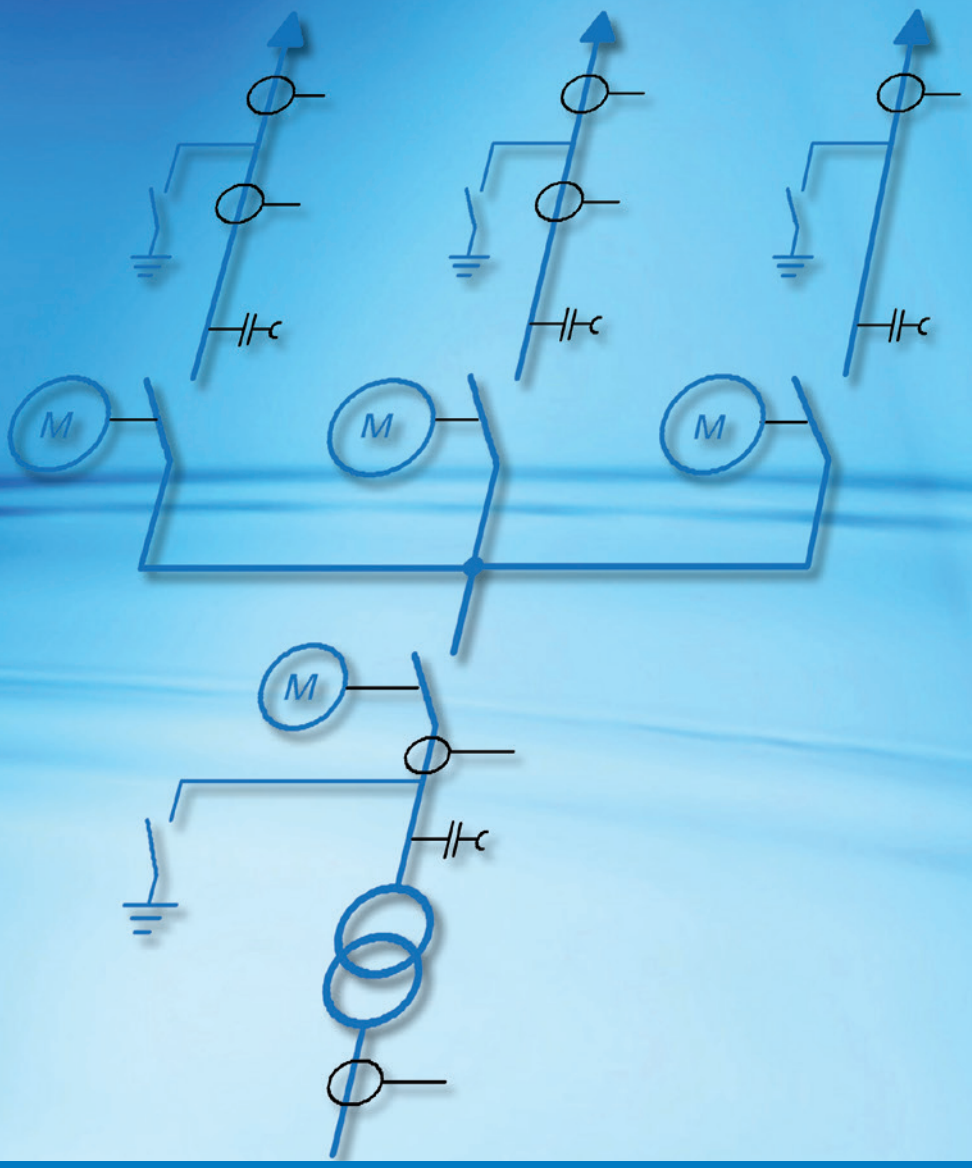

Focus on Power Presence

8/2017 (E)

kries

Company Profile

Kries-Energietechnik GmbH & Co KG

Foundation: 1994

Main Tasks: Designing and manufacturing of electronic measuring and test systems for condition monitoring and failure locating in power distribution networks and remote control systems for effective distribution network operating.

Kries-Energietechnik, Consulting

Foundation: 1982

Main Tasks: Planning and distribution of components and systems for power-grids.

Focus and Background

Availability of electrical power is a basic requirement for economic strenght, quality of infrastructure and life.

Power distribution networks are the connecting links between power generation and consumer. Since they are spread widely they are sensitive to failures but they can be operated and controlled by intelligent monitoring systems. Inside the distribution network the share of decentral power generators increases permanently and requires additional measures for network monitoring and control.

Our work is focused on designing of intelligent components and systems for monitoring and control of power distribution networks which are capable to meet the highest requirements of power availability.

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Index

CAP-Line
Voltage detection systems (VDS), voltage monitoring, PT replacement

IKI-Line
Fault indicators, protection relays and feeder control units

PONLINE®
Remote monitoring and operating, distribution automation,
SCADA solutions

CAP-Line

Voltage detection systems, voltage measurement

- **CAP-Line**
  Product overview
- **CAPDIS®-S1+(R4.5)**
  FAIL-SAFE
  Integrated capacitive voltage detecting system
- **CAPDIS®-S2+(R4.5)**
  FAIL-SAFE
  Integrated capacitive voltage monitoring system
- **CAPDIS®-S2_55**
  Voltage Detection System (VDS) acc. IEC 61243-5 and IEC 60255
- **CAPDIS®-Sx_HV**
  Voltage Detection System (VDS) for high-voltage applications
- **CAPDIS®-PI (R4)**
  Voltage Detection System (VDS) for retrofitting
- **VOIS+**
  Integrated capacitive voltage detecting system
- **VOIS R+**
  Integrated voltage indicating system with relay output
- **CAPDIS®-M/4**
  Voltage measuring and monitoring,
  Replacement for PTs
- **CAPDIS®-4o**
  PT replacement ohmic sensors 1-36 kV
- **CAP-Phase**
  Universal Tester
- **CAPDIS®-Sense**
  Voltage sensors for retrofit applications

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CAP-Line

Product overview

	Voltage detection system	Voltage detection system with relay output	Voltage detection system with relay output	Voltage detection system (with relay output)	Voltage detection system for retrofit	Voltage detection system for retrofit
	CAPDIS-S1+ (R4.5)	CAPDIS-S2+ (R4.5)	CAPDIS-S2_55	CAPDIS-S1(S2)_HV	CAPDIS-PI-HR	CAPDIS-PI-RR4
						
Item no.	2502145	2502134	2502134_H002	2502145_H001 (2502134_H001)	2501382	2501384
Application	Voltage detection	Voltage detection Voltage monitoring Interlock of earthing switch	Voltage detection Voltage monitoring Protection functio-nality	Voltage detection Voltage monitoring for high-voltage applications	Retrofit of capactive interfaces	Retrofit of capactive interfaces
Standard	IEC 61243-5	IEC 61243-5	IEC 61243-5 IEC 60255-26	IEC 61243-5	IEC 61243-5	IEC 61243-5
Voltage level	LRM	LRM	LRM	LRM	HR auf LRM	HR auf LRM
Display	LCD	LCD + LED	LCD + LED	LCD + (LED)	LCD	LCD
Indication for	Voltage present Maintenance test passed Overvoltage Asymmetric con-dition Broken lead	Voltage present Maintenance test passed Overvoltage Asymmetric con-dition Broken lead Aux. power missing	Voltage present Maintenance test passed Overvoltage Asymmetric con-dition Broken lead Aux. power missing	Voltage present Maintenance test passed Overvoltage Asymmetric con-dition Broken lead (Aux. power missing)	Voltage present Maintenance test passed Overvoltage Asymmetric con-dition	Voltage present Maintenance test passed Overvoltage Asymmetric con-dition
Relay output	-	2 changeovers	2 changeovers	(2 changeovers)	-	-
Self test	yes	yes	yes	yes	yes	yes
C2m	settable, 6 values	settable, 6 values	settable, 6 values	settable, 6 values	fixed	settable, 8 values
Un	1 - 52 kV	1 - 52 kV	1 - 52 kV	1 - 480 kV	1 - 52 kV	1 - 52 kV
Auxiliary power	-	24 ... 230 VAC/DC	24 ... 230 VAC/DC	(24 ... 230 VAC/DC)	-	-
Interface to IKI	Y-Cable	Y-Cable	Y-Cable	Y-Cable	-	Y-Cable
Accessories	Cable set	Cable set	Cable set	HV cable set	-	-

	Voltage measurement	Voltage amplifier
	Capdis-M	Capdis-4(o)
		
Item no.	2500785	2500307(2502073)
Application	Voltage measurement and monitoring	Voltage amplification
Norm	IEC 61243-5	IEC 61243-5
Voltage level	LRM	4x100 V, 0.5 VA
Indication for	LCD + LED: Voltage, frequency, alarms	-
Relay outputs	-	2 changeover contacts (-)
Auxiliary power	from S2+ or CAPDIS-4	24 ... 230 VAC/DC
Additional outputs	ModbusRTU optional	4x4...20 mA

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Product overview

	Voltage detection system	Voltage detection system with relay output
	VOIS+	VOIS-R+
		
Item no.	2502165	2502063
Application	Voltage detection	Voltage detection Voltage monitoring Interlock of earthing switch
Norm	IEC 61243-5	IEC 61243-5
Voltage level	LRM	LRM
Display	LCD	LCD
Indication for	Voltage present Asymmetric condition	Voltage present Asymmetric condition
Relay output	-	1 changeover
Self test	no	no
Maintenance test	no	no
C2m	fixed	fixed
Auxiliary power	-	24 - 230 VAC/DC
Interface to IKI	-	-
Accessories	Cable set	Cable set

CAPDIS®-S1+(R4.5)

FAIL-SAFE

Integrated capacitive voltage detecting system

Fail-Safe-Functions

- **Voltage detecting system (VDS) for high voltage**
  Detection of voltage condition in high voltage equipment according to IEC 61243-5.
  Integrated continuous three phase voltage indication.

- **No battery required, no maintenance required**
  For voltage detecting and self test no external power supply or battery is required

- **Complete insulation monitoring of capacitive divider**
  Primary and secondary isolation monitoring and of capacitive divider.
  Isolation problems are indicated on display.

- **Inherent safety**
  The CAPDIS-S1+ includes a self test which offers inherent safety; no external test device is required. Self test function according to patent DE 103 04 396.The test is activated by the Test-button and does not need any auxiliary supply. This test allows to distinguish between voltage absence and any device fault. This test is mandatory for safe detection of voltage absence! Optional broken signal lead detection.

- **Adjustable for Smart-Grid applications**
  Secondary part of capacitive divider is adjustabel by user. Correct adjustment is important to use CAPDIS® in combination with Smart-Grid Systems such as IKI-50. Six steps to set the correct value are available. In case of a non-correct setting, the mismatch is indicated.

- **Integrated 3-phase test point**
  Acc. to the LR-specification in IEC 61243-5.
  The test point can be used for phase comparison and phase sequence test, e.g. by universal tester type CAP-Phase.

- **Integrated Y-Interface**
  To connect CAPDIS® to Smart-Grid Systems such as IKI-50 or IKI-22.

CAPDIS®-S1+(R4.5)

FAIL-SAFE

Integrated capacitive voltage detecting system

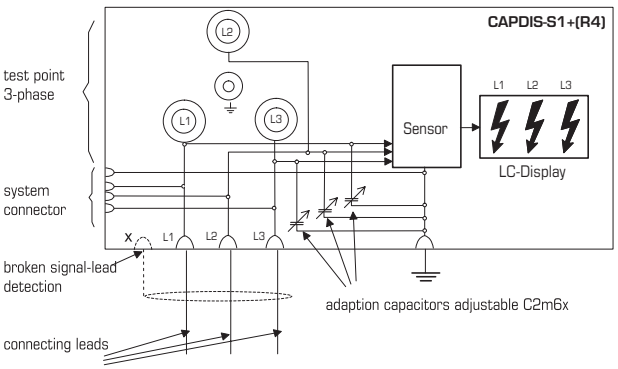
universal C2m-Module

Function and Technical Data

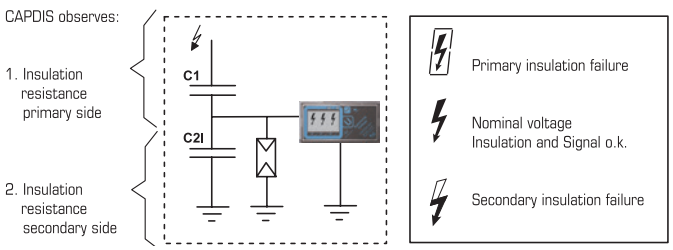
Applied standard	IEC 61243-5 (VDS)

Indication LCD	Indication during normal operation with nominal voltage	Explanation	Indication during bringing into service with nominal voltage	Indication with pressed Test-button
	Overvoltage	Insulation problem at primary part of divider or U >> 1.2xUn	C2m < Min.	CAPDIS® OK
	Nominal voltage present	Signal OK Insulation OK U > 0.45xUn	C2m correct	internal error
	Voltage present	Insulation problem at secondary part of divider 0.1xUn < U < 0.45xUn	C2m > Max.	internal error
No indication	No voltage	Short circuit at connecting leads U < 0.1xUn	C2m >> Max.	internal error
ERROR		System error	System error	broken lead (with optional broken lead detection)

Housing	front panel mount, h x w x d = 48 x 96 x 37 mm, for cut 45 x 92 mm
Operating temperature	- 25 °C to +75 °C, storage temperature: - 30 °C to +70 °C, IP 54
Connectors for signal leads	fast-on receptacles 4.8 x 0.8 mm
Required data for order	rated voltage UN, capacitance of coupling electrode C1
Item no.	2502145 CAPDIS-S1+/ R4.5 with signal lead test
Universal C2m-Modules	2501155 Low values (100, 470, 570, 1000, 3300, 4700 pF) 2501156 Medium values (330, 2200, 2530, 6800, 10000, 16800 pF) 2501157 High values (330, 2200, 2530, 10000, 22000, 32000 pF) further values on request



Insulation monitoring of capacitive divider with CAPDIS



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CAPDIS®-S2+(R4.5)

FAIL-SAFE
Integrated capacitive voltage monitoring system with relay contacts

Fail-Safe-Functions

- **Voltage detecting system (VDS) for high voltage**
  Detection of voltage condition in high voltage equipment according to IEC 61243-5.
  Integrated continuous three phase voltage indication.

- **No battery required, free of maintenance**
  For voltage detecting and self test no external power supply or battery is required.

- **Complete insulation monitoring of capacitive divider**
  Primary and secondary insulation monitoring of capacitive divider.
  Insulation problems are indicated.

- **Inherent safety**
  The CAPDIS-S1+ includes a self test which offers inherent safety; no external test device is required. Self test function according to patent DE 103 04 396. The test is activated by the Test-button and does not need any auxiliary supply. This test allows to distinguish between voltage absence and any device fault. This test is mandatory for safe detection of voltage absence! Optional broken signal lead detection.

- **Adjustable divider for Smart-Grid applications**
  Secondary part of capacitive divider is adjustable by user. Correct adjustment is important to use CAPDIS® in combination with Smart-Grid Systems (IKI-50, IKI-20a). Six steps to set the correct value are available. In case of a non-correct setting, the mismatch is indicated.

- **Relay and LED outputs**
  For remote monitoring of voltage condition two relay contacts are integrated. The relays are driven by auxiliary voltage. Two LEDs show the actual relay state.

- **Integrated 3-phase test point**
  Acc. to the LR-specification in IEC 61243-5.
  The test point can be used for phase comparison and phase sequence test, e.g. by universal tester type CAP-Phase.

- **Integrated Y-Interface**
  To connect CAPDIS® to Smart-Grid Systems such as IKI-50 or IKI-22.

CAPDIS®-S2+(R4.5)

FAIL-SAFE

Integrated capacitive voltage monitoring system with relay contacts

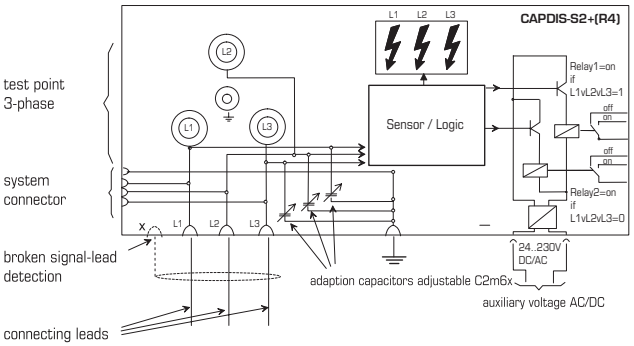
Function and Technical Data

Applied standard	IEC 61243-5 (integrated voltage detecting system)

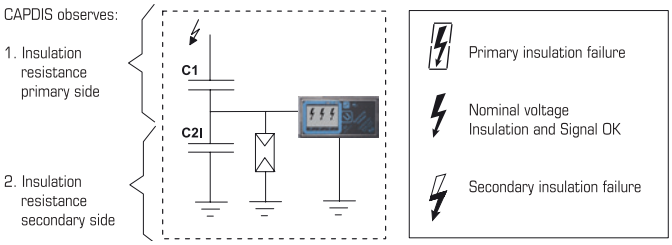
LCD indications

Indication LCD	Indication during normal operation with nominal voltage	Explanation	Indication during bringing into service with nominal voltage	Indication with pressed Test-button	Relay functions CAPDIS-S2+
	Overvoltage	Insulation problem at primary part of divider or U >> 1.2xUn	C2m < Min.	CAPDIS® OK	Relay 1 and 2: ON at least 1 phase with U >> 1.2xUn or earth fault (asymmetry)
	Nominal voltage present	Signal OK Insulation OK U > 0.45xUn	C2m correct	internal error	Relay 1: ON min. 1 phase with U> = 0.1xUn
	Voltage present	Insulation problem at secondary part of divider 0.1xUn < U < 0.45xUn	C2m > Max.	internal error	
	No voltage	Short circuit at connecting leads U < 0.1xUn	C2m >> Max.	internal error	Relay 2: ON min. 1 pahse with U < 0.1xUn
ERROR		System error	System error	broken lead (with optional broken lead detection)	Relay 1 and 2: OFF Missing auxiliary power, or internal fault, or broken lead detection

LEDs	Green LED: Relay 2, red LED: Relay 1
Auxiliary voltage	24 - 230 VAC/DC +/- 10%, power consumption: < 1 W
Switching - power of relays	250 VAC, 5 A / 30 VDC, 5 A / 250 VDC, 0.3 A
Dimensions	h x w x d = 48 x 96 x 37 mm, recommended cutout: h x w = 45 x 92 mm
Operating temperature	-25 °C to +75 °C, storage temperature: -30 °C to +70 °C, IP 54
Connectors for signal leads	fast-on receptacles 4.8 x 0.8 mm
Required data for order	rated voltage UN, capacitance of coupling electrode C1
Item no.	2502134 (CAPDIS-S2+_R4.5 with signal lead test)
Universal C2m-Modules (Standard)	2501155 Low values (100, 470, 570, 1000, 3300, 4700 pF) 2501156 Medium values (330, 2200, 2530, 6800, 10000, 16800 pF) 2501157 High values (330, 2200, 2530, 10000, 22000, 32000 pF) further values on request



Insulation monitoring of capacitive divider with CAPDIS



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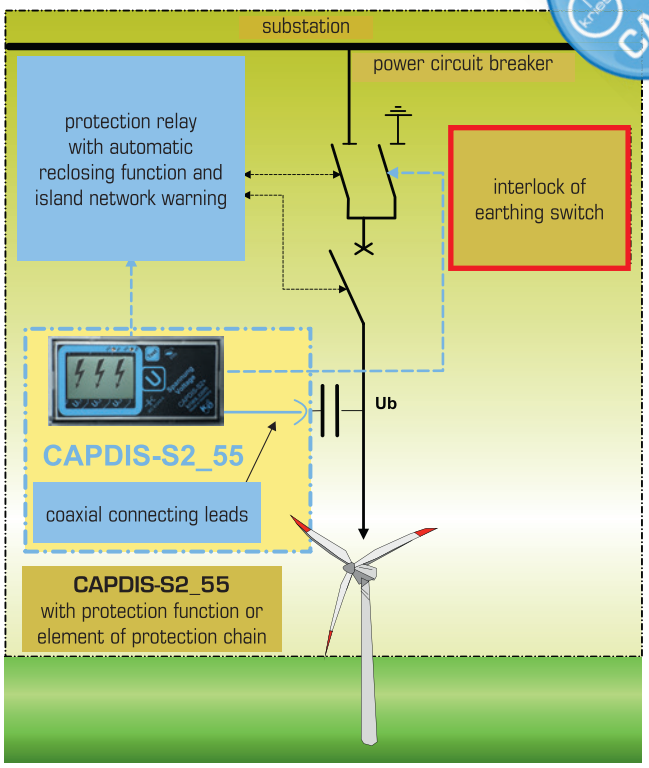
CAPDIS®-S2_55(R4.5)

Voltage Detection System (VDS)
acc. to IEC 61243-5 and IEC 60255
FAIL-SAFE

- **Application as active sensor for power circuit breakers in combination with protection relays**

- **Fail-safe voltage detection and protection functionality**

VDS according IEC 61243-5 and according protection relay norm IEC 60255. CAPDIS-S2_55 is specially made for integration in feeders with power circuit breakers as stand-alone unit for voltage detection or as sensor in combination with protection relays. It is rated to withstand high-frequency disturbance from atmospherical surge voltages, ark-back and resoncance oscillation at all inputs and outputs. Furthermore it is capable to absorb these disturbances partially and therfore prevents propagation of them to other secondary equipment. This additional immunity to disturbance allows the use of CAPDIS-S2_55 for safety-related applications beside voltage detection functionality.



- **Prevention of switching errors**

Decentralised power generation demands a detection of reverse voltage presence and prevention of switching errors substations and power circuit breakers. Instead of using PTs, capacitive voltage detection systems aligned with the protection relay can be used as economic alternative. Reverse voltage detection increases personal safety of operators and prevents switching errors which may lead to black-out of the complete feeder.

- **Island network warning**

At substation to generate an island network warning it is important to detect reverse voltage before switching on the power circuit breaker. This warning prevents switching during a automatic reclosing operation when reverse voltage is still present.

- **Complies with norm for protection relays IEC 60255**

and is therefore empowered for protection and safety-related applications.

- **Free of maintenance and self-monitored**

no batterie required for self test.

- **Integrated interface to CAPDIS-M**

For easy retrofit with CAPDIS-M an interface for auxiliary power and relay control is integrated in CAPDIS-S2+

- **Dry contact ouput and LED indication**

Two switch-over contacts to connect to protection relay or to interlock earthing switch. Two LEDs at the front for status of output contacts.

CAPDIS®-S2_55(R4.5)

FAIL-SAFE
Voltage Detection System (VDS)
acc. to IEC 61243-5 and IEC 60255

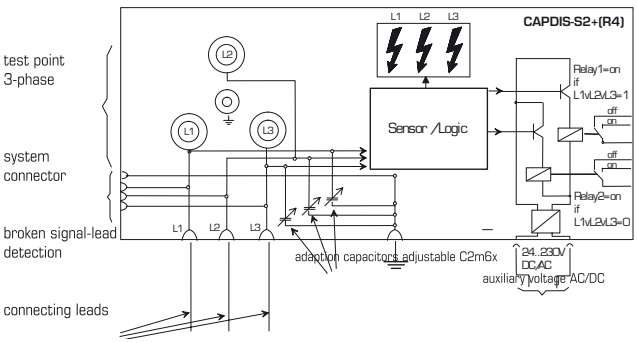
Function and technical data

Applied standard	IEC 61243-5 (integrated voltage detecting system) and IEC 60255

LCD indications

Indication LCD	Indication during normal operation with nominal voltage	Explanation	Indication during bringing into service with nominal voltage	Indication with pressed Test-button	Relay functions CAPDIS-S2+
	Overvoltage	Insulation problem at primary part of divider or U >> 1.2xUn	C2m < Min.	CAPDIS® OK	Relay 1 and 2: ON at least 1 phase with U >> 1.2xUn or earth fault (asymmetry)
	Nominal voltage present	Signal OK Insulation OK U > 0.45xUn	C2m correct	internal error	Relay 1: ON min. 1 phase with U> = 0.1xUn
	Voltage present	Insulation problem at secondary part of divider 0.1xUn < U < 0.45xUn	C2m > Max.	internal error	
	No voltage	Short circuit at connecting leads U < 0.1xUn	C2m >> Max.	internal error	Relay 2: ON min. 1 pahse with U < 0.1xUn
ERROR		System error	System error	broken lead (with optional broken lead detection)	Relay 1 and 2: OFF Missing auxiliary power, or internal fault, or broken lead detection

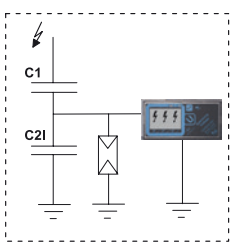
LEDs	Green LED: relay 2, red LED: relay 1
Auxiliary voltage	24 - 230 VAC/DC +/- 10%, power consumption: < 1 W
Switching - power of relays	250 VAC, 5 A / 30 VDC, 5 A / 250 VDC, 0.3 A
Inherent time detection no voltage	180 ms (LCD + output contacts)
Dimensions	h x w x d = 48 x 96 x 37 mm, recommended cut: h x w = 45 x 92 mm
Operating temperature	-25 °C to +75 °C, storage temperature: -30 °C to +70 °C, IP 54
HV_EM_Absorber	2509398 Filter against EMC disturbances, 10 cm, to be installed as close as possible to C1
Required data for order	rated voltage UN, capacitance of coupling electrode C1
Item no.	CAPDIS-S2_55 item no. 2502134_H002
Universal C2m-Modules (Standard)	2501155 Low values (100, 470, 570, 1000, 3300, 4700pF) 2501156 Medium values (330, 2200, 2530, 6800, 10000, 16800pF) 2501157 High values (330, 2200, 2530, 10000, 22000, 32000pF) further values on request
EMC testing norm	IEC 60255-26

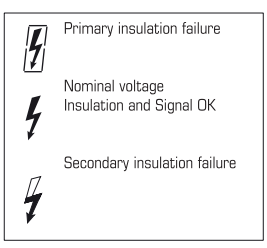


Insulation monitoring of capacitive divider with CAPDIS

CAPDIS observes:

1. Insulation resistance primary side
2. Insulation resistance secondary side





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CAPDIS®-S1_HV
CAPDIS®-S2_HV

Integrated Voltage Detection System (VDS)
for high-voltage applications (52..480 kV)

- **Voltage detecting system (VDS) for high voltage (52 .. 480 kV)**
  Detection of voltage condition in high voltage equipment according to IEC 61243-5.
  Integrated continuous three phase voltage indication.

- **No battery required, free of maintenance**
  For voltage detecting and self test no external power supply or battery is required.

- **Complete insulation monitoring of capacitive divider, fail-safe**
  Primary and secondary insulation monitoring of capacitive divider.
  Insulation problems are indicated with three different levels.

- **Inherent safety, fail-safe**
  The CAPDIS-Sx:_HV includes a self test which offers inherent safety; no external test device is required. Self test function according to patent DE103 04 396. The test is activated by the Test-button and does not need any auxiliary supply. This test allows to distinguish between voltage absence and any device fault. This test is mandatory for safe detection of voltage absence! Optional broken signal lead detection.

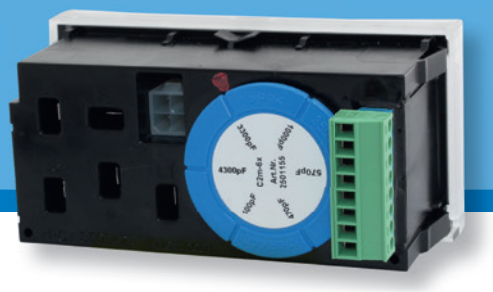
- **Relay and LED outputs (CAPDIS-S2+_HV)**
  For remote monitoring of voltage condition two relay contacts are integrated. The relays are driven by auxiliary voltage. Additionally, two LEDs show the actual relay state.

- **Integrated 3-phase test point**
  Acc. to the LR-specification in IEC 61243-5.
  The test point can be used for phase comparison and phase sequence test, e.g. by universal tester type CAP-Phase.

- **Integrated Y-Interface**
  To connect CAPDIS® to Smart-Grid Systems such as IKI-50 or IKI-22.

CAPDIS®-S1_HV
CAPDIS®-S2_HV

Integrated Voltage Detection System (VDS) for high-voltage applications (52..480 kV)



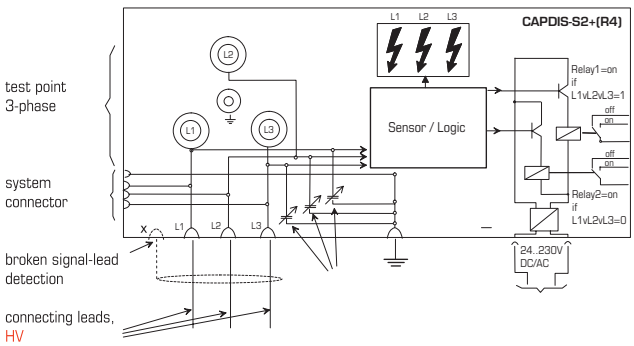
Function and Technical Data

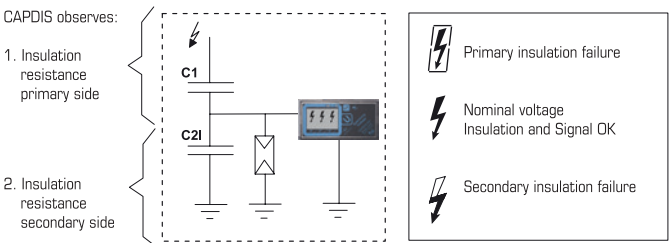
Applied standard	IEC 61243-5 (integrated voltage detecting system)

LCD indications

Indication LCD	Indication during normal operation with nominal voltage	Explanation	Indication during bringing into service with nominal voltage	Indication with pressed test button	Relay functions CAPDIS-S2+
	Overvoltage	Insulation problem at primary part of divider or U >> 1.2xUn	C2m < Min.	device and display OK	Relay 1 and 2: ON at least 1 phase with U >> 1.2xUn or earth fault (asymmetry)
	Nominal voltage present	Signal OK Insulation OK U > 0.45xUn	C2m correct	faulty display	Relay 1: ON min. 1 phase with U> = 0.1xUn
	Voltage present	Insulation problem at secondary part of divider 0.1xUn < U < 0.45xUn	C2m > Max.	internal device fault	
empty (S1)  (S2)	No voltage	Short circuit at connecting leads U < 0.1xUn	C2m >> Max.	internal device fault	Relay 2: ON min. 1 phase with U < 0.1xUn
ERROR		System error	System error		Relay 1 and 2: OFF Missing auxiliary power, or internal fault,

LEDs	Green LED: Relay 2, red LED: Relay 1
Auxiliary voltage	24 - 230 VAC/DC +/- 10%, power consumption: < 1 W
Switching-power of relays	250 VAC, 5 A / 30 VDC, 5 A / 250 VDC, 0.3 A (resistive current), 1250 VA
Dimensions	h x w x d = 48 x 96 x 37 mm, recommended cutout: h x w = 45 x 92 mm
Operating temperature	-25 °C to +55 °C, storage temperature: -30 °C to +70 °C, IP 54
Connectors for signal leads	fast-on receptacles 4.8 x 0.8 mm
HV_EM_Absorber	2509398 Filter against EMC disturbances, 10 cm, to be installed as close as possible to C1
Required data for order	rated voltage UN, capacitance of coupling electrode C1
Item no.	CAPDIS-S1_HV item no. 2502145_H001 CAPDIS-S2_HV item no. 2502134_H001
Universal C2m-Modules	2501155 Low values (100, 470, 570, 1000, 3300, 4700 pF) item no. 2501155 2501156 Medium values (330, 2200, 2530, 6800, 10000, 16800 pF) item no. 2501156 2501157 High values (330, 2200, 2530, 10000, 22000, 32000 pF) item no. 2501157





Insulation monitoring of capacitive divider with CAPDIS

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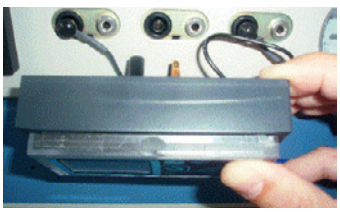
CAPDIS®-PI (R4)

Voltage Detection System (VDS) for retrofitting

- **VDS for retrofitting medium voltage switchgears**
  Transformation of HR or LRM interfaces to integrated voltage detection systems acc. to IEC 61243-5
- **Retrofit without interfering with the switchgear**
  Retrofitting of all HR and LRM interfaces acc. to IEC 61243-5 possible
- **CAPDIS-PI-Retrofit for retrofitting aged interfaces,**
  whose electrical values are not acc. to IEC 61243-5 anymore
- **No battery required**
  Voltage detection and self-test without auxiliary power or battery
- **Free of maintenance**
- **Insulation monitoring of C1 at primary side of capacitive divider**
  Early detection of insulation problems at primary C1 capacity
- **Integrated self-test**
  For voltage detection no additional counter check is neccessary
  Self test acc. to Patent DE 103 04 396
- **Integrated three-phase measurement interface**
  LR interface for phase comparison and rotary field detection integrated e.g. by universal tester type CAP-Phase.
- **Optional Y-interface to fault detector “Grid-Inspector IKI-50”**
  Can be used for voltage measurement of primary voltage without PTs.

before: HR-interface
- Maintenance test required every 6 years
- Voltage detection only with counter check



Installation: 1 min.

after: CAPDIS-PI-HR
- No maintenance
- Integrated self-test
- Longer lifespan

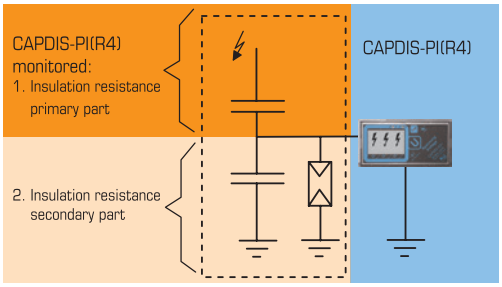
CAPDIS®-PI (R4)

Voltage Detection System (VDS) for retrofitting

Technical Data

Applied standard	IEC 61243-5

LCD indications



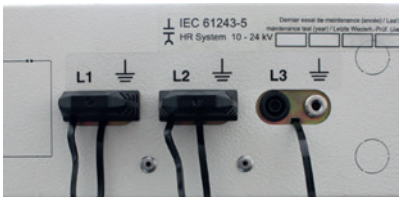
Indication LCD	Indication during normal operation with nominal voltage	Explanation	Indication during bringing into service with nominal voltage	Indication with pressed Test-button
⚡	Overvoltage	Insulation problem at primary part of divider or U>> 1.2xUn	C2m < Min.	CAPDIS® OK
⚡	Nominal voltage present	Signal OK Isolation OK U > 0.45xUn	C2m correct	internal error
⚡	Voltage present	Insulation problem at secondary part of divider 0.1xUn < U < 0.45xUn	C2m > Max.	internal error
No indication	No voltage	Short circuit at connecting leads U < 0.1xUn	C2m >> Max.	internal error

Requirements	HR or LRM interface at switchgear
Measurement interface	LR at front of CAPDIS-PI
Housing	plastic
Dimensions	h x w x d = 52 x 111 x 38 mm
Protection degree	IP 54
Operating Temperature	-25 °C ... +75 °C
Self-Test	via self-test button
Phase comparison	(without battery or auxiliary power) via LR or LRM phase comparators acc. to IEC 61243-5 (e.g. CAP-Phase)

VERSIONS

CAPDIS-PI-HR(R4) for HR-interface:	Item no.: 2501382
CAPDIS-PI-LRM(R4) für LRM-interfaces:	Item no.: 2501383
CAPDIS-PI-RR4 Retrofit:	Item no.: 2501384

CAPDIS-PI-RR4 Retrofit can be used as voltage sensor for directional fault detection via "Grid-Inspector IKI-50" or to retrofit HR interfaces whose electrical values are not acc. to IEC 61243-5 anymore.



before: maintenance check current below 3.2 uA

Retrofit: approx. 10 Min.

after: Voltage detecion system fully conform to IEC 61243-5 with voltage interface to IKI-50

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VOIS+

Integrated capacitive voltage detecting system

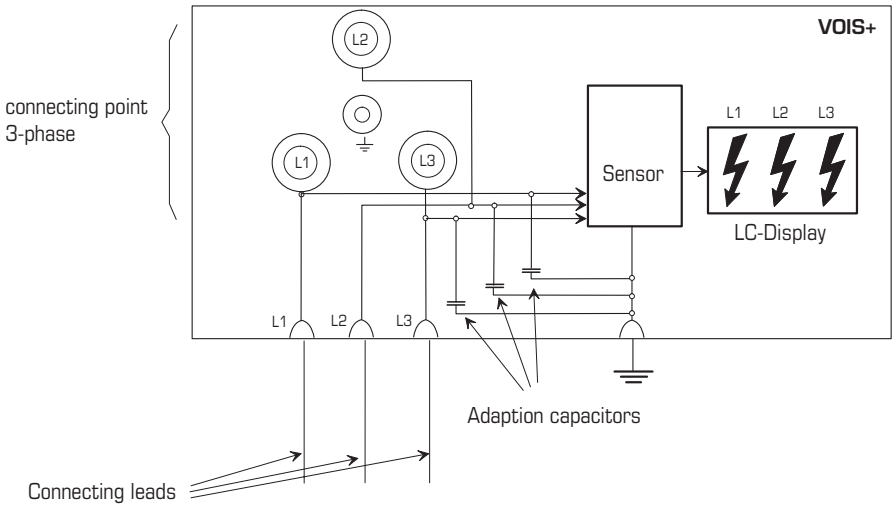
- **Voltage detecting system for high voltage (VDS)**
  Integrated three phase capacitive voltage detecting system according to IEC 61243-5
- **No battery required**
  For voltage detecting no battery or external power supply is required.
- **Integrated 3-phase test point**
  Acc. to LR-specification in IEC 61243-5 to be used for phase comparison and phase sequence test
- **Economical alternative**
  to plug-in voltage detectors

VOIS+

Integrated capacitive voltage detecting system

Technical Data

Applied standard	IEC 61243-5 (voltage detecting system)
Indication per phase	U < 10% of U_N no voltage -> no indication U > 10% of U_N. voltage present -> arrow
Housing	front panel mounting, plastics
Dimensions	h x w x d = 48 x 96 x 37 mm
Recommendet cutout	h x w = 45 x 92 mm
Operating temperature	-25 °C to +70 °C
Storage temperature	-30 °C to +80 °C
Protection class	IP 54
Connectors for signal leads	fast-on receptacles 4.8 x 0.8 mm
Suitable tester for phase comparison	LRM acc. to IEC 61243-5 e.g. type CAP-PHASE (part no.: 2500623)
Required data for order	capacitance of coupling electrode C1 rated voltage U_N
Item no.	2502062 (with 4-pole system connector) 2502165 (without 4-pole system connector)



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VOIS R+

Integrated Voltage indicating system with relay output

- **Voltage detecting system for high voltage (VDS)**
  Integrated three phase capacitive voltage detecting system according to IEC 61243-5
- **Relay output**
  Changeover contact for condition monitoring
- **No battery required**
  For voltage detecting no battery or external power supply is required.
- **Integrated 3-phase test point**
  Acc. to LR-specification in IEC 61243-5 to be used for phase comparison and phase sequence test
- **Economical alternative**
  to plug-in voltage detectors

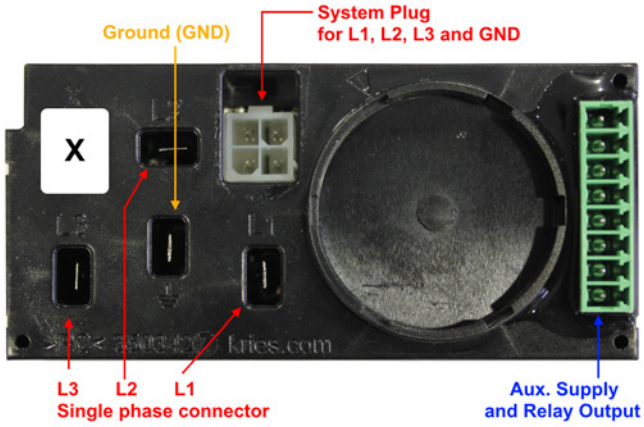
VOIS R+

Integrated Voltage indicating system with relay output

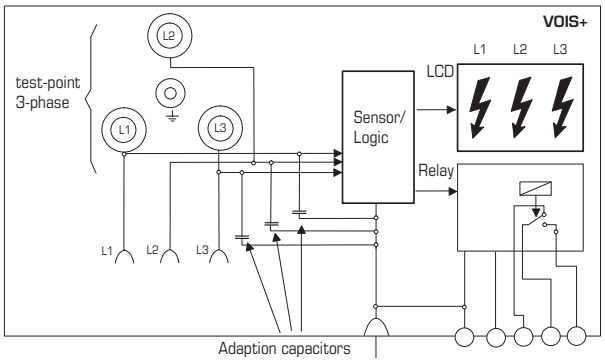
Technical Data

Applied standard	IEC 61243-5 (voltage detecting system)
Indication per phase	U < 10% of U_N no voltage -> no indication U > 10% of U_N. voltage present -> arrow
Housing	front panel mounting
Dimensions	h x w x d = 48 x 96 x 37 mm
Recommendet cutout	h x w = 45 x 92 mm
Operating temperature	-25 °C to +55 °C
Storage temperature	-30 °C to +80 °C
Protection class	IP 54
Auxiliary power	24 - 230 VAC/DC, 1 VA, galvanically insulated
Suitable tester for phase comparison	LRM acc. to IEC 61243-5 e.g. type CAP-PHASE
Required data for order	capacitance of coupling electrode C1 rated voltage U_N
Item no.	2502063

Rear side



Principle sketch



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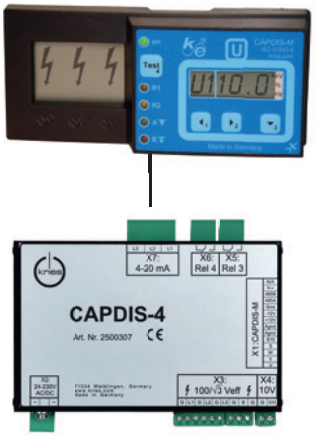
CAPDIS®-M/4

Voltage Measuring and Monitoring
Replacement for Voltage Transformer

CAPDIS-M: Voltage monitoring plugin-module for U0-interface of CAPDIS-Sx+

- Calibration per phase by teach-function
- Voltage measuring and monitoring for 3 phases (selectable)
- Under- and overvoltage monitoring (threshold adjustable)
- Under- and overfrequency monitoring (threshold adjustable)
- Interface to voltage transducer and amplifier CAPDIS-4

CAPDIS-4: Voltage transducer and amplifier CAPDIS-M

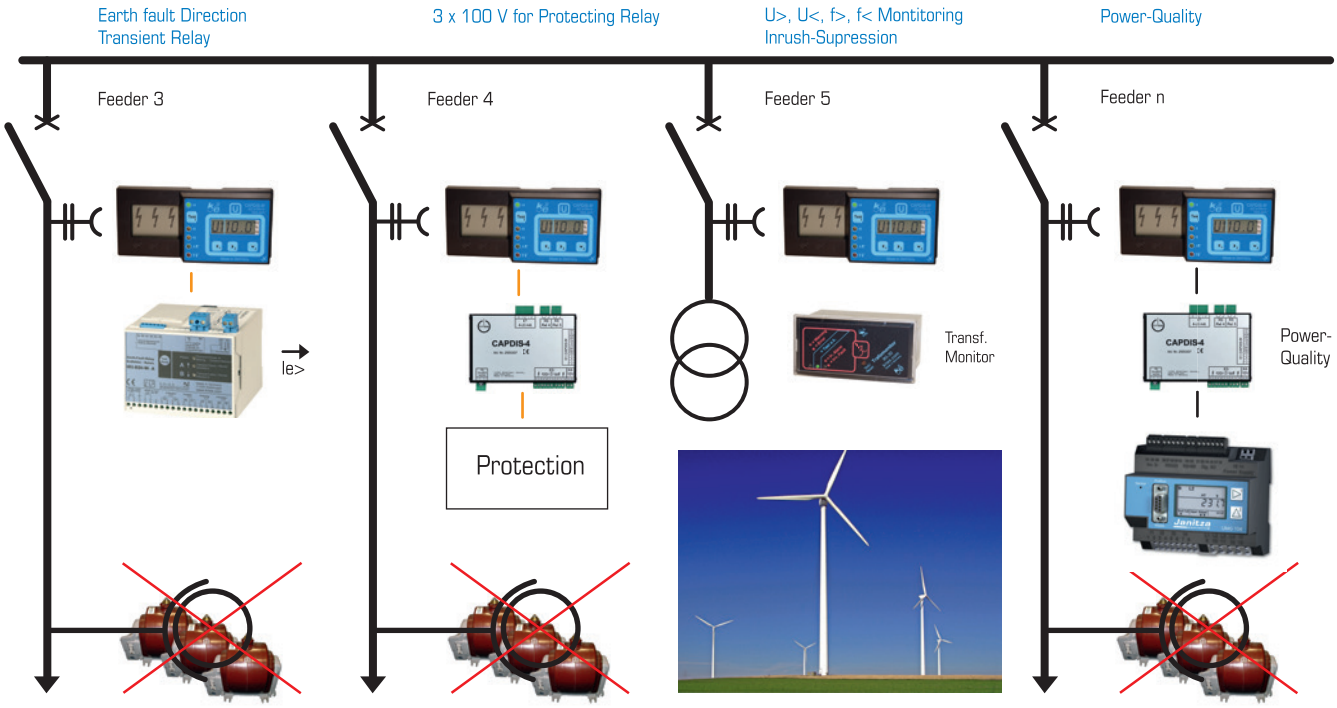


- DIN-rail module for connecting to CAPDIS-M
- Voltage transducer: 3 outputs 3 x 0 (4) ... 20 mA
- Voltage amplifier: 3 outputs 3 x 100 VAC, 0.5 VA per channel

CAPDIS®-M/4

Voltage Measuring and Monitoring
Replacement for Voltage Transformer

Sample applications



Technical Data

CAPDIS-M	
Function	Measuring, display and threshold monitoring of voltage and frequency
Auxiliary power supply	by CAPDIS-S2+(R3), via system cable by CAPDIS-S4 or PCMC (24..230 VAC/DC)
Voltage measuring	3 phases, displayed phase selectable by means of button
Accuracy	<= 3% f. m. r.
Calibration	by teach function
Indication	via LEDs of CAPDIS-M, additionally via relay output of CAPDIS-4 or CAPDIS-S2+(R3)
Output	RS 485 for connection to CAPDIS-4 or IKI-EDI-W or interface to CAPDIS-S2+(R3)
Voltage monitoring	Threshold value settable in 1% steps
Frequency monitoring	Threshold value settable in 0.1 Hz steps
Delay	settable 0 ... 99 s
Housing	plug-in housing for CAPDIS-S1+ or CAPDIS-S2+; hxwxd = 50x115x30 mm
Item no.	2500785 (Standard), 2500770 (Modbus output)
CAPDIS-4	
Function	3-phase voltage transducer and amplifier
Power supply	24 ... 230 VAC/DC
Output	3 x 0 ... 100 VAC (3x0.5 VA), 3 x (0)4 ... 20 mA, 2 relay outputs, auxiliary power supply for CAPDIS-M
Accuracy	app. 3% f. m. r.
Housing	for DIN rail mounting; hxwxd = 130x175x49 mm
Item no.	2500307

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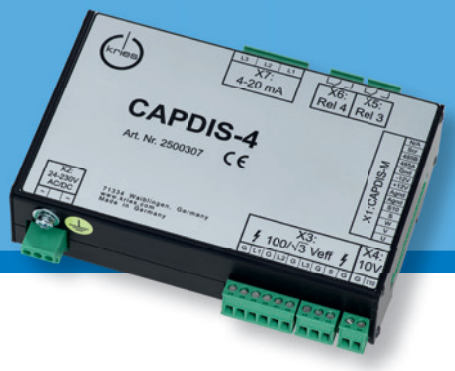
CAPDIS®-4o

Potential Transformer-Replacement

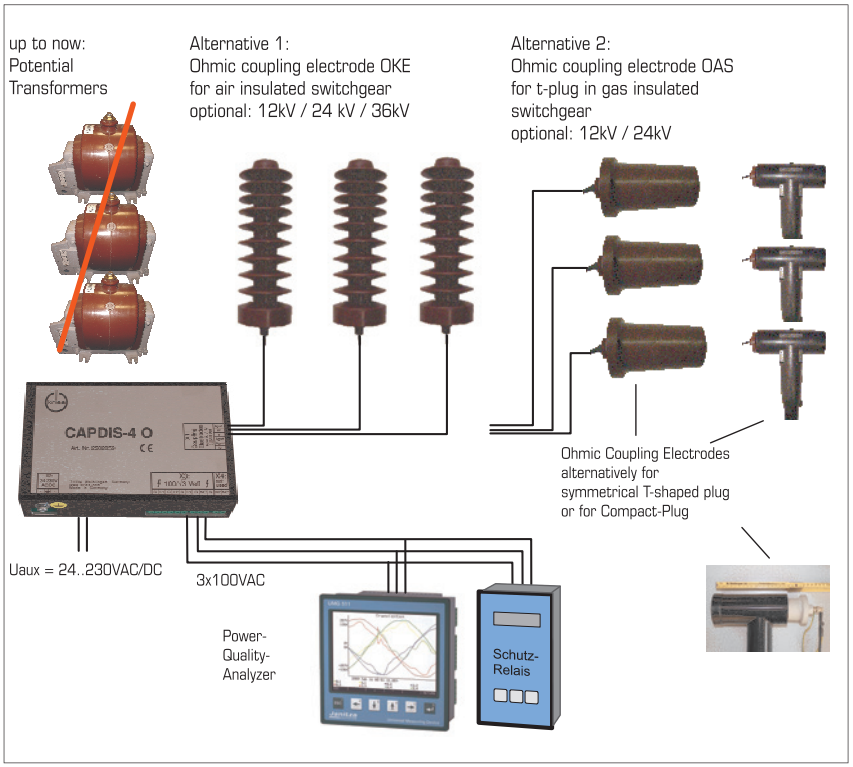


- **CAPDIS-4o**
  Replacement for potential transformer in medium voltage.
  Replacement of inductive voltage transformers by ohmic low power sensors and voltage amplifier CAPDIS-4o.
  System-Class: 1%

- **Handling Advantages**
  - minimum space required, no additional measuring compartment required
  - no demounting during lightning impulse tests required
  - no ferroresonance

- **System-Components**
  - Ohmic divider type OKE for air-insulated switchgears row 12 kV or 24 kV
  - Ohmic divider type OAS for ellbow-plugs in gas-insulated switchgears row 12 kV or 24 kV
  - Voltage amplifier type CAPDIS-4o
    Input: low power signal from ohmic divider
    Output: 3x 100 VAC /√3, 3x 0.5 VA; zero-sequence voltage 100 VAC (only _HF-version)

- **Application**
  Installation of protection relay and network analysers with conventional 100 VAC-voltage input.
  Cost effective alternative for potential transformers in feeders

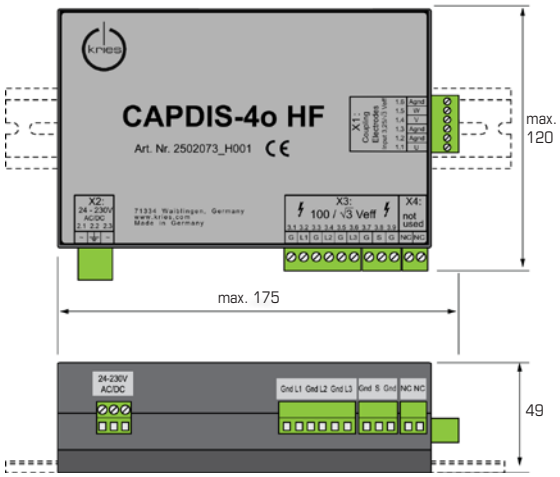


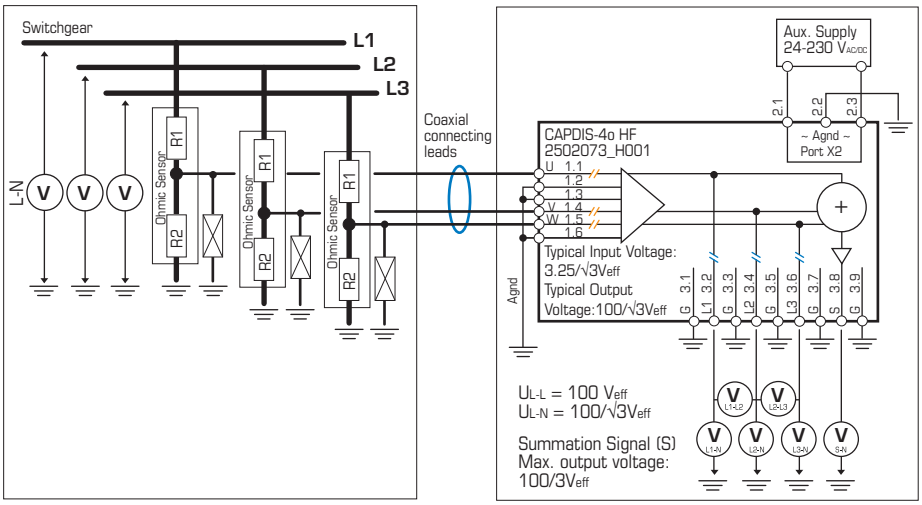
CAPDIS®-4o

Potential Transformer-Replacement

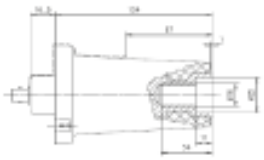
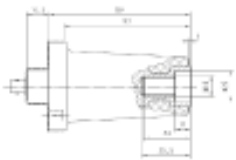
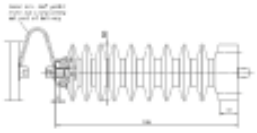
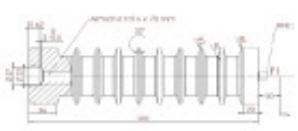
Technical Data

Auxiliary voltage	24 ... 240 VAC/DC
Nominal frequency	50 ... 60 Hz
Power consumption	about 7.5 VA
Protecting degree	IP 40
Input signal	3.25 V / √3
Output signal	3 x 100 VACeff, 3 x 0.5 VA
Temperature range	Storage: -25 °C ... +85 °C Transport: -25 °C ... +85 °C Operation: -20 °C ... +70 °C
Accuracy Class	1, acc. to IEC 60044-7
Weight	600 g
Dimensions	h x w x d = 115 x 175 x 49 mm
Mounting	35 mm-C-bar
Item nos. 2502073 2502073_H001 2502073_H002	 bandwidth fg=200 Hz, no zero-seq. voltage output bandwidth fg=2 kHz, incl. zero-seq. voltage output with burden 200 kOhm for sensors from Zelisko
Connecting leads, coaxial	standard lengths l = 3 m, 6 m





Selection of ohmic dividers

OAS 12, OAS 24 with BNC for asymmetrical ellbow-plugs OAS 12: 100M/32,5k; OAS 24: 200M/32,5k OAS 12: 2043187; OAS 24: 2043188	**OAS 12, OAS 24 with BNC** for symmertrical ellbow-plugs OAS 12: 100M/32,5k; OAS 24: 200M/3,25k OAS 12: 2043623; OAS 24: 2043624	**OKE 12, OKE 24 with BNC** for air-insulated switchgears OKE12; 100M/32,5k; OKE24; 200M/32,5k OKE12: 2043189; OKE 24: 2043190	**OKE 36 with BNC** for air-insulated switchgears 300 M/32,5 k 2043544
			

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CAP-Phase

Universal Tester

- **Combined phase comparator and voltage detector**
  Universal tester for voltage detection, phase comparison and phase sequence test at capacitive HR- and LRM interfaces according to IEC 61243-5.
- **No battery required**
  Self-powered microprocessor technology
- **Phase sequence indication**
- **Maintenance test**
  For capacitive HR or LRM interfaces
- **Integrated self test**
  Covering universal tester and test leads
- **Scope of supply**
  Universal-Tester, two test leads (length 2 m),
  two HR/LRM adaptors, carrying case

CAP-Phase

Universal Tester

Accessories

Padded shoulder bag CAP-Phase
hard-wearing fabric
item no.: 3501101

Test lead set 2 x 4.5 m
item no.: 2500344

Universal adapter cable set
Adapter cables for bushings with not standardised distances of interfaces
item no.: 2500063

Test lead 20 cm
Short test lead for easy handling in case of voltage detection and interface testing
item no.: 2500356

Technical Data

Applied standard	IEC 61243-5 (voltage detecting and phase comparison)
Classification of phase comparator according to standard	UPC
Dimensions of device	h x w x d = 170x80x35 mm
Test leads	2 x 2 m
Dimensions of carrying case	h x w x d = 275 x 340 x 83 mm
Auxiliary voltage	not required
Protection class	IP 54
Operating temperature	-25 °C to +55 °C
Storage temperature	-30 °C to +70 °C
Item no.	2500623

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CAPDIS®-Sense

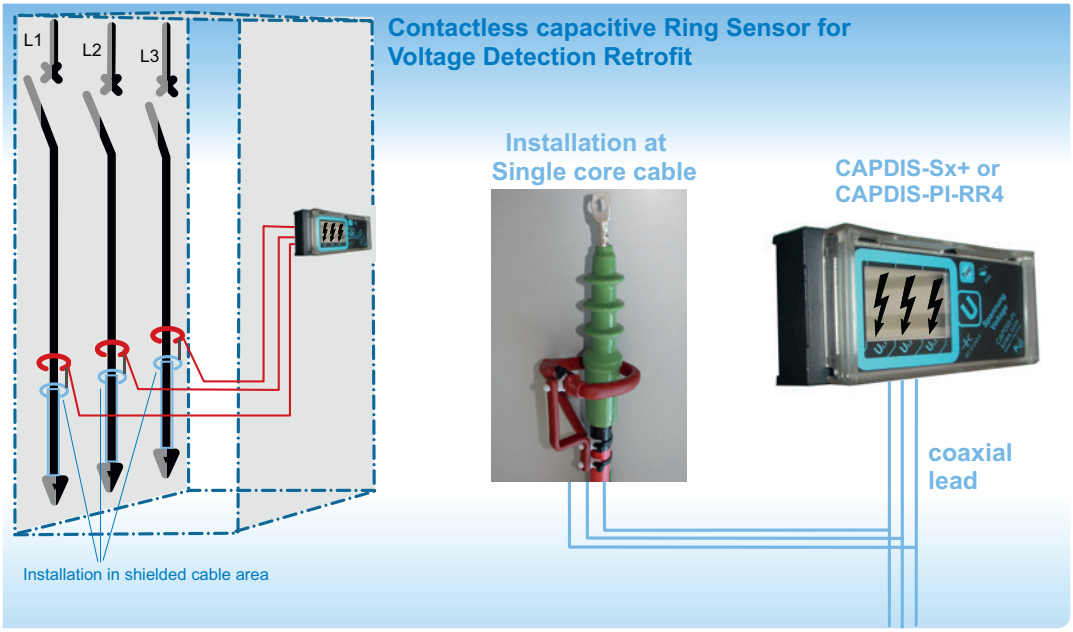
Sensors for Voltage Detection Systems (VDS) acc. to IEC 61243-5 for retrofit applications

- **Voltage detection systems for retrofitting (6-24 kV)**
  Air-insulated switchgears have to be opened for voltage detection. By opening the cable compartment, protection against arc faults is disconnected. The operator is under high risk of injury during arc fault. Existing switchgears can easily be retrofitted with voltage sensors CAPDIS-Sense, and together with CAPDIS-Sx+ they offer the same functionality as built-in systems. Sensors can be mounted to air-insulated cable terminations from 6 kV to 24 kV.

- **Functionality according IEC 61243-5**
  - Integrated three-phase voltage detection via CAPDIS-Sx+R4
  - Phase comparison with LRM phase comparator (e.g. CAP-Phase)
  - No maintenance test
  - Integrated functional test via Test-button

- **No battery or auxiliary power required, free of maintenance**

- **Interface to directional fault detectors from IKI-Series(IKI-22, IKI-50)**

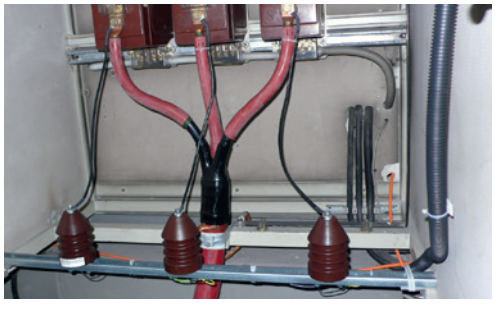


Capacitive voltage sensors

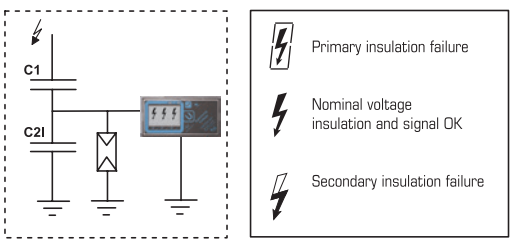
for voltage detection and voltage measuring

- **Capacitive sensors for 12 - 36 kV**
- **Voltage detection**
  in combination with voltage detection systems (VDS) type CAPDIS® or VOIS.
- **Voltage measuring**
  in combination with voltage detection systems (VDS) type CAPDIS® and feeder control device Grid-Inspector IKI-50.
- **With post-insulator functionality (TSKA) or without post functionality (KKE)**
  Sensors type TSKA can also be used as insulator inside the switchgear. Sensors type KKE without insulator functionality are the ideal solution for retrofitting old air-insulated switchgears.
- **Variants**

Coupling electrodes	Type	Nominal voltage [kV]	C1 [pF]	Item no.	Picture
	KKE12	12	20 +- 20%	2044125	
	KKE24	24	7 +- 20%	2043992	
Insulators					
	TSKA12	12	20 +- 20%	2044194	
	TSSKA24	24	15 +- 20%	2044243	
	TSKA36	26	7.5 +- 20%	2039388	



Installation example of KKE12

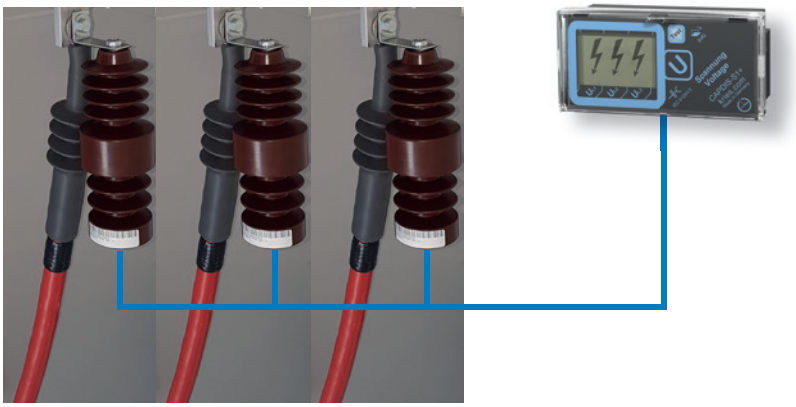


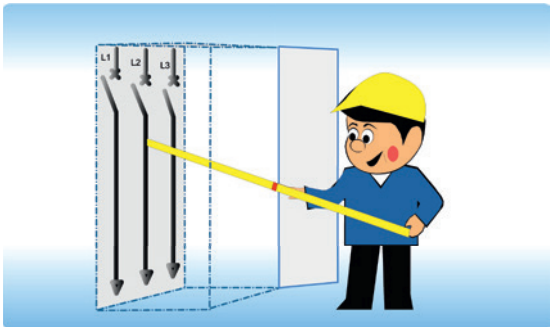
Principle of capacitive dividers with CAPDIS

Mounting kit for voltage sensors

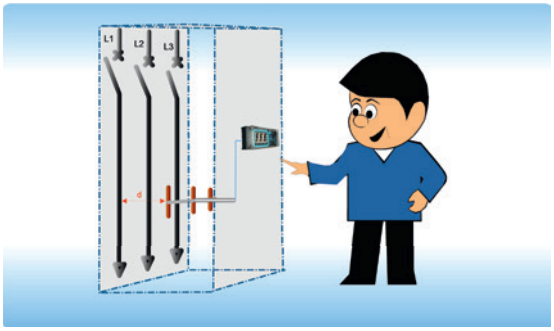
Mounting kit for retrofitting of voltage sensors directly at cable terminations of air-insulated switchgears

- **Easy retrofitting of voltage sensors directly at cable terminations of air-insulated switchgears**
- **Minimal effort = minimal disconnecting time**
  Only 15 minutes to retrofit a fault-arc-proof voltage detection with CAPDIS® due to easy to use mounting kit for voltage sensors KKE.
- **Safe voltage detection with CAPDIS® due to closed switchgear doors during operation**





Until now: No fault-arc protection during voltage detection due to open door



Today, state of the art: protection against fault-arc during operation and voltage detection due to closed doors.

Item no.	Appropriate to	Nominal voltage	Included in the set	Additionally needed
2512206 (1x per KKE)	KKE24, KKE36	2 - 24 kV (KKE24) 24 - 36 kV (KKE36)	Angle bracket for mounting of KKE at cable termination, srcrew M8, washer, plastic screws to cover non-used connectors	KKE24/36, cable, CAPDIS

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IKI-Line

Fault indicators, protection relays and feeder control units

- **IKI-Line**
  Overview
- **IKI-10light**
  Earth fault detector
- **IKI20C_PULS**
  CT-powered short circuit and earth fault detector
- **IKI-20**
  Fault indicators
- **IKI-22**
  Directional short circuit and earth fault indicator
- **IKI-30**
  Transformer monitor & protection relay acc. to IEC 60255
- **IKI-35**
  Transformer monitor & protection relay acc. to IEC 60255 with LCD
- **IKI-50**
  Feeder control unit for RMU
- **IKI-50_104**
  Feeder control unit with IEC 104
- **IKI-Overhead**
  Fault indicator for overhead lines
- **IKI-Primary-Tester**
  Primary tester for devices of IKI-Series

IKI-Line

Overview

		IKI-50	IKI-50-PULS-EW	IKI-20	IKI-20PULS
					
Item no.		2500446	2500448	2500971	2500992
Short circuit		X	X	X	X
Directional short circuit		X	X		
Earth fault		X	X	X	X
Directional earth fault		X	X		
Directional earth fault sensitive (cos(phi))		X	X		
Directional earth fault transient			X		
Earth fault Pulsation method			X		X
Load monitoring		X	X		
Control of switchgear		X	X		
Protection relay DMT, IDMT					
Auxiliary power needed		X	X		X
Neutral earthing	type of fault, recommendation				
Recommended CTs (Item no.), cable-set for CTs have to be added.					
Petersen coil	short circuit	3 IKI-LUM (2501381)	3 IKI-LUM (2501381)	3 IKI-LU (2503381)	3 IKI-LU (2503381)
	incl. earth fault	3 IKI-LUM + 1 IKI-SU-EDI (2506381) (wattmetrical) 2)	3 IKI-LUM (2501381 (transient, pulsating current detection)		3 IKI-LU (2503381) + 1 IKI-SU/PULS (2505381)
isolated	short circuit	3 IKI-LUM (2501381)	3 IKI-LUM (2501381)	3 IKI-LU (2503381)	3 IKI-LU (2503381)
	incl. earth fault	3 IKI-LUM (2501381) + 1 IKI-SU-EDI (2506381) (wattmetrical) 2)	3 IKI-LUM (2501381) (transient, pulsating current detection)		
solidly or resistance earthed	short circuit	3 IKI-LUM (2501381)	3 IKI-LUM (2501381)	3 IKI-LU (2503381)	3 IKI-LU (2503381)
	incl. earth fault	3 IKI-LUM (2501381)		3 IKI-LU (2503381)	

Types of CTs for screened and non-screened cable

CT for screened cable	CT for non-screened but insulated cable 1)
IKI-LU (2503381, set of 3x)	IKI-LU-ISO (2510381, order 3x for one set)
IKI-LUM (2501381, set of 3x)	IKI-LUM-ISO (2500461, order 3x for one set)
IKI-30-LU (2502030, set of 3x)	IKI-30-LU-ISO (2502983, order 3x for one set)

1) e.g. paper insulated three-core cable
2) only with 1F-SW

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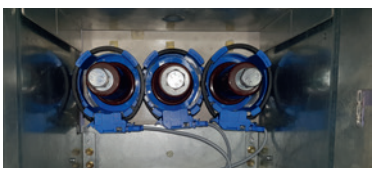
IKI-Line

Overview

		IKI-20C	IKI-20CPULS	IKI-22	IKI-30	IKI-35
						
Item no.		2500378	2503000	2501991	2500287	2503290
Short circuit		X	X	X	X	X
Directional short circuit				X		
Earth fault				X	X	X
Directional earth fault				X		
Directional earth fault sensitive (cos(phi))						
Directional earth fault transient				X		
Earth fault pulsation method			X			
Load monitoring						
Control of switchgear						
Protection relay DMT, IDMT					X	X
Auxiliary power needed				for earth fault direction		
Neutral earthing	type of fault, recommendation					
Recommended CTs (Item no.) (additional cable set for CTs needed)						
Petersen coil	short circuit	3 IKI-LU-1500 (2501808)	3 IKI-LU-1500	3 IKI-LU-1500 (2501808)	3 IKI-30-LU (2502030)	Set IKI-LUM_D92 (2512106_H001)
	incl. earth fault		3 IKI-LU-1500 + 1 IKI-SU-PULS (2506381)	3 IKI-LU-1500 (2501808)	3 IKI-30-LU (2502030) + 1 IKI-GSU	Set IKI-LUM_D92 (2512106_H001) + 1 IKI-30-GSU (2502040)
isolated	short circuit	3 IKI-LU-1500 (2501808)		3 IKI-LU-1500 (2501808)	3 IKI-30-LU (2502030)	Set IKI-LUM_D92 (2512106_H001)
	incl. earth fault			3 IKI-LU-1500 (2501808)	3 IKI-30-LU (2502030) + 1 IKI-GSU	Set IKI-LUM_D92 (2512106_H001) + 1 IKI-30-GSU (2502040)
solidly or resistance earthed	short circuit	3 IKI-LU-1500 (2501808)		3 IKI-LU-1500 (2501808)	3 IKI-30-LU (2502030)	Set IKI-LUM_D92 (2512106_H001)
	incl. earth fault	3 IKI-LU-1500 (2501808) 1)		3 IKI-LU-1500 (2501808)	3 IKI-30-LU (2502030) + 1 IKI-GSU	Set IKI-LUM_D92 (2512106_H001) + 1 IKI-30-GSU (2502040)

CTs for mounting on bushing (on request)

CTs	Driescher, Ormazabal, Schneider	Siemens
Set IKI-LUG_D92 (IKI-20)	2512104_H003	2512104_H004
Set IKI-LU-1500_D92 (IKI-22, IKI-20C)	2512105_H003	2512105_H004
Set IKI-LUM_D92 (IKI-50, IKI-35)	2512106_H003	2512106_H004
Set IKI-30-LU_D92 (IKI-30)	2512288_H003	2512288_H004



CTs mounted on bushings

IKI-10light

Earth fault detector

- **Earth fault detector IKI-10light**
  Detection and indication of earth faults on high voltage cables (3-52 kV)
- **Reliable fault detection**
  Microcontroller-based independent overcurrent-time characteristic
- **Dry contacts for remote monitoring**
- **Parameters adjustable by user**
  Pickup current, reset mode and relay function
- **Self test function**
  Activation by means of Test-Button
- **Included energy buffer**
  Lithium battery guarantees function in case of power loss
- **Included split core transformer**
  For balanced current measurement
- **Wall mountable or panel type housing available**
  Wall mountable type with LED & flag-indication available
- **Optional blinking unit for remote outdoor indication**

IKI-10light

Earth fault detector

Split core transformer

Blinking unit

IKI-10light-W with flag

Technical Data

Item no.	IKI-10light-P, panel type, LED indication: 2500903 IKI-10light-W, wall mountable type, LED indication: 2500902 IKI-10light-W, wall mountable type, LED and Flag indication: 2500905
Power supply	230 V AC, 50-60 Hz
Additional energy buffer	lithium battery
Input	split core transformer (balanced current)
Output	- 2 dry contacts (1 NC, 1 NO) - external indication by optional blinking unit
Pickup current IE>	selectable: 20, 40, 60, 80 A
Pickup time tI>	70 ms / 250 ms
Housing	wall or panel mounting
Dimensions	IKI-10light-P, panel type, #2500903: w x h x d = 96 x 48 x 84 mm IKI-10light-W, wall mountable type, #2500902: w x h x d = 110 x 82 x 33.5 mm IKI-10light-W, wall mountable type, #2500905, w x h x d = 119 x 82 x 35.5 mm
Operating temperature	25 °C to +75 °C
Storage temperature	-30 °C to +80 °C
Protection class	IKI-10light-P, panel type: IP 42 IKI-10light-W, wall mountable type: IP 65
Accessories	split core transformer for balanced current type IKI-10-GSU: Item no.: 2504381 for cable-triple diameter: max. Ø = 130 mm Item no.: 2504381_H001 for cable-triple diameter: max. Ø = 160 mm connecting lead for IKI-10-GSU: Item no.: 3503137_E, length 10 m, other lengths on request
Optional Accessories	IKI-10-blinker, external LED, suitable for outdoor installation Item no.: 2500883 connecting lead: l = 7 m, other lengths on request

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IKI-20C_PULS

Short circuit and earth fault detector

- **CT-powered short circuit and earth fault detector**
  - Detection, indication and signalisation of short circuits in distribution networks
  - Earth fault detection for resistive or solidly terminated networks
  - Detection of earth faults in inductive terminated networks via pulsation method

- **Measurement and indication**
  - Reliable fault detecion due to IDMT characteristic
  - Intuitive user interface via LCD and DIP-switches

- **Settings adjustable by user**
  - Trip currents for short circuit and activation of pulsation method
  - Reset mode and reset time

- **Self test function**
  Display test via integrated self-test
  Installation test with primary test function (activation via DIP-switch)

- **Free of maintenance**
  CT powered, no battery, no auxiliary power required
  Indication buffer via integrated capacitor for 4 hours

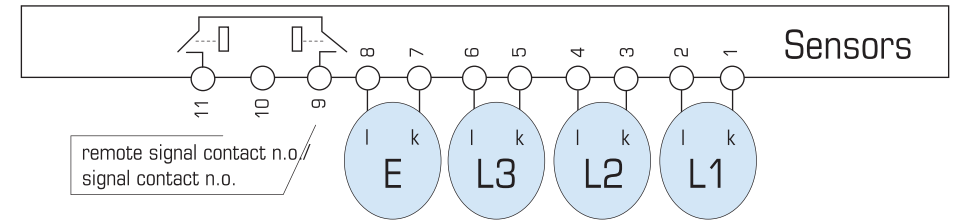
- **Dry contacts**
  1 output for short circuit
  1 output for earth fault

IKI-20C_PULS

Short circuit and earth fault detector

Technical Data

Settings via DIP-switches

Pickup current I>	adjustable: 400, 600, 800, 1000 A			
Pickup time tI>	100 ms			
Reset	manually via button and adjustable: 2 h, 4 h, automatic after current reoccurence			
Outputs	2 wiper signals (1s), 1x short circuit, 1x earth fault (pulsation method) Rating: 24 Vdc +-15%, Imax = 0.1 A			
Primary test	activation via DIP-switch, works with currents higher than 10 A			
Buffer for fault indication	Short circuit two phase: I>>=400 A, t>>= 100 ms: buffer time: 3 h Short circuit three phase: I>>= 400 A, t>>=100 ms: buffer time 4 h			
Pulsation method	Range of summation current: Pulsation amplitude: Pickup time: Pulsation method: - asymmetrical: - symmetrical: Reset	8 A .. 60 A min. 3 A max. 30 s adjustable: symmetrical or asymmetrical Period: 2.5 s +-0.2 s On-time: 1 s +-40 ms Period: 2.5 s +-0.2 ms On-time: 1.25 s +-80 ms adjustable via DIP-switch: special reset: identical Ito short circuit reset standard reset: reset after no pulsation current is detected		
Housing	Type: Dimensions : Recommended cutout: optional: Degree of protection:	Panel mount (DIN 43700) 96 x 48 x 80 mm (w x h x d) 92 x 45 mm (w x h) Wall housing type IKI-WG, item no. 3500955 IP 40		
Operational temperature	-25 ... +55 °C (Standard)			
Storage temperature	-30 ... +70 °C			
Item nos.: Evaluation unit Evaluation unit including pulsation method Current transformers Connecting lines CTs L1, L2, L3 Balanced core CT Connecting lines E	 d = 52 mm Set (3 pcs) w x d = 250 x 50 mm (1 pc.)	 Type Type Type 	 IKI-20C_PULS IKI-LUs_1500 3 m IKI-SUs/PULS 3 m	 item no. 2503000 item no. 2501808 item no. 3503118_S item no. 2502017 item no. 3503118_E
Terminal diagram				

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IKI-20

Short circuit and earth fault indicator

- **Short circuit / earth fault indicator IKI-20**
  Detection, indication and remote monitoring of short circuits in high voltage networks. Additional indication of earth faults in networks with solid, low resistive or short low resistive earthed termination and non-directional indication of earth faults in networks with Petersen coil or isolated networks.
  For earth-fault location in isolated networks or in case of using Petersen coils, directional earth fault indicators (type IKI-EDI-W or IKI-10EDI-I) or the pulsation method (use of IKI-PULS Petersen coil only) are recommended.

- **Fault detection and indication features**
  - reliable fault detection with independant overcurrent-time characteristic
  - true current measurement
  - self-explaining LCD display, additional ultra bright LED for fault indication

- **User adjustable parameters**
  - pickup current and pickup time for short circuit and separately for earth fault
  - reset mode and reset time

- **Self test function**
  activation by means of Test-button or remotely by dry contact

- **Applicable in closed loop or radial networks**
  Display of first and second alarm event without any change of settings
  Requirement: automatic reclosure

- **Free of maintenance, powered by current transformers, internal buffering depending on versions:**
  1) IKI–20T: power supply by auxiliary power 110 … 230 VAC; additional buffer by capacitor for at least 12 h

  2) IKI-20U: power supply by auxiliary power 24 … 230 VAC/DC; additional buffer by capacitor

  3) IKI-20B: buffered by integrated lithium battery (life cycle at least 17 years)

- **Digital outputs**
  digital dry contacts optionally 1, 2 or 3 relays

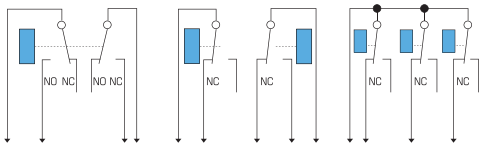
IKI-20

Short circuit and earth fault indicator

Technical Data

parameters adjustable by DIP-switches located behind front panel

Pickup current I>>	adjustable: 100, 200, 300, 400, 600, 800, 1000 or 2000 A
Pickup current IE>	adjustable: 40, 80, 100 or 150 A
Pickup time tI>>	adjustable: 60, 80, 150 or 200 ms
Pickup time tIE>	adjustable: 60, 80, 150 or 200 ms
Reset	adjustable: 2 h, 4 h, manually/externally, automatically
Inputs	- remote reset by external dry contact - 4 signal inputs for current transformers (2pole) - remote test by external dry contact
Outputs - type IKI-20X**1** - type IKI-20X**2** - type IKI-20X**3**	dry contacts (wipe pulse or permanent contact): 1 relay with 1 NO + 1 NC contact for all fault types 2 relays with 1 NO or 1 NC contact for short-circuits and 1 NO or 1 NC for earth-faults 3 relays with 1 NO or 1 NC contact, common root phase selective monitoring of faults at L1, L2, L3
Power supply	by current transformers: partly at primary currents above 1 A; completely above 5 A; internal buffering depending on version
Housing	standard housing according to DIN 43700 for front panel mounting dimensions: 96 x 48 x 80 mm (w x h x d) recommendet cut: 92 x 45 mm (w x h) optionally: installation in wall housing type IKI-WG, part no. 3500955
Protection class	IP 40
Operating temperature	-25 ... +55 °C
Storage temperature	-30 ... +70 °C



IKI-20X1 IKI-20X2 IKI-20X3

Part numbers

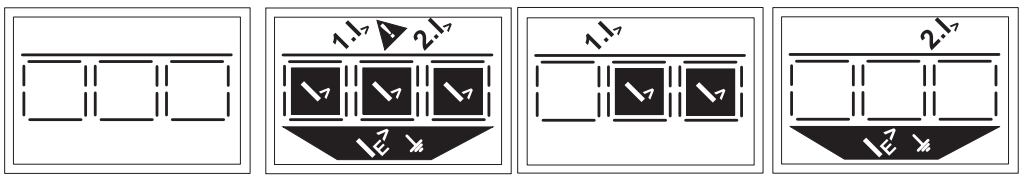
Relay contact	IKI-20By	IKI-20Ty	IKI-20Uy
y = 1 switchover	2500971	2500974	2500977
y = 2 NC	2500972	2500975	2500978
y = 2 NO	2501972	2501975	2501978
y = 3 NC	2500973		
y = 3 NO	2501973		

Current transformers

Input 1, 2 u. 3: split core transformer type IKI-10 LU or specifically for bushings of different manufacturers

Input 4: split core transformer for balanced current measurement type depending on diameter

Indication examples



Standby | Remote test or display test (all segments active) | 1. short circuit L2 and L3 | 2. earth fault

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IKI-22

Directional fault indicator

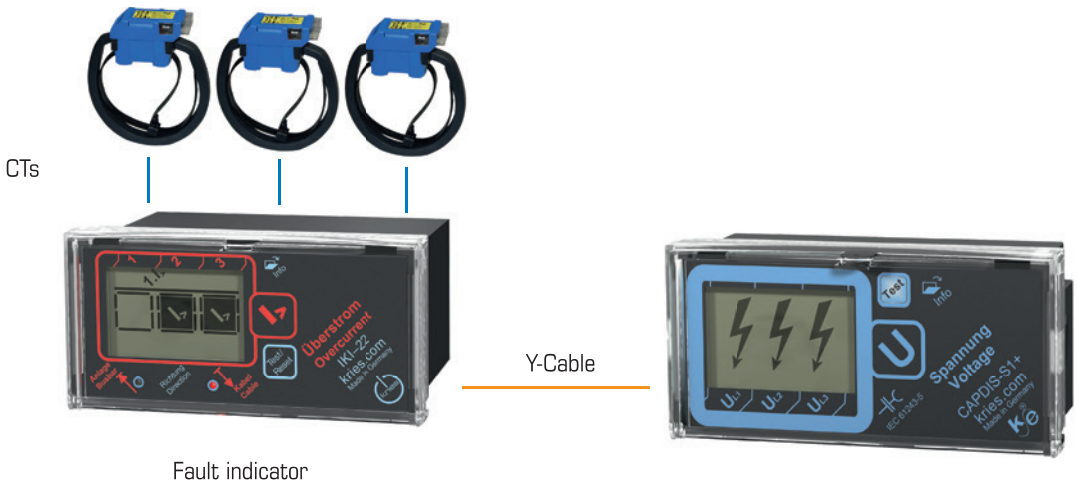
- **Directional fault indication for all types of networks**
  Directional detection, indication and signalisation of short circuits and earth-faults. Transient earth fault direction indication for isolated or compensated networks.

- **No need for voltage transformers, voltage signal is derived from VDS type CAPDIS**
  Voltage signals for directional indication are derived from voltage detection system CAPDIS® via Y-cable.

- **Earth fault detection without balanced core CT**
  Zero sequence current is calculated by summation of all three phase currents. Therefore no balanced core CT is neccessary.

- **No auxiliary power needed**
  Basic short circuit and earth fault detection without the need to connect IKI-22 to auxiliary power. For transient earth fault detection auxiliary voltage is needed.

- **Simple user-interface**
  Concept of indication and setting is identical to all other IKI-20. IKI-22 blends seamlessly into the fault detector series IKI-20: Indication of faulty phase via LCD, indication of first and second fault, indication of fault direction via LED, setting via DIP-switches, test and reset by means of Test-button.



Fault indicator
IKI-22

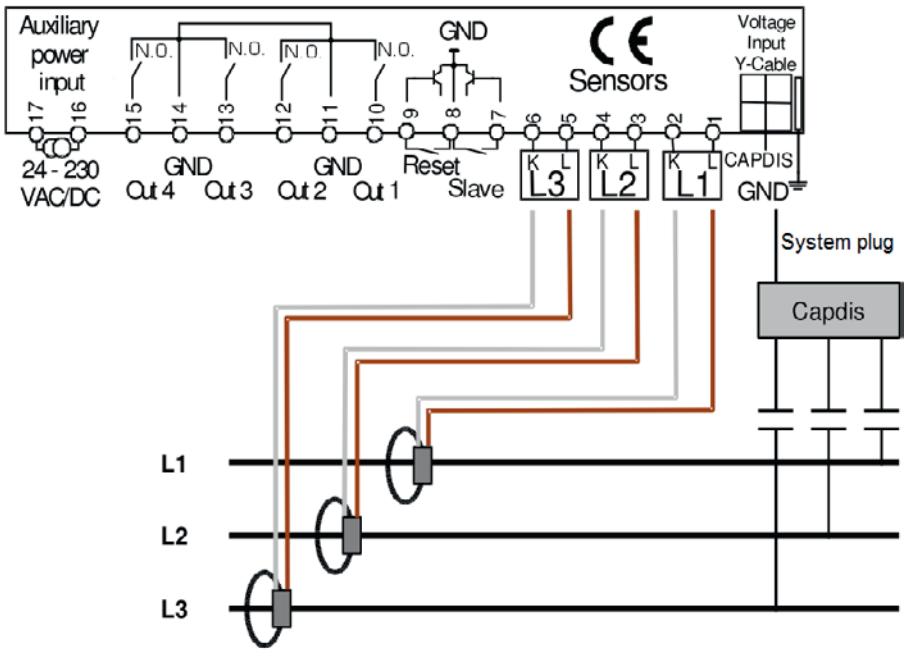
Voltage detection system
CAPDIS

IKI-22

Directional fault indicator

Technical Data

Pickup current short circuit	100, 200, 300, 400, 600, 800, 1000, 2000 A
Pickup time short circuit	60, 80, 150, 200 ms
Pickup current earth fault	40, 80, 100, 200 A
Pickup time earth fault	60, 80, 150, 200 ms
Transient earth fault detection	Pickup voltage adjustable Pickup current adjustable Waiting for zero sequence voltage 0, 100 ms, 1 s, 5 s
Reset	auto, 2 h, 4 h, external
Input	Remote reset by external dry contact 3 x CTs Remote test by external dry contact
Outputs – four contacts	Short circuit forward and backward Earth fault forward and backward
Indication buffer	Lithium battery, 3.6 Ah, life-time minimum15 years
Auxiliary power	24..230 VAC/DC, max. 2 VA Only needed for transient earth fault direction detection
Housing	Panel mount (DIN 43700)
Dimensions	96 x 48 x 80 mm (w x h x d)
Recommended cutout	92 x 45 mm (w x h)
Temperature	IP 40, operation: –25 °C ... +55 °C, storage: –30 °C ... +70 °C
Item no.	2501991_H001



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IKI-30

Transformer Monitor and Protection Relay acc. to IEC 60255

- **Intelligent transformer monitoring**
  Applicable for transformers with nominal power Pn:160 … 2500 kVA (@5-15 kV); 250 …7500 kVA(@20-25 kV); 400 …12000 kVA(@30-36 kV)
  Application a) Overcurrent- and short circuit/earth fault protection by combination of IKI-30 and circuit breaker/load breaker
  Application b) Overcurrent protection by combination of IKI-30 with load breaker and high voltage fuses; (tripping by IKI-30 disabled in range of short circuit current; disconnection by high voltage fuses)

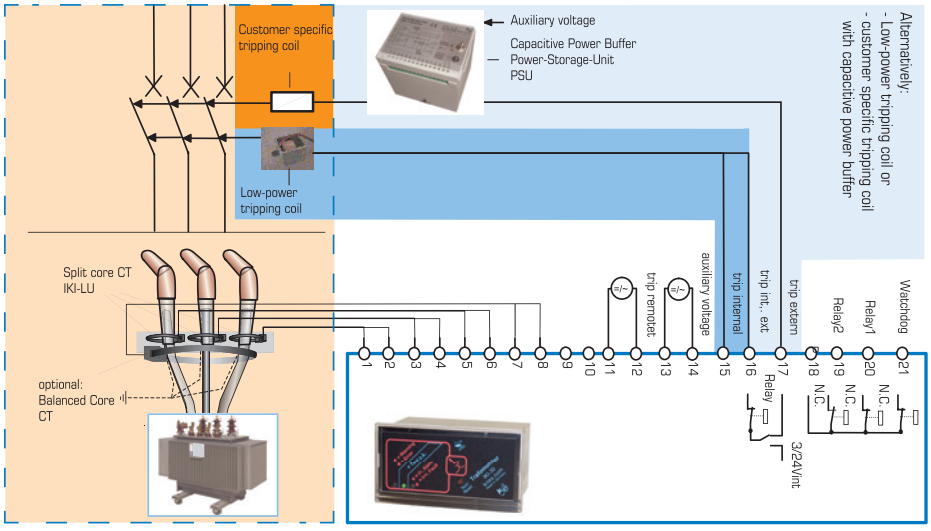
- **Selectable tripping options:**
  - DMT definite minimum time characteristic (ANSI 51)
  - IDMT inverse definite minimum time characteristic (ANSI 51); 2 curves available
  - instantaneous overcurrent characteristic (ANSI 50)
  - external, fast tripping without delay
  - earth fault stage characteristic (ANSI 50N, 51N)

- **Release of tripping coil optionally:**
  - low power tripping coil (no external power supply needed)
  - standard tripping coil (with separate power storage unit PSU)

- **Self test,** on-site function test by means of Test-button; relay for watchdog alarm

- **Event-recorder** for up to 16 events; download via interface-cable to PC

- **Maintenance-free, power supply by current transformer**
  power supply buffered by lithium battery
  (live cycle > 15 years, if current transformers are not connected)



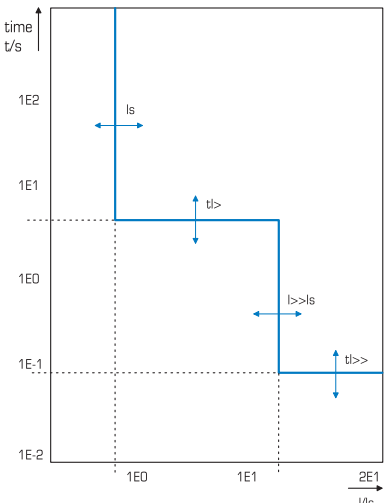
IKI-30

Transformer Monitor and Protection Relay acc. to IEC 60255

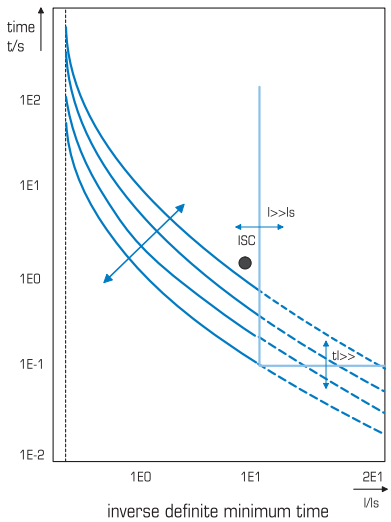
Technical Data

User adjustable parameters by means of DIP-switches behind front cover

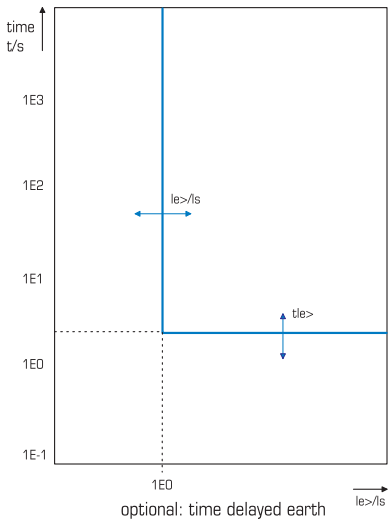
Pickup current Is	3 ranges	16 adjustable values each; range 1: 5..20 A; range 2: 25..100 A; range 3: 110..260 A
Maximum continous load current	600 A	
Short circuit level I>> short circuit-threshold short circuit delay time	 ratio I>>/Is tI>>	 8 values selectable (2..20) 8 values selectable (0..2 s); disabling of tripping possible
Overcurrent level I> - Independent overcurrent delay time - IDMT 1 (IEC very invers) IDMT 2 (IEC extremely invers) characteristic shift	 pickup value I>/ Is tI> start point I>/ Is start point I>/ Is v	 8 values selectable (1.1..3) 16 values selectable (1..300 s) 8 values selectable (1.1..3) 8 values selectable (1.1..3) 8 values selectable (0.05..10 s)
Optionally earth stage Ie> earth fault pickup value earth fault delay time	 ratio Ie>/Is tIe>	 8 values selectable (0.1..2) 8 values selectable (0..5 s)
Frequency	50/60 Hz selectable	
Inherent delay	approximately 43 ms	
Reset	after 2 h or automatic after current recovery or manual by key	
Power supply	by current transformers; if primary current > 1 A; complete supply if primary current > 5A; buffered by lithium battery	
Current transformers	connected to input 1, 2, 3: optionally to input 4:	split core current transformer type IKI- 30 LU balanced current split core transformer type depending on diameter
According to	IEC 60255-5	
Operating/storage temperatur	-25 °C ... +55 °C / -30 ... +70 °C	
Housing	front panel mounting: dimension: recommended cutout:	(acc. to DIN 43700); IP 40 96 x 48 x 80 mm (w x h x d) 92 x 45 mm (w x h)
Item no.	- Transformer monitor IKI-30_1 - Option for tripping coil 24 V@0.1 Ws Typ IKI-30E2 - Wall mountable housing - Low power tripping coil IKI-30-TC - Interface cable for PC / IKI-30	2500287 2503287 (Relay: N.C.) | 2504287 (Relay: N.O:) 2500994 wxhxd = 180x110x137 mm 2500275 3 V, 0.02 Ws 2501047 cable with USB connector for downloading the eventrecorder to a PC



time delayed and instantaneous overcurrent characteristic



inverse definite minimum time and instantaneous overcurrent characterisitc



optional: time delayed earth stage characteristic

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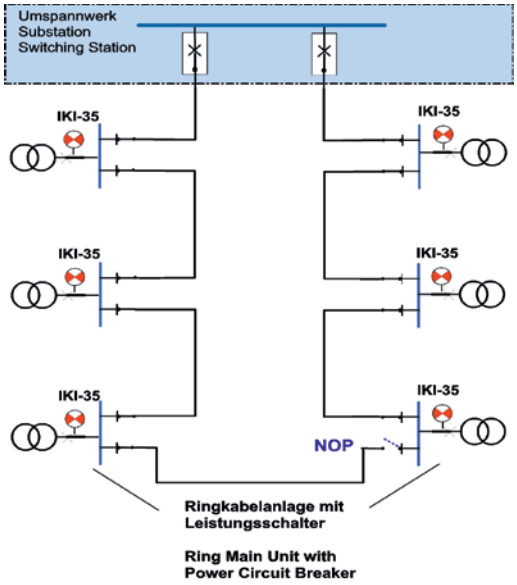
IKI-35

self-powered protection relay acc. to IEC 60255
reliable & compact protection for distribution network

- **Self-powered overcurrent protection relay**
  - Application for transformer or feeder protection
  - Available with wide-range CTs
  - Overcurrent, short circuit and optional earth fault stage
  - Intuitive operation and setting by display
  - Inrush restraint function
  - Event recorder
  - Earth fault stage selectable by balanced core CT or asymmetry calculation from three single core CTs



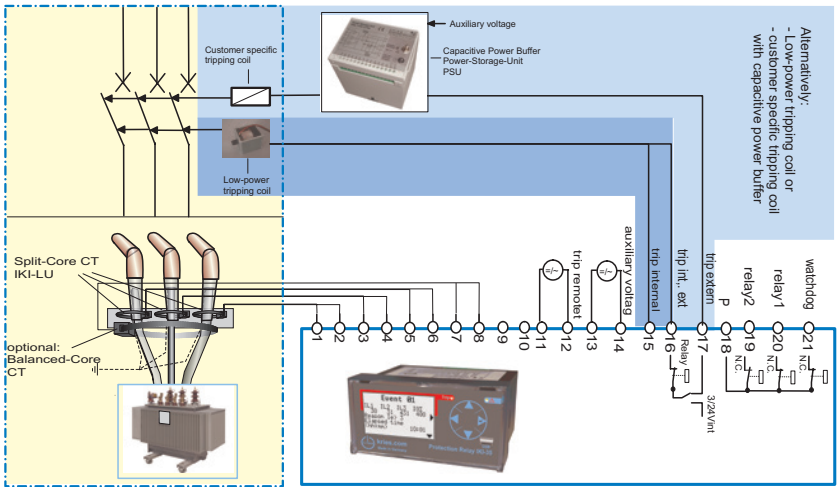
- **Protection Characteristics**
  - DMT I> (ANSI 51)
  - IDMT I>, four characteristics selectable (ANSI 51)
  - 2 short circuit stages I>>, I>>> (ANSI 50)
  - external fast trip
  - earth fault stage DMT or IDMT Ie> (ANSI 51N or 51G)
  - inherent earth fault stage Ie>> (ANSI 50N or 50G)

- **Tripping coil optional**
  - Low power tripping coil, 0.02 Ws, no external supply
  - Standard tripping coil (separate capacitive power storage PSU)

- **Self test function**

- **Event recorder** for up to 16 events; download via interface-cable to PC

- **Maintenance minimised due to self powering by CTs**
  (Buffer battery lifetime > 15 years if no CT supply is available)



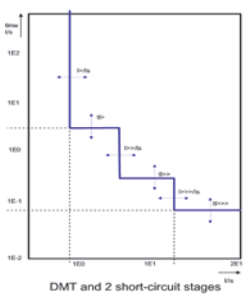
IKI-35

self-powered protection relay acc. to IEC 60255
reliable & compact protection for distribution network

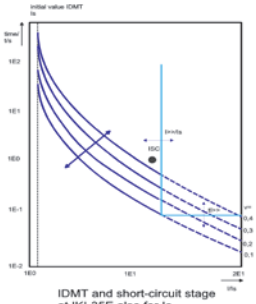
Technical Data

Parameter setting by display or via USB interface and PC software Kries-Config

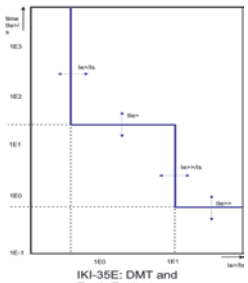
CT-Type	wide-range CT	wide-range CT IKI-LUM-D92
Nominal current In	primary side nominal current	selectable 10 ... 250 A
Short Circuit stage I>>:		
pickup values	ratio I>>>/In, I>>/In	selectable 2..20 or deactivated
delay time	tI>>>, tI>>	selectable 0..2 s
Overcurrent stage I>:		
DMT-pickup	ratio I>/ In	selectable 1.1 ... 3
delay time	tI>	selectable 0.3 ... 300 s
IDMT 1/2/3/4	inverse characteristics	selectable 1. extremely; 2. very; 3. normal; 4. long time
initial value	ratio I>/In	selectable 1.1 ... 3
shifting factor	v	selectable 0.05 ... 10 s
Earth fault stage Ie>:		
Earth fault pickup value	ratio Ie>>/In	selectable 0.1 ... 2 or deactivated
delay time	tIe>>	selectable 0 ... 2 s
Ie>_DMT-pickup value	ratio Ie>/In	selectable 0.1 ... 2
delay time	tIe>	selectable 0 ... 5 s
Ie>_IDMT 1/2/3/4	inverse characteristics	selectable 1. extremely; 2. very; 3. normal; 4. long time
initial value	ratio Ie>/In	selectable 0.1 ... 2
shifting factor	v	selectable 0.05 ... 10 s
Frequency	of network	selectable 50/60 Hz
Inherent time	approximately 43 ms	
Reset	for trip indication	selectable 2 h/4 h/8 h or autom. after current recovery/ by push buttons
Relays	2	function selectable: NC/ NO, selectable logic: I> + Ie>; I>; Ie>; Trip
Auxiliary supply	CT-supplied	buffered by lithium battery ; alternatively 24 ... 230 VAC/DC;
Earth fault stage	by asymmetry calculation or with separate balanced core CT at input 4	
Product standard	IEC 60255-5	
Operation / storage temperature	-40 °C ... +70 °C / -30 °C ... +70 °C	
Housing	front panel mounting	DIN 43700
	dimensions	wxhxd=96 x 48 x 80 mm
	recommended cutout	92 x 45 mm
Protection degree	IP 40	Optional: protection degree front IP 54
Current transformers	connected to input 1, 2, 3:	split core current transformer type IKI-LUM-D92
	optionally to input 4:	balanced current split core transformer type IKI-30-GSU
Types and item nos		
IKI-35	2510455	incl. 3x wide-range CTs IKI-LUM-D92
Wall mountable housing	2500994	
Low pow. tripping coil IKI-30-TC	2500275	3 V, 0.02 Ws
Kries-Config PC software	2501986	Configuration and event recoder read-out via PC



DMT and 2 short-circuit stages



IDMT and short-circuit stage at IKI-35E also for Ie



IKI-35E: DMT and Earth-Fault stage

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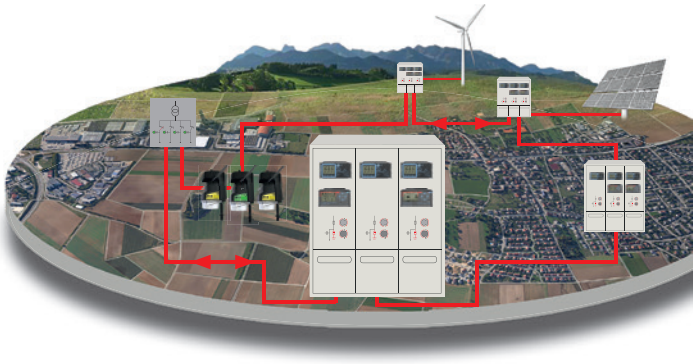
Grid-Inspector IKI-50

...for an efficient distribution grid

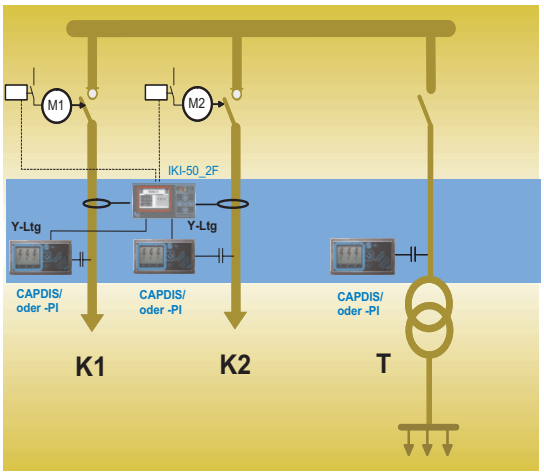
- **Load monitoring / measurement values**
  - Voltage, current, power, cos-phi...
  - Instantaneous and mean values
  - Limit value monitoring



- **Fault detection**
  - Short circuit (directional, non-directional)
  - Earth fault detection (four independant algorythms)
  - Suitable for all kind of neutral earthing systems
  - No balanced core current transformer needed (except sensitive earth fault detection)
  - Failure forecast functionality

- **Remote control and automation**
  - Control capability of up to two motorised switches (four digital inputs, four digital outputs)
  - Automatic switch-over functionality
  - Programmable PLC functionality

- **IKI-50 is free of maintance**
  - No battery
  - 6 hrs indication buffer (internal capacitive UPS, free of maintenance)

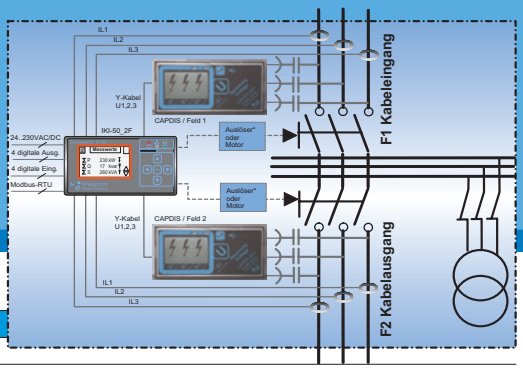


- **One IKI-50 monitors all feeders of standard RMU**
  - IKI-50-1F monitors one feeder
  - IKI-50-2F monitors two feeders (or parallel cables)
  - Internal calculation of measurement values for transformer feeder

- **Ohmic sensor (optional)**
  Optional connection to ohmic sensors for precision voltage measurement (class 1) instead of capacitive measurement via CAPDIS

Grid-Inspector IKI-50

...for an efficient distribution grid



Technical Data

General	
Degree of protection	IP 20
Insulation voltage	1 kV, 1 min.
Housing	DIN 43700
Recommended cutout	92 x 45 mm
Wire cross section of connecting cables	max. 2.5 mm²
Operational temperature	-25 °C ... +55 °C (max. 40 °C during calibration)
Storage temperature	-25 °C ... +70 °C
Indication buffer	6 h, internal capacitive buffer

	Inspector IKI-50_1F for 1 Feeder	Inspector IKI-50_2F for 2 Feeder	Notes
Measurement values			
Residual and phase currents I0, I1, I2, I3	x	x	
Phase shift I12, I23, I31	x	x	
Residual and phase voltages U0, U1, U2, U3	x	x	
Phase-to-phase voltages U12, U23, U31	x	x	
Phase shift U12, U23, U31	x	x	
Real, reactive, apparent power and energy	x	x	
Phase shift cos-phi	x	x	
Frequency	x	x	
Mean values I, U, PQS directional	x	x	
Minimum and maximum values of mean values for I, U, PQS with automatic reset	x	x	
Minimum and maximum values of mean values for I, U, PQS with manual reset	x	x	
Internal calculation of transformer feeder or parallel cable I, PQS	-	x	
Precision of current measurement	3%	3%	referring to measurement value
Precision of voltage measurement using CAPDIS as sensor	3%	3%	calibration required
Precision of voltage measurement using ohmic sensors	1%	1%	no calibration required
Measurement range current	1.5 ...1400 A	1.5 ... 1400 A	
Inputs, outputs, interfaces			
Digital outputs, dry contact, NO / NC, max 5A	4	4	configurable by PLC logic
Digital inputs, 24 VDC	4	4	configurable by PLC logic
RS-485 with Modbus RTU-Slave	1	1	
Output for tripping coil, 24 VDC, 0.1 WS	2	2	
Remote test functionality	x	x	
Auxiliary power 24 ... 230 VAC/DC, input power max. 3 VA	x	x	
Current transformers, split-core	3	6	
Balanced core current transformer	1	-	needed only for sensitive earth fault detection
Voltage input for CAPDIS	1	2	
Self-test, primary test function	x	x	
Failure forecast and fault detection			
Short circuit (I>>), directional	x	x	
Earth fault (Ie>), directional	x	x	
Sensitive earth fault (Ie> wattmetrical or varmetrical), directional	x	-	
Transient earth fault detection (Ie> Wiper), directional	x	x	only version _Puls_EW
Earth fault detection with pulsation current method (Ie> Pulse)	x	x	only version _Puls_EW
Directional failure forecast function	x	x	only version _Puls_EW
Event history (1 ... 20)	x	x	
Threshould value monitoring U, I, f, QU	x	x	
PLC programmable	x	x	
Device models			
IKI-50_1F: basic unit	x	-	
IKI-50_2F: basic unit	-	x	
IKI-50_1F_PULS_EW with pulsation method and transient fault detection	x	-	
IKI-50_2F_PULS_EW with pulsation method and transient fault detection	-	x	
IKI-50_1F_SW, IKI-50_1F_PULS_EW_SW	x	-	additional interface for balanced core CT
IKI-50 1%: class1 voltage measurement with ohmic sensors	x	x	ohmic sensors additionally needed

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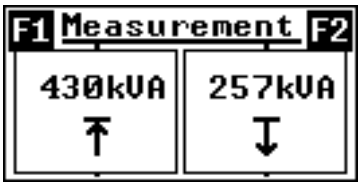
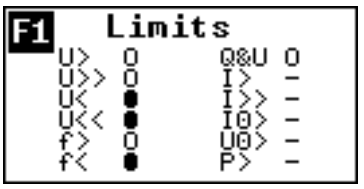
Grid-Inspector IKI-50

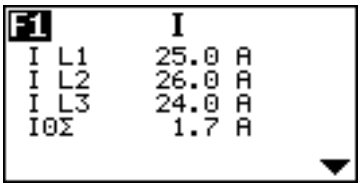
Applications

- **Load current monitor: optimal use of grid capacity**

  Grid-Inspector IKI-50 measures three phase voltage and current. These measurements are used to calculate all derived values for load monitoring such as power and cos-phi. All values are available as instantaneous, mean and min/max values. Hereby complete load monitoring can be realized. Additionally, power quality values can be observed by an integrated limit value monitoring. All values can be displayed at the LCD, for remote transmission a RS-485 interface with ModbusRTU protocoll is available. With CAPDIS® as voltage measurement sensor a precision of 1-3% is reachable. Ohmic dividers as voltage measurement sensors provide a precision of 1%, e.g. for monitoring voltage limits within the distribution network.







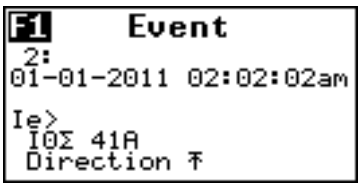
- **Fault detection: allows selective detection of faults in all types of neutral earthing, even in compensated networks**

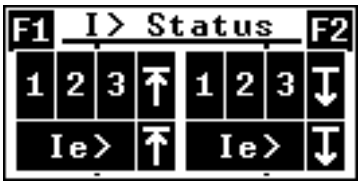
  For compensated or isolated networks fault currents are relatively low compared to possible load currents or short circuit currents. For these types of networks earth faults can be detected by:

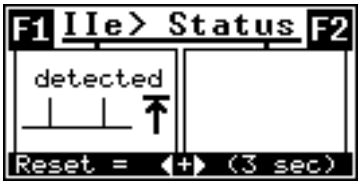
  Wattmetrical detection via residual current and voltage measurement: Type IKI-50_1F_SW (only with balanced core CT).

  Pulsating residual current detection:
  Type IKI-50_xF_PULS-EW

  Transient detection: Type IKI-50_xF_PULS-EW

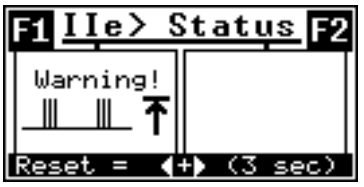


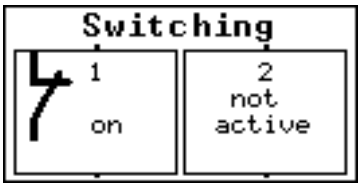




- **Failure forecast: detects problems in insulation before total breakdown of network occurs**

  Grid-Inspector IKI-50_xF_PULS_EW offers a unique failure forecast functionality by evaluation of intermittent earth faults. Dependant on the total amount of transient signals within a settable time period, different alarm levels can be configured. This feature allows insulation problems to be detected and reported before a permanent outage occurs.

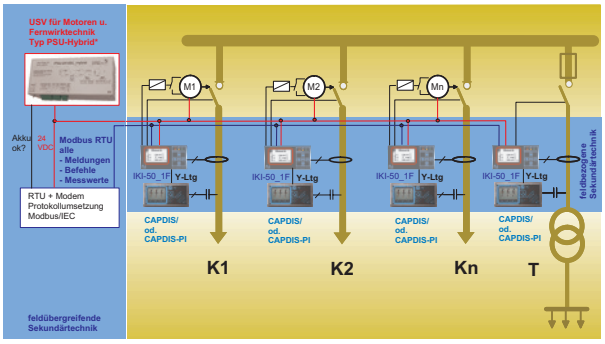




Grid-Inspector IKI-50
Applications

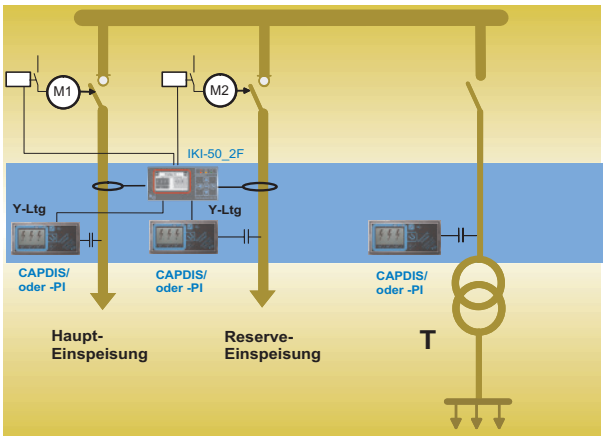
- **Remote control of Smart-Grid transformer stations**

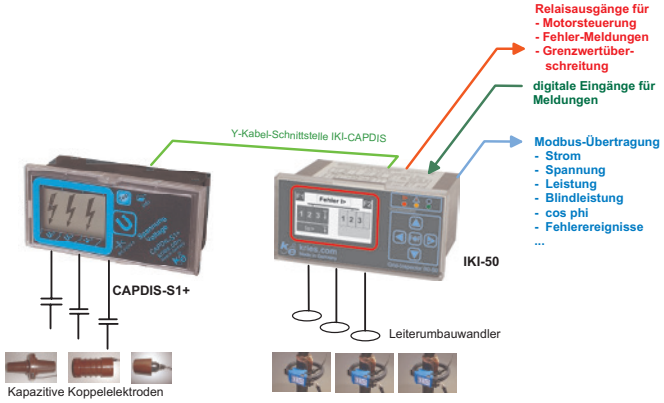
Intelligent transformer stations are often remotely controlled. Remote switching is only allowed when monitoring of the switch positions is available and when assuring that current levels are below maximum allowed limits of switching capabilities of the switch. The picture on the right shows an example for a switchgear with more than two cable feeders. Analog wiring for switch positions and motor control is only done within the feeder. Wiring to RTU is simply done by two-wire ModbusRTU. Buffering for motors and RTU is provided by PSU-Hybrid.

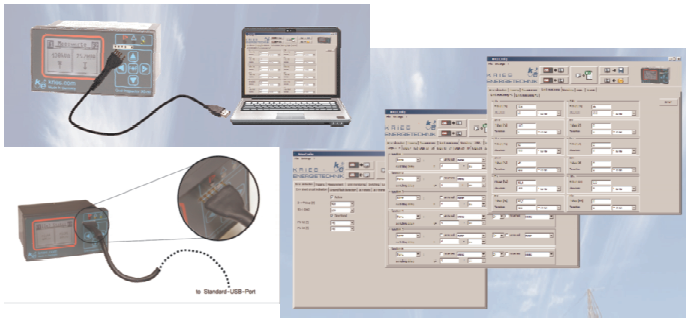


- **Automatic transfer-switch (ATF)**

Automatic transwer-switch is used to reduce outage times of VIP customers down to several seconds. The customer is supplied by one main and one reserve feeder. In case of power loss at main feeder, IKI-50 automatically switches over to reserve feeder. This process is finished within seconds after power loss and therefor the customer is reenergized very quickly without the need of remote control.







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Grid-Inspector IKI-50_104

... for an efficient distribution grid
including interface IEC 60870-5-104

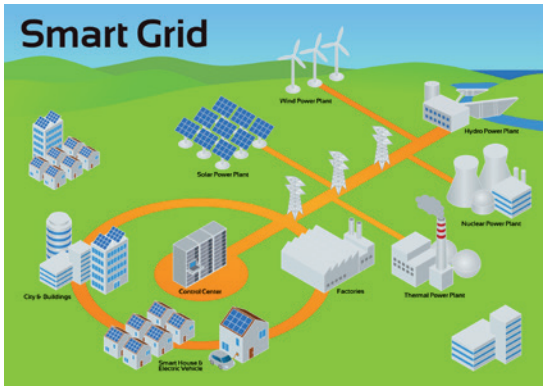
- **Functionality as in IKI-50-PULS-EW**
  - Load monitoring
  - Fault detection
  - Automation and PLC

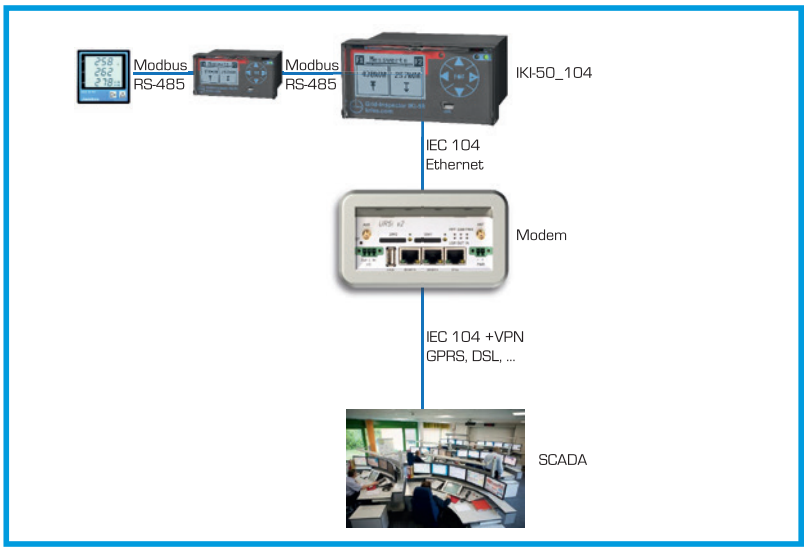
- **IEC 60870-5-104**
  IKI-50_104 is equipped with a network connector for direct connection to SCADA or RTU via standard protocoll IEC 104.

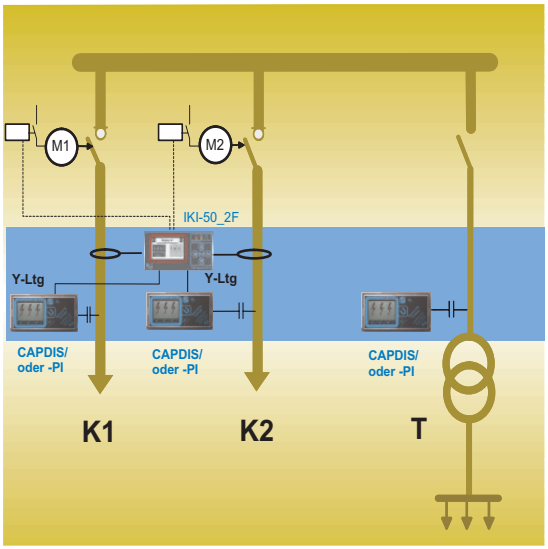
- **Webserver**
  Settings and configuration of IEC 104 connection via integrated webserver.

- **ModbusRTU Masterfunction**
  Additional slave devices with ModbusRTU can be polled by IKI-50_104. Polled data is translated to IEC 104 inside IKI-50.

- **Safety**
  - Configuration protected by password
  - User management
  - Webserver can be deactivated
  - Encryption of connection with additional VPN router possible







Grid-Inspector IKI-50_104

… for an efficient distribution grid including interface IEC 60870-5-104

Technical Data IKI-50_104

General	
Degree of protection	IP 20
Isolation voltage	1 kV, 1 min.
Housing	DIN 43700
Recommended cut-out	92 x 45 mm
Wire cross section of connecting cables	max. 2.5mm²
Operational temperature	-25 °C … +55 °C (max. 40 °C during calibration)
Storage temperature	-25 °C … +70 °C
Indication buffer	6h, internal capacitive buffer

	Inspector IKI-50_1F for 1 feeder	Inspector IKI-50_2F for 2 feeders	Notes
Measurement values			
Residual and phase currents I0, I1, I2, I3	x	x	
Phase shift I12, I23, I31	x	x	
Residual and phase voltages U0, U1, U2, U3	x	x	
Phase-to-phase voltages U12, U23, U31	x	x	
Phase shift U12, U23, U31	x	x	
Real, reactive, apparent power and energy	x	x	
Phase shift cos-phi	x	x	
Frequency	x	x	
Mean values I, U, PQS directional	x	x	
Minimum and maximum values of mean values for I, U, PQS with automatic reset	x	x	
Minimum and maximum values of mean values for I, U, PQS with manual reset	x	x	
Internal calculation of transformer feeder or parallel cable I, PQS	-	x	
Precision of current measurement	3%	3%	referring to measurement value
Precision of voltage measurement using CAPDIS as sensor	3%	3%	calibration required
Precision of voltage measurement using ohmic sensors	1%	1%	no calibration required
Measurement range current	0.5..1000A	0.5..1000A	
Inputs, outputs, interfaces			
Digital outputs, dry contact, NO / NC, max 5A	4	4	configurable by PLC logic
Digital inputs, 24 VDC	4	4	configurable by PLC logic
IEC 60870-5-104, RJ45	1	1	
Webserver for parameterisation of IEC 104	1	1	
RS-485 with ModbusRTU Master	1	1	
Remote test functionality	x	x	
Auxiliary power 24 … 230 VAC/DC, input power max. 3 VA	x	x	
Current transformers, split core	3	6	
Balanced core current transformer	1	-	needed only for sensitive earth fault detection
Voltage input for CAPDIS	1	2	
Self-test, primary test function	x	x	
Failure forecast and fault detection			
Short circuit (I>>), directional	x	x	
Earth fault (Ie>), directional	x	x	
Sensitive earth fault (Ie> wattmetrical or sin-phi/cos-phi method), directional	x	-	
Transient earth fault detection (Ie> Wiper), directional	x	x	
Earth fault detection with pulsation current method (Ie> Pulse)	x	x	
Directional failure forecast function	x	x	
Event history (1 … 20)	x	x	
Threshould value monitoring U, I, f, QU	x	x	
PLC programmable	x	x	
Device models			
IKI-50_1F_PULS_EW_104 with transient fault detection	x	-	
IKI-50_2F_PULS_EW_104 with transient fault detection	-	x	
IKI-50_1F_PULS_EW_SW_104	x	-	additional interface for balanced core CT
IKI-50_104 1%: class1 voltage measurement with ohmic sensors	x	x	ohmic sensors additionally needed

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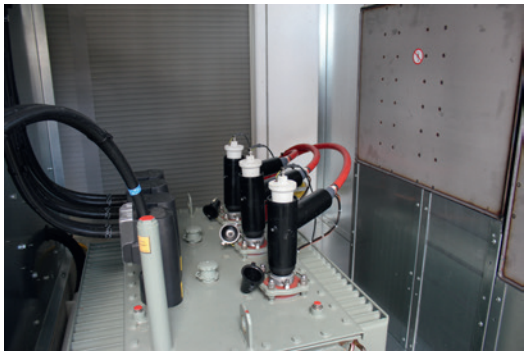
Ohmic voltage sensors

for precise voltage measurement in RMUs

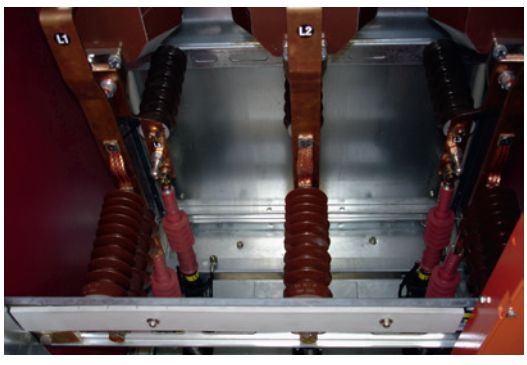
- **Voltage measurement with class 1**
  in combination with feeder control unit Grid-Inspector IKI-50 or voltage amplifier CAPDIS-4o.
- **One set of sensors can be shared by several measurement devices**
  connection of up to five IKI-50 to one set of sensors possible
- **Secondary voltage 3.25 VAC**
- **Suitable for new switchgears or retrofitting**
- **Sensors for SF6 switchgears 12 - 24 kV type OAS**
  Installation at T-shape connector



Installation of OAS at transformer

Mounting of OAS at asymmetrical t-shape plug

- **Sensors for air-insulated switchgears 12 - 36 kV type OKE**
  Installation as coupling electrode at e.g. cable compartment



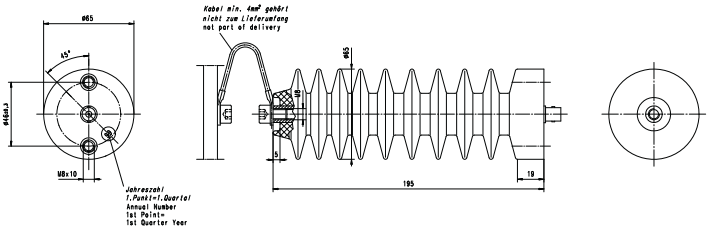
Installation example of OKE in air-insulated switchgear

Ohmic voltage sensors

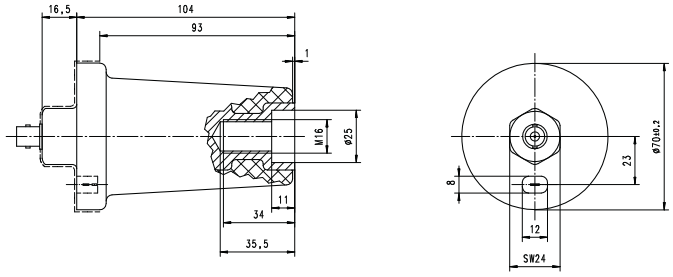
for precise voltage measurement in RMUs

Technical Data

description	type	nominal voltage [kV]	R1/R2 [Ohm]	item no.	suitable for
ohmic sensor for symmetrical T-shape plugs					all symmetrical T-shape plugs
	OAS12	12	100 M / 32.5 k	2043623	
	OAS24	24	100 M / 32.5 k	2043624	
ohmic sensor for asymmetrical T-shape plugs					NKT CB 24/630 Cellpack CTS 630A
	OAS12	12	100 M / 32.5 k	2043187	
	OAS24	24	200 M / 32.5 k	2043188	
ohmic coupling electrode for air-insulated switchgears					all air-insulated switchgears
	OKE12	12	100 M / 32.5 k	2043189	
	OKE24	24	200 M / 32.5 k	2043190	
	OKE36	36	300 M / 32.5 k	2043544	



Dimensions OKE24



Dimensions OAS24

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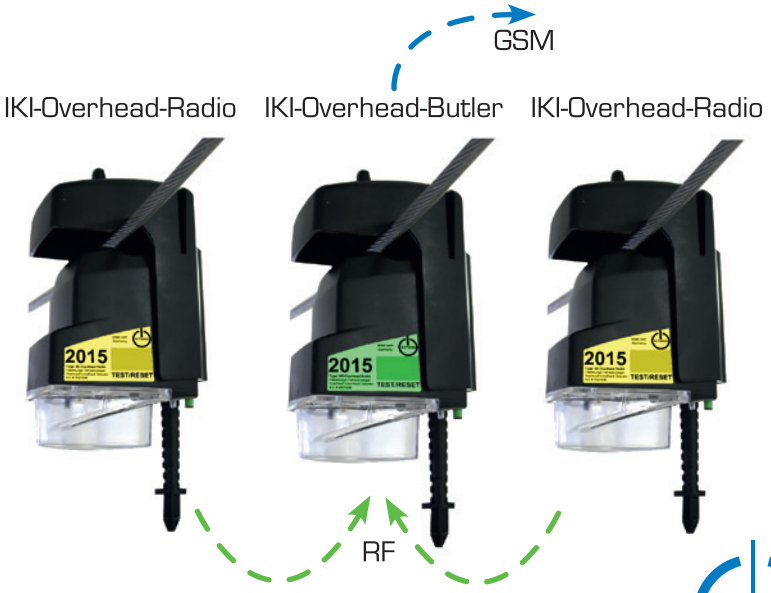
IKI-Overhead

Overhead-Line Fault Indicator
Complete Solution for Local and Remote Indicating Types

- **Overhead-line fault indicator**
  Short circuit and earth fault detection in overhead line networks
- **Ultra-bright LED indication**
  Visibility cone 360°, even visible in extreme sunlight
- **Easy installation and self-test by operation rod**
  integrated indication for correct installation; no special tools required
- **Reliable fault detection**
  Microcontroller-based independent overcurrent-time characteristic; short circuit and earth fault detecting; suitable for high-impedance earth faults
- **Optional: remote alarm by radio transmission and GSM**
  by IKI-Overhead Radio (yellow label) and IKI-Overhead Butler (green label)
- **User adjustable parameters by DIP-switches**
  Pickup current (automatic or fixed 200-600 A). Reset (2-8 h, manually or automatic after return of minimum load current)
- **Long life cycle**
  Due to high-quality lithium battery (included) and nanowatt technology
- **Applicable in closed loop or radial networks with renewables**
  Display of first and second alarm event without any change of settings. Requirement: automatic recloser

Principle of communication: up to 8 IKI-Overhead Radios communicate with one IKI-Overhead Butler via short distance RF connection.

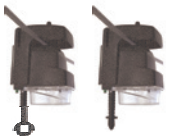
IKI-Overhead Butler communicates by GSM with PONLINE-Master or any SMS-client. PONLINE-Master can be linked to any existing SCADA-System



IKI-Overhead

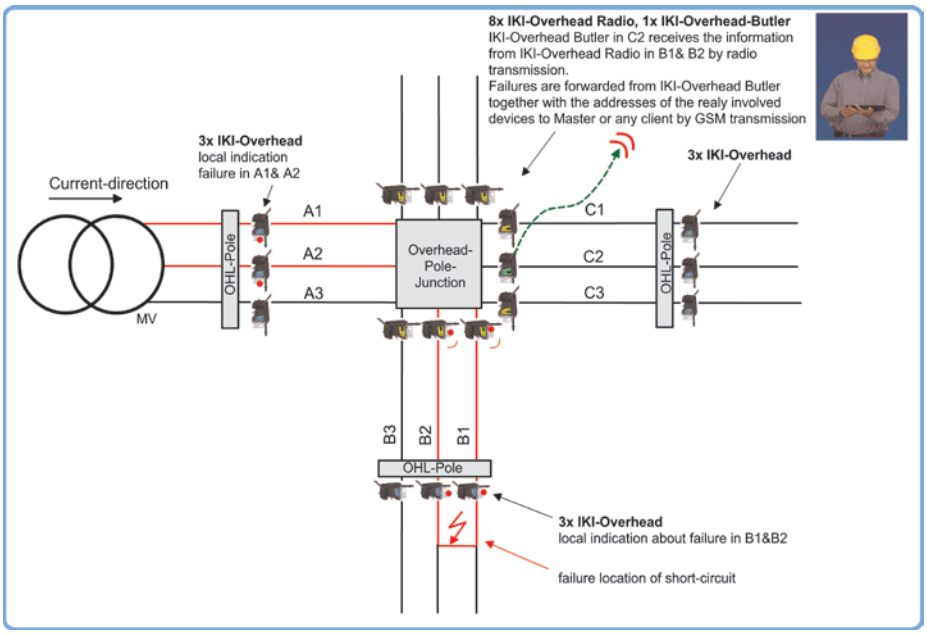
Overhead-Line Fault Indicator
Complete Solution for Local and Remote Indicating

Technical data

Power supply: Pickup current I>>: Pickup time tI>>: Reset: Visibility: Dimensions: Installation: Self-test: Protection class: Rated nominal voltages: Rated power frequency Operating temperature: Storage temperature: Conductor rope cross: Housing: Standard-Type: IKI-Overhead R2 Item no. 2501302	lithium battery (life time approx. 15 years); for IKI-Overhead Radio and IKI-Overhead Butler battery life-time min. 10 years; automatic, 200, 400, 600 A 60 ms, 200 ms 2 h, 4 h, 6 h, 8 h, manually, automatically after return of minimum primary current 3 A for at least 10 s approx. 50-100 m at bright sunlight; approx. 500 m at night h = 210 mm; Ø = 130 mm by operating rod (bajonet or ring) by operating rod and magnet IP 68 1 kV to 36 kV 50-60 Hz -30 °C to +75 °C -30 °C to +80 °C 20 mm^2 to 490 mm^2, corresponding sectional area: to a diameter of 5 mm to 35 mm plastics, UV stable CT-Type Standard device with local LED indication	
IKI-Overhead Radio Item no. 2501304	Device with short-distance radio connection up to 50 m. Failure information will be forwarded from IKI-Overhead Radio to IKI-Overhead Butler	
IKI-Overhead Butler Item no. 2501306	Device with short-distance radio connection for communication with up to 8 pcs IKI-Overhead Radio. With additional GSM-Modem to forward information to PONLINE-Master or any SMS-client; GSM-SIM-card not included.	
Mounting: Item no. 25xxyyzz Item no. 25xxyyzz_H001	Standard type: by means of operation rod with bajonet adapter Clamp-stick type: by means of operation rod with clamp (shot gun)	

Principle of overhead-line failure detection with local and remote indicating devices.

Failures are indicated up to the failure location



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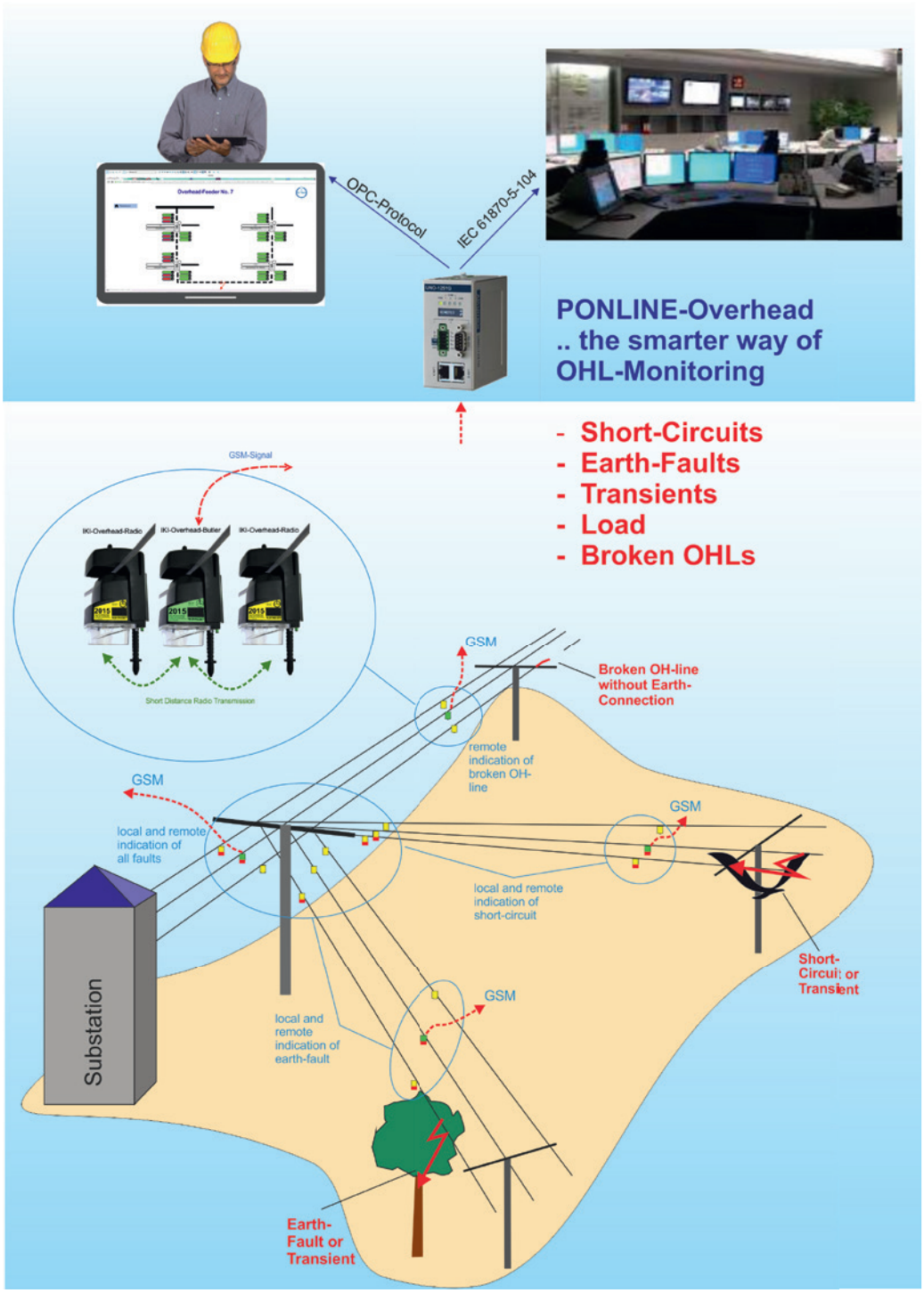
IKI-Overhead

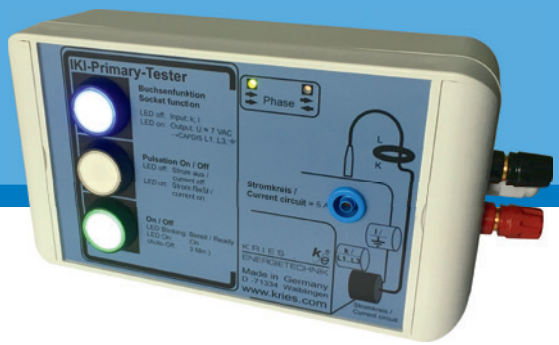
Overhead-Line Fault Indicator
Complete Solution for Local and Remote Indicating Types

- **Showing all relevant status information**
  Together with PONLINE-System, IKI-Overhead shows you all needed information from your overheadline distribution network including all types of faults and load information:



IKI-Primary-Test

Primary tester for all fault detectors of IKI-Line



- **Easy primary test device for all fault indicators type IKI**
  IKI-Primary-Test outputs 5A current and 6 VAC voltage to test all fault indicators of the IKI-Line series. Non-directional indicators (IKI-20, IKI-20_PULS, ...) can be tested to indicate and report faults correctly, directional indicators (IKI-22, IKI-50, ...) can be additionally tested for correct indication of fault direction. The test includes the complete chain from sensors to relay ouputs.

- **Integrated test of pulsation method**
  to check devices with earth fault detection via pulsation method (IKI-20_PULS, IKI-20C_PULS, IKI-50)

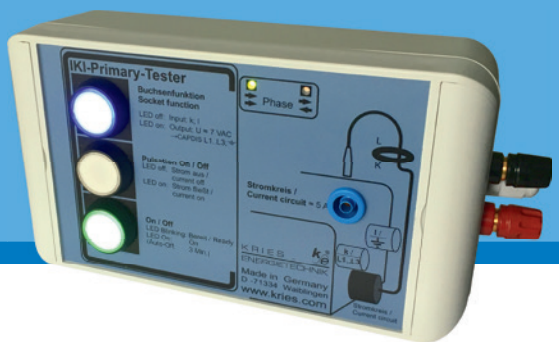
- **Reduced time for testing because of simple wiring**
  easy loop through of test cable without the need of opening the CT

- **Easy test procedure**
  the device is operated by means of just three push buttons

- **Handy unit delivered in carrying case**

IKI-Primary-Test

Primary tester for all fault detectors of IKI-Line



Technical Data

Auxiliary power	230 VAC
Length of connecting line	3 m
Current output	5 A, length of connecting line: 2 m
Voltage output	7 VAC, phase shift 180° settable
Automatic power down	Current output after 3 min.
Degree of protection	IP 65
Dimensions h x w x d	250 x 110 x 70 mm
Operating temperature	-25 °C ... 50 °C

Connection of current output to CTs

Connection of voltage output to CAPDIS

Connection of current output to balanced core CT

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PONLINE®

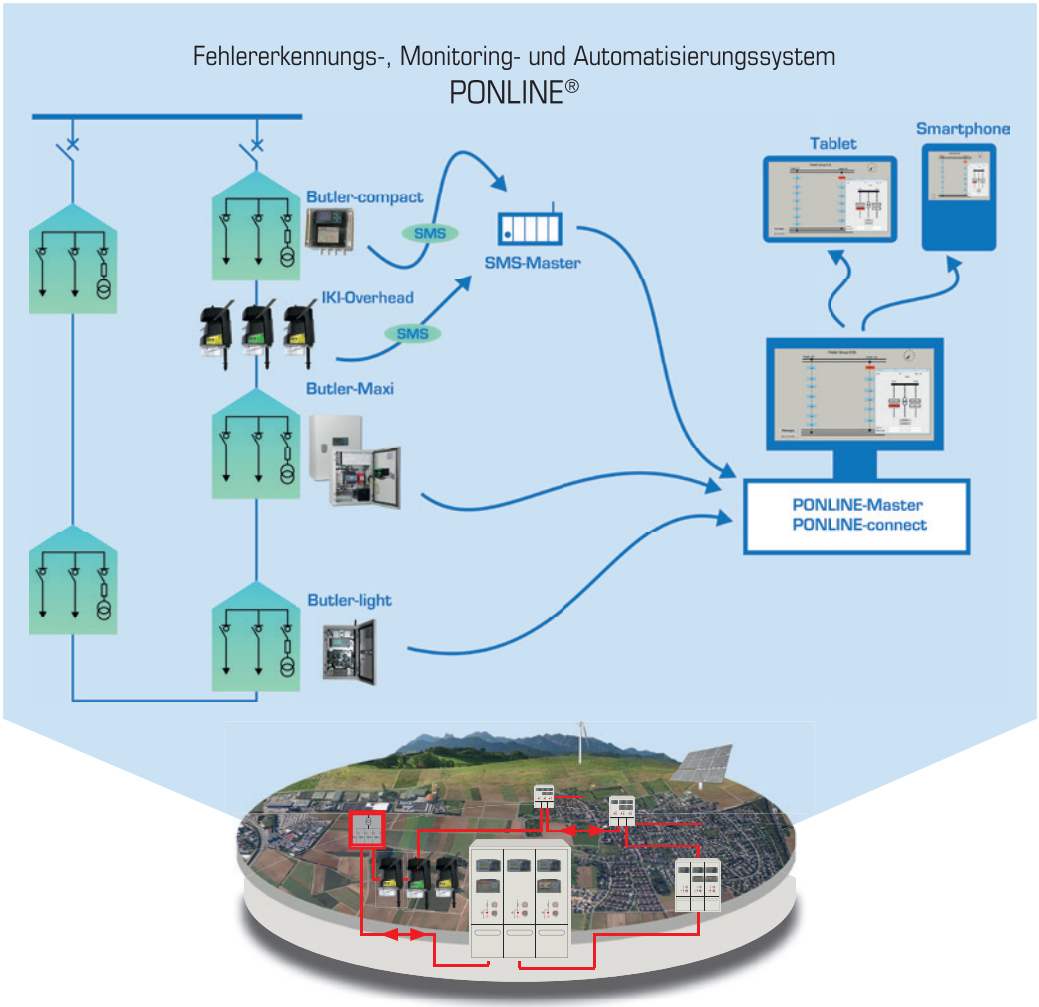
Remote monitoring, remote operating, SCADA solutions

- **PONLINE®**
  Fault detection, monitoring and automation,
  remote terminal units & software
- **PONLINE®-Butler-light**
  Remote terminal unit
- **PONLINE®-Butler-compact**
  Remote terminal unit
- **PONLINE®-ATS_50**
  Automatic transfer switch
- **PONLINE®-Tablet**
  Powerful tablet for configuration software of IKI-50 and IKI-35 and connection to PONLINE-Connect webinterface.
- **PSU Overview**
  Power storage units, UPS systems
- **PSU_24V_Hybrid_60W**
  Power storage unit, capacitive UPS with low maintenance
  Charging unit for lead batteries

PONLINE®

Fault detection, monitoring and automation

PONLINE® is a complete solution for outage time reduction, load-monitoring and automation. Due to online functions for fault detection, load control and automation, it can transfer your distribution grid to a Smart-Grid. Information is collected by the PONLINE-Master and easily accessible by desktop PCs or mobile devices like smart-phones or tablets.



PONLINE® comprises the following modules:

- **A) Remote terminal units:**

  - Butler-Compact: fault reporting via SMS
  - Butler-Light: fault reporting, load control and automation via GPRS
  - IKI-Overhead Butler: fault reporting for overhead line networks (see datasheet)

- **B) PONLINE-Connect:**

  - PONLINE-Connect: Database and visualisation software
  - PONLINE-Master: Server for PONLINE-Connect

PONLINE®

Remote terminal units

A.1) RTU Butler-Compact

- Fault reporting via SMS
- Detection of short circuits/earth faults
- Incl. 3xCTs for HV-side
- Event-driven reporting
- Including antenna
- 2 additional inputs
- Free of maintenance, integrated capacitive buffer for 90 s

Technical Data

Auxiliary voltage	85 ... 230 VAC/DC
Buffer	internal capacitive buffer for 90 s, free of maintenance
Operating temperature	-25 °C ... 65 °C
Housing	plastic
Dimensions h x w x d	130 x 130 x 100 mm
Mounting	wall mountable
Current trandformers	3 x split core CTs (inner diameter d = 55 mm)
Item no.	2500245

A.2) RTU Butler-Light

- Complete feeder monitoring, e.g.:
  - load monitoring
  - failure (short circuit, earth fault)
  - failure forecast
  - Ready for automation
- Safe VPN-connection via GPRS-Router
- Built-in Grid-Inspector IKI-50 for monitoring of 1-3 feeders
- Free of maintenance, no battery required
- Digital and analog signal inputs and outputs

Technical Data

Auxiliary voltage	110 ... 240 VAC/DC
Buffer	internal capacitive buffer for 5 mins, free of maintenance
Operating temperature	-25 °C ... 65 °C
Housing	metal enclosed
Dimensions h x w x d	300 x 200 x 150 mm
Mounting	wall mountable
Current transformers	GPRS with VPN-tunnel, OPC protocol
Item no.	2502086

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A. 3) RTU Butler-Light with LV-monitoring

- Complete feeder monitoring, e.g.
  - load monitoring
  - failure (short circuit, earth fault)
  - failure forecast
  - Ready for automation
- Safe VPN-connection via GPRS.Router
- Built-in Grid-Inspector IKI-50 for monitoring of 1-3 feeders
- Free of maintenance, no battery required
- Digital- and analog signal inputs and outputs

Low voltage monitoring

- Low voltage load current monitoring device
- Installed in low voltage compartment
- Connection to Butler-Light via two wire Modbus
- Up to 20 CTs installable
- Scalable by adding additional evaluation units (Puls 20 CTs)

Technical Data

Auxiliary voltage	110 ... 240 VAC/DC
Buffer	internal capacitive buffer for 5 mins, free of maintenance
Operating temperature	-25 °C ... 65 °C
Housing	metal
Dimensions h x w x d	300 x 200 x 150 mm
Mounting	wall mountable
Current transformers	3x split core CTs per feeder (inner diameter d = 55 mm)
Item no.	2502086

Low voltage measurement	
Auxilitary voltage	90 ... 276 VAC / DC
Load measurement	load current
Measurement channels	20
Communicaton	RS-485, Modbus
Weight	270 g (without CTs)

PONLINE®

Software

B.1) Software PONLINE-Connect:

Master/Client SCADA solution with browser-based client software for PC or mobile devices e.g. notebooks, tablets or smartphones:

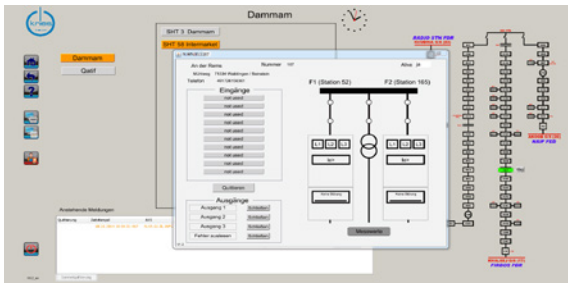
- Indication of alarms (short circuit, earth fault)
- Graphic feeder visualisation
- Graphic measurement value visualisation
- Graphic switch position visualisation
- Database for measurement values alarms, event jounal
- Quick overview per dashboard functionality

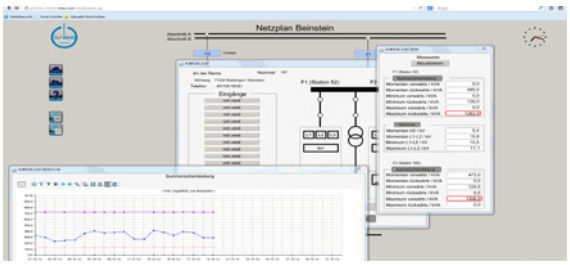
Optional:

- Remote control of feeder switches
- Alarm forwarding via e-mail or SMS

Master software located either on:

- Remote PONLINE-Host-Server
- Local PONLINE-Private-Server





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B.2) Server Hardware PONLINE-Master

- 19“-Rack or Desktop-PC
- Including Windows-Server operation system
- Pre-installed software PONLINE-Connect
- Scalable hardware
- Fail-safe RAID FDD-System for backup data

Technical Data PONLINE-Master (example, extendable)

Hardware	DELL PowerEdge T110 II Tower Chassis
Power supply	110 ... 240 VAC, 50/60 Hz, max. 9 A
Memory	8 GB
Processor	Intel Xeon E3
Storage	1.7 TB, RAID 10
Number of clients (devices) (extendable)	5,000 process variables, corresponds to e.g.: - 50 IKI-Overhead-Butler connected to a total of 250 IKI-Overhead-Radio, including current measurements and first faults, second faults notifications - 160 IKI-Overhead-Butler connected to a total of 800 IKI- Overhead-Radio, first faults only - 90 Butler-Light ... or any combination of these
Security	Secure communication over OpenVPN
Communication	HTTPS
Communication Protocols	Modular concept: - OPC-Server (default) - Modbus TCP - IEC 60870-5-104 (optional)

B.3) SMS-Modul SMS-Master

- Receiving SMS from Butler-Compact
- Including GSM-Module for SMS
- Interface to PONLINE-Connect

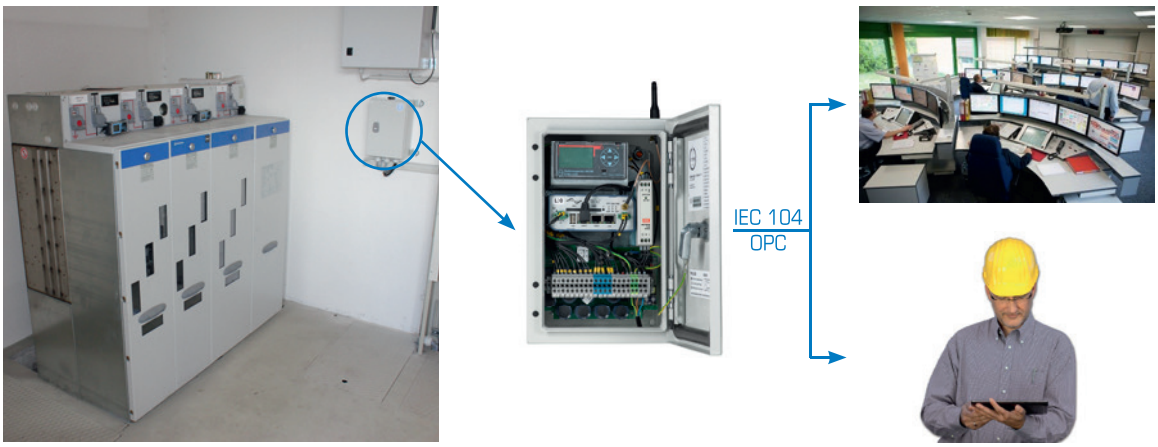
Technical Data SMS-Master

Hardware	PLC: WAGO-I/O-SYSTEM 750 Modem: INSYS GSM 4.3
Number of clients (devices)	65 (IKI-Overhead-Butler or Butler-Compact)
Power supply	110 ... 240 VAC, 50/60 Hz, max. 1 A
Required SIM card size	Standard SIM
GSM Modem	900/1800 MHz
Communication to PONLINE-Connect	OPC, TCP/IP
Communication to Butler	SMS (GSM)
Communication to SCADA system	IEC 60870-5-104 OPC

PONLINE®-Butler-Light

Monitoring system for RMUs

- **Complete solution monitoring transformer stations**
  Butler-Light includes feeder control unit IKI-50 for measurement values and fault detection in medium voltage grids, a short-time UPS and a router or modem for remote transmission.
- **Easy connection to PONLINE-Connect or SCADA**
  using standard protocols such as IEC 60870-5-104, ModbusRTU or OPC
- **Easy installation due to compact wall-mountable housing**
  All components required are pre-wired inside the compact housing. Only the sensors for voltage and current have to be placed inside the switchgear.
- **Free of maintenance**
  due to capacitor-based integrated UPS
- **Optional integration of additional devices via ModbusRTU**
  for example standard IKI-50 or low voltage measurement devices
- **Different transmission modules available**
  depending on local conditions, different routers or modems are available e.g. GSM, 3G, 4G or SHDSL

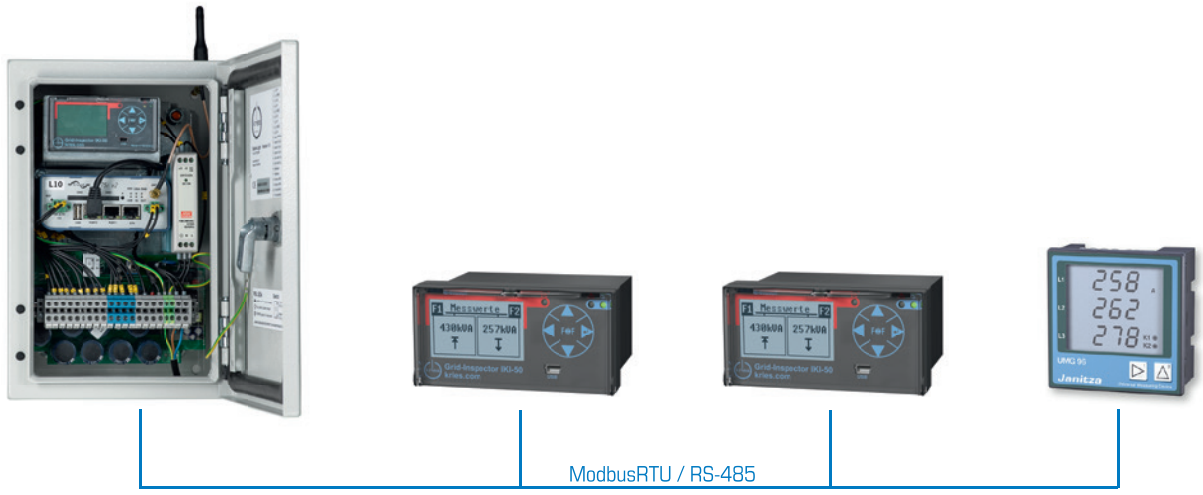


PONLINE®-Butler-Light

Monitoring system for transformer stations

Technical Data

Item nos Butler-Light-GPRS with IKI-50 Butler-Light-GPRS without IKI-50 Butler-Light-Cable without IKI-50	 2502086 2502086_H002 2502086_H003
Auxiliary power	100-240 VAC ±10%
Power consumption	typ. 14 Watt, max. 20 Watt 50 W peak during boot process
Buffering time	typ. 5 min. (dependant on connected load)
Charging time of internal buffer	approx. 15 min.
Internal voltage	24 VDC
Modem Version GPRS Version Cable	 GPRS/EDGE (Class 10) 850/900/1800/1900 MHz VPN OpenVPN Firewall SIM card 3V SHDSL-router for existing copper networks Distance between routers up to 15 km
Housing	metall housing, wall-mountable
Dimensions	h x w x d in mm: 300×200×150
Weight	6 kg
Operating temperature	-25 °C to +65 °C
Storage temperature	-25 °C to +70 °C
Protection class	IP 54



Optional additional Modbus-Slaves
e.g. feeder-controller IKI-50, LV-measuring devices, digital I/O-ports

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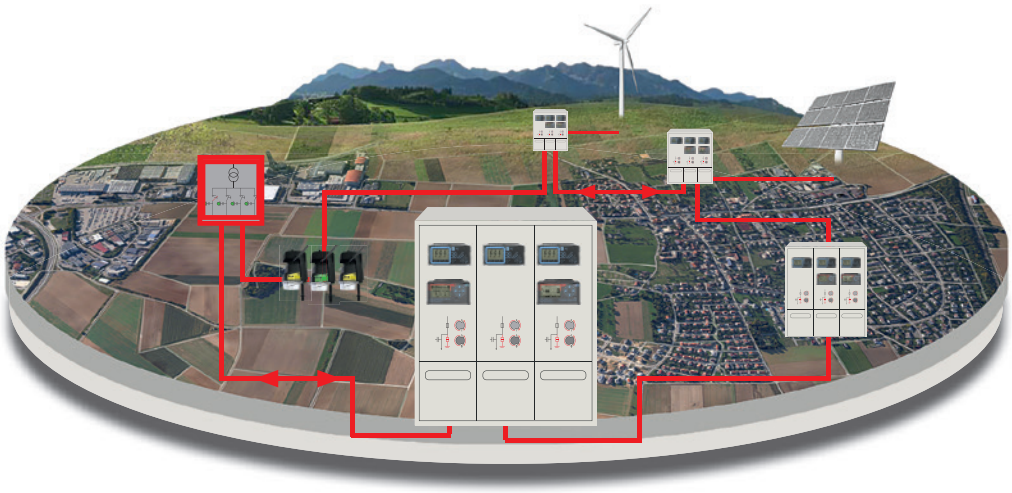
PONLINE®-Butler-compact

Remote Terminal Unit

- **GSM-RTU PONLINE-Butler**
  PONLINE-Butler is designed for use in ring-main units and substations of power-distribution networks. It provides SMS-based transmission of fault events to SCADA and/or mobile phone.
- **Easy parameterisation on site**
- **Event-driven communication via SMS**
- **Integrated buffered power supply unit - maintenance free**
  Long lasting capacitor system
- **Application dependent functionality**
  PONLINE-Butler Standard: 12 digital inputs, 4 outputs
  PONLINE-Butler - IKI-XX: 4 digital inputs und 4 outputs
- **Optionally integrated IKI-xx or external CAPDIS-S2_R4**
  Compact retrofit set-up on request + add. solutions e.g. for transmission of measurements or mobile earth fault detection within generator operation



PONLINE®-Butler-Compact

Remote Terminal Unit

Technical Data

PONLINE-Butler-Compact with intergrated short circuit and earth fault indicator IKI-50

Item no.	2500245
Power supply	85-230 VAC/DC, 45-65 Hz
Max. current	0.4 A
Buffer time	at least 90 s
Inputs	12
Outputs	4 Relay NO, 220 V-/250 V, ~1 A, 62.5 VA/30W
GSM	900 / 1800 MHz
SIM interface	SIM card 3 V
Housing	wall mounting
Dimensions	h x w x d 130 x 130 x 75 mm I 130 x 130 x 100 mm
Weight	1 kg
Operation temperature	-25 °C to +60 °C
Storage temperature	-25 °C to +70 °C
Protection class	IP 54
Connections	internal terminal connector
Event-driven message transmission	Yes
Cyclic message transmission	Yes
Status information	12 LEDs
Interface	Modbus, USB

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Automatic Transfer Switch PONLINE®-ATS_50

Medium-Voltage Outage Recovery in Seconds

Application

Reduction of outage time at your customers down to less than 3 seconds by an Autmatic Transfer Switch System based on Feeder-Controller IKI-50; applicable for:

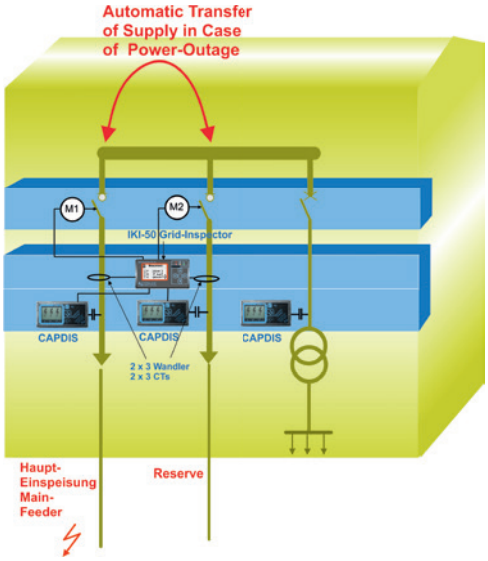
- industrial customers with high power-availabilty demand,
- customers with two sources input,
- high security applications such as:
  - road and railway tunnels,
  - hospitals, data centers,
  - sky scrapers, densly populated areas,
  - event areas (stadiums, airports, train stations ...).

2 sec before blackout

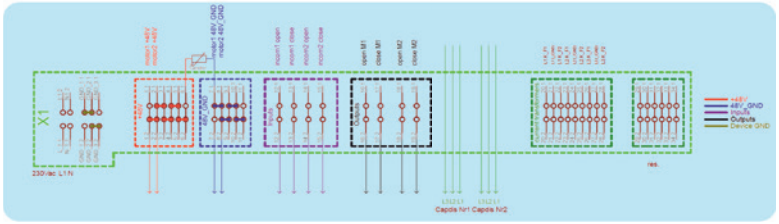
blackout

3 sec after blackout

- **Medium-Voltage Outage Time Minimization**
  - automatic power recovery in medium-voltage stations after power-outages due to failures or overloads,
  - complete plug and play solution,
  - applicable for all motorized switchgears,
  - completely prefabricated intelligence,
  - failure-prediction function,
  - integrated UPS system for highest reliability.
  - directional fault detection for distinguishing internal and external failures in order to provide selective tripping



- **Components integrated in System-enclosure**
  - Feeder-controller type Grid-Inspector IKI-50 with integrated PLC logic and PC-configuration-software, directional load monitoring and failure detection, CTs installed either at bushings or at cables, voltage-interface to CAPDIS®-S2+ (VDS-system).
  - UPS type PSU-Hybrid maintenance minimized, life-time maximized,
  - 2 fail-safe voltage detecting systems type CAPDIS®-S2+,
  - ATS-Interface clamp compatible with most motorized RMUs



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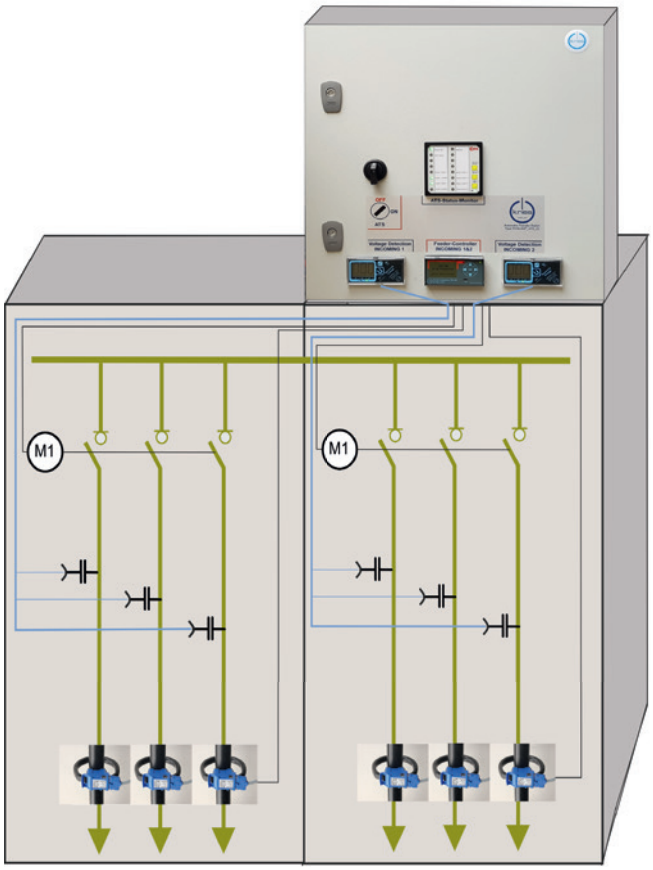
Automatic Transfer Switch PONLINE®-ATS_50

Medium-Voltage Outage Recovery in Seconds

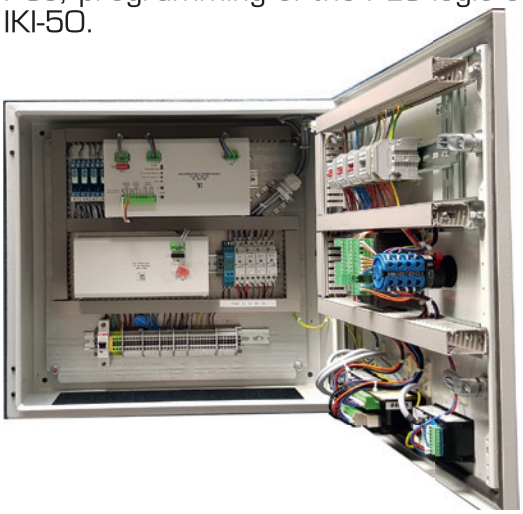
Feeder-controller type Grid-Inspector IKI-50 offers complete control of main and reserve supply feeder.
IKI-50 comes with Modbus RTU; digital I/Os and optional Ethernet connection.

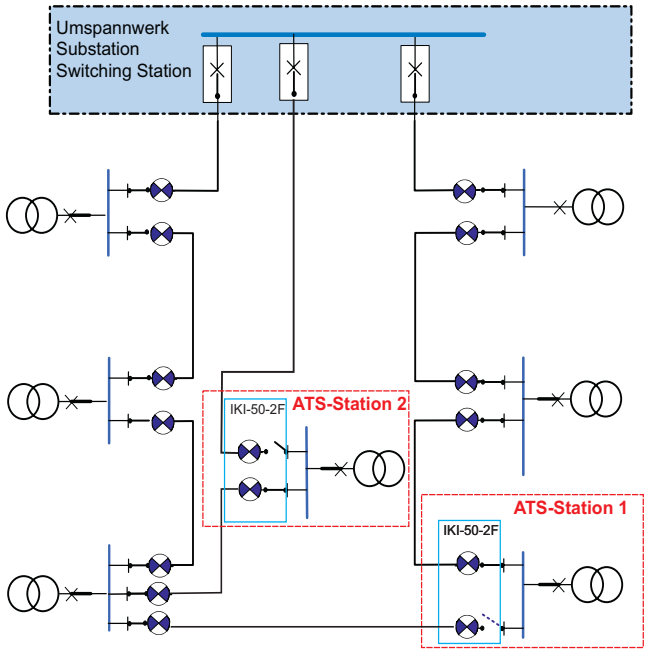
Fail-safe voltage detecting system CAPDIS®-S2+ for main and reserve feeder; either in system enclosure or in switch-gear panel; Any CAPDIS®-S2+ pre-installed in the switchgear can also be used for ATS.



Technical Details

- System enclosure with wxhxd = 500x500x250 mm,
- UPS available with 24 VDC or 48 VDC
- RTU-communication port IEC 60870-5-104,
- Parameterization-software type **Kries-Config**; suitable for Windows PCs; programming of the PLC logic of IKI-50.





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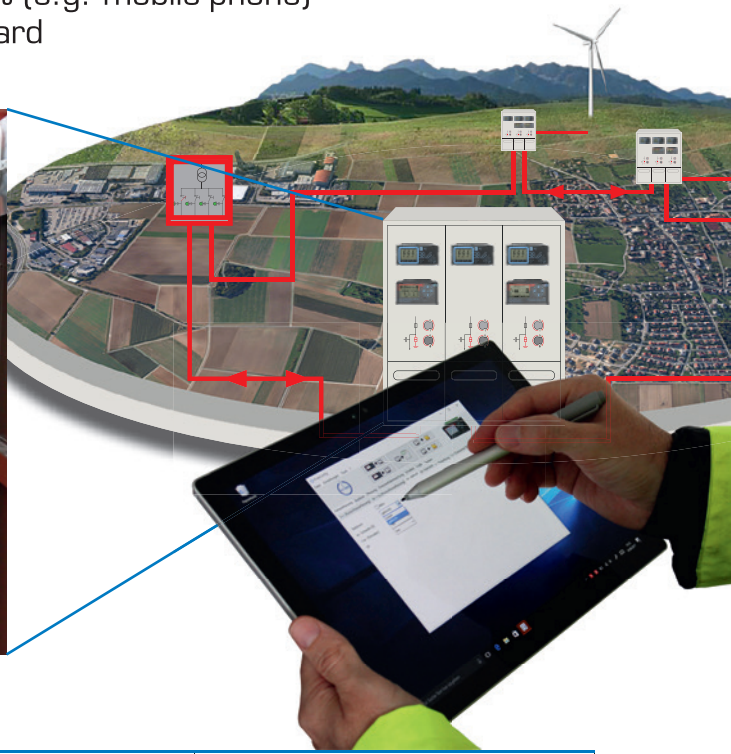
PONLINE®-Tablet

Service tablet for Kries-Config and PONLINE-Connect

- **Configuration of Kries devices via Kries-Config Software**
  Comfortable parameterization of e.g. fault indicator IKI-50 or protection relay IKI-35 via PC-Software Kries-Config via USB.
  Tablet comes with Kries-Config beeing preinstalled.

- **Operating tablet for SCADA solution PONLINE-connect**
  Via integrated browser software an easy-to-use and comfortable solution to connect to PONLINE-Master with PONLINE-Connect software is given. PONLINE-Tablet is ideal to be used as mobile tool as its much more compact and light-weight than a classic Laptop

- **Modern high-performance tablet with Windows-10**
  - Complete PC with preinstalled Windows-10 as tablet
  - USB-interface for connection to IKI-50 or IKI-35
  - WLAN for online connection to any hotspot (e.g. mobile-phone)
  - Operation via pen, touch or optional keyboard
  - Inclusive protection sleeve



Item no.	Scope of delivery	Type	Display	Technical data
2502992	Tablet, pen, charger and protection sleeve	Microsoft Surface Pro	Diagonal dimension: 12,3“ (31,2 cm) Resolution: 2.736 x 1.824	Processor: Intel Core i5-6300U, 2,4 GHz RAM: 4 GB HDD (SSD): 128 GB

PONLINE®-Controller-Box

Series of metal housings for retrofitting of switchgears

- **Retrofit of secondary equipment without mechanical intervention at the switchgear**
  The housing series is fixed at the switchear with a crossbrace and clamping fixture. The switchgear is not changed in any way (e.g. holes)
- **Modular**
  The housings are available in different sizes and can be easily combined to a complete housing system.
- **Retrofit with secondary equipment directly at the feeder**
  The position of the housings can be easily adjusted to fit directly to the feeder the devices are linked to. An optimal position for easy operation is therefor easily achivable
- **Plug-and-play, optional pre-wiring**
  Devices like feeder control unit IKI-50, protection relay IKI-35 or CAPDIS can be delivered and already being pre-wired and mounted in the housing. Easier installation on site is achieved.
- **Fits all types of transformer stations**
  Due to minimized height, the housing series fits nearly all types of installation situations. Optional wall-mouting-kits ad even more flexibility.

PONLINE®-Controller-Box

Gehäuseserie für Nachrüstung an Schaltanlagen

Technical data

Type	IKI-Module 150 mm	IKI-Module 180 mm	IKI-Module 300 mm	PSU-Module	Crossbrace with clamping fixture
					
Dimensions W x D x H mm	150 x 180 x 70	180 x 180 x 70	300 x 180 x 70	180 x 180 x 450	40 x 40 x 500 - 1500
Number of cutouts 45 x 92 mm (Devices not included)	1	2	2	-	-
Control switches (for Motor Control Unit)	-	2	2 (optional)	-	-
Additional options			MotorControlUnit MCU (optional)		
Material	Aluminium	Aluminium	Aluminium	Aluminium + Polycarbonate	Aluminium
Item no.	2502218	2502219	2502239 (without control switches, without MCU) 2502220 (With control switches and MCU)	2502221	2502240
Applications	Retrofit of single devices: -> IKI-Line -> CAP-Line Optimal installation with direct reference to the related feeder	Retrofit of single devices at motorized feeders. Integrated switches can be used as remote/local or On/Off switches. -> IKI-Line -> CAP-Line In combination with Motor Control Unit MCU a complete feeder control can be easily retrofitted. Optimal installation with direct reference to the related feeder	Retrofit of two single devices at motorized or non-motorized feeders. The optional switches can be used as remote/local or On/Off switches. -> IKI-Kine + CAP-Line (e.g. IKI-50 + CAPDIS-S1+) In combination with Motor Control Unit MCU a complete feeder control can be easily retrofitted. Optimal installation with direct reference to the related feeder	Retrofit of UPS type PSU-Hybrid including batteries. The housing can be installed at the side of the switchgear. -> PSU-Hybrid The housing includes two batterie-holders for batteries up to 12 Ah. The housing is mounted at the same crossbrace than the other housings as well.	The crossbrace with two clamping fixtures is the holder for all housings of the PONLINE-Controller-Box-series. It can be installed without any changes to the switchear (like drilling holes e.g.)

PONLINE-Controller-Box for PSU inclusive wall mounting kit

PONLINE-Controller-Box for PSU open incl. wall mounting kit and battery holders

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Power Storage Units PSU

UPS systems, long-living, low maintenance

- **Short-time buffer: PSU-110**
  Buffer for seconds, output voltage: 110 … 322 VDC

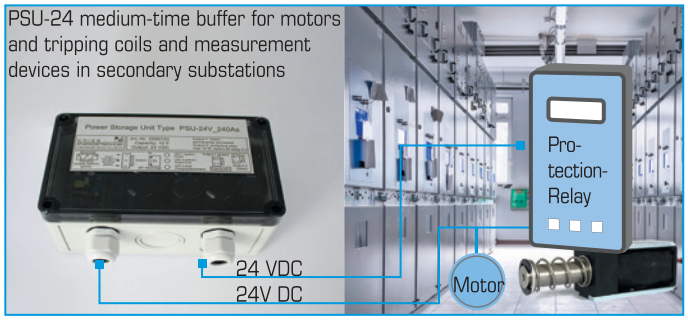
  Application 1: buffer for network analysers, protection relays or monitoring devices:

  During short-term interruptions all safety related devices or power-quality meters have to be buffered. In case of automatic transfer functions, the power outage during switching-over needs to be buffered.

- **Supply extension after power outage: PSU-24**
  Buffer for seconds or minutes; output voltage: 24 VDC

  Application 2: Buffer for protection relays, RTUs, motors or tripping coils of switchgears:

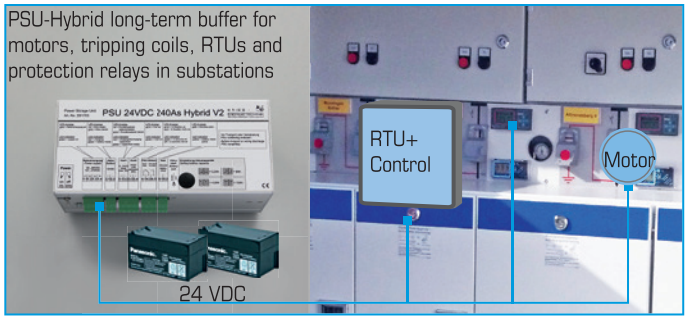
  After power loss in secondary substations, auxiliary power has to be buffered for a few seconds or minutes to operate motors or tripping coils via protection-relays.



- **Long-term buffer: PSU-Hybrid**
  Buffer for minutes or hours, output voltage: 24 VDC

  Application 3: Buffer for complete switchgear incl. control devices and RTU.

  After power loss in secondary remote operated switchgears, RTUs and motors have to be buffered for minutes or hours. PSU-Hybrid offers a combination of battery and capacitive buffer to supply high-current motor start-up and tripping coils even during very low temperature or older battery.



Power Storage Units PSU

UPS systems, long-living, low maintenance

Type	Capacity	Auxiliary Power	Voltage	Voltage	Charge Q out 1 Buffer Time dt out 1	Voltage	Voltage	Charge Q out 2 Buffer Time dt out 2	Application	Item no.	Picture
	farad	input	out 1 Un= Uout nominal	out 1 Min ... Max	Q = Imax x dt Q = 0,5C (U1² - U2²) /Un dt (s) = E / P	out 2 Un= Uout nominal	out 2 Min ... Max	Q = Imax x dt Q = 0,5C (U1² - U2²) /Un dt (s) = E / P	preferred		
PSU_24V_1,4As	150 mF	24 ... 240 VAC/DC	24 VDC	19 ... 28.8 VDC	Q = 1.4 As = 11 A x 0.13 s dt = 43 J/P (Pmax = 264 VA)				1	2500716	1
PSU_24V_1,8As	220 mF	100 ... 240 VAC/DC	24 VDC	19 ... 26 VDC	Q = 1.8 As dt = 33.6 J/P	24 VDC	regulated	Q = 0.45 A x 2 s dt = 21.6 J/P (Pmax = 10 VA)	1	2500044	
PSU_24V_240As	10 F	85 ... 240 VAC/DC	24 VDC	12 ... 25 VDC	Q = 100 As = 4 A x 25 s dt = 2400 J/P (Pmax = 150 VA)	24 VDC	regulated	Q = 0.4 A x 5 s dt = 48 J/P (Pmax = 10 VA)	1, 2	2500720	2
PSU_24V_600As	20 F	85 ... 240 VAC/DC	24 VDC	12 ... 25 VDC	Q = 200 As = 8 A x 25 s dt = 4800 J/P (Pmax = 240 VA)	24 VDC	regulated	Q = 0.4 A x 5 s dt = 48 J/P (Pmax = 10 VA)	1, 2	2500723	
PSU_110V_0,1As	600 + 300 uF	110 ... 240 VAC/DC	DC in = DC out AC in x 1.4 = DC out	... 240 VDC ... 336 VDC		DC in = DC out AC in x 1.4 = DC out	... 240 VDC ... 336 VDC		1	2500722	3
example 1		110 VAC	110 VAC x 1.4 = 154 VDC	100 ... 154 VDC	Q1 = 0.04 As (Imax = 100 A) dt = 6.16 J/P	110 VAC x 1.4 = 154 VDC	100 ... 154 VDC	Q1 = 0 ...133 As (Imax = 100 A) dt = 2 J/P (Pmax = 10 VA)			
example 2		230 VAC	230 VAC x 1.4 = 322 VDC	200 ... 322 VDC	Q2 = 0.09 As (Imax = 200 A) dt = 29 J/P	230 VAC x 1.4 = 322 VDC	200 ... 322 VDC	Q2 = 0.03 As (Imax = 200 A) dt = 9.5 J/P (Pmax = 10 VA)			
PSU_48V_0,5As	2 x 6 mF	24 ... 240 VAC	48 VDC	30 ... 54 VDC	Q = 0.126 As (Imax = 40 A) dt = 6 J/P	48 VDC	30 ... 54 VDC	Q = 0.126 As (Imax = 40 A) dt = 6 J/P	1	2500732	
PSU-Hybrid	8,. F	100 ... 240 VAC 127 ... 300 VDC	24 VDC	12 ... 25 VDC	Q = 100 As = 4 A x 25 s dt = 2400 J/P	24 VDC, 60 VA	23 ... 25 VDC	size of battery selectable	3	2501704	

	dimensions - h x w x d		mounting
Picture 1	130 x 130 x 130 mm		wall mounting
Picture 2	110 x 180 x 90 mm		wall mounting
Picture 3	78 x 100 x 125 mm		DIN-rail mounting
Picture 4	225 x 105 x 110 mm		DIN-rail mounting

Rule of thumb for calculation of buffer capacity required

$C = (2*P*dt) / (U_1^2-U_2^2)$
P: Nominal power of tripping coil or motor
dt: duration of operation

Rule of thumb for calculation of buffer time

$dt = C* (U_1^2-U_2^2) / 2P$
U1: Maximum output voltage
U2: Minimum output voltage

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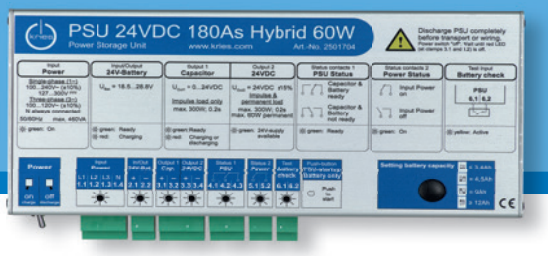
PSU_24V_Hybrid_60W

Power Storage Unit
Capacitive UPS without maintenance
Automised RMUs



- **Combined UPS for high and low power loads**
  Load during auxiliary power: 60 W permanent + 300 W impulse load
  Load during buffer time: 60 W permanent + 300 W impulse load
  Application example:
  e.g. battery 40 Ah: buffer time 5 h@60 W + 50x 300 W impulse discharges
  e.g. battery 1.3 Ah: buffer time 11 min@30 W + 38x300 W impulse discharges

- **Impulse power** suitable for high power loads, e.g. motors, tripping coils

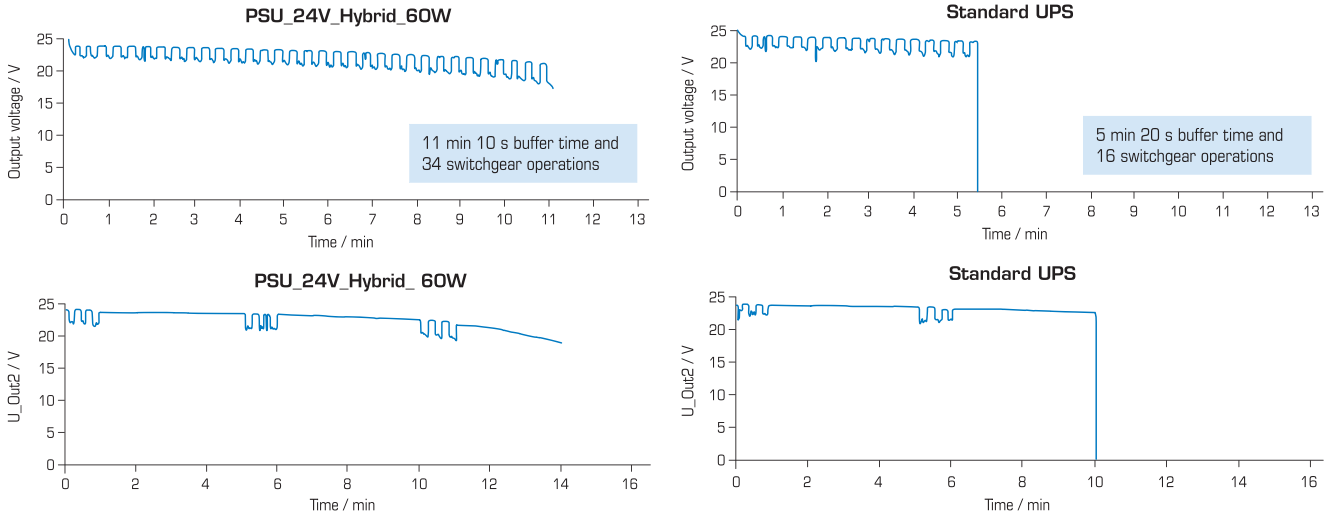
- **Permanent power** suitable for low power loads, e.g. RTU, protection ..

- **Space saving and maintenance minimised solution**
  only one charging unit for battery and capacitor; no fan required

- **Permanent high power availability**
  Extended battery buffer time and extended battery service life
  due to the combination of capacitor-buffer for high impulse loads and battery for low permanent loads. Twice the service life of a conventional UPS.

- **Inputs- and outputs for RTU connection**
  Relay output for remote monitoring of capacitor charge status and battery status. Remote quality test of battery by external input.

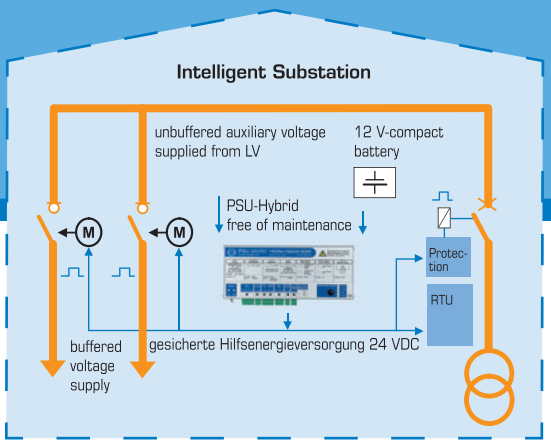
Efficiency-comparison: PSU-Hybrid vs standard UPS with same battery size, 1.3 Ah



Result: PSU-Hybrid offers twice the buffer time and twice the switching capacity of a standard UPS with same battery

PSU_24V_Hybrid_60W

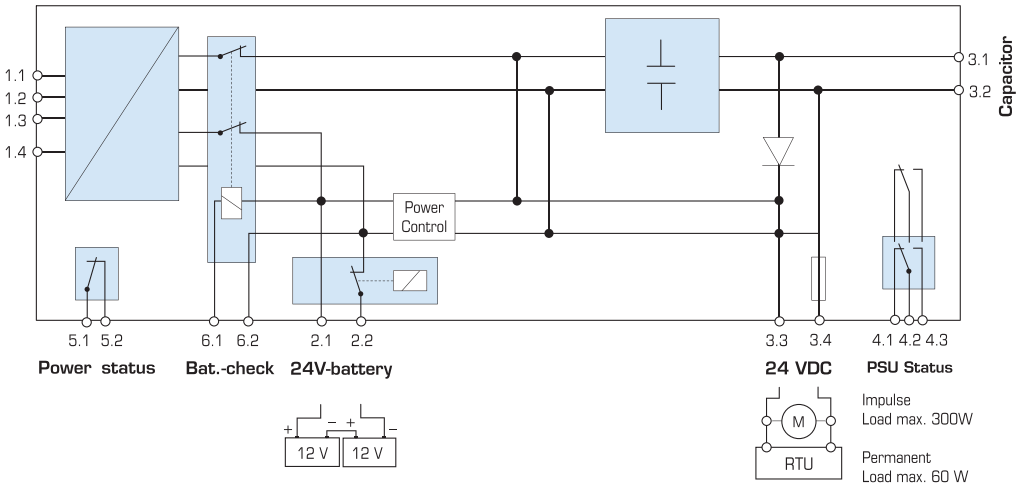
Power Storage Unit
Capacitive UPS without maintenance
Automised RMUs



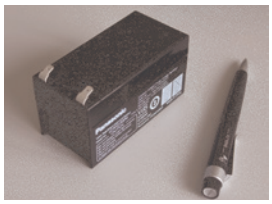
Technical Data

Item no.	2501704 2501704_H001 (Low-drop-version for peak current >300W)
Auxiliary Voltage	90 ... 264 VAC . 125 ... 375 VDC (1-phase supply, optional: 3-phase supply)
Output	60 W permanent load + up to 300 W impulse load
Contact	AC/DC Auxiliary Availability
Input	Start: performs battery test
Capacitor	Capacity 10 F Charge 240 As
Battery module	Capacity: customer selectable Current: settable dependent on battery size (1.3 Ah.12 Ah, further values on request)
Dimensions	h x w x d = 225 x 105 x 110 mm
Weight	2 kg
Protection degree	IP 42
Operating temperature	-25 ... +60 °C
Storage temperature	-30 ... +70 °C
Housing	aluminium
Mounting	DIN-rail

Block Diagram



Example of compact battery suitable for PSU-Hybrid



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