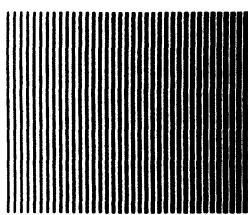


BH SERIES (PEN-WRITING TYPE)
HYBRID RECORDER
(Including Operation Alarm and External Drive)



INSTRUCTIONS

CONTENTS

Before use

■ Preface [Requests and notices]	i
⚠ For safe use	ii
⚠ Warnings	iii

Introduction

1. Introduction	
1.1 Confirmation	1
1.2 Attachments	2
2. Names of Component Parts ⚠	3

Operation

3. Operation	
3.1 Basic operation	5
3.2 Applied operation	6
3.3 Selection of functions (DIP. SW1) ⚠	8
4. Indication and Display	
4.1 Analog indication	9
4.2 Digital display	10
5. Recording Operation	
5.1 Recording operation	11
5.2 Recording and fast feed	12
5.3 Recording names and pen intervals	13
5.4 Digital recording and printing contents	14

Setting

6. Basic Setting	
6.1 Setting keys and setting items	15
6.2 Setting ranges	16
6.3 Characters of display	17
6.4 Setting errors and remedial measures	18
7. Setting Methods	
7.1 Chart speed and speed No.	19
7.2 Time (year/month, day/hour, minute)	21
7.3 Data printing	24
7.4 Fixed time recording	25
7.5 Skip function/(setting memory)	28

Option

8. Alarm (Option)	
8.1 Before setting alarms	31
8.2 Setting of alarm set values	33
8.3 Alarm value copy	34
8.4 Alarm action stop	36
9. External Drive (option) and Terminal Connections ⚠	37
10. Time Axis Synchronization (option)	38

Preparations

11. Installation to Panel ⚠	39
12. Connections	
12.1 Terminal board diagram ⚠	40
12.2 Cautions on connection ⚠	41
12.3 Connections of power & protective conductor terminals ⚠	42
12.4 connections of measuring input terminals ⚠	43
12.5 Connections of alarm output terminals (option) ⚠	44
13. Unlocking and Draw-Out of Internal Unit ⚠	45
14. Mounting and Recording Pens	46
15. Loading of Chart ⚠	50

Maintenance

16. Maintenance	
16.1 Daily inspection	52
16.2 Cleaning and lubrication/storage methods ⚠	53
16.3 Troubleshooting ⚠	54
16.4 Consumables and reference exchange intervals ⚠	58
17. Input type Codes and Unit Codes	59
18. Specifications Table	60

Note) Read the items marked with ⚠ in the title without fail. They comprise ⚠ **Warning** and ⚠ **Caution**.



PREFACE Requests and notices

Thank you for your purchase of BH series hybrid recorder (pen-writing type) having a 180mm recording width. Please read this instruction manual without fail for using this instrument correctly and safely and also preventing troubles in advance.

Separate Instruction Manuals

This instruction manual describes options ① alarm, ② external drive, and ③ time-axis synchronization in addition to the standard specifications. When the instrument is provided with the communication interface (option), the [instruction manual for communication interface] is attached as a separate manual. For other options, their instruction manuals are attached, respectively.

Request to designers, instrument controllers, and sale agents

Deliver this instruction manual to the operator of this instrument without fail.

Request to the operator of this instrument

This instruction manual is necessary for maintenance, too. Keep this manual with due care until the instrument is discarded.

Notices

1. No part of this manual can be reproduced in any form, without permission.
2. For the contents of this manual, alteration is reserved without notice in the future.
3. This manual has been prepared by making assurance doubly sure about its contents.
However, if any question arises or if any error, an omission, or other deficiencies were found, please inform your nearest CHINO's sales agent of them.
4. You are requested to understand that CHINO is not responsible for any operation results.



FOR SAFE USE

1 Installation of the Instrument and Environment

This instrument is designed for mounting on an indoor instrumentation panel for use. Don't mount it on a desk or the like. Never run or store this instrument in any inflammable gas or vapor atmosphere.

- This instrument conforms to IEC standard safety class I (with protective conductor terminal).

2 Indication Labels of This Instrument

The following indication labels are mounted for safe use of this instrument. Read the corresponding items in this manual without fail after understanding their contents.

Indication label	[Name] and place	Contents (meanings) ➡ Corresponding items
	[Alert symbol mark] Various terminals (rear panel)	Handle these places with due care, otherwise [electric shock accident] or [injuries] may result. ➡ 12. Connections
	[Protective conductor terminal] Right side of power terminals (rear panel)	This terminal is connected to the ground for preventing an electric shock accident. ➡ 12.3 Connections of power terminals and protective conductor terminal
90-120V AC 50/60Hz 45VA	[Power supply specifications] Power terminals ※	Specifications of the power supply (voltage range, frequency, power consumption) for this instrument. ➡ 12.3 Connections of power and protective conductor terminals
	[Transportation lock] Right side panel of internal unit (inside)	Lock for preventing the internal unit for jumping out during transportation or when mounting the instrument onto a panel or dismounting it from the panel. ➡ 13. Unlock and drawing out of internal unit

※ The 200V system (180 - 240V AC) and the free power supply (100 - 240V AC) are also available.

3 Symbols in This Manual

The cautions to be observed for preventing the damage of this instrument and unexpected accidents are sorted by the following symbols according to their importance degrees for enabling operators to use this instrument safely.

Symbols	Ranages of cautions
	This symbol is described in the titles (items) where Warning or Caution is explained.
Warning	This symbol describes the cautions for avoiding the possibilities when the user is in danger of causing serious injuries or death due to an electric shock accident or other accidents.
Caution	This symbol describes the cautions for avoiding the possibilities when the user is in a danger of causing slight injuries or this instrument or peripheral units may be damaged.
	This symbol shows a caution when this instrument does not function as specified or when such a possibility exists.
	This reference serves as a supplement for handling and operation, and it may be convenient for users.

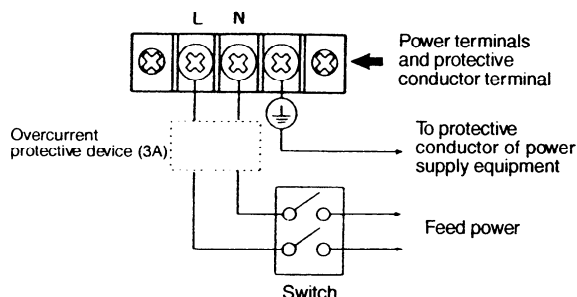
WARNINGS

This paragraph covers important warnings for safety to be observed before reading the instructions. Fully understand the following warnings before reading this manual. These warnings are important for preventing the danger to human bodies as well as accidents.

1 Switch and overcurrent protective device

Mount a switch and an overcurrent protective device (breaker, circuit protector or the like) for the power supply within 3m where the operator can reach them handily. This instrument is not provided with any replaceable overcurrent protective device.

Use these switch and overcurrent protective device conforming to IEC947-1 and IEC947-3.



2 Connect the instrument to the ground with out fail.

Connect the protective conductor terminal to the ground without fail before turning on the power supply. Don't disconnect it during use for preventing an electric shock accident.

3 Before turning on the power supply first

Make sure that the feed voltage is within the range indicated on the power label for safety before turning on the external power switch.

4 Don't repair or modify the instrument.

Don't repair or modify the instrument by replacing parts by any persons other than servicemen approved by our company, otherwise the instrument may be damaged or the instrument does not function normally, and also, accidents like an electric shock accident may occur. The internal unit and case are provided with electric circuits and moving parts. Don't put your hands, etc. into them, otherwise an electric shock accident or injuries may result.

5 Use the instrument according to the instruction manual.

Use the instrument correctly and safely according to this instruction manual. You should understand that we are not responsible for any injuries, damage, lost profits, and any other demands which may be caused by wrong uses.

6 Stop feeding power supply, if an abnormal symptom occurs.

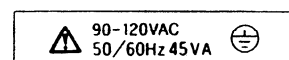
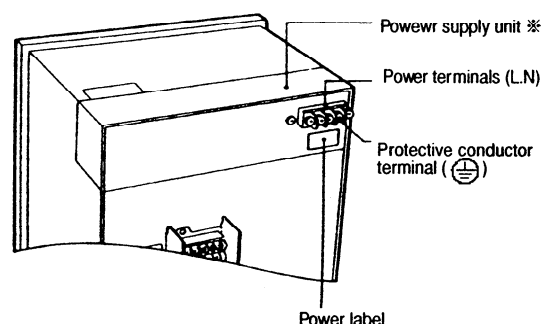
If abnormal odor, noises, or smoke occurs, or if the instrument is hot to such an extent as it cannot touch by hand, a dangerous trouble may occur. Turn off the power supply at once, and inform our representatives of it.

Reference Non-replaceable overcurrent protective device

The following fuse is mounted on the power supply unit of this instrument for safety.

Maker : LITTEL FUSE INC.

Type : 215002P, 250V 2A



※ Never remove the power supply unit case for preventing an electric shock accident.

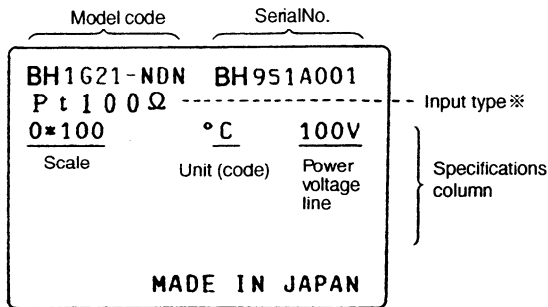
1. INTRODUCTION

1.1 Confirmation

1 Confirmation of model code

Confirm the input type and other data by the label 1 model code on the upper face of the case.

A sample of single-range label 2



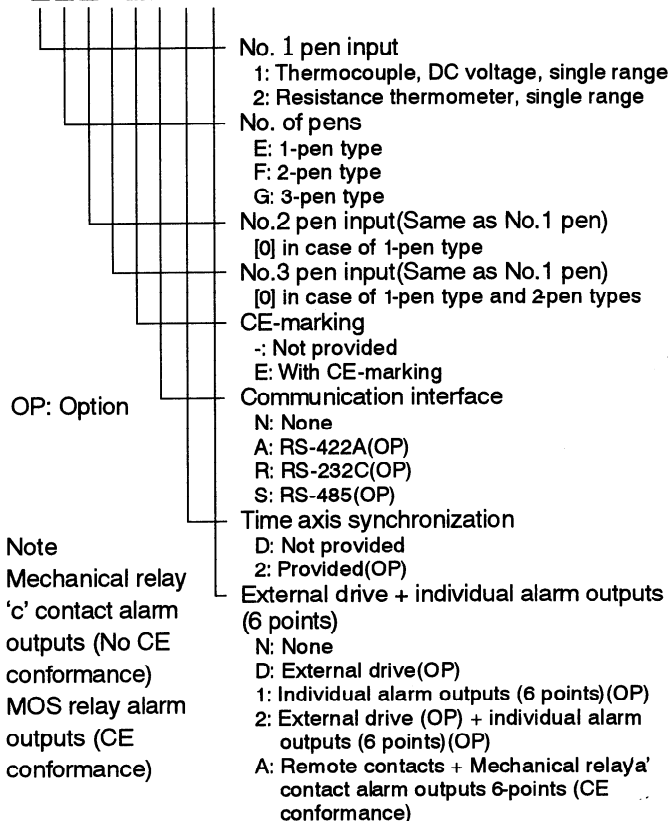
1 P = -50 * 150°C (MI)

Channel No.
Scale
Unit (code ※)
Input type (code ※)

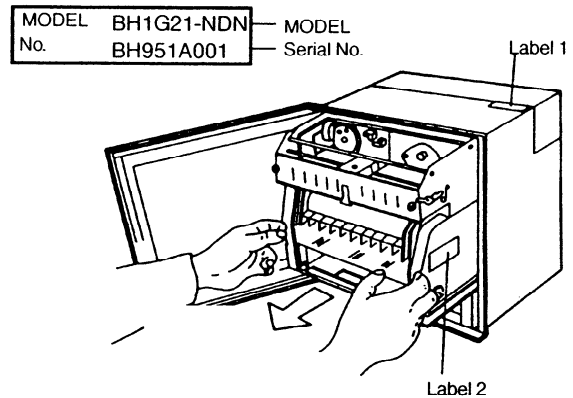
- ① 1-pen type: The unit is indicated by the code.
- ② Multi-pen type: Input specifications of each channel are indicated on the specifications column. The unit and input type are indicated by the codes.

Model Code

BH1E00-NDN



Confirm the input type and other data by the label model code on the upper face of the case.



2 Items to be specified in advance (Caution and requests)

1 Attached chart (Recording chart)

The chart corresponding to the standard scale is delivered. A 0 to 100 divisions (equally divided into 100 divisions) chart EH1001 is mounted to the instrument having a scale other than the standard scale.

Standard scales and chart No.

Standard scale	Chart No.	Standard scale	Chart No.
0 to 50°C	EH05045	0 to 1000°C	EH05036
0 to 100°C	EH05001	0 to 1200°C	EH05035
0 to 150°C	EH05044	0 to 1400°C	EH05031
0 to 200°C	EH05043	0 to 1600°C	EH05034
0 to 250°C	EH05042	0 to 1800°C	EH05030
0 to 300°C	EH05041	400 to 1600°C	EH05048
0 to 400°C	EH05040		
0 to 500°C	EH05039	0 to 5mV	
100 to 250°C	EH05049	0 to 10mV	
-20 to +80°C	EH05056	0 to 20mV	
-40 to +80°C	EH05055	0 to 50mV	
-50 to +150°C	EH05052	-5 to +5mV	
-50 to +100°C	EH05053	-10 to +10mV	
-50 to +50°C	EH05054	1 to 5V	
-100 to +50°C	EH05051		
-100 to +200°C	EH05065	4 to 20mA	
-50 to +200°C	EH05064	10 to 50mA	
50 to 100°C	EH05050	Double scale	
0 to 600°C	EH05038	Other than the standard scales	
0 to 800°C	EH05037		

Since the temperature scales (°C) are linear, they can be used in common, irrespective of the types of thermocouples and resistance thermometers.

2) Restriction of digital recording and printing functions

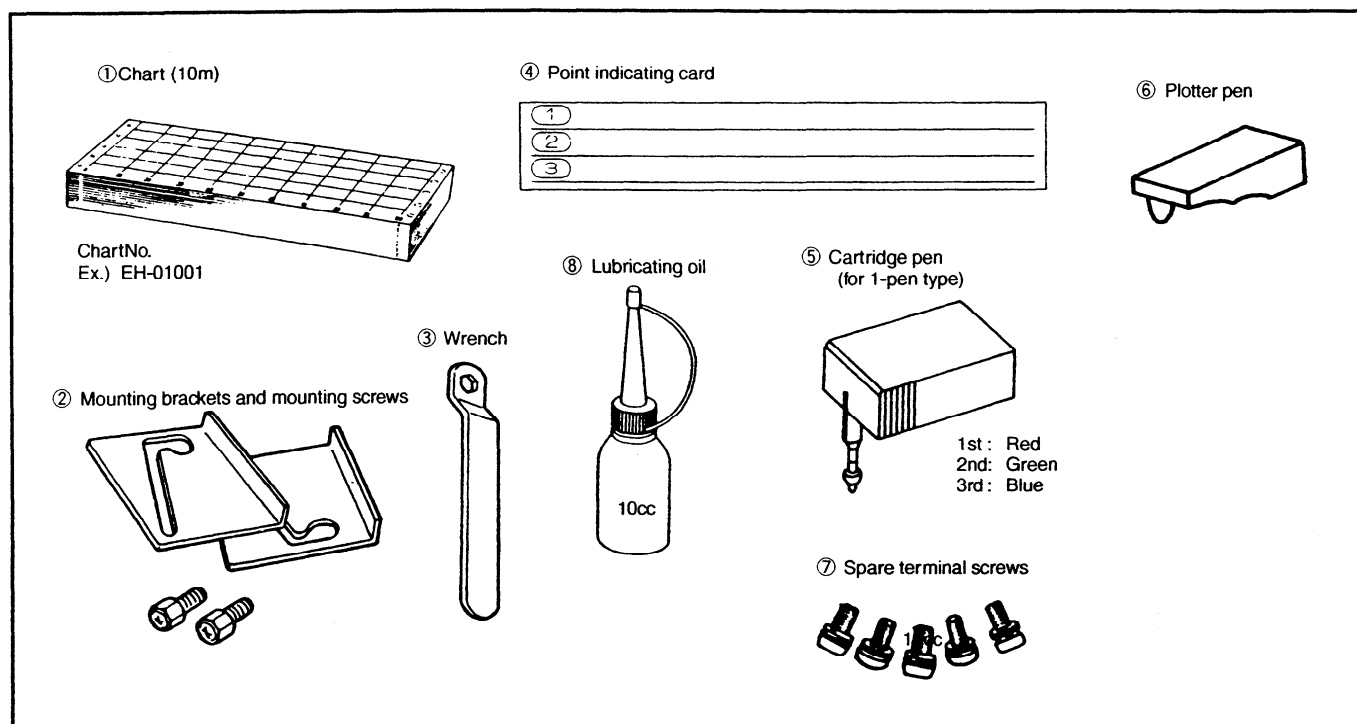
- ① If the chart speed is set to be higher than 151mm/H, no printing functions are possible. (Data cannot be printed.)
- ② Since digital characters are formed by one-pin dots, characters are not formed correctly, if the power supply is turned off during the formation of characters, and this condition does not mean any trouble.

1.2 Attachments

1 Appearance check

- ① Check if the door on the front panel of the instrument is free of flaws and fissures.
- ② Check if the door is opened and closed smoothly.
- ③ Check if the entire case is free of fissures and flaws.

2 Attachments check



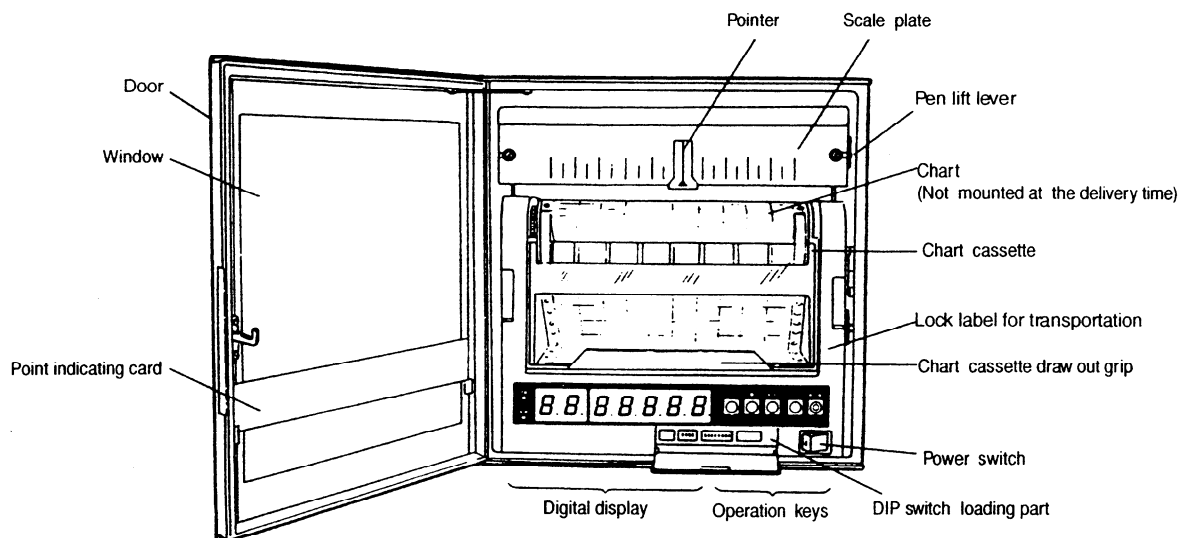
3 Ordering of consumables

Various pens and chart are consumables. For ordering them, please specify them, referring to the following table.

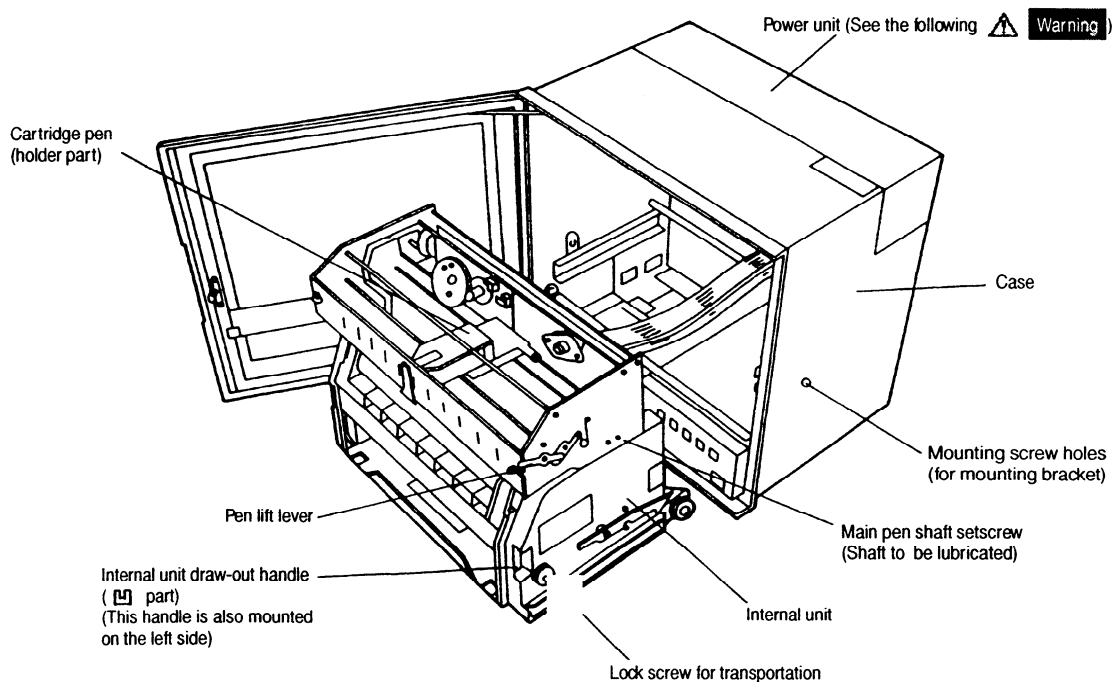
Name	Article name and specifications for ordering	Handling unit
Chart	Chart No. (Example EH05001)	1 case (containing 15 pads)
Cartridge pen	BH cartridge pen <input type="checkbox"/> pen For No. ○ pen, <input type="checkbox"/> , ○ : 1 to 3	1 bag (containing 3 pieces)
Plotter pen	BL plotter pen	1 bag (containing 3 pieces)

2. NAMES OF COMPONENT PARTS

1 Front panel



2 Internal unit drawing ass'y



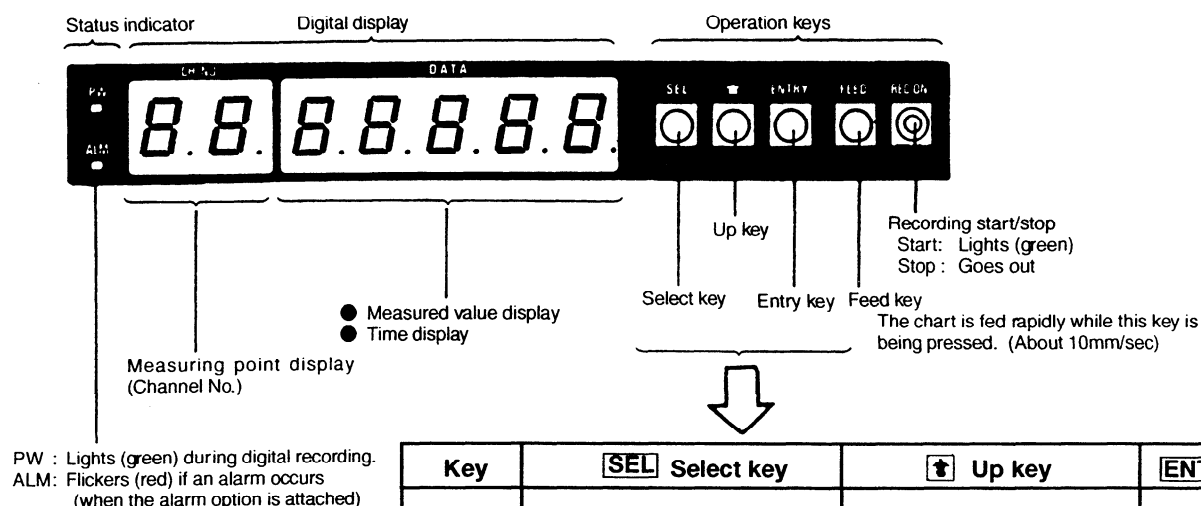
 **Warning** Don't remove the case and cover of the power supply unit.

Don't remove the case and cover of the power supply unit for preventing an electric shock accident, since the unit contains electric circuits.

 **Caution** Don't remove the internal unit as illustrated above.

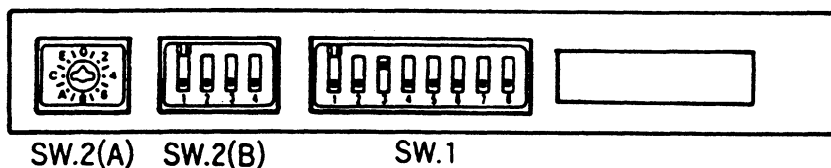
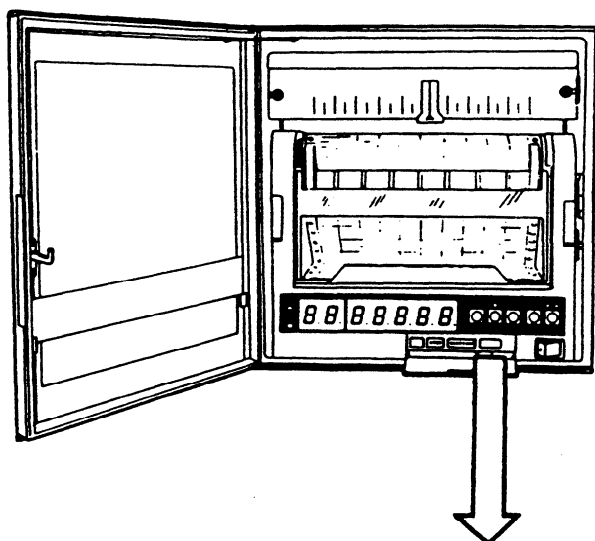
Draw out the internal unit until it is stopped by the stopper for preventing it from falling or being damaged. Electric circuits are mounted at the innermost of the internal unit and the case interior.

3 Digital indicator and operation keys



Key	[SEL] Select key	[↑] Up key	[ENT] Entry key
Operation	Selects the display mode.	Advances channels stepwise in case of one-point continuous display.	
Setting	<ul style="list-style-type: none"> Transfers from setting mode to display mode or viceversa by pressing this key for longer than 2 seconds. Advances setting items stepwise. 	<ul style="list-style-type: none"> Setting start Advances numerics and signs stepwise. Advances channel numbers stepwise. 	<ul style="list-style-type: none"> Selects parameters. Enters the setting contents.

4 DIP switches



Switch name	Contents
SW.1	Selects the power frequency, chart speed No., keylock function, etc. See 3.3 on page 8.
SW.2(B)	This switch applies to the communication function. Don't touch this switch. (Note)
SW.2(A) (Rotary switch)	This switch applies to the communication function. Don't touch this maintenance switch.

Note : For the switch operation, refer to **Caution** in par. 3.3 on page 8.

Set positions at the delivery time based on the standard specifications.
If the communication (option) function is provided, No.3 of SW2(B) is turned on.

3. OPERATION

3.1 Basic Operation

This instrument can be operated at once simply by turning on the power supply. No troublesome setting is necessary, in particular.

1 Turn on the power supply

2 Initialisation sequence

It takes about 15 seconds to perform the initialisation operation.

3 Time setting

Year, month, and day can be changed in addition to time (hours, minutes).

The instrument is preset to the Japanese time at the delivery time.

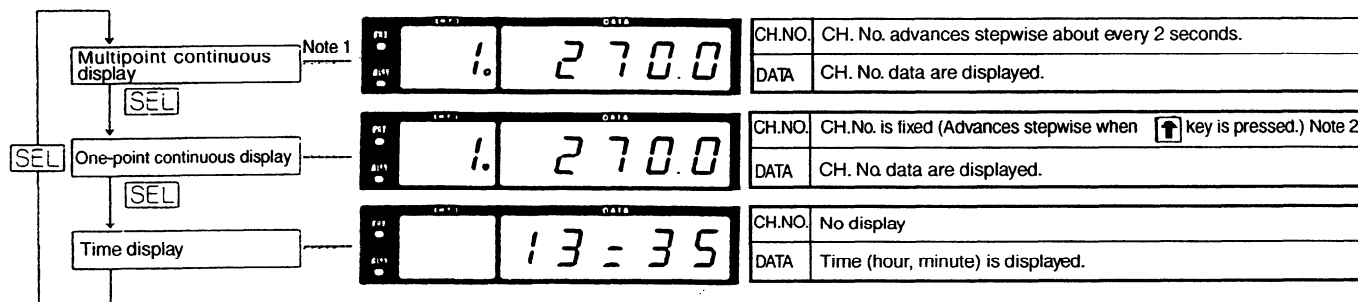
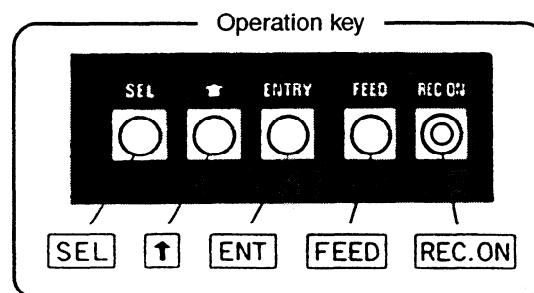
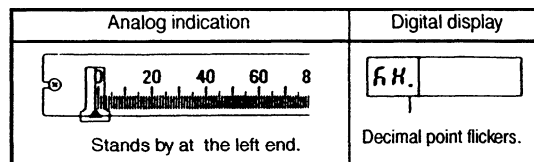
Change method ----- See par. 7.2 on page 21.

4 Chart mounting condition check

Try pressing **FEED** switch, and check if the chart is correctly fed fast while this key is being pressed. (About 10mm/sec)

5 Display selection

The display contents change each time **SEL** key is pressed.



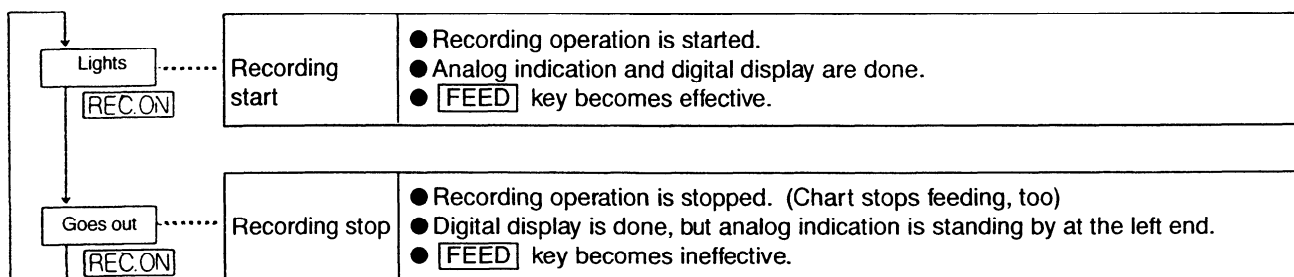
Note 1: In case of the 1-pen type, channel No. is fixed to 1. data are updated every about 0.5sec. (in the same way as in one-point continuous display).

Note 2: In case of the 1-pen type, channel No. is fixed to 1, every if ↑ key is pressed. Data are updated every about 0.5sec.

※ The decimal point of CH No. flickers in multipoint sequential display, and lights in one-point continuous display.

6 Recording start/stop

The lamp (green) lights or goes out repeatedly, each time **REC.ON** key is pressed.

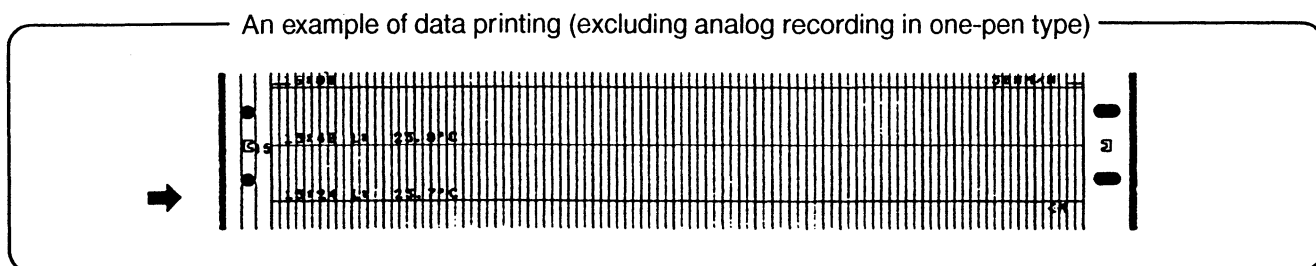


3.2 Applied Operation

1 Digital recording of present data → [Data print]

- ① Data at the demanded time (15:24 hours in case of the example) are recorded digitally together with analog recording.
- ② The recording time depends upon the chart speed. It takes about 5 minutes in case of 25mm/H, for example.

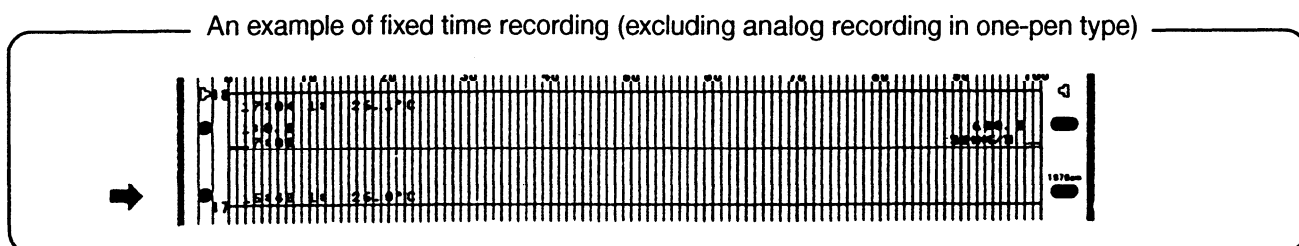
Starting method See par. 7.3 on page 24.



2 Digital recording at a fixed interval → [Fixed time recording]

- ① Data are digitally recorded at a preset interval together with pen-writing analog recording.
- ② The interval time and start time must be set.
(Neither interval time nor start time is set at the delivery time.)

Setting method See par. 7.4 on page 25.



3 Chart speed change → [Chart speed]

One of three speed numbers is selected.
The speed of each speed No. can be reset.

Setting method See par. 7.1 on page 19.

Setting range

1(mm/H) to 599(mm/H) and 10(mm/M) to 200(mm/M) for each speed No.

4 Deletion of unused channels ➡ [Skip function]

- ① Unused channels can be skipped in 2-pen and 3-pen types. No operation is done in deleted channels.
- ② No operation is done, if they are deleted in one-pen type.

Deletion method See par. 7.5 on page 28.

Caution Pens in deleted channels

Remove the cartridge pens in deleted channels, and store them after covering them with their caps.

5 Functioning of alarm (option) ➡ [Alarm value setting] (key setting)

- ① No alarm value is set at the delivery time.
- ② For alarm operation, set alarm values.

Setting method See par. 8.2 on page 33.

6 Setting of the same alarm value to the other channels ➡ [Alarm value copy] (key setting)

The same alarm value can easily be set to the other channels.

Setting method See par. 8.3 on page 34.

7 Reset lock ➡ [Key lock] (DIP. SW1)

Set contents can be confirmed, but they cannot be changed if key lock is selected.

Locking method See par. 3.3 on page 8.

8 Deletion of time printing ➡ [Time printing] (DIP. SW1)

Time printing occurs at certain intervals, and it depends upon the chart speed. Time printing can be deleted.

Deletion method See par. 3.3 on page 8.

Time printing intervals			
Chart speed	Less than 4mm/H	5 to 9mm/H	Higher than 10mm/H
Printing interval	12 to 3H	2H	1H

9 Deletion of digital recording function ➡ [Digital recording] (DIP. SW1)

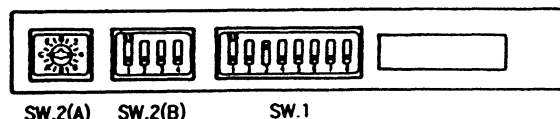
- ① Date (year, month, day), ② Scale (divisions), ③ Chart speed, ④ Time lines, and ⑤ Time to be printed at fixed time can be deleted.

Deletion method See par. 3.3 on page 8.

3.3 Selection of Functions (DIP. SW1)

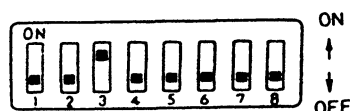
1 Mounting position and names of switches

After taking out the chart cassette, the switches are accessible at the lower part of the internal unit.



2 Functions and the status when switches are turned on or off

Set positions of SW1 at the delivery time



Functions	OFF	ON	Delivery time (OFF)	Remarks
Time printing	Provided	Not provided	Provided	See reference 2.
Fixed time printing	Provided	Not provided	Provided	See reference 2.
Unoccupied	—	—	—	
Power frequency	50Hz	60Hz	50Hz	
Chart speed No.3			50mm/H	
Chart speed No.2			25mm/H	
Chart speed No.1			12.5mm/H	
Key lock	UNLOCK	LOCK	UNLOCK	See reference 1.



Caution Before operating switches

- Electronic parts may be broken by the static electricity of the body when touching switches SW.1 to SW.3.
- Discharge the static electricity from the body by touching a grounded metal (the side panel of the internal unit in case of this instrument, for example) by hand before operating SW1 to SW3.

Remarks

SW.2 and SW.3

SW.2 are mainly used for communication (except for No.8), while SW.3 are mainly used for maintenance. Don't touch any switches other than SW.2 communication (option) switches.

Reference 1 What does the key lock mean?

- Setting cannot be changed.
- FEED** and **REC. ON** keys become inoperable.
- Set contents can be confirmed.

Reference 2 Selection of fixed time printing and time printing functions

- These functions are selectable by turning on or off No.7 and No.8 of DIP. SW1.
- Turn the power switch ON → OFF → ON without fail after selection.
(The switch position is recognizable only when the power switch is turned on.)

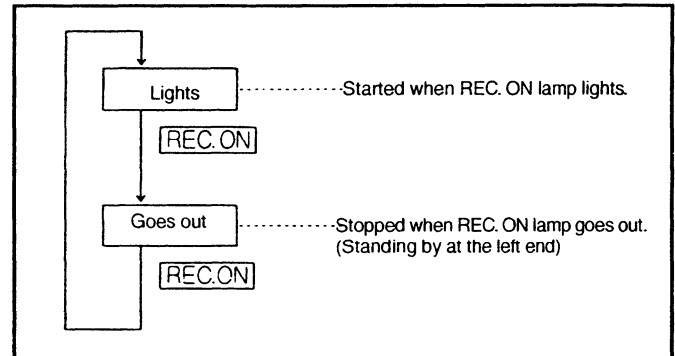
Functions	No.	OFF	ON
Fixed time printing	7	Provided	Not provided
Time printing	8	Provided	Not provided

4. INDICATION AND DISPLAY

4.1 Analog Indication

1 Indication start and stop

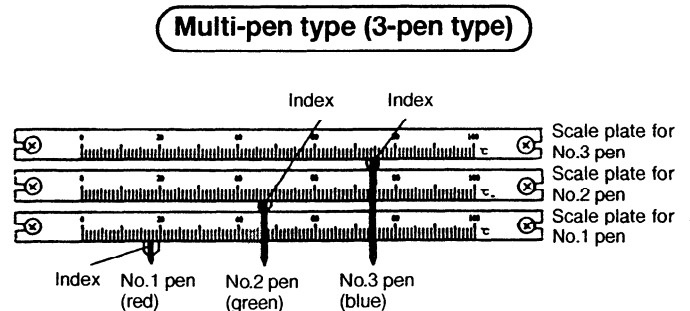
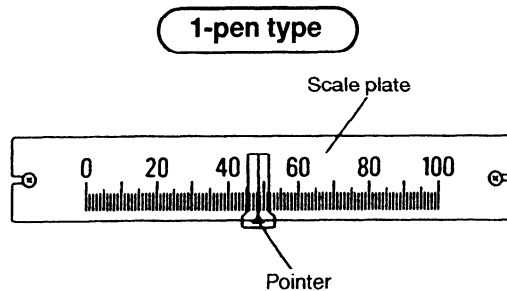
- ① Indications are started (The lamp lights) and stopped (The lamp goes out) alternately each time **REC. ON** key is pressed once.
- ② Indications shift to the left end to be standing by when indications are stopped.



Remarks Digital display is irrespective of whether the **REC. ON** key is pressed or not.

Even if analog indication is stopped by pressing **REC. ON** key, digital display is done without being affected by analog indication stop.

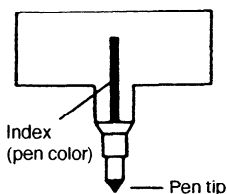
2 Analog indication



Reference 1

The 2-pen type is not provided with No.3-pen ass'y in the 3-pen type.

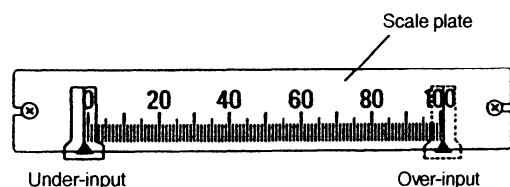
Reference 2 Pointers (indexes) of multi-pen type



- ① The pointer structure is different from the structure of one-pen type.
- ② The pen color line provided at the upper part of the cartridge pen pipe serves as a pointer (index).

Reference 3

Indication in case of an under-input and an over-input



The indication is about 0.5mm less than MIN. or more than MAX.

Reference 4

Analog indication up-date interval

Analog indication data are updated every about 0.5sec.
It takes about 2 seconds to shift the analog indication over the entire span.

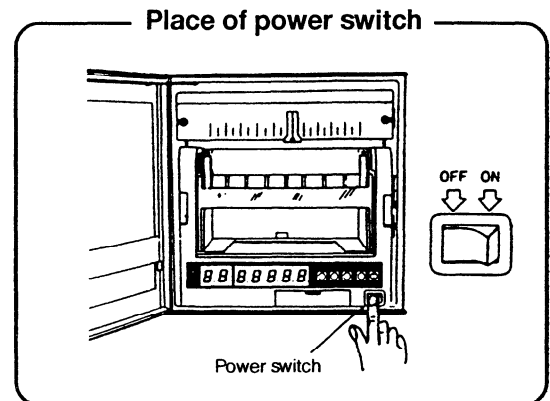
4.2 Digital Display

1 Display start and stop

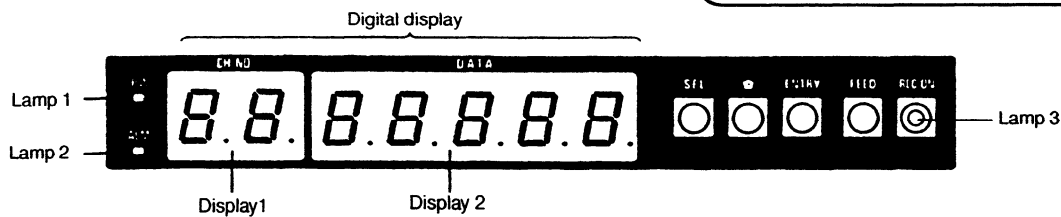
Display appears when the power switch is turned on.
No exclusive display switch is provided.

Reference 1 Analog indication

If **REC. ON** lamp goes out, analog indication is not started, but it is standing by at the left end, even if the power switch is turned on.



2 Names and functions of digital indicator



PW	(green)	Lights during digital recording & printing.
ALM	(red)	Flickers during the occurrence of an alarm (when a certain alarm point is set to an alarm status.) ※ 1
REC. ON	(green)	Lights when recording is started, and goes out when recording is stopped.
CH. NO.		Data display channel No. (Not displayed during time display) ※ 2
DATA		Data or time is displayed. ※ 2

※ 1: Flickers when an alarm function (option) is provided.

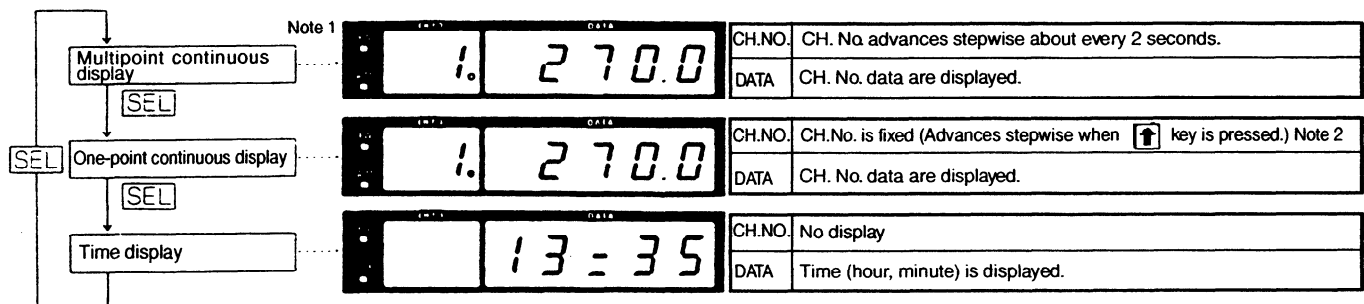
※ 2: Indicates the setting contents in the setting mode.

3 Selection of display modes

- The display contents change in the order of multipoint sequential display → one-point continuous display → time display, each time **[SEL]** key is pressed once.
- CH. No. advances stepwise, each time **[↑]** key is pressed in one-point continuous display mode. (excluding one-pen type)

Reference 2 Display in case of an under-input or an over-input

Over-input	!	---
Under-input	!	---

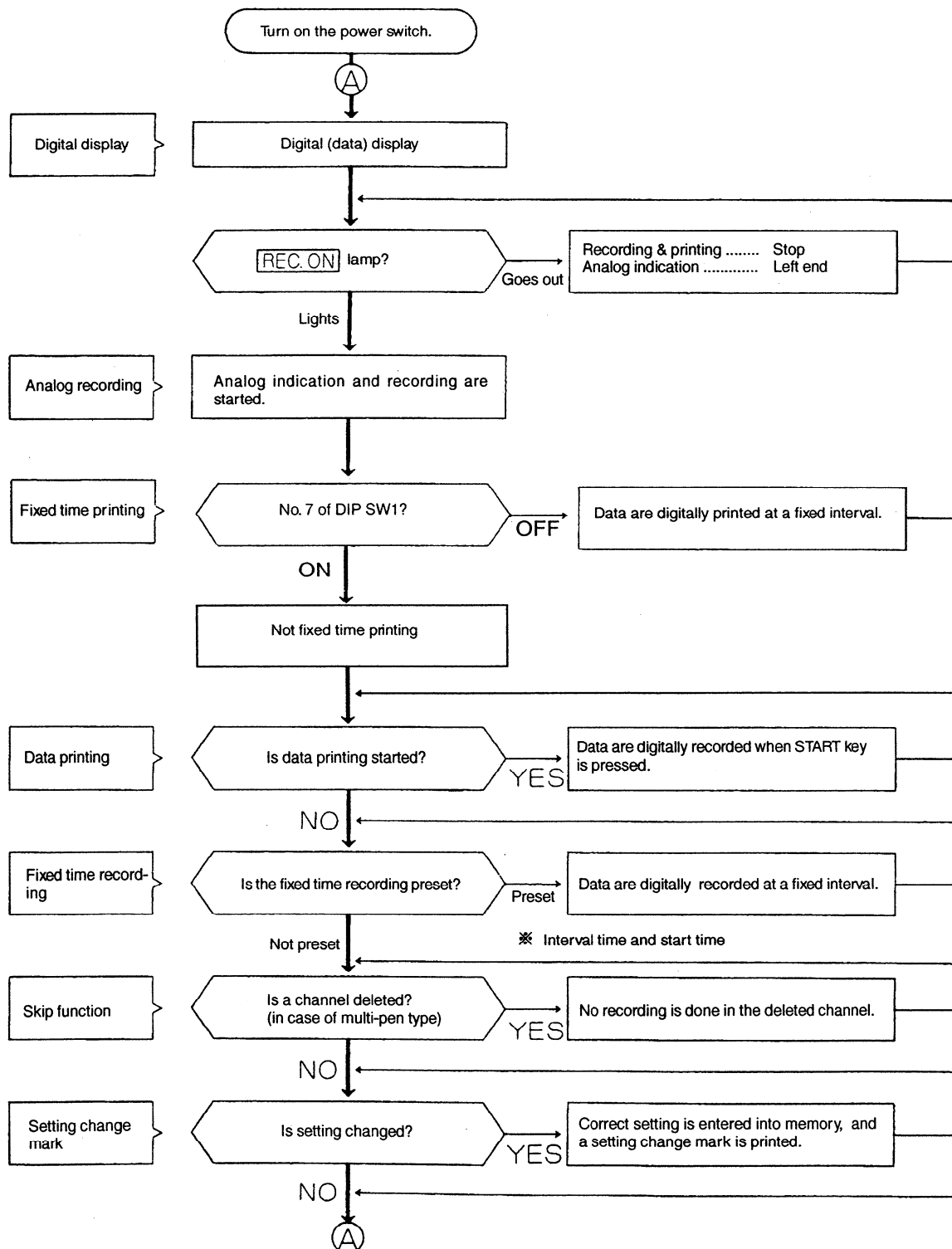


Note 1: The decimal point of CH. No. flickers. Channel No. is fixed to 1 in case of one-pen type. Data are updated every about 0.5sec.

Note 2: The decimal point of CH. No. remains lit. Channel No. is fixed to 1 in case of one-pen type, even if **[↑]** key is pressed. Data are updated every about 0.05sec.

5. RECORDING OPERATION

5.1 Recording Operation



Remarks

Digital recording (printing) time

Data are dot-printed according to the chart speed. If the chart is not fed by the printing width (7 dots), characters are not finished. Accordingly, the printing time depends upon the chart speed.

Reference

Whether time is printed or not;

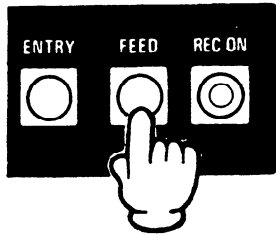
No time is printed when No.8 of DIP. SW1 (which selects whether time is printed or not) is turned on.

5.2 Recording and Fast Feed

1 Fast feed of chart

The chart can be fed fast, and this function is convenient for the following cases.

- ① Setting of the time scale to the present time
- ② Chart feed check after chart exchange
- ③ Chart feed for newly recording data



Condition : **REC. ON** lamp (green) is lit.

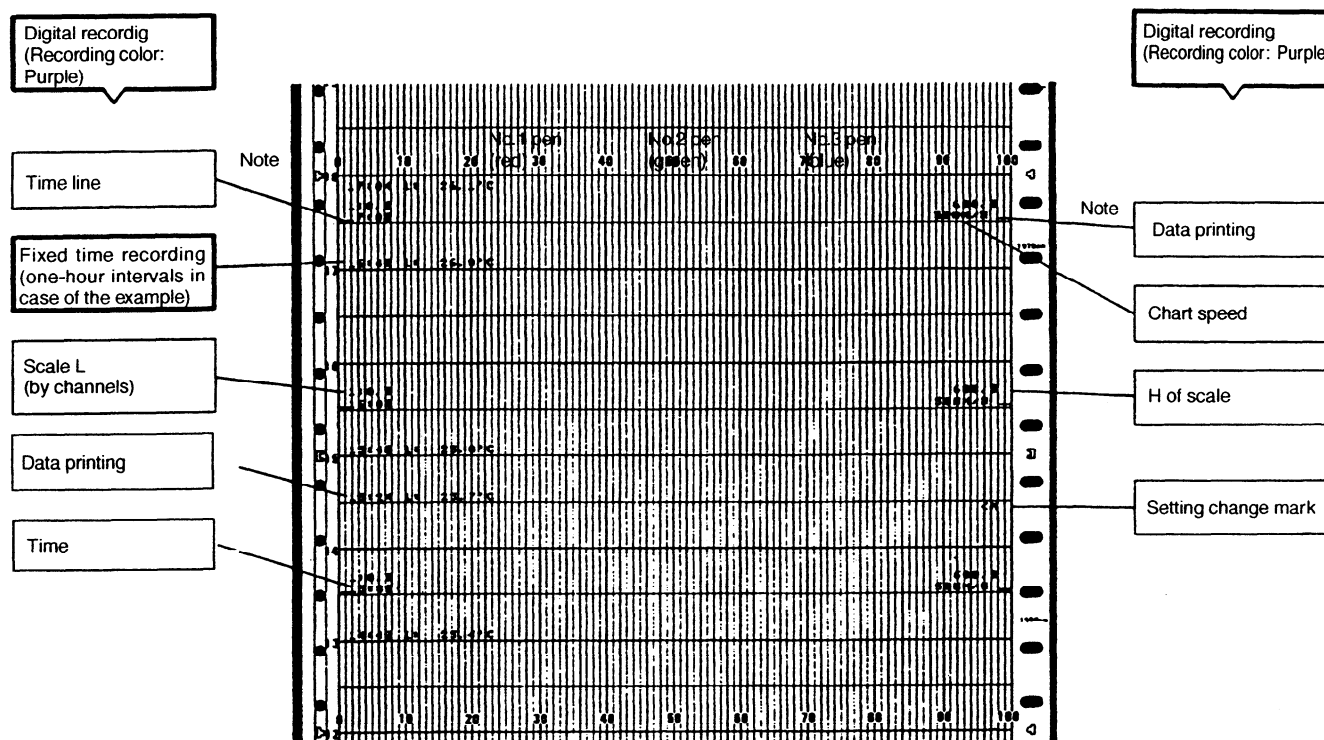
Method : The chart is fed at a speed of about 10mm/sec when **FEED** key is pressed.

Remarks : During the extinction of **REC. ON** lamp —
Don't press **FEED** switch, otherwise the pen exchange mode is selected to fix the indications. Press **REC. ON** switch to light its lamp before starting this operation.

5.3 Recording Names and Pen Intervals

Recording can be sorted into analog recording with a cartridge pen and digital recording where characters are formed by dotting with plotter pens.

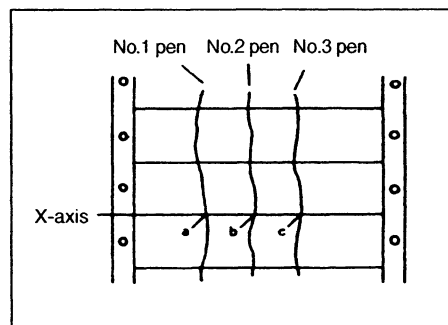
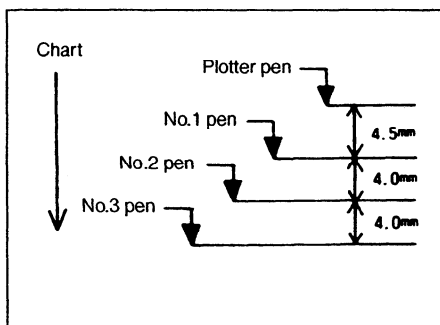
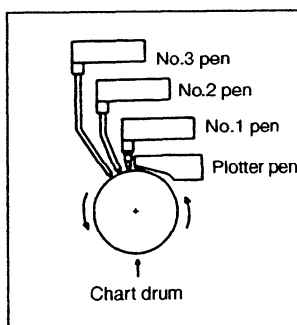
The following figure shows an example of 1-pen type digital recording. Analog recording is excluded for easy reading in this case.



(Note) This shows the time of No.1 pen in case of multi-pen type.

Remarks Pen intervals in case of multi-pen type

Each pen is not aligned on the same time axis. Be careful since recording time lag occurs in recording results, because of the intervals as shown in the following figure. The time line printed by the plotter pen shows the time of No.1 pen. When the time axis synchronization function (option) is provided, recording results can be compared on the same time axis without any time lag. (See the right figure.)



Reference Recording time difference in multi-pen type

Assume that No.1 pen (point a) serves as the reference in the axis in the right figure given above, and No.2 pen (point b) records data after about 19 minutes, if the chart speed is 12.5mm/H.

Chart speed	No.2 pen (b)	No.3 pen (c)
12.5mm/H	After about 19min	After about 38min
25mm/H	After about 10min	After about 19min
50mm/H	After about 5min	After about 10min

5.4 Digital Recording and Printing Contents

Division	Recording name	Recording contents		Remarks												
Digital recording	Fixed time recording ※ Signs and decimal point are included.	1. Time 2. Channel No. 3. Measured value (max. 6 digits ※) 4. Unit (2 digits)		Data are recorded on analog recording at a preset optional interval. This interval time is restricted by the chart speed. Refer to (Remarks).												
	Data printing ※ Signs and decimal point are included.	1. Time 2. Channel No. 3. Measured value (max. 6 digits ※) 4. Unit (2 digits)		By pressing START key, data at the start point are recorded on analog recording.												
Digital printing	Fixed time printing	1. Time line 2. Time 3. Chart speed 4. Scale (L) 5. Scale (H) Items 4 and 5 are printed in different channels.		• Printing is done at a fixed interval according to the chart speed. • The printing cycle depends upon the contents and chart speed.												
	Alarm printing (only when the option is attached)	In case of the occurrence of an alarm	1. Occurred time 2. Channel 3. Alarm type 4. Level	These data are printed on the right side of the chart when an alarm occurred, and also, when the alarm has been reset. <div>In case of the occurrence of an alarm</div> $\frac{11:49}{1} \quad \frac{1}{2} \quad \frac{H}{3} \quad \frac{1}{4}$ <div>In case of the reset of the alarm</div> $\frac{11:50}{1} \quad \frac{1-1}{2} \quad \frac{1}{3}$												
	Setting change mark printing	1. Setting change mark ● This mark is printed on the right side of the chart when setting has been changed. ● If not printed, this setting change is not completed, so that the instrument is operated with the previous set contents.	<table><tr><th>Setting item</th><th>Change mark</th></tr><tr><td>Chart speed</td><td><H</td></tr><tr><td>Time</td><td><O</td></tr><tr><td>Fixed time digital recording</td><td><I</td></tr><tr><td>Alarm value</td><td><A</td></tr><tr><td>Skip</td><td><K</td></tr></table>			Setting item	Change mark	Chart speed	<H	Time	<O	Fixed time digital recording	<I	Alarm value	<A	Skip
Setting item	Change mark															
Chart speed	<H															
Time	<O															
Fixed time digital recording	<I															
Alarm value	<A															
Skip	<K															

Remarks 1 Be careful since neither digital recording nor printing is started in the following case.

Neither digital recording nor printing is started, if the chart speed is set to be higher than 151mm/H. The shortest interval time of fixed time recording is restricted according to the chart speed.

See (Remarks) given below. (For related item, refer to page 25.)

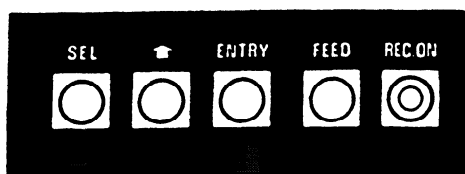
Remarks 2 Digital recording & printing

Since characters are formed by dotting, character sizes may differ according to the chart speed, and also, the right and left printing positions may be deviated from each other on the chart.

6. BASIC SETTING

6.1 Setting Keys and Setting Items

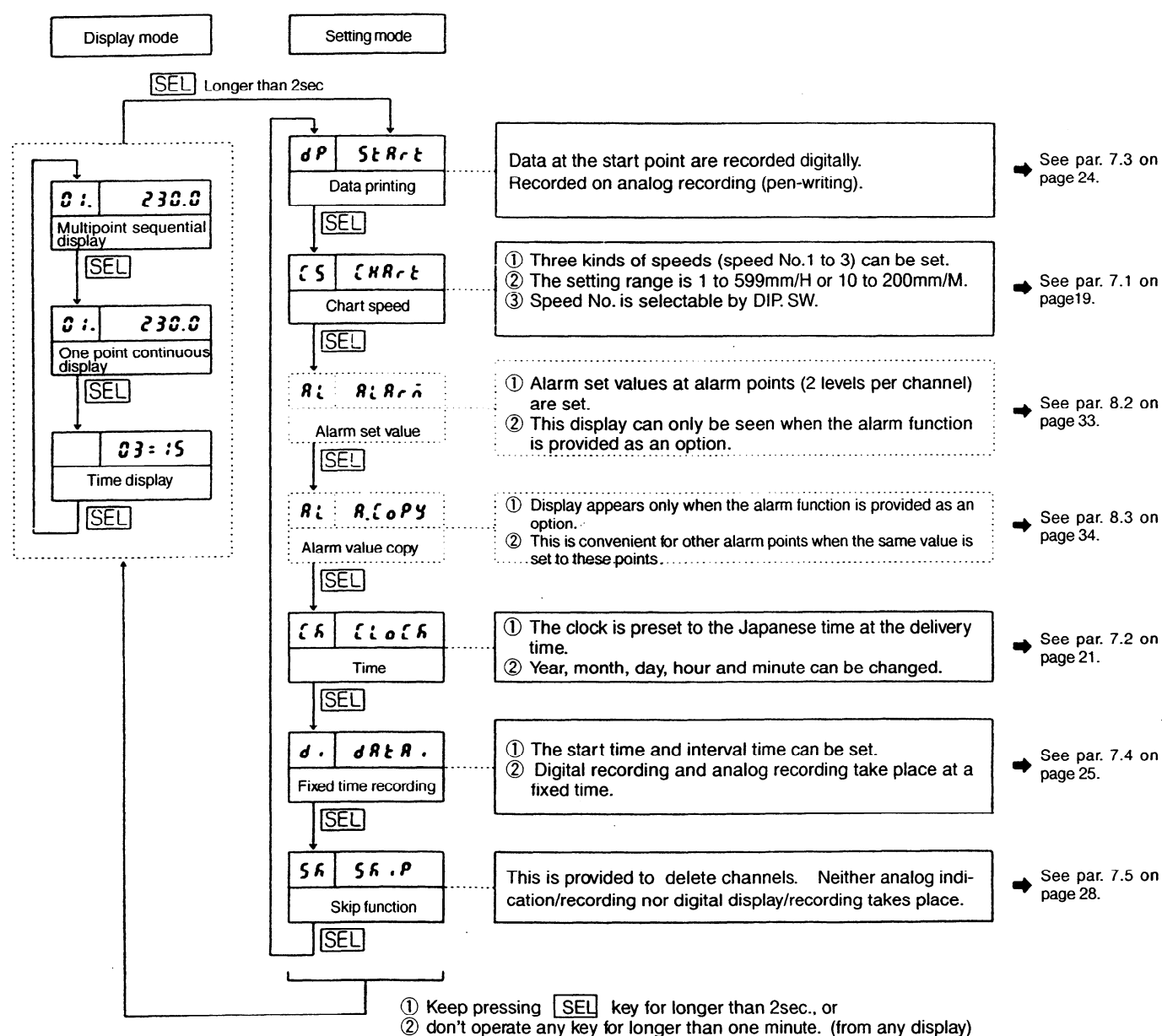
1 Setting keys



Setting keys

- SEL** : Advances through the modes, and selects setting items
- ↑** : Starts setting, and advances numerics and channels No.
- ENT** : Executes entry, stepwise advance of parameters, and move of cursor.
- Key symbols employed in the flow chart

2 Setting items



6.2 Setting Ranges

Setting items	Parameters	Delivery time	Setting ranges
Chart speed	Speed No.1	12.5(mm/H)	1 to 599 (mm/H) or 10 to 200(mm/M) (Common each speed)
	Speed No.2	25(mm/H)	
	Speed No.3	50(mm/H)	
Time	Hour, minute	Preset to the Japanese time.	00:00 to 23:59
	Year		1993 to 2092
	Month, day		01/01 to 12/31
Fixed time recording	Interval time	Not set	00:02 to 24:00 ※
	Start time	Not set	00:00 to 23:59
Skip function (Channel deletion)	Channel 1	No skip	Whether the skip function is provided (1) or not (0) can be set every channel.
	Channel 2	No skip	
	Channel 3	No skip	
	The instrument stops functioning, if all channels (channel 1 in case of 1-pen type) are skipped.		

※The shortest interval time is restricted according to the chart speed. For details, refer to **Remarks 1** on page 14.

Reference 1 Chart speed No. selection

Chart speed No. can be selected by DIP. SW1.
See page 19.

Reference 2 Month/day error decision

This instrument judges the leap year and whether the month is a 31-day month or a month with thirty or less days, and issues a set error (5.E), if Feb. 30 is set, for example.

Reference 3 Whether fixed time recording is possible or not

Digital recording is not performed, if DIP. SW1 No.7 is set to ON, even if fixed time recording is preset.
See page 8.

Reference 4 Digits in display

The number of display digits are already designated depending on the scale range.
For instance 0.1 digit is not displayed in a range of 0 to 2000°C.

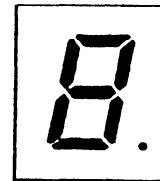
Reference Setting change mark

- ① A setting change mark is printed on the right side of the chart when **ENT** (entry) is done after changing various set values.
- ② The change mark depends upon the kinds of setting.
- ③ If no change mark is printed after a change, it is caused by no entry due to a setting error.

Setting item	Setting change mark
Chart speed	<H
Time	<O
Fixed time recording	<I
Alarm (when the alarm functions provided as an option)	<A
Skip	<K

6.3 Characters of Display

This instrument uses a 7-segment indicator. Alphabetic characters are displayed as shown in the following table, since part of them cannot be reasonably represented.



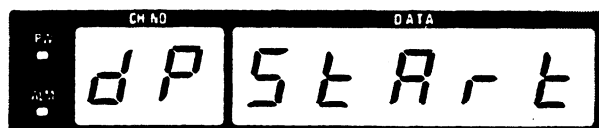
7-segment
LED

1 Alphabetic characters

A	B	C	D	E	F	G	H	I	J	K	L	M
<i>A</i>	<i>b</i>	<i>C</i>	<i>d</i>	<i>E</i>	<i>F</i>	<i>G</i>	<i>H</i>	<i>I</i>	<i>J</i>	<i>K</i>	<i>L</i>	<i>M</i>

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
<i>n</i>	<i>o</i>	<i>P</i>	/	<i>r</i>	<i>S</i>	<i>t</i>	<i>U</i>	<i>V</i>	<i>W</i>	/	<i>Y</i>	<i>Z</i>

2 Major characters employed



Display		Characters		Meanings
CH.NO.	DATA	CH.NO.	DATA	
<i>dP</i>	<i>StAr-t</i>	DP	START	Data printing execution (start)
<i>CS</i>	<i>CHART</i>	CS	CHART	Chart speed setting item
<i>AL</i>	<i>ALARM</i>	AL	ALARM	Alarm value setting item ※
<i>AL</i>	<i>A.COPY</i>	AL	A.COPY	Alarm value copy setting item ※
<i>CK</i>	<i>CLOCK</i>	CK	CLOCK	Time setting item
<i>dI</i>	<i>DATAI</i>	DI	DATAI	Fixed time recording setting item
<i>SK</i>	<i>SKIP</i>	SK	SKIP	Skip function setting item

※ Displayed only when the alarm option is added.

3 Numerical value/sign

1	2	3	4	5	6	7	8	9	0	Space	Minus	Hyphen	Colon	~
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	<i>9</i>	<i>0</i>		<i>-</i>	<i>-</i>	<i>:</i>	<i>~</i>

6.4 Setting Errors and Remedial Measures

1 Kinds of setting errors

Two kinds of setting errors are present; **S.E.** and **F.E.**.

1	S.E. (Abbreviation of SET ERROR)
A set value is out of the setting range, but the setting format is correct.	

An example of **S.E.**

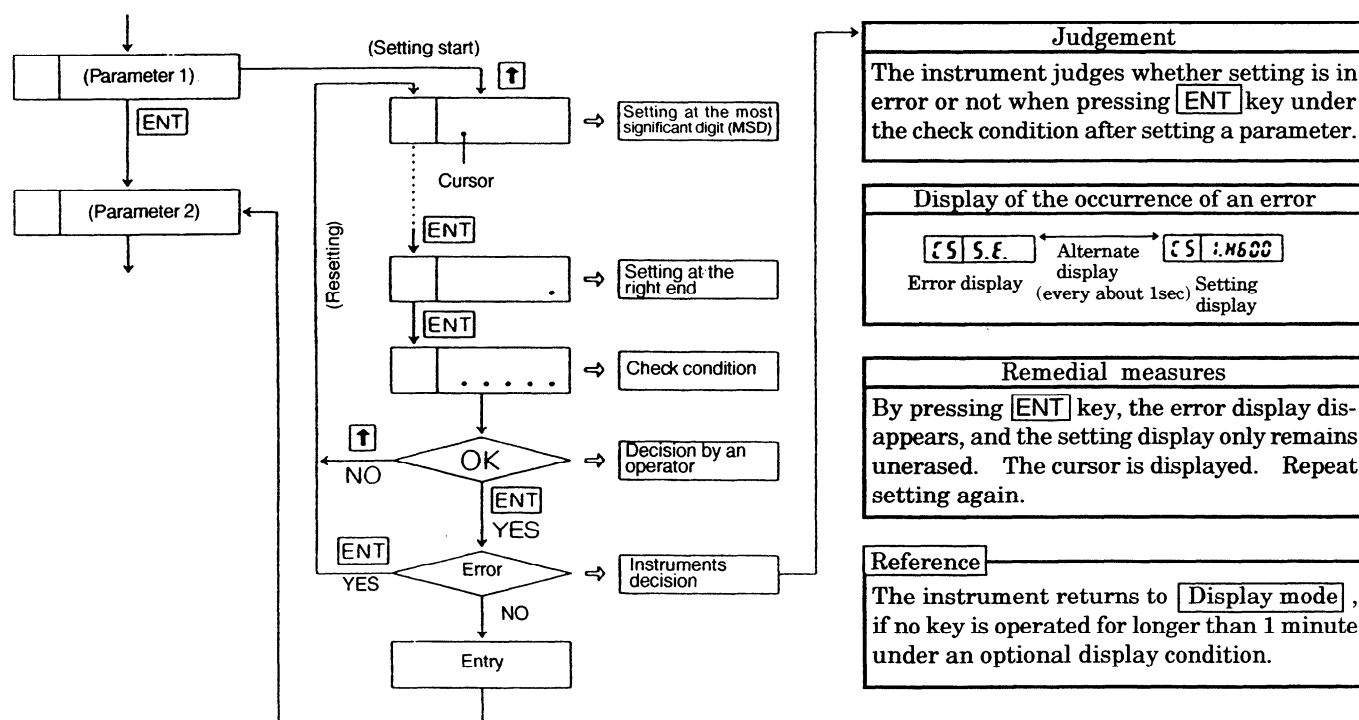
Chart speed (CS Chart)
Occurrence of <div style="border: 1px solid black; padding: 2px; display: inline-block;">CS 1.2000</div> ⇒ <div style="border: 1px solid black; padding: 2px; display: inline-block;">S.E.</div>
<div style="display: flex; align-items: center; margin-left: 100px;"><div style="border-left: 1px solid black; border-top: 1px solid black; width: 50px; height: 50px; margin-right: 10px;"></div><div>Chart speed is set to 600mm/H. Speed No.</div></div>
Since the setting range is 1 to 599 (mm/H) or 10 to 200(mm/M), 600(mm/H) is out of the setting range.

2	F.E. (Abbreviation of FORMAT ERROR)
A setting format is in error. S.E. is displayed preferentially, if F.E. occurs concurrently.	

An example of **F.E.**

Fixed time recording (d . d R t . R .)	
Occurrence of	<div style="display: inline-block; border: 1px solid black; padding: 5px; margin: 0 5px;"> d . : . 00 </div> ⇒ F . E .
<div style="display: flex; align-items: center; justify-content: center; margin: 0 auto; width: 50%;"> <div style="border-top: 1px solid black; width: 20px; height: 10px; margin-right: 5px;"></div> <div style="text-align: left;">Space</div> </div> <div style="display: flex; align-items: center; justify-content: center; margin: 0 auto; width: 50%;"> <div style="border-top: 1px solid black; width: 20px; height: 10px; margin-right: 5px;"></div> <div style="text-align: left;">Interval time</div> </div>	
<hr style="border: 1px dashed black;"/> <p>At the delivery time or setting is done after clearing, all digits are spaced (┘). If ENT key is pressed and “minute” is set without setting any “hour” digit for setting 10:00 hours, for example.</p>	

2 Decision of errors and remedial measures



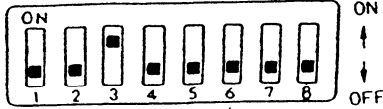
7. SETTING METHODS

7.1 Chart Speed and Speed No.

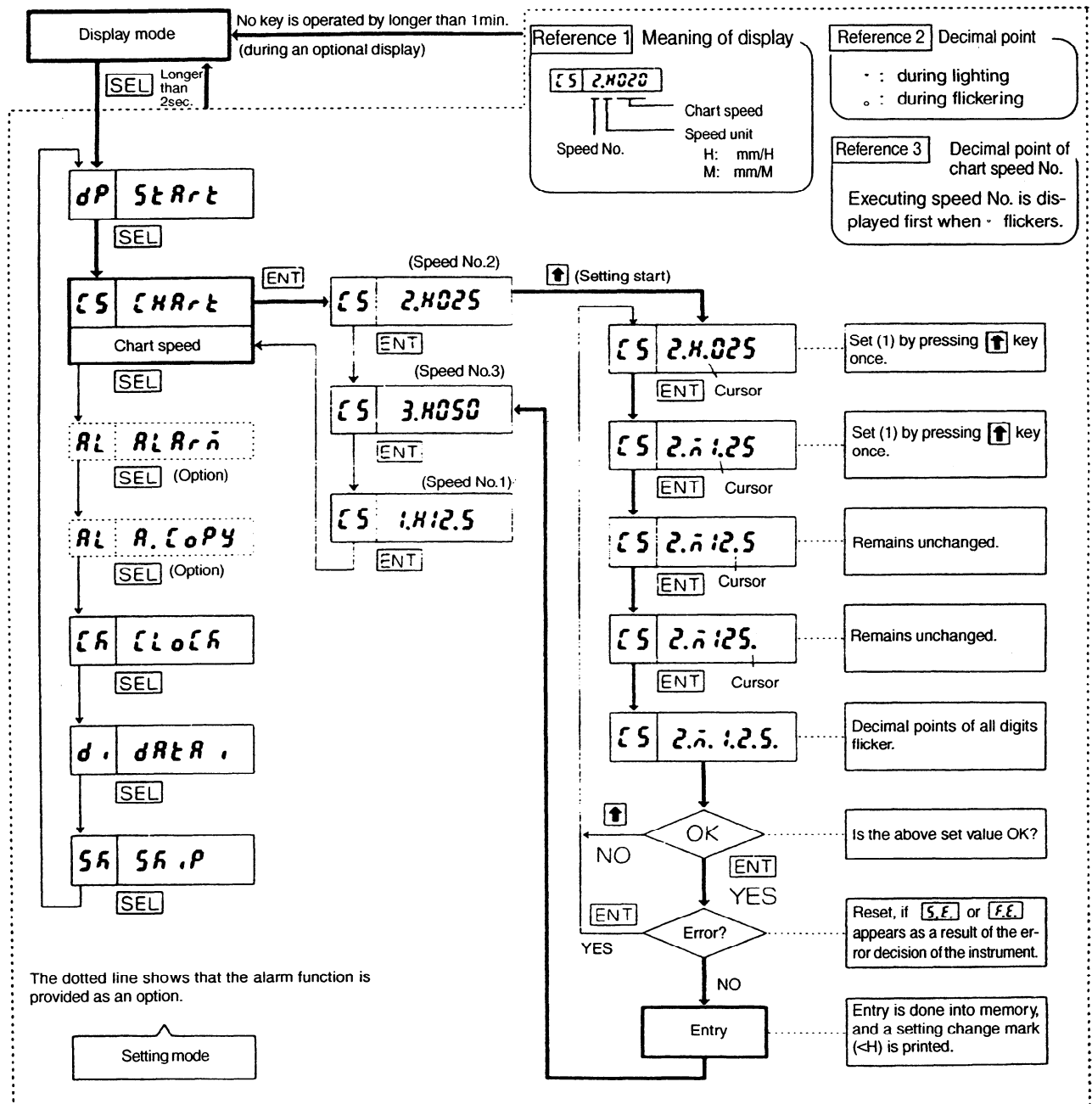
1 Setting flow chart

<Example> Change of the speed of chart speed No. (2) from 25 to 125(mm/H)

Set positions of SW1 at the delivery time

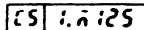



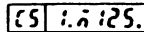



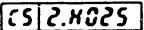


Functions	OFF	ON	Delivery time (OFF)	Setting range
Time printing	Provided	Not provided	Provided	
Digital recording	Provided	Not provided	Provided	
Unoccupied	-----	-----	-----	
Power frequency	50Hz	60Hz	50Hz	
Chart speed No.3			50mm/H	1 to 599(mm/H)
Chart speed No.2			25mm/H	or
Chart speed No.1			12.5mm/H	10 to 200(mm/M)
Key lock	UNLOCK	LOCK	UNLOCK	



2 Clearing value

The instrument returns to the initial value easily at every speed No.

- ① Select a speed No. by parameter selection 
- ② Set the instrument to be ready for setting by pressing  key. 
- ③ Press  key to shift the cursor to the right end. 
- ④ Press  key several times to select a space. 
- ⑤ An initial value is selected and the speed No. transfers to the next one when pressing  key twice. 


Reference 1 How to return to display mode

Speed No.	Initial value
1	12.5mm/H
2	25mm/H
3	50mm/H

If the chart speed is not specified by the customer, it is set to the initial value at the delivery time.

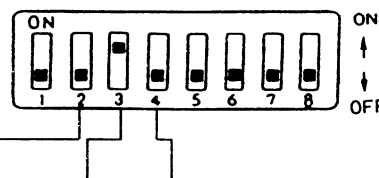
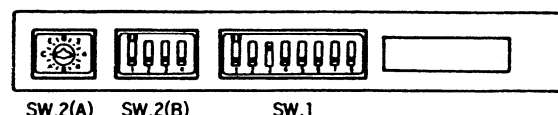
If a specified value is cleared, it returns to the initial value.

Reference 2 How to return to display mode

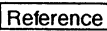
For returning the instrument to display mode when it is desired to stop or finish setting, continue pressing  key for longer than 2 seconds.

3 Chart speed No. selection

- ① Speed No.1 to 3 are switched by DIP. SW1.
- ② DIP. SW1 are mounted at the DIP. SW1 mounting part below the operation switches.
- ③ No.2 to 4 switches of DIP. SW1 are switched to a desired speed No. Speed No. is set to [2] (25mm/H) at the delivery time.



Reference 1 In case of wrong selection


SW 2	SW 3	SW 4	Speed No.
OFF	OFF	OFF	1 
OFF	ON	ON	2
ON	ON	ON/OFF	1
ON	OFF	ON	1


Speed No.	No.2	No.3	No.4	At the delivery time from factory
1	ON	OFF	OFF	12.5mm/H
2	OFF	ON	OFF	25mm/H
3	OFF	OFF	ON	50mm/H

Reference 2 Selection by an external contact signal

- ① When the [external drive] function (option) is provided, speed numbers can be switched by an external contact signal.
- ② For switching with [external drive], turn off No.2 to No.4 of DIP. SW1. ※

Reference 3 If DIP. switches were changed over during setting;

If speed No. is changed by DIP. SW or external contacts during setting, the actual speed changes, but its change is not displayed. The above change is displayed by pressing  key.




※ For the switch operation, refer to  **Caution** in par. 3.3 on page 8.

7.2 Time (year/month, day/hour, minute)

1 Status at the delivery time and setting range

Parameters	Delivery time	Setting example	Setting range
① Hour, minute	Set to the Japanese time.	14 : 27	00 : 00 to 23 : 59
② Year		1994	1993 to 2092
③ Month, day		Feb. 15	01/01 to 12/31

Reference In case of setting out of the setting range

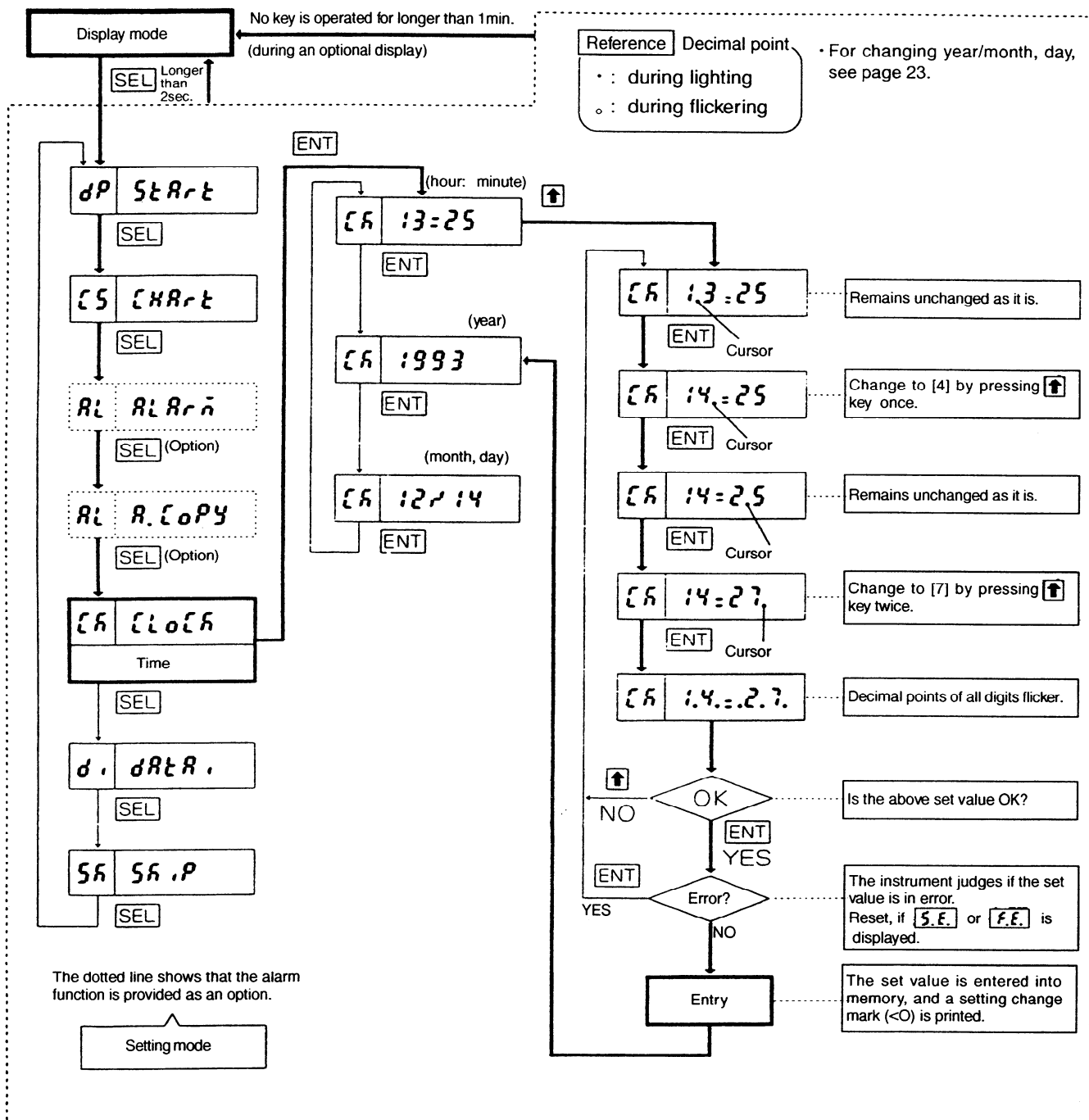
If the instrument judges it as an , it displays  and the set value alternately.
Reset parameters within the range by pressing  key.

2 Caution on setting

Time consists of three parameters ① hour, minute ② year ③ month, day, and set (or changed) by corresponding parameters. Set value are entered when ① hour & minute have been set. Set ① hour and minute without fail when ② year or ③ month & day have been changed.

3 Setting flow chart

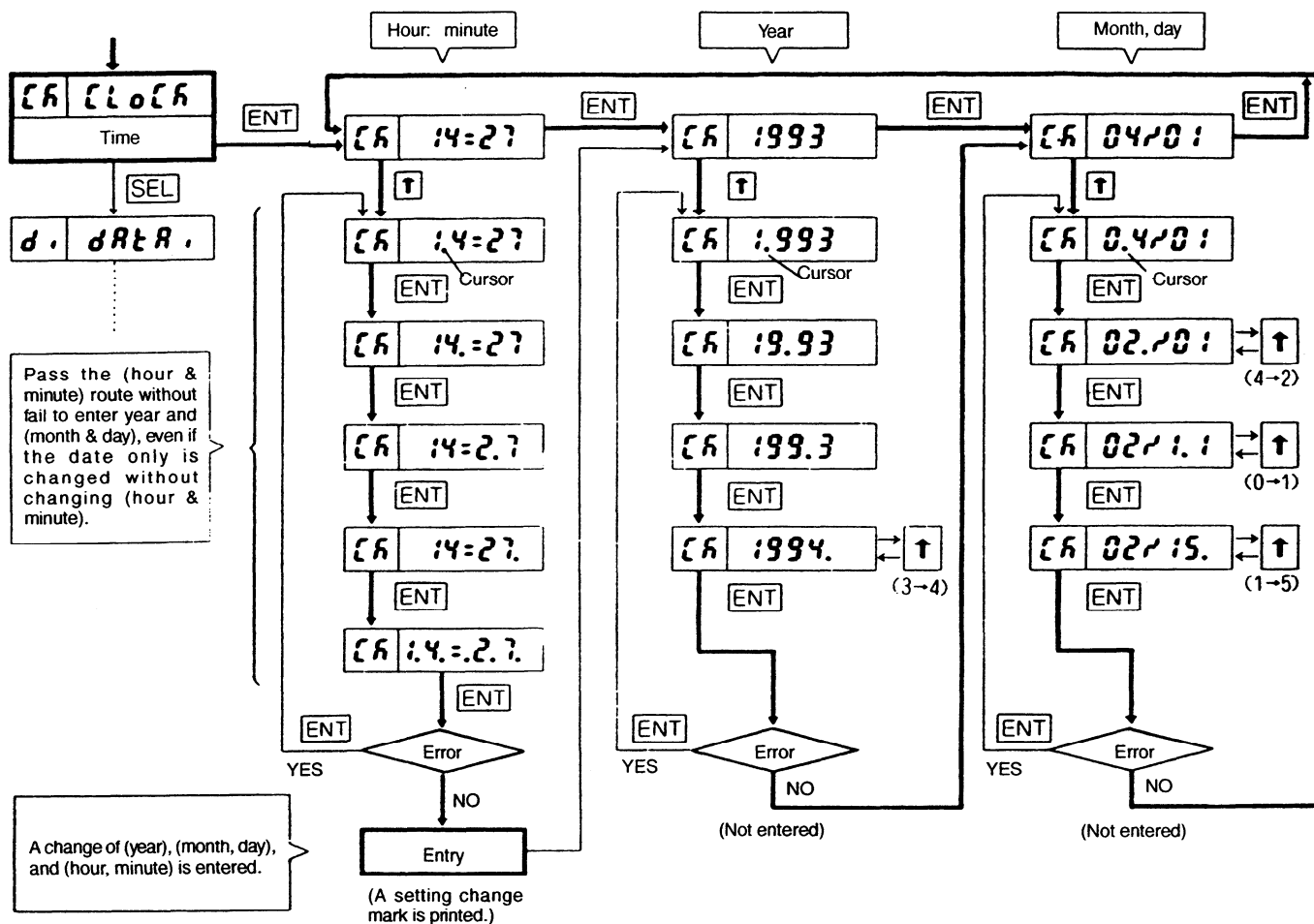
<Example> A change of hour : minute from 13:25 to 14:27



4 For changing the year/month, day

<Example> A change from April 1, 1993 to Feb. 15, 1994 (without changing hour & minute)

If the (hour & minute) route is skipped after changing the year, month, and day, the date is not entered.
Pass the (hour & minute) route without fail for entering the date.



Reference 1 For resetting to the **display mode**

For resetting the instrument to **display mode** when you want to stop or finish setting, continue pressing **SEL** key for longer than 2 seconds.

Reference 2 Backup of clock

- The clock is backed up with a lithium battery even after the power supply has been turned off.
- It is backed up for longer than 10 years, assuming that it is operated for 8 hours every day.

Reference 3 Time start

- Time is started when (hour & minute) have been entered.
- Time display is stopped during setting, but time is counted continuously.

Reference 4 Time clearing

- Time cannot be cleared.
Set time to a desired time (including year/month & day).

Reference 5 A 31 day month and a month with thirty days or less

- The instrument judges the leap year (whether February consists of 28 days or 29 days) and whether the month consists of 31 days or 30 or less days, referring to the built-in calendar at the ~~error~~ position.

Reference 6 Clock accuracy

Monthly difference $\pm 2\text{min.}$

Reference 7 Setting interruption

The instrument is reset to **display mode** from optional display when **SEL** key is pressed for longer than 2 seconds.

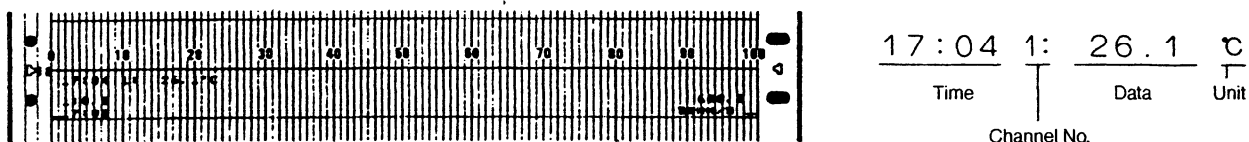
7.3 Data Printing

1 Data printing

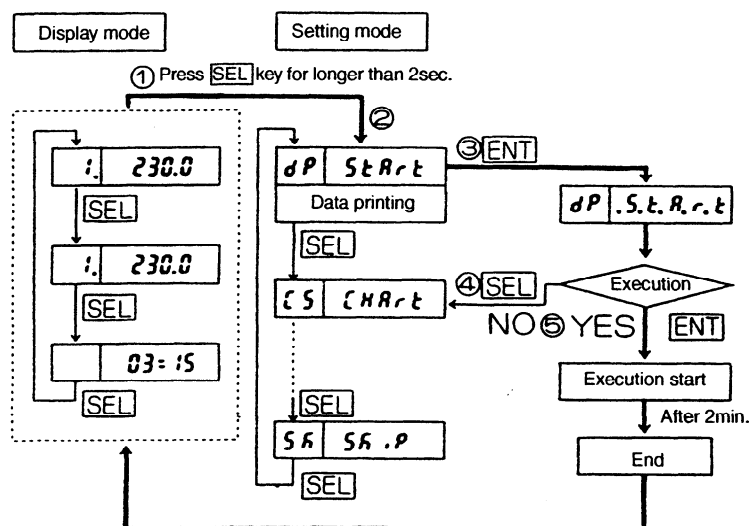
- ① Data are held and digitally recorded on analog record when (**ENT**) key is pressed.
- ② For executable conditions, refer to **Remarks**.
- ③ Digital characters cannot be formed until the chart advances about 2mm. Accordingly, the recording time depends upon the chart speed. See reference.

An example of data printing

<Recording contents>



2 Execution method



Remarks Non executable conditions

1. **REC. ON** goes out.
2. Data printing is being executed.
3. Key lock condition
4. Chart speed is higher than 151mm/H.

Reference 1 Examples of recording time in data printing

The recording time depends upon the chart speed.

Speed	Time	Speed	Time
12.5mm/H	Approx. 9 min	75mm/H	Approx. 1.5min
25mm/H	Approx. 4.5min	100mm/H	Approx. 1.1min
50mm/H	Approx. 2.3min	150mm/H	Approx. 1.0min

Time shows the duration required until recording ends after pressing START (**ENT**) switch.

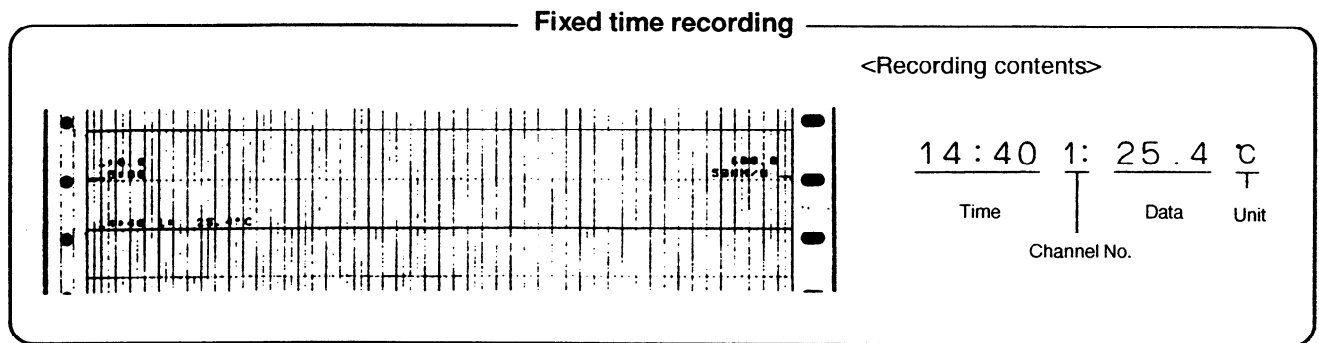
Reference 2 Functions of keys during execution

All keys are functional, except for data printing execution.

7.4 Fixed Time Recording

1 Fixed time recording

- ① Data are recorded on analog recording at a preset interval time.
- ② Fixed time recording cannot always be done, depending upon the chart speed.
See **Remarks 2** on page 27.
- ③ Digital characters cannot be formed until the chart advances about 2mm. (Formed by 7-line dots)



2 Status at the delivery time and setting range

These parameters are not set at the delivery time (clear status). Therefore, the fixed time recording is not available under these conditions.

Parameter	Delivery time	Setting example	Setting range
Interval time	Not set	02.00	0.01 to 24.00 ※
Start time	Not set	10:00	0:00 to 23:59

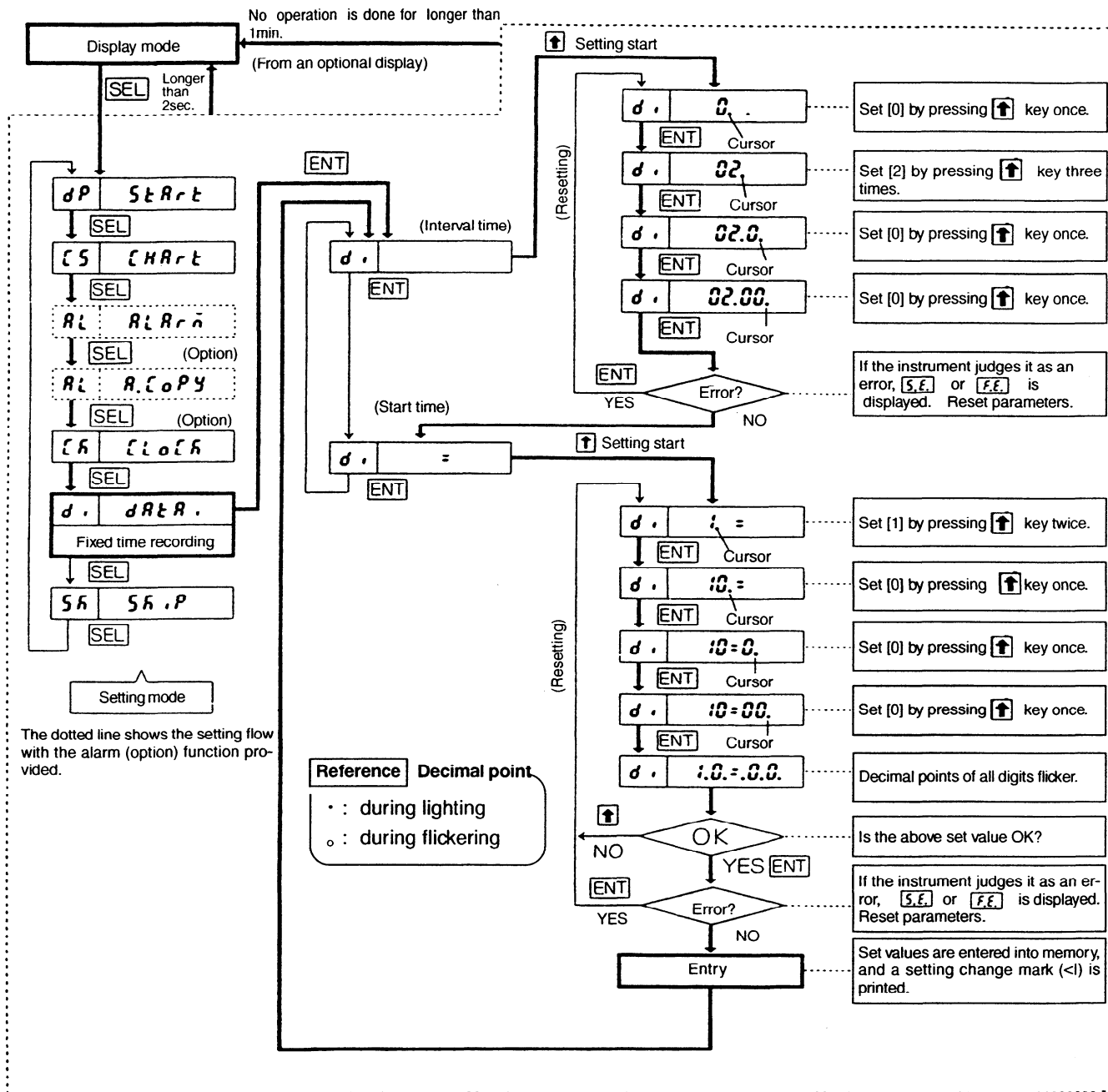
※ This setting is limited by the chart speed. If impossible, **[5.0]** is displayed.

Remarks Entry of setting

[Start time] is entered after setting it. Even if the interval time only is changed, observe the [start time] setting procedure, otherwise no entry is done.

3 Setting flow chart

<Example> Interval time → 02.00, Start time → 10:00



4 Clearing a set value (Stop of fixed time recording)

If the start time is cleared, neither interval time nor start time is set, so that the fixed time recording is not performed. (Status at the delivery time)

- ① Select [start time] parameter. Start time
- ② Press key to be settable. A cursor appears on the left side. Setting start
(Desimal point flickers)
- ③ Shift the cursor to the right end by pressing key three times. Bring the cursor to the right end.
Press key three times.
- ④ Select a space (: blank) by pressing key several times. Set a space.
Cursor
- ⑤ When pressing key, the decimal points of all digits flicker.
- ⑥ For clearing, press key. The [start time] is cleared to shift to the [interval time] parameter. YES NO
- ⑦ For stopping clearing, continue pressing key for longer than 2 seconds, and the processing returns to For longer than 2sec

Remarks 1 Change of interval time only

Even if the only is changed, it is not entered, and returned to the last time.
After changing to the [start time], bring the cursor to the right end, and press key twice.
After this entry, a setting change mark (<I) is printed on the right side of the chart.

Remarks 2 Fixed time recording cannot be executed in the following case.

- ① If the chart speed is higher than 151mm/H, the fixed time recording cannot be executed unconditionally.
- ② Even if the chart speed ranges from 1mm/H to 150mm/H, the interval time is restricted, otherwise recording overlaps each other. See (Remarks).
- ③ If the condition is not satisfied in interval time setting, an display appears.
See (Reference) on page 14.
If the chart speed was changed to be lower halfway, the required recording time may become multiple times of the preset interval time.

Reference An example of the shortest interval time

Chart speed	Shortest interval time
5mm/H	Longer than 44 minutes
12.5mm/H	Longer than 18 minutes
25mm/H	Longer than 9 minutes
50mm/H	Longer than 5 minutes
100mm/H	Longer than 3 minutes

※ The interval time is restricted by the lowest chart speed out of 3 speed, irrespective of the execution speed.
For the method of obtaining the shortest interval time, refer to on following reference.

Reference How to obtain the shortest interval time

$$\text{Interval time (min)} \geq \frac{216 \times 1}{\text{Chart speed (mm/H)}} \times$$

※ Use the lowest speed out of 3 speeds.

[Example] Assume that 3 chart speeds are 12.5, 25, and 50(mm/H), and the shortest interval time is obtained by $216 \times 1/12.5 \leq 18(\text{min})$. An display appears if the interval time is set to be shorter than 18 (min).

7.5 Skip Function/(setting memory)

When the skip function is used in channels where no recording is required in 2-pen or 3-pen type, indications, display, and records can be read easily.

1 Skip function

- ① Corresponding channels are deleted.
- ② None of indications, display, and recording is done in skipped channels.
- ③ Setting is required every channel.

Reference

In case of a skipped channel;

- ① Analog indication — Standing by at the left end
- ② Analog recording — Recording is done at the left end. ※
- ③ Digital display — None
- ④ Digital recording — None

※ No recording is done, if pens are removed in advance.

2 Status at the delivery time and setting range

- ① All channels are not set to be skipped at the delivery time.
- ② Set either skipped (1) or not (0) every channel.

Setting whether a channel is skipped or not

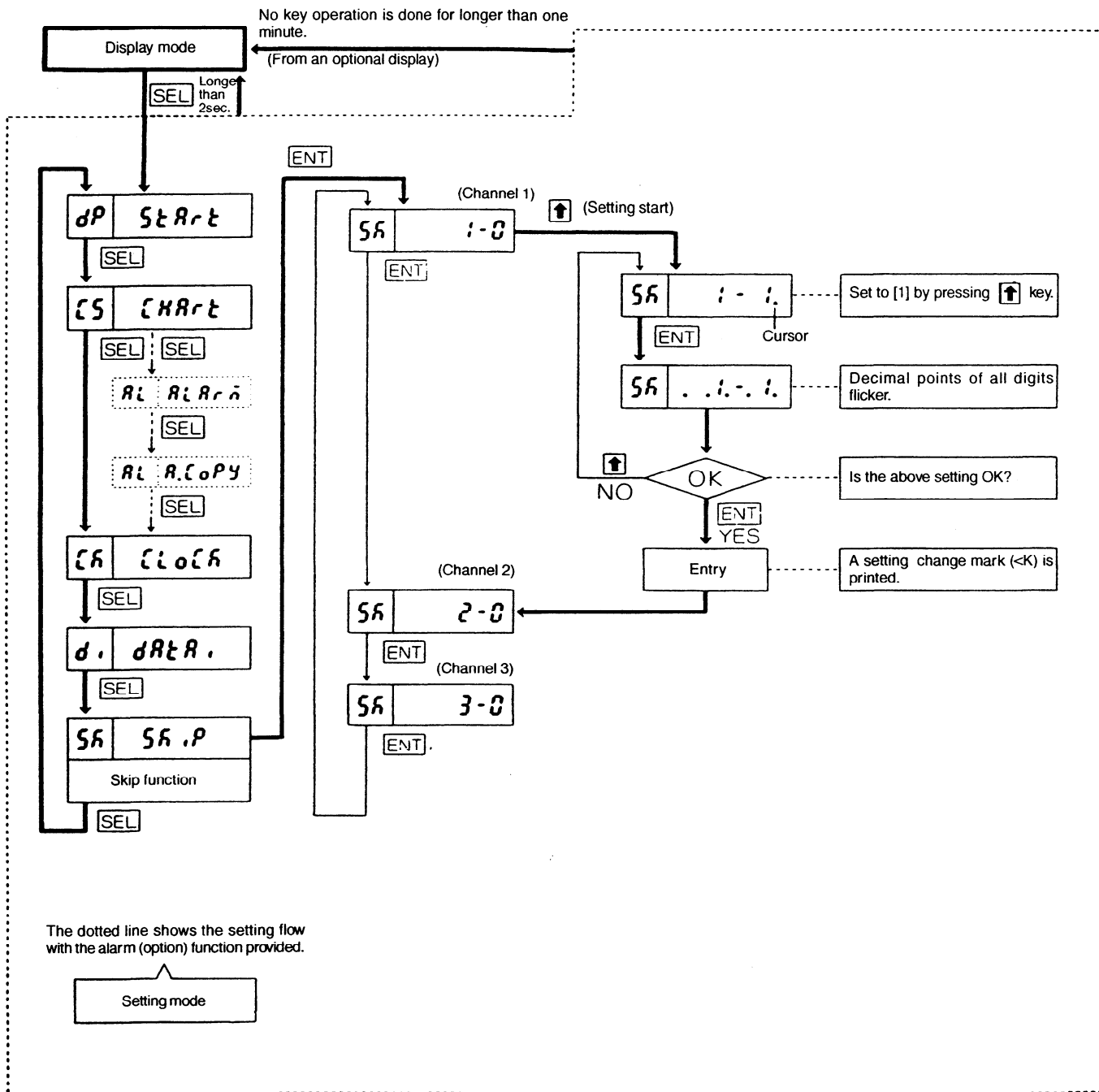
56 : - 0

Skipped/Not skipped { 0: Not skipped
1: Skipped

Channel No.

3 Setting flow chart

<Example> For skipping channel No.1 in 3-pen type



4 Clearing the setting (Return to the delivery parameters)

Skip setting cannot be cleared. Check the skip condition in each channel by parameter selection, and change skipped channels, if any, to non-skipped channels.

- Remarks** If all channels are skipped; _____
- ① If channel 1 (in 1-pen type), channels 1 and 2 (in 2-pen type) or channels 1, 2, & 3 (in 3-pen type) are set to be skipped, an **[St.]** display appears, and the recording operation is stopped.
 - ② For setting to **[setting mode]**, continue pressing **[SEL]** key for longer than 2 seconds, and resetting can be done.

Reference For resetting to **[display mode]**; _____

The instrument is reset to **[display mode]** when **[SEL]** key is pressed for longer than 2 seconds or when no operation is done for longer than one minute during optional setting display.

[Setting MEMO] _____

Chart speed	Speed No.1	Speed No.2	Speed No.3	Speed No. selection
	mm/	mm/	mm/	
Fixed time recording	Interval time		Start time	
	Hour	Minute	Hour	Minute
Skip	Channel No.	1	2	3
	Present/Absent			

[Remarks]

8. ALARM (option)

8.1 Before Setting Alarms

1 Alarm specifications at the delivery time

- ① The instrument is delivered to conform to your order specifications. However, alarm set point values are not set yet. Set them to your desired values.
- ② If alarm specifications are not specified at the time of ordering, the instrument is delivered with the standard alarm specifications. (See the right table)
- ③ None of alarm type, output No., and output processing is changeable.

2 Alarm points

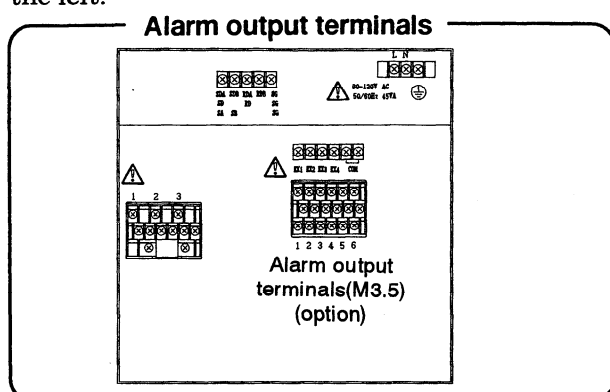
- ① Two alarm points are provided every channel, and they are called level 1 and level 2.
- ② Six alarm points are provided in total. Output No.3 to 6 don't function in the 1-pen type standard alarm.

3 Alarm types and display

Alarm type		Alarm standby	
		Not provided	Provided
Absolute value	Higher-limit	H	∩ H
	Lower-limit	L	∩ L
Change ratio	Lifting limit	U	∩ U
	Lowering limit	d	∩ d
Differential	Higher-limit	b	∩ b
	Lower-limit	S	∩ S

4 Output

Six alarm output terminals are provided, and their output numbers are given as 1 to 6, starting with the left.



5 Output processing

This software connection is provided to output plural alarm points as one-point output, and two types (OR and AND) are available.

6 Set values (Alarm values)

Since the alarm set values (alarm values) are not set yet, no alarm functions. Set alarm values for the alarm points where alarm action is necessary. For the setting method, see par. 8.2 on the page 33.

Standard alarm specifications without any specified alarm specifications

Alarm point	Alarm type		Output No.	Output processing	Alarm value
	CH. NO.	Level			
1 (pen)	1	H	1	OR	Not set
	2	L	2	OR	Not set
2 (pen)	1	H	3	OR	Not set
	2	L	4	OR	Not set
3 (pen)	1	H	5	OR	Not set
	2	L	6	OR	Not set

Remarks 1 AND output

If alarm occurs at all the higher-limit or lower-limit alarm points of the output No. specified, an alarm signal is output from its output No.

Remarks 2 OR output

If alarm occurs at one of the higher-limit or lower-limit alarm points of the output No. specified, an alarm signal is output from its output No.

Remarks 3 Composite processing of AND and OR

AND processing is done after OR processing.

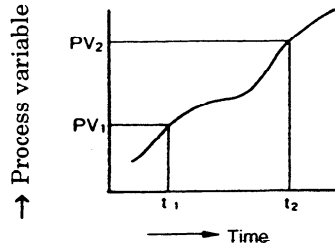
Remarks 4 Change ratio alarm

An alarm is triggered, if a variable (maximum value — minimum value) per measuring interval is larger than a set value.

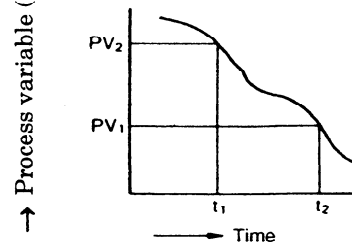
The variable comprises two kinds; rising limit and lowering limit.

※ 5sec. usually

(Rising limit alarm: **U** or **UU**)



(Lowering limit alarm: **d** or **Ud**)



$PV_2 - PV_1 = \text{Change width}$

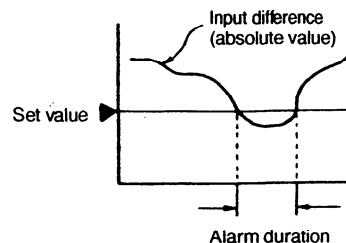
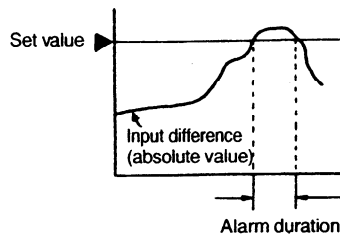
$t_2 - t_1 = \text{Measuring interval (About 5sec)} \times n, n: 1 \text{ to } 9 \text{ (specified)}$

Remarks 5 Differential alarm

An alarm occurs, if a difference between one channel and another channel is larger than a set value (higher-limit) or smaller than the set value (lower-limit).

(Differential higher-limit alarm: **b** or **Ub**)

(Differential lower-limit alarm: **S** or **US**)



A differential higher-limit alarm occurs, if the input difference (absolute value) > alarm set value, or a differential lower-limit alarm occurs if input difference (absolute value) < alarm set value.

Remarks 6 Alarm standby

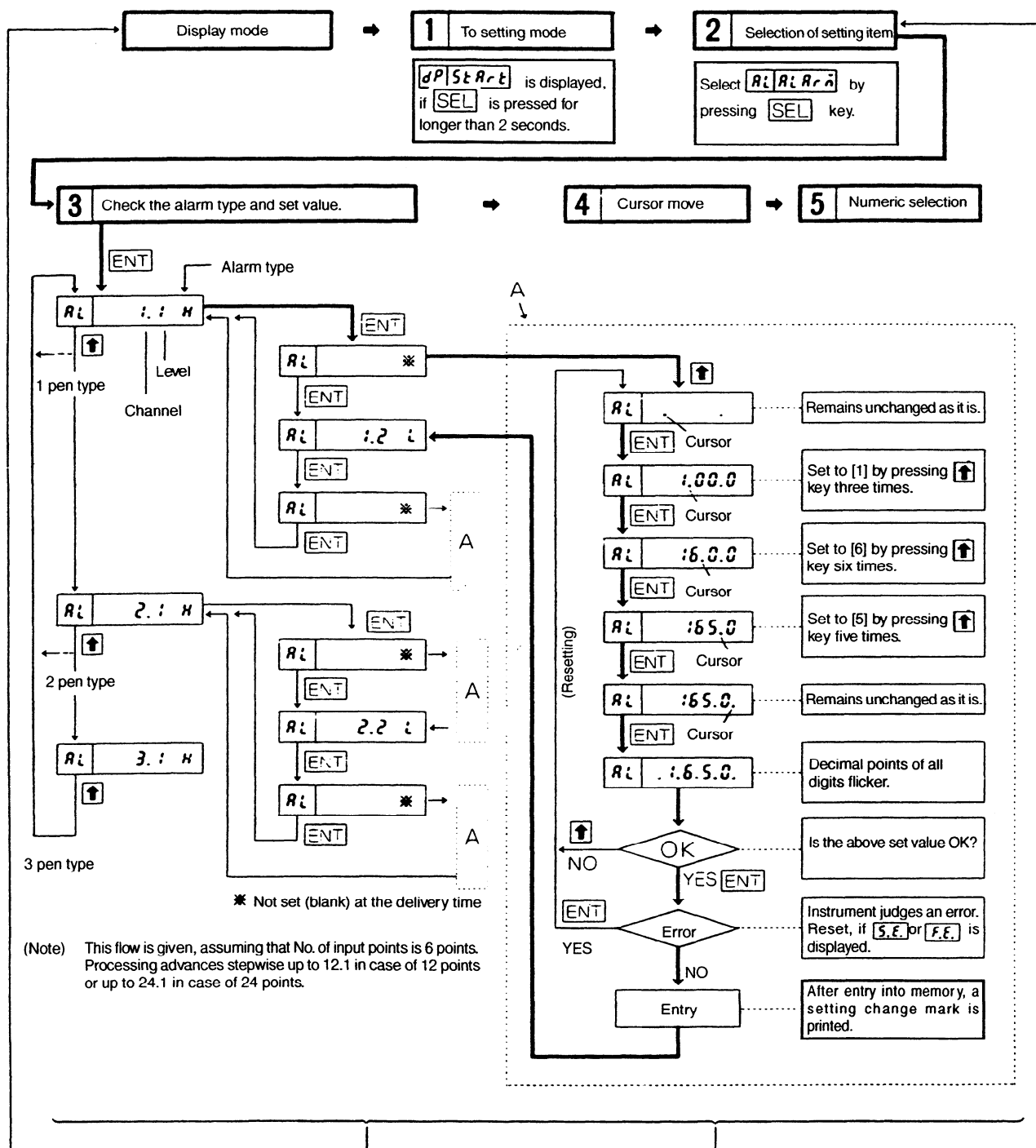
This function is provided so as not to trigger any alarm until a PV value enters the setting range when power has been turned on. On setting change, this function is executed by resetting after clearing once.

8.2 Setting of Alarm Set Values

Caution Alarm setting (Alarm action execution)

- ① The alarm action is not executed under the delivered condition, because alarm values (alarm set values) are not set yet.
- ② If it is desired to execute alarm action, set alarm values to desired values.

<Example> Setting of the set value of level 1 (absolute value higher-limit alarm) of channel 1 to 165.0 (from the value at the delivery time)



SEL key is pressed for longer than 2sec., or no operation is done for longer than one minute.

SEL

8.3 Alarm Value Copy

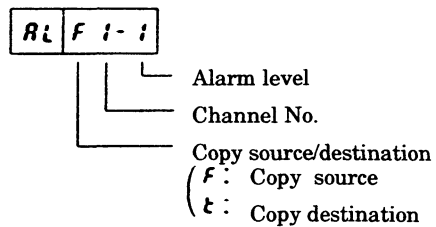
1 Alarm value copy

- ① This function is provided to copy an alarm value of a certain channel to other channel levels.
- ② This function is convenient when the same alarm value can be set to other alarm points in the multi-pen type.

Remarks Selection of channels exceeding the number of pens

For setting copy designation, if channels are selected more than the number of pens, an **5.8.** display appears when par. 6) is executed. Reset the channels by pressing **ENT** key.

Reference 1 Meaning of display



2 Copy flow chart

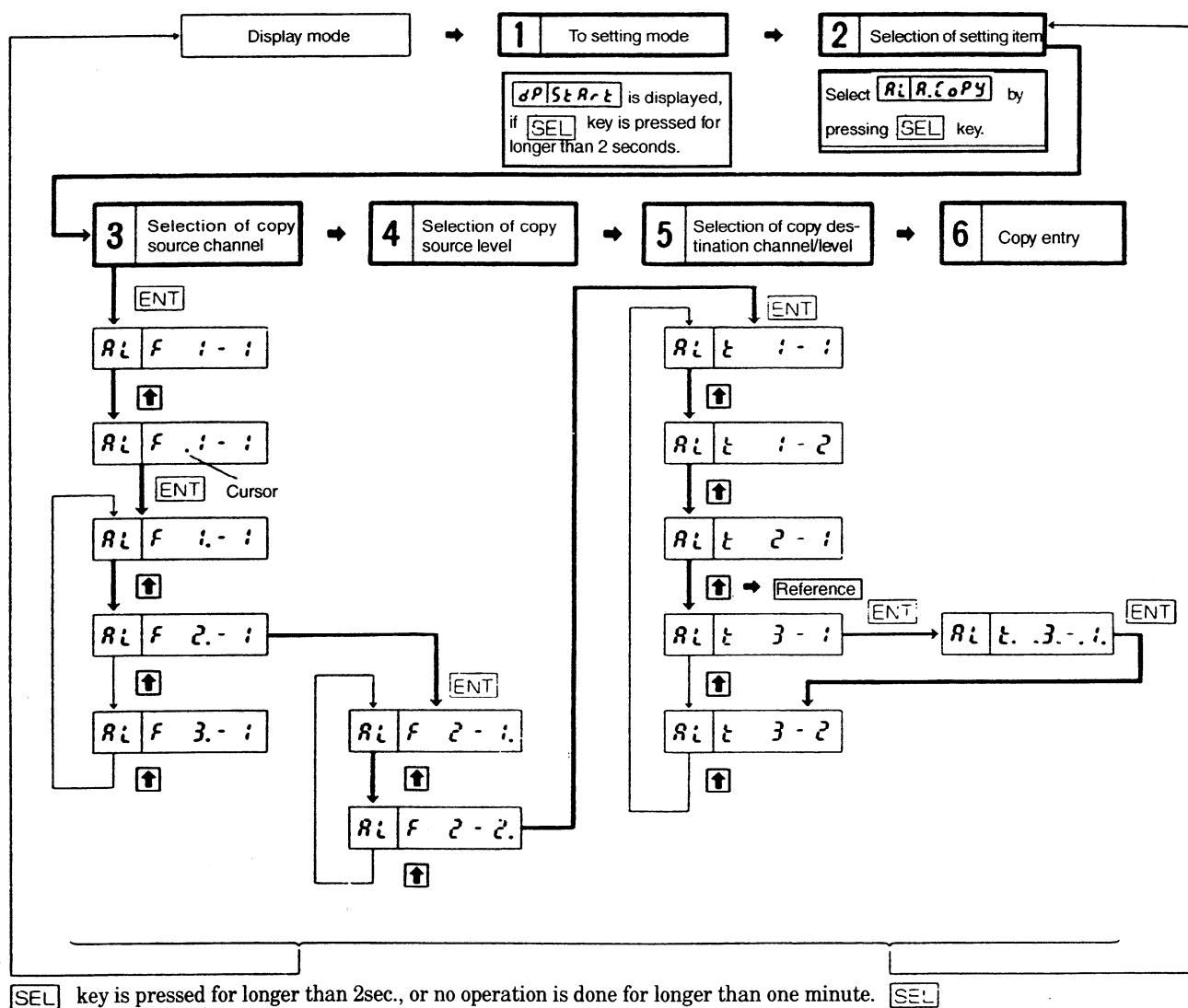
<Example> At 3-pen type

	Copy source	Copy destination
Channel	2	3
Alarm level	2	1


Reference 2 Alarm value check

No alarm value can be confirmed by copy display.

Confirm it, referring to the flow chart in par. 9.2 on page 33.



Reference 3 Copy source (2-2) channel/level

The copy destination channel/level advances stepwise when pressing  key except for the copy source channel/level (2-2).

8.4 Alarm Action Stop

1 Alarm action stop

- ① The alarm action can be stopped every alarm point.
- ② The alarm action is stopped by clearing its alarm value. The cleared alarm point is not set in the same way as in the delivery condition.

Alarm execution and stop

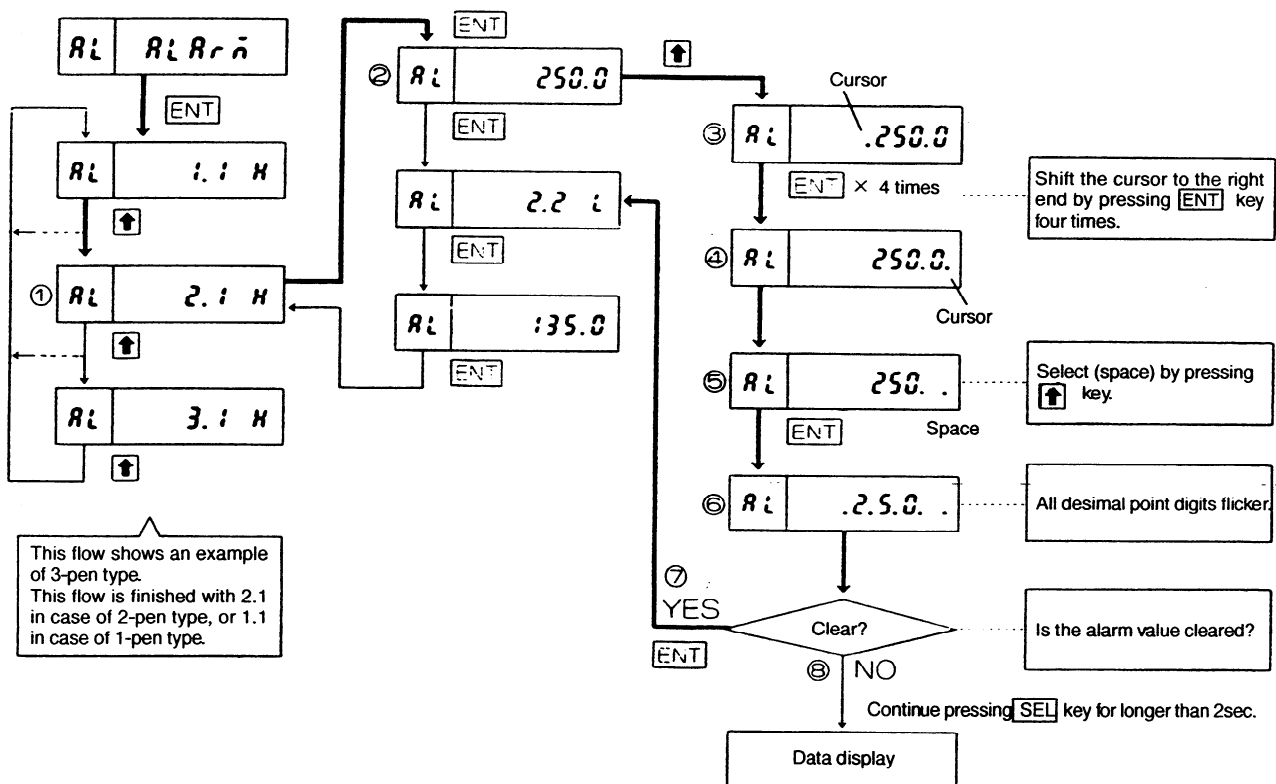
Stop	Clearing an alarm value (not set)
Execution	Setting of an alarm value

The alarm is stopped or executed every alarm point.

2 Clearing an alarm value

<Example> Clearing a set value of 250.0 of level 1 of channel 2

Space the least significant digit of the alarm value according to the same procedure (see par. 32) as in [alarm value setting].



- ① Select the channel and level to be cleared.
- ② Display the alarm value by pressing **ENT** key.
- ③ By pressing **↑** key, the cursor appears.
- ④ Shift the cursor to the right end by pressing **ENT** key four times.
- ⑤ Select the space by pressing **↑** key several times.
- ⑥ By pressing **ENT** key, decimal points of all digits flicker.
- ⑦ Press **ENT** key, if alarm value can be cleared. The alarm value is cleared, and the alarm type of the next level is displayed.
- ⑧ For stopping clearing, continue pressing **SEL** key for longer than 2 seconds. The instrument returns to the data display **display mode**.

Reference Clearing all alarm points


Clearing should be done every alarm point. Collective clearing of all alarm points cannot be done.

9. EXTERNAL DRIVE (option) AND TERMINAL CONNECTIONS

1 External drive

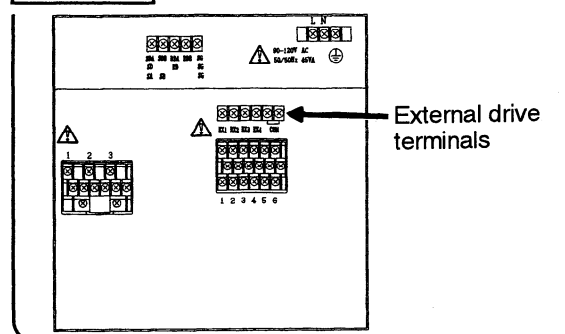
The following operation is executable by a contact signal from the terminals.

- ① Recording start and stop
- ② Chart speed (3 speeds (speed No.)) selection
- ③ Data printing

 **Warning** Turn off the feed source power supply before starting connections.

Turn off the feed source power supply before starting the connections of external drive terminals for the purpose of preventing an electric shock accident.

Reference External drive terminals.



2 External drive function and relation with external drive terminals

External drive functions				Across COM and EX□ terminals			Remarks	[ON : Shorted OFF : Open]
				EX1	EX2	EX3		
Recording	Execution	Speed No.	1	OFF	OFF	—	[REC.ON] and [FEED] keys are effective. Note: DIP. SW1 takes precedence of others. See [Remarks]	
			2	ON	OFF	—		
			3	OFF	ON	—		
	Stop			ON	ON	—	[REC.ON] and [FEED] keys are invalid.	
Data printing start				※	※	ON	Continue the ON time for longer than 1sec.	<div>For longer than 1sec.</div>

※ Data printing cannot be executed unless recording is being executed.

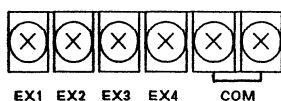
Remarks Selection of speed No. by external drive

The selection by DIP. SW takes precedence of the selection by external drive. For selection by external drive, turn off No.2 to No.4 of DIP. SW1. Setting can be done irrespective of the key lock condition.

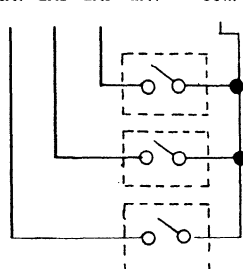
Warning No-voltage contacts

For the contacts to be connected to external drive terminals, use the contacts of a switch, a relay, or the like which is driven at a voltage level of lower than 30V AC or 60V DC or manual contacts.

3 Connections of external drive terminals



Give a no-voltage contact signal (short-circuit or open). Read "12.2 Cautions on connections (on page 41)" without fail before starting connections.



Functions
Execution of data printing
Recording execution and stop. Execution: Selection of speed No.

Reference: External drive terminal characteristic

Voltage when contacts are open: Approx. 5V

Current when contacts are shorted: Approx. 2mA

Warning Treat connected cords properly

Treat connected cords securely so as not to allow them to be caught by a person or an article. If cords are broken or cut due to catching, an electric shock accident or other failures may occur.

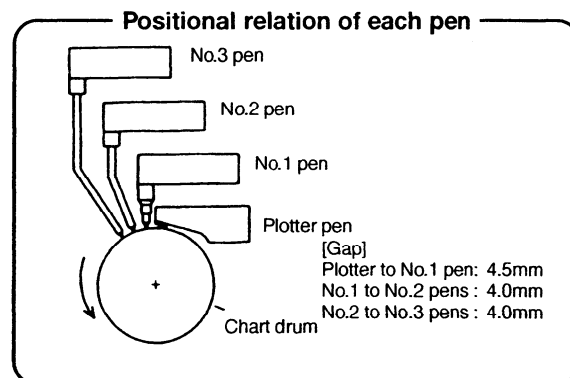
10. TIME AXIS SYNCHRONIZATION (option)

1 What is the time axis synchronization?

This option is provided for the multiple-pen type only (2-pen and 3-pen types)

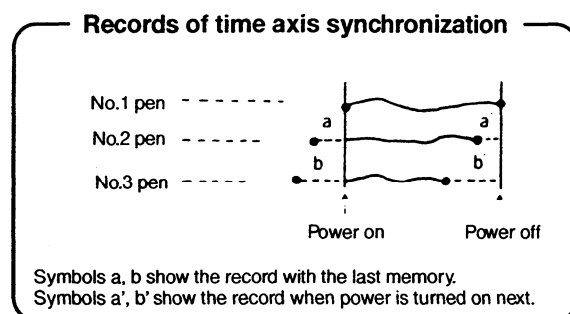
- ① This function is provided to correct the misalignment on the time axis among pens, so that recording at the same time can be obtained on the chart.
- ② In normal recording, a gap (about 3.3mm) exists between each pen, so that the measured values at the same time are deviated with reference to the time axis.
- ③ This time axis synchronization function is provided to store measured values of gaps (a, b) from No.1 pen into memory, and record the measured values in the memory when the chart has advanced to the time axis of No.1 pen.

Accordingly, records of each pen are free of any time axis difference on the chart.



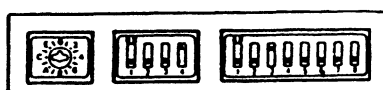
Reference 1 Time axis synchronization/asynchronization selection

- ① The time axis synchronization can be switched to normal mode (time axis asynchronization). Select the normal mode for monitoring the present indication or checking the scale.
- ② Select these modes by No.4 of DIP. SW2(B).



Time axis synchronization/asynchronization selection

SW.2(A) SW.2(B) SW.1



Time axis synchronization/
asynchronization selection

No. of DIP. SW2	4
Time axis synchronization mode	ON
Normal mode	OFF

<Selective operation procedure>

- ① Turn off the power supply.
- ② Select No.4 of DIP. SW2 (B). ※
- ③ Turn on the power supply.
(Check the DIP. SW2 (B) position only when the power supply is turned on.)

2 Operation for turning on the power supply

1) First use

No.2 and No.3 pens are standing by at the left end until the chart is fed to the start time axis of No.1 pen.

2) The 2nd and subsequent use (Turning on the power supply from being turned off)

No.2 and No.3 pens function simultaneously when No.1 pen functions. However, the last measured values (before turning off the power supply) are recorded until No.1 pen reaches the start time axis.

Remarks Chart speed change

If setting of the chart speed of execution speed No. is changed, No.2 and No.3 pen memory is cleared.

Accordingly, No.2 and No.3 pens are standing by at the left end until No.1 pen reaches the start time axis.

Reference 2 Analog indication and digital display

The analog indication shows measured values from memory in the same way as in pen recording, and those other than No.1 pen are past values.

The digital display shows present measured values.

11. INSTALLATION TO PANEL



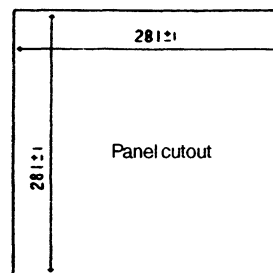
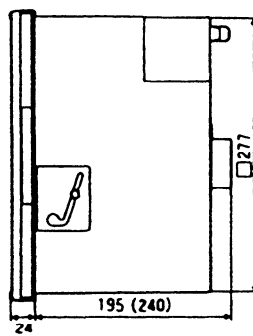
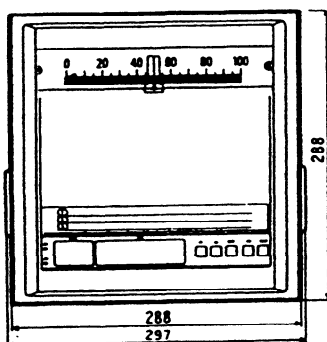
Warning Mount this instrument on a panel for use.

Mount the instrument on a panel without fail for preventing its falling down, drop, and other failures, except for portable type. Use a steel panel having a thickness of 2mm to 6mm. Don't mount the instrument at a place directly exposed to the sunlight. Separate the instrument from a place subjected to an electric field and a magnetic field.

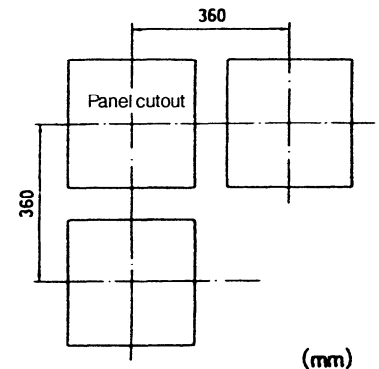
1 Requirements of mounting place

Ambient temperature and humidity	Surrounding environment	Others
The ambient temperature and humidity shall be stable within the following ranges. Temperature range : 0 to 50°C Humidity range : 20 to 80%RH Don't mount the instrument at a place where is subjected to a hot blast (70°C).	1. Overvoltage category II 2. Contamination degree (Contamination class) 2 3. Altitude Lower than 2,000m	1. Mounting angle: Forward tilting : 0° Backward tilting: 0 to 30° Lateral tilting : 0° 2. A place free of vibrations and shocks

2 External dimensions and panel cutout



Minimum space when plural instruments are mounted



() shows the multi-pen type (2-pen type, 3-pen type). When an option (external drive, communication, alarm*) is added, this size increases by 16mm, and the terminal board profile differs.

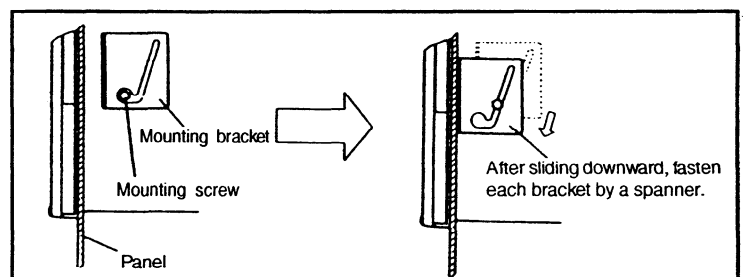
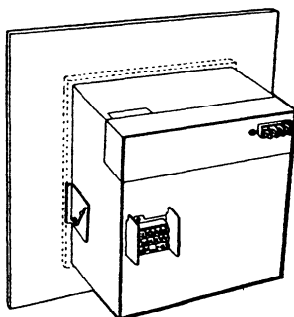
* For the mechanical relay 'a' contact alarm outputs, the depth is 27mm longer.

Use the mounting panel having a thickness of more than 2mm but less than 6mm.

3 Mounting method

Lock the instrument before mounting the instrument for preventing a danger. (See page 45)

- ① Prepare the attached mounting brackets (right and left brackets, one each) two mounting screws and a spanner.
- ② Insert this instrument into the panel cutout from the front.
- ③ Screw the mounting screws lightly onto the right and left side panels of the case, slide the mounting brackets downward until they are closely attached to the panel, and then, fasten the mounting screws with the spanner.



● Two mounting brackets are provided for right side and left side.



Caution Fastening torque is within 15kg-cm.

The case is made of plastics. Don't fasten it excessively, otherwise it may be deformed or cracked. Keep the fastening torque within 15kg-cm.



Caution Transportation lock

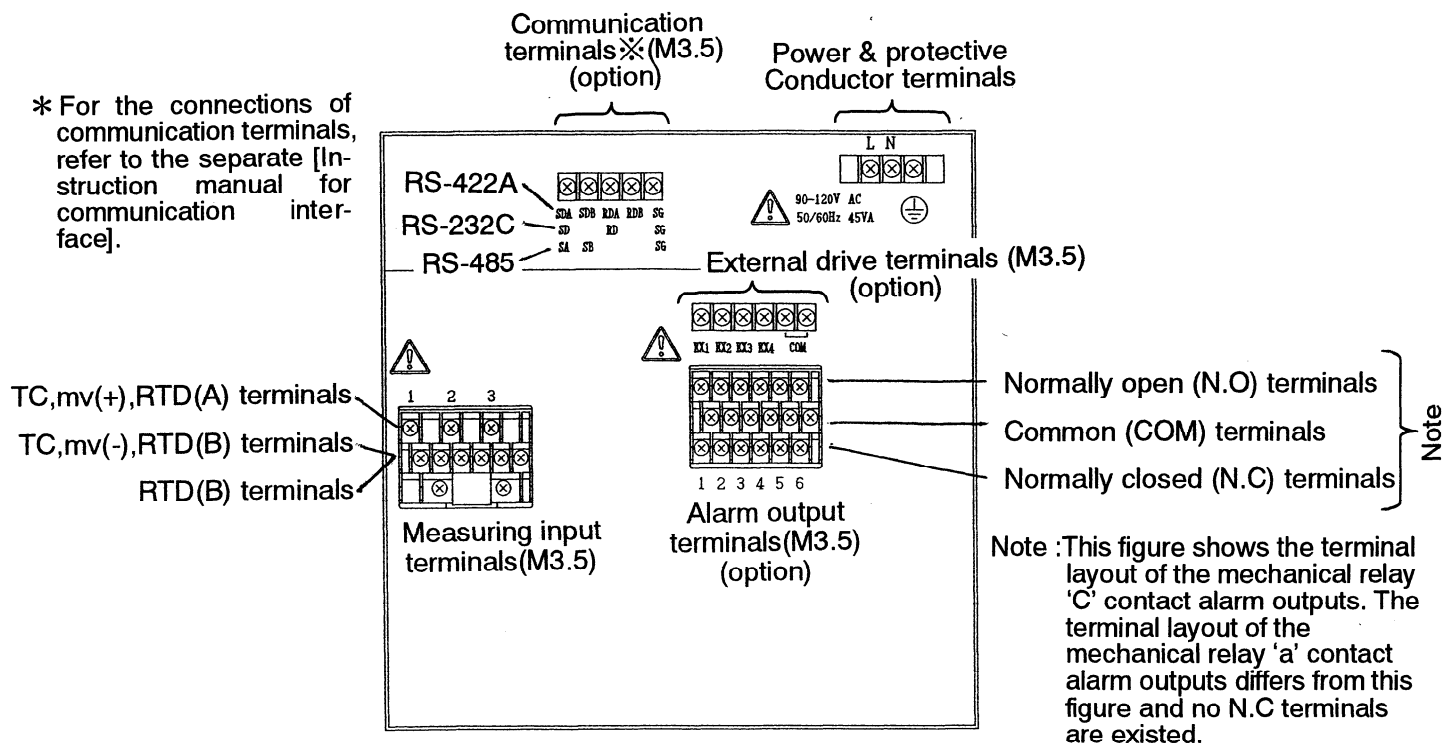
Lock the instrument without fail when mounting it onto or dismounting it from the panel or when transporting or relocating the instrument.

12. CONNECTIONS

12.1 Terminal Board Diagram



The terminal board shown in the following figure is provided when the full option (model BH1G11-AD2) is mounted with 3-pen type resistance thermometer inputs.



Warning Alert symbol marks (⚠) and places

The alert symbol mark (⚠) is mounted at a place where one may receive an electric shock if one should touch. (See the following table) Read paragraphs describing the connections of individual terminals.

Name of terminals	Power terminals	Measuring input terminals	Alarm output terminals
Mounting place of label	Lower left of power terminals	Upper left of terminal cover	Upper left of terminal cover

Reference Input terminal board and alarm terminal board are removable.

The input terminal board and alarm terminal board ※ are removable for easy connections.

※ If external drive is provided, external drive terminal board is also removable.

- ① Each terminal board can be removed by removing two mounting screws.
- ② Each terminal board is connected to the instrument by a connector

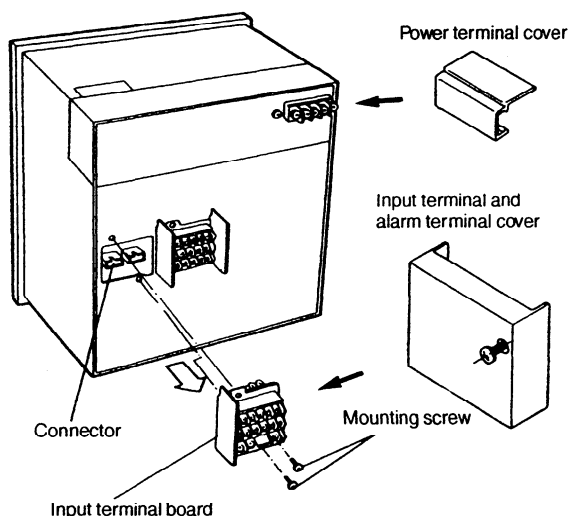


Caution Turn off the power supply in advance.

For mounting or dismounting the terminal board, turn off the external power switch for the purpose of preventing the electric circuits from being damaged.

Remarks Exchange of terminal board

The thermocouple input terminal board only cannot be replaced with that of other instruments, otherwise the calibration becomes incorrect.



12.2 Cautions on Connections

Observe the following cautions during connections for securing safety and reliability.

1 Feed source power supply

Use a single-phase power supply having a stable voltage without any waveform distortion for the purpose of preventing wrong operations.

Warning Addition of a switch and an overcurrent protective device

Add a switch and an overcurrent protective device (3A) to the feed source power supply for preventing an electric shock accident during connection work. This instrument is not provided with any replaceable overcurrent protective device.

Warning Turn off the feed source power supply before starting connections.

Turn off the feed source power supply in advance without fail for preventing an electric shock accident when the power supply and input/output terminals are connected.

2 Separate input/output connections from a strong power circuit

Don't place the input/output cables to be close to or in parallel with any drive power line or other strong power circuits. Separate them more than 50cm from strong power circuits when they are placed to be close to or in parallel with strong power circuits.

3 Separate the thermocouple input terminals from a heat source

Separate the thermocouple input terminals from a heat source (a heating body) for the purpose of reducing a reference junction compensation error. Don't expose these terminals to the radiation of direct sunlight, etc.

4 Separate all connection cables from noise sources

Separate all connection cables to the instrument from a noise source as far as possible, otherwise an unexpected trouble may occur. Take a remedial measure if the cables cannot be separated from a noise source due to unavoidable circumstances.

Major noise sources	Remedial measures
Electromagnetic switch, power line having waveform distortion, inverter, thyristor regulator	Insert noise filters between power terminals and input/output terminals. A CR filter is often used.

5 Use crimp style terminals

- Mount crimp style terminals as connection cables' termination for preventing the looseness or disconnection of terminals and a short-circuit failure between terminals.
- For crimp style terminals, use an insulation sleeve for preventing an electric shock accident.

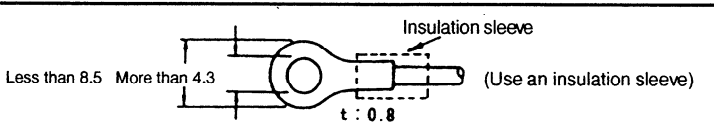
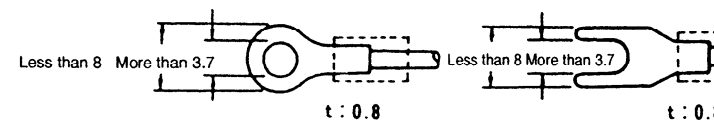
6 Unused terminals

Don't use any unused terminals for relaying, otherwise electric circuits may be damaged.

Warning Treat connected cables properly

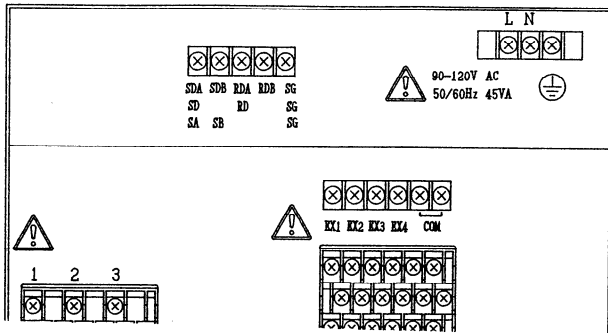
Treat connected cables securely so as not to allow them to be hooked by a person or a substance, otherwise the connections may be disconnected or cut to cause an electric shock accident or other accidents.

Reference Kinds of terminals and termination

Terminal name	Screw diameter	Termination (unit: mm)
Power and protective conductor terminals	M4	
Terminals other than specified above	M3.5	

12.3 Connections of Power and Protective conductor Terminals

1 Power terminals and protective conductor terminal



Warning Turn off the feed source power supply

Turn off the feed source power supply without fail before connecting the power terminals and protective conductor terminal for the purpose of preventing an electric shock accident.

2 Connection of power terminals

Use a 600V vinyl insulated cable (IEC 227-3), with the crimp style terminals and an insulation sleeve.

Caution Be careful with the power voltage and noises.

The power voltage of this instrument is indicated on the power terminals assembly. Don't apply any voltage other than indicated, otherwise a trouble occurs or malfunction results.

If noises are mixed into the power supply, take a remedial measure, such as the installation of a noise cut transformer, etc.

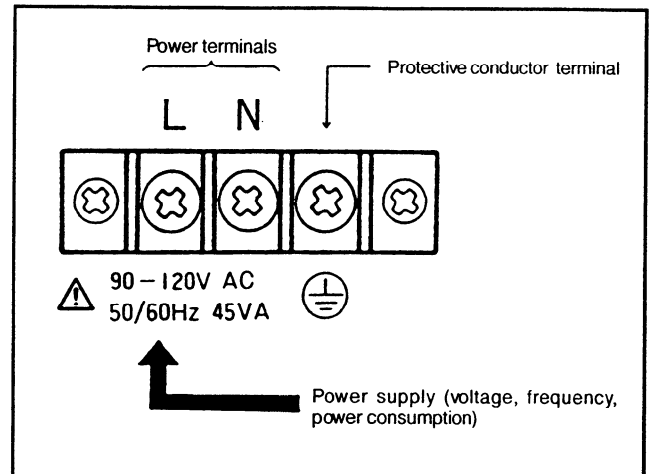
3 Connection of protective conductor terminal

Connect this terminal to the protective conductor of the power supply equipment without fail. For this connection, use a cable with a crimp style terminal and an insulation sleeve.

- Grounding wire: A copper wire having a wire diameter of larger than 2mm²

Warning mark at power terminals

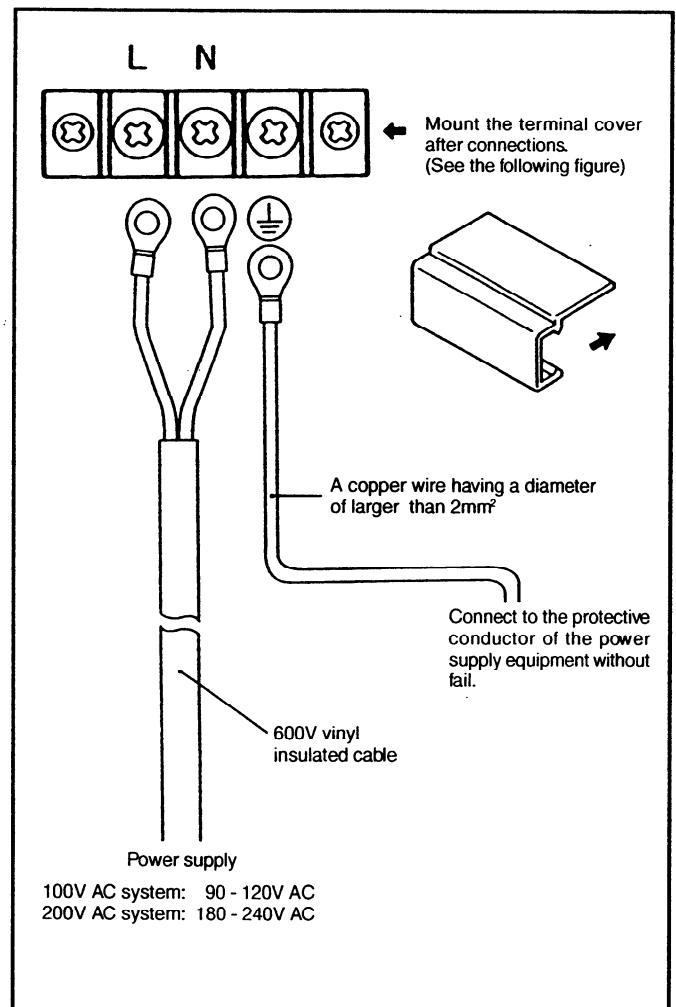
A voltage exceeding 90V AC or 180V AC is applied to the power terminals after connections. Mount the power terminal cover (transparent) without fail after connections for the purpose of preventing an electric shock accident.



Remarks L.N indication of power terminals

This indication conforms to the CSA standard, Canada. The live side of the single-phase AC power supply is indicated as L, and the neutral side is indicated as N.

Observe the L.N connections for obtaining satisfactory performance.



12.4 Connections of Measuring Input Terminals



1 Measuring input terminals

- ① Never touch the power terminals after connections, otherwise an electric shock accident occurs. Turn off the feed source power supply for safety.
- ② Input signals (par. 19) are decided according to the models (par. 1.1). Be careful not to apply any inputs other than specified, otherwise this instrument may be damaged. See (**caution**).
- ③ For the connections, use cables with crimp style terminals and an insulation sleeve.
- ④ The measuring input terminals are provided at the lower left of the terminal board.

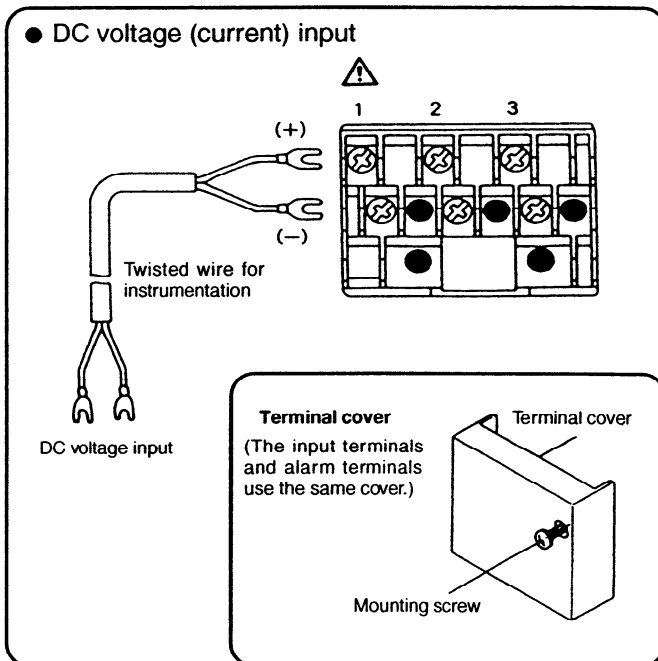


Caution Allowable input voltage

Input type	Allowable input voltage
Voltage, thermocouple input	$\pm 10V$ DC
Resistance thermometer input	Don't apply any voltage

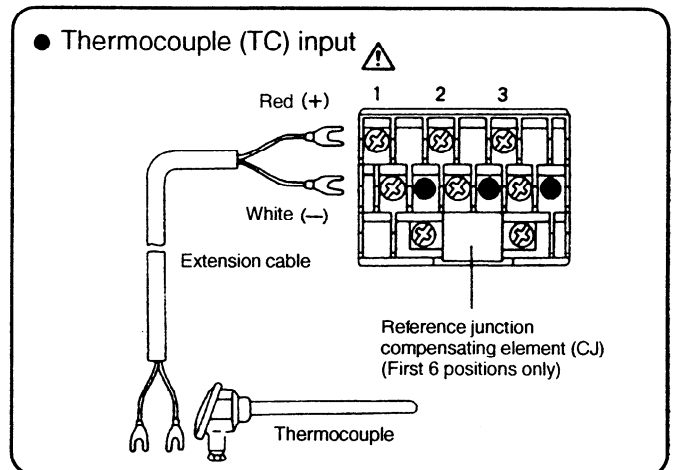
2 Connections of DC voltage (current) input

- ① Be careful not to apply any voltage exceeding $\pm 10V$ to the input terminals, except for non-standard inputs.
- ② Use a twisted cable for instrumentation as the input cable for the purpose of suppressing noises.



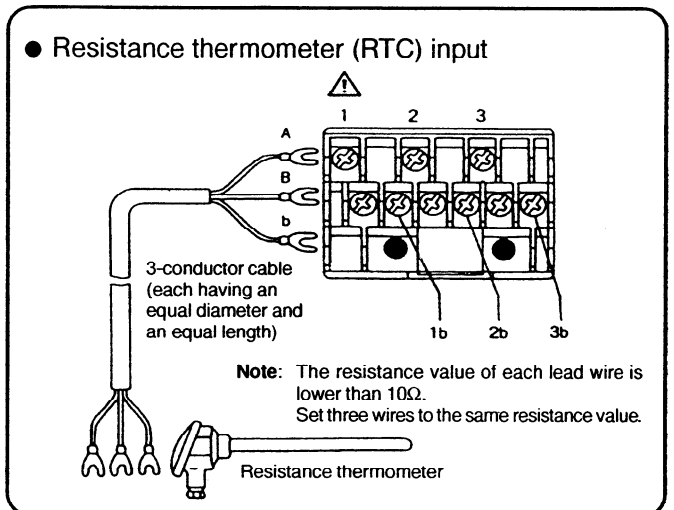
3 Connections of thermocouple (TC) inputs

Use a thermocouple cable (or extension cable) to the input terminals of this instrument without fail. If a copper wire is used halfway, a noticeable measuring error occurs. Don't use a pair of thermocouple wires in parallel with other instruments (controller, etc.).



4 Connections of resistance thermometer (RTD) inputs

For the input wire, use a 3-conductor cable where each conductor has an equal resistance value. Don't use one resistance thermometer in parallel with other instruments (controller, etc.).

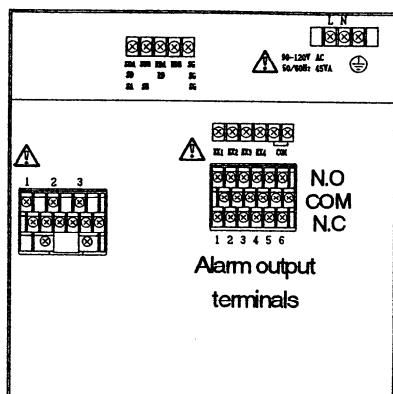


Warning (⚠) mark of measuring input terminals

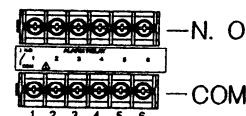
A high voltage may be applied to the measuring input terminals due to common mode noises. The allowable noise value is lower than 30V AC or 60V DC. Make sure that the noises are lower than the allowable values. Mount the terminal cover after connections for the purpose of preventing an electric shock accident and protecting the input wires. In case of thermocouple inputs, an error of the reference junction compensation can be reduced by the terminal cover.

12.5 Connections of Alarm Output Terminals (option)

1 Alarm output terminals



Terminal layout of the MOS relay alarm outputs or the mechanical relay 'a' contact alarm outputs



Caution Take safety measures.

The alarm outputs of this instrument may become out of order due to wrong operation, troubles, abnormal inputs, or other causes. Take safety measures on the load side against output failures as occasion demands.

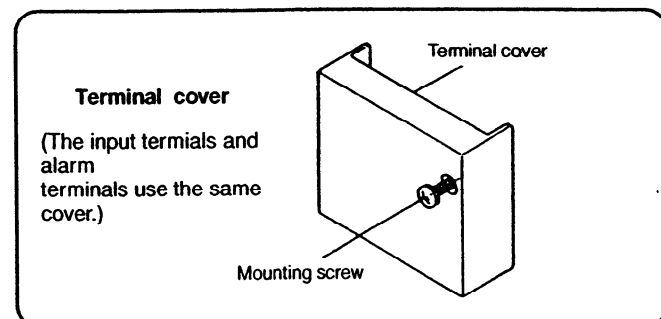
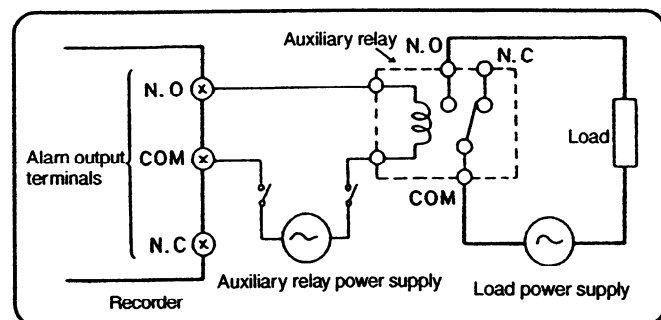
2 Connections of alarm output terminals

Turn off the feed source power supply and auxiliary relay power supply before starting connections for the purpose of preventing an electric shock accident.

- ① Connect the load via an auxiliary relay conforming to the load specifications.
- ② Connect the output cables with crimp style terminals.

Caution Connection via an auxiliary relay

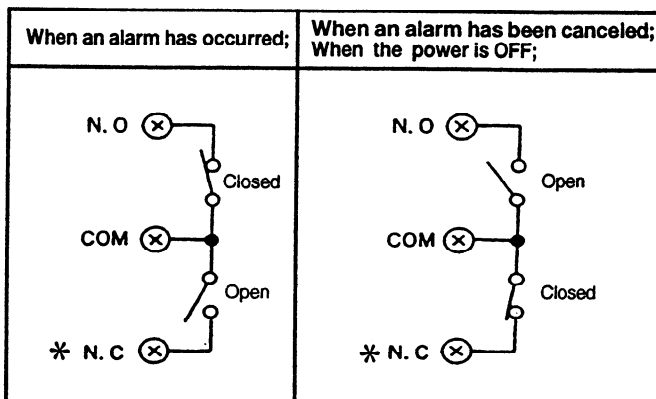
Don't connect any load directly to the alarm terminals of this instrument, but connect the load via an auxiliary relay without fail.



Warning () mark at alarm output terminals

Connect a load lower than specified to the alarm output terminals. The auxiliary relay power supply is applied to the alarm output terminals after connections and the operator receives an electric shock by touching these terminals. Mount the terminal cover without fail after connections.

3 Contact conditions between terminals



*No N.C terminals are existed for the MOS relay alarm outputs or the mechanical relay 'a' contact alarm outputs.

Remarks Rated contact capacity

Resistive load : 100V AC 0.5A, 200V AC 0.2A
Inductive load : 100V AC 0.2A, 200V AC 0.1A

Reference 1 Alarm points and output No.

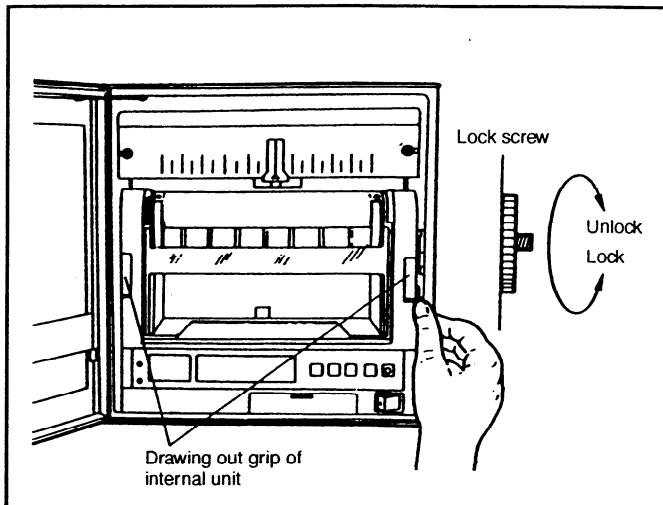
Two alarm points are provided every channel (CH). Output No. of each alarm point is designated. Its standard is as shown in **Reference 2**, if not designated.

Reference 2 Standard alarm points and output No.

Alarm points	CH. No.	1		2		3	
	Level	1	2	1	2	1	2
Output No.		1	2	3	4	5	6

13. UNLOCKING AND DRAW-OUT OF INTERNAL UNIT

1 How to remove the transportation lock screw

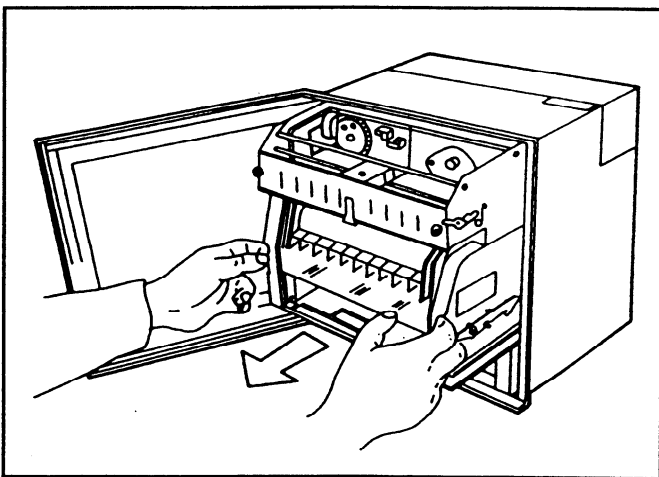


Remarks For re-transportation

Lock the internal unit without fail before transporting the instrument.

2 Drawing out the internal unit

The internal unit can be drawn out of the case by pulling it this side while pressing the stopper level downward. Hold the internal unit securely by both hands so as not to drop it.



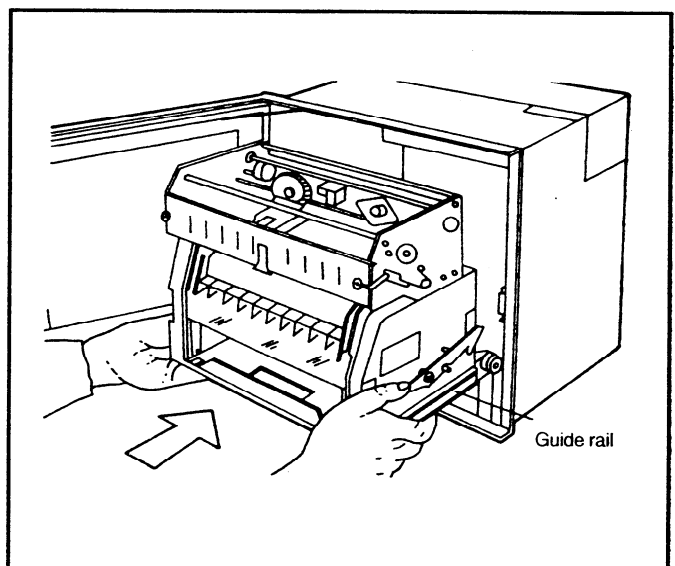
Caution Don't put your hands into the interior.

The internal unit contains electric circuits and moving parts. If you should touch these components, you may be injured. Never put your hands into the internal unit.

Caution Don't draw out the internal unit.

It is not necessary for running and operation to draw out the internal unit. Don't draw out the internal unit, otherwise it may drop or its electric circuits may be broken. Particularly be careful if the internal unit is drawn out for operating the maintenance power switch due to unavoidable circumstances.

3 Reinserting the internal unit

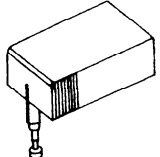
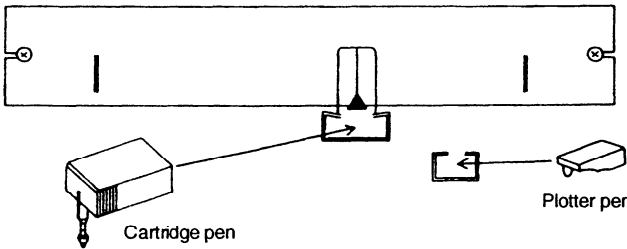



14. MOUNTING OF RECORDING PENS

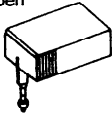
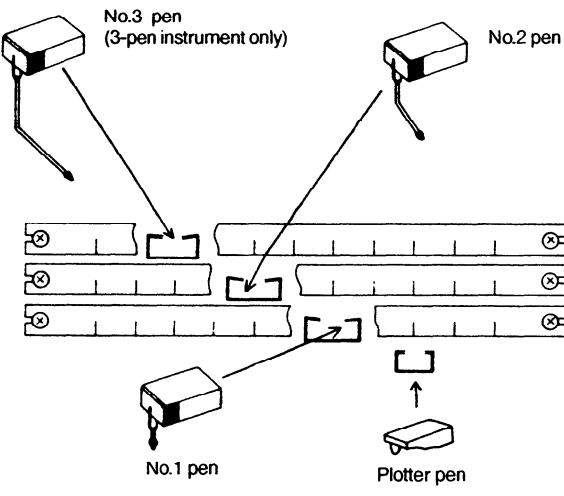
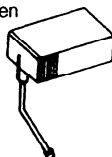
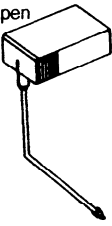

1 Recording pens

The recording pens for this instrument are sorted into the cartridge pens for analog recording and the plotter pen for digital recording. These cartridge pens are expendable (throw away type).

1) Pens for 1-pen instrument and mounting positions

Name	Profile	Ink color	Mounting position
Cartridge pen (for analog recording)		Red	
Plotter pen (for digital recording)		Purple	

2) Pens for multi-pen instrument (2-pen & 3-pen instruments) and mounting positions

Name	Profile	Ink color	Mounting position
Cartridge pen (for analog recording)	No.1 pen 	Red	
	No.2 pen 	Green	
	No.3 pen 	Blue	
Plotter pen (for digital recording)		Purple	

Remarks 1 Handling of pen tip

The pen tip is made of felt. Don't apply any strong force to the pen tip, otherwise the tip may be crushed, and clear recording is no longer possible.

Remarks 2 Handling of pen pipe

Don't bend the pen pipe by applying strong force to it when mounting it. Otherwise recording may be deviated or clear recording is impossible.

Remarks 3 Pen cap

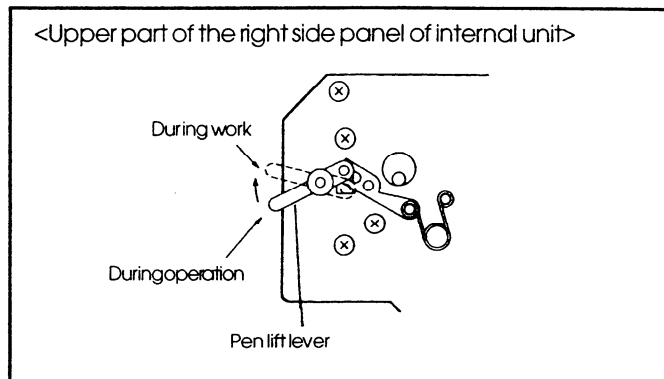
Each pen is provided with a cap for dry prevention and pen tip protection. Remove it before mounting the pen. (Don't remove it after mounting, otherwise the pen pipe may be bent.)

Remarks 4 For a long-time operation stop

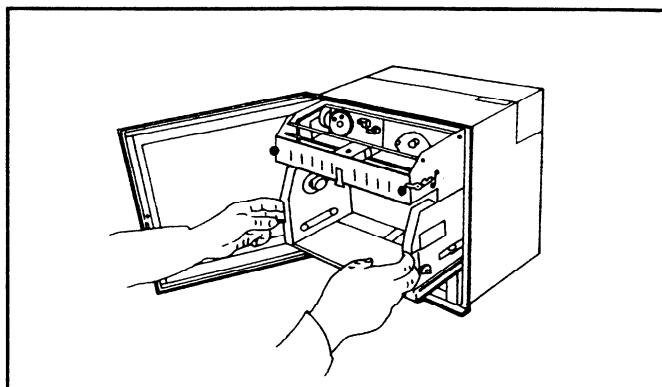
If the instrument is not used for longer than one day, remove its pens, and store them after mounting their pen caps. If the instrument is left as it is without removing the pens, the chart may be blurred with ink.

2 Mounting pen for one-pen instrument

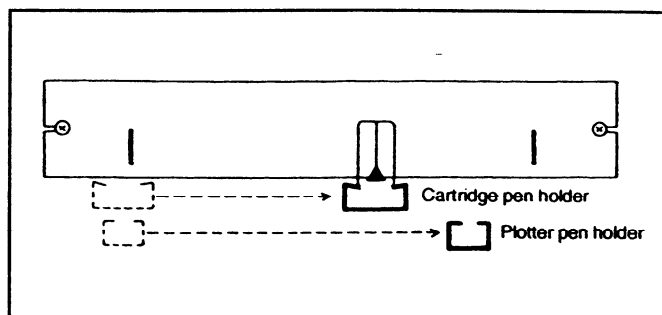
- 1) Prepare the pens
Refer to the pens and their mounting positions on page 46.
- 2) Lift the pen lift lever, otherwise a line will be written on the chart during pen exchange work.



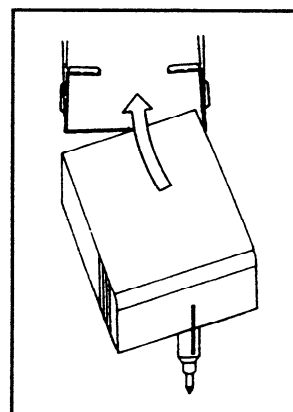
- 3) Draw out the chart cassette and internal unit.
After removing the chart cassette, draw out the internal unit until it stops for easy mounting.



- 4) Select the pen exchange mode
 - ① Press **REC. ON** key to go out the lamp, and each pen holder shifts to the left end.
 - ② By pressing **FEED** key next, each pen holder shifts to the position where these pen holders don't overlap each other.



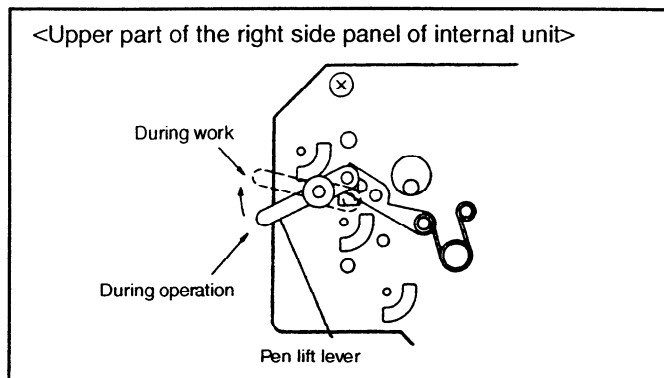
- 5) Trial use of pens and pen caps
Ink will not come out of new pens sometimes. Try writing on a piece of paper. Remove the pen caps before mounting the pens. Keep these pen caps without discarding them.
- 6) Mounting of plotter pen
Insert the plotter pen securely into the pen holder at the lower innermost of the scale plate until the pen stops. (Incomplete mounting may cause a recording trouble.)
- 7) Mounting of cartridge pen
 - ① Lower the pen lift lever once.
 - ② The pen holder is mounted at the lower innermost of the pointer. Insert the cartridge pen securely until it stops with a click. (Incomplete mounting will cause a recording trouble.)
 - ③ Lift the pen lift lever again.
- 8) For easy insertion to each holder
Face each pen sideways more or less before inserting it, instead of inserting it from the front of the holder.



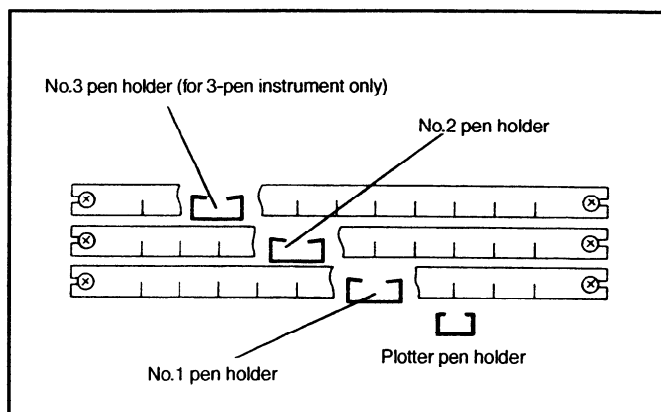
- 9) After mounting
 - ① House the internal unit into the case.
 - ② Return the chart cassette together with the mounted chart into the internal unit, and the pens are lowered by the pen lift levers to be ready for recording.
 - ③ Press **REC. ON** key to light the lamp, and continue pressing **FEED** key for several seconds. Make sure that recording is done with the cartridge pens.

3 Mounting method of 2 & 3-pens instrument

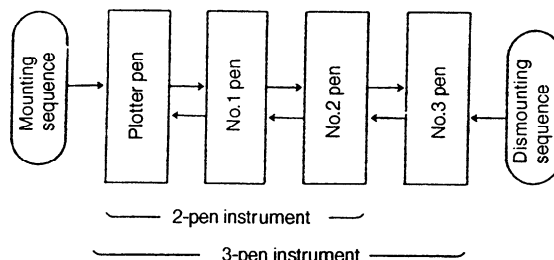
- 1) Prepare the pens
Refer to the pens and their mounting positions on page 46.
- 2) Lift the pen lift lever, otherwise a line will be written on the chart during pen exchange work.



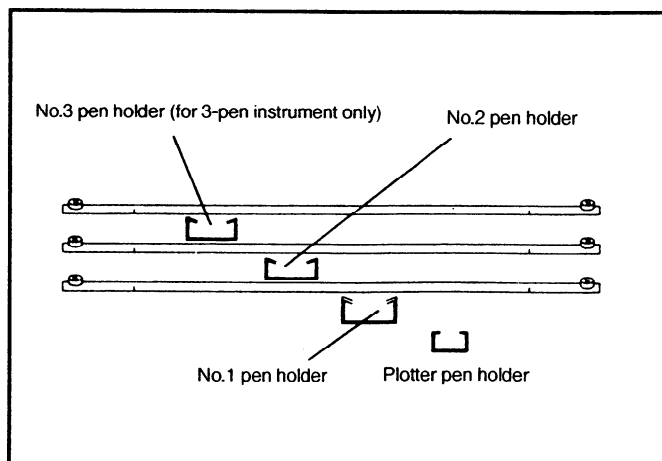
- 3) Draw out the chart cassette and internal unit.
After removing the chart cassette, draw out the internal unit until it stops for easy mounting.
- 4) Select the pen exchange mode
 - ① Press **REC.ON** key to go out the lamp, and each pen holder shifts to the left end to be standing.
 - ② By pressing **FEED** key next, each pen holder shifts to the position where it does not overlap with other pen holders.



- 5) Mounting sequence of each pen
The mounting sequence is not specified. However, the following sequence is recommendable for easy mounting without staining your hands.

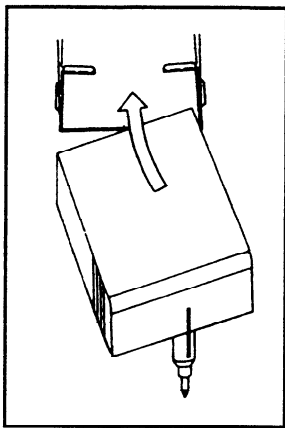


- 6) Trial use of pens and pen caps
Ink will not come out of new pens sometimes. Try writing on a piece of paper. Remove the pen caps before mounting the pens. Keep these pen caps without discarding them.
- 7) Mounting of plotter pens
Insert the plotter pen securely into the pen holder at the lower innermost of the scale plate until the pen stops. (Incomplete mounting may cause a recording trouble.)
- 8) Mounting of cartridge pens
 - ① Face each scale plate upward.
 - Lower the pen lift lever once. (If the lever is set upward with the pen mounted, the scale plate does not turn.)
 - The pen holder is positioned at the rear of the scale plate, and the pen cannot be mounted under this condition.
 - Turn the scale plate upward until it stops. (The scale plate is reset to the front when releasing your hand.)
 - Each pen holder can be seen through the clearance between the scale plates.



- ② Sequence of inserting pens into their holders.

It is recommended for smooth insertion to insert each pen by turning it slightly sideways inserted of inserting it from the front of the holder.



- ③ Reset the scale plates as before
Reset each scale plate to face the front from being facing upward.

- ④ Lift the pen lift lever.
If the pen lift lever is set downward, lift it again.

9) After mounting

- ① House the internal unit into the case.
② Return the chart cassette together with the mounted chart into the internal unit, and the pens are lowered by the pen lift levers to be ready for recording.
③ After pressing **REC. ON** key to light the lamp, continue pressing the **FEED** key for several seconds.

Make sure that recording is done with the cartridge pens.

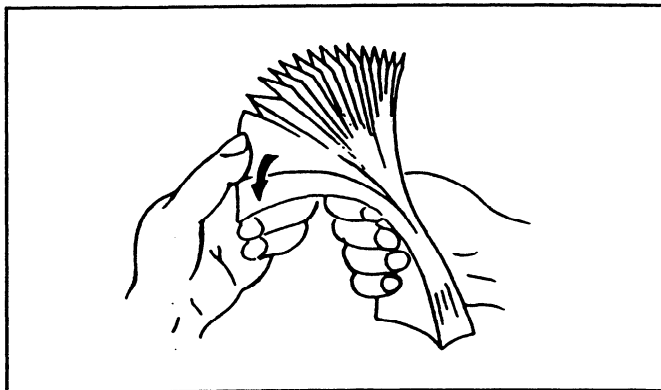
Reference When **REC. ON** goes out; —

Each pen changes from **standing by at the left end** to **pen exchange mode** or from **pen exchange mode** to **standing by at the left end**, each time **FEED** key is pressed once.

15. LOADING OF CHART

1) Prepare the chart

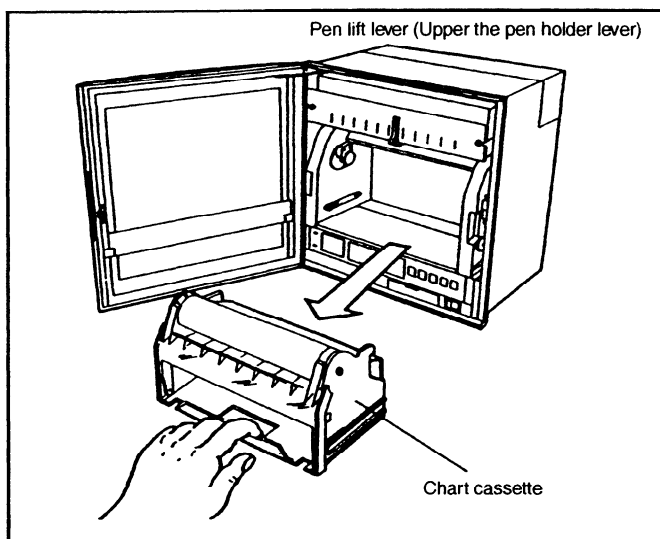
Shuffle it both ends sufficiently to prevent it double feeding.



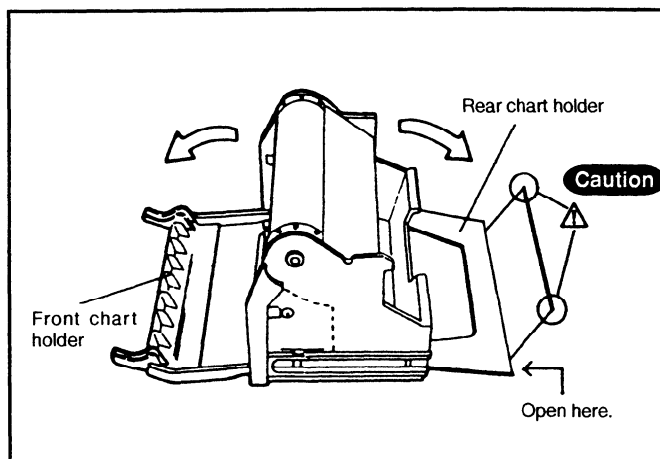
2) Lift the pen lift lever.

If it is set downward, a line will be written on the chart (or drum) when the chart cassette is inserted or drawn out.

3) Take out the chart cassette

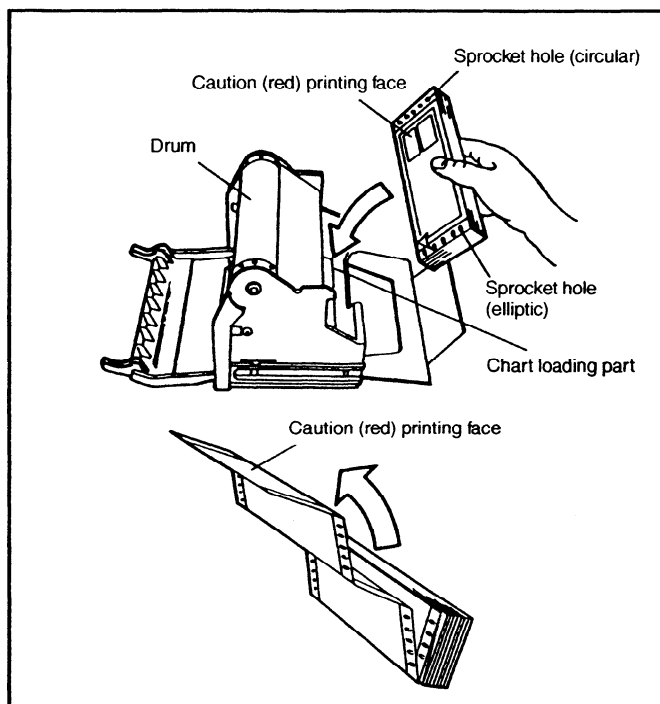


4) Open the chart holders



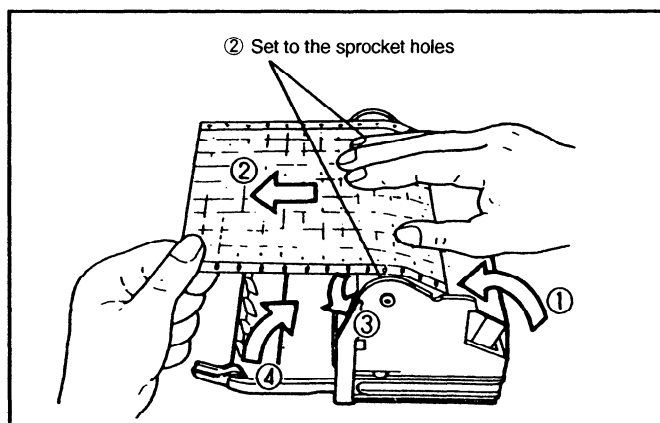
5) Put the chart into the loading part

Be careful not to set the sprocket holes (circular and elliptic holes) wrongly.



6) Set the chart



- ① Draw out the chart about 30cm, and close the rear chart holder.
- ② Set the chart to the drum sprocket.
- ③ Insert the chart into the chart fold part by folding it 2 to 3 folds.
- ④ Make sure that the chart is set to the sprocket holes, and close the front chart holder.
(Press the chart securely by the right hand until it is set properly, otherwise it may be displaced.)



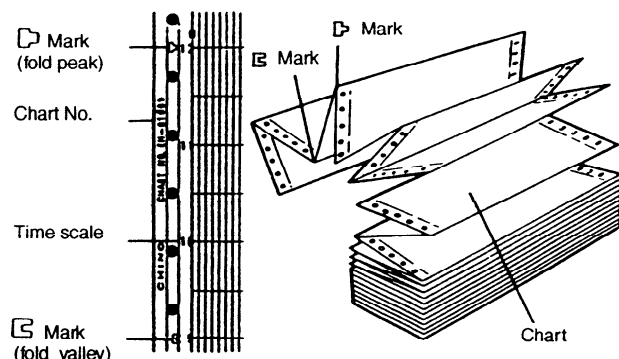
Caution Turning direction of chart drive gear

Don't turn the chart drive gear inward, otherwise the chart cannot be returned, and it causes a chart feed failure.

Remarks Chart folds

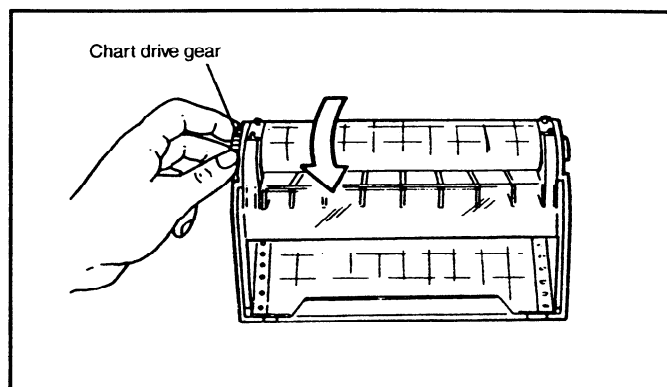
A  mark is printed at the top and  mark is printed at the valley at both ends of each fold of the chart.

Be careful not to reverse these folds when the chart is put to the chart mounting part, otherwise a folding failure occurs.



7) Chart feed check

Turn the chart drive gear this side, and make sure that the chart is fed smooth.

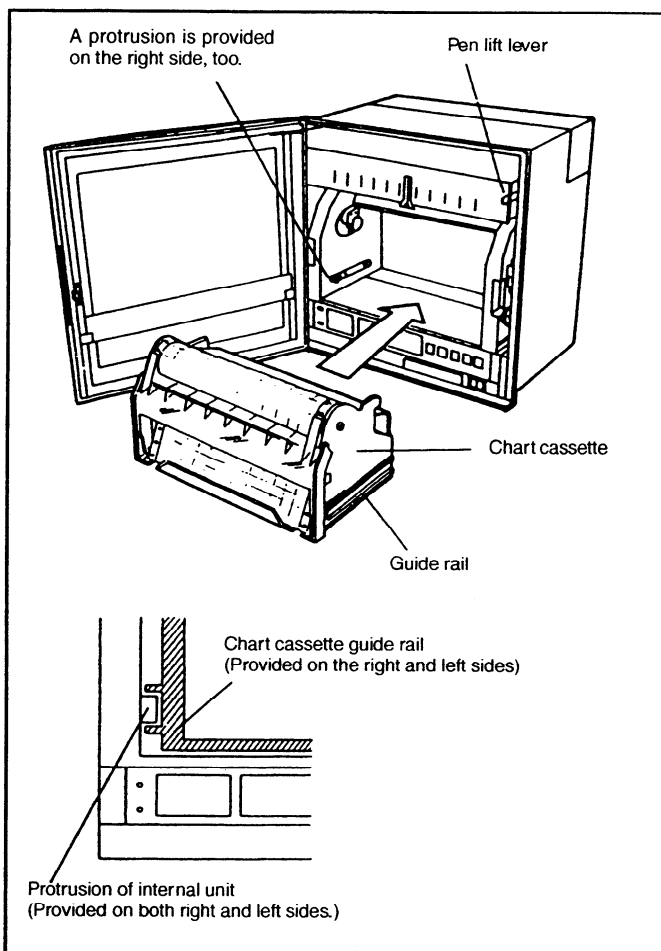


Remarks Turning direction of chart drive gear

Don't turn the chart drive gear forward, otherwise the chart cannot return, and a chart feed failure results.

If the chart is not fed normally, set it again from the beginning.

- 8) Replace the chart cassette into the internal unit
The chart cassette is provided with guide rails at the right and left bottoms.
Insert the chart cassette after fitting the convexed portions of the rails into the protruded portions of the internal unit.



9) Chart mounting condition check

Continue pressing **FEED** (fast feed) key for several seconds, and make sure that the chart mounting condition and feed are smooth. Chart will not move for a while just after starting running. It can be solved by pressing **FEED** key.

10) Lower the pen lift lever.

If the pen lift lever is set upward, lower it, and the cartridge pen is set downward to be ready for recording.

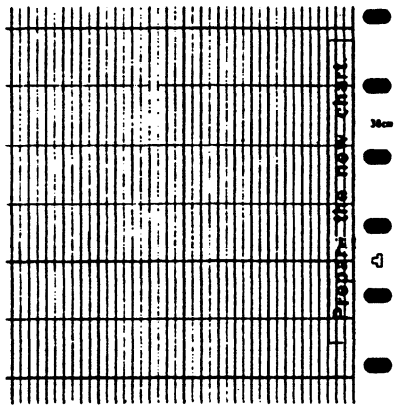
16. MAINTENANCE

16.1 Daily Inspection

Check the residual quantity of the chart and recording conditions, and use the instrument under a good condition at all times.

⚠ Caution Overcurrent protective device

This instrument is not provided with any overcurrent protective device. Mount an overcurrent protective device externally. Turn off the power switch in advance when removing the internal unit.

Check and maintenance items	Remedial measures
Chart	<p>The chart can be recorded for about 32 days when it is continuously used at a chart speed of 25mm/H. An end mark appears at the right end of the chart when the chart comes to an end. Replace the chart with new one.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Prepare a new chart</p> <p>For ordering, specify chart No. and handling unit.</p> <p>① Chart No. is printed on the right side of the chart. <Ex.> EH-01001</p> <p>② Handling unit: 1 case (containing 15 charts)</p> </div> 
Cartridge pen (for analog recording)	<p>Replace the cartridge pen with new one when the analog recording line (trend line) has blurred to be thick. For the exchange method, see page 46.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>For ordering Please specify the article name and handling unit.</p> <p>① Article name: BH cartridge pen □ - pen type For No. ○, □: 1, 2, 3 ○: 1 (red), 2 (green), 3 (blue)</p> <p>② Handling unit: 1 bag containing 3 pens</p> </div>
Plotter pen (for digital recording)	<p>Replace the plotter pen with new one when the digital recording and printing characters have blurred to be thick. For the exchange method, refer to page 46.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>For ordering Please specify the article name and handling unit.</p> <p>① Article name : BH plotter pen</p> <p>② Handling unit: 1 case containing 3 bags</p> </div>
Chart feed condition	<p>Check if the chart is fed normally without any double feed, deviation from the sprocket, and other failures. Mount the chart again from the beginning, if an abnormal condition was detected. The chart cannot always be fed normally if the working humidity range is out of the specified range (20 to 80%RH).</p>
General function conditions	<ul style="list-style-type: none"> • Are the analog indications and digital display normal? • Are the analog recording and digital recording normal? • Are the instrument is free of abnormal noises, abnormal odor, abnormal heating, or other defects? <p>If an abnormal condition was detected, take proper remedial measures, referring to par. 16.3 on page 54.</p>

16.2 Cleaning and Lubrication/Storage Methods

1 Cleaning of door and other components

The door and front indicator are molded with plastic (ABS-94HB). For cleaning them, wipe them off with a dry soft cloth or a cloth moistened with lukewarm water or a neutral detergent.

Caution Don't use any solvent chemicals.

Don't use tinner, benzine, and other solvent chemicals, otherwise the surfaces will melt. The door window and front chart holder are made of acryl. Don't use any solvent chemicals, otherwise they may be broken.

2 Cleaning and lubrication of main shafts of pens.

Clean and lubricate the main shafts of pens once every 6 months. Two main shafts are mounted for one-pen type, three main shafts are mounted for 2-pen type, and four main shafts are mounted for 3-pen type.

Remarks 1 Turn off the record switch first

Turn off the record switch to go out the green lamp before starting cleaning and lubrication.

Remarks 2 Clean the main shafts before lubrication

Clean the main shafts with a soft cloth before lubricating them.

Remarks 3 Don't lubricate any resin gears

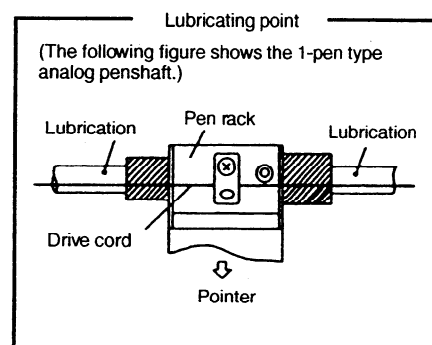
Don't lubricate any resin gears. No lubrication is necessary for them.

Remarks 4 Lubricating oil

Don't use any other lubricating oil, but the attached lubricating oil. Don't use the lubricating oil, if its color has turned to dark yellow or brown.

Remarks 5 Handling of pen holder

Don't move any pen holder rightward or leftward by hand.



3 Storage method of this instrument

Be careful with the following items when storing the instrument for a long time (longer than one month)

1) Preparation before storage

- ① Remove the cartridge pens and plotter pen and store them after mounting their caps.
- ② Remove the chart and store it. Apply the transportation lock to it.
- ③ Fasten the terminals of the terminal board so as not to remove them.
- ④ Keep the instrument free of being contaminated with dust by covering it with a vinyl bag or the like.

2) Storage place

- ① Store the instrument at a well-ventilated place free of being exposed to the direct sunlight.
- ② Store the instrument at a place free of corrosive gases, vibrations, shocks, the possibilities of crumbling or drop.
- ③ Store the instrument at a place where the ambient temperature is comparatively stable within a range of 0 to 50°C without any moisture, steam, or the like.

16.3 Troubleshooting

This paragraph shows the symptoms, causes, and remedial measures to be observed when the operation or functions of this instrument are abnormal.

The following table summarizes the classification of abnormal symptoms. Read the corresponding item.

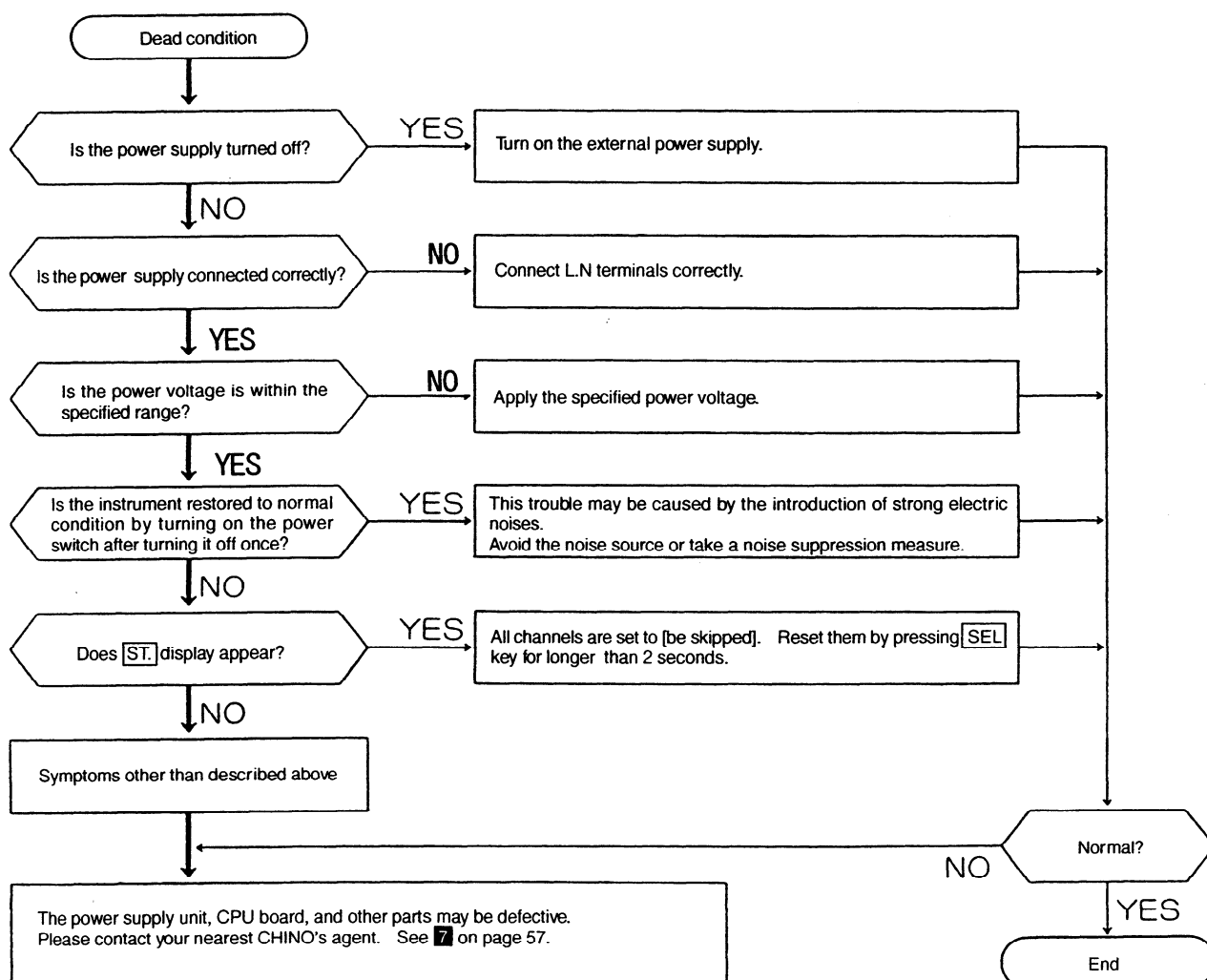
1 Dead condition	4 Abnormal analog recording (pen-writing)
2 Abnormal analog indications	5 Abnormal digital recording and printing
3 Abnormal digital display	6 Abnormal setting

Remedial measures cannot be taken easily for abnormal symptoms other than described above.

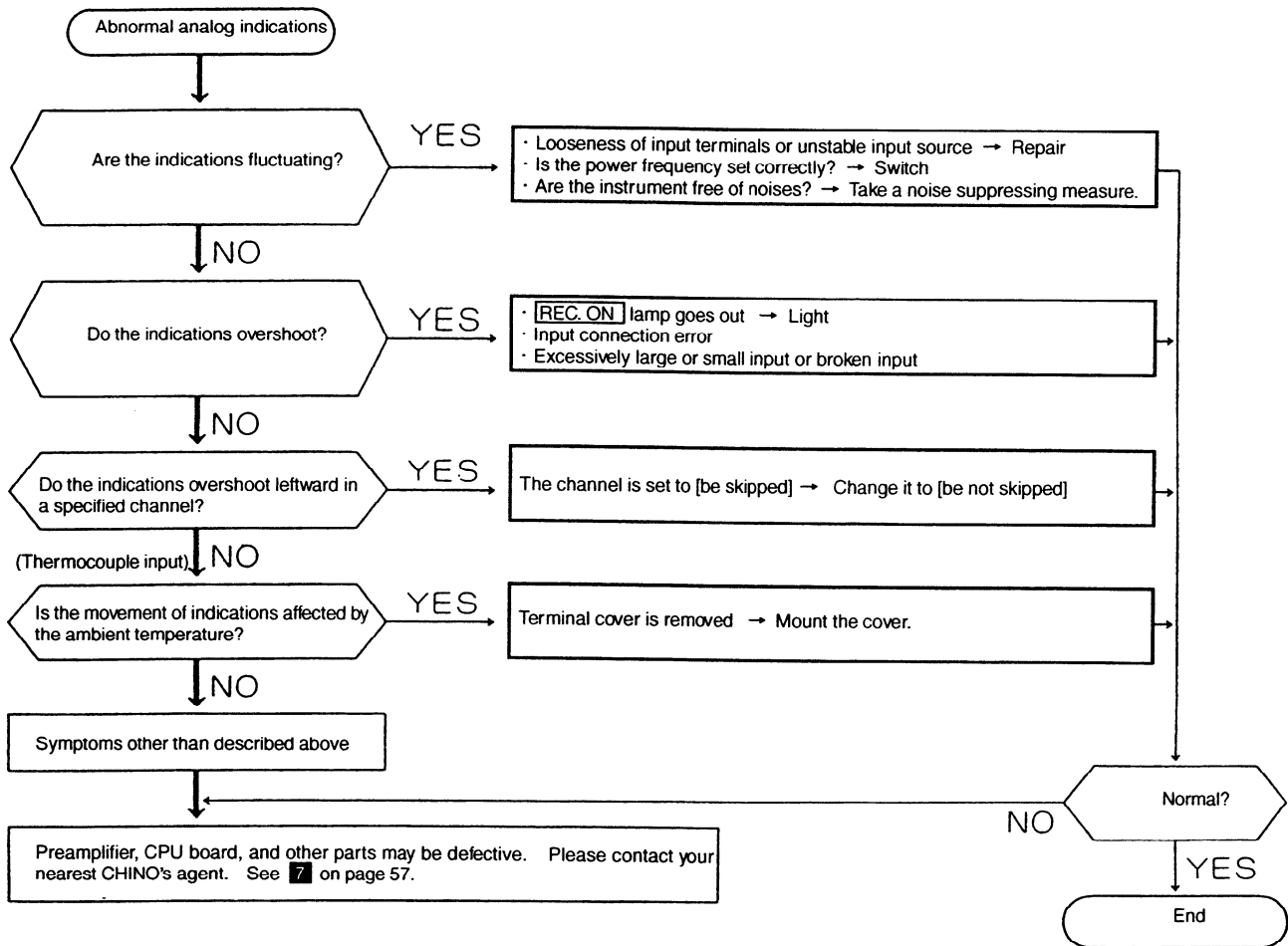
⚠ Warning **Repair and modifications** —————

Don't repair or modify the instrument by replacing its units and parts, otherwise the instrument cannot be recovered or repaired correctly, and an electric shock accident may occur or the instrument may be broken.

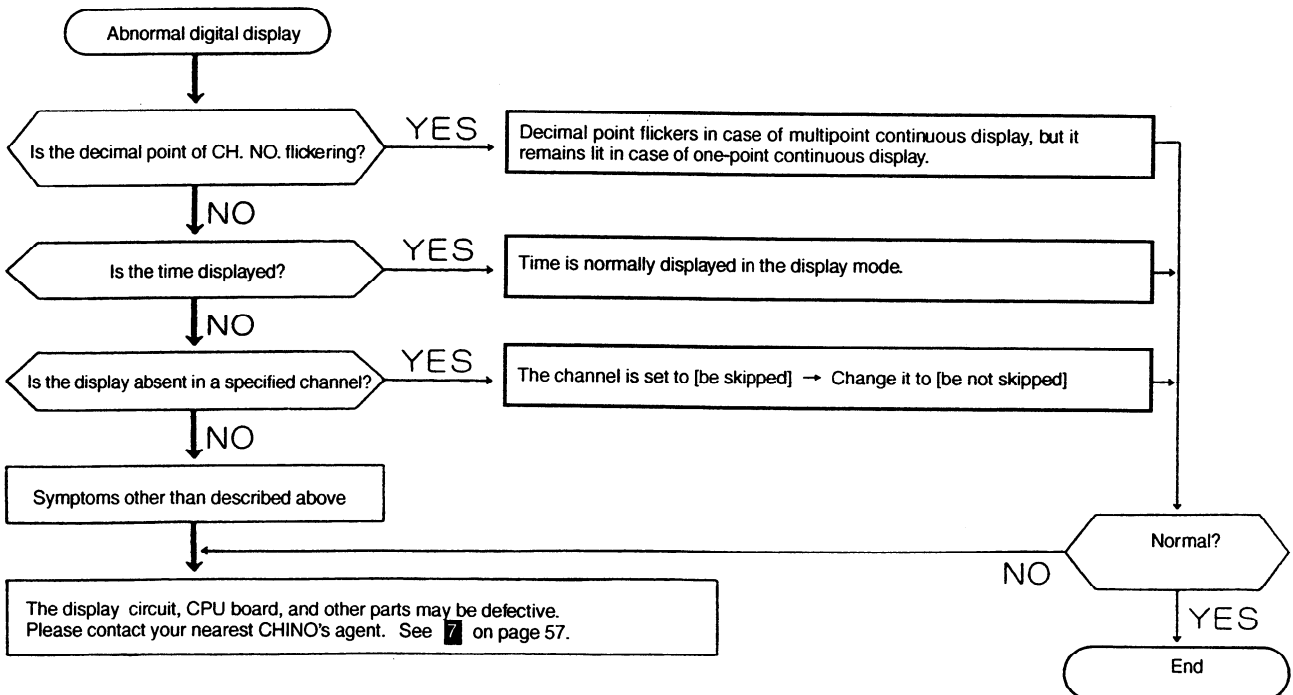
1 Dead condition



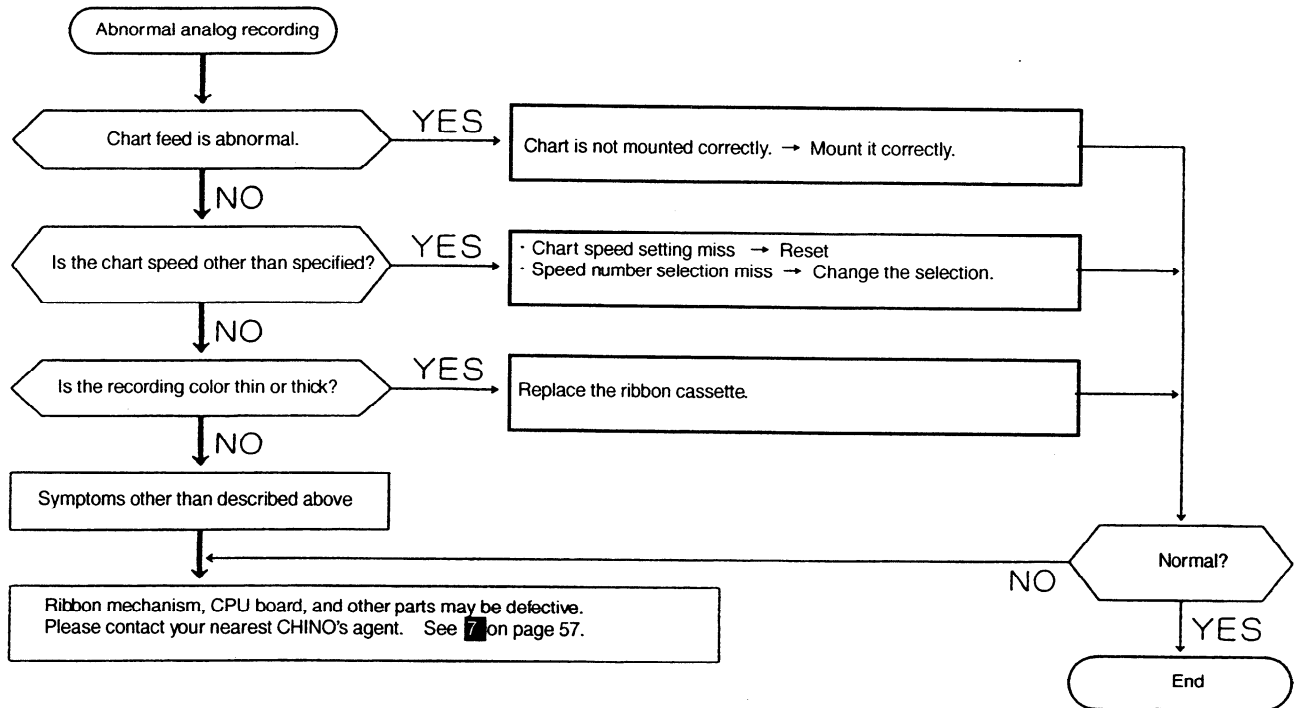
2 Abnormal analog indications



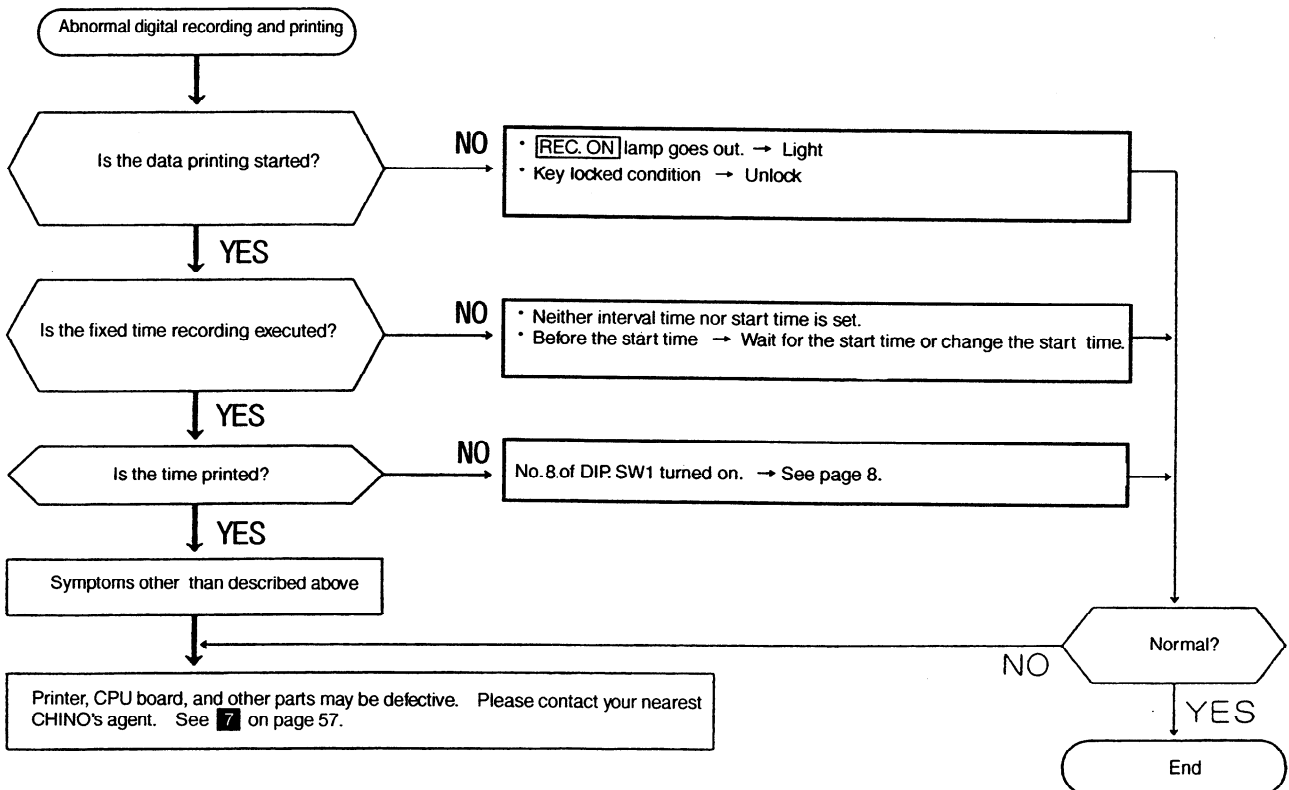
3 Abnormal digital display



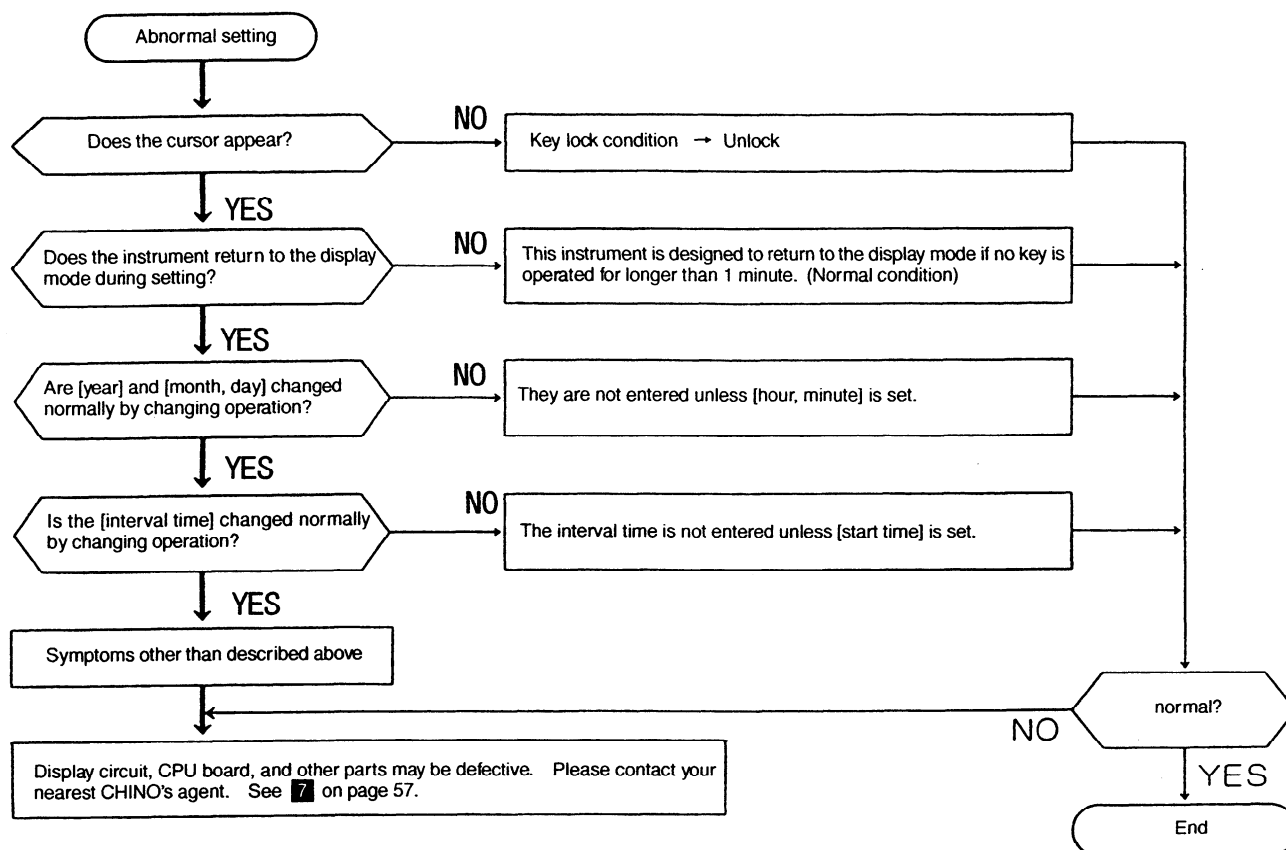
4 Abnormal analog recording (pen writing)



5 Abnormal digital recording and printing



6 Abnormal setting



7 Method of contacting the CHINO's agent

If your instrument has become abnormal and the trouble seems to be not caused by an operation failure or a handling failure, but it seems to be caused by defective parts, please contact the sales agent from which you purchased your instrument or CHINO's agent at once by specifying the following items.

Survey items	Examples	Remarks
① Sales agent from which you purchased your instrument	CHINO's agent	Sales agent from which you purchased your instrument, or the like
② Instrument model	BH1G11-NDN	Label 2 (mounted on the left side panel of internal unit) → See page 56.
③ Serial No. of instrument	BH951A001	
④ Scale, etc. of instrument	K, 0 to 1200°C , 100V AC	
⑤ Abnormal contents	No.1 pen remains stopped abruptly.	Occurrence time, occurrence frequency, and other data
⑥ Notes	Special mounting environments (high temperature, high humidity), etc. and other items related to detected abnormal symptoms	

16.4 Consumables and Reference Exchange Intervals

This instrument comprises several consumables. You are recommended to check and replace them periodically for using the instrument under a good condition for a long time.

Warning Parts exchange

Don't replace any parts other than the chart and pen mounting parts, otherwise the instrument cannot be repaired correctly or a dangerous accident may occur. For replacing consumables and other parts, please contact CHINO's agent.

1 Consumables and reference exchange intervals

Names of consumables			Reference exchange intervals	Working conditions and other remarks	
Mechanical parts	Servo mechanism		4 to 6 years	Assume that the instrument is used under the following standard conditions • Temperature: 25°C , Humidity: Lower than 80%RH • A place free of corrosive • A place free of dust, moisture, and soot • A place free of vibrations and shocks • A place where the functions of instrument are not affected unfavorably	
	Main shaft of pen, auxiliary shaft, bearing		4 to 6 years		
	Pen holder mechanism		4 to 6 years		
	Drive cord		4 to 6 years		
	Chart drive mechanism		4 to 6 years		
	Chart holder (front, rear)		4 to 6 years		
	Various motors		4 to 6 years		
Electrical parts	Power supply unit		5 years	Ambient temperature: at 25°C	
	Relay	For input	5 years	Inside the preamplifier	
		For alarm	100,000 times	Resistive load	Switching count
			30,000 times	Inductive load	
	EEPROM		10 years holding	Rewriting count: 10,000 times	
	Lithium battery		10 years	8-hours operation per day (Ambient temperature: Lower than 40°C)	
	DIP. SW		2,000 times	Switching count	
	Key		3 to 8 years	Depends largely upon the working conditions and atmospheres.	

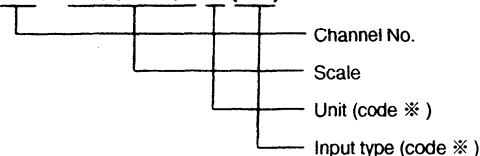
17. INPUT TYPE CODES AND UNIT CODES

Label 2 indicates details of input specifications, etc.

- ① 1-pen type : The unit is indicated by the code.
 ② Multi-pen type : Input specifications of each channel are indicated on the specifications column.
 The unit and input type are indicated by the codes.

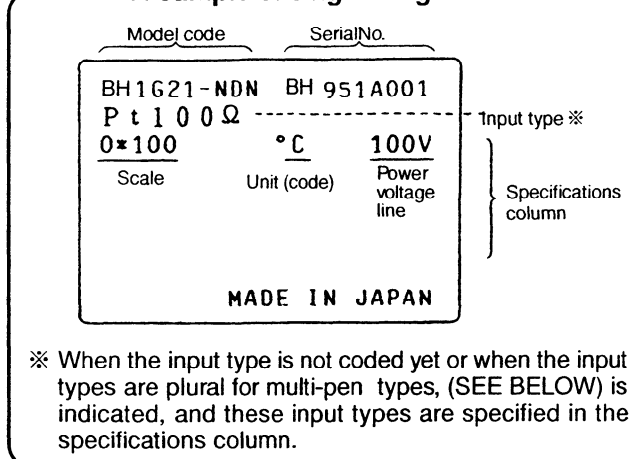
(Example)

1P = -50 * 150°C (MI)



※ If the input type and unit are not coded yet, they are indicated by actual input type and unit.

A sample of single-range label 2



Input Type Codes

Sort	Input type	Code	Sort	Input type	Code	Sort	Input type	Code
Thermo-couples	B (Old PR6-30%)	B	Thermo-couples	WWR5-26	W	mV	0 to 10mV DC	M1
	R (Old PR13%)	R		WWR5-26	O		0 to 5mV DC	M5
	S (Old PR10%)	S		Cu-CuCo	U		-5 to +5mV DC	M6
	K (Old CA)	K		AuFe-Cr	A		-10 to +10mV DC	M7
	E (Old CRC)	E		Platinel ※			0 to 20mV DC ※	
	J (Old IC)	J		U(DIN J) ※			0 to 50mV DC ※	
	T (Old CC)	T		L(DINT) ※			1 to 5V DC	V6
	N(Old Nicrosil-Nisil)	N	Resistance thermometers	Pt100Ω	13	mA		
	Ni-NiMo ※			JPt100Ω	10		4 to 20mA DC	A4
	PR5-20 ※			Pt-Co (Old Pt50Ω)	PC		10 to 50mA DC ※	
	PR20-40	P						

※ No code is provided.

Unit Codes

Unit ※	Code	Unit ※	Code	Unit ※	Code	Unit ※	Code
°C	°C	pH	PH	mmH ₂ O	33	mol	61
°F	°F			mmHg	34	ppm	62
K	K	m/s	11	kg/cm ²	35	ppm SO ₂	63
Hz	HZ	m/min	12	Torr	36	ppm CO	64
g	G	m ³ /s	14	kcal	42	ppm CO ₂	65
kg	KG	m ³ /min	15	cal	43	%	91
A (DC)	A	m ³ /h	16	cal	44	%RH	92
mA (DC)	MA	kg/h	17	A (AC)	51	Others	99
V (DC)	V	t/h	18	mA (AC)	52		
mV (DC)	MV	rpm	21	μV (DC)	54		
kW (AC)	KW	ton	31	V (AC)	55		

※ Each unit is indicated by characters on the scale plate. (DC) is identified by “_” below characters, while (AC) is identified by “~” below characters.

※ Each unit is printed in 2 digits. Printed characters are restricted (large 3 in case of m³, for example).

18. SPECIFICATIONS TABLE

Items		Contents
Input specifications	Input signals	Specify the input from the following items every pen. Scales are provided by the number of pens. DC voltage $\pm 7\text{mV}$, $\pm 14\text{mV}$, $\pm 25\text{mV}$, $\pm 70\text{mV}$, $\pm 5\text{V}$ Thermocouple B, R, S, K, E, J, T, N, Ni-NiMo, PR5-20, PR20-40, WWR5-26, WWR0-26, U, L, platinel AuFe-Cr Resistance thermometer ... Pt100 Ω , JPt100 Ω , old Pt50 Ω , Pt-Co
	Accuracy rating (under the reference condition)	Digital display and recording ... Thermocouple input, resistance thermometer input : <div style="display: flex; align-items: center;"> <div style="border-left: 1px solid black; padding-left: 5px; margin-right: 5px;"> Thermocouple input does not include any reference junction compensation accuracy </div> <div style="margin-left: 10px;"> $\pm 0.3\%$ of scale range ± 1 digit or $\pm 1^\circ\text{C}$, whichever is larger DC voltage: $\pm 0.1\%$ ± 1 digit Analog indication $\pm 0.5\%$ of the scale range </div> </div>
	Temperature drift	$\pm 0.01\%\text{FS}/^\circ\text{C}$ (Thermocouple input is calculated by electromotive force conversion)
	Reference function compensation accuracy	K, E, J, T, N platinel ... Lower than $\pm 0.5^\circ\text{C}$ (at 0°C) R, S, Ni-NiMo, AuFe-Cr, WWR5-26, WWR0-26, U, L ... Lower than $\pm 1.0^\circ\text{C}$ (at 0°C)
	Allowable signal source resistance	Thermocouple input, DC voltage input Lower than $1\text{k}\Omega$ (without burnout) Resistance thermometer input Lower than 10Ω per wire (Pt100, JPt100)
	Input resistance	Thermocouple input, DC voltage input Higher than $8\text{M}\Omega$, higher than $1\text{M}\Omega$ when a voltage divider is used.
	Common mode voltage	Lower than 30V AC or 60V DC
	Common mode rejection ratio	More than 130dB
	Series mode rejection ratio	More than 50dB
	No. of measuring points	1 point (1-pen type), 2 points (2-pen type), 3 points (3-pen type), 3 types
	Measuring cycle	Approx. 125msec .
	Terminal board	Detachable type (Removable for connections) ... Input terminals and alarm terminal
Recording specifications	Balancing time	Approx. 2 sec/full scale (180mm)
	Recording system	Analog recording Cartridge pen Digital recording Plotter pen
	Recording color	Analog recording Red (No.1pen), green (No.2 pen), blue (No.3 pen) Digital recording Purple
	Recording chart	Fan-fold type : Total width 200mm , Total length 20m , Effective recording width 180mm
	Chart speed	Standard: 3 speeds (12.5 , 25 , 50mm/H) are selectable by DIP switches.
		Combinations of 3 speeds can be specified. 3 speeds can be set optionally. ※ ※ Setting range: 1 to 599mm/H or 10 to 200mm/M .
	Fixed time recording	Time, point No., measured values, and unit are recorded and printed on analog recording every setting interval.
	Data printing	Digital recording and printing are executed on analog recording at an optional time. The digital recording and printing contents are the same as those in fixed time recording.
	Date and time printing	Time line and time are printed every hour sharp, and the date (year, month, day) is printed at $00:00$ hour. Printing intervals depend upon the chart speed.
	Scale printing	The scale zero is printed on the left side and the scale span is printed on the right side at a fixed interval.

Items		Contents
Recording specifications	Chart speed printing	The executing chart speed is printed at a fixed interval on the right side.
	Alarm occurrence/cancellation printing (when alarm option is added)	When an alarm occurs: Time, point No., alarm type, and level are printed on the right side. When an alarm has been canceled: Time, point No., and level are printed on the right side.
	Setting change mark printing	When setting change ends, characters showing the change items are printed on the right side.
	Skip function	Analog indication/recording and digital display/recording can be skipped by setting this function every channel.
Indication and display specifications	Analog indication	Scale plate and pointer
	Scale plate	Max. dual scales 150 equal divisions
	Indication dead band	0.2% of the scale range
	Digital display	7-segment LED, character height 15mm
		2-digits ... Channel (point) No. 5 digits ... Data (measured values) display
	Display items	Measured value display ※ or time display ※ Measured value display is done by multi-point sequential display or one-point continuous display. (display selection)
	Setting display	Digital display part is shared by key operation.
General specifications	Status display	Recording on/off Green LED Illuminated switch ALM Red LED Flickers during the occurrence of an alarm PW Green LED Lights when power supply is turned on.
	Rated supply voltage	Specify 100V AC line (90 to 120V AC) or 200V AC line (180 to 240V AC) ,50/60Hz
	Power consumption	Approx. 45VA max.
	Working temperature range	0 to 50°C
	Humidity range	20 to 80%RH (No dew condensation is allowable.)
	Countermeasure against power interruption	Set contents are held by EEPROM. Clock is backed up for longer than 10 years by a lithium battery (when the instrument runs for 8 hours every day)
	Insulation resistance	Higher than 20MΩ at 500V DC across measuring terminals and protective conductor terminal Higher than 20MΩ at 500V DC across power terminals and protective conductor terminal Higher than 20MΩ at 500V DC across measuring terminals and power terminals
	Dielectric strength	500V AC, 1min. Across measuring terminals and protective conductor terminal 1500V AC, 1min. Across power terminals and protective conductor terminal 1500V AC, 1min. Across measuring terminals and power terminals
	Case	Door ABS resin ※ Case Ordinary steel plate Power supply Ordinary steel plate ※ Heat resisting temperature 80°C
	Painting color	Door Black (equivalent to Munsell code N3.0) Case Grey (equivalent to Munsell code N7.0)
	Mounting method	Panel flush-mount type
	Weight	Approx. 8.0kg (1-pen type), Approx. 8.5kg (2-pen type), Approx. 9.0kg (3-pen type)

Option specifications

Option names	Specifications
External drive ※	No-voltage contact 3 inputs Chart speed: 3-speed selection (2 inputs), Data printing (1 input)
Communication ※	One of RS-232C, RS-422A, and RS-485 ① Main parameters setting and check ② Transmission of measured values and status information
Alarm output (6P) ※	No. of output points : 6 points Alarm types : Absolute values (higher-limit, lower-limit), Difference (higher-limit, lower-limit), Change ratio (increase limit, decrease limit) Standby alarm : Whether the standby alarm is provided or not can be specified every alarm type. Output processing : OR or AND output can be specified every alarm point. Setting level : 2 levels/channel
Non-standard input	Voltage-dividing input : Higher than 5V DC to lower than 60V DC (A voltage divider is built in) Power supply input : Lower than 50mA (A resistor can be mounted outside or it can be mounted as a built-in part)
Burnout	If an input signal is interrupted, its indication overshoots the higher-limit. (excluding the voltage-dividing input and current input)
Time-axis synchronization (Applicable to multi-pen type only)	Recording due to a difference of the mechanical positions of pens is corrected with time.

※The depth is extended by 16mm as compared with the standard instrument.

For the mechanical relay 'a' contact alarm outputs, the depth is 27mm longer.

CHINO

CHINO CORPORATION

32-8, KUMANO-CHO, ITABASHI-KU, TOKYO 173-8632

Telephone: 81-3-3956-2171

Facsimile: 81-3-3956-0915

E - m a i l: inter@chino.co.jp

Web site: <http://www.chino.co.jp>

The first edition Dec.2001

Printed in Japan ()