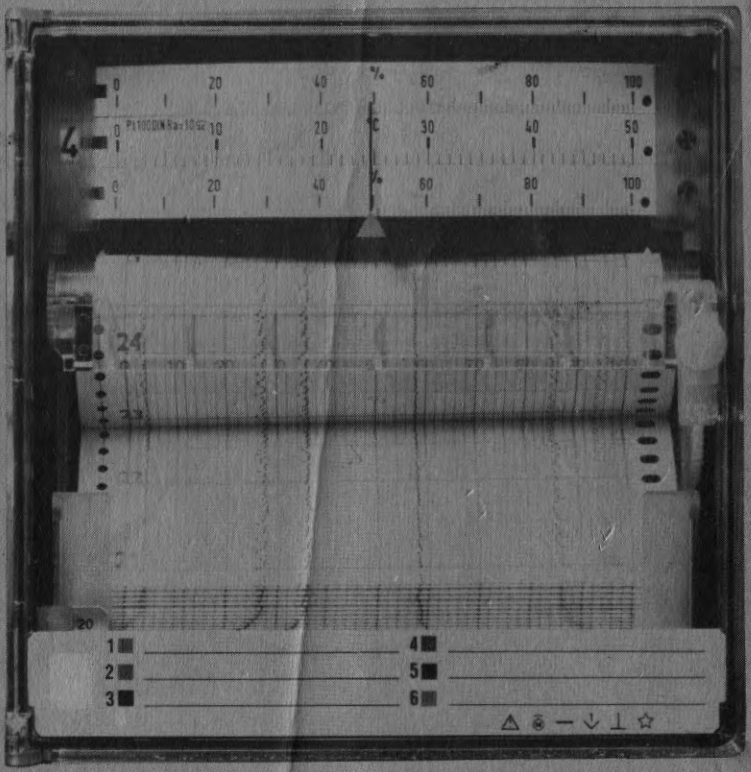
Motorschreiber 144
Motorized Point Recorder 144
Enregistreur asservi 144



Bedienungsanleitung
Operating Instructions
Mode d'emploi
4012 150 51611

Gültig ab Nr.: 8070
Valid from No.:
Valable depuis No.:

PHILIPS

PHILIPS

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1. ACCESSORIES

(supplied with instrument)

	Description	Order no.
2	fixing clamps to DIN 43 834	**4012 151 00121**
1	chart reading rule per measuring range	**4012 140 32501**
1	check resistor per measuring range for resistance thermometer input in 2-wire connection	**4012 151 01131**
2	folded charts with linear decimal graduation and time lines according to chart speed	
	for chart speed 20 mm/h	**4012 142 91461**
	for chart speed 10 mm/h	**4012 142 91451**
	for chart speed 60 mm/h	**4012 142 91471**
	for special chart speed (chart paper with graduation to specification)	**9404 392 52..1**
2	sets of ink ribbon carriers Colours per set: violet, red, black, green, blue, brown	**4012 151 52641**
2	keys to DIN (on recorders with door lock)	**4012 027 45001**

1.1. Optional accessories

(order separately)

Description	Order no.
Matching module For 0 . . . 20 and 4 . . . 20 mA input signals from active sources for recorders with intrinsically safe input circuits (1 module needed for each input channel)	**9404 207 12001**
Construction: voltage and current-limiting resistance network	
Mounting: to standard mounting rail 32, to DIN 46 277	
Dimensions: drawing no. 4012 150 62521	

2. DESCRIPTION

2.1. Applications

The Motorized Point Recorder 144 is a universal instrument for all applications in the process control industry.

Various input circuits enable the connection of conventional signal sources, such as thermocouples, resistance thermometers, potentiometric transducers, or signal transmitters with a current or voltage output. Any combination of input signals is possible.

The scale is composed of three strips so that matching to the measuring range used is unproblematic.

2.2. Versions

Standard version: mains supply 220 V, 50 Hz
Chart speed 20/120 mm/h, door fitted with catch

Other versions (specify when ordering):

Chart speed 10/60 mm/h or 60/360 mm/h,
door fitted with lock
Mains supply: see ‚Special versions'

Complete the Order no. using code numbers from the table of measuring ranges

	For non-intrinsically safe input signals		
	Number of measuring ranges	Number of limit contacts	**Order no.**
Six-channel recorder	1	0	**9404 336 40..1**
	1	1	**9404 336 50..1**
	1	2	**9404 336 60..1**
	2...6	0	**9404 336 90..1**

	For intrinsically safe input signals	
	Number of measuring ranges	**Order no.**
	1	**9404 337 40..1**
	2...6	**9404 337 90..1**

2.2.1. Special versions

Replace the 9th digit (0) of the Order no. with the code number of the required special version.

Supply voltage	Code number	Supply voltage	Code number
110 V, 50 Hz	. . . . . .1. . .	220 V, 60 Hz	. . . . . .4. . .
240 V, 50 Hz	. . . . . .2. . .	110 V, 60 Hz	. . . . . .5. . .
24 V, 50 Hz	. . . . . .3. . .		

2.2.2. Code numbers for measuring ranges

MEASURING RANGES (For limiting values, see 'Technical Data'.

RECORDERS WITH 1 RANGE

Thermocouple input	With separate temperature compensation, reference temperature 20 °C				With separate temperature compensation, reference temperature 50 °C		
Range	Fe-Const DIN Code no.	NiCr-Ni DIN Cr/Al Code no.	PtRh-Pt DIN Code no.	Range	Fe-Const DIN Code no.	NiCr-Ni DIN Cr/Al Code no.	PtRh-Pt DIN Code no.
20 . . . 250 °C	10	20	–	50 . . . 250 °C	15	27	–
20 . . . 400 °C	11	21	–	50 . . . 400 °C	16	28	–
20 . . . 600 °C	12	22	–	50 . . . 600 °C	17	29	–
20 . . . 900 °C	13	23	–	50 . . . 900 °C	18	30	–
20 . . . 1200 °C	–	24	40	50 . . . 1200 °C	–	31	45
20 . . . 1400 °C	–	–	41	50 . . . 1400 °C	–	–	46
20 . . . 1600 °C	–	–	42	50 . . . 1600 °C	–	–	47
	With built-in temperature compensation, reference temperature 20 °C						
20 . . . 250 °C	74	80	–				
20 . . . 400 °C	75	81	–				
20 . . . 600 °C	76	82	–				
20 . . . 900 °C	77	83	–				
20 . . . 1200 °C	–	84	87				
20 . . . 1400 °C	–	–	88				
20 . . . 1600 °C	–	–	89				
To specification	78	85	38				
Range with zero suppression, built-in constant current source	79	86	39				

Thermocouples or other d.c. voltage sources, scale to specification (with thermocouples, indicate reference temperature)	Code no.
0 . . . 5 mV up to 0 . . . 100 mV	01
Range with zero suppression, built-in constant current source	09
0 . . . 100 mV up to 0 . . . 50 V, zero suppression not possible	02

D.c. current	Scale 0 . . . 100 %	Sale to spec.	Scale with 2nd graduation
	Code no.	Code no.	Code no.
0 . . . 20 mA	03	05	34
4 . . . 20 mA, built-in constant current source	04	06	35
0 . . . 10 µA up to 0 . . . 100 mA	–	07	36
Range with zero suppression, built-in constant current source	–	08	37

Resistance input, built-in constant current source

Resistance thermometer Pt 100 Ω DIN	2-wire connection, Ra = 10 Ω Code no.	3-wire connection Code no.	LiCl humidity sensor[1]	Code no.
− 30 . . . + 60 °C	50	62	0 . . . 60 °C	90
− 30 . . . +120 °C	51	63	To specification	91
0 . . . 50 °C	52	64		
0 . . . 60 °C	53	65		
0 . . . 100 °C	54	66		
0 . . . 150 °C	55	67		
0 . . . 200 °C	56	68	Potentiometric transducer	
0 . . . 300 °C	57	69	50–30–50 Ω	92
0 . . . 400 °C	58	70	40–50–40 Ω	93
50 . . . 150 °C	59	71	To specification	94
100 . . . 400 °C	60	72		
To specification	61	73		

2 . . . 6 MEASURING RANGES[2] (up to 3 scale graduations possible, indicate when ordering)	Code no.
Without accessories	95
with built-in temperature compensation[3]	96
With built-in constant current source	97
With built-in temperature compensation and const. current source	98

[1] Only for LiCl humidity sensor 9404 152 01001.
[2] Ranges and scales for thermocouple measurement start at their respective reference temperatures. (Does not apply to ranges with suppressed zero).
[3] Only possible for one thermocouple type.

2.3. Technical data

INPUT

Thermocouples or d.c. voltage

a) Measuring span:	5 mV . . . 100 mV Source resistance R_s up to 300 Ω /mV. No lead resistance adjustment necessary. Input resistance $R_i > 1$ MΩ
Zero suppression range:	≦ ± 150 % of span
b) Measuring span:	100 mV . . . 50 V built-in voltage divider. Input resistance $R_i \geqq 10$ kΩ/V.
Thermocouples:	Fe-Const, NiCr-Ni (Cr/Al), PtRh-Pt to DIN. Also to other standards.

D. c. current
Measuring span: 10 μA . . . 100 μA, $R_i = 1$ kΩ
> 100 μA . . . 100 mA
voltage requirement 100 mV

Note

Shunt resistors ahead of the channel selector switch prevent the current signal loop from being interrupted.

Resistance thermometer Pt 100 DIN:	$\Delta R = 20\Omega$ . . . 200 Ω
Thermometer current:	0.5 mA constant
Two-wire connection:	External resistance R_a must be adjusted to 10 Ω
Three-wire connection:	With a resistance up to 10 Ω per lead, **no** lead resistance adjustment is necessary.
Potentiometric transducer:	$\Delta R = 20\Omega$ . . . 200 Ω total resistance ≦ 2 kΩ

Note

With a resistance up to 10 Ω per lead, **no** lead resistance adjustment is necessary.

Temperature compensation:	with thermocouple input
Internal compensation:	reference temperature 20 °C ±1.5 °C
External compensation:	via separate reference junction (e.g. TRANSOSTAT)

Constant Current Source

Output:	1 mA ±0.1 %
Built-in for:	a) resistance thermometer Pt 100 DIN b) potentiometric transducers c) ranges with suppressed zero
Zero suppression range:	≦ ±150 % of span

Note

Zero suppression is **not** possible for voltage inputs of 100 mV . . . 50 V.

Interference suppression (applies to measuring spans of 5 . . . 100 mV)

Max. interference at 50 or 60 Hz for:

recorders with non-intrinsically safe input circuits

common mode: 100 x input span ≙ 1 % error
suppression: ≧ 80 dB
series mode: 250 V ≙ 1 % error
suppression: ≧ 120 dB

recorders with intrinsically safe input circuits

common mode: 4 x input span ≙ 1 % error
suppression: ≧ 50 dB
series mode suppression: ≧ 100 dB

RECORDING

Measurement principle:	Linear conversion of the analogue input signal into proportional angular steps (pointer position) with automatic null-balance at scale centre after each print.
Null-balance:	Pointer goes to scale centre automatically after each print.
Overall error:	≦ 1 % of measuring span
Settling time:	3 s approx.
Resolution:	0.2 % (corresponds to 502 steps for 0 . . . 100 mm scale length)
Sensitivity:	0.2 % (corresponds to one step)
Reproducibility:	Within 0.2 %
Print timing:	5 s
Scale:	Consists of three strips. Different graduation per strip possible.
Graduated length:	105.6 mm
Recording method:	With ink ribbons
Colour sequence:	To DIN 43 831 for six channels: violet red black green blue brown
Width of print:	0.4 mm approx.
Chart paper:	Folding chart
Chart width: Recording width: Chart length: Folded height:	120 mm 100 mm 16 m 40 mm
Chart drive:	Synchronous motor
Chart speed:	20/120 mm/h, selectable (standard version) 10/60 mm/h or 60/360 mm/h on request

POWER SUPPLY

A. c. voltage:	220 V, 50 Hz (standard version)
Other voltages:	110 V, 50 Hz 240 V, 50 Hz 24 V, 50 Hz 110 V, 60 Hz 220 V, 60 Hz
Voltage tolerance:	— 15 % . . . + 10 %
Power consumption:	max. 13 VA
Power supply effect:	≦ 0.1 % with a voltage change of — 15 % . . . + 10 %

Fuses for recorders with intrinsically safe input circuits

Supply voltage	Fuse cartridge M . . . C to DIN 41 571
110 V, 50 Hz	0,125 (125 mA, semi-fast acting)
220/240 V, 50 Hz	0,063 (63 mA, semi-fast acting)
24 V, 50 Hz	0,500 (500 mA, semi-fast acting)
110 V, 60 HZ	0,125 (125 mA, semi-fast acting)
220 V, 60 Hz	0,063 (63 mA, semi-fast acting)

LIMIT CONTACTS:	only possible on recorders for **non**-intrinsically safe inputs and one measuring range
Number of contacts:	one or two SP change-over contacts
Relay:	S. P. D. T. contact is energized below min. limit and above max. limit
Contact rating: Voltage: Current: Power:	 ≦ 250 V a. c. ≦ 1 A a. c. ≦ 150 VA
Contact adjustment:	manual positioning of limit pointers
Adjustment range:	0 . . . 100 % of scale

Releasing contact: (in series with the limit contacts)	SP normally-open contact (is used to prevent premature alarm before the pointer has settled at new value)
Contact rating:	
Voltage:	≦ 250 V a. c.
Current:	≦ 1 A a. c.
Power:	≦ 150 VA (resistive load)
Additional channel selector switch:	used for correlating limit contacts to particular channels
Contact rating:	
Voltage:	≦ 30 V d. c.
Current:	≦ 5 mA d. c.

Note

Only resistive load. Load must not have a positive temperature coefficient.

Signal memory unit:	to store the alarm signal (max. 2 or 6) during the remaining channel selector cycle (→Data sheet 7450 32 102211)

ENVIRONMENTAL CONDITIONS

Permissible ambient temperature:	— 10 . . . + 50 °C
Storage temperature:	— 40 . . . + 60 °C
Temperature effect:	
On measuring ranges ≧10 mV:	≦ 0.2 %/10 °C
On measuring ranges 5 mV . . . < 10 mV:	≦ 0.4 %/10 °C
Climatic category: (to DIN 40 040)	JWG
Lower temperature limit:	— 10 °C → J
Upper temperature limit:	+ 50 °C → W
Relative humidity:	≦ 65 % yearly average, no condensation → G

EXPLOSION PROTECTION:	to VDE 0171
Type of protection:	Intrinsic safety (Ex) i G5, PTB certificate III B/E 26 858 S
Limiting conditions passive sources: external capacitance: external inductance:	 ≦700 nF ≦ 26 mH
active sources:	require matching module (→ section 1.1.)
Installation:	outside hazardous area

Note

Each instrument must have a separate fuse (see section 2.3., Power Supply)

HOUSING

Dimensions:	144 x 144 mm to DIN 43 831
Mounting method:	in panel cut-out
Depth behind panel:	300 mm
Fixing clamps:	type 290 to DIN 43 834
Mounting position:	vertical an angle of ≦ ±15° is permitted
Electrical connections:	screw terminals for 2 x 1.5 mm² flexible cables including end crimps
Mode of protection:	to DIN 40 050 (IEC 144)
Housing:	IP 30
Front:	IP 54
Terminals:	IP 20
Materials	
Housing:	sheet steel, passivated
Front door:	clear PMMA, with catch or lock to DIN
Weight:	3.5 kg approx.
Connecting diagram:	4012 150 73721 (Fig. 25)
Dimensions:	4012 150 62491 (Fig. 26)

2.4. Principle of operation

2.4.1. General

A universal input circuit enables the connection of voltage, current, and resistive signal sources.

Up to six different input signals can be connected to the Motorized Point Recorder 144. Plug-in modules (1, Fig. 1) contain the circuitry necessary for conditioning the input signals. A built-in constant current source (4, Fig. 1) on recorders for resistance input or for current and voltage measurements with range suppression, and a built-in temperature compensating circuit (3, Fig. 1) for thermocouple inputs increase the flexibility of the instrument.

The six input signals are applied to the electronics one after the other via the conditioning modules (1, Fig. 1), the channel selector switch (2, Fig. 1) and the active filter (5, Fig. 1). The electronic circuitry converts the analogue signal into digital pulses which drive the stepping motor (8, Fig. 1). The defined angular steps of the motor are indicated on the recorder scale by means of a gear-driven pointer. Every 5 s a chopper bar drops and marks the pointer position on the chart with a differently coloured ink ribbon for each input channel.

If the recorder is fitted with limit-signalling contacts (10, Fig. 1), the pointer position is sensed opto-electrically and signalled by built-in relays.

A releasing contact (11, Fig. 1) in series with the signalling relays, prevents premature alarm signalling before the pointer has settled.

An additional channel selector switch (2a, Fig. 1) enables the limit-signalling contacts to be correlated to particular input channels.

2.4.2. Measurement cycle

The measurement cycle of the Motorized Point Recorder 144 is 5 s long and is startet by a reed relay (13, Fig. 1) which is actuated by the chopper bar after each printing. The stepping motor (8, Fig. 1) then runs to null-balance at scale center, whereby the required direction is given by the pointer position. With the pointer at 0 . . . 50 % of scale, a vane blanks off a light beam; for 50 . . . 100 % of scale, this light beam is unobstructed. The final position at 50 % of scale is given by two electronic ‚threshold' circuits (9, Fig. 1). The entire optical null-balance operation is completed within 2 seconds and prepares the stepping motor for the next input signal.

Simultaneously with null-balance, the channel selector has switched to the next input signal which is then converted to a digital signal. This conversion is done by amplifying the input value to 0 . . . 500 mV (6, Fig. 1) and then changing it to a — 250 . . . 0 . . . + 250 mV signal. An analogue/digital converter (7, Fig. 1) produces 251 . . . 0 . . . 251 pulses which are applied to the stepping motor. The entire conversion is also completed within the first 2 seconds.

The digital signal drives the stepping motor and pointer to the new position within 1 second. After a further 2 seconds max., the chopper bar drops and the next measurement cycle is started by the reed relay.

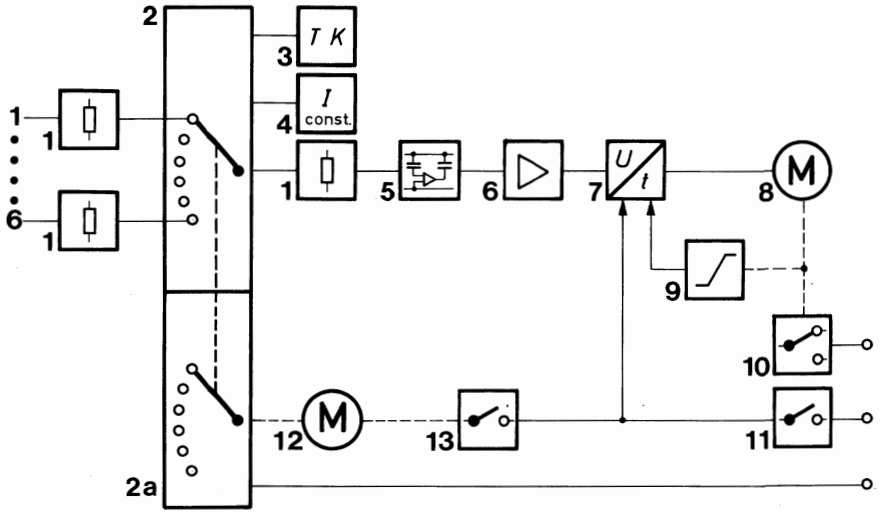


Fig. 1 Block diagram of Motorized Point Recorder 144

1 Conditioning and dummy modules
2 Channel selector switch
2a Additional channel selector switch
3 Temperature compensation
4 Constant current source
5 Active filter
6 Pre-amplifier
7 Analogue/Digital converter (with logic and stepping motor control circuit)
8 Stepping motor
9 Optical null-balance
10 Limit-signalling relay
11 Releasing contact
12 Synchronous motor for chart drive, channel selection, and printing
13 Chopper bar reed relay

2.5. CONSTRUCTION

2.5.1. Mechanical construction

General

The Motorized Point Recorder 144 consists of a sheet steel housing and the complete recorder insert (injection-moulded chassis). The recorder front is covered by a frameless, transparent door (→ section 2.3.).

This door can be fitted with a catch (Fig. 13) or with a lock (Fig. 14), as shown in section 4.1.2.

After opening the door, the chart table and the magazine for the ink ribbons can be withdrawn (→ section 4.2.).

The measured value is indicated by a pointer in front of a curved scale consisting of three strips (3, Fig. 2). Each strip can be graduated differently. The pointer position is marked on the chart paper by means of a chopper bar and an inked ribbon.

For service and maintenance, the complete recorder insert can be removed from the housing after unscrewing two slotted captive nuts at the rear of the housing.

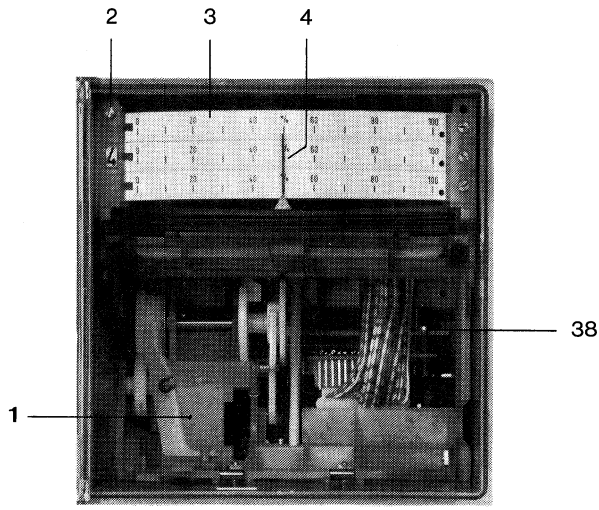


Fig. 2 Motorized Point Recorder 144 with chart table removed.

1 Drive unit
2 Adjuster for print intensity
3 Scale with three strips
4 Pointer
38 Zero adjusting potentiometer

Chart table

The chart table (→ Fig. 3) is designed for folded charts with a folded height of 40 mm, a recording width of 100 mm and a length of 16 m. The chart table contains the gearing (ratio 1:6) for the two-speed chart drive. By selecting different gear rations, basic chart speeds of 10, 20 or 60 mm/h are obtained (→ section 4.2.3.). Chart table removal is described in section 4.2.1.

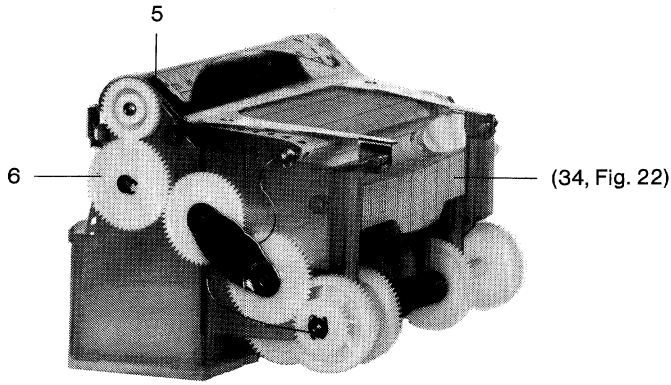


Fig. 3 Chart table of Motorized Point Recorder 144

5 Tensioning plate with guide rule
(34, Fig. 22). Folded chart in supply compartment
6 Gear wheel for manual chart transport

Drive unit

The drive unit contains the following components:

a) synchronous motor (29, Fig. 18) for:
chart drive
chopper bar operation
channel selector switch
movement of ink ribbon carriers

b) drive shaft for:
chopper bar cam plate
worm for channel selector operation
crank plate for ink ribbon movement

c) single channel monitoring lever (25, Fig. 16)
With this lever it is possible to arrest channel selection at a particular channel, so that this channel is recorded continuously at 5 second intervals. Switchback to normal operation is possible at any time.

d) arresting lever (31, Fig. 19)
This lever arrests the various mechanical movements in a definite position whenever the recorder is taken out of operation (→ section 4.4.) or whenever the chart table is removed for access to the paper or ink ribbons.

The arresting lever stops the mechanism just after channel selection, before the chopper bar has dropped, and with all the ink ribbons in the magazine.

e) ink ribbon magazine (Fig. 4)
Each ink ribbon is mounted to its own plastic (POM) carrier. The six carriers are stacked on top of each other in a magazine.

The bottom carrier (e. g. violet ribbon for channel 1) is pushed forwards out of the magazine by a pusher arm and is held in the printing position by two spring clips (8, Fig. 4).

After printing, the carrier is drawn back into the magazine and placed on top of the other carriers.

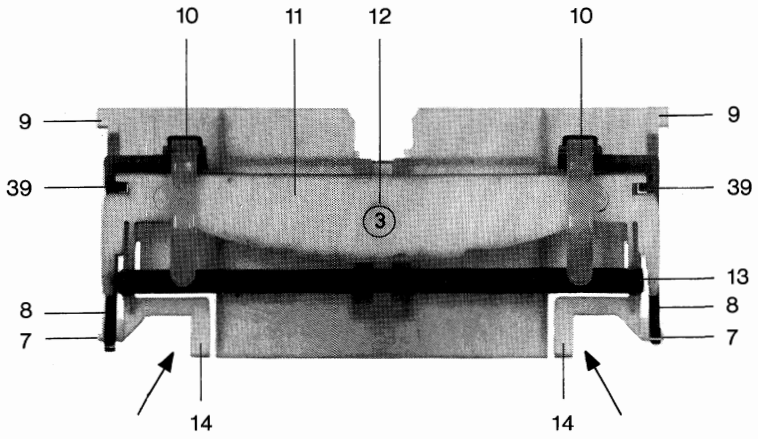


Fig. 4 Ink ribbon magazine

7 Spigot
8 Positioning clip
9 Guide lug
10 Retaining arm
11 Ink ribbon carrier
12 Carrier identification
13 Ink ribbon
14 Finger tabs
39 Guide slot for ink ribbon carriers

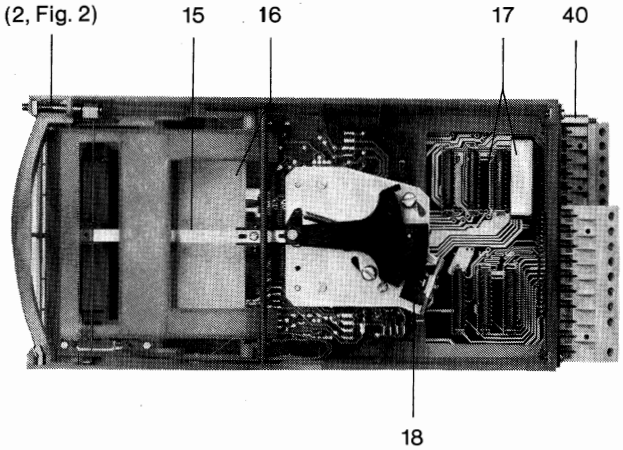


Fig. 5 Top view of Motorized Point Recorder 144

(2, Fig. 2), Adjuster for print intensity
15 Pointer
16 Pusher for ribbon carriers
17 Conditioning module and sockets (text legible from rear of recorder)
18 Opto-electric null-balance
40 Threaded spindle.

2.5.2. Electrical construction

General

The electronics of the Motorized Point Recorder 144 are mounted on printed circuit boards. Extensive use of integrated circuits is made.

The plug-in conditioning modules are positioned in the rear section of the recorder. Pre-amplifier and motor control circuitry also consist of plug-in modules.

The input circuit contains seven sockets for conditioning modules. Of these, six are positioned ahead of the channel selector switch and the seventh common socket is positioned behind the channel selector (→ Fig. 5).

Recorders for only one measuring range have dummy modules fitted to the sockets 1 . . . 6 and a common conditioning module in socket 0.

Recorders for 2 . . . 6 measuring ranges have individual conditioning modules for each channel in sockets 1 . . . 6 and the common socket 0 is fitted with a dummy module.

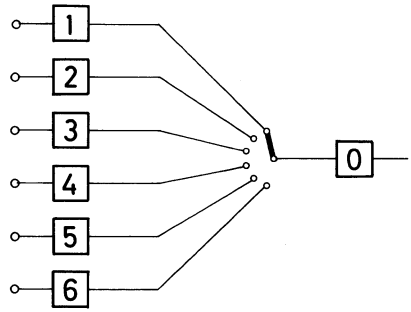


Fig. 6 Channel selector switch and sockets for conditioning modules

Recorders for thermocouple input

For measurements with thermocouples, two methods of temperature compensation are possible:

a) built-in temperature compensation,

b) external temperature compensation.

a) If built-in temperature compensation is used, this is possible for only one type of thermocouple.

In this case, the compensating leads are taken right up to the recorder terminals which act as the cold-junction reference point. A copper resistor built into the terminal strip senses the ambient temperature. Any deviation from the reference temperature of 20 °C is compensated for automatically.

For recorders with 2 . . . 6 measuring ranges, the temperature compensation can be correlated to particular measuring ranges or to particular channels. The conditioning modules used in these cases have a black edge around the identification label.

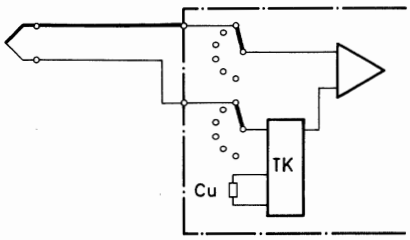


Fig. 7 Built-in temperature compensation (recorders with one measuring range)

b) If external temperature compensation is used, each thermocouple input is compensated separately (e. g. Transostat).

This arrangement is used for recorders with measuring ranges using different types of thermocouples.

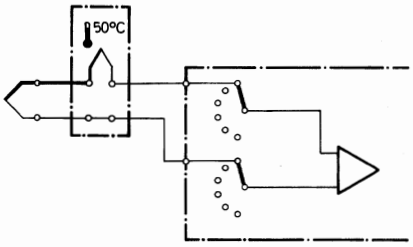


Fig. 8 External temperature compensation

Recorders for current input

Recorders for current measurement need a conditioning module in each of the sockets 1 . . . 6. These modules contain a shunt resistor, so that the current signal is **not** interrupted during channel selection.

Recorders for resistance input

These versions have a built-in constant current source. For measurements with resistance thermometers we recommend 3-wire connection, as this eliminates the need for lead resistance adjustment if the lead resistance remains below 10 Ω. With higher lead resistances, a special conditioning module is needed (indicate lead resistance when ordering).

If 2-wire connection is used, the lead resistance (R_L) must be adjusted to 10 Ω. This can be done, even without an ohmmeter, by using the check resistor supplied with the instrument (→ Fig. 10). For a more detailed explanation, see section 4.2.7.

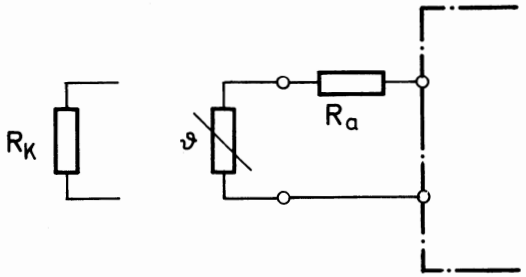


Fig. 10 Resistance thermometer in 2-wire connection
Lead resistance adjustment with an ohmmeter or with a check resistor

ϑ Resistance thermometer
R_a External resistance
R_k Check resistor

Note

The conditioning modules for resistance measurements in 2-wire and 3-wire connection are different (→ section 2.2.).

If the recorder is fitted with a conditioning module for 3-wire connection but the resistance thermometer is to be connected in 3-wire substitute connection (g, Fig. 24), a lead equalizing resistor (R_e) must be included. In the example shown in Fig. 24 for input channel 2, this resistor is fitted in the lead to terminal 6.

The value of R_e **must** be matched to the lead resistance between points a) and b) (excluding the resistance of the thermometer) and may not exceed 10 Ω.

3. INSTALLATION

3.1. Mounting

The Motorized Point Recorder 144 has front dimensions of 144 x 144 mm to DIN 43 831. The depth behind panel is 300 mm.

During installation, consideration must be given to possible heat radiation from adjacent equipment. The ambient temperature range specified in section 2.3.

The instrument is introduced into the panel cut-out from the front and is fixed by using clamps type 290 to DIN 43 834 (21, Fig. 11). Alternative mounting methods are shown in Fig. 26.

Note

Position the clamps and tighten the jack screws alternately, until the housing is firmly mounted.

The normal mounting position is with the front vertical. If the panel is sloping, and angle $\alpha \leqq \pm 15°$ should not be exceeded.

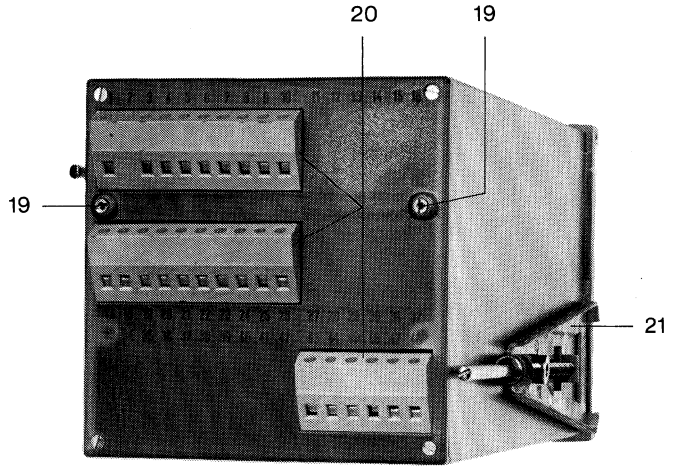


Fig. 11 Rear view of Motorized Point Recorder 144

19 Slotted captive nut
20 Connecting terminals
21 Fixing clamp to DIN 43 834

3.2. Electrical wiring

All electrical wiring must conform to local standards (e. g. VDE 0100).

Separate runs are to be made for the mains supply lead and the input signal leads.

The connecting terminals will accept either two flexible leads (cross section 1.5 mm^2) including end crimps, or screw-on flat-pin 6.3 mm connectors to DIN 46 247.

All connections are to be made according to the diagram in Fig. 25.

Attention!

Recorders for input signals coming from hazardous areas must be fitted with a fuse type AMG to DIN 41 571 in the mains supply lead (→ section 2.3., Power Supply).

3.3. Signal leads

To avoid the effects of electrical and magnetic interference on the input leads, it is recommended that these be twisted or screened and the screens connected to the earthing screw at the rear of the recorder.

3.3.1. Input signals from active sources on recorders with (Ex)i input circuit

For direct connection of active sources with a signal current output of 0 . . . 20 mA or 4 . . . 20 mA to a recorder with intrinsically safe input circuit, each input channel for such signals must be fitted with a matching module for current and voltage limiting (→Fig. 11).

When suitably protected by a matching module, the signals from active sources in a hazardous area can be connected to a recorder together with other types of input signal.

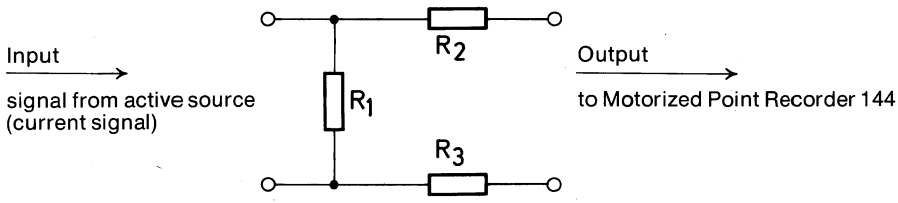


Fig. 12 Circuit of matching module for voltage and current limiting

intrinsically safe measuring circuits must be wired according to VDE 0165

4. OPERATION

4.1. Preliminary checks

4.1.1. Checking the mains supply

Check that the mains voltage indicated on the type label corresponds to the voltage at the place of installation.

4.1.2. Housing door

Depending on version, the recorder can be fitted with a catch or a lock on the front door.

Doors fitted with a catch are opened by turning the catch to the left (→ Fig. 13). The door can be closed again using slight pressure.

On doors fitted with a lock to DIN 43 832, the key supplied with the instrument must be inserted and turned to the left (→ Fig. 14).

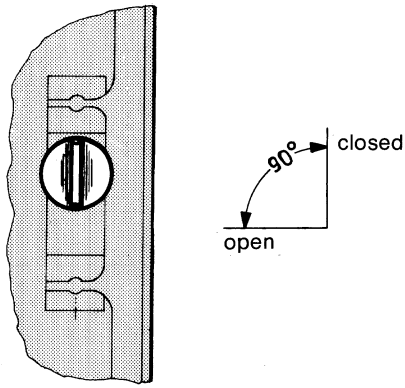


Fig. 13 Door fitted with catch

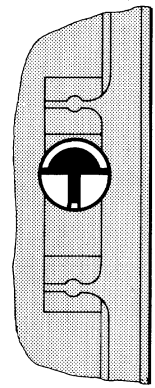


Fig. 14 Door fitted with lock

4.1.3. Checking the conditioning modules

On recorders with 2 . . . 6 measuring ranges the correlation between the input channels and measuring ranges is marked on the channel identifying label (22, Fig. 15) as shown below:

Scale with three strips
(3, Fig. 2)

I
II
III

Channel identifying label
(22, Fig. 15)

1 ■ I	4 ■ I
2 ■ II	5 ■ II
3 ■ III	6 ■ III

In the example
measuring range I for channels 1 and 4
measuring range II for channels 2 and 5
measuring range III for channels 3 and 6

4.1.4. Channel identification

The channel identifying label (22, Fig. 15) is fitted to the inside of the recorder door. It is intended for TAG marking or for similar channel identification.

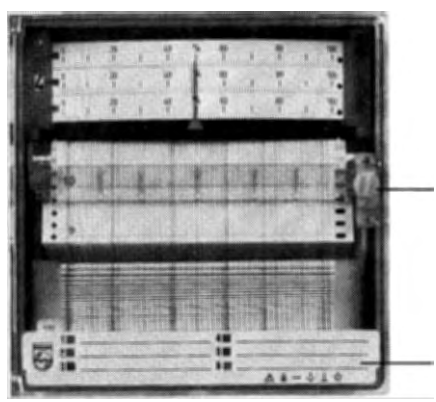


Fig. 15 Front of Motorized Point Recorder 144

22 Channel identifying label
(Fig. 13) door catch

4.2. Commissioning

4.2.1. Chart table, general

The chart table (Fig. 3) together with the two-speed gearing for chart drive forms a single unit. In order to replace the chart paper, or before taking the recorder out of commission, the chart table is to be removed as follows:
with the recorder door open, the chart table must be pressed downwards (against the spring pressure) at the points marked with arrows in Fig. 16. The chart table can then be withdrawn forwards.

The procedure must be reversed when replacing the chart table.

Note

When replacing the chart table, make sure that the separator bar (35, Fig. 22) has lifted only one fold of the chart and that the lever for single channel monitoring is in the required position (→ section 4.2.5.).

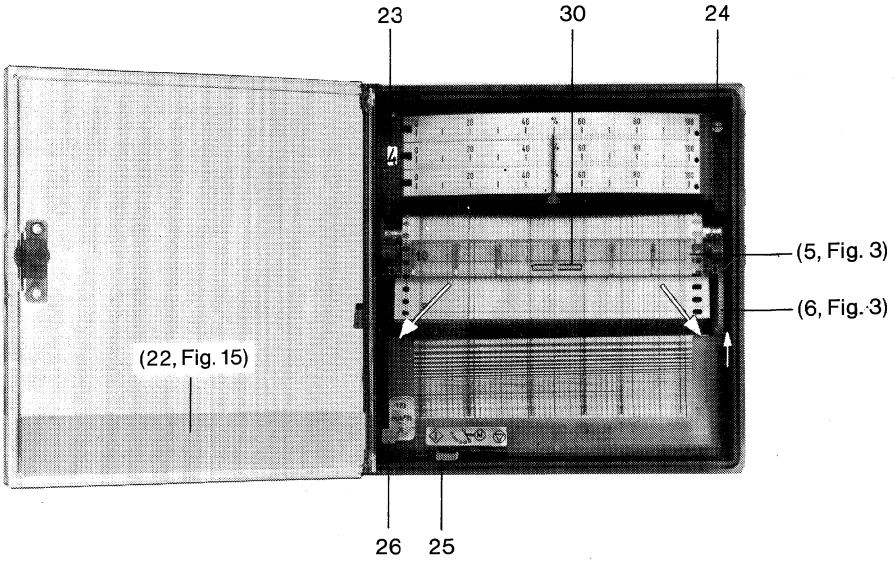


Fig. 16 Motorized Point Recorder with door opened

23 Channel indicator
24 Screw holding scale strip
(5, Fig. 3) Tensioning plate with guide rule
25 Lever for single channel monitoring
26 Chart speed selector
(22, Fig. 15) Channel identifying label (remove backwards)
(6, Fig. 3) Gear wheel for manual chart transport
30 Mark on guide rule for adjusting to time lines of chart paper

4.2.2. Ink ribbon magazine and carriers

Open recorder door and remove chart table.

Removing the ink ribbon magazine

The finger tabs on the magazine (14, Fig. 4) are to be pressed together between thumb and forefinger in the direction shown by the arrows, and the magazine can be swung downwards and withdrawn forwards.

Placing the ink ribbon carriers in the magazine

Fold the two retaining arms (10, Fig. 4) upwards. The ink ribbon carriers (11, Fig. 4) must be placed in the magazine in the correct order (→ Fig. 4).

When positioning the carriers in the magazine, check that the cut-outs of the carrier slide into the guide slots in the magazine (39, Fig. 4).

Sequence of ribbons as follows:
channel 1: violet
channel 2: red
channel 3: black
channel 4: green
channel 5: blue
channel 6: brown

If the recorder has stopped with the channel indicator (23, Fig. 16) not at channel 1 but, for example, at channel 3, the ink ribbon carrier with the identification number 3 (12, Fig 4) must be placed in the magazine first. (Identification number must always face upwards.) All the other ink ribbon carriers must then be placed in the magazine in the correct sequence. In this case the sequence is 4, 5, 6, 1 and 2.

With all six carriers in position, the retaining arms can be folded back down and the magazine replaced in the recorder.

Replacing the ink ribbon magazine

Grasp the magazine by the finger tabs and press these together whilst sliding the magazine into the guide slots (28, Fig. 17). When the magazine has been inserted up to the pivot points, it can be rotated upwards until the spigots (7, Fig. 4) locate in the holes (27, Fig. 17) in the recorder side plates (see also Figs. 17, 18 and 19).

Replace chart table and ensure that the lever for single channel monitoring is in the required position.

4.2.3. Selecting chart speed

Open recorder door and select the required chart speed with the lever (26, Fig. 16) at the front of the recorder. Depending on version, a basic chart speed of 10, 20 or 60 mm/h is possible. This speed can be increased in the ratio 1:6. Chart speed selection can also be done whilst the recorder is running (→ section 2.5.1.).

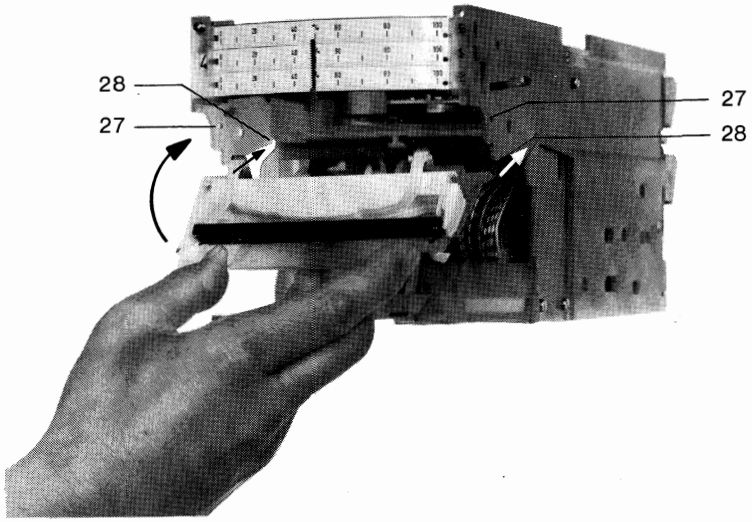


Fig. 17 Motorized Point Recorder removed from housing (replacing ink ribbon magazine)

27 Holes in recorder side plates
28 Guide slots with pivot point

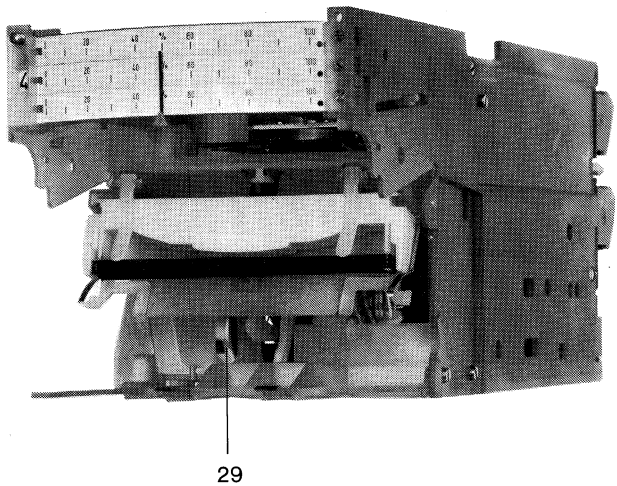


Fig. 18 Motorized Point Recorder 144 removed from housing (ink ribbon magazine inserted up to pivot points)

29 Synchronous motor

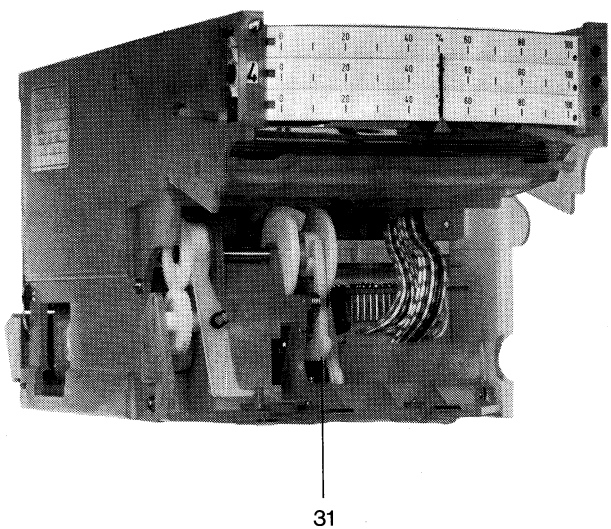


Fig. 19 Motorized Point Recorder 144 removed from housing (ink ribbon magazine in position)

31 Arresting lever

4.2.4. Réglage du temps sur le papier d'enregistrement

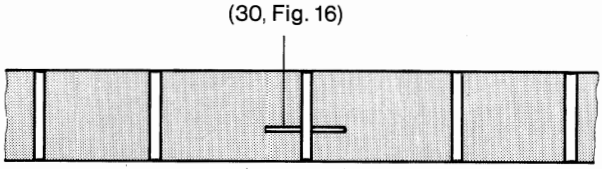
Un réglage du temps doit avoir lieu, afin que le moment de l'enregistrement corresponde aux lignes de temps sur le papier d'enregistrement.

En tournant la roue dentée (6, Fig. 3 et Fig. 16) dans la direction de la flèche le papier d'enregistrement peut être déplacé manuellement. La marque (30, Fig. 16) de la réglette de guidage (5, Fig. 3) sert d'appui pour ce réglage, la marque étant située 20 mm vu de la ligne d'enregistrement.

Exemple

Si l'avancement du papier s'élève à 20 mm/h et si l'on doit régler au point d'enregistrement de 16 heures, il faudra régler la ligne de 15 heures à la marque (30, Fig. 16) de la réglette de guidage (5, Fig. 3).

Ensuite il faut compenser le temps mort en tournant la roue dentée (6, Fig. 3) dans le sens inverse jusqu'en butée.

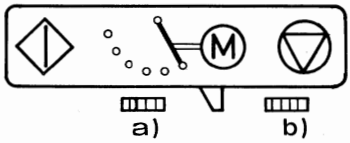


(5. Fig. 3) Enregistreur asservi 144
Volet-tendeur avec réglette de guidage

(30, Fig. 16) Marque sur la réglette de guidage (réglage du temps sur le papier d'enregistrement)

4.2.5. Régler le commutateur de sélection de voies

Mettre le commutateur de sélection de voies (25, Fig. 16) dans la position désirée (→ paragraphe 2.5.1.).



(25, Fig. 16) Enregistreur asservi 144
Commutateur de sélection de voies

Position a): enregistrement de 6 voies
Position b): enregistrement d'une voie

4.2.6. Mise en circuit de l'alimentation

Mettre l'alimentation en circuit.

Après environ 30 minutes de marche la température de service est atteinte.

4.2.7. Equilibrage de ligne

Un équilibrage de ligne n'est nécessaire que pour une mesure par thermomètre à résistance en circuit deux fils (équilibrage à 10 Ω). Pour cela, court-circuiter les lignes de mesure dans la tête de raccordement du thermomètre à résistance. Débrancher les lignes de mesure de l'enregistreur asservi 144.

Mesurer la résistance de ligne (R_L) à l'aide d'un pont de résistance ou d'un ohmmètre. Diminuer la résistance d'équilibrage de ligne (R_e) jusqu'à ce que cette résistance et la résistance de ligne mesurée (R_L) s'élèvent à 10 Ω .

S'il n'y a pas de pont de mesure, la résistance de ligne pourra être équilibrée comme suit.

Remplacer le thermomètre à résistance par une résistance de contrôle. (La résistance de contrôle est incluse dans la fourniture.) La valeur indiquée sur l'enregistreur asservi 144 peut être plus élevée que celle indiquée par la résistance de contrôle. Diminuer la résistance d'équilibrage de ligne jusqu'à ce que l'enregistreur indique la valeur de résistance de la résistance de contrôle.

Ensuite il faut remplacer la résistance de contrôle par le thermomètre à résistance. Connecter le thermomètre à résistance et les lignes de mesure (→ Fig. 20).

$R_a = R_e + R_L$

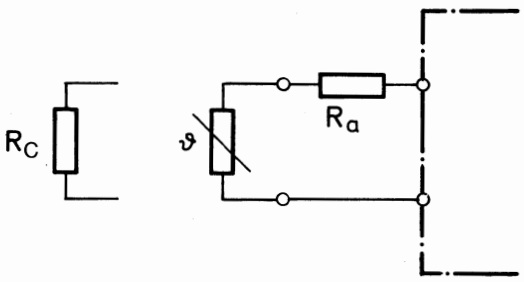


Fig. 20 Mesure avec un thermomètre à résistance en circuit deux fils Equilibrage de ligne à l'aide d'un pont de mesure ou d'une résistance de contrôle

ϑ Thermomètre à résistance
R_a Résistance externe
R_C Résistance de contrôle
R_L Résistance de ligne

4.3. Trouble shooting

4.3.1. General

If the Motorized Point Recorder 144 is not working properly, the source of trouble should be located by systematic searching. Before examining the recorder itself more closely, all possible external sources of error should be checked, e. g. primary elements, input leads, etc.

If the fault cannot be traced after completing all the checks in section 4.3., we recommend sending the recorder back to your supplier.

In the following, a few hints for trouble shooting are given.

4.3.2. Mechanical check

If Motorized Point Recorder 144 is not printing:

a) Check that the ink ribbon carriers are located properly and in the correct sequence (→ section 2.3.) in the magazine (→ Fig. 4).

b) Check that the ink ribbon magazine is located properly in the recorder, i. e. that both spigots (7, Fig. 4) are located in the holes in the recorder sideplates.

c) Check that the ink ribbons are not dry or have not jammed.

d) Check that the printing insensity (2, Fig. 2) is not too low, as this could prevent the chopper bar pushing the pointer down far enough.

e) Check that the chart table is positioned correctly in the recorder (→ section 4.2.1.).

4.3.3. Electrical check

Checking the connections:

a) Are all connections in good condition and according to the connecting diagram in Fig. 25?

b) Is the mains supply voltage at terminals 47 and 48 at the correct value? (→ Fig. 25)

c) Are the earth lead and possible screening leads connected properly?

Note

It is often forgotten that with certain types of primary elements the signal leads are either earthed directly or via the screens, or that there is a galvanic connection via the recorder housing.

Particularly thermocouples are often earthed or at least have a greatly reduced insulation resistance at high temperatures.

4.3.4. Checking the conditioning modules

Disconnect mains supply and input signal leads from recorder.

After unscrewing the two slotted nuts at the rear of the instrument, the recorder insert can be removed from the housing.

a) Check that the correct conditioning modules have been allocated to their corresponding input channels.

b) Are the conditioning modules located properly in their sockets? (Text on top of module legible from rear of recorder.)

c) Check that on recorders with only one measuring range, the conditioning module is located in socket 0 and that sockets 1 . . . 6 are fitted with dummy modules.

It should be noted that with current measurements (also with the same range on all input channels), all 6 sockets ahead of the channel selector switch must be fitted with conditioning modules. The common socket 0 behind the channel selector switch must be fitted with a dummy module.

d) Is the colour coding of the conditioning modules correct for the application? (→ section 5).

e) Before re-inserting the recorder in its housing, check that the solder terminal for the internal earth lead is positioned correctly on the threaded spindle (40, Fig. 5).

4.3.5. Functional check

Proceed as follows:

a) Disconnect input leads at recorder terminals and check whether the primary element is supplying the required output signal.

With thermocouple or resistance thermometer measurements, the correct output values for a given temperature can be taken from corresponding tables (→ section 6.3.).

If the fault cannot be traced to the primary element, the Motorized Point Recorder 144 must be checked.

b) Using a suitable signal source, the electrical values corresponding to each measuring range are to be simulated. The values for span start and end of span are indicated on each conditioning module.

Using the single channel monitoring lever (25, Fig. 16) stop channel selection at the input channel required as described in section 2.5.1.

b) The channel being recorded is displayed at the front of the recorder (23, Fig. 16).

For conditioning modules with built-in temperature compensation, the temperature at terminal 2 (reference junction) must be measured with a mercury or electronic thermometer. Using the corresponding tables (→ section 6.3.), the measured reference temperature is to be converted into an electrical value. This value (millivolt signal) is to be subtracted from the value for span start and also from the value for end of span. The difference between these two voltage signals gives the true values for span start and end of span.

If these values are not indicated exactly by the pointer of the recorder, proceed as follows:

c) Check the electrical zero (→ section 6.3.).

d) Check whether the fault is in the conditioning module.

If a spare conditioning module with an identical measuring range is available, repeat the operations under b) to determine the values for span start and end of span.

If the pointer indicates the correct values for span start and end of span, the error is definitely in the original conditioning module which will have to be replaced.

However, should the pointer still show **incorrect** values, it can be assumed that the fault is in the recorder itself. In such a case, the Motorized Point Recorder 144 should be returned to the supplier.

4.4. Shut-down

If the Motorized Point Recorder 144 is to be shut down, the various mechanical movements must be arrested in a definite position. This position is achieved by removing the chart table. The recorder will then switch off after it has completed a printing cycle (→ section 2.5.1.). The mains supply lead and the input signal leads can now be disconnected.

Note

Before switching off the Motorized Point Recorder 144, check that other equipment in the same input signal loop are not affected. This applies particularly to standardized current signals or to limit-signalling equipment connected in the circuit. If other equipment should be affected, appropriate measures must be taken before disconnecting the recorder.

5. CHANGING A MEASURING RANGE

5.1. General

Plug-in conditioning modules and the three separate scale strips make range changes simple.

5.2. Exchanging the conditioning modules

To modify a recorder from a single input range (only 1 conditioning module necessary for all six input channels) to two or more input ranges, five additional conditioning modules are necessary (→ section 2.5.2.).

If a modification is intended, the following points should be noted:

a) When re-ordering or modifying, please indicate the exact Order no. for the required conditioning module.

Conditioning modules with the following Order nos. can be used in the Motorized Point Recorder 144:

Conditioning module for measuring ranges without built-in temperature compensation (yellow edge)
Order no. 9404 392 20 . . 1

Conditioning module for measuring ranges with built-in temperature compensation (black edge)
Order no. 9404 392 27 . .1

Conditioning module for measuring ranges with built-in temperature compensation and built-in constant current source (black edge)
Order no. 9404 392 28 . . 1

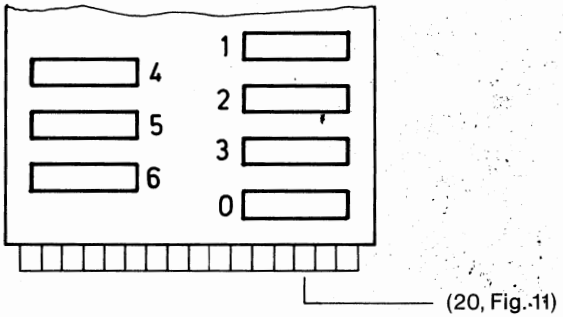
Dummy module: Order no. 9404 392 23001

b) Before exchanging the conditioning modules, the mains supply and the input signal leads must be disconnected from the recorder terminals. The recorder must then be removed from its housing after releasing two slotted nuts at the rear of the instrument.

The conditioning modules are positioned as follows (→ 17, Fig. 5);

Recorders with 1 measuring range: conditioning module in socket 0, dummy modules in sockets 1 . . . 6.

Recorders with 2 . . . 6 measuring ranges: conditioning modules for channels 1 . . . 6 in sockets 1 . . . 6, dummy module in socket 0.



(17, Fig. 6) Socket positions for conditioning modules (text legible from rear of recorder)

(20, Fig. 11) Connecting terminals

c) On recorders with only one measuring range and built-in temperature compensation, all thermocouples must be of the same type. Conditioning modules have a black edge.

d) On recorders with more than one measuring range and built-in temperature compensation, the thermocouple(s) allocated to the range(s) with temperature compensation must be of the same type. Conditioning modules have a black edge.

e) A new range for the same thermocouple type only needs a new conditioning module.

f) If a different type of thermocouple is to be connected, the recorder should be sent back to the supplier.

g) Before re-inserting the recorder in its housing, check that the solder terminal for the internal earth lead is positioned correctly on the threaded spindle (40, Fig. 5).

5.3. Exchanging the scale

5.3.1. Removing the scale

Before removing the scale, the pointer should be brought to scale start. This is done as follows:

Select an input channel for voltage or current input. Short circuit the terminals of this channel with a wire link.

If the recorder is only for resistance input or for voltage and current inputs with zero suppression, a simulator must be provided to generate the simulated value for range start and this signal must be applied at the input terminals.

If, for example, channel 1 has been selected, the chart table must be removed immediately after channel 6 has printed. The pointer will then run to null-balance at scale center and then go to scale start. The recorder will then switch itself off.

For a different input channel, the same procedure applies.

The cheese head screw (24, Fig. 16) at the right-hand end of the scale is to be loosened. Using a screwdriver in the hole at the right-hand end of the scale strip, carefully push the scale strip out of its retaining slot and remove it forwards.

5.3.2. Replacing the scale

The new scale strip must be positioned in the left-hand slot first and then slid into the right-hand slot. Using the screwdriver, position the scale strip so that the pointer and scale start are perfectly aligned. Retighten the cheese head screw.

Replace chart table and remove wire link or simulator from input terminals.

6. MAINTENANCE

6.1. Replacing chart paper

A red line, starting about 60 cm from the end of the chart, indicates that the chart is nearly used up.

After opening the recorder door (→ section 4.1.2.), remove the chart table (→ section 4.2.1.).

To remove the remaining paper, the tensioning plate with guide rule (5, Fig. 3) can be swung upwards by pressing with both thumbs at the points marked by arrows in Fig. 21. The remaining folds of paper can then be removed from the supply compartment (34, Fig. 22) and deposited in the receiving compartment.

The folded chart can be removed upwards from the receiving compartment (33, Fig. 21) by pushing a finger through the hole in the bottom of the compartment (32, Fig. 21).

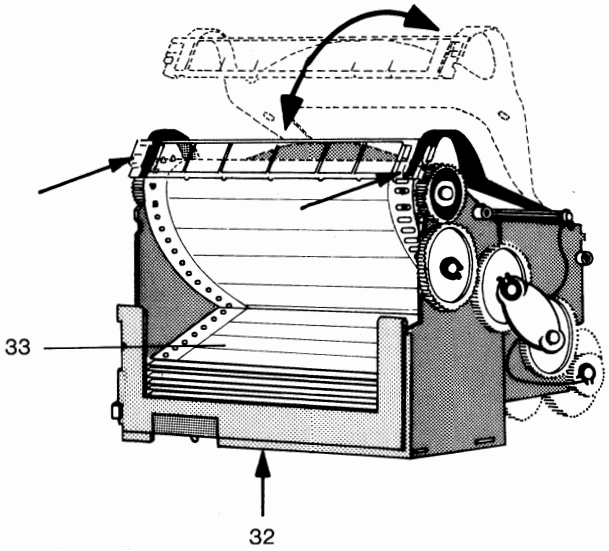


Fig. 21 Opening chart table for chart removal

32 Hole in bottom of receiving compartment
33 Receiving compartment for folded chart

Before placing the new chart in the supply compartment, the separator bar (35, Fig. 22) must be pressed forwards as shown by the arrow in Fig. 22 and held in this position (→Fig. 23).

The new folded chart can then be placed in the supply compartment (34, Fig. 22) with the calibration upwards and the leading edge pointing towards the guide surface (36, Fig. 22). Press folded chart firmly down into the compartment and then remove several layers (approx. 40 cm) and release separator bar. The loose end of chart is then taken forwards over the guide surface and over the transport drum (37, Fig. 22). Check that the chart is flat on the guide surface, that the time lines are horizontal, that the separator bar has separated only one fold of paper, and that the sprockets of the transport drum are positioned accurately in the holes of the chart paper.

Fold tensioning plate with guide rule down over the transport drum and press down until it clicks into position. The loose end of chart paper is to be folded and placed in the receiving compartment. Replace chart table in recorder and ensure that the lever for single channel monitoring is in the required position.

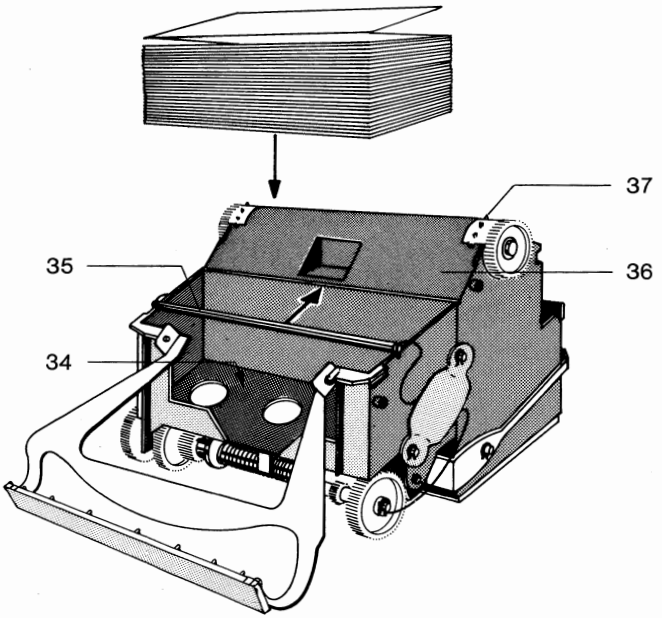


Fig. 22 Placing new folded chart in supply compartment

34 Supply compartment
35 Separator bar
36 Guide surface
37 Sprockets on transport drum

Note

Before placing chart into supply compartment, **loosen** the layers from each side as shown in Fig. 23.

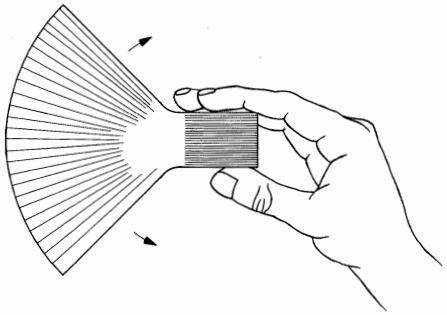


Fig. 23 Loosening folds of chart paper

6.2. Exchanging ink ribbons

If the recording is poor, even with maximum print intensity, the ink ribbon carriers (11, Fig. 4) must be replaced. To do this, the chart table and the ink ribbon magazine must be removed from the recorder (→ section 4.2.1. and section 4.2.2.).

6.2.1. Checking printing intensity

With new ink ribbon carriers in the magazine, the setting of the print intensity adjuster (2, Fig. 2) must be checked and re-adjusted if necessary.

6.3. Zero adjustment

6.3.1. General

The electrical zero may only be adjusted with the recorder at operating temperature. This temperature is reached after about 30 minutes operation.

A separate zero adjustment for each channel is not necessary.

6.3.2. Adjustment

Recorders for ranges **without** built-in temperature compensation.

Select an input channel for voltage or current input. Short circuit the terminals of this channel with a wire link.

If the recorder is only for resistive input or for voltage and current inputs with zero suppression, a simulator must be provided to generate the simulated value for range start, and this signal must be applied at the input terminals.

If, for example, channel 1 has been selected, the chart table must be removed immediately after channel 6 has printed. The pointer will run to null-balance at scale center and then go to scale start. The recorder will then switch itself off.

Check whether the pointer is at range start on scale. If this is not the case, the single channel monitoring lever (25, Fig. 16) must be held in position b) for single channel monitoring (→ section 4.2.5.) whilst the arresting lever (31, Fig. 19) is briefly pushed towards the rear of the recorder.

The pointer will now run to null-balance at scale center and back to scale start at intervals of 5 seconds. The pointer can now be adjusted to coincide with scale start ± 0.1 mm by using the zero potentiometer (38, Fig. 2).

A screwdriver with blade dimensions of 0.5 x 3 mm is needed for the slot in the potentiometer spindle.

Recorders for measuring ranges **with** built-in temperature compensation.

Measure the temperature at terminal 2 (reference junction) with a mercury or electronic thermometer. The corresponding electrical values can be taken from one of the following tables.

Thermovoltages to DIN 43 710

Values for resistance thermometers to DIN 43 760

These tables are found in Section 1 of our Industrial Automation Catalogue for Process Control Instrumentation.

The resulting value is to be subtracted from the value for range start of the range being checked (value is indicated on the conditioning module). The difference between the two mV values gives the true value for range start. This true value must be provided by a suitable signal source and is to be connected to the input terminals of the channel being checked. The electrical zero can then be adjusted as described above.

Note

Once the electrical zero has been adjusted for the selected measuring range, this adjustment is valid for all other ranges and input channels.

6.4. Chart table gears

The gears of the chart table need no maintenance.

6.5. Oiling the drive unit

The points shown in Fig. 24 are to be oiled with V-oil 1501/70 at intervals determined by the operation conditions.

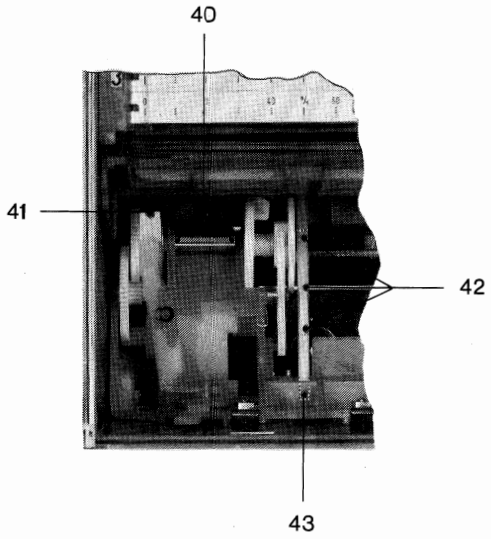


Fig. 24 Lubrication points of drive unit

40 Shaft bearings
41 Cam surface to right of gear
42 Sliding surfaces for crank pin
43 Pivot pin