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Apart from the analog record, a numeric print-out of date, time, measured value, TAG no., engineering unit, scale values, chart speed, alarms, calculated values, etc.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 interactively 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
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: ≤±1 K
Types K, J, E, T, N, L, U: ≤±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).
**Input signal and span**

<table>
<thead>
<tr>
<th>Input signal and span</th>
<th>Range limits</th>
<th>Error limits of display</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 mV</td>
<td>-20.00 ... 20.00 mV</td>
<td>±0.2%</td>
<td>±3 digit 10 µV</td>
</tr>
<tr>
<td>60 mV</td>
<td>-60.00 ... 60.00 mV</td>
<td>±0.2%</td>
<td>±2 digit 10 µV</td>
</tr>
<tr>
<td>200 mV</td>
<td>-200.00 ... 200.00 mV</td>
<td>±0.2%</td>
<td>±2 digit 100 µV</td>
</tr>
<tr>
<td>2 V</td>
<td>-2.000 ... -2.000 V</td>
<td>±0.1%</td>
<td>±2 digit 1 mV</td>
</tr>
<tr>
<td>6 V</td>
<td>-6.000 ... 6.000 V</td>
<td>±0.3%</td>
<td>±2 digit 1 mV</td>
</tr>
<tr>
<td>20 V</td>
<td>-20.00 ... 20.00 V</td>
<td>±0.3%</td>
<td>±2 digit 10 mV</td>
</tr>
</tbody>
</table>

**Thermocouples**

<table>
<thead>
<tr>
<th>Thermocouples</th>
<th>Temperature</th>
<th>Error limits of display</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Pt 13% Rh-Pt</td>
<td>0 ... 1760 °C</td>
<td>±0.15%</td>
<td>±1 K</td>
</tr>
<tr>
<td>S Pt 10% Rh-Pt</td>
<td>0 ... 1760 °C</td>
<td>±0.15%</td>
<td>±1 K</td>
</tr>
<tr>
<td>B Pt 13% Rh-Pt 6% Rh</td>
<td>0 ... 1820 °C</td>
<td>±0.15%</td>
<td>±1 K</td>
</tr>
<tr>
<td>K Ni-Cr-Ni</td>
<td>-200 ... 1370 °C</td>
<td>±0.15%</td>
<td>±1 K</td>
</tr>
<tr>
<td>E Ni-Cr-CuNi</td>
<td>-200 ... 800 °C</td>
<td>±0.15%</td>
<td>±0.5 K</td>
</tr>
<tr>
<td>J Fe-CuNi</td>
<td>-200 ... 1100 °C</td>
<td>±0.15%</td>
<td>±0.7 K</td>
</tr>
<tr>
<td>T Cu-CuNi</td>
<td>-200 ... 400 °C</td>
<td>±0.15%</td>
<td>±0.7 K</td>
</tr>
<tr>
<td>L Fe-CuNi (DIN)</td>
<td>-200 ... 900 °C</td>
<td>±0.15%</td>
<td>±0.7 K</td>
</tr>
<tr>
<td>U Cu-CuNi (DIN)</td>
<td>-200 ... 400 °C</td>
<td>±0.15%</td>
<td>±0.7 K</td>
</tr>
<tr>
<td>W Cu 5% Re-W 26% Re</td>
<td>0 ... 2315 °C</td>
<td>±0.15%</td>
<td>±1 K</td>
</tr>
</tbody>
</table>

**Resistance thermometers**

<table>
<thead>
<tr>
<th>Resistance thermometers</th>
<th>Temperature</th>
<th>Error limits of display</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt 100 (DIN)</td>
<td>-200 ... 600 °C</td>
<td>±0.15%</td>
<td>±0.3 K</td>
</tr>
</tbody>
</table>

**Digital (logic) input**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTL level, OFF = &lt; 2.4 V; ON = &gt; 2.4 V</td>
<td>ON/OFF (potential-free)</td>
</tr>
</tbody>
</table>

**Direct current**

<table>
<thead>
<tr>
<th>Source resistance</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ... 20 mA Δ 0.000 ... 1.000 V via 50 Ω shunt</td>
<td>4 ... 20 mA Δ 0.000 ... 1.000 V via 50 Ω shunt</td>
<td></td>
</tr>
</tbody>
</table>

**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 Vrms (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.

DISPLAY AND OPERATION

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.

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 configured.

Disabling the alarm
With key switch.

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).

POWER SUPPLY

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, ≤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 Vrms (50/60 Hz) for all ranges

**INFLUENCING FACTORS**

**Temperature effect**  
(with a change of 10 K  
Display: ≤±0.1% of display ±1 digit  
Recording: ≤±0.2% of recording span

**Power supply effect**  
Operating voltage AC 90…132 V or 180…250 V  
Display: ≤±0.1% of display ±1 digit  
Recording: like digital display

**Effect of magnetic fields**  
AC (50/60 Hz) or DC field of 400 A/m:  
Display: ≤±0.1% of display ±1 digit  
Recording: ≤±0.5% of recording span

**Effect of source resistance**  
For a change of 1 kΩ:  
**DC voltage**  
Ranges <2 V: ≤±10 μV  
Ranges >6 V: ≤±0.1% of display

**Thermocouples**  
<±10 μV (<±100 μV if TC monitoring has been configured)

**Resistance thermometer**  
Effect of 10 Ω per lead (the three lead resistance must be equal);  
Display: ≤±0.1% of display ±1 digit  
Recording: ≤±0.1% of recording span

**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 or 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

ORDERING DATA
KS 3540
Order no.
1 – channel line recorder 9404 350 10001
2 – channel line recorder 9404 350 20001
3 – channel line recorder 9404 350 30001
4 – channel line recorder 9404 350 40001

OPTIONS (Order separately. Options are fitted into recorder, whereby several are possible in one instrument.)
Description Type code Order no.
Alarm relay 2 relays A 1 9404 350 00011
or 4 relays A 2 9404 350 00021
or 6 relays A 3 9404 350 00031
RS 422-A interface C 3 9404 350 00041
Internal fault & chart end detection Relay output 1) F 1 9404 350 00051
Remote control (5 inputs) R 1 9404 350 00061
Socket for memory card only for configuration data E 1 9404 350 00071
for configuration and measurement data E 2 9404 350 00111
Mathematical functions M 1 9404 350 00081
Door with non-reflective glass H 3 9404 350 00091
Portable version H 5 F 9404 350 00121
Power supply DC 24V P 1 9404 350 00141

1) Not possible with 6 alarm relays (Type code A 3)
2) Not possible im combination with option type P 1

CONSUMABLES AND ACCESSORIES
Description Order no.
Recording pens (3 per colour) red 4012 027 45509
green 4012 027 45511
blue 4012 027 45512
violet 4012 027 45513
Plotter pen (qty. 3) purple 4012 027 45514
Folded chart, 16 m long, graduation linear 4012 027 45489
graduation to specification 9404 392 38001
Memory card 64 kbyte 1) 4012 027 45499
256 kbyte 4012 027 45501
512 kbyte 4012 027 45502
1 Mbyte 4012 027 45507
Shunt resistor for current measurement, 50Ω ± 0,1 % 4012 151 57322
Certificate with calibration protocoll 9404 350 00201

Additional operating instructions
for recorder and options A1, A2, A3, F1, R1: in English 9499 040 25711
in German 9499 040 25718
for options C3, E1, E2, M1: in English 9499 040 27711
in German 9499 040 27718

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