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ControlMonitor CoMo Net®

Type 5863A1...

Web Server for Production Monitoring

Press-fit processes are frequently used joining techniques. However, subsequent nondestructive testing of these connections can be very problematic, virtually making in-process testing a must. CoMo Net is ideal for this purpose, recording the interdependent measurands, e.g. joining force and displacement distance, and evaluating their functional relationship. The evaluation results can then be used to separate nonconforming parts for reprocessing or to divide production into different tolerance classes. Designed as a web server, CoMo Net can be easily integrated into existing Ethernet networks.

Ethernet allows standardized communication at all levels throughout the company network. This opens up the possibility of setting up and displaying data on PCs or web terminals at any location on a local area network (LAN). The CoMo View or CoMo Net with web server functionality is then directly linked to the world of TCP/IP. This allows the use of familiar browser functions to control or view many functions and a great deal of information from anywhere in the world, naturally with appropriate safeguards and access authorizations. This use of the existing network structure simplifies centralized storage of quality data in larger, complex production facilities and offers cost advantages. Remote maintenance and diagnostics allow quick, expert and cost-effective on-site assistance in the event of a problem.

- Flexible monitoring of joining processes and product testing
- intuitive operation, multilingual
- y-channel for connecting piezoelectric and strain gage sensors as well as sensors with voltage output
- x-channel for connecting a displacement sensor (potentiometric, incremental, absolute) or a sensor with voltage output
- Measuring mode y(x) or y(t)
- Measurement and monitoring of, for example:
  - F(t) Force against time
  - F(s) Force against displacement
  - M(t) Torque against time
  - M(φ) Torque against rotation angle
  - s(t) Displacement against time
- Process monitoring in all 4 quadrants
- 12 evaluation functions, which can be freely combined, for monitoring threading, curve shape, slope, hysteresis, blocking force and final position.
- Real-time thresholds for overload protection or for speed control.

- Monitors up to 20 cycles per second
- Fast actuation of SPC via digital I/O
- Fault analysis ovver 20 measuring cycles
- 256 sets of parameters (with memory extension)
- High-speed data transmission for logging process
- Offline data conversion into the following formats: XML, HTML, text, Excel with curve superposition and qs-STAT (dfq)
- Top-hat rail mounting
- Options
  - Profibus DP
  - Incremental encoder for measuring displacement and angle
  - Compact flash memory expansion module

Short Description

The CoMo Net is a one-channel force and displacement measuring system for DIN rail mounting for monitoring and classifying industrial processes and operates on a 24 V industrial supply. 6 PLC-compatible digital inputs and outputs allow the system to be integrated into a machine control system. The CoMo Net can be networked via TCP/IP and Ethernet. The RS-232C interface is used for test and service purposes and for connecting a barcode reader.

Both process values and measured curves can be transmitted cyclically to a data server on the network. The necessary software service for this server is included. In addition to other export criteria, it is possible to choose whether these cyclical transfers are to export the data for all parts, or for only the good or the bad parts.

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Process Evaluation with up to 12 Functions
Up to 12 evaluation functions of different types, such as boxes, thresholds, limit, dy/dt or dy/dx gradient, integral and hysteresis can be activated and freely combined in order to monitor a process. The point of intersection of the curve with each evaluation object can be displayed as a trend or statistic (mean, standard deviation, cp- or cpk-value). The server also allows corresponding process values to be displayed and saved in numerical form. The result of the process evaluation (OK/NOK) is available at the interfaces (digital outputs, Profibus DP or Ethernet) as a control signal.

Quality Assurance and Documentation
The process data related to a specific production order can be saved in the Kistler database CoMo MIS. Quality documents can be produced or current production statistically analyzed with the statistics module integrated in CoMo MIS. The integration of this database into MES/ERP systems is supported.

Measuring Amplifier x-Channel (e.g. Displacement)
Voltage amplifier for potentiometric displacement sensor; power supply through control monitor. Depending on the application selected, the measurands saved are evaluated after the cycle.

Profibus DP (Extension Module)
System integration is possible via the Profibus (with a transmission rate up to 12 Mbaud), which can be provided as an optional extra. The following functions can be controlled:

Control
- Measuring cycle, Start/Stop
- Trigger for data storage
- Taring x,y
- Choose measurement program
- Statistics/Trend deleting
- Query: Measuring readiness/status
- Set reference signal for incremental encoder

Setup
- Evaluation functions

Read-In
- Part identification

Read-Out
- Status information
- Result of process evaluation
- Real-time results (x and y thresholds)
- 10 numerical process values

There is a choice of five different modes, which differ in terms of the amount of memory resources necessary for the input and output buffer of the PLC.

Mode	Bytes in	Bytes out	
Small1	2	3	–
Small2	4	10	–
Large1	12	26	Accommodates process values
Large2	24	50	Accommodates process values
Large3	40	50	Accommodates process values

Incremental – SSI Encoder
Module for optional connection of an incremental linear, angle or rotary encoder. It supports sensors with analog or digital signal output and with or without reference mark. No calibration or jumper settings are necessary. A Heidenhain-compatible connecting cable is available.

Compact Flash Memory Expansion Module (Option)
Slot for inserting a SanDisk compact flash card. Cards from 512 MB to 4 GB are supported. The memory expansion module currently serves as a FIFO buffer for data export and storage of the measuring program inclusive process curves and process results.

Calibration
The transmission factors of all amplifiers (charge, displacement and strain gauge) are checked within the scope of a function check against the capacitance and voltage references present in the CoMo Net. If these are outside the tolerances specified, the CoMo Net must be calibrated with an external charge or voltage source. All calibration values and other information such as the MAC address are stored in the EEPROM on the CA card.
The CoMo Net has CE conformity and complies with EMC standards EN 61000-6-4 (interference emission, industrial areas) and EN 61000-6-2 (interference immunity, industrial areas). Its interference immunity was tested with the grounding screw installed. Inputs and outputs are protected with varistors against electrostatic charges. Its degree of protection is IP20.

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Block Schematic Diagram ControlMonitor CoMo Net®

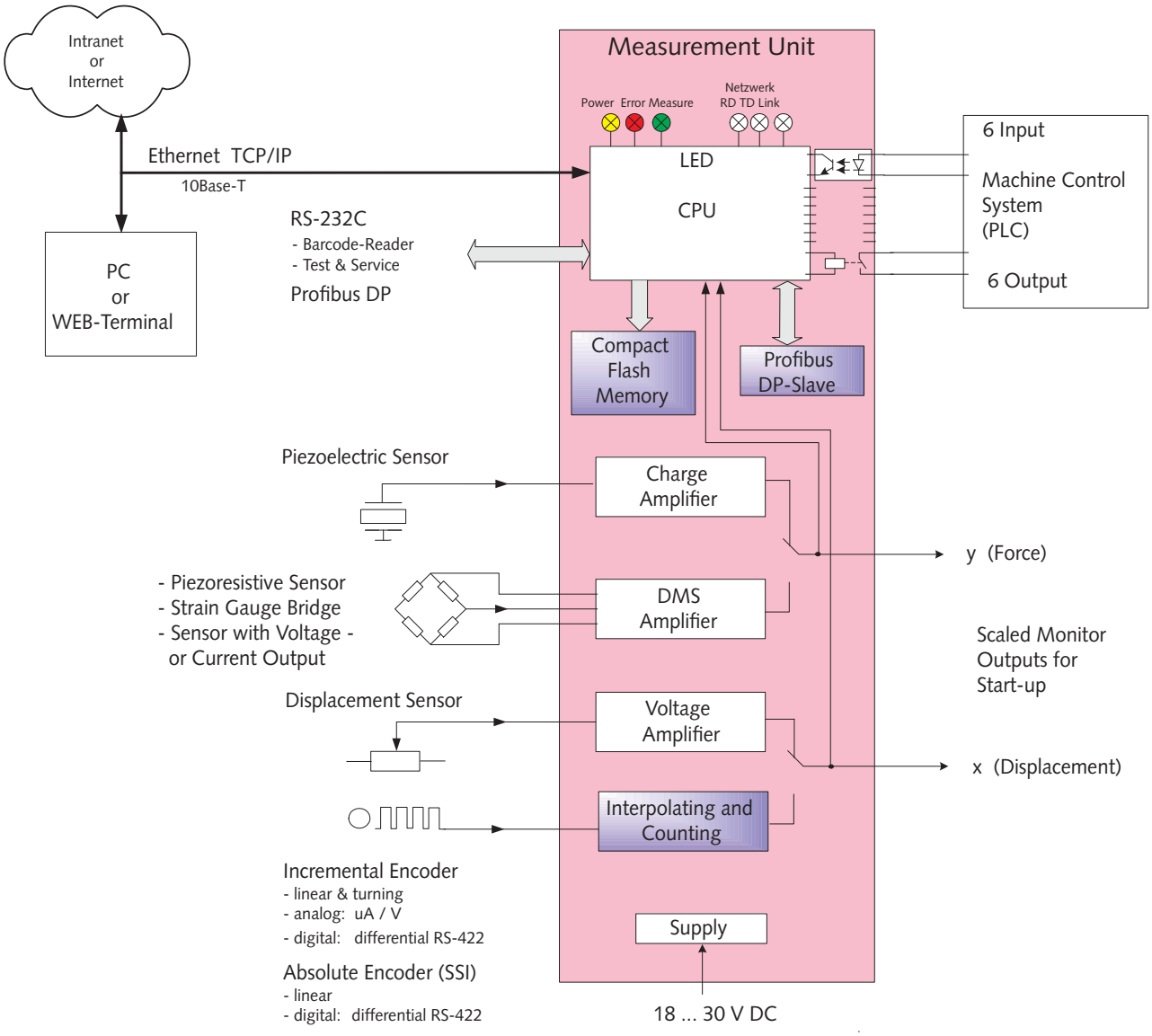

Fig. 1: Block schematic diagram ControlMonitor CoMo Net Type 5863A1…

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Network Integration of Process Monitoring

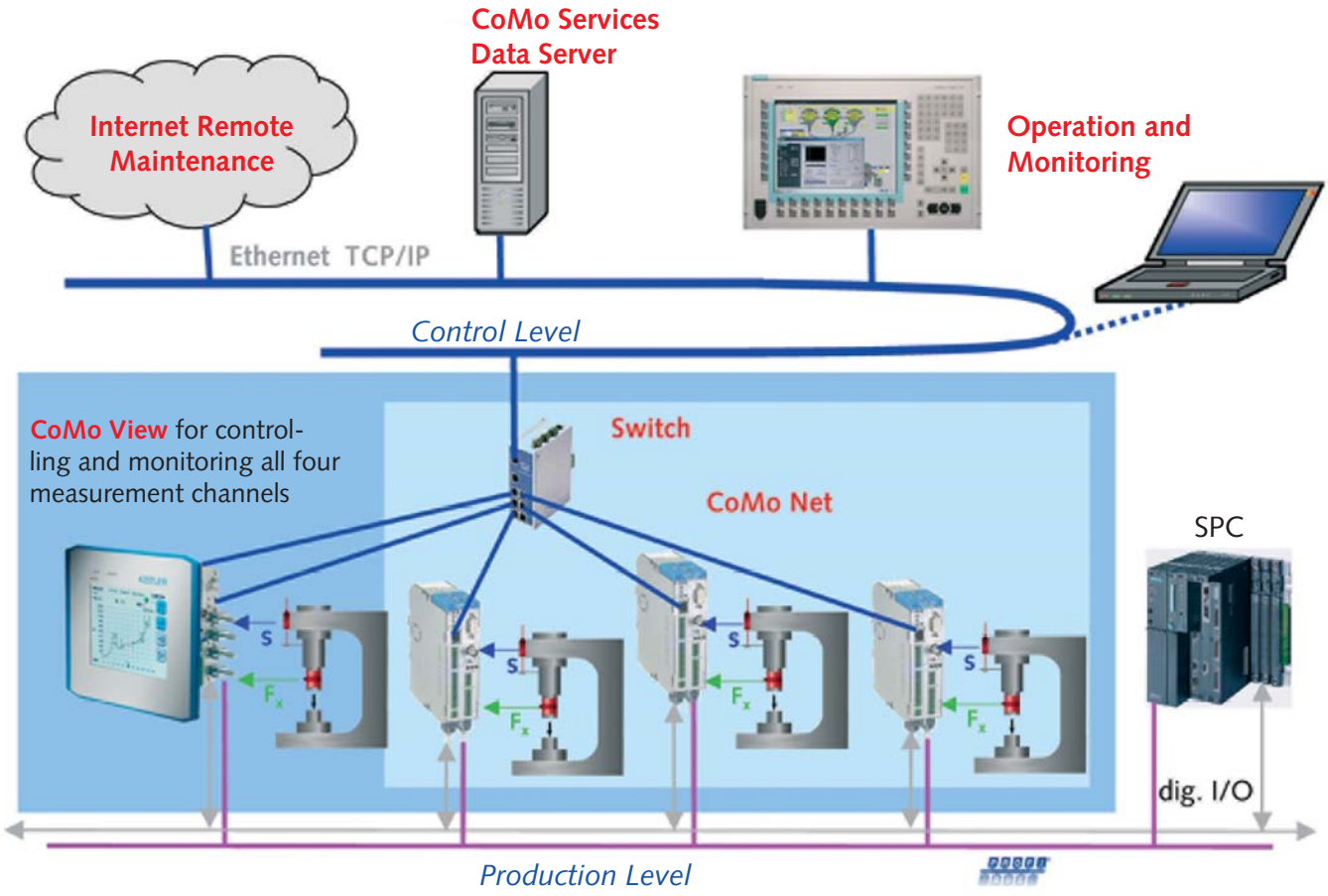

Fig. 2: Integration of single- or multichannel process monitoring into a production network

Monitoring and Control

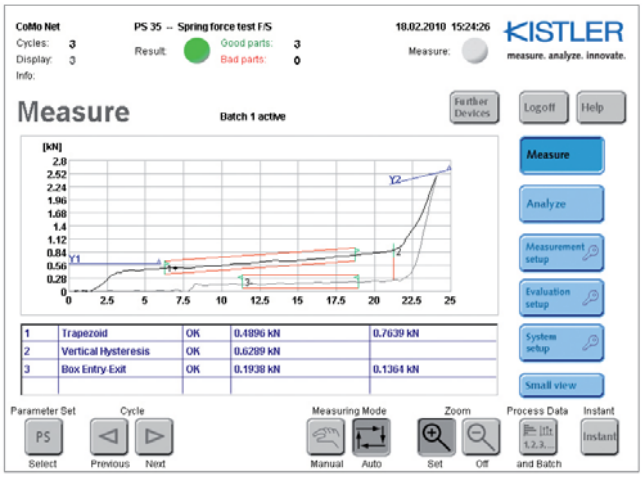

Fig. 3: Measurement

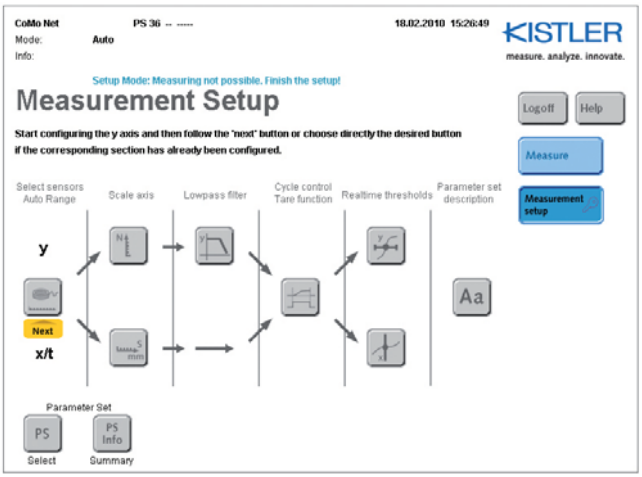

Fig. 4: Measurement setting

Evaluation Functions

Up to 12 evaluation functions of varying types such as boxes, thresholds, limit positions, gradients dy or dx and hysteresis can be activated and freely combined for the purpose of process monitoring.

The point of intersection of the curve with each evaluation object can be displayed as a trend or statistic (mean, standard deviation, cp- or cpk-value). The corresponding process values can be displayed and saved in numerical form. For process evaluation a good/bad control signal is triggered and passed to the interfaces (digital outputs, Profibus DP or Ethernet).

Limit Value Monitoring in Real Time

Real-time thresholds can be used to actuate trigger signals or, for example, to monitor safety criteria (such as overload protection).

Threshold	Quantity
	2
	4

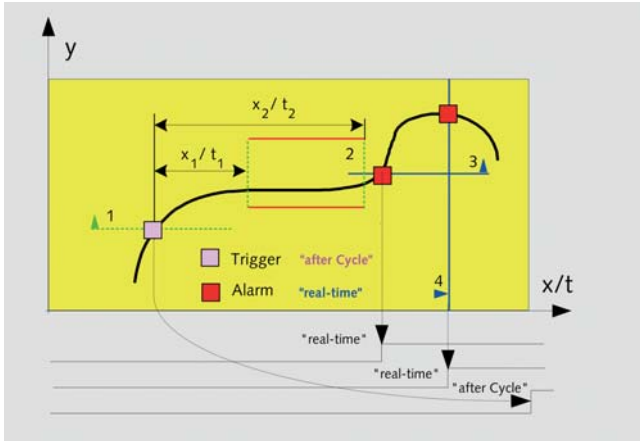

Fig. 5: Real-time threshold monitoring

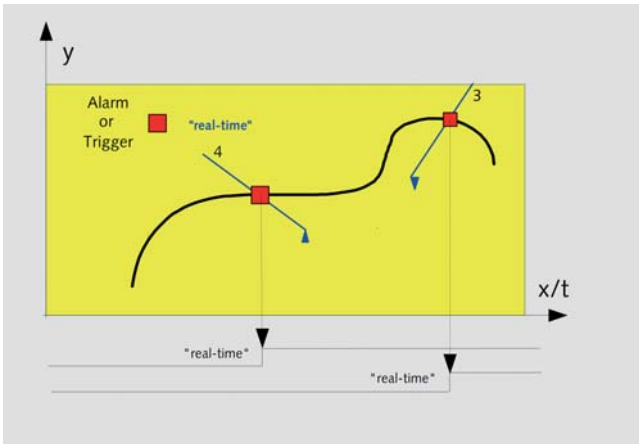

Fig. 6: Oblique real time threshold

Post-Cycle Evaluation Functions and Process Values

Evaluation Function	Numeric Process Values
	Entry/exit point
	Point of intersection
	Stop position Maximum value in end position band
	Difference y_{max}-y_{min} Maximum value y,x resp. y,t Minimum value y,x resp. y,t
	Gradient dy/dx resp. dy/dt Integral ∫y(x).dx resp. ∫y(x).dt
	Hysteresis dy resp. dx

Further thresholds are used to monitor various partial ranges of the signal characteristic. Green thresholds have to be passed through in the direction of the arrow. Red thresholds must not be passed through. Evaluation takes place after the measuring cycle.

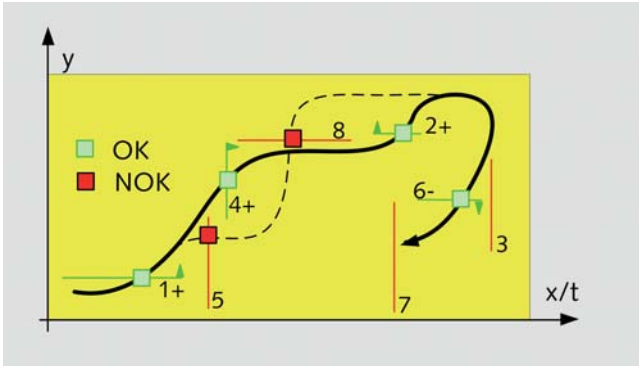

Fig. 7: Thresholds for monitoring partial ranges

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Boxes

The box function is used to monitor whether the signal characteristic enters and exits the prescribed sides of the box. The other sides must not be touched.

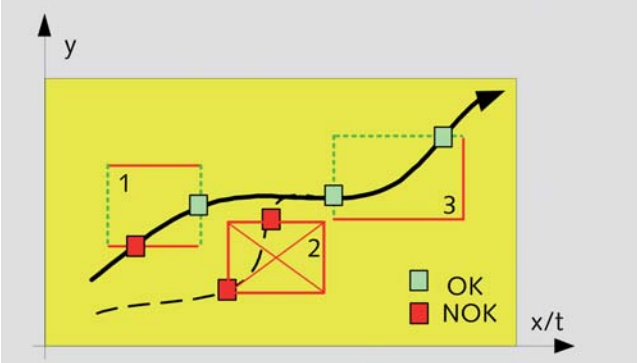

Fig. 8: Monitoring with box functions

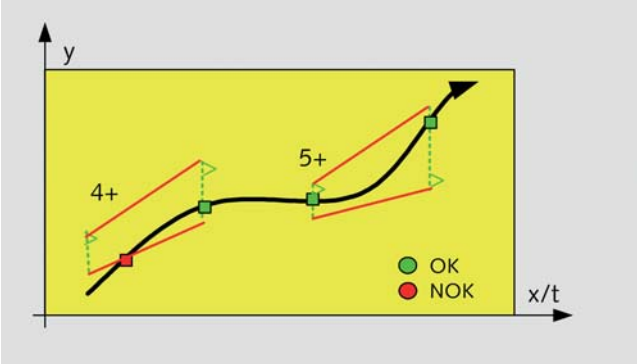

Fig. 9: Monitoring with inclined boxes

Stop Position

Checks whether the y- and x/t-coordinates of the last measuring point lie within the end position band or the end box if the upper limit is switched on.

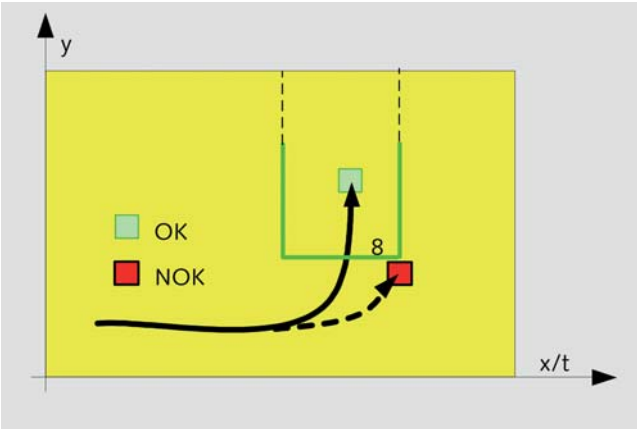

Fig. 10: Process values: coordinates of the stop position

Maximum Limit Box

Checks whether the y-maximum lies within the end box or the end position band.

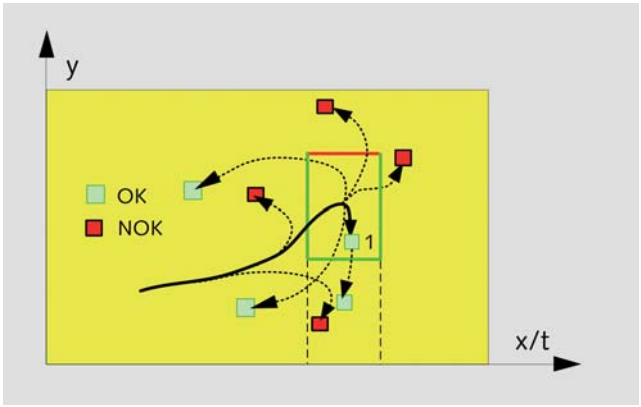

Fig. 11: Process values: maximum values within the end position band

Numerical Process Values

A maximum, minimum or relative maximum (difference between maximum and minimum) is determined and monitored within a box.

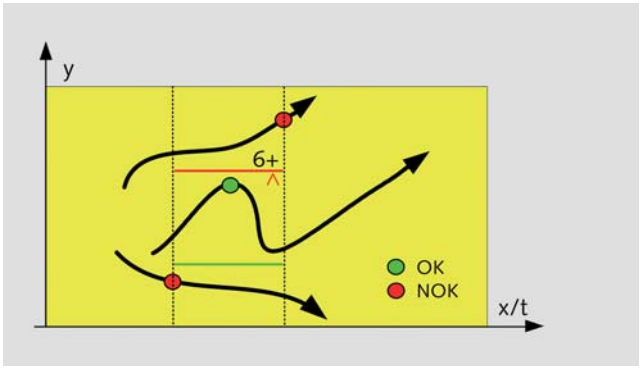

Fig. 12: Maximum

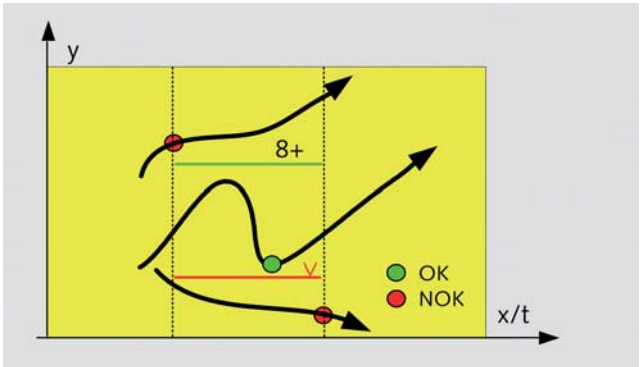

Fig. 13: Minimum

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The reference element for the relative maximum is the smallest measurand within the box limits.

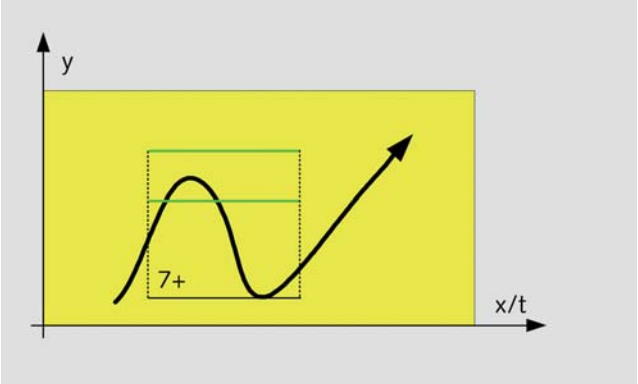

Fig. 14: Relative maximum

Gradient

This evaluates the gradient of the curve between two vertical limits.

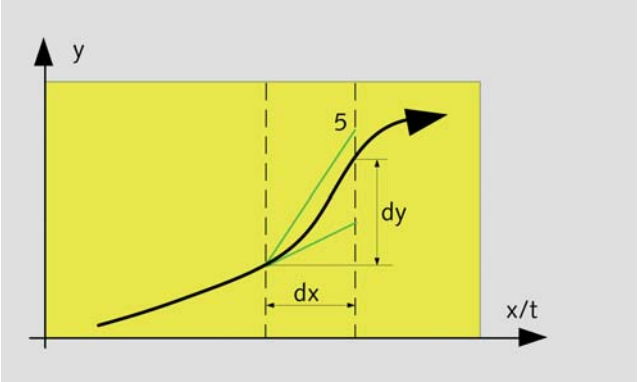

Fig. 15: Process value – gradient

Integral

This calculates the area below the measuring signal curve within the x and t limits respectively.

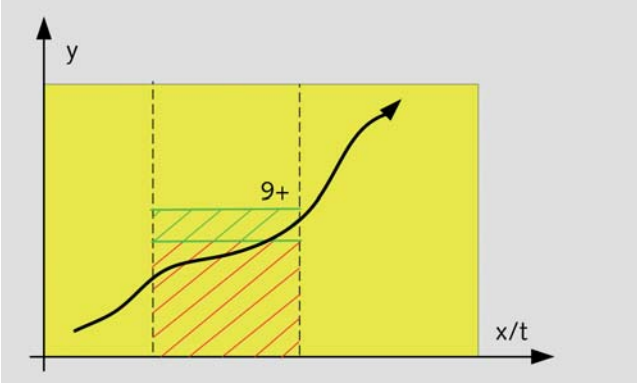

Fig. 16: Process value – integral

Hysteresis

The tolerance of the hysteresis is evaluated in the y or x direction at a specific position.

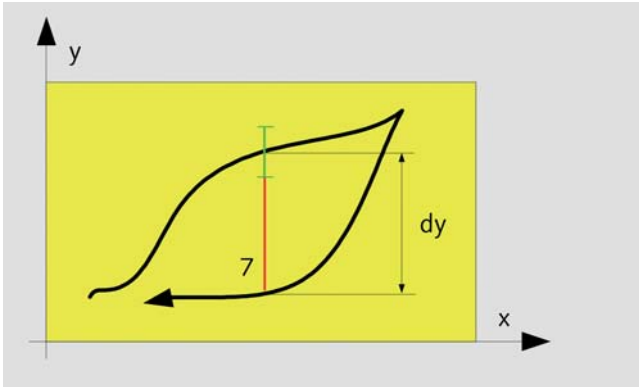

Fig. 17: Process value – dy

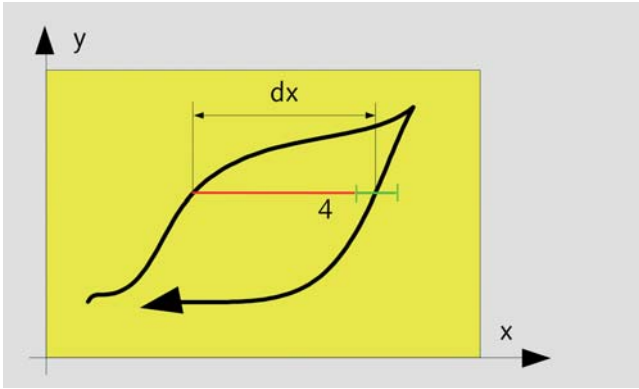

Fig. 18: Process value – dx

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Setting Evaluation/Process Analysis

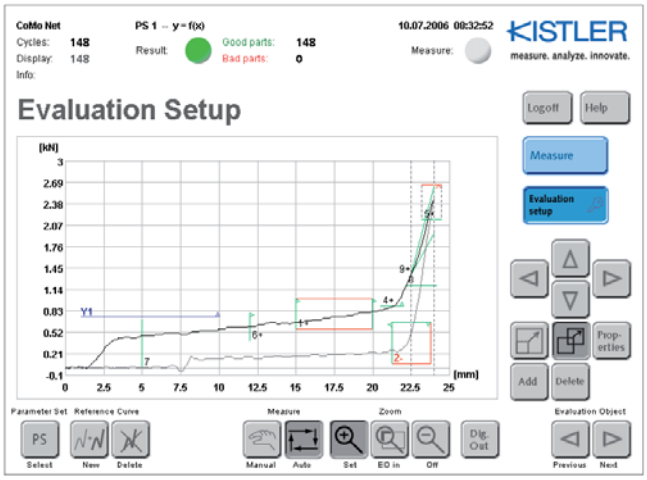

Fig. 19: Setting evaluation

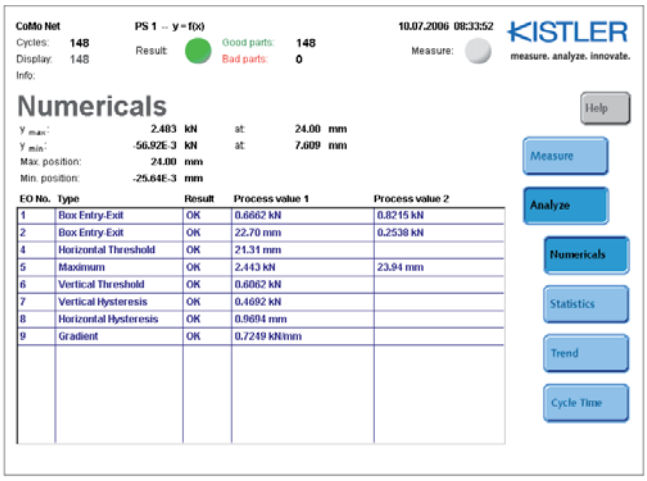

Fig. 20: Numerical analysis

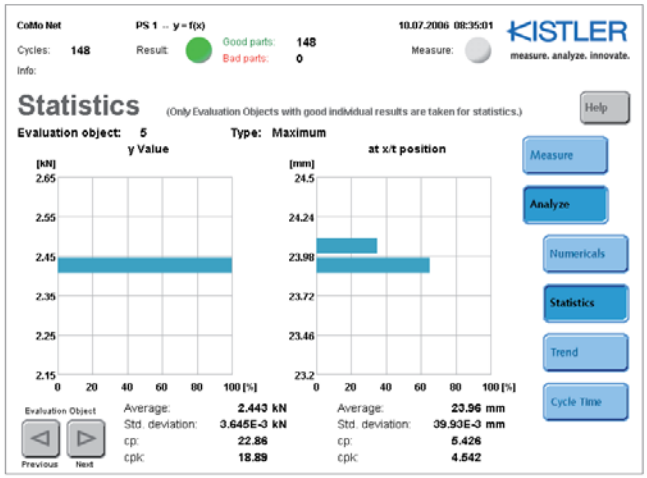

Fig. 21: Statistical analysis

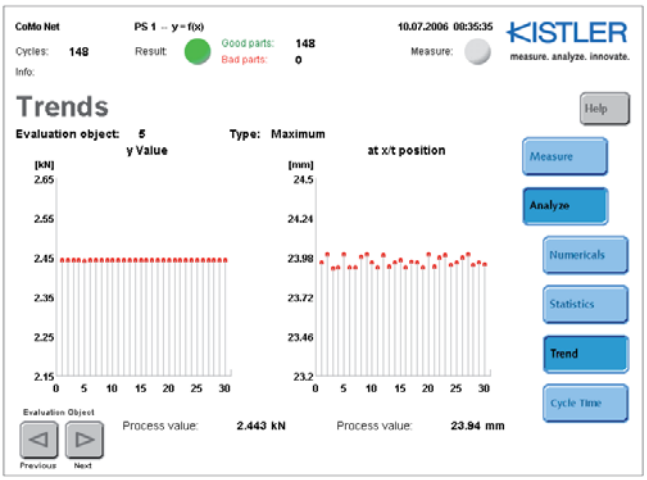

Fig. 22 Trend analysis

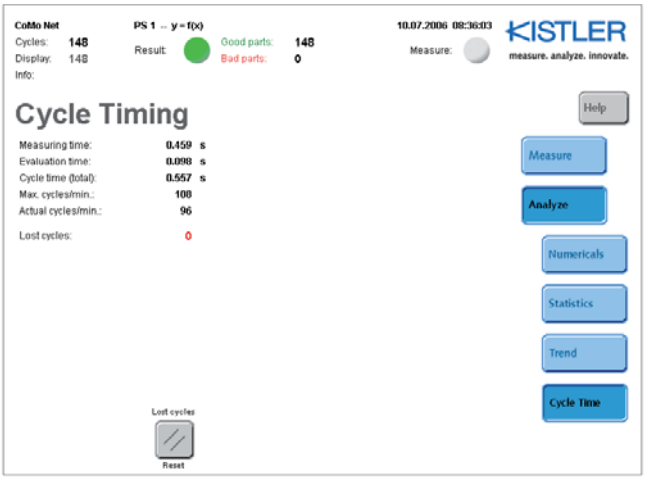

Fig. 23: Cycle time analysis

Technical Data

Analog Inputs (general data)		2
Sampling frequency per channel	kHz	10
Number of measured values per cycle		100 ... 1 000
Resolution of analog/digital converter		
(21 V_{pp})	Bit	12

y Channel

Charge Amplifier for Piezoelectric Sensor (BNC)		
Measuring range	pC	±100 … 1 000 000
(divided into 4 decade partial ranges)		
Anti-aliasing filter, 2nd order	kHz	3
Error		
with calibration	%	<1
without calibration	%	<3
Repeat error	%FS	<0,1
Zero point error and zero transition		
(Reset/Operate)	SW correction	
Switching times		
Reset/Operate	ms	<5
Operate/Reset		
(Residual charge <0,5 % FS)	ms	<15
Drift		
at 25 °C	pC/s	<±0,1
at 50 °C	pC/s	<±0,5

"Force" Voltage Amplifier for Sensors with Voltage Output		
(Instead of charge amplifier)		
Sensor types: Piezoresistive (current fed)		
Strain gauge bridge (voltage-fed, 4 or 6 conductor)		
Sensor with voltage or current output		
Measuring range	V	±0,005 … ±10
Range subdivision		
Range 1	V	±0,005 … ±0,05
Range 2	V	±0,05 … ±0,5
Range 3	V	±0,1 … ±1,0
Range 4	V	±1,0 … ±10
Common Mode		
of the differential input stage	V	±18
Anti-aliasing filter, 2nd order	kHz	3
Error		
Range ±0,005 … ±0,05 V	%	<1,5
Range ±0,05 … ±10 V	%	<1
Max. input voltage (continuous)	V	±20
Taring function (voltage feed after differential stage)		
Voltage source (2 ranges),		
Resolution	V	±1, ±0,1 (0,05 %)
Zero offset in relation to ±10 V output		
Scaling amplifier 1 … 10	V	±1 … ±10
Scaling amplifier >10 … 100	V	±1 … ±10

Power Source for Piezoresistive Sensor		
Supply voltage between +Ex (10 V) and $-I_{Ref}$		
Output current	mA	–4
Error	%	<0,5
Load resistance	kΩ	<4,7

Power Source for Strain Gauge Bridge		
Output voltage	V	5 or 10
Error	%	<0,5
Output current	mA	<40

Remarks

- The effective bridge voltage is measured and the result taken into account by the software (this is important for 6-conductor connections).
- Shunt calibration with selectable external resistance.
- The sum of the currents for the strain gauge bridge supply and the potentiometric displacement sensor must not exceed 60 mA because of the equipment power dissipation.

x Channel

Voltage Amplifier for Potentiometric Displacement Sensor		
Measuring range	V	±0,5 … ±10
Repeat error	%FS	<0,1
Zero offset		
of the input signal, resolution	V	±10 (±0,02)
Anti-aliasing filter, 4th order	kHz	0,65

Power Sources for Displacement Sensor Supply		2
Output voltage	V	±10
Error	%	<0,2
Output current	mA	<20

Expansion Module with Incremental Input (Option)		
Encoder counter	Bit	32
Sensor supply	V, mA	5, <80

Sensor Input, Analog (differential) for cable up to 30 m long			
Interpolation factor		IF	1 ... 10
Frequency, max.		kHz	250
Current signal	A, B	μA_{pp}	5 … 16
	Z	μA_{pp}	2 … 8
Spannungssignal	A, B	V_{pp}	0,6 ... 1,2
	Z	V_{pp}	0,2 ... 0,85

Linear Sensor		
Grating period (GP) according		
to technical data for sensor	µm	1 … 9 999
max. resolution A [A = GP/(IF·TF)]		
with TP = 10, IF = 10 and TF = 4	µm	0,25

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Displacement (A · 4 100 000)		
bipolar	mm	±1 025
min. resolution A [A = GP/(IF·TF)]		
with GP = 10, IF = 1 and TF = 1	µm	10
Displacement (A · 4 100 000)		
bipolar	mm	±41 000

Rotary Encoder

Number of pulses/rev. (PC) according to technical data for sensor	1 … 30 000
max. resolution A [A = 360 °/(PC · IF · TF)]	
with PC = 360, IF = 10 and TF = 4)	0,025 °
Displacement angle (A · 4 100 000)	±102 500 °
min. resolution A [A = 360 °/(PC · IF · TF)]	
with PC = 360, IF = 1 and TF = 1	1 °
Displacement angle (A · 4 100 000)	
bipolar	±4 100 000 °

Sensor Input, Digital

Signal A, B, Z	Level	RS-422A
Frequency, max	MHz	5

Linear Sensor

Grating period (TP) according to technical data for sensor	µm	1 … 9 999
max. resolution A [A = TP/(IF · TF)]		
with TP = 10 µm, IF = 1 without external		
interpolation and TF = 4	µm	2,5
Displacement (A · 4 100 000)		
bipolar	mm	±10 250
min. resolution A [A = TP/(IF · TF)]		
with TP = 10 µm, IF = 1 without external		
interpolation and TF = 1	µm	10
Displacement (A · 4 100 000)		
bipolar	mm	±41 000

Rotary Encoder

Number of pulses/rev. (PC) according to technical data of sensor	1 … 30 000
max. resolution A [A = 360 °/(PC · IF · TF)]	
with PC = 360 and IF = 1 without external	
interpolation and TF = 4	0,25 °
Displacement angle (A · 4 100 000)	
bipolar	±1 025 000 °
min. resolution A [A = 360 °/(PC · IF · TF)]	
with PC = 360 and IF = 1 without external	
interpolation and TF = 1	1 °
Displacement angle (A · 4 100 000)	
bipolar	±4 100 000 °

SSI Interface for Absolute Displacement Encoder

Data and clock pulse	level	RS-422A
Frequency	MHz	1

Interfaces

Analog Monitor Outputs (2 mm sockets, general data)		2
Output current	mA	<3
Error (without error, measuring amplifier)	%	0,5
Monitor Output y (Force)		
Output voltage for		
FS input signal	V	±10
Zero offset	mV	<±10
Zero transition (Reset/Operate)	pC	<±0,5
Monitor Output x (displacement corrected)		
Output voltage for		
FS input signal	V	0 … 10
Zero offset	mV	<±20

Digital Inputs (optocoupler, electrically isolated)		6
Bounce-masking	by software	
Logical input level, High	V	>14
Logical input level, Low	V	<8
Input current at 24 V	mA	5

Digital Outputs		6
(Photo MOS relay, electrically isolated, common feedback)		
Current loading, continuous	mA	<100
Current loading, pulse <0,1 s	mA	<300
Resistance when switched on	Ω	<50 (typ. 30)
Voltage	V	<40

Ethernet 10Base-T (electrically isolated)		
Transmission rate	Mbps	10
Topology	Twisted Pairs	2
LED displays for Receiver/Transmitter (RxD/TxD) and Link		2

Interface RS-232C

(No control leads, level according to standard, electrically isolated)	
Baud rates	19 200
Data format	8 data bits, 1 stop bit, no parity

Profibus DP

Interface	Type	RS-485A
Max. transmission rate	MBaud	12

Memory Expansion Module (Option)

Supported manufacturers		SanDisk
Name		Compact Flash Card
Size	MB	512 … 4 096

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General		
Evaluation time		
(according to the number of functions)	ms	ca. 16 … <500
Parameter sets (with memory expansion)		16 (256)
Parameter switching	ms	35
via digital inputs		
Display for WEB terminal		SVGA (800x600)
Operating temperature range	°C	0 … 50
Power supply	VDC	18 … 30
	W	ca. 7
Voltage between supply connections		
and case	V_{rms}	<40
Case for DIN rail mounting,		
Dimensions (BxHxT)	mm	40x150x127
Degree of protection	IP	30
Weight	kg	0,8

Connections		
Charge input		
for piezoelectric sensor	Type	BNC neg.
"Force" voltage amplifier	Type	Phoenix 3,5 mm
for sensors with voltage output		
(piezoresistive sensor, strain gauge bridge or other)		
Potentiometric displacement sensor	Type	Phoenix 3,5 mm
Incremental displacement sensor	Type	D-Sub-15P
Absolute displacement sensor	Type	D-Sub-15P
Monitor outputs		
x = displacement corrected	Type	2 mm test socket
y = force (charge amplifier or strain gauge)		
Digital outputs, qty. 6	Type	Phoenix 3,5 mm
Digital inputs, qty. 6	Type	Phoenix 3,5 mm
Equipment supply	Type	Phoenix 3,5 mm
Ethernet interface 10Base-T	Type	RJ45
Interface RS-232C	Type	D-Sub-9S
Profibus DP	Type	D-Sub-9S

Remarks
- The recommendations in the operating instructions concerning EMC must be observed.
- For applications subject to EMC, the electrically isolated measuring circuit can be grounded to the case using the cheese-head screw M2,5x5 under the input BNC.

Dimensions

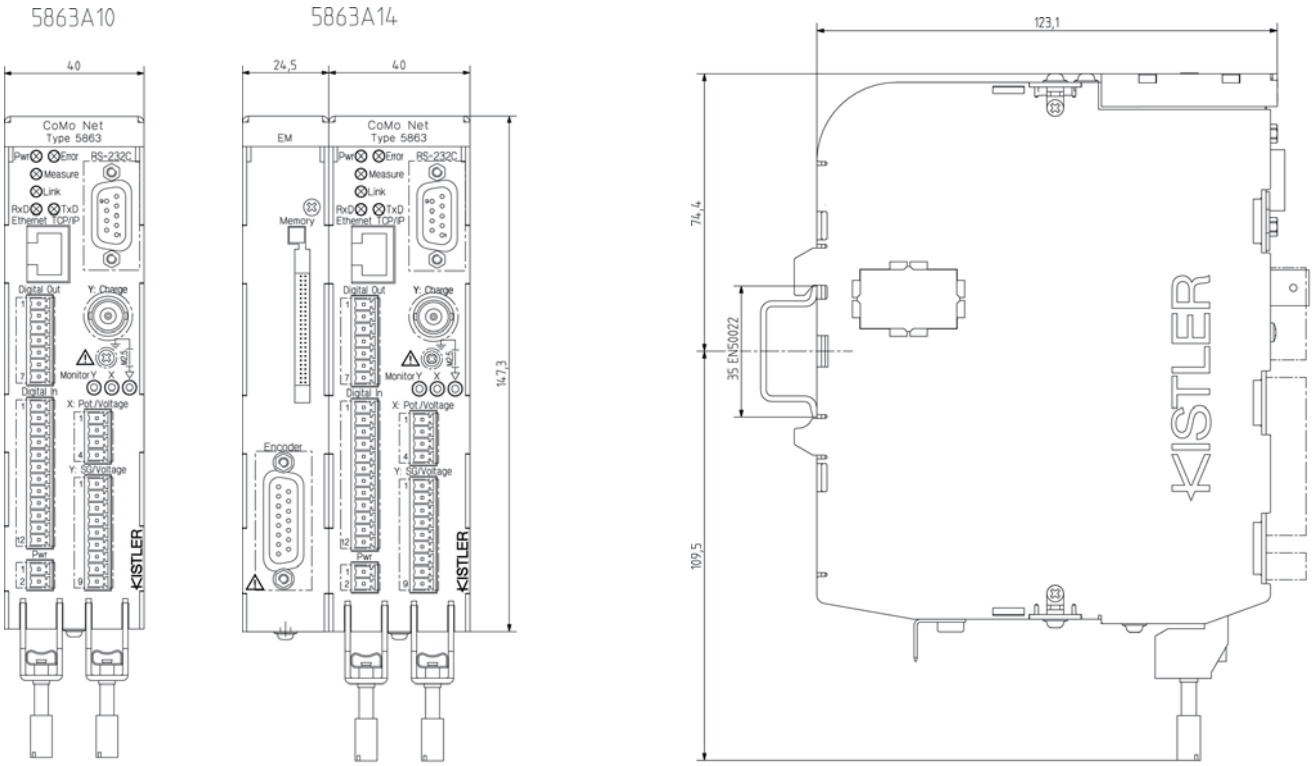

Fig. 24: Dimensions for ControlMonitor CoMo Net Type 5863A1…

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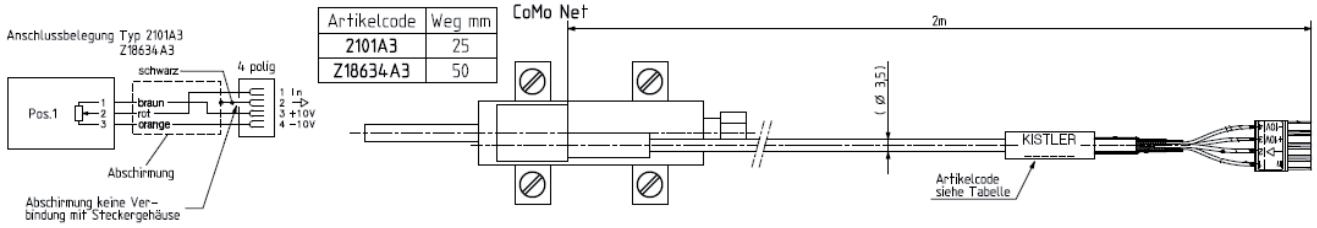
Displacement Sensors

Type 2101A3
Type Z18634A3

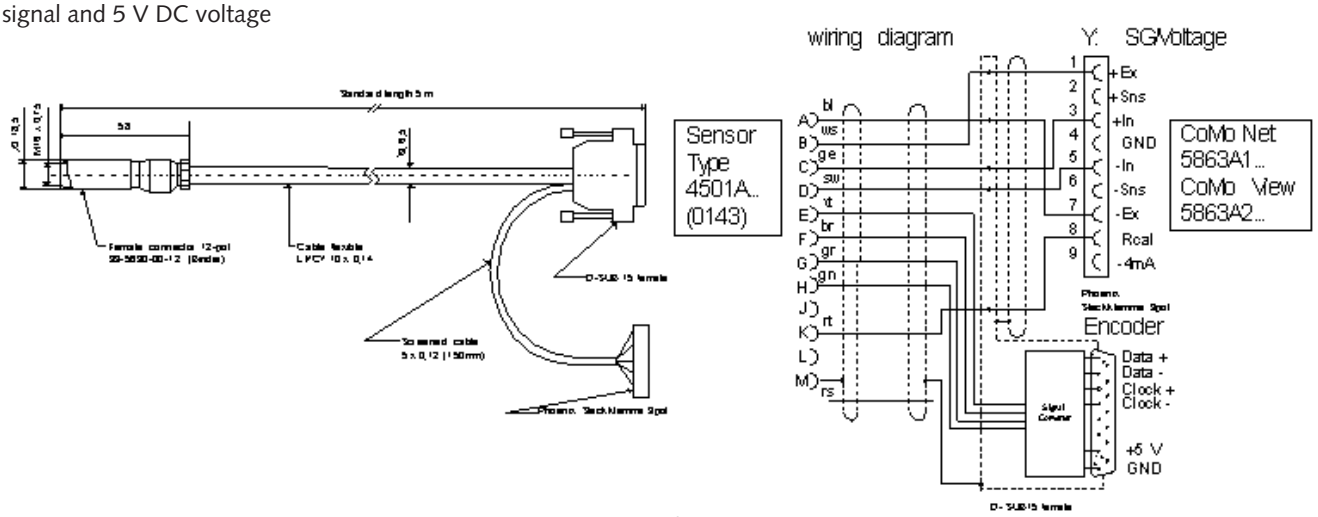
Potentiometric displacement sensor with 25 mm and 50 mm displacement.



Connecting Cables

Type 1200A121A1

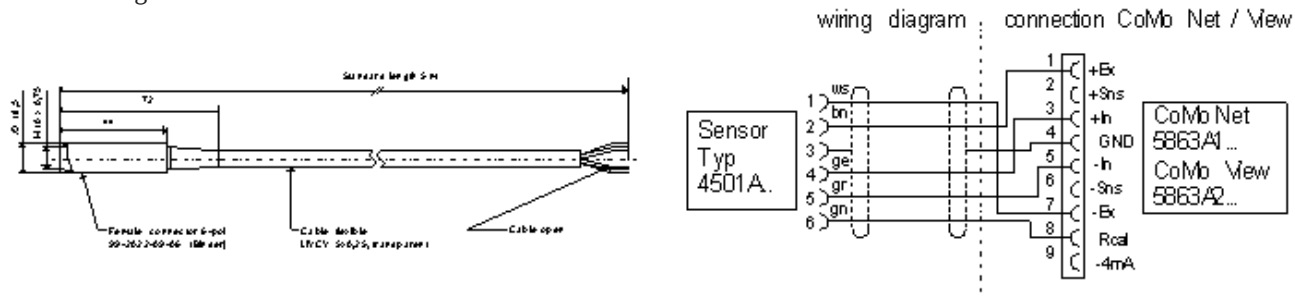
Connecting cable for a torque sensor with slipring and **angle measurement** Type 4501A… Version QA/HA with ±2 mV/V output signal and 5 V DC voltage



Cable connector	M16x0,75, 12 Pin – D-Sub female, 15 Pin/Phoenix 3,5 mm, 9 Pin
Degree of protection (EN60529)	IP40
Temperature	0 … 70 °C

Type KSM103820-5

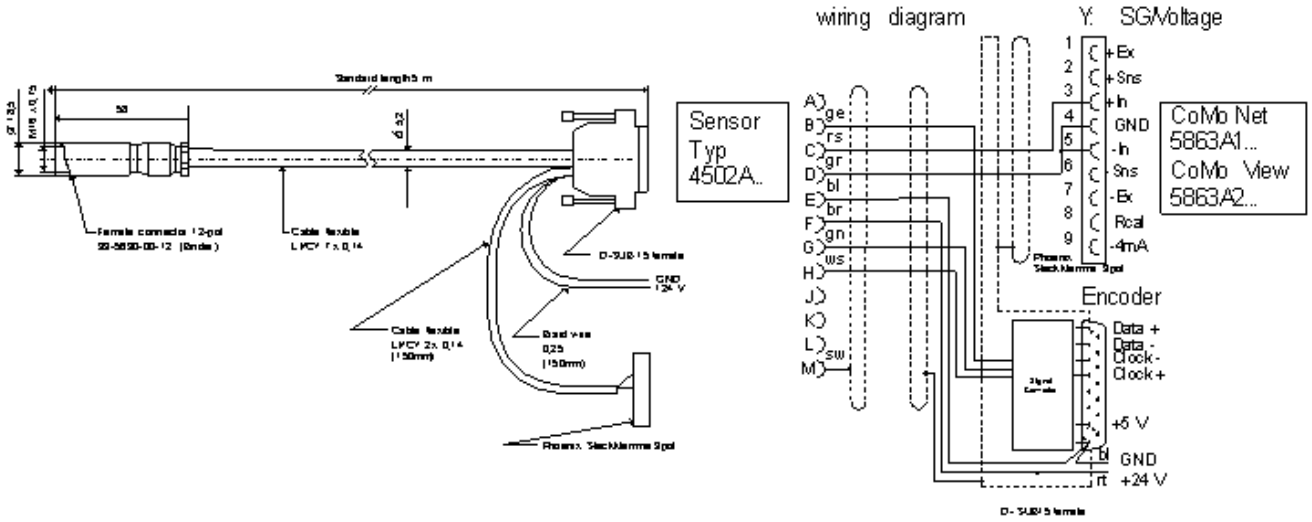
Connecting cable for a torque sensor with slipring **without angle measurement** Type 4501A… with ±2 mV/V output signal and 5 V DC voltage



Cable connector	M16x0,75, 6 Pin – open end
Degree of protection (EN60529)	IP40
Temperature	0 … 70 °C

Type 1200A121A2

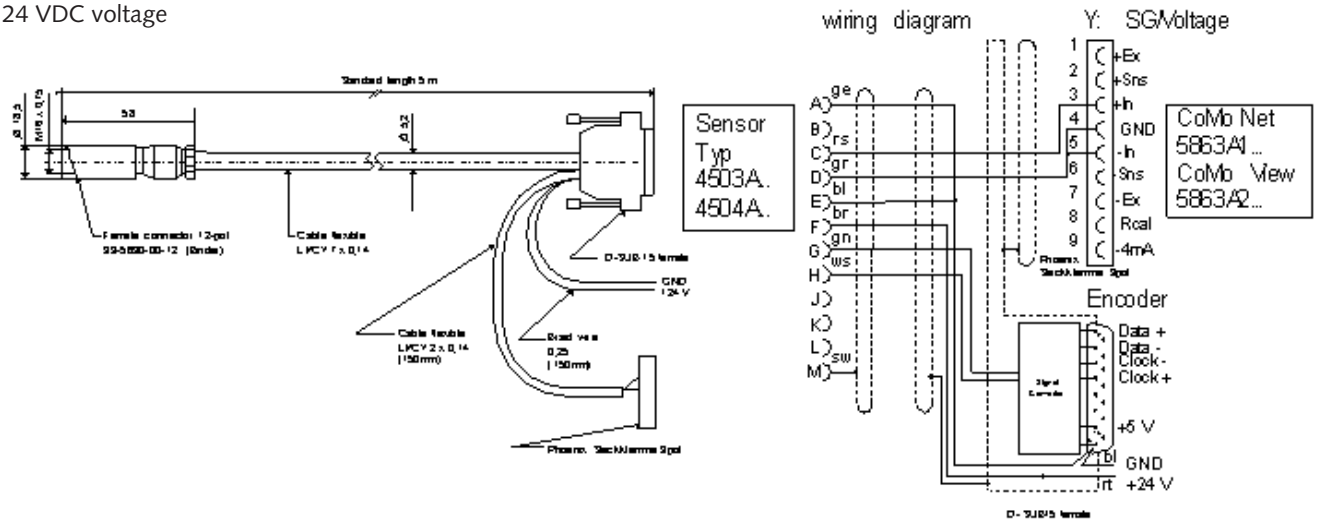
Connecting cable for a MiniSmart torque sensor **with angle measurement** Type 4502A… version QA/HA/RA/RAU and ±5 VDC output signal and 24 VDC voltage



Cable connector	M16x0,75, 12 Pin – D-Sub female, 15 Pin/Phoenix 3,5 mm, 9 Pin/2 wire with open end
Degree of protection (EN60529)	IP40
Temperature	0 … 70 °C

Type 1200A121A3

Connecting cable for a MiniSmart torque sensor **with angle measurement** Type 4503A_B1000 and ±10 VDC output signal and 24 VDC voltage



Cable connector	M16x0,75, 12 Pin – D-Sub female, 15 Pin/Phoenix 3,5 mm, 9 Pin/2 wire with open end
Degree of protection (EN60529)	IP40
Temperature	0 … 70 °C

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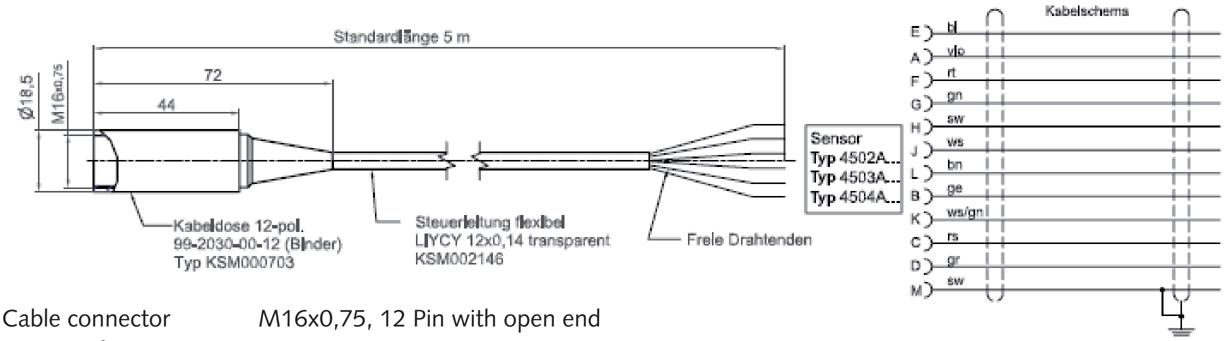
Type KSM124970-5

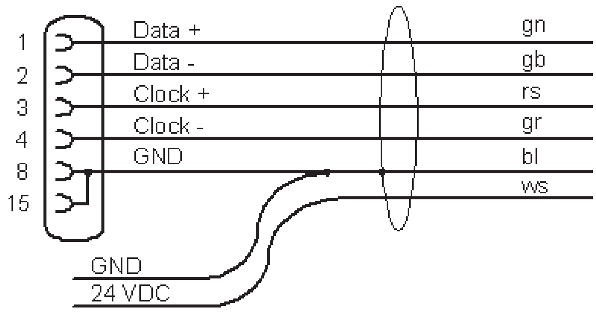
Connecting cable for a MiniSmart torque sensor without angle measurement Type 4502A… version Q/R/H with ±5 V output signal and 5 VDC voltage, Type 4503A__B1000 with ±10 V output signal and 24 VDC voltage, Type 4504A__B10000 with ±10 V output signal and 24 VDC voltage


Standardlänge 5 m
72
44
Ø18,5
M16x0,75
Kabeldose 12-pol.
99-2030-00-12 (Binder)
Typ KSM000703
Steuerleitung flexibel
LIYCY 12x0,14 transparent
KSM002146
Freie Drahtenden
Sensor
Typ 4502A...
Typ 4503A...
Typ 4504A...
Kabelschema
E bl
A vio
F rt
G gn
H sw
J ws
L bn
B ge
K ws/gn
C rs
D gr
M sw

Cable connector	M16x0,75, 12 Pin with open end
Degree of (EN60529) protection	IP40
Temperature	0 … 70 °C

Type Z20722A1

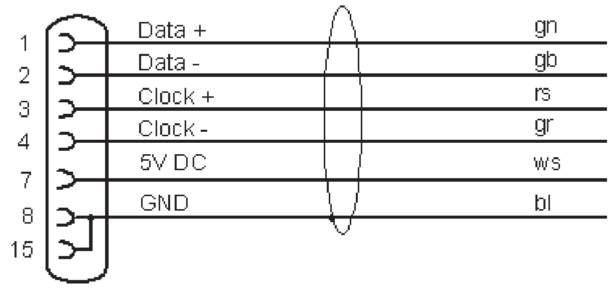
Connecting cable for an absolute displacement sensor with SSI-interface and 24 VDC voltage



Cable connector	D-Sub female, 15 Pin with open end
Degree of (EN60529) protection	IP40
Temperature	0 … 70 °C

Type Z20722A2

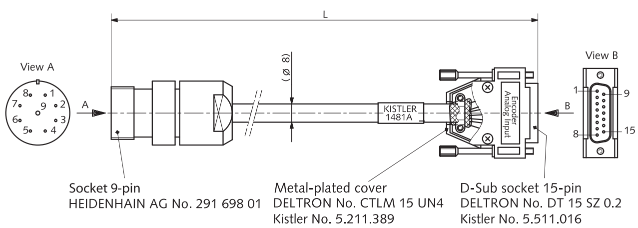
Connecting cable for an absolute displacement sensor with SSI-interface and 5 VDC voltage

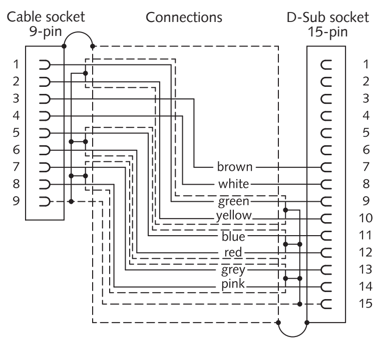


Cable connector	D-Sub female, 15 Pin with open end
Degree of (EN60529) protection	IP40
Temperature	0 … 70 °C

Type 1481Ax

Connecting cable for incremental displacement sensor, (Heidentain MT series, …)





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Accessories Included	Type
• Test cable for monitor outputs,	
2 mm sockets, red	5.590.097
2 mm sockets, black	5.590.096
• Ethernet crossover cable, category 5 STP, 2xRJ45, Length = 3 m	5.590.235

Optional Accessories

Displacement Sensors	Type
• Potentiometric displacement sensor with Phoenix connector 4-pin	
25 mm	2101A3
50 mm	Z18634A3
• For more displacement sensors please check www.Kistler.com, Search term: displacement sensor	
• Connecting cable for incremental displacement sensor compatible with Heidenhain Type MT…	
Length = 1 m	1481A1
Length = 2 m	1481A2

Connecting Cable Type	
• Connecting cable for torque sensor Type 4501A…, Version QA/HA with angle measurement, Length = 5 m	1200A121A1
Length = sp (l_{min} = 0,5 m, l_{max} = 5 m)	1200A121A1sp
• Connecting cable for torque sensor Type 4501A…, Version Q/R/H without angle measurement, Length = 5 m	KSM103820-5
• Connecting cable for torque sensor Type 4502A…, Version QA/HA/ RA/RAU, with angle measurement, Length = 5 m	1200A121A2
Length = sp (l_{min} = 0,5 m, l_{max} = 5 m)	1200A121A2sp
• Connecting cable for torque sensor Type 4503A3__B1000, with angle measurement, Length = 5 m	1200A121A3
Length = sp (l_{min} = 0,5 m, l_{max} = 5 m)	1200A121A3sp
• Connecting cable for torque sensor Type 4502A… Version Q/R/H, Typ 4503A__B1000 oder Typ 4504A__B10000 without angle measurement, Length = 5 m	KSM124970-5
• Connecting cable for an absolute displacement with SSI-interface, with 24 VDC voltage, Length = 5 m (open end)	Z20722A1
• Connecting cable for an absolute displacement with SSI-interface with 5 VDC voltage, Length = 5 m (open end)	Z20722A2
• RS-232C cable, null modem, D-Sub-9P/D-Sub-9S, Length 5 m	1200A27

Simulation Hardware	Type
• Simulator for feeding in force and displacement signals	Z15822
• Cable set suitable for Type Z15822	Z17862-1
	Z17862-2
• CD-ROM with Software Manufacturing Information System (MIS) for storing of production data in a database. The statistic tool (included in scope of delivery) analyses the production data and clearly describes the production status.	on demand

Ordering Key

Type 5863A ☐

CoMo Net® Base Unit Network connection via Ethernet 10 Mbit/s interface with RJ45 port, 2-channel amplifier, y measuring channel for charge, voltage and strain gage, x measuring channel for voltage and potentiometric sensor	**10**
CoMo Net® Base Unit with built-in **Profibus DP interface**	**11**
CoMo Net® Base Unit and expansion module with **compact flash memory expansion module**, incl. Compact Flash memory 4 GB	**12**
CoMo Net® Base Unit and expansion module with **incremental module** for connecting absolute and relative displacement sensor input signal (analog Vpp, Ipp or digital), mounted	**13**
CoMo Net® Base Unit and expansion module with **compact flash expansion module** incl. Compact Flash memory 4 GB and **incremental input** for connecting absolute and relative displacement sensor input signal (analog Vpp, Ipp or digital), mounted	**14**
CoMo Net® Base Unit with built-in **Profibus DP interface** and expansion module with **incremental input** for connecting absolute and relative displacement sensor input signal (analog Vpp, Ipp or digital), mounted	**15**
CoMo Net® Base Unit with built-in **Profibus DP interface** and expansion module with **compact flash memory expansion module** incl. Compact Flash memory 4GB and **incremental input** for connecting absolute and relative displacement sensor input signal (analog Vpp, Ipp or digital), mounted	**16**
CoMo Net® Base Unit with built-in **Profibus DP interface** and expansion module with **compact flash memory expansion module**, including Compact Flash memory 4 GB	**17**

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