ISOMETER® isoPV1685...

Insulation monitoring device with residual current monitoring (isoPV1685PFR only) for unearthed DC systems in photovoltaic installations up to 1500 V

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Device features

Only device versions isoPV1685PFR and isoPV1685P provide a locating current injector. The device version isoPV1685PFR additionally provides residual current monitoring!

- Insulation monitoring of large-scale photovoltaic systems
- Measurement of low-resistance insulation faults
- Separately adjustable response values R_{an1} (alarm 1) and R_{an2} (alarm 2) (both 200 Ω…1 MΩ) for prewarning and alarm. $R_{an1} \geq R_{an2}$ applies.
- Automatic adjustment to high system leakage capacitances up to 2000 µF, selectable range
- Connection monitoring of L+, L- for reverse polarity
- Integrated locating current injector up to 50 mA (isoPV1685P(FR) only)
- Fast detection of insulation faults on the AC side by means of residual current monitoring (inverter, transformer) allowing fast disconnection (isoPV1685PFR only)
- Residual current response values $I_{\Delta n}$ for prewarning and alarm (1…5 A) (isoPV1685PFR only)
- CT connection monitoring (isoPV1685PFR only)
- Device self test with automatic message in the event of a fault
- Alarm relays separately adjustable for insulation faults, residual current faults and device errors (isoPV1685PFR only);
- Alarm relays separately adjustable for insulation fault 1, insulation fault 2 (isoPV1685P, isoPV1685RTU only)
- CAN interface to output measured values, statuses and alarms
- RS-485 interface
  - isoPV1685(P)FR: BMS bus, e.g. to control the insulation fault location
  - isoPV1685RTU: BMS bus or Modbus (can be switched using the DIP switch)
- µSD card with data logger and history memory for alarms

Product description

The device is used for insulation and residual current monitoring of large photovoltaic systems up to DC 1500 V designed as IT systems. The measurement method specially developed for slow voltage fluctuations (MPP tracking) monitors the insulation resistance even in systems equipped with large solar generator panels where extremely high system leakage capacitances against earth exist due to interference suppression methods. Adaptation to system-related high leakage capacitances also occurs automatically.

Function

Insulation monitoring is carried out using an active measuring pulse which is superimposed onto the PV system to earth via the integrated coupling.

isoPV1685RTU:
If the insulation resistance between the PV system and earth falls below the preset prewarning response value R_{an1}, the “Alarm 1” LED lights and the alarm relay K1 switches. If the value also falls below response value R_{an2}, the “Alarm 2” LED also lights and the alarm relay K2 switches. The RS-485 interface can be switched between BMS bus and Modbus.

isoPV1685P:
If the insulation resistance between the PV system and earth falls below the preset prewarning response value R_{an1}, the “Alarm 1” LED lights and the alarm relay K1 switches. If the value also falls below response value R_{an2}, the “Alarm 2” LED also lights and the alarm relay K2 switches.

The locating current injector integrated in the device for insulation fault location is either activated externally via the BMS interface or via the internal backup master function if no external master has been connected. When starting the insulation fault location, the LED “PGH ON” signals the locating current pulse.

The insulation fault location can be started manually via the digital input 1, e.g. for insulation fault location with mobile insulation fault locators (e.g. EDS195).

isoPV1685PFR:
If the insulation resistance between the PV system and earth falls below the set prewarning response value R_{an1}, only the “Alarm 1” LED lights. When the value also falls below the alarm response value R_{an2}, the alarm relay K1 switches and the LED “Alarm 2” lights. The residual current is detected via an external measuring current transformer. The r.m.s. value is calculated by summing up the AC component that are below the cut-off frequency. If the residual current exceeds the set alarm response value, the corresponding alarm relay K2 switches and the associated "Alarm IdN" LED lights up. All relevant measured values and their statuses (Normal, Prewarning, Alarm) are cyclically sent via the CAN interface.

The locating current injector integrated in the device for insulation fault location is externally activated via the BMS interface. When starting the insulation fault location, the LED “PGH ON” signals the locating current pulse.

µSD card (isoPV1685P, isoPV1685PFR only)
The integrated µSD card is used as data logger for storing all relevant events.

The following measured values, statuses and alarms are stored during operation:

- Insulation resistance and leakage capacitance
- Residual current (isoPV1685PFR only)
- System voltage, partial voltages to earth, supply voltages
- Temperature locating current injector (isoPV1685P(FR) only)
- Temperature coupling L+, L–
- Insulation fault
- residual current fault (isoPV1685PFR)
- Connection faults and device errors

Following each device start, a new log file is generated. If the current file size exceeds 10 MByte during operation, a new file is generated. The file name contains time and date of its creation. The typical time that is needed until the maximum file size is reached is approximately 2 days. Hence, a µSD card with a memory space of 2 GBytes can record data for approx. 400 days.

When the maximum data limit of the card has been reached, the oldest file in each case will be overwritten. The history memory that is also copied to the µSD card contains all alarms in csv. format.

Standards

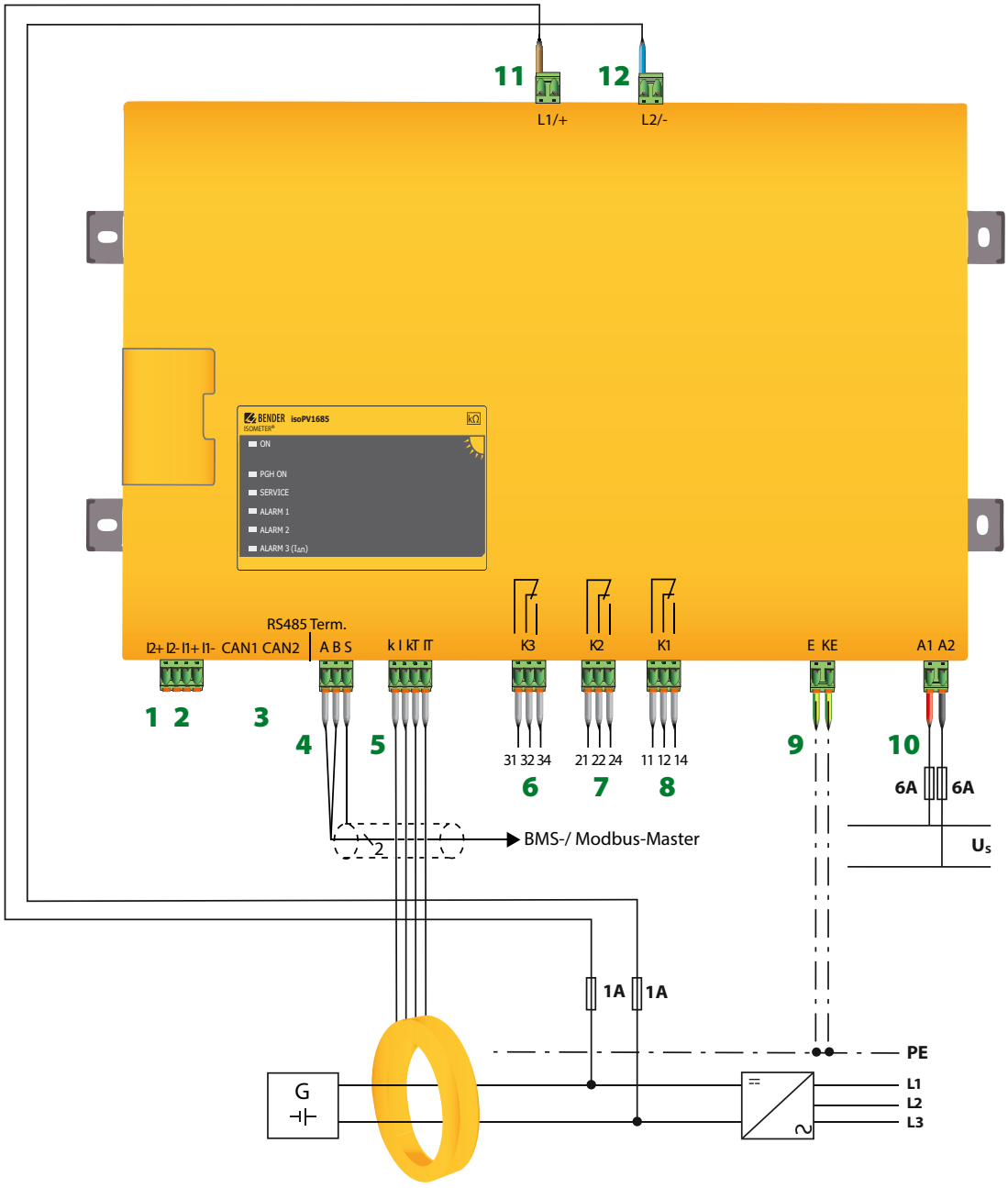
The isoPV1685… was designed according to the following standards:

- DIN EN 61557-8 (VDE 0413-8)
- IEC 61557-8
- IEC 61557-9 (isoPV1685P, isoPV1685PFR only)
- IEC 61326-2-4
- IEC 60730-1
- DIN EN 60664-1 (VDE 0110-1)
- UL1998 (software, isoPV1685RTU only)

Approvals and certifications

FUNCTIONAL SAFETY LISTED for isoPV1685RTU only

Wiring diagram



1 - **I2+, I2–** Currently has no function, digital input.

2 - **I1+, I1–** Digital input
isoPV1685PFR: Currently has no function.
isoPV1685P: Starting the insulation fault location in the manual mode.

3 - **CAN2, CAN1** Connection to CAN bus, 2 x RJ-45, can be terminated with CAN 120-Ω termination plug.

4 - **A, B, S** Connection to Modbus or BMS bus, RS-485, S= shield (connect one end to PE), can be terminated with RS-485 Term. switch.

5 - **k, I/kT, IT** isoPV1685PFR only:
Connection to measuring current transformer
k, I = measurement winding/kT, IT = test winding

6 - **31, 32, 34** Alarm relay K3 for internal device errors.

7 - **21, 22, 24** Description of relay assignment according to device type;
isoPV1685RTU and isoPV1685P only:
Alarm relay K2 for insulation faults.
isoPV1685PFR only:
Alarm relay K2 for residual current faults.

8 - **11, 12, 14** Alarm relay K1 for insulation faults.

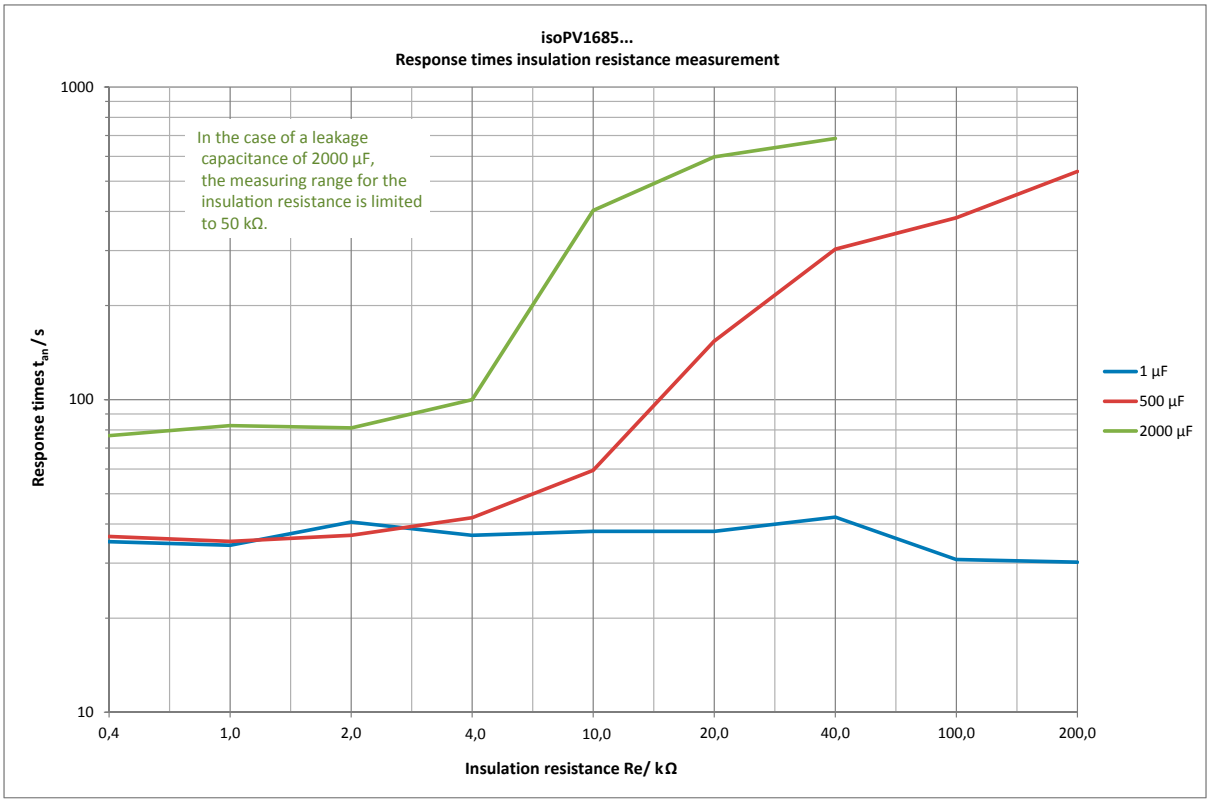
9 - **E, KE** Separate connections for E and KE to PE.

10 - **A1, A2** Connection to U_S = DC 24 V via a 6 A fuse on each line.

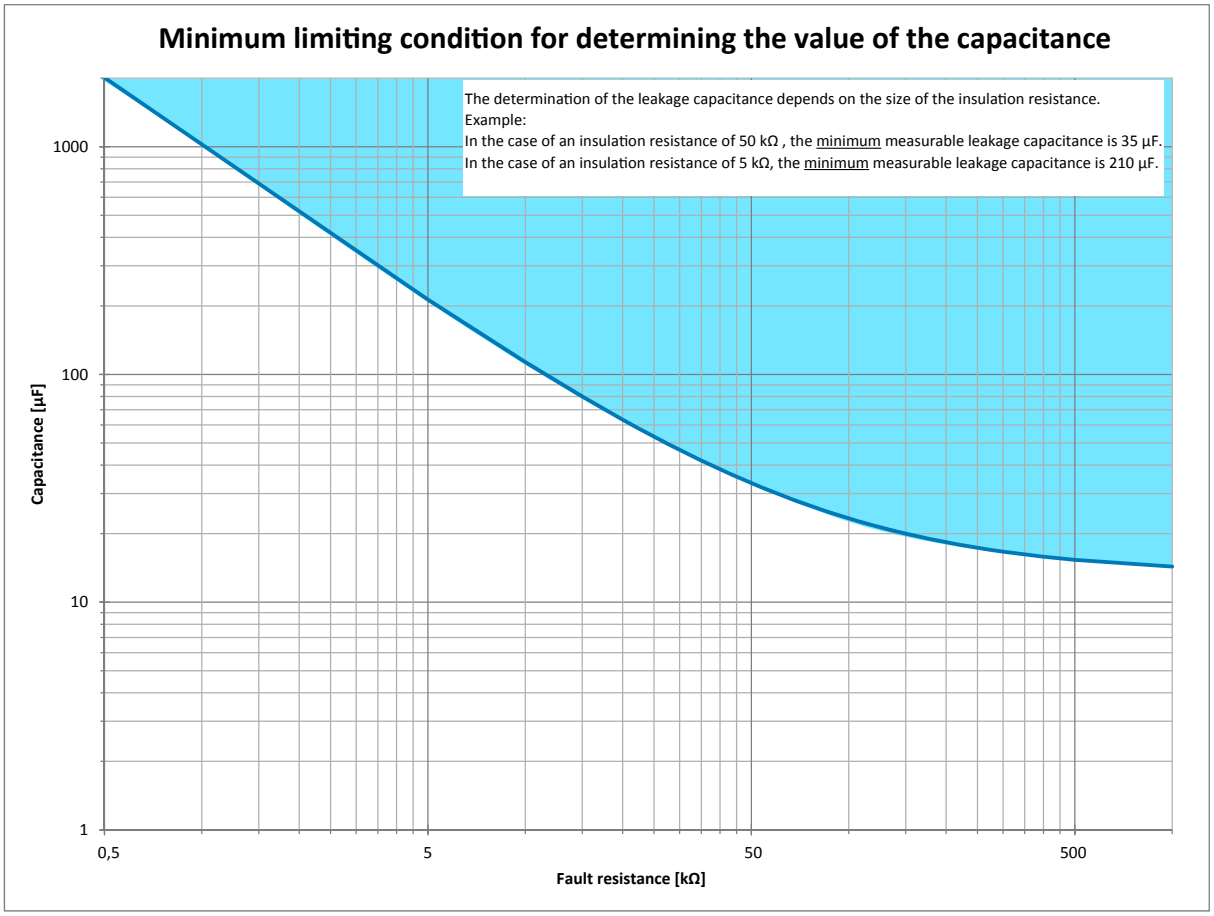
11 - **L+** Connection to L+ of the PV generator via 1 A fuse.

12 - **L–** Connection to L – of the PV generator via 1 A fuse.

Response time for insulation measurement



The measurable leakage capacitance depends on the insulation resistance



Technical data

Insulation coordination acc. to IEC 60664-1/IEC 60664-3

Insulation coordination acc. to IEC 60664-1	
Rated voltage	DC 1500 V
Rated impulse voltage/pollution degree	8 kV/2

Voltage ranges

Nominal system voltage U_n	DC 0…1500 V
Tolerance of U_n	DC +6 %
Supply voltage U_S (refer also to device name plate)	DC 18…30 V
Power consumption	≤ 7 W

Measuring circuit for insulation monitoring

Measuring voltage U_m (peak value)	±50 V
Measuring current I_m (at $R_F = 0\ \Omega$)	≤ 1.5 mA
Internal DC resistance R_i	≥ 70 kΩ
Impedance Z_i at 50 Hz	≥ 70 kΩ
Permissible extraneous DC voltage U_{fg}	≤ DC 1500 V
Permissible system leakage capacitance C_e	≤ 2000 µF (500 µF)*

Response values for insulation monitoring

Response value R_{an1} (Alarm 1)	200 Ω…1 MΩ (10 kΩ)*
Response value R_{an2} (Alarm 2)	200 Ω…1 MΩ (1 kΩ)*
Upper limit of the measuring range when set to C_{emax} = 2000 µF	50 kΩ
Relative uncertainty (10 kΩ…1 MΩ) (acc. to IEC 61557-8)	±15 %
Relative uncertainty (0.2 kΩ…< 10 kΩ)	±200Ω ±15 %
Response time t_{an}	see graphic
Hysteresis	25 %, +1 kΩ

isoPV1685P(FR) only: Measuring circuit for insulation fault location (EDS)

Locating current I_L DC	≤ 50 mA
Test cycle/pause	2/4 s

isoPV1685PFR only: Measuring circuit for residual current measurement

External measuring current transformer	type Ferroxcube T140/120/25-3E25
Rated insulation voltage (measuring current transformer)	1500 V
Rated frequency	1…6 kHz
Rated continuous thermal current I_{cth}	150 A
Operating uncertainty	0…35 %
Load	1 Ω
Number of turns of measurement winding	20
Number of turns of test winding	10

isoPV1685PFR only: Response values for residual current measurement (AC instantaneous tripping)

Rated residual operating current $I_{\Delta n1}$ (prewarning)	1 A…5 A (1 A)*
Rated residual operating current $I_{\Delta n2}$ (Alarm)	1 A…5 A (5 A)*
Relative uncertainty	±1 A
Response time t_{an}	≤ 1s
Hysteresis	25 %

isoPV1685PFR only: Cable lengths for measuring current transformers

Cable length	≤ 3 m

isoPV1685PFR only: Test winding

Output voltage across kT/IT at max. 40 mA locating current	0.5...0.8 V

Displays, memory

LEDs for alarms and operating states	2x green, 4 x yellow
µSD card (Spec. 2.0) for history memory and log files	≤ 32 GByte

Inputs

Digital inputs DigIn1/DigIn2:

High level	10…30 V
Low level	0…0.5 V

Serial interfaces

BMS/Modbus:

Interface/protocol	RS-485/BMS(Slave)/Modbus RTU (Slave); Protocol switchable
Connection	terminals A/B Shield: Terminal S
Cable length	≤ 1200 m
Shielded cable (shield to functional earth on one end)	2-core, ≥ 0.6 mm², e.g. J-Y(St)Y 2 x 0.6
Terminating resistor, switchable (RS-485 Term.)	120 Ω (0.5 W)
Device address, BMS bus or Modbus adjustable (DIP switch)	isoPV1685RTU: 2…17 (2)*
Device address, BMS bus adjustable (DIP switch)	isoPV1685P(FR): 2…33 (2)*

CAN:

Protocol	acc. to SMA/Bender specification V2.5
Frame format	CAN 2.0A 11-bit identifier
Baud rate	500 kBit/s
Connection via 2 x RJ45 acc. to CiA-303-1 connected in parallel	Pin 1: CAN-H Pin 2: CAN-L Pin 3, 7: CAN-GND
CAN identifier	permanently set acc. to the specification above
Cable length	≤ 130 m
Shielded cable	CAT 5 with RJ45 plug
Terminating resistor, can be connected (Term. CAN)	120 Ω (0.5 W)
Potential of the socket housing	functional earth potential

Switching elements

Switching elements	3 changeover contacts: K1 (insulation fault), K2 (isoPV1685P & isoPV1685RTU: insulation fault, isoPV1685PFR: residual current fault) K3 (device error)
Operating principle K1, K2	N/C operation or N/O operation (N/C operation)*
Operating principle K3	N/C operation, not changeable

Contact data acc. to IEC 60947-5-1:

Utilisation category	AC 13	AC 14	DC-12	DC-12	DC-12
Rated operational voltage	230 V	230 V	24 V	110 V	220 V
Rated operational current	5 A	3 A	1 A	0.2 A	0.1 A

Minimum contact rating	1 mA at AC/DC ≥ 10 V

For UL application:

Utilisation category for AC control circuits with 50/60 Hz (Pilot duty)	B300
AC load of the alarm relay outputs	AC 240 V, 1.5 A in case of a power factor of 0.35
AC load of the alarm relay outputs	AC 120 V, 3 A in case of a power factor of 0.35
AC load of the alarm relay outputs	AC 250 V, 8 A in case of a power factor of 0.75 to 0.80
DC load of the alarm relay outputs	DC 30 V, 8 A in case of ohmic load

Connection (except system coupling)

Connection type	pluggable push-wire terminals
Connection	
rigid/flexible	0.2…2.5 mm²/0.2…2.5 mm²
flexible with ferrule, without/with plastic sleeve	0.25…2.5 mm²
Conductor sizes (AWG)	24…12

Connection of the system coupling

Connection type	pluggable push-wire terminals
Connection	
rigid/flexible	0.2…10 mm²/0.2…6 mm²
flexible with ferrule, without/with plastic sleeve	0.25…6 mm²/0.25…4 mm²
Conductor sizes (AWG)	24…8
Stripping length	15 mm
Opening force	90…120 N

Technical data (continuation)

Environment/EMC

EMC	IEC 61326-2-4 Ed. 1.0
Classification of climatic conditions acc. to IEC 60721:	
Without solar radiation, precipitation, water, icing. Condensation possible temporarily:	
Stationary use (IEC 60721-3-3)	3K5
Transport (IEC 60721-3-2)	2K3
Long-term storage (IEC 60721-3-1)	1K4
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3M4
Transport (IEC 60721-3-2)	2M2
Long-term storage (IEC 60721-3-1)	1M3
Deviation from the classification of climatic conditions:	
Ambient temperature during operation	-40 …+70 °C
Ambient temperature for transport	-40 …+80 °C
Ambient temperature for long-term storage	-25 …+80 °C
Relative humidity	10…100 %
Atmospheric pressure	700…1060 hPa (max. height 4000 m)

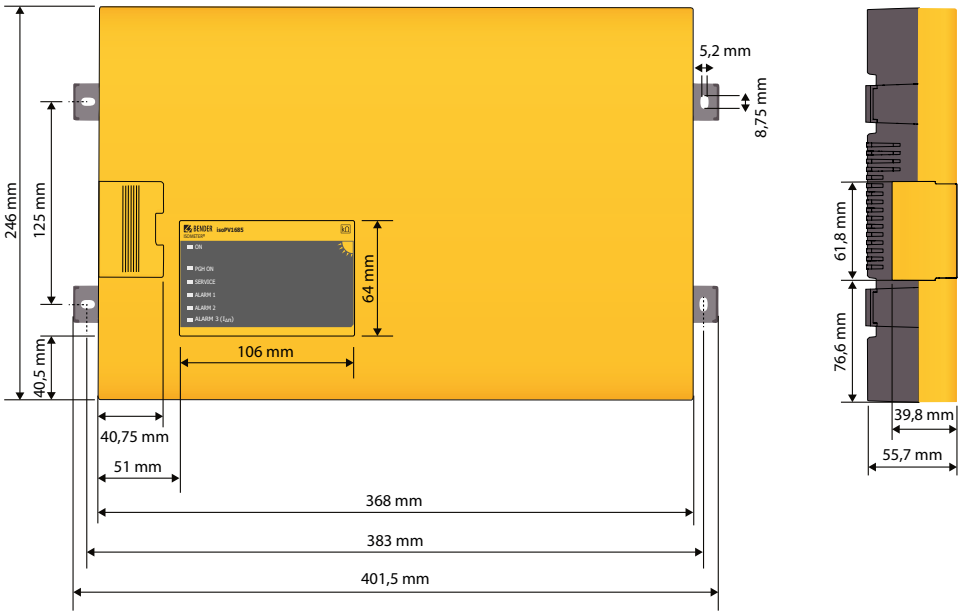
Other

Operating mode	continuous operation
Position of normal use	vertical, system coupling on top
PCB fixation	lens head screw DIN7985TX
Tightening torque	4.5 Nm
Degree of protection, internal components	IP30
Degree of protection, terminals	IP30
Weight	≤ 1300 g

( )* = Factory settings

Dimension diagram

Dimensions in mm



Ordering details

Response value range	Supply voltage [1]	Incl. µSD card	Type	Art. No.
200 Ω…1 MΩ	DC 18…30 V	–	isoPV1685RTU-425	B91065603
		■	isoPV1685P-425	B91065604
			isoPV1685PFR-425	B91065600

[1] Absolute values

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