

**SELF BALANCING RECORDER**  
**TR-400**  
**(PEN WRITING TYPE)**  
**INSTRUCTION MANUAL**

***Shinko***



## FOR SAFE USE OF THE PRODUCT

In order to use this instrument correctly and safely, be sure to observe the following cautions.

### 1. Installation place and terminal cover

#### (1) Panel mounting type

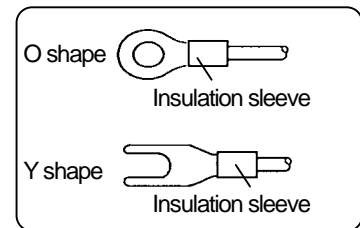
This instrument must be installed on the panel for operation. In order to avoid electric shock, provide means to prevent operators from touching any power supply section or input/output terminals.

#### (2) Mobile type

Provide a cover to the terminal section in order to avoid an electrical shock.

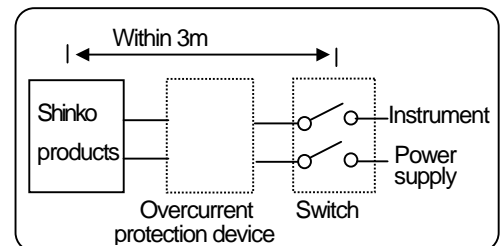
### 2. Terminal processes for connections

Crimp style terminals with an insulation sleeve should be employed for connections. O-shaped terminals should be used for the power supply and the protective grounding terminals.



### 3. Installation of a power supply circuit breaker

For the power supply, provide a switch which is suitable to the rated power supply for this instrument within easy reach or an overcurrent protection device within a distance of 3m from the unit.



### 4. Provide separate safety measures for the output functions

When the instrument is to be used in a system which has output functions including controls, alarm, etc., apply separate safety measures against phenomena which would be caused by malfunction due to misoperation, or failure of the instruments or sensors.

### 5. Symbol marks used for this instrument



This symbol is used on parts where there is an electric shock hazard. Be very careful against electric shock when wiring, maintaining or servicing these parts.



This symbol is used on parts which require protection by a ground terminal. Instruments with this symbol must be grounded for power supply facilities before starting operation.



## Warnings

Confirm power supply, voltage rating and grounding.	Before supplying power to the instrument, be sure to check that its rated voltage matches the supply voltage and that the power and protective grounding wiring has been connected correctly and securely.
Do not put your hands into the case.	Unless essential operational repairs are required, do not put your hands inside the rack or case. Electric shock or injury may occur.
Do not use in a gaseous atmosphere.	Do not operate or install the instrument in a place where there is a combustible or explosive gas or its vapor.
Maintenance and modification	When maintenance and modification become necessary, consult your nearest Shinko branch office, agent or your dealer. <Note> Only a service person designated by Shinko can perform maintenance and modification by replacing parts.

## SAFETY PRECAUTIONS

- To ensure safe and correct use, thoroughly read and understand this manual before using this instrument.
- This instrument is intended to be used for industrial machinery, machine tools and measuring equipment. Verify correct usage after consulting purpose of use with our agency or main office. (Never use this instrument for medical purposes with which human lives are involved.)
- External protection devices such as protection equipment against excessive temperature rise, etc. must be installed, as malfunction of this product could result in serious damage to the system or injury to personnel. Also proper periodic maintenance is required.
- This instrument must be used under the conditions and environment described in this manual. Shinko Technos Co., Ltd. does not accept liability for any injury, loss of life or damage occurring due to the instrument being used under conditions not otherwise stated in this manual.

### **Caution with respect to Export Trade Control Ordinance**

To avoid this instrument from being used as a component in, or as being utilized in the manufacture of weapons of mass destruction (i.e. military applications, military equipment, etc.), please investigate the end users and the final use of this instrument.

In the case of resale, ensure that this instrument is not illegally exported.

## ■ GENERAL AND MODELS

The TR-400 series pen-writing type recorders/recording alarms cover the 1- pen, 2-pen recorders and the pen-writing type recording alarms having an alarms mechanism out of the TR-400 series electronic recording/controlling alarms using a 180mm chart paper.

These TR-400 series instruments comprise the following standard models according to the combinations of the number of recording points (number of pens), types of input signals and alarm system.

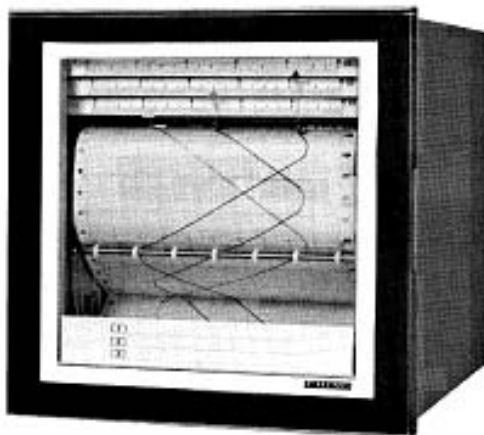
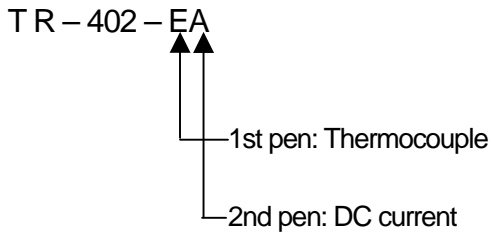
Please read corresponding items in this instruction manual after confirming your instrument model described at the lower part inside the door and the right side panel of the chassis.

### ● MODELS OF RECORDERS

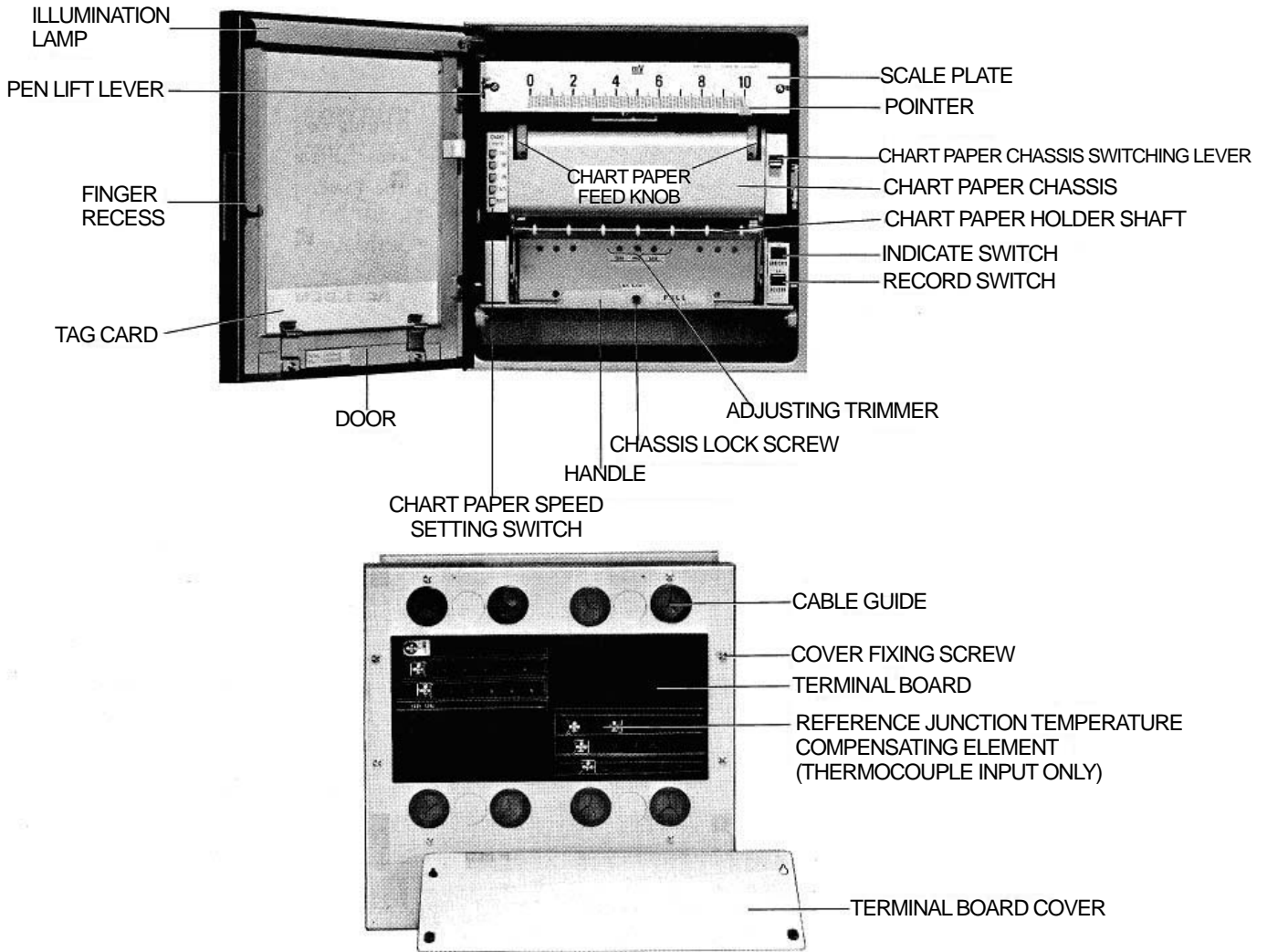
TR-4		□□	-	□	□□	Series: TR-400
Measuring point	01					1-point
	02					2-point
Input		E				Thermocouple
		R				RTD
		V				DC voltage
		A				DC current
Option				LH		High-limit/Low-limit alarm

When the input type of the 1st pen is different from that of the 2nd pen, the 2nd pen code is entered after the 1st pen code shown as below.

(Example)



## NAME AND FUNCTIONS OF COMPONENT PARTS



### ● HOW TO OPEN THE DOOR

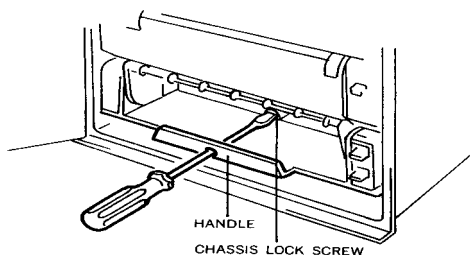
The door can be opened by applying your fingers to the finger recess, and pulling it toward you.

### ● HOW TO DRAW OUT THE CHASSIS

The chassis is fixed by the chassis lock screw to prevent the chassis from coming out during transportation.

Loosen this screw using a flathead (-) screwdriver, and pull the handle toward you, and the chassis can be drawn out.

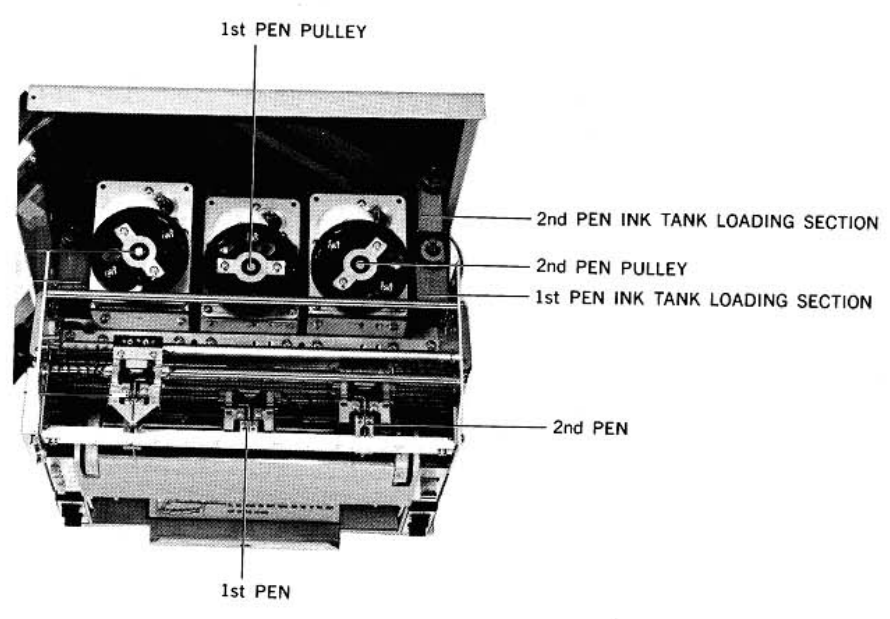
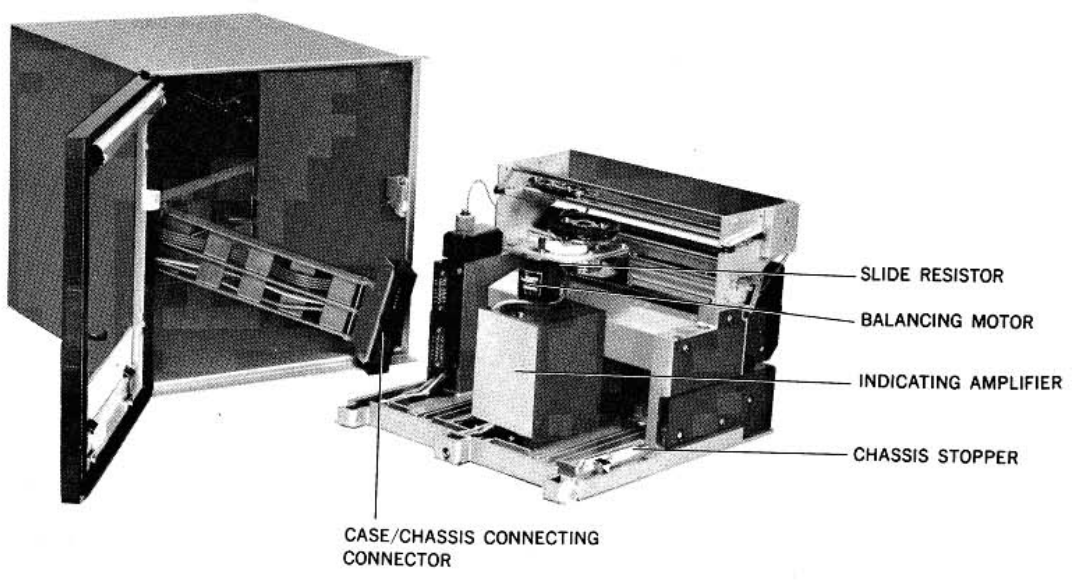
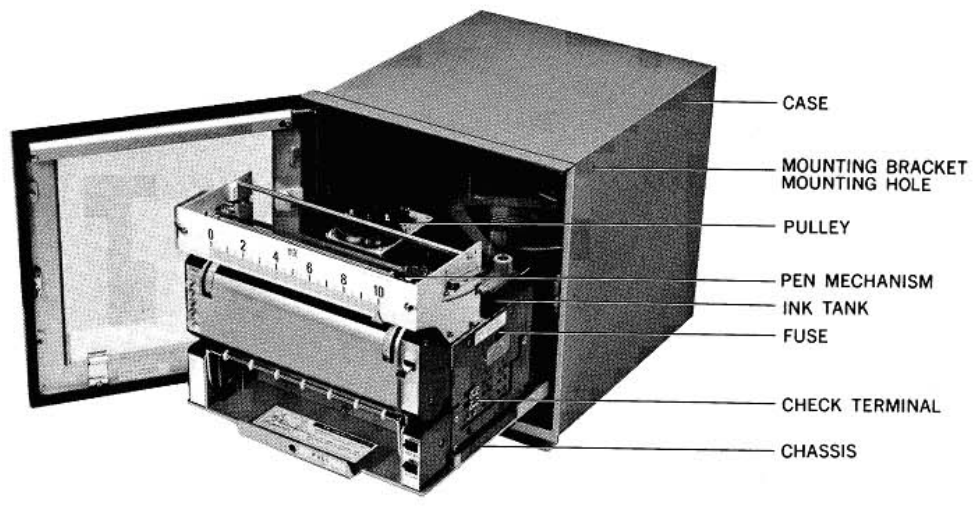
Tighten this screw securely without fail when transporting the instrument again.



### ● HOW TO TAKE OUT THE CHASSIS

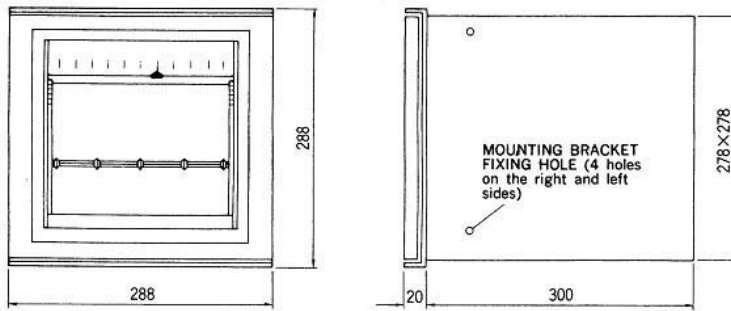
The chassis will not be drawn out of the case usually. Observe the following procedure when taking the chassis out of the case for maintenance and check.

- ① Draw out the chassis until it is stopped.
- ② Disconnect the connector after unscrewing the fixing screw of the case-chassis connecting connector by using a Phillips-head (+) screwdriver.
- ③ Press the chassis stopper mounted at the lower left part of the chassis upward by fingers, and carefully take the chassis out of the case.

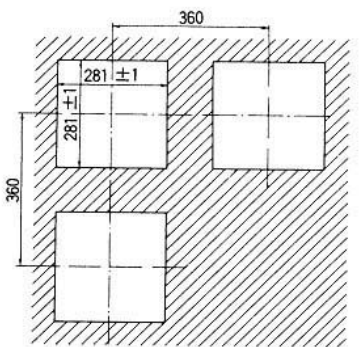


## INSTALLATION

### EXTERNAL DIMENSIONS

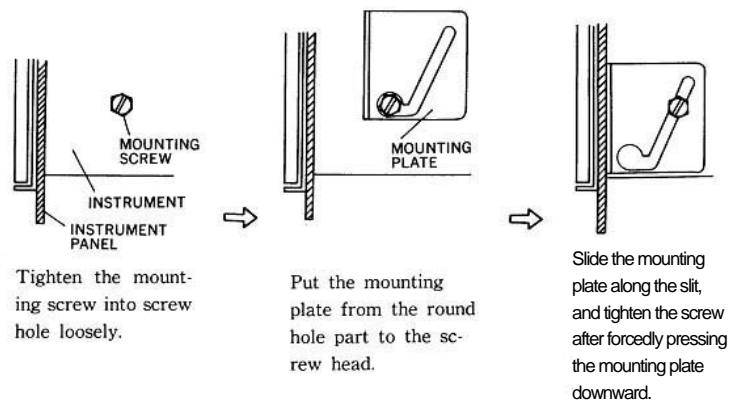


### PANEL CUTOUT AND MOUNTING SPACE



Unit : mm

### HOW TO FIX THE MOUNTING BRACKET



This instrument can be used as a desk-top type instrument. When mounting it on an instrument panel, observe the following procedure.

- ① Prepare a square panel cutout of  $281 \pm 1$  mm x  $281 \pm 1$  mm on the instrument panel.
- ② If two or more instruments are mounted in series, separate their center lines at least 360mm from each other.
- ③ Mount this instrument into the panel cutout.
- ④ Fasten attached mounting screws loosely into the mounting bracket mounting holes (two upper holes and two lower holes) on both side of the case.
- ⑤ Put each attached mounting plate to the mounting screw head from the round hole part, and slide it along the slit.
- ⑥ Press the mounting plates on both side panels forcedly downward, and fix them by a wrench or a screwdriver, while closely attaching them to the instrument panel.

- ⑦ Fix four mounting plates on both side panels, and the instrument is mounted on the instrument panel.

#### <Caution 1>

Identify the right and left mounting plates from each other, referring to the above figure when mounting.

#### <Caution 2>

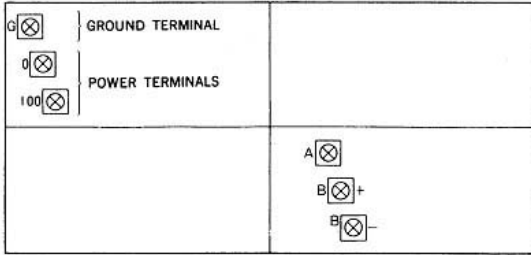
Do not mount the instrument in the following places.

- A dusty place or a place with corrosive gas atmosphere present
- A place with an ambient temperature higher than  $50^{\circ}\text{C}$  or lower than  $-10^{\circ}\text{C}$
- A place where ambient temperature changes rapidly or is damp
- A place near a strong power circuit or a place subject to induction interferences
- A place subject to mechanical vibrations and shocks
- A place subject to strong winds, e.g. in front of a blast duct

# CONNECTIONS

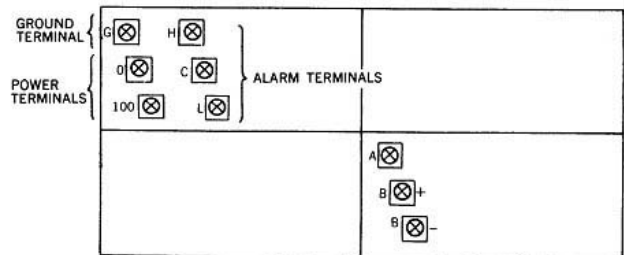
## ● TERMINAL BOARD

### • 1-pen recorder



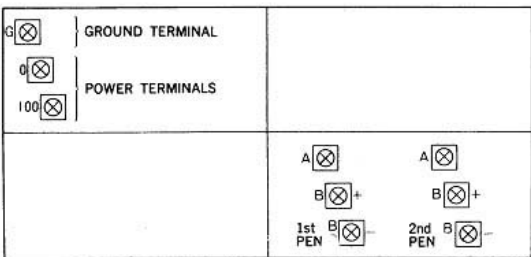
INPUT TERMINALS  
 ( Thermocouple, DC input: (+), (-) terminals  
 RTD input: (A) (B) (B) terminals )

### • 1-pen high-limit (low-limit) type recording alarm



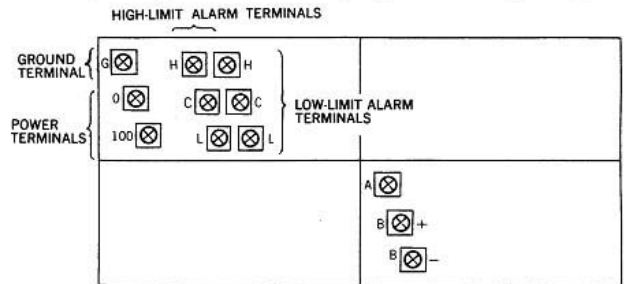
INPUT TERMINALS  
 ( Thermocouple, DC input: (+), (-) terminals  
 RTD input: (A) (B) (B) terminals )

### • 2-pen recorder



INPUT TERMINALS  
 ( Thermocouple, DC input: (+), (-) terminals  
 RTD input: (A) (B) (B) terminals )

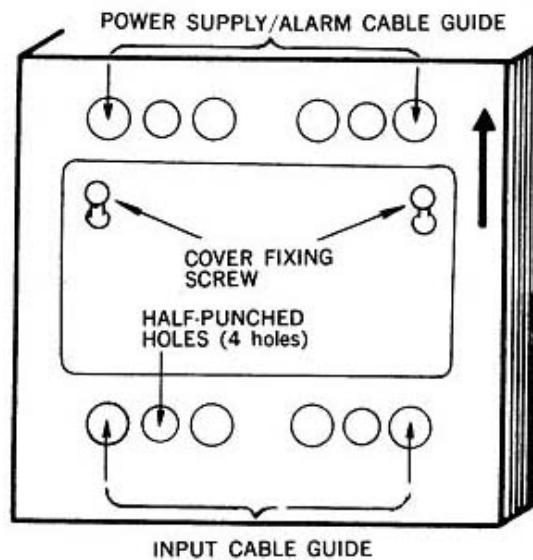
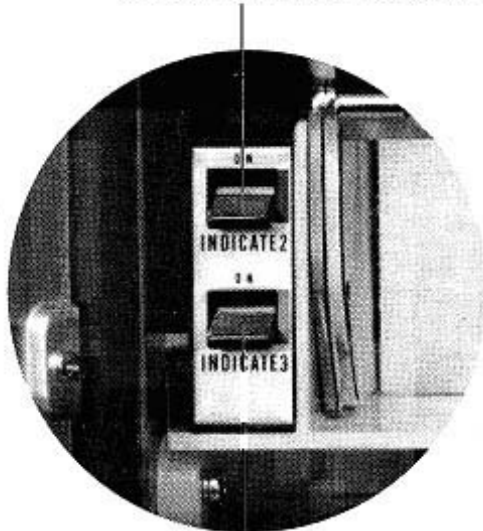
### • 2-pen high-limit (low-limit) type recording alarm



INPUT TERMINALS  
 ( Thermocouple, DC input: (+), (-) terminals  
 RTD input: (A) (B) (B) terminals )



INDICATE SWITCH FOR 2nd PEN



Connect cables to the power terminals, ground terminal and input terminals of this instrument. Connect cables to the alarm terminals in the case of the recording alarm.

The mounting layout of terminals on the terminal board differs according to the instrument models.

Connect cables to corresponding terminals, referring to the terminal board diagram.

① Set the INDICATE and RECORD switches of this instrument to OFF (lower side) without fail before starting wiring.

The INDICATE switches for 2 pens are arranged on the right and left sides of the chassis.

Turn OFF these INDICATE switches, respectively.

② Loosen two cover setscrews of the rear panel of the case using a Phillips-head (+) screwdriver, and remove the terminal board cover.

③ Lead connecting cables into the instrument through the cable guide, while separating the power cable and input cable from each other.

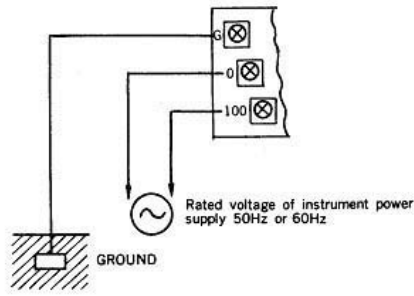
④ After connections, mount the terminal board cover without fail.

#### <Caution>

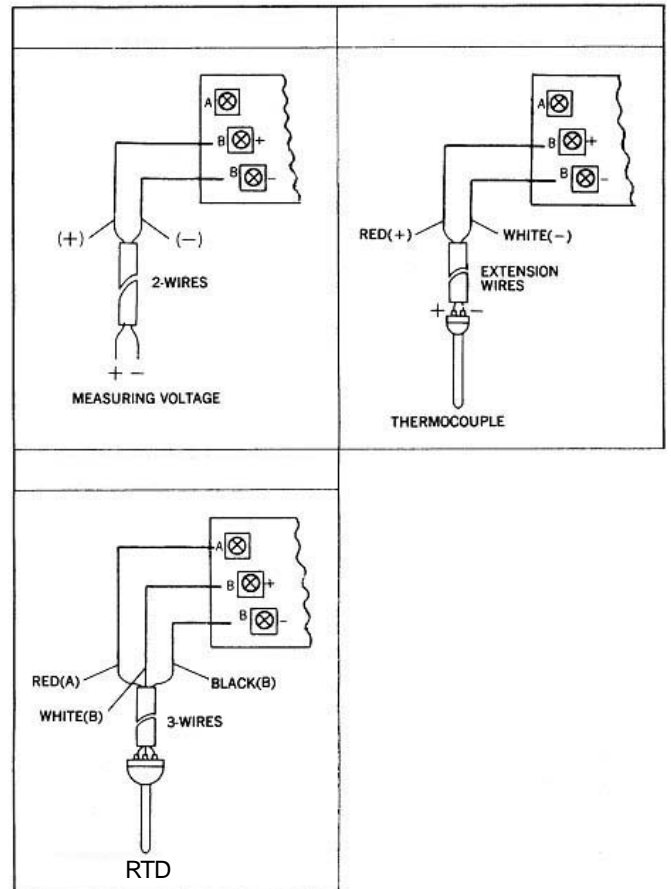
Be careful with the following items during connections.

- If the input circuit wiring is parallel to or intersects with a high voltage circuit, separate the former from the latter more than 50cm.
- Separate the instrument power supply from the final control equipment power supply or the like whose voltage fluctuates rapidly.
- Solder conductors securely, and fasten terminals tightly.

● CONNECTIONS OF POWER TERMINALS AND GROUND TERMINAL



● CONNECTIONS OF INPUT TERMINALS



● CONNECTIONS OF POWER TERMINALS AND GROUNDING TERMINAL

Connect the specified power supply to the power terminals.

The power voltage of this instrument is 110, 120, 130, 220, 230, or 240V AC (Must be specified).

Use this instrument with the specified rated voltage and frequency without fail.

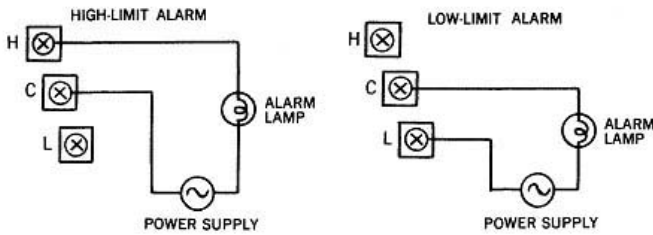
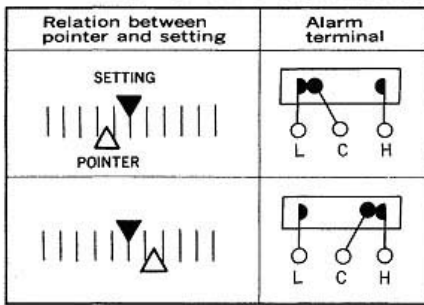
For grounding, solder a conductor to a copper plate, and bury the copper plate into a wet ground.

● CONNECTION OF INPUT TERMINALS

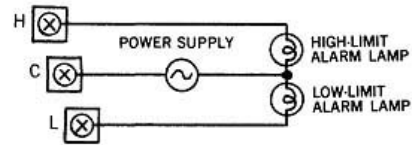
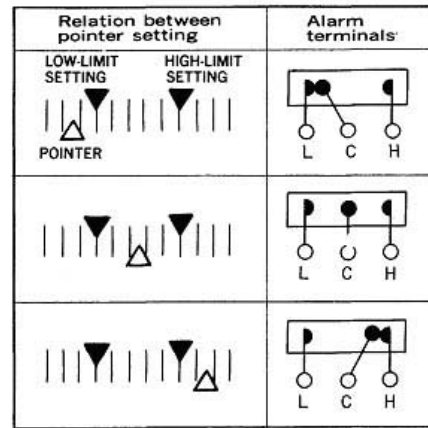
Connect a sensor to be combined with this instrument or wires to respective input terminals.

- DC voltage, current input: Connect to  $\oplus$   $\ominus$  terminals
- Thermocouple input: Connect to  $\oplus$   $\ominus$  terminals
- RTD input : Connect to (A), (B), (B) terminals

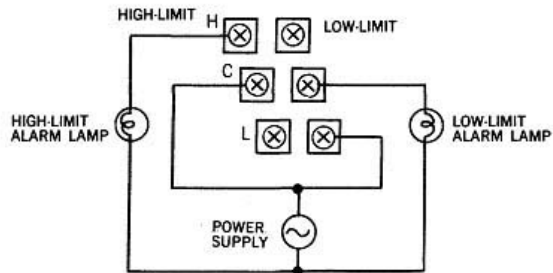
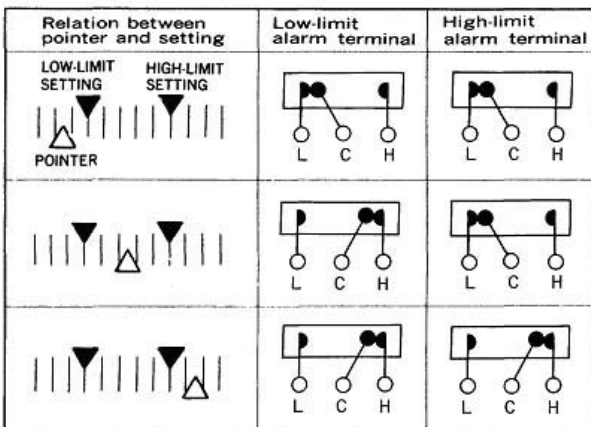
● EXAMPLE OF HIGH-LIMIT OR LOW-LIMIT TYPE ALARM ACTION AND CONNECTIONS



● EXAMPLE OF 2-PEN HIGH-LIMIT/LOW-LIMIT TYPE ALARM ACTION AND CONNECTIONS



● EXAMPLE OF 1-PEN HIGH-LIMIT/LOW-LIMIT TYPE ALARM ACTION AND CONNECTIONS



● CONNECTION OF ALARM TERMINALS (In the case of recording alarm only)

• High-limit or Low-limit type recording alarm

A no-voltage on-off contact signal is outputted across alarm terminals (H)-(C) and across alarm terminals (L)-(C) as illustrated above.

Connect an alarm device, such as a lamp or a buzzer as illustrated above.

If the 2-pen recording alarm is provided with two sets of alarm mechanism, connect an alarm mechanisms.

• 1-pen high-limit/low-limit type recording alarm

A no-voltage on-off contact signal is outputted across the high-limit alarm terminals (H)-(C)-(L), and also across

low-limit alarm terminals (H)-(C)-(L) as illustrated above. Connect an alarm device, such as a lamp, or a buzzer as illustrated above.

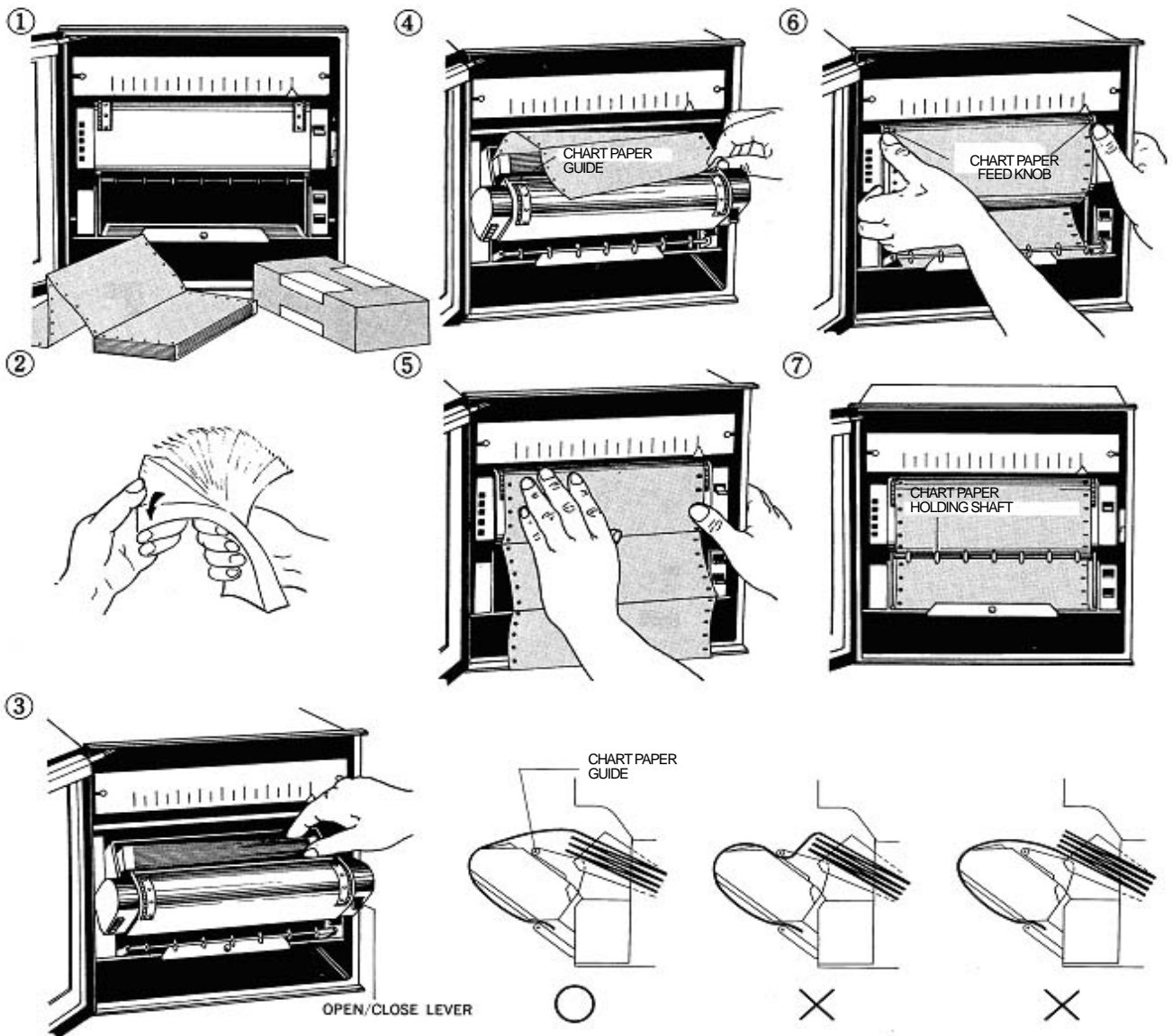
• 2-pen High-limit type recording alarm

A no-voltage on-off contact signal is outputted across alarm terminals (H)-(C)-(L) as illustrated above.

Connect an alarm device, such as a lamp, or a buzzer as illustrated above.

If the 2-pen recording alarm is provided with two sets of alarm terminals, connect an alarm device to the alarm terminals of respective alarm terminals.

## LOADING METHOD OF THE CHART PAPER



- ① Prepare the chart paper from the accessory box. The scale characteristic of thermocouple and RTD input comprises a linear scale and non linear scale. Prepare chart paper to conform with the scale range.
- ② In order to prevent a double feed of chart paper, hold one end of the paper and shuffle them sufficiently.
- ③ Unlock the paper chassis open/close lever by lifting it with fingers, tilt the chassis toward you, and put the chart paper into the loading section at the innermost of the chassis with the start of the chart paper facing upward (so that the circular paper feed holes are positioned on the left side, and oblong holes are positioned on the right side).

- ④ Draw out the chart paper (Do not let it pass through the position below the chart paper guide).
- ⑤ Set the feed holes on both sides of the chart paper to the sprocket, and reset the tilted chassis as before.
- ⑥ Draw out the chart paper about 30cm by turning the paper feed knob toward you while the paper holder shaft is tilted, and fold it on the chart paper receiving base.
- ⑦ Reset the tilted paper holder shaft, and the chart paper has been set properly. The chart paper can be continuously recorded at a feed rate of 25mm/h for about one month. The residual amount of the chart paper is indicated by a red numeric at the right end of the paper. When the chart paper comes to an end, the end mark appears at the right end of the paper. Prepare new chart paper.

## SETTING OF CHART PAPER SPEED

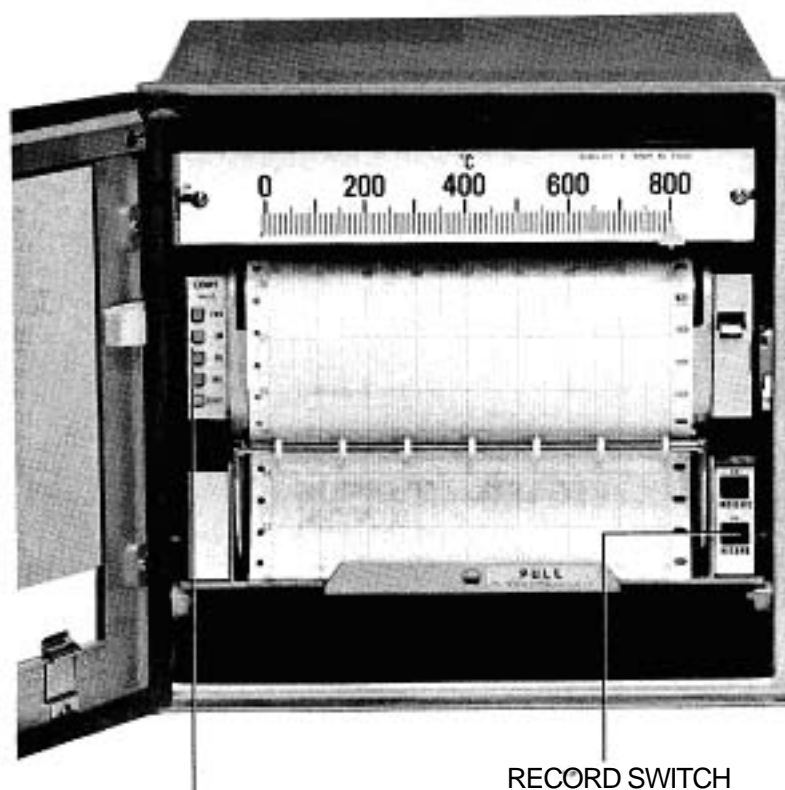


CHART PAPER SPEED SETTING SWITCH

RECORD SWITCH

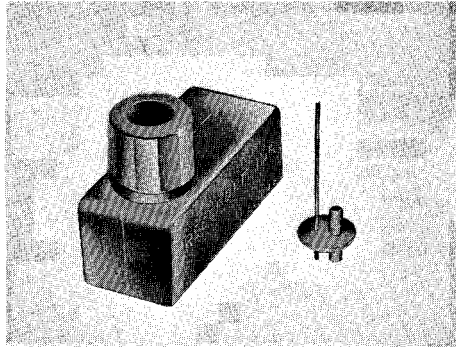
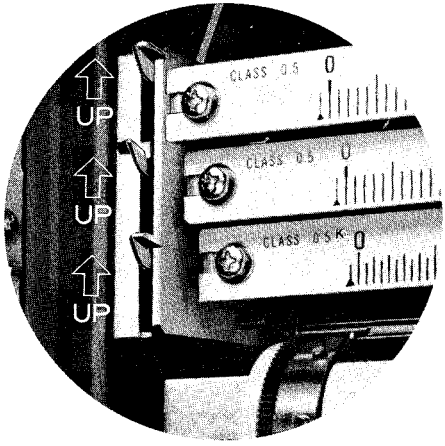
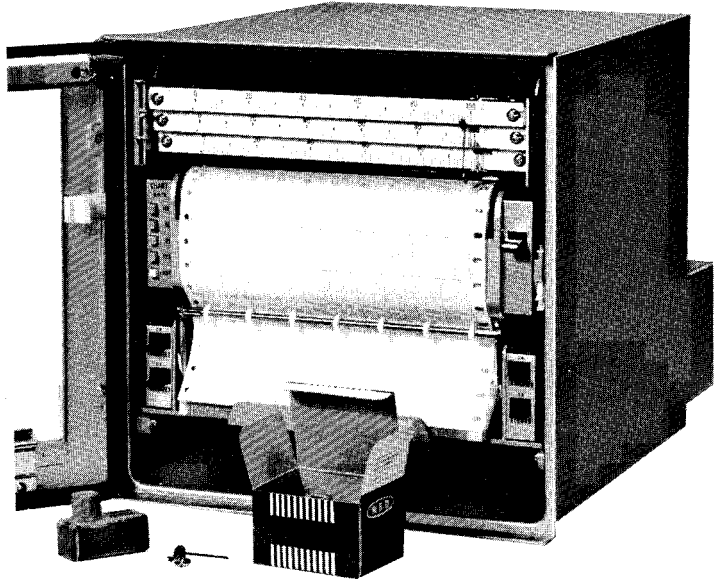
### ● SETTING OF CHART PAPER SPEED

For chart paper speed setting, switches are mounted at the front left end inside the door.

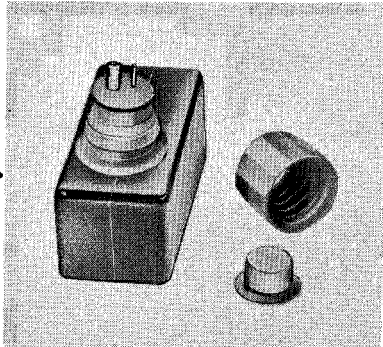
The chart paper speed is selectable in 4 steps, 12.5, 25, 50, and 100mm/h by these four switches.

- ① Set the desired chart paper speed by pressing one of the four switches.
- ② The chart paper is fed at the set speed by turning ON the RECORD switch.
- ③ If it is desired to set the start point of recording to a chart paper scale, set it to the chart paper scale by pressing the FAST switch.  
For manual feeding of the chart paper, turn the chart paper feed knob mounted near the sprocket by hand.
- ④ To stop the chart paper feed, turn OFF the RECORD switch.

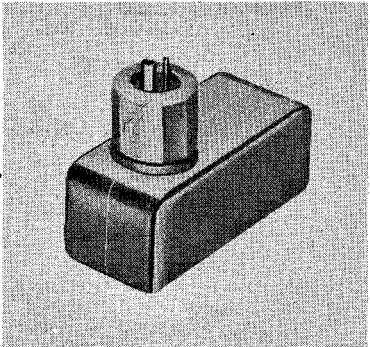
# LOADING METHOD OF RECORDING INK



Prepare the ink tank and tube connector for each pen.



After removing the cover from the ink tank, remove the intermediate cover, and put the tube connector instead.



Put cover.

① Prepare the recording ink (ink tank) and tube connector from the accessory box.

1st, 2nd recording pens are mounted as viewed from the innermost, and the ink colors of these pens are as shown below.

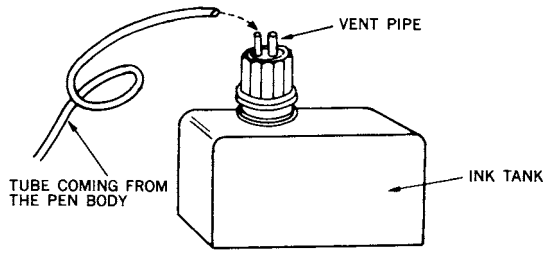
Instrument	Ink colors
1-pen instrument	Red
2-pen instrument	1st pen: Red, 2nd pen: Green

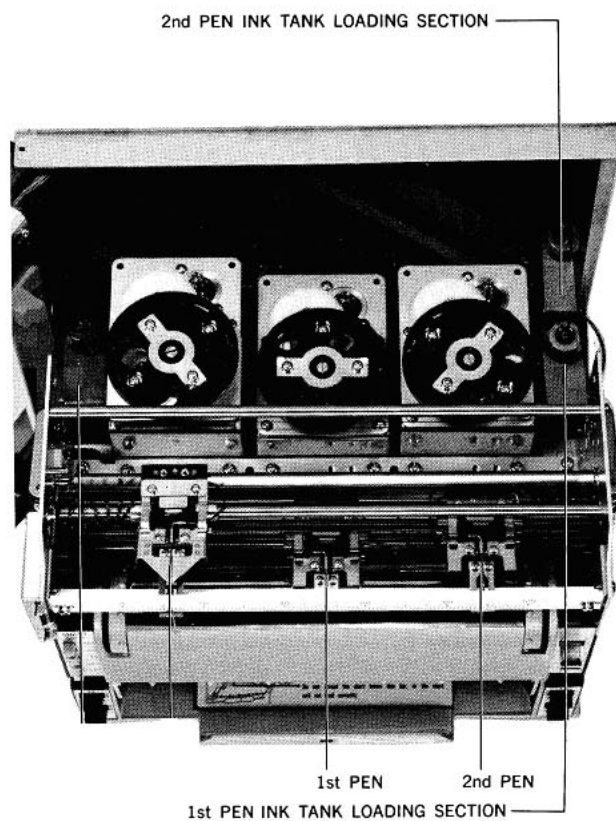
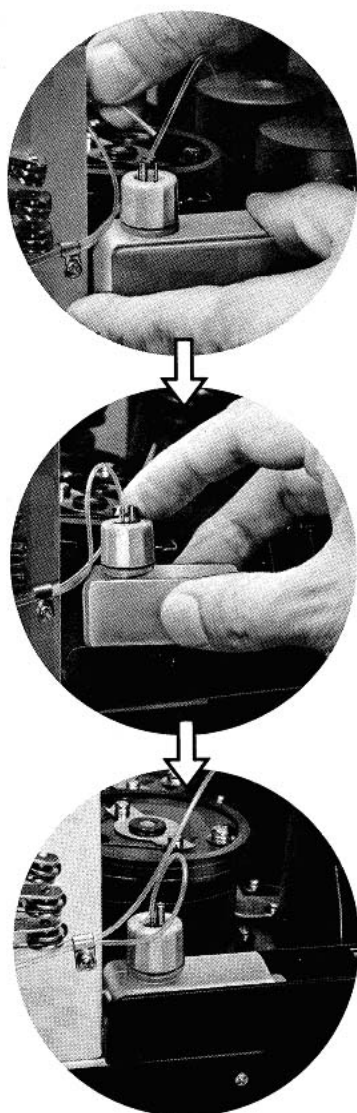
② Draw the chassis out of the case. If the chassis lock screw is tightened, loosen this screw using a flathead (-) screwdriver.

③ Lift the pen lift lever of each pen to lift all pens from the chart paper.

④ After removing the cover and intermediate cover of the ink tank of each pen, put the tube connector instead, and put the cover.

⑤ Connect the tube coming from 1st pen body to the thinner metal pipe of the red ink tank.





- ⑥ Lift the red ink tank, and press the tank by the thumb and the middle finger slowly, while holding the vent pipe by the forefinger.
- ⑦ When ink overflows the 1st pen tip slightly, release the forefinger, and stop pressing the tank.
- ⑧ Mount the ink tank into the 1st pen ink tank loading section. Now, 1st pen recording ink has been set.
- ⑨ In case of multi-pen instruments, set 2nd pen (green) recording ink according to the same procedure as specified in ⑤ – ⑧.
- ⑩ Reset the chassis as before and the recording ink has been set completely.

It is not necessary to tighten the chassis lock screw, except when relocating the instrument again.

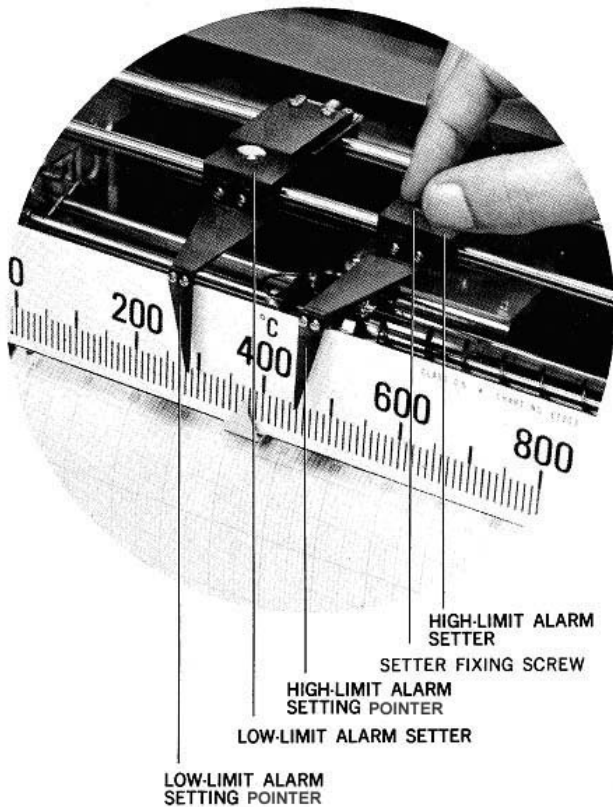
**<Caution>**

If recording is interrupted for a long time, lift the pen to lift the pen from the chart paper to prevent the paper from being stained with blur or ink.

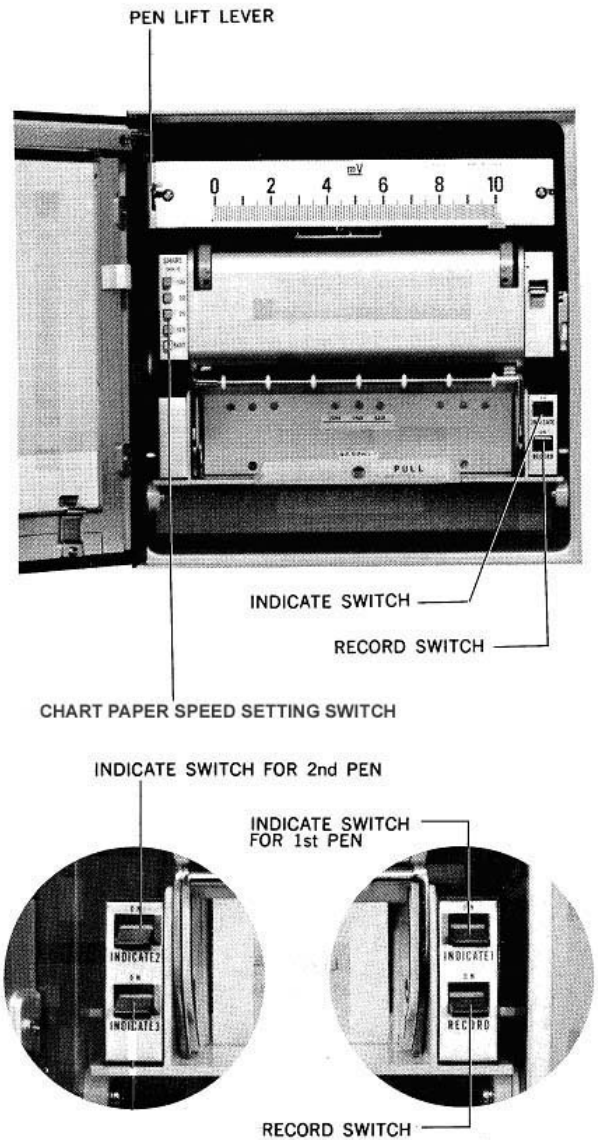
To prevent the adhesion of the pen tip ink, suck ink from the pen tube into the ink tank.

## OPERATION

### ● SETTING OF ALARM POINT (in case of recording alarm only)



### ● OPERATION



### ● SETTING OF ALARM POINT (in the case of recording alarm only)

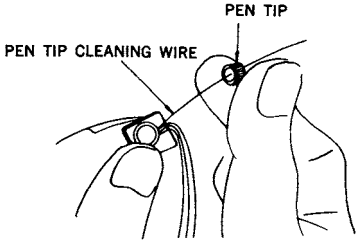
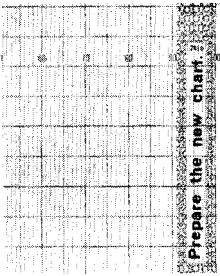
- ① Draw out the chassis.
- ② Loosen the fixing screw of the alarm setter by turning it counterclockwise with fingers.
- ③ Relocate the alarm setter leftward or rightward by holding the fixing screw with fingers, and set the setting pointer to a desired scale on the scale plate. The set point on the scale plate serves as an alarm point.
- ④ After setting, tighten the fixing screw securely.
- ⑤ The high-limit/low-limit recording alarm has two alarm setters for low-limit and high-limit. Set two setters.
- ⑥ If the alarm mechanism is added to both 1st pen and 2nd pen in the 2-pen recording alarm, set respective alarm points.

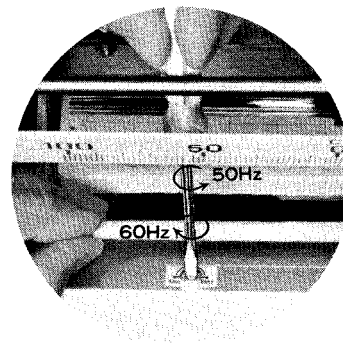
### ● OPERATION

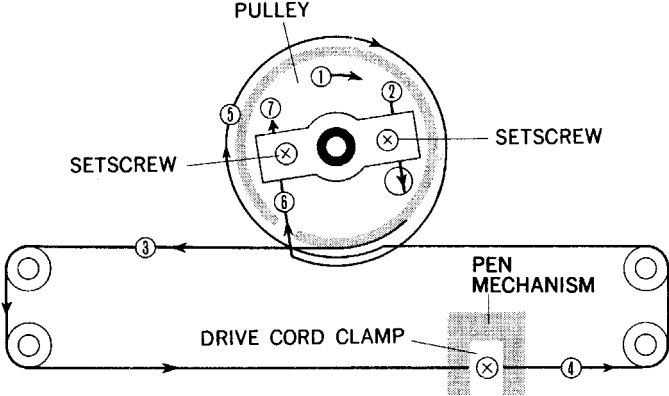
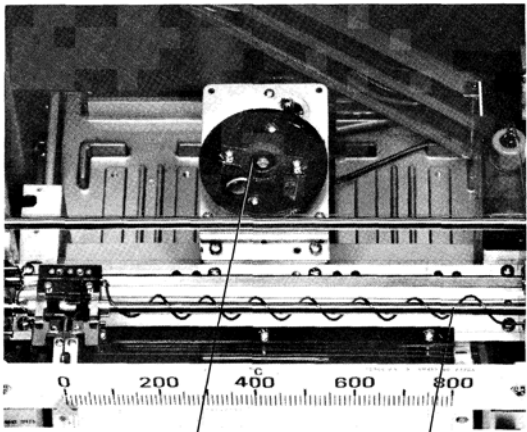
- ① Turn ON the INDICATE switch by setting it upward. The pointer will move with the illumination lamp lit. Turn on respective INDICATE switches in the case of 2-pen instrument.
- ② Lower the pen lift lever of each pen, and put the recording pen onto the paper slowly.
- ③ Set the chart paper speed setting switch to the desired speed.
- ④ Turn ON the RECORD switch by setting it upward. The instrument is placed to the operating condition, and the chart paper starts feeding.



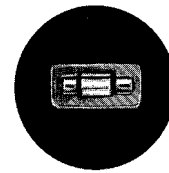
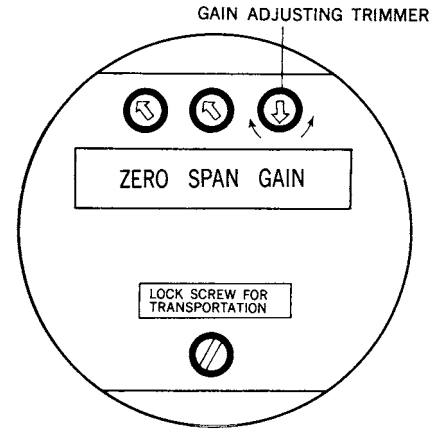
# ■ CHECK AND MAINTENANCE

Maintenance and check items	Procedures
Replacement of ink tank	<p>The recording ink consumption more or less differs according to working conditions. It lasts about one month in continuous recording.</p> <p>When the ink has run short, replace the ink tank with a new one, referring to the loading method of recording ink on pages 14 and 15.</p>
Cleaning of pen tip	<p>Since ink becomes dry, it is possible that the pen tip is clogged with ink during a long-time interruption of recording.</p> <p>When the pen tip has been clogged, remove the pen body by turning the pen tip counterclockwise, immerse the pen tip into hot water, and clean it with the attached cleaning wire.</p> 
Replacement of pen tip	<p>If the recording line becomes obscure due to the wear of the pen tip, replace the pen tip with a new one.</p>
Replacement of chart paper	<p>The chart paper can be used for about 1 month when the instrument is continuously operated at the chart paper speed of 25mm/h.</p> <p>When the chart paper comes to an end, the end mark appears on the right end of the paper.</p> <p>Replace the chart paper with spare paper, referring to the "loading method of chart paper" on page 12.</p> 



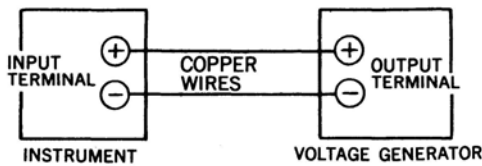
Maintenance and check items	Procedures
Replacement of drive cord	<p>After removing old (or cut) drive cord, replace it with a new one according to the following procedure. Be careful with kink or damage due to the distortion during replacement.</p>  <ol style="list-style-type: none"> <li>① Turn the pulley fully clockwise.</li> <li>② Fix one end of the drive cord by setscrew ② in the figure.</li> <li>③ Pull the drive cord from ③ to ④ through the lower part of the pulley groove after passing the pulley hole.</li> <li>④ Stretch the pulley cord around the pulley by one turn through the drive cord clamp of the pen body as shown in the figure ⑤. Keep the drive cord clamp loosened.</li> <li>⑤ Pass the drive cord to ⑥ → ⑦ from the upper side of the pulley groove.</li> <li>⑥ Fix the drive cord by setscrew ⑦ while pulling it, so that it is stretched to about 500 to 600g without looseness.</li> <li>⑦ Turn the pulley fully counterclockwise by one turn.</li> <li>⑧ Shift the pen body leftward to set the pointer to the triangle mark (▲) at the left end of the scale plate.</li> <li>⑨ Fix the drive cord by fastening the drive cord setscrews of the pen body. Now, the drive cord has been set properly. Make sure that the pointer is set to triangle mark (▲).</li> </ol>
Lubrication	<p>Lubricate the mechanical parts periodically once every 6 months or so in order to prevent wear of mechanical parts and maintain a good operating condition.</p> <ol style="list-style-type: none"> <li>① Remove dust and dirt from the parts to be lubricated before lubricating them. Fully clean the pen body shaft, in particular.</li> <li>② Use the attached lubricating oil after opening the tip of its vessel.</li> <li>③ Supply oil to such an extent as it does not drip, and wipe off surplus oil.</li> <li>④ Parts to be lubricated <ul style="list-style-type: none"> <li>• Pen shaft (After lubrication, wipe off oil sufficiently.)</li> <li>• Servo mechanism gear and bearing</li> <li>• Other slide parts</li> </ul> </li> </ol> 

Maintenance and check items	Procedures
Gain adjustment	<p>If pointer's movement becomes dull or the pointer oscillates and remains unstable during balancing due to a change of the indicating amplifier gain, adjust the gain by turning the GAIN adjusting trimmer on the front panel of the chassis. The gain increases when turning the GAIN trimmer clockwise.</p> <p><b>&lt;Caution&gt;</b> For moving the pointer, connect an input to check terminals, or move it by holding the pulley. Never move the pointer forcedly by hand when checking the operating condition of the pointer.</p>
Replacement of fuse	<p>If the fuse has blown, draw out the chassis, and remove the fuse cover mounted on the right side panel of the chassis.</p> <p>Replace the blown fuse with new 1A cartridge fuse (250V 1A).</p>

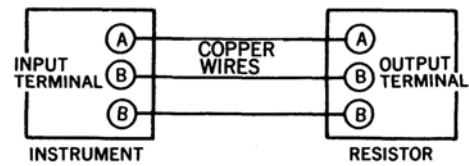


## SCALE TEST

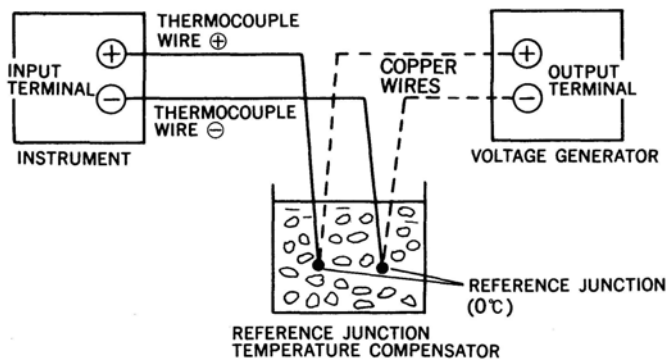
### [Connection of DC voltage input]



### [Connection of RTD input]



### [Connection of thermocouple input]



## ● PREPARATION

The scale testing method differs according to the type of input signals.

Please read corresponding item.

In the case of multi-pen instruments, test the scale of every pen.

### ① Preparation of tools

#### ● In the case of DC voltage input

Prepare a DC standard voltage generator.

#### ● In the case of thermocouple input

Prepare a DC standard voltage generator, a reference junction temperature compensator, and a testing thermocouple.

#### ● In the case of RTD

Prepare a precision variable resistor (variable up to 3 digits before decimal point and 2 digits after decimal point. Unit:  $\Omega$ )

② Turn OFF the INDICATE switch and RECORD switch of this instrument, and connect lead wires to corresponding input terminals at which the scale test is done.

③ Turn ON the corresponding INDICATE switch.

## ● SCALE TEST

Wait for longer than 15 minutes after turning ON the INDICATE switch, before testing the scale.

① Set the DC standard voltage generator or precision variable resistor to the input value corresponding to the scale to be tested.

② Read the indicating value. The instrument is operating normally when error is within the specified range.

The indicating accuracy of this instrument is  $\pm 0.25\%$  in the case of DC voltage input and  $\pm 0.5\%$  in other cases.

③ Test the scales at least 3 points (both end and center of the scale). It is desirable to test the scale at 5 or more points at almost equal intervals.

④ If the accuracy exceeds the specified range as a result of this scale test, calibrate the scale, referring to the calibration on page 22.

### <Caution>

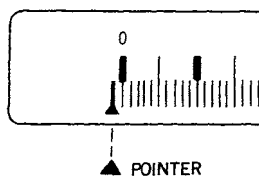
- In the case of thermocouple input, confirm that the reference junction temperature is at  $0 \pm 0.1^\circ\text{C}$  by using a precise mercury thermometer. If you use an electronic reference junction temperature compensator, use a precise one, and refer to an instruction manual of the compensator.
- In the case of RTD input, use the same three wires in length and diameter.

## ■ CALIBRATION

If the indicating accuracy exceeds the specified range as a result of the scale test and if the instrument requires the calibration, observe the following procedure.

### (1) CONFIRMATION OF TRIANGULAR MARK (▲)

- ① Turn OFF the INDICATE switch
- ② After drawing out the chassis, shift the pointer to the minimum scale line by turning the pen pulley (with which the scale test is done) counterclockwise by hand.  
In case of the pulleys of the multi-pen instrument, the center pulley is used for the 1st pen, and the right pulley is used for the 2nd pen.
- ③ Make sure that the pointer indicates the mark (▲) when turning the pulley until it is stopped by the stopper.



- ④ If the pointer does not indicate the mark (▲), loosen the drive cord clamp of the pen mechanism, and set the pointer to the mark (▲) correctly.
  - ⑤ Tighten the clamp, and reset the chassis as before.  
Now, the mark (▲) has been confirmed.
- (2) More than 15 minutes after turning ON the INDICATE switch, adjust the ZERO adjusting trimmer and SPAN adjusting trimmer mounted on the front panel of the chassis. Unload the chart paper during calibration.  
The center trimmer of the multi-pen instrument adjusting trimmer is used for the 1st pen, and the right trimmer is used for the 2nd pen.

### (3) UPPER LIMIT ADJUSTMENT

Turn clockwise the adjusting trimmer for preventing pointer from reading off-scale.  
Lower limit:  
Turn counterclockwise the adjusting trimmer for preventing pointer from reading off-scale.

### (4) ZERO-POINT ADJUSTMENT

- ① In the case of thermocouple type (with C.J)  
By feeding an input whose value corresponds to the minimum scale reading, adjust the zero-point using the adjusting trimmer VR3 of pre-amplifier.
- ② In the case of DC voltage type and thermocouple type (without C.J)  
By feeding an input whose value corresponds to the minimum scale reading, calibrate the scale using the zero-point adjusting trimmer of servo amplifier.

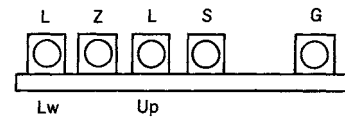
### (5) SPAN ADJUSTMENT

By feeding an input whose value corresponds to the maximum scale reading, calibrate the scale using the span adjusting trimmer of servo amplifier.

Accuracy of indication:

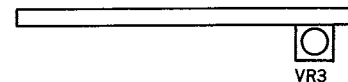
- DC voltage input :  $\pm 0.25\%$   
Thermocouple input:  $\pm 0.5\%$

### ● POSITION OF SERVOAMPLIFIER TRIMMER



- Z:** Zero-point adjusting trimmer  
**S:** Span adjusting trimmer  
**L:** Adjusting trimmer for preventing pointer from reading off-scale  
**Up:** Upper limit  
**Lw:** Lower limit  
**G:** Gain adjusting trimmer

### ● POSITION OF PRE-AMPLIFIER TRIMMER



- VR3:** Zero-point adjusting trimmer (with C.J)

### (6) ADJUSTMENT OF ADJUSTING TRIMMER FOR PREVENTING POINTER FROM READING OFF-SCALE

#### ● UPPER LIMIT

By feeding an input whose value is about 5% greater than the corresponding maximum scale reading, adjust the adjusting trimmer for prevention of reading off-scale so that the pointer indicates the middle point between the maximum scale reading and the mechanical stopper.

#### ● LOWER LIMIT

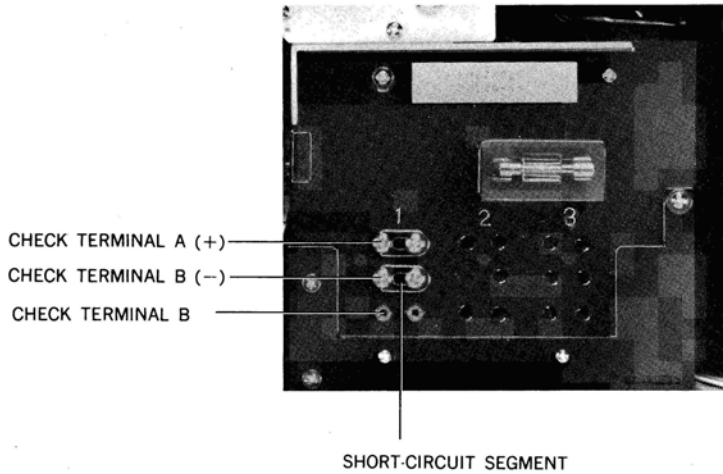
By feeding an input whose value is about 5% smaller than the corresponding minimum scale reading, adjust the adjusting trimmer for prevention of reading off-scale so that the pointer indicates the middle point between the minimum scale reading and the mechanical stopper.

#### <Caution>

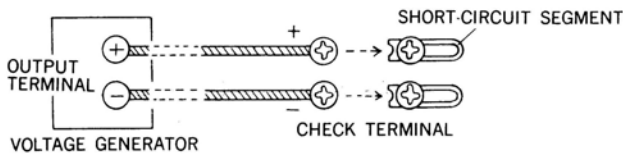
Test and calibrate the scale under the following standard conditions.

- Room temperature:  $23 \pm 2^\circ\text{C}$   
Humidity :  $55 \pm 10\% \text{RH}$   
Power supply : Rated voltage  $\pm 2\%$

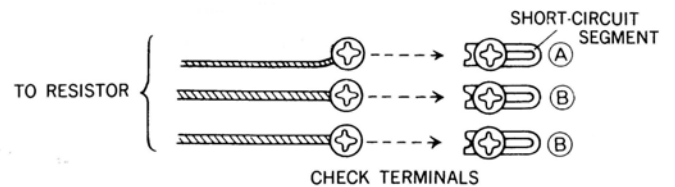
## ■ SIMPLIFIED SCALE CHECK



### ● DC voltage and thermocouple inputs



### ● RTD input



Check terminals are accessible on the right side panel after drawing the chassis of this instrument.

The scale can be checked easily by these terminals without disconnecting external cables.

The check terminals of the multi-pen instrument are arranged for 1st pen and 2nd pen as viewed from the left side.

- ① Loosen the check terminal screws, and open the right and left terminals by shifting the short-circuit segment rightward.
- ② Connect a DC standard voltage generator or precision variable resistor to the left check terminals.
- ③ The checking method differs according to the types of input signals.  
Refer to corresponding item.
- ④ After check, reset the short-circuit segment as before without fail.

#### ● IN THE CASE OF DC VOLTAGE INPUT

- ① Connect the DC standard voltage generator to check terminals  $\oplus$   $\ominus$ .
- ② Set the DC standard voltage generator to an input value corresponding to the scale to be checked, and check the scale.

#### ● IN THE CASE OF THERMOCOUPLE INPUT

- ① Connect the DC standard voltage generator to check terminals  $\oplus$   $\ominus$ .
- ② Read the temperature at the input terminals on the rear panel of this instrument by using a glass rod

thermometer.

- ③ Set the DC standard voltage generator to the value obtained by subtracting the thermoelectromotive force corresponding to the temperature measured in ② from an input value (normal thermoelectromotive force) corresponding to the scale to be checked, and check the scale.

#### ● IN THE CASE OF RTD INPUT

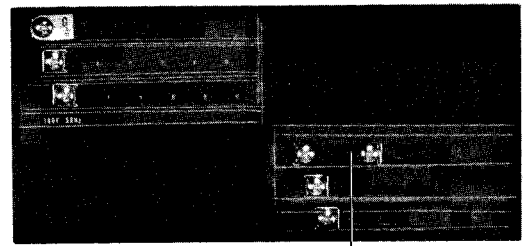
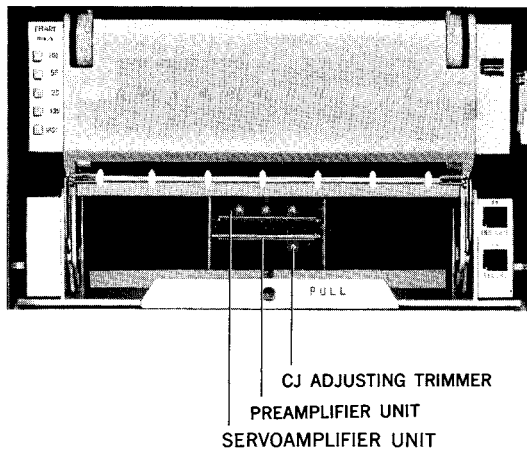
- ① Connect the precision variable resistor to check terminals (A), (B), (B).  
For the connection method, refer to the scale test on Page 18.
- ② Set the precision variable resistor to an input value corresponding to the scale to be checked, and check the scale.

#### <Caution>

The scale check by check terminals is a simple method for checking the operation of this instrument.

For accurate scale test, refer to the scale test on page 21.

## SCALE CHANGE (Replacement of scale plate, preamplifier unit and reference junction temperature compensating element)



REFERENCE JUNCTION TEMPERATURE  
COMPENSATING ELEMENT

Scale can be easily changed in this instrument by replacing the scale plate and preamplifier unit.

When the scale plate, preamplifier unit and/or reference junction temperature compensating element have been replaced due to a scale change or a trouble, perform zero adjustment and span adjustment without fail, referring to the scale test and calibration on pages 21 and 22.

If the preamplifier unit or reference junction temperature compensating element was replaced in the case of a thermocouple input, apply an input corresponding to the minimum scale as specified in the scale test on page 21, and adjust the CJ adjusting trimmer at the front lower part of the servo amplifier unit by turning it under the detached condition of the front panel, so that the indication meets the minimum scale of the scale plate. Then calibrate scale.

### ● SCALE CHANGE

① For DC voltage and thermocouple input, the scale can optionally be changed, irrespective of the types of input and scale range.

Be careful with the following items.

- When changing from the DC voltage input to the thermocouple input, mount the reference junction temperature compensating element, in principle.
  - When changing from the thermocouple input to the DC voltage input, remove the reference junction temperature compensating element.
  - A semiconductor element is employed as the reference junction temperature compensating element, and it is not necessary to replace this element according to the types of thermocouple.
- ② For RTD input, the scale can optionally be changed, irrespective of the types of inputs and scale range.
- ③ The scale cannot be changed from the DC voltage input or thermocouple input to RTD input, or from RTD input to the DC voltage input or RTD input.

### ● REPLACEMENT OF SCALE PLATE

The scale plate is fixed to the chassis by right and left setscrews.

Observe the following procedure when replacing the scale plate due to the scale change, etc.

- ① Remove the scale plate by removing the setscrews.
- ② Temporarily fix the scale plate to be mounted.
- ③ Turn OFF the INDICATE switch, and shift the pointer leftward by turning the pulley counterclockwise until the pointer is stopped by the stopper.
- ④ Slide the scale plate rightward or leftward while holding it, and set the mark ▲ of the scale plate to the pointer.
- ⑤ Fix the scale plate by tightening the right and left setscrews.

### ● REPLACEMENT OF PREAMPLIFIER UNIT

- ① Remove the front panel by removing the right and left setscrews at the front lower part of the chassis.
- ② The preamplifier unit is mounted in the indicating amplifier unit by connector connection. The preamplifier unit can be pulled out by drawing it toward you and by applying your fingers to its drawer handle.
- ③ Press the new preamplifier unit into the innermost along the guide groove in the indicating amplifier unit.
- ④ Mount the front panel as before, and the replacement of the preamplifier unit is completed.

### ● REPLACEMENT OF REFERENCE JUNCTION TEMPERATURE COMPENSATING ELEMENT

The reference junction temperature compensating element is fixed by two setscrews to the rear terminal board and it is easily detachable. When fixing it, the arrow "↑" should point upward.

## GENERAL SPECIFICATIONS

### [STANDARD SPECIFICATIONS]

#### INPUT SIGNAL

Thermocouple: K, J, T, E, R, B  
 RTD : Pt 100, JPt100 (3-wire system)  
 DC voltage : 1 to 10mV  
 DC current : 4 to 20mA (shunt resistor 10 $\Omega$  built-in)

**SCALE LENGTH** : 180mm

#### INDICATING ACCURACY

DC voltage, current : Within  $\pm 0.25\%$  of input span  
 Thermocouple, RTD: Within  $\pm 0.5\%$  of input span

**DEAD BAND** : 0.1% of input span

#### BALANCING TIME

Approx. 2.0sec (50Hz), or  
 approx. 1.6sec (60Hz) for full scale

**CHART PAPER** : Fanfold chart paper  
 Effective recording width 180mm  
 (total width: 200mm )  
 Total length: 20m

**NUMBER OF RECORDING POINTS**: 1-pen, 2-pen (2 types)

**RECORDING SYSTEM**: Continuous recording with ink pen  
 1st pen: Red, 2nd pen: Green

**CHART PAPER SPEED**: 12.5, 25, 50, 100mm/h

**ALARM SYSTEM** : High-limit (Low-limit system  
 High-limit/Low-limit) system  
 (Common setting at each point)

**SETTING ACCURACY**:  $\pm 0.5\%$  of input span

**ALARM DEAD BAND** : 0.6% of input span

**CONTACT CAPACITY**: 1A 100V AC, 0.5A 200V AC

**POWER SUPPLY** : 110, 115, 220, 230, 240V AC (Must be  
 specified) 50/60Hz

**ALLOWABLE VOLTAGE FLUCTUATION**  
 Within  $\pm 10\%$  of rated value

**AMBIENT TEMPERATURE**: -10 $^{\circ}$ C to 50 $^{\circ}$ C

**AMBIENT HUMIDITY** : 30 to 90% RH

#### ALLOWABLE SIGNAL SOURCE RESISTANCE

Thermocouple input: Lower than 150 $\Omega$  (Burnout function  
 is provided)

RTD input : Lower than 10 $\Omega$  per wire

DC voltage input : Lower than 10k $\Omega$

#### INPUT RESISTANCE

Thermocouple input: Approx. 8M $\Omega$

DC voltage input : Approx. 8M $\Omega$

**MAXIMUM COMMON MODE VOLTAGE**: 250V AC

**COMMON MODE REJECTION RATIO** : More than 50dB

**SERIES MODE REJECTION RATIO** : More than 50dB

#### INSULATION RESISTANCE

Between input terminal and ground terminal: 20M $\Omega$  or more,  
 at 500V DC

Between power terminal and ground terminal: 20M $\Omega$  or more,  
 at 500V DC

Between input terminal and power terminal: 20M $\Omega$  or more,  
 at 500V DC

#### DIELECTRIC STRENGTH

Between input terminal and ground terminal : 500V DC for 1 min.

Between power terminal and ground terminal: 1000V DC for 1 min.

Between input terminal and power terminal : 1000V DC for 1 min.

**ILLUMINATION**: Fluorescent lamp

#### POWER CONSUMPTION

1-pen: Approx. 23VA

2-pen: Approx. 28VA

**CASING** : Front door ---- Diecast aluminum  
 Rear case ---- Steel plate

**COATING** : Door ---- Munsell N1.5 (black)  
 Case ---- Metallic silver

**EXTERNAL DIMENSIONS**: 288 x 288 x 300 (W x H x D)mm

**MOUNTING** : Flush panel mount

**MOUNTING POSTURE** : Horizontal in lateral direction  
 Forward tilting ---- Less than 0 $^{\circ}$   
 Backward tilting ---- Less than 30 $^{\circ}$

**WEIGHT** : 1-pen (Approx. 12kg)  
 2-pen (Approx. 13.5kg)

### [OPTIONAL SPECIFICATIONS]

#### HIGH-LIMIT/LOW-LIMIT ALARM (option code: LH)

TR-401: Terminals (H), (C), (L) for High-limit alarm

Terminals (H), (C), (L) for Low-limit alarm

TR-402: Terminals (H), (C), (L) for the 1st pen alarm

Terminals (H), (C), (L) for the 2nd pen alarm

Setting range : 0 to 100% for full scale (High-limit and Low-limit  
 values do not cross.)

Setting accuracy :  $\pm 0.5\%$  of input span

Alarm dead band : 0.6% of input span

Contact capacity : 1A 100V AC (resistive load)

0.5A 200V AC (resistive load)

### ACCESSORIES

Accessories	Quantity
Instruction manual	1 copy
Chart paper	3 volumes
Tag card	2 (inside the door)
Mounting bracket	1 set
Fuse 1A (spare)	2
Wrench	1
Phillips-head (+) screwdriver (4mm)	1
Flathead (-) screwdriver (3mm)	1
A pair of tweezers	1
Allen (hexagonal) wrench	1
Lubricating oil (10cc)	1
1st pen ink (red)	3
2nd pen ink (green)	3 (for TR-402)
Pen tip (spare)	2
Tube connector	2
Pen tip cleaning wire	2



## STANDARD SCALE

Input	Scale range (°C)	Scale division	1 division (°C)	Chart paper number
K	-100 to 200	150 (Linear)	2	18150
	0 to 150	150 (Linear)	1	18150
	0 to 200	100 (Linear)	2	18100
	0 to 300	150 (Linear)	2	18150
	0 to 400	80 (Linear)	5	18080
	0 to 500	100 (Linear)	5	18100
	0 to 600	120 (Linear)	5	18120
	0 to 800	80 (Linear)	10	18080
	0 to 1000	100 (Linear)	10	18100
	0 to 1200	120 (Linear)	10	18120
	100 to 250	150 (Linear)	1	18150
600 to 1200	120 (Linear)	5	18120	
J	0 to 200	100 (Linear)	2	18100
	0 to 300	150 (Linear)	2	18150
	0 to 400	80 (Linear)	5	18080
	0 to 600	120 (Linear)	5	18120
T	-100 to 200	150 (Linear)	2	18150
	-50 to 50	100 (Linear)	1	18100
	-50 to 100	150 (Linear)	1	18150
	-50 to 150	100 (Linear)	2	18100-25
	0 to 100	100 (Linear)	1	18100
	0 to 150	150 (Linear)	1	18150
	0 to 200	100 (Linear)	2	18100
0 to 300	150 (Linear)	2	18150	
E	-50 to 150	100 (Linear)	2	18100-25
	0 to 150	150 (Linear)	1	18150
	0 to 200	100 (Linear)	2	18100
	0 to 300	150 (Linear)	2	18150
R	0 to 1400		20	18014R
	0 to 1600	80 (Linear)	20	18080
B	0 to 1800		20	18018B
Pt100 Jpt100	-100 to 50	150 (Linear)	1	18150
	-50 to 50	100 (Linear)	1	18100
	-50 to 100	150 (Linear)	1	18150
	-50 to 150	100 (Linear)	2	18100
	-40 to 80	120 (Linear)	1	18120
	-20 to 80	100 (Linear)	1	18100
	0 to 50	100 (Linear)	0.5	18100
	0 to 100	100 (Linear)	1	18100
	0 to 150	150 (Linear)	1	18150
	0 to 200	100 (Linear)	2	18100
	0 to 300	150 (Linear)	2	18150
	0 to 400	80 (Linear)	5	18080
	0 to 500	100 (Linear)	5	18100
50 to 100	100 (Linear)	0.5	18100	
100 to 250	150 (Linear)	1	18150	
4 to 20mA DC 0 to 10mV DC	0 to 200	100 (Linear)	2	18100
	0 to 300	150 (Linear)	2	18150
	0 to 400	80 (Linear)	5	18080
	0 to 500	100 (Linear)	5	18100
	0 to 600	120 (Linear)	5	18120
	0 to 800	80 (Linear)	10	18080
	0 to 1000	100 (Linear)	10	18100
	0 to 1200	120 (Linear)	10	18120

The unit is °C, except for mV and mA in the case of DC input.





**\*\*\*\*\* Inquiry \*\*\*\*\***

For any inquiry about this unit, please contact the shop where you purchased the unit or our agency after checking the following.

- Model name .....TR-401-E
- Input type .....K
- Option .....LH
- Serial number .....No.xxxxxx

In addition to the above, please let us know the details of malfunction, if any, and the operating conditions.

**SHINKO TECHNOS CO.,LTD.  
OVERSEAS DIVISION**

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