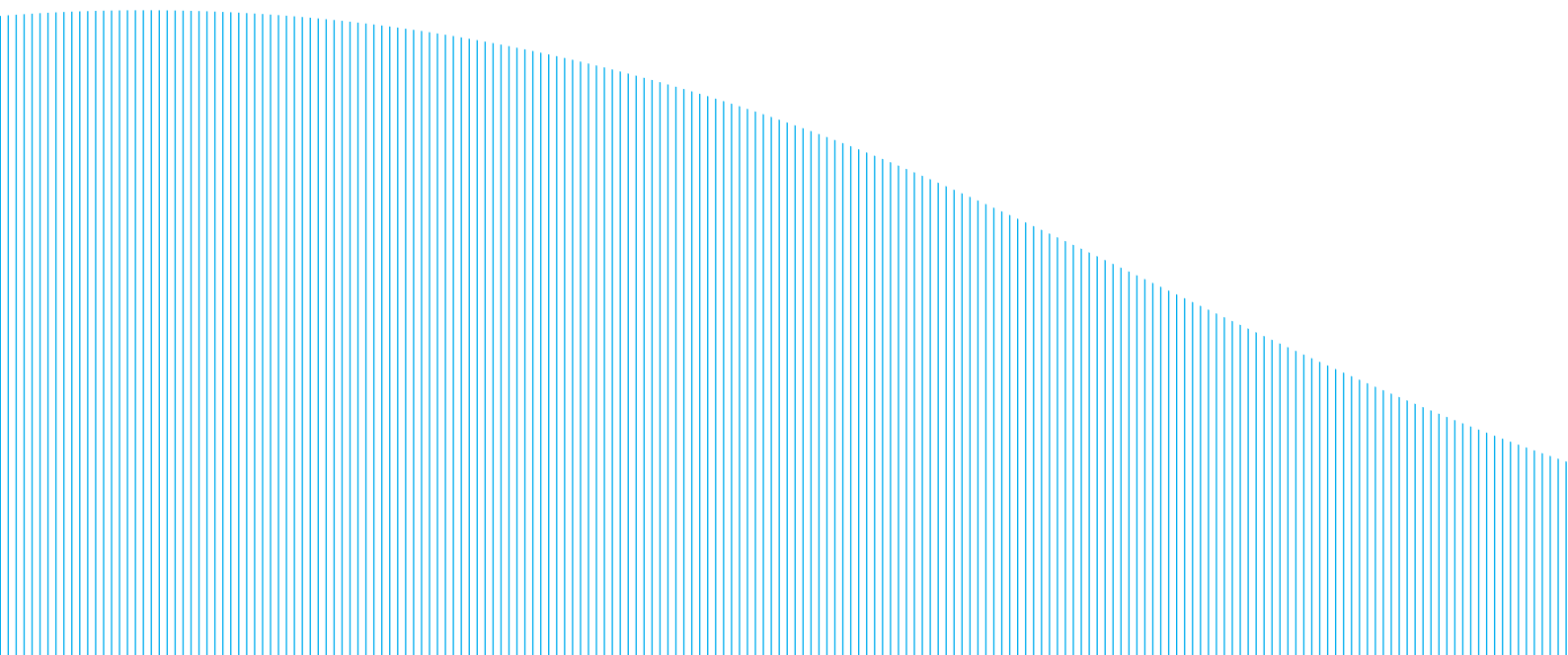
Measuring and control technology for

Data cables, automotive cables and building wires

SIKORA
Technology To Perfection



Content

Systems for length measurement are available upon request.

Introduction

SIKORA AG is a leading manufacturer and supplier of innovative online measuring, control, inspection, analysis and sorting technology for the wire and cable, hose and tube, sheets, optical fiber and plastics industries. Worldwide, users of these measuring devices benefit from increased quality, profitability and efficiency of the manufacturing process. Modern laser and X-ray technologies measure product parameters such as diameter, ovality, wall thickness and concentricity, precisely and reliably.

Continuous control of production data helps to avoid wall thickness oversizes and allows more efficient material usage. The cable manufacturer consumes less insulation material and achieves a more efficient material usage. Every micrometer of insulation material that can be saved by the use of measuring and control technology makes production more economical and saves increasingly scarce resources.

SIKORA is headquartered in Bremen, Germany. Since 1973, the high-quality devices have been developed and manufactured at this site. When it comes to service and sales, SIKORA is globally active with operating subsidiaries in Brazil, China, France, India, Italy, Japan, Korea, Malaysia, Mexico, Poland, Turkey, the United Arab Emirates and the USA. In cooperation with more than 30 local representatives worldwide, SIKORA serves all customer demands for optimum quality control and productivity. In addition, international service locations assure fast and reliable customer support on site, any time.

Since 1993, SIKORA has been meeting the requirements of DIN EN ISO 9001. The certification confirms SIKORA's focus on continuous improvement. Customer satisfaction is SIKORA's primary objective.

Innovation, technological know-how, quality and service are the four pillars of SIKORA's company philosophy. A strong research and development team continuously works on the development of new technologies, enabling manufacturers of data and automotive cables and building wires to increase process reliability, efficiency and the ecological balance of their production lines.

Measuring devices for the production of data cables, automotive cables and building wires

Manufacturing of data cables, automotive cables or building wires requires continuous monitoring of the cable parameters, such as the wall thickness, concentricity, diameter and ovality. Of course, all delivered cables have to be free of defects. SIKORA offers innovative, user-friendly measuring, control and testing systems that are specifically designed for quality control of these cable types during the production process.

1 PREHEATER 6000 TC – The perfect temperature at the push of a button

PREHEATER 6000 TC

Preheating system with integrated temperature measurement and control

Manufacturers of cables, specifically automotive and data cables, require reliable conductor preheating to ensure an optimum adhesion of the insulation on the wire, or controlled foaming. With the PREHEATER 6000 TC (Temperature Controlled), SIKORA offers an advanced solution for a precise conductor preheating, the basis for high-quality cable production and a repeatable control of the process.

The PREHEATER 6000 TC is available for temperatures from 50 to 150 °C (optionally 250 °C), for a product diameter of 0.32 to 2.8 mm (0.08 to 6 mm²) and for a line speed of up to 2,500 m/min. Preheating for larger sized wires is available on request.

In some applications, it may be sufficient to control the output power of a conductor preheating device, only depending on the conductor size and type, line speed and required temperature. However, there are numerous influences on the accuracy of the conductor temperature, such as the ambient temperature, the initial temperature of the conductor and particularly the development of the temperature of the wire guiding short-circuit wheel within the first ten to 20 minutes after starting the production or after an interruption of the production.

The PREHEATER 6000 TC is positioned before the extruder and conductively heats the conductor to the desired nominal temperature. The intelligent combination of the integrated non-contact measurement of the conductor temperature and the controlling module of the PREHEATER 6000 TC allows continuous adjustments to the heating power of the device to assure the correct temperature. The result is a stable temperature of the wire that always matches the set nominal temperature, independent of the conductor material, the dimensions of the conductor and the line speed. No further settings are necessary.

Bright LED displays directly at the PREHEATER 6000 TC clearly show the measured temperature from all directions.

Innovative current pre-control for highest precision in temperature control

The PREHEATER 6000 TC is characterized by its innovative current pre-control. During start-up processes, the current pre-control first intervenes in the heating phase of the system. This results in rapid heating and temperature pre-control of the conductor within a few seconds, for a precise conductor temperature, and thus, a fast start-up process. The precise temperature value of the heated conductor is then verified with the non-contact IR camera and readjusted if necessary.

Whether temperature control with IR camera switched on or in manual mode – with the SIKORA current pre-control in the PREHEATER 6000 TC, a precise and reliable control of the conductor temperature is always guaranteed under all production conditions.

Technical Data

Functional Principle
Conductive heating including non-contact measurement and control of the conductor temperature

Conductor Material
Copper, aluminum, steel

Diameter Range
0.45 - 2.8 mm (0.16 - 6 mm²) – standard system
0.32 - 1.2 mm (0.08 - 1 mm²) – small wire system
0.32 - 2.8 mm (0.08 - 6 mm²) – wide range system*
Given dimensions are for solid round conductors (for stranded conductors). Larger diameters on request

Line Speed
From 50 up to 2,500 m/min**

Heating Frequency
2,000 Hz

Power Rating
10, 20, 30 or 35 kW (others on request)

Conductor Temperature
+ 50 to + 150 °C (optionally + 250 °C), based on an initial temperature of the conductor of + 20 °C (Temperatures below + 50 °C on request)

Power Supply
3 phases 400 V, ± 10 %, 47 to 63 Hz

Enviromental Temperature
+ 15 to + 45 °C

Humidity
Max. 95 %, no condensation

Interfaces
Ethernet/UDP interface, serial interface RS485 + RS232
Optional: 1 analog input and 1 analog output, 0 to 10 V, industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet)

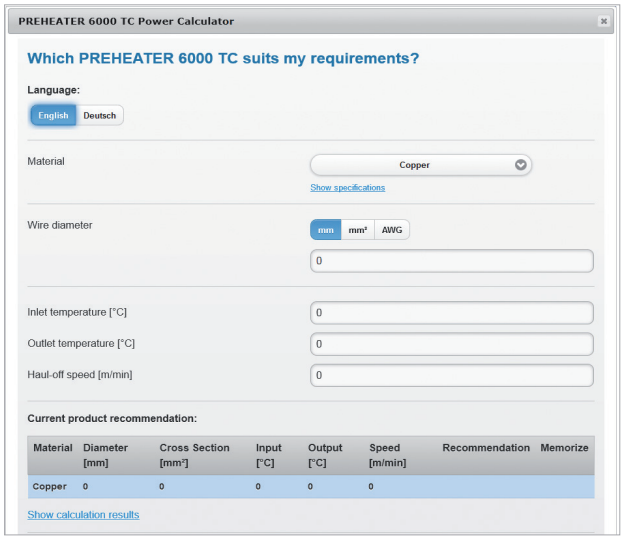
* For applications where smaller and bigger wires are produced on the same line

** The maximum line speed depends on the conductor size, desired temperature and the power of the selected PREHEATER 6000 TC

ISO 9001 verification
For the calibration of the PREHEATER 6000 TC, SIKORA offers a calibration set containing a gold-coated sensor with a diameter of 1 mm and a very low emission value as well as oxidation capability, which guarantees a precise measurement and a long working life. The calibration is easy and fast and ensures regular safety for production lines by comparing contact and non-contact temperature measurements.

Online Power Calculator PREHEATER 6000 TC
Three device models are available for the power range of 10, 20, 30 and 35 kW. A power calculator on the SIKORA website www.sikora.net/powercalc assists the customer in choosing the optimal device for his needs.

The SIKORA temperature measuring system is also available as the stand-alone system WIRE-TEMP 6000.



Online power calculator
www.sikora.net/powercalc

Typical features
- Optimum adhesion of the PE (or other plastics) on the conductor due to the unique conductor preheating
- Perfect foaming control
- Continous non-contact temperature measurement and control
- Wire break detection (optional)
- The PREHEATER 6000 TC can easily be installed into new lines and retrofitted into existing lines

2 CENTERVIEW 8000 – The most valuable system in cable production

CENTERVIEW 8010e

CENTERVIEW 8025e

8-point eccentricity measurement
4-axis diameter measurement
8-point ovality measurement

The CENTERVIEW 8000 is a non-contact measuring system, specifically designed for production lines of all round cables with single or stranded conductors or foamed insulations. Typical applications are automotive, telephone, RF, LAN or coax cables.

The SIKORA system measures the concentricity, wall thickness, diameter and the ovality of cables with high single value precision during production. The measuring values are taken from four axes (diameter, ovality) respectively at eight points (concentricity) and are visualized on an integrated display or at the processor systems of the ECOCONTROL Series. The operator immediately receives clear information about diameter and eccentricity values that can be used instantly to control the extruder speed or haul-off speed and centering of the cross head. This assures maximum material savings, online quality control and a repeatable production process. The measuring system is suitable for product diameters from 0.25 to 10 and 0.5 to 25 mm. The CENTERVIEW 8000 is the only online eccentricity measuring device in the market with integrated 4-axis lump detection.

Measurement of micro-coax cables

For a number of applications, such as mobile phones, LED displays or medical probes, micro-sized wires, so called micro-coax cables, are used. For this field of application, the CENTERVIEW 8010 is optionally also available for product diameters from 0.1 to 10 mm.

Automatic gauge head positioning

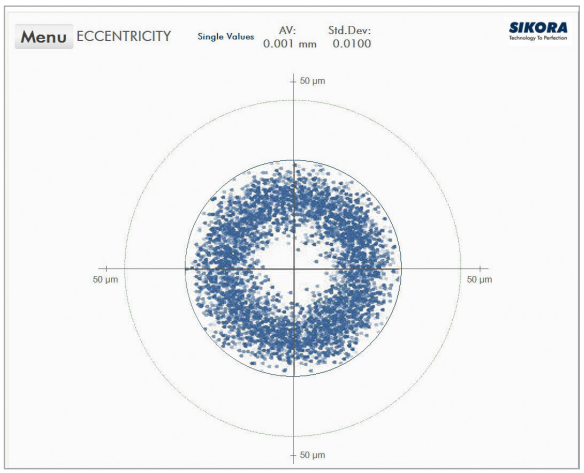
The CENTERVIEW 8000 automatically centers to the position of the conductor in the gauge head, without touching the object to be measured. As a result of the automatic gauge head positioning, a complex, manual alignment of the device or a mechanic guiding of the cable before or after the CENTERVIEW 8000 is not necessary.

The CENTERVIEW 8000 provides the operator with maintenance-freedom, reliability and life-long precision. Start-up losses are avoided, cable quality is permanently improved and the productivity of the line is increased simultaneously.

Integrated monitor
Optionally integrated in the CENTERVIEW 8000e is a 7" TFT monitor, which displays the relevant measuring values. The operation is intuitive and menu-driven via touch screen.

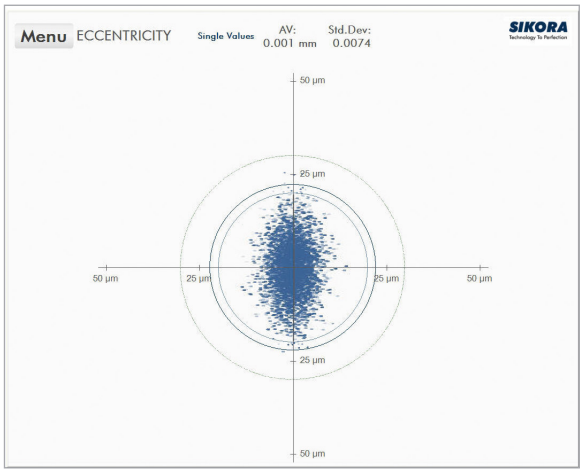
The scatter plot displays the distribution of short-term variations
The scatter plot is a visualization of 5,000 single values from the CENTERVIEW 8000, which are displayed on the CENTERVIEW's integrated monitor or on an optional ECOCONTROL system (see page 21). With the help of the scatter plot, the distribution of short-term variations of the eccentricity is graphically displayed. Every single dot represents a single value of the eccentricity regarding value and direction. The distribution of the scatter plot highlights the standard deviation of the eccentricity.

Ring type distribution of the single values
A ring type scatter plot indicates a permanently rotating eccentricity value, which could be a result of a rotating (oscillating) conductor prior to the extruder crosshead.



Random, circular type distribution of the single values
A circular distribution of the single values of the eccentricity shows their range of variation. The representation helps to optimize the extrusion process with regard to a minimum standard deviation.

Ellipse type distribution of the single values
An ellipse type distribution of the single dots happens if the conductor is oscillating or vibrating in one direction directly before entering the crosshead, and therefore, causes eccentricity variations.

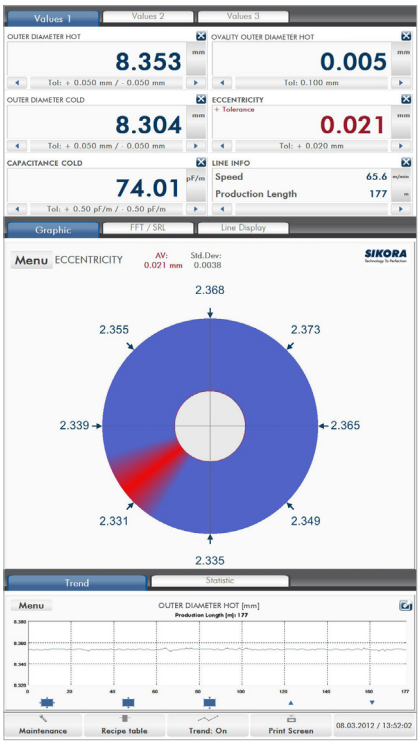


Standard display

The standard way of representing eccentricity using a cross-section of the cable is the tool for the operator when centering the crosshead. Only the display of single values in the form of a scatter plot provides the operator with the necessary information to take suitable measures to optimize concentricity.

Typical features

- Non-contact 8-point concentricity measurement
- 4-axis diameter and 4-axis ovality measurement
- Scatter plot shows distribution of short-term variations
- Automatic centering of the gauge head to the cable position
- Integrated 7" TFT monitor for the display of production data
- Measurement of micro-coax cables



ECOCONTROL 6000 main screen with standard presentation of eccentricity

Technical Data CENTERVIEW 8000

Measuring Principle

Non-contact, optical/inductive with 4-axis CCD line technology combined with impulse-driven laser light sources

Exposure Time

0.25 µs

		Accuracy		Repeatability		Measuring
Product Name	Prod. Diameter	Eccentricity	Diameter	Eccentricity	Diameter	rate
CENTERVIEW 8010*	0.25 - 10 mm**	better ± 1 µm***	± 0.5 µm	± 1 µm	± 0.1 µm	500/s
CENTERVIEW 8025*	0.5 - 25 mm	better ± 2.5 µm***	± 1 µm	± 2 µm	± 0.2 µm	500/s

* All data also applies to the CENTERVIEW 8010/8025e and CENTERVIEW 8010/8025 C models

** Optionally, the CENTERVIEW 8010 is also available for micro-coax cables with product diameters from 0.1 to 10 mm

*** Stranded: 2 µm (CENTERVIEW 8010), 5 µm (CENTERVIEW 8025)

Interfaces

RS485 + RS232 diagnosis interface
Optional: Profibus-DP (option at CENTERVIEW 8000e), industrial fieldbus (e.g. Profinet IO, EtherNet/IP, CANopen, DeviceNet)

Power Supply

115 or 230 V AC ± 10 %, 50/60 Hz, 500 VA

3 LASER Series 2000 – Efficient diameter control at any time

From
0.05 mm to
300 mm

LASER Series 2000 XY

LASER Series 2000 T

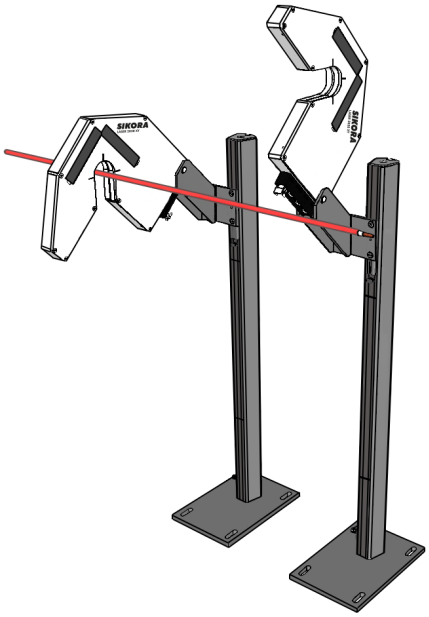
LASER Series 2000 XY models
for efficient 2-axis diameter measurement
LASER Series 2000 T models
for efficient 3-axis diameter measurement
LASER Series 2000 F/R models
for the efficient measurement of flat and round cables

With the gauge heads of the LASER Series 2000, SIKORA offers high-quality laser technology for efficient diameter measurement, meeting the increasing demands of the cable sector in regard to quality and productivity. High precision, reliability and continuous functionality are the outstanding features of the dual and triple-axis gauge heads for a product range of 0.05 to 300 mm. Due to their functional design, the systems can easily be integrated into any production line.

The technique behind these gauge heads is a state-of-the-art CCD line sensor technology with a high pixel resolution, combined with laser diodes as light sources and intelligent powerful analysis software. The outstanding feature of the non-contact and non-destructive measuring technology is the extremely high single value precision, which is an important aspect for the calculation of the standard deviation. The short exposure time assures reliable readings at all common line speeds. Product vibrations have no influence on the measurement and guide rollers are not needed.

Typical features

- Highest precision and reliability
- No moving parts
- No calibration
- Availability: 99.8 %



Swivel gauge head function

The measuring heads are free from wearing parts, have a nearly unlimited lifetime and even after years of operation, the devices measure as precisely as on the first day. The optical measuring principle, without any moving parts, ensures an availability of 99.8 %. Calibration or maintenance procedures are not necessary.

Specific gauge heads for every application

LASER Series 2000 XY

With the LASER Series 2000 XY, SIKORA offers efficient gauge heads for a precise diameter measurement in two planes. Innovative regarding the laser and the CCD sensor – the diameter measurement based on diffraction analysis sets highlights. This technology does neither require rotating mirrors nor optical components, is absolutely maintenance-free, does not require any calibration and offers the highest precision during the entire operating time.

LASER Series 2000 T

The LASER Series 2000 T models are 3-axis gauge heads for precise diameter and ovality measurement that leave nothing to be desired. The focus of the 3-axis gauge heads is on defining the ovality of a product. An oval is defined by five tangents, and therefore, by using three measuring axes (six tangents on the oval) not only the min/max value of the oval, but also the orientation of the oval is defined.

LASER Series 2000 F/R (Flat/Round cables)

For the reliable online acquisition of double, triple or multi-wire flat cables as well as for round conductors, the LASER Series 2000 F/R offers an exact measurement of the width and the height of the measuring object – even if the product twists up to ± 15 degrees during production.

Intelligent design

Interesting is the design of the LASER Series 2000 devices for protection against contamination. The smaller gauge heads are equipped with a unique and proven multi-slot protection. The gauge heads for larger measuring ranges as well as all triple-axis devices are open at the bottom, which prevents water and dirt from falling into the gauge head.

A special feature of the larger models and 3-axis measuring heads is the swiveling gauge head design, allowing the head to be moved up and out of the production area.

Interfaces + Industry 4.0

The LASER Series 2000 gauges offer a maximum of flexibility regarding the interfaces and are therefore, designed for the use under the aspect of Industry 4.0. You can find an interesting range of display and control units for data collection and automatic control, such as the ECOCONTROL 6000, on page 21.

Technical Data LASER Series 2000

Product Name	Product Diameter*	Accuracy**	Repeatability	Exposure Time
LASER 2005 XY	0.05 - 5 mm	± 0.25 µm	± 0.1 µm	0.2 µs
LASER 2010 XY/T	0.2 - 10 mm	± 0.5 µm	± 0.1 µm	0.2 µs
LASER 2025 T	0.2 - 25 mm	± 1.0 µm	± 0.2 µm	0.2 µs
LASER 2030 XY	0.2 - 25 mm	± 1.0 µm	± 0.2 µm	0.2 µs
LASER 2030 F/R	0.2 - 25 mm (round) 0.5 - 20 mm (flat: width) 0.25 - 10 mm (flat: thickness)	± 1 µm (round) ± 5 µm (flat)		0.2 µs
LASER 2050 XY/T	0.5 - 50 mm	± 2.5 µm	± 0.5 µm	0.2 µs
LASER 2100 XY/T	1.0 - 100 mm	± 5.0 µm	± 1.0 µm	0.2 µs

Measuring Rate

500 measurements/sec/axis (higher measuring rates on demand)
LASER 2050 T: 1,000 measurements/sec/axis
LASER 2005 XY: 1,200 measurements/sec/axis

Interfaces

Serial interface RS485, setup and diagnosis interface RS232; Optional: analog output or alternatively industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet, OPC UA)

Power Supply

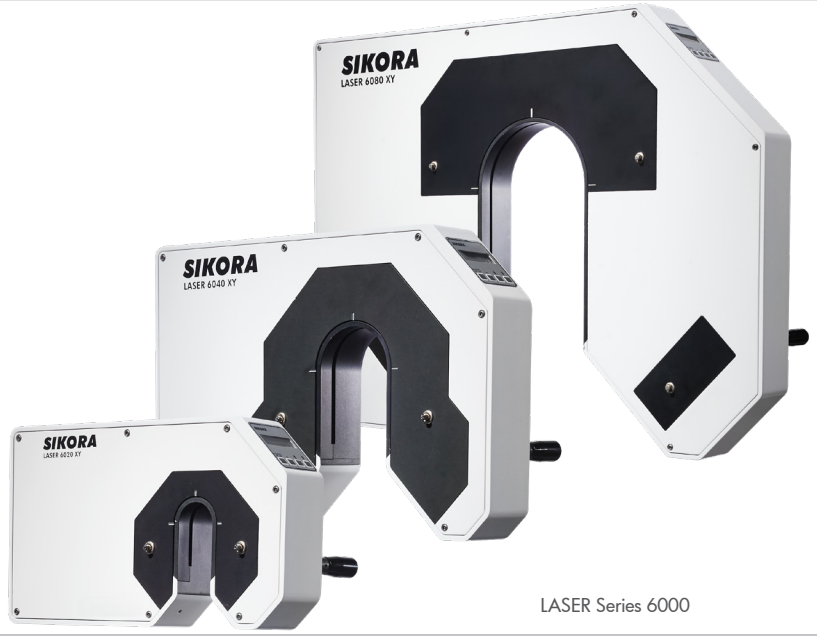
100 - 240 V AC ± 10 %, 50/60 Hz

* Larger measuring ranges on demand

** ± 0.01 % of the measuring value

4 LASER Series 6000 – A milestone in diameter measurement

From 0.2 mm to 78 mm



LASER Series 6000

LASER Series 6000 for high-end diameter measuring in the area of Non Destructive Testing (NDT)

No other diameter gauge head attracts as much attention as any of the three models of the LASER Series 6000.

The gauge heads of the LASER Series 6000 combine a variety of new technological features for the highest precision and reliability for sustainable improvement of the productivity and reproducibility of production processes regarding Industry 4.0.

Up to 5,000 measurements per second per axis, all with extremely high single value precision, allow for optimum line control, provide reliable statistical data and allow the detection of lumps and neckdowns. The SIKORA gauge heads measure the diameter of cables with impressive precision and repeatability. Three gauge head models cover product diameters from 0.2 to 78 mm.

Integrated display in the gauge head

The devices include an integrated LCD display that provides the operator with diameter values at one glance, directly at the measuring device.

Lump detector function

The high measuring rate of the diameter devices also permits the detection of lumps and neckdowns. With the two-in-one system, investment costs are reduced. In addition, there is more space in the line as both functions are integrated into one gauge head.

Typical features

- Innovative CCD line sensor technology combined with pulse controlled laser diodes
- Impressive precision
- Up to 5,000 measurements per second per axis
- Integrated lump detection function
- Integrated LCD display
- Universal interface module for all connections
- Optimum installation and protection of the connection cables
- Two-year warranty

LASER 6020 XY with integrated display

Functional design in perfection

A special feature is the swivel type gauge head. Conveniently, the gauge head can be moved up and out of the line, for example during production changes. The measuring heads are open at the bottom to prevent dirt and water from falling into the measuring area. The feeding of the connection cables to the interface module is protected against water, dirt and mechanical influences, directly in the gauge head stand.

The opening range of the gauges is twice as large as the measuring range, for an easy and safe passage of the product and possible joints.

Interfaces + Industry 4.0

A universal interface module is directly integrated in the gauge head for any connections such as RS485, RS232, Profibus-DP or alternatively an industrial fieldbus such as Profinet IO, EtherNet/IP, CANopen, DeviceNet or OPC UA. With these interfaces, the device series is best equipped under the aspect of Industry 4.0.

LASER 6080 XY on a swiveling comfort stand

Technical Data LASER Series 6000

Product Name	Product Diameter	Accuracy*	Repeatability	Exposure Time
LASER 6020 XY	0.2 - 18 mm	± 0.2 µm	± 0.1 µm	0.2 µs
LASER 6040 XY	0.5 - 38 mm	± 0.5 µm	± 0.2 µm	0.2 µs
LASER 6080 XY	1.0 - 78 mm	± 1.0 µm	± 0.5 µm	0.2 µs

Measuring Rate

2,500 measurements/sec/axis
5,000 measurements/sec/axis for LASER 6020 XY (optional)

Interfaces

RS485, RS232, LAN
Optional: Analog output or alternatively industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet, OPC UA)

Power Supply

100 - 240 V AC ± 10 %, 50/60 Hz, 30 VA

* ± 0.01 % of the measured value

5 LUMP 2000 – Lump-free production

LUMP 2000 T

LUMP 2000 XY

LUMP 2000 for detection of lumps and neckdowns in two or three planes

For continuous quality control in cable production lines, lump detectors are just as essential as diameter measuring devices* and spark testers. The 2-axis and 3-axis lump detectors LUMP 2000 XY and LUMP 2000 T detect the smallest lumps and neckdowns on the product surface precisely and with high reliability at all line speeds.

A powerful signal processor evaluates the number, height, depth and length of the fault location. The combination of the double sensor technology (differential measuring principle) with infrared light sources assures a fault detection with the highest reliability, even under difficult conditions such as dirt, dust or extreme vibration.

Typical features

- 2-axis and 3-axis lump/neckdown detection
- Highest reliability due to double sensor technology
- Fault analysis regarding type, dimension, length, number and position
- Elimination of "ghost faults"**

The lump detector is robust and can easily be installed in every extrusion line or rewinding machine lines due to its small dimensions.

The setting of tolerance thresholds and the visualization of lumps and neckdowns is realized with the REMOTE 6000 or a processor system of the ECOCONTROL Series. Alternatively, the LUMP 2000 devices can be directly integrated into the line control via Profibus or other interfaces.

Technical Data LUMP 2000

Product Name	Product Diameter***	Min. Fault Length
LUMP 2010 XY/T	0.5 - 10 mm/0.25 - 10 mm	0.5 mm
LUMP 2025 XY	0.5 - 25 mm	0.5 mm
LUMP 2035 T	0.5 - 35 mm	0.5 mm

Line Speed
Up to 3,000 m/min

Power Supply
100 - 240 V AC ± 10 %, 50/60 Hz

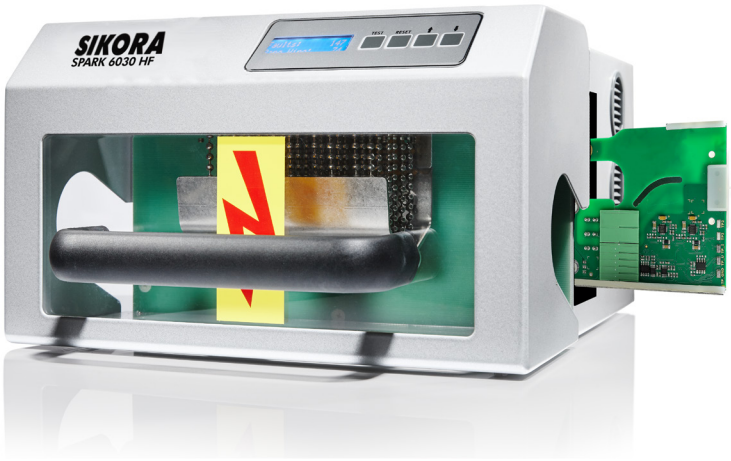
Interfaces
Serial interface RS485, setup and diagnosis interface RS232, fault contact Optional: analog input for tolerance (lump/neckdown) or alternatively industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet)

* Systems for diameter measurement and high-speed surface inspection are available upon request

** "Ghost faults" are caused by light fluctuations from the outside, and thus, are no real faults

*** For smaller dimensions, the FIBER LUMP 6003 is available

6 SPARK 2000/SPARK 6000 – Successful without breakdowns



SPARK 6030 HF
with exchangeable self-test module

Highlights SPARK 6030 HF

- Integrated function test for
  - High voltage
  - Short-circuit current
  - Function/Sensitivity
  - Capacitive load
  - Corona level
- Log file for detected breakdowns
- Log file for self-test

High-Frequency (HF) and Direct Current (DC) spark testers

During the extrusion process of wires and cables, their insulation is inspected by high voltage spark testers to detect possible insulation faults length-relatedly at an early stage. For testing, the dry cable runs through the sturdy bead chain electrode of the spark tester and is exposed to the selected test voltage. This allows for quality control and ensures that only faultless cables are delivered.

For the use in extrusion lines and rewinding lines, SIKORA offers Direct Current (DC), High-Frequency (HF) and Alternating Current (AC) spark testers. The test voltage is continuously adjustable. The spark testers conform to approved test standards (AS, BS, CS, CENELEC, EN, UL, VDE) and safety regulations (as demanded by DIN/VDE 0800, IEC 479-1).

SPARK 6030 HF (High-Frequency spark tester)

The SPARK 6030 HF is a high-frequency high voltage spark tester, developed for the detection of faults in the insulation of cables such as automotive cables and building wires up to 30 mm. Alternatively, the SPARK 2030 UL is available.

SPARK 6020 DC (Direct Current spark tester)

The SPARK 6020 DC is a direct current spark tester, designed for the testing of telephone wires, data cables and mini-coax cables with foam insulation with a diameter from 1.0 to 20 mm.

Function

The SPARK 6030 HF and the SPARK 6020 DC devices distinguish between punctual faults (pin holes) and bare patches. The sturdy electrode and electronic box of the spark testers form one integral unit. Included in the devices is a display, visualizing the selected test voltage, the capacitive load and number of high voltage breakdowns. The display is combined with a control panel for entering the test voltage. For production lines without a line computer, SIKORA recommends the use of the SPARK 6030 HF with the processor-controlled display/control device REMOTE 6000.

Typical features

- Reliable detection of pin holes and bare patches in the insulation of wires and cables
- Integrated display with keypad
- Processor controlled test voltage
- Integrated 3-step self-test and calibration system (optional at SPARK 6030 HF)
- Fulfills all important test and safety standards (BS, VDE, CENELEC, UL, AS, CS etc.)
- Meets safety requirements according to DIN/VDE 0800, IEC 479-1

Innovation: Integrated 3-step self-test and calibration system

According to European standards, open operated measuring and testing equipment has to be checked regularly. Therefore, spark testers are tested with regard to high voltage, short-circuit current and function (sensitivity). So far, cable manufacturers have had to use an external testing device. The SPARK 6030 HF includes an integrated 3-step auto-testing and calibration system on request. This test is documented and saved in a log file that can be recalled at any time.

1. Integrated high voltage and corona level test

The spark tester checks the displayed high voltage of the device for accuracy. The high voltage has to be within a tolerance of 5 %. Additionally, the corona level is measured and displayed.

2. Integrated short-circuit current test

In addition to the high voltage test, the spark tester automatically checks the maximum short-circuit current in case of an accidental touch of the test electrode, which should not exceed 10 mA (according to EN61010-1:2010).

3. Integrated function (sensitivity) test

The spark tester automatically performs a function test (sensitivity test). In this case, 20 artificial faults (breakdowns) are initiated that are detected and reported.

Exchangeable self-test module

The functional and self-test module, which is optionally integrated in the SPARK 6030 HF, can be easily exchanged for calibration. A submission of the complete device to SIKORA or the assignment of a service engineer is not necessary.

For applications that do not require the integrated display and/or self-test and calibration system, SIKORA offers the SPARK 2030 UL.

Technical Data SPARK 2000/6000

Product Name	Product Diameter	Test Voltage
SPARK 6020 DC	1.0 - 20 mm	1.0 to 20 kV DC
SPARK 2030 UL	up to 30 mm	1.0 to 15 kV (RMS)
SPARK 6030 HF	up to 30 mm	1.0 to 15 kV (RMS)

Interfaces
RS485, RS232, analog input and output test voltage, Ethernet/UDP*
Optional: Profibus-DP, industrial fieldbus* (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet)

Power Supply
SPARK 2030 UL: 115/230 V AC ± 10 %, 50/60 Hz
SPARK 6020 DC, SPARK 6030 HF: 100 - 240 V AC ± 10 %, 50/60 Hz

* Only for SPARK 6000 devices

7 CAPACITANCE 2000 – Superior capacitance measurement with innovative multi-zone technology including FFT and SRL prediction

Capacitance measuring devices with multi-zone electrode for ultra-high frequency and length resolution as well as bare patch detection

For all LAN, coax, telephone or RF cables, the transmission of high frequency, analog or digital signals at minimum loss for the signal amplitude is an essential quality feature. In this context, the measurement of the capacitance during the cable production is of crucial importance. The capacitance determines the impedance of the cable for the specified frequency range and thus, the quality of the cable significantly.

CAPACITANCE 2000 is a capacitance measuring device, which is installed in the cooling trough. It measures online precisely the capacitance of the wire insulation and reliably detects bare patches. Additionally, the system recognizes periodical capacitance changes and determines the Structural Return Loss (SRL).

Multi-zone electrode

The combination of one short and one long measuring electrode, integrated into one measuring tube (multi-zone technology), is unique.

Typical features

- Auto-adjusting stand-alone capacitance measuring system
- Unique multi-zone electrode
- Reliable capacitance measurement and bare patch detection
- Integrated FFT analysis and SRL prediction

The short measuring electrode with a length of 10 mm identifies periodical capacitance variations with high spatial resolution by means of Fast Fourier Transformation (FFT). From the FFT data, the SRL is determined and gives information about the expected attenuation of the RF signal during data transmission. The long measuring electrode of 125 mm measures with high precision the average value of the capacitance.

CD-Control (Capacitance/Diameter-Control)

Precise measuring values for the capacitance and the diameter, as they are provided by the mentioned capacitance and diameter measuring devices of the LASER Series 2000/6000 respectively CENTERVIEW 8000, are the basis for a perfect CD-Control.

The CD-Control assures that the capacitance and the diameter comply with the requirements. This is achieved by an automatic adjustment of the cooling trough and by the control of the line speed. Both influenced quantities are controlled by the ECOCONTROL 6000.

FFT analysis and SRL prediction

The detection of periodical capacitance variations and the prediction of the Structural Return Loss (FFT and SRL) are available as special features directly on the measuring tube via a diagnosis interface.

The processer system ECOCONTROL 6000 offers the display of the FFT/SRL relevant measuring values.

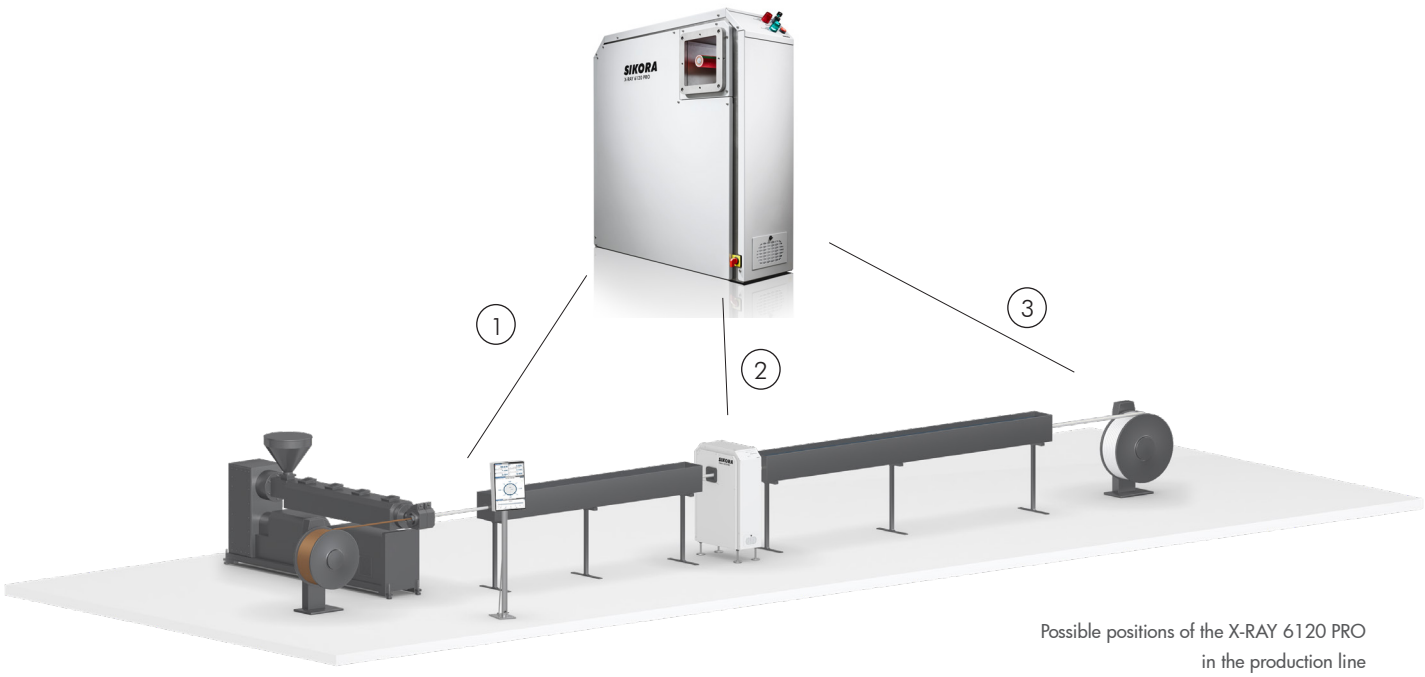
FFT analysis and production data are clearly displayed at the vertical, 22" wide-screen monitor of the ECOCONTROL 6000

Technical Data CAPACITANCE 2000

Product Name	CAPACITANCE 2010	CAPACITANCE 2025	CAPACITANCE 2060
Product Diameter	0.5 - 10 mm	1 - 25 mm	1 - 60 mm
Capacitance Range*	0 - 300 pF/m	0 - 300 pF/m	0 - 100 pF/m
Measuring Rate	1,000 Hz	1,000 Hz	1,000 Hz
Accuracy	0.15 % deviation of the measuring range		
Resolution	14 Bit (10 fF/m at measuring range 100 pF/m, 30 fF/m at measuring range 300 pF/m)		
Active Length	125 mm (separated into two measuring zones with 125 and 10 mm)		
Interfaces			
RS485, RS232 diagnostic interface Optional: industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet), two high speed analog outputs 0 to 10 V			
Power Supply			
115 or 230 V AC ± 10 %, 50/60 Hz			

* Other capacitance ranges on demand

8 X-RAY 6000 PRO – Intelligent partner in the production of cables



Possible positions of the X-RAY 6120 PRO in the production line

Measurement of the wall thickness, concentricity, diameter and ovality of single and multi-layer products

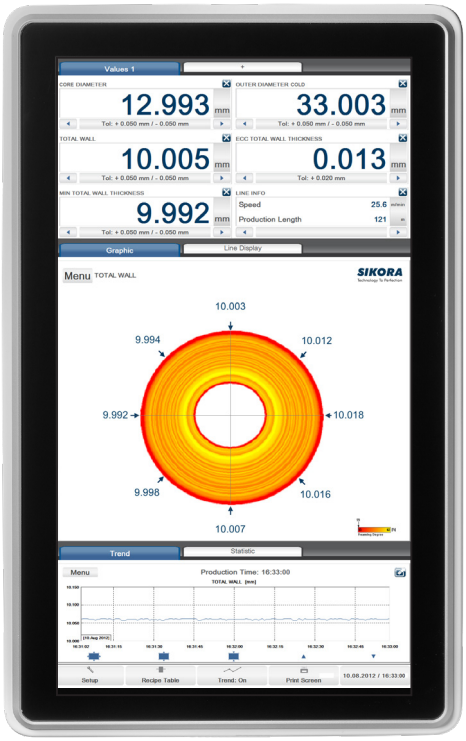
For quality control of cables in jacketing lines as well as for the measurement of RF cables with foamed PE insulation, the X-RAY 6000 PRO ensures compliance with requested cable specifications by continuously measuring the wall thickness, concentricity, diameter and ovality of up to three different cable layers.

Sheathing lines

In sheathing lines, the X-RAY 6000 PRO is typically installed between two cooling troughs. In this position the device measures the outer jacket of the cable. An additional diameter gauge head at the end of the production line, combined with Hot-Cold-Control, considers the shrinkage of the diameter.

RF cables

The X-RAY 6000 PRO is suitable for the measurement of the foaming and wall thickness of RF cables. For this application, the X-ray measuring device is also installed between two cooling trough sections or directly after the crosshead. An additional X-RAY 6000 PRO is used at the cold end of the line for further quality control.



Monitor image: RF cable with foamed PE insulation

Display and control device ECOCONTROL 6000

The X-RAY 6000 PRO includes as a standard the display and control device ECOCONTROL 6000 with a vertically arranged 22" TFT monitor. It is either mounted on a separate stand or integrated in the control cabinet of the line control. The ECOCONTROL 6000 is conveniently and intuitively operated via touch screen. All relevant measuring values are numerically as well as graphically and as trend and statistical data shown at a glance.

Features of the ECOCONTROL 6000 at one glance:

- Line presentation with pictograms of the connected devices
- Display of the single values and eccentricity of the wall thickness incl. highlighting of the min. wall thickness in color
- Length related trend diagram with zoom function for all values
- Statistics with the minimum/maximum/mean value, standard deviation, Cp and CpK values
- Reel and length related data storage

The wall thickness values are displayed at eight points and allow the operator, with the help of the eccentricity values, an optimal automatic centering of the extrusion tool. The ECOCONTROL 6000 is most efficiently used with the automatic control of the line speed or extruder rpm under consideration of the minimum values.

The production data is clearly displayed at the vertical, 22" wide-screen monitor of the ECOCONTROL 6000

X-RAY 6120 PRO with 22" monitor

Typical features X-RAY 6000 PRO

- Measurement of the wall thickness, concentricity, diameter and ovality of up to three different material layers
- Automatic control of the line speed or extruder rpm under consideration of the minimum values
- Selectable measuring rate from 1 to 3 Hz (optional 10/25 Hz)
- 22" vertical, wide-screen monitor
- Intuitive touch screen operation
- No calibration

Safety aspects
Concerns on the safety of X-ray devices are arbitrary as the radiation is of no relevance because of the low energy. Practically, a human is exposed to a much higher radiation on a flight from New York to Frankfurt.

Quality assurance and significant cost savings
From the very first day of operation, the X-RAY 6000 PRO assures a continuous online quality control during cable production. An offline quality control is no longer necessary. Simultaneously, the system reduces the wall thickness to the smallest permissible value by taking into account the statistical fluctuation. Quality assurance and the reduction of material usage lead to a significant increase of productivity, repeatable processes and cost savings.

Check your specific material savings associated with the purchase of an X-RAY 6000 PRO by using our online ROI calculator at: www.sikora.net/roi.

Technical Data
X-RAY 6000 PRO

Measuring Principle

Non-contact with latest X-ray technology

Product Name	Diameter*	Accuracy
X-RAY 6020 PRO	0.65 - 15 mm	5 µm
X-RAY 6035 PRO	5.0 - 30 mm	5 µm
X-RAY 6070 PRO	6.0 - 65 mm	10 µm
X-RAY 6120 PRO	10 - 110 mm	10 µm
X-RAY 6200 PRO	20 - 180 mm	20 µm
X-RAY 6300 PRO	30 - 270 mm	30 µm

Measuring Rate

1 to 3 Hz (optional 10 Hz/25** Hz)

Interfaces

RS232, USB

Optional: LAN, industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet), OPC DA/UA

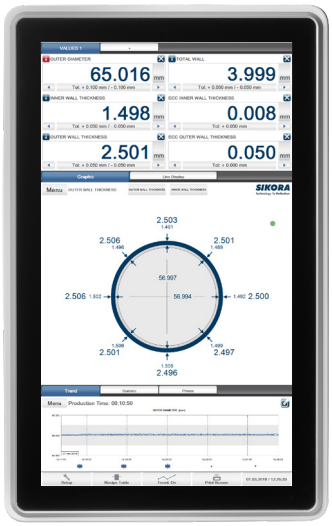
Power Supply

100 - 240 V AC ± 10 %, 50/60 Hz

* Larger and smaller measuring ranges on demand

** For X-RAY 6035 PRO and X-RAY 6070 PRO

9 Partner of the measuring systems – Powerful processors systems



ECOCONTROL 6000
with 22“ monitor

ECOCONTROL 1000
with 15“ monitor

ECOCONTROL 600
with 8.4“ monitor

Premium processor systems with 22“, 15“ or 8.4“ TFT color monitor and touch screen operation

Three ECOCONTROL processor systems form the SIKORA premium segment of display and control devices. Intelligent software technology, clear arrangements, intuitive structure and easy usability are their convincing characteristics.

Choose the extremely innovative and powerful ECOCONTROL 6000, the unique ECOCONTROL 1000 or the smart ECOCONTROL 600. Each of these display and control systems exceeds all expectations in their class.

The innovative display of the line including pictograms of the connected devices provides a unique overview, while the numeric and graphic display of the measuring values, trend diagrams and statistics fulfill every wish regarding process visualization.

The 22”, 15” and 8.4” TFT monitors and the intuitive touch screen control of the ECOCONTROL 6000, 1000 and 600 processor systems represent an intelligent and cutting edge technology.

Software packages (optional)

Automatic diameter/wall thickness control

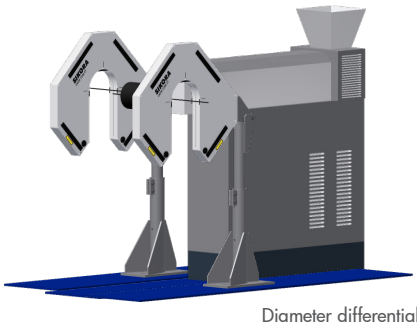
In combination with the control module SET POINT, the ECOCONTROL systems deliver quality assurance and cost reduction. They ensure a continuous, automatic control of the diameter or wall thickness to the nominal value by controlling either the line speed or the extruder rpm.

Measurement of the average wall thickness according to the differential measuring method

With the diameter differential method, the diameter of the product is measured without contact at specific points before and after the extruder by SIKORA laser gauge heads. The evaluation is realized via the processor controlled display and control systems ECOCONTROL 6000 or 1000.

A delay time memory controlled by the line speed delays the diameter value measured before the extruder until this point of the product reaches the position of the second gauge head after the extruder. Using the difference between the diameter measuring values, recorded at the identical position, the average wall thickness is determined with high precision. The material shrinkage is already considered in the displayed wall thickness measuring value.

For production lines where, in addition to the wall thickness, eccentricity values of the product are required or where a wall thickness determination by means of a differential measurement is insufficient due to the cable construction, the use of the X-ray measuring system X-RAY 6000 PRO is recommended.



Diameter differential technique

Hot/Cold Module HC 2000 (ECOCONTROL 6000/1000)

With the Hot/Cold Module HC 2000, the material shrinkage is continuously calculated and considered automatically for the control of the diameter and/or wall thickness.

FFT analysis/Structural Return Loss (SRL)

Optionally, the ECOCONTROL 6000 visualizes periodical variations of the product parameter from an FFT analysis of the measuring values as well as the Structural Return Loss (SRL) data, that is specifically tailored to the requirements of the production of data and RF cables. This software package was developed with the support of competent partners within the industry. The FFT analysis leads to transparency of the processes, shows risks, that are caused e.g. by variations of the diameter, and indicates potential causes.

Data storage

The data storage on a SSD medium is a standard for the ECOCONTROL 6000 and 1000. For the ECOCONTROL 600, an external media storage (USB, optional LAN) is available. Time, length or reel related production reports are available for each of the three ECOCONTROL devices (6000, 1000 and 600).

CD-Control (Capacitance/Diameter)

The CD-Control is a highlight of the SIKORA development in the field of automatic control technology. The system controls both the line speed as well as the positioning of the cooling trough. The diameter and also the capacitance are controlled to the nominal value taking into consideration that these values influence each other. The CD-Control compensates the necessary correction in the control process by an advanced calculation of the expected changes of the respective measuring parameters. The SIKORA CD-Control provides a perfect, fast and precise control.

VIRTUAL 2000 – Intelligent software concept

The virtual gauge technology is suitable for all applications, which require a fast wall thickness control, but due to line configuration or the product structure, a diameter or wall thickness measurement directly after the extruder is not possible. Only after the cooling section, that is to say in greater distance from the cross head, the real measurement is done by this technology.

The basis of the design is the simple, but sophisticated idea that an extrusion model knows the volume output of the extruder in its different operating conditions to predict with the highest accuracy the value of the produced cold wall thickness of a cable. The volume output is recorded once in a user friendly way by the ECOCONTROL 6000 in combination with the measuring device.

Technical Data ECOCONTROL

Technical Data ECOCONTROL	6000	1000	600
Display			
TFT color monitor	22" (vertical) (alternatively 15", horizontal)	15"	8.4"
Inputs/Outputs			
Serial interface RS485 for the connection to measuring devices	8*	4*	1
Electrically isolated digital inputs for the connection to testing devices	8*	4*	4*
Analog inputs 16 Bit, ± 10 V (bipolar)	8*	4*	-
Analog outputs 16 Bit, ± 10 V (bipolar)	8*	4*	-
Contact outputs for tolerance and status messages (max. 30 V, max. 0.5 A)	8*	4*	4*
Communication interface via RS232 or LAN	1*	1*	1*
Interface for printer	1*	1*	1*
Electrically isolated input for rotary pulse generators (0/15 V)	1	1	1
Electrically isolated interface module for control of the diameter (HC 2000)	1*	1*	-
USB customer interface	1	1	1
Industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet)	Yes*	Yes*	No
LAN interface (selectable OPC DA2/UA/SuiteLink)	1*	1*	1*
Wi-Fi	1*	-	-
Data Storage			
	SSD	SSD	External media*
Power Supply			
	100 - 240 V AC ± 10 %, 50/60 Hz		

* Depending on the equipment

10 REMOTE 6000/DISPLAY 2000 – Visualization and control of the production data

REMOTE 6000

DISPLAY 2000

Standard display and control device REMOTE 6000

The REMOTE 6000 is the standard display and control device, universally applicable for all SIKORA diameter and capacitance measuring devices, lump detectors and spark testers. The measuring values are displayed on a six-digit, 25 mm high, clear LED display. It is suitable for panel mounting or for assembly on the gauge head. The REMOTE 6000 includes a product library for up to 50 cable recipes. Nominal values and tolerances can easily be recalled.

Automatic Control – Cost Savings

In combination with the control module SET POINT, an automatic control of the line speed or extruder rpm assures optimum process control and cost savings.

Interfaces

A serial interface for the connection to an external computer is standard for the collection of data or the PLC line control. An Ethernet interface for PLC connection is optionally available.

Applications:

LASER Series 2000/6000 with the REMOTE 6000

The REMOTE 6000 can be combined with a diameter gauge head of the LASER Series 2000/6000. The average diameter value of the connected measuring device is clearly shown on the LED display. Via a control key, the average diameter of the measuring axis x, y or the ovality is selectable on the display.

CAPACITANCE 2000 with the REMOTE 6000

In combination with the capacitance measuring device CAPACITANCE 2000, the REMOTE 6000 clearly shows the capacitance measuring values as a decentralized display device.

LUMP 2000 with the REMOTE 6000

In combination with a LUMP 2000, the REMOTE 6000 shows the number as well as the type of faults. Clear symbols inform the operator if the fault is a lump or neckdown. Lump or neckdown information, such as the height, depth and length of the fault are stored, giving the operator the possibility to view previous faults.

SPARK 2000/6000 with the REMOTE 6000

The REMOTE 6000 is also available for the connection with the SPARK 2000/6000 to visualize insulation breakdowns. Parameters such as the nominal test voltage can be entered easily. User-friendly symbols and numeric displays clearly show the current test voltage and the number of breakdowns.

Typical features REMOTE 6000

- Large, clearly arranged display and keypad
- Easy installation at any distance to the measuring head
- Automatic control module SET POINT (optional)
- Serial interface for the connection to a measuring head, or a PC (optional)

Basic display device DISPLAY 2000

Interesting is the DISPLAY 2000, a display device for the combination with the SIKORA diameter measuring devices of the LASER Series 2000/6000 or the CAPACITANCE 2000, that shows the diameter and ovality of the measured product. It is suitable for installation into a control cabinet or at the gauge head.

Especially for applications that require a connection of the measuring system to the line control via a Profibus interface or whenever a clearly visible second display is requested, the DISPLAY 2000 is a reasonable and inexpensive supplement.

Typical features DISPLAY 2000

- Digital display
- Selectable monitoring parameter (diameter, ovality, capacitance)
- Installation at any distance to the gauge head
- Serial interface for the connection to a gauge head

Technical Data REMOTE 6000

Measuring Value Display
Digital, 6-digit e.g. 000.000 ... 500.000 mm
Position of decimal point is adjustable

Display Update
Programmable, factory setting 1/sec

Nominal Value/Tolerance Selection
Via keypad (operation guided via a 4-digid LED display)

Product Storage
Up to 50 product types, comfortable programming via the diagnosis software

Tolerance Message/Control Action
a) In clear text on LED display
b) 4 potential-free contact outputs (optional)

Interfaces
RS485 (gauge head), USB (for service)
Optional: LAN/Ethernet-UDP

Power Supply
100 - 240 V AC ± 10 %, 50/60 Hz

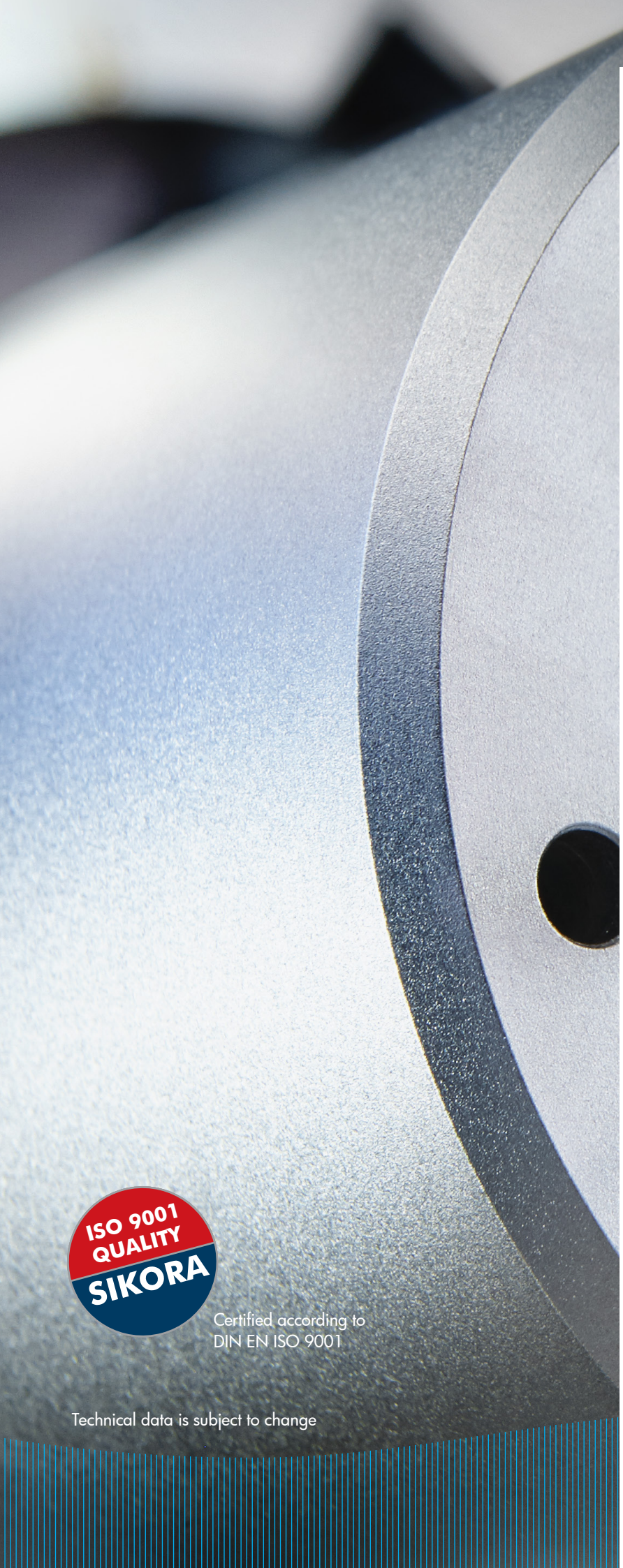
Technical Data DISPLAY 2000

5-Digit Display
Digit height of 25 mm
The bright, big figures are easy to read even from a distance of 12 m

Interfaces
(Bi-directional serial interface) RS485

Power Supply
100 - 240 V AC ± 10 %, 50/60 Hz

For your precise notes:



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