



# ISOMETER® isoHV525

AC/DC



Insulation monitoring device for unearthed  
AC, AC/DC, and DC systems (IT systems)  
up to 3(N)AC, AC/DC 0...1000 V or DC 0...1000 V  
Software versions: D0500 V1.xx (isoHV525-M4-4)  
D0453 V1.xx (isoHV525-S4-4)



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# 1. Important information

## 1.1 How to use this manual



*This manual is intended for qualified personnel working in electrical engineering and electronics!*

To make it easier for you to understand and revisit certain sections in this manual, we have used symbols to identify important instructions and information. The meaning of these symbols is explained below:



**DANGER**

*This signal word indicates that there is a **high risk** of danger that will result in **death or serious injury** if not avoided.*



**WARNING**

*This signal word indicates a **medium risk** of danger that can lead to death or serious injury if not avoided.*



**CAUTION**

*This signal word indicates a **low level risk** that can result in **minor or moderate** injury or damage to property if not avoided*



*This symbol denotes information intended to assist the user in making **optimum use** of the product.*

## 1.2 Technical support: Service and support

For commissioning and troubleshooting Bender offers you:

### 1.2.1 First level support

Technical support by phone or e-mail for all Bender products

- Questions concerning specific customer applications
- Commissioning
- Troubleshooting

**Telephone:** +49 6401 807-760\*  
**Fax:** +49 6401 807-259  
In Germany only: 0700BenderHelp (Tel. and Fax)  
**E-Mail:** support@bender-service.com

### 1.2.2 Repair service

- Repair, calibration, update and replacement service for Bender products
- Repairing, calibrating, testing and analysing Bender products
- Hardware and software update for Bender devices
- Delivery of replacement devices in the event of faulty or incorrectly delivered Bender devices
- Extended warranty for Bender devices with in-house repair service or replacement device at no extra cost

**Telephone:** +49 6401 807-780\*\* (technical issues)  
+49 6401 807-784\*\*, -785\*\* (sales)  
**Fax:** +49 6401 807-789  
**E-Mail:** repair@bender-service.com

Please send all devices for repair to the following address:

Bender GmbH, Repair service,  
Londorfer Str. 65,  
35305 Gruenberg

### 1.2.3 Field service

On-site service for all Bender products

- Commissioning, parameter setting, maintenance, troubleshooting for Bender products
- Analysis of the electrical installation in the building (power quality test, EMC test, thermography)
- Training courses for customers

**Telephone:** +49 6401 807-752\*\*, -762 \*\*(technical issues)/  
+49 6401 807-753\*\* (sales)  
**Fax:** +49 6401 807-759  
**E-Mail:** [fieldservice@bender-service.com](mailto:fieldservice@bender-service.com)  
**Internet:** [www.bender-de.com](http://www.bender-de.com)

\* Available from 7.00 a.m. to 8.00 p.m. 365 days a year (CET/UTC+1)

\*\* Mo-Thu 7.00 a.m. - 8.00 p.m., Fr 7.00 a.m. - 13.00 p.m.

## 1.3 Training courses

Bender is happy to provide training regarding the use of test equipment. The dates of training courses and workshops can be found on the Internet at [www.bender.de](http://www.bender.de) -> Know-how -> Seminars.

## 1.4 Delivery conditions

Bender sale and delivery conditions apply. For software products, the "Softwareklausel zur Überlassung von Standard-Software als Teil von Lieferungen, Ergänzung und Änderung der Allgemeinen Lieferbedingungen für Erzeugnisse und Leistungen der Elektroindustrie" (software clause in respect of the licensing of standard software as part of deliveries, modifications and changes to general delivery conditions for products and services in the electrical industry) set out by the ZVEI (Zentralverband Elektrotechnik- und Elektronikindustrie e.V.) applies. Sales and delivery conditions can be obtained from Bender in printed or electronic format.

## 1.5 Inspection, transport and storage

Inspect the dispatch and equipment packaging for damage, and compare the contents of the package with the delivery documents. In the event of damage in transit, please contact Bender immediately. The devices must only be stored in areas where they are protected from dust, damp, and spray and dripping water, and in which the specified storage temperatures can be ensured.



## 1.6 Warranty and liability

Warranty and liability claims in the event of injury to persons or damage to property are excluded if they can be attributed to one or more of the following causes:

- 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 and the use of replacement parts or accessories not approved by the manufacturer.
- Catastrophes caused by external influences and force majeure.
- Mounting and installation with device combinations not recommended by the manufacturer.

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

## 1.7 Disposal

Abide by the national regulations and laws governing the disposal of this device. Ask your supplier if you are not sure how to dispose of the old equipment.

The directive on waste electrical and electronic equipment (WEEE directive) and the directive on the restriction of certain hazardous substances in electrical and electronic equipment (RoHS directive) apply in the European Community. In Germany, these policies are implemented through the "Electrical and Electronic Equipment Act" (ElektroG). According to this, the following applies:

- Electrical and electronic equipment are not part of household waste.
- Batteries and accumulators are not part of household waste and must be disposed of in accordance with the regulations.
- Old electrical and electronic equipment from users other than private households which was introduced to the market after 13th August 2005 must be taken back by the manufacturer and disposed of properly.

For more information on the disposal of Bender devices, refer to our homepage at [www.bender.de](http://www.bender.de) -> Service & support.

## 2. Safety instructions

### 2.1 General safety instructions

Part of the device documentation in addition to this manual is the enclosed "Safety instructions for Bender products".

### 2.2 Work activities on electrical installations



*Only skilled persons are permitted to carry out the work necessary to install, commission and run a device or system.*



**DANGER**

---

#### ***Risk of electrocution due to electric shock!***

*Touching live parts of the system carries the risk of:*

- *An 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. Observe the rules for working on electrical installations.*

---

If the device is used outside the Federal Republic of Germany, the applicable local standards and regulations must be complied with. The European standard EN 50110 can be used as a guide.

## 2.3 Intended use



*Only skilled persons are permitted to carry out the work necessary to install, commission and run a device or system.*

The ISOMETER® isoHV525 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 ... 1,000 V or DC 0 ... 1,000 V. The maximum permissible system leakage capacitance  $C_e$  is 150  $\mu$ F. DC components existing in AC systems do not influence the operating characteristics, when a minimum load current of DC 100 mA flows. A separate supply voltage  $U_s$  allows de-energised systems to be monitored, too. Please heed the limits of the area of application indicated in the technical specifications. Any use other than that described in this manual is regarded as improper.



*To ensure that the ISOMETER® functions correctly, an internal resistance of  $\leq 1 \text{ k}\Omega$  must exist between L1/+ and L2/- via the source (e.g. the transformer) or the load.*



*In the event of an alarm message of the ISOMETER®, the insulation fault should be eliminated as quickly as possible.*



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

Two variants of the isoHV525 ISOMETER®s are available:

- isoHV525-M4-4 with an analogue output
- isoHV525-S4-4 with a serial interface

## 3. Function

### 3.1 isoHV525-M4-4

#### 3.1.1 Features

- Monitoring the insulation resistance  $R_F$  for unearthed AC/DC systems
- Automatic adaptation to the system leakage capacitance  $C_e$  up to 150  $\mu\text{F}$
- Two separate response values for Alarm 1 and Alarm 2
- Alarms are signalled via alarm relays ("K1", "K2")
- 0... 10 V analogue output (galvanically separated)

#### 3.1.2 Function description

The ISOMETER® measures the insulation resistance  $R_F$  and the system leakage capacitance  $C_e$  between the system to be monitored (L1/+, L2/-) and earth (PE). If the value  $R_F$  exceeds the set response values, this will be indicated by the relays "K1" and "K2".

If the insulation resistance  $R_F$  exceeds the release value (response value plus hysteresis), the alarm relays switch back to their initial position.

The device function can be tested using the Test/Reset button.



*The isoHV525 determines the system leakage capacitance via an impedance measurement whose frequency is adjusted to the most accurate insulation measurement. The measurement signal is influenced by rectifiers or inverters, and can lead to phase errors which in turn can lead to a distorted system leakage capacitance value.*

#### 3.1.2.1 Manual self test

The integrated self test function tests the function of the insulation monitoring device and the connection to earth. A self test is started by pressing the external Test/Reset button. Relay 1 ("K1") is switched during a manual self test. In the event of a fault, relay 2 ("K2") switches and the measuring function is interrupted.

Internal device errors can be caused by external disturbances or internal hardware errors. After eliminating the fault, the alarm relays are automatically reset or are reset to the initial position by pressing the Test/Reset button. The self test can take a few minutes.

### 3.1.2.2 Malfunction

In addition to the described self test, several functions in the insulation monitoring device are continuously checked during operation. If the error occurs again after restarting the device, then contact Bender Service.

### 3.1.2.3 Signalling assignment of the alarm relays K1/K2

Pre-alarm and test are assigned to relay 1 ("K1"). The main alarm and device fault are assigned to relay 2 ("K2").

### 3.1.2.4 Measuring and response times

The measuring time is the period essential for the detection of the measured value. The measuring time is reflected in the operating time  $t_{ae}$ . The measuring time for the insulation resistance value is mainly determined by the required measuring pulse duration, which depends on the insulation resistance and system leakage capacitance of the system to be monitored. The measuring pulse is produced by the measuring voltage generator, which is integrated in the ISOMETER®. System disturbances may lead to extended measuring times.

### Operating time $t_{ae}$

The operating time  $t_{ae}$  is the time required by the ISOMETER® to determine the measured value. For the measured insulation resistance value, it is dependent on the insulation resistance and the system leakage capacitance.

### 3.1.2.5 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

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.

### 3.1.2.6 Analogue output

The isoHV-M4-4 ISOMETER® outputs and analogue voltage in the range 0...10 V.

Activation	Setting	Description
	FAC	
	U 0...10 V	0...10 V, Permissible load > 20 kΩ
on	120 kΩ	The scaled reference value for the displayed non-linear resistance at 50% of interface control..

Calculation of the insulation resistance using the analogue output:

$$R_F \text{ (k}\Omega\text{)} = \frac{A_1 \times R_{SKM} \text{ (k}\Omega\text{)}}{A_2} - R_{SKM} \text{ (k}\Omega\text{)}$$

Variable	Description
$R_F$	Insulation fault in kΩ
$R_{SKM}$	Scaled reference value in kΩ (i.e. 120 kΩ)
$A_1$	Upper analogue output value (i.e. 10 V)
$A_2$	Measured analogue output value



*The analogue output provides stable output values only after the isoHV525-M4-4 has been initialized.*

## 3.2 isoHV525-S4-4

### 3.2.1 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)
- Automatic adaptation to the system leakage capacitance  $C_e$  up to 150  $\mu\text{F}$
- Two separate response values for Alarm 1 and Alarm 2
- Alarm are signalled via alarm relays ("K1", "K2")
- Selectable N/C or N/O relay operation
- Selectable start-up delay, response delay and delay on release
- Fault memory can be activated.
- RS-48 5 (galvanically isolated) with the following protocols:
  - BMS interface (Bender measuring device interface) for data exchange with other Bender components
  - Modbus RTU
  - IsoData (for continuous data output)

### 3.2.2 Function description

The ISOMETER® measures the insulation resistance  $R_F$  and the system leakage capacitance  $C_e$  between the system to be monitored (L1/+, L2/-) and earth (PE). The RMS value of the nominal system voltage  $U_n$  between L1/+ and L2/-, as well as the residual voltages  $U_{L1e}$  (between L1/+ and earth) and  $U_{L2e}$  (between L2/- and earth) are also measured. From a minimum value of the nominal system voltage, the ISOMETER® determines the faulty conductor L1/+ or L2/-, which shows the distribution of the insulation resistance between conductors L1/+ and L2/-.

The value range of the faulty conductor is  $\pm 100\%$ :

Display	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:

$$\text{Fault on conductor L1/+} \rightarrow R_{L1F} = (200 \% * R_F) / (100 \% + R \%)$$

$$\text{Fault on conductor L2/-} \rightarrow R_{L2F} = (200 \% * R_F) / (100 \% - R \%)$$

If the values  $R_F$  or  $U_n$  exceeds the set response values, this will be indicated by the relays "K1" and "K2". In addition, the operation of the relay (n.c./n.o.) can be set and the fault memory "M", activated. If the values  $R_F$  or  $U_n$  exceed their release value (response value plus hysteresis) uninterrupted for no longer than the period  $t_{off}$ , then the alarm relays will switch back to their initial position. If the fault memory is enabled, the alarm relays remain in the alarm state until the external Test/Reset button is pressed or until the supply voltage  $U_s$  is switched off. The device function can be tested using the Test/Reset button. Device parameters are initially assigned by Bender. Parameterisation of the ISO-METER® isoHV525-S4-4 is also possible via the BMS bus, for example by means of a BMS-Ethernet gateway (COM465IP) or Modbus RTU.



*The isoHV525 determines the system leakage capacitance via an impedance measurement whose frequency is adjusted to the most accurate insulation measurement. The measurement signal is influenced by rectifiers or inverters, and can lead to phase errors which in turn can lead to a distorted system leakage capacitance value.*

### 3.2.2.1 Manual self test

The integrated self test function tests the function of the insulation monitoring device and the connection to IT system to be monitored. A self test is started by pressing the external test/reset button. Relay 1 ("K1") is switched during a manual self test. In the event of a fault, relay 2 ("K2") switches and the measuring function is interrupted. Internal device errors can be caused by external disturbances or internal hardware errors. After eliminating the fault, the alarm relays are automatically reset or are reset to the initial position by pressing the Test/Reset button. The self test can take a few minutes.



### 3.2.2.2 Malfunction

In addition to the described self test, several functions in the insulation monitoring device are continuously checked during operation. If the error occurs again after restarting the device or after restoring the factory settings, please contact Bender Service.

### 3.2.2.3 Signalling assignment of the alarm relays K1/K2

Pre-alarm and test are assigned to relay 1 ("K1"). The main alarm and device fault are assigned to relay 2 ("K2").

### 3.2.2.4 Measuring and response times

The measuring time is the period essential for the detection of the measured value. The measuring time is reflected in the operating time  $t_{ae}$ . The measuring time for the insulation resistance value is mainly determined by the required measuring pulse duration, which depends on the insulation resistance  $R_F$  and system leakage capacitance  $C_e$  of the system to be monitored. Measuring pulse is produced by the measuring pulse generator integrated in the ISOMETER®. The measuring times for  $C_e$ ,  $U_{L1e}$ ,  $U_{L2e}$  and R % are synchronous. System disturbances may lead to extended measuring times. In contrast, the time for the nominal system voltage measurement  $U_n$  is independent and considerably shorter.

#### Response delay $t_{on}$

The response delay  $t_{on}$  can be set uniformly for all messages 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 measured value is exceeded 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.

#### Operating time $t_{ae}$

The operating time  $t_{ae}$  is the time required by the ISOMETER® to determine the measured value. For the measured insulation resistance value, it is dependent on the insulation resistance  $R_F$  and the system leakage capacitance  $C_e$ .

#### 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 $t_{\text{off}}$

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

#### 3.2.2.5 External, combined Test or reset button T/R

Reset = Press the external button < 1.5 s

Reset with subsequent test = Press the external button > 1.5 s

Stop measuring function = Press and hold the external button.

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.



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

#### 3.2.2.6 Fault memory

The fault memory can be activated or deactivated with the parameter "M". When the fault memory is activated, all pending relay alarm messages remain available until they are deleted using the reset button (internal/external), or the supply voltage  $U_S$  is turned off.

### 3.2.2.7 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). ASCII characters are used in the data transfer.



*The isoHV525-S4-4 ISOMETER® uses the device name "isoHV425" when it reports on the BMS bus.*

#### 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.



*The isoHV525-S4-4 ISOMETER® uses the device name "isoHV425-D4-4" when it reports on Modbus.*

#### 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 43](#).



*The IsoData protocol can only be terminated by sending the command "Adr3" during an interval of the isoHV525-S4-4 ISOMETER®.*

The parameter address, baud rate and parity for the interface protocols are configured via the RS-485 interface.



*With "Adr = 0", the IsoData protocol is activated. 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 9,600 baud. If the baud rate is set unequal to "---", the Modbus protocol with configurable baud rate is activated.*

## 4. Installation, connection and commissioning



*Only skilled persons are permitted to carry out the work necessary to install, commission and run a device or system.*



**DANGER**

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

- *An 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. Observe the rules for working on electrical installations.*



*For all connection cables to PE (terminals E and KE), the cross-section of the connection cable must be adapted to the back-up fuse of connections "A1" and "A2".*

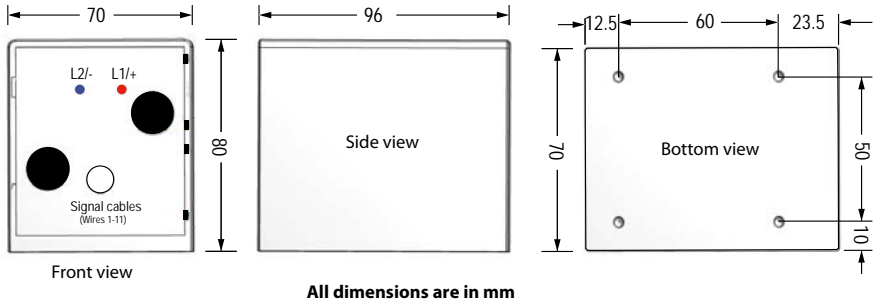
### 4.1 Mounting

#### **Screw mounting:**

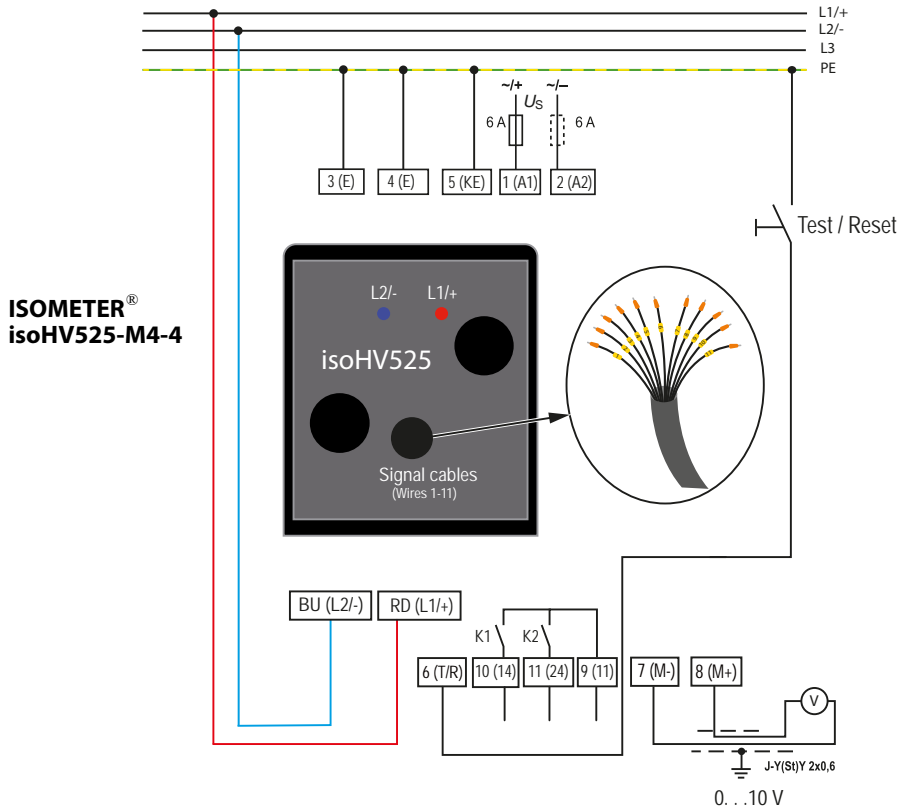
Fix the device with four M4 screws; see the dimension diagram on [Page 22](#).

### 4.2 Connecting the device

Wires 1 and 2 (corresponding to "A1" and "A2") have to be connected to the supply voltage  $U_s$  according to IEC 60364-4-43, which means, the connections have to be protected against short circuit by means of a protective device (a 6 A fuse is recommended). Concerning the connection of terminals "L1/+" (RD) and "L2/-" (BU) to the IT system to be monitored, devices for protection against a short circuit in accordance with IEC 60364-4-43 can be omitted if the wiring is carried out in such a way as to reduce the risk of a short circuit to a minimum. Only one ISOMETER® may be controlled via an external Test/Reset button. The parallel connection of several test or reset inputs for combined testing of ISOMETER®s is not allowed.

**Dimension diagram**


**isoHV525-M4-4:** Connect the device as shown in the wiring diagram below.



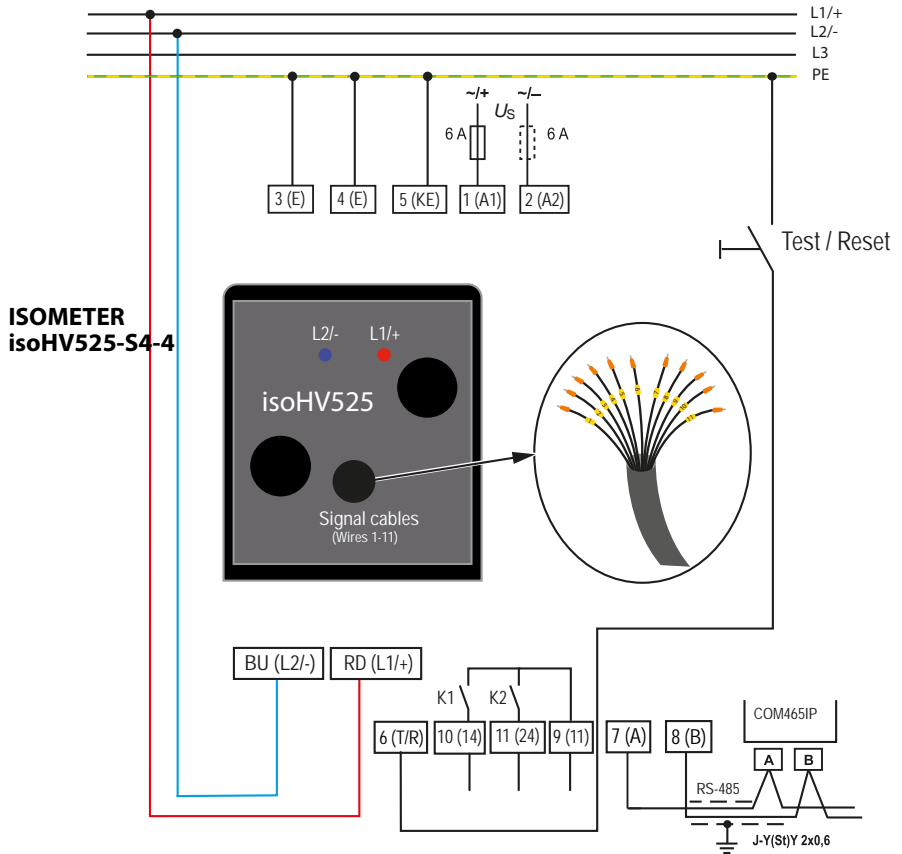


*The lower temperature range applies only when the cable is firmly laid or installed.*

#### Legend to the wiring diagram for isoHV525-M4-4:

Wire number	Terminal	Connection
<b>1</b> <b>2</b>	<b>A1</b> <b>A2</b>	Connection to the supply voltage $U_s$ via fuses (line protection): If supplied from an IT system, both lines have to be protected by a fuse.
<b>3 and 4</b> <b>5</b>	<b>E</b> <b>KE</b>	Connect each terminal separately to PE.
<b>6</b>	<b>T/R</b>	Connection for the external combined Test/Reset button
<b>7</b> <b>8</b>	<b>M-</b> <b>M+</b>	Analogue output
<b>9</b> <b>10</b> <b>11</b>	<b>11</b> <b>14</b> <b>24</b>	Common connection for "K1" und "K2" Connection to alarm relay "K1" Connection to alarm relay "K2"
<b>RD</b> <b>BU</b>	<b>L1/+</b> <b>L2/-</b>	Connection to the IT system to be monitored

**isoHV525-S4-4:** Connect the device as shown in the wiring diagram below.



*The lower temperature range applies only when the cable is firmly laid or installed.*



### Legend to the wiring diagram for isoHV525-S4-4:

Wire number	Terminal	Connection
1 2	A1 A2	Connection to the supply voltage $U_s$ via fuses (line protection): If supplied from an IT system, both lines have to be protected by a fuse.
3 and 4 5	E KE	Connect each terminal separately to PE.
6	T/R	Connection for the external combined Test/Reset button
7 8	A B	Serial RS-485 communication interface Example: connection of a BMS Ethernet gateway COM465IP
9 10 11	11 14 24	Common connection for "K1" and "K2" Connection to alarm relay "K1" Connection to alarm relay "K2"
RD BU	L1/+ L2/-	Connection to the IT system to be monitored

## 4.3 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 4 min.
3. **Start a manual self test** by pressing the Test/Reset button.  
Relay 1 ("K1") is switched during the self test.
4. **Check the function using a genuine insulation fault.**  
Check the ISOMETER® in the system being monitored against earth by using a suitable resistance, for example.

## 5. isoHV525-S4-4 parameter overview

### 5.1 Setting the response value

"R1" and "R2" are the two parameters that monitor the insulation resistance  $R_F$ . 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 value (see table below), the alarm will be cleared. The parameters "U <" and "U >" can be activated or deactivated to monitor the nominal system voltage  $U_n$ . The maximum undervoltage value is limited by the overvoltage value.

Parameter	Activation	Setting			Description	Available via	
		Range	FAC	Cs		BMS	Modbus
R1	<b>on</b>	R2 ... 500	<b>50</b>	k $\Omega$	Pre-alarm $R_{an1}$ Hys. = 25 %/min. 1k $\Omega$	X	X
R2	<b>on</b>	10... R1	<b>25</b>	k $\Omega$	Alarm value $R_{an2}$ Hys. = 25 %/min. 1k $\Omega$	X	X
U<	<b>off</b>	30 ... "U>"	<b>30</b>	V	Alarm value Undervoltage RMS Hys. = 5 %/min. 5 V	X	X
U>	<b>off</b>	"U<"... 1,10k	<b>1100</b>	V	Alarm value Overvoltage RMS Hys. = 5 %/min. 5 V	X	X

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

### 5.2 Configuration of the relay operating mode

Relay K1		Relay K2		Description	Available via	
FAC	Cs	FAC	Cs		BMS	Modbus
<b>n.c.</b>		<b>n.c.</b>		Relay operating mode (n.c./n.o.).	X	X

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

### 5.2.1 Alarm assignment "r1" and "r2"

In the alarm assignment, each notification/alarm is assigned to the corresponding relay with the setting "on". In the event of an unsymmetrical insulation fault, only the alarm corresponding to the assigned and affected conductor (L1/+ or L2/-) will be set.

K1 „r1“		K2 „r2“		Alarm description	Available via	
FAC	Cs	FAC	Cs		BMS	Modbus
off		on		Device error E.xx	X*	X
on		off		Pre-alarm R1 Fault $R_F$ on L1/+	X*	X
on		off		Pre-alarm R1 Fault $R_F$ on L2/-	X*	X
off		on		Alarm R2 Fault $R_F$ on L1/+	X*	X
off		on		Alarm R2 Fault $R_F$ on L2/-	X*	X
off		on		Alarm $U_n$ Undervoltage	X*	X
off		on		Alarm $U_n$ Overvoltage	X*	X
off		off		Manually started device test		X
off		off		Device start with Alarm (S.AL)		X

FAC = Factory setting; Cs = Customer setting

\* Value can be read only. Assigning a new value is not possible.

### 5.2.2 Fault memory configuration

FAC	Cs	Description	Available via	
			BMS	Modbus
off		Memory function for alarm messages (fault memory)	X	X

FAC = Factory setting; Cs = Customer setting

### 5.3 Interface configuration

Setting			Description		Available via	
Range	FAC	Cs			BMS	Modbus
0 / 3 ... 90	<b>3</b>	( )	BusAdr.	Adr = 0 deactivates BMS as well as Modbus and activates isoData with continuous data output (115k2, 8E1)	X	X
---/ 1,2k ... 115k	"---"	( )	Baud rate	"---" --> BMS bus (9k6, 7E1) "1,2k" ... "115k2" --> Modbus (variable, variable)	X	X
8E1 8o1 8n1	<b>8E1</b>	( )	Modbus	<b>8E1</b> - 8 Data bits even parity, 1 Stop bit <b>8o1</b> - 8 Data bits odd parity, 1 Stop bit <b>8n1</b> - 8 Data bits no parity, 1 Stop bit		X

FAC = Factory setting; Cs = Customer setting;  
( ) = User setting that is not modified by FAC.

### 5.4 Time configuration

Parameter	Setting			Description	Available via	
	Range	FAC	Cs		BMS	Modbus
t	0 ... 10	<b>0</b>	s	Start-up delay when starting the device	X	X
ton	0 ... 99	<b>0</b>	s	Response delay for K1 and K2	X	X
toff	0 ... 99	<b>0</b>	s	Delay on release for K1 and K2	X	X
test	OFF / 1 / 24	<b>24</b>	h	Repetition time for device test	X	X

FAC = Factory setting; Cs = Customer setting;

## 5.5 Function configuration

Parameter	Activation		Description	Available via	
	FAC	Cs		BMS	Modbus
nEt	on		Test system connection during device test	X	X
S.Ct	on		Device test during device start		X

FAC = Factory setting; Cs = Customer setting

## 5.6 Measured value description

Description	
<b>Insulation resistance</b>	$R_F$
1 k $\Omega$ ... 4 M $\Omega$	Resolution 1 k $\Omega$
<b>System leakage capacitance</b>	$C_e$
1 $\mu$ F ... 200 $\mu$ F	Resolution 1 $\mu$ F
<b>Nominal system voltage L1 - L2</b>	$U_n$
0 V <sub>RMS</sub> ... 1.15k V <sub>RMS</sub>	Resolution 1 V <sub>RMS</sub>
<b>Residual voltage L1/+ - PE</b>	$U_{L1e}$
0 V <sub>DC</sub> ... 1.15k V <sub>DC</sub>	Resolution 1 V <sub>DC</sub>
<b>Residual voltage L2/- - PE</b>	$U_{L2e}$
0 V <sub>DC</sub> ... 1.15k V <sub>DC</sub>	Resolution 1 V <sub>DC</sub>
<b>Fault location in %</b>	
-100 % ... +100 %	
<b>Insulation resistance</b>	$R_{UGe}$
1 k $\Omega$ ... 4 M $\Omega$	Resolution 1 k $\Omega$

## 6. Data access to the isoHV525-S4-4 using the BMS protocol

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

BMS channel no.	Operation value	Alarm
1	$R_F$	Pre-alarm R1
2	$R_F$	Alarm R2
3	$C_e$	----
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	$U_{L1e}$	---
11	$U_{L2e}$	---
12	Update counter	---
13	$R_{UGe}$	---
14	---	---
15	---	---

## 7. Data access to the isoHV525-S4-4 using the Modbus RTU protocol

Requests to the ISOMETER® can be made using the function code 0x03 (read multiple registers) or the command 0x10 (write multiple registers). The ISOMETER® generates a function-related answer and sends it back.

### 7.1 Reading the Modbus register from the ISOMETER®

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

#### 7.1.1 Master device sends a command to the ISOMETER®

In the following example, the ISOMETER® master requests the content of register 1003 with 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

#### 7.1.2 The ISOMETER®s answers 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

## 7.2 Writing to the Modbus register (parameter setting)

Registers in the device can be modified with the Modbus command 0x10 (set multiple registers). Parameter registers are available from address 3000. The content of the register is listed in the table on [Page 40](#).

### 7.2.1 Master device sends a command to the ISOMETER®

In this example, the Master addresses the ISOMETER® with address 3 and requests that the content of the register with 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

### 7.2.2 The ISOMETER®s answers 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



## 7.3 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)

### 7.3.1 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

## 8. ISOMETER® Modbus register assignment

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

Register	Measured value			Device fault
	Without alarm	Alarm 1	Alarm 2	
1000 to 1003	<b>R<sub>F</sub></b> Insulation fault (71) [no alarm]	<b>R<sub>F</sub></b> Insulation fault (1) [prewarning]	<b>R<sub>F</sub></b> Insulation fault (1) [alarm]	--- Connection earth (102) [device fault]
1004 to 1007	---	---	---	---
1008 to 1011	<b>U<sub>n</sub></b> Voltage (76) [no alarm]	<b>U<sub>n</sub></b> Undervoltage (77) [alarm]	<b>U<sub>n</sub></b> Overvoltage (78) [alarm]	--- Connection to system (101) [device fault]
1012 to 1015	<b>C<sub>e</sub></b> Capacitance (82) [no alarm]	---	---	---
1016 to 1019	<b>U<sub>L1e</sub></b> Voltage (76) [no alarm]	---	---	---
1020 to 1023	<b>U<sub>L2e</sub></b> Voltage (76) [no alarm]	---	---	---
1024 to 1027	Fault location in % --- (1022) [no alarm]	---	---	---
1028 to 1031	<b>R<sub>UGe</sub></b> Insulation fault (71) [no alarm]	---	---	---
1032 to 1035	Measured value update counter --- (1022) [no alarm]	---	---	--- Device error (115) [device fault]

( ) = Channel description code (see [Chapter 8.2](#)); [ ] = Alarm type (see [Chapter 8.1.2.2](#))

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 ... 500
3006	RW	Reserved	---	---	---
3007	RW	Alarm value resistance measurement "R2"	UINT 16	kΩ	10 ... R1
3008	RW	Activation alarm value undervoltage "U<"	UINT 16	---	0 = Inactive 1 = Active
3009	RW	Alarm value undervoltage "U<"	UINT 16	V	30 ... U>
3010	RW	Activation alarm value overvoltage "U>"	UINT 16	---	0 = Inactive 1 = Active
3011	RW	Alarm value Overvoltage "U >"	UINT 16	1/10 V	U< ... 1100
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 = 1.2 k 2 = 2.4 k 3 = 4.8 k 4 = 9.6 k 5 = 19.2 k 6 = 38.4 k 7 = 57.6 k 8 = 115.2 k

Register	Property	Description	Format	Unit	Value range
3017	RW	Parity "Adr 2"	UINT 16	---	0 = 8N1 1 = 8O1 2 = 8E1
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 2 = 24
3022	RW	Reserved	---	---	---
3023	RW	Reserved	---	---	---
3024	RW	Checking 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 <a href="#">Chapter 8.1.3</a>
3028	RW	Alarm assignment of relay 2 "r2"	UINT 16	---	Bit 9 ... Bit 1 See <a href="#">Chapter 8.1.3</a>
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"
9800 to 9809	RO	Device name	UNIT 16 (ASCII) - refer to <a href="#">Chapter 8.1.1</a>	---	---

Register	Property	Description	Format	Unit	Value range
9820	RO	Software ID number	UINT 16	---	Software D 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

## 8.1 Device-specific data type of the ISOMETER®

### 8.1.1 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						

### 8.1.2 Measured value

Each measured value is available as a channel and consists of 8 bytes (4 registers). The first measured 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	

#### 8.1.2.1 Float = Floating point value of the channels

Word	0x00																0x01															
	HiByte								LoByte								HiByte								LoByte							
Bit	31	30						24	23	22					16	15					8	7						0				
	S	E	E	E	E	E	E	E	E	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M				

Representation of the bit order for processing analogue measured values according to IEEE 754  
**S** = Sign; **E** = Exponent; **M** = Mantissa

#### 8.1.2.2 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	Fault		
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 fault
	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
<b>Test</b>	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 the bits 0 to 2. Bits 3, 4 and 5 are reserved and always have the value 0. Bit 6 or 7 is 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.

### 8.1.2.3 R&U = Range and unit


Bit	7	6	5	4	3	2	1	0	Meaning
<b>Unit</b>	-	-	-	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	1	0	Second
	-	-	-	0	1	1	1	0	Minute
-	-	-	0	1	1	1	1	Hour	
-	-	-	0	1	1	1	1	Day	
-	-	-	1	0	0	0	0	Month	
<b>Range of validity</b>	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.

### 8.1.3 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. 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 < $\Omega$	Prealarm R1 - Fault $R_F$ at L1/+
3	rx -R1 < $\Omega$	Prealarm R1 - Fault $R_F$ at L2/-
4	rx +R2 < $\Omega$	Alarm R2 - Fault $R_F$ at L1/+
5	rx -R2 < $\Omega$	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



## 8.2 Channel description

Value	Measured value description/alarm message operating message	Note
0		
1 (0x01)	Insulation fault	
71 (0x47)	Insulation fault	Insulation resistance $R_F$ in $\Omega$
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 fault	ISOMETER® fault
129 (0x81)	Device fault	
145 (0x91)	Own address	

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

<b>Value</b>	<b>Description of parameters</b>
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, device 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

## 9. IsoData data string

In IsoData mode, the ISOMETER® continuously sends the entire data string with a cycle time of approximately 1 second. Communication with the ISOMETER® in this mode is not possible and no additional sender may be connected to the RS-485 bus cable.

IsoData is activated by setting  $Adr = 0$ . The IsoData protocol can only be terminated by sending the command "Adr3" during an interval of the isoHV525-S4-4.

String	Description
;	Start symbol
v;	Insulation fault location ' ' / '+' / '-'
1234, 5;	Insulation resistance $R_F$ [k $\Omega$ ]
1234;	System leakage capacitance $C_e$ [ $\mu$ F]
1234, 5;	Reserved
+1234;	Nominal system voltage $U_n$ [ $V_{RMS}$ ] 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 [%]
1234, 5;	Approximate asymmetrical insulation resistance $R_{UGe}$ [k $\Omega$ ]
1234;	Alarm message [Hexadezimal] (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/- 0x0010 Alarm insulation resistance $R_F$ an L1/+ 0x0020 Alarm insulation resistance d $R_F$ an L2/- 0x0030 Alarm insulation resistance $R_F$ symmetrical 0x0040 Alarm undervolatge $U_n$ 0x0080 Alarm overvoltage $U_n$ 0x0100 System test message 0x0200 Device start with alarm
1	Update counter, consecutively counts from 0 to 9. It increases with the update of the insulation resistance value.
<CR><LF>	End of string

## 10. Technical data

### 10.1 Tabular representation

( )\* = Factory settings

#### 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, M+(A), M-(B)
Rated voltage .....	1000 V
Overvoltage category .....	III

##### Rated impulse voltage:

IC1/(IC2-4) .....	8 kV
IC2/(IC3-4) .....	4 kV
IC3/IC4 .....	4 kV

##### Rated insulation voltage:

IC1/(IC2-4) .....	1,000 V
IC2/(IC3-4) .....	250 V
IC3/IC4 .....	250 V

Pollution degree .....	3
------------------------	---

##### Safe isolation (reinforced insulation) between:

IC1/(IC2-4) .....	Overvoltage category III, 1000 V
IC2/(IC3-4) .....	Overvoltage category III, 300 V
IC3/IC4 .....	Overvoltage category III, 300 V

##### Voltage tests (routine test) acc. 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 .....	$\leq 3$ W, $\leq 9$ VA

### IT system being monitored

Nominal system voltage $U_n$ .....	AC 0...1,000 V/DC 0...1,000 V
Tolerance of $U_n$ .....	AC +10 %, DC +10 %
Frequency range of $U_n$ .....	DC, 15...460 Hz

### Measuring circuit

Permissible system leakage capacitance $C_e$ .....	≤ 150 μF
Permissible extraneous DC voltage $U_{fg}$ .....	≤ 1,600 V
Measuring voltage $U_m$ .....	±45 V
Measuring current $I_m$ bei $R_F$ .....	120 μA
Internal resistance $R_i$ .....	390 kΩ

### Response values

#### ISOMETER isoHV525-S4-4:

Response value $R_{an1}$ .....	11...500 kΩ (50 kΩ)*
Response value $R_{an2}$ .....	10...490 kΩ (25 kΩ)*
Relative uncertainty $R_{an}$ .....	±15 %, at least ±3 kΩ
Hysteresis $R_{an}$ .....	25 %, at least 1 kΩ
Undervoltage detection.....	30...1.09 kV (off)*
Overvoltage detection.....	31...1.10 kV (off)*
Relative uncertainty $U$ .....	±5 %, at least ±5 V
Relative uncertainty depending on the frequency ≥ 200 Hz.....	-0.075 %/Hz
Hysteresis $U$ .....	5 %, at least 5 V

#### ISOMETER isoHV525-M4-4:

Response value $R_{an1}$ .....	(for customized variant refer to the name plate) 50 kΩ*
Response value $R_{an2}$ .....	(for customized variant refer to the name plate) 25 kΩ*
Relative uncertainty $R_{an}$ .....	±15 %, at least ±3 kΩ
Hysteresis $R_{an}$ .....	25 %, at least 1 kΩ

### Time response

Response time $t_{an}$ at $R_F = 0.5 \times R_{an}$ and $C_e = 1 \mu F$ acc. to IEC 61557-8.....	≤ 20 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)*

### Measured values, storage

#### ISOMETER isoHV525-S4-4:

Insulation resistance measured value range ( $R_F$ ).....	1 kΩ...4 MΩ
Operating uncertainty.....	±15 %, at least ±3 kΩ
Nominal system voltage measured value range ( $U_n$ ).....	30...1.15 kV r.m.s.

Operating uncertainty.....	±5 %, at least ±5 V
System leakage capacitance measured value range $R_F > 20 \text{ k}\Omega$ .....	0 . . . 200 $\mu\text{F}$
Operating uncertainty.....	±15 %, at least ±2 $\mu\text{F}$
Password .....	off/0 . . . 999 (0, off)*
Fault memory alarm messages .....	on/(off)*

#### ISOMETER isoHV525-M4-4:

Insulation resistance measured value range ( $R_F$ ) .....	1 $\text{k}\Omega$ . . . 4 $\text{M}\Omega$
Operating uncertainty.....	±15 %, at least ±3 $\text{k}\Omega$

#### Serial interface (valid for isoHV525-S4-4 devices only)

Interface/protocol .....	RS-485/BMS, Modbus RTU, isoData
Baud rate .....	BMS (9.6 kbit/s), Modbus RTU (selectable), isoData (115.2 kbits/s)
Cable length (9.6 kbits/s) .....	≤ 1,200 m
Cable: twisted pairs, shield connected to PE on one side .....	min. J-Y(St)Y 2x0.6
Device address, BMS bus, Modbus RTU .....	3 . . . 90 (3)*

#### Analogue output (valid for isoHV525-M4-4 only)

Operating mode.....	Mid-scale 120 $\text{k}\Omega$
Functions.....	Insulation value
Voltage.....	0 . . . 10 V ( $\geq 20 \text{ k}\Omega$ )
Tolerance.....	±10 %, +2 % of the full scale value

#### Switching elements

Switching elements .....	2 x 1 N/O contact, 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
Minimum contact rating .....	1 mA at AC/DC $\geq 10 \text{ V}$

#### Environment/EMC

EMC .....	IEC 61326-2-4, EN 50121-3-2
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#### Ambient temperatures:

Operation:	
( $U_n < 700 \text{ V}$ ) .....	-55 . . . +70 °C
( $U_n > 700 \text{ V}$ ) .....	-55 . . . +55 °C
Transport .....	-55 . . . +85 °C
Storage .....	-55 . . . +70 °C

**Classification of climatic conditions acc. to IEC 60721:**

Stationary use (IEC 60721-3-3) .....	3K8
Transport (IEC 60721-3-2) .....	2K4
Long-term storage (IEC 60721-3-1).....	1K6

**Classification of mechanical conditions acc. to IEC 60721:**

Stationary use (IEC 60721-3-3) .....	3M7
Transport (IEC 60721-3-2) .....	2M4
Long-term storage (IEC 60721-3-1) .....	1M12

**Connection type**

isoHV525-M4-4 .....	0.8 m connection cable
isoHV525-S4-4 .....	3 m connection cable
Minimum bending radius of the connection cable .....	> 40 mm

**Other**

Operating mode .....	continuous operation
Degree of protection, built-in components (DIN EN 60529) .....	IP65
Device housing material .....	ABS UL94-V0 (filled with Wevo PUR403FL)
Screw mounting .....	4 x M4 (screw depth max. 7 mm)
Tightening torque .....	max. 3 Nm (26 lb-in)
Weight.....	≤ 1,100 g

## 10.2 Standards, approvals and certifications

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

- EN 61557-8 (VDE 0413-8): 2015-12/Ber1: 2016-12
- EN 50155: 2008-03
- IEC 61557-8: 2014/COR1: 2016
- EN 45545-2: 2013 + A1: 2015
- UL94 V0

Subject to change! The specified standards take into account the edition valid until 07.2019 unless otherwise indicated.



## 10.3 Ordering information

Type	Version	Article number
isoHV525-M4-4	Analogue output	B91036530
isoHV525-S4-4	Serial interface	B91036531



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