



Measuring and control  
technology for

## — Insulating and sheathing lines

**SIKORA**  
Technology To Perfection



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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, sheet, optical fiber and plastics industries. Worldwide, users of these measuring devices benefit from increased manufacturing quality, profitability and efficiency. 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 a 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.

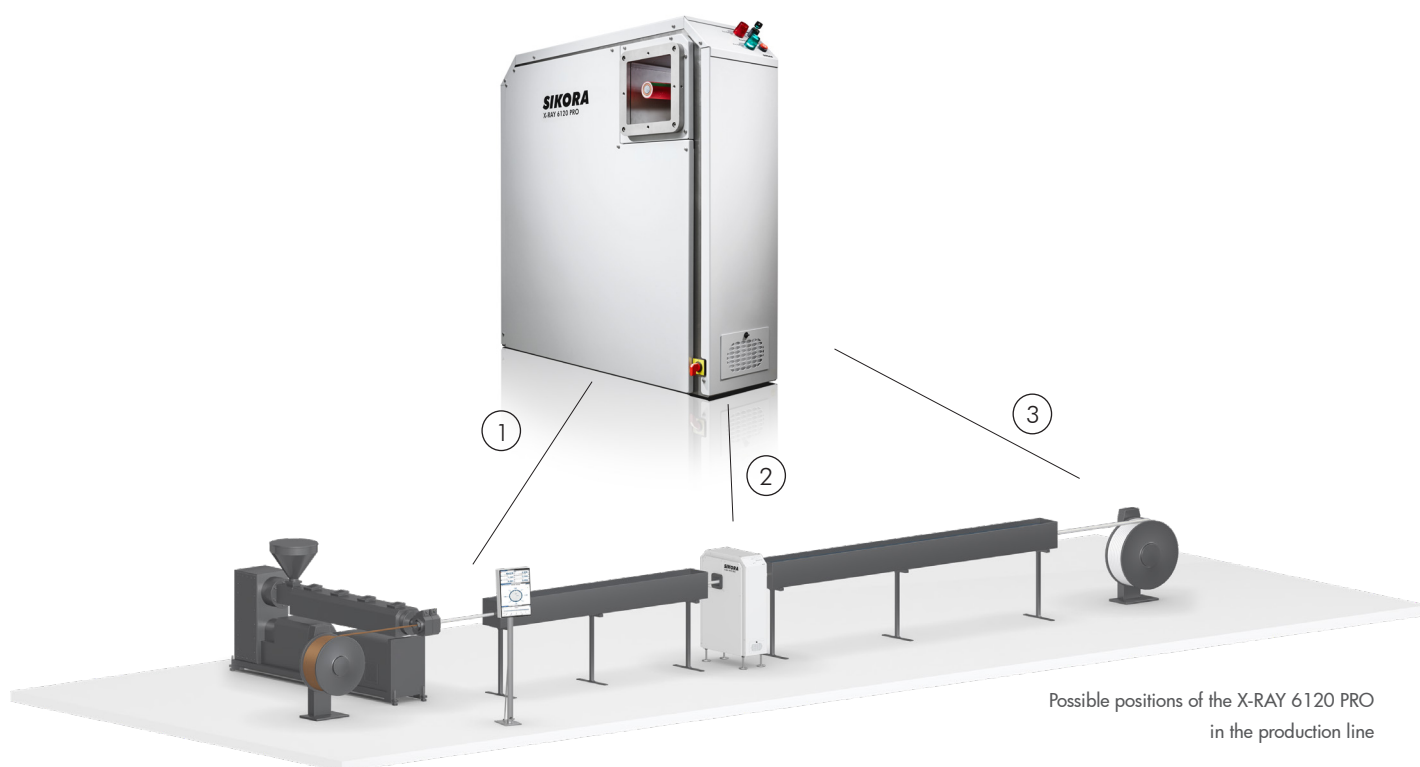
Since 1993, SIKORA has met the requirements of DIN EN ISO 9001. The certification confirms SIKORA's focus on continuous improvement. Customer satisfaction is SIKORA's primary objective.

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 to increase the process reliability, efficiency and the ecological balance of their production lines.

### Measuring technology for insulating and sheathing lines

The production of cables requires compliance with high quality levels and numerous standards. Today, cable manufacturers aim to produce economically, and therefore, they choose measuring devices that are focused on quality control. SIKORA has developed efficient and innovative technologies specifically for insulating and sheathing lines that assure quality during the entire production process.

# 1 X-RAY 6000 PRO – Intelligent partner in sheathing lines



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

For quality control of cables in sheathing lines, the X-RAY 6000 PRO with its XY-measurement continuously ensures compliance with requested cable specifications regarding wall thickness, concentricity, diameter and ovality.

### 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 is positioned at the end of the production line, combined with Hot-Cold-Control, it considers the shrinkage of the diameter.

### X-RAY 6000 PRO for single and multi-layer products

The X-RAY 6000 PRO measures the wall thickness, concentricity, diameter and ovality of up to three different cable layers. Typically, it is used at tandem extrusion lines.

### 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" TFT monitor, or 15" monitor
- Intuitive touch screen operation
- No calibration



### 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 can be mounted on a separate stand or remotely integrated into the control cabinet of the line. The ECOCONTROL 6000 is conveniently and intuitively operated via touch screen. All relevant measuring values are visualized numerically and graphically along with trend and statistical data.

#### 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 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 of the X-RAY 6000 PRO is clearly displayed on the vertical 22" TFT monitor of the ECOCONTROL 6000



X-RAY 6120 PRO with 22" monitor

### 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.

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 lead to a significant increase of productivity, repeatable processes and cost savings.

### Safety

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

## 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

## 2 LASER Series 2000 – Efficient diameter control at any time



LASER Series 2000

**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 S/R models**  
for the efficient measurement of sector and round cables

### Typical features

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

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, laser diodes as light sources and intelligent 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. A short exposure time assures reliable readings at all common line speeds.

The LASER Series 2000 is free from wearing parts and has a nearly unlimited lifetime. Even after years of operation, the devices measure as accurately 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.



Swivel gauge head function



## 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 operation 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 S/R

The LASER Series 2000 S/R (Sector cable/Round cable) is most suitable for the precise measurement of the height of straight and prespiralled sector conductors, as well as for round cables. The fascinating 5-axis concept of the S/R heads requires no rotation of the gauge head, and thus, no maintenance.

Typically, the S/R gauge heads are installed before and after the extruder, whereby the average wall thickness is calculated, based on the two diameter values. For a perfect wall thickness control, the two gauge heads are combined with the processor system ECOCONTROL 6000.

### Intelligent design

The design of the LASER Series 2000 offers 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 and S/R devices are open at the bottom, which prevents water and dirt from falling into the gauge head.

A special feature of the larger models is the swiveling gauge head design, which allows the head to be moved up and out of the extrusion line. The measuring heads are free from wearing parts, remain highly precise throughout their lifespan and do not require any calibration or maintenance.

### Interfaces + Industry 4.0 (Internet of Things)

The LASER Series 2000 gauges offer maximum flexibility regarding interfaces. They are designed for the use under the aspect of Industry 4.0 (Internet of Things). You can find an interesting range of display and control units for data collection and automatic control such as the ECOCONTROL 6000 on page 12.

## Technical Data LASER Series 2000

Product Name	Product Diameter	Accuracy*	Repeatability	Exposure Time
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
LASER 2200 XY	5.0 - 190 mm	± 10.0 μm	± 2.0 μm	0.2 μs
LASER 2300 XY	50 - 300 mm	± 20.0 μm	± 4.0 μm	0.2 μs
LASER 2050 S/R	1.0 - 35 mm (sector)	± 20 μm	± 4.0 μm	0.2 μs
	0.5 - 50 mm (round)	± 2.5 μm	± 0.5 μm	
LASER 2100 S/R	1.0 - 35 mm (sector)	± 20 μm	± 4.0 μm	0.2 μs
	1.0 - 100 mm (round)	± 5.0 μm	± 1.0 μm	
Measuring Rate				
500/sec/axis (higher measuring rates on demand) 1,000/sec/axis for LASER 2050 T				
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				

\* ± 0.01 % of the measured value

### 3 LASER Series 6000 – A milestone in diameter measurement



LASER 6080 XY

#### 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 the models of the LASER Series 6000. The LASER 6080 XY combines a variety of new technological features for a diameter measurement with impressive precision and reliability to improve productivity of the production line sustainably.

Up to 2,500 measurements per second, all with an extremely high single value precision, enable an optimum line control and provide reliable statistical data.

#### Integrated display in the gauge head

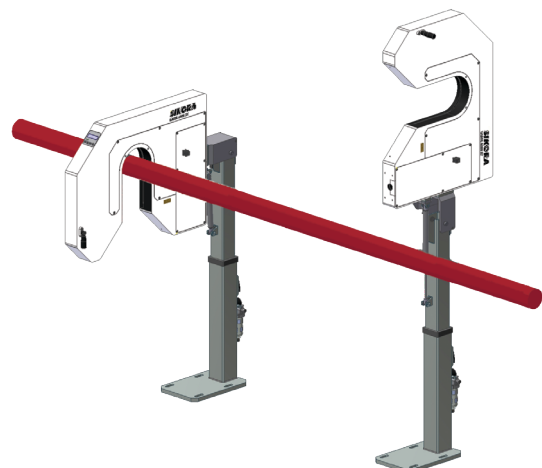
The device includes an integrated LCD display that provides the operator with diameter values at one glance, directly at the measuring device.

#### Lump detector function

The high measuring rate of the diameter devices of the LASER Series 6000 also permits the detection of lumps and neck-downs. 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
- 2,500 measurements per second per axis
- Integrated LCD display
- Integrated lump detection function
- Universal interface module for all connections
- Optimum installation and protection of the connection cables
- Two-year warranty



Swivel gauge head function

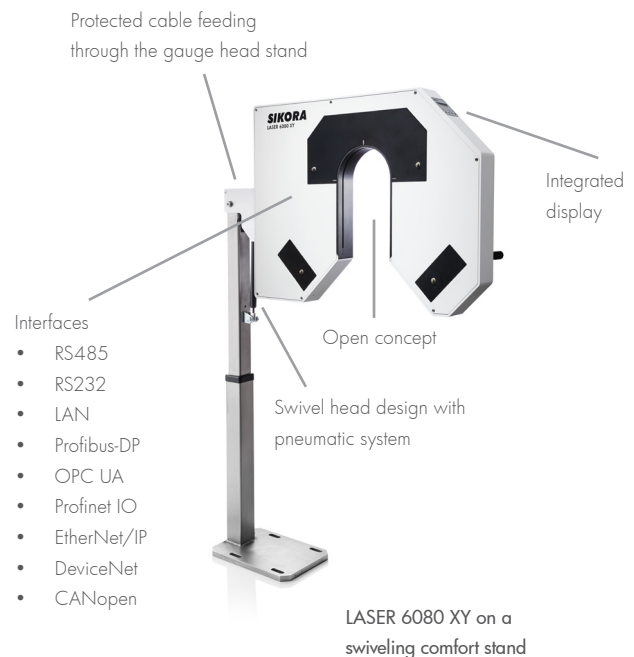
### Functional design in perfection

A special feature of the LASER Series 6000 is the swivel type gauge head. Conveniently, the gauge head can be moved up and out of the line 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 gauge is twice as large as the measuring range, for an easy and safe passage of the product and possible joints.

### Interfaces + Industry 4.0 (Internet of Things)

A universal interface module is directly integrated in the gauge heads 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.

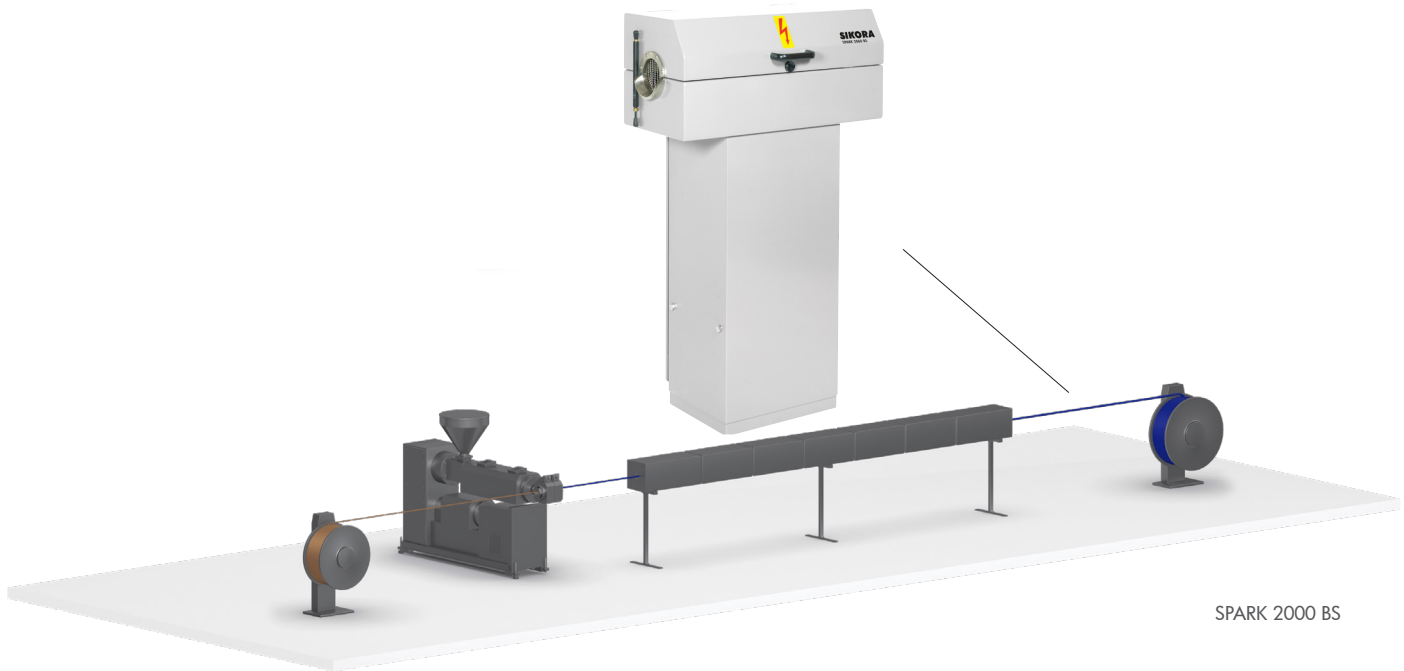


## Technical Data LASER Series 6000

Product Name	Product Diameter	Accuracy*	Repeatability	Exposure Time
LASER 6080 XY	1.0 - 78 mm	± 1.0 µm	± 0.5 µm	0.2 µs
<b>Measuring Rate</b>				
2,500 measurements/sec/axis				
<b>Interfaces</b>				
RS485, RS232, LAN Optional: Analog output or alternatively industrial fieldbus (e.g. Profinet IO, EtherNet/IP, Profibus-DP, CANopen, DeviceNet, OPC UA)				
<b>Power Supply</b>				
100 - 240 V AC ± 10 %, 50/60 Hz				

\* ± 0.01 % of the measured value

## 4 SPARK 2000 BS – Successful without breakdowns



SPARK 2000 BS

### Alternating current spark tester (AC)

During the extrusion process of wires and cables, the insulation is inspected by (high voltage) spark testers allowing possible insulation defects to be detected and record them length-relatedly, at an early stage. For testing, the dry cable runs through the sturdy bead chain electrode of the spark tester that is installed after the cooling section. Here, the cable insulation is exposed to the selected test voltage. Thus, the quality management is able to assure that only faultless cables are delivered.

SIKORA offers different models of the SPARK 2000 BS, covering a diameter range from 1 to 200 mm. For all systems, the test voltage is continuously adjustable from 1.6 to 35 kV.

The sturdy electrode and the electronic box of the SPARK 2000 BS form one integral unit that is easy to install into new or existing lines. Optionally, the SPARK 2000 BS can be combined with the display and control device REMOTE 6000.

The REMOTE 6000 includes a display, a keypad for the settings of the test voltage, a fault counter and allows for a length related recording of the detected spark faults.

The spark tester conforms to approved test standards (AS, BS, CS, CENELEC, EN, UL, VDE) and safety regulations (as demanded by DIN/VDE 0800, IEC 479-1).

### Typical features

- Reliable fault detection
- Controlled test voltage
- Fulfills all important test and safety standards

## Technical Data SPARK 2000 BS

### Measuring Principle

Test device with bead chain electrode

### Gauge Head

### Product Diameter

SPARK 2060 BS

1 - 60 mm

SPARK 2100 BS

1 - 100 mm

SPARK 2140 BS

1 - 140 mm

SPARK 2200 BS

1 - 200 mm

### Interfaces

RS485, RS232, electrically isolated contact, analog input and output test voltage

Optional: Profibus-DP, Profinet IO

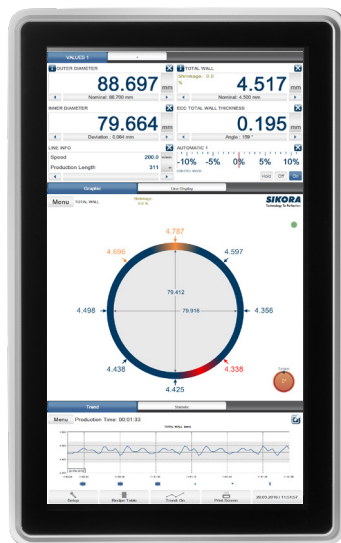
### Test Voltage

1,6...25 kV (30/35 kV optional)

### Power Supply

100 - 240 V AC,  $\pm 10\%$ , 50/60 Hz

## 5 Partner of the measuring systems – Premium 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.

#### 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.

#### 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 visualized via the 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, the use of the X-ray measuring system X-RAY 6000 PRO is recommended.

#### FFT analysis

Optionally, the ECOCONTROL 6000 visualizes periodical variations of the product parameter from an FFT analysis of the measuring values. 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).

#### 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

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, $\pm 10$ V (bipolar)	8*	4*	-
Analog outputs 16 Bit, $\pm 10$ 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 $\pm 10$ %, 50/60 Hz		

\* Depending on the equipment

## 6 REMOTE 6000/DISPLAY 2000 – Visualization and control of 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 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.

#### Control

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 PLC line control. An Ethernet interface for PLC connection is optionally available.

### 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 diameter of the measuring axis x, y or the ovality is selectable on the display.

### SPARK 2000 with the REMOTE 6000

Combined with the SPARK 2000, the REMOTE 6000 serves as a device for the display and setting of parameters such as the nominal test voltage. 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 from 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, 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)
- Installation at any distance from 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-digit 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  $\pm$  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  $\pm$  10 %, 50/60 Hz

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