VARIMETER IMD
Insulation monitor
LK 5894

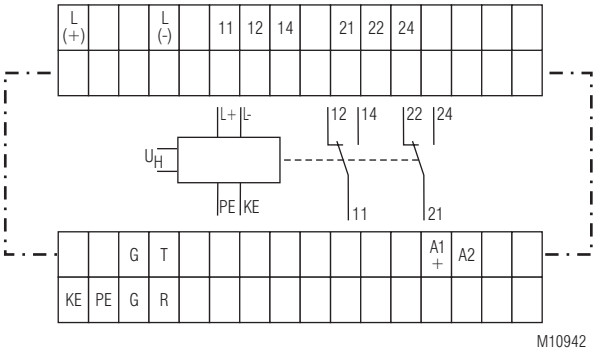
Translation of the original instructions

0269334

Product Description

The insulation monitor LK 5894 of the varimeter IMD family provides best insulation monitoring of modern IT systems in an optimum and state of the art way fulfilling the relevant standards. The device can be used in the most flexible way for AC, DC and AC/DC systems even with large leakage capacity to earth (PE). The adjustment of the setting values is simple and user friendly done on 2 rotary switches on the front of the device. Via LEDs the measured value, device parameters and device status are indicated easy to read.

Circuit Diagram



M10942

Connection Terminals

Terminal designation	Signal description
A1+, A2	DC-Auxiliary voltage
L(+), L(-)	Connection for measuring ciruit
KE, PE	Connection for protective conductor
G, R	Control input (manual/auto reset) G/R not bridged: Manual reset G/R bridged: Auto reset
G, T	Control input (External test input) connection option for external device test pushbutton
11, 12, 14	Alarm signal relay (1 changeover contact)
21, 22, 24	Prewarning signal relay (1 changeover contact)

Your Advantages

- Preventive fire and system protection
- Quick fault localisation through selective earth fault detection to L+ and L-
- Universal application in non-earthed AC, DC, AC/DC networks with up to 690 V nominal voltage
- Suitable for large leakage capacitances up to 1000 µF
- Simplest setting via engaging rotary switches
- Optimised measuring times - normally shorter than with known methods
- Monitoring also with voltage-free mains
- Measuring circuit with broken wire detection
- No additional coupling device required

Features

- Insulation monitoring according to IEC/EN 61557-8
- Detection of symmetric and asymmetric insulation faults
- 2 changeover contacts
- Prewarning threshold setting range: 20 kΩ ... 2 MΩ
- Alarm threshold setting range: 1 kΩ ... 250 kΩ
- Energized or de-energized on trip can be selected for output relay
- Setting the maximum leakage capacitance to shorten the response time
- Simple, clearly arranged adjustment of the device with screwdriver
- LED chain to indicate the current insulation resistance
- Display of active measuring circuits
- Automatic and manual device self-test
- Width: 90 mm

Approvals and Markings

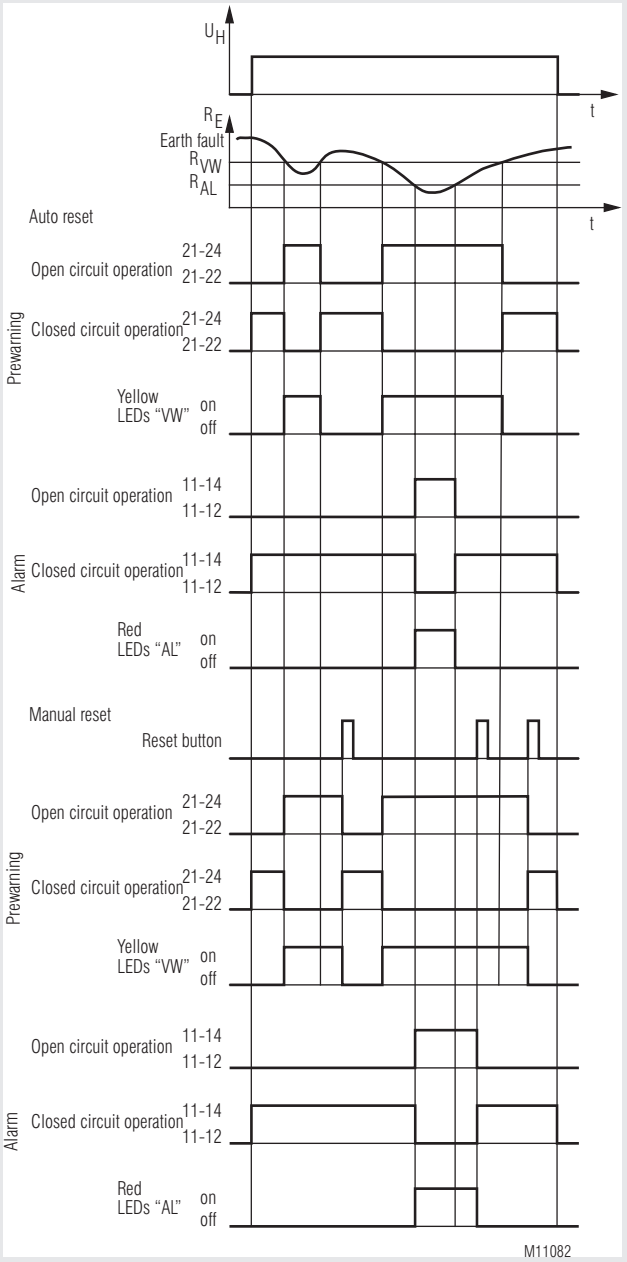
CE | c UL us LISTED Canada / USA | AC/DC | UKCA

Applications

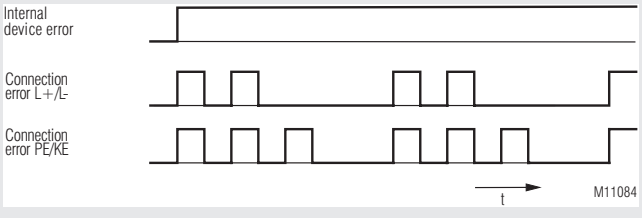
Insulation monitoring of:

- Non-earthed AC, DC, AC/DC networks
- UPS systems
- Networks with frequency inverters
- Battery networks
- Networks with direct current drives
- Hybrid and battery-powered vehicles

Function Diagram



Flashing Codes LED "ERR"



Function

If the device is supplied with DC auxiliary voltage, the a green "PWR" LED comes on. Switching on the auxiliary voltage is followed by an internal self-test for 10 sec, where the LEDs of the indicator string light up in sequence. After this, measurement of the insulation resistance in the measuring circuits begins.

Measuring circuit
(Insulation measurement between terminals L(+) / L(-) and PE / KE)
Terminals L(+) and L(-) are connected to the mains to be monitored. Broken wire detection, constantly effective during operation, generates an error messages if both terminals are not connected with low resistance through the mains.
In addition, the two terminals PE and KE must be connected to the protective conductor system via separate lines. An error message is given here as well if a line is interrupted (see section "Actions in case of connection faults").
If the main measuring circuit is activated, an active measuring voltage with alternating polarity is applied between L(+) / L(-) and PE / KE to measure the insulation resistance. During the measuring phase with positive polarity, the "Active" LED flashes with a long On-phase and with negative polarity with a short On-phase.
The length of the positive and negative measuring phases depends on the settings on the rotary switch "CE/µF", the actual leakage capacitance of the monitored network and with DC networks, on the level and duration of possible mains voltage fluctuations. Correct and preferably quick measurement is thus given with different mains conditions. In the event of particularly adverse conditions and major interferences, the measuring analysis can be steadied and delayed in addition with rotary switch "tv" if necessary.
The current insulation resistance is determined and analysed at the end of each measuring phase. The LED chain show the resistance determined, and the output relays for prewarning "VW" and alarm "AL" switch according to the respective response values set. If the response thresholds have been undercut, the LEDs "VW" or "AL" light according to the insulation fault location: "+", "-" or "+" and "-" simultaneously for AC faults or symmetric insulation faults.

Storing insulation fault message
If terminal R is open, the insulation fault messages from the main and auxiliary measuring circuit are stored when the respective response value is undercut, but also when the insulation resistance returns to the OK-range. In addition, the temporary minimum values of the insulation resistance are indicated on the LED chain through dimmed LEDs.
If the "Reset" button on the device front is pressed or terminal R is connected with G, the stored insulation fault messages are reset when the insulation resistance is again in the OK-range.

Output relay for insulation fault messages
The rotary switch "CE/µF Rel." allows selecting the operating current (A) or standby current (R) principle for the output relays "AL" (contacts 11-12-14) and "VW" (contacts 21-22-24).
With the operating current principle, the relays respond when the response values are undercut, with the standby current principle they release when the response values are undercut.
If 2 different response values are not needed, "VW" and "AL" can be set to the same value. The output relays switch together in this case.

Broken wire detection
As mentioned above, both the main measuring circuit and the auxiliary measuring circuit are constantly monitored for wire breaks - not only at Power-On or a manual or occasional automatic test. The response time of monitoring is only a few seconds.
Broken wire detection between L(+) and L(-) is performed via coupled alternating voltage. This alternating voltage is short-circuited if the terminals are connected to the connected mains at low-resistance. The device detects that the mains to be monitored is properly connected. Since this broken wire detection is carried out with alternating voltage, large capacitances should be avoided between L(+) and L(-), since the capacitive reactance of these capacitances also short-circuits this alternating voltage. The device would no longer detect a connection fault on L(+)/L(-). Especially parallel lines should be prevented over larger distances.
If larger capacitances between L(+)/L(-) cannot be avoided or if the coupled alternating voltage interferes with the system, version LK 5894.12/011 (without broken wire detection on L(+)/L(-)) shall be used.

Function

Device test functions

Principally, 2 different test functions are implemented: The "self-test" and the "expanded test":

The self-test of the device is performed automatically after Power-On and every 4 operating hours. It can also be triggered manually at any time by pressing the "Test" button at the device front or with an external pushbutton connected between terminals T and G.

With the self-test, contrary to the expanded test, the status of the output relays and the analogue output are not affected; the sequence is as follows:

Switching to the negative measuring phase is performed for 4 sec. The „Active“ LED flashes here with a brief On-phase. The LEDs of the LED chain are selected in sequence and the internal circuit is checked. After this, switching to the positive measuring phase is performed for 4 sec. The „Active“ LED flashes here with a long On-phase. The LED chain cycles again and additional internal tests are performed. Insulation measurement continues normally after a pause of 2 sec if no faults have occurred.

The expanded test is started when the internal or external "Test" button is pressed (or is still held) at the end of the 8 sec self-test, described above. The sequence is the same as with the self-test (2 measuring phases at 4 sec + 2 sec pause); however, the output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and the analogue output proceeds to its lowest value.

If the Reset button is pressed during the 8 sec or terminals R-G are connected, the expanded test is terminated after these 8 sec. Otherwise, the phases of the expanded test are constantly repeated, where, in addition, the "ERR" LED and the fault signalling relay (contacts 31-32-34) constantly receive current. However, the expanded test is terminated as soon as the Reset button is pressed. The device switches to the OK-state and restarts insulation measurement.

Behaviour with internal device faults

If internal device faults were detected during the test function, the "ERR" LED is lit continuously and the measuring circuit is deactivated internally ("Active" LED goes off). The output relays "AL" and "VW" as well as the associated LEDs switch to the alarm state and all LEDs of the LED chain extinguish.

Behaviour in the case of connection faults

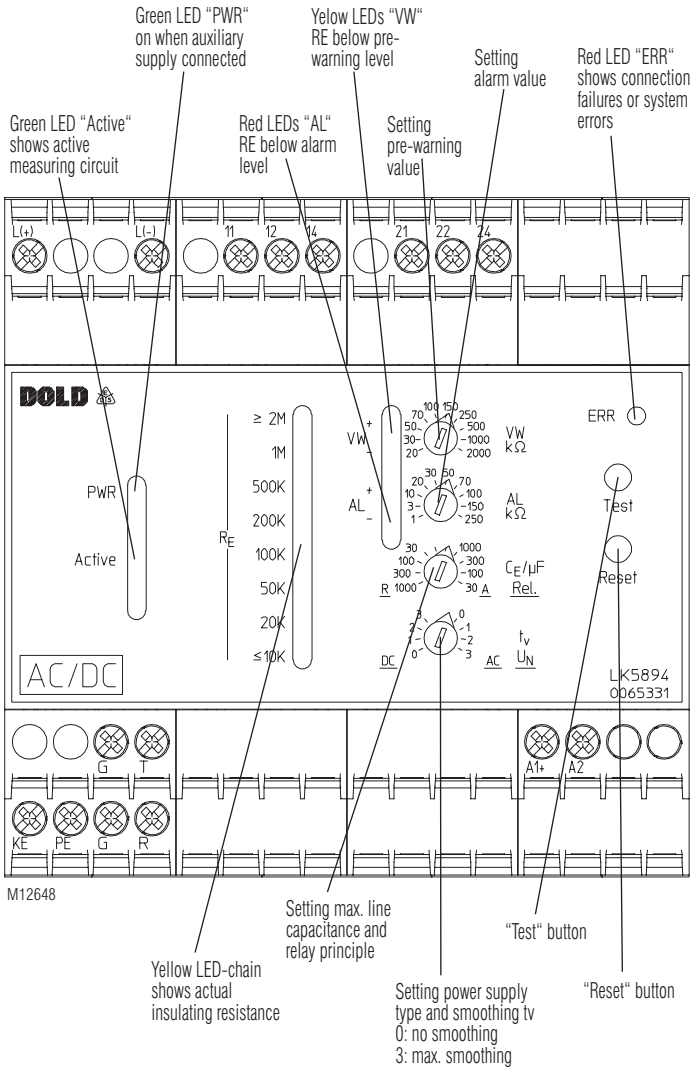
If broken wire is detected on terminals L(+) / L(-), the measurement is interrupted and the LED "HM" goes off. This connection failure is indicated by LED "ERR" with "failure code 2". The output relays "AL" and "VW" as well as the corresponding LEDs go into alarm state and all LEDs of the indicator LED chain go off. After removing the the interruption the measurement of the insulation resistance starts again. Stored alarm states remain active.

When interrupting the connection PE / KE to the protective ground, the unit reacts in the same way as with an interruption on L(+) / L(-), only the LED "ERR" shows "failure code 3".

Indicators

Green LED „PWR“:	On, when auxiliary supply connected	
Red LED „ERR“:	Permanent on: Flashing:	At system error At connection failure
Green LED „Active“:	Flashing:	At active measuring ciruit, ON-OFF-ratio per measurement phase: Long ON period during measurement phase with positiv polarity Short ON period during measurement phase with negative polarity
Yellow LED chain:	8 LEDs indicate the actual insulating resistance (≤ 10 kΩ ... ≥ 2 MΩ)	
Yellow LED „VW +“:	Permanent on:	R_E lower then prewarning value to + potential
Yellow LED „VW -“:	Permanent on:	R_E lower then prewarning value to - potential
Yellow LEDs „VW +“ and „VW -“ simultaneity:	Permanent on:	AC-fault / symmetric fault
Red LED „AL +“:	Permanent on:	R_E lower then tripping value to + potential
Red LED „AL -“:	Permanent on:	R_E lower then tripping value to - potential
Red LEDs „AL +“ and „AL -“ simultaneity:	Permanent on:	AC-fault / symmetric fault

Setting



Notes

Risk of electrocution!
Danger to life or risk of serious injuries.

- Disconnect the system and device from the power supply and ensure they remain disconnected during electrical installation.
- The voltage of the monitored voltage system is connected to terminals L(+) / L(-). Please observe sufficient distance to terminals of neighbour devices and to the grounded metal cabinet or box (min 0.5 cm).
- The terminals of the control inputs T, R and G have no galvanic separation to the measuring circuit L(+) and L(-) and are electrically connected together, therefore they have to be controlled by volt free contacts or bridge. These contacts ore bridges must provide a sufficient separation depending on the mains voltage on L(+)-L(-).
- No external potentials may be connected to control terminals T and R. The associated reference potential is G (identical with PE), and the connection of the terminals is made via bridges to G.

Attention!

- Before checking insulation and voltage, disconnect the monitoring device LK 5894 from the power source!
- In one voltage system to be monitored, only one insulation monitor must be installed. A second insulation monitor would influence the first one. When coupling separate voltage systems that each have an insulation monitor, all insulation monitors except one have to be disabled.
- Device terminals PE and KE must always be connected via separate lines to different terminal points of the protective-conductor system.
- The device must not be operated without KE/PE connection!
- The measuring circuit should not be connected via longer parallel guided wires, as this may interfere with the broken wire detection. Also large capacities between L(+) und L(-) have to be avoided.

Attention!

- The main measuring circuit can be connected with its terminals L(+) and L(-) both to the DC and also AC side of a mixed network; it is done most practically where the primary incoming power supply takes place. Selector switch "tv / U_N" should be set accordingly.
- To monitor a 3NAC system, the unit can be connected to the neutral conductor of the three-phase mains with one pole (L(+) and L(-) are bridged). Due to the low-resistance (approx. 3 - 5 Ω) mains coupling of the 3 phases in the feeding transformer, insulation faults on the phases not directly connected can also be detected.
- If a monitored AC system includes galvanically connected DC circuits (e.g. via a rectifier), an insulation failure on the DC side can only be detected correctly, when a current of min 10 mA can flow via the semiconductor connections.
- If a monitored DC system includes galvanically connected AC circuits (e.g. via an inverter), an insulation failure on the AC side can only be detected correctly, when a current of min 10 mA can flow via the semiconductor connections.
- The main measuring circuit is designed for large leakage capacitances up to 1000 µF. The selection switch "CE/µF" must be set accordingly. Measurement of the insulation resistances is not falsified by this; however, longer periods are required for the measuring phases than with small capacitances. If the maximum approximate leakage capacitance is known, the selector switch "CE/µF" can possibly be set to smaller values, which reduces the response time further.
- For the main measuring circuit, the nominal voltage range for DC is specified with 690 V; however, absolute values up to max. DC 1000 V are permissible.

Technical Data

Measuring ciruit L(+) / L(-) to PE / KE

Nominal voltage U_N:	DC 0 ... 690 V;	AC 0 ... 690 V
Voltage range:	DC max. 1000 V;	AC max. 760 V
Frequency range:	DC or 16 ... 1000 Hz	
Max. line capacitance:	1000 µF	
Internal resistance (AC / DC):	> 280 kΩ	
Measuring voltage:	Approx. ± 95 V	
Max. mesured current (R_E = 0):	< 0.35 mA	

Response values R_E

Pre-warning („VW“):

kΩ:	20	30	50	70	100	150	250	500	1000	2000

Alarm („AL“)

kΩ:	1	3	10	20	30	50	70	100	150	250

Each adjustable via rotational switches

Response inaccuracy:	± 15 % + 1.5 kΩ	IEC 61557-8
Response value hysteresis		
at range 10 kΩ ... 700 kΩ:	Approx. 25 %	
Out of range:	Approx. 40 % + 0.5 kΩ	
On delay		
at C_E = 1 µF,		
R_E of ∞ to 0.5 * response value:	< 10 s	

Input auxiliary voltage

DC-Input (A1+ /A2)	
Nominal voltage U_H:	DC 24 V
Voltage range:	0.8 ... 1.25 U_H
Nominal consumption:	Max. 5 W

Control input (between T, R and G)

Current flow:	Approx. 3 mA
No-load voltage to G:	Approx. 12 V
Permissible wire length:	< 50 m
Min. activation time:	0.5 s

Output

Contacts:	2 x 1 changeover contacts for VW and AL	
Thermal current I_{th}:	4 A	
Switching capacity		
to AC 15:		
NO contact:	3 A / AC 230 V	IEC/EN 60947-5-1
NC contact:	1 A / AC 230 V	IEC/EN 60947-5-1
Electrical life		
at 8 A, AC 250 V:	1 x 10^4 switching cycles	
Short circuit strength		
max. fuse rating:	4 A gG / gL	IEC/EN 60947-5-1
Mechanical life:	10 x 10^6 switching cycles	

General Data

Operating mode:	Continuous operation	
Temperature range		
Operation:	- 25 ... + 60 °C	
Storage:	- 40 ... + 70 °C	
Relative air humidity:	93 % at 40 °C	
Atmospheric pressure	860 ... 1600 mbar (86 ... 106 kPa)	
Altitude:	≤ 4000 m	IEC 60664-1
Clearance and creepage distances		IEC 60664-1
Rated impulse voltage / pollution degree		
Measuring ciruit L(+) / L(-) to auxiliary voltage DC and relay contacts VW, AL:	8 kV / 2	
Auxiliary voltage DC to relay contacts VW, AL:	8 kV / 2	
Relay contact VW to relay contact AL:	4 kV / 2	
Insulation test voltage		
Routine test:	AC 5 kV; 1 s AC 2.5 kV; 1 s	

Technical Data

EMC

Electrostatic discharge (ESD):	8 kV (air)	IEC/EN 61000-4-2
HF irradiation		
80 MHz ... 2.7 GHz:	10 V / m	IEC/EN 61000-4-3
Fast transients:	4 kV	IEC/EN 61000-4-4
Surge voltages		
between A1 - A2:	1 kV	IEC/EN 61000-4-5
Between L(+) - L(-):	2 kV	IEC/EN 61000-4-5
Between A1, A2 - PE and		
L(+), L(-) - PE:	4 kV	IEC/EN 61000-4-5
Between control line:	0.5 kV	IEC/EN 61000-4-5
Between control line		
and earth:	1 kV	IEC/EN 61000-4-5
HF-wire guided	10V	IEC/EN 61000-4-6
Interference suppression:	Limit value class A*)	

*) The device is designed for the usage under industrial conditions (Class A, EN 55011).
When connected to a low voltage public system (Class B, EN 55011) radio interference can be generated. To avoid this, appropriate measures have to be taken.

Degree of protection

Housing:	IP 40	IEC/EN 60529
Terminals:	IP 20	IEC/EN 60529
Housing:	Thermpolastic with V0 behaviour according to UL subject 94	
Vibration resistance:	Amplitude 0.35 mm frequency 10 ... 55 Hz	IEC/EN 60068-2-6
	Amplitude ± 1mm, frequency 2 ... 13.2 Hz 13.2 ... 100 Hz, acceleration ± 0.7 g_n IEC/EN 60068-2-6	
Shock resistance:	10 g_n / 11 ms, 3 pulses	IEC/EN 60068-2-27
Climate resistance:	25 / 060 / 04	IEC/EN 60068-1
Terminal designation:	EN 50005	
Wire connection		DIN 46228-1/-2/-3/-4
Screw terminals (fixed):	1 x 4 mm² solid or 1 x 2.5 mm² stranded ferruled (isolated) or 2 x 1.5 mm² stranded ferruled (isolated) DIN 46228-1/-2/-3-4 or 2 x 2.5 mm² stranded ferruled (isolated) DIN 46228-1/-2/-3	
Insulation of wires or sleeve length:	8 mm	
Wire fixing:	Plus-minus terminal screws M3,5 terminal with wire protection	
Fixing torque:	0.8 Nm	
Mounting:	DIN rail	IEC/EN 60715
Weight:	Approx. 500 g	

Dimensions

Width x height x depth:	90 x 90 x 121 mm

UL-Data

Measuring ciruit L(+) / L(-) to PE / KE

Voltage range:	AC/DC max. 600 V
Switching capacity:	Pilot duty B300, C300, R300 4 A 250 Vac, Resistive 4 A 30 Vdc, Resistive
Wire connection:	Min. 60 °C copper conductors only Torque 0.8 Nm
Test specification:	ANSI/UL 60947-1, 5th Edition ANSI/UL 60947-5-1, 3rd Edition CAN/CSA-C22.2 No. 60947-1-13, 2nd Edition CAN/CSA-C22.2 No. 60947-5-1-14, 1st Edition

Technical data that is not stated in the UL-Data, can be found in the technical data section.

Standard Type

LK 5894.12/010/61 DC 24 V

Article number:	0065331
• Outputs:	1 changeover contact for pre-warning 1 changeover contact for alarm
• Auxiliary voltage:	DC 24 V
• Setting range pre-warning:	20 kΩ ... 2 MΩ
• Setting range alarm:	1 kΩ ... 250 kΩ
• Adjustable line capacitance	
• Open- / or closed circuit operation	
• Width:	90 mm

Variants

Ordering example for variants

LK 5894 .12 /010 /61 DC 24 V 1 ... 250 kΩ 20 kΩ ... 2 MΩ

- Set. range pre-warning
- Setting range alarm
- Auxiliary voltage
- UL approval (on request)
- Variant, if required
- Contacts
- Type

LK 5894.12/011: Without wire-break detection at L(+)/L(-)

LK5894.12/110: Fixed function de-energised on trip, the relays react immediately after connection of auxiliary voltage

LK5894.12/111: Fixed function de-energised on trip, the relays react immediately after connection of auxiliary voltage; without broken wire detection on L(+)/L(-)

LK 5894.12/040: With reduced measuring voltage
Measuring voltage: Approx. ± 45 V

Response values R_E
Pre-warning („VW“):

kΩ: 5 10 20 30 50 70 100 150 250 500

Alarm („AL“)

kΩ: 1 3 10 20 30 50 70 100 150 250

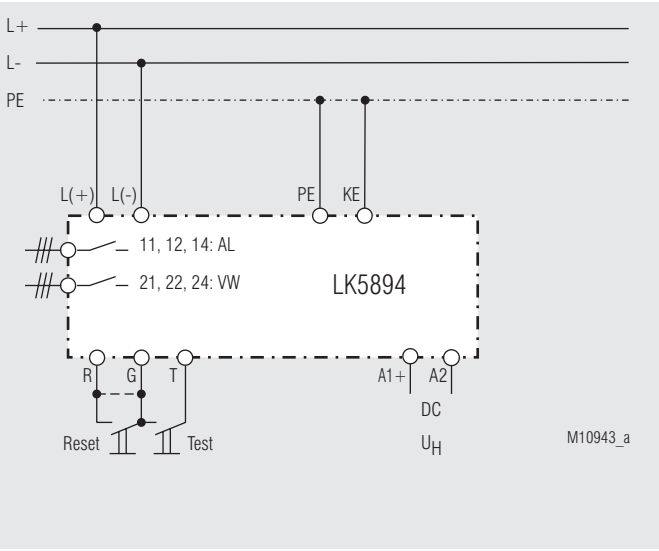
Each adjustable via rotational switches

LK 5894.12/802: Suitable for photovoltaic
Nominal voltage U_N:
DC 0 ... 600 V; AC 0 ... 400 V
Voltage range:
DC max. 690 V; AC max. 460 V

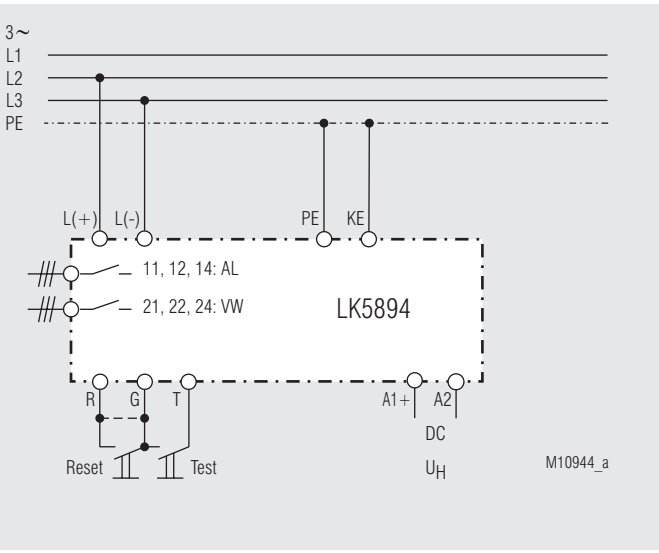
Accessories

HK 3087N.16/004 DC 24 V: Interface module with gold contacts and 8 kV isolation between contacts and relay coil.
Suitable for potential-free control of the control inputs.
Article number: 0069865

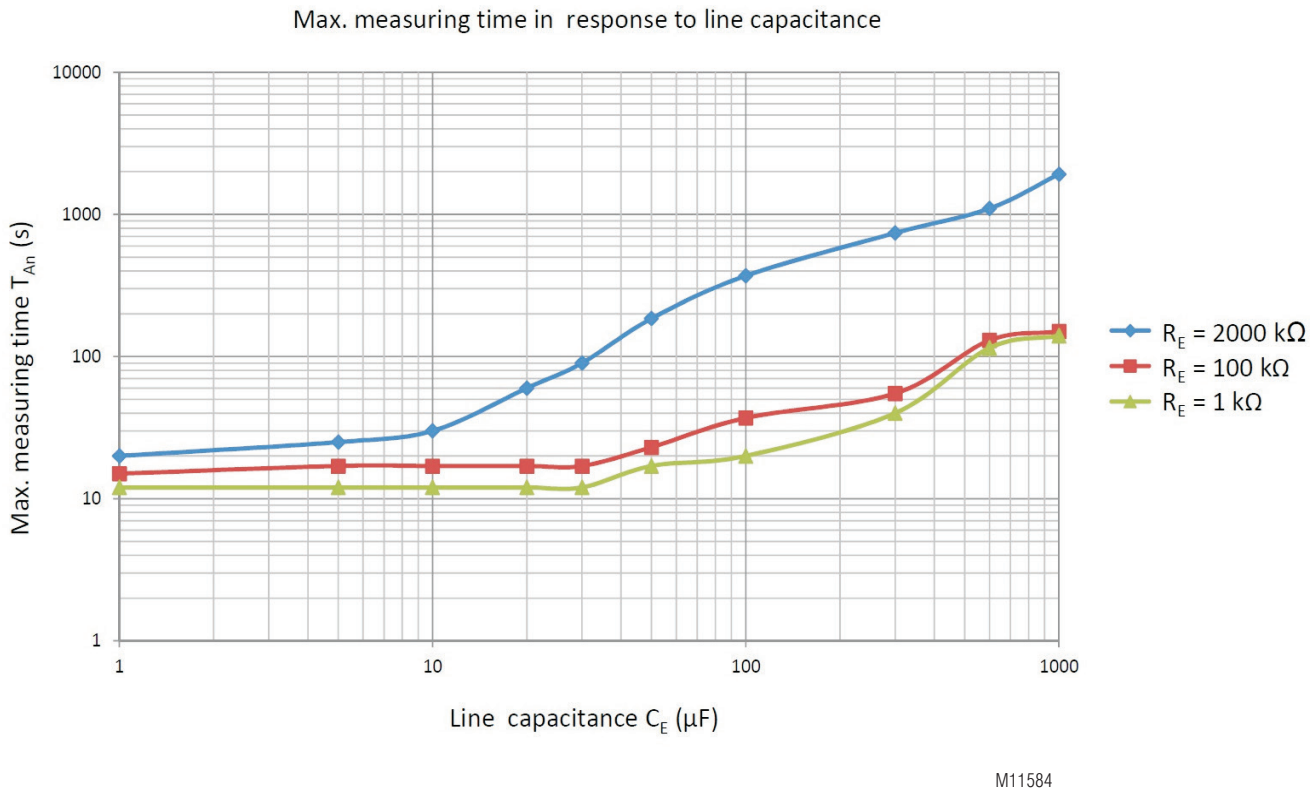
Connection Examples



Insulation monitoring DC-side



Insulation monitoring AC-side


Max. measuring time in response to line capacitance
Max. measuring time T_{An} (s)
10000
1000
100
10
1
1
10
100
1000
Line capacitance C_E (µF)
R_E = 2000 kΩ
R_E = 100 kΩ
R_E = 1 kΩ
M11584