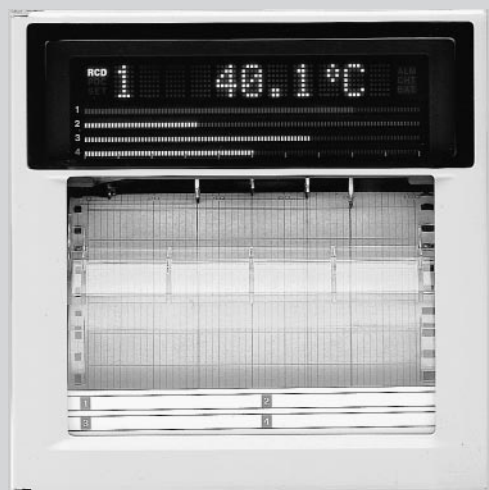




# Line recorder KS 3540



Available with 1, 2, 3 or 4 input channels

Universal inputs, i.e. any combination of voltage, thermocouples, Pt 100, logic signals

Simple, interactive operation and configuration

Multi-language operation

Alpha-numeric print-out of measured values and messages

Options:  
Mathematic functions, plug-in memory card (1 Mbyte),  
RS 422A interface, remote control

## PROFILE

The KS 3540 is a compact line recorder with a chart width of 100 mm and continuous recording. The inputs are freely configurable, which means that all conventional signals such as DC voltage/current, thermocouples, resistance thermometers and logic signal can be connected without changes in hardware.

Apart from the analog record, a numeric print-out of date, time, measured value, TAG no., engineering unit, scale values, chart speed, alarms, calculated values, etc. is possible.

The high reliability of the recorder is ensured by special contactless techniques, e.g. a brushless DC motor and an ultrasonic position detector. An 11-digit alphanumeric display provides good readability. In addition, the measured values are displayed as an analog bargraph.

Configuration and parameter setting is done inter-actively and is therefore very simple. The KS 3540 can be used for monitoring or for quality-control purposes in numerous application areas, e.g. for process temperatures and pressures, environmental measurements, production supervision, or furnace monitoring. Similarly, it can be used in medical diagnostics, in aircon applications, etc.

## TECHNICAL DATA

### INPUT

**Measuring interval:** 125 ms per channel

**Integration time of A/D converter**  
20 ms (50 Hz) or 16,7 ms (60 Hz)

### Signal types

Direct voltage: from 20 mV to 20 V  
Thermocouples: Types R, S, B, K, E, J, T, N, W, L, U  
Resistance thermometer: Pt 100  
Logic signals: contact or DC voltage, TTL level  
Direct current: with 50Ω shunt across input terminals

### Max. permissible input voltage

For ranges up to 2 volts and for thermocouple input:  
DC ±10 V (continuous).  
For 6 volt and 20 volt ranges: DC ±30 V (continuous).

### Temperature compensation for thermocouple measurement

Built-in or external, configurable per channel.

### Error of temperature compensation

Types R, S, B, W:  $\leq \pm 1$  K  
Types K, J, E, T, N, L, U:  $\leq \pm 0,5$  K

### Thermocouple break monitoring

ON/OFF configurable per channel, upscale or downscale configurable (valid for all channels).  
Normal:  $< 2$  kΩ; Break:  $> 10$  MΩ.  
Sensing current: approx. 100 nA.

### Filter

For damping the input signal, ON/OFF configurable per channel.  
When ON: mean-value generation from 2 to 16 measurements.

### Calculation

#### Difference measurement

Between any two channels. The number of the reference channel must always be lower than the number of the measurement channel. Possible with DC voltage, thermocouple and Pt100 inputs.  
Both channels must be configured for the same range.

#### Linear scaling

Possible with DC voltage, thermocouple and Pt100 inputs.  
Scaling limits: -20.000 to 20.000  
Decimal point: configurable by user.  
Engineering unit: configurable, up to 6 characters (alphanumeric and special).

#### Square rooting

Possible with DC voltage input.  
Scaling limits: -20.000 to 20.000  
Decimal point: configurable by user.  
Engineering unit: configurable, up to 6 characters (alphanumeric and special).

## Measuring ranges and error limits

Input signal and span	Range limits	Error limits <sup>1)</sup> of display		Resolution
<b>Direct voltage</b>				
20 mV	-20,00 ... 20,00 mV	± 0,2%	± 3 digit	10 µV
60 mV	-60,00 ... 60,00 mV	± 0,2%	± 2 digit	10 µV
200 mV	-200,0 ... 200,0 mV	± 0,2%	± 2 digit	100 µV
2 V	-2,000 ... 2,000 V	± 0,1%	± 2 digit	1 mV
6 V	-6,000 ... 6,000 V	± 0,3%	± 2 digit	1 mV
20 V	-20,00 ... 20,00 V	± 0,3%	± 2 digit	10 mV
<b>Thermocouples</b>				
R Pt 13% Rh-Pt	0 ... 1760 °C	± 0,15%	± 1 K <sup>2)</sup>	0,1 K
S Pt 10% Rh-Pt	0 ... 1760 °C	± 0,15%	± 1 K <sup>2)</sup>	
B Pt 13% Rh-Pt 6% Rh	0 ... 1820 °C	± 0,15%	± 1 K <sup>2)</sup>	
K NiCr-Ni	-200 ... 1370 °C	± 0,15%	± 1 K	
E NiCr-CuNi	-200 ... 800 °C	± 0,15%	± 0,5 K	
J Fe-CuNi	-200 ... 1100 °C	± 0,15%	± 0,7 K	
T Cu-CuNi	-200 ... 400 °C	± 0,15%	± 0,7 K	
L Fe-CuNi (DIN)	-200 ... 900 °C	± 0,15%	± 0,7 K	
U Cu-CuNi (DIN)	-200 ... 400 °C	± 0,15%	± 0,7 K	
N Nicrosil-Nisil	0 ... 1300 °C	± 0,15%	± 0,7 K	
W W 5% Re-W 26% Re	0 ... 2315 °C	± 0,15%	± 1 K	
<b>Resistance thermometers</b>				
Pt 100 (DIN)	-200 ... 600 °C	± 0,15%	± 0,3 K	0,1 K
<b>Digital (logic) input</b>				
Voltage	TTL level, OFF = < 2,4 V; ON = > 2,4 V			
Contact	ON/OFF (potential-free)			
<b>Direct current</b>				
0 ... 20 mA ≅ 0,000 ... 1,000 V via 50 Ω shunt				
4 ... 20 mA ≅ 0,000 ... 1,000 V via 50 Ω shunt				

<sup>1)</sup> The %-value is referred to the display value.

<sup>2)</sup> Not specified for the range 0 ... 400 °C

### Measurement error

The values in the table apply for a recorder used under the following standard conditions:

Temperature 23 °C ± 2 K, relative humidity 55% ± 10%, supply voltage AC 90 to 132 V, or 180 to 250 V, frequency 50/60 Hz ± 1%, warm-up time at least 30 minutes.

Other conditions, e.g. vibration should not have a negative effect on recorder operation.

## INPUT CONDITIONS

### Input resistance

>10 MΩ (thermocouples and DC voltage up to 2 V)  
Approx. 1 MΩ (6 V and 20 V ranges).

### Source resistance

Thermocouples and DC voltage: ≤ 2kΩ.  
Resistance thermometer: ≤ 10Ω per lead. The 3 lead resistances must be equal.

### Quiescent input current

<10 nA (approx. 100 nA with configured TC break monitoring)

### Max. common mode interference

AC 250 V<sub>rms</sub> (50/60 Hz)

### Common mode suppression

120 dB (50/60 Hz ± 0,1%)

### Series mode suppression

40 dB (50/60 Hz ± 0,1%)

### Insulation resistance

Between each terminal and ground:  
>20 MΩ, measured with AC 500 V

### Test voltages

Mains input against ground:  
AC 1500 V (50/60 Hz), 1 minute.  
Switching outputs against ground:  
AC 1500 V (50/60 Hz), 1 minute.  
Measuring inputs against ground:  
AC 1000 V (50/60 Hz), 1 minute.  
Between input channels: AC 1000 V (50/60 Hz), 1 minute, (except with Pt100, where „b“ terminals are inter-connected)

## RECORDING AND PRINT-OUT

### Recording method

Replaceable fibre-tipped pens for continuous recording, replaceable plotter pen for alpha-numeric printing.

### Settling time

< 1 s (according to IEC TC85 method)

### Recording error

For trend recording: ≤ ± 0,3% of adjusted span  
Sensitivity (dead zone): ≤ ± 0,2% of span

### Pen offset compensation

Configurable ON/OFF

### Chart paper

Folded chart, 16 m long  
Effective recording width: 100 mm

### Chart speed

Configurable 1 to 12.000 mm/h, in 82 steps.

### Chart speed switch-over

2 speeds can be configured, switch-over by means of external contact. The "remote control" option (Type code R1) is necessary.

### Chart speed error

≤ ± 0,1% with recordings >1000 mm (does not include stretching or shrinking of the chart).

### Recording format

#### a) Analog record

Zone recording:  
Zone width ≥ 5 mm, configurable in steps of 1 mm.  
Range expansion (zoom of partial span):  
Limit positions: 1 to 99%  
Limit values: within the recording range

#### b) Numeric print-out

Alarms:  
On the right-hand edge of the chart, type of alarm and time (h/min) are printed. Alarm print-out can be made when alarm occurs and when it disappears, or only when it occurs, or suppressed completely (selected configuration valid for all channels).

Periodic print-out:  
On the left-hand edge of the chart, date (month/day), time (h/min), chart speed and measured value are printed for each channel.  
Printing interval INT/EXT is configurable.  
INT: Uses the internal timer. Depends on chart speed or the configured interval (up to 24 hours).  
EXT: Triggered by external contact. The "remote control" option (Type code R1) is necessary.

Print-out of channel number or TAG number: 5 characters configurable for each channel.

Print-out of measured value:  
ON/OFF configurable for every channel.

Print-out of scaling:  
 ON/OFF configurable, valid for all channels.  
 With ON and recording zone >50 mm, the values are printed at 0% and 100%. For measurements with range expansion, the limit value is also printed.  
 Print-out of messages:  
 Via operating keys or external contacts. The „remote control“ option (Type code R1) is necessary. Up to 5 messages possible.  
 Contents: Time and message (up to 16 characters).

Start of print-out:  
 ON/OFF configurable.  
 With ON, the starting time is also printed.

Print-out of chart speed:  
 ON/OFF configurable.  
 With ON, the time of chart speed switch-over is printed.

Listing:  
 Prints a list of all ranges, alarm settings, etc.

Manual print-out:  
 Via operating keys or an external contact, the latest measured values are printed (analog recording is interrupted). The „remote control“ option (Type code R1) is necessary.

SET-UP listing:  
 This prints a list of all settings configured during SET-UP.

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## DISPLAY AND OPERATION

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### Display type

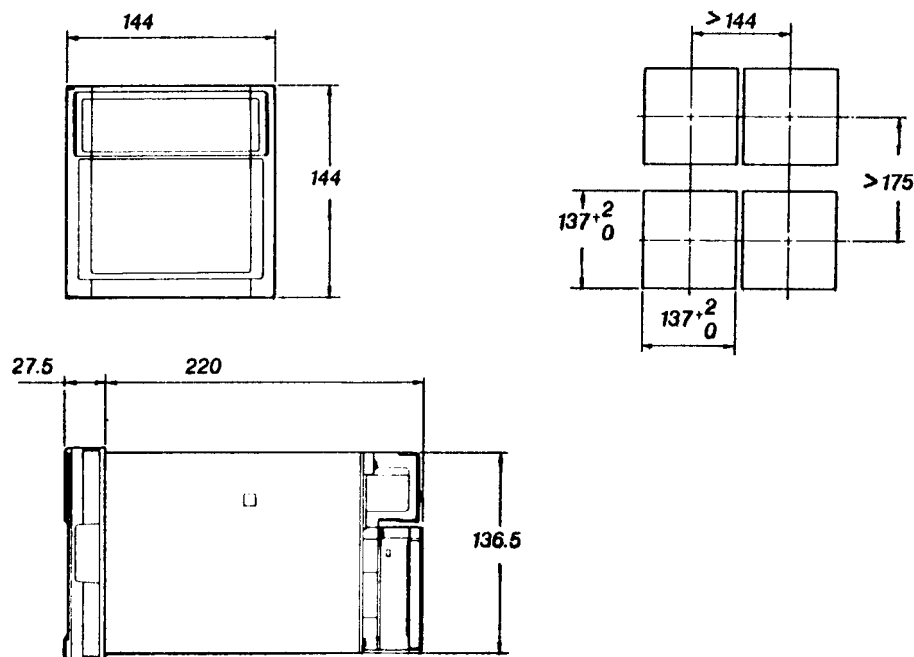
Vacuum-fluorescent display with 11 characters, 5x7 dot matrix

The display for operator guidance is selectable for English, French, or German.

### Digital display

AUTO: Cyclic display of each channel (channel number, type of alarm, measured value, engineering unit).  
 MAN: Permanent display of a selected channel (channel number, type of alarm, measured value, engineering unit).  
 DATE: Displayed as year/month/day.  
 TIME: Display of time (h/min/s).  
 Automatic switch-over from Winter Time to Summer Time is configurable.  
 VIEW: Display of operating status.

## Dimensions (in mm)



### Bargraph display

Measured values: reference point configurable at left (0%) or at center (50%) for each channel.  
 Alarm: segment of alarm set-point blinks on alarm.

### Other displays

RCD: recording in progress.  
 POC: pen-offset compensation ON.  
 SET: set-up mode.  
 ALM: common alarm (not referred to a particular channel).  
 CHT: chart end (Type code F1).  
 BAT: back-up battery low, replacement necessary.

### Disabling the operating keys

With key switch.  
 Keys which are to remain in operation can be defined by configuration.

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## ALARMS

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### Number of limit values

Up to 4 per channel

### Type of alarm

MIN/MAX alarm (L/H)  
 MIN/MAX difference alarm (dL/dH)  
 MIN/MAX gradient alarm (RL/RH)  
 The reference time of the gradient alarm is configurable (1 to 15 measurement intervals).

### Alarm display

Limit values are highlighted as a line in the bargraph, which blinks on alarm.

### Hysteresis

Approx. 0,5% of measuring span (or 0%) configurable (valid for all channels and values)

### Display when ALARM ACK key is pressed

#### HOLD not active:

Pressing the ALARM ACK key has no effect on display.

#### HOLD active:

On alarm, the display starts to blink. When the ALARM ACK key is pressed, the alarm status is displayed (continuously lit or off).

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## POWER SUPPLY

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### Nominal voltage

AC 115 V or 230 V, recorder adjusts automatically.  
 Permissible tolerances:  
 90...132 V and 180...250 V

### Mains frequency

50 or 60 Hz, ±2%, switchover not necessary

### Power consumption

Max. 40 VA

### Back-up battery for memory

Lithium battery fitted in recorder to secure the adjusted parameters. Useful life approx. 10 years. Low battery is displayed at recorder front.

## ENVIRONMENTAL CONDITIONS

Operating temperature: 0...50°C  
 Relative humidity: 20...80% (in the range 5...40°C)  
 Vibration: 10 to 60 Hz,  $\leq 0,5$  g  
 Shock: not allowed

### Magnetic field strength

$< 400$  A/m (DC and AC, 50/60 Hz)

### Electromagnetic compatibility

To IEC 801, RFI suppression to German PTT regulation Vfg 1046/84.

### Permissible interference levels

#### Common mode interference

Voltage input: the peak value must be less than 1,2 x of measuring span.  
 Thermocouples: the peak value must be less than 1,2 x the thermovoltage.  
 Resistance thermometer:  $< 50$  mV

#### Series mode interference

$< AC$  250 V<sub>rms</sub> (50/60 Hz) for all ranges

## INFLUENCING FACTORS

### Temperature effect

(with a change of 10 K)  
 Display:  $\leq \pm 0,1\%$  of display  $\pm 1$  digit  
 Recording:  $\leq \pm 0,2\%$  of recording span

### Power supply effect

Operating voltage AC 90...132 V or 180...250 V  
 Display:  $< \pm 0,1\%$  of display  $\pm 1$  digit  
 Recording: like digital display

### Effect of magnetic fields

AC (50/60 Hz) or DC field of 400 A/m:  
 Display:  $< \pm 0,1\%$  of display  $\pm 1$  digit  
 Recording:  $< \pm 0,5\%$  of recording span

### Effect of source resistance

For a change of 1 k $\Omega$ :

#### DC voltage

Ranges  $< 2$  V:  $< \pm 10$   $\mu$ V  
 Ranges  $> 6$  V:  $< \pm 0,1\%$  of display

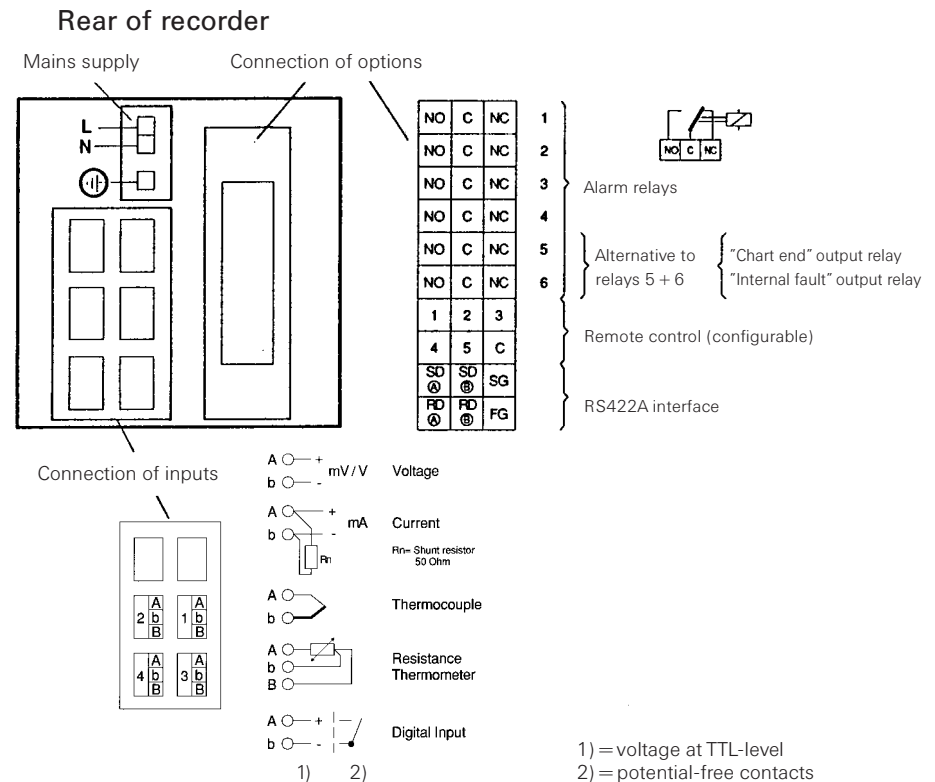
#### Thermocouples

$< \pm 10$   $\mu$ V ( $< \pm 100$   $\mu$ V, if TC monitoring has been configured)

#### Resistance thermometer

Effect of 10  $\Omega$  per lead (the three lead resistance must be equal):  
 Display:  $< \pm 0,1\%$  of display  $\pm 1$  digit  
 Recording:  $< \pm 0,1\%$  of recording span

## Connections



## OPTIONS

### Alarm relays

Type code A1: 2 alarm relays  
 Type code A2: 4 alarm relays  
 Type code A3: 6 alarm relays (not possible in combination with Type code F1).

### Switching outputs

One potential-free switchover contact per relay.  
 Contact rating: DC 250 V; 0,1 A or AC 250 V; 3 A  
 Normally-open or normally-closed operation configurable.

### Additional functions

Logic connection of outputs (AND/OR).  
 Alarm acknowledgement enable/disable (key ALARM ACK)

### RS 422A interface

(Type code C3)  
 Via this interface, data can be transmitted to a host computer. In addition, the recorder can be configured from the computer.  
 Transmission principle: Asynchronous, 4-wire, half-duplex  
 Transmission speed: 75 to 9600 bits/s  
 Word length: 7 or 8 bits  
 Stop bit: 1 or 2  
 Parity: uneven, even, or none  
 Lead length: max. 1200 m

### Socket for memory card

For inserting a memory card with max. 1 Mbyte.

#### Type Code E1:

Write/read of configuration data.

#### Type Code E2:

Write/read of configuration and measurement data.

The 64 kbyte memory card can only be used with Type Code E1. Up to 5 configuration files can be stored.

### Internal fault and chart end detection

(Type code F1)  
 A fault in the CPU and the end of the recording chart are signalled by separate relays.  
 Output: potential-free switchover contact

Contact rating: DC 250 V; 0,1 A

AC 250 V; 3 A,

Not possible in combination with 6 alarm relays (Type code A3).

### Door with non-reflective glass

(Type code H3)

## Mathematical functions

(Type code M1)

One input channel is used for the calculations.

Available functions:

Basic operations +, -, x, :

SQR square rooting

ABS absolute value

LOG logarithm to base 10

EXP exponent

Comparing operations: <, >, =, ≠

Logic combinations: AND, OR, XOR,

NOT (only possible between two channels).

Constants: K01 to K10

Example of configuration:

03=(01+02):K01; K01=2

Channels 1 and 2 are added and then divided by the value 2. The result is output on channel 3.

Statistical calculations:

MAX: maximum value

MIN: minimum value

AVE: average value

SUM: sum

A record of the statistical values is only possible as a numeric print-out. For the recording interval, see „Recording format“.

## Remote operation

(Type code R1)

Five of the following remote functions can be configured. Control is by means of external contacts.

- Start/Stop of recording
- Switchover to 2nd chart speed
- Start of message printing (max. 5 messages)
- Start of manual print-out
- TLOG Start/Reset (only in combination with Type code M1)

- Start of periodic print-out
- Start transfer of measurement data to the memory card (Type code E2 necessary).

## CONFORMITY TESTS

The instrument has CE-marking

## Electro-magnetic compatibility

EMI: EN 55 011, Group 1, Class A

EMC: EN 55 082-2

## GENERAL

### Housing

Material: sheet steel

Door frame: die-cast aluminium, grey finish

### Mode of protection

Front: IP 54 to IEC 529 (DIN 40 050)

### Mounting method

In panel cut-out

Panel thickness: 2...26 mm

### Mounting position

Forward incline: 0 degrees

Backward incline: max. 30 degrees

### Error of internal clock

100 ppm

### Safety standards

to IEC 348 (VDE 0411)

### Warm-up time

Ready for operation approx. 30 minutes after switch-on.

**Weight:** approx. 3,8 kg

## ORDERING DATA

### KS 3540

Order no.

1 – channel line recorder	<b>9404 350 10001</b>
2 – channel line recorder	<b>9404 350 20001</b>
3 – channel line recorder	<b>9404 350 30001</b>
4 – channel line recorder	<b>9404 350 40001</b>

**OPTIONS** (Order separately. Options are fitted into recorder, whereby several are possible in one instrument.)

Description	Type code	Order no.
Alarm relay	2 relays A1	<b>9404 350 00011</b>
	or 4 relays A2	<b>9404 350 00021</b>
	or 6 relays A3	<b>9404 350 00031</b>
RS 422-A interface	C3	<b>9404 350 00041</b>
Internal fault & chart end detection		
Relay output <sup>1)</sup>	F1	<b>9404 350 00051</b>
Remote control (5 inputs)	R1	<b>9404 350 00061</b>
Socket for memory card		
only for configuration data	E1	<b>9404 350 00071</b>
for configuration and measurement data	E2	<b>9404 350 00111</b>
Mathematical functions	M1	<b>9404 350 00081</b>
Door with non-reflective glass	H3	<b>9404 350 00091</b>
Portable version <sup>2)</sup>	H5 F	<b>9404 350 00121</b>
Power supply DC 24V	P1	<b>9404 350 00141</b>

<sup>1)</sup> Not possible with 6 alarm relays (Type code A3)

<sup>2)</sup> Not possible in combination with option type P1

## CONSUMABLES AND ACCESSORIES

Description	Order no.
<b>Recording pens</b> (3 per colour)	
red	<b>4012 027 45509</b>
green	<b>4012 027 45511</b>
blue	<b>4012 027 45512</b>
violet	<b>4012 027 45513</b>
<b>Plotter pen</b> (qty. 3)	purple <b>4012 027 45514</b>
<b>Folded chart</b> , 16 m long, graduation linear	<b>4012 027 45489</b>
graduation to specification	<b>9404 392 38001</b>
<b>Memory card</b>	
64 kbyte <sup>1)</sup>	<b>4012 027 45499</b>
256 kbyte	<b>4012 027 45501</b>
512 kbyte	<b>4012 027 45502</b>
1 Mbyte	<b>4012 027 45507</b>
<b>Shunt resistor</b> for current measurement, 50Ω ± 0,1 %	<b>4012 151 57322</b>
<b>Certificate</b> with calibration protocol	<b>9404 350 00201</b>
<b>Additional operating instructions</b>	
for recorder and options A1, A2, A3, F1, R1:	in English <b>9499 040 25711</b>
	in German <b>9499 040 25718</b>
for options C3, E1, E2, M1:	in English <b>9499 040 27711</b>
	in German <b>9499 040 27718</b>

<sup>1)</sup> Only suitable for read/write of configuration data (Type Code E1).

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