impeller
Instruction manual	1 copy

3. SPECIFICATIONS

(1) Compatible detector

Direct reading flow direction current meter (DCM-II)

Flow velocity

(a) Measurement accuracy 3%

(b) Measurement range 0.05-3.00M/S

Flow direction

(a) Measurement accuracy $\pm 5^\circ$

(b) Measurement range 0-360°

(c) Measurement period Every turn of impeller

(2) Print item

observation year, month, day, hour, minute

Machine No.

Flow velocity calculation formula ($V=A.N+B$)

Average flow velocity, average flow direction

Flow direction flow velocity average time,

observation interval time

(3) Display item

Year, month, day, hour, minute (display switching system)

Momentary flow direction, average flow direction (display switching system)

(4) Flow velocity calculation unit m/s or knot

(switch selection system)

(5) Flow direction flow velocity average time setting

1-99 min (set to panel switch)

(6) Observation interval time setting

1-99 min (set to panel switch)

- (7) Year, month, day, hour, minute setting
Set by panel switch 4 digits by 4 digits
- (8) Recording paper for printer
Width \pm 0.5mm (ordinary paper)
Roll diam 80 ϕ or less
- (9) Ink ribbon
Special ribbon
- (10) Print size
Max. 24 digits
- (11) Print system
Serial dot impact system
- (12) Usable time with built-in battery
48 hours or more
- (13) Power supply
Built-in battery 12V (6V 3AH X 2)
External DC power supply DC 12V \pm 1V
Commercial AC 100V \pm 10V
- (14) Battery voltage indication
Indication by 0-20V meter
- (15) Outside dimensions
230(H) X 486(W) X 195(D)
- (16) Weight
Approx. 12kg

Option

(17) Analog voltage output

Momentary flow velocity 0-2.55m/s ' 0-2.55V

(18) RS-232C digital output

Stop bit 1

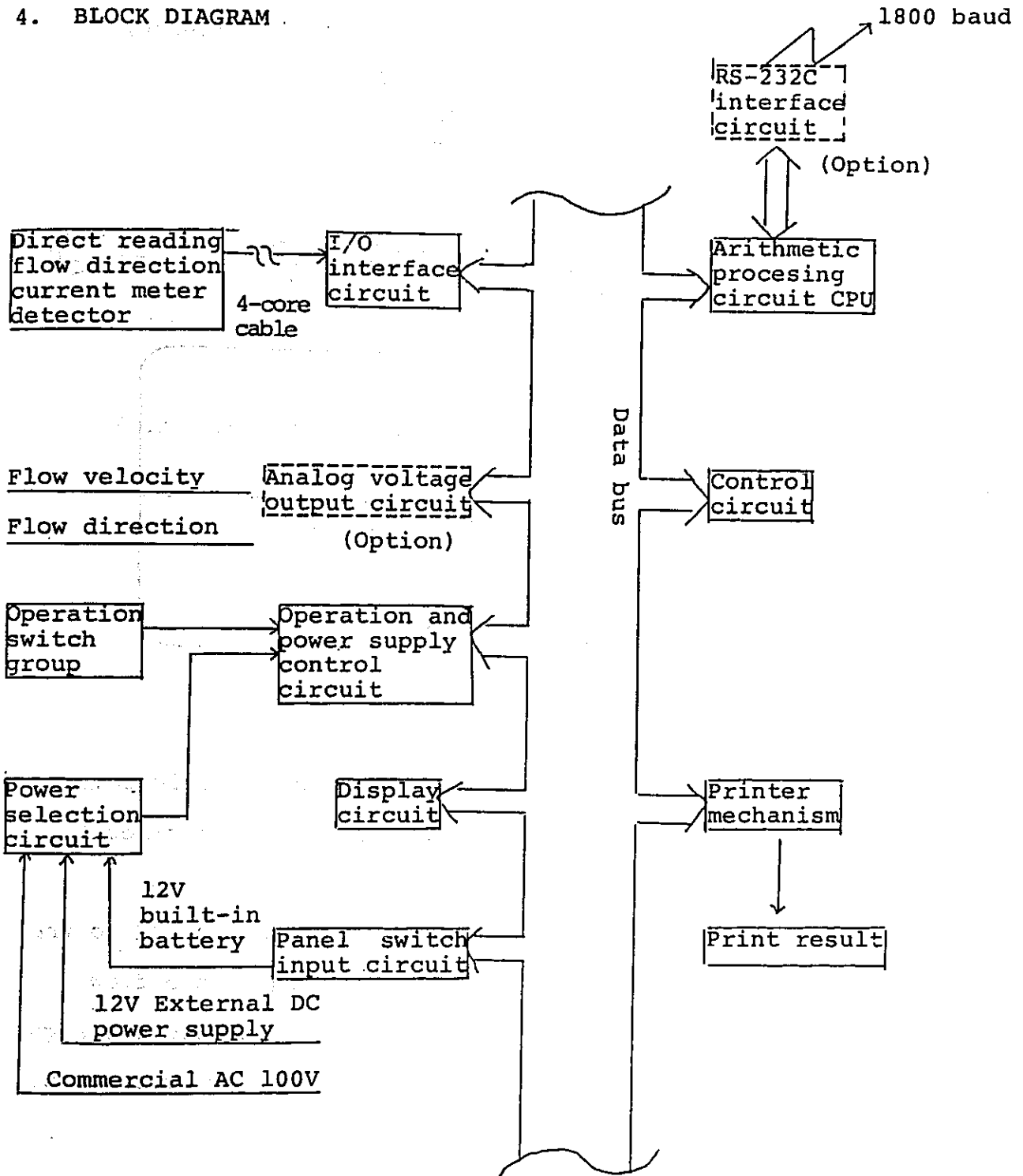
Data bit 7

Parity bit 1 (even)

Transfer speed 4800 baud

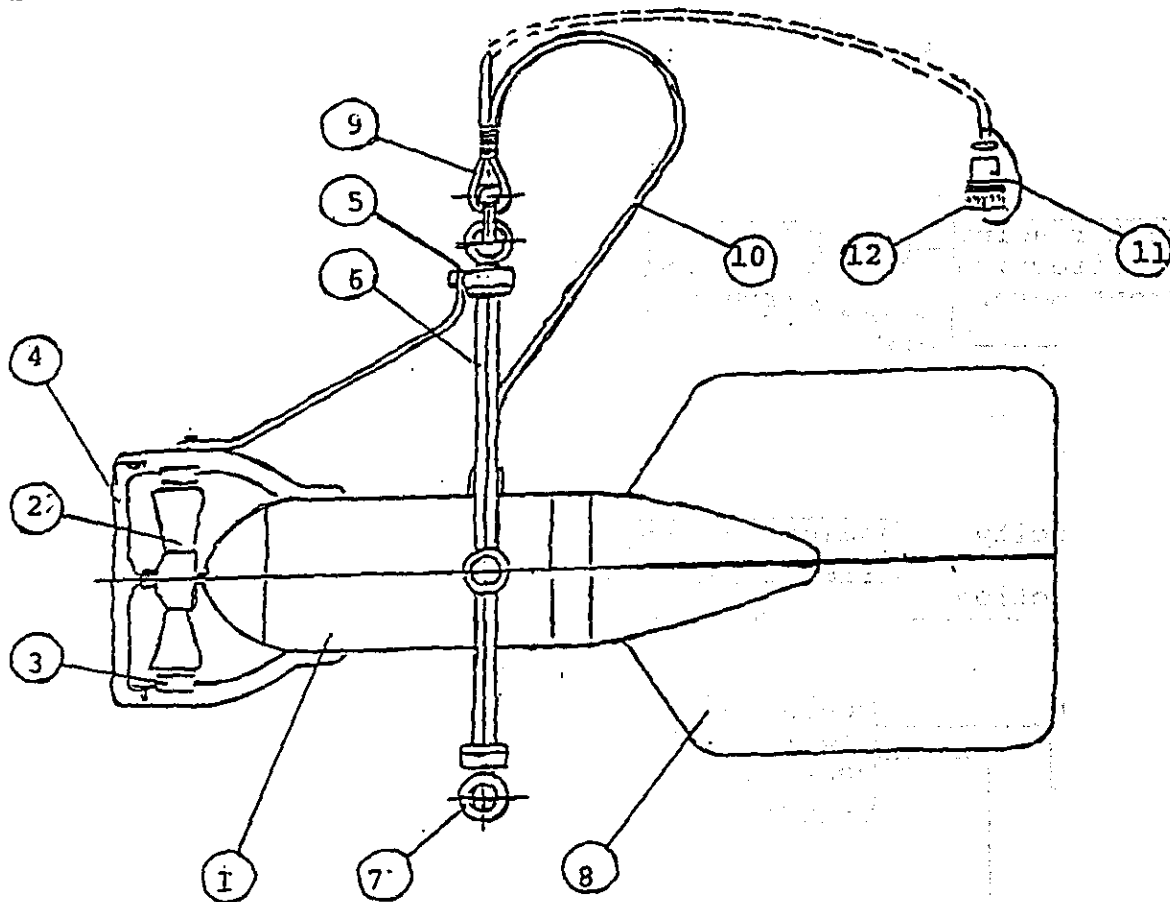
Momentary flow velocity and flow direction output
in 4 digits

4. BLOCK DIAGRAM



5. PARTS NAMES AND FUNCTIONS

5-1 Detector



- (1) Main body ----- Flow direction detecting magnetic compass and signal processing electric circuit are incorporated.
- (2) Impeller ----- Through the metallic piece secured to the shaft, rotation according to the flow velocity is converted to an electric signal.
- (3) Impeller ----- This is provided for impeller protection.
protection frame
- (4) Impeller shaft----- Movable shaft holder for impeller holder installation/removal.
- (5) Joint ----- Movable portion for facilitating main body to face flow direction.

- (6) Hanging ring ----- For connection of main body and cable.
(upper)
- (7) Hanging ring ----- For weight installation.
(lower)
- (8) Fin ----- For causing the head of detector to
face flow direction.
- (9) Simple ----- Protection of cable folding part.
- (10) Cable ----- Cable for signal transmission and
hanging. (4core 50m)
- (11) Connection connector -- For the connection with indicating
section.
- (12) Connector cover ----- For the connector humidity and dust
prevention.

No.	Name	Quality of the material	Number	Note
	Outside appearance drawing.			

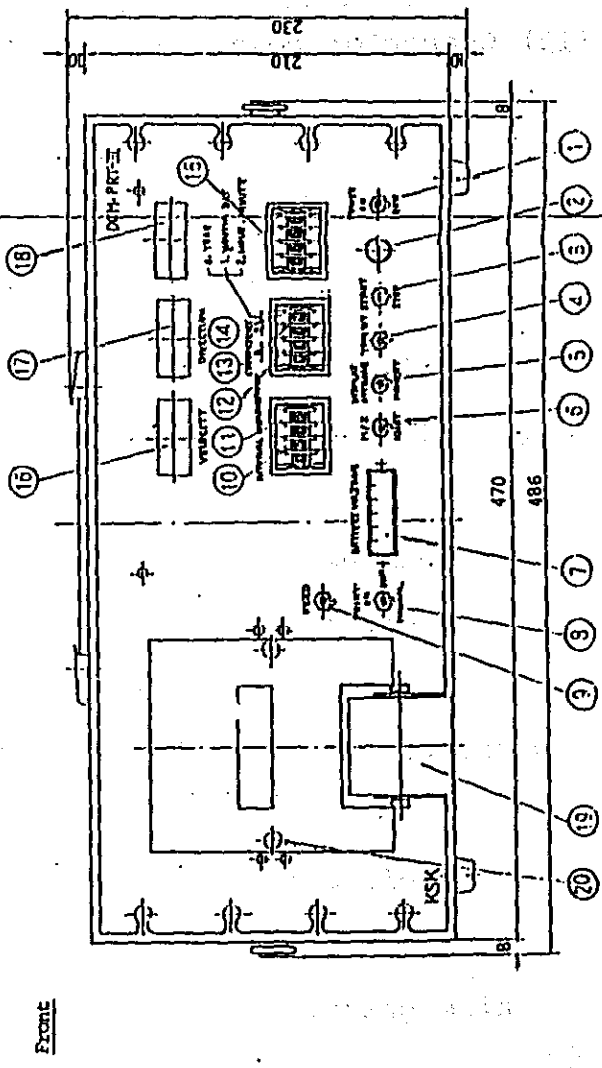
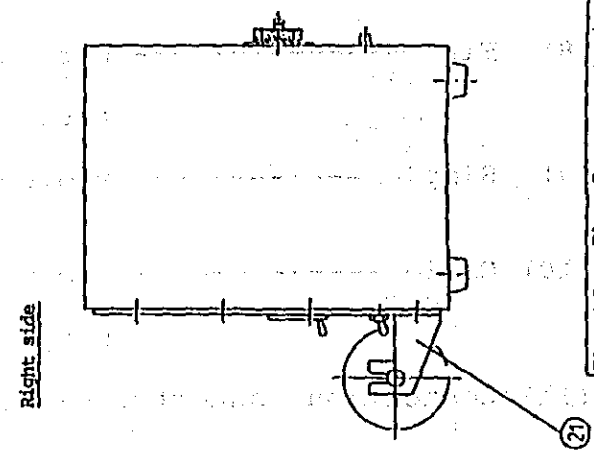
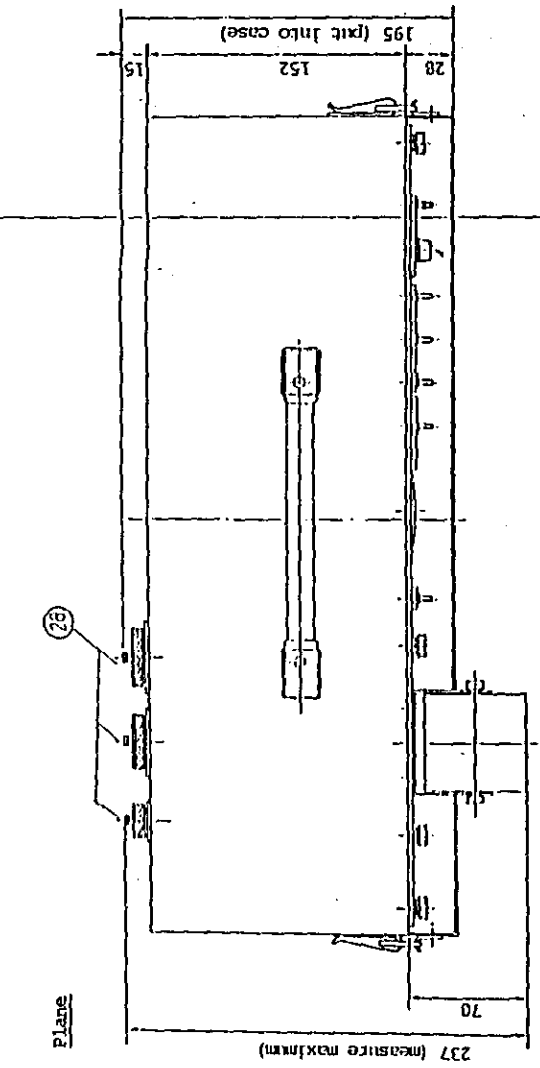
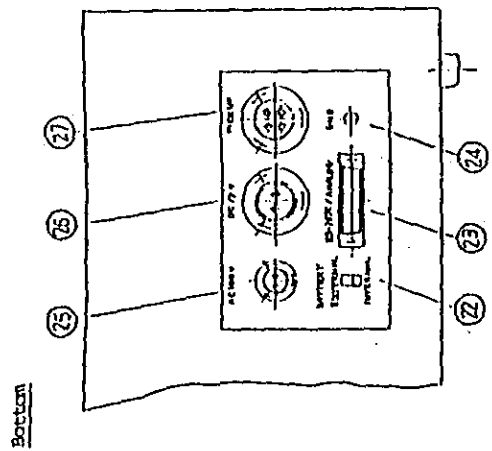


Plate I Data Plan Correct matters
 I 59-8
 II Measure 1/2
 DCY - PRT - III
 Drawings No. 12-118 (1)

(1) POWER SWITCH

Power ON/OFF switch of apparatus. Power is supplied when it is set to ON .

(2) FUSE

2A fuse is used.

(3) START/STOP SWITCH

When the switch is in START position, measurement starts. When the switch is in STOP position, measurement stops.

(4) TIME SET SWITCH

This is for setting and correction of year, month, day, hour and minute.

(5) AVERAGE/MOMENT SWITCH

This is for selecting average value of moment value for the display of flow velocity and flow direction.

(6) M/S/KNOT SWITCH

This is for selecting m/s or knot as the unit of display value.

(7) BATTERY VOLTAGE METER

This indicates voltage of built-in battery.

(8) PRINT SWITCH

When this switch is set to ON, the printer operates only when calculation result is printed.

The printer does not operate in OFF position.

MANUAL is used when recording paper is to be fed as desired.

(9) FEED SWITCH

Switch for recording paper feed.

- (10) INTERVAL SETTING SWITCH
2-digit panel switch for setting measurement interval
1-99 (min).
- (11) MEASUREMENT SETTING SWITCH
2-digit panel switch for setting measurement time
1-99 (min).
- (12) COEFFICIENT (A) SETTING SWITCH
Value of impeller coefficient (A) is set in 2 digit.
- (13) COEFFICIENT (B) SETTING SWITCH
Value of impeller coefficient (B) is set in one digit.
- (14) Y.M.H. SELECT SWITCH
Any of the values 0,1,and 2 is selected in one digit.
- (15) Y.M.H. SETTING SWITCH
4-digit panel switch for setting value of year,month,
day,hour and minute.
- (16) VELOCITY DISPLAY
Flow velocity value is displayed.
- (17) DIRECTION DISPLAY
Flow direction value is displayed.
- (18) Y.M.H.DISPLAY
Any of year,month,day,hour and minute is displayed.
- (19) RECORDING PAPER
Roll type printer paper is set.
- (20) PRINTER COVER SET SCREW
This screw is removed, printer cover is opened, and
printer ribbon is replaced.
- (21) RECORDING PAPER SUPPORT FITTING
Bobbin is inserted to recording paper and this is set.
It is removed when instaling the case lid.

(22) BATTERY CHANGE SWITCH

This is used normally on internal side,
and built-in battery is used. External
side is used when external battery is used.

(23) RS-232 C/ANALOG OUTPUT CONNECTOR

As an option, RS-232 C signal and analog
voltage signal are output.

(24) GND

Frame ground.

(25) AC100V CONNECTOR

AC100V power cord is connected.

(26) DC12V CONNECTOR

This is used when external battery is
connected with DC12V power cord.

(27) PICKUP CONNECTOR

Connector from the detector is connected.

(28) CONNECTOR CAP

This is a cover for preventing humidity
and dust when enclosing.

6. PREPARATION FOR MEASUREMENT

- (1) Take out the detector from the containing box.
- (2) Impeller installation. Remove impeller shaft holder (4), and fix (4) with the shaft being inserted to bearing. At this time, when the shaft and bearing are fastened in loose condition, trouble such as breaking of bearing stone and failure of the impeller to turn normally may occur. Thoroughly check and then fix. Install the impeller so that there is more or less play in the front and rear. Check tightening condition of bearing lock nut so that the impeller does not become loose during measurement.
- (3) Connect power cord.
- (4) Connect detector cable.
- (5) Set ink ribbon and paper.

Set ink ribbon as shown Fig. 6-1(A) and apply tension so as be slack.

Insert recording paper through he path shown in Fig. 6-1(A) and (B), set the PRINT switch to MANUAL, and press FEED switch. Then the paper is fed automatically.

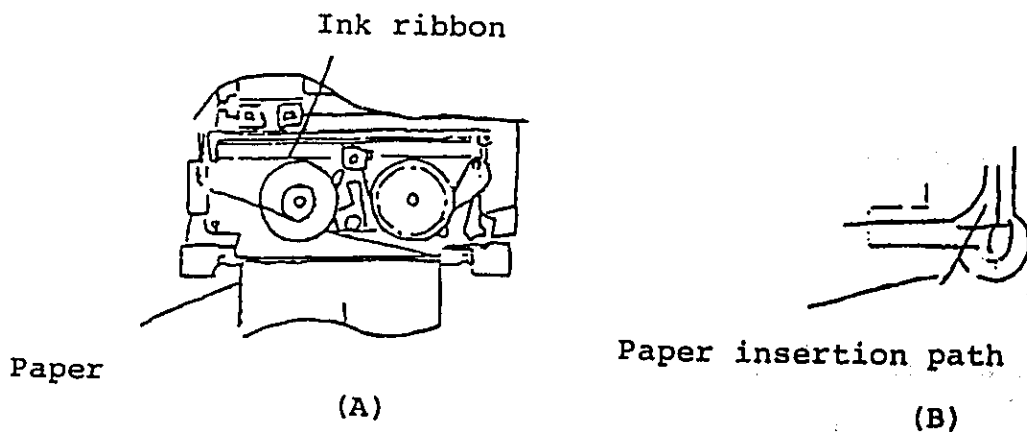


Fig. 6-1 Ink ribbon/paper replacement

During ink ribbon replacement, be careful so that the main body is not smeared by ink. When smeared, make clean with solvent such as alcohol immediately. Be thoroughly careful so that dust is kept out of paper.

7. MEASUREMENT OPERATION

7-1 Power On

Set POWER switch to ON. Then the battery indication meter indicates built-in battery voltage. Indication 12-14V is normal.

7-2 Date and Time Setting

Set date and time according to the following sequence using (4) TIMESET switch, (14) Y.M.H. select switch and (15) Y.M.H. setting switch.

(a) Year setting

Set (14) Y.M.H. select switch to 0, set (15) Y.M.H. setting switch to AD NNNN, and turn on (4) TIMESET switch. Set value is displayed on (18) Y.M.H. display. Fig. 7-1 is an example in which year is set to 1984.

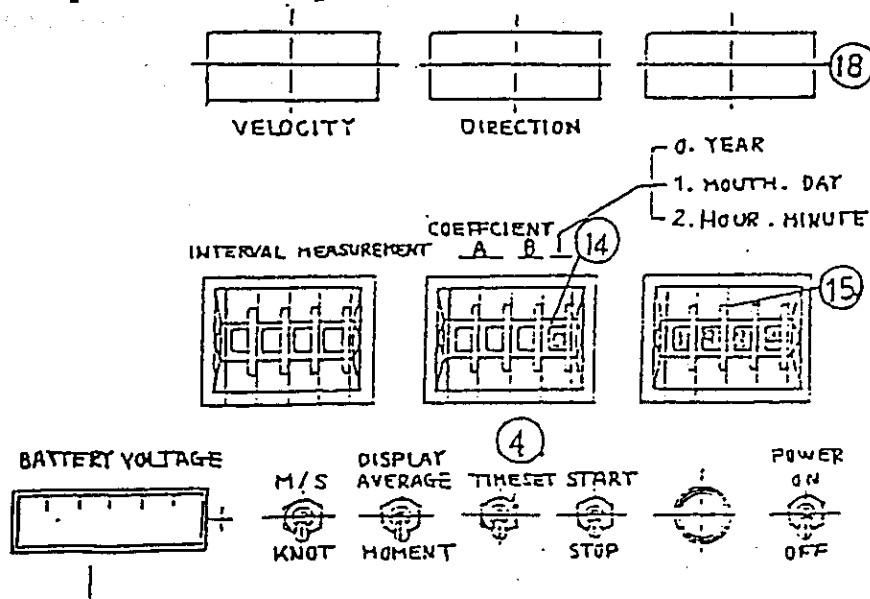


Fig. 7-1 Year setting

(b) Month and day setting

Set (14) Y.M.H. select switch to 1, set (15) Y.M.H. select switch to NN month and NN day in 4 digits, and turn on (4) TIMESET switch. Set value is displayed on (18) T.M.H. display.

(c) Hour and minute setting

Set (14) Y.M.H. select switch to 2, set (15) Y.M.H. setting switch to NN hours and NN days in 4 digits, and turn on (4) TIMESET switch. Set value is displayed on (18) Y.M.H. display. Internal timer operates at the instant (4) TIMESET switch of hour/minute setting is turned on.

- Note 1. When set value is not normal, 9999 is displayed on (18) Y.M.H. display. Set correct value.
- Note 2. When measurement is started without setting data and time, measurement is started from 0000 year, 00 month, 00 day, 00 hour, 00 minute.
- Note 3. When Y.M.H. select switch is set to any of 0, 1 and 2, a value corresponding to it is displayed. The display is changed at every turn of the impeller during observation. When the impeller does not turn, display is changed every 1 minute.
- Note 4. Turn on POWER switch after battery indication becomes 0V completely.

7-3 Impeller Coefficient Setting

Impeller inspection sheet records inspection formula of Eq. 1. Set coefficient (A) and (B) to COEFFICIENT setting switch, (12) and (13) as shown in Fig.7-2.

$$V = 0.45N + 0.01 \text{ ————— Eq.1}$$

(A) (B)

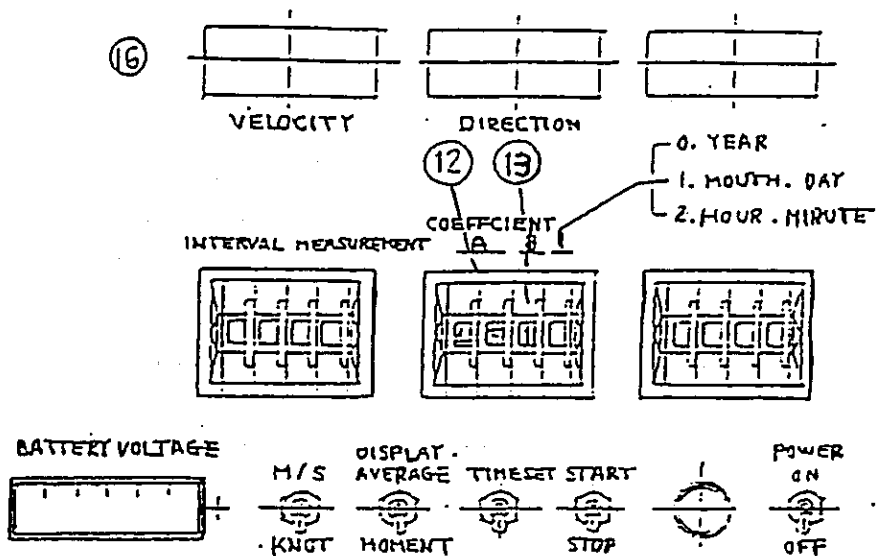


Fig. 7-2 Coefficient setting

Note 1. Max. setting value of (A) is 65. When a value exceeding 65 is set, 9999 is displayed on (16) flow velocity display.

7-4 Measurement Interval and Measurement Time Setting

Measurement interval and measurement time are defined by the time chart of Fig. 7-3. Set measurement interval with (10) INTERVAL setting switch and measurement time with (11) MEASUREMENT setting switch to a desired value of 1 to 99 (min).

In the case of Fig. 7-4, measurement interval is 5 min and measurement time 2 min.

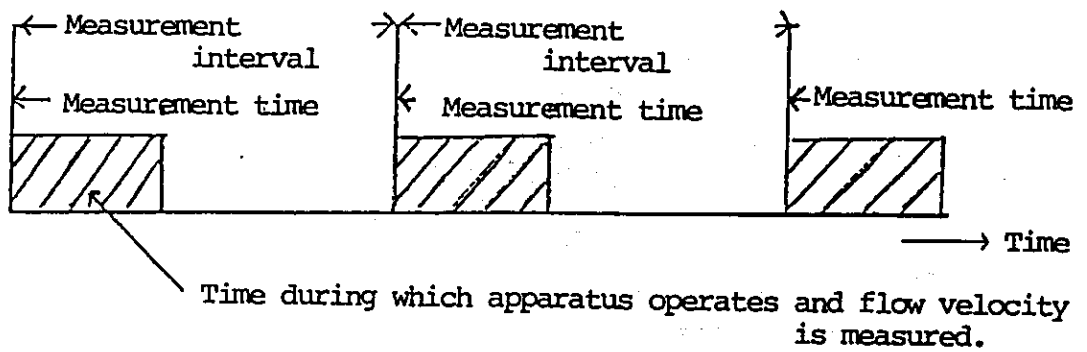


Fig. 7-3 Measurement time chart

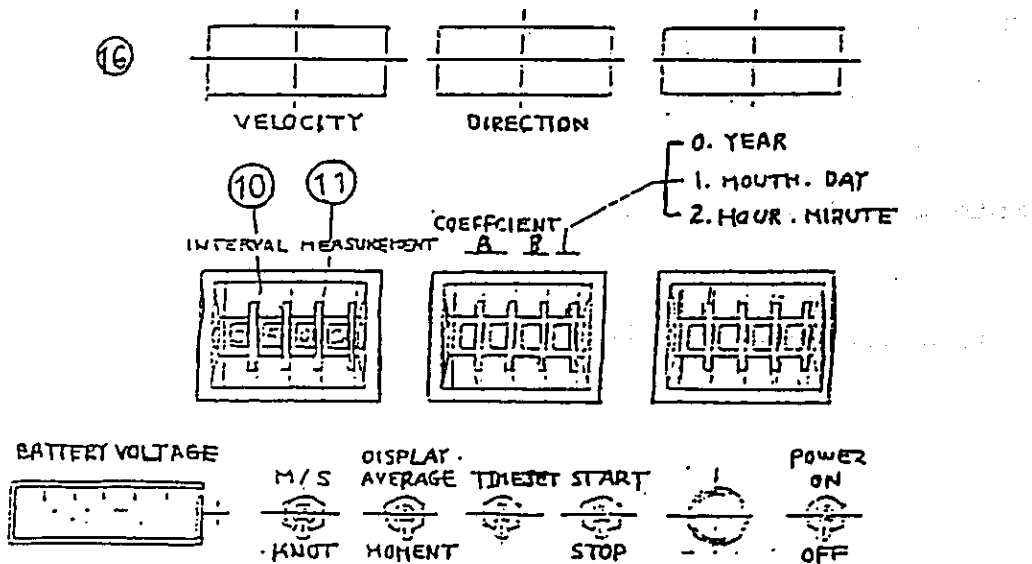


Fig. 7-4 Measurement interval and measurement time setting

7-5 Measurement Start

Set (3) START/STOP switch to START. Then measurement starts. At this time, when (8) PRINT switch is in ON position, the printer operates, and machine No. calculation formula, measurement interval, measurement time and date are printed. As shown in Fig. 7-5, measurement is performed according to the timer.

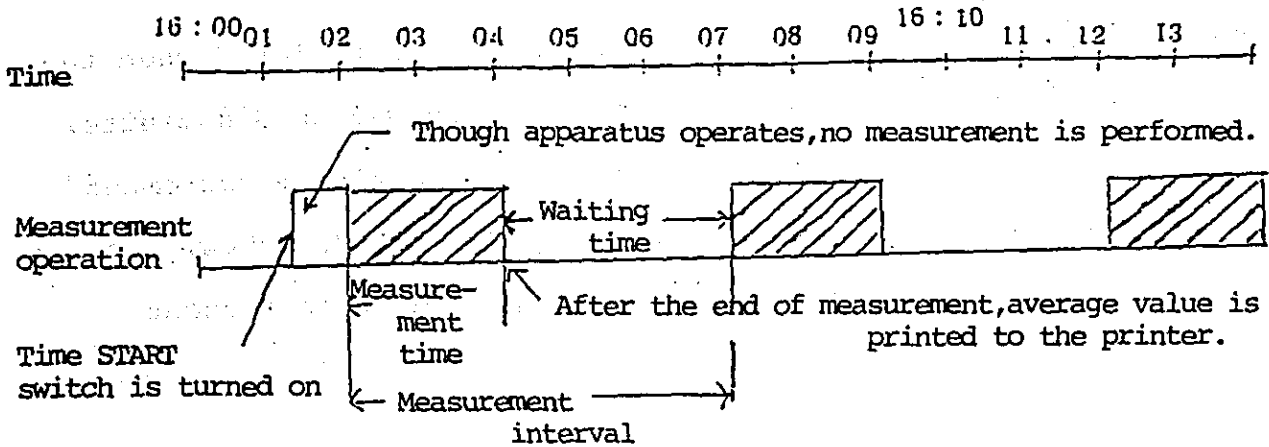


Fig. 7-5 Measurement time chart

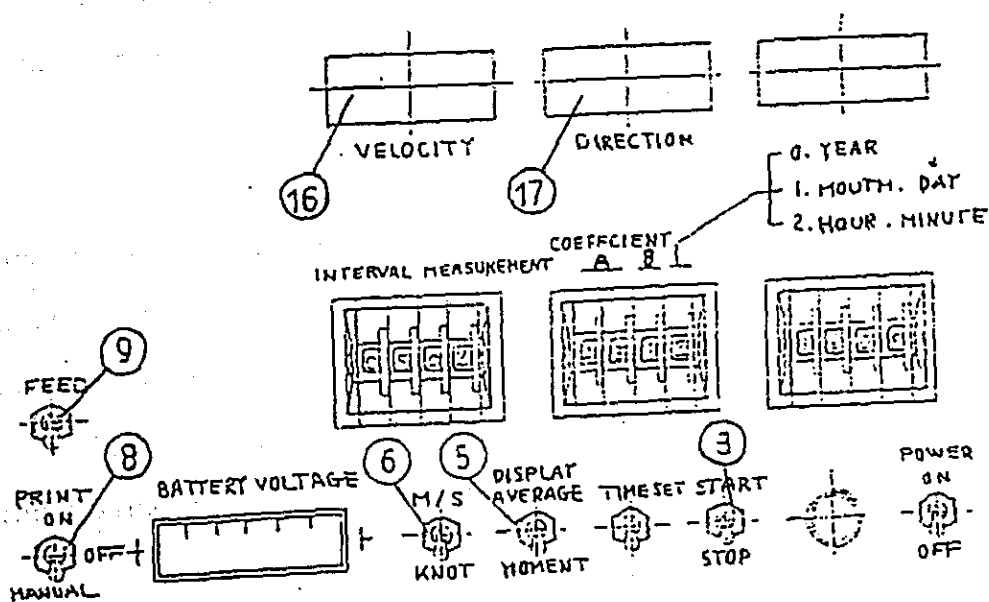


Fig. 7-6

7-6 Operation during Measurement

(a) Changeover between momentary value and average value.

When (5) DISPLAY switch is set to AVERAGE, average flow velocity is displayed on (16) VELOCITY display, while when it is set to MOMENT, momentary flow velocity at each turn of the impeller is displayed.

Note. Display is renewed at every turn of the impeller. When the impeller does not turn, display is renewed once a minute. When display content is to be changed during measurement waiting, set (3) START/STOP switch to START. Then, a value specified by switch (5)(6) is displayed at an instant of setting.

(b) Flow velocity unit changeover

When (6) M/S/KNOT switch is positioned to M/S, (16) VELOCITY display displays flow velocity in m/s. When the switch is positioned to KNOT, flow velocity is displayed in knot.

Average flow velocity value to be printed to the printer is also changed through this switch.

(c) Printer control

Printer control is performed by (8) PRINT switch. When the switch is set to ON, the printer operates only during printing. The printer is normally used in this condition. When the switch is in OFF position, the printer does not operate at all. In the MANUAL position, power is supplied to the printer constantly.

Note. Though the printer in the MANUAL mode, power consumption increases. When measurement is made using built-in battery, be sure to use with the switch in ON position.

7-7 Measurement Termination

For stopping or terminating measurement, position (3) START/STOP switch to STOP. 000 display is made on displays (16) and (17), and measurement is terminated. Thereafter the timer alone remains operating.

For restarting the measurement, position (3) START/STOP switch to START.

8. CALCULATION METHOD

8-1 Flow Velocity Calculation

In the case of this current meter, one pulse (pella pulse) is generated at every turn of the propeller. From the number of pella pulses integrated during measurement time, average flow velocity calculation is performed according to Eqs. 8-1 and 8-2.

Number of rotary pulses : P1

Measurement time : T1 (min)

Average number of revolutions (N) = $\frac{P1}{60 \times T1}$ Eq.8-1

Propeller inspection formula from $V=AN+B$

Average flow velocity = $AN+B$ m/Sec : Eq.8-2

8-2 Flow Direction Calculation

Flow direction data is sampled at every pella pulse during measurement, and frequency graph is plotted on the memory as shown in Fig.8-1. After the end of measurement, flow direction of the highest frequency is assumed to be main flow direction, and average flow direction is calculated in the range of $\pm 45^\circ$ with respect to the main flow direction by load average method.

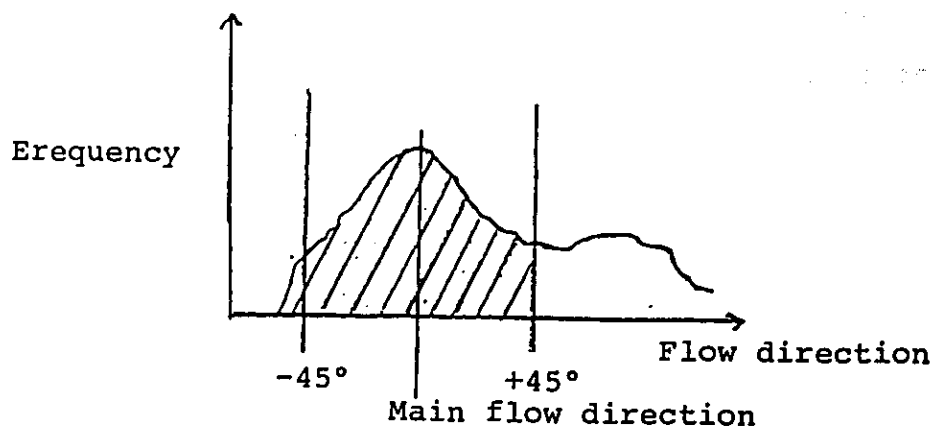


Fig. 8-1

9. DESCRIPTION OF PRINT CONTENT

002 00:04 0.00m/s 0° — When pella is not turning,
 001 00:02 2.19m/s 124° — 0 m/s 0° is printed

Date 0000/0/0 ← When measurement is statd
 Formula U=0.45N+0.01 ← without setting date and time,
 Measurement time 1 ← 0 is printed
 Interval time 2

DCM-2 (PRT-3 No.65136)

012 17:23 1.98knot 124°
 011 17:21 3.38knot 124°
 010 17:19 3.34knot 124°
 009 17:17 2.85knot 227° — Average flow velocity 2.85 m/s
 008 17:15 1.55m/s 234° — Average flow direction 227°
 007 17:13 1.49m/s 234°
 006 17:11 1.49m/s 234°
 005 17:09 1.43m/s 234°
 004 17:07 1.45m/s 234°
 003 17:05 1.33m/s 234°
 002 17:03 1.17m/s 234° — Average flow velocity 1.17 m/s
 001 17:01 1.36m/s 234° — Average flow direction 234°

Measurement No. →
 and time

Date 1984/10/14 ← Date
 Formula U=0.45N+0.01 ← Calculation formula
 Measurement time 1 ← Measurement time
 Interval time 2 ← Measurement interval
 DCM-2 (PRT-3 No.65136) ← Apparatus machine No.

(a) Measurement in rough weather

In the measurement at the time of rough sea weather, error in flow direction and flow velocity may occur due to rolling of measurement ship. Accordingly, when a high measurement accuracy is required, avoid measurement as far as possible, or employ installation method shown in Fig.10-1.

(b) Ship fixing method

To avoid effect due to winds and waves, measurement ship must employ 2-point anchor.

(c) Observation when flow velocity is high

In the measurement of relatively high flow velocity (1.5m or more), suspend the attached weight (fish-shaped) (Fig. 10-2).

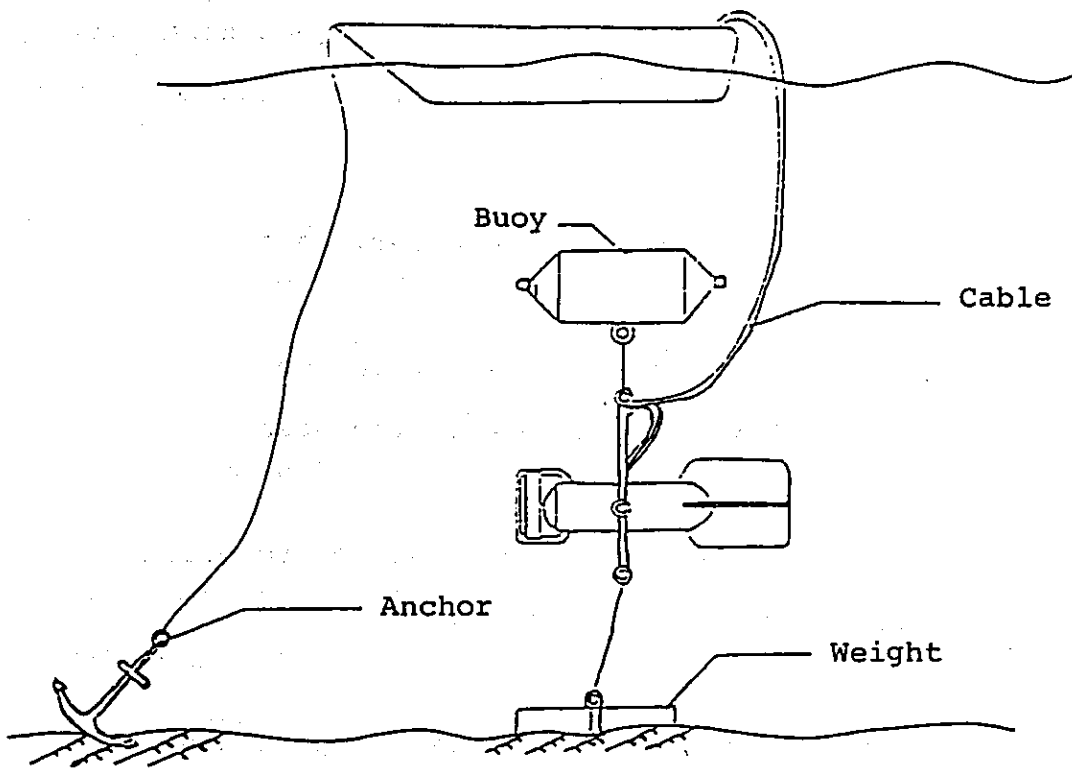


Fig. 10-1

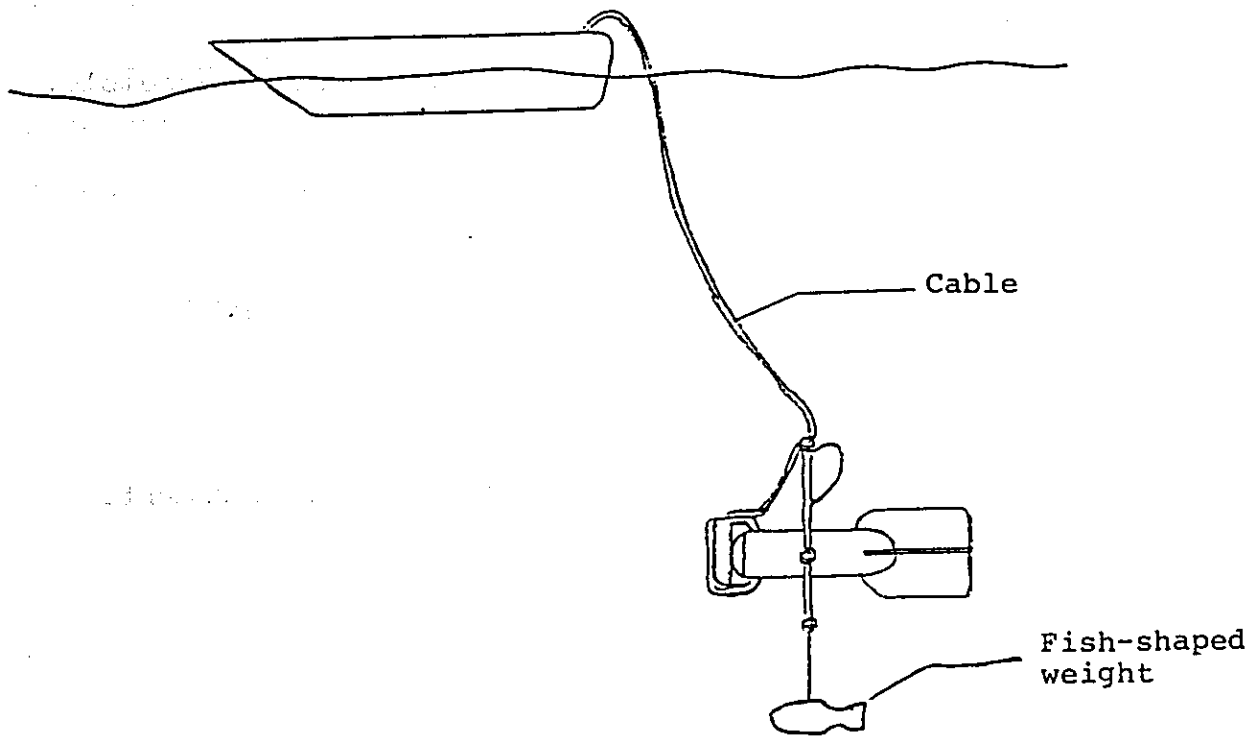


Fig. 10-2

11. CAUTION ON HANDLING

11-1 Detector

(a) Impeller

Since light material is used for the impeller, be careful not to drop or give shocks in mounting/removal.

After measurement is completed, wash with water to prevent shaft corrosion, wipe thoroughly, and enclose in the specified container.

(b) Bearing

During impeller mounting/removal, be careful not to break jewel. Never apply oil and grease to bearing.

(c) Main body

Since the direction detector using magnetic compass and electric circuit are incorporated inside, be thoroughly careful not to give large shocks.

(d) Disassembling main body

To maintain main body inside water tight, never disassemble.

11-2 Printer

(a) Connector cover

When the connector is not connected, be sure to apply connector cap.

(b) Switches

Leave switches in OFF position except during measurement.

(c) Main body

In the handling of indicator main body, be thoroughly careful not to drop or give shocks.

Due to measurement characteristics, there is a possibility of being covered by water (rain water and sea water). Prevent as far as possible. When measurement has finished, put the printer in the container after thoroughly removing humid air and contamination.

11-3 Cabtire Cable

(a) Connector

Humid air and dust on the connector at the end of cable may cause trouble such as contact failure. When not in use, be sure to apply humidity prevention cap.

(b) Cable

Cable contains piano wire and is designed to have tensile strength of 150kg or more. Be thoroughly careful not to bend to an extreme degree or injure the cover.

APPENDIX 9

ELECTROMAGNETIC CURRENT METER

(MODEL: EMC-108)

YOKOGAWA NAVITEC

EMC108

Instruction Manual

RECORDING CURRENT METER
(ELECTROMAGNETIC TYPE)



YOKOGAWA NAVITEC



1st Edition
IM 80U20M05E

Cotents

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1. Outline

(1) Features

The flow velocity sensor's operating principle is the same as that in electromagnetic logs widely used to measure ship's speed, being based on Faraday's law. The sensor has a built in coil and iron core which generates a magnetic field near electrodes, and as each of the 4 electrodes used is located around the sensor at 90 degree intervals, flow velocity is detected by the electrodes standing opposite each other. Because of its spherical shape, it is not hardly influenced by tilting.

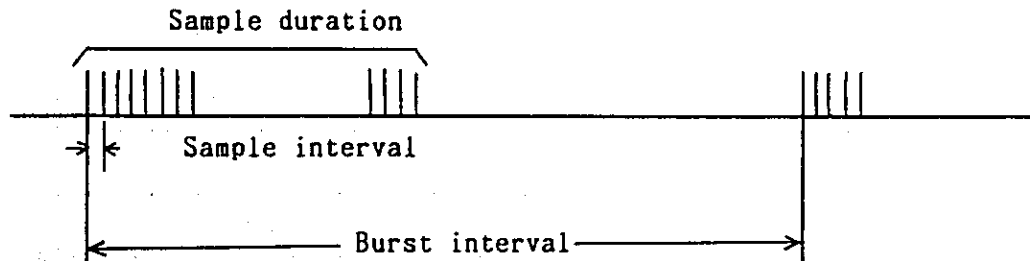
The electromagnetic type has no moving parts and can measure a very wide range of flow velocity.

(2) Recording

This meter enables measurement using any combination of sample interval, burst interval and sample duration.

Measured data is recorded on cassette tape and can be printed out on an X/Y plotter or printer used in conjunction with a data analysis computer.

Data recording



Measurement is started at each burst interval and is made by the number of sample duration times for each sample interval.

- a. Sample interval : (0.25)*, 0.5, 1, 2, 4, 8, 16, and 32 sec.
(Time interval required to acquire measurement data.)
- b. Burst interval : 1, 2, 5, 10, 20, 60, 120, 240, and 480 min., continuous
(Time interval required to start measurement.)
- c. Sample duration : 32, 64, 128, 256, 512, 1024, 2048, and 4096 pcs.
(Because of above mentioned specifications, this meter has a wide range of application from measurement of coastal current flow to tidal movement.)

* 0.25 : Temperature data are missing for every 32 data items.

2. 1 Specifications

(1) Measuring method

By 2-axis electromagnetic sensor

(2) Measuring range

Flow velocity	0 to ± 2 m/sec.
Direction	0 to 359°
Temperature	-5 to 30° C

(3) Accuracy

Flow velocity	$\pm 1\%$ of FS + 3 cm/sec.
Direction	$\pm 3^\circ$
Temperature	$\pm 0.2^\circ$ C

- (4) Resolution
 - Flow velocity 0.2 cm/sec.
 - Direction 1.0°
 - Temperature 0.04° C
- (5) Recording
 - Sample interval : (0.25) *, 0.5, 1, 2, 4, 8, 16, and 32 sec.
 - Burst interval : 1, 2, 5, 10, 20, 60, 120, 240, and 480 min., continuous
 - Sample duration : 32, 64, 128, 256, 512, 1024, 2048, and 4096 pcs.

* Temperature data are missing for every 32 data items.
- (6) Tape used
 - AD90 (TDK) 450 feet or AD60 (TDK) 300 feet
- (7) Usable depth
 - 450m max.
- (8) Weight
 - 29kg (weight in the water: 15 kg)
- (9) Battery
 - Alkali batteries (AM-1) 14 pcs.

2. 2 C o n f i g u r a t i o n

2.2.1 Configuration

- (1) Current meter.....1
- (2) Wooden box for storage.....1

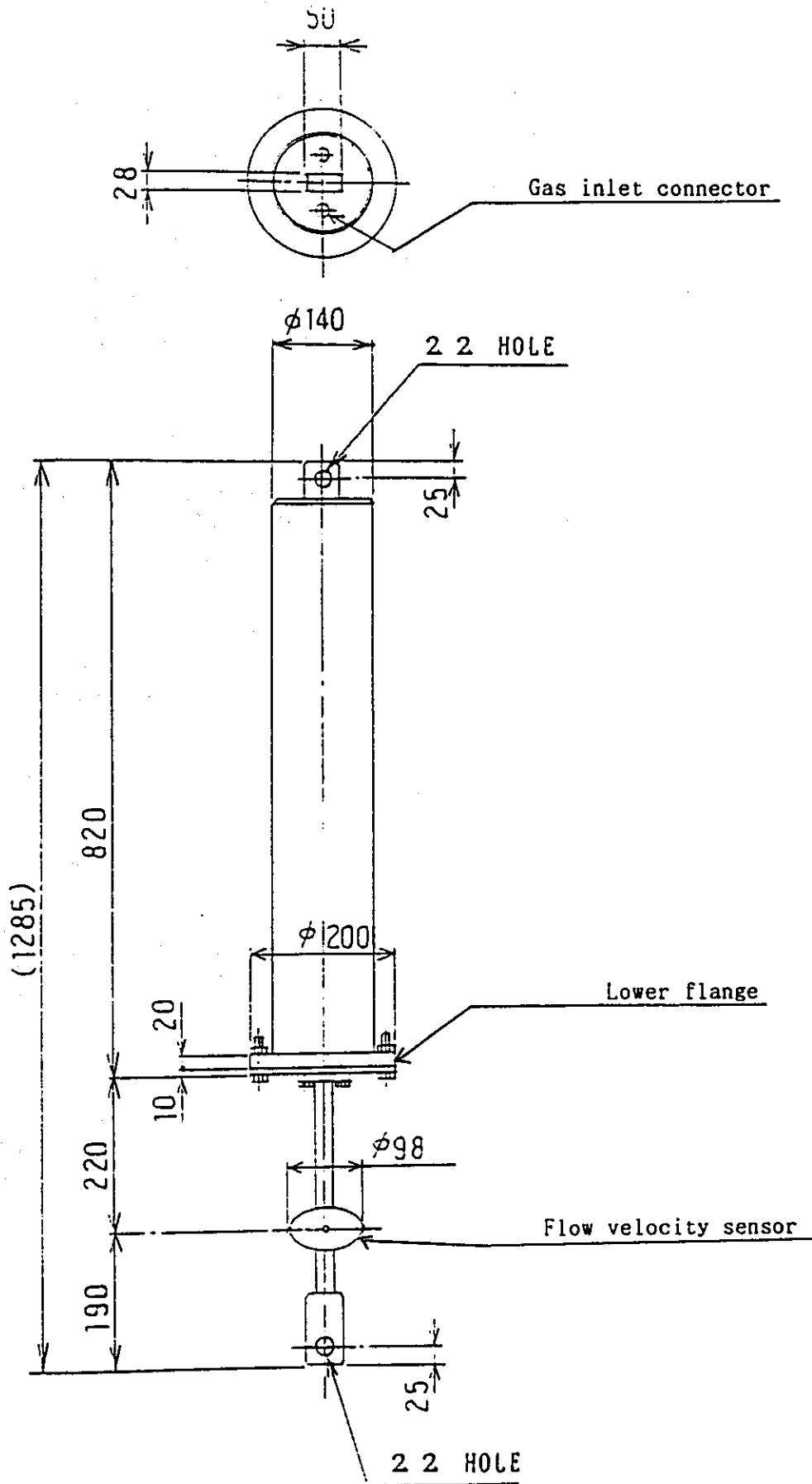
2.2.2 Spare parts

- (1) Battery box.....1
 (Usually used, housed in the mainframe)
- (2) Batteries AM-1.....14
- (3) Cassette tape AD90 (TDK) or AD60 (TDK).....1
- (4) Silica gel.....3

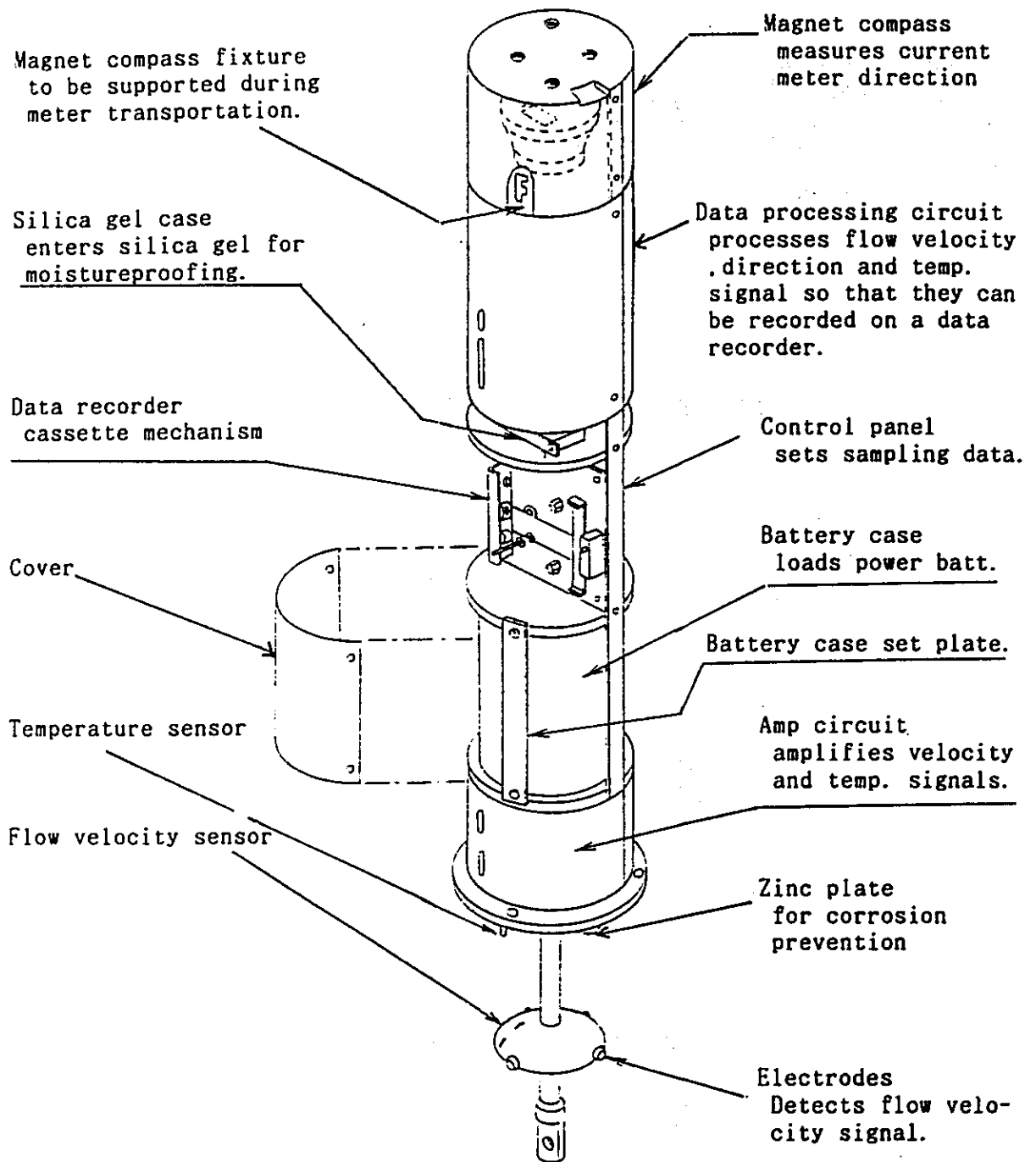
2.2.3 Accessories

- (1) Screwdrivers.....2
- (2) Spanners.....2
- (3) Hexagon head wrench.....1

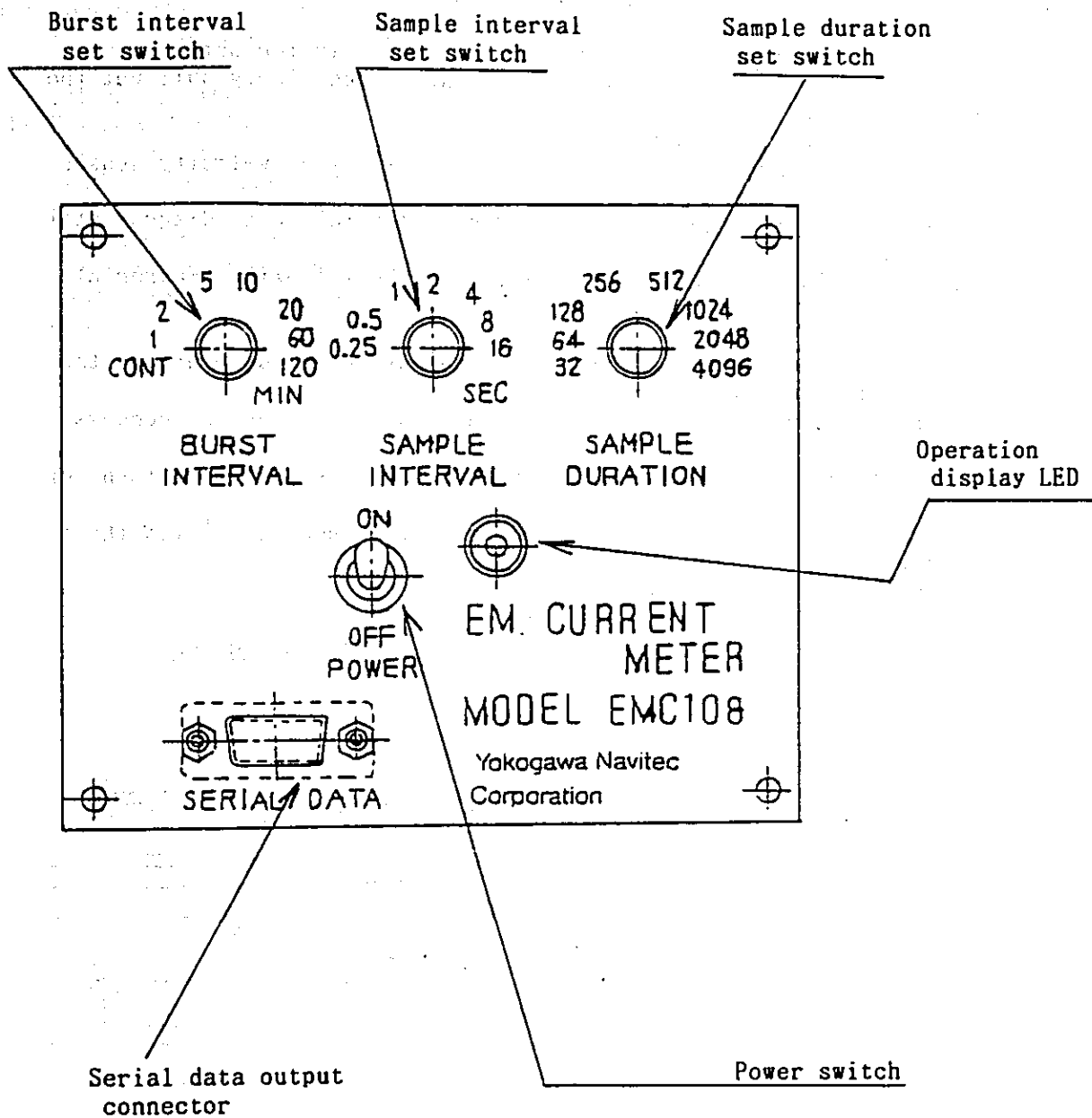
2.3 Dimensional outline drawing



2.4 Functional description



Control panel detail



3. 1 Measurement preparation

(1) Open the cover of the wooden shipping box and take out the meter after fixing nuts.

Next, place the meter on the cover plate turned inside out.

(2) Remove the four bolts from the lower flange, then slowly pull out the internal assembly.

(3) Install the magnet compass.

Magnet compass installing direction varies with flow velocity sensor direction.

When the velocity sensor faces downward

Refer to the following diagram at left.

When the velocity sensor faces upward

Refer to the following diagram at right.

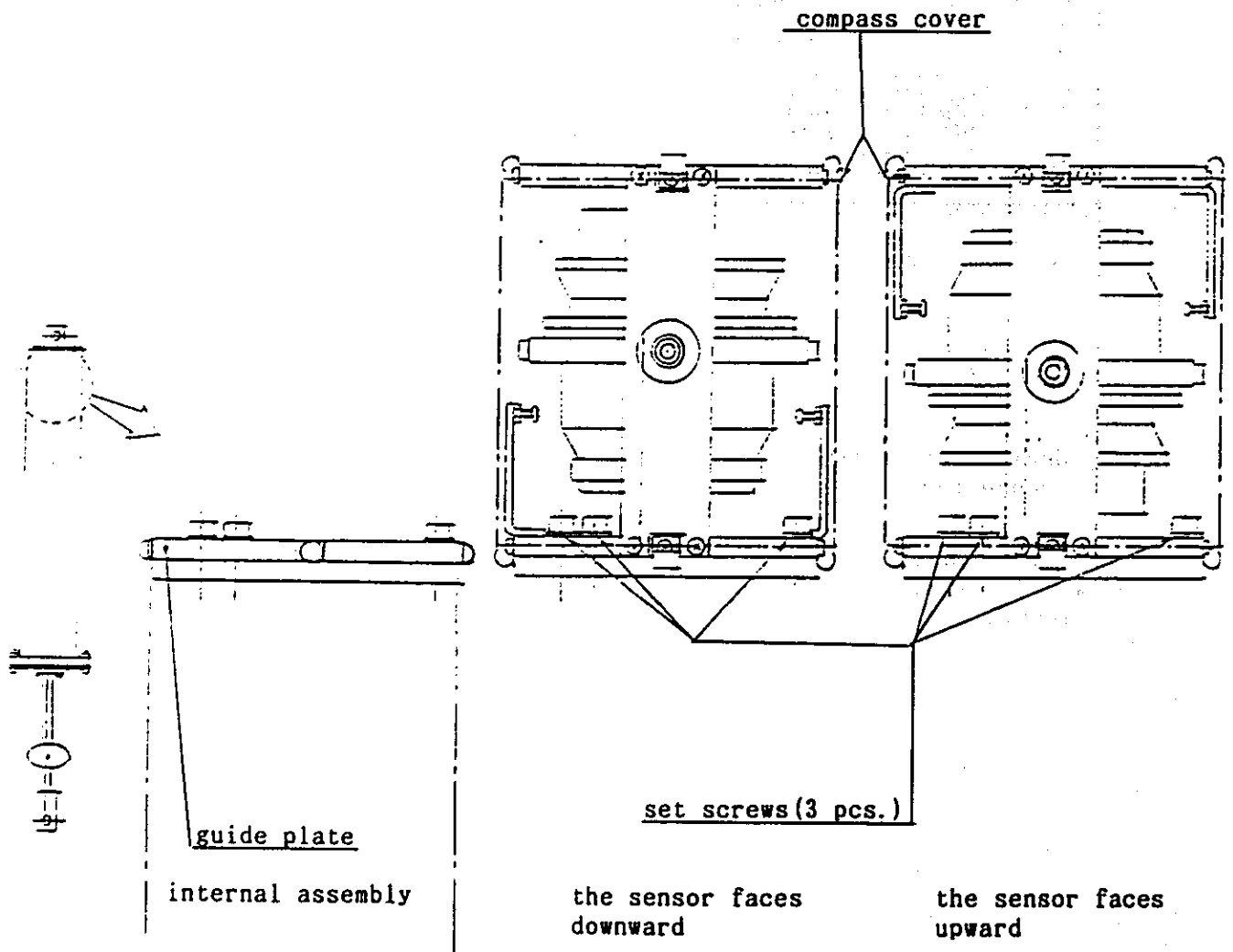
a. Remove the set screws (3 pcs.) to take out the guide plate in the internal assembly.

note. Carefully store the guide plate as it is used for compass installation.

b. Take the magnet compass out of the compass packaging box, then remove the compass cover.

c. Match the connector with the guide pin, then secure it with the set screws (3 pcs.).

d. Install the compass cover.



*Caution When measurement is made with the sensor facing upwards, X flow direction becomes opposite that of the normal installation. Pay attention to data processing.

- (4) Remove the battery case set plate, then take out the batteries. At this time, disconnect the power lead connector. Load the batteries into the battery cases in accordance with item 3.1 (5), then install the battery plate and connect the power lead connector.
- (5) Battery loading
There are battery cases in the meter or in the wooden box as spare. Load 14 AM-1 alkali batteries into the battery cases, making sure that the batteries are new so that no battery voltage drop occurs during measurement (check the batteries manufacturing dates.). These cases are located at the upper and lower sections. Load the batteries as instructed on the battery case or as shown in the following diagram.

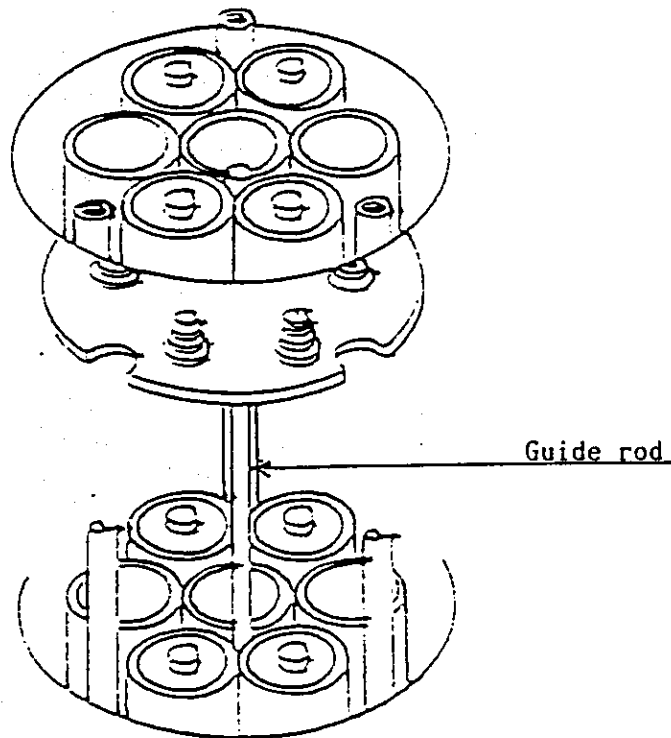
Battery replacement procedure

How to load batteries

Upper side

Middle side

Lower side

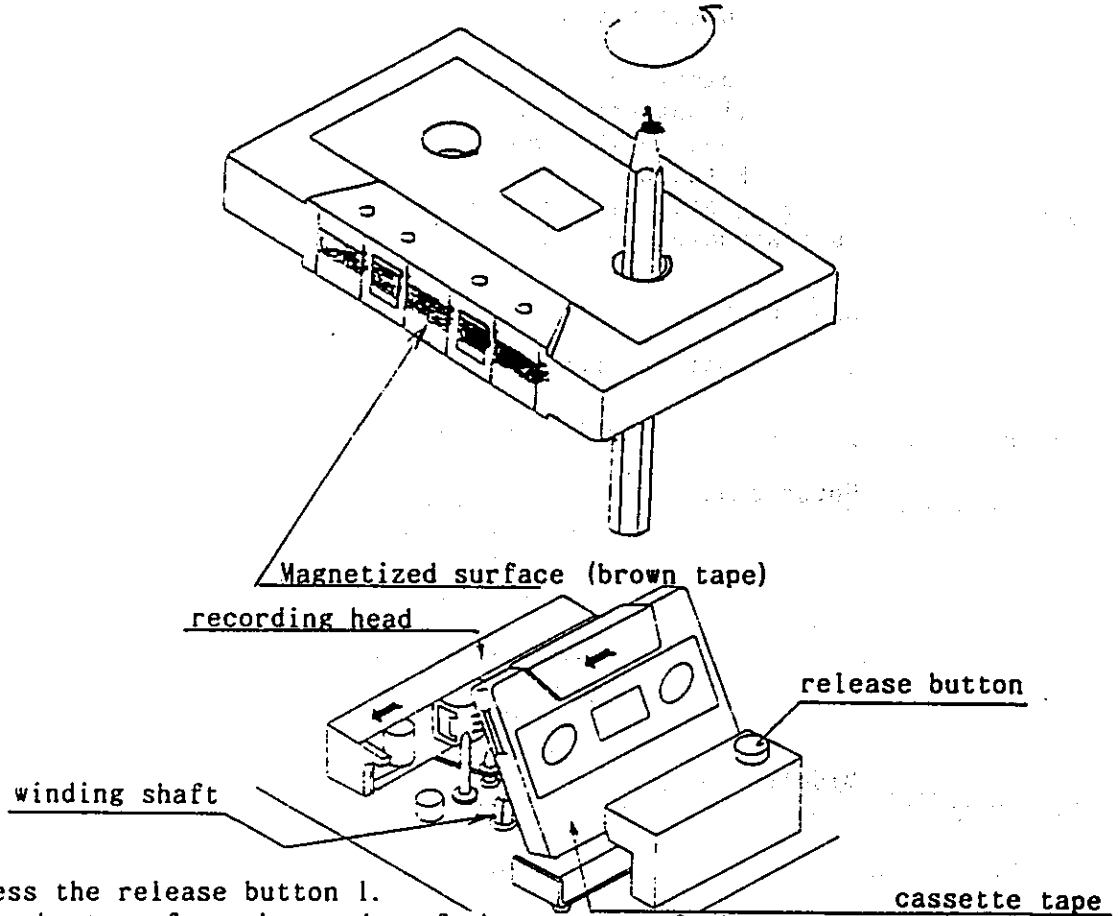


- (6) Power check
Turn the power switch to ON (move the switch knob while pulling it forward as it is lockable), then check that the LED on the panel light up. Set each switch as follows.
BI : CONT SI : 1 SD : 32
The LED is green when the power is turned ON. (disappears 30 sec. later)
It flashes red during measurement.
After completing the checks turn OFF the power.

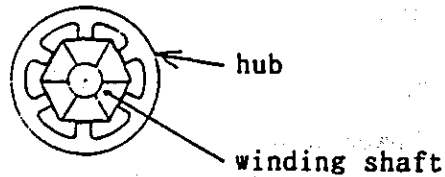
(7) Cassette tape setting

Remove the data recorder cover, then set the cassette tape. Always use new AD60 or AD90 tape depending on the amount of that needs to be stored.

- a. Wind the tape until the brown magnetic tape surface appears.



- b. Press the release button 1.
c. Set the tape from the reader of the cassette 2, then push it downward 3. (Do not push the recording head.)
Make sure that the winding shaft securely engages the tape hub.



- d. Push the recording head 4 in the direction of the cassette tape travel until it is completely locked.
e. Feed the tape at idling speed to remove tape slack, and set the burst interval to CONT. and the sample interval to 0.5 SEC. Then turn ON the power to start the motor. If the tape feed side starts rotating, turn OFF the power.

(8) Recording data setting

Set burst interval, sampling interval and sample duration to the desired values.

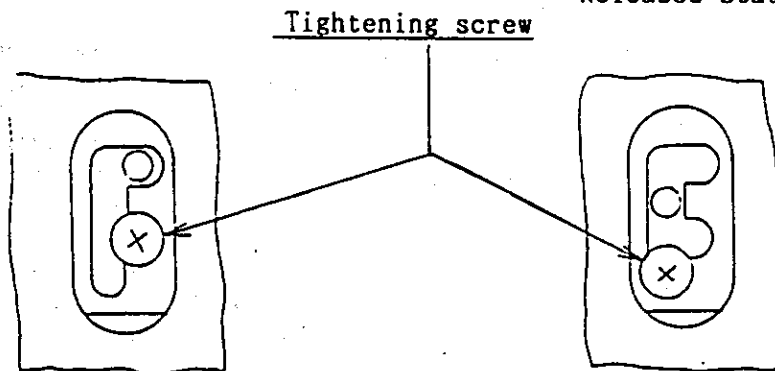
note. For recording time and the number of data points, refer to the quick reference table on page 16.

(9) Holding and releasing the magnetic compass

The magnetic compass located at the extreme top of the internal assembly is locked during transportation, but can be released and adjusted during usage by following the procedure below.

Holded state

Released state



Loosen the screw with a screwdriver so that the screw and guide locations are as shown in the above figures, then tighten the screw.

(10) Cleaning contaminated O-rings and checking for scratches.

Wipe off contamination on the O-ring inserted below the lower flange with a clean cloth and check for scratches on the O-ring as scratched O-ring may cause water leakage. If the O-ring is scratched, replace it with a new one, making sure to apply the attached O-ring grease.

(11) Always use silica gel for internal dehumidification.

(12) Power ON

Turn ON the power to check for the description in item 3.1 (4) again and correctly record the time at this moment.

(13) Internal assembly installation

Slowly insert the internal assembly into the outer chamber then hold it with the four bolts, making sure that the bolts are tightened evenly. If necessary, hold the bolt insertion holes with wire to match these holes.

(14) Cleaning the sensor electrode

Lightly polish the sensor electrode with the fully moistened sandpaper. Even if the slightly film of oil on the electrode may cause large measurement error.

Therefore, do not touch the electrode after the sensor has been cleaned.

(15) Cautions to be observed during long time continuous measurement and used in high humidity environments.

When the meter is used for a long time or in high humidity environments, seal the internal assembly with nitrogen from the top of the chamber. For details on gas sealing, refer to page 12.

3.2 Measurement start

(1) Meter transport

Try to protect the meter from shock during transport as much as possible as it has already been set to the measuring condition.

(2) Meter installation

When the meter arrives at the measuring site, attach a meter fixture to the meter, then tie one end of a rope to the meter. Next, lower the meter into the water by extending the rope.

note : The electrode is easily damaged by shock, so always handle the meter with care.

(3) Installation caution

The magnetic compass is built into the upper part of the meter, so do not install the meter near magnetic materials such as iron, etc.

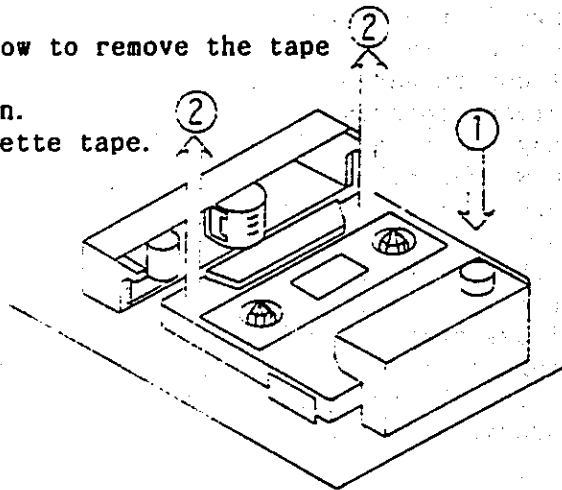
3.3 Meter recovery

At the end of the estimated measuring period, recover the meter.

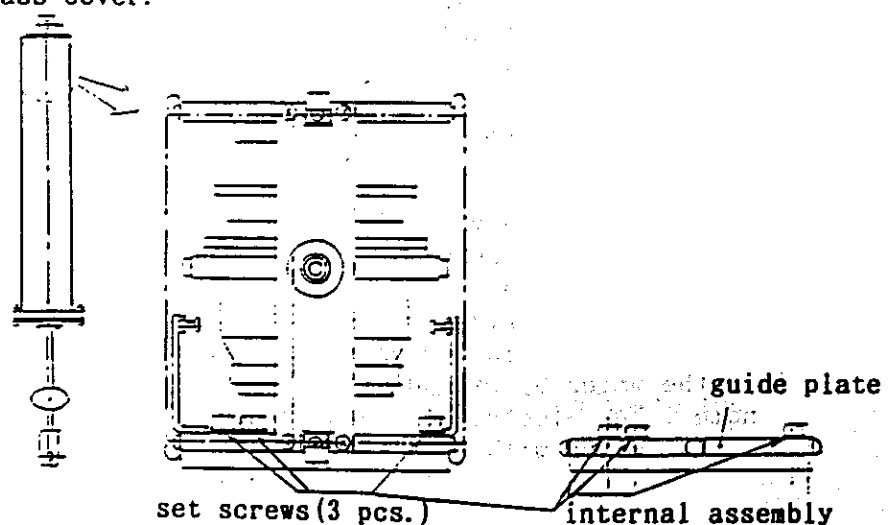
- (1) Tie one end of the rope to the meter, then hold the other end to the meter recovery ship.
- (2) Pull the meter and the meter fixture out of the water.
Recover the meter carefully and handle it with care as the electrode is very susceptible to shock damage.
- (3) Correctly record the time at recovery.
- (4) After recovery, wash the meter with clean fresh water to remove salt and extraneous matter, then wipe it dry with a cloth.
- (5) Remove the four bolts from the lower flange, slowly pull out the internal assembly, then turn the power switch to OFF and record the time.
- (6) Thoroughly wipe the mating surface of the lower flange clean.
- (7) Remove the cassette tape and store it in the special case.
Remove the tape in accordance with the procedure described below.

How to remove the tape

- 1) Press the release button.
- 2) Lift the end of the cassette tape.



- (8) Remove the batteries from each battery case, then store them at a separate location to prevent them getting mixed up with new batteries.
- (9) Remove the magnet compass. (Refer to the figure shown below.)
 - a. Remove the compass cover.
 - b. Remove the set screws (3 pcs.), then remove the compass.
 - c. Secure the guide plate to the internal assembly with the set screws.
 - d. Close the compass cover.



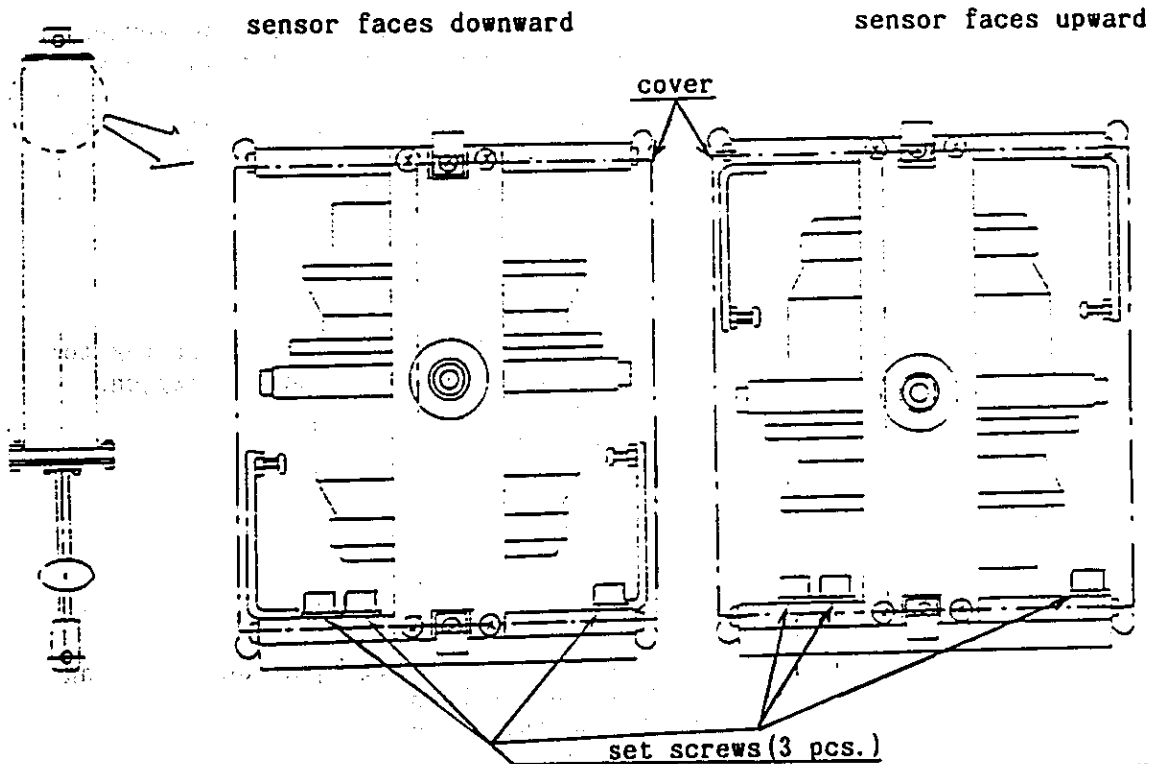
- (10) Check the number of attached tools, then place them together with the meter into the wooden box.
- (11) When the zinc plate for corrosion prevention is eroded, replace it with a new one.

3. 4. Meter storage and transport

- (1) Hold the magnetic compass (refer to page 10), then accommodate it into the compass packaging box.
- (2) Thoroughly dry the meter, then put it into the special wooden box and tighten the setting bolts.
- (3) Attach a caution label to the box before shipment, then instruct the transportation company to handle the box carefully.

4. Magnetic compass installation depending on sensor direction

- (1) The meter is assembled prior to shipment with the sensor facing downward ;therefore, in this case, install the meter so that the sensor faces downward.
- (2) When the meter is used with the sensor facing upward.
 - a. Remove the magnetic compass cover.
 - b. Remove the magnetic compass set screws (3 pcs.), then remove the compass.
 - c. Turn the compass 180°, then match the connector and guide pin and tighten the set screws. (3 pcs.)
 - d. Close the cover.



note. When measurement is made with the sensor facing upward, the X flow direction becomes opposite that of the normal installation. Pay attention to the data processing.

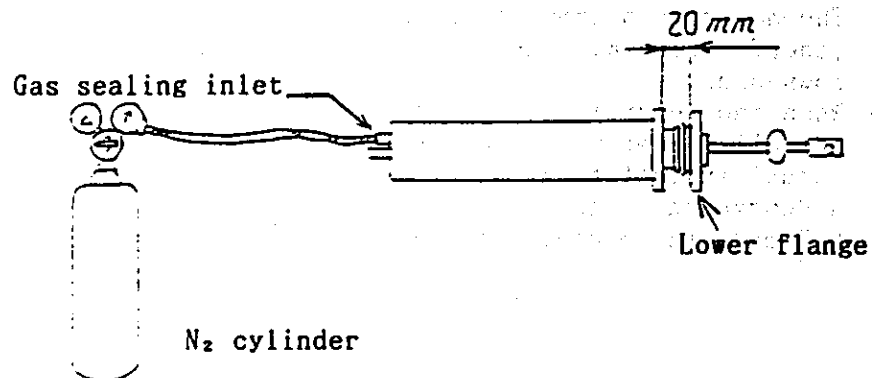
5. Nitrogen gas moistureproof sealing

5.1 Necessary tool

- (1) Nitrogen filled cylinder
3.4 ℓ and 10 ℓ cylinders are readily available on the market.
- (2) Universal pressure regulator
Pressure regulators with primary and secondary pressure gauges and a regulating valve are readily available on the market.
- (3) Gas hose (about 2 m long)
- (4) Special gas injection nozzle (to be ordered separately)

5.2 Gas sealing

- (1) Set the nitrogen pressure regulator, gas hose and injection nozzle as desired.
- (2) Remove the screw from the gas sealing inlet at the top of the meter, then push in the injection nozzle until it stops.
- (3) Remove the four screws from the lower flange of the meter, then pull out the internal chassis about 20 mm.



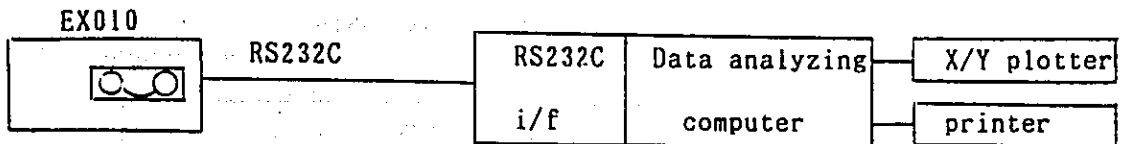
- (4) Open the valve on the nitrogen cylinder.
(The cylinder's primary pressure is indicated on the regulator gauge.)
- (5) Slowly turn (loosen) the pressure regulator valve, then stop when a gas flowing sound is produced (a hissing sound).
- (6) When the air in the meter is replaced by nitrogen about 60 sec. later, close the regulator valve.
- (7) Tighten the meter flange to seal the upper gas inlet.

5.3 Others

- (1) The 3.4 ℓ cylinder can be used about 15 times.
- (2) Although nitrogen itself is not poisonous, be careful about letting too much escape into the atmosphere and causing a local lack of oxygen.
(Specific gravity of N₂:0.967)
- (3) Nitrogen is widely available from industrial gas outlets.

6. Data analysis

The recovered cassette tape is analyzed in accordance with the following flow. Data stored in the tape is output after being converted to an RS232C signal by the special reader (EX010), so this signal is connected to a data analysis computer via an RS232C interface.



7. Data recording

- (1) Cassette tape and recording capacity
Use the following cassette tapes.

300 feet AD60 (TDK)
450 feet AD90 (TDK)

Recording capacity

Tape used	No. of files	No. of data points
300 feet	2556	81792
450 feet	3835	122720

1 data	File no.	12bits
	Data no.	12bits
	X flow velocity	12bits
	Y flow velocity	12bits
	Direction	10bits
	Temperature	12bits

The file No. increments by 1 for every 32 data items.
The data No. increments by 1 for each data.

(2) Data sample

Data sample combination table

SAMPLE DURATION (PC)	SAMPLE INTERVAL (sec)					
	0.5	1	2	4	8	16
32	1	1	2	5	5	10
64	1	2	5	5	10	20
128	2	5	5	10	20	60
256	5	5	10	20	60	120
512	5	10	20	60	120	240
1024	10	20	60	120	240	480
2048	20	60	120	240	480	
4096	60	120	240	480		
BURST INTERVAL (min)						

The combination of less than the burst interval set value is available. For continuous operation (CONT), data is recorded for each sample interval.

Sample: The combination below is available when burst interval is set to 5 min.

SAMPLE DURATAION	SAMPLE INTERVAL (sec)				
	0.5	1	2	4	8
32	1	1	2	5	5
64	1	2	5	5	
128	2	5	5		
256	5	5			
512	5				

To be set under the condition of (burst interval) > (sample interval) × (sample duration).

(3) Measurement time

Example: burst interval 5 min.
 sample interval 1 sec.
 sample duration when set to 64

64 data points/sec are recorded every 5 min..

Measurement time for each burst

$$\begin{array}{r} \text{(sample interval)} \times \text{(sample duration)} \\ 1 \quad \quad \quad \times \quad \quad 64 \quad \quad = 64 \text{ sec.} \end{array}$$

Total measurement time when 300 feet tape is used

$$\begin{array}{r} \text{(Recording capacity)} \div \text{(sample duration)} = \text{(burst)} \\ 81792 \quad \quad \quad \div \quad \quad 64 \quad \quad = 1278 \end{array}$$

$$1278 \times 5 \text{ (min.)} = 6390 \text{ min.} = 106.5 \text{ hours} = 4.4 \text{ days}$$

Example

burst interval CONT.
sample interval 0.5 sec.
sample duration Same at any position

Data/0.5 sec. is recorded

Total measurement time when 450 feet tape is used

$$\begin{array}{r} \text{(Recording capacity)} \times \text{(sample interval)} \\ 122720 \quad \quad \quad \times \quad \quad 0.5 \quad \quad = 61360 \text{ sec.} \\ \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad = 17 \text{ hours} \end{array}$$

8. Measurement time quick reference table

BI : BURST INTERVAL h : HOUR
 SI : SAMPLE INTERVAL d : DAY
 SD : SAMPLE DURATION

BI	SI	SD	300 ft		450 ft		BATTERY CONSUMPTION h	
			h	d	h	d		
1	0.5	32	42.6	(1.7)	63.9	(2.6)	66.1	
		64	21.3		31.9		33.1	
		32	42.6	(1.7)	63.9	(2.6)	48.4	
2	0.5	32	85.2	(3.5)	127.8	(2.6)	131.6	
		64	42.6	(1.7)	63.9	(2.6)	66.1	
		128	21.3		31.9		33.1	
		32	85.2	(3.5)	127.8	(2.6)	96.5	
		64	42.6	(1.7)	63.9	(2.6)	48.4	
		32	85.2	(3.5)	127.8	(2.6)	* 62.8	
5	0.5	32	213	(8.8)	319.5	(13.3)	325.1	
		64	106.5	(4.4)	159.7	(6.6)	164.2	
		128	53.2	(2.2)	79.8	(3.3)	82.5	
		256	26.6		39.9	(1.6)	41.3	
		512	13.3		19.9		20.7	
		32	213	(8.8)	319.5	(13.3)	239	
	1	0.5	64	106.5	(4.4)	159.7	(6.6)	120.4
			128	53.2	(2.2)	79.8	(3.3)	60.4
			256	26.6		39.9	(1.6)	30.2
			32	213	(8.8)	319.5	(13.3)	* 156
			64	106.5	(4.4)	159.7	(6.6)	* 78.2
			128	53.2	(2.2)	79.8	(3.3)	* 39.3
2	0.5	32	213	(8.8)	319.5	(13.3)	* 92.3	
		64	106.5	(4.4)	159.7	(6.6)	* 46.3	
		128	53.2	(2.2)	79.8	(3.3)	* 23.1	
		32	213	(8.8)	319.5	(13.3)	* 50.7	
10	0.5	32	426	(17.7)	639.1	(26.6)	637	
		64	213	(8.8)	319.5	(13.3)	325.1	
		128	106.5	(4.4)	159.7	(6.6)	164.2	
		256	53.2	(2.2)	79.8	(3.3)	82.5	
		512	26.6		39.9	(1.6)	41.3	
		1024	13.3		19.9		20.7	
	1	0.5	32	426	(17.7)	639.1	(26.6)	470.8
			64	213	(8.8)	319.5	(13.3)	239
			128	106.5	(4.4)	159.7	(6.6)	120.5
			256	53.2	(2.2)	79.8	(3.3)	60.4
			512	26.6		39.9	(1.6)	30.2
			32	426	(17.7)	639.1	(26.6)	* 309.4
2	0.5	64	213	(8.8)	319.5	(13.3)	* 156.2	
		128	106.5	(4.4)	159.7	(6.6)	* 78.5	
		256	53.2	(2.2)	79.8	(3.3)	* 39.3	
		32	426	(17.7)	639.1	(26.6)	* 183.5	
		64	213	(8.8)	319.5	(13.3)	* 92.3	
		128	106.5	(4.4)	159.7	(6.6)	* 46.3	
4	0.5	32	426	(17.7)	639.1	(26.6)	* 101.2	
		64	213	(8.8)	319.5	(13.3)	* 50.7	
		128	106.5	(4.4)	159.7	(6.6)	* 25.3	
		32	426	(17.7)	639.1	(26.6)	* 153.3	
20	0.5	32	852	(35.5)	1278	(53.2)	1224	
		64	426	(17.7)	639.1	(26.6)	637	
		128	213	(8.8)	319.5	(13.3)	325	
		256	106.5	(4.4)	159.7	(6.6)	164	
		512	53.2	(2.2)	79.8	(3.3)	82.5	
		1024	26.6		39.9	(1.6)	41.3	

Battery life is less than cassette capacity.
 Therefore, under thin setting, measurement is limited by battery life.
 Battery : Alkali battery (AM-1)
 Consumption time at 25° C (This table is based on calculation, so allow for a margin when using it.)

BI : BURST INTERVAL
 SI : SAMPLE INTERVAL
 SD : SAMPLE DURATION

h : HOUR
 d : DAY

BI	SI	SD	300 ft		450 ft		BATTERY CONSUMPTION h
			h	d	h	d	
20	0.5	2048	13.3		19.9		20.7
		32	852	(35.5)	1278	(53.2)	1914
		64	426	(17.7)	639.1	(26.6)	470
		128	213	(8.8)	319.5	(13.3)	239
		256	106.5	(4.4)	159.7	(6.6)	120.6
		512	53.2	(2.2)	79.8	(3.3)	60.3
		1024	26.6		39.9	(1.6)	30.2
		32	852	(35.5)	1278	(53.2)	* 606
	2	64	426	(17.7)	639.1	(26.6)	* 309.4
		128	213	(8.8)	319.5	(13.3)	* 156.2
		256	106.5	(4.4)	159.7	(6.6)	* 78.5
		512	53.2	(2.2)	79.8	(3.3)	* 39.3
		32	852	(35.5)	1278	(53.2)	* 362
		64	426	(17.7)	639.1	(26.6)	* 183.3
		128	213	(8.8)	319.5	(13.3)	* 92.3
		256	106.5	(4.4)	159.7	(6.6)	* 46.3
4	32	852	(35.5)	1278	(53.2)	* 201.8	
	64	426	(17.7)	639.1	(26.6)	* 101.2	
	128	213	(8.8)	319.5	(13.3)	* 50.7	
	256	106.5	(4.4)	159.7	(6.6)	* 25.4	
	32	852	(35.5)	1278	(53.2)	* 106.7	
	64	426	(17.7)	639.1	(26.6)		
	128	213	(8.8)	319.5	(13.3)		
	256	106.5	(4.4)	159.7	(6.6)		
60	0.5	32	2556	(106)	3835	(159)	3174
		64	1278	(53.2)	1917.5	(79.8)	1766
		128	639	(26.6)	958.7	(39.9)	936
		256	319.5	(13.3)	479.3	(19.9)	482
		512	159.7	(6.6)	239.6	(9.9)	245
		1024	79.8	(3.3)	119.8	(4.9)	123.5
		2048	39.9	(1.6)	59.9	(2.4)	62
		4096	19.9		29.9		31
	1	32	2556	(106)	3835	(159)	2455
		64	1278	(53.2)	1917.5	(79.8)	1332
		128	639	(26.6)	958.7	(39.9)	695
		256	319.5	(13.3)	479.3	(19.9)	355
		512	159.7	(6.6)	239.6	(9.9)	179
		1024	79.8	(3.3)	119.8	(4.9)	90.5
		2048	39.9	(1.6)	59.9	(2.4)	45.3
		32	2556	(106)	3835	(159)	* 1689
2	64	1278	(53.2)	1917.5	(79.8)	* 893	
	128	639	(26.6)	958.7	(39.9)	* 459	
	256	319.5	(13.3)	479.3	(19.9)	* 233.3	
	512	159.7	(6.6)	239.6	(9.9)	* 117.5	
	1024	79.8	(3.3)	119.8	(4.9)	* 58.9	
	32	2556	(106)	3835	(159)	* 1040	
	64	1278	(53.2)	1917.5	(79.8)	* 538	
	128	639	(26.6)	958.7	(39.9)	* 273.7	
4	256	319.5	(13.3)	479.3	(19.9)	* 138.1	
	512	159.7	(6.6)	239.6	(9.9)	* 269.3	
	32	2556	(106)	3835	(159)	* 588	
	64	1278	(53.2)	1917.5	(79.8)	* 299.3	
	128	639	(26.6)	958.7	(39.9)	* 151.3	
	256	319.5	(13.3)	479.3	(19.9)	* 76	
	32	2556	(106)	3835	(159)	* 314.8	
	64	1278	(53.2)	1917.5	(79.8)	* 159.9	
8	128	639	(26.6)	958.7	(39.9)		
	256	319.5	(13.3)	479.3	(19.9)		
	512	159.7	(6.6)	239.6	(9.9)		
	1024	79.8	(3.3)	119.8	(4.9)		
	32	2556	(106)	3835	(159)		
	64	1278	(53.2)	1917.5	(79.8)		
	128	639	(26.6)	958.7	(39.9)		
	256	319.5	(13.3)	479.3	(19.9)		
16	512	159.7	(6.6)	239.6	(9.9)		
	1024	79.8	(3.3)	119.8	(4.9)		
	32	2556	(106)	3835	(159)		
	64	1278	(53.2)	1917.5	(79.8)		
	128	639	(26.6)	958.7	(39.9)		
	256	319.5	(13.3)	479.3	(19.9)		
	512	159.7	(6.6)	239.6	(9.9)		
	1024	79.8	(3.3)	119.8	(4.9)		

BI : BURST INTERVAL
 SI : SAMPLE INTERVAL
 SD : SAMPLE DURATION

h : HOUR
 d : DAY

BI	SI	SD	300 ft		450 ft		BATTERY CONSUMPTION h
			h	d	h	d	
120	0.5	32	5112	(213	7670	(319	5277
		64	2556	106	3835	159	3174
		128	1278	53.2	1917	79.8	1766
		256	639	26.6	958.7	39.9	936
		512	319.5	13.3	479.3	19.9	482
		1024	159.7	6.6	239.6	9.9	245
	2048	79.8	3.3	119.8	4.9	123	
	4096	39.9	1.6	59.9	2.4	62	
	1	32	5112	213	7670	319	* 4235
	64	2556	106	3835	159	* 2455	
	128	1278	53.2	1917	79.8	1332	
	256	639	26.6	958.7	39.9	695	
	512	319.5	13.3	479.3	19.9	355	
	1024	159.7	6.6	239.6	9.9	179	
	2048	79.8	3.3	119.8	4.9	90.5	
	4096	39.9	1.6	59.9	2.4	45.3	
	2	32	5112	213	7670	319	* 3049
	64	2556	106	3835	159	* 1689	
	128	1278	53.2	1917	79.8	* 2893	
256	639	26.6	958.7	39.9	* 459		
512	319.5	13.3	479.3	19.9	* 233.2		
1024	159.7	6.6	239.6	9.9	* 117.6		
2048	79.8	3.3	119.8	4.9	* 58.9		
4	32	5112	213	7670	319	* 1950	
64	2556	106	3835	159	* 1048		
128	1278	53.2	1917	79.8	* 538		
256	639	26.6	958.7	39.9	* 273.8		
512	319.5	13.3	479.3	19.9	* 138		
1024	159.7	6.6	239.6	9.9	* 69		
3	32	5112	213	7670	319	* 1134	
64	2556	106	3835	159	* 588		
128	1278	53.2	1917	79.8	* 299.8		
256	639	26.6	958.7	39.9	* 151.3		
512	319.5	13.3	479.3	19.9	* 76.8		
16	32	5112	213	7670	319	* 617	
64	2556	106	3835	159	* 314.8		
128	1278	53.2	1917	79.8	* 159.8		
256	639	26.6	958.7	39.9	* 79		

BI : BURST INTERVAL
 SI : SAMPLE INTERVAL
 SD : SAMPLE DURATION

h : HOUR
 d : DAY

BI	SI	SD	300 ft		450 ft		BATTERY CONSUMPTION		
			h	d	h	d	h	d	
240	0.5	32	10224	(426)	15340	(638)	*	7889	
		64	5112	(213)	7670	(319)	*	5277	
		128	2556	(106)	3835	(159)	*	3174	
		256	1278	(53.2)	1917	(79.8)	*	1766	
		512	639	(26.6)	958.7	(39.9)	*	936	
		1024	319	(13.3)	479.3	(19.9)	*	482	
		2048	159.7	(6.6)	239.6	(9.9)	*	245	
		4096	79.8	(3.3)	119.8	(4.9)	*	123	
		1	32	10224	426	15340	639	*	6674
			64	5112	213	7670	319	*	4243
			128	2556	106	3835	159	*	2455
			256	1278	53.2	1917	79.8	*	1332
	512		639	26.6	958.7	39.9	*	695	
	1024		319	13.3	479.3	19.9	*	355	
	2048		159.7	6.6	239.6	9.9	*	179	
	4096		79.8	3.3	119.8	4.9	*	90	
	2		32	10224	426	15340	639	*	5102
			64	5112	213	7670	319	*	3049
			128	2556	106	3835	159	*	1689
			256	1278	53.2	1917	79.8	*	893
		512	639	26.6	958.7	39.9	*	459	
		1024	319	13.3	479.3	19.9	*	233	
		2048	159.7	6.6	239.6	9.9	*	117	
		4096	79.8	3.3	119.8	4.9	*	58	
		4	32	10224	426	15340	639	*	3468
			64	5112	213	7670	319	*	1950
			128	2556	106	3835	159	*	1040
			256	1278	53.2	1917	79.8	*	538
	512		639	26.6	958.7	39.9	*	273	
	1024		319	13.3	479.3	19.9	*	138	
	2048		159.7	6.6	239.6	9.9	*	69	
	8		32	10224	426	15340	639	*	2114
			64	5112	213	7670	319	*	1134
			128	2556	106	3835	159	*	588
			256	1278	53.2	1917	79.8	*	299
			512	639	26.6	958.7	39.9	*	151
		1024	319	13.3	479.3	19.9	*	76	
		16	32	10224	426	15340	639	*	1187
			64	5112	213	7670	319	*	617
			128	2556	106	3835	159	*	314
			256	1278	53.2	1917	79.8	*	159
			512	639	26.6	958.7	39.9	*	80

BI : BURST INTERVAL
 SI : SAMPLE INTERVAL
 SD : SAMPLE DURATION

h : HOUR
 d : DAY

BI	SI	SD	300 ft		450 ft		BATTERY CONSUMPTION h
			h	d	h	d	
480	0.5	32	20448	(852	30680	(1272	* 10485
		64	10224	426	15340	639	* 7889
		128	5112	213	7670	319	* 5277
		256	2556	106	3835	159	* 3174
		512	1278	53.2	1917	79.8	* 1766
		1024	639	26.6	958.7	39.9	* 936
		2048	319	13.3	479.3	19.9	* 482
		4096	159.7	6.6	239.6	9.9	* 245
		32	20448	852	30680	1272	* 9353
		64	10224	426	15340	639	* 6674
		128	5112	213	7670	319	* 4243
		256	2556	106	3835	159	* 2455
	512	1278	53.2	1917	79.8	* 1332	
	1024	639	26.6	958.7	39.9	* 695	
	2048	319	13.3	479.3	19.9	* 355	
	4096	159.7	6.6	239.6	9.9	* 179	
	32	20448	852	30680	1272	* 7693	
	64	10224	426	15340	639	* 5102	
	128	5112	213	7670	319	* 3049	
	256	2556	106	3835	159	* 1689	
	512	1278	53.2	1917	79.8	* 893	
	1024	639	26.6	958.7	39.9	* 459	
	2048	319	13.3	479.3	19.9	* 233	
	4096	159.7	6.6	239.6	9.9	* 117	
	32	20448	852	30680	1272	* 5677	
	64	10224	426	15340	639	* 3468	
	128	5112	213	7670	319	* 1950	
	256	2556	106	3835	159	* 1040	
	512	1278	53.2	1917	79.8	* 538	
	1024	639	26.6	958.7	39.9	* 273	
	2048	319	13.3	479.3	19.9	* 138	
	4096	159.7	6.6	239.6	9.9	* 69	
	32	20448	852	30680	1272	* 3725	
	64	10224	426	15340	639	* 2114	
	128	5112	213	7670	319	* 1134	
	256	2556	106	3835	159	* 588	
	512	1278	53.2	1917	79.8	* 299	
	1024	639	26.6	958.7	39.9	* 151	
	2048	319	13.3	479.3	19.9	* 76	
	32	20448	852	30680	1272	* 2207	
	64	10224	426	15340	639	* 1187	
	128	5112	213	7670	319	* 617	
	256	2556	106	3835	159	* 314	
	512	1278	53.2	1917	79.8	* 159	
	1024	639	26.6	958.7	39.9	* 79	

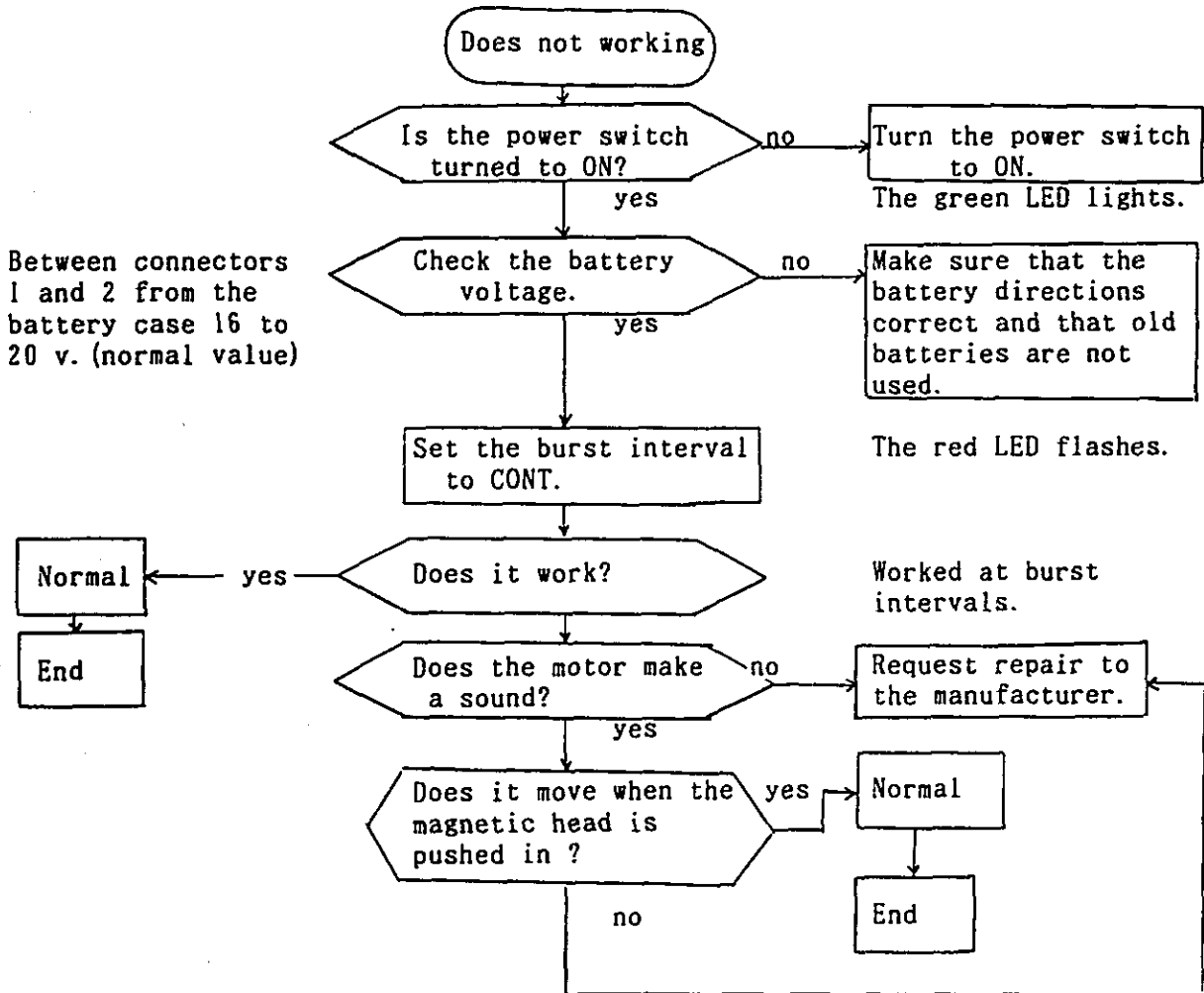
CONTINUE

	0.25		5.6		9.5		11.4
	0.5		11.3		17		23.3
	1		22.7		34		45.7
	2		45.4	(1.8)	68.1	(2.8)	86.9
	4		95.8	(3.7)	136	(5.6)	130
	8		181.7	(7.5)	272	(11.3)	135
	16		363.5	(15.1)	545	(22.7)	91.8

9. Maintenance and inspection

- (1) Because a contaminated sensor electrode (especially one covered by a film of oil) may prevent accurate measurement, be sure to lightly polish the electrode surface with the attached paper (No. 600) prior to installation.
- (2) Check for scratches and/or stains on the O-ring, and if they are present, replace the O-ring with a new one.
- (3) When the corrosion prevention zinc plate is corroded, replace it with a new one.
- (4) Once a year, clean the data recorder's magnetic head and the pinch roller with a cassette disk cleaning kit.
- (5) Check to make sure that the electrode is not broken.

10. Troubleshooting flow-chart



APPENDIX 10

EMC-108 CHECKER

YOKOGAWA NAVITEC

ST035

Instruction Manual

EMC108 CHECKER

1st Edition
IM TT20156E

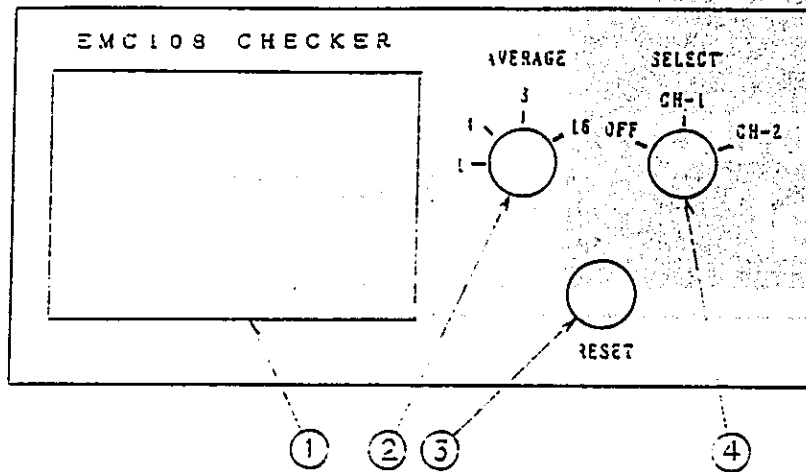
YOKOGAWA NAVITEC



1. Outline

This checker is used to check the function of the EMC108 in combination with EM Current meter EMC108.

2. Display unit and switch panel



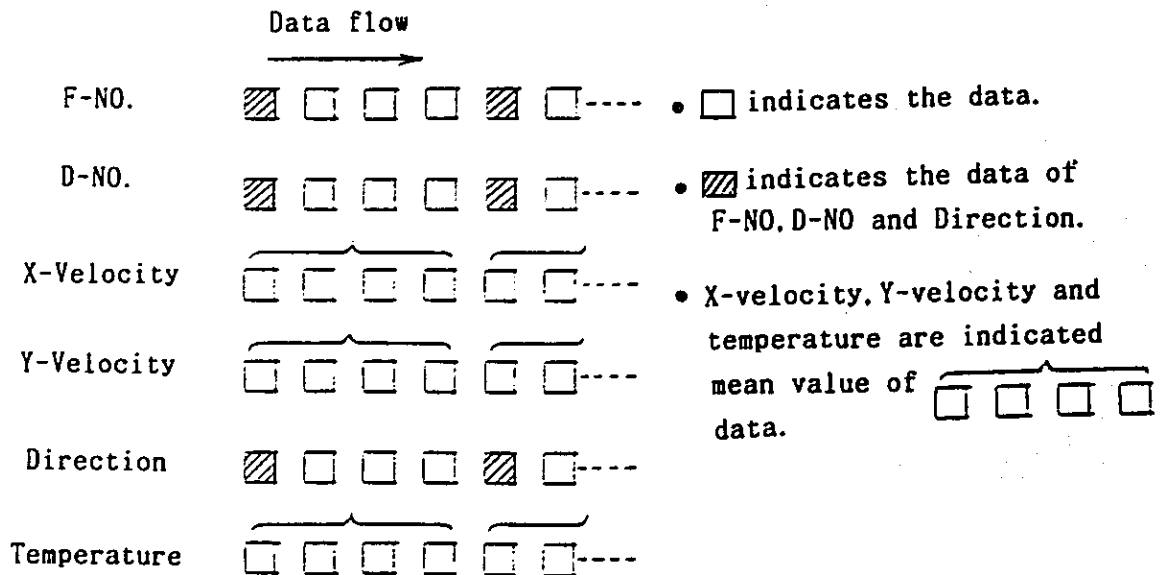
- (1) Display unit (2) Changeover switch for the selection of average time.
 (3) Reset switch (4) Power ON/OFF and display selection switch

2.1 Switch operation

(1) Average time changeover switch

- X and Y flow velocity and temperature data are measured and mean value of the selected times by the switch (2) is displayed.
- When the last number of data is entered, file number, data number and direction data is displayed and no average function is available.

For example, if the switch is set at position 4, 4th data for File No., Data No. and the direction is displayed and average data of 4 each data for X flow velocity, Y flow velocity and temperature is displayed.



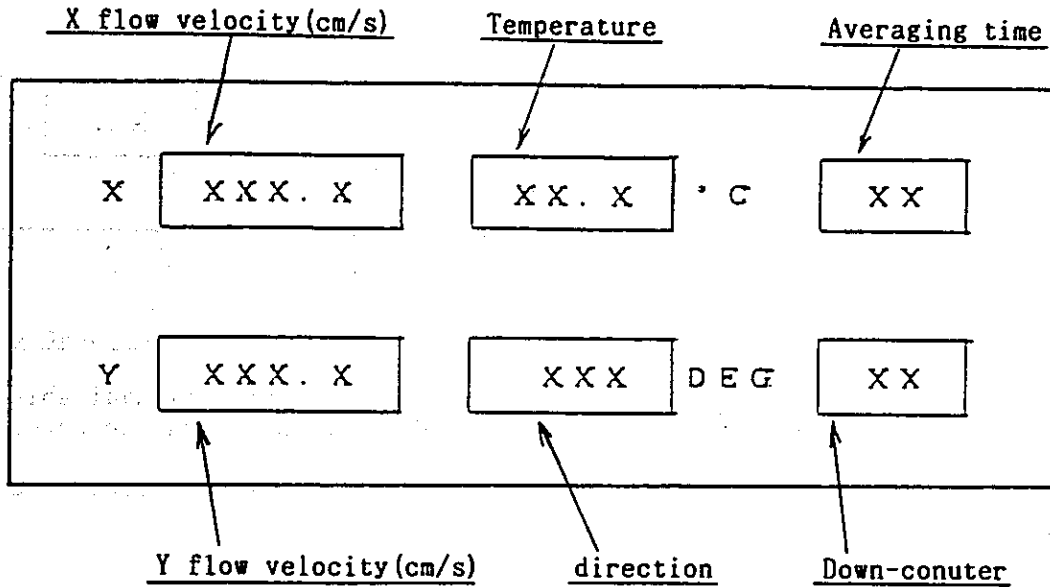
(2) Reset switch

If this switch is pressed, the same display as described later for power on is displayed.

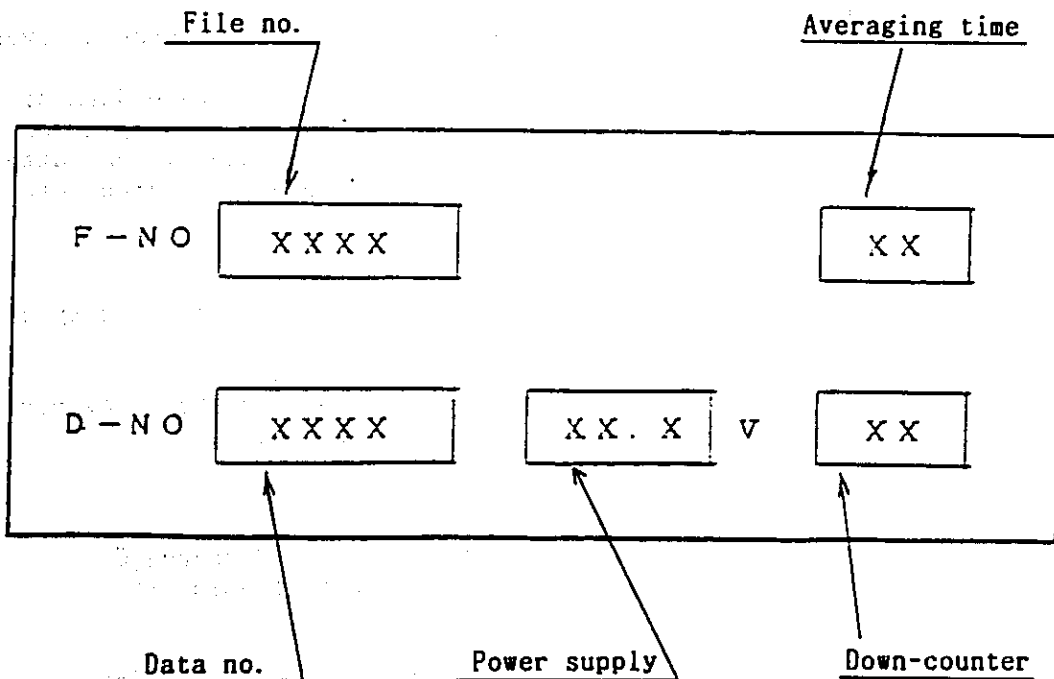
2.2 Power ON/OFF and display selection switch

(1) Power is on when the switch is set at CH-1 or CH-2.

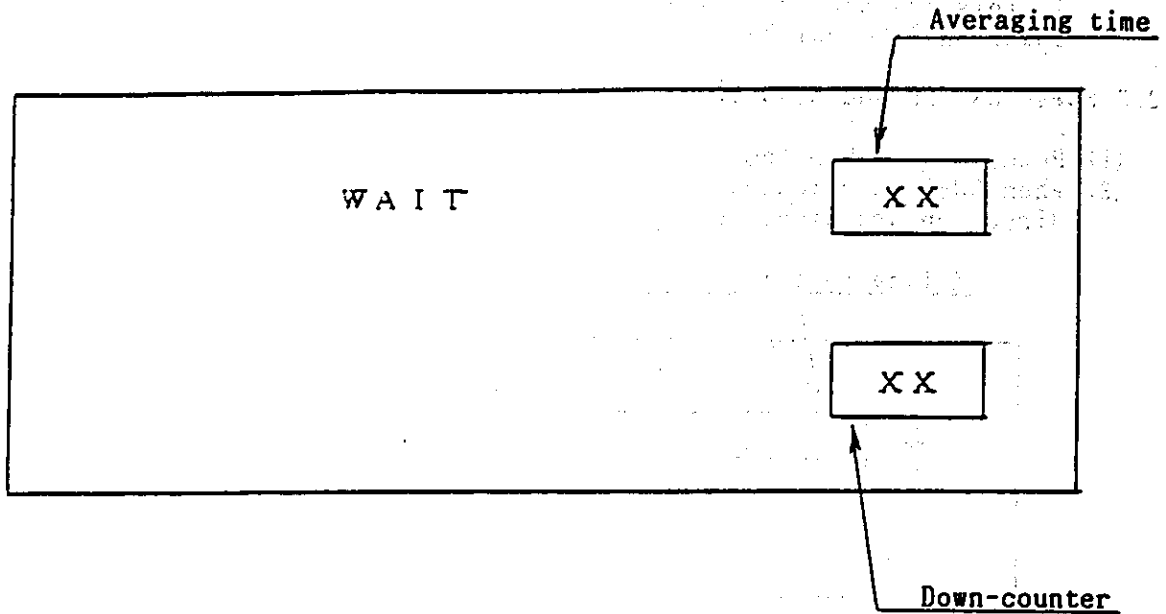
(2) When CH-1 is selected, X flow velocity, Y flow velocity, temperature and direction are displayed.



(3) When CH-2 is selected, File No., Data No. and power supply volatge are displayed.



2.3 Display when the power supply is ON



When the power supply is ON, display as shown above is available.

Averaging time: The number coincides with the one selected by the switch (2).

Down-counter: When this number shows "0", the display is updated.

3. Checking procedure

- (1) Connect the connecting cable to the "serial data" connector of the EMC108 which is located at panel unit of EMC108.
- (2) Set the select switch at CH-1.
- (3) Set the average switch at 1.
- (4) Turn on the power switch of EMC108. Display data is updated every sampling time.
- (5) When the average switch is set at 4 to 16, the average data of the number corresponding to the number of the switch is displayed.
- (6) When the select switch is set at CH-2, the voltage of the battery is displayed. Change the battery when the display indicates less than 6.5V.

Note.

- ▲ 0 to 4095 is displayed for File No..The number is increased by one every 32 data.
- ▲ The Date no. is displayed repeatedly from 0 to 4095.
- ▲ Down counter displays the average time. The number shows towards 0 and the data is updated when the counter reaches 0.

4. Caution

- (1) If the checker is used in the temperature of 50 degree C or over for long period, display unit is damaged. Avoid of using it in such high temperature.
- (2) Avoid drop or strong shock.
- (3) Take the battery out in case it is not used for long time.
- (4) Avoid of using in the area where direct splash of water is expected.

APPENDIX 11

CASSETTE MAGNETIC TAPE READER

(MODEL:EX-010)

YOKOGAWA NAVITEC

EX010

Instruction Manual

CMT READER

YOKOGAWA NAVITEC



1st Edition
IM TT5078E

Thank you for purchasing CMT Reader.
Please read this manual carefully before using.

Content

1. Specification.....	1
2. Output data format.....	2
3. Data specifications.....	3
4. Receiver side sample flow.....	4
5. Operation.....	4
6. Notice.....	5
7. Interconnection to the computer.....	5

Outline

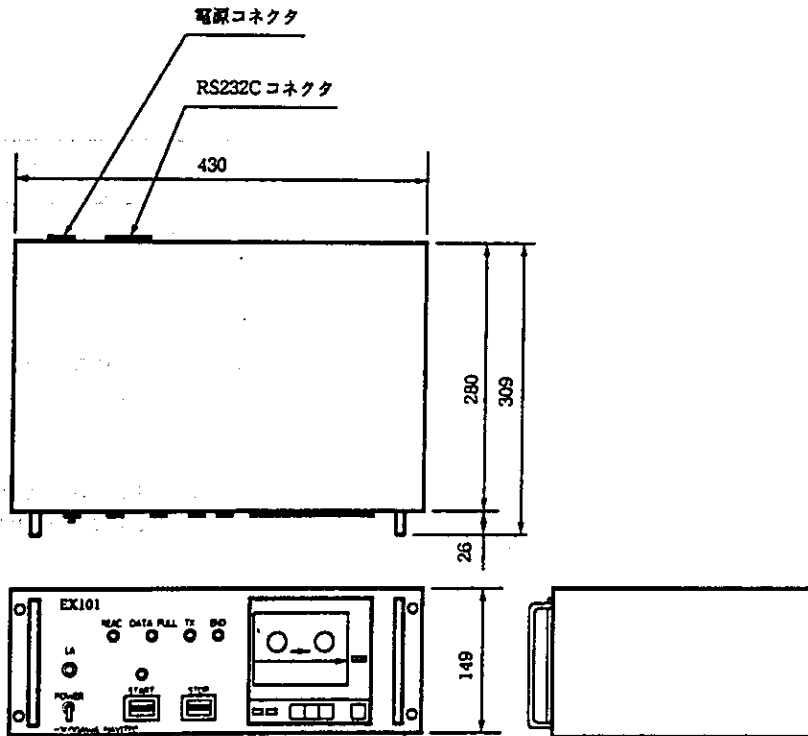
Data stored in the cassette tape by EMC108 (recording current meter) is converted to a serial signals by this Reader, so this signals are connected to a data analysis computer via a RS232C interface.

1. Specification

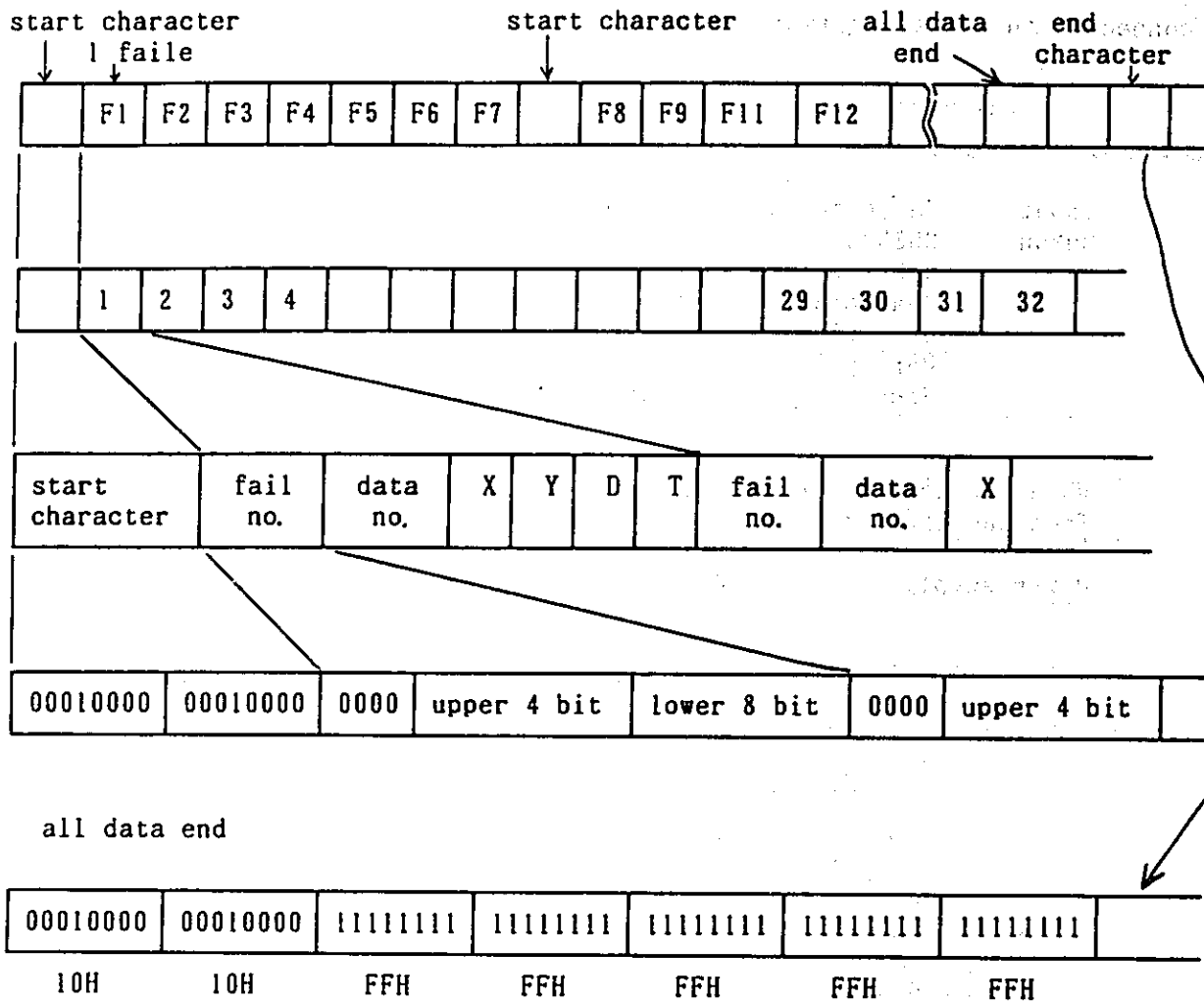
Input Cassette tape recorded by EMC108
Output RS232C
 8 bit binary serial data format
Character : 8 bit
Stop bit : 2 bit
Parity : even
Speed : 2400 bit per second

When "Request to send" signal receive, one character is transmitted, from the EX010 to the computer.

Power supply AC 100 V 50/60 Hz



2. Output data format



1 fail : 32 data
 1 data : fail no., data no., X, Y, D, T (each data has 12 bits)
 1 character: 8 bits

- ▲ Start character (10H, 10H) is transmitted every seven files.
- ▲ After all data items are transmitted, End character (FFH) are transmitted over 12 characters.

3. Data specification

Fail No. : repeatly 0 ~ 4095 (increments by 1 for every 32 data items)
 Data No. : repeatly 0 ~ 4096 (increments by 1 for each data)

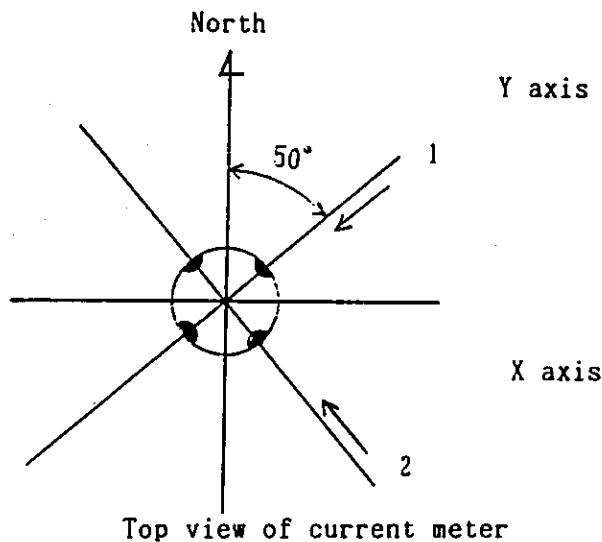
X : X flow velocity
 data velocity
 0 -300 cm/s
 2048 0 cm/s
 4095 300 cm/s

Y : Y flow velocity
 same as X

T : temperature
 data temperature
 0 -30° C
 2048 0° C
 4095 30° C

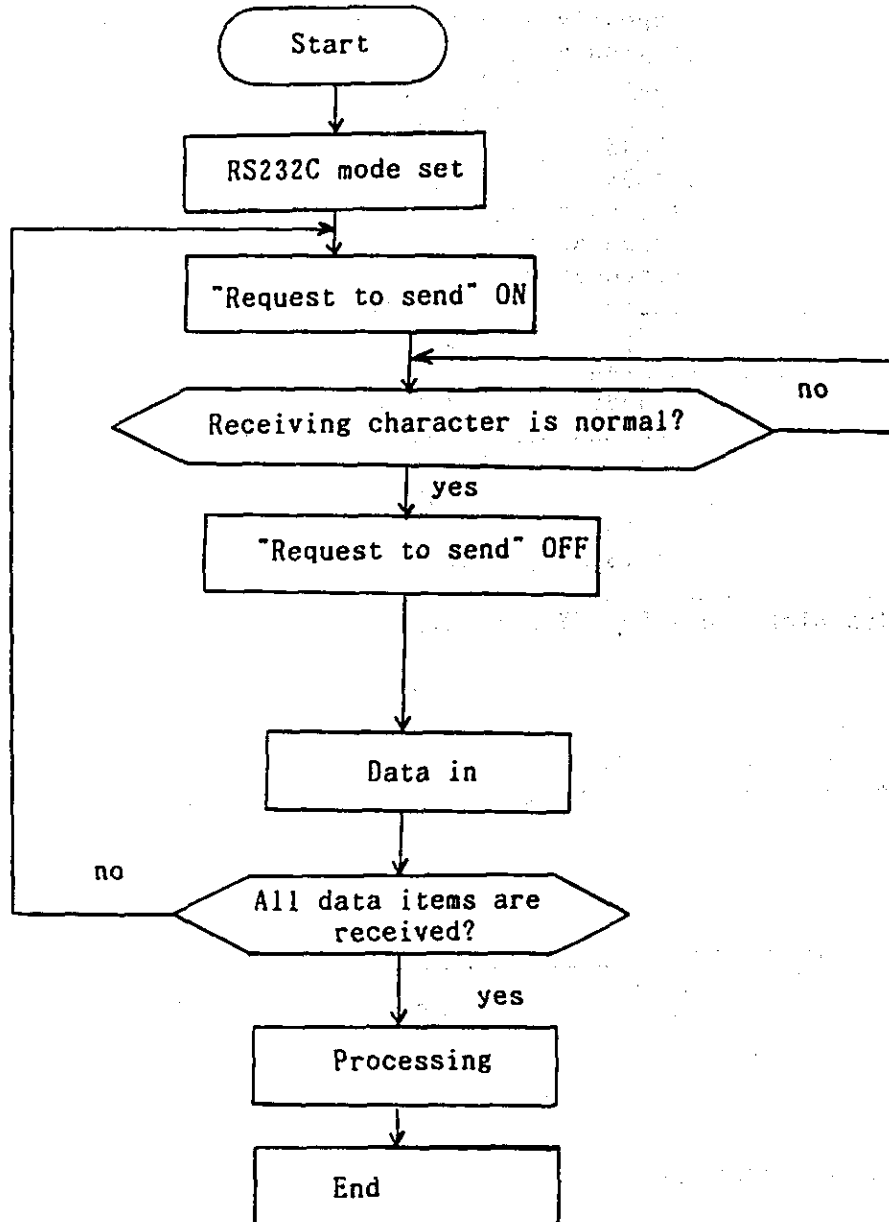
D : Compass direction
 data direction
 0 0°
 180 180°
 359 359°

(sample) D = 50° (Y axis direction)



Y	from Y axis flow velocity	1	+ 2049 ~ 4095
	out to Y axis flow velocity		- 2047 ~ 0
X	from X axis flow velocity	2	+ 2049 ~ 4095
	out to X axis flow velocity		- 2047 ~ 0

4. Receiver side sample flow



5. Operation

1. Set the power ON.
2. Set the cassette tape to the reader.
3. Re-wind the tape completely. (press the "REW" switch).
4. Run the computer of data receiving program.
5. Press the "START" switch.

The "END" lamp light when whole data items transmission is completed and automatic re-wind is finished.

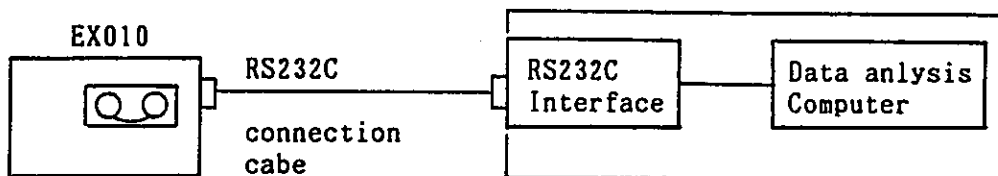
Each lamp and switch description

START switch (white) : Start the data processing or re-starting.
 STOP switch (red) : Stop the data processing.
 START lamp (green) : Indicate the data processing is starting.
 READ lamp (green) : Indicate the data is reading from cassette tape.
 DATA FULL lamp (red) : Indicate the data buffer is full condition.
 TX lamp (red) : Indicate the data is under transmitting.
 END lamp (red) : Indicate the whole data items are transmitted.

6. Notice

- ▲ Keep clean the tape reader head.
- ▲ Do not use under the condition of low and high temperature or high humidity.
- ▲ DO NOT touch the switch of the reader under data processing.

7. Interconnection to computer



EX010 ↔ RS232C Interface Connection

EX010 output pin	RS 232 C input pin
FG (frame ground) 1	1 FG (frame ground)
RD (receive data) 2	2 SD (send data)
SD (send data) 3	3 RD (receive data)
CS (clear to send) 4	4 RS (request to send)
RS (request to send) 5	5 CS (clear to send)
SG (signal ground) 7	7 SG (signal ground)

VECTOR ELECTROMAGNETIC CURRENT METER

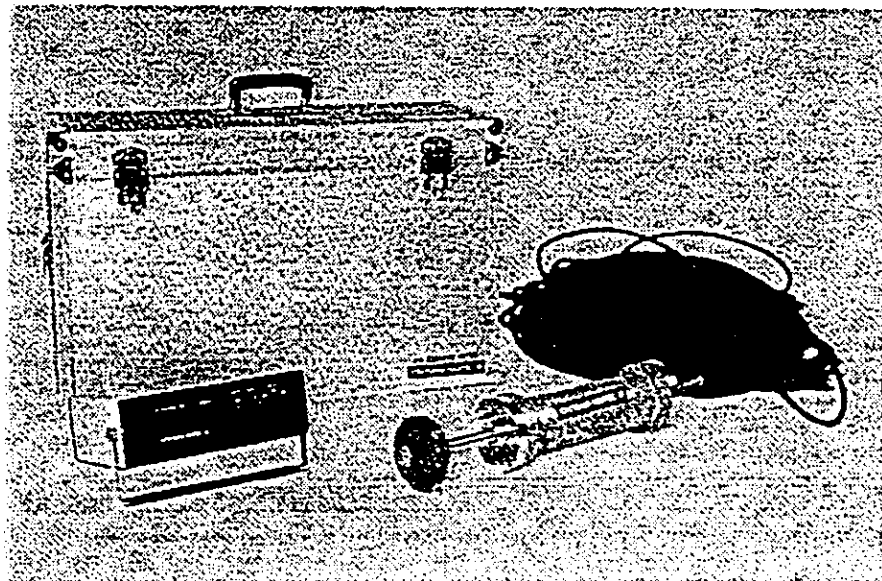
(MODEL : EMC-107)

YOKOGAWA NAVITEC

Instruction Manual

EMC107

VECTOR ELECTROMAGNETIC
CURRENT METER



YOKOGAWA NAVITEC ◆

1st Edition:
IM 80U20M00E

Thank you for purchasing our vector electromagnetic current meter.
Please read this instruction manual carefully before using.

CONTENTS

1. Outline.....	1
2. Specifications.....	1
3. Configuration and Outline Drawing.....	2
4. Operation.....	4

. Outline

The flow velocity sensor's operating principle is the same as that in electromagnetic logs widely used to measure ship's speed, being based on Faraday's law. The sensor has a built in coil and iron core which generates a magnetic field near electrodes, and as each of the 4 electrodes used is located around the sensor at 90 degree intervals, flow velocity is detected by the electrodes standing opposite each other. Because of its spherical shape, it is not hardly influenced by tilting. The electromagnetic type has no moving parts and can measure a very wide range of flow velocity. This meter is also provided with a temperature sensor so that it can display water temperature. These measuring items are indicating on the liquid crystal display.

. Specifications

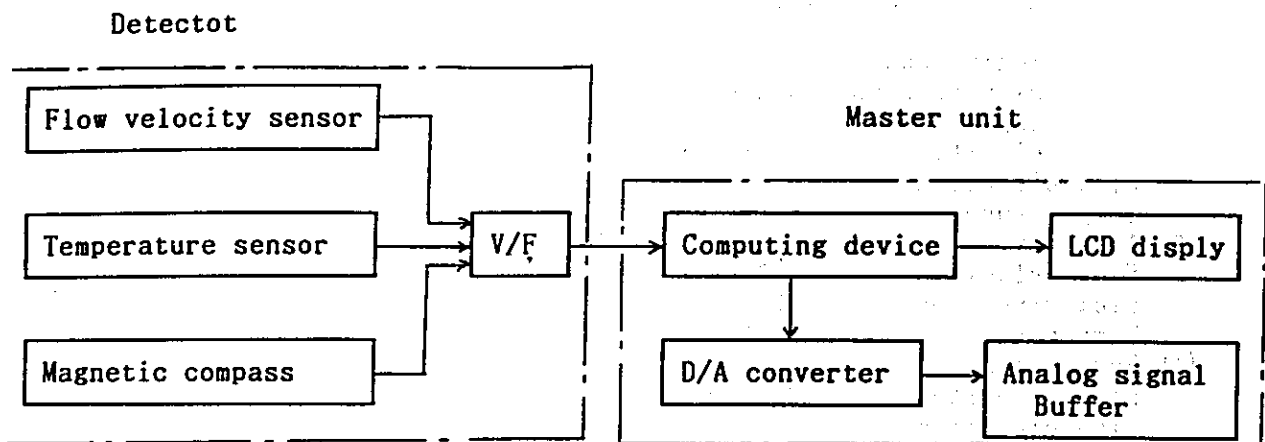
- (1) Measuring method
X-Y 2 axis electromagnetic sensor
- (2) Measuring range
Flow velocity 0 ~ 200 cm/sec
Flow direction 0° ~ 359°
Temperature -5° ~ 35° C
- (3) Accuracy
Flow velocity ± 1% of displayed value plus 2cm/sec
Flow direction ± 5° (at more than 5cm/sec)
Temperature ± 0.2° C
- (4) Resolution
Flow velocity 0.1 cm/sec
Flow direction 1°
Temperature 0.1° C
- (5) Analog Output (option)
Flow velocity VR : 0 ~ 0.4 VDC / 0 ~ 2 m/sec
Flow direction D : 0 ~ 1V DC / 0 ~ 540° 2mA MAX
Temperature 0 ~ ± 1V DC / 0 ~ 50° C 2mA MAX
- (6) Display
Flow velocity 200.0 cm/sec
Flow direction 359°
Temperature 35.0° C "-- sign is displayed at below 0° C.
- (7) Averaging
5, 10, 20, 40 and 80 sec. (selective)
- (8) Power
Alkali batteries (SUM-1 type) 6 psc., 12 hours (continuous)
[Manganese batteries SUM-1 type 8 hours, at 25° C]
Option : External power (10 to 15 VDC)
- (9) Cables
Length : 15, 30 and 60 m 3 types
Tensile : 50kgf max
- (10) Water resistance
Detector 6 kgf/cm²
Master unit dripproof construction
- (11) Operating temperature range -10 to 50° C

3. Configuration and Outline Drawing

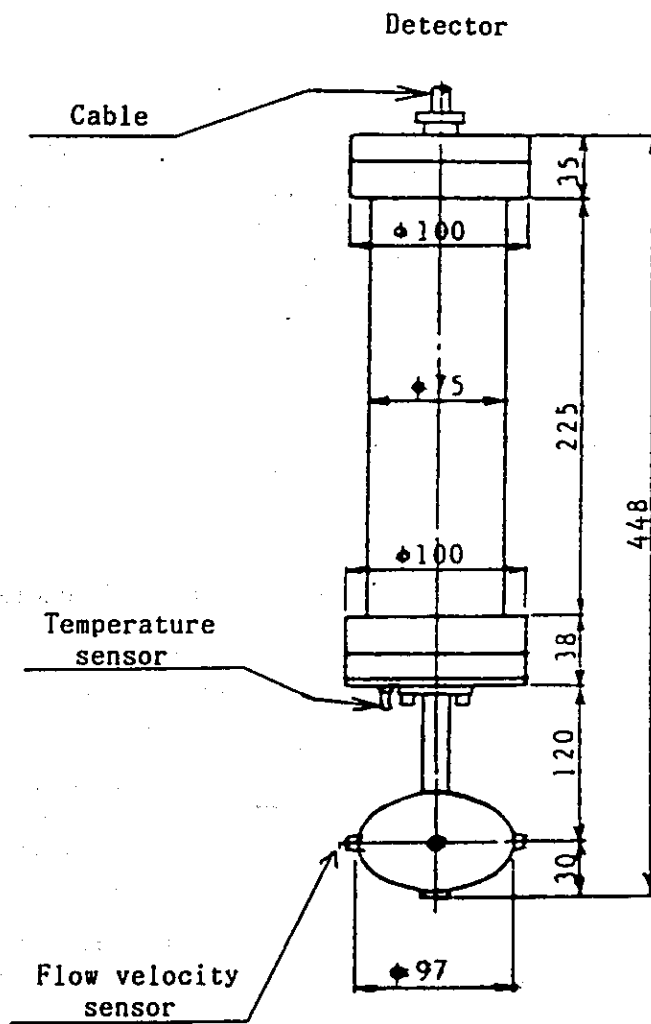
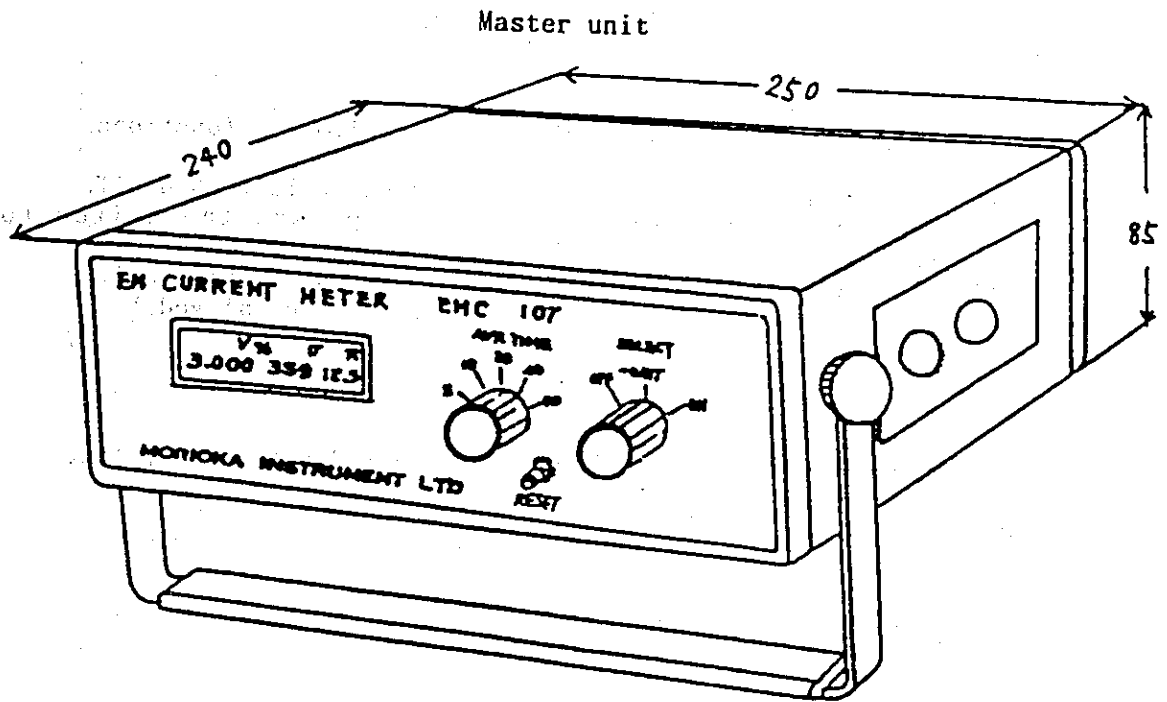
(1) Configuration

- 1) Master unit 1 set
- 2) Detector (with built in pre-amp, magnetic compass, flow velocity sensor, temperature sensor) with cable 1 set
- 3) Carrying box 1 set
- Optional: External power cable (10 m) 1 set
- Output cable (2 m) 1 set

This meter consist of the detector and the master unit and its block diagram is as shown in the following.



(2) Dimensional outline drawing



Operation

(1) Detector support

Firmly support the detector so that the cable used to suspend the detector from a bridge or base does not slip off. The sensor can be used in any direction.

(2) Master unit function

The 3 switches on the front panel have the following functions.

1) SELECT switch

"OFF" The state in which the master unit power is turned off.

When the meter is not used, always set the switch to this position.

"BATT" The voltage of batteries is shown on the display unit.

(For external power, a voltage of 7V is displayed.)

Display	BATT	CHECK
		8.1V

If voltage drops below 6.5V, the display indicates the following.

Display	BATT	CHANGE
		6.5V

If the above display is shown, replace the battery.

"ON" Measurement can be started.

2) SAMPLE TIME select switch

The mean flow velocity for the time set by the knob is shown on the display unit.

Time is given in "sec".

For example, if the knob is set to 40, the mean flow velocity for 40 seconds is displayed.

5: The mean value of 8 samples for 5 sec.

10: The mean value of 16 samples for 10 sec.

20: The mean value of 32 samples for 20 sec.

40: The mean value of 64 samples for 40 sec.

80: The mean value of 128 samples for 80 sec.

This knob also has a resetting function and therefore measurement start time is automatically reset every time any of the above times is set.

3) RESET switch

Measurement is started again immediately after this switch is pressed.

4) The 3 connector on the side have the following functions.

"SENSOR" detector connection connector: Connects the connector at the end of the detector cable.

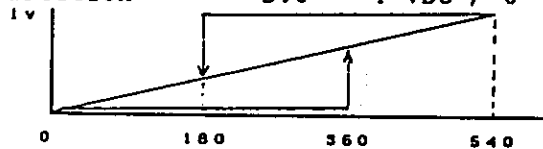
(Optional)

Analog output can be fed to the outside via an "OUT" cable.

Flow velocity

Vector velocity VR: 0 ~ 0.4 VDC / 0 ~ 2m/sec

Flow direction D: 0 ~ 1 VDC / 0 ~ 540°



Water temperature

-10° C	-----	-0.2v
0° C	-----	0v
10° C	-----	0.2v
30° C	-----	0.6v

The analog output cable is attached and the relationship between cable colors and output is as follows.

Wire color	Red	Green	White	Black
Output	VR	D	T	GND
Connector pin	A	B	C	D

Master unit is automatically switched to external power and starts operating regardless of the presence or absence of the battery in the master unit if a voltage of 12VDC is connected via the "EX. SUPPLY" power connector.

Also, since there is no polarity on the terminal, it is not necessary to pay attention to reverse \pm polarity.

The master unit also has the following features in addition to the above.

1) A buzzer sounds every time one measurement ends. For example, if the sample time is set to 20 sec. for measurement, the buzzer sounds every 20 sec. to inform the operator of the need to update the display at the end of measurement.

2) The counter is displayed at the top right of the display unit for operation check.

For example, if the sample time is set to 5 sec., the counter starts counting from 5, then decrements the number one by one.

Thus display is updated when the counter displays 0.

If the sample time is set to 10 sec., the counter starts counting from 10, and if it is set to 20 sec., the counter starts counting from 20.

(3) Measurement procedure

1) Clean the flow velocity sensor electrode to avoid contamination.

If it is oily, clean it with sopy water. If it is not cleaned, lightly polish its surface with sand paper (No.400 or finer).

2) Firmly connect the detector cable to the detector. Check that the batteries are loaded into the master unit, then check for voltage with the "SELECT" knob set to "BATT". If voltage is below 6.5V replace the batteries.

3) Turn the "SELECT" switch to the "ON" position, then set the knob to the desired sample time.

Since the select switch has a "RESET" function, measurement starts from this moment.

4) The counter is displayed at the top right of the display and when it displays 0, the data is updated.

5) Pressing the "RESET" button, measrement re-starts from this moment.

(4) Operational cautions

▲ Handle the detector with care as it is easily damaged by strong shock. This is especially true of the temperature sensor.

▲ Because it takes about 1 minute until amplifier is stabilized after power on, waite 1 minute before stating measurement.

▲ Always measur away from magnetic, materials(such as iron, etc.) because there is a magnetic compass in the detector.

▲ When the detector is suspended, it may ratate due to cable twist.

Therefore, start measurement only after the detector has stopped rotating

▲ Pay attention to flow velocity sensor contamination. Since the meter measures extremely low electrical signals, electrode contamination

- ▲ Pay attention to flow velocity sensor contamination. Since the meter measures extremely low electrical signals, electrode contamination exerts an adverse influence on meter accuracy, so be sure to clean the electrode prior to starting measurement.
- ▲ Make sure that water does not penetrate into the detector cable connector. If it does, dry the connector thoroughly.
- ▲ When the meter is not used for a long time, remove the batteries from the meter.

If you have any questions or service requests, please contact us.
Shiba-hosoda Bldg.
1-3-2 Shiba-daimon, Minato-ku, Tokyo, Japan

Phone :03-459-6622
Facsimil :03-459-8607
Telex :246-6074 YNVTOK J

Kinds of Equipment

Maker's or Agent's Address

1. Tide Gauge

KYOWA SHOKO CO. LTD.
2-899, IKEBUKURO, TOSHIMA-KU,
TOKYO 171, JAPAN
TELEPHONE: 03-980-4361
FACSIMILE: 03-980-5646

2. Wind Direction and
Wind Speed Anemometer
Model: KDD-300

KOSHIN DENKI KOGYO CO. LTD.
1-20-19, JIYUGAOKA, MEGURO-KU
TOKYO 152, JAPAN
TELEPHONE: 03-717-3191
FACSIMILE: 03-725-0362

— ASK TO —

TAMAYA TECHNICS INC.
4-4-4, GINZA, CHUO-KU, TOKYO
104, JAPAN
TELEPHONE: 03-561-8711
FACSIMILE: 03-561-8719
TELEX : J23827 SOKUTAMA

3. Ultra sonic Wave Height
Model: SSW-II

KYOWA SHOKO CO. LTD.
2-899, IKEBUKURO, TOSHIMA-KU,
TOKYO 171, JAPAN
TELEPHONE: 03-980-4361
FACSIMILE: 03-980-5646

4. Personal Computer

TAMAYA TECHNICS INC.
4-4-4, GINZA, CHUO-KU, TOKYO
104, JAPAN
TELEPHONE: 03-561-8711
FACSIMILE: 03-561-8719
TELEX : J23827 SOKUTAMA

5. Direct Reading Current Meter

Model: DCM-PRT-III

KYOWA SHOKO CO., LTD.

2-899, Ikebukuro, Toshima-Ku,
Tokyo 171, Japan

TELEPHONE: 03-980-4361

FACSIMILE: 03-980-5646

6. Salinity and Temperature

Measuring Bridge

Model: MC-5

KAWAMURA & CO., LTD.

3-27-9, Asakusabashi, Taito-Ku,
Tokyo 111, Japan

TELEPHONE: 03-861-4171

FACSIMILE: 03-861-4175

TELEX : 265-5776 RIVILL-J

ASK TO

TAMAYA TECHNICS INC.

4-4-4, GINZA, CHUO-KU, TOKYO

104, JAPAN

TELEPHONE: 03-561-8711

FACSIMILE: 03-561-8719

TELEX : J23827 SOKUTAMA

7. Portable Turbidimeter

Model: PT-1

TAMAYA TECHNICS INC.

4-4-4, GINZA, CHUO-KU, TOKYO

104, JAPAN

TELEPHONE: 03-561-8711

FACSIMILE: 03-561-8719

TELEX : J23827 SOKUTAMA

8. Van Dorn Water Sampler

TAMAYA TECHNICS INC.

4-4-4, GINZA, CHUO-KU, TOKYO

104, JAPAN

TELEPHONE: 03-561-8711

FACSIMILE: 03-561-8719

TELEX : J23827 SOKUTAMA

9. Variable Speed Tubing Pump
- NIHON MILLIPORE LTD.
1-3-12, KITASHINAGAWA,
SHINAGAWA-KU, TOKYO 140,
JAPAN
TELEPHONE: 03-474-9111
FACSIMILE: 03-474-9129
TELEX : MILLIPOR J24948
10. Self Recording Current Meter
Model: MTC-111
- KYOWA SHOKO CO., LTD.
2-899, IKEBUKURO, TOSHIMA-KU,
TOKYO 171, JAPAN
TELEPHONE: 03-980-4361
FACSIMILE: 03-980-5646
11. EM Current Meter
Model: EMC-108
- YOKOGAWA NAVITEC CORPORATION
1-3-2, DAIMON, SHIBA MINATO-KU,
TOKYO 105, JAPAN
TELEPHONE: 03-459-8877
FACSIMILE: 03-459-8607
TELEX : 246-6074 YNVTOK-J
12. EM Current Meter
Model: EMC-107
- YOKOGAWA NAVITEC CORPORATION
1-3-2, DAIMON, SHIBA MINATO-KU,
TOKYO 105, JAPAN
TELEPHONE: 03-459-8877
FACSIMILE: 03-459-8607
TELEX : 246-6074 YNVTOK-J
13. An Power Failure Unit
Model: UPS-510
- TAMAYA TECHNICS INC.
4-4-4, GINZA, CHUO-KU, TOKYO
104, JAPAN
TELEPHONE: 03-561-8711
FACSIMILE: 03-561-8719
TELEX : J23827 SOKUTAMA

JICA