

CONTENTS

1. INTRODUCTION

1.1 Features of the AL Series Hybrid Recorder	1
1.2 Checks and Preparations	1
1.3 Model Confirmation	2
1.4 Power Frequency Check and Voltage Switchover	2

2. NAMES AND FUNCTIONS OF PARTS

2.1 Front	4
2.2 Internal Rack	5
2.3 Rear Panel	5
2.4 Operation Keys	6

3. OPERATING PROCEDURE

3.1 Before switching the power on	8
3.2 After switching the power on	8

4. INSTALLATION

4.1 Limitations on installation position	9
4.2 Panel installation	9
4.3 Side-by-side installation	9
4.4 Dimensions	9

5. CONNECTIONS

5.1 Before connecting	10
5.2 Connection to each terminal	10

6. REPLACING CONSUMABLES

6.1 How to attach the analog recording pen	12
6.2 How to attach the plotter pen (for digital recording/ printing)	13
6.3 How to load the chart	14

7. SWITCHING POWER ON AND OPERATION

7.1 Before switching power on	15
7.2 Switching the power on and machine status	15
7.3 Parameter values set on shipment (initial values)	15
7.4 Selection between measurement value and clock display	16
7.5 Operation and interrupting the recording functions (RECORD ON/OFF)	16
7.6 On-demand instantaneous digital recording (DATA PRINT)	17
7.7 Performing list printing (LIST key)	17
7.8 Fast feeding of recording chart (FEED)	17
7.9 Display and printing on alarm (occurrence/cancel- lation)	18
7.10 On/off selection of alarm printing	19
7.11 Over-range indication and recording	19
7.12 Skip function (cancellation of channels)	19
7.13 Change of functions	19

8. SETTING AND CONFIRMATION OF PARAMETERS

8.1 Setting and confirmation	20
8.2 Clock (Time)	22
8.3 Chart Speed	23
8.4 Ranges	24
8.5 Scale	27
8.6 Alarms	29
8.7 Fixed Time Interval Digital Recording Display	31
8.8 Tags	33
8.9 Unit	35
8.10 Copy Function	37
8.11 °C/°F Selection	38

9. DIGITAL RECORDING/PRINTING FORMATS

10. RELATIONSHIP BETWEEN CHART SPEED AND DIGITAL PRINTING

10.1 Relationship between chart speed and digital printing	42
10.2 Simultaneous processing	43

11. MEMORY CLEAR (Initialization of Setting Data)

11.1 Initialization of parameters	44
11.2 Initialization of scale calibration data	44
11.3 Initialization of clock	44
11.4 How to operate the memory clear function	45

12. SPECIFICATION CHECK FUNCTION

12.1 Display mode	46
12.2 Preparations before operation	46
12.3 ROM version No. and Linearization No.	47
12.4 DIP switch condition	47
12.5 External drive input condition	47

13. MAINTENANCE/CHECKING

14. CHECKING AND CALIBRATING THE SCALE

14.1 Scale Checking	49
14.2 Scale Calibration	50

15. OPTIONS

15.1 6-point alarm output	56
15.2 Burnout	56
15.3 External drive signals	57
15.4 Extraction of square roots	59
15.5 Time axis synchronization	60

16. GENERAL SPECIFICATIONS

61

1. INTRODUCTION

1.1 FEATURES OF THE AL SERIES HYBRID RECORDER

- ① This unit is a microprocessor-based, multi-range 100-mm hybrid recorder with continuous analog recording using felt-tip pens and digital plotter recording.
- ② 1-pen, 2-pen and 3-pen models are available and the digital servo system using an encoder makes possible continuous analog trend recording while measured values can be printed at specified time intervals.
- ③ The date, time, chart speed and scale can also be printed as well as the measured values.
- ④ In the display section, a simultaneous triple-value digital display is available as well as a bar-graph indication.

1.2 CHECKS AND PREPARATIONS

Perform the following checks and preparations before starting to operate the recorder:

1.2.1 External appearance check

After unpacking, check the following points.

- ① Damage or cracks of the front (plastic) window.
- ② That the door can be opened and closed smoothly.
- ③ That the case is not damaged, scratched or stained.

1.2.2 Accessory check

The following accessories are supplied with the recorder. For their appearance, refer to the page 3.

1) In the accessory box

Item Name	Quantity	Remarks
① Fuse (250 V 3A)	1	Spare
② Analog recording pen	3	3 of each pen
③ Key	2	To activate the key lock mechanism.
④ Terminal screw (4 mm)	5	Spare.
⑤ Plotter pen (Black)	2	For printing.
⑥ Lubricant (10 cc)	1	For maintenance
⑦ Recording chart*	1	Including 3 charts.

2) Inside package or recorder

Item Name	Quantity	Remarks
⑧ Mounting	1	For panel mounting.
⑨ Position indication card	2	Inside the door.
⑩ Instruction manual	1	
⑪ Test Certificate	1	

* The standard chart is Part No. EM-001. Charts with a variety of scales are available. The minimum ordering unit is a carton containing 15 charts.

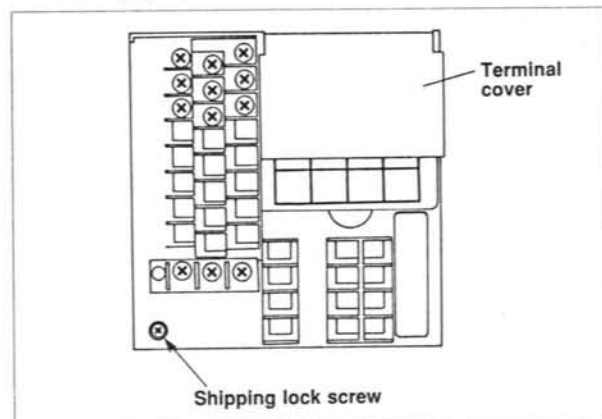
1.2.3 Preparations

1) Opening the door

A finger recess is provided on the right of the door. Insert your finger into the recess and pull towards you to open.

2) How to access the internal instrument (rack)

Loosen the lock screw located at the bottom of the back of the unit. Open the door, holding down the keypad inside the rack, insert your finger into the recess and pull towards you. (See the diagram at the bottom of the page.)



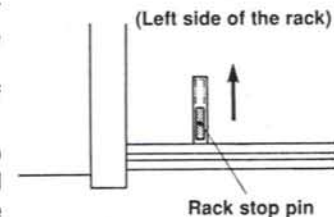
Ref. 1 Shipping lock screw

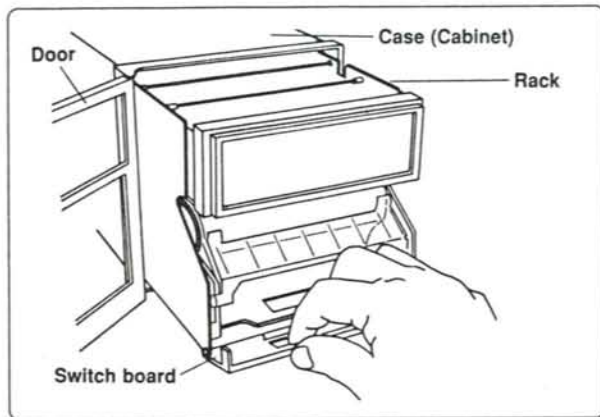
The mechanism is secured in the case using a shipping screw, to prevent it coming out during transportation. Loosen the screw when the recorder is to be operated. For safety, re-tighten the screw before transporting the recorder.

Ref. 2 How to take out the rack

Take out the rack from the cabinet for checking or maintenance by the following procedure:

- ① Pull out the rack until it stops (about 3/4 of the way).
- ② Release the stop pin located under the left side of the rack.
- ③ Pull the rack out of the cabinet.
- ④ Remove the two cables connected to the inside of the case (terminal box).

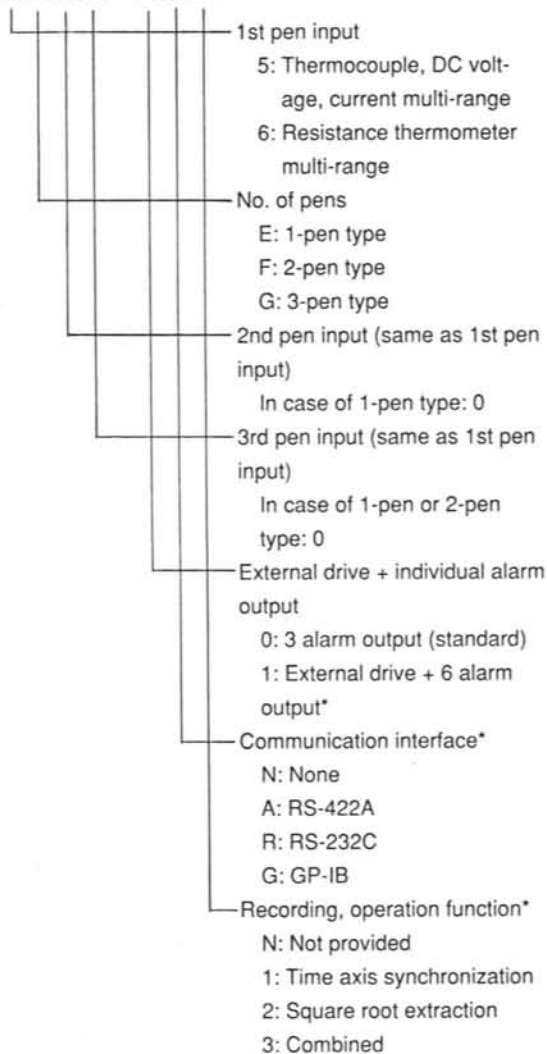




1.3 MODEL CONFIRMATION

Operations differ depending on the types of input signals. Before use, check the types of input signals.

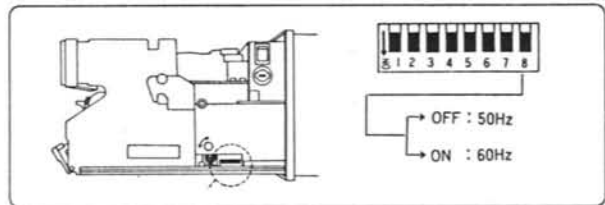
AL□□□□-□□□



Items marked * are optional.

1.4 POWER FREQUENCY CHECK AND VOLTAGE SWITCHOVER

The power supply frequency of this unit is set to 50 Hz before shipment. When using with a 60 Hz power supply, set switch #8 of the 8-element DIP switch located under the right side of the rack to the ON (down) position.



Note 1: If any trouble occurs...

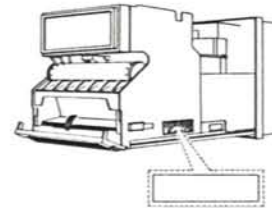
If any trouble occurs due to an accident during transportation or missing accessories, call your dealer or nearest agent.

Note 2: Trouble in use

We are not responsible for any problems due to mishandling of this unit. Please read the instructions carefully before operating.

Ref. 1 Type and Serial No.

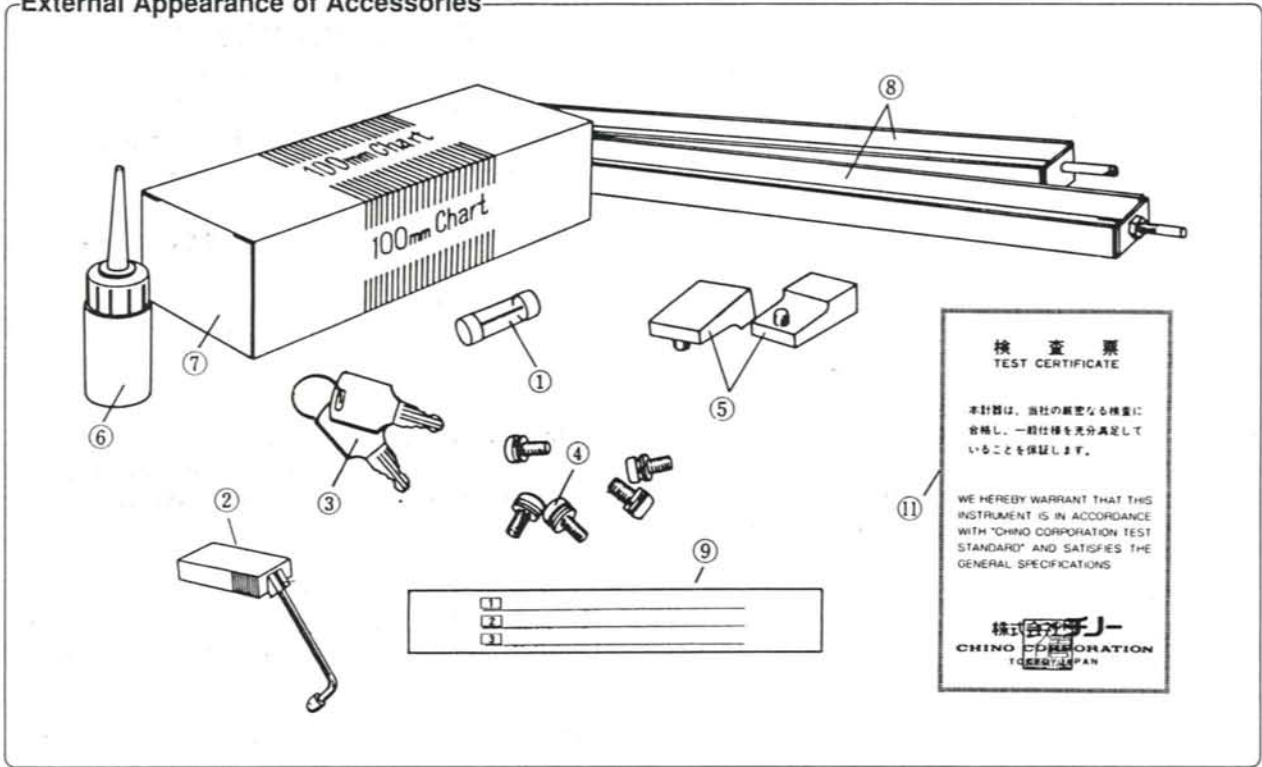
Printed on the right side of the rack.



Ref. 2 Operating procedure

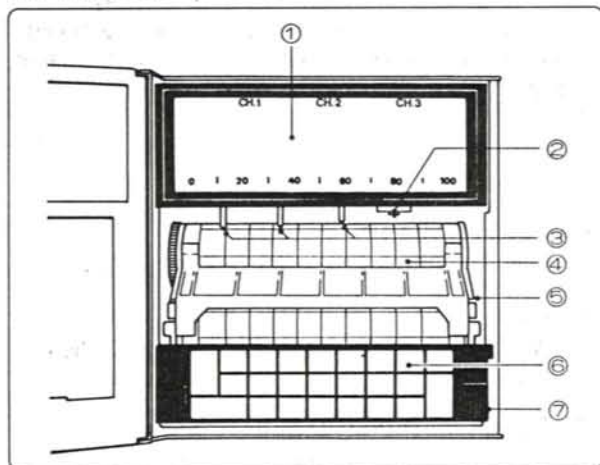
When using this unit for the first time, follow the simplified operating procedure on page 8.

External Appearance of Accessories



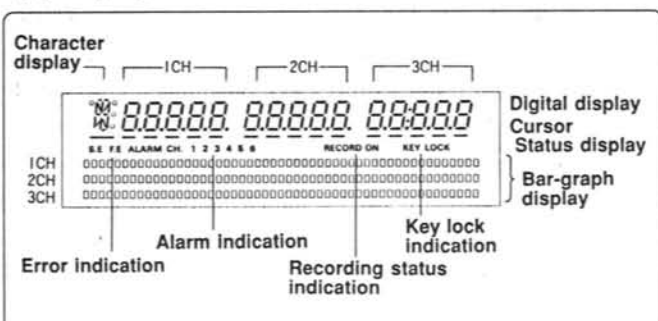
2. NAMES AND FUNCTIONS OF PARTS

2.1 FRONT




- ① Display area
- ② Digital recording mechanism
- ③ Analog recording mechanism
- ④ Chart paper
- ⑤ Chart feed mechanism
- ⑥ Operation keys
- ⑦ Switch board

(1) Display



i) Digital display (See page 16)

Display mode	① Measured value for each channel ② Clock display
Setup mode	Parameter setting display

The display mode alternates each time the  key is pressed.

ii) Bar-graph display (See page 16)

The measured value of each channel is displayed by a 51-segment bar-graph. Every 5th segment has the same color as the corresponding recording pen.


iii) Status display

a) Error indication


Lights when there is an error in setting.


 : Setting error,  : Format error

b) Alarm indication (See page 18)


The  indicator and channel number light when an alarm occurs, while the cursor and alarm number blink.


c) Recording status indication

 lights : Recording function is operating.

 not lit : Recording function is not operating.

d) Key lock indication

 lights : Keys are locked.

 not lit : Keys are not locked.

(2) Digital recording mechanism

This section performs the digital recording and printing using a black felt pen as a plotter.

(3) Analog recording mechanism

This section performs continuous analog recording, using up to three felt-tip pens; red for 1CH, green for 2CH and blue for 3CH.

(4) Recording chart (See page 14 for loading)

Fan-fold chart paper with an effective recording width of 100 mm (114 mm including margins) and length of 10 m.

(5) Chart feed mechanism (See page 23 for setting)

Feeds the recording chart at the set speed.
Setting ranges: 1 - 600 mm/hour or 1 - 200 mm/min.

(6) Operation keys

Used for settings and operation.
For the functions of these keys, refer to pages 6 and 7.

(7) Switch board

Incline towards you when taking out the internal rack or chart feed mechanism.

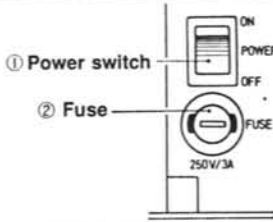
Ref. Segments of the character display



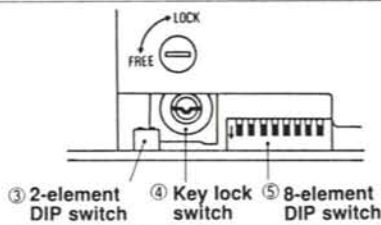
The character display has 15 segments.
There is no segment for the left of the bottom line.

2.2 INTERNAL RACK

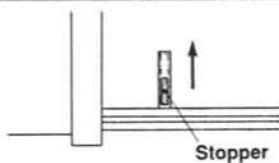
Right side of the rack I



Right side of the rack II



Left side of the rack



(1) Power switch

Switch for turning the recorder ON and OFF.

(2) Fuse

A 250 V 3A power fuse is incorporated in the fuse holder.

(3) 2-element DIP switch

These switches should be up. These are factory preset to set the mechanical functions. Do not touch.

(4) Key lock switch

The key lock function prevents the program from being changed by accident. When locked, only the **DISPLAY** and **ENTRY** key functions are accepted. (See page 18.)

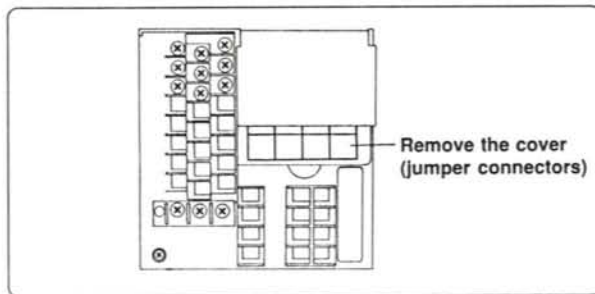
(5) 8-element DIP switch (See page 19)

This switch is used when changing the power frequency, calibrating and for other functions as required.

(6) Stopper

When taking the rack completely out from the case, lift this stopper. Before pulling the rack out from the case, the shipping lock screw should be released. (See page 1.)

2.3 REAR PANEL



1) Remove the cover.

When the cover is removed, you can see the jumpers used to change the input signal type.

2) Change the input signal type by changing the jumpers.

Remove and reinstall the jumpers depending on the type of the signal input to each channel.

mV, THERMO V. COUPLE	DC 4~20mA (R _i = 250Ω)	DIVIDER 1 / 1000	Pt 100, 50 Pt - Co

Note 1: Status when shipped

Voltages : [DC voltage, thermocouple] position is selected. Reinstall the connectors when using the DC current or the 12.5 V, 25 V or 60 V DC ranges. (See page 26.)

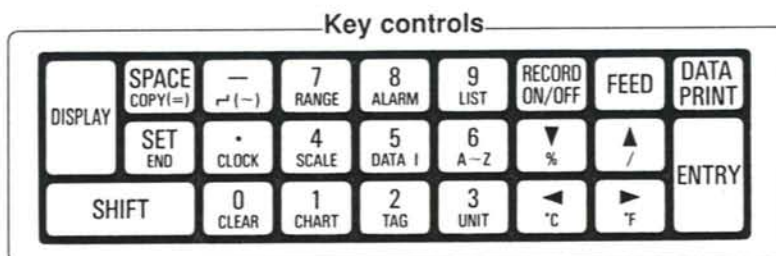
Resistors : Fixed. Not necessary to change. (Reinstalling the connectors may cause the recorder to malfunction.)

Note 2: Selection between voltage and resistance measurement

Not possible. This is fixed depending on the type of recorder.

2.4 OPERATION KEYS


These keys are used to set and check parameters and to operate the recorder.










































Ref. How to use dual-function key

Each of the dual function keys (   , etc.) has two functions

Upper function Press the key on its own.

Lower function Press the key with  held depressed.

Key	Name	Function
	DISPLAY key	<ol style="list-style-type: none"> ① Switches the display mode — Each time it is pressed, the display alternates between "Measured value" and "Clock display". ② When pressed during setting, interrupts setting and returns to the display mode.
	SPACE key	<ol style="list-style-type: none"> ① Deletes unnecessary digits. ② Deletes the decimal point. ③ Inserts a blank character in unit or tag setting. (The digit becomes blank.)
	SET key	Used to set or change parameters. The setting indicator lights and the cursor lights under the leftmost digit of the parameter that can be changed.
	SHIFT key	Used in combination with dual-function keys. When the lower function of a dual-function key is required, press the key with the SHIFT key held depressed.
   	Minus Decimal point 0 ~ 9 <div style="display: inline-block; vertical-align: middle; margin-left: 10px;"> } Numeric keys </div>	<ol style="list-style-type: none"> ① Use when entering a parameter. ② To enter a decimal point, move the cursor to the next digit and press the "." key before entering a figure. ③ To delete the decimal point, move the cursor to the next digit and press the SPACE key.
	RECORD key	Turns the recording functions ON/OFF. (Recording operations include analog and digital recording/printing and chart feed.)
	FEED key	Used to fast feed the recording chart. The recording chart will be fed while this key is pressed and stop when it is released. (This function is valid while the recording functions are ON.)
	Down key	<ol style="list-style-type: none"> ① During the setting operation, press to select the parameter above the cursor (other than numerals). Each time it is pressed, the parameter changes upward (up key) or downward (down key). ② When checking settings, press to change the channel number. (Except for 1-pen models.)
	Up key	
 	Cursor keys	Press to move the cursor to the left or right. ( : Each time this key is pressed, the cursor moves to the left by one digit, and stops at the leftmost digit.) ( : Each time this key is pressed, the cursor moves to the right by one digit, and stops at the rightmost digit.)
	DATA PRINT key	Pressed for digital printing of current values. If it is pressed during digital printing, printing will be overwritten. (See page 17.)

Key	Name	Function
	ENTRY key	Press to store the settings in the ROM. When there are several parameters, such as the range or scale of a 2-pen or 3-pen model, it performs temporary registration. The parameters are not stored finally until the  key is pressed.
	COPY key	Used to copy the same settings to the another channel. (See page 37.) (This function is not provided with 1-pen models.)
	END key	Press to store the temporary-stored settings in the ROM. This is not used in 1-pen models or for settings which have only one parameter (such as chart speed).
	From key	This key is used between the 0% input (left side) and 100% input (right side) for range and scale settings. (It is displayed as "↔", but means " ~ ".)
	CLOCK key	Press to set the time. For time setting, see page 22.
	CLEAR key	In the setting mode, press to clear the parameter currently displayed.
	RANGE key	Press to check or set the range. For the checking and setting procedure, refer to page 24.
	SCALE key	Press to check or set the scale. For the checking and setting procedure, refer to page 27.
	CHART key	Press to check or set the chart speed. For the checking and setting procedure, refer to page 23. (Three speeds can be pre-set for recorders equipped with external drive. See page 57)
	ALARM key	Press to check or set alarms. For the checking and setting procedure, refer to page 29.
	DATA Interval key	Press to enter the fixed interval digital recording setting mode. For the checking and setting procedure, refer to page 31.
	TAG key	Press to check and set tags. For the checking and setting procedure, refer to page 33.
	LIST key	Press this key to print a list of the settings. To interrupt printing, press the RECORD key to (OFF). See page 17.
	Alphabet key	Press to change from a numeric to an alphabetic display when setting tag or unit. Press the  to step through the letters in the forward direction (A→B→C...) and press the  to step through the characters in the reverse direction (Z→Y→X...).
	UNIT key	Press to check or set the unit. For the checking and setting procedure, refer to page 35.
	Percent (%) key	Press to use the "%" symbol in tag and unit setting. This has no relationship with the conversion of measured values. This symbol is handled as 2 digits.
	Slash (/) key	Press to use the "/" symbol in tag and unit setting.
	°C key	Press to use the "°C" symbol in tag and unit setting. This has no relationship with the conversion of measured values. This symbol is handled as 2 digits.
	°F key	Press to use the "°F" symbol in tag and unit setting. This has no relationship with the conversion of measured values. (See page 39.) This symbol is handled as 2 digits.

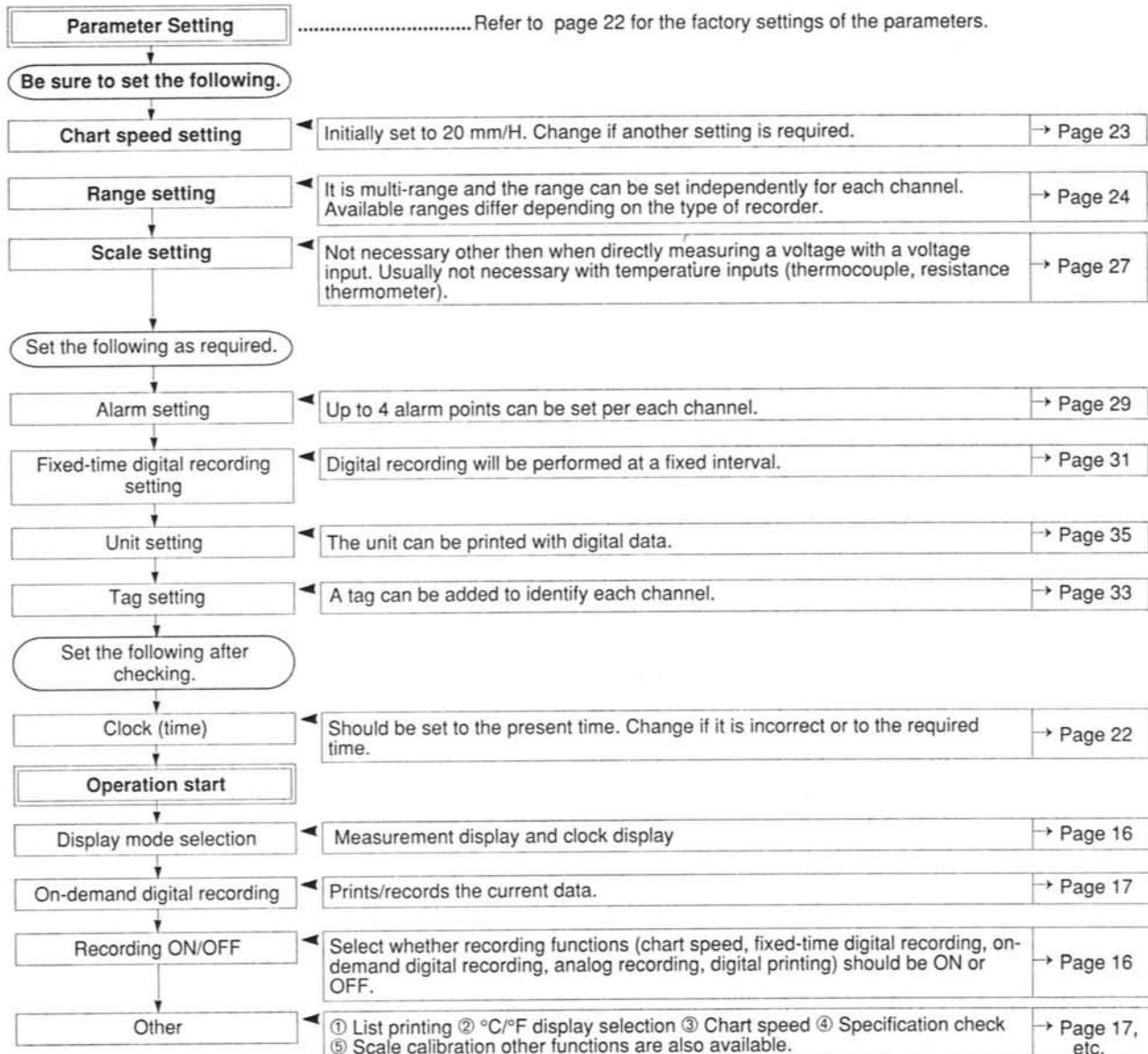
3. OPERATING PROCEDURE

When using the recorder for the first time, follow the procedure below so that you can understand the required items and start to use it quickly.

3.1 BEFORE SWITCHING THE POWER ON

1 Check ① Check external appearance and accessories See page 1. ② Preparations See page 1. ③ Check the type of the unit See page 2. ④ Check the power source .. See page 2.	2 Installation ① Limitations on installation position ② How to install in a panel ③ Weight ④ Power consumption	See page 9.	3 Connections ① Before connecting See page 10. ② Input terminals See page 10. ③ Alarm terminals See page 11. ④ Power and ground terminals See page 11.
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3.2 AFTER SWITCHING THE POWER ON



4. INSTALLATION

This unit can be used on the desk, but it is designed so that it can be installed in an instrument panel.

4.1 LIMITATIONS ON INSTALLATION POSITION

1 Ambient temperature and humidity ranges

Temperature range: 0 — 40°C
 Humidity range: 20 to 80% Rh
 Install in a stable place with the above environmental conditions

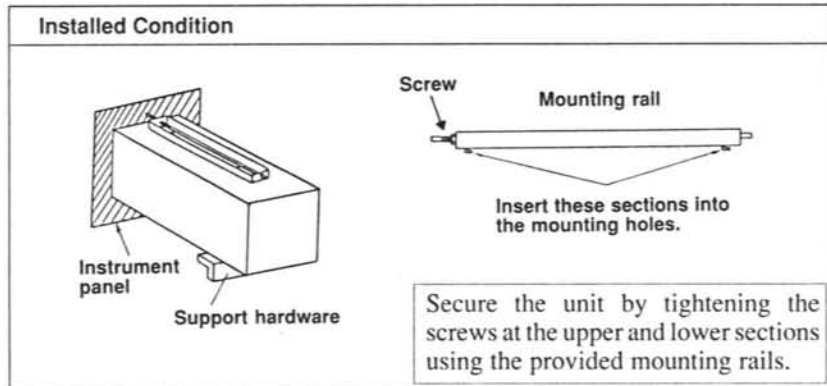
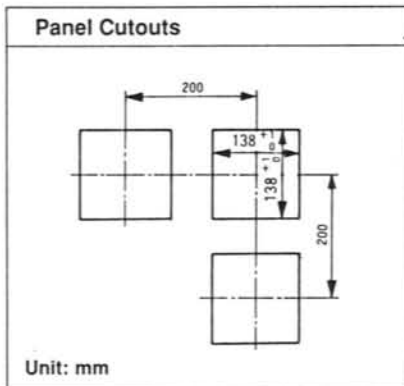
2 Ambient environment

Do not install in the following places:
 1. In a place with is dirty or dusty
 2. In a place filled with corrosive gas
 3. In a place subject to vibrations or shocks

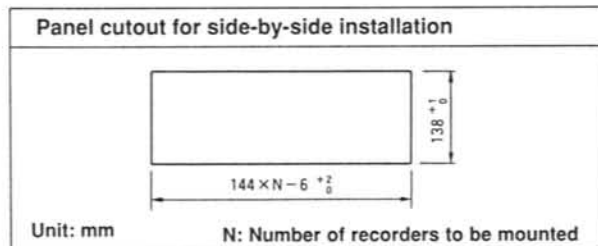
3 Inclined installation

Forward tilting: 0°
 Backward tilting: 0 — 30°
 Angles exceeding the above limits will affect recording operations.

4.2 PANEL INSTALLATION



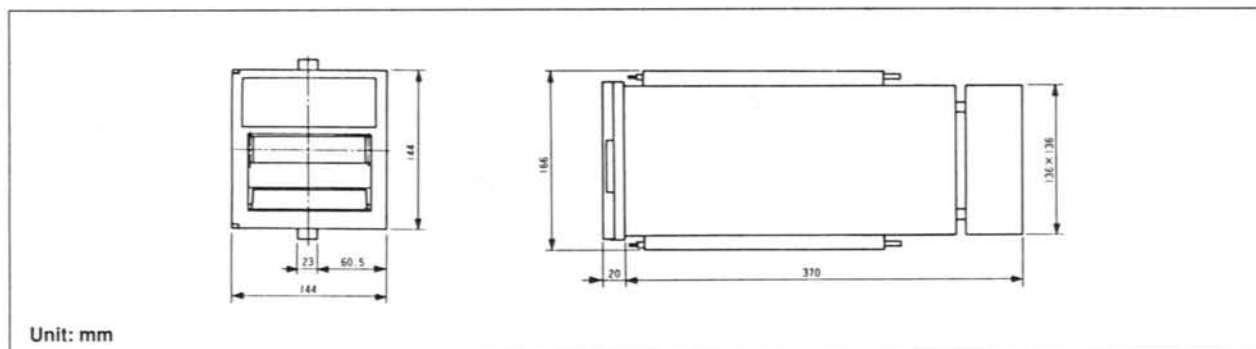
4.3 SIDE-BY-SIDE INSTALLATION



Note: How to install when side-by-side installation is required.

Use the support bracket (see the above figure). In this case, the lower mounting rail is not required.

4.4 DIMENSIONS



Ref. 1 Weight

1-pen type: Approx. 4.6 kg
 2-pen type: Approx. 4.9 kg
 3-pen type: Approx. 5.2 kg

Ref. 2 Power consumption

1-pen type: Approx. 50 VA
 2-pen type: Approx. 55 VA
 3-pen type: Approx. 50 VA

Ref. 3 Operation on transportation

When transporting or moving the unit, be sure to tighten the shipping lock screw to prevent the rack from coming out. → See page 1.

5. CONNECTIONS

There are three sections to be connected. Connect them to the terminal board on the rear panel.

5.1 BEFORE CONNECTING

1 High-voltage circuitry

Keep the input signal cables away from high-voltage circuits and appliances which generate high levels of noise, etc.
If the cables are parallel to the high-voltage circuits, separate by more than 30 cm.

2 Power voltage fluctuations

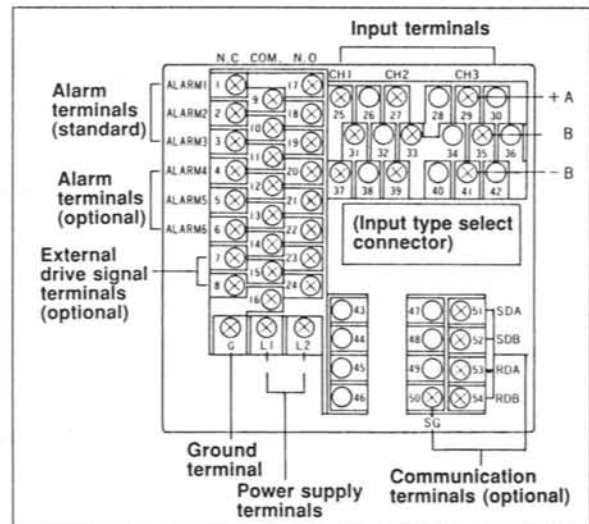
Do not supply the power to the unit from a source which has severe fluctuation of voltage or waveform distortion.

3 Tightening of terminals

Confirm that copper wires are firmly soldered and terminals are tightened securely.

5.2 CONNECTION TO EACH TERMINAL

Connection 1	Input terminals	→	Terminals (No.) 1st pen input: 1CH (25, 31, 37) 2nd pen input: 2CH (27, 33, 39) 3rd pen input: 3CH (29, 35, 41) Note: 31, 33 and 35 are not required for voltage measurement.
Connection 2	Alarm terminals (if required)	→	Terminals (No.) Output 1: ALARM1 (1, 9, 17) Output 2: ALARM2 (2, 10, 18) Output 3: ALARM3 (3, 11, 19)
Connection 3	Power supply terminal Ground terminal	→	Terminals (No.) Power supply : (L1, L2) Ground : (G)



1) Connection 1 (connection of input terminals)

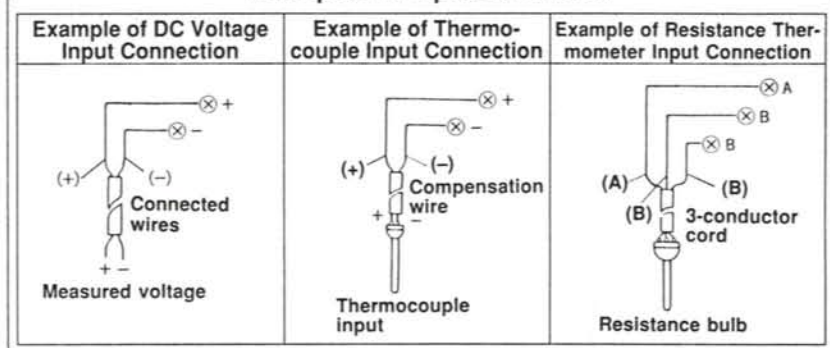
- Connection differs depending on the type of input signals. (See the table below.) The negative terminals for voltage measurement are listed in the right most column.
- The terminal No. is determined for each pen input depending on the number of pens.

Terminal Name	1-pen type	2-pen type	3-pen type	+, A	B	-, B
CH1	Input	1st pen input	1st pen input	25	31	37
CH2		2nd pen input	2nd pen input	27	33	39
CH3			3rd pen input	29	35	41

Note: When using a range of more than 5 V with DC voltage or DC current input

Remove the name plate (black) located under the input terminal section, and re-connect the input select connectors. Re-connect them referring to the instructions on the name plate (black). For details, refer to page 23.

Examples of input terminals:



2) Connection 2 (Connection of alarm terminals)

- Although 4 alarm settings are available for each input channel, up to three alarm outputs are provided (ALARM1 - 3).
- When an alarm occurs, the line between N.O and COM is short-circuited and an energized output (non-voltage contact output) is output, and the line between N.O and COM will be open.

Ref. 1 Output when lower limit alarm is set

When the lower limit alarm output is selected for output 1 (ALARM1), the output status due to relationship between the measured value and the set value is as shown on the right.

Ref. 2 Output when upper limit alarm is set

When the upper limit alarm output is selected for output 2 (ALARM2), the output status due to relationship between the measured value and the set value is as shown on the right.

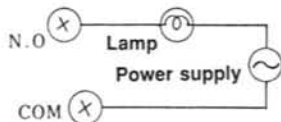
(Lower limit/upper limit alarm output status)

Higher-Limit and Lower-Limit Alarm Output Conditions

Relation between reading Value and Set Point	(ALARM 1) Lower-Limit Alarm Output	(ALARM 2) Upper-Limit Alarm Output
<p>Lower limit point Upper limit point</p> <p>Reading value</p>		
Power OFF		

Ref. 3 Connection example

To light the indicator when an alarm occurs.



Ref. 4 Contact capacity

100 V AC, 0.5 A (load resistance)
200 V AC, 0.2 A (load resistance)
If the above values are not enough, use a additional relay, etc.

Ref. 5 Alarm setting

The type of alarm (upper/lower limit), set value, alarm No. and output No. can be set optionally for each alarm point.

For the setting and checking procedure, see page 27.

Ref. 6 ALARM 4 - 6

This is effective when the 6-point alarm option is added. It is used in the same way as ALARM 1 - 3.

Ref. 7 Alarm specifications

Alarm system : Individual setting, individual indication, OR select output system

Alarm indication : Common occurrence indication and flickering of digital or analog bargraph display

Setting method : Individual setting for each point (key operation)

Ref. 8 OR select output

Multiple alarm points can be set for a single output No. The signal will be output when an alarm occurs at any of the alarm points.

3) Connection 3 (Connection of power supply and ground terminals)

- Power supply terminal The power supply is from 81 V to 264 V AC. Use a stable power supply.
- Ground terminal Solder copper wire to a copper plate and ideally bury the plate in damp earth.

Note: When the power frequency selector and fuse are connected externally

Although the operation of this unit is not affected directly by the power frequency (50 Hz, 60 Hz), be sure to set the correct value to your area to prevent noise from entering the unit. -> Page 2. Use a fuse rated at more than 3A because a high surge current will flow when the power is turned ON.

6. REPLACING CONSUMABLES

6.1 HOW TO ATTACH THE ANALOG RECORDING PEN

- ① Take out the analog recording pen from the accessory box.
- ② Pens are arranged from the bottom in the order of the 1st pen (1CH), the 2nd pen (2CH) and the 3rd pen (3CH). The ink colors of the pens are as follows:

1st pen	Red	(1-pen, 2-pen, 3-pen types)
2nd pen	Green	(2-pen, 3-pen types)
3rd pen	Blue	(only 3-pen type)

- ③ Open the door and pull out the rack.
- ④ When the **RECORD ON** indicator is lit, press the **RECORD ON/OFF** key to set to OFF. (If it is ON, subsequent operations are not possible.)
- ⑤ Press the **ENTRY** key while holding the **SHIFT** key depressed. The pen holder will move to the position where pen can be exchanged easily. (The clearances between the pens are optimized.)
- ⑥ Open the display section.
- ⑦ Remove the pen cap and insert the pen into the pen holder. At this time, insert firmly so that the pen is completely fixed.
- ⑧ Press the **ENTRY** key while holding the **SHIFT** key depressed. The pen will return to its previous position and pressing the **RECORD ON/OFF** key will be possible.
- ⑨ Close the display section and slide back the rack.

Note 1: Pen handling

Felt-tip pens using pipes are used. Do not apply excessive force to the pipe.

Note 2: Pen holder handling

Never move the pen holder to the left or right by force. Also do not insert the pen with the pen cap attached.

Note 3: Pen tip handling

As the pen tip is made of nylon fiber, do not press it forcibly because it may be damaged.

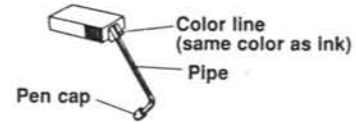
Note 4: After replacing the pen

With a new pen, ink may not be output smoothly at first. In such a case, rub the pen lightly against paper.

Note 5: When not used for an extended period of time

When the unit is not to be used for an extended period of time, remove the pen and store with pen cap in place, to prevent the pen drying up and to extend the ink life.

Prepare the analog recording pen ①②



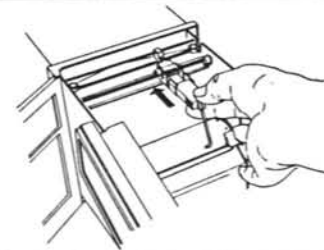
Pull out the rack ③



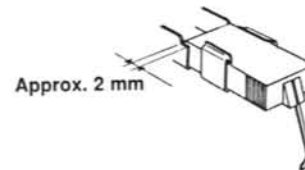
Open the display section ⑥



Insert the pen into the holder ⑦



Check that the pen is firmly secured ⑦



Ref. Ink consumption

The ink consumption will differ depending on operating conditions, but normally it will last for about 800 m to 1200 m of continuous recording.

6.2 HOW TO ATTACH THE PLOTTER PEN (FOR DIGITAL RECORDING/PRINTING)

- ① Take out the plotter pen from the accessory box. The ink in the plotter pen is black.
- ② Open the door and pull out the rack.
- ③ If the "RECORD ON" indicator is lit, press the **RECORD ON/OFF** key to set to OFF. (If it is ON, subsequent operations are not possible.)
- ④ Press the **ENT** key while holding the **SHIFT** key depressed. The pen holder will move to the position where the pen can be exchanged easily.
- ⑤ Hold the handle with a square hole at the bottom of the chart feed mechanism and pull out the mechanism to remove it.
(When the recording chart is loaded, pull out the mechanism while lifting the recording chart on the recording chart holder.)
- ⑥ Open the display section.
- ⑦ Remove the pen cap and insert the pen into the pen holder until it is held securely.
- ⑧ Press the **ENT** key while holding the **SHIFT** key depressed. The pen will return to its previous position and pressing the **RECORD ON/OFF** key will be possible.
- ⑨ Close the display section and slide the rack back into the recorder.

Note 1: Pen tip handling

As the pen tip is made of nylon fiber, do not press it forcibly because it may be damaged.

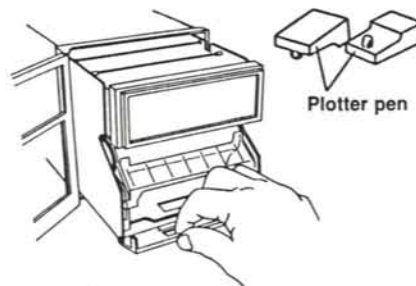
Note 3: After replacing the pen

With a new pen, ink may not be flow smoothly at first. In such a case, rub the pen lightly against paper.

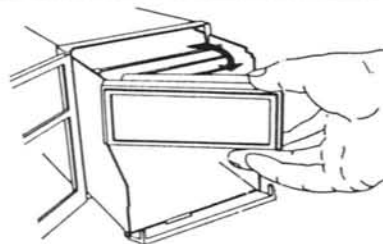
Ref. Ink consumption

The ink consumption may differ depending on the operating conditions, but normally it can be used for about 80,000 characters.

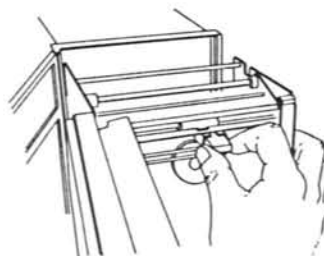
Prepare the pen and pull out the rack ① ②



Open the display section ⑥



Insert the pen into the holder ⑦



Note 2: Pen holder handling

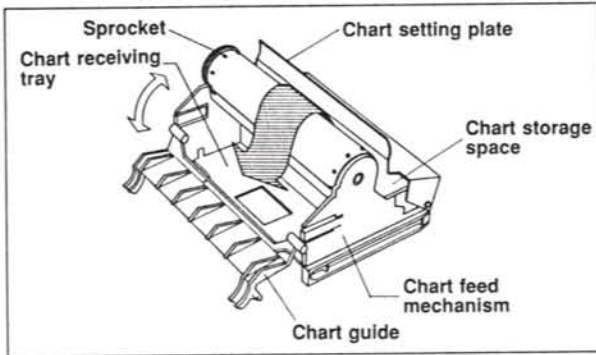
Never move the pen holder to the left or right forcibly. Also do not insert the pen with the pen cap attached.

Note 4: When not to be used for an extended period of time

When the recorder is not to be used for an extended period of time, remove the pen and store with pen cap attached to prevent it drying up and to extend the ink life.

6.3 HOW TO LOAD THE CHART

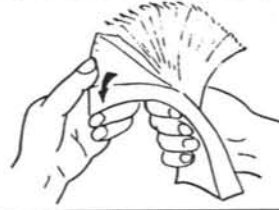
- ① Take out the recording chart from the accessory box.
- ② Loosen the recording chart to prevent two or more sheets being feed together.
- ③ Pull out the chart feed mechanism and open the chart setting plate. Then set the chart into the chart receiving tray with its first section facing up. (Set so that the round sprocket holes are on the left and the oval holes are on the right.)
- ④ Hold down the chart guide toward the front and pull out about 2 cms of the recording chart.
- ⑤ Set the chart so that the holes are on the sprockets, and replace the chart setting plate. Then turn the drum and fold the chart two or three times on the chart holder.
- ⑥ Return the chart guide back to its previous position.
- ⑦ Slide the chart feed mechanism back into the rack.



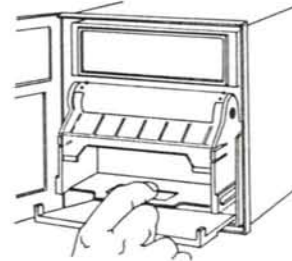
Ref. 1 Length of recording chart

Charts are about 10 m long, which makes possible continuous recording for about 20 days at a chart speed of 20 mm/hour.

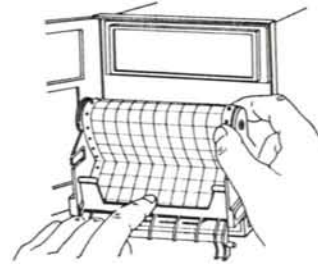
Loosen the chart ②



Pull out the chart feed mechanism ③



Place the recording chart on the tray ⑤



Ref. 2 End mark on recording chart

The remaining amount of chart is indicated by red marks on the right edge of the chart. When the chart has almost all been used, these red end marks will appear on the right. When you see them, replace the chart.

7. SWITCHING POWER ON AND OPERATION

7.1 BEFORE SWITCHING POWER ON

1 Power frequency switching

Did you set to the correct power frequency (50 Hz or 60 Hz) for your area?

→ See page 2

2 Attachment of pen and recording chart

- ① Attachment of analog recording pen
- ② Attachment of plotter pen
- ③ Attachment of recording chart

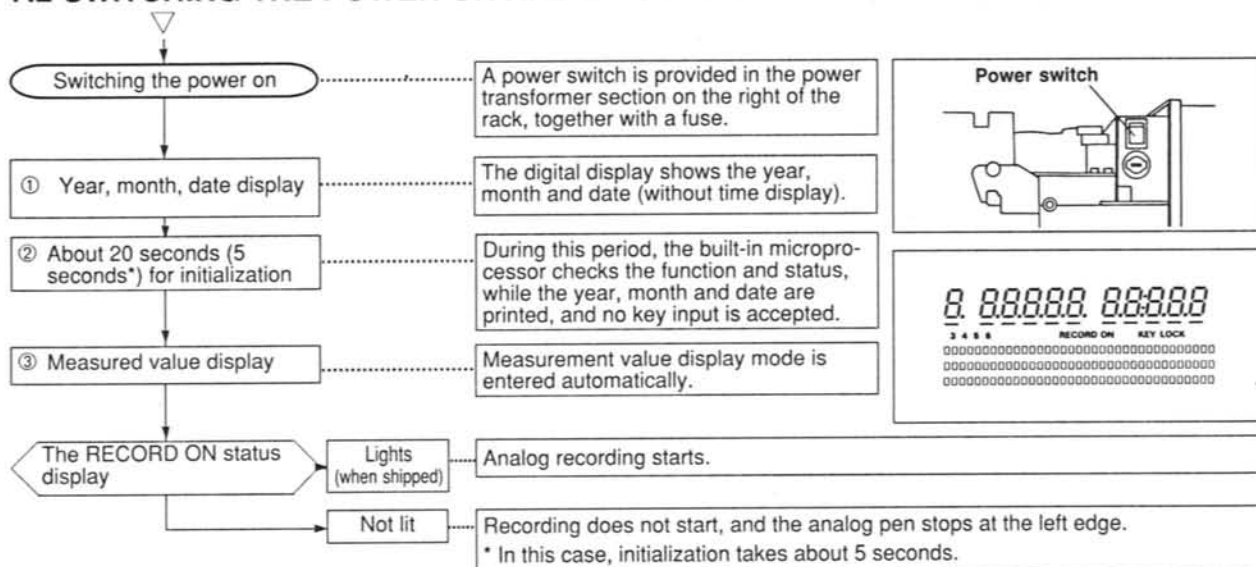
→ See pages 12 - 14

3 Connections

- ① Input terminals
- ② Alarm terminal (if required)
- ③ Power supply and ground terminals

→ See page 10

7.2 SWITCHING THE POWER ON AND MACHINE STATUS



<Remarks> After ③, the unit operates with the registered parameters. On shipment, parameters are set as shown in item 7.3. Change them as required.

7.3 PARAMETER VALUES SET ON SHIPMENT (INITIAL VALUES)

Parameters		Factory/Initial		Setting Value	Setting/Check Method	
Number of Setting	Name				Section	Page
1	Clock (Time)	Present time		(Note)	8.2	21
	Chart speed	25 mm/H		Same as on left	8.3	22
	Constant-interval recording	Blank (Not set)			8.7	29
n	Range	Voltage measurement	K: 0 ~ 1200°C		Same as on left	8.4
		Resistance measurement	Pt100:-200 ~ 500°C			
	Scale	Voltage measurement	0 ~ 1200	8.5		25
		Resistance measurement	-200 ~ 500			
	Unit	°C		8.9		33
Tag	Blank (Not set)		8.8	31		
n x 4	Alarm	Blank (Not set)		8.6	27	

(Note) 00:00, May 1, 1989

<Remark> Related items → See page 21

How to initialize

Refer to "memory clear function" on page 41.

Blank (No setting)

Since it is not designated, the corresponding function is not available. Set as required.

Concerning "n"

Number of channels. "1" for 1 pen, "2" for 2 pens and "3" for 3 pens.

Ref. 1 2-pen and 3-pen models

The same initial values are set for the range, scale and unit of each pen.



Ref. 2 Parameters for blank items

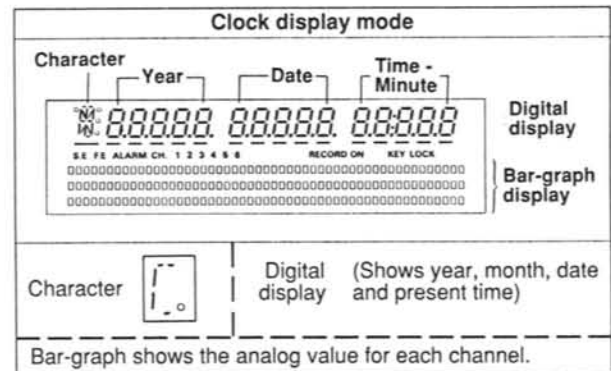
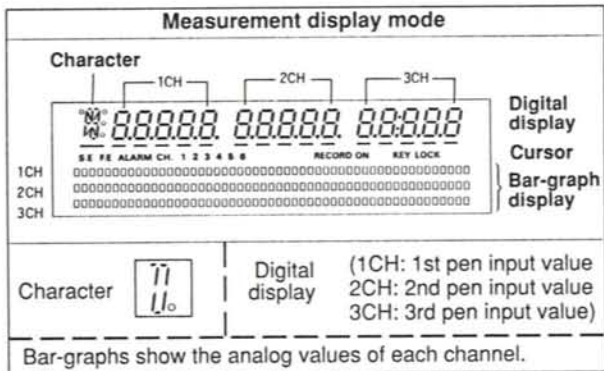
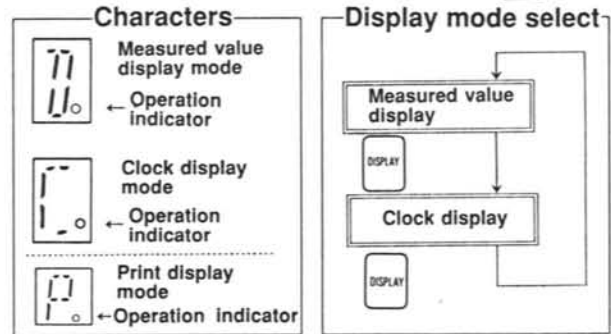
Characters identifying the setting mode and supplementary indications are displayed.

Ref. 3 External drive type

The chart speed is set to the same value (20 mm/H) for each of the three speed settings.


7.4 SELECTION BETWEEN MEASUREMENT VALUE AND CLOCK DISPLAY ()

- ① The display mode can be changed at any time during operation.
- ② Each time the  key is pressed, the display mode alternates between display of measured values and the clock display.
- ③ When the plotter is performing digital recording or printing, the display changes to the print display mode.
- ④ A character is displayed at the left end of the display and the operation indicator lights.
- ⑤ During the setting mode, the operation indicator goes out.
- ⑥ In the setting mode, pressing the  key restores the previous display.



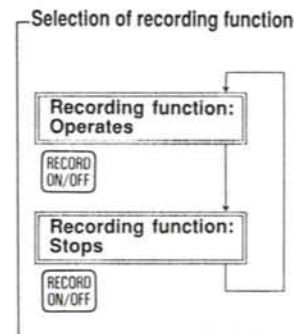
<Note> The 5th segment of each bar-graph is the same color as the corresponding pen.

7.5 OPERATION AND INTERRUPTING THE RECORDING FUNCTIONS ()

- ① During operation, operation can be interrupted and restarted at any time.
- ② Each time the  key is pressed, the recording function alternates between off and on.
- ③ The recording function is operating when the status indicator is lit, and is stopped when it is not lit.
- ④ On shipping, it is set for operation (ON).

Recording Functions	Operating (ON)	Stop (OFF)
① Chart feed	Operates	Stops
② Fixed interval digital recording	Operates	Stops
③ Instantaneous digital recording	Possible	Not possible
④ Analog recording	Operates	Stops(left edge)
⑤ Digital print *, List print	Operates	Stops

* Year/month/date, time, chart feed, scale, unit, etc.



Note: Fixed interval digital recording during setting

If the preset time for fixed interval digital recording is reached while setting parameters, digital recording will not be performed.

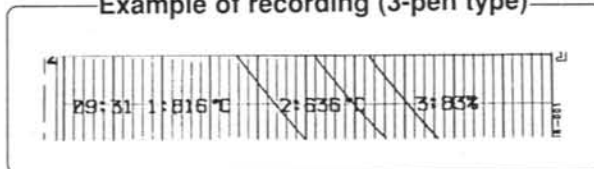
Ref. Digital printing and chart speed

- ① For digital printing, when printing will occur and what is to be printed are determined according to the chart speed. -> See page 42
- ② When the chart speed exceeds 300 mm/hour (5 mm/minute), only the timing line will be printed.

7.6 ON-DEMAND INSTANTANEOUS DIGITAL RECORDING (DATA PRINT)

- ① During operation, the current data can be printed (by digital recording) at any time.
- ② When the DATA PRINT key is pressed, the time when the key is pressed and the current measured values are recorded digitally. (Refer to the diagram on the right.)
- ③ Two recording methods are available depending on the chart speed, as follows:

Example of recording (3-pen type)



1 When the chart speed is less than 300 mm/hour

Digital recording is performed on the chart. It does not affect the chart feed or analog recording. Inclined recording or overprinting may occur depending on the chart speed.

Overprinting



2 When the chart speed exceeds 300 mm/hour

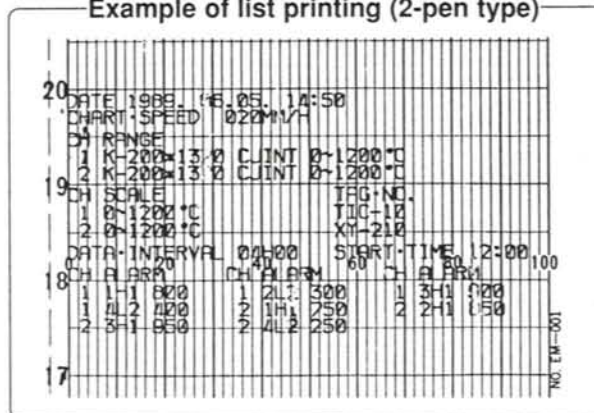
Digital recording is performed on the recording chart, however, the following phenomena appear:

- ① Chart feed stops
- ② Recording is performed with the analog recording is shifted to the left edge. During recording, data input is also interrupted.

7.7 PERFORMING LIST PRINTING (9 LIST KEY: PRESS 9 LIST WHILE HOLDING SHIFT)

- ① During operation, a list of current settings can be printed at any time.
- ② When the 9 LIST key is pressed, a list of parameters is printed on the recording chart.
- ③ When this is done during printing, analog recording will be shifted to the left end. During list printing, data input is also interrupted and parameter setting is not possible.
- ④ To interrupt list printing, refer to the "note" below.

Example of list printing (2-pen type)



Parameter list items

- ① Year/month/date/time
- ② Chart speed
- ③ Range settings for each channel
- ④ Scale settings and units for each channel
- ⑤ Other items (tag, alarm, fixed interval recording) are not printed unless they are registered.

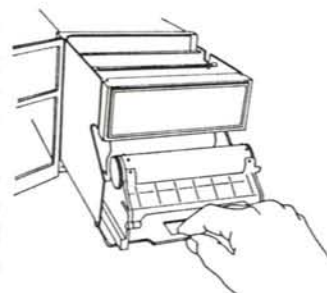
7.8 FAST FEEDING OF RECORDING CHART (FEED)

- ① The chart can be fed at high speed regardless of the recording mode using the operation keys.
- ② While the FEED key is pressed, the recording chart will be fed at approx. 600 mm/hour, regardless of the registered chart speed.
- ③ When the key is released, the registered chart feed speed is resumed.
- ④ To feed the chart manually, refer to "reference".

Ref. To feed the chart manually

Pull out the chart feed mechanism slightly from the rack (by about 5 mm), and turn the gear on the left of the drum by hand.

Note: Do not turn the gear with the chart feed mechanism in place.

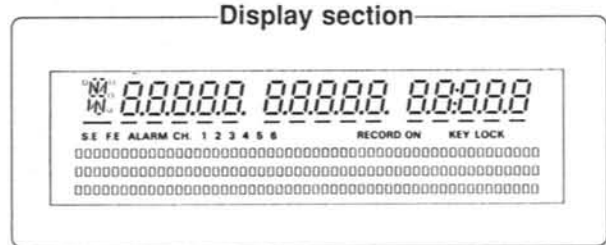


Note: When the **RECORD ON** indicator is not lit and printing is interrupted.

- ① When the recording function is not engaged (**RECORD ON** is not lit), the **DATA PRINT**, **9**, **FEED** keys are disabled.
- ② To interrupt digital printing or list printing, press the **RECORD ON/OFF** key. After the current line has been printed, printing will be stopped. The remaining data will not be printed even when the **RECORD ON/OFF** key is pressed again.
If an alarm occurs during printing, printing will be interrupted, but it will be restarted when the cause of the alarm is removed.

7.9 DISPLAY AND PRINTING ON ALARM (OCCURRENCE/CANCELLATION)

- ① When an alarm occurs, the channel No. and alarm No. of the alarm are displayed while the bar-graph shows the approximate value.
- ② When alarm occurs or is cleared, details will be printed on the right of the recording chart.



1) Display when an alarm occurs

① Channel in which the alarm occurs is displayed

During the occurrence of an alarm (until it is canceled), **ALARM CH** and the channel number are displayed in red in the status display section.

② Display of alarm No.

During the occurrence of an alarm (until it is canceled), the cursor under the measured value of the corresponding channel blinks to indicate the alarm No.

Measurement value indication
 Cursor
 Alarm number 1 2 3 4

③ Flickering indication

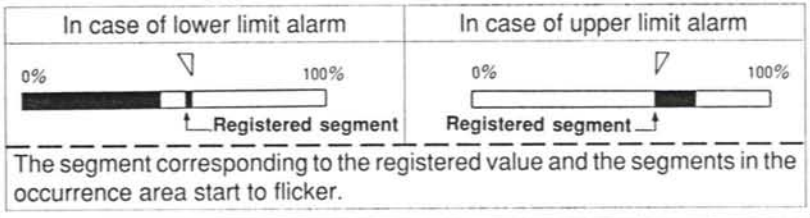
When alarm occurs, the measured value of the corresponding channel and bar-graph display flicker.

→ Refer to "Reference 1"

Flickering is stopped by pressing the **ENT** key.

→ Refer to "Reference 2".

Ref. 1 Flickering point on bar-graph display



Ref. 2 When flickering is stopped

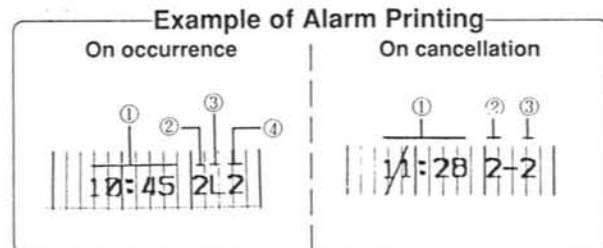
- ① Even when flickering of the indication is stopped, the alarm output is not canceled.
- ② The flickering cannot be stopped. After an alarm is canceled (the correct value is entered), flickering will not occur until another alarm occurs or the alarm associated with another alarm number occurs.

2) Printing when alarm occurs

- ① If an alarm occurs or is canceled during printing, the alarm indication is printed at the right end of the chart.

Status	Printing Details			
When an alarm occurs	① Occurrence time	② CH No.	③ Alarm type	④ Alarm No.
	① Cancellation time	② CH No.	③ Hyphen	④ Alarm No.

- ② Up to five data items are printed on one line.



Note: Data memory amount for alarm occurrence and cancellation

- ① The maximum memory capacity is 48 data items. Since up to 5 data items are printed on each line, if alarm occurrence and cancellation are repeated frequently and the amount of data exceeds 48 data items before the recording chart advances by 3.6 mm to print the next line, the 49th and later data item will not be printed. In this case, when the 48th data item is reached, **OVER FLOW** is printed after alarm printing is performed.
- ② When alarm printing is performed, since the data is reduced slightly, new data can be stored, but **OVER FLOW** will be printed after 48 data items.

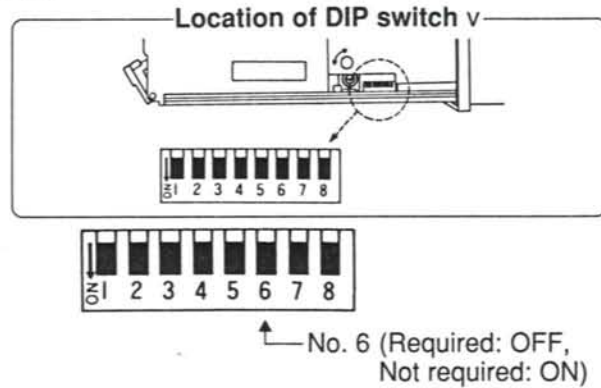
7.10 ON/OFF SELECTION OF ALARM PRINTING

- ① When the alarm printing is not required, the alarm printing can be interrupted.
- ② Alarm display and alarm output are performed normally.

<How to select>

Switch over the DIP switch on the right side of the rack.

- ① Turn the power switch to OFF. -> Refer to "Ref. 2".
- ② Set DIP switch No.6 to the ON position (down).
- ③ Turn the power switch to ON.



Ref. 1 To resume alarm printing

In the same way as above, set the DIP switch to OFF in item ②.

Ref. 2 Confirmation of DIP switch setting

Confirmation is performed when the power is switched on. Switching it over during operation has no effect.

7.11 OVER-RANGE INDICATION AND RECORDING

Overload input direction	Input exceeding the analog recording range			Input exceeding the measurable range of Range No.		
	Digital		Analog recording	Digital		Analog recording
	Display	Recording		Display	Recording	
0% direction (towards the left)	Normal*	Normal*	Over the left end	□ □ □ □ □	— — — — —	Over the left end
100% direction (towards the right)	Normal*	Normal*	Over the right end	□ □ □ □ □	+ — — — —	Over the right end

<Remark> Digital display and recording has a margin from +10 to +15% beyond the measurable range. However, if it exceeds the display range (5 digits), it becomes the same as over-range.

7.12 SKIP FUNCTION (CANCELLATION OF CHANNELS)

Channels for which range setting has not been registered will be skipped and are not displayed or recorded; this is the same as reducing the number of channels.

What is skipping?

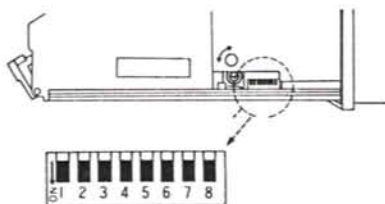
- ① Measurement value display ... Not lit.
- ② Bar-graph display Not lit.
- ③ Digital recording No.
- ④ Analog recording Over left end.

Ref. Skip operation

When the range setting for a channel is not performed, "clear" is registered for the channel. Input and then press to register "clear".
Related items → Refer to "Note 2" on page 25.

7.13 CHANGE OF FUNCTIONS Refer to related items on page 47.

The DIP switch located on the right side of the rack allows some functions to be changed.



No.	Function	Ref. Page	Normal	OFF (upper position)
1	Determination of operation mode and communication parameters	Memory Clear	All OFF for no communication functions	No communication functions (See page 43)
2		Check Mode		
3		Scale Calibration		
4	—	—	OFF	During operation
5	°C/°F select	36	OFF	°C
6	Alarm printing ON/OFF selection	18	OFF	Printing is required (ON)
7	Time-axis synchronization select (optional)	56	OFF	Not executed
8	Power frequency select.	2	ON/OFF	50 Hz

8. SETTING AND CONFIRMATION OF PARAMETERS

8.1 SETTING AND CONFIRMATION

- ① When the recorder is shipped, the parameters are set as shown in the table below. Although the recorder will operate (display and analog recording) when power is turned on as it is, the required parameters should be set.
- ② Any required range can be set. Be sure to select and set to the required ranges.
- ③ Fixed time interval digital recording, alarm and tag are not registered before delivery. Set them if they are required.

Fixed time interval digital recording

This is function performs digital recording automatically, at a fixed interval which can be registered.

1) Names of parameters and values when shipped

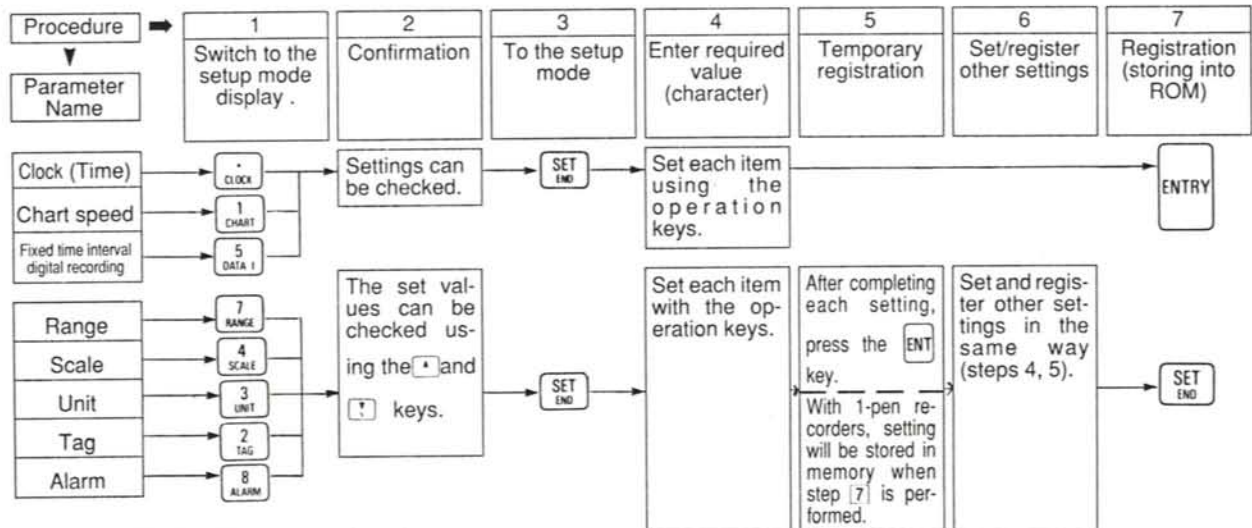
Parameters		Factory Setting	Remark	Setting/Check Method	
Number of Setting	Name			Section	Page
1 (Common)	Clock (Time)	Set to the present time	Initial value: 00:00 May 1 1989	8.2	21
	Chart speed	25 mm/H	Setting range: 1 - 600 mm/H (hour) and 1 - 200 mm/M (minute)	8.3	22
	Fixed time interval digital recording	Blank (No setting)	Set the start time and interval time	8.7	29
No. of pens (No. of Channels)	Range *1	Voltage measurement	K:0 ~ 1200°C	8.4	23
		Resistance measurement	Pt100: -200 ~ 500°C		
	Scale *2	Voltage measurement	0 ~ 1200	8.5	25
		Resistance thermometer	-200 ~ 500		
	Unit *3	°C	There is no conversion, even if °F is registered. → See page 36.		8.9
Tag *3	Blank (No setting)	Within 9 digits		8.8	31
Individual	Alarm	Blank (No setting)	Up to 4 points can be set per channel	8.6	27

*1: Designated for each pen input (channel). (Can be judged from its type)

*2: When the analog recording range is set, the value will be set automatically.

*3: Character which is printed in digital recording/printing. Not related to the display.

2) Outline of setting/confirmation procedure



<Note 1> \square \square through \square keys should be pressed while the \square key is depressed.

<Note 2> To return to the display mode during setting or after confirming settings, press the \square key.

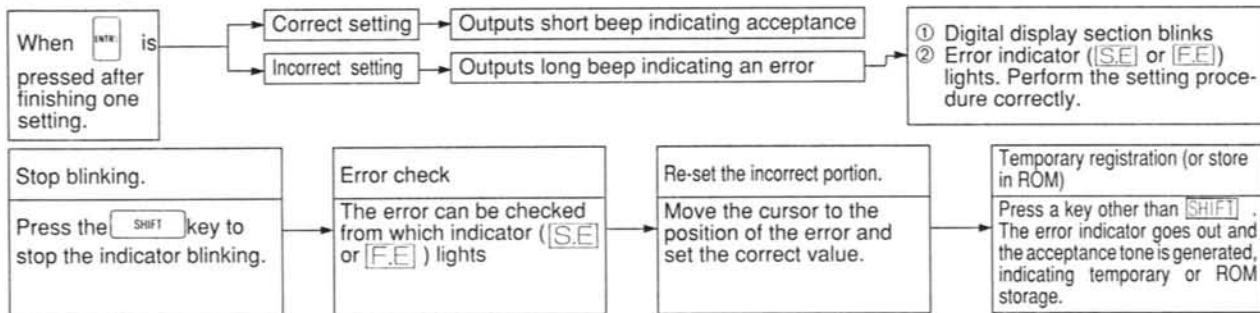
<Note 3> The characters for each digit of the unit and tag should be set and confirmed using the \square \square keys.

3) Setting mode display Initial values are shown

▼: Initial cursor position

Mode Name	Display style	Mode Name	Display style
Clock (time)	<p>Year (A.D.) Month/day Hour minute (time)</p> <p>(Time is shown in 24-hour format)</p> <p>Parameter</p>	Range	<p>Range No. Channel No. Input value of the left of the chart (within 5 digits) Input value of the right of the chart (within 5 digits)</p> <p>Parameter CJ select</p>
Chart speed	<p>Chart speed</p> <p>Unit (parameter) ... H and M</p>	Scale	<p>Channel No. Scale setting (11 digits max. from the leftmost digit) Scale value of input at the left of the recording chart (within 5 digits) Scale value of input at the right of the recording chart (within 5 digits)</p> <p>Parameter</p>
Fixed time interval operation	<p>Hours minutes Interval time</p> <p>Hour minute Start time</p> <p>Parameter (Time is shown in 24-hour format)</p>	Unit	<p>Channel No. Positions in which characters can be registered (up to 5 digits)</p> <p>Character to be registered (shows the character to be registered in the indicated position)</p> <p>Parameter</p>
Alarm	<p>Alarm No. Output No. Alarm type Alarm value (up to 5 digits)</p> <p>Parameter</p>	Tag	<p>Channel No. Positions in which characters can be registered (up to 9 digits)</p> <p>Character to be registered (Shows the character to be registered in the indicated digit)</p> <p>Parameter</p>

4) Setting errors and countermeasures



Ref. 1 What does S.E refer to?

It stands for Setting Error. It lights when the contents of a setting are invalid, even if the format is correct.

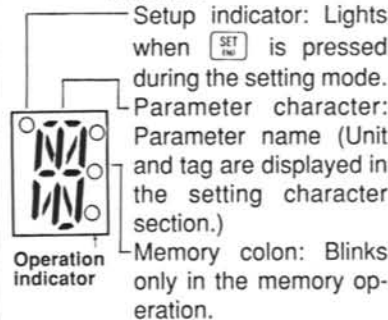
Ref. 2 What does F.E refer to?

It stands for Format Error. It lights when there is a mistake in the format of a setting.

Ref. 3 When a mistake is made in data entry

When an incorrect value (character) is set, return the cursor to the required digit and input the correct value (or character)

Ref. 4 Display of parameter section



Ref. 5 When key entry is not accepted even after several attempts

When **SET INC** (**SHIFT** + **SET INC**) is pressed, it returns to the display mode and the settings are not changed, but if there are parameters which have been accepted when the **ENTR** key was pressed, the corresponding values will be changed.

Note 1: Data input during setting

Data input is interrupted since the **SET END** key is pressed to complete setting (returns to display mode). When the display mode is changed to the setup mode temporarily to check a parameter, data input can be continued.

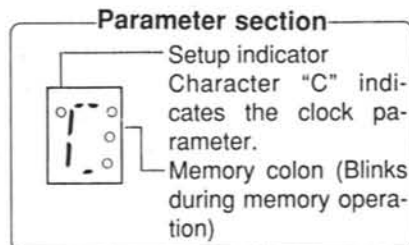
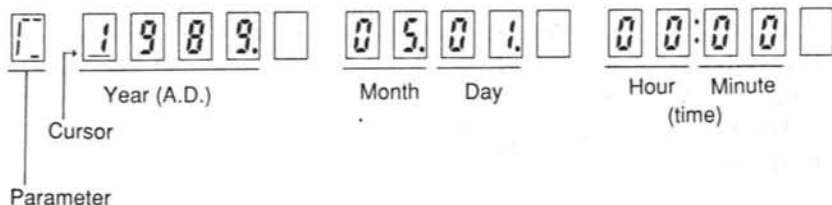
Note 2: Recording function during setting

No key inputs concerning recording (**RECORD ON/OFF**, **FEED**, **DATA PRINT**, **Q LIST**) are accepted until the **SET END** key is pressed to complete the setting (to return to the display mode).

8.2 CLOCK (TIME)

The year/month/day and time can be changed. Although they are set when the recorder is shipped, check them by selecting the display mode and change them if they are incorrect.

1) Clock mode display Initial values are shown



2) Setting items and key operations

Setting Items

- ① Year : 4 digits
 - ② Month/day : 4 digits
 - ③ Time : 4 digits (hours & minutes)
- <Note> Time is shown in 24-hour format.

Key Operations

- ① For the key functions such as **CLOCK**, **0 CLEAR**, etc.*, press the corresponding key while holding the **SHIFT** key depressed.
- ② When a numeric key is pressed, the cursor will advance to the next digit.

3) Setting procedure

1 Change to the clock mode



The display will change to the clock mode. Counting continues but the displayed time will not change. To check the time, refer to item 4).

2 Set the setting mode



(Bar-graph indicator goes out and setting indicator lights.)

The cursor lights under the leftmost digit the setting (modification) of which is possible.

(**RIGHT**): To move the cursor to the right.)

(**LEFT**): To move the cursor to the left.)

3 Clock setting



Set the correct present time.

4 Registration (memory)



(The memory colon blinks and the setting change mark is printed.)

When storage into ROM is completed, the display mode before entering the setting mode is resumed.

4) Checking procedure From the measurement value display mode, press the **DISPLAY** key to change to the clock mode. Press it again to return to the measurement display mode.

Concerned items → See page 15.

Ref. 1 Clock

The clock has been set to the present time before shipment. Since the clock is backed up by a built-in lithium battery, counting continues even when power supply is interrupted, or the power is turned OFF. The life of the battery is about 5 years (total power-OFF time).


Ref. 2 Starting the clock

In step 4) above, when the **ENTRY** key is pressed, counting the seconds starts from "00".

Ref. 3 Setting the time

The time is shown in the 24-hour format. The setting range is from "00:00" to "23:59".


Ref. 5 To return to the display mode

While setting is being performed, pressing the  key returns to the display mode engaged before entering the setting mode.

Ref. 4 Initial value and initialization

Initial value 1989 (year) 5 (month) 1 (day) 00 (hour) 00 (minute)

For initialization, refer to page 41.

Pressing the  key shows the initial value.

Ref. 6 Setting to "60 minutes"

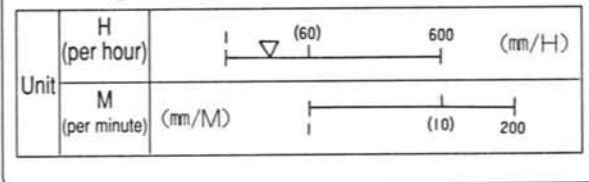
An input of "60 minutes" will not be accepted. Input as "1 hour".

<Example> 13:60 → 14:00

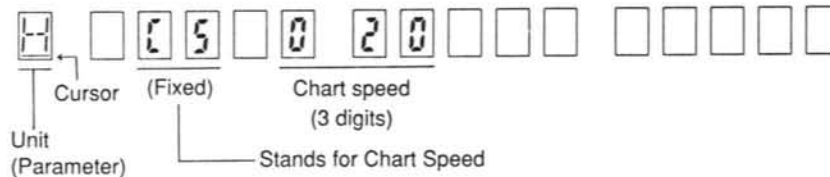
8.3 CHART SPEED

This mode is used to set the chart speed. The setting ranges are shown in the diagram on the right. For both H (hour) and M (minute) speeds, setting is possible in 1-mm steps. In the range between 60 and 600 mm/H, either H or M can be used, but accuracy will be higher with the H unit.

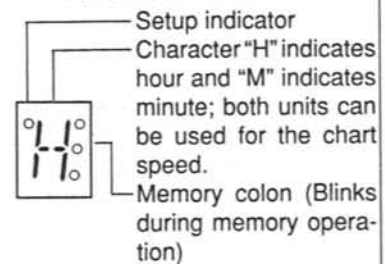
Setting Ranges: (▽ : Initial value ... 20 mm/H)



1) Chart speed mode displayInitial values are shown



Parameter section






2) Setting items and key operations

Setting Items

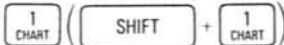
- Unit (H or M) : 1 digit
- Chart speed : 3 digits

Key Operations

- For key functions such as  and , press the corresponding key while holding the  key depressed.
- When a numeric key is pressed, the cursor will advance to the next digit.

3) Setting procedure

1 Change to the chart speed mode





The display will be changed to the chart speed mode.

2 Set to the setting mode



(The bar-graph indicator goes out and the setting indicator lights.)



The cursor lights under the leftmost digit the setting (modification) of which is possible.

-  : To move the cursor to the right.)
-  : To move the cursor to the left.)

3 Selection of the unit




Select the unit required.


-  : Speed per hour (mm)
-  : Speed per minute (mm)

4 Setting of chart speed




Set the speed (feed distance: mm) for the selected unit as 3 digits.

(For 50 mm, input )

5 Registration (memory)
 (Memory colon blinks and setting change mark is printed.)
 When storing into ROM is completed, the display mode before entering the setting mode is restored.

Note: Effect on fixed time interval digital recording setting
 When the chart speed is changed, the setting for fixed time interval recording will be cleared. If fixed time interval recording is required, set it again.


4) Checking procedure The current setting can be checked by the procedure **1** in 3) above.

Ref. 1 Clear
 When the  key is pressed, the initial value (20 mm/H) will be displayed.

Ref. 2 Initial value and initialization

Initial value	20 mm/H
---------------	---------


 Related items → See page 44.

Ref. 3 To return to the display mode
 While setting is being performed, pressing the  key returns to the display mode before entering the setting mode.

8.4 RANGES


This unit is provided with multiple ranges. The type of range and the analog recording range should be set for each pen input (channel).






1) Range mode display Initial values (for voltages) are shown






Parameter section
 Setup indicator
 Character "R" indicates the range parameter.
 Memory colon (Blinks only during memory operation)



2) Setting items and key operations




Setting items
 The following items can be set for each channel:
 ① Range No. (type of range) : 2 digits
 ② CJ select (internal/external selection) : 1 digit
 ③ Analog recording range : Within 11 digits*
 * Within 5 digits +  + within 5 digits




Key operations
 ① For key functions such     press the corresponding key while holding the  key depressed.
 ② When a numeric key is pressed, the cursor will advance to the next digit.

3) Setting procedure

1 Change to the range mode
 ( + )
 The display will change to the range mode.

2 Checking
 
 Range settings for other channels can be checked. (Not available for 1-pen recorders.)
 This procedure may be omitted during setting.

3 Set to the setting mode
 (The bar-graph display goes out and the setting indicator lights.)
 The cursor lights under the leftmost digit the setting (modification) of which is possible.
 ( : To move the cursor to the right.)
 ( : To move the cursor to the left.)

4 Selection of channel No.
  
 Select the channel No.

5 Selection of range No.



For range No.:

- Voltage input → See table 1
- Resistance input → See table 2

6 CJ select



Select whether CJ (reference contact temperature compensation) is used or not.

- Used (required): 1
 - Not used (not required): 0
- Set to "0" for other than thermocouple inputs.

7 Setting of analog recording range



- ① Set the left margin (0% position) of the recording chart within 5 digits.
- ② Press **SHIFT** + **← (-)**
- ③ Set the right margin (100% position) of the recording chart within 5 digits.

8 Temporary registration

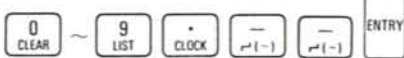


(For 1-pen recorder, skip to step 10.)

When the setting for one channel is completed, be sure to register it temporarily.

With a 1-pen recorder, this operation functions in the same way as step 10 and the display mode is restored.

9 Setting and registration of other channels



For 2-pen and 3-pen recorders, perform setting procedures (from step 4 through 9) in the same way as above. If the same setting is required, use the copy function for easier setting. → See page 37.

10 Registration (memory) of temporarily registered values



(Memory colon blinks and setting change mark is printed.)

The contents registered in step 8 are stored in ROM (memory), and the display mode before entering the setting mode is restored.

4) Checking procedure The current settings can be checked by procedures 1 and 2 in 3) above.

5) Setting example

Example	CH No.	Range Type	Analog Recording Range	Set Value (Display Format)
①	1	DC: -12.5 ~ 12.5 mV	-5 ~ 12mV	A 1050-5 ← 12
②	2	K: -200 ~ 600°C	-100 ~ 500°C	A 2191-100 ← 500
③	3	Pt100: -200 ~ 300°C	50 ~ 250°C	A 354050 ← 250

6) Range selection with current input

- ① Input range is +20 mA.
- ② Since the input signal flows through the input resistor (250 ohms), the short-circuit connectors on the rear of the recorder should be changed to 4 - 20 mA (for each channel).
- ③ Set the range No. and analog recording range by converting the input level to a voltage using the equation [current x 250 ohms].

<Example> For 2 - 10 mA: As the voltage level is 0.5 V - 2.5 V, set the range No. to "12".

Rear of the instrument (short-circuit connectors)



Note 1: Range No. 13 - 15

When range 12.5 V, 25 V, or 60 V DC is selected, change the short-circuit connectors for input type selection to the division ratio of 1/1000.

Note 2: If "clear" is registered

- ① During range setting, if "clear" (**0 CLEAR** + **ENT**) is registered, all the functions of the channel will be canceled (measurement value and bar-graph displays go out and analog recording stops). Also, the settings of scale, alarm, unit and tag will be cleared (as a channel for which no range setting has been set).
- ② When only the channel No. is changed and "clear" is registered, the channel before modification will be processed as above, and the display will show the setting values of the following channel before modification.

Note 3: Channels in which no range setting is performed

For channels in which no range setting has been performed, setting the scale, alarm, unit and tag are not possible. (If executed, a set error (S.E) will occur.)



Ref. 2 Changing the range

When the range of the channel in which the scale and unit are set is changed, the type of range and unit are copied. When the setting is entered without changing the range, the contents will not be copied.

Ref. 4   keys

When pressed, the channel No. will be counted up or down wherever the cursor is positioned, and the contents of the range will be displayed. (This function is not available with a 1-pen recorder.)


Ref. 6 Setting error


When the display blinks when the  key is pressed, a setting error occurs. In this case, press any key other than the  key to stop it blinking, then perform setting again.
→ Refer to "Setting error" on page 21.

Ref. 1 Unit and decimal point in Tables 1 and 2

- ① Unit: The unit for digital printing/recording when list printing and unit setting are not performed.
- ② Decimal point: The number of digits below the decimal point of the measurement value when scale setting is not performed.

Ref. 3 To clear the decimal point or the whole display

 : Press to clear one character such as the decimal point or an unnecessary digit.

 : Press to clear the setting display.

Ref. 5: Initial value and initialization

Input	Range No.	CJ	Analog recording range
Voltage	20 (K)	1 (required)	0 ~ 1200°C
Resistance	52(Pt100)	0 (not required)	-200 ~ 500°C

For initialization, refer to page 44.

Ref. 7 Minimum analog recording range, etc.

Any required range can be set, but the resolution or accuracy will be changed. → See page 61.


During setting or checking, press the  to restore the display mode.

Table 1: Range No. List (For voltages: DC voltage/current, thermocouple input)

Range Type				Range Type				Range Type			
No.	Measuring Range	Unit	Decimal Places	No.	Measuring Range	Unit	Decimal Places	No.	Measuring Range	Unit	Decimal Places
05	DC: -12.5 ~ 12.5 mV	MV	2	18	K: -200 ~ 300°C	°C	1	33	W5: 0 ~ 2320°C	°C	0
06	DC: -25 ~ 25mV	MV	2	19	K: -200 ~ 600°C	°C	1	34	W0: 0 ~ 2320°C	°C	0
07	DC: -60 ~ 60mV	MV	2	20	K: -200 ~ 1370°C	°C	0	35	PR20: 0 ~ 1880°C	°C	0
08	DC: -120 ~ 120mV	MV	1	21	E: -200 ~ 350°C	°C	1	36	PR5: 0 ~ 1800°C	°C	0
09	DC: -200 ~ 200mV	MV	1	22	E: -200 ~ 900°C	°C	0	37	NiMo: 0 ~ 1310°C	°C	0
10	DC: -500 ~ 500mV	MV	1	23	J: -200 ~ 400°C	°C	1	38	AuFe: 0 ~ 300K	K	1
11	DC: -2 ~ 2 V	V	3	24	J: -200 ~ 1100°C	°C	0	39	Platinel: -100 ~ 300°C	°C	1
12	DC: -5 ~ 5 V	V	3	25	T: -200 ~ 250°C	°C	1	40	Platinel: -100 ~ 600°C	°C	1
13	DC: -12.5 ~ 12.5V	V	2	26	T: -200 ~ 400°C	°C	1	41	Platinel: -100 ~ 1390°C	°C	0
14	DC: -25 ~ 25V	V	2	27	R: 0 ~ 1760°C	°C	0	42	U: -200 ~ 250°C	°C	1
15	DC: -60 ~ 60V	V	2	28	S: 0 ~ 1760°C	°C	0	43	U: -200 ~ 450°C	°C	1
				29	B: 400 ~ 1820°C	°C	0	44	U: -200 ~ 600°C	°C	0
				30	NiCr: 0 ~ 350°C	°C	1	45	L: -200 ~ 450°C	°C	1
				31	NiCr: 0 ~ 700°C	°C	1	46	L: -200 ~ 900°C	°C	0
				32	NiCr: 0 ~ 1300°C	°C	0				

Table 2: Range No. list (For resistances: Resistance thermometer input)

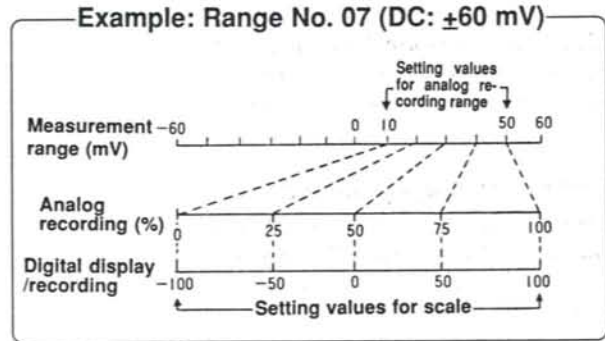
Range Type				Range Type				Range Type			
No.	Measuring Range	Unit	Decimal Places	No.	Measuring Range	Unit	Decimal Places	No.	Measuring Range	Unit	Decimal Places
50	Pt100: -100 ~ 100°C	°C	1	53	JPt100: -100 ~ 100°C	°C	1	56	JPt50: -200 ~ 649°C	°C	1
51	Pt100: -200 ~ 300°C	°C	1	54	JPt100: -200 ~ 300°C	°C	1	57	PtCo: 4 ~ 374K	K	1
52	Pt100: -200 ~ 649°C	°C	1	55	JPt100: -200 ~ 649°C	°C	1				

8.5 SCALE

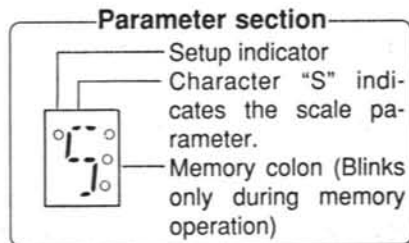
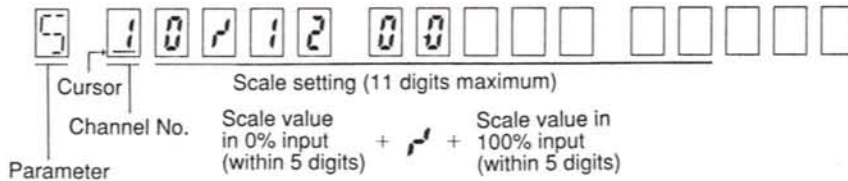
This setting is used to set the scale for the analog recording range. The set value is used by the digital display and digital recording.

In the example on the right, the relationship between the analog recording position and the digital display/recording with respect to the input is as follows:

Input Signal (mV)	-60	0	10	30	50	60	100
Analog Recording (%)	Below lower limit		0	50	100	Above higher limit	
Digital Display/Recording	-450	-150	-100	0	100	150



1) Scale mode display.... Initial values (for voltage) are shown



2) Setting items and key operations

Setting Items

The following items can be set for each channel

- Scale value for analog recording range with 0% input: within 5 digits
- Scale value for analog recording range with 100% input: within 5 digits

Key Operations

- For key functions such $\boxed{4}$ SCALE, $\boxed{-}$ $\boxed{+}$, \boxed{SET} END, $\boxed{0}$ CLEAR, press the corresponding key while pressing \boxed{SHIFT} .
- When a numeric key is pressed, the cursor will be advanced to the next column.
- Scale values can be set from "-9999" to "9999". (The decimal point can be set to any column.)

3) Setting procedure

1 Change to the range mode

$\boxed{4}$ SCALE (\boxed{SHIFT} + $\boxed{4}$ SCALE)

The display will be changed to the scale mode.

2 Checking

$\boxed{\uparrow}$ / $\boxed{\downarrow}$ %

Scale settings for other channels can be checked. (Not available for 1-pen recorders.) This procedure may be omitted when setting.

3 Set to the setting mode

\boxed{SET} END (Bar-graph indicator goes out and setting indicator lights.)

The cursor lights under the leftmost digit the setting (modification) of which is possible.

$\boxed{\rightarrow}$: To move the cursor to the right.)
 $\boxed{\leftarrow}$: To move the cursor to the left.)

4 Selection of channel No.

$\boxed{1}$ CHART $\boxed{2}$ TAG $\boxed{3}$ UNIT

Select the channel No.

5 Scale setting

$\boxed{0}$ CLEAR $\boxed{9}$ LIST $\boxed{\cdot}$ CLOCK $\boxed{+}$ $\boxed{-}$

Set the scale value corresponding to the analog recording range. How to insert the decimal point -> See item 5).

6 Temporary registration

\boxed{ENTRY} (For 1-pen recorders, skip to step $\boxed{8}$.)

When the setting for 1 channel is completed, be sure to register it temporarily. With 1-pen recorders, this operation functions in the same way as step $\boxed{8}$ and the display mode resumes.

7 Setting and registration for other channels



For 2-pen and 3-pen recorders, perform setting procedures (from step 4 through 6) in the same way as above. If the same setting is required, use the copy function for easier setting. → See page 37.

8 Registration (memory) of temporarily registered values



(Memory colon blinks and setting change mark is printed.)

The contents registered in step 6 are stored in ROM (memory), and the display mode before entering the setup mode resumes.

4) Checking procedure Current setting condition can be checked by the procedures 1 and 2 in 3) above.

5) Setting of decimal point

1 For DC voltage/current input

In step 5 of scale setting, set the scale to a value in which the decimal point is indicated.

<Example> Measurement value in range No. 6, analog recording range of 0 - 20 mV with 5 mV input

Scale Setting	Measured Value
None	5.00
-10 ↗ 10	-5
-10.0 ↗ 10.0	-5.0
-10.00 ↗ 10.00	-5.00

2 For temperature inputs

In step 5, set the scale to a value in which the decimal point is indicated.

- To increase the number of digits

<Example>

Range Setting	Scale Setting	Measured Value
K : 0 ~ 1200	0.0 ↗ 1200.0	850.3

- To decrease the number of digits (for values with nothing below the decimal point)

<Example>

Range Setting	Scale Setting	Measured Value	Remark
T : 0 ~ 200	None	120.3	→ "Ref. 2"
	0 ↗ 200	120.3	Note)
	0 ↗ 200.0	120	→ "Note 1"

Note) Because the scale setting has not been changed, the number of decimal places will be the standard for the range. → See Note 1.

Note 1: Rule for setting the decimal point

When the decimal point positions differ for the values of the 0% and 100% inputs, the one with less digits below the decimal point will be valid. To decrease the number of digits for temperature input, use this rule.

<Example>

Scale Setting	Measured Value
0.000 ↗ 100.00	60.00
50.0 ↗ 150.00	60.0
0.00 ↗ 100	60

Note 2: If "clear" is registered

- ① During range setting, if "clear" (0 CLEAR + ENTRY) is registered, the value for range setting will appear (in the same condition as in "Ref. 1"). Setting the unit is done in the same way, while the alarm and tag settings will be cleared (initial value: blank).
- ② When only the channel No. is changed and "clear" is registered, the channel before modification will be processed as above, and the display will show the setting value for the following channel before modification.

Note 3: Scale setting and alarm point

The setting values for alarm points are determined by the value set for the scale. When the scale setting is changed, check the alarm points.

Note 4: Decimal point in range setting (analog recording range)

Although it is copied to the scale, the decimal point will be ignored and that listed in Tables 1 and 2 on page 26 will be used. To change it, refer to "Ref. 9".

Ref. 1 Range setting and scale

When the range setting is performed, the registered values are copied for the scale. Since the voltage (mV, V) range will be scaled at the registered value, scale setting will be required.

<Example> When range No. 06 and a range of 0 - 20 mV are registered, the scale will be set from 0 - 20 mV.

Ref. 2 Scale for temperature input

Since the range setting value (range) is copied, scale setting is not required. However, to change the decimal point shown in Tables 1 and 2 on page 26, refer to item 5).

Ref. 3 0% input, 100% input

0% input: Set the value for the left end of the analog recording range (left of recording chart)

100% input: Set the value for the right end of the analog recording range (right of recording chart)

Ref. 4 Initial value and initialization

Input	Scale range
Voltage	0 ~ 1200
Resistance	-200 ~ 500

For initialization, refer to page 44.

Ref. 5 Setting error

When the display blinks when the is pressed, it indicates that a setting error has occurred. In this case, press any key other than the key to stop it blinking, then perform setting again.
→ Refer to "Setting error" on page 21.

Ref. 6 To return to the display mode

Press the key to return to the display mode during setting or checking.

Ref. 7 To clear the decimal point or the whole display

: Press to clear one digit such as the decimal point or an unnecessary digit.
: Press to clear the whole setting display.

Ref. 8 keys

When pressed, the channel No. will be advanced upward or downward whatever the position of the cursor, and the details of the scale will be displayed.
(This function is not available with 1-pen recorders.)

Ref. 9 Changing the decimal point after copying

Change the decimal point temporarily, and perform setting again.
<Example> Range: R010500.0 → 10.0
Scale (copy) : 0.0 → 10.0
Temporary setting : 0.0 → 10
Re-setting : 0.0 → 10.0

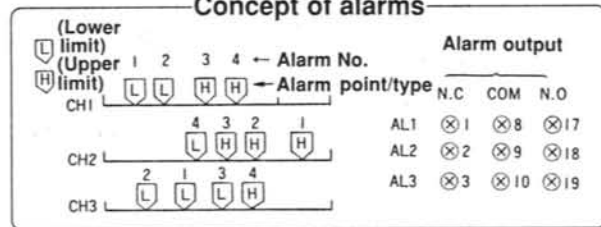
8.6 ALARMS

① Number of alarms (alarm points)

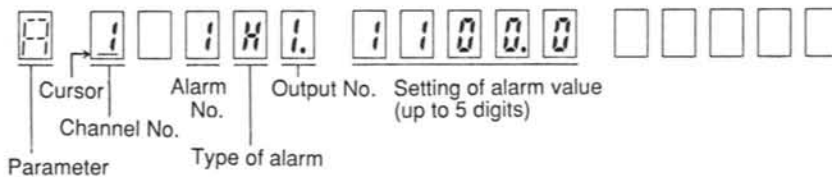
Up to four alarm points are available for each channel, and alarms can be set at any point between the upper and lower limits. A total of 8 points are available with 2-pen recorders and a total of 12 points are available with 3-pen recorders.

② There are three alarm output points. Any alarm can be output from any of these alarm output points. Each time an alarm occurs, an alarm output is generated.

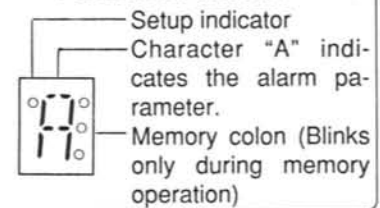
Concept of alarms



1) Alarm mode displayInitial value: "H" only



Parameter section



2) Setting items and key operation

Setting Items

The following items can be set within the values below for each alarm point:

- Channel No.: 1 digit
- Alarm No.: 1 digit
- Type of alarm: 1 digit
- Output No.: 1 digit
- Alarm value: 5 digits

Key Operations

- For key functions such as , , , press the button while holding the key depressed.
- When the numeric key is pressed, the cursor will be shifted to the next digit.

3) Setting procedure

① Change to the alarm mode



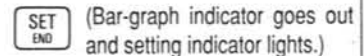
Display will be changed to the alarm mode.

② Checking



Alarm settings for other channels can be checked. All the alarm points currently set will be displayed sequentially.
This procedure may be omitted when setting.

③ Set to the setting mode



The cursor lights under the leftmost digit the setting (modification) of which is possible.
(): To move the cursor to the right.)
(): To move the cursor to the left.)

4 Selection of channel No.

1 CHART 2 TAG 3 UNIT

Select the channel No.

5 Selection of alarm No.

1 CHART ~ 4 SCALE

Up to four points can be specified for each channel. This designation is required to differentiate between alarm points.

6 Selection of type of alarm

▲ / ▼ % ("H" and "L" are displayed alternately.)

Select the alarm type between upper limit (H) or lower limit (L).
 [H] : Upper limit alarm
 [L] : Lower limit alarm

7 Selection of output No.

1 CHART 2 TAG 3 UNIT (For [0], refer to "Reference 10".)

Select the output No from which the alarm signal is to be output. If "0" is selected, no signal will be output but the alarms will be displayed. Even if "0" is selected, printing takes place when alarms occurs and are canceled.

8 Setting of alarm value

0 CLEAR ~ 9 LIST . CLOCK - (-)

Set the required alarm value within 5 digits. When the scale setting has been performed, set using the scaled value.

9 Temporary registration

ENTRY (When pressed, the next alarm point display will appear.)

When the setting of 1 alarm point is completed, be sure to register it temporarily.

10 Setting and registration of other alarm points

0 CLEAR ~ 9 LIST . CLOCK - (-) ▲ / ▼ % ENTRY

In the same way, set the other alarm points (from steps [4] to [9]).

11 Registration (memory) of temporarily registered data

SET END (Memory colon blinks and setting change mark is printed.)

The values registered in step [9] are stored in ROM (memory) and the display mode before entering the setup mode resumes.

4) Check procedure Current setting condition can be checked by procedures [1] and [2] in 3) above.

5) Setting examples

Ex-ample	CH No.	Range Setting		Scale Setting	Alarm No.	Alarm Type	Output No.	Alarm Value	Alarm Setting
		No.	Analog Recording Range						
①	1	06	-10 ~ 10	0 ~ 1000	2	Higher	1	5mV*	A1 2H1750
②	2	06	0 ~ 20	0 ~ 1000	3	Lower	1	250	A2 3L1250
③	2	06	-5 ~ 25	0 ~ 1000	1	Higher	1	10mV*	A2 1H1500

* When scale setting is performed, alarm values will not effective for the analog recording range. Refer to "Note 3" on page 26.

Note 1: If "clear" is registered

- ① During range setting, if "clear" ([0 CLEAR] + [ENTRY]) is registered, the alarm for this alarm point does not operate.
- ② When only the channel No. or alarm No. is changed and "clear" is registered, the alarm point before modification will be cleared as above, and the display will show the setting values of the alarm No. of the following channel before modification.

Note 2: When "clear" is registered during scale setting:

During scale setting, if "clear" is registered, all the alarm settings for the corresponding channel will be canceled, and re-setting will be required.

Ref. 1 Alarm No.

Up to four alarm points can be set for one channel. To distinguish between them, an alarm No. can be added. No restriction applies to numbering or order.

Ref. 2 Alarm type

Two types of alarm are available; upper limit alarms and lower limit alarms. Either can be selected for each alarm point.

Ref. 3 OR output

Two or more alarm outputs can be set for a single output No. When an alarm occurs at any point, an alarm signal will be output to the specified output No.

Ref. 4 Display order

When checking the alarm settings using the keys, the alarm settings will be shown in alarm No. order. Press the key to count up the number and press the to count down.

Ref. 5 Initial value and initialization

Initial value Only "H" is shown*
For the initialization operation, refer to page 44.
* In this case, only H (upper limit) alarms are set, and others are blank.

Ref. 6 To return to the display mode,

Press the key to return to the display mode during setting or checking.

Ref. 7 Alarm printing

When an alarm occurs or is canceled (normal condition), it is printed on the left of the chart.

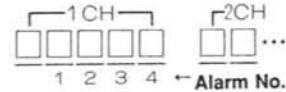
Occurrence	08:45 1L2
Cancellation	13:20 3-1

Related items → See page 18.

Ref. 8 Output format

Contact capacitance: 100 V AC 0.5 A
200 V AC 0.2 A
Output points: 3 points, standard
(Up to 6 points are available as an option.)

Ref. 9 Alarm display



The channel No. appears while the alarm No. blinks.

Ref. 10 Display only

When alarm output signals are not necessary and only the alarm display is required, set the output No. to "0". If this is done, alarm printing will be performed.

Refer to procedure [7].

Ref. 11 How to cancel an alarm

Alarms are not canceled unless the measurement value becomes within the normal range again, or the alarm point setting is changed.

Ref. 12 To clear the decimal point or the whole display

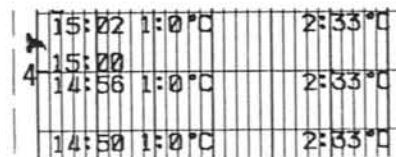
: Press to clear one character such as the decimal point or an unnecessary digit.
 : Press to clear the whole setting display.

8.7 FIXED TIME INTERVAL DIGITAL RECORDING

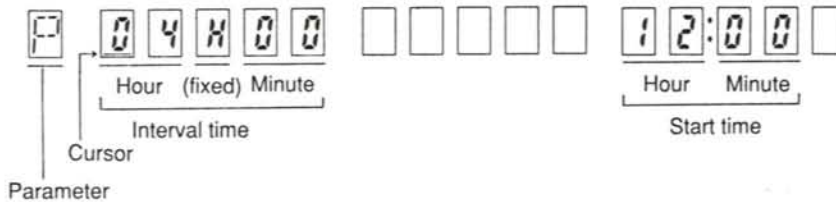
This function allows digital recording at fixed intervals. Since the starting time (24-hour format) can be set, digital recording is possible at a fixed interval from any required time.

In digital recording, (1) the present time, (2) channel No. and (3) measurement value are printed, in this order.

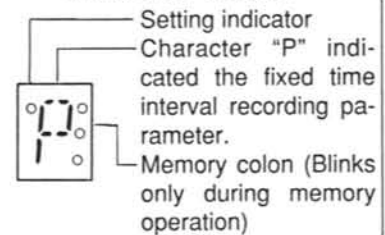
Recording example



1) Fixed time interval Digital Recording display ... Initial values are blank.



Parameter section



2) Setting items and key operations

Setting Items

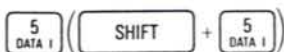
- Interval time : 4 digits
- Start time : 4 digits (24-hour system)

Key Operations

- For key functions such as press the button while pressing the key.
- When a numeric key is pressed, the cursor will be shifted to the next digit.

3) Setting procedure

1 Change to the fixed time interval recording mode




The display will change to the fixed time interval recording mode.


2 Set to the setting mode



(Bar-graph indicator goes out and setting indicator lights.)

The cursor lights under the leftmost digit the setting (modification) of which is possible.

(): To move the cursor to the right.)

(): To move the cursor to the left.)

3 Setting of interval time



The interval time should be set from 5 minutes (minimum) to 24 hours (maximum). However, if the minimum time is set, the chart speed will be limited. → Refer to "Note 1".

4 Setting of start time



Set the start time in the 24-hour format.

The setting range is from 00 hour 00 minute to 23 hours 59 minutes.

5 Registration (memory)



(Memory colon blinks and setting change mark is printed.)

When registration into ROM is completed, the display mode before entering the setup mode will resume.

4) Checking procedure Current setting condition can be checked by procedure 1 in 3) above.

Note 1: Setting condition of interval time

When the minimum time is set, the chart speed will be limited as follows:

$$T \geq \frac{10}{CS} (H)$$

(T: Interval Time CS: Chart Speed (mm/H))

However, at the minimum time interval, 5 minutes (1/12H) will have priority.



Example 1: CS = 20 mm/H

$\frac{10}{20} = 0.5 H$ (42 minutes),
Setting should be more than 42 minutes.

Example 2: CS = 200 mm/H

$\frac{10}{200} = 0.05 H$ (4.2 minutes),
As the minimum time is limited to 5 minutes, the setting should be more than 5 minutes.

Note 2: If "clear" is registered

① During range setting, if "clear" ( + ) is registered, fixed time interval digital recording will not be performed.

Note 3: Change of chart speed

When the chart speed is changed, the contents of the fixed time interval digital operation in memory will be cleared. Set it again if required.

Note 4: When the power is turned OFF due to a power cut, etc. → Is the time for fixed time interval digital recording changed?

① Not changed	When power is restored within the next day → Re-setting not required
② Changed	When the power is restored after the next day and the value "24/interval time" is not an integer. → Re-setting required.

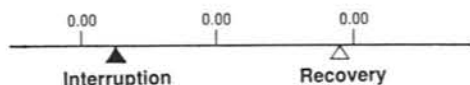
<Reference 1> When "24/interval time" is an integer:

Hour:Minute	1: 00	1: 12	1: 20	1: 30	1: 36	2: 00	2: 20	2: 40								
	3: 00	4: 00	4: 48	6: 00	8: 00	12: 00	24: 00		48							
Minute	5	6	8	9	10	12	15	16	18	20	24	30	32	36	40	45

When an interval time in the above chart is selected, the setting time will not be changed.

<Reference 2> Relationship between interruption/recovery and whether resetting is required or not

Re-setting not required



Regardless of the interval time

Re-setting required



With the above condition and an interval time other than covered by <ref. 1>.

Ref. 1 Interval time

This is the interval between digital recording. It can be set in 1-minute steps.

Setting of "60 minutes" is impossible; in this case, set as "1 hour".

For conditions, refer to "Note 1".

Ref. 2 Start time

This is the starting time of digital recording. It can be set from 00:00 to 23:59, in 1-minute steps.

If a time before the present time is set, digital recording will start from the next day.

Ref. 3 Initial value and initialization

Initial value	Blank
---------------	-------

For initialization, refer to page 44.

Ref. 4 To return to the display mode

To return to the display mode during setup, press the



Ref. 5 To clear the display

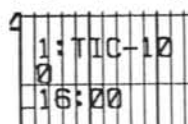
Press to clear the whole display in the setting section.

8.8 TAGS

Tags can be set for each channel. The details of tags will be printed when digital printing or list printing is performed so that the inputs being measured/recorded can be checked.

Printing example

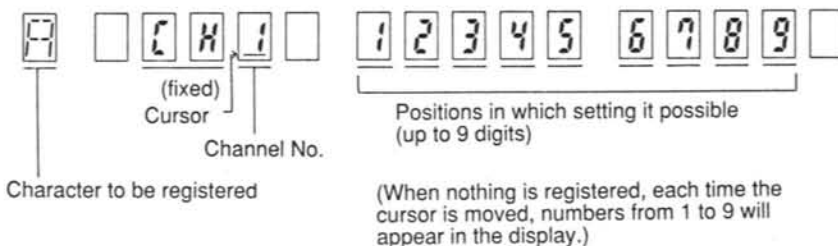
(Digital printing)



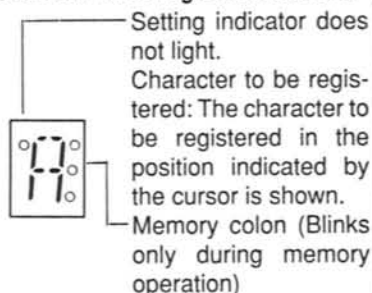
(List printing)



1) Tag mode displayInitial values are blank.



Character to be registered section.



2) Setting items and key operations

Setting Items

The following can be set for any required channel:

- Tag setting characters: Within 9 digits

Key Operations

- For key functions such as press the button while pressing the .
- Designate the position of the character to be set with the cursor keys .

3) Characters that can be set

Numerals	0 ~ 9, —	
Letters	A ~ Z	(A → B → C.....) (A → Z → Y.....) 6/A-Z to change from numerals to letters.
Other	←, %, /, °C, °F	← (Space): , %, /, °C, and °F should be pressed with held depressed.

°C and °F are regarded as 2 digits. Therefore, they cannot be used as the ninth digit.

4) Setting procedure

1 Change to the tag mode

2 TAG (SHIFT) + 2 TAG

The display will be changed to the tag mode.

2 Checking

↑ ↓ → ←

① Select the channel No. with the ↑ ↓ .

② Move the position (indicated by the decimal point) with → ← , and check the setting

3 Set to the setting mode

SET END (Bar-graph goes out.)

The cursor lights under the channel No. The digit indicated by the cursor can be set (modified).

(→) : To move the cursor to the right.
(←) : To move the cursor to the left.)

4 Setting of interval time

1 CHART 2 TAG 3 UNIT

Select the channel No.

5 Setting of tag characters

Refer to possible characters.

① Move the cursor so that is under the first digit to be set, and press the required character key. (Check the character to be registered in the display.)

② Set the characters after the second digit in the same way.

6 Temporary registration

ENTRY (With 1-pen recorders, step 8 will enter the data.)

After the setting for one channel is completed, be sure to store it temporarily.

With 1-pen recorders, the operation will be the same as in step 8, and the display mode will resume.

7 Setting and registration of other channels

Same as steps 4 to 6.

When tag settings of other channels are required with 2-pen or 3-pen recorders, set the tag for other channels in the same way, with steps 4 through 6. If the same settings are required, use the "copy" function for simpler operation. → See page 37.

8 Registration of temporarily registered data

SET END (Memory colon blinks and setting change mark is printed.)

The contents registered in step 6 will be stored in ROM, and when the operations are completed, the display before entering the setup mode will resume.

5) Checking procedure Current setting condition can be checked by procedures 1, 2 in 4) above.

6) Setting example (Key operation example. Cursor key is omitted.)

①	Before setting : MV	▲ (7 times) + ▲ (12 times) + ▲ (3 times) + □ + 1 + 0
	Set characters: TIC-10	T I C - 1 0
②	Before setting : TIC-10□A	CLEAR + ▼ (3 times) + ▼ (2 times) + □ + 2
	Set characters: XY-2	All digits blank X Y - 2
③	Before setting : T5C-10AB	CLEAR + (□ only) + ▲ (2 times) + □ + 1 + 5 + / + 2 + 0
	Set characters: AB-15/20	All digits blank A B - 1 5 / 2 0

Note 1: If "clear" is registered

- ① During range setting, if "clear" (CLEAR + ENTRY) is registered, tag printing will not be performed for the corresponding channel.
- ② When only the channel No. is changed and "clear" is registered, the channel before modification will be processed as above, and the display shows the setting of the following channel before modification.

Note 2: When "clear" is registered during scale setting:

During scale setting, if "clear" is registered, the tag setting will also be cleared. Re-set the tag if required.
→ See page 28

Ref. 1 To clear all digits

Press to cancel the display of all digits. Use this function to reduce the number of digits, etc.

Ref. 2 To reduce the number of digits

- ① If unnecessary characters are cleared with the key, they are dealt with as "spaces". The digits defined as "spaces" will appear when checking.
- ② When all the digits are cleared with the key and setting is done from the first digit, the unnecessary digits will be canceled.

Ref. 3 What is a tag?

A name attached to a channel for identification.

Ref. 4 Initial value and initialization

Initial value	Blank
---------------	-------

For the initialization operation, refer to page 44.

Ref. 5 To return to the display mode,

Press the key to return to the display mode during setting or checking.

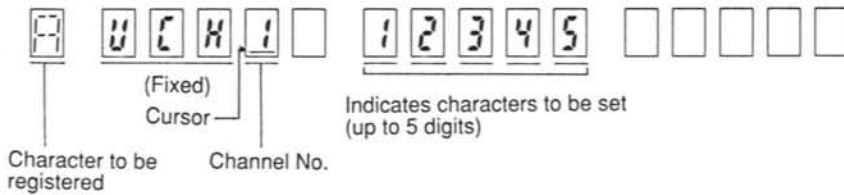
8.9 UNIT

Units can be set for each channel individually. When the units are set, they will be printed on the recording chart when digital recording/printing or list printing is performed. However, in digital recording, only the first 2 digits will be printed.

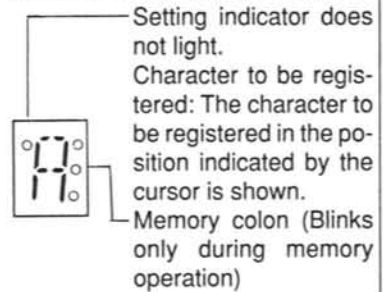
Printing example



1) Unit mode displayInitial values are blank



Character to be registered section



2) Setting items and key operations

Setting Items

The following items can be set for each channel:

- ① Unit setting character: Within 5 digits

Key Operations

- ① For key functions such as press the button while pressing the key.
- ① Designate the position where the character is to be placed using the cursor keys .

3) Characters that can be set

Numerals	0 ~ 9, —	[0] ~ [9] [—]
Letters	A ~ Z	[A] (A → B → C……) [Z] (A → Z → Y……) 6/A- to change from numerals to letters. [x]
Other	□, %, /, °C, °F	□ (Space): [SPACE], %, /, °C, and °F should be pressed with [SHIFT] held depressed.

Since “°C” and “°F” are handled as 2 digits, they cannot be used as the 5th digit.

4) Setting procedure

1 Change to the unit mode

[3] UNIT ([SHIFT] + [3] UNIT)

The display will change to the unit mode.

2 Checking

[↑] [↓] [→] [←]

- Select the channel No. with the [↑] [↓] keys.
- Move the digit position (indicated by the decimal point) with the [→] and [←] keys, and check in the setting character display.

3 Set to the setting mode

[SET] [END] (Bar-graph goes out.)

The cursor lights under the channel No. The digit indicated by the cursor can be set (modified).
 ([→] : To move the cursor to the right.)
 ([←] : To move the cursor to the left.)

4 Setting of channel No.

[1] CHART [2] TAG [3] UNIT

Select the channel No.

5 Setting of unit character

Refer to characters that can be set.

- Move the cursor to the first digit to be set, and press the required character key. (Check in the setting character display section.)
- Set the second and later characters in the same way.

6 Temporary registration

[ENTRY] (With 1-pen recorders, step [8] will enter the setting.)

After the setting for one channel is completed, be sure to store temporarily.
 With 1-pen recorders, the procedure will be the same as in step [8], and the display mode will resume.

7 Setting and registration of other channels

Same as steps [4] to [6].

When tag setting for other channels are required with 2-pen or 3-pen recorders, set the tags for other channels in the same way as steps [4] through [6]. If the same setting contents are required, use the “copy” function for simpler operation. → See page 37.

8 Registration of temporarily registered data

[SET] [END] (Memory colon blinks and setting change mark is printed.)

The contents registered in step [6] will be stored in ROM, and when the operations are complete, the display before entering the setup mode will resume.

5) Checking procedure The setting condition can be checked by procedures [1], [2] in 3) above.

6) Setting example (Key operation example. Cursor key is omitted.)

① ppm	Before setting : MV	[A] (3 times) + [Z] (6 times) + [A] (12 times)
	Set characters: PPM	P P M
② kg/cm ²	Before setting : G/CM2	[A] (4 times) + (After this, operations are not required.)
	Set characters: K/CM2	K

Example② shows the setting when “g” is omitted to reduce the number of digits because there would be 6 digits.

Note 1: If "clear" is registered

- ① During range setting, if "clear" (+) is registered, the unit will not be printed for the corresponding channel.
- ② When only the channel No. is changed and "clear" is registered, the channel before modification will be processed as above, and the display shows the setting of the following channel before modification.

Note 2: When the range is changed

When the range setting is changed, the registered unit will be cleared and the unit which has the same contents as the range setting will be copied.
→ Refer to Table 1 and Table 2 on page 26.

Note 3: When "clear" is registered during scale setting:

During scale setting, if "clear" is registered, the unit setting will also be cleared, and the same unit as the range setting will be copied.
→ Refer to Table 1 and Table 2 on page 26.

Note 4: Unit printing conditions

When unit is printed:

- ① Digital recording : Top two digits .
② Digital printing : From the rightmost digit
③ List printing : From the leftmost digit

Unit Setting Characters	Digital Recording	Digital Printing	List Printing
	○○○ PP	PPM	PPM
	○○○ PP	PPM	PPM
	○○○	PPM	PPM
□ : Set a space.			

Ref. 1 To clear all digits

Press to cancel the display for all digits. Use this function to reduce the number of digits, etc.

Ref. 2 To reduce the number of digits

- ① If unnecessary digits are cleared with the key, they are printed as "spaces" but will still be shown in the display.
- ② When all the digits are cleared with the key and setting is done from the first digit, unnecessary digits will be canceled.

Ref. 3 Initial value and initialization

Initial value	°C
---------------	----

For the initialization operation, refer to page 44.

Ref. 4 To return to the display mode,

Press the key to return to the display during setting or checking.

Ref. 5 keys

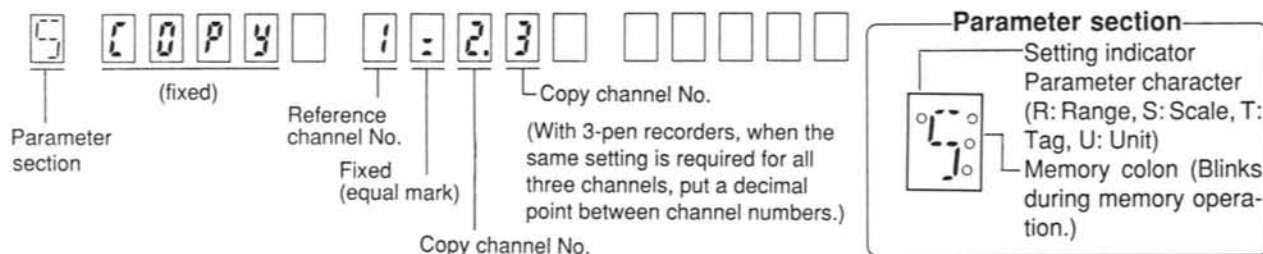
These keys are handled as unit characters. No conversion is performed. For related items, refer to page 38.

8.10 COPY FUNCTION

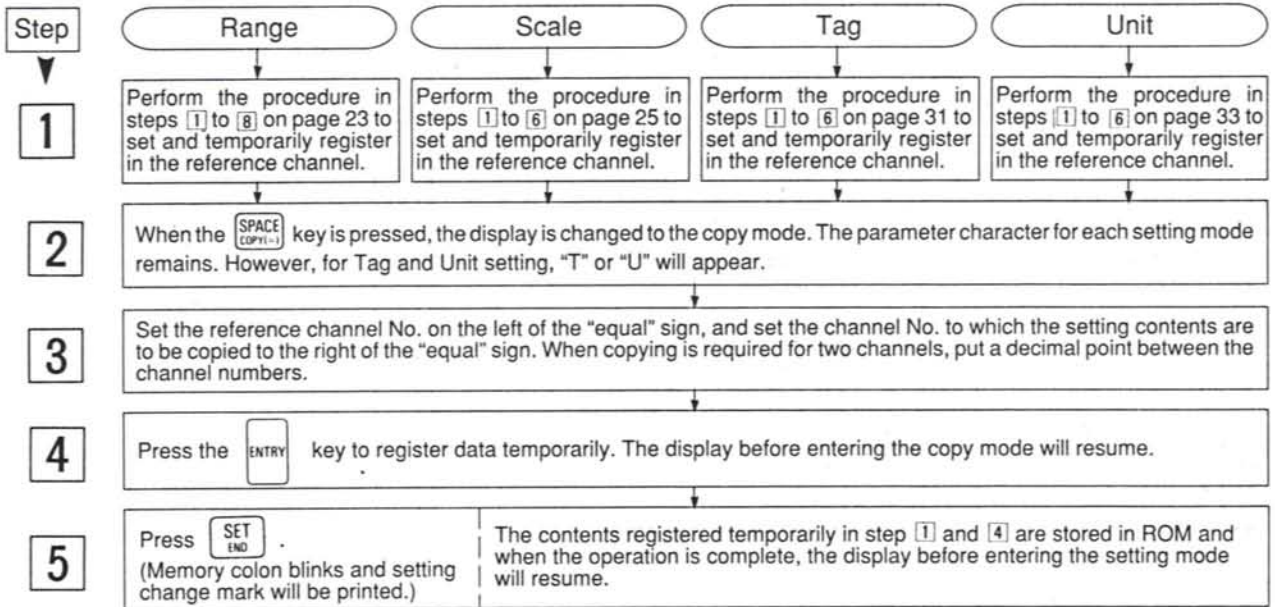
- ① It is convenient to use the "copy function" when the same settings are to be used for another channel.
- ② The copy function is available for the four parameters (a: Range, b: Scale, c: Tag, d: Unit) which are set for each channel independently, but not for "Alarms".

1) Copy mode display

(Example: When copying the contents of channel 1 to channels 2 and 3 in scale setting.)



2) Setting procedure



Note 1: Copying a channel with no range setting

When the copy function is used for Scale, Tag or Unit parameters, if a channel No. (to which settings are to be copied) in which no range setting has been done is set to the right of the "equal" sign, it will cause a Set Error (S.E). For a channel with no range setting, refer to item 7.12 (on page 19).

Note 2: When the copy function is used for Unit or Tag

The parameter character display will be changed to "T" or "U" respectively.

8.11 °C/°F SELECTION

- When a thermocouple or resistance thermometer input is used, the unit is set as "°C". If "°F" is required, use the following conversion equation.
- Conversion between °C and °F

$$^{\circ}\text{C} = \frac{5}{9}(\text{°F} - 32) \quad \text{°F} = \frac{9}{5} \times \text{°C} + 32$$

1) How to switch over

Switch over with the DIP switch located on the right side of the rack.

- Turn the power switch OFF. → Refer to "Reference 2".
- Set DIP switch No. 5 to ON (down).
- Turn the power switch ON.

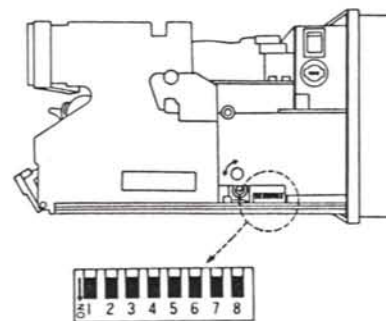
Note 1: Range for "K" unit

For ranges No. 38 (AuFe) and No. 57 (Pt-Co), the above operations do not apply because they indicate absolute temperature (K).

Ref. 1 To return to °C

In step ② of the above switching procedure, set the switch to OFF, and perform in the same way.

DIP switch setting for upper limit and lower limit alarms



No. 5: OFF for °C, ON for °F

Note 2: Relationship with unit setting

The above conversion is not performed even if "°F" is used for the unit setting (page 33). It is only for printing.

Ref. 2 Checking the DIP switch setting

Checking is performed only when the power is turned ON. Therefore, it will not be switched if the switch setting is changed during operation.

2) Measurement range list for °F (Fahrenheit)

For the measurement range list for °C (Centigrade), refer to page 26.

Range Type				Range Type				Range Type			
No.	Measuring Range	Unit	Decimal Point	No.	Measuring Range	Unit	Decimal Point	No.	Measuring Range	Unit	Decimal Point
18	K : -300 ~ 550	*F	1	33	Ws : 32 ~ 4200	*F	0	50	Pt100 : -100 ~ 200	*F	1
19	K : -300 ~ 1100	*F	1	34	Wo : 32 ~ 4200	*F	0	51	Pt100 : -300 ~ 550	*F	1
20	K : -300 ~ 2450	*F	0	35	PR ₂₀ : 32 ~ 3400	*F	0	52	Pt100 : -300 ~ 1200	*F	1
21	E : -300 ~ 650	*F	1	36	PR ₅ : 32 ~ 3250	*F	0	53	JPt100 : -100 ~ 200	*F	1
22	E : -300 ~ 1650	*F	0	37	NiMo : 32 ~ 2350	*F	0	54	JPt100 : -300 ~ 550	*F	1
23	J : -300 ~ 750	*F	1	38	AuFe : 0 ~ 300	K	1	55	JPt100 : -300 ~ 1200	*F	1
24	J : -300 ~ 2000	*F	0	39	Platinel : -100 ~ 550	*F	1	56	JPt150 : -300 ~ 1200	*F	1
25	T : -300 ~ 450	*F	1	40	Platinel : -100 ~ 1100	*F	1	57	Pt-Co : 4 ~ 374	K	1
26	T : -300 ~ 750	*F	1	41	Platinel : -100 ~ 2500	*F	0				
27	R : 32 ~ 3200	*F	0	42	U : -300 ~ 450	*F	1				
28	S : 32 ~ 3200	*F	0	43	U : -300 ~ 800	*F	1				
29	B : 800 ~ 3300	*F	0	44	U : -300 ~ 1100	*F	0				
30	NiCr : 32 ~ 650	*F	1	45	L : -300 ~ 800	*F	1				
31	NiCr : 32 ~ 1250	*F	1	46	L : -300 ~ 1650	*F	0				
32	NiCr : 32 ~ 2350	*F	0								

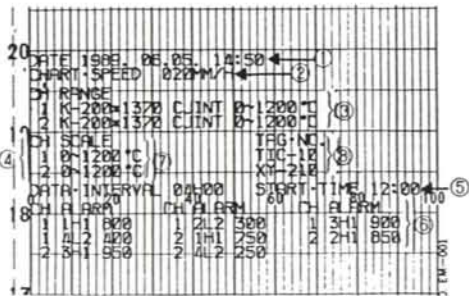
<Note 1> "Unit" in the above list is that used in digital printing/recording when list printing and unit setting are not performed.

<Note 2> "Decimal point" shows the number of digits below the decimal point of the measurement value when no scale setting is done.

9. DIGITAL RECORDING/PRINTING FORMATS

<p>Fixed time interval digital recording</p>		<p>The data is printed in black on the analog chart at a fixed interval time which has been set previously. (If the interval time is not set, this is not performed. For the checking of the setting contents, refer to page 31.)</p> <table border="1"> <thead> <tr> <th>①</th> <th>②</th> <th>③</th> <th>④</th> </tr> </thead> <tbody> <tr> <td>Time</td> <td>Channel No.</td> <td>Data recording</td> <td>Unit (top two digits)</td> </tr> </tbody> </table>	①	②	③	④	Time	Channel No.	Data recording	Unit (top two digits)								
①	②	③	④															
Time	Channel No.	Data recording	Unit (top two digits)															
<p>On-demand digital recording</p>		<p>When the DATA PRINT key is pressed, the latest data will be recorded instantaneously. For related items, refer to page 17.</p> <table border="1"> <thead> <tr> <th>①</th> <th>②</th> <th>③</th> <th>④</th> </tr> </thead> <tbody> <tr> <td>Time</td> <td>Channel No.</td> <td>Data recording</td> <td>Unit (top two digits)</td> </tr> </tbody> </table>	①	②	③	④	Time	Channel No.	Data recording	Unit (top two digits)								
①	②	③	④															
Time	Channel No.	Data recording	Unit (top two digits)															
<p>Alarm printing</p>	<p>Alarm printing has a over digital printing. If an alarm occurs during digital printing, the alarm is printed and the right side of the digital printing will be omitted.</p>	<p>When an alarm occurs or it is canceled, alarm printing is performed on the right of the chart. For related items, refer to page 18.</p> <p>When an alarm occurs</p> <table border="1"> <thead> <tr> <th>①</th> <th>②</th> <th>③</th> <th>④</th> </tr> </thead> <tbody> <tr> <td>Alarm time</td> <td>Channel No.</td> <td>Alarm type (H: upper limit, L: lower limit)</td> <td>Alarm No.</td> </tr> </tbody> </table> <p>When an alarm is canceled</p> <table border="1"> <thead> <tr> <th>⑤</th> <th>⑥</th> <th>⑦</th> </tr> </thead> <tbody> <tr> <td>Cancellation time</td> <td>Channel No.</td> <td>Alarm No.</td> </tr> </tbody> </table> <p>("-" will be inserted between (6) and (7).)</p>	①	②	③	④	Alarm time	Channel No.	Alarm type (H: upper limit, L: lower limit)	Alarm No.	⑤	⑥	⑦	Cancellation time	Channel No.	Alarm No.		
①	②	③	④															
Alarm time	Channel No.	Alarm type (H: upper limit, L: lower limit)	Alarm No.															
⑤	⑥	⑦																
Cancellation time	Channel No.	Alarm No.																
<p>Digital printing (fixed time interval printing)</p>	<p>Example of printing (when two or more items are printed at the same time).</p>	<p>The following items are printed at a fixed time interval depending on the chart speed. Four print formats are available in fixed time interval recording, in each of which different items are printed. For details, refer to page 42.</p> <table border="1"> <thead> <tr> <th>①</th> <th>②</th> <th>③</th> <th>④</th> </tr> </thead> <tbody> <tr> <td>Fixed time</td> <td>Time</td> <td>Chart speed</td> <td>Scale (corresponding to 0% input)</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th>⑤</th> <th>⑥</th> <th>⑦</th> <th>⑧</th> </tr> </thead> <tbody> <tr> <td>Scale (corresponding to 100% input)</td> <td>Channel No.</td> <td>Tag</td> <td>Unit</td> </tr> </tbody> </table> <p>Reference Full printing for one channel No. When the tag (7) is not registered and the values for scale (4) (5) and unit (8) are the same, the settings for the specified channel No. (6) will be printed in one operation.</p>	①	②	③	④	Fixed time	Time	Chart speed	Scale (corresponding to 0% input)	⑤	⑥	⑦	⑧	Scale (corresponding to 100% input)	Channel No.	Tag	Unit
①	②	③	④															
Fixed time	Time	Chart speed	Scale (corresponding to 0% input)															
⑤	⑥	⑦	⑧															
Scale (corresponding to 100% input)	Channel No.	Tag	Unit															
<p>Setting change mark</p>		<ol style="list-style-type: none"> When a parameter setting is changed, the setting change mark will appear on the right of the chart. When the setting change mark is not printed, the setting conditions will not be stored in ROM, and the settings immediately before printing will continue to be used. 																

List printing



If all the parameter settings are to be printed on the recording chart at the same time, press the 9
LIST key to start list printing.

For related items, refer to page 17.

No.	Item (details)
①	Clock
②	Chart speed
③	Range (for each channel)
④	Scale (for each channel)
⑤	Fixed time interval digital recording*
⑥	Alarm (for each channel/level)*
⑦	Unit (for each channel)
⑧	Tag (for each channel)*

* These items are printed only when the parameters are registered. "Unit" and "Tag" are printed on the "Scale" line.

Reference: Details of list printing

1) Clock

DATE 1989.06.05.14:50

Meaning: 14:50, June 5th, 1989

2) Chart speed

CHART SPEED 020MM/H (Standard)

External drive (3-step chart speed selection) format (optional)
 CHART-SPEED 1:020MM/H 3:150MM/H
 (CS 1:20mm/H, CS2:50mm/H, CS3:150mm/M)

3) Range

CH RANGE
 1 K-200x1370 CJINT 0~1200°C
 2 K-200x1370 CJINT 0~1200°C

① Channel No. ② Range type
 ③ CJ internal/external select (ROOT: Extraction of square root)
 ④ Analog recording range

4) Scale (unit, tag)

CH SCALE TAG NO.
 1 0~1200°C TIC-10
 2 0~1200°C XM-210

① Scale range ② Unit ③ Tag*
 * When not registered, only "TAG NO." is printed.

5) Fixed time interval recording

DATA INTERVAL 00:00
 START TIME 12:00

① Interval time ② Start time
 (Printing is performed only when this function is engaged.)

6) Alarm

CH ALARM CH ALARM
 1 1H1 800 2 2L2 300
 1 1L2 400 2 2H1 750
 2 3H1 950 2 2L2 250

① Channel No. ② Alarm No. ③ Alarm type
 ④ Output NO. ⑤ Alarm value
 When any one of the settings (for only 1 alarm point), "ALARM" will be printed on the third line.
 (No details will be printed if nothing has been registered.)

7) Time-axis synchronization (optional)

TIME AXIS SYNCHRONIZING OFF

When the time-axis synchronization option is added, the DIP switch setting will be printed (function ON/OFF). Refer to page 60.

10. RELATIONSHIP BETWEEN CHART SPEED AND DIGITAL PRINTING

10.1 RELATIONSHIP BETWEEN CHART SPEED AND DIGITAL PRINTING

The items printed differ depending on the chart speed.

Printing Type Chart Speed (mm/H)	1	2	3	4
		① CH No., ② Tag, ③ Scale, ④ Unit, ⑤ Time, ⑥ Time line, ⑦ Chart speed	① Chart speed, ② Time, ③ Time line	Time line only
1 ~ 9	—	Only 12:00	Every 6 hrs.	At power ON, at 00:00
10 ~ 15	Every 4 hrs.	—	Every 2 hrs.	At power ON, at 00:00
16 ~ 30	Every 4 hrs.	Every 2 hrs.	Every hour	At power ON, at 00:00
31 ~ 60	Every 2 hrs.	Every hour	—	At power ON, at 00:00
60 ~ 119	Every hour	—	Every 30 min.	At power ON, at 00:00
120 or more	Every 30 min.	—	—	At power ON, at 00:00

- ① The printing interval should be entered as a specified time.
- ② Year/month/date printing is performed at 00:00 regardless of the chart speed.
- ③ The channel No. will be printed at the above interval, for each channel separately when the scale and unit have the different values or when a tag setting is registered. (In order from the lowest channel No.)
- ④ When the chart speed exceeds 300 mm/H, only the time will be printed.

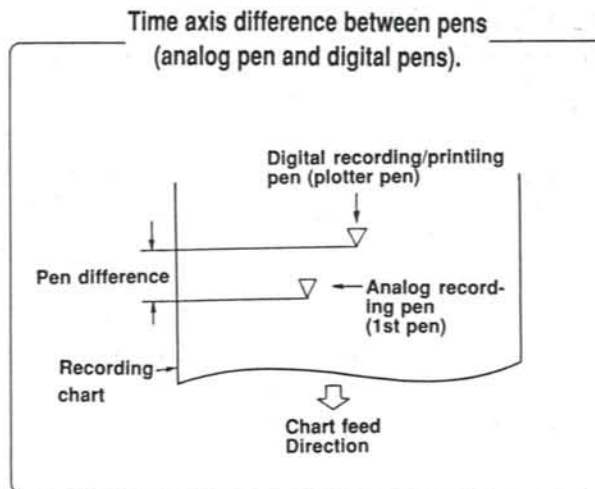
Reference: Timing and digital printing items at different chart speeds

Printing Type Time	Chart Speed (mm/H)						
	1 ~ 9	10 ~ 15	16 ~ 30	31 ~ 60	61 ~ 119	120 ~ 300	300 ~
00 : 00	3,4	1,4	1,4	1,4	1,4	1,4	3
00 : 30	—	—	—	—	3	1	3
01 : 00	—	—	3	2	1	1	3
01 : 30	—	—	—	—	3	1	3
02 : 00	—	3	2	1	1	1	3
02 : 30	—	—	—	—	3	1	3
03 : 00	—	—	3	2	1	1	3
03 : 30	—	—	—	—	3	1	3
04 : 00	—	1	1	1	1	1	3
04 : 30	—	—	—	—	3	1	3
05 : 00	—	—	3	2	1	1	3
05 : 30	—	—	—	—	3	1	3
06 : 00	3	3	2	1	1	1	3
06 : 30	—	—	—	—	3	1	3
07 : 00	—	—	3	2	1	1	3
07 : 30	—	—	—	—	3	1	3
08 : 00	—	1	1	1	1	1	3
08 : 30	—	—	—	—	3	1	3
09 : 00	—	—	3	2	1	1	3
∫	∫	∫	∫	∫	∫	∫	∫
12 : 00	2	1	1	1	1	1	3
∫	∫	∫	∫	∫	∫	∫	∫
18 : 00	3	3	3	1	1	1	3
∫	∫	∫	∫	∫	∫	∫	∫
00 : 00	3,4	1,4	1,4	1,4	1,4	1,4	3

10.2 SIMULTANEOUS PROCESSING

1) Time axis difference between pens

- ① Digital recording/printing pen (plotter pen) and analog recording pen (1st pen) are shifted in the direction of the time axis.
- ② The digital printing performed at a fixed interval (such as the timing line) is performed slightly earlier than the 1st pen because of this difference so that it coincides with the recording by the 1st pen.



2) Digital recording and alarm printing

These are printed immediately when alarm occurs.

3) Simultaneous processing with digital printing and alarm printing

Alarm printing is performed with a slight delay to match the digital printing line.

4) Other simultaneous processing

The processing performed when the digital printing or recording occurs in sequence are shown below.

Items printed and recorded simultaneously		Processing details
Digital printing	Alarm printing	<ol style="list-style-type: none"> ① When alarm printing occurs during digital printing: After one line is printed, the chart is advanced by 3.6 mm then alarm printing is performed on the right of the chart. (Only the left side of the digital data will be printed and the right side will be omitted.) ② When the time when digital printing should occur is reached during alarm printing: When digital printing is required on a line on which alarm printing is being performed, alarm printing is interrupted until digital printing starts, then digital printing is performed on the left of the recording chart while alarm printing is performed on the right of the same line.
	Instantaneous digital recording	<ol style="list-style-type: none"> ① When [DATA PRINT] key is pressed during digital printing: After the line currently being printed is finished, digital recording is performed immediately, resulting in overprinting. After digital recording is completed, the chart is advanced by 3.6 mm then digital printing is re-started. ② When the digital printing time is reached during digital recording: After digital recording is finished, only the timing line is printed.
	Fixed time interval digital recording	<ol style="list-style-type: none"> ① When digital recording is present on a line on which digital printing is to be performed: On the first line only the timing line is printed, then digital recording is performed. The remaining items of digital printing will not be printed. On the second line, printing is interrupted. After digital recording is finished, the chart is advanced by 3.6 mm then the remaining contents will be printed. ② When the digital printing time is reached during digital recording: After digital recording is finished, only the timingline is printed.
Digital recording	Alarm printing	<ol style="list-style-type: none"> ① Alarm occurs during digital recording: After digital recording is finished, the recording chart is advanced by 3.6 mm and alarm printing is performed. ② When fixed-time digital recording is present on a line on which alarm printing is to be performed: After digital recording is finished, the recording chart is advanced by 3.6 mm and alarm printing is performed. ③ When on-demand digital recording is activated during alarm printing: Data will be overprinted.

Ref. 1 What is digital recording?

The measures values are recorded digitally. There are two types of digital recording; on-demand digital recording and the fixed time interval digital recording.

Ref. 2 What is digital printing?

The details printed in the fixed time interval digital printing include year/month/date, time, timing line, chart speed, range, scale, channel No. and tag.

11. MEMORY CLEAR (Initialization of Setting Data)

This recorder has the three memory clear functions. As the setting data is stored in an EEPROM, it is maintained even after the power is switched off.

Memory clear functions:

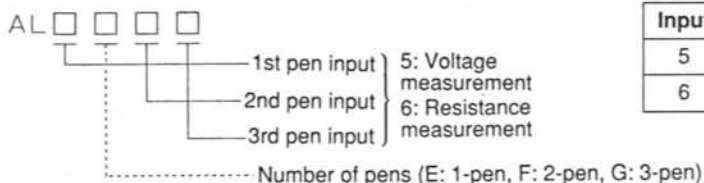
- ① Initialization of setting parameters
- ② Initialization of scale calibration data
- ③ Initialization of clock

11.1 INITIALIZATION OF PARAMETERS

- ① All the parameters are reset to the condition when shipped.
- ② The initial values of each parameter are shown in the Table on the right.
- ③ Use this table as a reference when changing (setting) parameters.

Parameter Name	Initial Value
Range	Differs for each type → Refer to "Reference"
Scale	
Unit	
Alarm	All clear (blank).
Fixed-interval digital recording	Cleared (blank).
Chart speed	20 mm/H
Tag	All clear (blank).
Recording condition	Engaged (ON).
Display mode	Measured value display.

Reference: Initial values of range, scale, unit



Input	Range	Scale	Unit
5	K : 0 ~ 1200°C	0 ~ 1200	°C
6	Pt100: -200 ~ 500°C	-200 ~ 500	°C

11.2 INITIALIZATION OF SCALE CALIBRATION DATA

All the compensation data (adjusted values) for scale calibration are reset to the initial values when shipped. However, compensation may be applied to the values of ③ and ④ on the right when shipped.

Compensation data (adjusted values) to be cleared:

- ① Zero and span adjustment values for each range
- ② Shift setting value for scale
- ③ Zero and span adjustment values for analog recording
- ④ Time axis adjustment between pens
- ⑤ Deadband range adjustment of alarms

11.3 INITIALIZATION OF CLOCK

When initialization is performed, the clock will be reset to the value shown on the right. When shipped, the clock is set to the present time.

Initial value	1989 (year) 05 (month) 01 (day) 00 (hour) 00 (minute)
---------------	---

12. SPECIFICATION CHECK FUNCTION

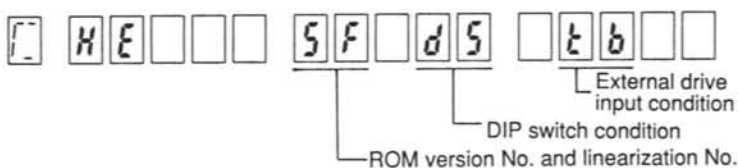
Some of the specifications of this unit can be checked by DIP switch and key operations. Three items can be checked, as shown on the right.

Specification items that can be checked

- ① ROM version No. and linearization No.
- ② DIP switch condition
- ③ External drive (optional) input condition

12.1 DISPLAY MODE

1) Check mode



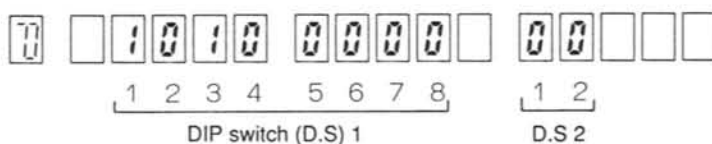
2) ROM version No.



3) Linearization No.



4) DIP switch condition

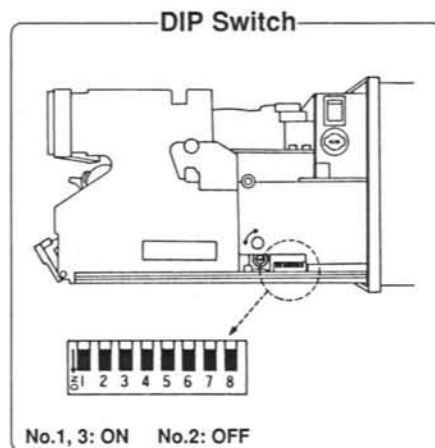


5) External drive (optional) input condition



12.2 PREPARATIONS BEFORE OPERATION

- ① Turn the power OFF.
- ② Slide out the rack and locate the 8-element DIP switch on the right side.
- ③ Set switch No. 2 of the 8-element DIP switch to OFF, and switches No. 1 and 3 to ON.
- ④ Turn the power switch ON.
- ⑤ The check mode display will appear.



External Drive Display

① EXT.1 and EXT.2 (terminals)

Chart Speed	EXT.1	EXT.2
CS1	0	0
CS2	1	0
CS3	0	1
Stop	1	1

② DATA PRINT

Digital recording external drive	
Stop	0
Excution	1

③ LIST PRINT

List print external drive	
Stop	0
Excution	1









0: Open, 1: Shorted

Ref. 1 DIP switch positions and functions



No.1	No.2	No.3	Functions	
ON	OFF	ON	Specification check mode	
OFF	OFF	OFF	Standard specification	
ON	OFF	OFF	Operation mode With communication*	
OFF	ON	OFF		GP-IB
OFF	ON	OFF		RS-232C
ON	ON	OFF	RS-422A	







* Available as option

12.3 ROM VERSION NO. AND LINEARIZATION NO.

- | | | |
|---|--|---|
| <p>1 Preparation
Perform the preparations shown in item 12.2.</p> | <p>2 Set to the version No. display
Move the cursor to  then press </p> | <p>3 Set to the linearization No. display
(Version No. and linearization No. are displayed alternately.)
 </p> |
| <p>4 Set to the check mode display

Return to the check mode display. When the checking of other items is not required, proceed to step 6.</p> | <p>5 To check other items
  → 
① DIP switch condition: Proceed to step 2 in item 12.4.
② External drive condition: Proceed to step 2 in item 12.5.</p> | <p>6 End and return to the operation mode
Turn the power switch OFF, and reset the DIP switch (refer to "Reference" on page 46), then turn the power ON again.</p> |







12.4 DIP SWITCH CONDITION

The ON/OFF condition of the two DIP switches (D.S 1/2) can be checked.  shows ON,  shows OFF. DIP switch 2 (D.S 2) has been set at the factory and must not be touched.

- | | | |
|---|---|---|
| <p>1 Preparation
Perform the preparations shown in item 12.2.</p> | <p>2 Set to the version No. display
Move the cursor to  then press </p> | <p>3 Confirmation of switch condition
"0" shows OFF and "1" shows ON.</p> |
| <p>4 Set to the check mode display

Return to the check mode display. When the checking of other items is not required, proceed to step 6.</p> | <p>5 To check other items
  → 
① ROM version/linearization No.: Proceed to step 2 in item 12.3.
② DIP switch condition: Proceed to step 2 in item 12.4.</p> | <p>6 End and return to the operation mode
Turn the power switch OFF, and reset the DIP switch (refer to "Reference" on page 43), then turn the power ON again.</p> |


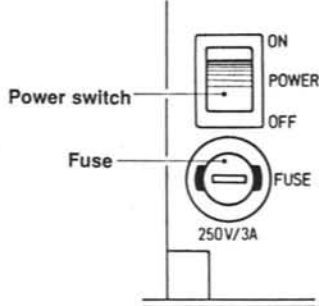
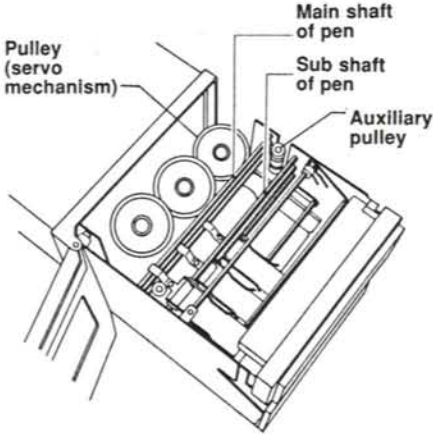
<Remark> Refer to page 19 for the functions of Dip Switch 1 (No. 8),

12.5 EXTERNAL DRIVE INPUT CONDITION

- | | | |
|---|---|---|
| <p>1 Preparation
Perform the preparations shown in item 12.2.</p> | <p>2 Set to the version No. display
Move the cursor to  then press </p> | <p>3 Confirmation of switch condition
"0" shows OFF (open), and "1" shows ON (short-circuited).</p> |
| <p>4 Set to the check mode display

Return to the check mode display. When the checking of other items is not required, proceed to step 6.</p> | <p>5 To check other items
  → 
① ROM version/linearization No.: Proceed to step 2 in item 12.3.
② External drive condition: Proceed to step 2 in item 12.5.</p> | <p>6 End and return to the operation mode
Turn the power switch OFF, and reset the DIP switch (refer to "Reference" on page 46), then turn the power ON again.</p> |

13. MAINTENANCE/CHECKING

- ① So that the recorder works in optimum condition, maintenance and checking should be performed periodically.
- ② For maintenance and checking, follow the items listed in the table below, and replace or supply consumables or apply lubricant as required.

Check/Maintenance Item	Remedy
Pen replacement (analog recording pen, plotter pen)	<ul style="list-style-type: none"> • When the ink becomes faint, replace the pen with a new one referring to sections 6.1 and 6.2 on page 12-13. • Pens can be stored for about 1 year. Avoid using pens that are too old. • If the pen tip dries up, it will not be usable. Be sure to replace the caps after use.
Replacement of chart	<p>The chart will be used up in about 20 days when used continuously at a speed of 20 mm/H. When the chart is nearly used up, the paper out mark will be printed on the right of the chart. When you see this; replace the chart, referring to section 6.3 on page 14.</p> 
Fuse Replacement	<p>When the fuse blows, turn the power switch OFF, check the cause, then replace the fuse.</p> <ol style="list-style-type: none"> ① Pull out the rack and turn the fuse holder located at the rear of the right side counterclockwise to remove it. ② Replace the old fuse with the 250 V 3A tubular fuse provided or equivalent. ③ To reinstall, turn the fuse holder clockwise while pressing it in lightly. <p>Note: Turn the power OFF before replacement Be sure to turn the power OFF before replacing the fuse.</p> 
Lubrication	<p>To prevent wear of the mechanism and to keep the recorder in optimum condition, lubricate the mechanism section at approximately 6-month intervals.</p> <ol style="list-style-type: none"> ① Wipe off dirt and dust from points where lubricant is required, especially the main shaft of the analog recording pen, the main shaft of the plotter pen and the semi-cylindrical shaft at the rear of the plotter. ② Make a hole in the tip of the bottle of lubricant. ③ Lubricate carefully with a few drops of oil. Make sure that oil does not flow from the points being lubricated, and wipe off excess oil. ④ Points to be lubricated: <ul style="list-style-type: none"> • Main and sub shafts of the analog recording pen • Main and semi-cylindrical shafts and each bearing of the plotter • Sections where the servo mechanism gears engage • Auxiliary pulley bearing • Other hinged sections <p>Note: Do not lubricate the bearing of the servo mechanism</p> 

14. CHECKING AND CALIBRATING THE SCALE

- ① With this recorder, the range can be set for each channel separately. The scale of each channel should also be checked separately.
- ② 5 calibration functions are available for the adjustment of the scale of this recorder, as shown on the right. Use the appropriate functions according to your requirements.
- ③ As all adjustments are performed using software, no mechanical adjustments of trimmers, etc. is required.

Adjustment (compensation) functions:

- ① Scale calibration (zero, span adjustments of measured values)*
- ② Shift setting (shift setting of display value)*
- ③ Zero and span adjustments of analog recording operation
- ④ Time axis adjustment of pens
- ⑤ Deadband range adjustment of alarms

Items marked with an asterisk can be adjusted for each channel separately.


14.1 SCALE CHECKING

Check the scale of each channel separately. Even if two or more channels used the same range, there may be differences between them.

Accuracy of the tester:

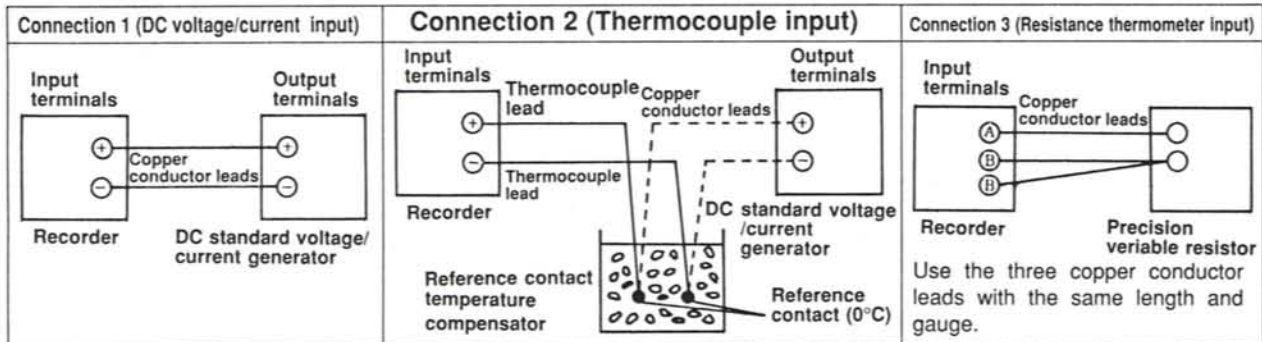
The accuracy of this recorder is basically 0.1%. (Refer to page 58 for details.) A tester with a higher accuracy than the recorder should be used.

1) Preparations

- ① Turn the power switch OFF and connect according to the input signal. (Refer to the diagram below.) Connect the tester to the recorder's input terminals corresponding to the channel No. to be checked.
- ② Install the terminal cover.
- ③ Turn the power switch ON and press the  key to select the measured value display mode.
- ④ After more than 30 minutes have elapsed with the power ON, start the checking operation.

When a reference contact temperature compensator (CJ) is not available:

When the CJ selection is set to "1" (internal) for a thermocouple input, if a reference contact temperature compensator is not available, use Connection 1 below. In this case, set the CJ selection for the range setting to "0" while the checking is being performed. In this case, compensation for reference contact temperature is impossible.



2) Checking Procedure

- ① Set the tester (DC standard voltage/current generator or accurate variable resistor) to the input value corresponding to the scale to be checked.
- ② At this time, read the digital display value and check whether the reading has the specified accuracy or not.
- ③ Check at least the minimum, maximum and center scale points; checking at more than 5 points at equal interval is recommended.
- ④ Next, change the connection to the channel No. to be checked, and repeat the operation.
- ⑤ Also check the analog recording position.

Note 1: When reading the digital value

If the shift setting (see section 14.3) has been done, the scale value will be shifted. Take this into consideration when reading the digital display value.

Note 2: When using a reference contact temperature compensator

Check that the reference contact temperature is set at 0°C. When using an electronic reference contact temperature compensator, refer to its instructions for connection, etc.

Reference: 8-element DIP switch (No. 1 - 3)

Switches No. 1 to 3 of the DIP switch determine the specifications for the operation mode and function selection mode.

Operating specification	No.1	No.2	No.3	Specification	
	OFF	OFF	OFF	Standard	(with no communications)
ON	OFF	OFF	With communication*	GP-IB	
OFF	ON	OFF		RS-232C	
ON	ON	OFF		RS-422A	

Function specification	No.1	No.2	No.3	Function
	OFF	OFF	ON	Scale calibration
ON	OFF	ON	Specification check	
OFF	ON	ON	Memory clear	
ON	ON	ON	Used by manufacturer	

14.2 SCALE CALIBRATION

14.2.1 Scale calibration for each channel

- ① This adjusts the zero and span for digital display/recording with respect to the range set for each channel.
- ② Even when this calibration is done, the analog recording position will not be changed. Check and, if it is shifted, perform adjustment for analog recording again.
- ③ After scale checking has been done, if it does not have the specified accuracy, perform adjustment by the following procedure.

1) Preparation

- ① Connect the tester to the channel No. to be calibrated. → Refer to "preparation" for scale check (section 14.1).
- ② Be sure to attach the terminal cover. → Ref. 1
- ③ Set the 8-element DIP switch as follows:
<No. 1 and 2 to OFF, No. 3 to ON, No. 4 - 8: no change>
- ④ Turn the power switch ON. The scale calibration selection mode will be displayed.
- ⑤ After leaving for more than 30 minutes with the power ON, perform calibration as follows.

Ref. 1 Attaching the terminal cover

If the terminals are exposed to the air, their temperature may change. Be sure to attach the terminal cover, especially when calibrating thermocouple inputs.

Ref. 2 8-element DIP switch



No. 1, 2 : OFF
No. 3 : ON

2) Scale calibration selection mode display





- ① Scale calibration for each channel
- ② Shift setting for each channel
- ③ Zero and span adjustments for analog recording
- ④ Time axis adjustment for the pen
- ⑤ Deadband range setting for alarms

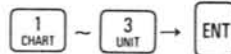
3) Calibrating Procedure


- ① Set to the scale calibration/operation mode display



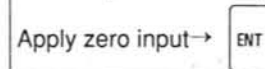
Move the cursor to the  position and press the  key to change the display to the scale calibration/operation mode.


- ② Selection of channel No.



Set the channel No. to which the tester is connected, and press the  key to change to the display for zero adjustment.

- ③ Zero adjustment (acquisition of compensation data)



The 0% input for the analog recording range (left position input) will be shown. Input the same value from the tester and press the  key to change to the display for span adjustment.

4 Span adjustment (acquisition of compensation data)

Apply span input →

The 100% input for the analog recording range (right position input) will be shown. Input the same value from the tester and press the key to return to the display for zero adjustment.

5 Calibration of other channels

Steps 2 to 4

- ① Connect the tester to the next channel No. to be calibrated, and leave for more than 15 minutes with the power ON before performing calibration.
- ② Perform calibration of this channel in the same way as above (steps 2 - 4).

6 Compensation data memory and completion of operation

(Memory colon blinks and setting change mark will be printed.)

- ① Press the (+) key to store the compensation data in memory.
- ② To finish the operation, turn the power switch OFF and reset the DIP switch to its original settings (see "Reference" on page 46) and turn the power switch ON again.

Zero adjustment display

Zero adjustment 0% input value for analog recording range

Span adjustment display

Memory colon Span adjustment 100% input value for analog recording range

Note 1: Selection of channel with no range setting

If a channel No. for which no range setting has been performed is selected in the above step 2, it will cause an error.

Note 2: When is pressed with the display in steps 2, 3

Scale calibration of the selected channel will not be performed.

Note 3: When "clear" is registered with the display in steps 2, 4

When "clear" (+) is registered, the compensation data for the selected channel will be initialized and the display in step 1 will resume.

14.2.2 Shift setting for each channel

- ① This is to set the amount by which the digital display/recording of the channel should be shifted (moved in parallel) with respect to the channel's scale setting.
- ② Shift setting does not affect analog recording operations.
- ③ It is used to shift the display/recording slightly even if the measured value (digital display/recording) is correct.
- ④ When the shift setting has been done, the values are shifted by the set amount. Do not forget this when you inspect the scale.

1) Preparation

- ① Set the 8-element DIP switch as follows: <No. 1 and 2 to OFF, No. 3 to ON, No. 4 - 8: no change>
- ② Turn the power switch ON. The scale calibration selection mode will be displayed.
- ③ After leaving more than 30 minutes with the power ON, perform the setting operation as follows.

Example of shift setting

Scale setting : 0 - 1200
 Measured value : 1035
 When the scale is normal but measured value "1040" is required, press the key to shift to "1040". (In this case, the amount of shift is "5".)

Ref. 1 : 8-element DIP switch



2) Scale calibration selection mode display



- ① Scale calibration for each channel
- ② Shift setting for each channel
- ③ Zero and span adjustments for analog recording
- ④ Time axis adjustment for the pen
- ⑤ Deadband range setting for alarms

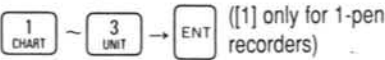
3) Setting procedure

1 Set to the scale calibration/operation mode display



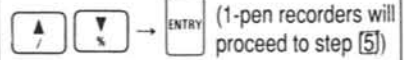
Move the cursor to the **S** position and press the **ENT** key to change the display to the scale calibration/operation mode.

2 Selection of channel No.



Set the channel No. to be shifted and press the **ENT** key to change the display to the measured value.

3 Shift setting



The cursor lights under at the last digit of the measured value. Enter the required value and press the **ENT** key. The display in step **1** will resume.

4 Setting the shift of other channels

Steps **2** **3**

Set the shift for other channels in the same way as above (steps **2** **3**)

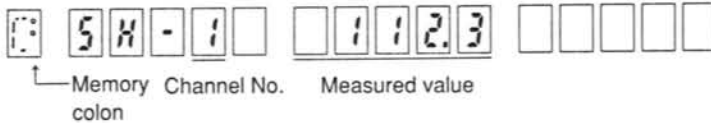
5 Shift setting memory and completion of operation



(Memory colon blinks and setting change mark will be printed.)

- ① Press the **SET END** key to store the shift setting data in memory.
- ② To finish the operation, turn the power switch OFF and return to the DIP switch to its original settings (see "Reference" on page 46) and turn the power switch ON again.

Shift setting display



Note 1: Selection of channel with no range setting

If a channel No. for which no range setting has been performed is selected in step **2** above, it will cause an error.

Note 2: When "clear" is registered with the display in steps **2**, **3**

When "clear" (**D CLEAR** + **ENT**) is registered, the shift setting value for the selected channel will be initialized and the display in step **1** will resume.

14.2.3 Zero and span adjustments for analog recording(including zero adjustment for the plotter)

- ① This covers the adjustment of the zero and span of the analog printer which records trends on the recording chart, and can be set for each channel separately.
- ② This adjustment will not affect the measured value (digital display/recording).
- ③ Only the zero adjustment is required for the plotter pen, with channel No. 0.

1) Preparation

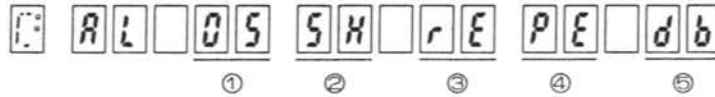
- ① Set the 8-element DIP switch as follows:
<No. 1 and 2 to OFF, No. 3 to ON, No.4 - 8: no change>
- ② Turn the power switch ON. The scale calibration selection mode will be displayed.
- ③ After leaving for more than 30 minutes with the power ON, perform calibration as follows.

Ref. 1: 8-element DIP switch



No.1, 2 : OFF
No. 3 : ON

2) Scale calibration selection mode display



- ① Scale calibration for each channel
- ② Shift setting for each channel
- ③ Zero and span adjustments for analog recording
- ④ Time axis adjustment for the pen
- ⑤ Deadband range setting for alarms

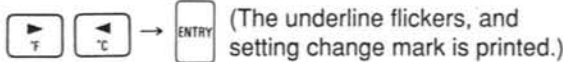
3) Adjustment Procedure

1) Set to the scale calibration/operation mode display



Move the cursor to the **r** position and press the **ENT** key to change the display to the scale calibration /operation mode. Pens will be moved to the left end (zero position).

3) Zero adjustment (acquisition of compensation data)



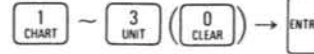
- ① Press **▶** once to move the pen to the right by 0.1 mm, and press **◀** to move it to the left by 0.1 mm.
- ② Set the pen to the required position (normally the 0% position on the chart), then press the **ENT** key.
- ③ The display is changed for span adjustment, and the pen moves to the span position. In the case of the plotter pen, the display in step 1 will resume.

5) Adjustment of other channels



Set the next channel No. to be adjusted, and perform adjustment in the same way as above (steps 2 - 4).

2) Selection of channel No.



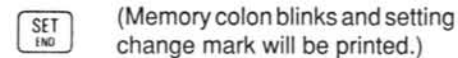
- ① Set the channel No. to be adjusted and press the **ENT** key to change to the display for zero adjustment. The pen of the selected channel No. will be moved to the zero position, while the other pens move to the 50% positions. The recording chart will be fed at the 20 mm/H speed.
- ② Channel No. 0 is for zero adjustment of the plotter pen.

4) Span adjustment (acquisition of compensation data)



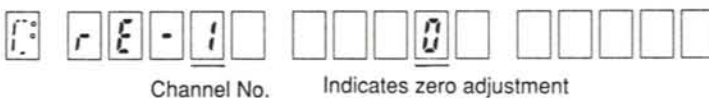
- ① Using the **▶** **◀** keys, set the pen to the required position (normally the 100% position on the chart), then press the **ENT** key.
- ② The display in step 1 will resume.

6) Compensation data memory and completion of operation

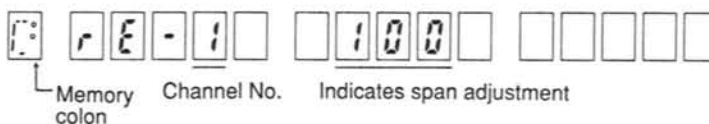


- ① Press the **SET END** key to store the acquired compensation data in memory.
- ② To finish the operation, turn the power switch OFF and return the DIP switch to its original settings (see "Reference" on page 46) and turn the power switch ON again.

Zero adjustment display



Span adjustment display



Note 1: When **SET END** is pressed with the display in step 2, 3

The zero and span adjustments of the selected channel will not be performed.

Note 2: When "clear" is registered with the display in steps 2, 4

When "clear" (**0 CLEAR** + **ENT**) is registered, the compensation data for the selected channel will be initialized.

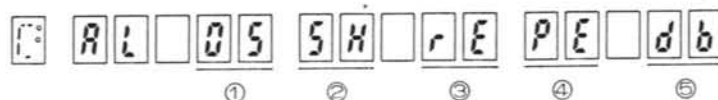
14.2.4 Adjustment of the time axis of the pen

- ① This adjusts the time axis of the plotter pen (for digital printing/recording). (Adjustment of the plotter pen with respect to the 1st pen.)
- ② Adjustment of the difference between analog recording pens is required only when the time axis synchronization unit (optional) is added.

1) Preparation

- ① Set the 8-element DIP switch as follows:
<No. 1 and 2 to OFF, No. 3 to ON, No. 4 - 8: no change>
- ② Turn the power switch ON. The scale calibration selection mode will be displayed.

2) Scale calibration selection mode display



Timing line:

The timing line will be printed at a fixed interval although the interval differs depending on the chart speed.
→ Refer to page 39.

Reference : 8-element DIP switch



No. 1, 2 : OFF
No. 3 : ON

- ① Scale calibration for each channel
- ② Shift setting for each channel
- ③ Zero and span adjustments for analog recording
- ④ Time axis adjustment for the pen
- ⑤ Deadband range setting for alarm

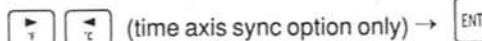
3) Adjustment Procedure

1 Set to the scale calibration/time axis mode display



Move the cursor to the **P** position and press the **ENT** key to change the display to the scale calibration/time axis mode.

2 Set to 1st pen adjustment mode



The cursor lights under **1** shown above. (With the optional time axis sync unit attached, the cursor will move to **2**, **3**.)

Press the **ENT** key to change to the display for the adjustment of the time axis between the plotter pen and 1st pen.

3 The following operations will be performed automatically:

- ① Each pen moves to the left end and the chart is fed slightly.
- ② The reference pen (plotter pen for 1-pen recorder, the 1st pen for others) draws a straight line from the zero position to the span position.
- ③ The chart is fed slightly and, the recorded line (straight line) comes close to the pen to be adjusted.
- ④ The pen to be adjusted moves slowly to draw a line between the 40% and 60% points on the chart.

4 Time axis adjustment



When the **!** key is pressed, the chart is fed by 0.1 mm. When the pen to be adjusted comes to the line drawn by the reference pen, press the **ENT** key.

5 Adjustment for 2nd and 3rd pen

(Available only when time axis sync option is attached)

Move the cursor to the required pen No. using the **→** **←** keys, and perform adjustment in the same way (steps **2** - **4**).

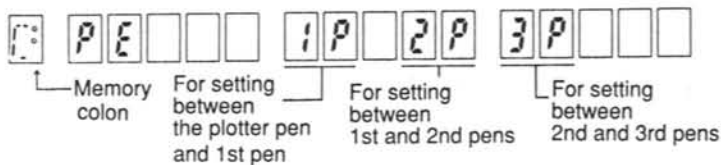
6 Compensation data memory and completion of operation



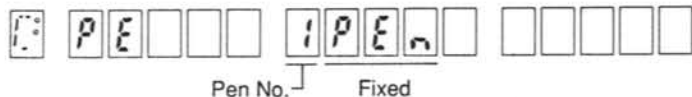
(Memory colon blinks and setting change mark will be printed.)

- ① Press the **SET** key to store the acquired compensation data in memory
- ① To finish the operation, turn the power switch OFF and return the DIP switch to its original settings (see "Reference" on page 46) and turn the power switch ON again.

Time axis mode display



Display in time axis adjustment



Note 1: When "clear" is registered

When "clear" ($\text{[0 CLEAR]} + \text{[ENT]}$) is registered during adjustment, the compensation data will be cleared and the display in step [1] will resume. When the time axis sync option is attached, the compensation data of the selected pen No. will be cleared.

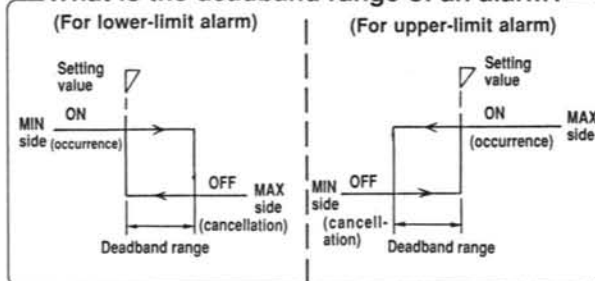
Note 2: Are all pens inserted firmly?

Check that the pens are fully inserted into their holders.

14.2.5 Deadband range setting for alarms

- This is to set the deadband ranges of alarms.
- When an alarm occurs, it will be output immediately, but the margin for the alarm's cancellation can be altered. (See the diagram on the right.)
- The initial value is 0.1%, and setting is possible between 0.1% and 5.0%, in 0.1% steps.
- The value is set as a percentage of the scale setting range.

What is the deadband range of an alarm?



1) Preparation

- Set the 8-element DIP switch as follows:
<No. 1 and 2 to OFF, No. 3 to ON, No. 4-8: no change>
- Turn the power switch ON. The scale calibration selection mode will be displayed.

Reference 8-element DIP switch



No.1, 2 : OFF
No. 3 : ON

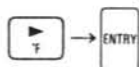
2) Scale calibration selection mode display



- Scale calibration for each channel
- Shift setting for each channel
- Zero and span adjustments for analog recording
- Time axis adjustment for the pen
- Deadband range setting for alarms

3) Setting Procedure

1 Set to the scale calibration/deadband range mode display



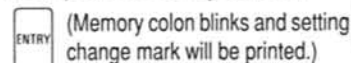
Move the cursor to the **d** position and press the **[ENT]** key to change the display to the scale calibration /deadband range mode.

2 Setting of deadband range



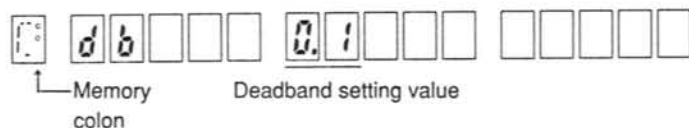
Set the value between 0.1 and 5.0. (The decimal point is fixed.)

3 Setting data memory and completion of operation



- Press the **[ENT]** key to store the setting data into memory.
- To finish the operation, turn the power switch OFF and return the DIP switch to its original settings (see "Reference" on page 46) and turn the power switch ON again.

Deadband mode display



Note : When "clear" is registered

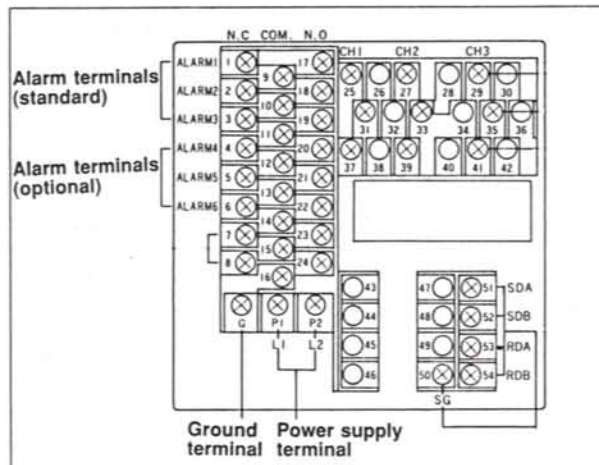
When "clear" ($\text{[0 CLEAR]} + \text{[ENT]}$) is registered during adjustment, the setting data will be initialized (to 0.1%).

15. OPTIONS

15.1 6-POINT ALARM OUTPUT

- ① With this option, 3 alarm outputs are added to the standard 3 points, resulting in a total of 6 alarm outputs.
- ② Any alarm output No. from 1 to 6 can be set.
- ③ For setting of alarms, refer to page 29.
- ④ For connections related to alarms, refer to page 11.

Output 1	ALARM 1 (1, 9, 17)	Standard version
2	2 (2, 10, 18)	
3	3 (3, 11, 19)	
4	4 (4, 12, 20)	Effective when 6-point alarm output (optional) is provided
5	5 (5, 13, 21)	
6	6 (6, 14, 22)	

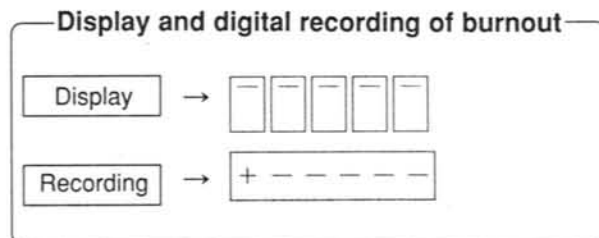


15.2 BURNOUT

When any of the input lines is short-circuited, the analog recording (reading) of the corresponding channel will reach the upper limit (right end), and the display and digital recording will be changed as shown in the diagram on the right.

Note: Differentiating between burnout and over-range

Since there is no difference, pay special attention.



15.3 EXTERNAL DRIVE SIGNALS

- ① Instead of using the front panel keys, when contact signals (short-circuit or open) are applied to the external drive terminals, the recording operation can be stopped, and instantaneous digital recording and list printing can be activated.
- ② Any of three preselected chart speeds can be selected for recording. The setting of the three chart speeds is performed using front panel keys.

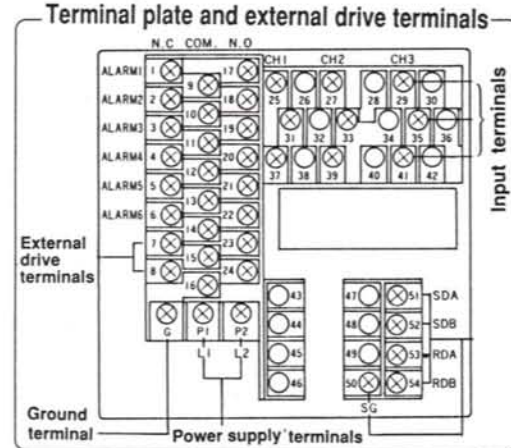
External drive functions

- ① Selection of operate/stop of recording function
- ② Selection of any of three chart speeds
- ③ Execution of instantaneous digital recording
- ④ Execution of list printing

1) Relationship between the external drive function and terminals

Function			Terminal No. and signal			
Re-cording function*	Op-eration	Chart speed	CS1	Between terminals ⑦ and ⑬	Open	Open
			CS2		Open	Short-circuit
			CS3	Short-circuit	Open	
	Stop	Short-circuit	Short-circuit			
Execution of instantaneous digital recording			Short-circuit between terminals ⑭ and ⑱ (more than 0.3 seconds)			
Execution of list printing			Short-circuit between terminals ⑲ and ⑳ (more than 0.3 seconds)			

* When the **RECORD ON** indicator on the front panel is not lit (recording function stopped), external drive functions are not available. Press the **RECORD ON/OFF** key so that the indicator lights.



Note 1: When the chart speed setting is changed

The fixed time interval digital recording will be cleared from memory. Re-set it if required. It will not be cleared by the selection of a new chart speed using an external contact signal.

For related items, refer to "Note 3" on page 32.

Note 2: Interval time setting condition for fixed time interval recording operation

- ① The minimum setting of the interval time for fixed time interval digital recording is limited according to the chart speed. → Refer to "Note 1" on page 32.
- ② The lowest speed among the three speeds is used for judgment. When the minimum interval time is to be set, it is necessary to set chart speeds which are not used to higher values.

Ref. 1 **RECORD ON** status display

For the external drive to function, the status display on the front panel should be **RECORD ON**. When the stop function is selected externally, the **RECORD ON** status display will go out.

Ref. 2 Setting of CS1 - 3

Setting CS1 - 3 is performed in the same way as setting the chart speed (see page 23), but the way it is stored in memory is different. Refer to item 2) (on the next page) for details.

Ref. 3 External drive in setting lock condition

When the **KEY LOCK** status display is lit, no front panel keys will function. → Refer to page 5. However, the external drive function is effective even when the **KEY LOCK** display is lit.

Ref. 4 If short-circuit is released mid-way

- ① The operate/stop selection of the recording function is also used for the selection of the chart speed. If both terminal groups (between ⑦ and ⑬, and between ⑱ and ⑳) are made open, CS1 will be selected.
- ② On-demand digital recording and list printing will continue to operate even if the terminals are short-circuited for more than 0.3 seconds then the short-circuit is released.

Ref. 5 Priority between on-demand digital recording and list printing, and during setting

- ① There is no priority. The item related to the terminals short-circuited first will be executed. When either pair of terminals is short-circuited, no other short-circuiting operation will be accepted.
- ② During the setting of parameters, short-circuiting will not be accepted.

15.4 EXTRACTION OF SQUARE ROOTS

- ① Square-roots can be extracted only when a DC voltage is input.
- ② Operation is designated in the position used for CJ selection in range setting.
- ③ For the measurement of flow using differential pressure, the amount of flow can be directly measured from the discharge signal and displayed after the square-root has been extracted.

1) Expressions related to the extraction of square-roots

The extraction of square-roots is done when the input voltage (R_x) is 1% or more of the analog recording range ($R_s - R_0$)

When it is less than 1%, the scale value (S_x) is fixed at the minimum value (S_0).

$$S_x = (S_s - S_0) \sqrt{\frac{R_x - R_0}{R_s - R_0}} + S_0$$

where, $R_x \geq (R_s - R_0) \times 0.01$

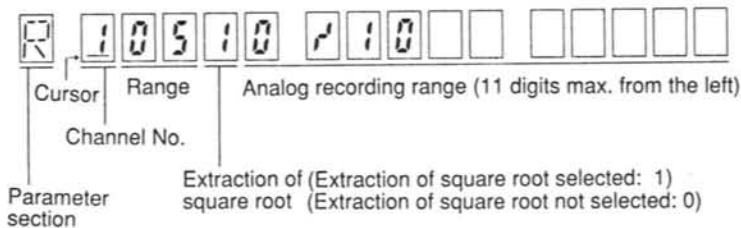
When the following equation is satisfied,

$$R_x < (R_s - R_0) \times 0.01$$

the value $S_x = S_0$.

2) Setting procedure

- ① In the range setting mode, the CJ switchover digit is used to specify whether or not square-roots are to be extracted.



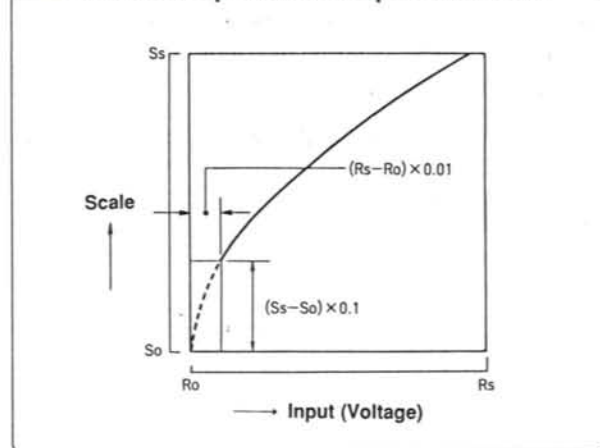
- ② The range No. for which the extraction of square roots can be designated is shown in the table on the right. When any range No. 18 - 46 (thermocouple input) is designated, the numeral which would otherwise indicate the extraction of square roots will indicate the normal CJ selection.
- ③ For the range setting method, refer to page 24. All setting operations except for the digit used for the extraction of square roots are the same.

Ref. 1 To designate range No. 13 - 15

For range No. 13 - 15, the partial pressure resistance circuit is used. It is necessary to re-connect the short-circuited connectors on the rear of the recorder so that the partial pressure can be input.

→ Refer to "Note 1" on page 25.

Relationship between input and scale



R_0 : 0% point input value of analog recording range

R_s : 100% point input value of analog recording range

S_0 : Scale value with 0% input of scale setting

S_s : Scale value with 100% input of scale setting

R_x : Input voltage, S_x : Scaling value

Applicable range No.

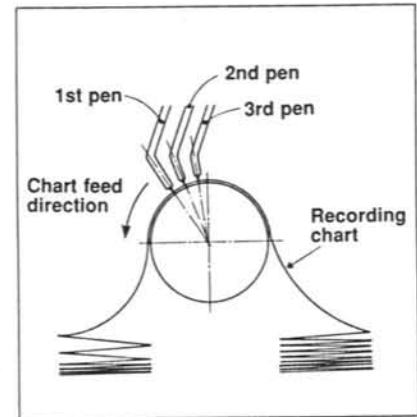
NO.	Range type	Unit	Decimal point
	Measurable range		
05	DC : -12.5 ~ 12.5mV	MV	2
06	DC : -25 ~ 25mV	MV	2
07	DC : -60 ~ 60mV	MV	2
08	DC : -120 ~ 120mV	MV	1
09	DC : -200 ~ 200mV	MV	1
10	DC : -500 ~ 500mV	MV	1
11	DC : -2 ~ 2V	V	3
12	DC : -5 ~ 5V	V	3
13	DC : -12.5 ~ 12.5V	V	2
14	DC : -25 ~ 25V	V	2
15	DC : -60 ~ 60V	V	2

Ref. 2 Range selection with current input

The current input must be converted into a voltage with an input resistor (250 ohms). This conversion can be done by re-connecting the short-circuit connectors located on the rear of the recorder. For the method and the selection of the range No., refer to section 5) on page 25.

15.5 TIME AXIS SYNCHRONIZATION

- ① This is an option exclusively for 2-pen and 3-pen recorders.
- ② With this option, the difference of the time axis between pens can be compensated so that data measured at exactly the same time is recorded on the chart.
- ③ In normal recording, since there are a fixed interval (approx. 3 mm) between pens, data measured at the same time will be recorded at slightly shifted positions in the time axis direction.
- ④ With the time axis sync option, the measured values for each pen will be stored in memory while the recording chart is fed by the difference with respect to the 1st pen. When the chart is fed by an amount corresponding to the timing of the 1st pen, the data will be output from the memory to the pen to be recorded. This operation synchronizes the timing with which data is written to the chart.



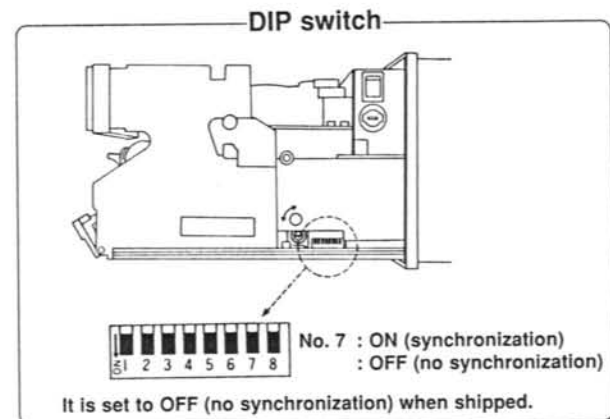
1) Selection of whether or not time axis synchronization should be performed

When the time axis sync option is attached, whether or not it is to be used can be selected, by DIP switch setting, in the following way:

- ① Turn the power switch OFF.
- ② Set DIP switch No. 7 as follows:
(Synchronization: ON,
No synchronization: OFF (setting when shipped))
- ③ Turn the power switch ON.

Reference Confirmation of DIP switch setting

DIP switch settings are checked only when the power is turned ON. Therefore, there will be no change if a setting is changed during operation.



2) Operation when power is ON

1) When EXECUTION has been selected

The 2nd and 3rd pens will record with the time differences previously stored in memory.

2) When switched to EXECUTION immediately before power ON

Pens other than the 1st pen will not follow the change of input and not function after the recording chart is fed by the amount of the time difference. This is because the measured data is stored in memory and pens are waiting until the chart is fed. Pay attention; this is not a malfunction.

Note 1: When the setting is changed

Immediately after a setting is changed, the data corresponding to the amounts of the time difference for the 2nd and 3rd pens will be recorded in place of the previous setting. That is, the setting change is also executed on the same time axis as that of the recording chart. After the chart speed is changed, recording will not be performed correctly for a time.

Note 2: Memory period with the chart speed of less than 89 mm/H

The memory for the 2nd and 3rd pens does not contain all of the data, but stores the average value of the data obtained in the measurement period (125 msec per channel).

Chart speed	Memory period	Chart speed	Memory period
Less than 4 mm/H	90 x 125 mm sec	20 ~ 29 mm/H	5 x 125 mm sec
5 ~ 9 mm/H	18 x 125 mm sec	30 ~ 49 mm/H	3 x 125 mm sec
10 ~ 19 mm/H	10 x 125 mm sec	50 ~ 89 mm/H	2 x 125 mm sec

Ref. 1 Display during recording with time axis synchronization

Digital display → Present measured value
Bar-graph display → Data from the same memory as the pen

<Remark> If the digital display and the bar-graph display do not coincide for a pen other than the 1st pen, it is not a malfunction.

Ref. 2 Compensation for mechanical drift with respect to the 1st pen

There is a function to compensate for this drift. Adjust it when more accurate time synchronization is required. For adjustment, refer to page 54.

16. GENERAL SPECIFICATIONS

1) Input specifications

Number of measurement inputs : 1, 2 or 3

Measuring range : Can be set for each channel according to the following table.

① DC voltage/current, thermocouple input (voltage system)

Type of input	Range No.	Measuring range	Display resolution	
DC voltage	05	-12.5 ~ 12.5mV	0.01	
	06	-25 ~ 25mV		
	07	-60 ~ 60mV		
	DC voltage	08	-120 ~ 120mV	0.1
		09	-200 ~ 200mV	
		10	-500 ~ 500mV	
		11	-2 ~ 2V	
12		-5 ~ 5V		
DC voltage (with built-in driver)	13	-12.5 ~ 12.5V	0.01	
	14	-25 ~ 25V	0.01	
	15	-60 ~ 60V	0.01	
DC current	*	-20 ~ 20mA		
Thermocouple	K	18	-200 ~ 300°C	0.1
		19	-200 ~ 600°C	
		20	-200 ~ 1350°C	
	E	21	-200 ~ 350°C	0.1
		22	-200 ~ 900°C	1
	J	23	-200 ~ 400°C	0.1
		24	-200 ~ 1100°C	1
	T	25	-200 ~ 250°C	0.1
		26	-200 ~ 400°C	
	R	27	0 ~ 1760°C	1
	S	28	0 ~ 1760°C	
	B	29	400 ~ 1820°C	
	Nicrosil -Nicil	30	0 ~ 350°C	0.1
		31	0 ~ 700°C	
		32	0 ~ 1300°C	
	WWRe ₅₋₂₆	33	0 ~ 2320°C	1
	WWRe ₀₋₂₆	34	0 ~ 2320°C	
	PR ₂₀₋₄₀	35	0 ~ 1880°C	
	NiNiMo	36	0 ~ 1800°C	
	AuFeCr	37	0 ~ 1310°C	
	38	0 ~ 300K		
PLATINEL	39	-100 ~ 300°C	0.1	
	40	-100 ~ 600°C	1	
	41	-100 ~ 1390°C		
U (DIN T)	42	-200 ~ 250°C	0.1	
	43	-200 ~ 450°C		
	44	-200 ~ 600°C		
L (DIN J)	45	-200 ~ 450°C	0.1	
	46	-200 ~ 900°C	1	

* DC voltage range No. are used as input current x 250 ohm.

② Resistance thermometer input (resistance system)

Type of input	Range No.	Measuring range	Display resolution	
Resistance thermometer	Pt100Ω	50	-100 ~ 100°C	0.1
		51	-200 ~ 300°C	
		52	-200 ~ 649°C	
	JPt100Ω	53	-100 ~ 100°C	
		54	-200 ~ 300°C	
	JPt50Ω	56	-200 ~ 649°C	
	Pt-Co	57	4 ~ 374K	

Minimum analog recording range: See the following table

DC voltage	More than 1/5 of the measurement range
Thermocouple	Approx. more than 2/5 of the measurement range when it is calculated as an electromotive force. (Any negative measurement range must be over 0°C.)
Resistance thermometer	Pt100 ohm, JPt100 ohm more than 100°C JPt55 ohm more than 200°C

Input resistance : Thermocouple/DC voltage input: 8 Mohm or more
DC voltage input : 1 Mohm. (with built-in voltage divider)
DC current input : 250 ohm +0.1%

2)Recording specification

Chart speed : Arbitrarily selected from 1 to 600 mm/hour and from 1 to 200 mm/minute (in 1-mm/min. steps)

Recording chart : System — Fan-fold paper
Effective recording width — 100 mm
Overall width — 114 mm
Overall length — 10 m Number of recording points: 1, 2, or 3 points

Recording method :
Analog recording : Felt-tip pen, continuous recording.
Digital recording : Felt-tip pen, plotter type.

Recording colors:
Analog recording : 1. Red, 2. Green, 3. Blue
Digital recording : Black

Fixed-interval printing: At specified intervals, the following are printed out:
Year, month, date, time, time line, chart speed, range (scale), tag and unit. When the chart feed speed is 300 mm/hour or less, the interval is determined according to the chart feed speed. When the chart feed speed is more than 300 mm/hour, only the time line is printed.

- Fixed-interval digital recording : Time, channel number and data are recorded digitally on the analog recording chart. If the chart feed speed is 300 mm/hour or less, the interval can be set as required. Channels that are not set are not recorded.
- On-demand digital recording : When specified, time, channel number and data are recorded digitally. If the chart speed is 300 mm/hour or less, measured values are recorded together with analog recording; if the chart feed speed is more than 300 mm/hour, analog recording is stopped to perform recording.
- Setting change mark : When the settings are changed, a * mark is printed on the right of the recording chart.
- Alarm printing : When an alarm occurs, the time, channel No., alarm type, alarm level (alarm No.) are printed out on the right of the recording chart. When an alarm is canceled, the time, channel No., and alarm level (alarm No.) are printed out on the right of the recording chart.
- List printing : Details of setting including date, chart speed, range and scale settings of each channel, etc. are printed out whenever required.

3) Digital specifications

- Digital display:
- FL display tube : 15-segment x 1 digit, character height 8 mm 7-segment LCD display, character height 7 mm
- Display items : 5-digit cursor or time using the same color as that used for measuring and recording values for all channels.
- Status display : The following items are displayed in the fluorescent display.
- Alarm : Identification of alarm channel No. and alarm No. (with cursor)
- RECORD ON : Lights when recording is ON. (during analog recording, digital recording printing and feeding chart paper)
- KEY LOCK SE, FE : Lights during key lock.
- SE, FE : Lights when a mistake is made in setting.
- Analog display : 100-mm 51-segment bar-graphs
Every 5th segment is the same color as that used for recording; other segments are white.
Ch. 1: Red, Ch. 2: Green, Ch. 3: Blue
- Recording chart lighting : LED
- Data display range : 9999 - 99999 (decimal points can be set optionally)

4) Alarm specifications

- Number of settings : 4 points can be set per channel (individual setting)
- Setting system : Individual setting of each point (high-limit/low-limit can be set as required.)
- Alarm output : 3 terminals (N.C, COM, N.O) x 3 point output. (OR output is possible) 6 points are optionally available.
- Contact capacity : 100 V AC, 0.5 A, 200 V AC, 0.2 A (with resistance load) Alarm deadband: 0.1 - 0.5% (variable) of analog recording area

5) Power supply specification

- Power source : 81 V to 264 V AC, 50 Hz/60 Hz (Free power supply)
- Measures against power failures : Details of settings are stored in an EEPROM. The clock is backed up by a lithium battery. (over 5 years) Memory data and clock are backed up for 3 years or more for models with time axis sync spec.
- Power consumption : Single-pen model: approx. 50 VA
2-pen model : approx. 55 VA
3-pen model : approx. 60 VA

6) Performance

- Accuracy : +0.1%+0.1 digit of the measuring range (at room temperature 23°C+2°C)
(Thermocouple inputs do not include reference junction compensation accuracy.) Please refer to the table for details of accuracy rating.
- Reference point compensation accuracy:
K,E,J,T, Nicrosil-Nisil, Platinel +0.5°C or less
Thermocouple inputs other than above +1°C or less
- Temperature coefficient : +0.01% of the measuring range
- Measuring period : 125 m sec/CH
- Allowable signal source resistance:
Thermocouple/DC voltage — 1 k ohm or less
DC voltage (with built-in voltage divider) — 100 ohm or less
Resistance thermometers — 10 ohm or less per lead
- Recording deadband : 0.5 mm or less
- Series-mode rejection ratio: 50 dB or more
- Common-mode rejection ratio : 130 dB or more
- Maximum input voltage : under 5 V range — 10 V
- Insulation resistance :
- Between measuring terminals and ground terminal:
500 V DC, 20 Megohm or more
- Between power terminals and ground terminal:
500 V DC, 20 Megohm or more
- Between measuring terminals and ground terminal:
500 V DC, 20 Megohm or more

Withstand voltages :

Between measuring terminals and ground terminal:
500 V AC, for 1 minute

Between power terminals and ground terminal:
1500 V AC, for 1 minute

Between measuring terminals and power terminals:
1500 V AC, for 1 minute

7) Construction

Material : DoorABS resin
CasePlain steel plate

Color : DoorsBlack
CaseMunsell N7.0 (gray)

Weight : 1-pen mode : approx. 4.6 kg
2-pen model : approx. 4.9 kg
3-pen model : approx. 5.2 kg

Installation method : On-desk or in-panel

8) Normal operation conditions

Ambient temperature/: 0 - 40°C, 20 - 80% Rh
humidity

Power supply voltage : 81 V - 264 V AC

Normal mode noise :

DC voltage input : less than 1.2 times of the measurement range

Thermocouple input : less than 1.2 times of the measurement range

Resistance thermometer : lower than 50 mV

Common mode voltage : lower than 200 V AC

Mounting position : Forward tilting 0°
Backward tilting 0° ~ 30°
Lateral tilting 0° ~ 10°

Warming-up time : Longer than 30 min.

9) Transportation and storage conditions

Ambient temperature : -20°C - +60°C

Ambient humidity : 5 ~ 95% Rh (non-condensing.)

Vibrations : 10 ~ 60 Hz less than 0.5 G

Impact : less than 40 G

Note) The above conditions are specified in the packaged condition.

Details of accuracy range ([]% ±1: abbreviation of ±1 digit)

Basic	Input		Accuracy
	DC voltage		
Thermocouple	AuFe, PR5, PR20		±0.2%±1
	Other than the above	-200 ~ 0°C	±0.15%±1
0°C ~		±0.1%±1	
Resistance thermometer	Pt-Co		±0.15%±1
	Other than the above		±0.1%±1

Ex-ceptions	Input	Accuracy	
	Thermocouple	B	400~800°C : ±0.15%±1
R,S		0~200°C : ±0.15%±1	
W0		0~100°C : ±0.15%±1	
Resistance thermometer	AuFe	20 K or less: ±0.5%±1	20~50K:±0.3%±1
	PR5	0~100°C:±4%	100~200°C:±0.5%±1
	PR20	0~300°C:±1.5%±1	300~500°C:±0.8%±1
	Pt-Co	20 K or less: ±0.5%±1	20~50K:±0.3%±1
	Other than above	-100 ~ +100°C: ±0.15%±1 (excluding JPt50)	