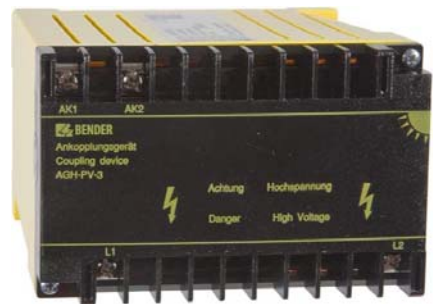




ISOMETER® isoPV coupling device AGH-PV

AC/DC

PV



Insulation monitoring device for unearthed
IT AC, AC/DC and DC systems
for photovoltaic systems up to AC 793 V/DC 1100 V
Software version: D351 V2.0

optec

energie ist messbar

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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!



Please read this manual **before** mounting, connecting and commissioning the device. Always keep this manual within easy reach for future reference.

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:



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



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



This signal word indicates a **medium risk of danger** that can lead to **death** or **serious injury** 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
E-mail: support@bender-service.de

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 guarantee for Bender devices, which includes an in-house repair service or replacement devices 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.de

Please send the devices for **repair** to the following address:

Bender GmbH, Repair-Service,
Londorfer Str. 65,
35305 Grünberg

1.2.3 Field service

On-site service for all Bender products

- Commissioning, configuring, maintenance, troubleshooting of 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.de

Internet: 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.com -> 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.) (German Electrical and Electronic Manufacturer's Association) also applies.

Sale 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 13 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.com -> 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 **qualified personnel** 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

The ISOMETER[®] is intended for:

- monitoring the insulation resistance of IT systems

Use which deviates from or is beyond the scope of the intended use is considered non-compliant. The Bender companies shall not be liable for any losses or damage arising therefrom.

Intended use also implies:

- compliance with all information in this operating manual and
- compliance with any test intervals

2.3.1 Personnel

Only appropriately qualified personnel may work on the ISOMETER®. Qualified means familiar with the installation, commissioning and operation of the product and with training appropriate to the work. Personnel must have read and understood the safety section and warning information in this operating manual.

2.3.2 Hazards when handling the ISOMETER® isoPV

The ISOMETER® is constructed according to the state-of-the-art and the recognised technical safety rules. Nevertheless, when it is being used, hazards may occur to the life and limb of the user or third parties or there may be adverse effects on the ISOMETER® or on other valuable property. Only use the ISOMETER®:

- within the scope of its intended use
- in perfect working order

Any faults which may impair safety must be eliminated immediately. Impermissible modifications and the use of spare parts and additional devices which are not sold and recommended by the manufacturer of the devices may cause fires, electric shocks and injuries.

Unauthorised persons must not have access to or contact with the ISOMETER®.

Warning signs must always be easily legible.

Damaged or illegible signs must be replaced immediately.

In order to meet the requirements of the 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.

2.3.3 Note

Make sure that the operating voltage is correct!

Prior to insulation and voltage tests, the ISOMETER® must be disconnected from the power system for the duration of these tests.

In order to check the proper connection of the device, it is recommended to carry out a functional test.

Make sure that the basic settings meet the requirements of the IT system.

Children and unauthorised persons must not have access to or contact with the ISOMETER®.

2.4 Directions for installation



Only one insulation monitoring device may be used in each interconnected IT system.

When insulation or voltage tests are to be carried out, the device shall be isolated from the system for the test period..

The terminals \equiv and KE have to be connected by a separate wire to the protective conductor (PE). If the terminals L1, L2 of the device are connected to an IT system under operation, the terminals \equiv and KE must not be disconnected from the protective conductor (PE).

In order to check the proper connection of the device, it is recommended to carry out a functional test using a genuine insulation fault RF, e.g. via a suitable resistance, before starting the ISOMETER.

The device variant -3.. is delivered with the following factory setting:

ISO SETUP:	Alarm 1/Alarm 2 (response values) = 4 k Ω /1 k Ω
ISO SETUP:	Operating mode K1/K2 = N/O operation (N.O.)
ISO SETUP:	Memory = off
ISO ADVANCED:	System leakage capacitance = 2,000 μ F Measurement method = AMP4
COM SETUP:	Bus address = 3 (slave)

Please check if the basic setting of the ISOMETER® complies with the requirements of the IT system to be monitored.

Response value R_{an}

For correct setting of the response value in k Ω , it is useful to know the present value of the insulation resistance of the photovoltaic system.

Subject to the IEC 62109-2 standard, a drop in insulation resistance at the input of the photovoltaic inverter below a specified minimum value is not permitted. This resistance is dependent on the performance range of the photovoltaic system.

For systems ≤ 30 kVA it is imperative that:

the insulation resistance between the inverter input and the earth is at least 500 k Ω . For mains voltages greater than 500 V the formula below applies:

$$R = \frac{1 \text{ k}\Omega}{V} \cdot V_{\text{maxPV}}$$

For systems > 30 kVA the following formula applies:

$$R = \frac{5000 \text{ V} \cdot V_{\text{maxPV}}}{P_{\text{max}}}$$

 V_{maxPV}

= Maximum value of the photovoltaic system voltage

 P_{max}

= Maximum value of the active power of the photovoltaic system



When an AC system being monitored contains galvanically coupled DC circuits: An insulation fault can only be monitored correctly when the rectifiers carry a continuous load current of 5... 10 mA.

3. Function

3.1 Features isoPV

- ISOMETER® for IT AC systems with galvanically connected rectifiers or converters and for IT DC systems (IT = unearthed systems)
- Particularly suitable for monitoring photovoltaic systems
- isoPV is always operated in combination with the coupling device AGH-PV
- Automatic adaptation to the existing system leakage capacitance
- **AMP^{Plus}**-Measurement method (European Patent: EP 0 654 673 B1)
- Choice of measurement methods to meet different requirements
- Two separately adjustable response ranges of 0.2 kΩ...100 kΩ each (Alarm 1, Alarm 2)
- Two-line LC display
- Automatic device self test
- Memory with real-time clock to store alarm messages with date and time stamp
- BMS interface (Bender Measuring Device Interface) for communication with other Bender devices (RS-485 galvanically isolated)
- Internal disconnection of the ISOMETER® (via control signal; terminals F1/F2) from the IT system to be monitored (e.g. if several ISOMETER®s are interconnected)
- Current output 0(4)...20 mA (electrically isolated) in relation to the measured insulation value

3.2 Features AGH-PV

- Coupling device required for ISOMETER® isoPV, each AGH-PV is specially designed for the corresponding isoPV
- Nominal voltage range AC 0...793 V and DC 0...1,100 V
- DIN rail mounting

3.3 Application

The ISOMETER[®] type isoPV in combination with the AGH-PV coupling device monitors the insulation resistance of IT systems. It is suitable for universal use in 3(N) AC, AC/DC and DC systems. AC systems may include extensive DC-supplied loads, such as converters or thyristor-controlled DC drives. The adaptation to the existing system leakage capacitances takes place automatically.

Only use the AGH-PV coupling device supplied with the device for adaptation of the nominal voltage range.



The two devices isoPV and AGH-PV are ideally adapted to each other. The corresponding combination device required in each case can be identified via the serial number on the device label.



For repair work, both devices should be sent in in order to guarantee measuring accuracy. Otherwise, the measuring accuracy might be reduced!

isoPV can share the BMS bus with other bus devices.

3.4 Description of function

The ISOMETER[®] isoPV is connected between the unearthed system (IT system) and the protective conductor (PE) using the coupling device AGH-PV.

The response values and other function parameters are set via the function buttons. The parameters are indicated on the LC display and are stored in a non-volatile memory (EEPROM).

A microprocessor-controlled pulsating AC measuring voltage is superimposed on the IT system to be monitored (**AMPPlus**-measurement method*).

The measuring pulse consists of positive and negative cycles of the same amplitude. The period depends on the respective system leakage capacitances and the insulation resistance of the system to be monitored.

An insulation fault between system and earth closes the measuring circuit. The evaluation circuit calculates the insulation resistance which is indicated on the LC display or the external kW measuring instrument after the measuring time has expired.

The measuring time is dependent on the selected measurement method, the system leakage capacitance, the insulation resistance and the system-related disturbances. System leakage capacitances do not influence the measuring accuracy.

If the reading is below the selected response values Alarm 1/Alarm 2, the associated alarm relays respond, the LEDs "Alarm 1/2" light up and the measuring value is indicated on the LC display (in the event of DC insulation faults, the faulty supply line is indicated). If the terminals R1/R2 are bridged (external reset button [N/C contact] or wire jumper), the fault message will be stored. Pressing the reset button, resets the fault message, provided that the insulation resistance is at least above 25 % and at least 1 k Ω above the actual response value. The fault memory behaviour can also be set in the "ISO SETUP" menu, by selecting the submenu Memory: on/off.

*) **AMPPlus** measurement method (Adaptive Measuring Pulse), a measurement method developed by Bender (European Patent: EP 0 654 673 B1).

3.4.1 Measurement profiles

The measuring circuit of isoPV can be adjusted in the ISO ADVANCED/MEASURE menu to match different requirements:

DC = Suitable for pure AC systems

AMP = Suitable for converters with frequencies > 10Hz

AMP2 = Suitable for converters with frequencies < 10Hz

AMP3 = Suitable for photovoltaic plants with crystalline cells

AMP4 = Suitable for photovoltaic plants with thin-layer cells

Also refer to the measurement methods table starting from Page 42.



3.4.2 Self test

A self test can be started automatically or manually by means of the test button. In order to guarantee high functional reliability, the ISOMETER[®] provides comprehensive self test functions. After switching the device to the supply voltage, all internal measuring functions, the components of the process control, such as data and parameter memory as well as system and earth connections, are checked using the self test functions. The progress of the self test is shown on the display by a bar graph. Depending on the IT system conditions, the self test is completed after 15...20 seconds, then the message "Test ok!" appears on the display for approximately two seconds. Then the device returns to the normal measuring mode and the currently measured value will be displayed once the measuring time has elapsed.

When a device or connection fault is found, the message "Error!" appears on the display, the device error LED lights, the relay K2 (21-22-24) switches and the corresponding fault message (see table) will be indicated. If such a device error occurs, another self test will be started after approximately one minute. If no more faults are detected, the fault message will automatically be deleted, the system fault LED will go out.

During operation, the self test function can be started by pressing the test button (internal or external). The self test can also be started automatically every hour or every 24 hours by selecting the "ISO ADVANCED: Autotest:" menu.

The alarm relays 1/2 only switch after starting the self test function by pressing the test button, that means the relays do not switch when an automatic self test has been started.

Alarm message	Description	Actions
Connection PE?	No low-resistance connection between the terminals  and KE and the earth (PE).	<ol style="list-style-type: none"> 1. Check the wiring of the terminals  and KE and the earth (PE) 2. Press the "TEST" button 3. Switch the supply voltage off and on
Device error x	Internal device error	<ol style="list-style-type: none"> 1. Press the "TEST" button 2. Switch the supply voltage off and on 3. Please contact Bender



If, for functional reasons, the supply voltage cannot be switched on and off, a reset of the sequence control system can be carried out by pressing the buttons "RESET", "MENU" and "TEST" sequentially.

3.4.3 Current output for external measuring instrument

The isoPV utilises a current output electrically isolated from the device electronics and the RS-485 interface.

An output current range of 0...20 mA or 4...20 mA can be selected by means of the ISO SETUP menu, refer to Page 40. In addition, the centre scale mark can be set to 28k Ω or 120k Ω , related to an external measuring instrument.

3.4.4 Real-time clock

The real-time clock serves as a time base for the memory and self test functions. First, the correct time and date must be set in the "ISO ADVANCED" menu. If time and date are not set, a "C" (clock) is flashing in the standard display. In the event of a supply voltage failure, time and date will be stored for at least 30 days.

When the 24 h self test is activated in the ISO ADVANCED menu, it is possible to set the time (hour) for carrying out the self test by means of the "TEST: 12:00" menu. Then a self test will be started automatically once a day exactly at the preset time. If the 1 h test has been selected, the self test is automatically carried out every full hour.

3.4.5 Coupled IT systems

When using ISOMETER[®]s in IT systems, make sure that only one active ISOMETER[®] is connected in each interconnected system. If IT systems are interconnected via coupling switches, make sure that ISOMETER[®]s not currently used are disconnected from the IT system and deactivated. IT systems coupled via diodes or capacitances may also influence the insulation monitoring process so that a central control of the different ISOMETER[®]s is required.

3.4.6 Function input F1/F2 for connection or disconnection of IT systems being monitored

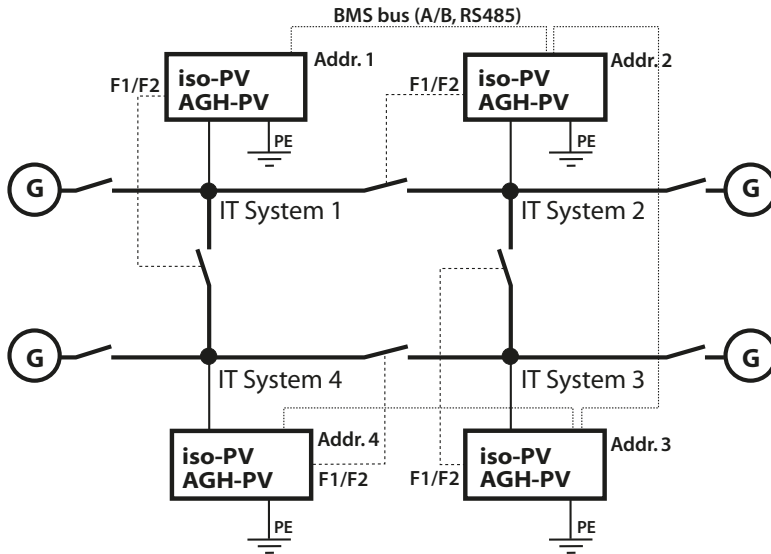
The ISOMETER[®] can be disconnected from the IT system and set to STANDBY mode with the function input F1/F2. If the input F1/F2 is bridged, the connections to the coupling device AK1/AK2 are switched off via internal coupling relays, the measuring function is stopped and the message "STANDBY" appears on the display. Instead of the most recently measured value the value > 1 MW will be indicated. Furthermore, the alarm relays and alarm LEDs stop signalling alarm messages.

After opening the function input F1/F2, the connection to the IT system will be restored and a completely new insulation resistance measurement cycle is started.

This function can be used to disconnect selectively individual isoPVs via auxiliary contacts of the respective coupling switch. One coupling switch each in a line-type or ring-type arrangement can deactivate a subsequent isoPV to ensure that only one ISOMETER[®] is active in each galvanically connected IT system.

If in a ring-type arrangement all coupling switches are closed, theoretically all

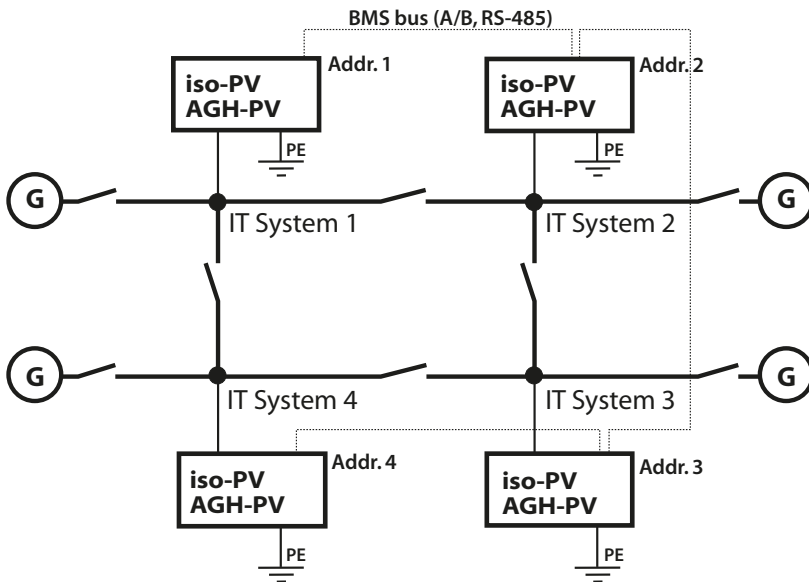
ISOMETER[®]s would be deactivated. In order to prevent this, a BMS master (BMS addr. 1) monitors the condition of the function input F1/F2 of all slave ISOMETER[®]s. When all slave ISOMETER[®]s are in the STANDBY mode, the insulation monitoring function of the master ISOMETER[®] and hence the function input F1/F2 of the master are without function in this mode. Details are illustrated in the graphic below:



3.4.7 ISONet function (COM SETUP)

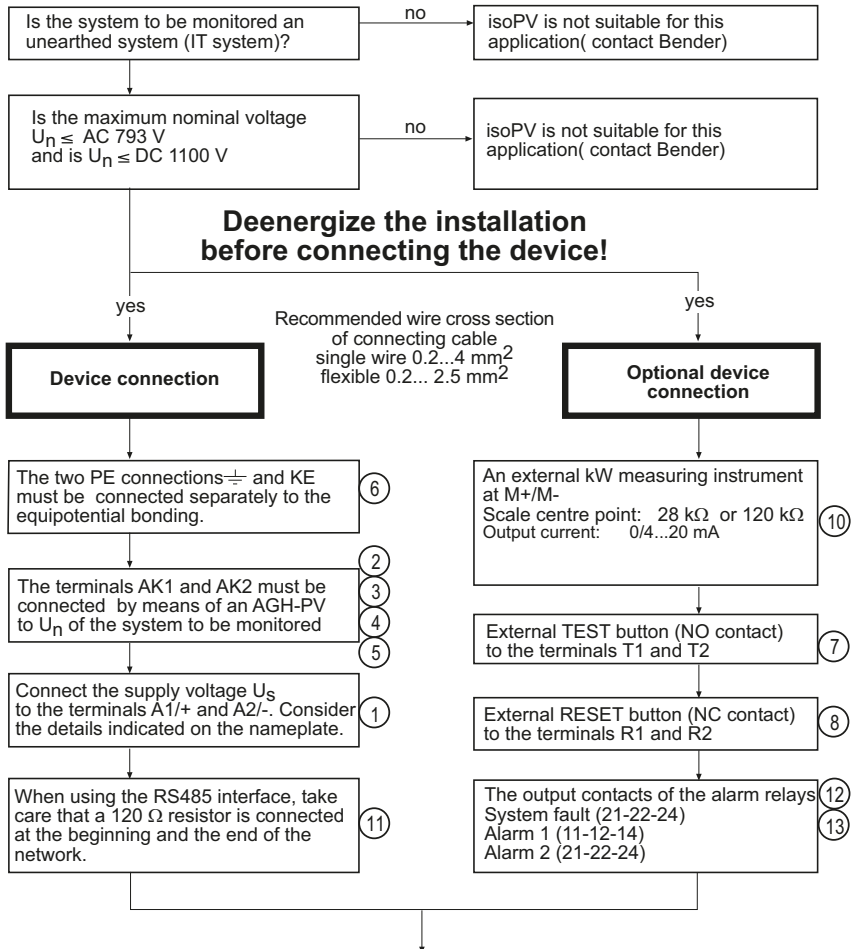
To activate this function, select "ISONet=ON" in the COM SETUP menu. This function is a type of scanning function. The BMS master with activated ISONet function controls the ISONet slave devices via the BMS bus. When the master ISOMETER[®] has finished one measuring cycle, the authorisation for insulation monitoring is passed on to the next higher BMS address. During the insulation monitoring process, all other ISOMETER[®]s are in the STANDBY mode. In this way it is prevented that ISOMETER[®]s influence each other in interconnected IT systems. In comparison to a solution with coupling switches and function input F1/F2, the response time will be extended because the measurement is not permanently carried out. This has the advantage that no auxiliary contacts of a coupling switch are required. Furthermore, this solution is recommended for IT systems coupled via capacitances or diodes.

Each ISONet slave checks the network for an ISONet master. If there is no master available, the display will show the fault message "ISONet Master?" With the ISONet function activated, the function input F1/F2 is automatically deactivated.

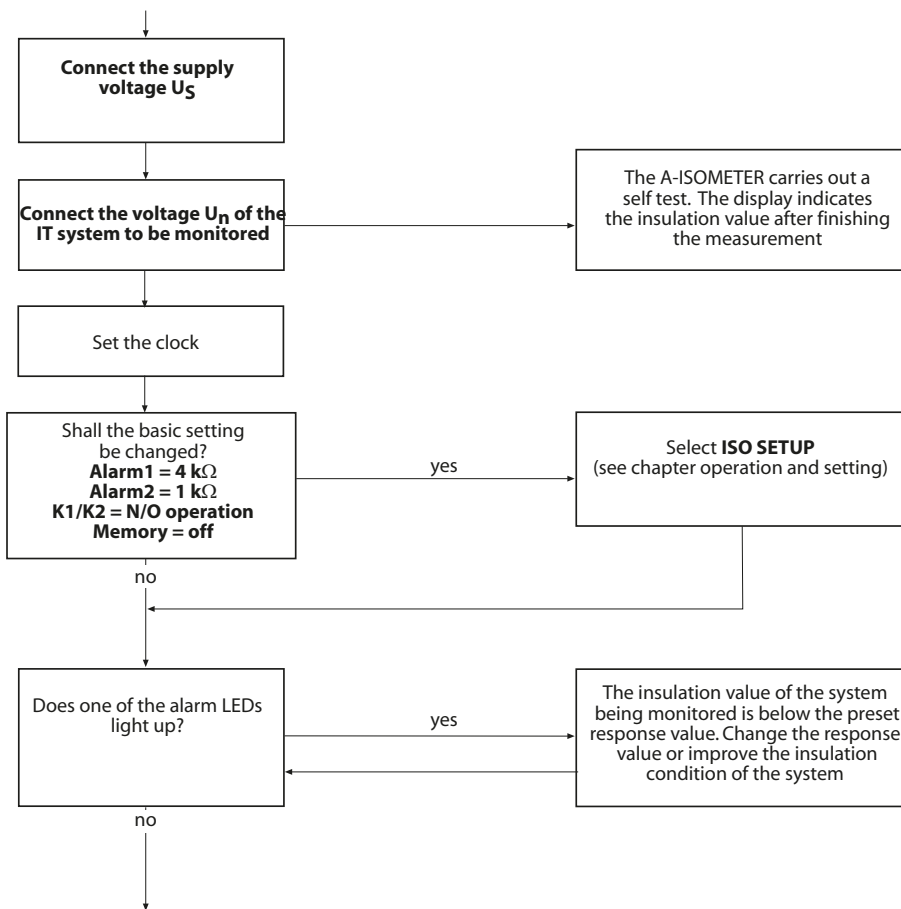


4. Commissioning flow chart (threepart)

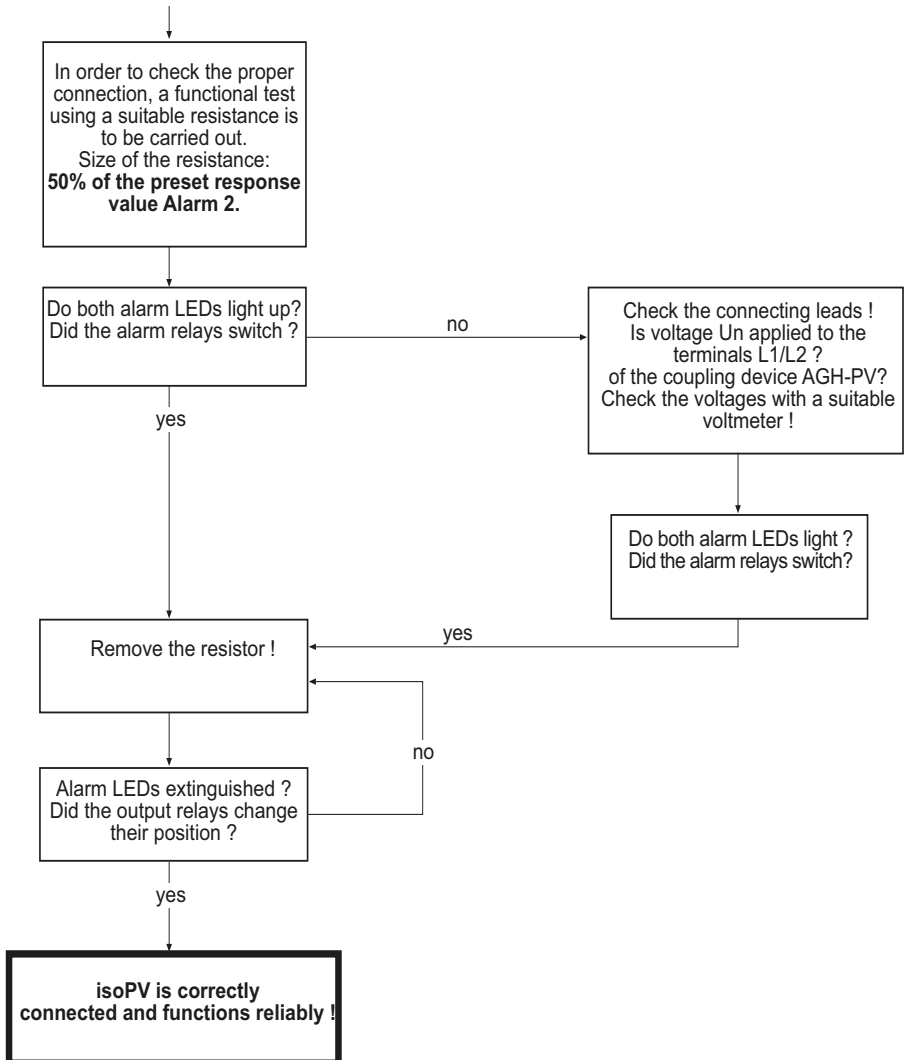
Commissioning of the ISOMETER® (1)



Commissioning of the ISOMETER® (2)



Commissioning of the ISOMETER® (3)



5. Installation and connection



DANGER

Risk of electrocution due to electric shock!

Touching live parts of the system carries the risk of:

- Electrocution due to 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.



CAUTION

Risk of injury from sharp-edged terminals!

Risk of lacerations.

Touch the enclosure and the terminals with due care.



CAUTION

Ensure disconnection from the IT system!

When insulation or voltage tests are to be carried out, the device must be isolated from the system for the test period. Otherwise the device may be damaged.



CAUTION

Risk of property damage due to unprofessional installation!

If more than one insulation monitoring device is connected to a conductively connected system, the system can be damaged. If several devices are connected, the device does not function and does not signal insulation faults. Make sure that only one insulation monitoring device is connected in each conductively connected system.



CAUTION

Risk of property damage due to unprofessional connection

Failure to connect the devices as illustrated in the manual may lead to deviating technical data and function restrictions.

**Check proper connection!**

Prior to commissioning of the installation, check that the device has been properly connected and check the device functions. Perform a functional test using an earth fault via a suitable resistance.

**Prevent measurement errors!**

When the AC system being monitored contains galvanically coupled DC circuits, take into consideration that: an insulation fault can only be detected correctly when the rectifier valves carry a minimum current of > 10 mA.

**For UL applications:**

*Only use 60/75°C copper lines!
For UL and CSA applications, the supply voltage must be protected via 5-A fuses.*

5.1 Installation of the isoPV



In order to ensure compliance with prescribed temperature limit values, install the isoPV and AGH-PV with a distance of at least 31 mm to all adjacent devices!

The cable length of the connecting cables between the AGH-PV and isoPV must not exceed 0.5 m.

**For UL-Applications:**

High Voltage Coupler AGH-PV should be mounted min. 30.8 mm away from the walls of a metal enclosure and uninsulated grounded parts and uninsulated live parts.

Use 60 °C/75 °C copper conductors only!

Tightening torque:

isoPV: 0.6 Nm...0.8 Nm, AGH-PV: 0.5 Nm

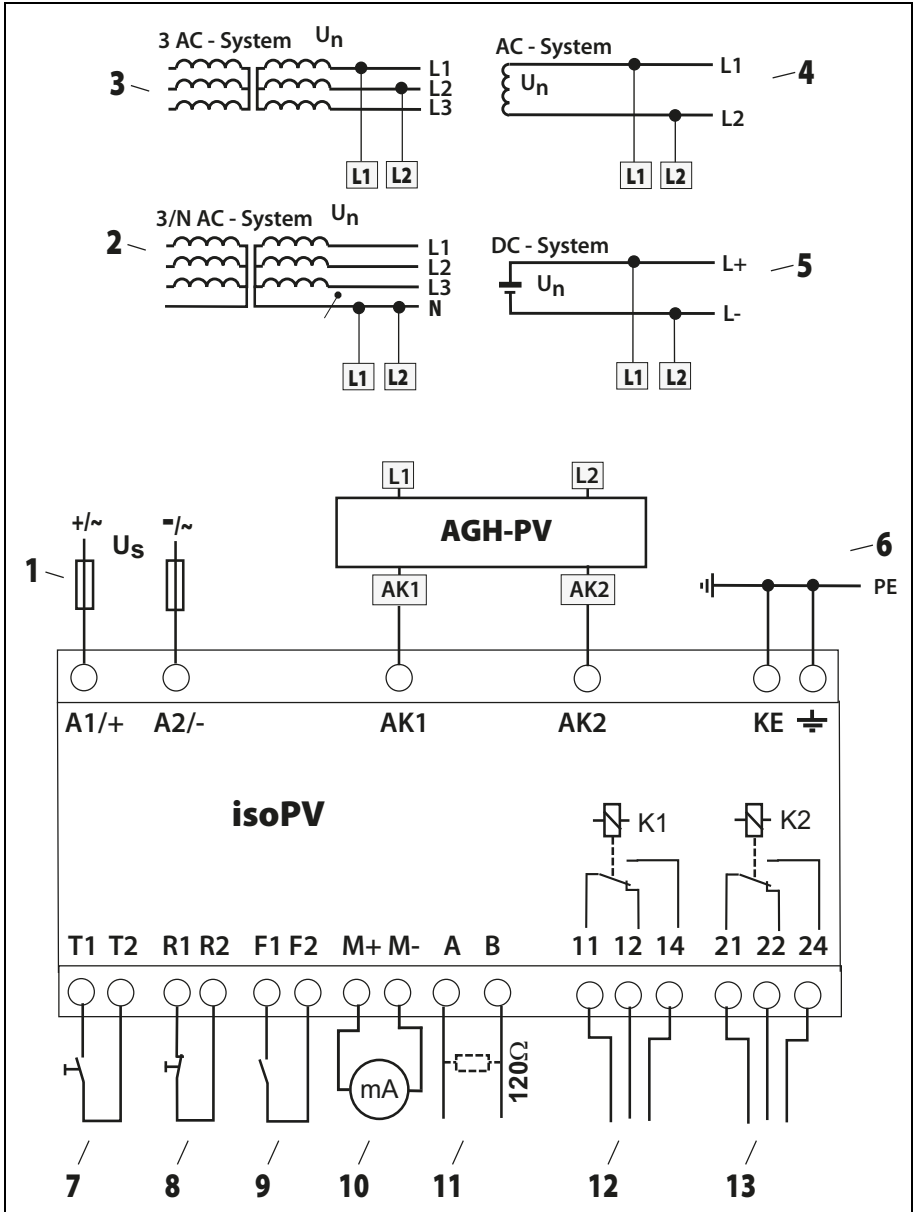
5.2 Wiring diagram

The terminals A1/+ and A2/- are to be connected to the supply voltage according to IEC 60364-4-43, that means, the connections are to be protected against short-circuit by means of a protective device (a 6 A fuse is recommended).


For UL and CSA applications, the use of 5 A fuses is mandatory.

Devices for protection against short-circuit in conformity with IEC 60364-4-43 for the coupling of terminals L1/L2 of the AGH-PV to the IT system being monitored can be omitted if the wiring is carried out in such a manner as to reduce the risk of a short-circuit to a minimum (a short-circuit-proof and earth-fault-proof wiring is recommended).

An external "TEST" button or an external reset button may only be connected to one ISOMETER[®]. A parallel connection of several test and reset inputs for collective ISOMETER[®] testing is not allowed.



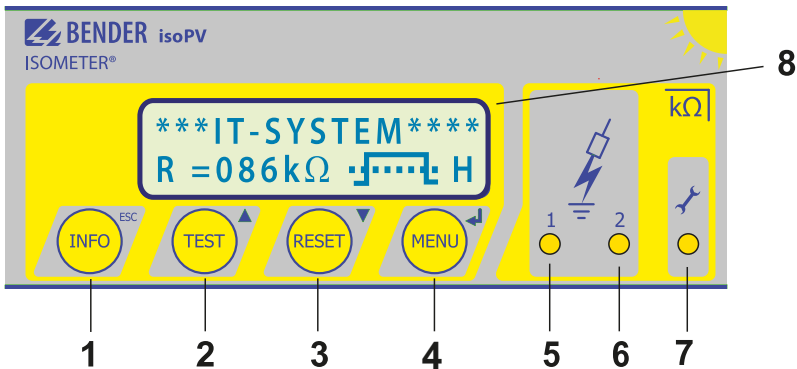
Legend wiring diagram:

1	Supply voltage U_S (see nameplate) via 6 A fuse; For UL and CSA applications, the use of 5 A fuses is mandatory.
2, 3	Connection to the 3 AC system to be monitored: Connect the terminals L1, L2 to neutral conductor N or terminals L1, L2 to conductor L1, L2.
4	Connection to the AC system to be monitored: connect terminals L1, L2 to conductor L1, L2.
5	Connection to the DC system to be monitored: Connect terminal L1 to conductor L+, terminal L2 to conductor L-
6	Separate connection of E  and KE to PE
*7	External "TEST" button (N/O contact)
*8	External "RESET" button (N/C contact or wire jumper), when the terminals are open, the fault message will not be stored.
*9	STANDBY by means of the function input F1, F2: when the contact is closed, the insulation resistance is not measured. Disconnection from the IT system
10	Current output, electrically isolated: 0...20 mA or 4...20 mA
11	Serial interface RS-485 (termination with a 120 W resistor)
12	Alarm relay 1; available changeover contacts.
13	Alarm relay 2 (device error relay); available changeover contacts.

*** The terminal pairs 7, 8 and 9 must be wired galvanically isolate and must not have a connection to PE!**

6. Operation and setting

6.1 Display and operating elements



-
- 1 "INFO" button: to query standard information/"ESC" button: back (menu function), to confirm parameter change

 - 2 "TEST" button: to call up the self test/arrow up button: parameter change, to move up in the menu

 - 3 "RESET" button: to delete stored insulation fault alarms:
Down button: parameter change, to move down in the menu

 - 4 "MENU" button: to call up the menu system
Enter button: to confirm parameter change

 - 5 ALARM LED "1" lights: insulation fault, first warning level reached.

 - 6 ALARM LED "2" lights: insulation fault, second warning level reached.


 - 7 Device error LED lights: isoPV faulty

 - 8 Two-line display for standard and menu mode

A detailed description of the operating elements is given on the following pages.



6.1.1 Display in standard mode



- | | |
|---|---|
| 1 | Indication of the insulation resistance in kW |
| 2 | Additional information about the insulation resistance:
„+“ = Insulation fault at L+
„-“ = Insulation fault at L-
„S“ = New measurement is being started |
| 3 |  = Polarity of the measuring pulse,
• = Valid BMS bus communication,
H = New entry in the memory data base
C = Flashing, clock is to be set |
| 4 | Messages:
- Insulation fault
- Connection PE?
- Device error x
- *****STAND BY***** |

6.1.2 Display in menu mode



-  Parameter change is permitted
-  Parameter change is blocked, enabling by a password

6.1.3 Function buttons

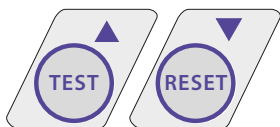
Two functions are assigned to each function button. In addition to the basic function marked with a circle, the buttons allow navigation within the menu.



Pressing the "INFO" button provides the following information without opening the menu:

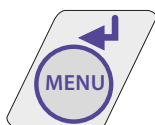
- Device name, firmware version
- Response values Alarm1 and Alarm2
- Leakage capacitance C_e (indication in case of insulation values $> 20 \text{ k}\Omega$), measurement not possible when using AMP3 and AMP4
- Setup status (for details about the setup status refer to the status table on Page 66
- COM-Setup (isoPV's own bus address)

Please have the details above on hand if you have a problem and if you contact Bender for technical questions.



Press the "TEST" button to start the self test of the ISOMETER®.

Press the "RESET" button to reset insulation fault alarms stored in the ISOMETER®. The memory function is only available after activating the fault memory in the ISO SETUP menu or after bridging the terminals R1/R2. Furthermore, the fault memory of the ISOMETER® can only be reset when the measured insulation value is at least 25 % and when the value is 1 k Ω higher than the set response value.



Press the "MENU" button to call up the menu system.

For menu control, the arrow buttons, Enter button and the "ESC" button are used:



Up button:
To move up in the menu, to increase the parameter value



Down button:
To move down in the menu, to decrease the parameter value



Enter button:
To select a menu item or sub menu item, confirm or store a parameter change and to return to the associated sub menu item or skip to the next entry field.



"ESC" button:
To return from a sub menu to the previous menu.
If the menu is not exited, the device automatically returns to the standard mode again after approximately five minutes.

For the sake of clarity, the following symbols are used in the menu diagrams for the representation of ENTER, UP/DOWN and "ESC":



6.2 Menu structure and menu mode

How to access the menu mode

Press the "MENU" button to switch from the standard mode to the menu mode and to the main menu. From here you can branch to the different submenus.


6.2.1 Navigation within the menu

Use the Up and Down buttons to select the appropriate menu item. A flashing cursor indicates which submenu is selected. Press the Enter button to call up the submenu of the associated menu.

In the submenus, the appropriate parameters are also selected by means of the Up and Down buttons. Press the Enter button to move the cursor to the edit field.

The "Arrow up" symbol tells you that you have reached the end of the menu list.

6.2.2 Parameter change

When the password protection is activated (symbolised by "padlock closed"  on the display), enter a valid password to be able to change parameters with the Up/Down buttons. Once the password is entered correctly, all parameters can be changed as long as you stay in the menu.

Changing the parameters usually has an immediate effect on the measuring and alarm functions. The changed parameter is stored in a non-volatile memory by pressing the Enter or "ESC" button after returning to the sub menu (flashing cursor in column 1).

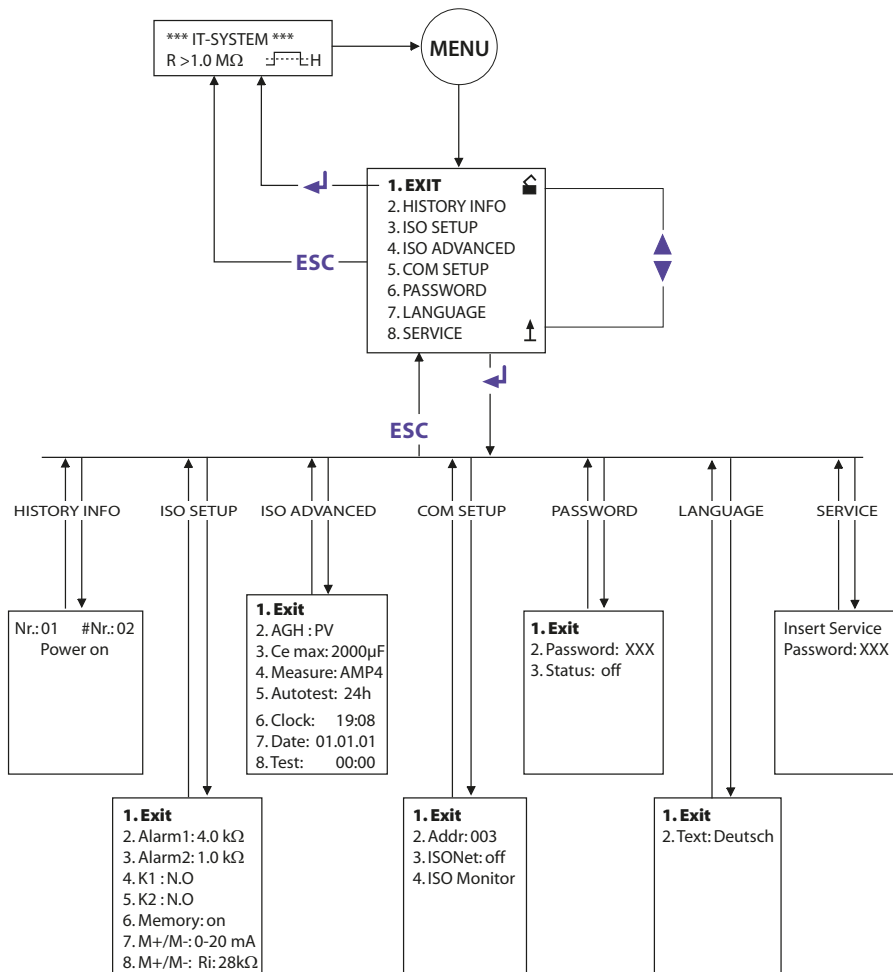
All measuring and alarm functions continue to run in the background during these menu operations.

6.2.3 Changing from the menu mode to the standard mode

Pressing the "ESC" button allows fast changing from the menu mode to the standard mode. Thus, the menu item "EXIT" need not to be activated.

If no button is pressed in a main or submenu, the system will automatically return from the menu mode to the standard mode after approximately five minutes.

6.2.4 Diagram menu structure



6.3 Menu HISTORY INFO

99 events with date and time stamp can be stored in the memory database. The database is designed as a ring memory, i.e. the eldest entry is overwritten. Data is written into a non-volatile memory and therefore is protected against voltage failure.

Data record Event

- 1 Switch the supply voltage on
- 2 Lowest measured insulation value
- 3...99 Response value Alarm 1 released
- 3...99 Response value Alarm 1 cleared
- 3...99 Response value Alarm 2 released
- 3...99 Response value Alarm 2 cleared
- 3...99 Error system connection released
- 3...99 Error system connection cleared
- 3...99 Error PE connection released
- 3...99 Error PE connection cleared
- 3...99 Device error released
- 3...99 Device error cleared
- 3...99 System reset (watchdog)

Display indication

- Power On
- Rmin
- Alarm1
- Alarm1
- Alarm2
- Alarm2
- System connection?
- System connection?
- PE connection?
- PE connection?
- Device error
- Device error
- System reset

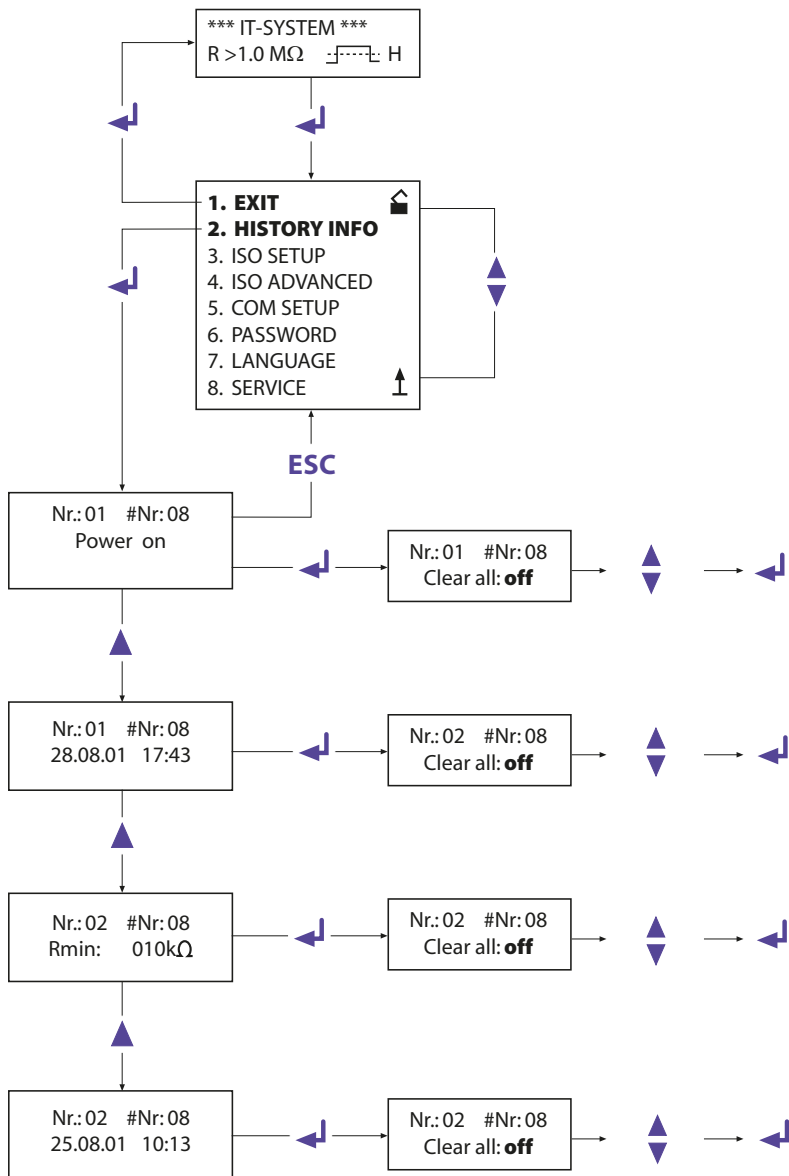


To store the events with the actual date and time stamp, you need to set the real-time clock in the ISO ADVANCED menu first. (refer to Page 45).

Data can be queried via the "HISTORY INFO" menu as follows: to change the data record number use the Up/Down buttons, to toggle between the data record number and the menu item for clearing the history memory ("Clear all:on") use the Enter button, and to leave the menu item use the "ESC" button.

In the standard mode, a new entry in the history memory is identified by an "H". The "H" will only be deleted when the HISTORY INFO menu item is called up.

6.3.1 Diagram HISTORY INFO



6.4 Menu ISO SETUP: Setting of the basic ISOMETER functions

This menu is used to set the alarm functions Alarm1 and Alarm2 (prewarning and alarm), the operating principle of the alarm relay K1 and K2 (N.O = N/O operation, N.C = N/C operation), the fault storage behaviour and a selection of two current output ranges.

For UL-application:

In order to ensure the proper functioning of the relay outputs, a manual, periodic self-test where the relay outputs are switched, has to be carried out by the user (delivery condition).

6.4.1 Response values Alarm1 and Alarm2

The response values Alarm1 and Alarm2 are selected with the Up/Down buttons and stored with the Enter button.

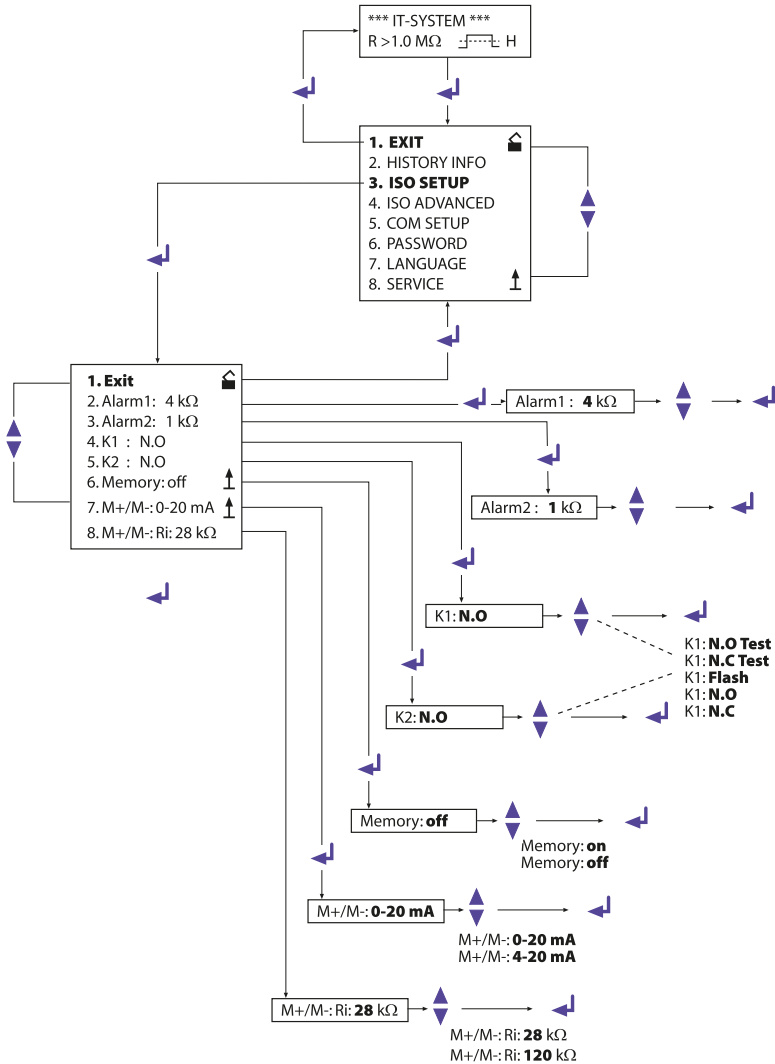
6.4.2 Operating principle of the alarm relays

K1/K2 are factory-set to N.O Test, that means N/O operation. When the supplement "Test" has been selected, the alarm relays switch over during a manual self test.

If the operating principle of the alarm relays does not have to be changed during a manual self test for any reason, N.C or N.O. has to be selected.

K1: N.C Test	= N/C operation contacts 11-12-14, with relay test (the alarm relay is energised during normal operation)
K1: N.O Test	= N/O operation contacts 11-12-14, with relay test (the alarm relay is deenergised during normal operation)
K1: N.C	= N/C operation contacts 11-12-14, without relay test (the alarm relay is energised during normal operation)
K1: N.O	= N/O operation contacts 11-12-14, without relay test (the alarm relay is deenergised during normal operation)
K1: Flash	= Flashing function contacts 11-12-14 (the alarm relay switches and the LED flashes in the event of an alarm message at approx. 0.5 Hz)
K2: N.C Test	= N/C operation contacts 21-22-24, with relay test (the alarm relay is energised during normal operation)
K2: N.O Test	= N/O operation contacts 21-22-24, with relay test (the alarm relay is deenergised during normal operation)
K2: N.C	= N/C operation contacts 21-22-24, without relay test (the alarm relay is energised during normal operation)
K2: N.O	= N/O operation contacts 21-22-24, without relay test (the alarm relay is deenergised during normal operation)
K2: Flash	= Flashing function contacts 21-22-24 (the alarm relay switches and the LED flashes in the event of an alarm message at approx. 0.5 Hz)

ISO SETUP diagram



During the automatic self test, the alarm relays are not switched over.



When a device error occurs at the ISOMETER, the relay K2 will automatically be activated as a device error relay.

6.4.3 Memory setting (on/off)

- Memory: on = Fault memory is activated
The device must be reset with the Reset button after clearing the fault.
- Memory: off = Fault memory deactivated (factory setting)

6.4.4 Current output for external measuring instruments

Factory setting: 0...20 mA

The current output of the isoPV can be set to "0...20 mA" or „4...20 mA" via the "M+/M-:" menu item.
The maximum load is 500 W.

6.4.5 Matching the current output to the centre scale mark of external measuring instruments

Factory setting = 28 kΩ

Use the menu item "8. M+/M- Ri:" in the ISO SETUP menu to select a centre scale mark.

- 8. M+/M- Ri:28kΩ = centre scale $R_{Sk} = 28\text{ k}\Omega$ (factory setting)
- 8. M+/M- Ri:120kΩ = centre scale $R_{Sk} = 120\text{ k}\Omega$ (compatible to IRDH275..-4..)

The function of the current output is dependent on the selected R_{Sk} .

Function 0...20 mA:

R_F = insulation fault, I = current in mA

$$R_F = \frac{20\text{ mA} \times R_{Sk}}{I} - R_{Sk}$$

Function 4...20 mA:

R_F = insulation fault, I = current in mA

$$R_F = \frac{16\text{ mA} \times R_{Sk}}{I - 4\text{ mA}} - R_{Sk}$$

Refer to the associated characteristic curves on Page 64.

For UL-applications:

The analogue output as such is not a "safe alarm" indication in compliance with UL1998. If the analogue output is intended to be used as a "safe alarm":

- the relay output (at least K1 or K2) must additionally be used to provide redundancy

OR

- both the relay outputs and the analogue output must be evaluated during the self-test, in order to ensure the proper functioning of the analogue output.

6.5 Menu ISO ADVANCED: Setting of the extended functions

6.5.1 External coupling device (AGH: PV)

Use the isoPV only in combination with the coupling device AGH-PV. The menu setting AGH:PV is pre-defined. The current software version does not allow other settings.

6.5.2 Adaptation of the system leakage capacitance (Cemax: 2000 μ F)

This menu can be used to adapt the ISOMETER[®] to the maximum system leakage capacitance (max. 2,000 μ F). Refer to the table "Measuring methods" for details about the duration of the response time.

Factory setting = 2,000 μ F

6.5.3 Changing the measurement method (Measure: AMP4)

In IT systems, the voltage of which changes at low-frequency as a consequence of operation, the response time t_{an} depends on the lowest frequencies occurring between system and earth during operation.

This is typical of converter systems including low-frequency control processes, direct current motors with low-frequency control processes or voltage changes in modules of photovoltaic systems caused by the weather.

In order to improve the quality of insulation measurements in the different applications and to avoid incorrect measurements, the special measurement method suited for the individual application can be selected.

In the following table, the response times in relation to the selected maximum leakage capacitance are listed and also the measurement profile to be set for the respective application.



Please note that the capacitance cannot be measured when using the profiles AMP3 or AMP4. Hence, no result will be displayed when the current leakage capacitance is queried by means of the INFO button.

6.5.4 Setting the repetition time for the automatic self test (Autotest: 24h)

		Setting the parameter C_e max		
		150 μ F	500 μ F	2000 μ F
Profile setting	Description	Response time t_{an} (acc. to IEC 61557-8) $R_{an} = 1k\Omega$ $C_e = 1\mu F$	Response time t_{an} $R_{an} = 1k\Omega$ $C_e = 200\mu F$	Response time t_{an} $R_{an} = 1k\Omega$ $C_e = 2,000\mu F$
DC	Standard measurement method using a DC measuring voltage for pure AC systems	< 3s	DC measurement method permissible for $C_e < 10\mu F$ only	DC measurement method permissible for $C_e < 10\mu F$ only
AMP	Standard measurement method using the pulse measurement method for AC/DC systems at system frequencies > 10Hz	< 16s	< 40s	< 150s
AMP2	Optimised measurement method using the pulse measurement method for AC/DC systems at system frequencies < 10Hz	< 30s	< 50s	< 200s
AMP3	Optimised measurement method for photovoltaic plants with crystalline cells or AC/DC system at system frequencies < 1Hz	< 140s	< 140s	< 300s
AMP4	Optimised measurement method for photovoltaic systems with thin-layer cells (factory setting)	< 370s	< 400s	< 500s

The time for the repetition of automatic self tests can either be set to 1 hour or to 24 hours or can be deactivated.

Factory setting = 24 h

6.5.5 Setting the real-time clock (Clock)

The time setting is the time base for the memory and the automatic self test. In case of supply voltage failure, the set real-time clock keeps running for approximately 30 days. When the device is switched on after this period, a flashing "C" appears on the display and the clock has to be set again.

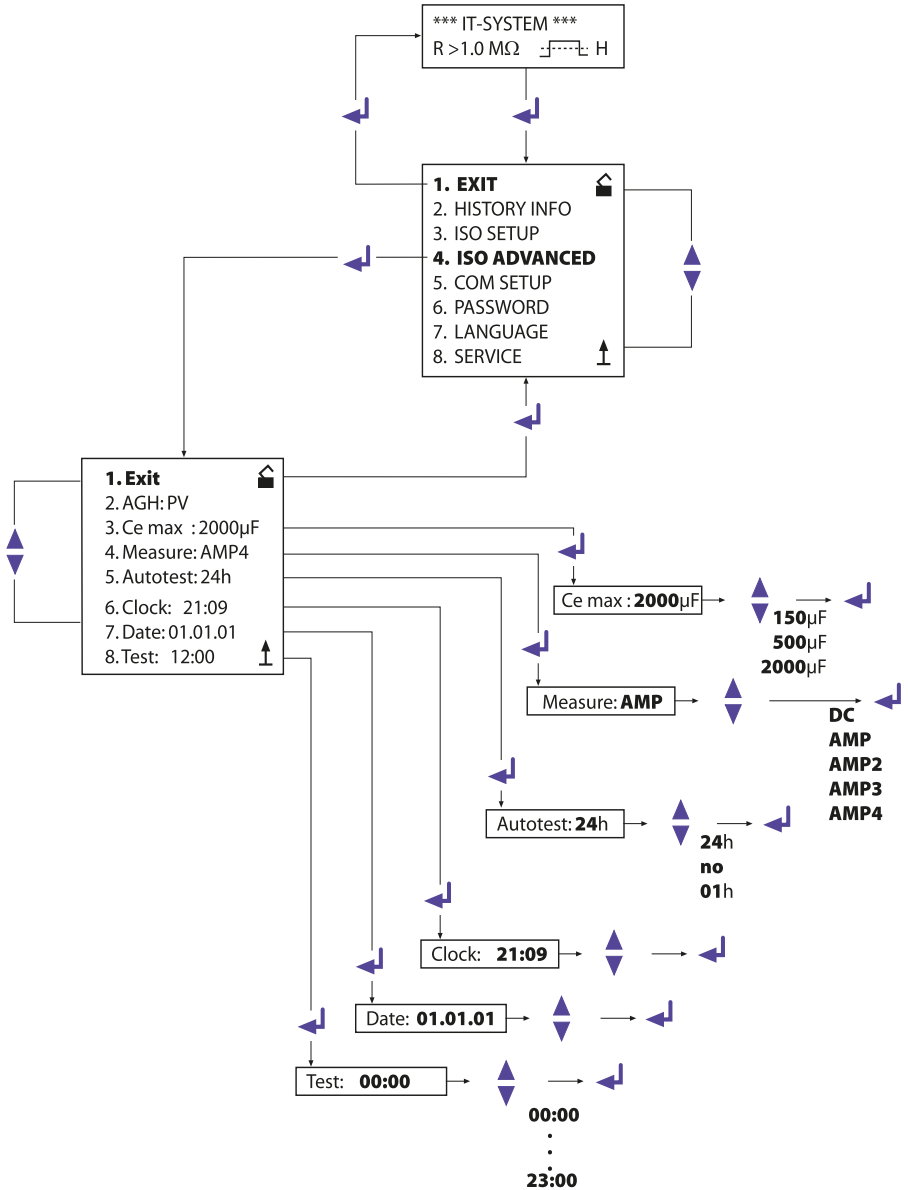
6.5.6 Setting the date (Date)

Not only is the time of day required but also the date has to be set for the history memory. In the event of supply voltage failure, the date function is not influenced for at least 30 days. When switching the device on at a later date, a new setting of the real-time clock and the date is required.

6.5.7 Specifying the start-up time for the automatic self test (Test)

When the 24 h self test is activated in the ISO ADVANCED menu, it is possible to set the time (hour) for carrying out the self test by means of the "TEST: 12:00" menu item. Then the self test is automatically carried out once a day at a given time. When the 1 hour auto test has been selected, the self test is carried out at every full hour.

6.5.8 Diagram ISO ADVANCED



6.6 Menu COM SETUP: Setting the BMS interface

6.6.1 Bus address "Addr:"

This menu is used to set the BMS bus address for isoPV. Take care that the bus address is not assigned twice.

The device is factory set to address 3 and hence operates as a slave.



Please note that the capacitance cannot be measured when using the profiles AMP3 or AMP4. Hence, no result will be displayed when the current leakage capacitance is queried by means of the INFO button.

6.6.2 ISOnet function

The function ISOnet is setted in the COM SETUP menu under ISOnet = ON. The ISOnet function of all ISOMETERs existing in the system must be set to "ON". The BMS master with activated ISOnet function controls the ISOnet slave devices via the BMS bus. When the master ISOMETER[®] has finished one measuring cycle, the authorisation for insulation monitoring is passed on to the next higher BMS address. During the insulation monitoring process, all other ISOMETER[®]s are in the STANDBY mode.

6.6.3 ISO monitor

This function allows to query the currently measured value as well as the messages of all bus-capable ISOMETER[®]s existing in the BMS network. After selecting the bus address, the entire information stored by the selected device is indicated on the display. The display indication is structured similar to the standard indication, but instead of the indication of the measuring pulse, the selected bus address is indicated. Without pressing a button, the indication changes to the standard indication of the isoPV after about five minutes.

If there is no information available from the selected ISOMETER[®], the message "!!!!NO DATA!!!!" will be displayed.

Information is being searched:

```
<<BUS SCANNING>>
R=      ADR:02
```

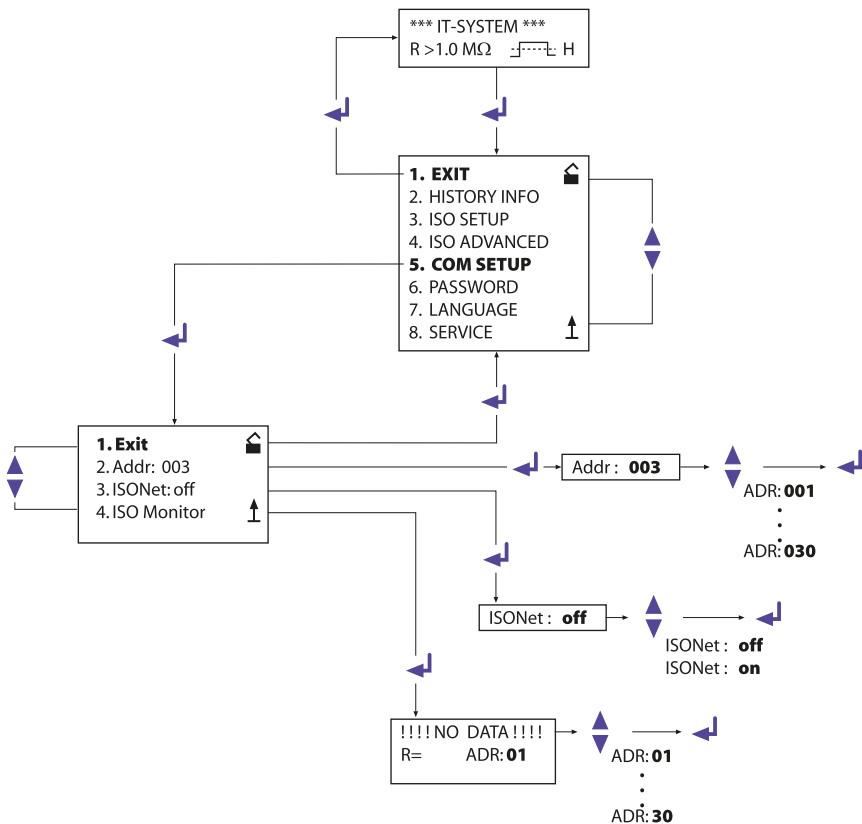
No data found:

```
!!!!NO DATA!!!!
R=      K      ADR:02
```

Current data address 03:

```
Insulation Fault
R= 010K      ADR:03
```

6.6.4 Diagram COM SETUP



6.7 PASSWORD menu

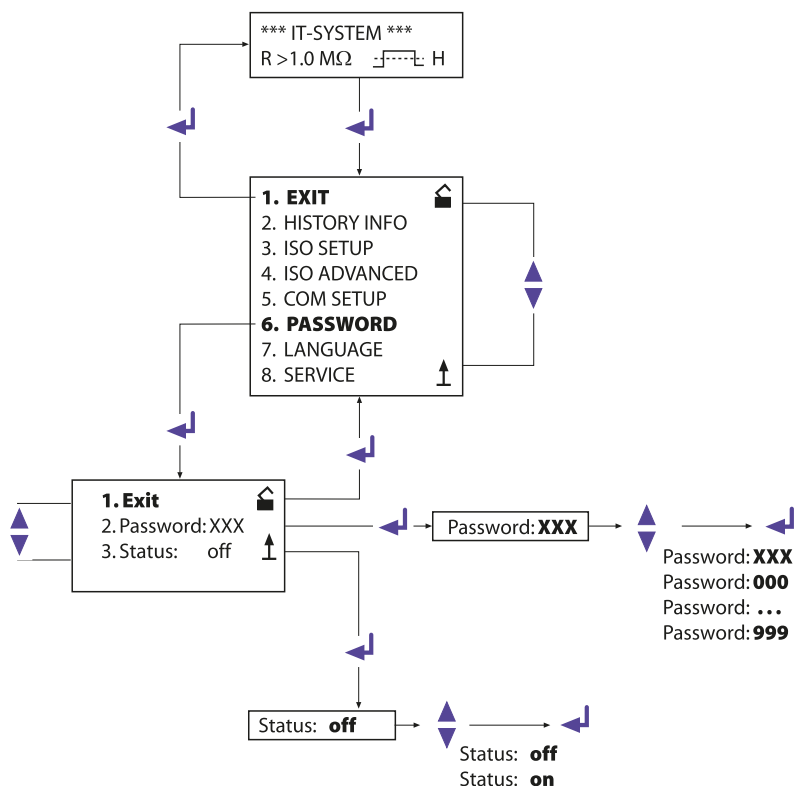
6.7.1 Setting and activating the password

This menu can be used to activate a "Password" query. This protects the ISOMETER® against unauthorised settings and modifications.

Set the desired password using the UP/DOWN buttons (menu item "2. Password: xxx") and confirm the setting with the ENTER button.

Activate the password in the menu item "3. Status: on" by clicking the ENTER button. The factory setting is "3. Status: off".

6.7.2 PASSWORD diagram

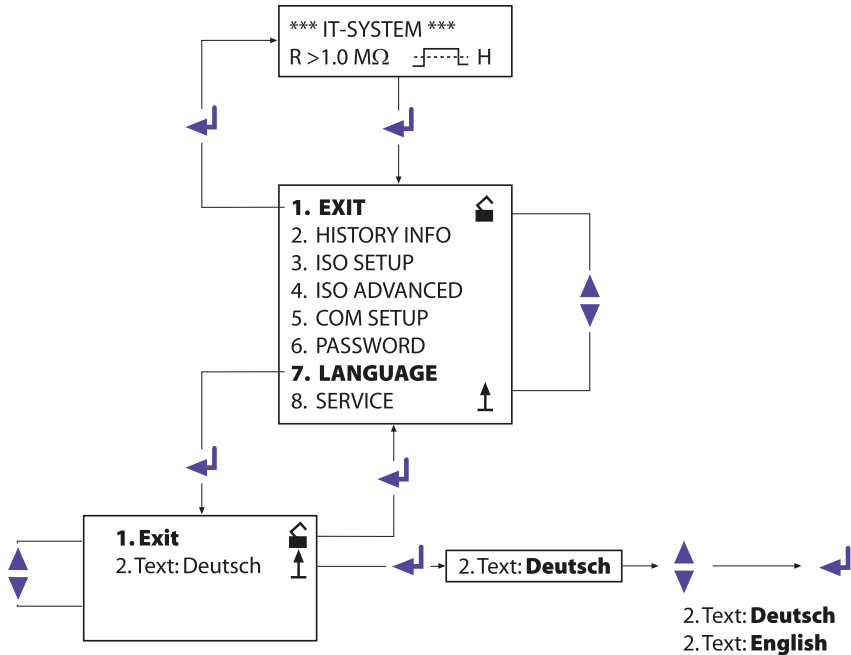


6.8 LANGUAGE Menu

6.8.1 Language setting

The menu item "Language" allows fault messages of the ISOMETER® to be set to different languages. There is a choice of German and English. The device menu is not influenced by the language selection.

6.8.2 Language diagram



6.9 SERVICE menu

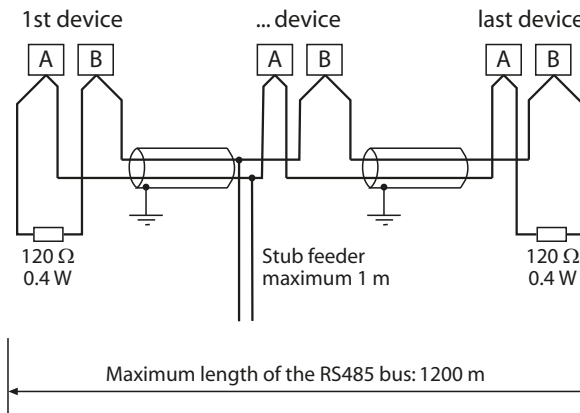
This menu item is intended for the Bender service personnel and protected by a password against erroneous settings. It is intended for fast fault clearance by qualified experts in the event of a device error.

7. Serial interface

7.1 RS-485 interface with BMS protocol

The RS-485 interface electrically isolated from the device electronics and the current output serves as a physical transmission medium for the BMS protocol. If several isoPV or other bus-capable devices are interconnected in a network via the BMS bus, the BMS bus must be terminated at both ends with a $120\ \Omega$ resistor.

An RS-485 network that is not terminated, is likely to get instable and may result in mal-functions. Only the first and the last device in one line may be terminated. Devices in between must not be terminated with $120\ \Omega$. Hence, stub feeders in the network must not be terminated. The length of the stub feeders is restricted to 1 meter.

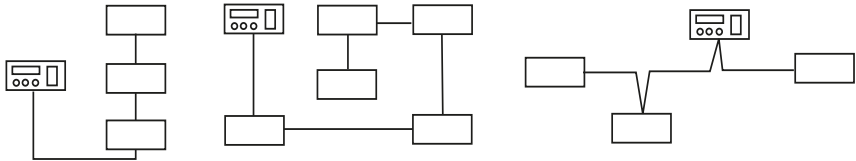


7.2 Topology RS-485 network

The optimum topology for the RS-485 network is a daisy-chain connection. In this connection, device 1 is connected to device 2, device 2 to device 3, device 3 to device n etc.. The RS-485 network represents a continuous path without branches.

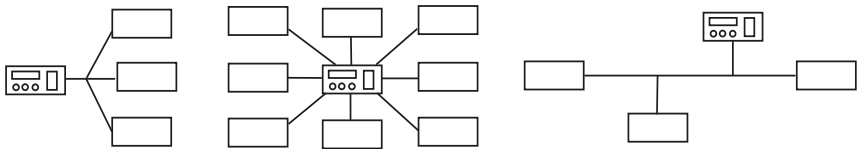
7.2.1 Correct arrangement

Three examples for correct arrangement:



7.2.2 Wrong arrangement

Three examples for wrong arrangement:



7.2.3 Wiring

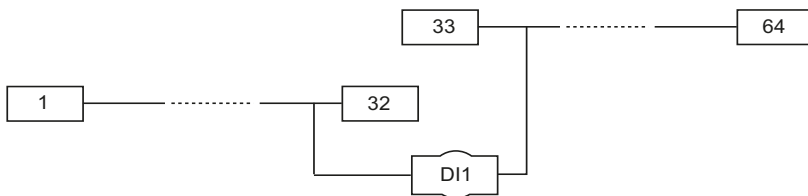
The suitable type of wiring for the RS-485 network is:

shielded cable, core diameter ³ 0.6 mm

(z.B. J-Y(St)Y 2x0.6), shield connected to earth (PE) on one end.

Connection to the terminals A and B.

The number of bus nodes is restricted to 32 devices. When more devices are to be connected, Bender recommends to use a DI1 repeater.



7.3 BMS protocol

This protocol is an essential part of the Bender measuring device interface (BMS bus protocol). Data transmission generally makes use of ASCII characters.

Interface data are:

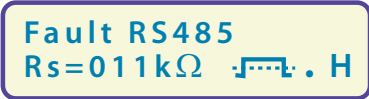
- Baud rate: 9,600 baud
- Transmission: 1 start bit, 7 data bits, 1 parity bit, 1 stop bit (1, 7, E, 1)
- Parity: even
- Checksum: Sum of all transmitted bytes = 0 (without CR and LF)


The BMS bus protocol works according to the Master-Slave principle. That means that one device represents the master while all other bus devices are slaves. It is important that only one master is present in each network. All bus devices are identified by a unique address. The master scans all other devices on the bus cyclically, listens to their signals and then carries out specific commands. Bus address 1 must be assigned to the master, thus to one of the isoPV devices.

7.3.1 BMS master

A master can query all warning and operating messages from a slave.

If the bus address 1 has been selected for one isoPV, the device automatically represents the master, that means that all addresses between 1 and 150 are cyclically scanned via the BMS bus for alarm and operating messages. If the master receives no answer from five subsequent addresses, the scanning cycle is started again. If the master recognises incorrect answers from a slave, the fault message "Fault RS485" will appear on the display.



Fault RS485
Rs=011kΩ  . H

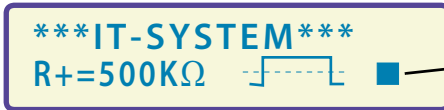
Fault causes may be:

- Addresses are assigned twice
- A second master exists on the BMS bus
- Interference signals occur on the bus lines
- A defective device is connected to the bus
- Terminating resistors are not activated

7.3.2 BMS slave

All isoPV devices are factory-set to slave mode (address 3). In a BMS network, one address must be selected from the address range 2...30 for each slave. There may be no gaps of more than five subsequent addresses, so that all slaves can be scanned by the master. For isoPV a BMS address can be selected from the address range 1...30. When assigning the addresses, also other devices such as EDS4xx must be considered.

The receipt of the BMS data is indicated by a flashing point on the display on the right of the measuring pulse indication.



Flashing point:
BMS data received

If no flashing point appears, it may be attributed to the following:

- No master available in the network
- More than one master available in the network
- RS-485 interface (terminals A/B) not connected or reversed

The following table gives an overview about essential alarm messages and the assignment of the messages indicated on the display or alarm indicator and test combinations, e.g. MK800.

Messages	Channel	Note
Insulation Fault	1	Insulation resistance < setting value Alarm 1
Insulation Fault	2	Insulation resistance < setting value Alarm 2
Connection system	3	Connection fault L1/L2 against IT system
Connection PE	4	Connection fault ≡ /KE against PE conductor
Device error	5	Internal device error

The BMS function is completely available in the standby mode (Stand-by: F1/F2).

7.3.3 Commissioning of an RS-485 network with BMS protocol

- Connect the terminals A and B of all bus devices in one line
- Switch the terminating resistors on at the beginning and end of the RS-485 network or if there are devices which do not include a terminating switch at the end of the bus, place a 120 Ω resistor between the terminals A and B.
- Switch the supply voltage on.
- Determine one isoPV as the master and assign address 1.
- Assign the addresses (2...30) subsequently to all other isoPVs and other bus devices (see table below)
- Check whether a flashing point appears on all devices (BMS commands are being received)
- The sub menu "ISO-Monitor" in the COM SETUP menu allows insulation values of the ISOMETER®s to be queried. Enter the address of the ISOMETER® before starting the query.

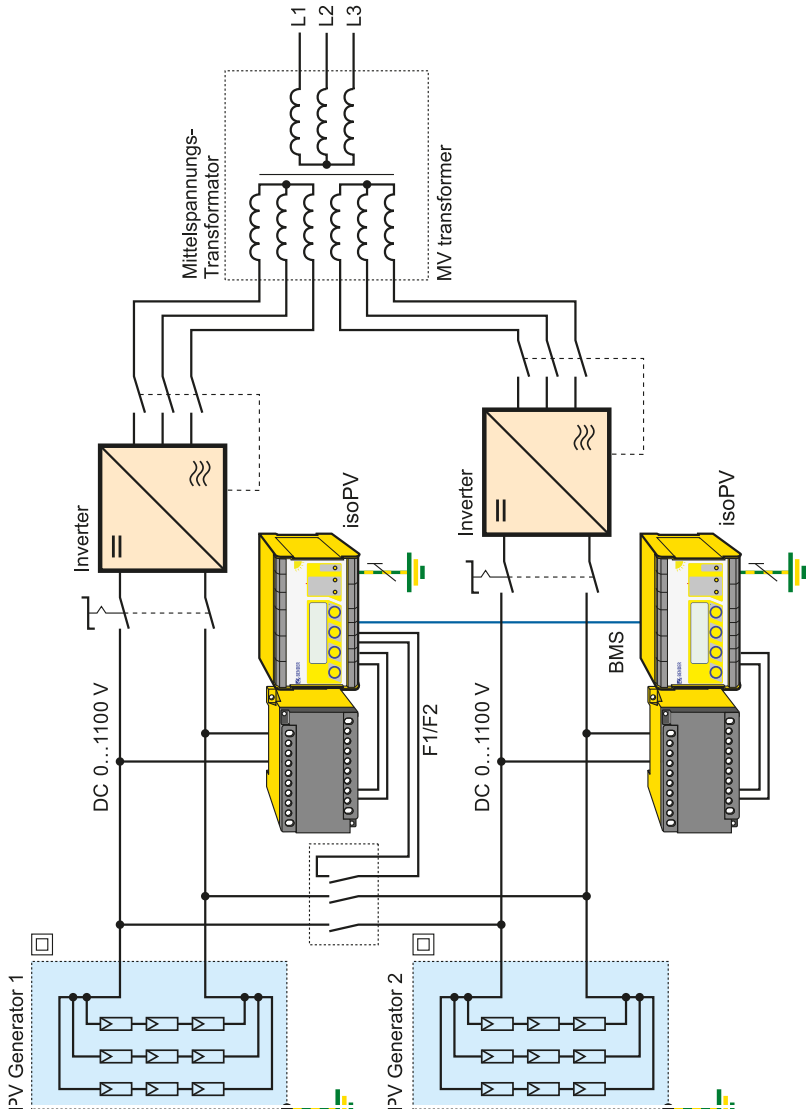
BMS bus address ranges (internal bus)

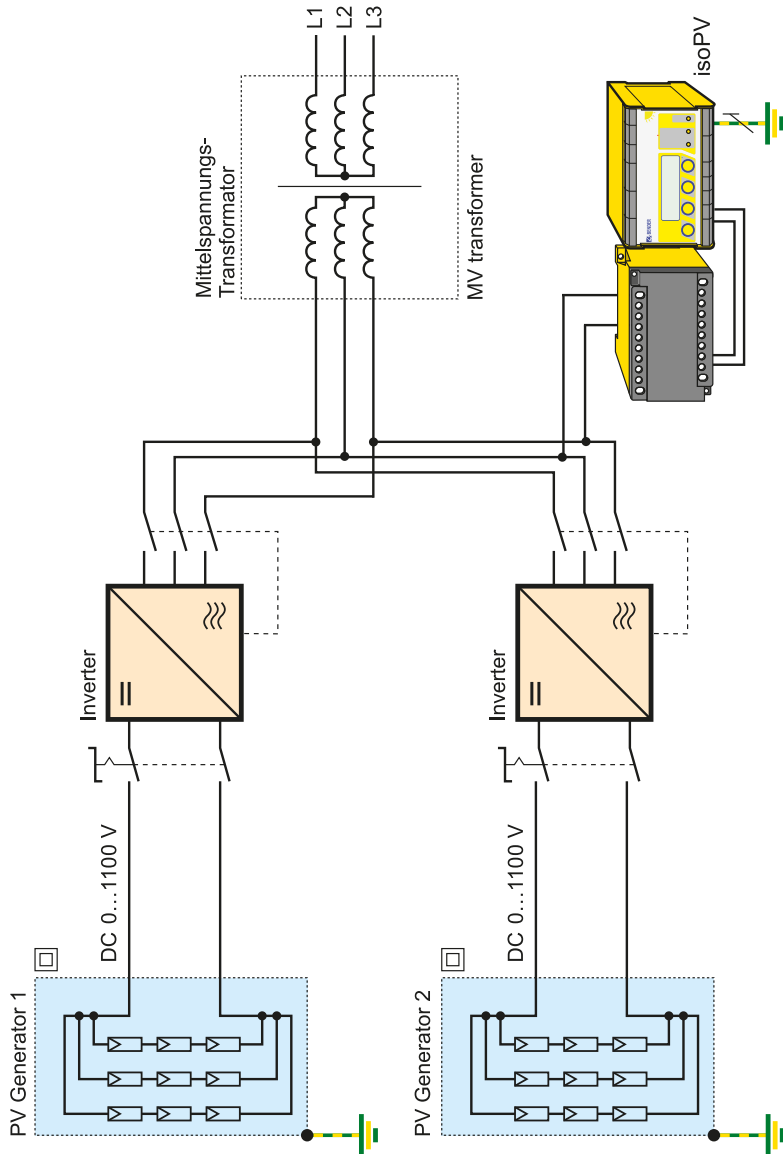
Addresses*	Device	Note
0		There is no device with address 0 !. Information sent to address 0 applies to all devices connected to the interfaces (broadcast)
1...30	IRDH275B/ 375B/575; isoPV	Insulation monitoring devices
1...30	FTC4...	Protocol converter
1...90	COM460IP	Protocol converter
1...90	EDS46.../49...	Insulation fault locators
1...150	MK800	Alarm indicator and test combination
111...119	PGH47...	Locating current injector
121...150	PGH47...E	Locating current injector



** Assign the addresses consecutively, there must be no gaps greater than five in the respective ranges
(1...30, 31...60, 61...90, 111...119 and 121...151)*

8. Coupled PV generators (application example)





9. Technical data isoPV with AGH-PV

9.1 Data in tabular form isoPV

The values marked with** are absolute values.

()* = factory setting

Insulation coordination acc. to IEC 60664-1

Definitions:

Supply circuit (IC2)	A1, A2
Output circuit (IC3)	11, 14, 24
Control circuit (IC4)	Up, KE, T/R, A, B, AK1, GND, AK2
Rated voltage	240 V
Overvoltage category	III
Rated impulse voltage:	
IC2/(IC3-4)	4 kV
IC3/(IC4)	4 kV
Rated insulated voltage:	
IC2/(IC3-4)	250 V
IC3/(IC4)	250 V
Pollution degree	3
Protective separation (reinforced insulation) between:	
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

Voltage ranges

Nominal system voltage U_n	via AGH-PV
isoPV-335:	
Supply voltage U_s (also see nameplate)	AC 88 . . . 264 V**
Frequency range U_s	42 . . 460 Hz
Power consumption	≤ 21,5 VA
Supply voltage U_s (also see nameplate)	DC 77 . . . 286 V**
Power consumption	≤ 5,5 VA
isoPV-327:	
Supply voltage U_s (also see nameplate)	AC 19.2 . . . 55 V**
Frequency range U_s	42 . . 460 Hz

Supply voltage U_s (also see nameplate).....	DC 19.2 . . . 72 V**
Power consumption	≤ 6 VA

For UL-application

Nominal system voltage U_n via AGH-PV isoPV-335:

Supply voltage U_s (also see nameplate).....	AC 88 . . . 250 V
Frequency range U_s	42 . . . 460 Hz
Power consumption AC	≤ 21,5 VA
Supply voltage U_s (also see nameplate).....	DC 80 . . . 250 V
Power consumption DC	≤ 5,5 VA

isoPV-327:

Supply voltage U_s (also see nameplate).....	DC 24 . . . 65 V
Power consumption	≤ 6 VA

Response values

Response value R_{an1}	0.2 . . . 100 kΩ
Factory setting R_{an1} (Alarm1)	4 kΩ
Response value R_{an2}	0.2 . . . 100 kΩ
Factory setting R_{an2} (Alarm2)	1 kΩ
Relative uncertainty (7 kΩ . . . 100 kΩ) (in accordance with IEC 61557-8:2007-01).....	± 15 %
Relative uncertainty (0.2 kΩ . . . 7 kΩ).....	± 1 kΩ
Response time t_{an}	see table starting from Page 42
Hysteresis	25 %, + 1 kΩ

Measuring circuit

Measuring voltage U_m (peak value).....	± 50 V
Measuring current I_m (at $R_F = 0 \Omega$).....	≤ 1.5 mA
Internal DC resistance DC R_i	≥ 35 kΩ
Impedance Z_i at 50 Hz.....	≥ 35 kΩ
Permissible extraneous DC voltage U_{fg}	≤ DC 1,100 V
Max. system leakage capacitance C_e	≤ 2,000 μF (2,000 μF)*

Displays

Display, illuminated.....	two-line display
Characters (number/height).....	2 x 16/4 mm
Display range measured value	0.2 kΩ . . . 1 MΩ
Operating uncertainty	± 15 %, ± 1 kΩ

Outputs/Inputs

"TEST"/"RESET" button	internal/external
Cable length "TEST"/"RESET" button, external	≤ 10 m
Current output (load).....	0/4 . . . 20 mA (≤ 500 W)

Accuracy current output,
related to the value indicated (1 kΩ... 100 kΩ) ± 15 %, ± 1 kW

Serial interface

Interface/protocol RS-485/BMS
 Connection terminals A/B
 Cable length ≤ 1,200 m
 Shielded cable (shield to PE on one end) 2-core, ≥ 0.6 mm², z. B. J-Y (St)Y 2 x 0.6
 Terminating resistor 120 Ω (0.5 Ω)
 Device address, BMS bus 1...30 (3)*

Switching elements

Switching elements 2 changeover contacts: K1 (Alarm 1), K2 (Alarm 2, device error)
 Operating mode K1, K2 N/C operation n.c./N/O operation n.o. (N/O operation n.o.)*
 Contact data acc. to IEC 60947-5-1:
 Utilisation category AC 13 AC 14 DC-12 DC-12
 Rated operational voltage 230 V 230 V 24 V 110 V 220 V
 Rated operational current 5 A 3 A 1 A 0.2 A 0.1 A
 Minimum contact rating 1 mA at AC/DC ≥ 10 V

Environment / EMC

EMC- not suitable for household and small companies IEC 61326-2-4
 Operating temperature -25 °C... +65 °C
 Classification of climatic conditions acc. to IEC 60721:
 Stationary use (IEC 60721-3-3) 3K5 (with condensation and formation of ice)
 Transport (IEC 60721-3-2) 2K3 (with condensation and formation of ice)
 Long-term storage (IEC 60721-3-1) 1K4 (with condensation and formation of ice)
 Classification of mechanical conditions acc. to IEC 60721:
 Stationary use (IEC 60721-3-3)
 for screw fixing with accessories B990056 3M7
 for DIN rail mounting 3M4
 Transport (IEC 60721-3-2) 2M2
 Long-time storage (IEC 60721-3-1) 1M3

Connection

Connection screw-type terminals
 Connection, rigid/flexible 0.2... 4 mm²/0.2... 2.5 mm²
 Connection flexible with connector sleeve, without/with plastic sleeve 0.25... 2.5 mm²
 Tightening torque 0.6... 0.8 Nm
 Conductor sizes (AWG) 24... 12
 Cable length between isoPV and AGH-PV ≤ 0.5 m

Other

Operating mode	continuous operation
Mounting	display oriented
Distance to adjacent devices	≥ 30 mm
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529)	IP20
Type of enclosure	X112, free from halogen
DIN rail mounting	DIN EN 60715/IEC 60715
Screw mounting by means of support (see Page 67)	2 x M4
Flammability class	UL94 V-0
Software version	D351 V2.0
Weight	< 510 g

(*) = factory setting

The values marked with** are absolute values.

9.2 Technical data in tabular form AGH-PV

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	AC 800 V
Rated impulse voltage/pollution degree	8 kV/3

Voltage ranges

Nominal system voltage U_n	AC, 3(N)AC 0...793 V, DC 0...1,100 V
Nominal frequency f_n	DC, 10...460 Hz
Max. AC voltage U_{\sim} in the frequency range $f_n = 0.1...10$ Hz:	$U_{\sim \max} = 110 \text{ V/Hz} * f_n$

Environment / EMC

EMC	IEC61326-2-4
Operating temperature	-25 °C...+65 °C
Classification of climatic conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3K5 (with condensation and formation of ice)
Transport (IEC 60721-3-2)	2K3 (with condensation and formation of ice)
Long-term storage (IEC 60721-3-1)	1K4 (with condensation and formation of ice)
Classification of mechanical conditions acc. to IEC 60721:	
Stationary use (IEC 60721-3-3)	3M7
Transport (IEC 60721-3-2)	2M2
Long-time storage (IEC 60721-3-1)	1M3

Connection

Connection	screw-type terminals
Connection, rigid/flexible	0.2...4 mm ² /0.2...2.5 mm ²
Connection flexible with connector sleeve, without/with plastic sleeve	0.25...2.5 mm ²

Tightening torque	0.5 Nm
Conductor sizes (AWG).....	24...12
Cable length between isoPV and AGH-PV	≤ 0.5 m

Other

Operating mode	continuous operation
Mounting	cooling slots must be ventilated vertically!
Distance to adjacent devices	≥ 30 mm
Degree of protection, internal components (DIN EN 60529)	IP30
Degree of protection, terminals (DIN EN 60529).....	IP20
Type of enclosure.....	X200, free from halogen
DIN rail mounting	DIN EN 60715/IEC 60715
Screw fixing.....	2 x M4
Flammability class	UL94 V-0
Weight.....	< 230 g

9.3 Standards, approvals and certifications

The ISOMETER® was designed in accordance with the following standards:

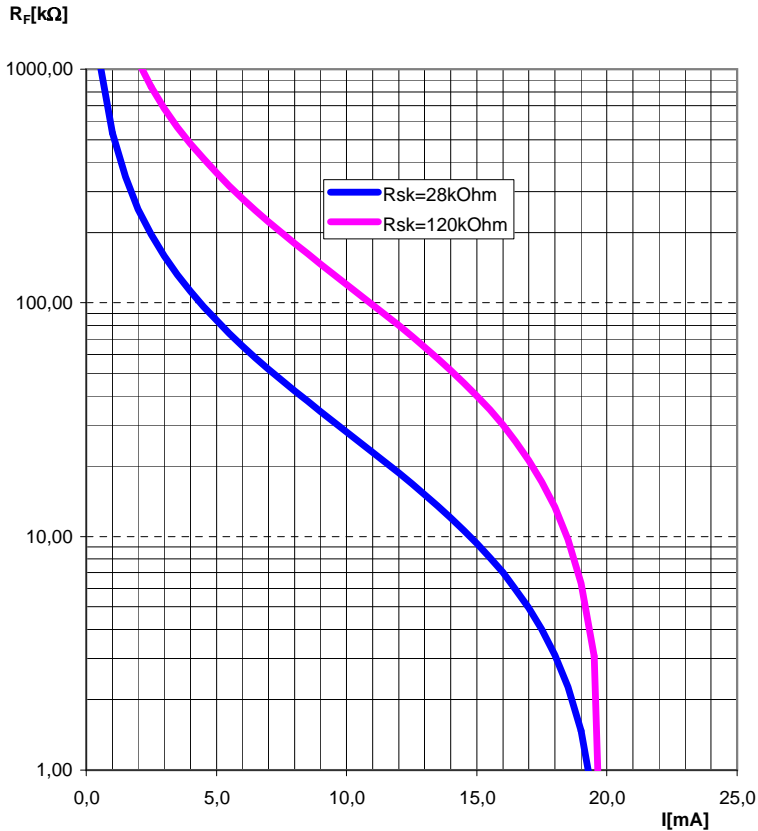
- DIN EN 61557-8 (VDE 0413-8)
- IEC 61557-8
- IEC 61326-2-4
- DIN EN 60664-1 (VDE 0110-1)
- DIN EN 60664-3 (VDE 0110-3)
- UL 508
- UL 1998 (Software)

Subject to change! The specified standards take into account the edition valid until 07.2018 unless otherwise indicated.



9.4 Characteristic curves

Current output 0...20 mA



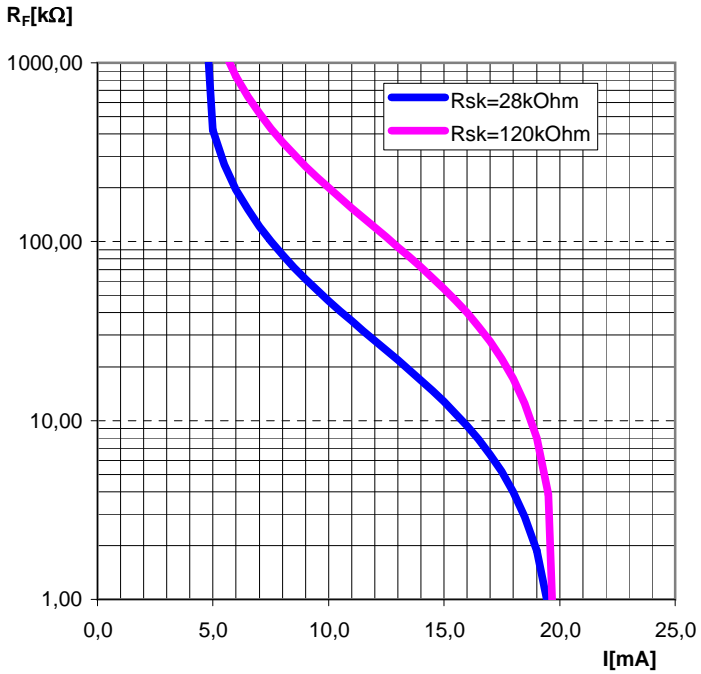
$$R_F = \frac{20 \text{ mA} \times R_{Sk}}{I} - R_{Sk}$$

R_F = Insulation fault in k Ω

R_{Sk} = Centre scale in k Ω

I = Current output in mA

Current output 4...20 mA



$$R_F = \frac{16 \text{ mA} \times R_{Sk}}{I - 4 \text{ mA}} - R_{Sk}$$

R_F = Insulation fault in kW

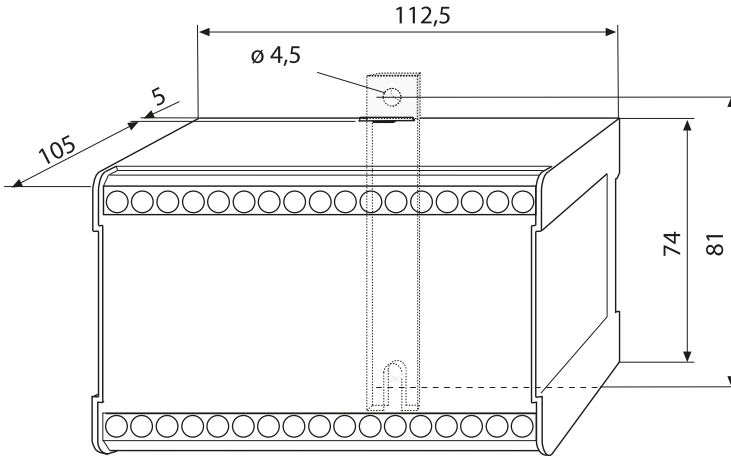
R_{Sk} = Centre scale in kW

I = Current output in mA

Status number

Position of numbers from the left	Value of the respective number				
	0 =	1 =	2 =	3 =	4 =
1	K1: N/O operation Test	K1: N/C operation Test	K1: flashing function	K1: N/O operation	K1: N/C operation
2	K2: N/O operation Test	K2: N/C operation Test	K2: flashing function	K2: N/O operation	K2: N/C operation
3		AK AGH-PV			
4	Cemax 1 μ F **	Cemax 10 μ F **	Cemax 150 μ F	Cemax 500 μ F	Cemax 2000 μ F
5					
6	Self test every 24 hours	Self test every hour	no periodic self test		
7	Language German	Language English			
8	Password protection not activated	Password protection activated			
9	DC measuring principle	AMP measuring principle	AMP2 measuring principle	AMP3 measuring principle	AMP4 measuring principle
10	max. filter frequency 0,1Hz **	max. filter frequency 1Hz **	max. filter frequency 10Hz **	max. filter frequency 50Hz **	
11	min. filter frequency 0,1Hz **	min. filter frequency 1Hz **	min. filter frequency 10Hz **	min. filter frequency 50Hz **	
12	BMS mode **	Isodata **	test data **		
13	Bus address in the tens place IRDH275				Value: 5 ... 9
14	Bus address in the units place IRDH275				Value: 5 ... 9
15	Number of pulses 2-9 **				Value: 5 ... 9
	** The parameters marked with two asterisks are settable via the Service menu item! A password is required for that purpose !				

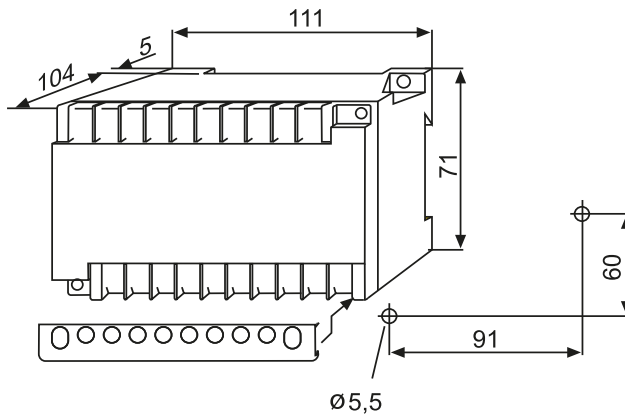
Dimension diagram enclosure isoPV



All dimensions in mm

- DIN rail mounting according to DIN EN 60715/IEC 60715
- Screw fixing
by means of a plug-in trapezoidal support
Order-No. B990056

Dimension diagram enclosure AGH-PV



All dimensions in mm

Illustration with terminal covers

9.5 Ordering information

Type	Nominal voltage U_n	Supply voltage U_s	Art.No.
isoPV-327 + AGH-PV consisting of: isoPV-327 AGH-PV	3(N)AC 0...793 V DC 0...1100 V – –	AC 19.2...55 V 42...460 Hz DC 19.2...72 V – –	B91065132W B91065130W B98039020W
isoPV-335 + AGH-PV consisting of: isoPV-335 AGH-PV	3(N)AC 0...793 V DC 0...1100 V – –	AC 88...264 V DC 77...286 V – –	B91065133W B91065131W B98039020W

Note: The devices isoPV and AGH-PV will be delivered as a set!

Accessories for screw fixing

Order No.: B990056

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