HIOKI

INSTRUCTION MANUAL

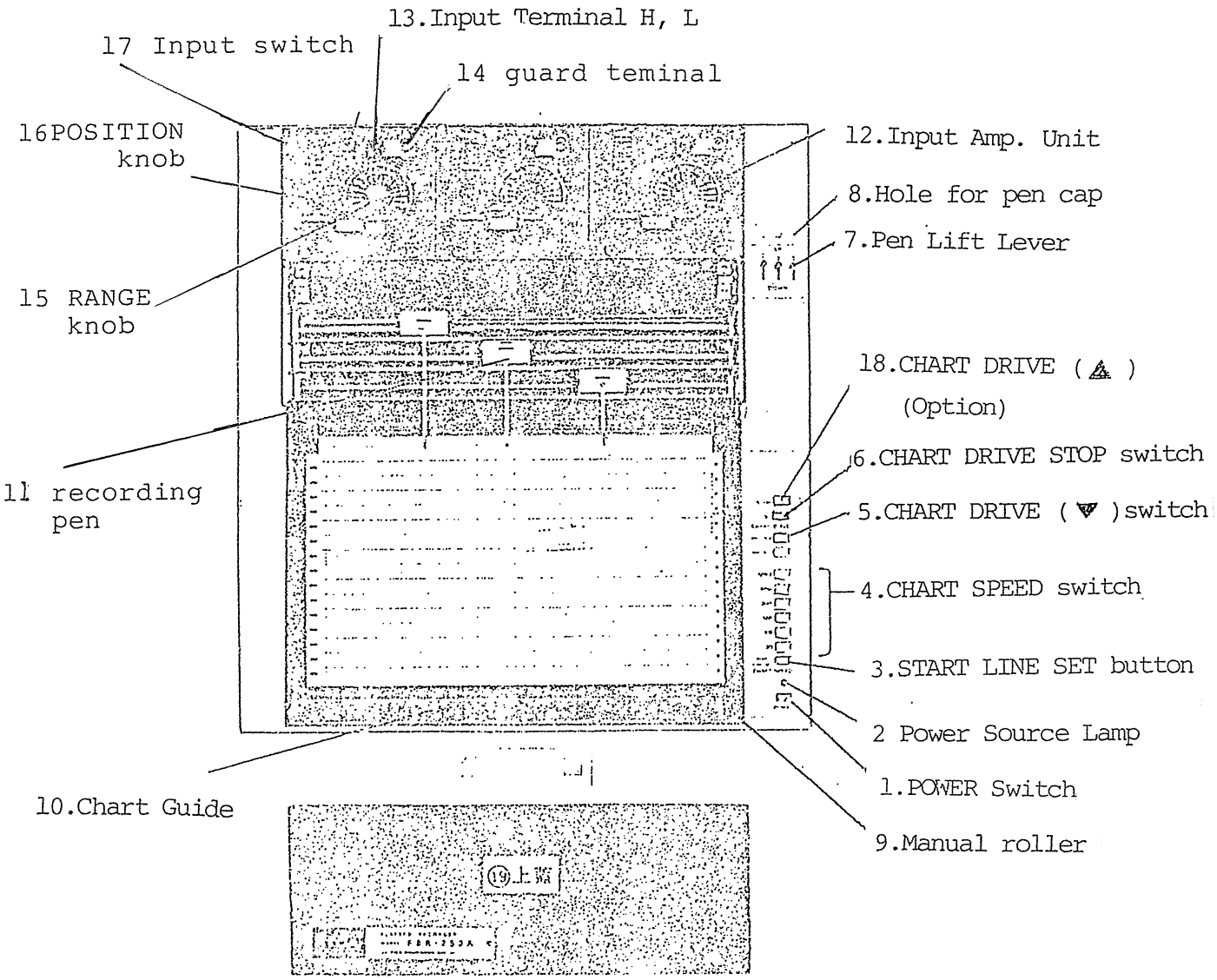
FBR-251A
FBR-252A
FBR-253A

FLAT BED RECORDER

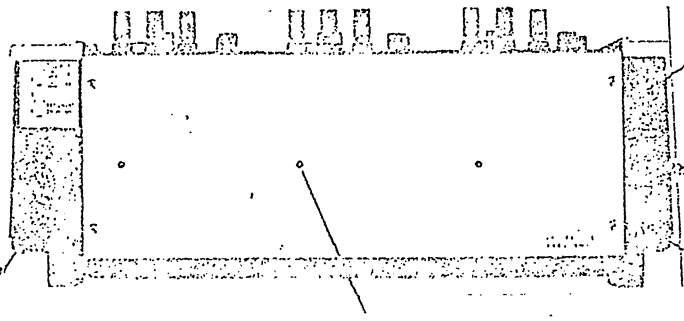
HIOKI E. E. CORPORATION

1.NAME AND FUNCTION OF EACH PART

Front Panel



BACK PANEL



FRONT PANEL

1.POWER Switch : Switch to power the instrument.
ON position by making this switch depressed
OFF position by making this switch lifted

2 Power Source Lamp : Lamp lit when the power is at ON position.

3.START LINE SET button : While pushing this button, the chart is fed at the speed of 60mm/min., irrespective of position of other setting switches
When the chart is fed by the remote or synchronous signal, linked with other equipments, this is used to match the pen position to the graduation of chart (start line).

4.CHART SPEED switch : Consist of sequence switches of 30, 60, 120, 300, 1200 mm and switch button of mm/min , mm/h.
In combination of both switches, 12-steps chart speed is available.

5.CHART DRIVE (▼)switch : With the switch marked ▼ depressed,chart is fed to the forward direction.

6.CHART DRIVE STOP switch : With this switch depressed, the chart feed stops.

7.Pen Lift Lever (UP/DOWN); By turning this lever to the DOWN side, pen goes down and recorder becomes ready for recording
By turning this lever to the UP side, the pen goes up and the recorder rests.

8.Hole for pen cap : Insert the removed pen cap into the hole not to loose it, when recording.

9.Manual roller : This roller makes manual feed possible.

10.Chart Guide : It takes play to feed to a fixed direction and is also used as chart cutter.

11.Recording pen : The 1st channel - red pen, the 2nd channel - green pen, the 3rd channel - blue pen

12.Input Amp. Unit : Input Amp. Unit for each channel

13.Input Terminal H, L : Termianl to connect the measuring lead.
It is normal connection of polarity to connect High impedance side against the earth to the H terminal, Low impedance to L terminal.
In this case, if the pen moves to the right direction from the zero position,it means plus(+) voltage, while to the left direction, it means (-) voltage.

14.Guard Terminal (G) : As to usage of input guard shield terminal, please refer to the paragraph of 2.1.4. Connection of Input Signal mentioned below.

15.RANGE knob : Knob to select the full scale range. Indicating figure shows a full scale value.

16.POSITION knob : Knob to adjust the zero point of pen or to move the pen position. With input signal zero, pen can be moved over the entire effective recording width.

17.Input switch(MEAS./ZERO) :Connect to the measured signal source at MEAS. position. Disconnect to the signal source and pen returns to the pre-set zero position at ZERO position.

18.CHART DRIVE (⚠) : Switch to mean REVERSE feed
(Option) With this switch depressed, the chart is fed reversely

19.Upper cover : When unloading the pen, this cover can be open or removed. Be sure to close it for dust proof in usual condition.

BACK PANEL

21.Power source cord : Cord to supply the power source to the instrument

22.FUSE holder : Fuse for power source, holding 2A fuse in it.

23.Earth Terminal : Terminal to earth the instrument

24.SPAN adj. hole : Variable resistor to calibrate the indicating value. Never touch it except for re-calibration prior to more accurate measurement

25.EXT. CHART DRIVE termianl:Terminal to drive the chart by the external signal. Upper 2 temrinals for inner/ external change-over. (1,2) Lower 2 terminals forexternal synchronous signal. (3,4) In case of fitting options, refer to the paragraph item 6 OPTIONS.

2.HOW TO HANDLE

2.1 Preparation

Preparation of recording will be explained in the following,but please set the switches and buttons accoridng to the following items or confirm the positions.

(1) POWER switch	OFF
(2) CHART DRIVE (STOP) switch	push(to be depressed)
(3) Pen lift lever	UP
(4) Input switch	ZERO

2.1.1 Upper cover

This cover is set for the purpose of dust-proof and protection of recording pen. Be sure to set it to the original position except maintenance of pen or loading of chart paper.

a) How to remove it

As shown in the left Fig. (No.4),, lift the cover up and remove it.

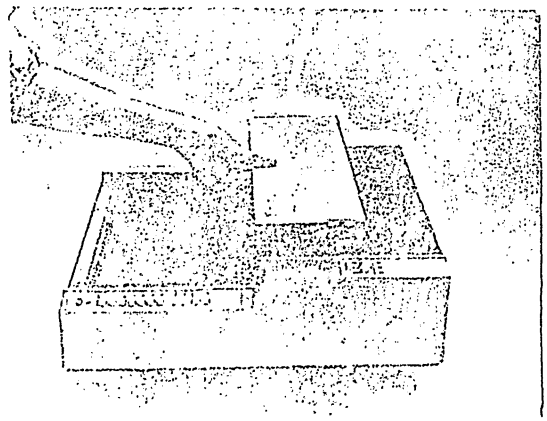


Fig. 4

b) Vertical maintenance

As shown in Fig. 5, the cover can be kept upright.

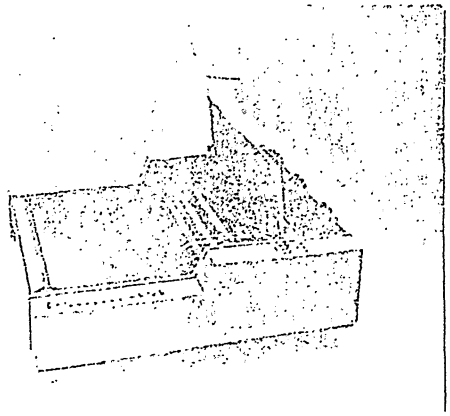


Fig. 5

2.1.2 Loading of Chart Paper

Both roll type and Z-fold type chart papers are provided in this recorder.

a) Lay down the chart guide as shown in Fig. 6.

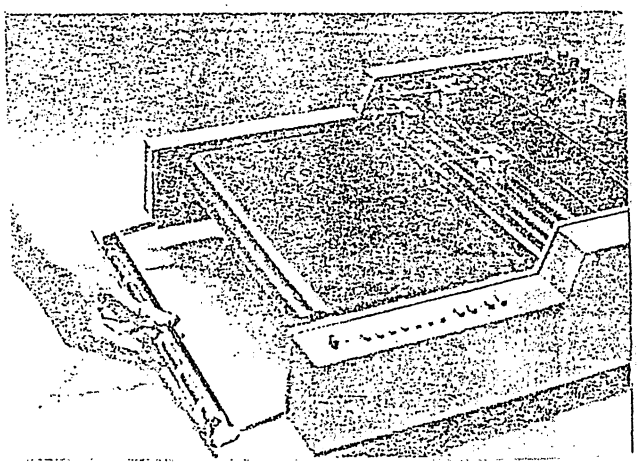


Fig. 6

b) Raise up the end of chart table as shown in Fig.7., and draw it out to you to remove it. Under the chart table, chart loading box can be seen.

NOTE: If the rubber roller is pressed down, the chart table may be difficult to draw out. Draw it out horizontally.

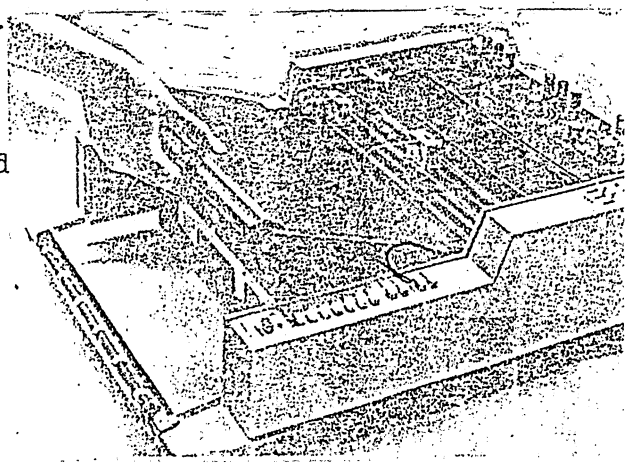


Fig. 7

c) As shown in Fig. 8, if the chart table is drawn out toward you until it is locked, it is kept in horizontal position.

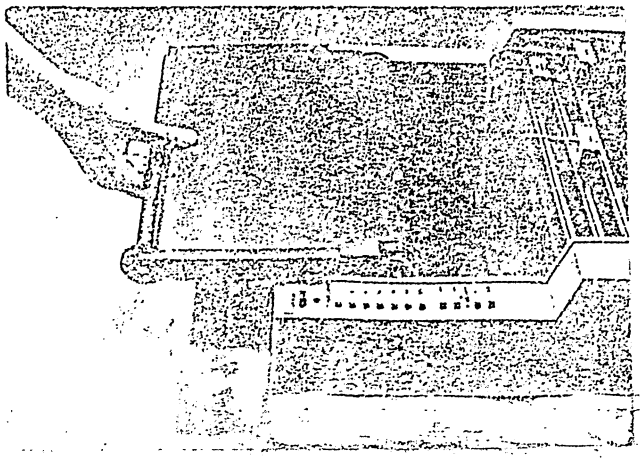


Fig. 8

d) Load the chart paper in the chart box, and draw out the tip of chart paper by 30 or 40 cm. (Fig.9 & 10) The following cares must be taken.

(1) Put the chart so that square sprocket hole is set to right side and retangle(oblong) hole to left side.

(2) When the chart paper is set in the box, bring it nearer to the right side completely. (Right side is reference of chart feed guide.)

(3) When the Z-fold chart is used, loose folds thoroughly as shown in the instructions inside of chart box, before loading the paper. Insufficient loose may cause trouble of chart - feed.

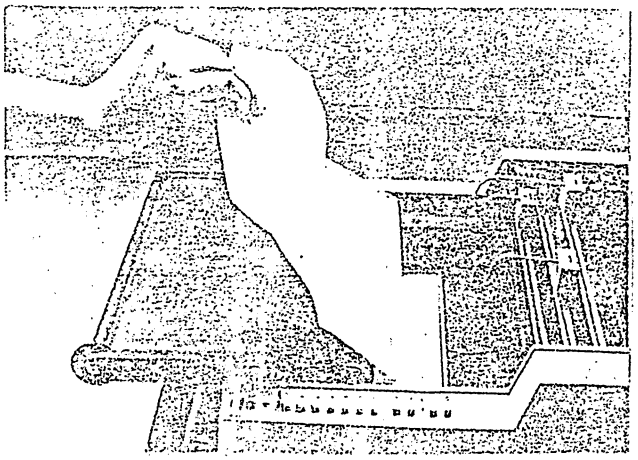
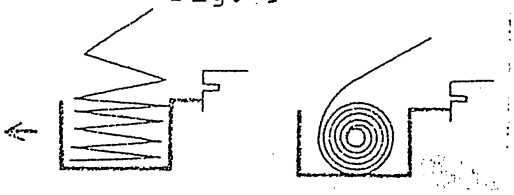


Fig. 9



Z-fold roll

e) Matching the sprocket hole to the sprocket, push the chart table until it stops, and psuh it down to lock it.

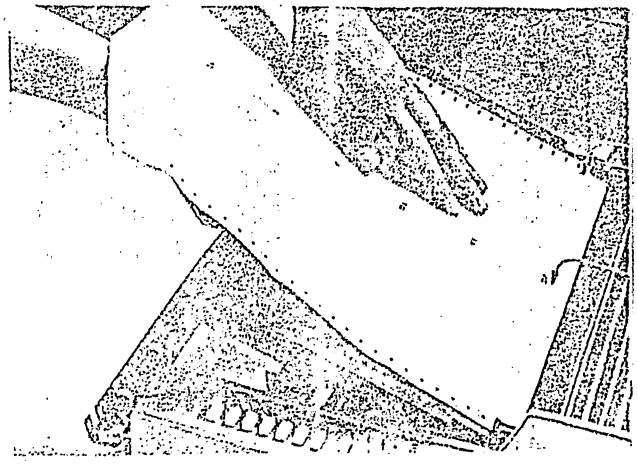


Fig. 10

f) After passing the tip of chart paper through the chart guide, close the chart quide.
In this case, pull the tip of chart paper on the table not to be loosen.

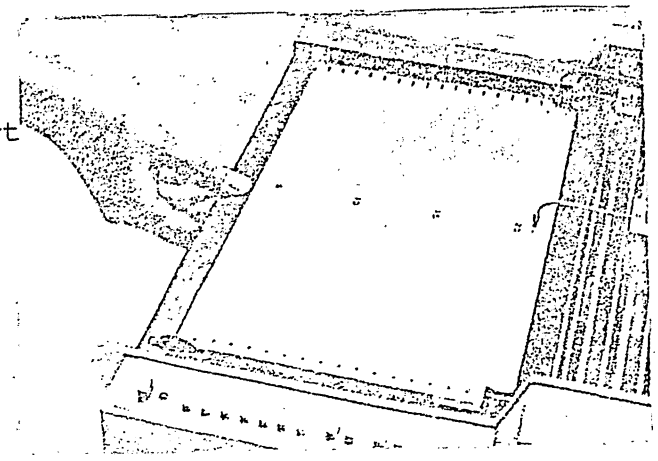
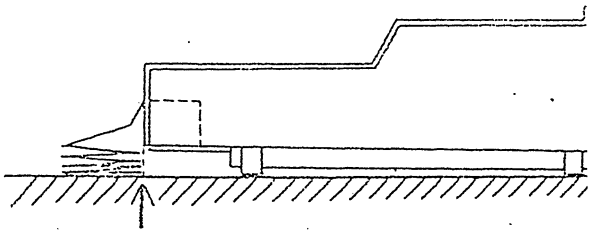


Fig. 11

g) How to set the recorded chart paper

Arrange the end of chart paper and the end of recorder as shown shown in Fig. 12.

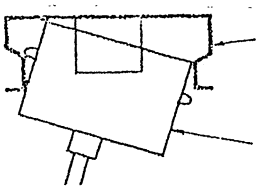
If the chart is moved from the proper position, Z-folding action may be abnormal.



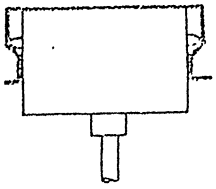
2.1.3 Setting of recording pen

This recorder adopts a disposable self-supply ink pen. It is not necessary to maintain the pen. Recording pens are 1st pen(red), 2nd pen(green) and 3rd pen(blue).

a) As shown in Fig. 13,14, Insert the left end of recording pen to the pen holder.



b) As shown in Fig. 15,16 insert the right end of recording pen to the pen holder



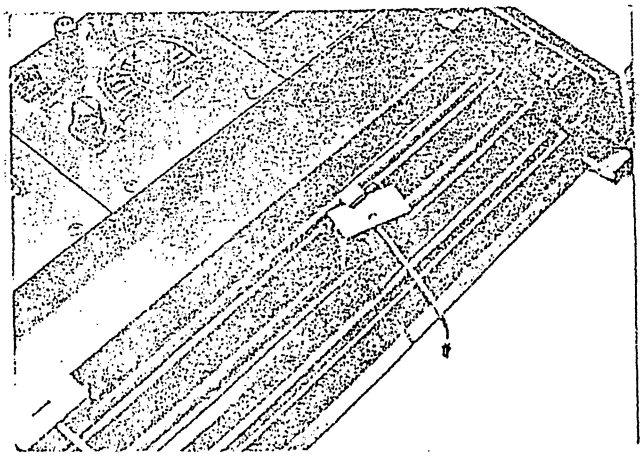


Fig. 14

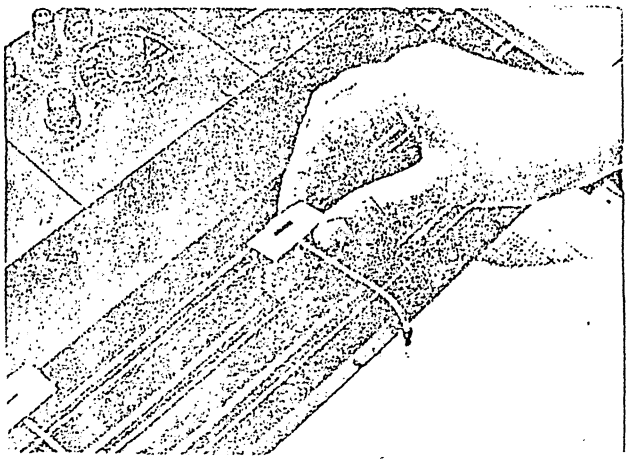


Fig. 16

c) When removing the recording pen, remove the pen from the click of pen holder as shown in Fig. 17. In this case, do not hold the pipe part.

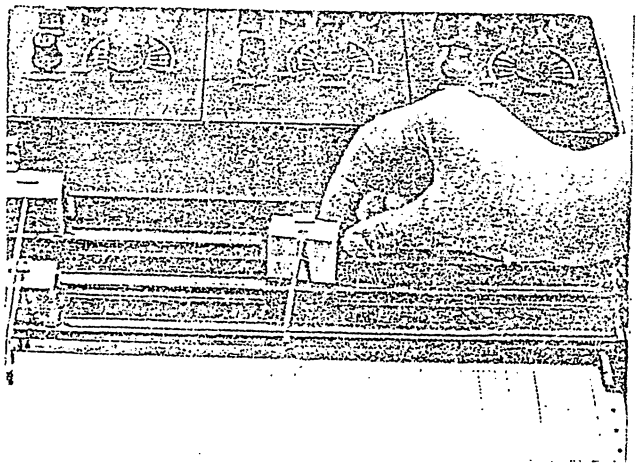
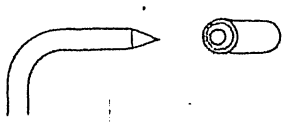


Fig. 17

d) While recording,insert the pen cap inot the hole for pen cap located beside pen lever, not to loose it.
When stopped to record for a while, or not to use for a long time, put the cap on the pen tip, to prevent the pen tip from getting dry or evaporating ink.



pen cap

Fig. 18

NOTE: As the pen tip is made of felt, care must be taken not to push it strongly or transform the tip fo pen.

2.1.4 Connection of Input signal

Input circuit system of this recorder is of floating input with guard shield,so it is superior in common mode noise rejection effect.
Depending on the state of signal source, connect the input lead as shown in Fig. 19 - 21.

Be sure to connect the earth lead to the EARTH terminal for countermeasure of noise and safety.

a) In case of signal source to be earthed

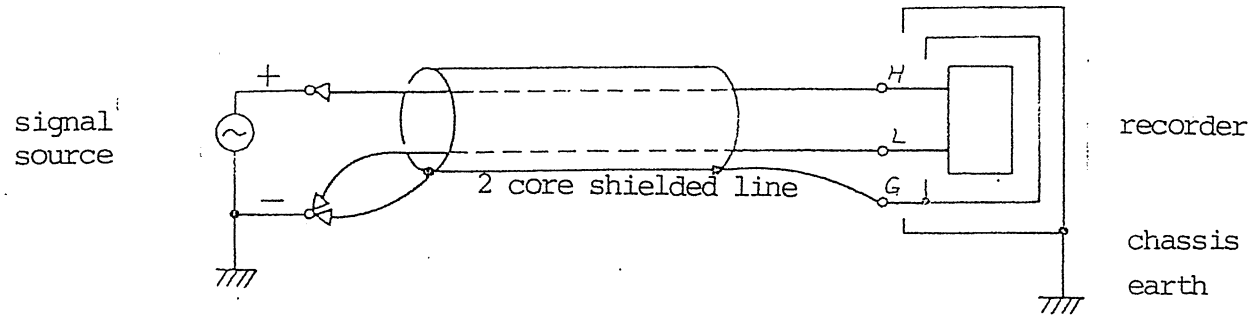


Fig. 19

b) In case of signal source not to be earthed

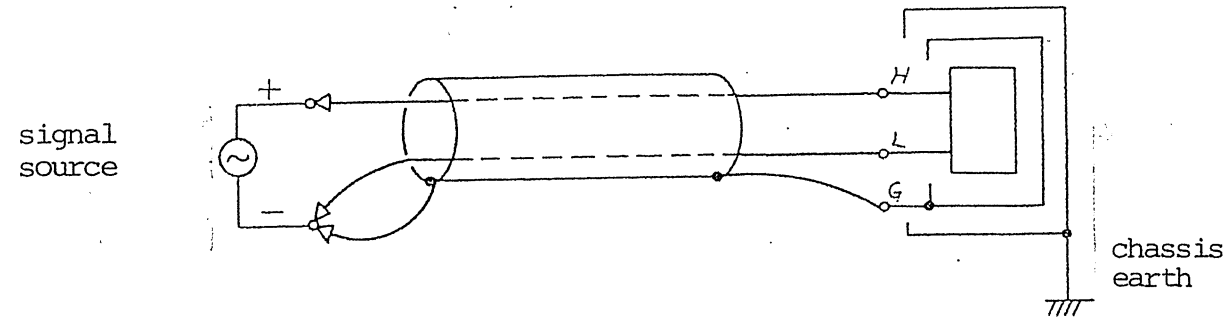


Fig. 20

c) In case of signal source to be shielded

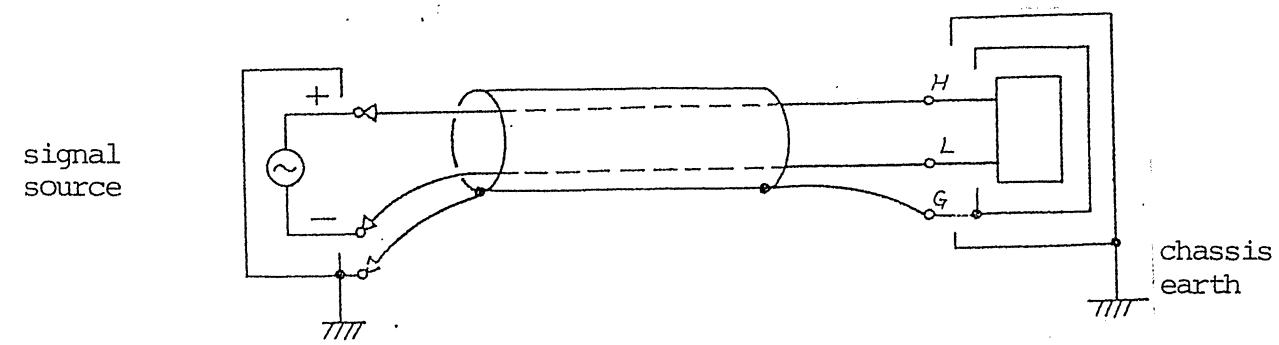
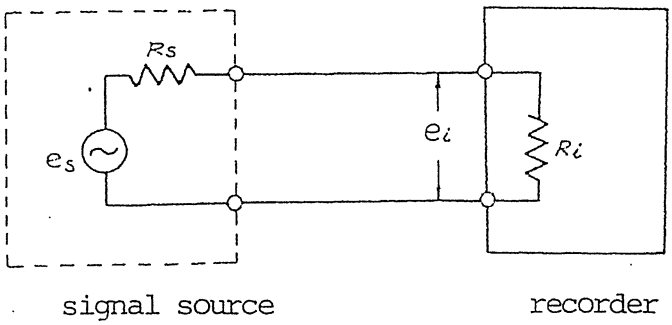


Fig. 21.

2.1.5 INFLUENCE OF SIGNAL SOURCE RESISTANCE

As input resistance of this recorder is approx. 1 Mohm,accuracy of recording is influenced by the amount of signal source resitance.



e_S = signal voltage
R_S = signal source resitance
Ri = input resitance of recorder
ei = input voltage of recorder

Fig. 22

$$ei = \frac{Ri}{Ri + Rs} e_s$$

As input resitance of thsi recorder is approx. 1 Mohm, the recorder records the signal appearently by approx. 1% lower than the correct indication, when signal source resitance is 10 Kohm.
When higher accurate recording is required, make the signal source resistance lower as possible as you can.
If the signal source resitance is over 10 Kohm, recording is influenced by the drift element, with exception of the above-mentioned error.
To minimize the influence of drift, make the signal source resitance small.

2.2 MEASUREMENT

After finishing the preparation, start the measurement.
Measuring procedure is done in the following manner.

2.2.1 General recording

a) Set the range knob.
When measured unexpected signal voltage, set the RANGE knob to max. voltage range (100V) , and raise the sensitivity in turn.

b) Depress the POWER switch. (Lamp lit when the power is in ON position.)

c) After confirming that input switch is set to "ZERO" position, turn the "POSITION" knob to set the zero point.
If the porality of measuring voltage is certain, set the zero point either to right or left end. If it is uncertain, set the zero point to center

d) Turn the input switch to "MEAS." side,and check the pen movement.
Select the adequate range according to necessity.

e) Set the CHART speed range.

f) Turn the pen lift lever to "DOWN" side.and contact the tip of recording pen to the chart paper.

g) Depress the chart drive(▼) button to feed the chart paper.

h) When stoped teh chart feed, depress the "STOP" button.

"NOTE" Do not depress more than two(2) chart speed setting buttons at a . at the same time.

2.2.2. Chart feed by EXT. synchronous signal

With use of EXT. CHART DRIVE terminal on the back panel, pulse-proportional feeding can be made.

a) Change-over command of INT/EXT

Change-over command of setting range feeding on teh from panel (INT.) or proportional fedding by synchronous signal is made by the termianls L - 2. Terminal 1 is common.

Terminals 1 - 2 ┬ INT. when these terminal are open(or H level).
└ EXT. when these terminal are short-circuited (or L level).

where, H level : $8.5V \leqq VH \leqq 12V$

L level : $-0.5V \leqq VL \leqq 3.5V$

b) Synchronous Signal

When applied the undermentioned signal wave as sunchronous signal to terminals 3 - 4, chart is fed 0.05mm per one wave.

(1) Pulse wave

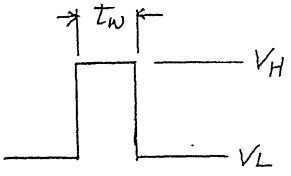


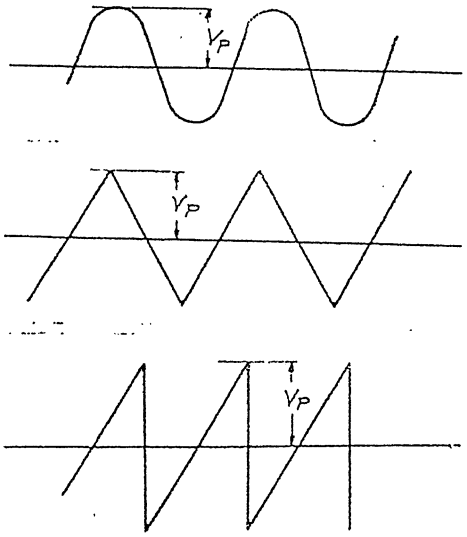
Fig. 23

VH: 4.5V = VH = 50V

VL:-50V = VL= 1V

tW: more than 10μS

(2) Sine wave, Triangle wave, Saw tooth wave



$7V \leq V_p \leq 50V$

Fig. 24

(3) Upper limit frequency and input impedance

upper limot of frequency(max.response freq.) : 400Hz(=pps)

input impedance : more than 10 Kohms

(c) How to set the chart start line by synchronous signal

In linked with other equipments, it may be required to measure accurately the transfer volume of chart by sunchronous signal of the the linked equipment.

In general, in this case, set the start line by the manual roller, but it is difficult to set with accuracy. due to teh mechanical backlash of gear etc.

In such a case,depress the "START LINE SET" button on the front panel, and the chart can be fed at speed of 60mm/min. ,while depressing,(irrespective of position of other command signal)

If the released this button when the pen is on the start line, chart begins to start by the following synchronous signal.

Namely, accurate measurement can be done without affected by the mechanical backlash at start time.

5. SPECIFICATIONS

5.1 Specifications

item	model	FBR-251A	FBR-252A	FBR-253A
1	system	DC servo automatic self-balancing continous pen writing		
2	number of pen	1	2	3
3	colour of pen	red	red,green	red,green, blue
4	measuring range	0 - 1, 2, 5, 10, 20, 50mV, 0.1, 0.2, 0.5V 0 - 1, 2, 5, 10, 20, 50, 100V full scale, 16 ranges		
5	input resistance	approx. 1 Mohm on all the ranges		
6	accuracy	±0.5% of full scale		
7	permissible signal source resistance	less than 10Kohm		
8	Input circuit	Floating input with guard shield		
9	Pen speed	more than 800mm/sec.		
10	Zero adjustment	-100% to +100%		
11	Chart width	250mm		
12	Chart	roll type 20m(type SG-10X) & Z-fold type 20m(type SG-10Z)		
13	Chart speed	30, 60, 120, 300, 600, 1200mm/min. & mm/h, 12 ranges & proportional feeding by external signal(0.05mm per one pulse)		
14	Type of pen	Cartridge type felt pen (Disposable)		
15	Ambient condition	0 - 40°C, 35 - 85%R.H.		
16	Power source	AC 100, 110, 115, 220,230, 240V ±10%, 50/60Hz		
17	Power consumption	approx. 11VA at balance , approx. 35VA at unbalance	approx.15VA at balance, approx. 46VA at unbalance	Approx. 19VA at at balance, approx. 62VA at unbalance
18	Weight	approx. 9.5kgs	approx. 11kgs.	approx.12.5kgs.
19	standard	pen 1 ea. fuse (2A) 2 pcs. pen drive cord 1 ea. chart paper roll type(SG-10X) 1 roll,Z-fold type(SG-10Z) 1 pce. vynle cover 1 pc. instruction manual 1 copy		

5.2 Characteristic Data(reference)

This flat bed recorder has the following electrical characteristic(typical characteristics) in addition to the specifications stated earlier. PLease refer to these characteristics when accurate measurement is made.

a) Common Mode Recjection Ration

AC 140dB (at frequency of power source)

DC 160dB

b) Max. Common Mode Voltage

AC 250V r.m.s.(at frequency of power source)

DC 500V

c) Normal Mode Recjection Ration

AC 40dB(atr frequency of power source)

d) Drift of zero point

0.1 - 0.2uV/ ^{o}C

(signal source resistance Rs $\leqq$ 10Kohms)

e) Max. Input Voltage

1mV to 0.2V range : DC 50V

0.5V to 100V range : DC 250V

6. Options

The following options are prepared in order to enlarge the functions of FBR recorder and make its operation easiler.

6.1 Chart reroll adapter

Upon deignation, the chart reroller adapter is delivered after fitting it.

(1) Put the accessory reals in the both ends of roll chart, matching the slit..

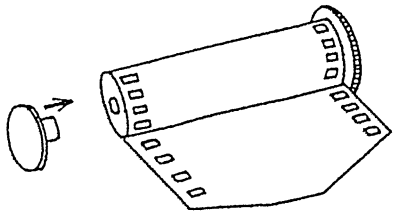


Fig. 26

(2) Set the chart paperwith reels on the rewind driving axis in the chart set box.

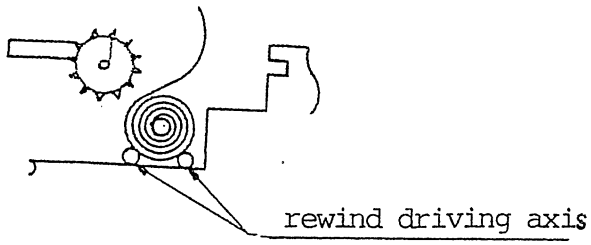


Fig. 27

(3) After setting the chart table, draw the tip of chart, attch it to the core with tape, and wind it 2 - 3 times.

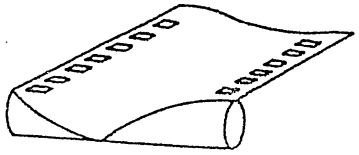


Fig. 28

(4) Put the reels in both end of chart core, and set it on the reroll driving axis.

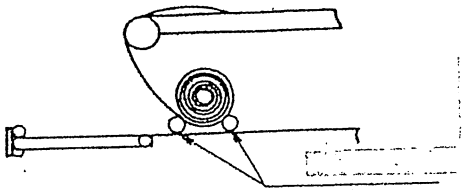


Fig. 29

(5) Close the chart guide not so as to loose the chart paper on the table.

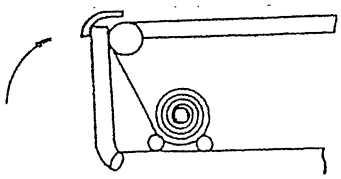


Fig. 30

6.2 Rewind - manual operation

When rewind operation is made, use the reroll adapter and roll chart paper.

As to attachement of chart paper, refer to the paragraph " CHART REROLL ADAPTER" mentioned before.

Depress the (▼) button for forward feeding, while (▲) button for reverse feeding.

NOTE: Reverse(rewind) operation is adopted to roll chart paper only.

6.3 Chart remote control(FORWARD?REVERSE, START/STOP)
With use of roll chart paper, set it as shown in the paragraph item 6.1.
Depress the chart stop switch on the front panel, set the remote control connector pin to EXT. singal.

Remote Control Connector Pin

3 - 21= COM
- Open(or H level) ---forward
- Short-circuited(or L level) ---reverse

4 - 22= COM
- Open(or H level) --- stop
- Short-circuited(or L level) ---start

L level(-0.5V ≦ VL ≦ 3.5V),H level(8.5V≦ VH≦ 12V)

With remote control to recorer, when chart speed is controlled by the button on the front panel, make the pin open (or applied to H level).

6.4 Pen Remote Control(UP/DOWN)
Turn the lever on the front panel to DOWN side.
(Keep the unused pen UP .)

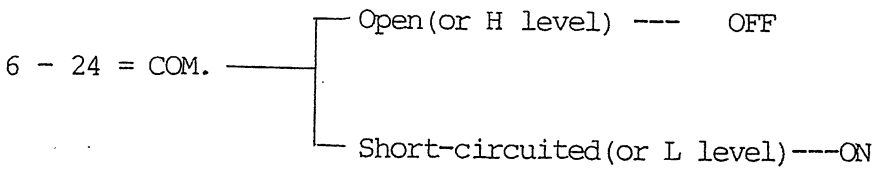
Remote Control Connector Pin

5 - 23 = COM.
- Open(or H level) -- pen DOWN
- short-circuited(or L level) --pen UP

6.5 Event Marker

Power source for event marker is included

Remote Control Connector Pin



NOTE: Due to the space for fitting the marker, effective recording width becomes approx. 240mm, so each pen do not deflect to full scale value.

6.6 Re-transmitting slidewire

With use of twin potentiometer, resistance value corresponding to the pen position can be obtained.

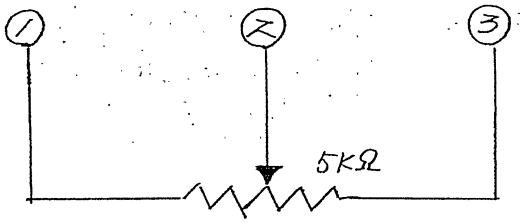
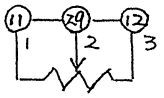
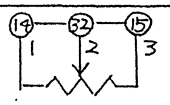
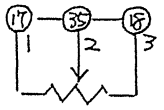


Fig. 31

Signals which control the remote control functions are listed in the following page.

	L level (short-circuited	H level (open)	Pin No.	
Chart Drive INT./EXT.	EXT	INT.	1 - 19 ‖ COM.	
CHart Drive EXT. INPUT			2 - 20 ‖ COM.	
Chart remote Control FORWARD/REVERSE	REVERSE	FORWARD	3 - 21 ‖ COM.	Depress the chart drive (STOP) button.
Chart Remote Control START/ STOP	START	STOP	4 - 22 ‖ COM.	ditto
PEN REMOTE Control UP/ DOWN	UP	DOWN	5 23 ‖ COM.	Pen lever is set to (DOWN) side.
Event Marker	ON	OFF	6 - 24 ‖ COM.	
Re-transmitting slidewire 1st pen				
ditto 2nd pen				
ditto 3rd pen				

arrangement of connector pin	19,20	21, 22,	23,24,	25, 26	27,28,	29,30	31,32	33,34	35,36
	1 2	3, 4,	5, 6,	7, 8	9,10,	11,12	13,14	15,16	17,18,

NOTE: Control Signal Level

1) C - MOS. H , L level of open collector
   H : 8.5V = VH = 12V

   L : -0.5V = VL = 3.5V

2) Open, short-circuited of contact point
   open = H
   short-circuited = L

HIOKI FBR-251A, 252A, 253A FLAT BED RECORDER
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