

RD6112 RECORDER-THERMOCOUPLE INPUT

Operator's Manual

NOTES AND WARNING NOTICES

- This device has been constructed and tested to comply with ÖVE/VDE 0411 and IEC 348, protective measures for the safety of electronic measuring instruments. This instrument also complies with US specification UL 1244, as well as Canadian specification CSA C 22.2 No O-M 1982, 151 - M 1986.
- The recorder left the factory in a perfect condition with regard to safety requirements. To maintain this condition and ensure safe operation, the user must observe the notes and warnings contained in this manual.
- Before connecting power it must be ensured that the operating voltage set on the instrument is the same as the power voltage.

Connect the power plug only to a connector with ground contact. Be sure that the protective effect is not cancelled out by an extension cable without the appropriate protection. Before turning power on and connecting any measuring and control circuits, make sure that the protective conductor terminal is connected to the protective conductor and that the power plug is connected.

Any interruption in the protective conductor either inside or outside the instrument, or any loosening of the protective conductor connection may render the instrument unsafe. Intentional interruption is not allowed.

- If safe operation is no longer possible, switch off the instrument and protect against accidental operation. This decision can be made when the instrument presents visible signs of damage.
- When opening covers or removing components, except in cases where this can be done by hand, live components may be exposed. Connection points may also be live.

Before adjustments, maintenance, servicing or replacing parts, make sure that the instrument is disconnected from all voltage sources if it is necessary to open the instrument.

If adjustments, maintenance or repair work is then unavoidable on the open, live instrument, such work should only be carried out by a qualified technician, who is familiar with the hazards involved.

Capacitors within the instrument may be charged even the instrument is disconnected from all voltage sources

- Make sure that the fuses used as replacement fuses are those of the specified type and specified rated current. Do not use rewired fuses or short-circuit the fuse holder.
- After repairing, servicing and closing the instrument, carry out a high voltage test using the values listed in the electrical data (chapter 7), and check the protective conductor.






This warning notice located in several places on the instrument means:

REFER TO THE OPERATING MANUAL


SUMMARY OF WARNING NOTICES

All warning notices included in this operators manual and appearing on the device are summarized in the following list:

Power supply unit

	Class 2 Transformer, safety insulation
	CAUTION: Indoor use only
T 50 / E	Operating temperature max. + 50 °C
 u 130 °C	Thermal protection + 130 °C

Bottom side of the device

	Safety insulation mark according to IEC 117
<p style="text-align: center;">WARNING</p> <p>To avoid electric shock disconnect power plug and measuring terminals before servicing. Instrument to be serviced by qualified personnel only.</p>	
<p>For continued protection against fire, replace only with fuse of the specified voltage and current ratings.</p>	
<p>9 Batteries, Fuses $\varnothing 5 \times 20$ mm or $\varnothing \frac{1}{4} \times 1\frac{1}{2}$ in.</p>	

Bottom side of the device, Battery-Accu compartment

BATT / ACCU (Battery operation / Accu operation).

T 1.0 A / 250 V slow (Power circuit fuse).

Rear side of the device

POWER 12 V dc / 0.3 A (Power supply adapter or 12 V Accu).


CAUTION

Take care for the position of the selector switch BATT / ACCU inside of the battery- accu tray on bottom side of the recorder.

WARNING -

Socket electrically connected to measuring terminals. To avoid electric shock socket must not be used if measured voltage exceeds 42 V .

Upper side of the device

— max. 750V 

Maximum voltage to ground 750V!

HOW TO USE THIS MANUAL

This manual contains all information needed to set-up, connect and operate the instrument.

All warnings must be read carefully; they pertain to important information.

- Chapter 1** provides a short overview about the recorder
- Chapter 2** explains how to unpack the instrument, inspect it, and plug it in
- Chapter 3** describes how to use the operating panel and the features that can be accessed.
- Chapter 4** explains the function and features of the recorder
- Chapter 5** describes how to check the functions of the recorder
- Chapter 6** provides important measurement directions
- Chapter 7** consists of the technical data sheet and the list of ordering numbers for the accessories available
- Chapter 8** presents the mechanical dimensioning diagrams
- Appendix A** shows all operating and interfacing elements of the main unit and the measuring units including their numbering

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CHAPTER 1

FIRST ENCOUNTERS

Note: All numbers found in the manual appearing within brackets [n] refer to the numbering of the functional elements and connectors found in Appendix A.

1.1. General

The OMEGA® RD6112 is a compact, microprocessor controlled single-channel recorder. It is primarily designed in SMD-technology and used for linearized registration of temperature / time. Temperature is sensed with thermocouples "J,K,T" or with PT 100 resistor (in 2-, 3- or 4-wire method).

The integrated digital display unit provides direct read-out of the measured temperature or can be used for displaying error messages when measuring lines are interrupted. The protocol print-out is applicable for measuring protocols.

A multi-functional power supply unit allows stationary or mobil application of the recorder. It can be provide up by 110 VAC, battery pack or an external 12VDC-supply.

A chart take-up unit is optionally available.

1.2. Units

The recorder consists of the following units:

- Main Unit
- Options

The main unit consists of the following units:

- Measuring Unit
- Time Base Unit
- Motor Unit

The different units can be separated to functional blocks (see Figure 1.1, block diagram).

1.2.1. Measuring Unit

Front panel	operational and connective elements
2W Adjustment	compensation potentiometer for lead's resistance Pt 100/2W
Multiplexer	measuring inputs are multiplexed to the measuring amplifier conforming to the selected measuring mode
Measuring Amplifier	conversion of the input voltage (thermo voltage or voltage drop on Pt-100 resistor) to a specific output voltage of the CPU
ADC	analog/digital-converter - output voltage of the measuring amplifier will be converted to a digital value
CPU	the complete measuring cable is controlled by the processor: - data acquisition - data calibration
DAC	digital/analog converter - the calibrated and linearized measuring value is converted to an analog voltage, which controls the servo amplifier
Servo Amplifier	controlling the servo motor, which is directly coupled to the pen
Display	display of current temperature value; measuring range overflow, invalid measuring range, encoded error messages when the measuring lines are interrupted.

1.2.2. Time Base Unit

Front panel	operational and connective elements
CPU	controlling chart feed and protocol print-out
DAC	digital/analog-converter - converting protocol characters into an analog voltage for print control
Driver	power amplifier for the stepper motor
Power Supply	External: with power pack or battery Internal: with accumulators (buffering or recharging operation) or batteries Fuse protection is independent of the type of power supply currently in use. The succeeding voltage regulator provides a constant supply voltage for the internal circuitry.

1.2.3. Motor Unit

Servo-motor	for registration on chart paper
Stepper-motor	for chart feed

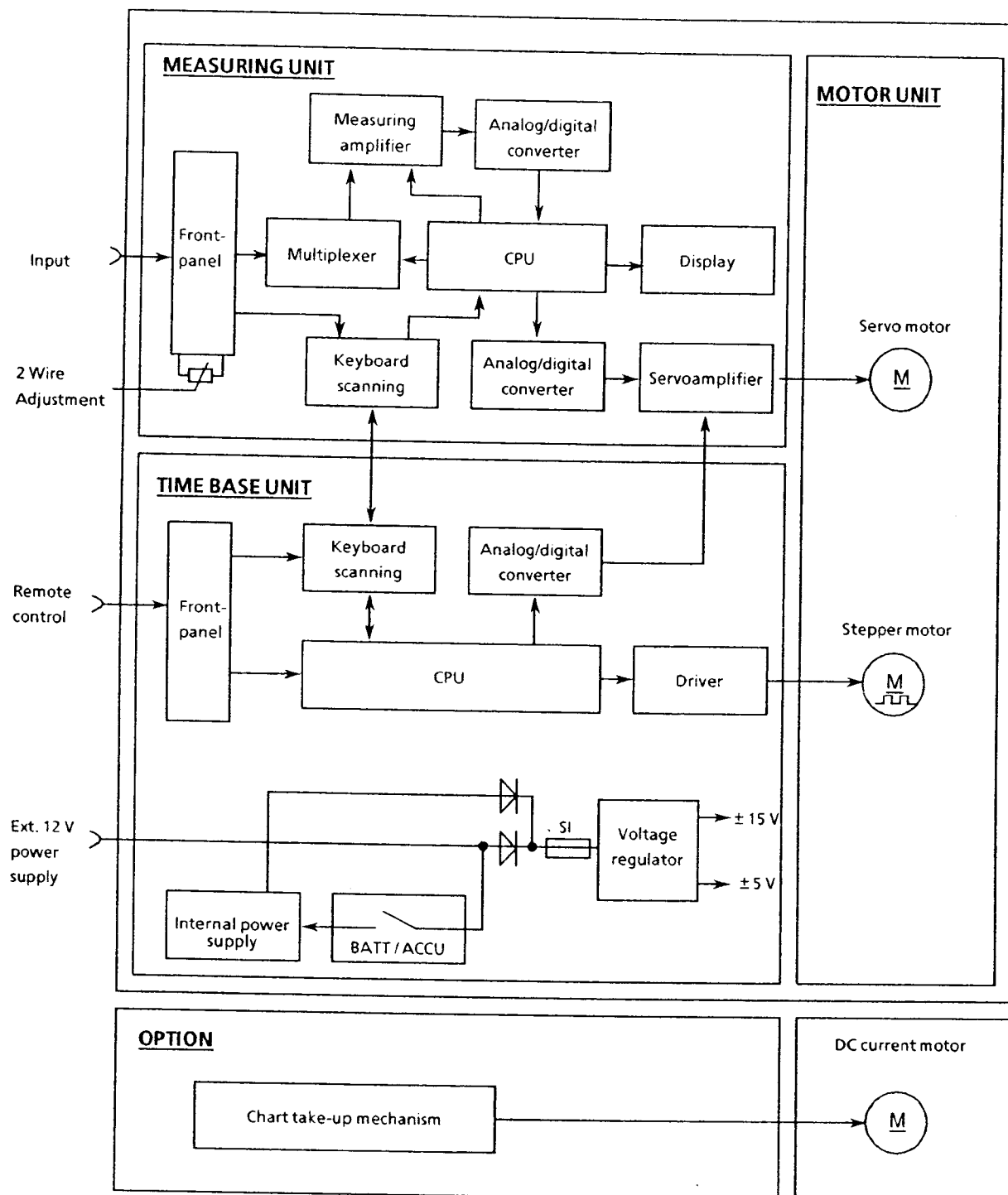


Fig. 1.1: Block diagram

CHAPTER 2 INSTALLATION

2.1. Unpacking

Remove the packing list and verify that all equipment has been received. If there are any questions about the shipment, please call the OMEGA Customer Service Department at 1-800-622-2378.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

NOTE

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

2.2. Checking of Delivery

In case of incomplete shipment contact your local sales organization. Refer to the table "Accessories Supplied" in chapter 7, "Technical Data".

2.3. Power Supply

The recorder can be powered in the following ways:

EXTERNAL - with power pack from the main supply
- with 12V Accu (e.g. car battery)

INTERNAL - with 9 Ni-Cd Accus
- with 9 batteries (each 1.5V)

WARNING

If internal and external power supply is concurrently available check the position of the BATT/ACCU switch! See table and figure 2.1.

Batteries installed Switch setting		Accus installed Switch setting	
BATT	ACCU	BATT	ACCU
1)	2)	3)	4)

- 1) Power mode permitted
- 2) Power mode not permitted (*batteries will be charged and may explode*).
- 3) Power mode permitted (*no charging or buffering*)
- 4) Power mode permitted (*with charging and buffering*)

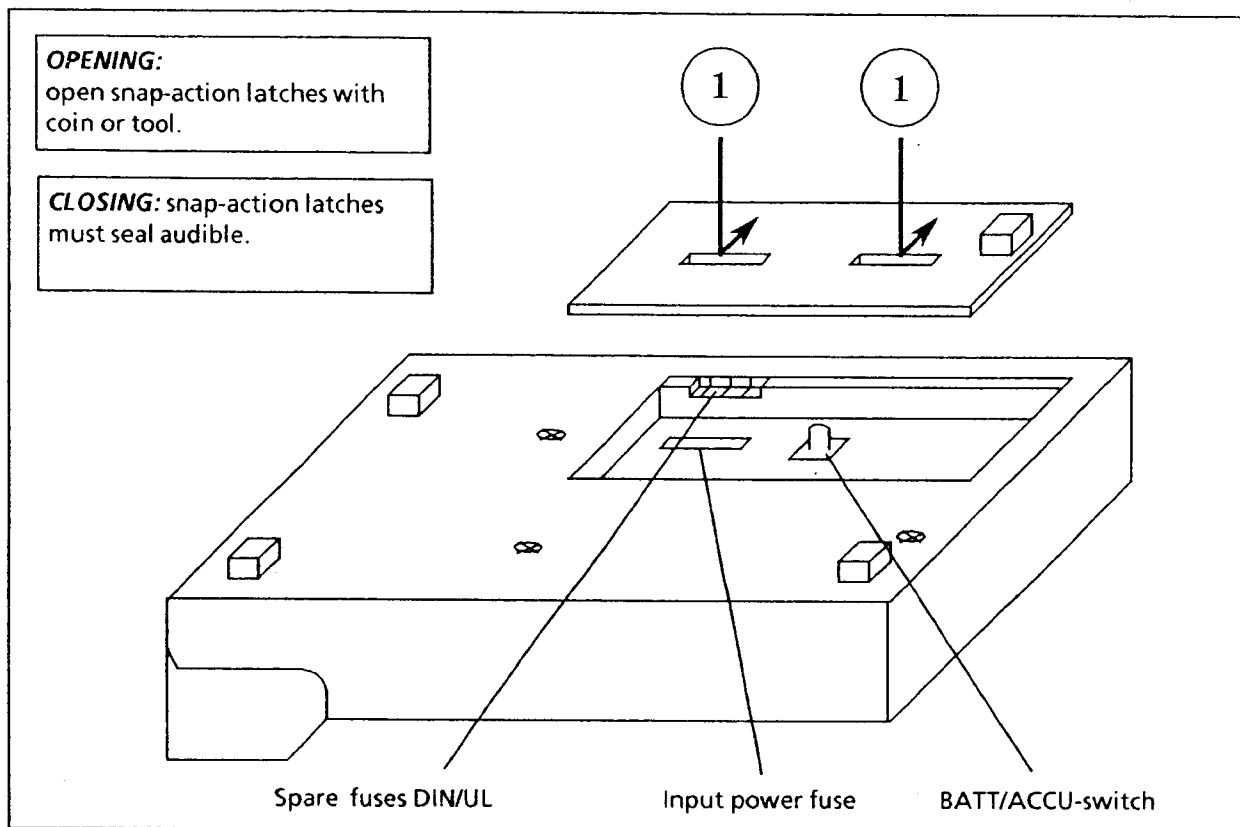


Fig. 2.1. Battery/Accu compartment

2.3.1. External Power Supply with Power Pack

WARNINGS

For your own safety and to avoid damage to the recorder, make sure that the operating voltage of the power pack and the input power voltage correspond to each other.

Always connect the power pack to the recorder before connecting it to the input power voltage.

If the power pack type is not specified explicitly at time of ordering, it will be supplied to fit for an input power voltage of 110V, 50/60Hz.

NOTE

Power packs that will fit the local requirements can be ordered separately (see chapter 7, "Technical Data").

2.3.2. External Power Supply with 12V Accumulator (e.g. car battery)

When powering the recorder externally with batteries or accumulators, check the polarity of the jack connector and the permitted voltage range.

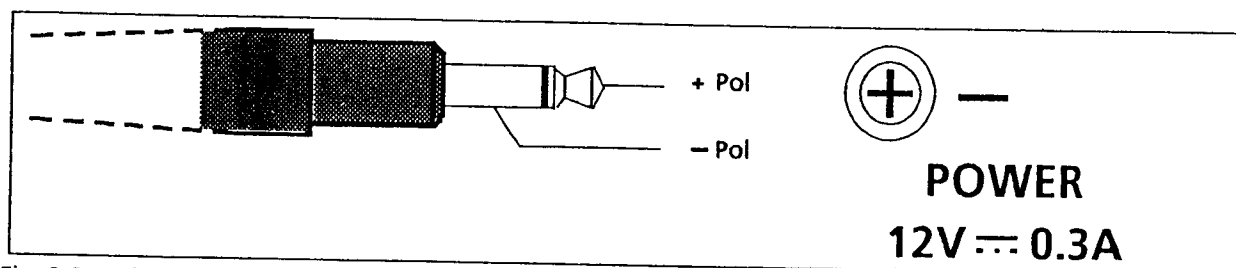


Fig. 2.2. Jack connector rear side of the instrument

The permitted voltage range of the power supply is +25% (15V) to -15% (10.2V) of the nominal value. Nominal voltage is 12V. Current consumption is typically 100 mA, maximal value is 300 mA.

2.3.3. Internal Power Supply with 9 Ni-Cd Accumulators

Check the polarity and the setting of the BATT/ACCU switch while inserting the accumulators (see table on page 2-1).

Using accumulators and the power pack in parallel provides buffering while recording and charging of the accumulators if the recorder is switched off.

Operating mode BUFFERING: recorder is switched to On

The accumulators are continuously charged while operating. In case of a power failure the recorder will be supplied uninterrupted from the accumulators.

The protocol provides information about type and condition of the power supply of the instrument.

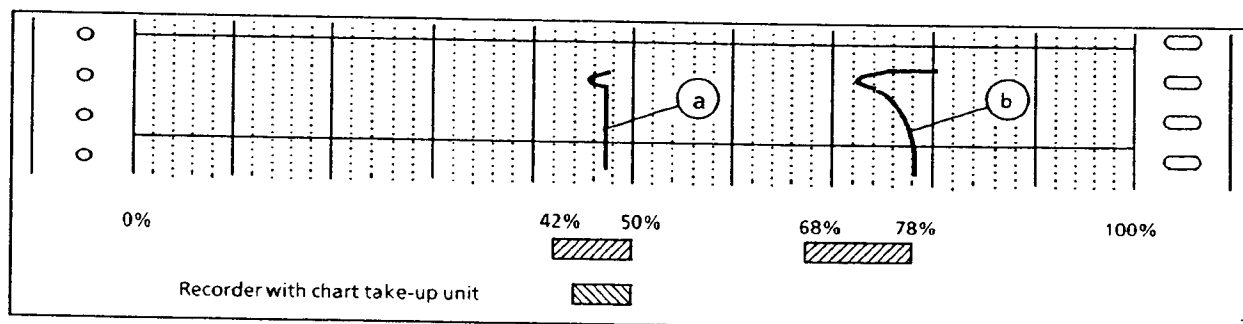


Fig. 2.3. Protocol of the supply voltage

- a) *The recorder is powered by batteries or accumulators (Internally or Externally).*
If the marker is located within the permitted range the recorder will operate properly.

The limited range of the power supply for recorders with chart take-up unit is only valid while printing the protocol, not for the registration.

- b) *The recorder is powered by the power pack.*
Marker is located appr. at 78% (no accumulators).
While buffering the accu the marker is located between 68% (Accu empty) and 78% (Accu full).

Operating mode CHARGING: instrument is switched off

The charging time, as specified in chapter 7, "Technical Data", refer to new value Ni-Cd accumulators with 1.8 Ah. Charging time increases with use.

NOTE

Check if the recorder is actually powered by the power pack. This can easily be controlled with the protocol print-out (signal (b) in fig. 2.3)

2.3.4. Internal Power Supply with 9 Batteries @ 1.5V

When inserting the batteries check polarity and setting of the BATT/ACCU switch (see table on page 2-1).

Operating period depends on the quality of the batteries (see chapter 7, "Technical Data")

2.3.5. Input Power Circuit Fuse

The input power circuit fuse is effective for all types of powering. The fuse is located in the battery/accumulator compartment (see fig. 2.1). The position is clearly marked by the label POWER.

WARNING

When replacing fuses never use fuse ratings other than the recommended values. The instrument must not be connected to the power outlet at this time.

2.4. Installation of Chart Paper

Ordering number and specifications can be found in chapter 7, "Technical Data".

2.4.1. Roll Paper

- turn swivel unit [16] upwards
- raise chart paper roll axis [20]
- mount chart roll on the axis
- adjust paper at the pin feed drum [18] so that the pins match the perforation
- close swivel unit [16]

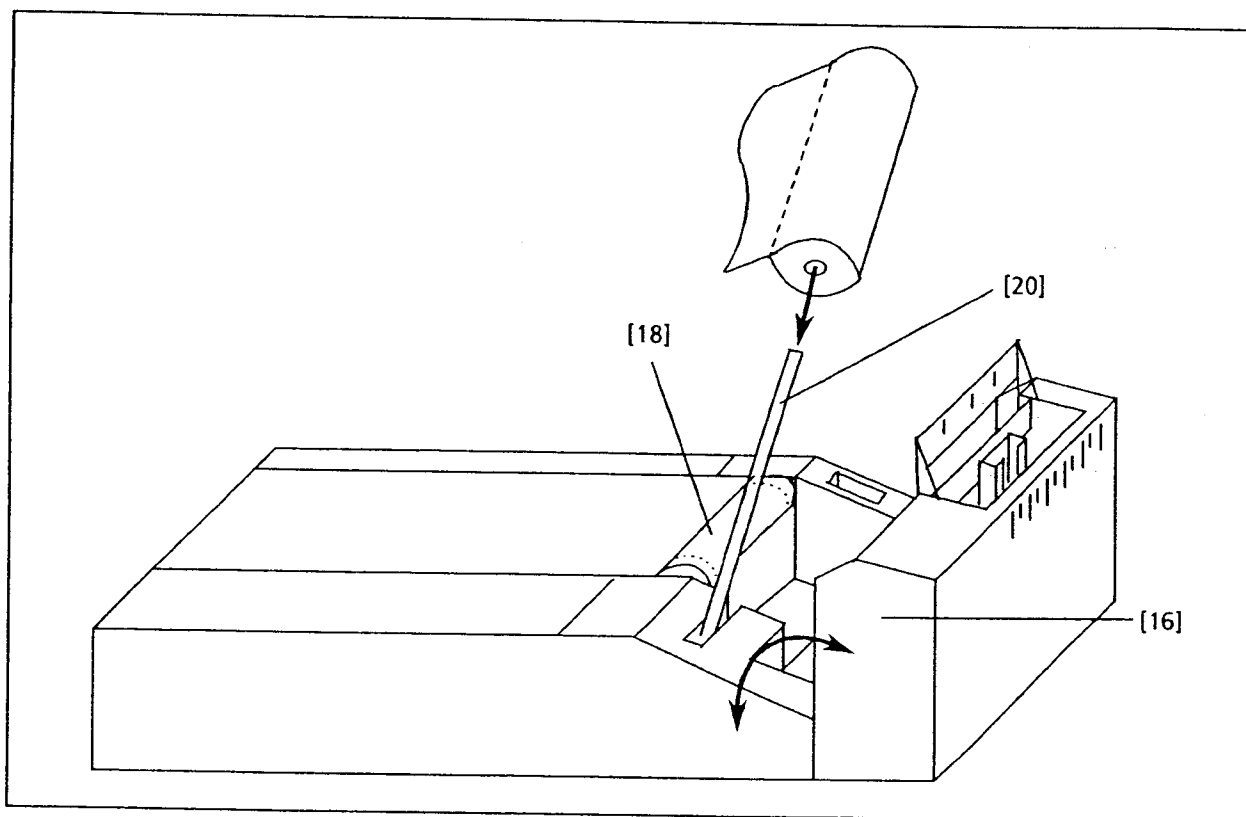


Fig 2.4. Installation of chart paper

NOTE

Approximately 1.5 m before end of paper a red line becomes visible.

2.4.2. Single Sheet Feeding

- turn on recorder
- hold down the progressive paper feed switch [3] in the forward direction "<<"
- move the chart paper into the single sheet feeder until contacting the pin feed drum
- the pins must catch the perforation of the paper
- release the paper feed switch

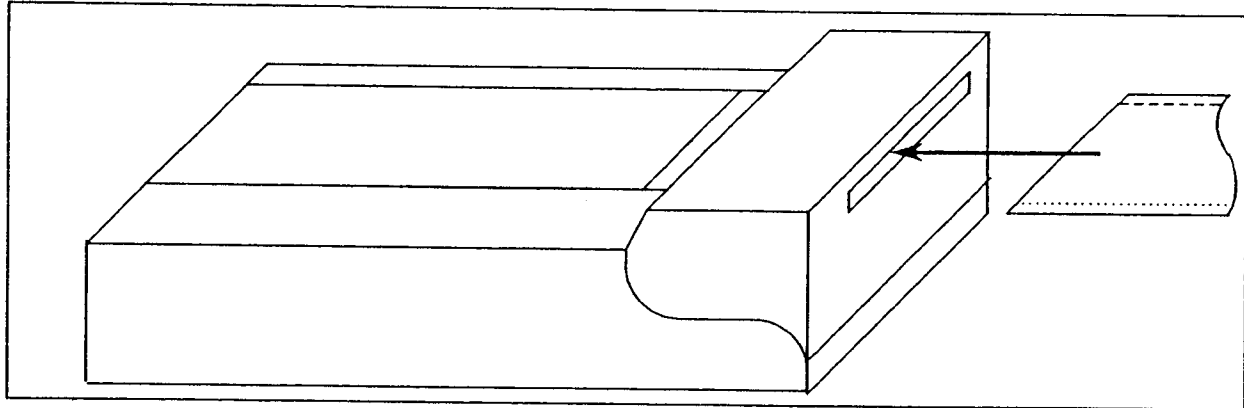


Fig 2.5. Single sheet feeding

2.5. Installing the Recording Pen

- remove pen cap from the pen; store it in the pen stall [21] (see fig. 2.6.).
- insert pen into the pen holder [22] until reaching the limit stop

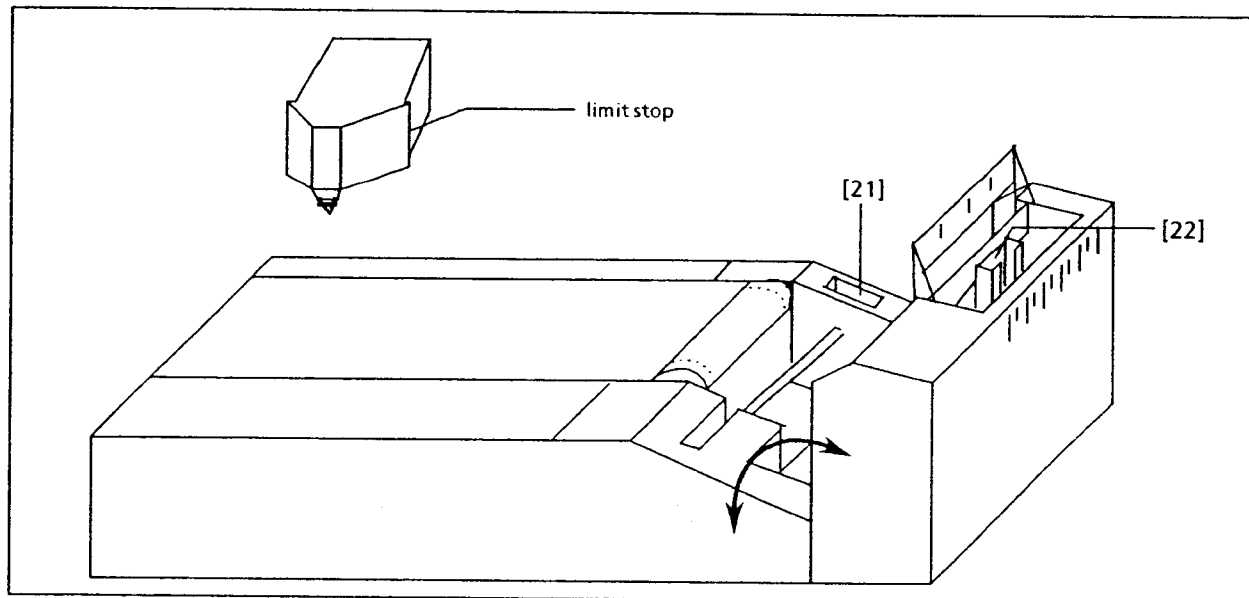


Fig. 2.6. Pen stall and pen

2.5.1. Recording Pens

Three different types of recording pens are available: disposable felt pens, ink pens (refillable) and sapphire pens.

Disposable felt pens (not refillable)

Advantage: no drying-out at difficult operating conditions

Two different models are available:

- standard ink for medium or fast chart speed
- fast drying ink for slow chart speed or high humidity

Recording length: for continuous registration approximately 1000 m; depending on humidity (absorbency of the paper changes with humidity), registration speed (chart speed) and duration of registration.

WARNING

It is recommended to cap the pens when registration is discontinued for more than one hour to prevent drying out.

Ink pen (refillable)

Advantage: can be refilled
changeable metal tips or felt tips

Recording length: approximately 1500 m.

Applications:

- metal tip: continuous line width
- felt tip: same attributes than disposable felt pens

When using ink pens, an ink pen set is needed (see chapter 7, "Technical Data")

Sapphire pen

Advantage: abrasion-proof and maintenance free

Application: useful when used with wax paper

2.6. Options

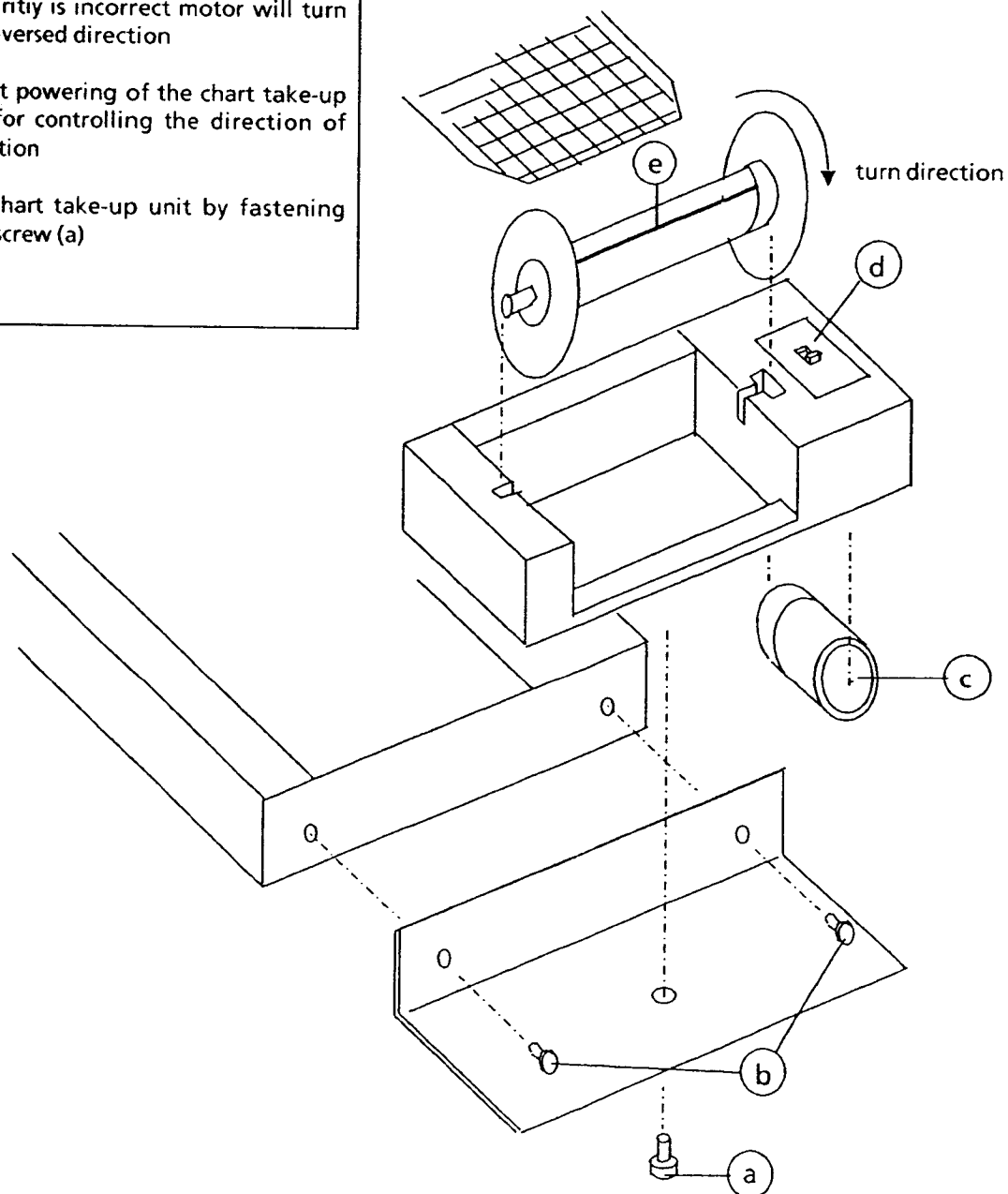
2.6.1. Chart Take-Up Unit

Mounting

- remove bottom cover by loosening screw (a)
- attach bottom of the housing with two phillips screws (b)
- install battery or accu (c) into the chart take-up unit. Check correct polarity of battery or accu. If polarity is incorrect motor will turn in reversed direction
- short powering of the chart take-up (d) for controlling the direction of rotation
- fix chart take-up unit by fastening the screw (a)

Installing paper

- remove chart take-up spool
- cut chart paper diagonally at the edges, feed chart into the slot (e) of the take-up spool
- wind up some turns manually
- insert take-up spool until latching audibly



CHAPTER 3

OPERATING AND CONNECTING ELEMENTS

3.1. Top Side of the Instrument

3.1.1. Time Base Unit (see section 4.1.)

- | | | |
|-----|-------------|--|
| [1] | 0 I I PEN | Main switch, power supply
0 ... OFF
I ... ON
I PEN ... ON with pen down |
| [2] | cm/h-cm/min | Selector switch for chart speed;
12 different speeds available |
| [3] | << >> | progressive chart feed switch
<< ... forwards
>> ... backwards |
| [4] | < 0 PROT | Operating modes selector switch
< ... Chart feed ON, speed corresponding to selected chart speed
0 ... Chart feed STOP

PROT ...Protocol print-out:
• supply voltage
• chart speed
• measurement parameters
• remote control (Time Base Unit) active |

3.1.2. Measuring Unit (see section 4.2.)

- | | | |
|-----|-------------------|--|
| [5] | <0>/ REC | Selector switch recording/zero setting

REC ... Registration
<0> ... Display of zero setting; the internal measurement input is connected to ground. The measurement is isolated in single-phase |
| [6] | <0> | Zero setting dial |
| [7] | PT100/OFF/COMP | Measuring mode selector switch
PT 100 ... 2,-3,-4-wire measuring with measuring resistance 100Ohm
OFF ... Measure with thermocouples J/K/T -cold junction switched off
COMP ... Measure with thermocouples J/K/T -cold junction switched on |
| [8] | 2W 3W 4W
J K T | Selector switch
2W ... 2-wire measuring Pt 100
3W ... 3-wire measuring Pt 100
4W ... 4-wire measuring Pt 100

J ... Measure with thermocouple (Fe/Cu-Ni)
K ... Measure with thermocouple (Ni-Cr/Ni-Al)
T ... Measure with thermocouple (Cu/Cu-Ni) |
| [9] | SPAN °C | SPAN-switch
Selecting of the indication range; (Scale 0% to 100%)
Ranges: 50/100/200/500/1000 °C |

- [10] **SHIFT °C** SHIFT-switch
 Calibrated zero suppression; (Measuring range starting point = scale 0%)
 Ranges: -100/0/100/200/300/400/500 °C

3.1.3. Measuring Inputs - Clamp Buttons (see section 4.2.5.)

- [11] **- 3w** MINUS 3-and 4-wire measuring Pt 100
 (Negative)
 [12] **-** MINUS 2-,3- and 4-wire measuring Pt 100 / thermocouple J/K/T
 (Negative)
 [13] **+** PLUS 2-,3- and 4-wire measuring Pt 100 / thermocouple J/K/T
 (Positive)
 [14] **+** PLUS 4-wire measuring Pt 100
 (Positive)

WARNING

Voltage difference between input and ground must not exceed 750V.

3.1.4. Digital Display (see section 4.2.6.)

- [15] Liquid crystal display, 3 $\frac{1}{2}$ digits
 display of temperature value, range overflow and error indication codes

3.1.5. Recording System (see section 2.4.)

- [16] Swivel unit with servo and recording system
 [17] Scale 0 ... 100, linear, 20 ticks
 [18] Pin feed drum for chart feed
 [19] Paper guidance for chart guiding and tear-off ruler
 [20] Chart paper roll axis
 [21] Pen stall assembly to store pens or pen caps
 [22] Pen holder
 [23] recording pen; disposable felt pens, ink pens (refillable) and sapphire pens

3.2. Rear Side of the Instrument

3.2.1. External Power Supply (see section 2.3.)

- [24] + - Receptacle DIN 45318 SG 3.5, for external power supply with power pack or accumulator 12V.

3.2.2. Remote Control (see section 4.1.4.)

- [25] 8 pin standard socket (DIN 45 326) for external control of the following functions
- | | | |
|---|------------------------------------|--|
| 1 | STOP/ENABLE
(active LOW) | Chart stop /
Releasing PULSE (switching from Internal to External) |
| 2 | REVERSE
(active LOW) | Reverting chart feed
Internal or external operating mode. |
| 3 | ⊥ | Ground connector
All control signals refer to this pin which is internally connected to negative. |
| 4 | PULSE
(active LOW) | Chart speed control
Controlled by external stepper pulses, only valid if ENABLE is active |
| 7 | PEN
(active LOW) | Pen down control |
| 8 | MARK
(active LOW) | Event marker
Positive needle pulse will be superimposed to registration
Amplitude approx. 3 mm ;
Pulse width 200 ms |

WARNING

The socket is electrically connected to the measurement inputs. To avoid electrical hazards do not use the plug when the voltage to be measured exceeds 42V to ground.

- [26] **2-WIRE
ADJUSTMENT** Adjustment dial (for Pt 100 2-wire measuring)
Compensation range of measuring line resistor max. 15 Ω
(short circuit on Pt 100 during adjustment)

- [27] Dust cover, operating possible when closed. Can be removed by plug-in hinges

3.3. Bottom Side of the Instrument

3.3.1. Battery Compartment (see section 2.3.)

- [28] Cover battery compartment
- [29] Snap-action latches, can be opened with coin or tool
- [30] Battery-Accu compartment for:
9 pc. batteries 1.5 V;
9 pc. Ni-Cd Accus 1.25 V;

WARNING

Before powering the recorder always check the setting of the BATT/ACCU switch.

- [31] **BATT / ACCU** Selector switch for operating with batteries or accu
- [32] **POWER** Main circuit fuse 1.0 A slow blow
- [33] Storage area for spare fuses DIN and UL

3.3.2. Others

- [34] Type plate, information about recorder type and serial number
- [35] Warning notice, refer to operating manual

4.1. Time Base Unit

4.1.1. Selection of Chart Speed

With the selection switch [2] 12 different chart speeds may be selected:

- 1/2/3/6/12/30 cm/h
- 1/3/6/12/30/60 cm/min

4.1.2. Progressive Chart Positioning (Forwards - Backwards)

<< >> Press button to selected feed direction and keep it; the paper moves with a speed of 6 cm/min for appr. 3 seconds and then with a speed of 60 cm/min.

WARNING

Maximum allowed paper feed in reverse direction:
with roll paper approx. 180 mm
full length of single sheets

Note: progressive chart feed is always possible even if chart feed is switched off

4.1.3. Activation of Chart Feed and Protocol Printout

< 0 PROT Chart feed switched off

< 0 PROT Chart moves in forward direction with selected chart speed

Condition: no external control signal of the Time Base Unit is active
(STOP/ENABLE or REVERSE)

< 0 PROT Start protocol:

- level of supply voltage
- measuring parameters (switch settings at Time Base Unit and measuring unit)
- remote control (if active)

Interrupting the protocol printout: only by switching off the instrument

When the protocol printout is started, measuring and chart feed is stopped. After finishing the protocol, the recorder returns to the previously selected operating mode.

Protocol

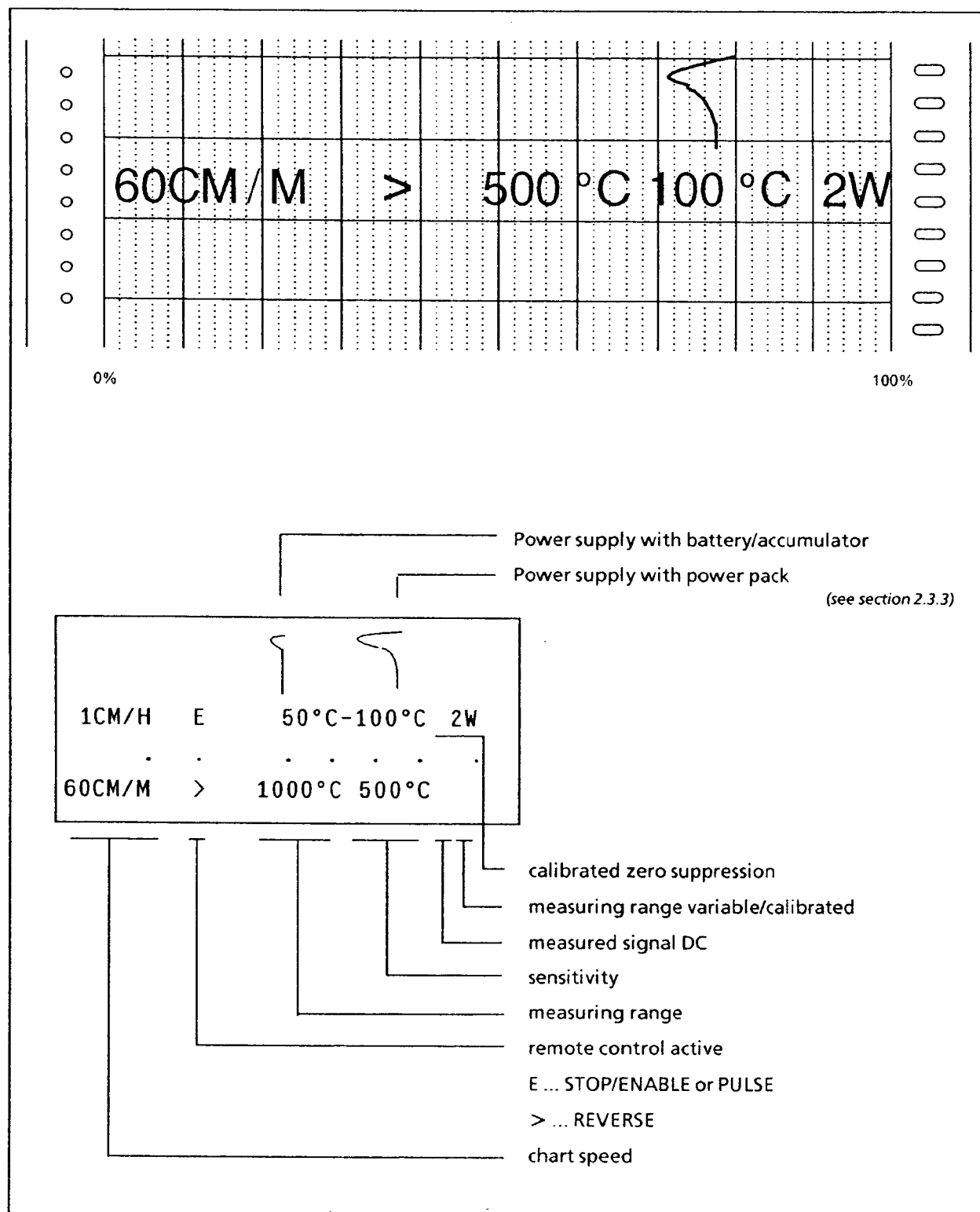


Fig. 4.1. Protocol printout

4.1.4. Remote Controlled Chart Feed

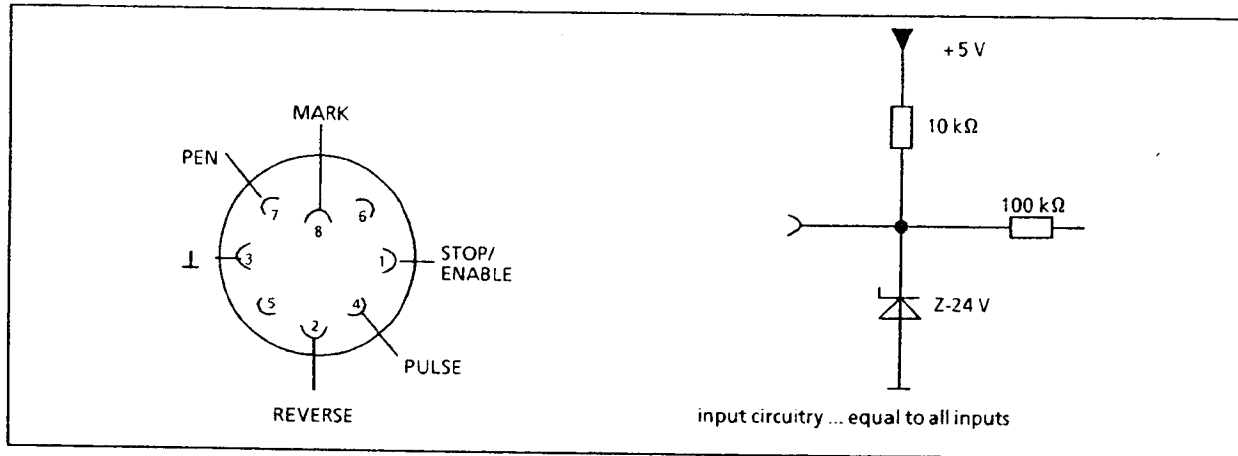


Fig. 4.2: 8-pin standard socket (DIN 45326), pin assignment and input circuitry

Control functions

Chart-drive functions can be controlled by different control circuits:

- TTL-signal (open collector)
- output of CMOS gates
- mechanical contact (active LOW)

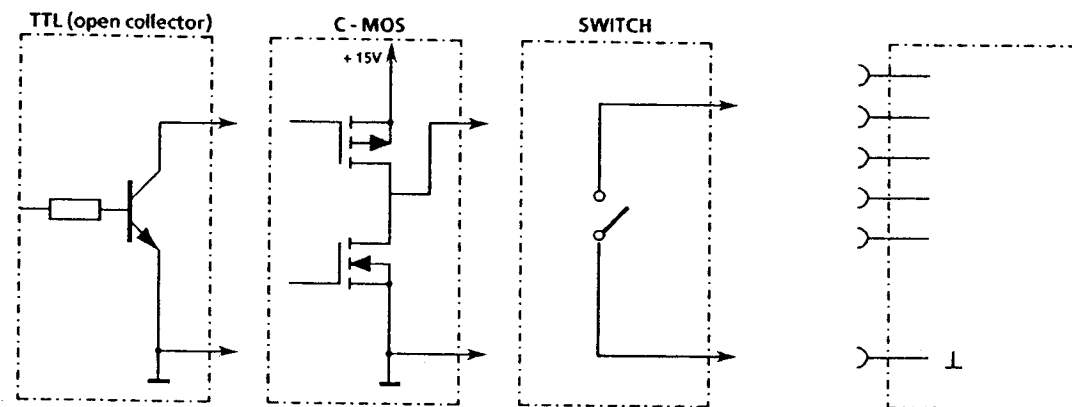


Fig. 4.3: Control circuits

Connector pin "1" (Pin 3)

Connector pin Ground is electrically connected to the negative input pin. All remote control signals are referenced to this pin "1".

WARNING

To avoid electrical hazards do not use this plug when the voltage to be measured exceeds 42V with reference to ground.

Connector pin "STOP / ENABLE" (Pin 1)

With connecting input STOP/ENABLE to ground chart feed is stopped. At the same time the signal EXTERN PULSE is automatically released (changing from internal to external motor control, see fig. 4.5).

Connector pin "REVERSE" (Pin 2)

When connecting input REVERSE to ground, the current chart feed direction is reversed. It acts independently from internal or external motor control.

WARNING

Maximum allowed paper feed in reverse direction:

- with roll paper approx. 180 mm
- full length of single sheets

Connector pin "PEN" (Pin 7)

When connecting input PEN to ground the pen will be lowered.

Condition: Main switch is set to "I" (pen status is up)

Connector pin "MARK" (Pin 8)

Each time input MARK is connected to ground a positive needle pulse with appr. 3mm elongation and pulse width of appr. 200 ms will be superimposed on the registration.

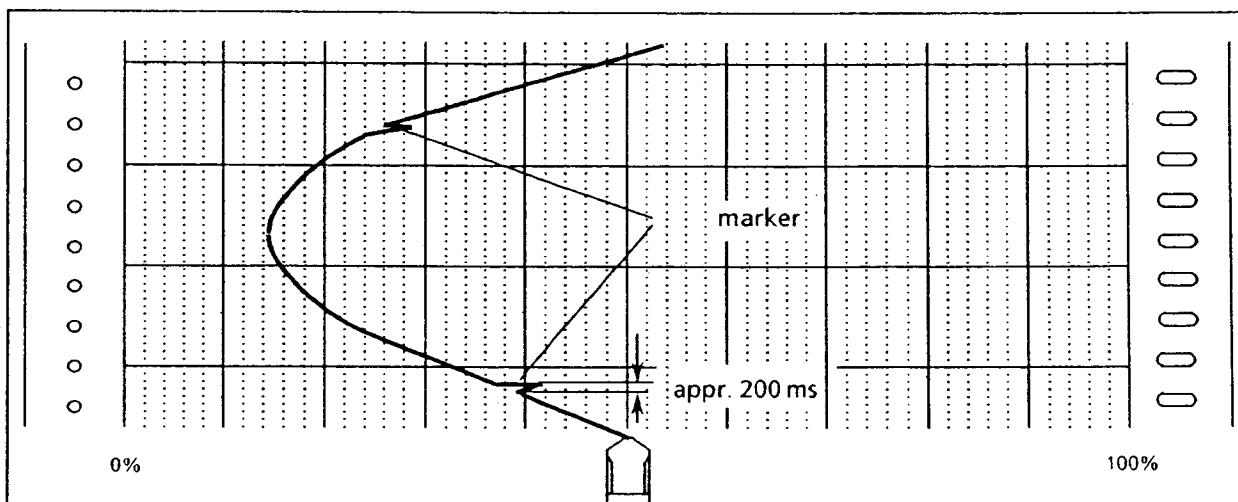


Fig. 4.4: Superimposed event marker

Connector pin "PULSE" (Pin 4)

Chart feed can be controlled by means of external pulses. The actual chart speed depends on the setting of the speed selection switch and (switch [2]) and the external pulse frequency.

Condition: Input STOP/ENABLE is connected to ground

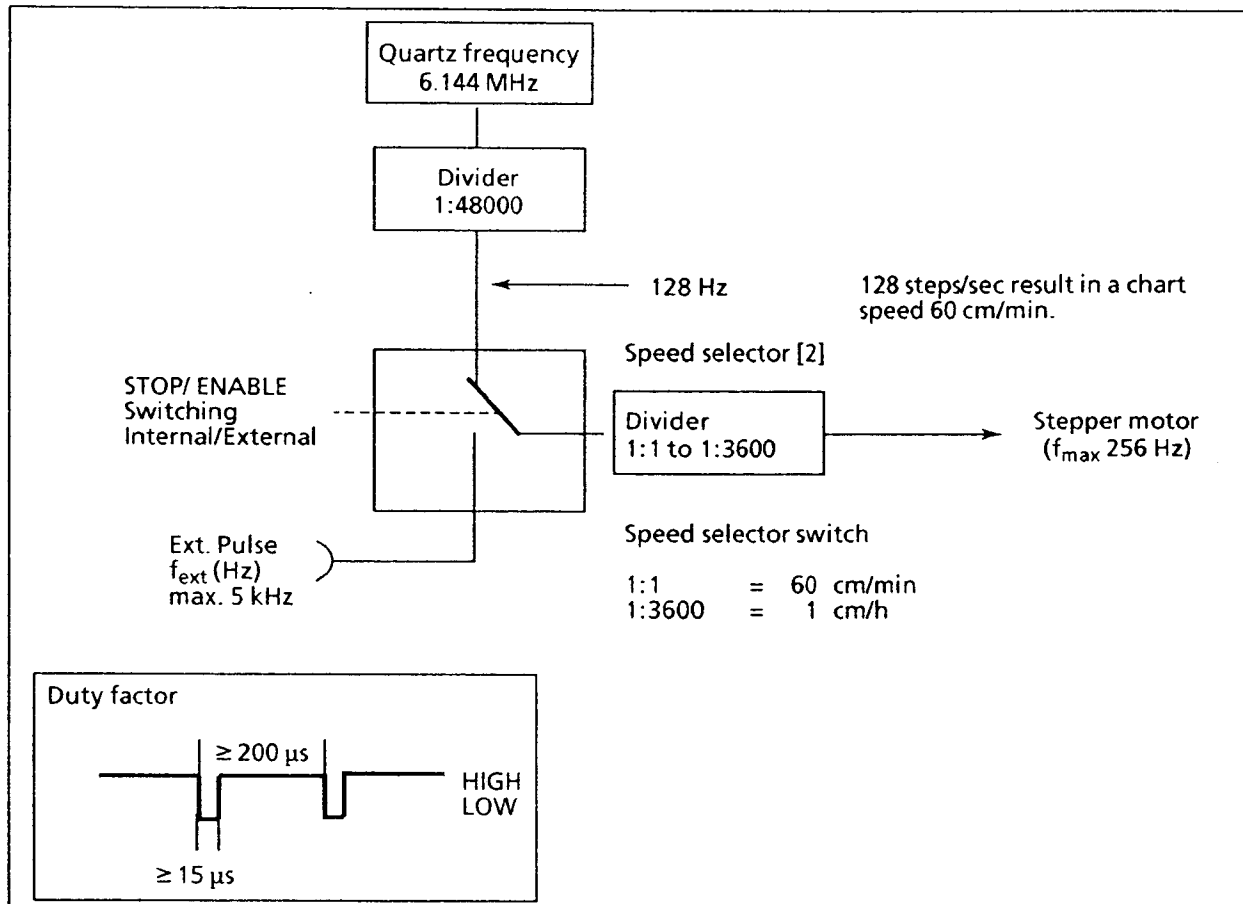


Fig. 4.5: Functional principles of external PULSE with STOP/ ENABLE

WARNING:

Maximum clock frequency for the stepper motor is 256 Hz.
With higher clock frequencies the motor stops.

Formula to calculate f_{ext} (Hz)

$$f_{ext} \text{ (Hz)} = \frac{\text{Actual chart speed [cm/min]} \quad (\leq 120 \text{ cm/min})}{\text{Switch selected speed [cm/min]}} \times 128 \text{ Hz}$$

If the formula is to be calculated with the basic unit [cm/h] these values must be converted to [cm/min].

4.2. Measuring Unit

4.2.1. Zero Setting

With the zero setting dial [6] zero can be shifted set in the range from 0 % to + 100 % of the recording width.

Zero setting without influencing the measured signal

The <0>/REC-switch [5] is set to <0>, the selected zero point (without SHIFT) will be represented

LCD-Display shows: OFF

With this feature, the current setting of the zero point can be controlled at any time, even while measuring.

4.2.2. Selecting a Measure Range

The starting value of the measuring range is selected by the SHIFT-switch [10].

The display range is selected by the SPAN-switch [9]. The final value of the measuring range results therefore from the added values of SHIFT and SPAN.

Example: A measuring range of 300°C to 800°C shall be selected:

- SHIFT-switch set to 300°C (the measuring range starts with 300°C at the currently selected zero position)
- SPAN-switch set to 500°C (the final value of the measuring range results: Addition of SHIFT 300°C and SPAN 500°C = 800°C)

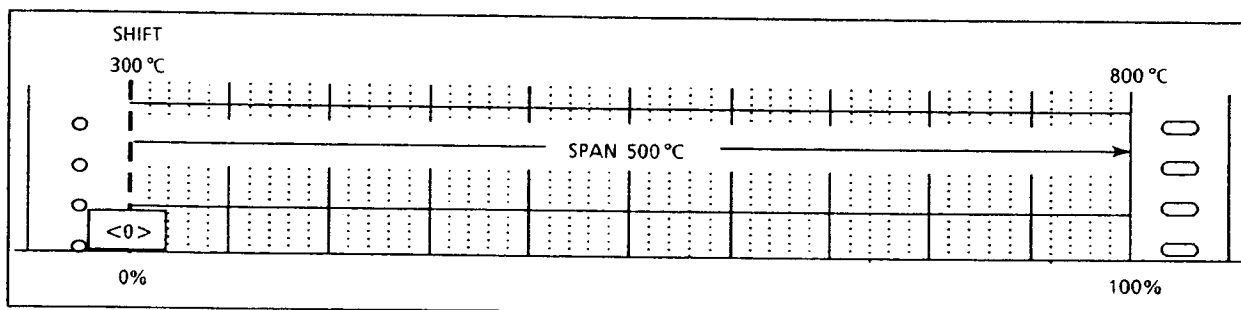


Fig.4.6: Selecting a measuring range

If the zero point is set to 70% instead of 0% the display is represented as shown in fig. 4.7:

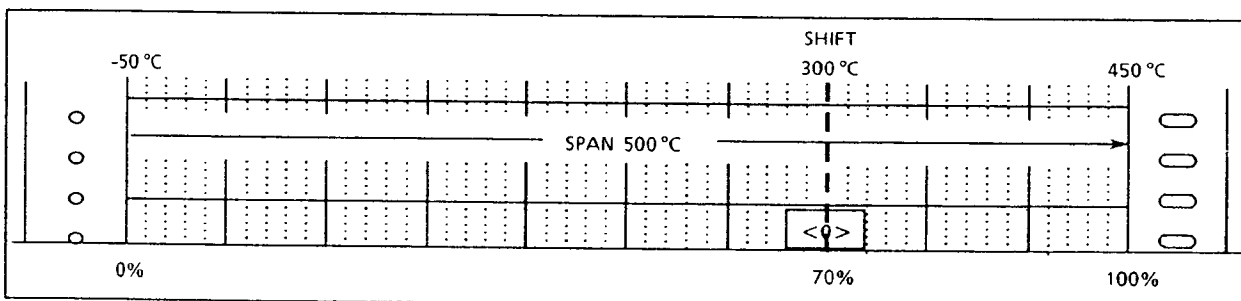


Fig. 4.7. Display range with zero position (70%)

4.2.3. Measurement with measure resistance Pt 100

Using the measuring resistance Pt 100 provides measuring of absolute temperature.

- Set measuring mode selector switch [7] to Pt 100.
- Select 2-, 3-, 4-wire measuring with selector switch [8]

2-wire measuring (2W)

For 2-wire measuring operation, the resistance of the measuring leads must be adjusted manually with the adjustment potentiometer (leads between Pt 100 and measuring input-clamp buttons). The potentiometer is located on the rear side of the instrument.

- max. 15 Ohm measuring lead resistance can be adjusted

The 2-wire adjustment potentiometer can be made with a small screw driver

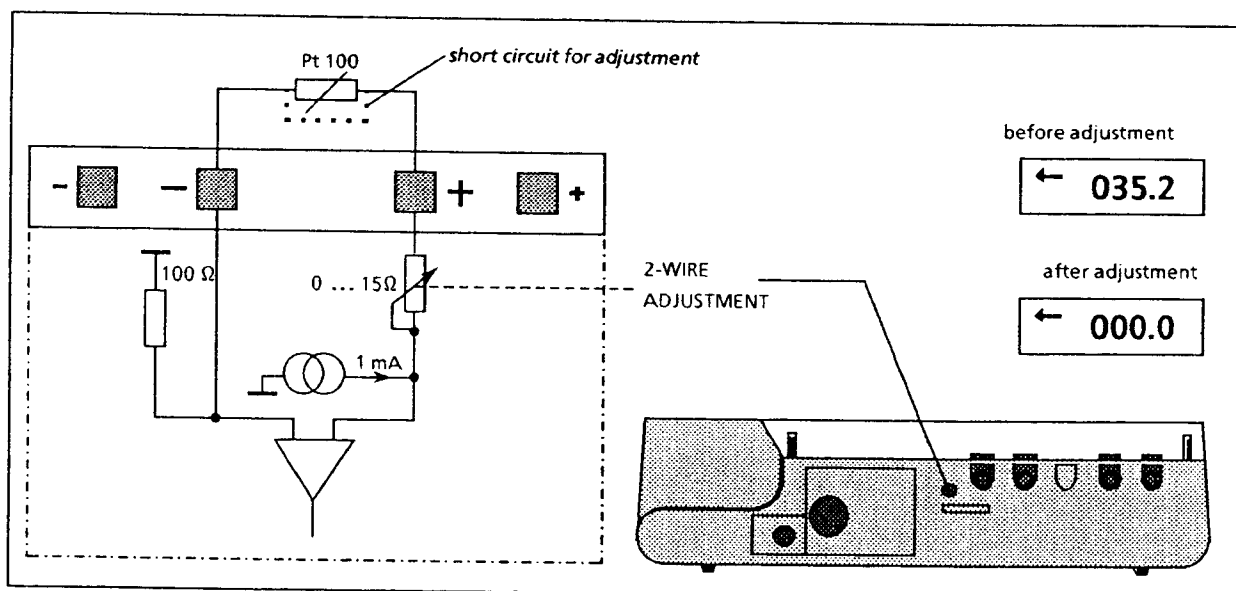


Fig. 4.8: 2-wire adjustment circuit diagram

Adjustment

- set recording pen for example to scaling point 0%
- make a short circuit on Pt 100
- connect the measuring cable
- adjust the recording pen with the 2-wire potentiometer to the scaling point 0%

Digital display: An arrow is displayed if the Pt 100 is short circuited. Start the adjustment process. The displayed value must be adjusted to 0°C

Erro indication:

- "OPE" measuring leads interrupted
- "OFL" temperature to high (about + 850°C)
- "UFL" temperature to low (below -100°C)
- "←" 2-wire adjustment (Pt 100 short circuited)

3-wire measuring (3W)

For 3-wire measuring operation, the resistance of the measuring leads is adjusted automatically with measuring cycle.

Error indications: "OPE" measuring leads interrupted
"OFL" temperature to high (about + 850°C)
"UFL" temperature to low (below -100°C)

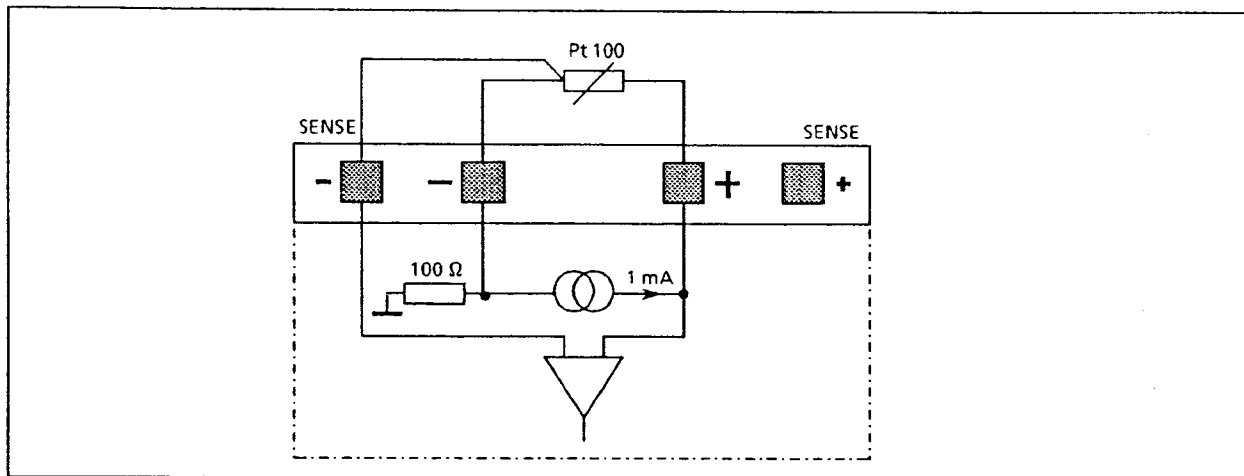


Fig. 4.9: 3-wire measuring circuit diagram

4-wire measuring (4W)

For 4-wire measuring operation, the resistance of the measuring leads is adjusted directly. The 4-wire measuring is the most precise.

Error indications: "OPE" measuring leads interrupted
"OFL" temperature to high (about + 850°C) or the measuring lead "SENSE +" is interrupted

Error localization: switch over to 3-wire measuring "3W"

- error indication constant - temperature to high
- temperature is displayed - measuring lead "SENSE +" is interrupted

"UFL" temperature to low (below -100°C)

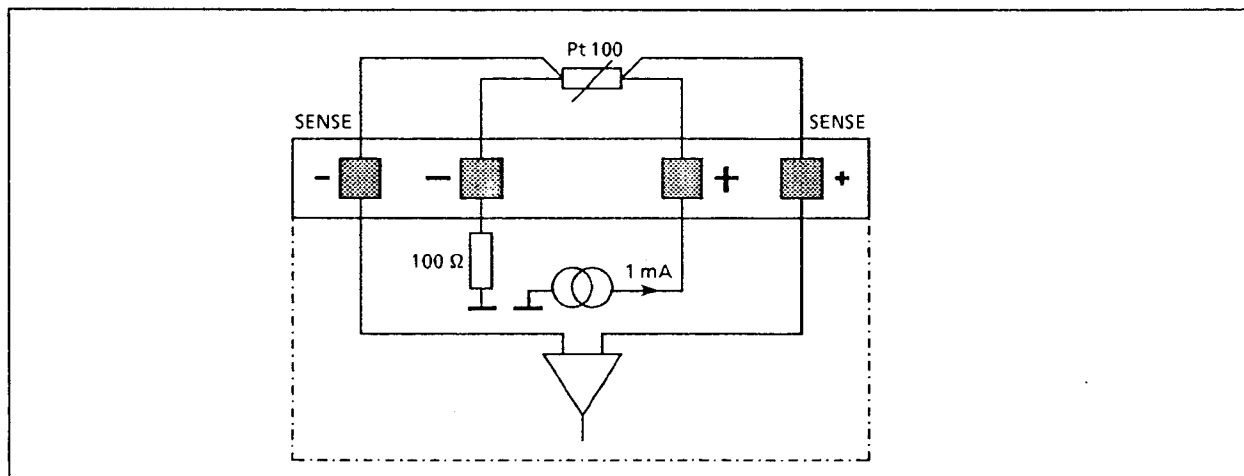


Fig. 4.10: 4-wire measuring circuit diagram

4.2.4. Measurements with Thermocouples J / K / T

Measure with thermocouples is an application for relative thermometry. If the cold junction is "ON" the temperature can also be measured absolutely.

The temperature for the cold junction is measured with a Pt 100, which is mounted on " + " clamp button.

- set measuring modes selector switch [7] to:
 - OFF** - cold junction switched "OFF" (thermometry relative)
the reference temperature of the cold junction is equal to the temperature of the clamp buttons..

Note:

- make a short circuit at measuring input
- cold junction switch "ON" (COMP)
- display shows the instantaneous temperature of clamp buttons

COMP - cold junction switched "ON" (thermometry absolute)
the reference temperature of the cold junction is 0°C

- With selector switch [8] the thermocouples J/K/T can be selected

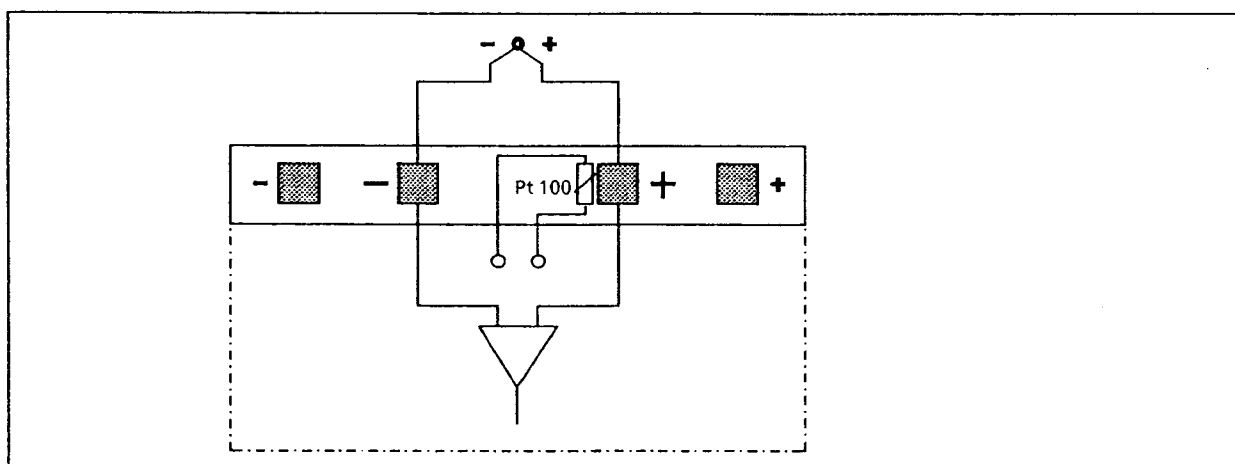


Fig. 4.9: Thermocouples measuring circuit diagram

Error indication:

- "OFL" Temperature too high
- "UFL" Temperature too low
- " ← " outside compensation range (about 70°C)

4.2.5. Measuring Input

At the rear side of the instrument four 4 mm safety measuring sockets are available. Flexible cords can be fixed with the clamp buttons.

The measuring inputs are floating and asymmetric.

WARNING

The voltage difference between measuring inputs and ground should not exceed 750V

Check the following points before connecting a measuring signal:

- Which type of temperature measuring shall be made (Pt 100 or thermocouple) ?
- Peak temperature label (measuring range SPAN and SHIFT).
- Input signal must not exceed the limits of the selected measuring range and the limits of the difference voltage between input and ground.

Chapter 7, "Technical Data" provides the following information about the measuring unit:

- Input Data
- Measuring current (Pt 100)
- Maximal temperature range
- Maximum difference voltage between signal and ground

4.2.6. Display Unit

The 3½ digits LCD-display shows the instantaneous temperature level directly. Also an error code (range error or range overflow) is indicated. Repetition rate is 2.2 per second.

Resolution of the display

Resolution changes accordingly to the selected measuring range (see table):

Measuring range	Resolution °C
< 200 °C	0.1
≥ 200 °C	1.0

Maximum display range of the LCD-Display

The maximum display range depends on the selected measuring mode:

Measuring mode	Max. display range °C	Overflow display
J IEC	- 100.0 + 1100	UFL OFL
K IEC / DIN	- 100.0 + 1200	UFL OFL
T IEC	- 100.0 + 400	UFL OFL
Pt 100 IEC / DIN	-100.0 + 850	UFL OFL

Note: Accuracy of the display unit is independent of the accuracy of the measuring unit. Errors are not added.

LCD-display indication:

OFF	<0>	zero point indication; <0>/REC selector switch in position <0>
UFL	UNDERFLOW	Temperature too low
OFL	OVERFLOW	Temperature too high
OPE	OPEN	measuring leads interrupted or measuring input opened (Pt 100 mode)
←	PT 100 / 2W	wire resistance adjusted manually
←	TC (J/K/T)	compensation out of range

4.3. Options

4.3.1. Chart Take-Up Unit

Actuation

The chart drum is driven similar to a spring driven clockwork: A DC-motor bends a spring which drives the take-up wheel. Two limit switches alternatively switch the motor on and off (ON ... spring unbended / OFF ... spring bended). The spring will only be bended, if paper is available.

WARNING:

Turn OFF the chart take-up wheel if no chart paper is available because in this case the motor would be running in idle.

Technical data

Environment:	according to the environmental conditions of the recorder (see chapter 7, "Technical Data")
Power supply:	battery 1.5 V
Chart take-up capacity:	minimum 100 rolls @ 16m length, standard or waxed paper
Weight:	0.72 kg (including battery)

CHAPTER 5

TESTING AND MAINTENANCE

The recorder performs in principle maintenance-free. Preventive maintenance e.g. lubricating is not necessary.

5.1. Functional control

5.1.1. Power Supply

See chapter 2.3, "Power Supply"

5.1.2. Time Base Unit

Chart Feed

- install chart paper and recording pen
- select chart speed e.g. 60cm/min
- turn on chart feed
- lower the pen for 60s, controlled by means of a stop-watch

Result: Length of the recorded line must be 60cm.

The other chart speed ranges can be controlled in the same way.

Protocol printout

See chapter 4.1.3, "Protocol printout".

Print EPROM release number of the time base unit

- turn off the recorder
- select a chart speed of 60cm/min
- press operating mode key "PROT" and keep it in
- turn on the recorder (set power switch to position "I")
- a two digit EPROM number will be printed. Then the recorder returns to its normal operating mode.

Linearity check of the DA-converter

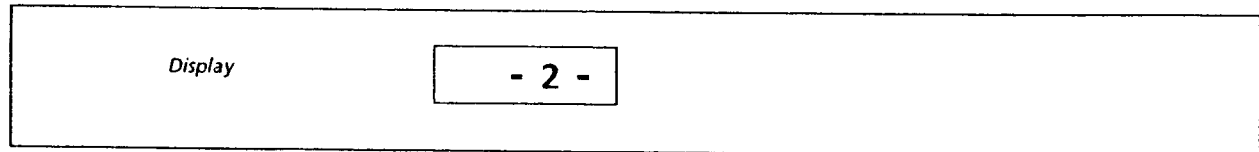
The internal DA-converter is only used for the protocol printout. Its linearity can be checked in the following way:

- select a chart speed of 30cm/min
- press operating mode key "PROT" and keep it in
- turn on the recorder (set power switch to position "I")
- the recorder writes two ramps over the total recording width

5.1.3. Measuring Unit without Input Voltage

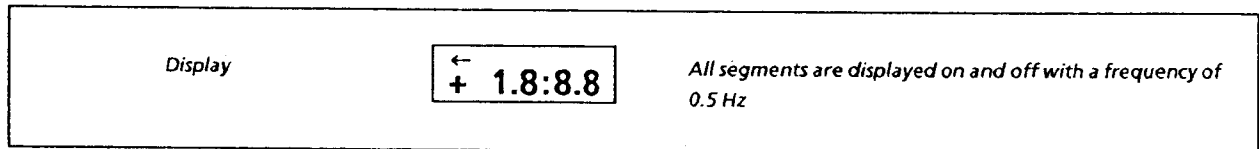
Eprom-version number displayed of the measuring unit

- turn off power switch
- set chart-speed to 60 cm/min
- press the progressive feed switch to forward and hold it in
- turn on power switch



Display segment test

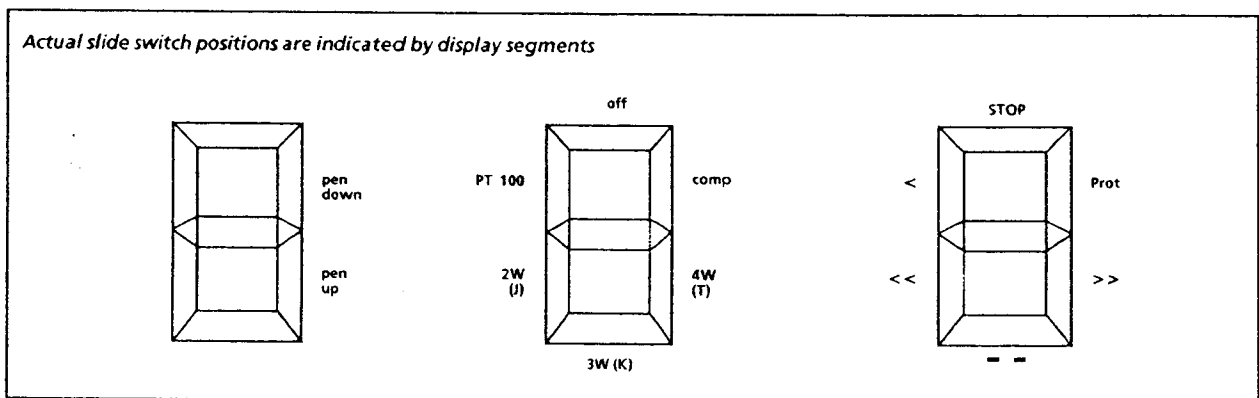
- turn off power switch
- set chart-speed to 30 cm/min
- press the progressive feed switch to forward and hold it in
- turn on power switch



Slide switch test

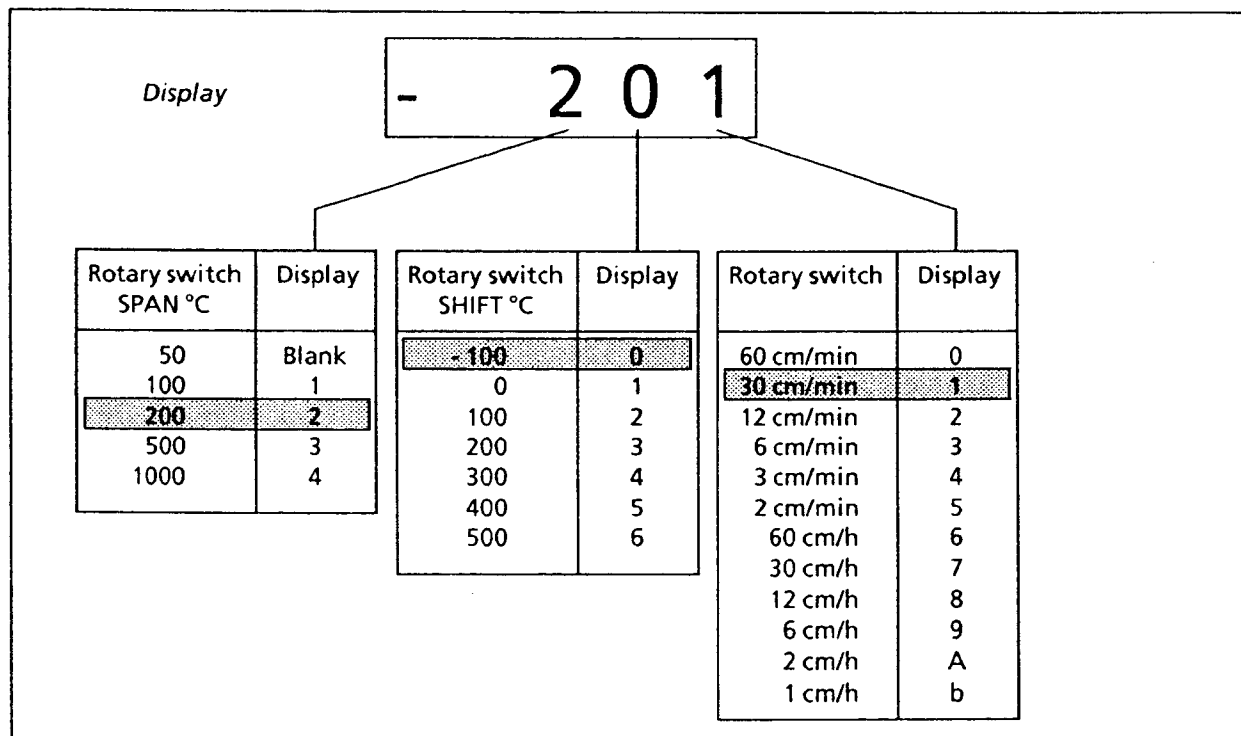
- turn off power switch
- set chart-speed to 12 cm/min
- set <0>/REC-switch to <0>
- press the progressive feed switch to forward and hold it in
- turn on power switch

Display



Rotary switch test

- turn off power switch
- set chart-speed to 12 cm/min
- set <0>/REC-switch to REC
- press the progressive feed switch to forward and hold it in
- turn on power switch
- The rotary switch positions are indicated in form of numbers and letters. A position change is displayed directly.



Zero setting

- Set <0>/REC-switch to "<0>"
- LCD-display shows OFF
- Using the zero setting dial, the pen position is adjustable from 0% to + 100%

Dead band

- Select slow chart speed (e.g. 3cm/min)
- Move pen using the zero setting dial at any position of the scale (e.g. center of the scale)
- Move pen holder manually 2 to 3 mm to the left
- Release pen holder slowly - pen moves to a specific position
- Repeat the same action to the right side

The difference of the two positions shows directly the dead band. Tolerances are shown in chapter 7, "Technical Data"

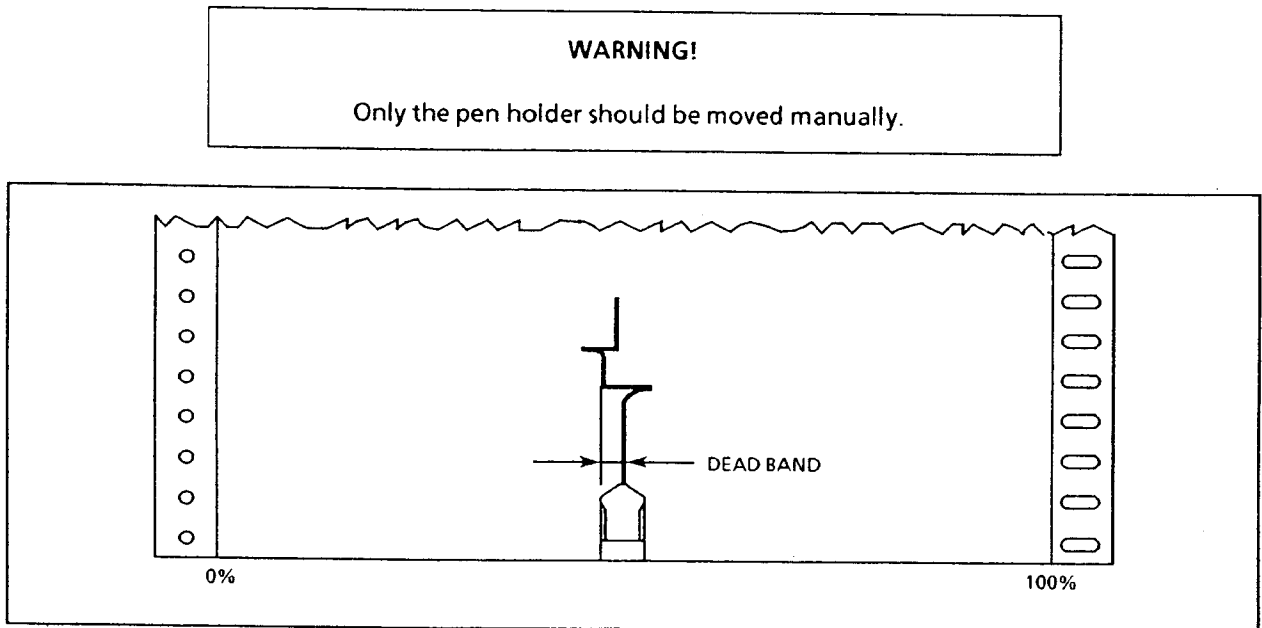


Fig. 5.1: Dead band

5.1.4. Measuring Unit with Thermocouple and Measuring Resistance

Table 5.1 "Thermoelectric Voltages and Measuring Resistance" represents the temperature ranges for the respective thermoelectric voltages for thermocouples J / K / T and the corresponding resistance values for specific temperatures for the Pt 100.

Thermocouples J / K / T

Temperature measurement with thermo couples can be checked for accuracy and functionality by applying a representative voltage to the measuring input, which conforms to the thermoelectric voltage of the respective thermocouple at a specific temperature (see table 5.1).

- select measuring range e.g. ZERO SHIFT 100°C and SPAN 200°C. The selected range is now specified from 100°C to 300°C
- set zero position to 0%
- at a temperature of 200°C the thermocouple applies a voltage of 10.777 mV (see table 5.1)
- switch off the cold-junction reference

Note: the table is only valid, if the cold-junction is switched off.

- when applying a voltage of 10.777 mV, the recorder must display a temperature of 200°C (represented by a deflection of 50%)

The reference voltage must be adjusted to an accuracy of minimum 0.1 mV.

Measuring resistance Pt 100

Temperature measurement with temperature resistance can be checked for accuracy and functionality by connecting a resistor to the measuring input. Its value must refer to the selected temperature (see table 5.1).

- select measuring range e.g. ZERO SHIFT 0°C and SPAN 400°C. The selected range is now specified from 0°C to 400°C
- set zero position to 0%
- at a temperature of 200°C the measuring resistance applies a value of 175.84 Ω (see table 5.1)
- when applying a resistive value of 175.84 Ω , the recorder must display a temperature of 200°C (represented by a deflection of 50%)

The reference resistor must be adjusted to an accuracy of 0.2 Ω .

Error Messages

See Section 4.2.3, "Measurement with measure resistance Pt 100", section 4.2.4, "Measurement with Thermocouples J/K/T, section 4.2.6, "Display unit"

Table 5.1: Thermoelectric Voltages and Values of Measuring Resistance

°C	J (Fe/Cu-Ni)	K (Ni-Cr/Ni-Al)	T (Cu/Cu-Ni)	Pt 100
	mV	mV	mV	Ω
-100	-4.632	- 3.553	- 3.378	60.25
-50	-2.431	-1.889	-1.819	80.31
0	0.000	0.000	0.000	100.00
100	5.268	4.095	4.277	138.50
150	8.008	6.137	6.702	157.31
200	10.777	8.137	9.286	175.84
300	16.325	12.207	14.860	212.02
400	21.846	16.395	20.869	247.04
500	27.388	20.640		280.90
600	33.096	24.902		313.59
700	39.130	29.128		345.13
800	45.498	33.277		375.51
900	51.875	37.325		
1000	57.942	41.269		
1100	63.777	45.108		
1200		48.828		

The Thermoelectric voltages represented in this table are only valid, if the cold junction reference is turned off.

Digital Display

See section 4.2.6.

CHAPTER 6

MEASURING DIRECTIONS

6.1. Ground and Noise Voltages

Appearance of noise voltages in the measuring circuitry may produce erroneous measuring results. These errors are not directly recognizable, but with high amplitudes of the noise voltage signal a jitter of the measured signal can be detected. Limits for the maximum amplitude of the noise voltage can be found in chapter 7, "Technical Data".

Reducing the noise voltage level is only possible by connecting the positive pole of the measured signal to the negative pole of the recorder input, and zero reference must be set to the final scale value of 100%. In this case 0% is corresponding to full scale.

With unfavorable grounding of the measuring circuitry noise voltages may occur. The measuring input of the recorder is floating, but the negative pole is near to ground potential because of its connection to the shielding. This shielding protects the electronics against leakage currents and interferences. For this reason the negative pole of the recorder input should be connected to the pole of the measured voltage which is nearer to ground. If possible, connect the negative pole directly or by means of a capacitor to ground.

EXAMPLE: With a series mode rejection (SMR) of $A = 40(\text{dB})$, calculate the maximum value of the noise voltage when a thermo voltage of 10mV (accuracy of 0.5%) is selected.

$$40 \text{ dB} = 20 \lg \frac{\text{Noise voltage (V}_{ss})}{0.1 \times 10^{-3} \quad (2 \times 0.5\% \text{ of } 10 \text{ mV})}$$

$$\text{Noise voltage (V}_{ss}) = 0.1 \times 10^{-3} \times 10^{40/20} = 10 \text{ mV}$$

6.2. Dynamical Behavior

When recording fast changing signals, under some circumstances dynamical errors may occur. The value of such an error depends on frequency, shape and amplitude of the measured signal, and on the source resistance of the signal. Always observe the cut-off frequency of the recorder of 1 Hz.

Settling time of the servo system is always constant, therefore the dynamical error becomes smaller when the amplitude of the measured signal becomes smaller. Switching the recorder to a less sensitive measuring range can provide a more accurate registration of the signal shape.

Typical frequency response of the recorder in % of the desired value depending on the frequency of the input signal can be found in fig. 6.1.

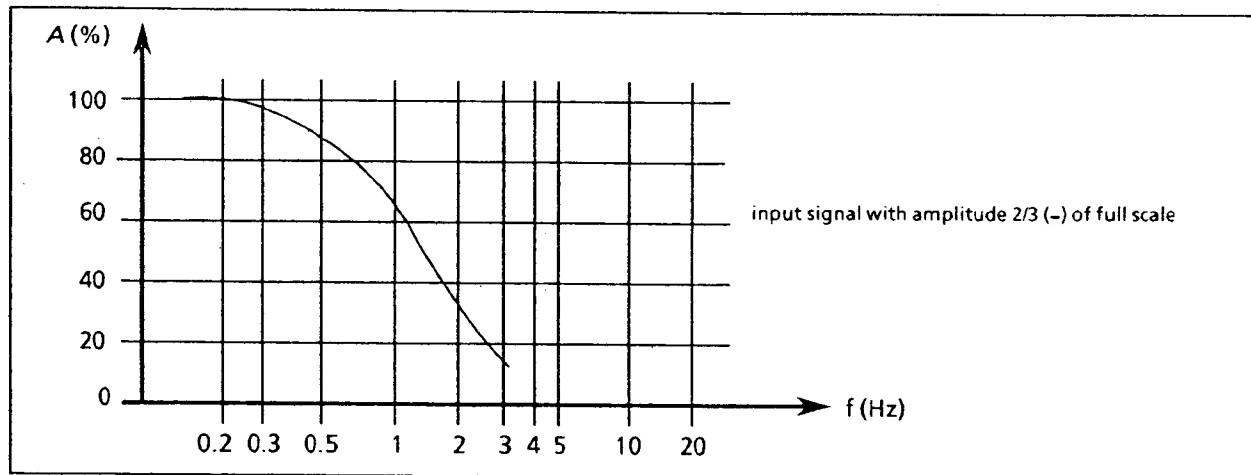


Fig. 6.1. Frequency response

CHAPTER 7

TECHNICAL DATA

SPECIFICATIONS

OPERATING AMBIENT TEMP:	0 to 50 deg C
POWER SUPPLY:	120VAC (through external transformer), 50/60 Hz; 12VDC internal C-size batteries (9 ea.), or NiCad batteries
RECORDING WIDTH:	100mm
MIN/MAX DISPLAY RANGES	
TYPE J:	-100.0 to +1100 deg C
TYPE K:	-100.0 to +1200 deg C
TYPE T:	-100.0 to +400 deg C
RTD:	-100.0 to +850 deg C
ACCURACY:	1.5% FS or 1.5 deg C (Thermocouple Input); 1% FS or 1 deg C (RTD)
RESPONSE TIME:	1.5 sec.
ZERO SUPPRESSION:	-100, 0, 100, 200, 300, 400, 500 deg C
MEASURING RANGES (SPAN):	50, 100, 200, 500, 1000 deg C
WEIGHT:	4.9 lb
DIMENSIONS:	3" H x 12" W x 9.1" D

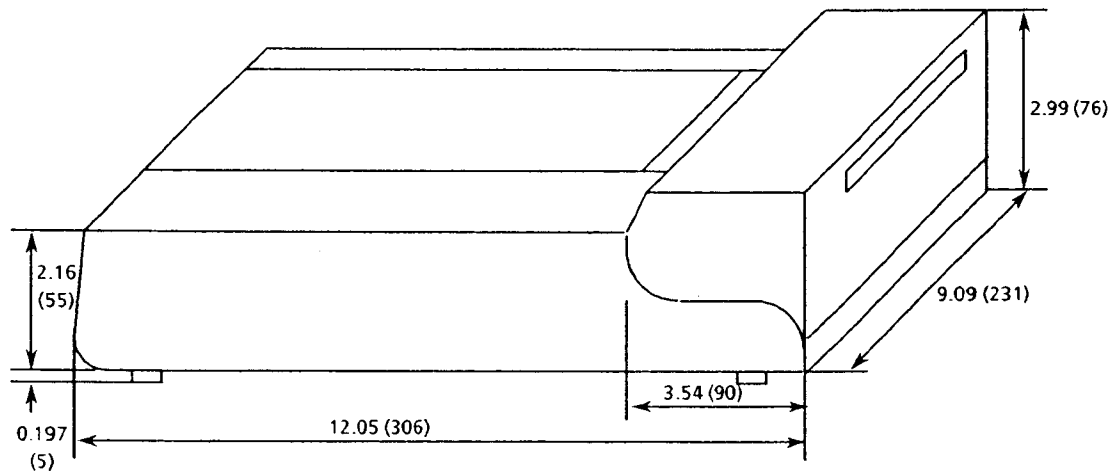
ACCESSORIES

DESCRIPTION	PART NUMBER
Carrying Case:	RDX6110-CASE
Roll Paper, 100mm x 16m, 0-100 scale:	RDX6110-RP
Roll paper, 100mm x 16m, 0-30 scale:	RDX6111-RP
Disposable Felt-tip pen, pkg of 3:	SL-301
9 NiCad rechargeable C-Cell batteries:	RDX6110-BAT

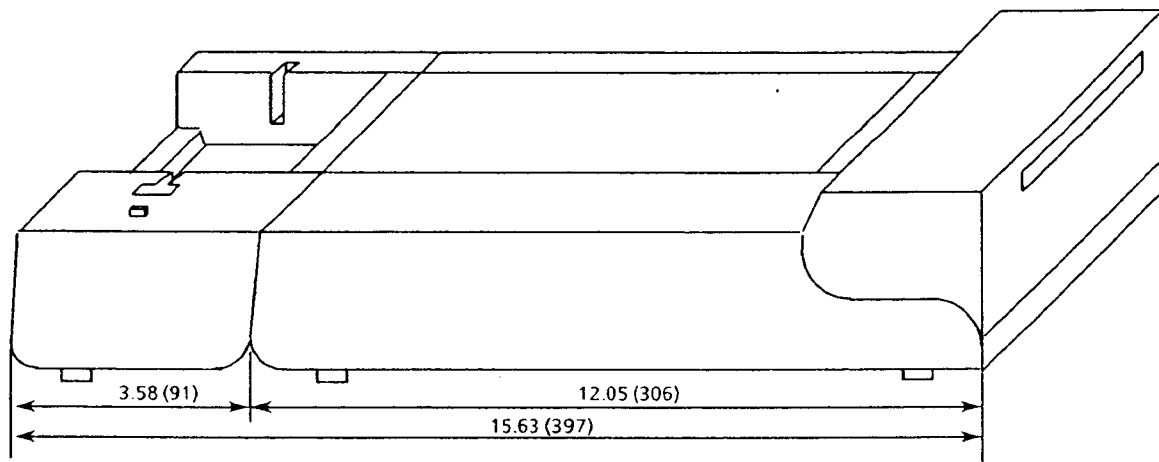
CHAPTER 8

MECHANICAL DIMENSIONS

Mechanical Dimensions



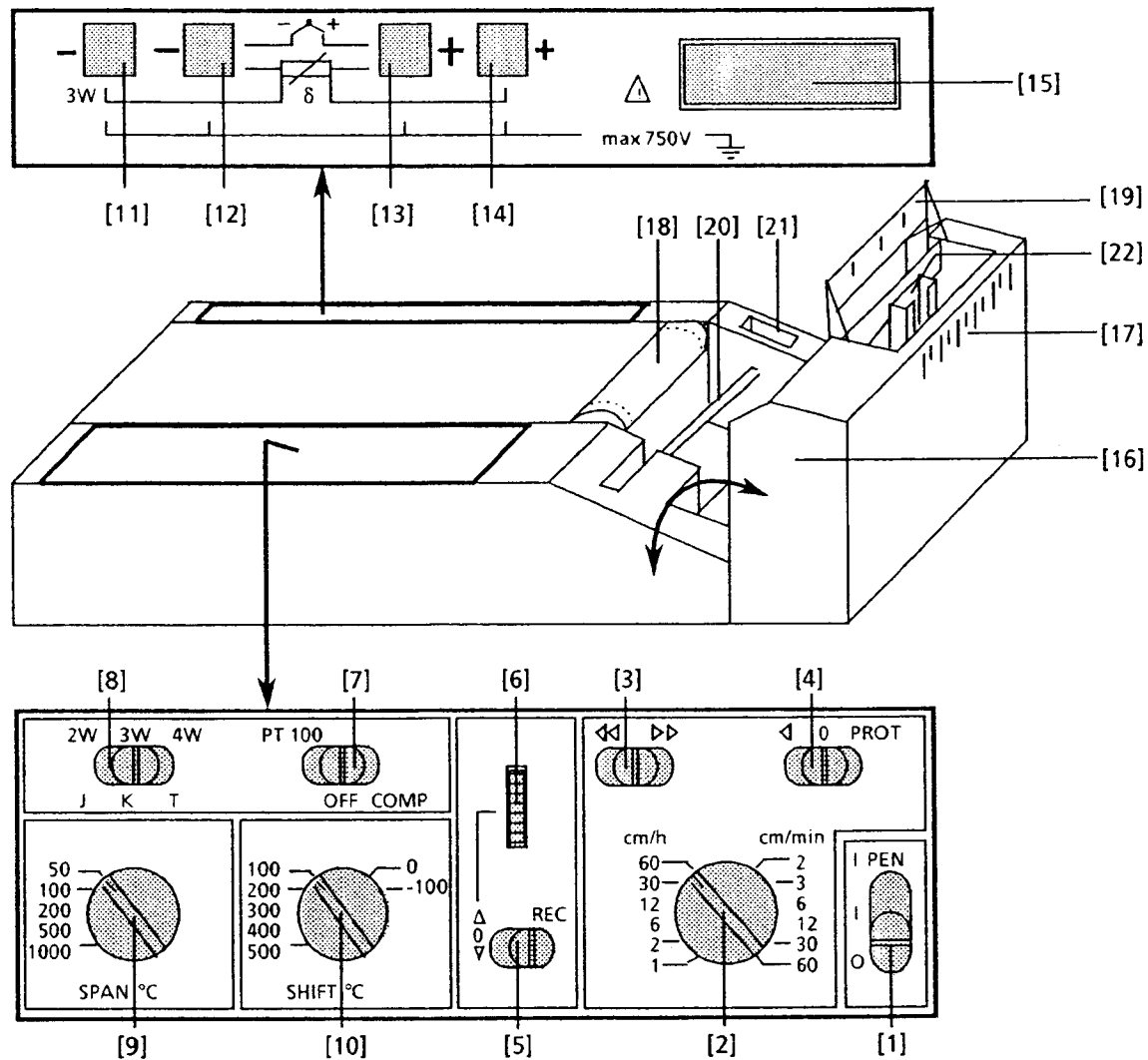
Mechanical Dimensions with Chart Take-Up Unit



All dimensions in inches (mm)

APPENDIX A

Top Side of the Instrument



Time Base Unit

- [1] Main switch, power supply
- [2] Selector switch for chart speed
- [3] Progressive paper feed switch
- [4] Operating modes selector switch

Measuring Input - Clamp Buttons

- [11] MINUS (Negative) Sense
- [12] MINUS (Negative)
- [13] PLUS (Positive)
- [14] PLUS (Positive) Sense

Measuring Unit

- [5] <0>/REC-Selector switch Recording/Zero setting
- [6] Zero setting dial
- [7] Measuring modes selector switch
- [8] Selector switch
- [9] SPAN - switch
- [10] SHIFT - switch

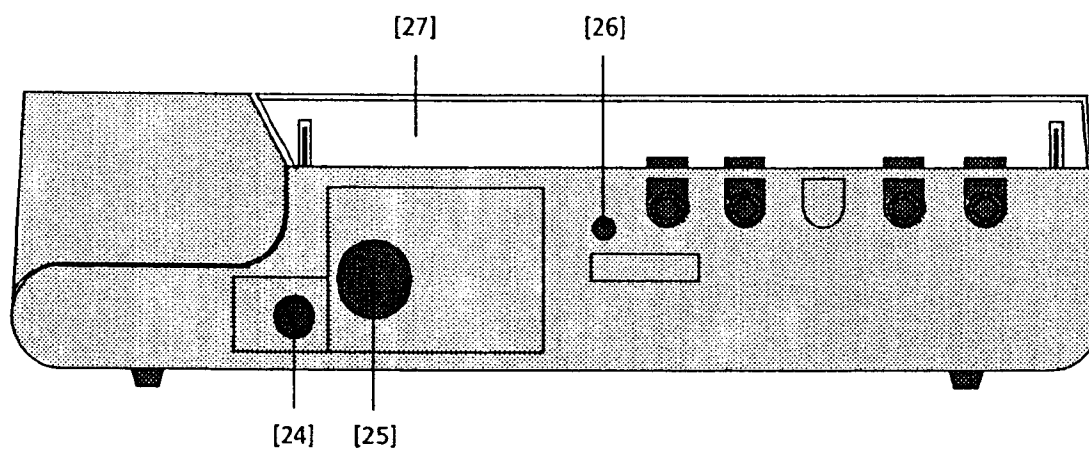
Recording System

- [16] Swivel unit
- [17] Scale
- [18] Pin feed drum
- [19] Tear-off ruler
- [20] Axis for chart paper roll
- [21] Pen stall assembly
- [22] Pen holder

Digital Display

- [15] LCD unit

Rear Side of the Instrument



External Power Supply

[24] Receptacle

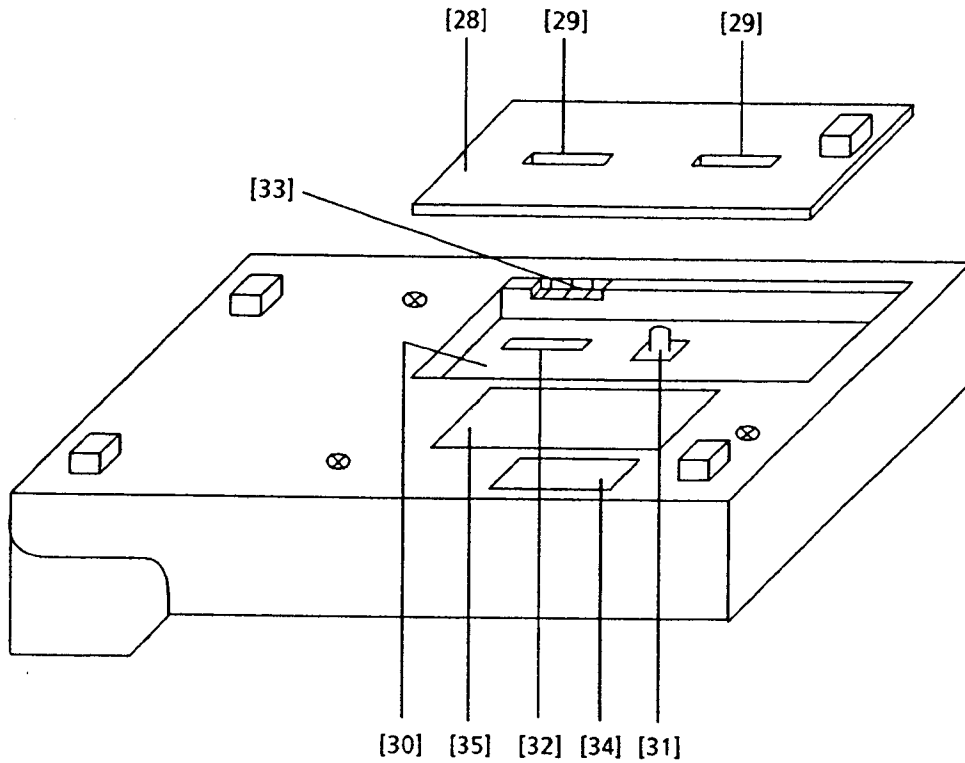
Remote Control

[25] 8 pin standard socket (DIN 45 326)

[26] Potentiometer for 2-wire adjustment
(Pt 100/2W)

[27] Dust cover with insertable cover
hinges

Bottom Side of the Instrument



Internal Power Supply

- [28] Cover for battery/accu compartment
- [29] Snap-action latches
- [30] Battery/accu compartment
- [31] Changeover switch for BATT/ACCU
- [32] Power fuse
- [33] Spare fuses

Others

- [34] Type plate
- [35] Warning note

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WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that our customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

THESE UNITS ARE INHERENTLY DANGEROUS AND ARE INTENDED TO BE INSTALLED AND USED ONLY BY QUALIFIED PERSONNEL. NO WARRANTY EXTENDED HEREIN WILL APPLY IF SUCH UNIT IS INSTALLED OR USED BY UNQUALIFIED PERSONNEL. THERE ARE NO WARRANTIES EXCEPT AS STATED HEREIN. THERE ARE NO OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR A PARTICULAR PURPOSE. OMEGA ENGINEERING, INC. IS NOT RESPONSIBLE FOR ANY DAMAGES OR LOSSES CAUSED TO OTHER EQUIPMENT, WHETHER DIRECT, INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, WHICH THE PURCHASER MAY EXPERIENCE AS A RESULT OF THE INSTALLATION OR USE OF THE PRODUCT. THE BUYER'S SOLE REMEDY FOR ANY BREACH OF THIS AGREEMENT BY OMEGA ENGINEERING, INC. OR ANY BREACH OF ANY WARRANTY BY OMEGA ENGINEERING, INC. SHALL NOT EXCEED THE PURCHASE PRICE PAID BY THE PURCHASER TO OMEGA ENGINEERING, INC. FOR THE UNIT OR UNITS OR EQUIPMENT DIRECTLY AFFECTED BY SUCH BREACH.

EVERY PRECAUTION FOR ACCURACY HAS BEEN TAKEN IN THE PREPARATION OF THIS MANUAL, HOWEVER, OMEGA ENGINEERING, INC. NEITHER ASSUMES RESPONSIBILITY FOR ANY OMISSIONS OR ERRORS THAT MAY APPEAR NOR ASSUMES LIABILITY FOR ANY DAMAGES THAT RESULT FROM THE USE OF THE PRODUCTS IN ACCORDANCE WITH THE INFORMATION CONTAINED IN THE MANUAL.


OMEGA ENGINEERING, INC.
An OMEGA Technologies Company
One Omega Drive, Box 4047
Stamford, Connecticut 06907-0047

Call OMEGA Toll Free*

Sales: 1-800-82-66342 / 1-800-TC-OMEGA

Customer Service: 1-800-622-2378 / 1-800-622-BEST

Engineering Assistance: 1-800-872-9436 / 1-800-USA-WHEN

*In CT: (203) 359-1660 CABLE: OMEGA EASYLINK: 62968934
And International TELEX: 996404 FAX: (203) 359-7700

Return Requests/Inquiries

Direct all warranty and repair requests/inquiries to OMEGA Customer Service Department, telephone number (203) 359-1660. BEFORE RETURNING ANY INSTRUMENT, PLEASE CONTACT THE OMEGA CUSTOMER SERVICE DEPARTMENT TO OBTAIN AN AUTHORIZED RETURN (AR) NUMBER. The designated AR number should then be marked on the outside of the return package.

To avoid processing delays, also please be sure to include:

1. Returnee's name, address, and phone number.
2. Model and Serial numbers.
3. Repair instructions.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. That way our customers get the latest in technology and engineering.

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