ISOMETER® isoGEN423

Insulation monitoring device for unearthed AC, AC/DC and DC systems (IT systems) up to 3(N)AC, AC 400 V, DC 400 V

Suitable for the application of generators acc. to standard DIN VDE 0100-551

Software version: D0494 V4.xx

isoGEN423_D00221_04_M_XXEN / 05.2023

Manual EN

Service and support for Bender products

First-level support
Technical support
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0700BenderHelp *
Fax: +49 6401 807-629
E-mail: support@bender.de
Available on 365 days from 7.00 a.m. to 8.00 p.m. (MEZ/UTC +1)
* Landline German Telekom: Mon-Fri from 9.00 a.m. to 6 p.m.: 6.3 cents/30 sec.; remaining time: 6.3 cents/min.
Mobile phone: higher, depending on mobile phone tariff

Repair service
Repair, calibration and replacement service
Londorfer Strasse 65 • 35305 Grünberg • Germany
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+49 6401 807-784, -785 (commercial issues)
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Field service
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+49 6401 807-753 (commercial issues)
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Inhaltsverzeichnis

1 General instructions

1.1 How to use this manual

This manual is intended for qualified personnel working in electrical engineering and elec tronics! Part of the device documentation, in addition to this manual, is the enclosed “Safety instructions for Bender products”.

Read the manual before installing, connecting and commissioning the device.
Always keep the manual within easy reach for future reference.

1.2 Indication of important instructions and information

DANGER! Indicates a high risk of danger that will result in death or serious injury if not avoided.

WARNING! Indicates a medium risk of danger that can lead to death or serious injury, if not avoided.

CAUTION! Indicates a low-level risk that can result in minor or moderate injury or damage to property if not avoided.

Information can help to optimise the use of the product.

1.2.1 Signs and symbols

	Disposal		Temperature range		protect from dust
	protect from wetness		Recycling	RoHS	RoHS guidelines

1.3 Training courses and seminars

www.bender.de > Know-how-> Seminars.

1.4 Delivery conditions

The conditions of sale and delivery set out by Bender apply. These can be obtained from Bender in printed or electronic format.

The following applies to software products:

ZVEI: Die Elektroindustrie

“Software clause in respect of the licensing of standard software as part of de-liveries, modifications and changes to general delivery conditions for products and services in the electrical industry.”

1.5 Inspection, transport and storage

Check the shipping and device packaging for transport damage and scope of delivery. The following must be observed when storing the devices:

1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded in case of:

- Improper use of the device.
- Incorrect mounting, commissioning, operation and maintenance of the device.
- Failure to observe the instructions in this operating manual regarding transport, commissioning, operation and maintenance of the device.
- Unauthorised changes to the device made by parties other than the manufacturer.
- Non-observance of technical data.
- Repairs carried out incorrectly.
- Use of accessories and spare parts not recommended by Bender.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not recommended by the manufacturer.

This operating manual and the enclosed safety instructions must be observed by all persons working with the device. Furthermore, the rules and regulations that apply for accident prevention at the place of use must be observed.

1.7 Disposal of Bender devices

Abide by the national regulations and laws governing the disposal of this device.

For more information on the disposal of Bender devices, refer to

www.bender.de -> Service & support.

1.8 Safety

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. In Europe, the European standard EN 50110 applies.

DANGER! Risk of electrocution due to electric shock!
Touching live parts of the system carries the risk of:

- A fatal electric shock
- Damage to the electrical installation
- Destruction of the device

Before installing and connecting the device, make sure that the installation has been de-energised. The rules for working on electrical systems must be observed.

2 Function

2.1 Intended use

The ISOMETER® monitors the insulation resistance R_F of unearthed AC, AC/DC and DC systems (IT systems) with nominal system voltages of 3(N)AC, AC/DC 0…400 V or DC 0…400 V. The maximum permissible system leakage capacitance C_e is 5 µF. DC components existing in AC systems do not influence the operating characteristics, when a minimum load current of DC 10 mA flows. A separate supply voltage U_s allows de-energised systems to be monitored, too.

In order to meet the requirements of applicable standards, customised parameter settings must be made on the equipment in order to adapt it to local equipment and operating conditions. Please heed the limits of the range of application indicated in the technical data.

Any use other than that described in this manual is regarded as improper.

To ensure that the ISOMETER® functions correctly, an internal resistance of ≤ 1 kΩ must exist between L1/+ and L2/- via the source (e.g. the transformer) or the load.

If the ISOMETER® is installed inside a control cabinet, the insulation fault message must be audible and/or visible to attract attention.

2.2 Device features

- Monitoring the insulation resistance R_F for unearthed AC/DC systems
- Measurement of the nominal system voltage U_n (True RMS) with undervoltage and overvoltage detection
- Measurement of residual voltages to earth (L1+/PE and L2-/PE)
- Two operating modes: GEn and dc
- Automatic adaptation to the system leakage capacitance C_e up to 5 µF
- Selectable start-up delay, response delay and delay on release
- Two separately adjustable response value ranges of 5…200 kΩ (Alarm 1, Alarm 2)
- Alarm signalling via LEDs („AL1“, „AL2“), a display and alarm relays („K1“, „K2“)
- Automatic device self test with connection monitoring
- Selectable N/C or N/O relay operation
- Measured value indication via multi-functional LCD
- Fault memory can be activated
- RS-485 (galvanically isolated) including the following protocols:
  - BMS interface (Bender measuring device interface) for data exchange with other Bender components
  - Modbus RTU
  - IsoData (for continuous data output)
- Password protection to prevent unauthorised parameter changes

2.3 Functional description

The ISOMETER® measures the insulation resistance R_F. It features two operating modes: „GEn“ and „DC“. The two operating modes can be switched in the menu „SEt“.

2.3.1 GEn mode

The GEn mode is used in AC/DC or also in DC systems. The device complies with the maximum response time ≤ 1 s for C_e ≤ 1 µF and R_F ≤ R_{an}/2.

2.3.2 dc mode

The dc mode is only used in DC systems. In this mode, the device complies with the maximum response time of ≤ 1 s for C_e ≤ 2 µF and R_F ≤ R_{an}/2 in the event of asymmetrical insulation faults. In case of symmetrical insulation faults, response times of ≤ 10 s for C_e ≤ 5 µF and R_F ≤ R_{an}/2 are complied with. The system leakage capacitance C_e is also measured in this mode.

2.3.3 General measuring functions

The ISOMETER® measures the RMS value of the nominal system voltage U_n between L1/+ und L2/- as well as the residual voltages U_{L1e} (between L1/+ and earth) and U_{L2e} (between L2/- and earth).

When coupled to a **DC system**, the ISOMETER® determines from a minimum value of the nominal system voltage the faulty conductor L1/+ or L2/-, which shows the distribution of the insulation resistance between conductors L1/+ and L2/-. The distribution is indicated by a „+“ or „-“ sign preceding the insulation resistance measurement. The value range of the faulty conductor is ±100 %:

Indication	Meaning
-100 %	One-sided fault on conductor L2/-
0 %	Symmetrical fault
+100 %	One-sided fault on conductor L1/+

The partial resistances can be calculated from the total insulation resistance R_F and the faulty conductor (R %) using the following formula:

Fault on conductor L1/+ -> R_{L1F} = (200 % * R_F)/(100 % + R%)

Fault on conductor L2/- -> R_{L2F} = (200 % * R_F)/(100 % – R%)

When the ISOMETER® is coupled to an **AC system**, the fault location can only be determined in a connected DC system and the faulty conductor is detected either on L1/+ (+100 %) or L2/- (-100 %). Calculating the fault distribution is not possible in this case.

It is possible to assign the detected fault or the faulty conductor to an alarm relay via the menu. If the values R_F or U_n violate the response values activated in the „AL“ menu, this will be indicated by the LEDs and relays „K1“ and „K2“ according to the alarm assignment set in the „out“ menu. In addition, the operation of the relay (n.o./n.c.) can be set and the fault memory „M“ is activated.

If the values R_F or U_n do not violate their release value (response value plus hysteresis) for the period t_{off} without interruption, the alarm relays will switch back to their initial position and the alarm LEDs „AL1“/“AL2“ stop lighting. If the fault memory is activated, the alarm relays remain in alarm condition and the LEDs light until the reset button „R“ is pressed or the supply voltage is interrupted.

The device function can be tested using the test button „T“. Parameters are assigned to the device via the LCD and the control buttons on the front panel; this function can be password-protected. Parameterisation is also possible via the BMS bus, for example by using the BMS Ethernet gateway (COM465IP) or the Modbus RTU.

2.3.4 Isolation from the system to be monitored

If the device has no supply voltage U_s or is in stop mode, it decouples terminals „L1/+“ and „L2/-“ internally from the IT system being monitored. In this case, an insulation measurement up to DC 500 V can be carried out using an insulation tester.

2.3.5 Monitoring the insulation resistance

The two parameters that monitor the insulation resistance, „R1“ and „R2“, can be found in the menu „AL“ (see table on page 22). The value R1 can only be set higher than the value R2. If the insulation resistance R_F reaches or falls below the activated values R1 or R2, an alarm message will be signalled. If R_F exceeds the values R1 or R2 plus the hysteresis value (see table on page 22), the alarm will be cleared.

2.3.6 Undervoltage/overvoltage monitoring

In the menu „AL“ (see page 22), the parameters („U <“ and „U >“) for monitoring the nominal system voltage U_n can be activated or deactivated. The maximum undervoltage value is limited by the overvoltage value.

The RMS value of the nominal system voltage U_n is monitored. If the nominal system voltage U_n reaches, falls below or exceeds the limit values („U <“ or „U >“), an alarm will be signalled. If the maximum permissible nominal system voltage U_n set for the ISOMETER® is exceeded, an alarm message will be initiated even when the overvoltage limit value has been deactivated. The alarm will be deleted when the limit values plus hysteresis (see page 22) are no longer violated.

2.3.7 Self test/error codes

The integrated self test function checks the function of the insulation monitoring device, and connection monitoring checks the connections to the system to be monitored. The alarm relays are not switched during the self test. This can be changed using the parameter „test“ in the alarm assignment (menu „out“, page 22) eingestellt werden. During the test, the display indicates „tES“.

When malfunctions are detected or connections are missing, the LEDs „ON“/“AL1“/“AL2“ flash. The respective error codes („E.xx“) will be indicated on the display and the relay „K2“ switches. The relays can be assigned to a device error with the parameter „Err“ in the „out“ menu in the alarm assignment.

Error codes

If, contrary to expectations, a device error should occur, error codes will appear on the display. Some of these are described below:

Error code	Description
E.01	**PE connection error** The connections „E“ or „KE“ to earth are interrupted. **Action:** Check connection, eliminate error. The error code will be erased automatically once the error has been eliminated.
E.02	**Connection fault system** The internal resistance of the system is too high or the connection „L1/+“ or „L2/-“ to the system is interrupted. The terminals „L1/+“ and „L2/-“ are connected false. **Action:** Check connection, eliminate error. The error code will be erased automatically once the error has been eliminated.
E.03	The terminals „L1/+“ and „L2/-“ are connected to the DC system to be monitored with reversed polarity. Detection from $U_n < -30\,V_{DC}$
E.05	**Measurement technique error:** Due to system interferences or a device error, the insulation measuring value is no longer updated. The pre- and main alarm are set for the insulation measuring value simultaneously. **Calibration invalid after software update:** In case of a software update, „E.05“ appears together with „E.08“ if the new software is no longer compatible with the calibration of the device. Either the previous software version must be installed or the device must be calibrated new in the factory.
E.07	The permissible system leakage capacitance C_e according to the datasheet is exceeded (only in „dc“ setting).
E.08	A calibration error was detected during the device test. **Action:** If the error continues to exist after checking the device connections, there is an error inside the device.

Internal device errors „E.xx“ can be caused by external disturbances or internal hardware errors. If the error message occurs again after restarting the device or after a reset to factory settings (menu item „FAC“) , the device must be repaired. After eliminating the fault, the alarm relays switch back automatically or by pressing the reset button. The self test can take a few minutes.

It can be suppressed for the duration of the device start by setting the parameter in the menu „SEt“ to „S.Ct = off“. This allows the ISOMETER® to enter measurement mode quickly after connecting the supply voltage U_s.

Automatic self test

The device runs a self test after connecting the supply voltage U_s and later every 24 h (selectable at „Menu „t““ on page 24 : off, 1 h, 24 h).

Manual self test

By pressing the external test/reset button or the test button „T“ on the device for > 1.5 s, a self test is started. While holding down the test button „T“, all device-relevant display elements appear on the display.

2.3.8 Malfunction

In addition to the described self test, several functions in the insulation monitoring device are continuously checked during operation. If a fault is detected, the device error („Err“) will be signalled, the error code „E.xx“ appears on the display as an identifier for the error type xx and the LEDs „ON“/“AL1“/“AL2“ will flash.

If the error occurs again after restarting the device or after restoring the factory settings, please contact Bender Service.

2.3.9 Signalling assignment of the alarm relays K1/K2

The notifications for „device error“, „insulation fault“, „insulation impedance fault“, „undervoltage/overvoltage fault“, „device test“ and „device start with alarm“ can be assigned to the alarm relays via the „out“ menu. An insulation fault is indicated by the messages „+R1“, „-R1“, „+R2“ and „-R2“. Messages „+R1“ and „+R2“ indicate an insulation fault assigned to conductor L1/+, and the messages „-R1“ and „-R2“ indicate an insulation fault assigned to conductor L2/-.

The message „test“ indicates a self test.

The message „S.AL“ indicates a so-called „device start with alarm“.

After connecting to the supply voltage U_s and setting the parameter value to „S.AL = on“, the ISOMETER® starts with the insulation measured value R_F = 0 Ω and sets all activated alarms. The alarms will be cleared only when the measured values are up-to-date and no thresholds are exceeded. In the factory setting „S.AL = off“, the ISOMETER® starts without an alarm. It is recommended that the value set for the „S.AL“ parameter value is identical for both relays.

2.3.10 Measuring and response times

Operating time t_{ae}

The operating time t_{ae} is the time required by the ISOMETER® to determine the measured value. For the insulation measuring value R_F, the system leakage capacitance C_e, the residual voltages U_{L1e} and U_{L2e} and the fault location R%, it is dependent on the insulation resistance R_F and the system leakage capacitance C_e. System interferences can lead to longer operating times. The measuring time of the nominal system voltage U_n is independent of this and significantly shorter.

Response delay t_{on}

The response delay t_{on} can be set uniformly for all messages in the „t“ menu using the parameter „ton“, whereby each alarm message specified in the alarm assignment has its own timer for t_{on}. This delay time can be used for interference suppression in the case of short measuring times.

An alarm will only be signalled when a threshold value of the respective measuring value is violated for the period of t_{on} without interruption. Every time the threshold value is violated within the time t_{on}, the response delay „ton“ restarts once again.

Total response time t_{an}

The total response time t_{an} is the sum of the operating time t_{ae} and the response delay time t_{on}.

Delay on release t_{off}

The delay on release t_{off} can be set uniformly for all messages in the „t“ menu using the parameter „toff“, whereby each alarm message specified in the alarm assignment has its own timer for t_{off}. An alarm will continuously be signalled until the threshold value of the respective measured value is not violated (including hysteresis) for the period of t_{off} without interruption.
Each time the threshold value is not violated for the period of t_{off}, the delay on release „toff“ restarts once again.

Start-up delay *t*

After connection to the supply voltage U_S the alarm indication for the preset time (0…10 s) in the parameter „t“ is suppressed.

2.3.11 Password protection (on, OFF)

If password protection has been activated (on), settings can only be made subject to the correct password being entered (0...999).

2.3.12 Factory settings FAC

Activating the factory setting will reset all modified settings, with the exception of the interface parameters, to the default upon delivery.

2.3.13 External, combined test or reset button T/R

Reset = Press the external button < 1.5 s

Reset followed by a test = Press the external button > 1.5 s

Stop measuring function = Press and hold the external button

When the measuring function is stopped, the display shows „STP“.

The stop function can also be triggered via an interface command and in this case it can only be reset via the interface.

Only one ISOMETER® may be controlled via an external test/reset button.

A galvanic parallel connection of several test or reset inputs for testing multiple insulation monitoring devices is not allowed.

2.3.14 Fault memory

The fault memory can be activated or deactivated with the parameter „M“ in the „out“ menu. When the fault memory is activated, all pending alarm messages of the LEDs and relays remain available until they are deleted by using the reset button (internal/external) or the supply voltage U_s is turned off.

2.3.15 History memory HiS

When the first error occurs after clearing the history memory, all measured values (that are ticked in the table on page 26) are saved in the history memory. This data can be read out using the „HiS“ menu item. In order to be able to record a new data record, the history memory must first be cleared via the menu using „Clr“.

2.3.16 Interface/protocols

The ISOMETER® uses the serial hardware interface RS-485 with the following protocols:

- **BMS**
  The BMS protocol is an essential component of the Bender measuring device interface (BMS bus protocol). Data transmission takes place with ASCII characters.
- **Modbus RTU**
  Modbus RTU is an application layer messaging protocol and it provides Master/Slave communication between devices that are connected altogether via bus systems and networks. Modbus RTU messages have a 16-bit CRC (Cyclic Redundant Checksum), which guarantees reliability.
- **IsoData**
  The ISOMETER® continuously sends an ASCII data string with a cycle of approximately 1 s. Communication with the ISOMETER® within this mode is not possible and no additional transmitter may be connected to the RS-485 bus cable. The ASCII data string for the ISOMETER® is described on page 40.

The parameter address, baud rate and parity for the interface protocols are configured in the „out“ menu.

With „Adr = 0“, the menu entries baud rate and parity are not shown in the menu and the IsoData protocol is activated.
With a valid bus address (i.e. not equal to 0), the menu item „baud rate“ is displayed in the menu. The parameter value „---“ for the baud rate indicates the activated BMS protocol. In this case, the baud rate for the BMS protocol is set to 9600 baud. If the baud rate is set unequal to „---“, the Modbus protocol with configurable baud rate is activated.

The IsoData protocol can be cancelled by sending the command „Adr3“ during a non-transmission period of isoGEN423.

3 Installation, connection and commissioning

3.1 Dimensions

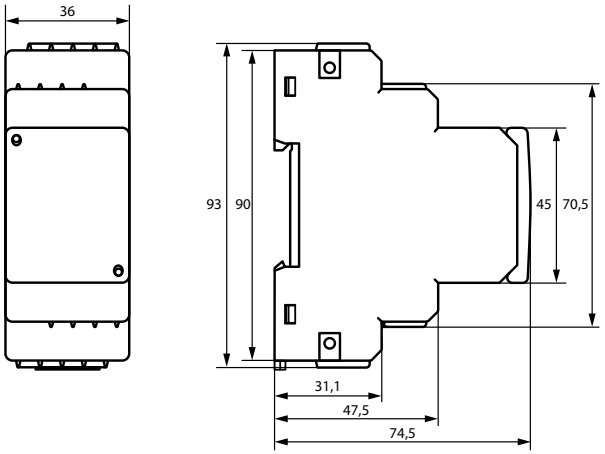
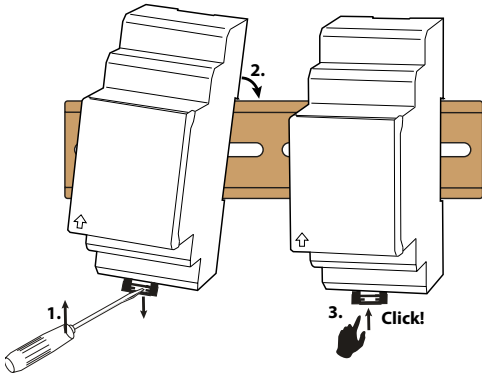
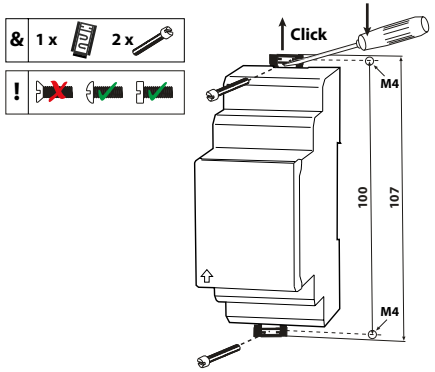


Fig. 3–1 All dimensions in mm

3.2 Mounting



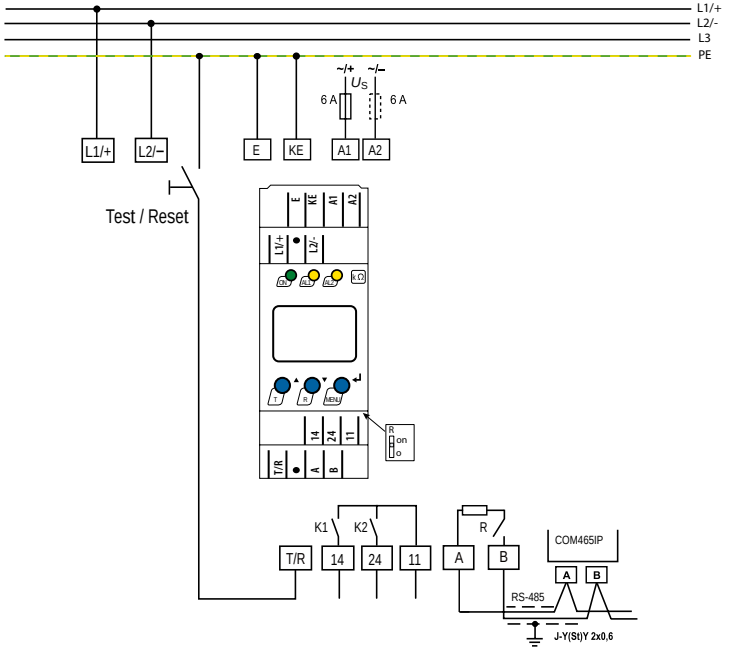
Variant A: DIN rail mounting



Variant B: Screw mounting

The front plate cover can be opened at the lower part marked with an arrow.

3.3 Wiring diagram



For details about the conductor cross sections required for wiring, refer to the technical data on page 41.

Legend

Terminal	Connections
A1, A2	Connection to the supply voltage U_s via fuse (line protection): If supplied from an IT system, both lines have to be protected by a fuse.*
E, KE	Connect each terminal separately to PE: The same wire cross section as for „A1“, „A2“ is to be used.
L1/+, L2/–	Connection to the IT system to be monitored
T/R	Connection for the external combined test and reset button
11, 14	Connection to alarm relay „K1“
11, 24	Connection to alarm relay „K2“
A, B	RS-485 communication interface with connectable terminating resistance Example: Connection of a BMS-Ethernet-Gateway COM465IP

**** For UL applications:***
Only use 60/75 °C copper lines!
For UL and CSA applications, it is mandatory to use 5 A fuses for the protection of the supply voltage U_s.

3.4 Commissioning

1. **Check that** the ISOMETER® **is properly connected** to the system to be monitored.
2. **Connect the supply voltage U_s to the ISOMETER®.**
   The device carries out a calibration, a self test and adjusts itself to the IT system to be monitored. When high system leakage capacitances are involved, this procedure may take up to 30 s. The standard display then appears showing the present insulation resistance, e.g.:

The pulse symbol signals an error-free update of the resistance and capacitance measuring values. If the measuring value cannot be updated due to disturbances, the pulse symbol will be blanked.

The voltage of the IT system to be monitored can also be selected as standard display.
By selecting the measured value display U_{L1L2} with the buttons ▲▼ and the following acceptance with the ↵ button, the standard display is changing to U_{L1L2}.

3. **Start a manual self test** by pressing the test button „T“. Whilst the test button is pressed and held down, all display elements available for this device are shown. During the test, the „tES“ symbol flashes. Any internal malfunctions detected are shown on the display as error codes (see page 10). The alarm relays are not checked during the test (factory setting). The setting can be changed in the „out“ menu, so that the relays switch to the alarm state during the manual self test.

4. **Check factory setting for suitability.**
   Are the settings suitable for the installation to be monitored?
   The list of factory settings are shown in the tables from page 22.
5. **Check the function using a genuine insulation fault.**
   Check the ISOMETER® in the system being monitored against earth, e.g. via a suitable resistance.

4 Operation of the device

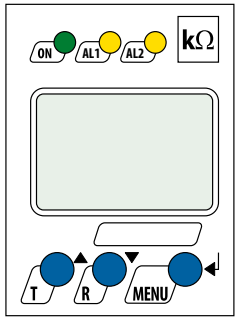
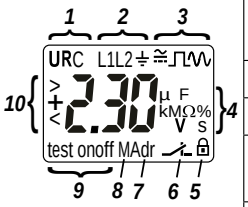
The menu structure is illustrated schematically on the following pages.

After pressing the „MENU“ button for > 1.5 s, the first menu item „AL“ appears.
Use ▲▼ and ↵ (Enter) buttons for navigation and settings.

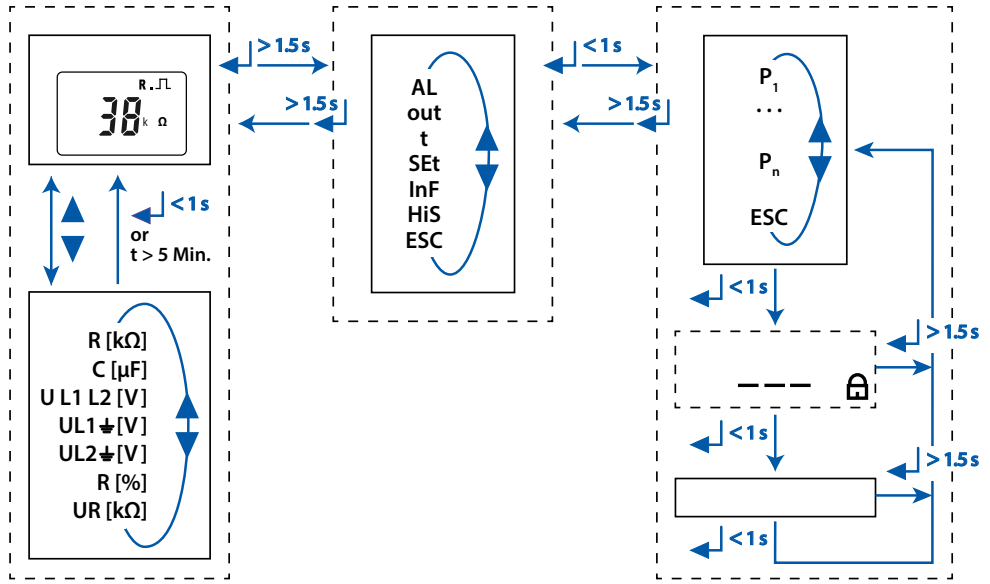
▲▼	Up and down button: • to navigate up or down in the menu settings • increasing or decreasing values
MENU ↵	Pressing the MENU/Enter button for **more** than 1.5 s: • Starts menu mode **or** • when the device already is in menu mode: Exit menu item (Esc). Any recent changes will not be stored. Pressing the MENU/Enter button for **less** than 1.5 s: • Confirms menu selection. **or** • confirms modified value.

The areas of the display that can be configured flash.

4.1 Display elements

Device front/display		Function
	ON AL1 AL2	green - on yellow - alarm yellow - alarm *Assignment according to table on page 23*
	▲ T	Up button Test button (press > 1.5 s) By pressing and holding the test button, the display elements are indicated.
	▼ R	Down button Reset button (press > 1.5 s)
	↵ MENU	ENTER MENU button (press > 1.5 s)
	1	**U**: Nominal system voltage U_n **R**: Insulation resistance R_F **C**: System leakage capacitance C_e
	2	Monitored conductor
	3	= : Voltage type DC ⊥⊥ : Error-free measured value update ~ : Voltage type AC
	4	Measured values and units
	5	Password protection is activated.
	6	In the menu mode, the operating mode of the respective alarm relay is displayed.
	7	Communication interface With measured value: isoData operation
	8	The fault memory is activated.
	9	Condition symbols
	10	Identification for response values and response value violation

4.2 Menu overview



Menu item	Parameter
AL	Querying and set response values
out	Configuring fault memory, alarm relays and interface
t	Setting delay times and self test cycles
SEt	Setting device control parameters
InF	Querying software version
HiS	Querying and clearing the history memory
ESC	Going to the next higher menu level

4.3 Menu „AL“

4.3.1 Response value setting

The two parameters that monitor the insulation resistance, „R1“ and „R2“, can be found in the menu „AL“. The value „R1“ can only be set higher than the value „R2“. If the insulation resistance R_F reaches or falls below the activated values „R1“ or „R2“, this leads to an alarm message. If R_F exceeds the values „R1“ or „R2“ plus the hysteresis (see table below), the alarm will be cleared.

The parameters („U <“ and „U >“) for monitoring the mains voltage can also be activated or deactivated in the „AL“ menu . The maximum undervoltage value is limited by the overvoltage value.

Display	Activation		Setting value			Description
	FAC	Cs	Value range	FAC	Cs	
R1 <	**on**		R2…250	**46**	kΩ	Pre-alarm value R_{an1} Hys. = 25 %/min. 1 kΩ
R2 <	**on**		5…R1	**23**	kΩ	Alarm value R_{an2} Hys. = 25 %/min. 1 kΩ
U <	**off**		10…U>	**10**	V	Alarm value undervoltage RMS Hys . = 5 %/min. 5 V
U >	**off**		U<…500	**500**	V	Alarm value overvoltage RMS Hys. = 5 %/min. 5 V

***FAC** = Factory setting; **Cs** = Customer settings*

4.4 Menu „out“

4.4.1 Configuration of the relay operating mode

Relay K1			Relay K2			Description
Display	FAC	Cs	Display	FAC	Cs	
1	**n.c.**		2	**n.c**		Operating mode of the relay n.c./n.o.

***FAC** = Factory setting; **Cs** = Customer settings*

4.4.2 Relay alarm assignment „r1“ and „r2“ and LED assignment

In the alarm assignment, each alarm is assigned to the respective relay with the setting „on“. The LED indication is directly assigned to the alarms and is not related to the relays.

In the event of an unsymmetrical insulation fault, only the alarm corresponding to the assigned conductor (L1/+ or L2/-) will be displayed.

K1 „r1“			K2 „r2“			LEDs			Alarm description
Display	FAC	Cs	Display	FAC	Cs	ON	AL1	AL2	
1 Err	**off**		2 Err	**on**		◎	◎	◎	Device error E.xx
r1 +R1 < Ω	**on**		r2 +R1 < Ω	**off**		●	●	○	Pre-alarm R1 Fault R_F at L1/+
r1 -R1 < Ω	**on**		r2 -R1 < Ω	**off**		●	●	○	Pre-alarm R1 Fault R_F at L2/-
r1 +R2 < Ω	**off**		r2 +R2 <Ω	**on**		●	○	●	Alarm R2 Fault R_F at L1/+
r1 -R2 < Ω	**off**		r2 -R2 < Ω	**on**		●	○	●	Alarm R2 Fault R_F at L2/-
r1 U < V	**off**		r2 U < V	**on**		●	○	◎	Alarm U_n Unterspan-nung
r1 U > V	**off**		r2 U > V	**on**		●	◎	○	Alarm U_n Undervoltage
r1 test	**off**		r2 test	**off**		●	●	●	Manually started device test
r1 S.AL	**off**		r2 S.AL	**off**		●	●	●	Device start with alarm

***FAC** = Factory setting; **Cs** = Customer settings*
○: LED off ◎: LED flashes ●: LED on

4.4.3 Fault memory configuration

Display	FAC	Cs	Description
M	**off**		Memory function for alarm messages (fault memory)

FAC = *Factory setting;* ***Cs*** = *Customer settings*

4.4.4 Interface configuration

Display	Setting value			Description	
	Value range	FAC	Cs		
Adr	0/3…90	**3**	( )	BusAdr.	Adr = 0 deactivates BMS as well as Modbus and activates isoData with continuous data output (115k2, 8E1)
Adr 1	--- / 1,2k…115k	**"---"**	( )	Baud rate	---" --> BMS bus (9k6, 7E1) „1,2k"…„115k2" --> Modbus (variable, variable)
Adr 2	8E1 8o1 8n1	**8E1**	( )	Modbus	**8E1** - 8 data bits, even parity, 1 stop bit **8o1** - 8 data bits, odd parity, 1 stop bit **8n1** - 8 data bits, no parity, 1 stop bit

FAC = *Factory setting;* ***Cs*** = *Customer settings*

( ) = Customer setting that is not modified by FAC.

4.5 Menu „t"

4.5.1 Time configuration

Display	Setting value			Description
	Value range	FAC	Cs	
t	0…10	**0**	s	Start-up delay when starting the device
ton	0…99	**0**	s	Response delay K1 and K2
toff	0…99	**0**	s	Delay on release K1 and K2
test	OFF/1/24	**24**	h	Repetition time device test

FAC = *Factory setting;* ***Cs*** = *Customer settings*

4.6 Menu „SEt"

4.6.1 Function configuration

Display	Activation		Setting value			Description
	FAC	Cs	Value range	FAC	Cs	
🔒	**off**		0…999	**0**		Password for parameter setting
GEn/dc			GEn/dc	**GEn**		Selecting the system to be monitored GEn: Generators (AC, AC with connected DC, DC) dc: DC system
nEt	**on**					Monitoring system connection during device test
S.Ct	**on**					Device test during device start
FAC						Restore factory settings
SYS						For Bender Service only

FAC = *Factory setting;* ***Cs*** = *Customer settings*

4.7 Measuring value display and history memory

Only R_F or U_n is permanently shown on the display (standard display). All other measuring value displays switch to the standard display after a maximum of 5 min. The symbol ⎍ indicates a current measured value. If this symbol does not appear, the measurement is still running and the latest valid measured value will be displayed. The symbols „<“ or „>“ will be displayed additionally to the measured value when a response value has been reached or violated, or the measured value is below or above the measuring range.

HiS	Display	Description
✓	± R kΩ ⎍	**Insulation resistance** R_F* 1 kΩ…2 MΩ Resolution 1 kΩ The „+“ or „-“ sign appears when a fault R_F < 100 kΩ is mainly detected at L1/+ or L2/- with |R%| ≥ 30 %. In addition, it must be U_n ≥ 20 V in the DC system.
✓	C µF ⎍	**System leakage capacitance** C_e 1 nF…17 µF Resolution 1 nF No update if R_F < 10 kΩ.
✓	~ ± U L1 L2 = V	**Nominal system voltage L1 - L2** U_n* 0 $V_{trueRMS}$…500 $V_{trueRMS}$ Resolution 1 $V_{trueRMS}$ In case of a DC system, the „+“ oder „-“ sign indicates at U_{RMS} > 20 V the polarity at the terminals „L1/+“ und „L2/-“. The sign „~“ indicates an AC system.
✓	± U L1 ⏚ = V	**Residual voltage L1/+ - PE** U_{L1e} 0 V_{DC}…± 500 V_{DC} Resolution 1 V_{DC}
✓	± U L2 ⏚ = V	**Residual voltage L2/- - PE** U_{L2e} 0 V_{DC}…± 500 V_{DC} Resolution 1 V_{DC}
✓	± R %	**Fault location in %** -100 %…+100 % This value display happens only in the „dc“ setting from the mains voltage U_n ≥ 20 V_{DC}. $R_{F+} = (200\% * R_F)/(100\% + x\%)$ $R_{F-} = (200\% * R_F)/(100\% - x\%)$

✓: The measuring value can be displayed in the history memory.

* : Only these measuring values are permanently displayed (standard display). All other measuring value displays are switching to the standard display after 5 min at the latest.

5 Data access using the BMS protocol

The BMS protocol is an essential component of the Bender measuring device interface (BMS bus protocol). ASCII characters are used for the data transfer.

BMS channel no.	Operation value	Alarm
1	R_F	Pre-alarm R1
2	R_F	Alarm R2
3	----	----
4	U_n	Undervoltage
5	U_n	Overvoltage
6	---	Connection fault earth (E.01)
7	---	Connection fault system (E.02)
8	---	All other device faults (E.xx)
9	Fault location [%]	---
10	C_e	---
11	---	---
12	Update counter	---
13	U_{L1e}	---
14	U_{L1e}	---
15	---	---

6 Data access using the Modbus RTU protocol

Requests to the ISOMETER® can be made using the function code 0x03 (Read Holding Registers) or the function code 0x10 (Write Multiple Registers). The ISOMETER® generates a function-related answer and sends it back.

6.1 Reading out the Modbus register from the ISOMETER®

The required Words of the process image can be read out from the ISOMETER® „Holding Registers“ using the function code 0x03. For this purpose, the start address and the number of the registers to be read out have to be entered. Up to 125 Words (0x7D) can be read out by one single request.

6.1.1 Command of the Master to the ISOMETER®

In the following example, the ISOMETER® master requests the content of the register 1003 with the address 3. The register contains the channel description of measuring channel 1.

Byte	Name	Example
Byte 0	ISOMETER® Modbus address	0x03
Byte 1	Function code	0x03
Byte 2, 3	Start address	0x03EB
Byte 4, 5	Number of registers	0x0001
Byte 6, 7	CRC16 Checksum	0xF598

6.1.2 Answer of the ISOMETER® to the Master

Byte	Name	Example
Byte 0	ISOMETER® Modbus address	0x03
Byte 1	Function code	0x03
Byte 2	Number of data bytes	0x02
Byte 3, 4	Data	0x0047
Byte 7, 8	CRC16 Checksum	0x81B6

6.2 Write Modbus register (parameter setting)

Registers in the device can be modified with the function code 0x10 (Write Multiple Registers). Parameter registers are available from address 3000. The content of the register is listed in the table on page 31.

6.2.1 Command of the Master to the ISOMETER®

In this example, in the ISOMETER® with address 3 the content of the register address 3003 is set to 2.

Byte	Name	Example
Byte 0	ISOMETER® Modbus address	0x03
Byte 1	Function code	0x10
Byte 2, 3	Start register	0x0BBB
Byte 4, 5	Number of registers	0x0001
Byte 6	Number of data bytes	0x02
Byte 7, 8	Data	0x0002
Byte 9, 10	CRC16 Checksum	0x9F7A

6.2.2 ISOMETER® answer to the Master

Byte	Name	Example
Byte 0	ISOMETER® Modbus address	0x03
Byte 1	Function code	0x10
Byte 2, 3	Start register	0x0BBB
Byte 4, 5	Number of registers	0x0001
Byte 6, 7	CRC16 Checksum	0x722A

6.3 Exception code

If a request cannot be answered for whatever reason, the ISOMETER® will send a so-called exception code with which possible faults can be narrowed down.

Exception code	Description
0x01	Impermissible function
0x02	Impermissible data access
0x03	Impermissible data value
0x04	Internal fault
0x05	Acknowledgement of receipt (answer will be time delayed)
0x06	Request not accepted (repeat request, if necessary)

6.3.1 Structure of the exception code

Byte	Name	Example
Byte 0	ISOMETER® Modbus address	0x03
Byte 1	Function code (0x03) + 0x80	0x83
Byte 2	Data (exception code)	0x04
Byte 3, 4	CRC16 Checksum	0xE133

7 Modbus register assignment of the ISOMETER®

Depending on the device condition, the information in the registers is the measured value without alarm; the measured value with alarm 1; the measured value with alarm 2; or only the device error.

Register	Measured value			Device error
	Without alarm	Alarm 1	Alarm 2	
1000 to 1003	R_F Insulation fault (71) [no alarm]	R_F Insulation fault (1) [prewarning]	R_F Insulation fault (1) [alarm]	--- Connection earth (102) [device error]
1004 to 1007	---	---	---	---
1008 to 1011	U_n Voltage (76) [no alarm]	U_n Undervoltage (77) [alarm]	U_n Overvoltage (78) [alarm]	--- Connection to system (101) [device error]
1012 to 1015	C_e Capacitance (82) [no alarm]	---	---	---
1016 to 1019	U_{L1e} Voltage (76) [no alarm]	---	---	---
1020 to 1023	U_{L2e} Voltage (76) [no alarm]	---	---	---
1024 to 1027	**Fault location in %** --- (1022) [no alarm]	---	---	---
1028 to 1031	R_{FU} Insulation fault (71) [no alarm]	---	---	---
1032 to 1035	**Measured value update counter** --- (1022) [no alarm]	---	---	--- Device error (115) [device error]

( ) = Channel description code (see chapter 7.2)

[ ] = Alarm type (see chapter 7.1.2.2)

Register	Property	Description	Format	Unit	Value range
3000	RW	Reserved	---	---	---
3001	RW	Reserved	---	---	---
3002	RW	Reserved	---	---	---
3003	RW	Reserved	---	---	---
3004	RW	Reserved	---	---	---
3005	RW	Pre-alarm value resistance measurement „R1“	UINT 16	kΩ	R2…250
3006	RW	Reserved	---	---	---
3007	RW	Alarm value resistance measurement „R2“	UINT 16	kΩ	5…R1
3008	RW	Activation alarm value undervoltage „U<“	UINT 16	---	0 = Inactive 1 = Active
3009	RW	Alarm value undervoltage „U<“	UINT 16	V	10…U>
3010	RW	Activation alarm value overvoltage „U>“	UINT 16	---	0 = Inactive 1 = Active
3011	RW	Alarm value Overvoltage „U >“	UINT 16	V	U<…500
3012	RW	Memory function for alarm messages (Fault memory) „M“	UINT 16	---	0 = Inactive 1 = Active
3013	RW	Operating mode of relay 1 „r1“	UINT 16	---	0 = n.o. 1 = n.c.
3014	RW	Operating mode of relay 2 „r2“	UINT 16	---	0 = n.o. 1 = n.c.
3015	RW	Bus address „Adr“	UINT 16	---	0/3 … 90
3016	RW	Baud rate „Adr 1“	UINT 16	---	0 = BMS 1 = 1.2k 2 = 2.4k 3 = 4.8k 4 = 9.6k 5 = 19.2k 6 = 38.4k 7 = 57.6k 8 = 115.2k
3017	RW	Parity „Adr 2“	UINT 16	---	0 = 8N1 1 = 8O1 2 = 8E1

Register	Property	Description	Format	Unit	Value range
3018	RW	Start-up delay „t“ during device start	UINT 16	s	0…10
3019	RW	Response delay „ton“ for relays „K1“ and „K2“	UINT 16	s	0…99
3020	RW	Delay on release „toff“ for relays „K1“ and „K2“	UINT 16	s	0…99
3021	RW	Repetition time „test“ for automatic device test	UINT 16	---	0 = OFF 1 = 1 h 2 = 24 h
3022	RW	Reserved	---	---	---
3023	RW	System and function selection	UNIT 16	---	0 = GEn 1 = dc
3024	RW	Test of the system connection during device test „nEt“	UINT 16	---	0 = Inactive 1 = Active
3025	RW	Device test during device start „S. Ct“	UINT 16	---	0 = Inactive 1 = Active
3026	RW	Request stop mode (0 = deactivate device)	UINT 16	---	0 = Stop 1 = ---
3027	RW	Alarm assignment of relay 1 „r1“	UINT 16	---	Bit 9…Bit 1 (see chapter 7.1.3)
3028	RW	Alarm assignment of relay 2 „r2“	UINT 16	---	Bit 9…Bit 1 (see chapter 7.1.3)

8003	WO	Factory settings for all parameters	UINT 16	---	0x6661 „fa“
8004	WO	Factory setting only for parameters resettable by FAC	UINT 16	---	0x4653 „FS“
8005	WO	Start device test	UINT 16	---	0x5445 „TE“
8006	WO	Clear fault memory	UINT 16	---	0x434C „CL“

Register	Property	Description	Format	Unit	Value range
9800 to 9809	RO	Device name	UNIT 16 (ASCII) - see chapter 7.1.1	---	---
9820	RO	Software ID number	UINT 16	---	Software ID Number
9821	RO	Software version number	UINT 16	---	Software version
9822	RO	Software version: Year	UINT 16	---	---
9823	RO	Software version: Month	UINT 16	---	---
9824	RO	Software version: Day	UINT 16	---	---
9825	RO	Modbus driver version	UINT 16	---	---

RW = Read/Write; **RO** = Read only; **WO** = Write only

7.1 Device-specific data type of the ISOMETER®

7.1.1 Device name

The data format of the device name is specified below:

Word 0x00	0x01	0x02	0x03	----------	0x08	0x09
10 Words in total Each Word contains two ASCII characters						

7.1.2 Measuring values

Each measuring value is available as a channel and consists of 8 bytes (4 registers). The first measuring value register address is 1000. The structure of a channel is always identical. Content and number depend on the device. The structure of a channel is shown with the example of channel 1:

1000		1001		1002		1003	
HiByte	LoByte	HiByte	LoByte	HiByte	LoByte	HiByte	LoByte
Floating point value (Float)				Alarm type and test type (AT&T)	Range and unit (R&U)	Channel description	

7.1.2.1 Float = Floating point value of the channels

Word	0x00								0x01							
Byte	HiByte								LoByte							
Bit	31	30						24	23	22						16
	S	E	E	E	E	E	E	E	E	M	M	M	M	M	M	M

Word	0x01							
Byte	HiByte							
Bit	15							8
	M	M	M	M	M	M	M	M

Word	0x01							
Byte	LoByte							
Bit	7							0
	M	M	M	M	M	M	M	M

Presentation of the bit order for processing analogue measuring values according to IEEE 754

S = Sign; **E** = Exponent; **M** = Mantissa

7.1.2.2 AT&T = Alarm type and test type (internal/external)

Bit	7	6	5	4	3	2	1	0	Meaning
	Test external	Test internal	Reserved	Reserved	Reserved	Alarm	Errors		
Alarm type	X	X	X	X	X	0	0	0	No alarm
	X	X	X	X	X	0	0	1	Prewarning
	0	0	X	X	X	0	1	0	Device error
	X	X	X	X	X	0	1	1	Reserved
	X	X	X	X	X	1	0	0	Warning
	X	X	X	X	X	1	0	1	Alarm
	X	X	X	X	X	1	1	0	Reserved
	X	X	X	X	X	…	…	…	Reserved
	X	X	X	X	X	1	1	1	Reserved
Test	0	0	X	X	X	X	X	X	No test
	0	1	X	X	X	X	X	X	Internal test
	1	0	X	X	X	X	X	X	External test

The alarm type is coded by bits 0 to 2. Bits 3, 4 and 5 are reserved and always have the value 0. Bit 6 or 7 is usually set when an internal or external test has been completed. Other values are reserved. The complete byte is calculated from the sum of the alarm type and the test type.

7.1.2.3 R&U = Range and unit

Bit	7	6	5	4	3	2	1	0	Meaning
Unit	-	-	-	0	0	0	0	0	Invalid (init)
	-	-	-	0	0	0	0	1	No unit
	-	-	-	0	0	0	1	0	Ω
	-	-	-	0	0	0	1	1	A
	-	-	-	0	0	1	0	0	V
	-	-	-	0	0	1	0	1	%
	-	-	-	0	0	1	1	0	Hz
	-	-	-	0	0	1	1	1	Baud
	-	-	-	0	1	0	0	0	F
	-	-	-	0	1	0	0	1	H
	-	-	-	0	1	0	1	0	°C
	-	-	-	0	1	0	1	1	°F
	-	-	-	0	1	1	0	0	Second
	-	-	-	0	1	1	0	1	Minute
	-	-	-	0	1	1	1	0	Hour
	-	-	-	0	1	1	1	1	Day
	-	-	-	1	0	0	0	0	Month
Range of validity	0	0	X	X	X	X	X	X	Actual value
	0	1	X	X	X	X	X	X	The actual value is lower
	1	0	X	X	X	X	X	X	The actual value is higher
	1	1	X	X	X	X	X	X	Invalid value

- The units of bits 0 to 4 are coded.
- Bits 6 and 7 describe the validity range of a value.
- Bit 5 is reserved.

The complete byte is calculated from the sum of the unit and the range of validity.

7.1.3 Alarm assignment of the relays

Several alarms can be assigned to each relay. For the assignment of each relay, a 16-bit-register is used with the bits described below. The following table applies to relay 1 and relay 2, in which „x" stands for the relay number. A set bit activates the specified function.

Bit	Display indication	Meaning
0	Reserved	When reading, always 0 When writing, any value.
1	x Err	Device error E.xx
2	rx +R1 < Ω	Pre-alarm R1- Fault R_F at L1/+
3	rx -R1 < Ω	Pre-alarm R1- Fault R_F at L2/-
4	rx +R2 < Ω	Alarm R2 - Fault R_F at L1/+
5	rx -R2 < Ω	Alarm R2 - Fault R_F at L2/-
6	rx U < V	Alarm message U_n - Undervoltage
7	rx U > V	Alarm message U_n - Overvoltage
8	rx test	Manually started self test
9	rx S.AL	Device start with alarm
10	Reserved	When reading, always 0 When writing, any value.
11	Reserved	When reading, always 0 When writing, any value.
12	Reserved	When reading, always 0 When writing, any value.
13	Reserved	When reading, always 0 When writing, any value.
14	Reserved	When reading, always 0 When writing, any value.
15	Reserved	When reading, always 0 When writing, any value.

7.2 Channel descriptions

Parameter	Measuring value description/ Alarm message Operating message	Note
0		
1 (0x01)	Insulation fault	
71 (0x47)	Insulation fault	Insulation resistance R_F in Ω
76 (0x4C)	Voltage	Measured value in V
77 (0x4D)	Undervoltage	
78 (0x4E)	Overvoltage	
82 (0x52)	Capacitance	Measured value in F
86 (0x56)	Insulation fault	Impedance Z_i
101 (0x65)	Connection system	
102 (0x66)	Connection earth	
115 (0x73)	Device error	Fault ISOMETER®
129 (0x81)	Device error	
145 (0x91)	Own address	

To convert parameter data, data type descriptions are required.
Text representation is not necessary in this case.

Parameter	Description of parameters
1023 (0x3FF)	Parameter/measured value invalid. The menu item of this parameter is not displayed.
1022 (0x3FE)	No measured value/no message
1021 (0x3FD)	Measured value/parameter inactive
1020 (0x3FC)	Measured value/parameter only temporarily inactive (e.g. while transmitting a new parameter). Indication in the menu „…“.
1019 (0x3FB)	Parameter/measured value (value) unit not displayed
1018 (0x3FA)	Parameter (code selection menu) unit not displayed
1017 (0x3F9)	String max. 18 characters (e.g. device type, - variant, …)
1016 (0x3F8)	
1015 (0x3F7)	Time
1014 (0x3F6)	Date: Day
1013 (0x3F5)	Date: Month
1012 (0x3F4)	Date: Year
1011 (0x3F3)	Register address (unit not displayed)
1010 (0x3F2)	Time
1009 (0x3F1)	Factor multiplication [*]
1008 (0x3F0)	Factor division [/]
1007 (0x3EF)	Baud rate
1022 (0x3FE)	
1023 (0x3FF)	Invalid

8 IsoData data string

In IsoData mode, the ISOMETER® continuosly sends the whole data string with a cycle time of approximately 1 s. Communication with the ISOMETER® within this mode is not possible and no additional sender may be connected via the RS-485 bus cable.

IsoData is activated in the menu „out“, menu item „Adr“ when it has been set to Adr = 0.
In this event, the symbol „Adr“ flashes on the measuring value display.

String	Description
!;	Start symbol
v;	Insulation fault location ´´/´+´/´-´
1234, 5;	Insulation resistance R_F [kΩ]
12345;	System leakage capacitance C_e [nF] (nur in Einstellung „GEn“)
123456;	reserved
+1234;	Nominal system voltage U_n [$V_{trueRMS}$] Nominal system voltage type: AC or unknown: ´ ´ DC: ´+´/´-´
+1234;	Residual voltage U_{L1e} [V_{DC}]
+1234;	Residual voltage U_{L2e} [V_{DC}]
+123;	Insulation fault location -100 … +100 [%]
123456;	reserved
1234;	Alarm message [hexadecimal] (without leading „0x“) The alarms are included in this value with the OR function. Assignment of the alarms: 0x0002 Device fault 0x0004 Prewarning insulation resistance R_F an L1/+ 0x0008 Prewarning insulation resistance R_F an L2/- 0x000C Prewarning insulation resistance R_F symmetrical 0x0010 Alarm insulation resistance R_F at L1/+ 0x0020 Alarm insulation resistance R_F at L2/- 0x0030 Alarm insulation resistance R_F symmetrical 0x0040 Alarm undervoltage U_n 0x0080 Alarm overvoltage U_n 0x0100 Message system test 0x0200 Device start with alarm
12	Update counter, consecutively counts from 0 to 99. It increases with the update of the insulation resistance value.
<CR><LF>	String end

9 Technical data

9.1 Tabular presentation

( )* = factory setting

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

Definitions:

Measuring circuit (IC1) ..... L1/+, L2/-
Supply circuit (IC2) A1, A2
Output circuit (IC3) 11, 14, 24
Control circuit (IC4) ..... E, KE, T/R, A, B
Rated voltage ..... 400 V
Overvoltage category III

Rated impulse voltage:

IC1/(IC2-4) ..... 6 kV
IC2/(IC3-4) ..... 4 kV
IC3/IC4 ..... 4 kV

Rated insulation voltage:

IC1/(IC2-4) ..... 400 V
IC2/(IC3-4) ..... 250 V
IC3/IC4 ..... 250 V
Pollution degree 3

Protective separation (reinforced insulation) between:

IC1/(IC2-4) ..... Overvoltage category III, 600 V
IC2/(IC3-4) ..... Overvoltage category III, 300 V
IC3/IC4 ..... Overvoltage category III, 300 V

Voltage test (routine test) according to IEC 61010-1:

IC2/(IC3-4) ..... AC 2.2 kV
IC3/IC4 ..... AC 2.2 kV

Supply voltage

Supply voltage U_s ..... AC 100…240 V / DC 24…240 V
Tolerance of U_s ..... -30…+15 %
Frequency range U_s ..... 47…63 Hz
Power consumption ..... ≤ 3 W, ≤ 9 VA

Monitored IT system

Nominal system voltage U_n ..... 3(N)AC, AC 0…400 V/DC 0…400 V
Tolerance of U_n ..... +25 %
Frequency range of U_n ..... DC, 35…460 Hz

Measuring circuit

Measuring voltage U_m ..... ±12 V
Measuring current I_m at R_F, $Z_F = 0$ ..... ≤ 110 µA
Internal resistance R_i, Z_i ..... ≥ 115 kΩ
Permissible system leakage capacitance C_e ..... ≤ 5 µF
Permissible extraneous DC voltage U_{fg} ..... ≤ 700 V

Response values

Response value R_{an1} ... R_{an2}...250 kΩ (46 kΩ)*
Response value R_{an2} ... 5 kΩ...R_{an1} (23 kΩ)*
Relative uncertainty R_{an} ... ±15 %, at least ±2 kΩ
Hysteresis R_{an} ... 25 %, at least 1 kΩ
Undervoltage detection U< ... 10 V...U> (off/10 V)*
Overvoltage detection U> ... U<...500 V (off/500 V)*
Relative uncertainty U ... ±5 %, at least ±5 V
Relative uncertainty depending on the frequency ≥ 400 Hz ... -0.015 %/Hz
Hysteresis U ... 5 %, at least 5 V

Time response

Response time t_{an}
of R_F = 0,5 x R_{an} and C_e=1 µF according to IEC 61557-8 ... ≤ 10 s
Start-up delay t ... 0...10 s (0 s)*
Response delay t_{on} ... 0...99 s (0 s)*
Delay on release t_{off} ... 0...99 s (0 s)*

Displays, memory

Display ... LC display, multi-functional, not illuminated
Display range measured value insulation resistance (R_F) ... 1 kΩ...2 MΩ
Operating uncertainty ... ±15 %, at least ±2 kΩ
Display range measured value nominal system voltage (U_n) ... 0...500 V_{RMS}
Operating uncertainty ... ±5 %, at least ±5 V
Display range measured value system leakage capacitance
of R_F > 10 kΩ (only „dc" mode) ... 0...17 µF
Operating uncertainty of R_F ≥ 20 kΩ and C_e ≤ 5 µF ... ±5 %, at least ± 0.1 µF
Password ... off/0...999 (0, off)*
Fault memory alarm messages ... on/(off)*

Interface

Interface/protocol ... RS-485/BMS, Modbus RTU, isoData
Baud rate ... BMS (9.6 kBit/s), Modbus RTU (selectable), isoData (115.2 kBit/s)
Cable length (9.6 kBit/s) ... ≤ 1200 m
Cable: shield connected to PE on one side ... recommended: CAT6/CAT7 min. AWG23*
* alternative: twisted pairs, shield connected to PE on one side ... J-Y(St)Y min. 2 x 0.8
Terminating resistor ... 120 Ω (0.25 W), internal, can be connected
Device address, BMS bus, Modbus RTU ... 3...90 (3)*

Switching elements

Switching elements ... 2 x 1 contacts, common terminal 11
Operating principle ... N/C operation/N/O operation (N/O operation)*
Electrical endurance, number of cycles ... 10 000

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

Utilisation category ... AC-12 / 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 / 2 A / 1 A / 0.2 A / 0.1 A
Necessary min. contact load (relay manufacturer's reference) ... 1 mA at AC/DC ≥ 10 V

Environment/EMC

EMC ... IEC 61326-2-4

Ambient temperatures:

Operation ... -40...+70 °C
Transport ... -40...+85 °C
Storage ... -40...+70 °C

Climatic class acc. to IEC 60721 (related to temperature and rel. humidity:

Stationary use (IEC 60721-3-3) ... 3K22
Transport (IEC 60721-3-2) ... 2K11
Langzeitlagerung (IEC 60721-3-1) ... 1K22

Classification of mechanical conditions acc. to IEC 60721:

Stationary use (IEC 60721-3-3) ... 3M11
for W variant ... 3M12
Transport (IEC 60721-3-2) ... 2M4
Long-term storage (IEC 60721-3-1) ... 1M12

Connection

Screw-type terminals:

Nominal current ... ≤10 A
Tightening torque ... 0.5...0.6 Nm (5...7 lb-in)
Conductor sizes ... AWG 24-12
Stripping length ... 8 mm
Rigid/flexible ... 0.2...2.5 mm^2
Flexible with ferrules with/without plastic sleeve ... 0.25...2.5 mm^2
Multi-conductor
rigid /flexible ... 0.2...1.5 mm^2
flexible with ferrules without plastic sleeve ... 0.25...1.5 mm^2
flexible with TWIN ferrules with plastic sleeve ... 0.5...1.5 mm^2

Push-wire terminals:

Nominal current ... ≤10 A
Conductor sizes ... AWG 24-14
Stripping length ... 10 mm
Rigid ... 0.2...2.5 mm^2
Flexible without ferrules ... 0.75...2.5 mm^2
Flexible with ferrules with/without plastic sleeve ... 0.25...2.5 mm^2
Multi-conductor flexible with TWIN ferrules with plastic sleeve ... 0.5...1.5 mm^2
Opening force ... 50 N
Test opening, diameter ... 2.1 mm

Other

Operating mode ... continuous operation
Mounting ... cooling slots must be ventilated vertically
Degree of protection, built-in components (DIN EN 60529) ... IP30
Degree of protection, terminals (DIN EN 60529) ... IP20
Enclosure material ... polycarbonate
DIN rail mounting acc. to ... IEC 60715
Screw fixing ... 2 x M4 with mounting clip
Weight ... ≤ 150 g

Option W

isoGEN423-D4W-4 for use in special climatic conditions.

9.2 Standards, approvals and certifications

The ISOMETER® has been developed in compliance with the following standards:

- DIN EN 61557-8 (VDE 0413-8): 2015-12/Ber1: 2016-12
- IEC 61557-8: 2014/COR1: 2016

9.3 Ordering information

Type	Version	Art. No.
isoGEN423-D4-4	Push-wire terminal	B71036325
isoGEN423-D4-4	Screw-type terminal	B91036325
isoGEN423-D4W-4	Push-wire terminal	B71036325W
Mounting clip for screw fixing (1 piece/device)		B98060008

9.4 Document revision history

Date	Document version	Valid from software version	State/Changes
04.2021	02	D0494 V1.31	*Editorial revision* *Added:* chapter 2.3.13: Note on stopped measuring function *Changed:* chapter 3.3: Wiring diagram, chapter 4.2: Menu overview representation *Corrected:* chapter 9.1: Term „Necessary minimum contact load", climatic classifications *Changed:* chapter 9.1: Name bus cable in section „Interface" *Added:* chapter 9.1: Option W; UKCA certificate, chapter 9.3: Ordering information isoGEN423-D4W-4 Revision history
05.2023	04	D0494 4.02	CHAdeMO function removed; figure „Dimensions" changed: 3D > 2D; Screw-type version added; Climatic classes changed

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