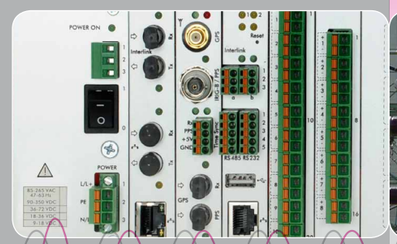
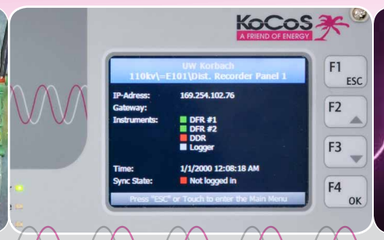
SHERLOG

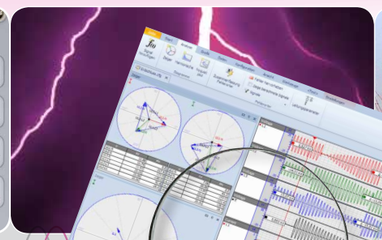
KOCOS - THE TECHNOLOGY GROUP | WHERE PRECISION MEETS QUALITY

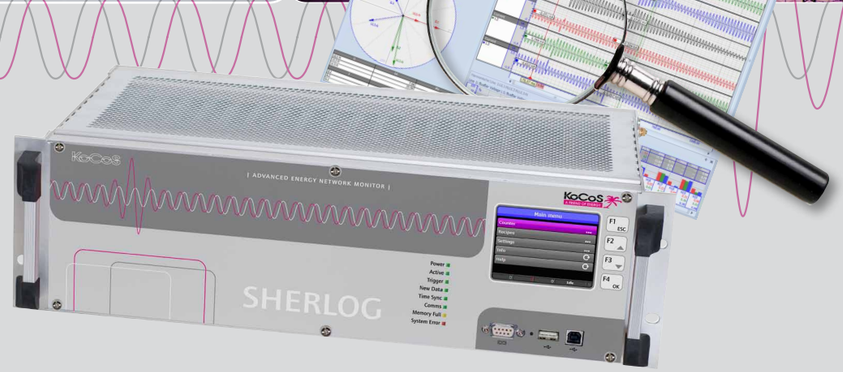
SHERLOG CRX.

Fault Recorder Systems









KoCoS Messtechnik AG
Südring 42
D-34497 Korbach, Germany
Tel. +49 5631 9596-0
info@kocos.com
www.kocos.com

KOCOS MESSTECHNIK AG

[ENG]

KoCoS
A FRIEND OF ENERGY

CONTENTS

KoCoS
A FRIEND OF ENERGY

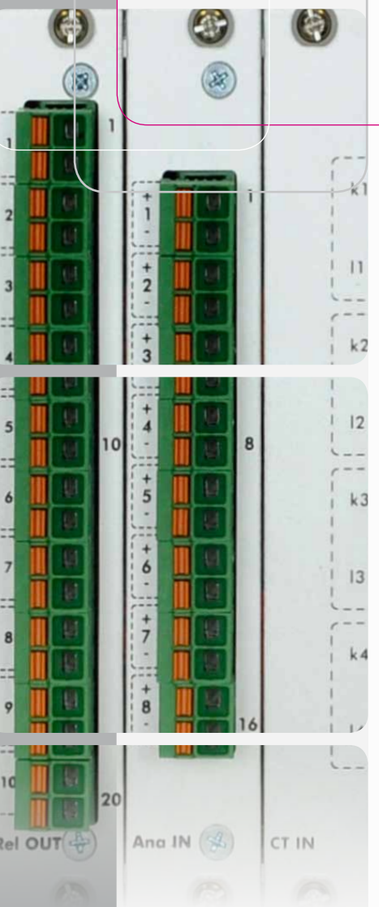
SHERLOG CRX

Fault recorder systems for professional power system and event analysis

One of the consequences of the integration of renewables is a sharp acceleration in the development of smart grids. The restructuring this brings and the growing dynamism of electricity supply systems have led to a steady increase in the importance of constant and reliable power systems monitoring.

A multitude of parameters have to be monitored in order to assess the security of supply and the power quality of an electrical power system. These parameters must provide vital information for the fast and effective restoration of system operation when a fault occurs, as well as serving as the basis for the extension of power systems and the optimisation of primary and secondary technology.

The wide-ranging requirements to be met by efficient power systems monitoring and the cost pressures acting on the installation and operation of supply equipment call for the use of multi-functional measurement and analysis systems. The SHERLOG CRX fault recorder system has been developed to meet these requirements and unites all the necessary monitoring functions in one device.



Customized systems, compact and flexible

SHERLOG CRX is a multi-functional measurement and analysis system for comprehensively monitoring and assessing equipment in electricity supply systems.

Because of the modularly scalable device concept, **SHERLOG** CRX can be equipped to suit individual requirements and can easily be adapted or extended should these requirements change.

Despite its compact size, **SHERLOG** CRX can be equipped with up to 32 analog inputs for AC and DC measurements and up to 128 binary inputs. Individual devices can be connected via an Interlink interface to monitor extensive installations.

Configuration is simple to modify

All analog inputs can be used for current measurement, for voltage measurement or for measuring low-level signals. The appropriate measuring ranges can easily be selected on site by customers.

Plug & Play technology

Extensions can be realized quickly and easily thanks to Plug & Play technology. Even swapping an entire module does not involve time-consuming, expensive adjustments, as the calibration data is saved in the module.

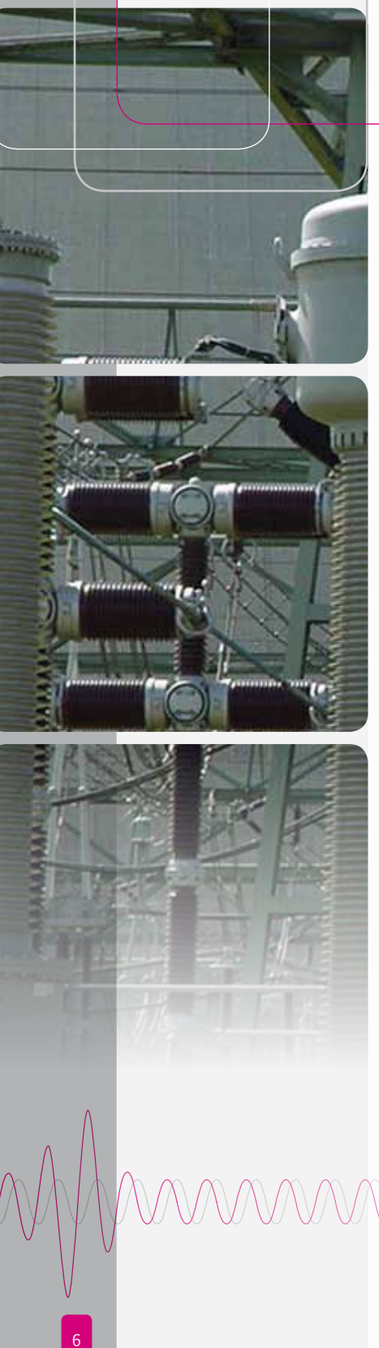
Multi-functional measurement and analysis system

SHERLOG CRX can be used as a centralized or decentralized monitoring system and unites the following functions in one device:

- High-resolution fault recorder for transient processes with sampling rates up to 30 kHz
- RMS recorder
- Continuous data recorder
- Event recorder
- Power quality analyser to IEC 61000-4-30 class A
- Fault locator
- Phasor measurement unit
- Sequence of events recorder
- Integration in substation control and protection systems to IEC 61850

Examples of applications

- Digital fault recorder with a high sampling frequency for detailed analysis of transient faults
- Generator monitoring in power plants
- Recording and identification of power swings
- Power quality analysis, e.g. to EN 50160
- Load and frequency recording
- Analysis of power consumption
- Assessment of the capacity utilisation and stability of supply systems
- Capture of influences resulting from a constantly fluctuating generator and load structure
- Monitoring of individually agreed connection conditions for compliance with limit values
- Documentation system for commissioning and service tests
- Chronological event recording and logging of binary status signals



Benefits to the user

- Detailed event recordings are available shortly after the occurrence of a fault
- The integrated message management features comprehensive notification functions for faults, enabling immediate action to be taken even when more than one department is involved
- Cost reductions result from the early detection of power system disturbances, while detailed information on faults and automatic initial evaluation with fault location lead to shorter power system downtimes
- Continuous and comprehensive recording of power system activity makes systems transparent. Sources of disturbances can be identified and potential energy savings revealed
- Proof of power system faults or of normal system operation and of compliance with quality criteria can be provided at any time

Advantages over digital protection relays

- Because comprehensive trigger criteria can be set independently of the protection function, it is possible to record even very slight anomalies in the supply system
- Unadulterated signal recording thanks to the broad bandwidth from DC to 15 kHz
- Identification of malfunctioning transducers, bad switching contacts or ferroresonance
- Simultaneous recording with fast sampling for detailed fault analysis and slow sampling for the identification of power swings and for carrying out stability evaluations
- Recordings include information on all plant components and their impact chain
- By recording data continuously in order to monitor power system operation comprehensively, proof of how a power system is operating can be provided at any time, even if no disturbances were detected during the period in question
- Exhaustive evaluation of power quality, including harmonic and flicker analysis to IEC 61000-4-30 class A, IEC 61000-4-7, IEC 61000-4-15

KoCoS
A FRIEND OF ENERGY

Multi-processor system

SHERLOG CRX features separate processors for the user interface and the communications interfaces. This innovative technology guarantees easy operation, fast data transmission and simultaneous data access for more than one user or application at a time – all the time.

Safe to operate even under extreme conditions

Because SHERLOG fault recorders contain no parts which are subject to wear and tear, such as hard disk memories, fans or UPSs, they are 100% maintenance-free and extremely safe to operate.

Their excellent immunity to electro-magnetic disturbances also ensures smooth operation even when conditions are extreme. What is more, all interfaces and all analog and binary inputs and outputs are galvanically isolated. Not only does this guarantee safe functioning, it also makes for a safe working environment.

Internal flash memory

SHERLOG CRX is equipped with a 32 GB flash memory. This large memory capacity enables measured values and faults to be recorded at a particularly high resolution over long periods of time, even when there is no permanent data connection to a mass storage medium (server). Measurement data is saved reliably and cannot be lost, even in the event of a power failure or when the device is switched off.

Communication interfaces

SHERLOG CRX features the following communication interfaces:

- Electric Ethernet
- Optical Ethernet (optical fibre)
- USB (active/passive)
- RS 485
- RS 232
- GSM/GPRS modem
- UMTS router

Time synchronisation

Power system monitoring and fault analysis with full area coverage call for precise time synchronisation. Only when measured values are recorded by a number of devices absolutely simultaneously is it possible to compare them with one another and evaluate them correctly. **SHERLOG** CRX can use all conventional methods of time synchronisation.

- GPS synchronisation with internal receiver
- GPS synchronisation with an external central clock
- DCF77
- NTP/SNTP
- IRIG-B
- Synchronisation to PC time
- Seconds pulse
- KoCoS-Interlink interface

Using the KoCoS-Interlink interface, any number of devices can be synchronised with one another using a simple 2-wire connection or fibre-optic loop. This results in a significant reduction in costs as only one measuring device per location needs to be synchronized as the "master" system.

OPERATING CONCEPT

Operation via touch screen

Using the built-in 3.5" touch screen, it is possible to carry out all basic tasks connected with operation and configuration. Being able to make settings on the device itself and read device status messages directly is particularly useful during commissioning. The user interface is clearly and ergonomically designed. All functions and measured value displays can be selected directly from the main menu. All important measured values and status information can be seen at a glance. Alternatively, the device can also be operated with the aid of the function keys.

Configuration and analysis with a PC

As well as using the touch screen, it is also possible to operate and configure **SHERLOG** CRX with the ergonomic, easy-to-understand SHERLOG software for Windows® operating systems. Furthermore, fully automated operation, complete with fault analysis, reporting and message management, is possible with the aid of the SHERLOG operating software.

Integrated web server

SHERLOG CRX has an integrated web server which allows users to access relevant measurement data from any PC, with any Internet browser.

IEC 61850 || Modbus

For integration in substation control and protection or for the exchange of data with other systems, **SHERLOG** CRX can use a range of data protocols, including IEC 61850 and Modbus.

SHERLOG CRX BASIC DEVICE

The basic CRX device contains:

General

- Housing: 19" (84 HP/3 U)
- 8 status LEDs
- 3.5" colour graphical display with touch operation
- 4 function keys

Slots

12 free slots to accommodate:

- up to 6 analog modules
- up to 8 binary modules

Binary outputs

10 freely configurable relay outputs for status and alarm signals or limit value violations to be issued to control systems or to be used to switch loads on or off, for example:

- 8 potential-free relay contacts
- 2 electronic relay outputs

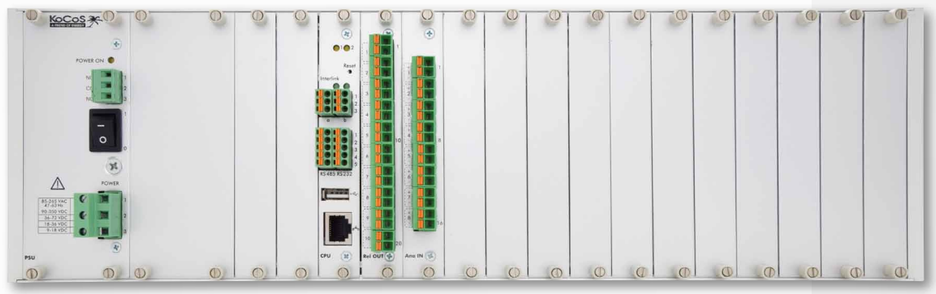
Interfaces

- 2 x RS232, 1 x RS485
- 2 x USB-A, 1 x USB-B
- 1 x Ethernet (TCP/IP, RJ45)
- Electric Interlink interface for networking several **SHERLOG** CRX- devices for the purposes of time synchronisation and cross-triggering

Time synchronisation

- Internal real-time clock
- NTP/SNTP

SHERLOG CRX.



SHERLOG CRX with 8 analog inputs

CRX-COMPONENTS

The following components can be integrated as required for the task in hand:

Power supply

SHERLOG CRX can be equipped with up to two power supply units.

The following power supply units are available:

- Wide-range power supply unit (85...265 VAC / 90...350 VDC)
- DC power supply units (9...18 VDC, 18...36 VDC, 36...72 VDC)

Redundant power supply

SHERLOG CRX can accommodate two independent power supply unit modules for redundant mains operation. Two different power supply units can be chosen if required (e.g. a wide-range power supply unit and a 24 VDC power supply unit)..

Each power supply unit has its own power input with power switch, a status display and a potential-free monitoring contact. The status of the power supply unit is also monitored internally and notification of the status can be provided when needed, for example in e-mail form.

Synchronisation module

The optional synchronisation module allows exact time synchronisation to various time standards. To provide optimum flexibility, the module is equipped with various inputs for external time signals as well as a built-in GPS receiver. The desired synchronisation interface can be selected in the SHERLOG operating software.

- On-board GPS receiver with SMA antenna connection
- Optical (STII) and electrical (RS232) GPS telegram and time pulse input (NMEA-0183, PPS)
- DCF77 pulse telegram input
- Seconds pulse input (PPS)
- IRIG-B input for B001, B002 and B003 telegrams

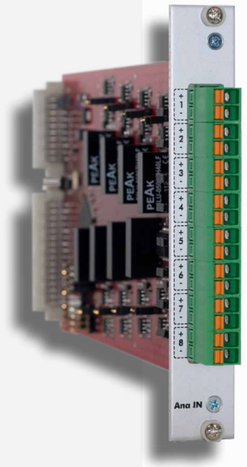
Fibre-optic interface module

Optional interface module for connecting **SHERLOG** CRX devices by means of a fibre-optic loop and for integration in optical TCP/IP networks.

- Optical Ethernet interface for integrating **SHERLOG** CRX in fibre-optic networks
- Optical Interlink interface for connecting a number of **SHERLOG** CRX devices for the purposes of time synchronisation and cross-triggering by means of a fibre-optic loop
- Second electrical Ethernet interface (RJ45)

Analog module with 8 universal inputs

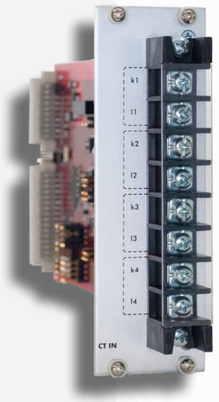
Analog module with 8 separate and fully galvanically isolated inputs for AC/DC measurements.
Each individual input features a selection of 4 measuring ranges for universal use.
Because of the absolutely linear frequency response, all the analog inputs are suitable for AC or DC quantities however they are configured and provide excellent accuracy across the entire frequency range.



Main applications:
- Voltage measurement
- Current measurement with external sensors (shunts, current clamps, etc.)
- Measurement of low-level signals

Measuring ranges:
- 300 VAC / ± 424 VDC
- 200 mVAC / ± 282 mVDC
- 700 mVAC / ± 1000 mVDC
- ± 20 mA or ± 100 mA via external measurement adapter

Features:
- Separate 16 bit A/D converter per channel, sampling rate 200 kHz
- Calibration data on board (plug & play)



Analog module with 4 current inputs

This module is equipped with 4 separate and fully galvanically isolated current inputs and is designed for direct connection to instrument and protection transformers.
Each individual input features a selection of 3 measuring ranges for universal use.

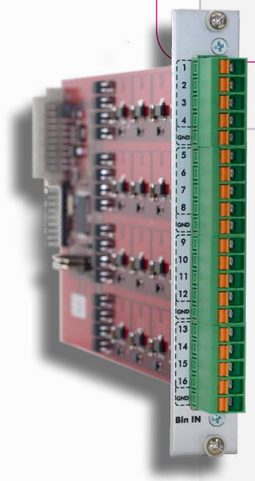
Measuring ranges:
- 10 AAC IN = 1 A, Imax = 10 x IN; IN = 5 A, Imax = 2 x IN
- 40 AAC IN = 1 A, Imax = 40 x IN; IN = 5 A, Imax = 8 x IN
- 200 AAC IN = 1 A, Imax = 200 x IN; IN = 5 A, Imax = 40 x IN

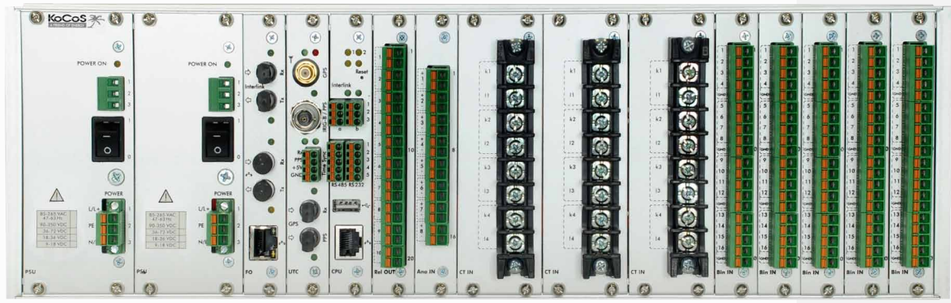
Features:
- Separate 16 bit A/D converter per channel, sampling rate 200 kHz
- Calibration data on board (plug & play)

Binary module with 16 inputs

16 channel acquisition module for binary status signals with galvanic isolation. The inputs are divided into 4 groups of 4 channels. Each group has one common reference point.
The special input circuitry of the binary inputs is designed for operation with voltages between 24 and 300 V. Signal misidentifications due to transients which can be caused by switching operations, for example, are effectively eliminated.

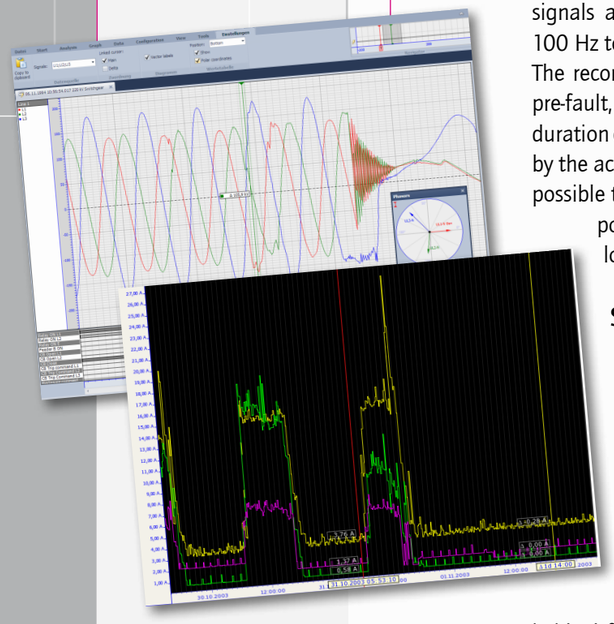
Features:
- 16 binary inputs in 4 groups of 4 channels
- Response threshold: 24 to 300 VDC
- Resolution: 0.1 ms
- Up to 8 input modules (128 binary inputs) possible





SHERLOG CRX example of possible configuration

RECORDING FUNCTIONS



Fast fault recording for power system faults

When a limit value violation occurs, all analog and binary signals are recorded with a configurable sampling rate of 100 Hz to 30 kHz.
The recording comprises configurable time windows for the pre-fault, fault and post-fault periods. The fault recording duration can either be set to a fixed length or can be controlled by the actual duration of the event. These recordings make it possible to carry out comprehensive and detailed analyses of power system faults, including determination of fault location.

Slow fault recording

In addition to the analog and digital signals which are measured directly, the RMS recorder can also record all the quantities calculated on the basis of these signals, such as frequency, unbalance, positive sequence system, negative sequence system and zero sequence system, active power, reactive power and apparent power, harmonics etc. The sampling rate can be set between 1 Hz and double the system frequency (100 Hz/120 Hz). The recording is ideal for detecting and assessing slow processes, such as power swings, or for generator monitoring.

Uninterrupted data recording with continuous recorder

The continuous recorder records measurement data nonstop. The recorded data can be downloaded to a central computer/database at regular intervals without interrupting the measurement. This enables continuous recording for a practically unlimited period of time. The averaging intervals can be set freely. The mean value for the interval time and the highest and lowest single RMS values are recorded for each averaging interval. These long-term recordings provide comprehensive information on the whole power system, expose slow and fast changes, show switch-on peaks and reveal potential for energy savings.

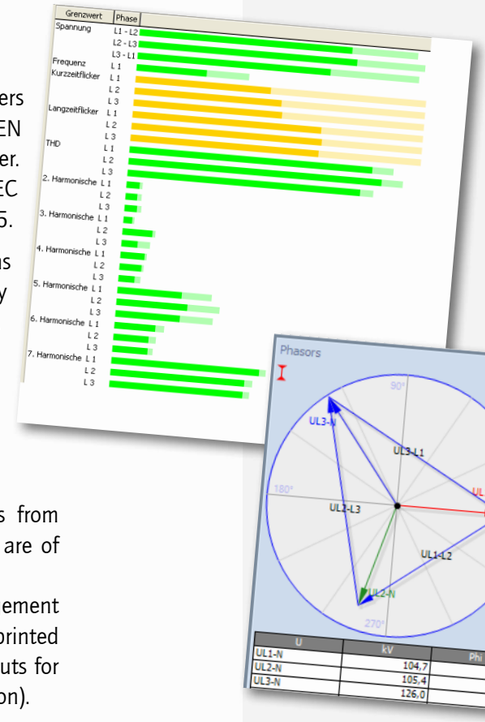
Event recording with dynamic sampling rates

Event recording provides information on the time, level and duration of limit value violations and a classification of events to EN 50160, UNIPEDE, CBEMA or ITIC, for example. RMS value event signatures can also be recorded if desired. To keep memory requirements to a minimum, the sample rate can be controlled dynamically. This means that fast signal changes are recorded with a higher resolution than slow signal changes.

Power quality analysis

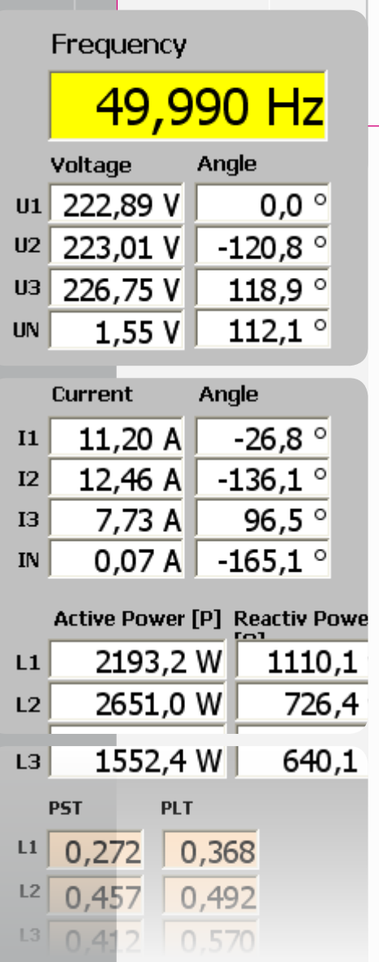
The continuous recording of all power system parameters allows comprehensive power quality analysis to DIN EN 50160 or quality criteria defined by the individual user. Characteristic values are captured and calculated to IEC 61000-4-30 class A, IEC 61000-4-7 and IEC 61000-4-15.

Because quality reports can be created automatically as PDF files as well, it is easy to provide proof of quality whenever required, even without specialist knowledge.



Recording of digital events and states

Binary inputs are primarily used to read in signals from protection relays and circuit breaker positions which are of decisive importance for the analysis of fault records.
Event classes with and without an acknowledgement obligation and message texts which can be listed or printed out chronologically can be assigned to the binary inputs for the continuous recording of binary signals (SER function).



SHERLOG OPERATING SOFTWARE

Binary inputs are primarily used to read in signals from protection relays and circuit breaker positions which are of decisive importance for the analysis of fault records.

All applications in one software package

The operating software always includes the full range of SHERLOG functions. However, the number of devices which can be managed is staggered and can be extended by means of upgrades.
The ergonomic graphical user interface, designed according to the Windows® Fluent concept, is geared to meet real-world requirements and provides a wide range of functions, including the following:

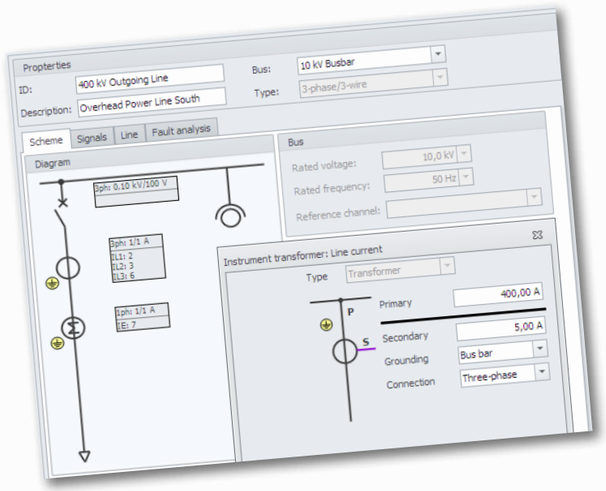
- Flexible configuration for optimum customisation to measurement tasks with due consideration of the network model
- Fully automatic operation of the measuring system with
  - · Long-distance data transmission
  - · Determination of fault type and fault location
  - · Printout or dispatch of fault reports or quality reports
  - · Archiving of records in a database
  - · Online monitoring
  - · Self-monitoring
- Easy-to-use manual functions for data evaluation and report creation
- Remote configuration
- Multi-screen support (optimum overview, a wealth of information at a glance)

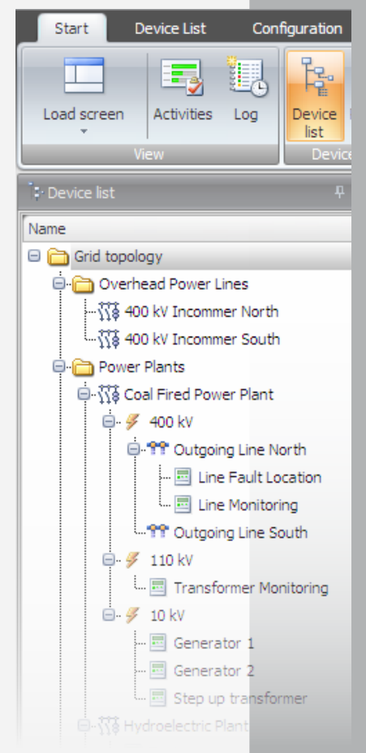
Online access to instantaneous measurement values

All measured or calculated quantities can be called up online and displayed on a PC without affecting the data recording which is currently in progress. The measurement values can be combined within display windows, rather as they can be in a control centre system. In addition to numerical display, the system also provides a range of graphical options, including analog pointer instruments, vector diagrams, bar graphs and oscilloscope displays.

Configuration

The configuration module takes into account the actualities and requirements of modern power supply systems in a very practical way. Measuring range parameters can be entered in the form of transformer ratios, while lines and bus bars can be configured using appropriate network models. The device parameters and specific configurations for individual measurement locations are saved and managed in a database.

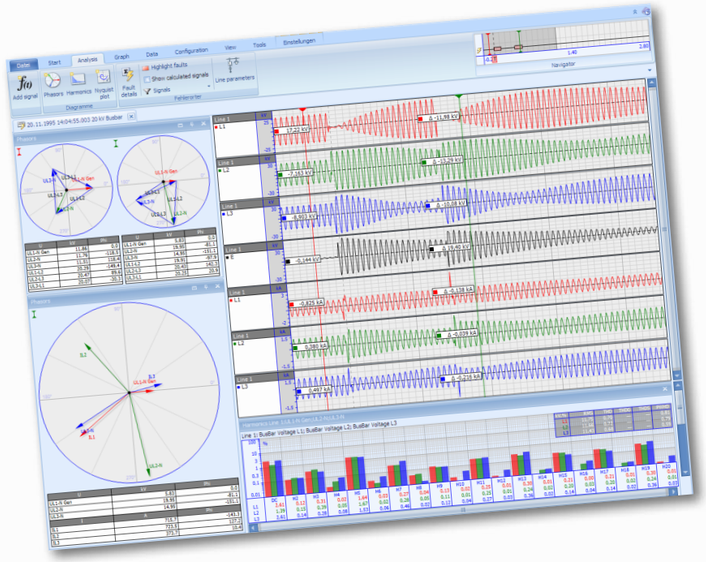




Evaluation of fault records

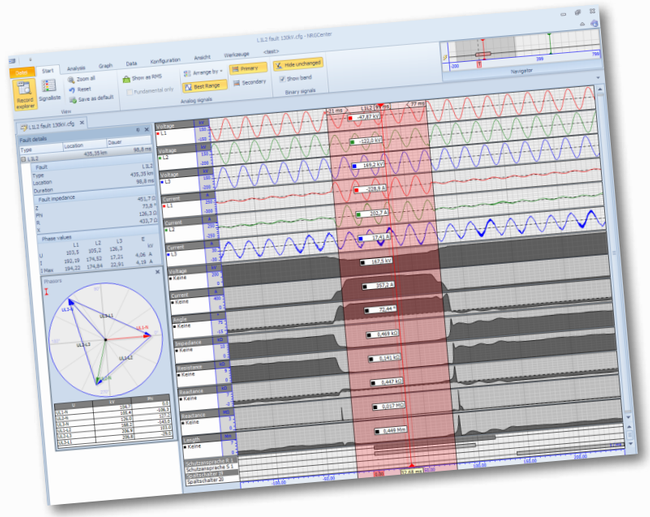
The software contains a comprehensive range of powerful analysis tools for the assessment of recorded data:

- Useful zoom functions and variable scaling
- Simultaneous display, superimposition and synchronisation of more than one fault record
- Vector displays
- Harmonic analysis on the basis of full waves or to IEC 61000-4-7 with interharmonics
- Nyquist plot
- Determination of fault location
- Freely configurable absolute and delta measurement cursors
- Formulary and formula editor for the calculation of further power system quantities
- Individual report creation using the clipboard
- Automatic report creation



Fault location

The powerful fault locator can characterise faults quickly to support control room staff as well as calculating the fault loop and detailing the fault type, fault impedance and fault location.



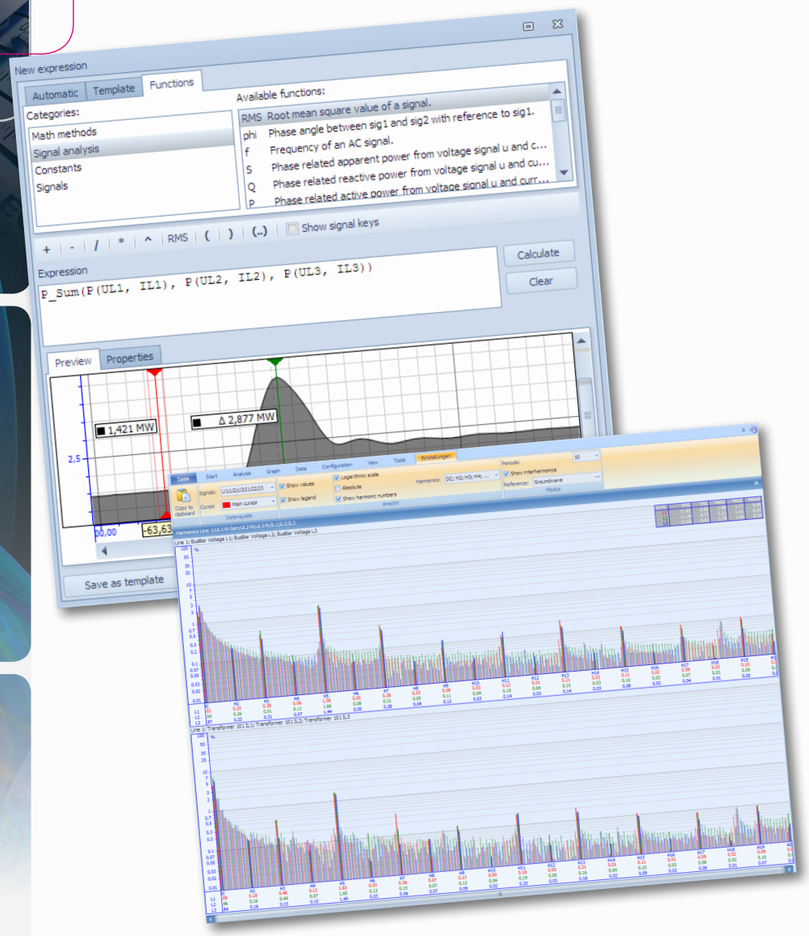
Fault details

Type	Location	Dauer
	435,35 km	98,8 ms
L1L2		
Fault		L1L2
Type		435,35 km
Location		98,8 ms
Duration		
Fault impedance		
Z		451,7 Ω
Phi		73,8 °
R		126,3 Ω
X		433,7 Ω
Phase values		

	L1	L2	L3	E
U	103,5	105,2	126,3	kV
I	192,19	174,52	17,21	4,06 A
I Max	194,22	174,84	22,91	4,19 A

Mathematical signal analysis

A formula editor can be used to make further mathematical calculations within fault records. The results are added to the fault record as an additional signal.



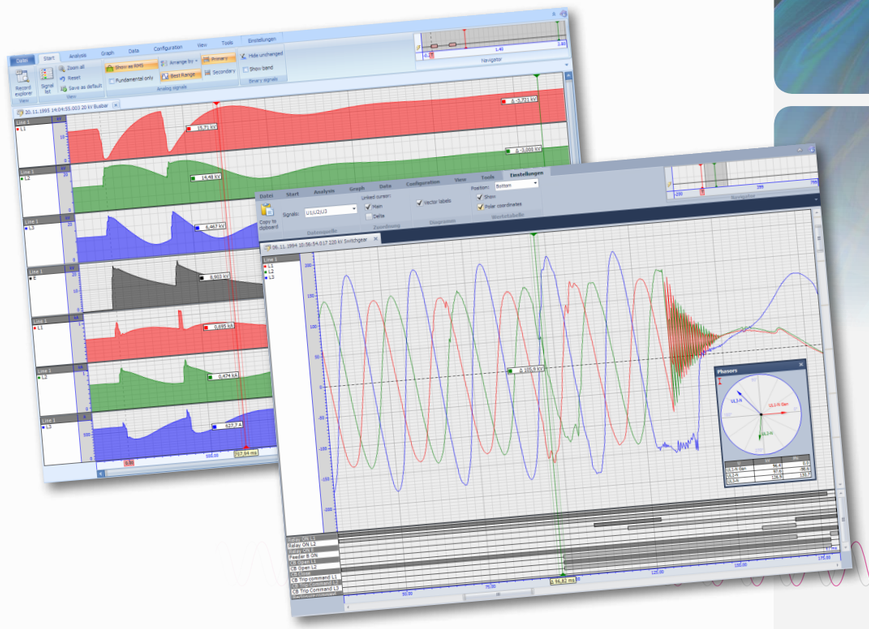
Grid quality analysis

Grid and power quality analysis can be carried out to EN 50160 and include the following:

- Slow changes with trend analysis
- Event recording with signature display
- Flicker analysis
- Harmonic analysis
- Analysis of interharmonics
- Event classification and assessment (UNIPEDE, ITIC, etc.)
- Graphical display of extreme value duration distribution
- Table overview of limit value violations
- User-defined limit value and analysis settings
- Automatic generation of monthly, quarterly and annual reports

Data formats

Import and export functions enable data to be exchanged between different systems using standard COMTRADE, CSV and PQDIF file formats.



Examples of possible device configurations

Main power supply unit	Redundant power supply unit	Optical interfaces	GPS/ DCF 77/ IRIG-B / Pulse	Main CPU	Relay outputs	1...8	9...16	17...24	25...32	16	32	48	64	80	96	112	128
Main power supply unit				Main CPU	Relay outputs	1...8				16							
Main power supply unit				Main CPU	Relay outputs	1...8	I 1...4		I 5...8		I 9...12		16	32	48	64	80
Main power supply unit				Main CPU	Relay outputs	1...8	I 1...4						16	32			

4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84

32 analog and 128 binary inputs
Current measurement with external sensors

Examples of applications:
- 4 separate energy systems (16 x voltage, 16 x current)
- 1 busbar and 9 lines (4 x voltage, 27 x current)

8 analog and 16 binary inputs
Current measurement with external sensors

Examples of applications:
- 2 busbars (8 x voltage)
- 1 energy system (4 x voltage, 4 x current)

20 analog and 80 binary inputs
Direct current measurement on protection transformers

Examples of applications:
- Double busbar and 4 lines (8 x voltage, 12 x current)

12 analog and 32 binary inputs
Direct current measurement on protection transformers

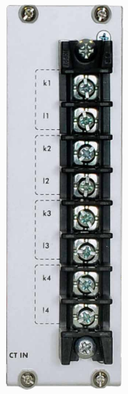
Examples of applications:
- 1 energy system and low-level signals
  (4 x voltage, 4 x current and 4 x 20 mA low-level signals)

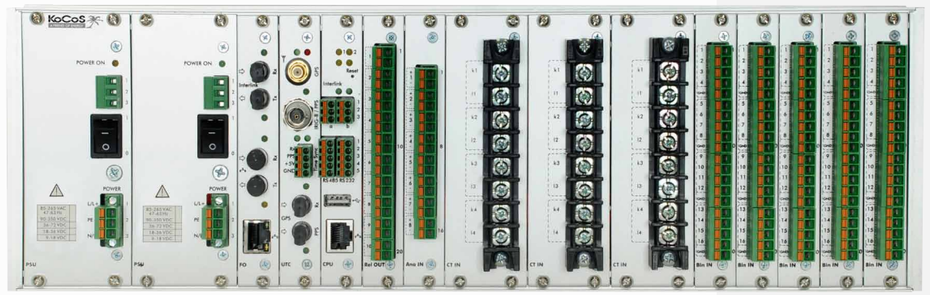
Options

Analog module type 1:
8 voltage/current or
low-level signal inputs

Analog module type 2:
4 current inputs

Binary input module
16 binary inputs





Technical Data

General description	Multi-processor system	Digital signal processor (DSP), for processing signals and processes in real time	
		Communication processor for mass data storage, simultaneous data communication using different interfaces and protocols, web server functionality and stand-alone operation	
	User controls and displays	8 status LEDs for alarm, trigger and status display 3.5" colour graphical display with touch screen and 4 function keys	
	Data memory	32 GB flash RAM for mass data storage 128 MB flash RAM for firmware	
	Quality system	Developed and manufactured to DIN ISO 9001:2000	
Power supply	Operating voltage	Type 1: 90...365 VDC and 85...265 VAC, 47...63 Hz Type 2: 9...18 VDC Type 3: 18...36 VDC Type 4: 36...72 VDC	
	Power consumption	Max. 30 VA with maximum configuration (32 analog and 128 binary inputs)	
	Redundancy	SHERLOG CRX can accommodate up to two independent power supply modules which can either be of the same type or of different types, ensuring power supply unit and power supply redundancy.	
Analog inputs	Number	Max. 32 analog inputs configurable for voltage, current or low-level signal measurement	
	Resolution/sampling	16 bit/200 kHz	
	Analog module type 1	Channel number	8 separate inputs with switchable measuring ranges
		Measuring ranges	300 VAC/±424 VDC 700 mVAC/±1000 mVDC 200 mVAC/±282 mVDC ±20 mA
		Overload	1000 VAC sustained
	Analog module type 2	Channel number	4 high-current inputs with switchable measuring ranges
		Measuring ranges	10 AAC, impedance 0.002 Ohm 40 AAC, impedance 0.002 Ohm 200 AAC, impedance 0.002 Ohm
		Overload	40 AAC sustained 200 AAC for 5 seconds 500 AAC for 1 second
Binary inputs	Number	Max. 128 binary inputs	
	Resolution	0.1 ms	
	Response threshold	24...300 VDC	

Binary outputs	Number	8 mechanical relay outputs, configurable as NC or NO contacts 2 electronic outputs
	AC switching capacity	Mechanical relay: 250 V, 8 A, resistive load Electronic relay: 60 V, 400 mA
	DC switching capacity	Mechanical relay: 300 V, 8 A, 50 W, resistive load Electronic relay: 60 V, 400 mA
Time synchronisation	Interfaces	Internal real-time clock, NTP/SNTP, IRIG-B, internal GPS receiver, external GPS central clock, DCF77, seconds pulse Interlink interface for the synchronisation of SHERLOG CRX devices with each other
Data communication	Interfaces	Standard: 2 x RS232, 1 x RS485 2 x USB-A, 1 x USB-B 1 x 10/100 Mbit Ethernet (RJ 45) Optional: 1 x 10/100 Mbit Ethernet optical (ST II) 1 x 10/100 Mbit Ethernet (RJ 45)
	Protocols	Standard: TCP/IP, Modbus TCP, GSM, GPRS Optional: IEC 61850, DNP 3.0, Profibus, IEEE C37.118 (PMU)
Function overview	Recording functions	Digital fault recorder, 2 sampling rates from 100 Hz to 30 kHz RMS fault recorder, sampling rate from 1 Hz to 120 Hz Power quality recording and evaluation Continuous data recording Event data recording Phasor measurement unit (PMU)
	Standards	IEC 61000-4-30 class A IEC 61000-4-7 harmonics and inter-harmonics IEC 61000-4-15 flicker EN 50160, IEEE 519 IEEE C37.118
Environment	Housing	19" housing for rack mounting, 84 HP/3 U
	Protection class	IP 52 (front panel)
	Dimensions	483 mm x 132.5 mm x 263 mm
	Storage temperature	-30...70°C
	Operating temperature	-5...55°C, minimum switch-on temperature: 0°C
	Relative humidity	5...95%, non-condensing
	Other	RoHS-compliant
Operating software	SHERLOG operating software for Windows 7, Windows 8.1 (32 and 64 bit), Windows 10 (32 and 64 bit), Windows Server 2012 R2	