The KS 3960 is an industrial point recorder with microprocessor control and max. 6 channels. Its front dimensions are 144 x 144 mm. There are two basic versions:

**KS 3960 B**
This is a low-cost recorder with two different input circuits:
- a) Standard
  For DC input (e.g. 0/4...20 mA or 0...10V signals).
- b) Universal
  Extended measurement value table for DC signals (mA, mV, V), thermocouples, resistance thermometers, and potentiometric transducers.

**KS 3960 A**
This version offers the same functions and input circuits as the KS 3960 B, additionally fitted with:
- an alpha-numeric printing system for recording date, time, texts, event marking, measurement value table, etc.

Both basic versions are freely programmable without any accessory equipment. Alternatively, the recorders can be configured remotely from a PC which is connected via a front-panel interface socket. A suitable Engineering Tool is available as a software package.

**OPERATING PRINCIPLE**
The input channels are polled by a wear-free semiconductor scanner which also provides galvanic isolation. The A/D converter works with high resolution, so that even small measuring spans can be processed accurately. Non-linear input signals, e.g. from thermocouples and resistance thermometers, are corrected, so that display and recording are temperature-linear.

The microprocessor controls the stepping motors for chart drive and recording system. Digital technology eliminates wear-prone components such as DC motors, cord drives, and feedback potentiometers, making the recorders practically maintenance-free.

**CONSTRUCTION**
The recorder is fitted in a sheet-steel housing for panel mounting. The front door gives protection type IP 54 (splash water).

The chassis is retained in the housing by means of a locking lever. After unlocking, the chassis can be drawn forwards, e.g. for convenient replacement of the printing head. For servicing, the chassis can be removed completely.

A ribbon cable with plug connects the recording chassis with the CPU. The power supply unit is fitted to the housing rear, thus ensuring good heat convection and minimum self-heating of the recorder.

A universal chart cassette enables roll or Z-fold charts to be used. For roll charts, a take-up spool is supplied as an accessory. The front edge of the chart is caught and wound up automatically.
TECHNICAL DATA

INPUT

Measurement inputs
No. of channels: 6, galvanically isolated via semiconductor switches.
Max. voltage against protective earth: 24 VDC
Excess voltage protection is provided by Varistors.

Measurement principle
A/D conversion according to the dual-slope method
Resolution: 14 1/2 bits
Channel scan time: 40 ms with 50 Hz

Permissible continuous overload
Max. 24 V, max. 40 mA

Interference suppression
Common mode: 90 dB with 50 Hz
Series mode: 60 dB with 50 Hz

Signal attenuation
1st-order low-pass filter adjustable
0-1-3-10-30-100 s or with automatic matching to chart speed.

Reference conditions
Ambient temperature: 21…25 °C
Relative humidity: 50…60 %
Source resistance: < 1 kΩ
Potential difference: < 1 V

STANDARD INPUT (U/I)

Measurement cycle
Normal: 240 ms
Fast: 150 ms

Input resistance
Direct voltage: 100 kΩ
Direct current: 50 Ω

Measurement ranges
Separately configurable for each channel.

<table>
<thead>
<tr>
<th>Input signal</th>
<th>Span</th>
<th>Resolution error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct voltage (DC U)</td>
<td>– 40…40mV</td>
<td>4 µV</td>
</tr>
<tr>
<td></td>
<td>– 100…100mV</td>
<td>10 µV</td>
</tr>
<tr>
<td></td>
<td>– 400…400mV</td>
<td>40 µV</td>
</tr>
<tr>
<td></td>
<td>–1000…1000mV</td>
<td>100 µV</td>
</tr>
<tr>
<td></td>
<td>1…+1V</td>
<td>0.1 mV</td>
</tr>
<tr>
<td></td>
<td>0…1V</td>
<td>0.1 mV</td>
</tr>
<tr>
<td></td>
<td>0.2…1V</td>
<td>0.1 mV</td>
</tr>
<tr>
<td></td>
<td>10…+10V(1)</td>
<td>1 mV</td>
</tr>
<tr>
<td></td>
<td>0…10V</td>
<td>1 mV</td>
</tr>
<tr>
<td></td>
<td>2…10V</td>
<td>1 mV</td>
</tr>
</tbody>
</table>

Direct current (DC I)
- 20…+20mA 2 µA 22 µA
- 20mA 2 µA 22 µA
- 20mA 2 µA 22 µA

(1) –20…+20V configurable

Recording range
Freely configurable within the selected input span, for example:
Input span –20…+20 mA
Recording range –2.5…+15.0 mA

UNIVERSAL INPUT (U/I/TC/RTD/R)

Measurement cycle
Normal: 640 ms
Fast: 400 ms

Input signals
Direct voltage (U)
For input signals ≤ 100mV:
Input resistance > 10 MΩ
Source resistance < 1 kΩ
For input signals ≥ 1 V:
Input resistance 100 kΩ

Direct current (I)
Input resistance 50 Ω

Thermocouples (TC)
Input resistance > 10 MΩ
Internal or external cold-junction compensation configurable.
Error of internal CJC: approx. 0.5 K

Reference temperature of external CJC: configurable for 0, 20, 50, or 70 °C
Action on sensor break: configurable for < 0 or > 100% of recording range

Resistance thermometer (RTD) and potentiometric transducer (R)
Connection with 3 or 2 leads configurable.
With 2-lead connection, lead resistance must be adjusted to 10 Ω.

Recording range
Freely configurable within the selected input span, for example:
Pt 100, input span –200…850 °C
Recording range –50…80 °C

Measurement ranges
Separately configurable for each channel.

<table>
<thead>
<tr>
<th>Input signal</th>
<th>Span</th>
<th>Resolution</th>
<th>Max. error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct voltage (DC U)</td>
<td>– 40…40mV</td>
<td>4 µV</td>
<td>36 µV</td>
</tr>
<tr>
<td></td>
<td>– 100…100mV</td>
<td>10 µV</td>
<td>80 µV</td>
</tr>
<tr>
<td></td>
<td>– 400…400mV</td>
<td>40 µV</td>
<td>320 µV</td>
</tr>
<tr>
<td></td>
<td>–1000…1000mV</td>
<td>1000 µV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1…+1V</td>
<td>0.1 mV</td>
<td>1 mV</td>
</tr>
<tr>
<td></td>
<td>0…1V</td>
<td>0.1 mV</td>
<td>1 mV</td>
</tr>
<tr>
<td></td>
<td>0.2…1V</td>
<td>0.1 mV</td>
<td>1 mV</td>
</tr>
<tr>
<td></td>
<td>10…+10V(1)</td>
<td>1 mV</td>
<td>11 mV</td>
</tr>
<tr>
<td></td>
<td>0…10V</td>
<td>1 mV</td>
<td>11 mV</td>
</tr>
<tr>
<td></td>
<td>2…10V</td>
<td>1 mV</td>
<td>11 mV</td>
</tr>
</tbody>
</table>

Direct current (DC I)
- 20…+20mA 2 µA 22 µA
- 20mA 2 µA 22 µA
- 20mA 2 µA 22 µA

Thermocouples (TC) to DIN IEC 348

<table>
<thead>
<tr>
<th>Type</th>
<th>Fe-CuNi</th>
<th>(–210) –100…1200 °C</th>
<th>0.2 K</th>
<th>1.3 K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type K</td>
<td>NiCr-Ni</td>
<td>(–270) –100…1370 °C</td>
<td>0.3 K</td>
<td>1.6 K</td>
</tr>
<tr>
<td>Type R</td>
<td>Pt13Rh-Pt</td>
<td>(–50) 100…1760 °C</td>
<td>0.5 K</td>
<td>1.8 K</td>
</tr>
<tr>
<td>Type T</td>
<td>Cu-CuNi</td>
<td>(–270) –100…400 °C</td>
<td>0.2 K</td>
<td>0.9 K</td>
</tr>
<tr>
<td>Type S</td>
<td>Pt10Rh-Pt</td>
<td>(–50) 100…1760 °C</td>
<td>0.5 K</td>
<td>1.8 K</td>
</tr>
<tr>
<td>Type N</td>
<td>NiCrSi-NiSi(–200) –100…1300 °C</td>
<td>0.4 K</td>
<td>1.7 K</td>
<td></td>
</tr>
<tr>
<td>Type E</td>
<td>NiCr-CuNi</td>
<td>(–270) –100…1000 °C</td>
<td>0.2 K</td>
<td>1.1 K</td>
</tr>
<tr>
<td>Type B</td>
<td>Pt30Rh-Pt6Rh(100) 600…1820 °C</td>
<td>0.6 K</td>
<td>2.0 K</td>
<td></td>
</tr>
</tbody>
</table>

Thermocouples (TC) to DIN 43 710

<table>
<thead>
<tr>
<th>Type L</th>
<th>Fe-Cu</th>
<th>(–200) –100…900 °C</th>
<th>0.2 K</th>
<th>1.1 K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type U</td>
<td>Cu-Cu</td>
<td>(–200) –100…560 °C</td>
<td>0.2 K</td>
<td>1.0 K</td>
</tr>
</tbody>
</table>

Resistance thermometer (RTD)
Pt100 DIN IEC 751
-200…850 °C 0.05 K 0.9 K
Ni100 DIN 43710
-60…180 °C 0.05 K 0.4 K

Potentiometric transducer (R)
0…300 Ω 0.03 Ω 0.4 Ω
0…1000 Ω 0.1 Ω 1.2 Ω

1) –20…+20V configurable
2) Slightly higher errors apply for the ranges in brackets.
Display and recording range
Freely configurable within the selected input span by means of „Value left“ and „Value right“, for example:
Input span Pt 100 -200...850 °C
Recording range -50...180 °C

Recording mode
- Dots or connected dots configurable, with dot spacing selectable for 3, 6, 12, 24, 48 seconds, or matched automatically to the chart speed.
- 2 event channels for recording ON/OFF signals, triggered by an alarm or an external signal.

Scale
Max. 4 scale graduations 0...100% or to specification (see Ordering Data, Options).
Length: 100 mm

Drive for recording system
Program-controlled stepping motor.
Resolution: 0,125 mm
Slewing speed: max. 125 mm/s
Recording width: 100 mm

Mechanical recording error \( \leq 0,3\% \) of recording width

Printing head
Replaceable, with 6 felt tips. Automatic head lift when recording stops.
Colours: violet, red, black, green, blue, brown
Trace length: appr. 1800 m per colour
Head life: approx. 6 months
Storage life: approx. 2 years

Chart drive
Program-controlled stepping motor.
Step length: 0,02 mm
Chart speed: 0-1-1,25-2,5-5-10-20-60- 120 mm/h, configurable

Chart paper
Universal cassette for Z-fold or roll charts to DIN 16 230
Chart width: 120 mm
Recording width: 100 mm

Z-fold charts
Length 16m, fold depth 40 mm, visible chart 30...80 mm

Roll charts
Length 31 m, visible chart 70...80 mm, automatic chart take-up


tables

ONLY WITH VERSION KS 3960 A

Alpha-numeric printing system
With printing head, colour violet.
Character height: approx. 2,2 mm
The following are printed:
- Date, time, chart speed.
- One recorder text (max. 20 characs.)
- Six event texts (max. 16 characters per text). Printing is cyclical or triggered by an alarm or external signal.
- Measurement value table, cyclical every 1, 2, 3, 4 or 12 hours, or triggered by an alarm or an external signal.
- Alarm marks along the recorded trace.
- Channel no.
- Configuration data.
- Scale graduation every 20 mm, divisions configurable from 1/1 to 1/7

Real-time clock
For printing of date/time in 12 or 24-hour mode, summer/winter time switch-over.
Clock is buffered with built-in CR2032 lithium battery, useful life > 3 years with recorder switched off.

OPERATION
By means of built-in keys and display elements.

Operating level
Start/Stop of recorder
Fast chart speed

Programming level
Measurement and recording ranges
Alarm settings
Chart speed
and other functions.

Test level
Test functions
Service functions
Program blocking
and other functions.

PC interface
For remote configuration and polling of measurement values via a PC.
The interface socket is accessible from the front. The necessary adapter cable and Engineering Tool software must be ordered separately, see „Accessories“.

ALARMS
6 limit values, configurable for MIN or MAX operation, free allocation to the recording channels.
Switching hysteresis of alarm output: 2 % of recording range

OPTIONS

Digital inputs/outputs
Control inputs:
Quantity: 4 (DI1...DI4), passive, galvanically isolated via opto-coupler.
Switching levels:
Low: -3...+5 V
High: +8...+30 V
Input resistance: > 5 kΩ
Signal duration: > 0,5 seconds
Max. 4 of the following functions can be selected and allocated to the inputs:
Chart-speed switch-over A/B
Start/Stop of recording
1...6 event texts, 1 recorder text
2 event channels, measurement value table
Fast/slow recording
Chart feed 10 to 100 mm
Summer time, and other functions.

Alarm outputs
6 output relays with potential-free switch-over contacts.
Contact rating: max. 50 V, 1 A, 30 W or 60 VA
Voltage output
24 VDC, ± 15%, max. 75 mA,
short-circuit proof, galvanically isolated, max. capacitive load 33 μF.
Used e.g. for:
Two-wire transmitter supply or for energizing the control inputs.

POWER SUPPLY

AC voltage
230V, 115V or 24V, 47...64 Hz
Tolerance range: -20...+15%
Power consumption: approx. 20 VA

DC voltage
24 VDC, -20...+15%, approx. 13 W

ENVIRONMENTAL CONDITIONS

Permissible temperatures
For operation: 0...50 °C
For storage: -25...70 °C
Climatic category
KWF to DIN 40 040
Relative humidity \( \leq 75\% \) yearly average, no condensation
Vibration test
To IEC 68-2-6
Mounting position
Front vertical with max. ± 15° inclination to DIN 16 257.
CONFORMITY TESTS

The instrument has CE-marking.

**Electrical safety**
- Meets EN 61 010-1.
- Excess voltage category II
- Contamination degree 2
- Protective class I (protective earth connection) to VDE 0411, Part 1

**Electromagnetic compatibility**
- Complies with EN 50 081-1 and EN50 082-2.
- Meets NAMUR recommendation NE 21.

GENERAL

**Housing**
- For mounting in a panel cut-out.
- Material: sheet steel, grey finish
- Transparent plastic door with catch.
- For dimensions, see Fig. 1

**Protection mode**
- According to IEC 529 (EN 60 529)
- Front with door: IP 54
- Terminals: IP 20

**Electrical connections**

**Signal inputs:**
- Screw terminals for max. 2.5 mm² solid or 1.5 mm² flexible with sleeve

**Digital inputs and outputs:**
- Via 25-pin D-type connector socket (plug is provided with recorder)

**230/115 VAC supply:**
- Appliance connector to IEC 320 (plug is provided with recorder)

**24V AC/DC supply:**
- Screw terminals

**Weight**
- approx. 4 kg
- (5.5 kg packed weight)

**Packaging dimensions**
- Overall: 490 x 290 x 290 mm

**Statistical article code**
- HS-Code 90308390

**Accessories**
- 2 Fixing clamps
- 1 Z-fold chart
- 1 Printing head
- 1 Chart-reading rule per graduation
- 1 Mains connector with 230/115 VAC supply
- 2 Fuses
- 1 Take-up spool for roll charts
- 1 Installation instruction (GB, D, F, E, I)
- 1 Manual „Operation, quick reference”
  - 1 x GB, 1 x D, 1 x F
- 1 Manual „Parameter setting, quick reference” (1 x GB, 1 x D, 1 x F)

---

Fig. 1 Overall dimensions (in mm)

Fig. 2 Operating controls KS3930 A/B and KS 3960 A/B
**Fig. 3 Electrical connections**

### Pin allocation for digital inputs/outputs (Pos. 3)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Alarm outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>DO1 NO contact</td>
</tr>
<tr>
<td>2</td>
<td>Common</td>
</tr>
<tr>
<td>15</td>
<td>NC contact</td>
</tr>
<tr>
<td>3</td>
<td>DO2 NO contact</td>
</tr>
<tr>
<td>16</td>
<td>Common</td>
</tr>
<tr>
<td>4</td>
<td>NC contact</td>
</tr>
<tr>
<td>17</td>
<td>DO3 NO contact</td>
</tr>
<tr>
<td>5</td>
<td>Common</td>
</tr>
<tr>
<td>18</td>
<td>NC contact</td>
</tr>
<tr>
<td>6</td>
<td>DO4 NO contact</td>
</tr>
<tr>
<td>19</td>
<td>Common</td>
</tr>
<tr>
<td>7</td>
<td>NC contact</td>
</tr>
<tr>
<td>20</td>
<td>DO5 NO contact</td>
</tr>
<tr>
<td>8</td>
<td>Common</td>
</tr>
<tr>
<td>19</td>
<td>NC contact</td>
</tr>
<tr>
<td>9</td>
<td>DO6 NO contact</td>
</tr>
<tr>
<td>22</td>
<td>Common</td>
</tr>
<tr>
<td>10</td>
<td>NC contact</td>
</tr>
</tbody>
</table>

### Pin Control inputs

<table>
<thead>
<tr>
<th>Pin</th>
<th>Control inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>DI1</td>
</tr>
<tr>
<td>12</td>
<td>DI2</td>
</tr>
<tr>
<td>25</td>
<td>DI3</td>
</tr>
<tr>
<td>13</td>
<td>DI4</td>
</tr>
<tr>
<td>11</td>
<td>OV ref. potential</td>
</tr>
</tbody>
</table>

### Ordering data

The basic setting for all channels is: Input range 4...20 mA, scale 0...100%. Different settings must be specified as options.

#### KS 3960 A with alpha-numeric printing system
- Standard input circuit (U/I)
- Universal input circuit (U/I / TC / RTD / R)

#### KS 3960 B without alpha-numeric printing system
- Standard input circuit (U/I)
- Universal input circuit (U/I / TC / RTD / R)

### Options

Must be ordered as separate items, will be fitted in recorder.

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recorder features, different from the basic version</td>
<td>9404 398 00011</td>
</tr>
<tr>
<td>Measuring range and scale to specification per recorder</td>
<td>Type S1</td>
</tr>
<tr>
<td>Non-reflecting door with lock</td>
<td>Type T1</td>
</tr>
<tr>
<td>Digital inputs/outputs</td>
<td>Type D1</td>
</tr>
<tr>
<td>24 VDC voltage source</td>
<td>Type Q1</td>
</tr>
</tbody>
</table>

1) Please specify range and scale for each channel, max. 4 scale graduation possible.
## CONSUMABLES

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Printing head</td>
<td>4012 027 45522</td>
</tr>
<tr>
<td>Z-fold chart 1)</td>
<td></td>
</tr>
<tr>
<td>with 0...100 linear graduation</td>
<td></td>
</tr>
<tr>
<td>no time marks</td>
<td>4012 027 45517</td>
</tr>
<tr>
<td>with time marks for chart speed 10 mm/h</td>
<td>4012 142 91451</td>
</tr>
<tr>
<td>20 mm/h</td>
<td>4012 142 91461</td>
</tr>
<tr>
<td>60 mm/h</td>
<td>4012 142 91471</td>
</tr>
<tr>
<td>blank chart</td>
<td>4012 027 45538</td>
</tr>
<tr>
<td>Roll chart 1)</td>
<td></td>
</tr>
<tr>
<td>with 0...100 linear graduation</td>
<td></td>
</tr>
<tr>
<td>no time marks</td>
<td>4012 027 45516</td>
</tr>
<tr>
<td>with time marks for chart speed 10 mm/h</td>
<td>4012 027 45523</td>
</tr>
<tr>
<td>20 mm/h</td>
<td>4012 027 45524</td>
</tr>
<tr>
<td>60 mm/h</td>
<td>4012 027 45525</td>
</tr>
<tr>
<td>blank chart</td>
<td>4012 027 45539</td>
</tr>
</tbody>
</table>

1) For the recorder KS 3960 A we recommend the chart without time marks, because the alpha-numeric printing system records the time regularly. Similarly, graduation lines can be printed, so that blank charts can also be used as an alternative.

## ACCESSORIES

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificate with calibration protocol (first calibration)</td>
<td>9404 397 00201</td>
</tr>
<tr>
<td>Engineering Tool (English, German)</td>
<td>9404 397 00111</td>
</tr>
<tr>
<td>Adapter cable for PC interface</td>
<td>4012 027 45542</td>
</tr>
<tr>
<td>Recorder manual English</td>
<td>9499 040 44711</td>
</tr>
<tr>
<td>German</td>
<td>9499 040 44718</td>
</tr>
<tr>
<td>French</td>
<td>9499 040 44732</td>
</tr>
</tbody>
</table>

## PARTS FOR RETRO-FITTING

for subsequent changes to a recorder

<table>
<thead>
<tr>
<th>Description</th>
<th>Order no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale strip blank</td>
<td>4012 027 45528</td>
</tr>
<tr>
<td>with one graduation to specification</td>
<td>4012 027 45529</td>
</tr>
<tr>
<td>with two graduations to specification</td>
<td>4012 027 45531</td>
</tr>
<tr>
<td>with three graduations to specification</td>
<td>4012 027 45532</td>
</tr>
<tr>
<td>with four graduations to specification</td>
<td>4012 027 45533</td>
</tr>
<tr>
<td>Chart-reading rule with one graduation to specification</td>
<td>4012 027 45535</td>
</tr>
<tr>
<td>Digital inputs/outputs, mounting kit with instructions</td>
<td>4012 027 45543</td>
</tr>
<tr>
<td>Voltage source 24 VDC, mounting kit with instructions</td>
<td>4012 027 45544</td>
</tr>
</tbody>
</table>

![Scale versions](image)

A scale plate with one, two, three or four scale graduations is required per recorder. (A, B, C, D).

Scale sequence from 1 at bottom to 4 at top according to sequence of order codes 1 to 4.