

Operating Manual



A-ISOMETER® IRDH275BU-6 Coupling device AGH575S-6

Insulation monitoring device for medium voltage IT systems
with galvanically connected rectifiers and converters
up to AC/DC 3.6 kV
in combination with coupling device AGH575S-6



Dipl.-Ing. W. Bender GmbH & Co.KG
Londorfer Str. 65 • 35305 Grünberg • Germany
Postfach 1161 • 35301 Grünberg • Germany

Tel.: +49 (0)6401-807-0
Fax: +49 (0)6401-807-259

E-mail: info@bender-de.com
Web server: <http://www.bender-de.com>

© 2005 BENDER Germany

All rights reserved.
Reprinting only with permission
of the publisher.
Subject to change!



Table of Contents

1. Safety information	7
1.1 Use for the intended purpose	7
1.2 Warranty and liability	7
1.2.1 Personnel	8
1.2.2 About the operating manual	8
1.2.3 Hazards when handling the A-ISOMETER® or coupling device	8
1.2.4 Inspection, transport and storage	9
1.2.5 Note	9
1.3 Explanations of symbols and warnings	9
1.4 Directions for installation	10
2. Function	11
2.1 Characteristics IRDH275BU-6 incl. AGH575S-6	11
2.2 Product description	12
2.3 Function	12
3. Installation and connection	17
3.1 Installation of the coupling device AGH575S-6	17
3.2 Wiring diagram	17
4. Operation and setting	21
4.1 Operating features and displays IRDH275BU-6	21
4.1.1 Display in the standard mode	22
4.1.2 Display in the menu mode	22
4.1.3 Function keys	23
4.2 Menu structure and menu mode	26
4.2.1 Diagram menu structure	27
4.3 Menu HISTORY INFO	28

4.3.1	Diagram HISTORY INFO	29
4.4	Menu ISO SETUP: Setting of the basic A-ISOMETER® functions	30
4.4.1	Response values Alarm 1 and Alarm 2	30
4.4.2	Operating principle of the alarm relays	30
4.4.3	Memory setting (on/off)	32
4.4.4	Current output for external measuring instruments	32
4.5	Menu ISO ADVANCED: Setting of the extended functions	33
4.5.1	Coupling devices AGH: 575S-6	33
4.5.2	Adaptation to the system leakage capacitance Cemax	33
4.5.3	Measuring principle(Measure: AMP)	33
4.5.4	Setting the repetition time for automatic self tests (Autotest: 24h)	33
4.5.5	Setting the real-time clock (Clock)	33
4.5.6	Setting the date (Date)	33
4.5.7	Specifying the starting time of the automatic self test (Test) (IRDH275B)	33
4.5.8	Diagram ISO ADVANCED	34
4.6	Menu COM SETUP: Setting the BMS interface	35
4.6.1	Bus address „Addr:“	35
4.6.2	Diagram COM SETUP	35
4.7	Menu PASSWORD	36
4.7.1	Activating and setting the password	36
4.7.2	Diagram PASSWORD	36
4.8	Menu LANGUAGE	37
4.8.1	Setting the national language	37
4.8.2	Diagram Language	37
4.9	Menu SERVICE	38
4.10	Parameterization via Internet	38
5.	Serial interfaces	39
5.1	RS485 interface with BMS protocol	39
5.2	Topology RS485 network	40

5.2.1	Correct arrangement	40
5.2.2	Wrong arrangement	40
5.2.3	Wiring	40
5.3	BMS protocol	41
5.3.1	BMS Master	41
5.3.2	BMS Slave	42
5.3.3	Commissioning of an RS485 network with BMS protocol	43
6.	Technical data IRDH275BU-6 with AGH575S-6	45
6.1	Data in tabular IRDH275BU-6	45
6.2	Data in tabular AGH575BU-6	48
6.3	Standards and approvals	49
6.4	Characteristic curves	50
6.5	Ordering details	56
6.5.1	A-ISOMETER® and coupling device	56
6.5.2	Measuring instruments	56
6.5.3	Label for modified versions	56

1. Safety information

1.1 Use for the intended purpose

The A-ISOMETER® with an additional coupling device is intended for:

- monitoring the insulation resistance of IT systems

Any other use, or any use which goes beyond the foregoing, is deemed to be use other than for the intended purpose. The BENDER companies shall not be liable for any losses or damage arising therefrom.

Use for the intended purpose also includes

- compliance with all information in the operating instructions, and
- compliance with test intervals.

As a basic principle, our "General conditions of Sale and Delivery" shall apply. At the latest, these shall be available to the operator when the contract is concluded.

1.2 Warranty and liability

Warranty and liability claims in cases of damage to persons and property shall be excluded if they are attributable to one or more of the following causes:

- Use of the A-ISOMETER® or the coupling device other than for the intended purpose
- Incorrect assembly or installation, commissioning, operation and maintenance of the A-ISOMETER® incl. coupling device.
- Failure to comply with the information in the operating instructions regarding transport, commissioning, operation and maintenance of the A-ISOMETER® incl. coupling device.
- Unauthorized structural modifications to the A-ISOMETER® or coupling device.
- Failure to comply with the technical data
- Improperly executed repairs, and the use spare parts or accessories which are not recommended by the manufacturer.
- Cases of disaster and force majeure
- Assembly and installation with device combinations not recommended.

This operating manual, especially the safety information, must be observed above all by personnel who work on the A-ISOMETER® or the coupling device. In addition, the rules and regulations that apply for accident prevention at the place of use must be observed.

1.2.1 Personnel

Only appropriately qualified staff may work on the devices. 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.

1.2.2 About the operating manual

This operating manual has been compiled with the greatest possible care. Nevertheless, errors and mistakes cannot be entirely ruled out. The BENDER companies assume no liability whatsoever for any injury to persons or damage to property which may be sustained as a result of faults or errors in this operating manual.

1.2.3 Hazards when handling the A-ISOMETER® or coupling device

The devices are constructed according to the state-of-the-art and recognized 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 A-ISOMETER®s incl. coupling devices or on other valuable property. The A-ISOMETER® incl. coupling device must only be used:

- for the purpose for which it is intended
- when it is in perfect technical condition as far as safety is concerned

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 or recommended by the manufacturer of the devices may cause fires, electric shocks and injuries.

Unauthorized persons must not have access to or contact with the A-ISOMETER® incl. coupling device. Warning signs must always be easily legible. Damaged or illegible signs must be replaced immediately.

1.2.4 Inspection, transport and storage

Inspect the dispatch packaging and equipment packaging for damage, and compare the contents of the package with the delivery documents. In the event of damage in transit, please inform the BENDER company immediately.

The devices must only be stored in areas protected from dust, damp and spray or dripping water, and in which the specified storage temperatures are maintained.

1.2.5 Note

Make sure that the operating voltage is correct!

Prior to insulation and voltage tests, the A-ISOMETER® incl. coupling device 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 system.

Children and unauthorized persons must not have access to or contact with the A-ISOMETER® incl. coupling device.

1.3 Explanations of symbols and warnings

The following symbols are used in BENDER documentation to draw attention to important information and to make it easier to find certain text passages.

The following examples explain the meaning of the symbols:



The "Attention" symbol is used to draw attention to information warning employees of hazardous situations.





Information you should know for correct handling of the product is marked with the "Info" symbol.

1.4 Directions for installation



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

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

The terminals  and KE shall be connected by a separate wire to the protective conductor (PE). If the device is connected by means of terminal AK via the coupling device to a system under operation, the terminals  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 earth fault, e.g. via a suitable resistance, before starting the device.

The devices, variant -6.. are delivered with the following factory setting:

ISO SETUP	Alarm 1 / Alarm 2 = 2 M Ω / 100 k Ω (response values)
ISO SETUP	Operating principle K1/K2 = N/O operation
ISO SETUP	Memory = off
ISO ADVANCED	System leakage capacitance = 5 μ F
ISO ADVANCED	Coupling device = AGH: 575S-6
COM SETUP	Bus address = 3 (slave)

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



When an AC system includes galvanically connected DC circuits, the following shall be considered:

Insulation faults in DC circuits can only be monitored correctly when the rectifiers carry a continuous load of 5...10 mA.

2. Function

2.1 Characteristics IRDH275BU-6 incl. AGH575S-6

- Device combination for use in medium voltage systems with converters up to AC/DC 3.6 kV (IT = unearthed systems))
- Automatic adaptation to the existing system leakage capacitance
- **AMPPlus** measuring principle (European Patent: EP 0 654 673 B1)
- Two separately adjustable ranges of the response value 100 k Ω ... 10 M Ω (Alarm 1, Alarm 2)
- Two-line LC display
- Automatic device self test
- Memory with real-time clock to store all alarm messages with date and time stamp.
- BMS interface (BMS protocol) for data exchange with other Bender devices (RS485 electrically isolated).
- Current output 0(4)...20mA (galvanically separated) in relation to the measured insulation value.
- Remote setting of certain parameters via the Internet (option; FTC470XET additionally required)

2.2 Product description

The A-ISOMETER® IRDH275BU-6 and coupling device AGH575S-6 monitor the insulation resistance of IT medium voltage systems up to 3.6 kV. 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. Drive systems including a converter and a motor in medium voltage systems can be monitored. When the AGH575S-6 is connected in the mid-point of the converter DC intermediate circuit, a maximum of ± 3.6 kV against PE may occur. The device automatically adapts itself to the existing system leakage capacitance.

The IRDH275BU-6 can be used in combination with a control and indication panel, e.g. PRC1470 version 2 or higher, on the BMS (BMS = Bender Measuring Device Interface) bus.

2.3 Function

The combination A-ISOMETER® IRDH275BU-6 and coupling device AGH575S-6 is operated between the unearthed system (IT system) and the protective conductor (PE).

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

A microprocessor-controlled pulsating AC measuring voltage is superimposed on the IT system to be monitored (**AMPplus** measuring principle*). The measuring cycle consists of positive and negative pulses of the same amplitude. The period of these pulses depends on the respective system leakage capacitances and the insulation resistances of the IT system to be monitored. An insulation fault between the IT system and earth closes the measuring circuit. From the measured current value, the microprocessor calculates the insulation resistance which is indicated on the LC display or the external kOhm measuring instrument.

The measuring time t_{an} is determined by the system leakage capacitances, the insulation resistance, and the system-related interference disturbances. System leakage capacitances do not influence the measuring accuracy. When virtually no disturbances are caused by the operation of converters, the measuring process takes about five minutes.

If the reading is below the selected response values Alarm 1/Alarm 2, the associated alarm relays respond and the alarm 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 [NC contact] or wire bridge), the fault indication will be stored. Pressing the RESET button, resets the insulation fault message, provided that the currently displayed insulation resistance is at least 25 % above the actual response value when the reset is carried out. The fault memory behaviour can also be set in the "ISO SETUP" menu, by selecting the sub menu Memory: on/off.

The connections for an external $k\Omega$ display supplied by the current output 0(4)...20 mA at M+/M- are galvanically isolated.

*) **AMPPlus** measuring principle "adaptive measuring pulse", a measuring principle developed by BENDER (European Patent: EP 0 654 673 B1).

Self test

A self test can be carried out manually using the TEST button or automatically. In order to guarantee high functional reliability, the A-ISOMETER® IRDH275BU-6 provides comprehensive self test functions. After switching the supply voltage on, all internal measuring functions, the components of the process control such as data and parameter memory as well as the earth connections are checked using the self test functions. The progress of the self test is indicated on the LC display by a bar graph. Depending on the conditions in the IT system to be monitored, the self test is running for 15...20 seconds, then the message "Test ok!" appears on the LC display for approximately 2 seconds. Then the device returns to the standard mode and the current measuring value is displayed after the expiry of the measuring time.

When a fault is found at the terminals \equiv and KE, the message "Error!" appears on the LC display, the system fault LED lights up, the relay K2 (21-22-24) switches and the respective fault message (see table) is indicated. If such a system fault occurs, a self test is started again every minute. If no more malfunction is detected, the fault message is deleted automatically and the system fault LED extinguishes.

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 "ISO ADVANCED: Autotest" menu. The alarm relays Alarm1/2 only switch after starting the self test function by

pressing the TEST button, that means if an automatic self test has been selected, the alarm relays do not switch.

Error message	Meaning	Steps to be taken
Connection PE?	No low-resistance connection of the terminals \equiv and KE to earth (PE)	<ol style="list-style-type: none"> 1. Check wiring of terminal \equiv and KE to earth (PE) 2. Press TEST button 3. Switch the supply voltage off and on
Device error x	Internal device error	<ol style="list-style-type: none"> 1. Press TEST button 2. Switch the supply voltage off and on 3. Contact BENDER



If the on/off switching of the supply voltage is not possible for technical reasons, a RESET of the process control can be carried out by pressing the "ESC", "RESET" and "MENU" key.

Current output for external measuring instrument

The current output of the A-ISOMETER® provides 0(4)...20 mA. The current output is galvanically isolated from the device electronics and the RS485 interface. The ISO SETUP menu, on page 31, allows to switch over between 0...20 mA and 4...20 mA.

Real-time clock

The real-time clock serves as a time base for the memory and self test functions. At first, the correct time and date must be set in the menu "ISO ADVANCED". 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 thirty days.

If the 24 V test is activated in the "ISO ADVANCED" menu, a special time of day can be selected for the execution of the self test in the menu "TEST":

12:00". Then a self test will be started automatically once a day exactly at the preset time. If the 1 h auto test has been selected, the self test is automatically carried out every full hour.

Function input F1/F2 to switch over to the standby mode

When the input terminals F1/F2 are bridged, the measuring function is stopped and the message "STANDBY" appears on the display. The currently measured value is blanked and the value $> 10 \text{ M}\Omega$ is indicated. The alarm relays and alarm LEDs no longer provide alarm messages. After opening the function input F1/F2, a completely new measuring cycle for insulation monitoring is started.

3. Installation and connection

3.1 Installation of the coupling device AGH575S-6



The coupling device is operated with voltages above 1000 V! Please observe the instruction for installation below.

- For operation the coupling device has to be installed into a "closed electrical operating area", refer to IEC 61800-5-1
- The coupling device is to be installed in a place where the pollution degree to be expected is ≤ 2 , refer to IEC 61800-5-1: 2003, subclause 4.2.6.2.2
- An "Enclosure suitable for high voltage areas" has to be selected for installation, refer to IEC 61800-5-1: 2003
- Make sure that the clearance between terminal 2 and the conductive parts of the enclosure used for the installation of the coupling device is at least 77 mm.

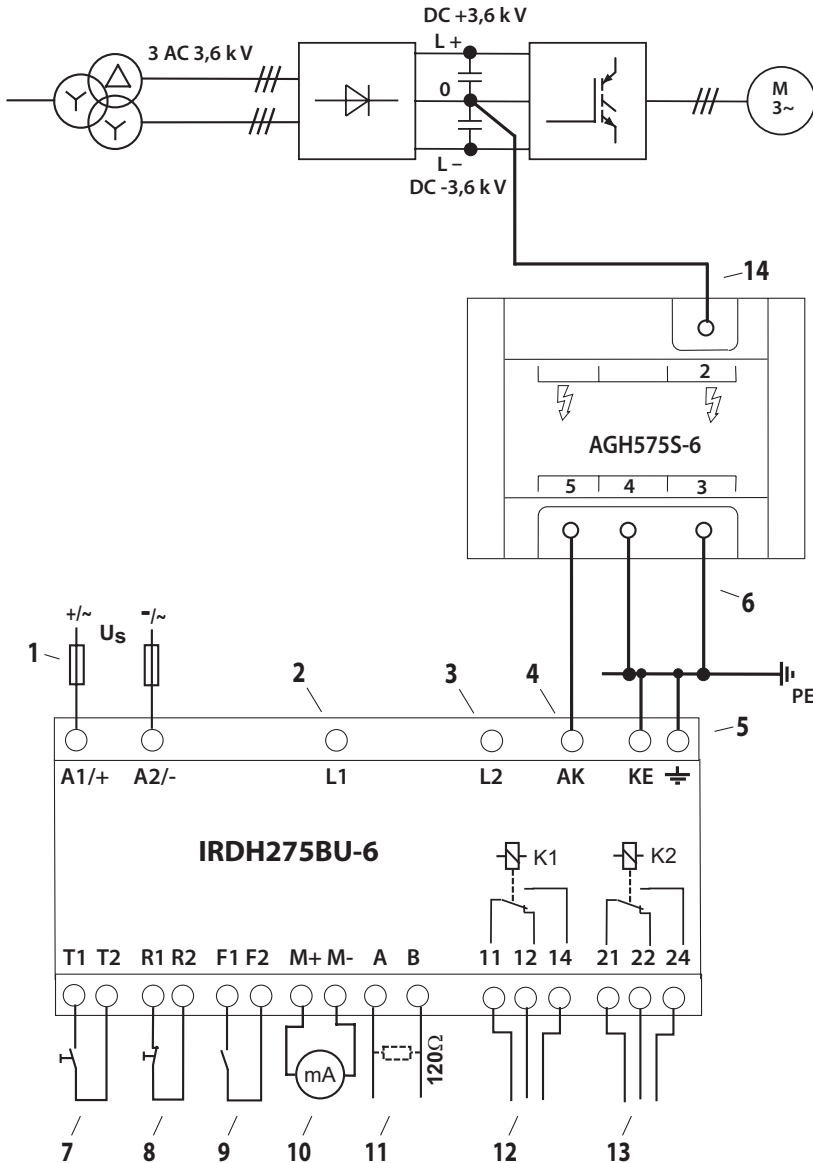
3.2 Wiring diagram

Connect the terminals A1/+ and A2/- to the supply voltage U_s in accordance with IEC 60364-4-43. The connections to the supply voltage shall be provided with protective devices to afford protection in the event of a short circuit (a 6 A fuse is recommended).

For the connection to the IT system to be monitored via the coupling device AGH575S-6, devices for protection against short-circuit in conformity with IEC 60364-4-43 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).

Only one A-ISOMETER® may be connected to an external TEST or RESET button. The TEST and RESET button for collective testing of several insulation monitoring devices must not be connected in parallel.

External coupling device connected via the terminal AK cannot be switched off via the internal coupling relays.



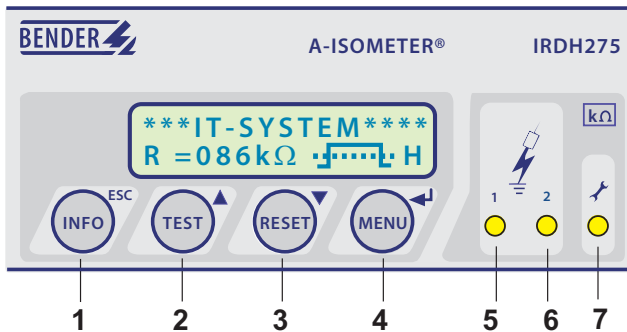
Legend to wiring diagram:

- 1 Supply voltage U_s (see nameplate) via 6 A fuse
- 2, 3 Terminals L1, L2 are not connected!**
- 4 Connection to the coupling device AGH575S-6:
connect terminal AK to terminal 5 of the coupling device.
- 5 Separate connection of $\text{---}\equiv\text{---}$ and KE to PE
- 6 Separate connection of the terminals 3 and 4 of the AGH575S-6 to PE
- 7 External TEST button (NO contact)
- 8 External RESET button (NC 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, insulation measurement does not take place.
- 10 Current output, galvanically separated:
0...20 mA or 4...20 mA
- 11 Serial interface RS485 (termination 120 Ω resistor)
- 12 Alarm relay 1; changeover contacts provided
- 13 Alarm relay 2 (system fault relay); changeover contacts provided
- 14 Connection of the coupling device to the converter:
Terminal 2 to the mid-point of the DC intermediate circuit

The wiring diagram before is to be taken by way of example.

4. Operation and setting

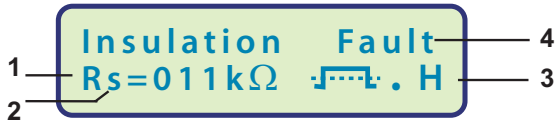
4.1 Operating features and displays IRDH275BU-6





- 1 INFO key: to query standard information /
ESC key: back to the menu function, confirmation parameter change
- 2 TEST button: to call up the self test/
Up key: parameter change, moving up in the menu
- 3 RESET button: to delete insulation fault alarms
Down key : parameter change, moving down in the menu
- 4 MENU key: to activate the menu system / Enter key: confirmation 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 System fault LED lights: IRDH275 defective
- 8 Two-line display for standard and menu mode

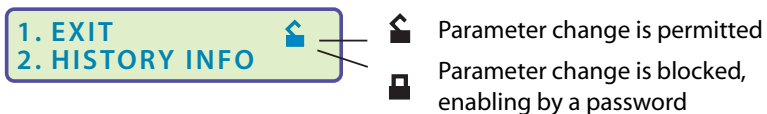
A detailed description of the operating elements is given on the following pages.

4.1.1 Display in the standard mode



- | | |
|---|---|
| 1 | Indication of the insulation resistance in kΩ |
| 2 | Additional information about the insulation resistance: <ul style="list-style-type: none"> "+" = insulation fault at L+ "-" = insulation fault at L- "s" = new measurement has started |
| 3 | <ul style="list-style-type: none">  = polarity of the measuring pulse  = valid bus communication signals H = new entry in the memory data base C = flashing, clock is to be set |
| 4 | Messages: <ul style="list-style-type: none"> - Insulation fault - Connection system? - Connection PE? - Device error x - *****STAND BY***** |

4.1.2 Display in the menu mode



4.1.3 Function keys

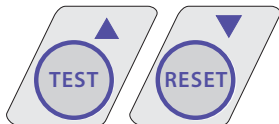
Two functions are assigned to each function key. In addition to the basic function marked with a circle, all the keys allow navigation within the menu.



Pressing the INFO key provides the following information without opening the menu:

- Device name, firmware version
- Response values Alarm 1 and Alarm 2
- Leakage capacitance C_e (only indication if insulation resistances $> 100 \text{ k}\Omega$)
- Setup status (for details refer to the table of the status numbers on page 53)
- COM-Setup (own bus address)

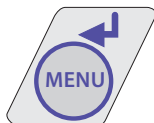
Please have the details above on hand if you have a problem and if you contact BENDER for technical questions.



Activating the TEST button starts the A-ISOMETER® self test.

Pressing the RESET button resets insulation and fault alarm messages stored in the A-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 A-ISOMETER® can only be reset when the present insulation value is 25% higher than the set response value.



The menu system is called up by pressing the MENU key.

For controlling the menu system, the arrow keys, the ENTER key and the ESC key are used:



Arrow up key:
Moving up in the menu, increasing a parameter



Arrow down key :
Moving down in the menu, reducing a parameter



ENTER key
Selecting a menu item or sub menu item, confirming or storing a parameter change and going back to the associated sub menu item or going to the next input area.



ESC key:
Returning from a sub menu to the previous menu.

If you do not exit the menu, the device automatically returns to the standard mode again after approximately five minutes.

For the sake of clarity, the following symbols are used for the functions ENTER, UP/DOWN and ESCAPE in the menu diagrams of this operating manual:



4.2 Menu structure and menu mode

Switchover to the menu mode

After pressing the MENU key, you can change from the standard mode to the menu mode. From the menu mode you can link to the different sub menus.


Navigation within the menu

Select the desired menu item using the UP/DOWN keys. The selected menu item is indicated by a flashing cursor. Press the ENTER key to open the associated sub menu.

Use the UP/DOWN keys again to select the desired parameters. Move the cursor to the edit field by pressing the ENTER key.

If you have reached the end of the main menu list, it will be indicated by the "Arrow UP" symbol.

Changing the parameters

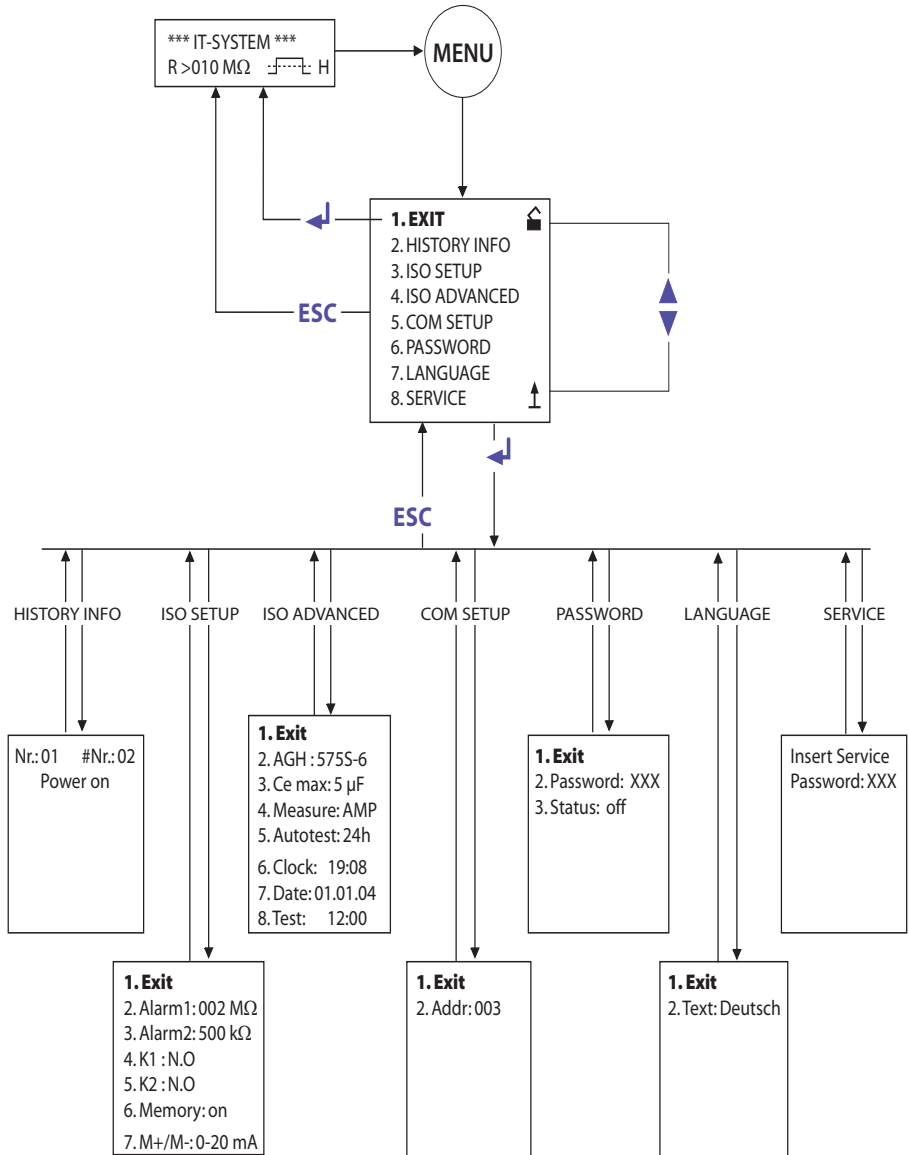
When password protection is activated, indicated by the symbol "padlock closed"  , the first thing to enter is the correct password before the parameters can be changed using the UP/DOWN keys. Entering the correct password once allows all parameters to be changed as long as you do not leave the menu.

Changing the parameter usually has an immediate effect on the measuring and alarm functions. The changed parameter is stored in a volatile memory by pressing the ENTER or ESC key after returning to the sub menu (flashing cursor in column 1). During menu operations, all measuring and alarm functions carry on working as usual in the background.

Changing from the menu mode to the standard mode

Pressing the ESC key allows fast changing from the menu mode to the standard mode. Thus, the menu item "EXIT" need not to be activated. Automatic switchover from the menu mode to the standard mode takes place when no key is pressed for approximately five minutes in a main or sub menu.

4.2.1 Diagram menu structure



4.3 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 provides protection 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)

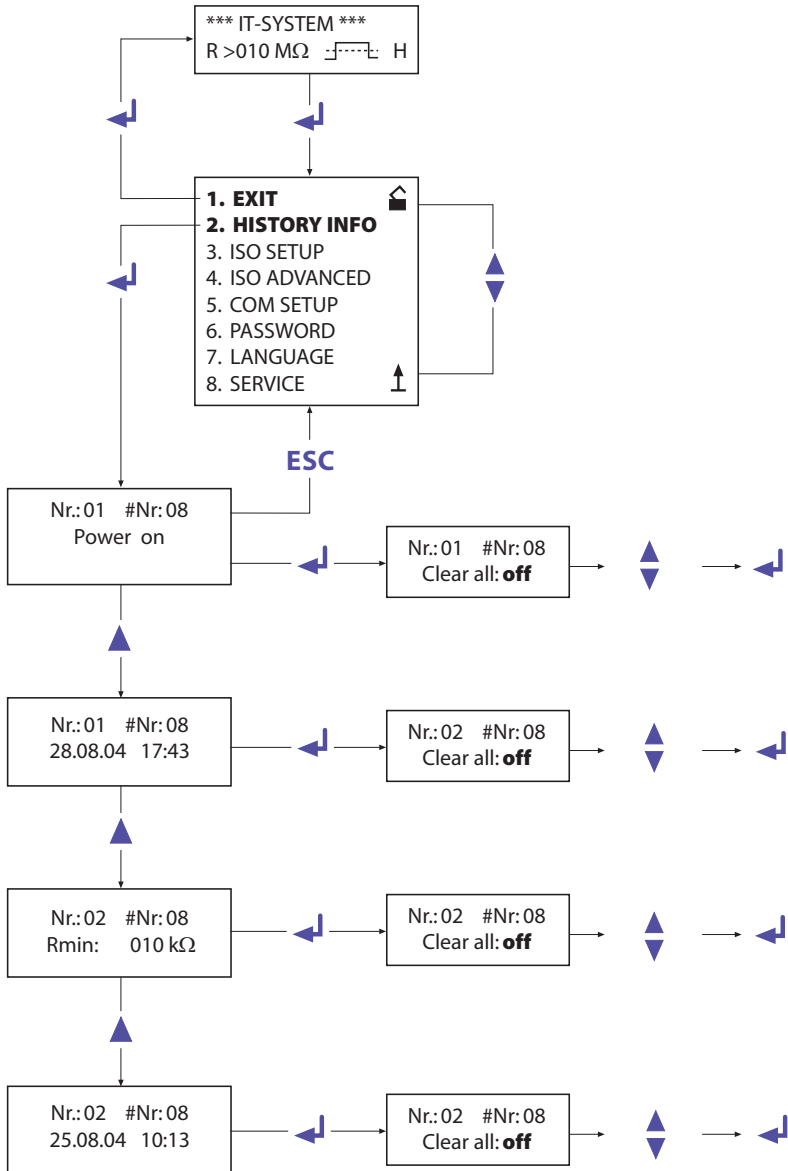
Display indication

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

Before storing the events with the actual date and time stamp, set the real-time clock in the ISO ADVANCED menu (refer to page 34).

The following function keys are provided to query data from the "HISTORY INFO" menu: the UP/DOWN keys to change the data record number, the ENTER key to change from the data record number to the menu item "Clear all:on" to delete the memory storage, and the ESC key to leave the menu. A new entry into the memory is signalled with an "H" on the display in the standard mode. The "H" will be deleted as soon as the "HISTORY INFO" menu is called up.

4.3.1 Diagram HISTORY INFO



4.4 Menu ISO SETUP: Setting of the basic A-ISOMETER® functions

All alarm functions such as Alarm 1 and Alarm 2 (prewarning and main alarm), the operating principle of the alarm relays 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 are set in this menu.

4.4.1 Response values Alarm 1 and Alarm 2

The response values Alarm 1 and Alarm 2 are selected with the UP/DOWN keys and stored with the ENTER key.

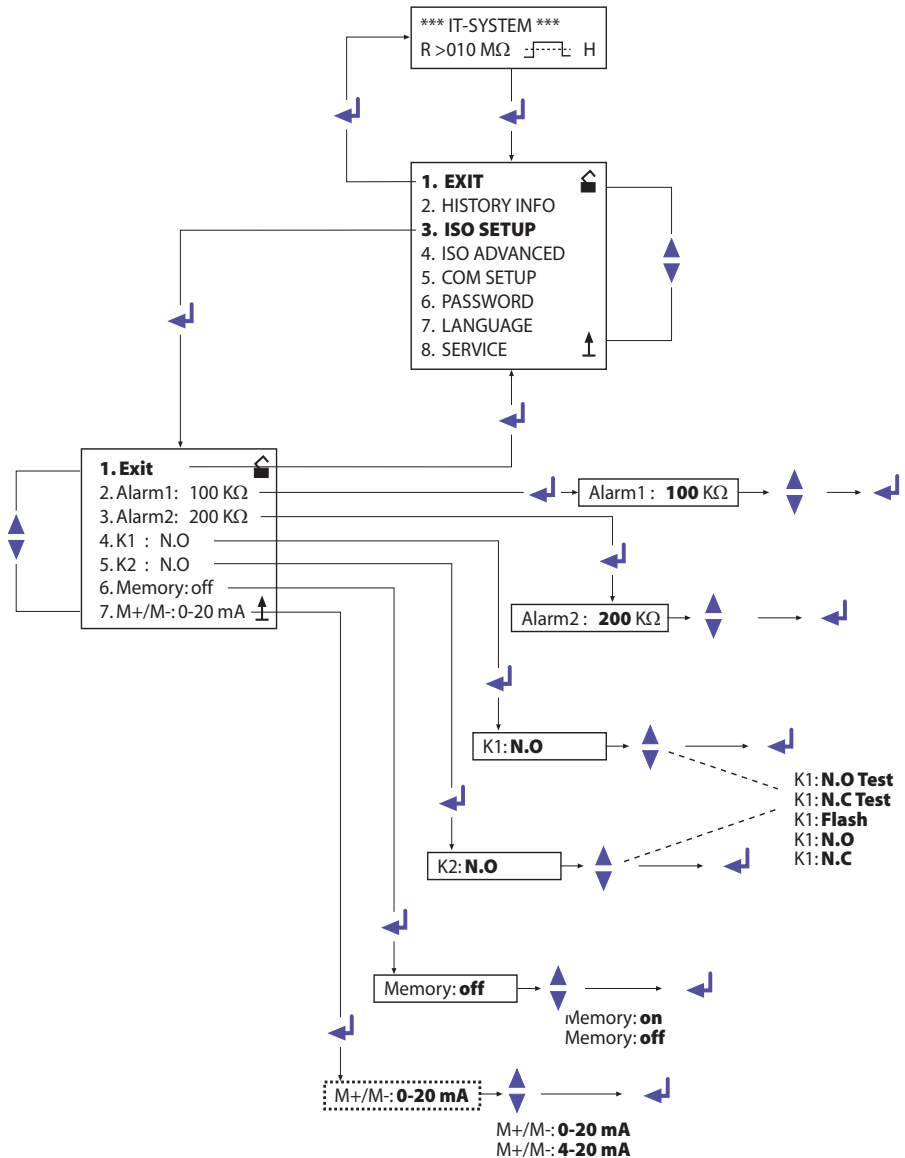
4.4.2 Operating principle of the alarm relays

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, for any reason, the alarm relays may not switch over during a manual self test, the settings N.C or N.O are to be selected.

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

Diagram ISO SETUP





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



When a system fault occurs at the A-ISOMETER®, the relay K2 will automatically be activated as a system fault relay.

4.4.3 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)

4.4.4 Current output for external measuring instruments

Factory setting: 0...20 mA

The current output of the IRDH275BU-6 can be set to "0...20 mA" oder "4...20 mA" via the menu point "M+/M-:". The maximum load is 500 Ω.

Function 0...20 mA:

R_F = insulation fault, I = current in mA

$$R_F = \frac{20 \text{ mA} \times 1200 \text{ k}\Omega}{I} - 1200 \text{ k}\Omega$$

Function 4...20 mA:

R_F = insulation fault, I = current in mA

$$R_F = \frac{16 \text{ mA} \times 1200 \text{ k}\Omega}{I - 4 \text{ mA}} - 1200 \text{ k}\Omega$$

The associated characteristic curves are illustrated on page 51.

4.5 Menu ISO ADVANCED: Setting of the extended functions

4.5.1 Coupling devices AGH: 575S-6

The A-ISOMETER® is connected to the AGH575S-6 by connecting the terminal AK to terminal 5. The nominal operating range is extended to AC 0...3.6 kV. When terminal 2 will be connected to the midpoint of the DC intermediate circuit, a voltage of 7.2 kV is permitted.

4.5.2 Adaptation to the system leakage capacitance Cemax

This menu allows to adapt the A-ISOMETER® to the maximum system leakage capacitance (5 or 10 μF). Please note that the basic measuring time will take no longer than five minutes when virtually no converter-related disturbances are present. Factory setting = 10 μF .

4.5.3 Measuring principle(Measure: AMP)

The AMP measuring principle is factory set.

4.5.4 Setting the repetition time for automatic self tests (Autotest: 24h)

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

4.5.5 Setting the real-time clock (Clock)

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

4.5.6 Setting the date (Date)

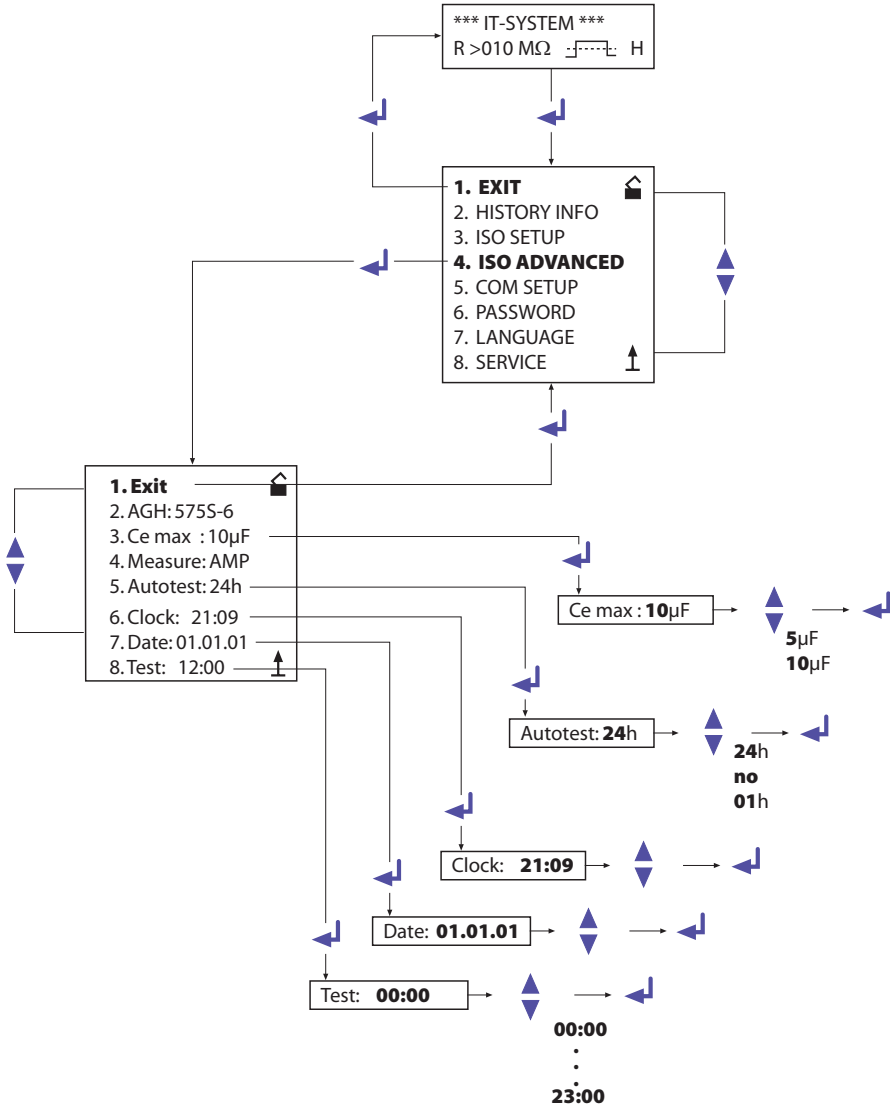
As well as the time, the date is required for the memory, too. In the event of power supply failure, the date function is not influenced for at least 30 days. If the device is switched on again after this period, a new setting of date and time of the real-time clock is required.

4.5.7 Specifying the starting time of the automatic self test (Test) (IRDH275B)

If the 24h self test is activated in the ISO ADVANCED menu, it is possible to set the time (hour) when the self test is to be carried out by means of the "TEST: 12:00" sub menu. Then the self test is automatically carried out once

a day at a given time. If the 1 hour auto test has been selected, the self test will be carried out at every full hour.

4.5.8 Diagram ISO ADVANCED



4.6 Menu COM SETUP: Setting the BMS interface

4.6.1 Bus address „Addr:“

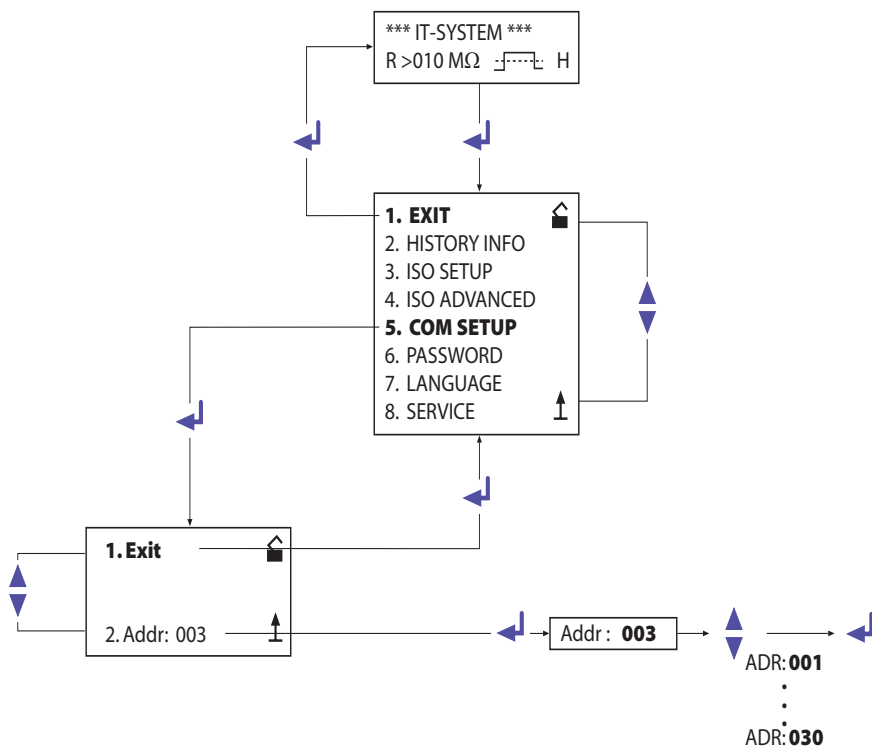
This menu item is used to set the BMS bus address of the A-ISOMETER®. Since there are several A-ISOMETERs in one system, take care that the bus address is not assigned twice.

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



If several A-ISOMETER®s are operated on one BMS bus, the addresses of other A-ISOMETER®s must be assigned one after the other, since only one device may represent the Master.

4.6.2 Diagram COM SETUP

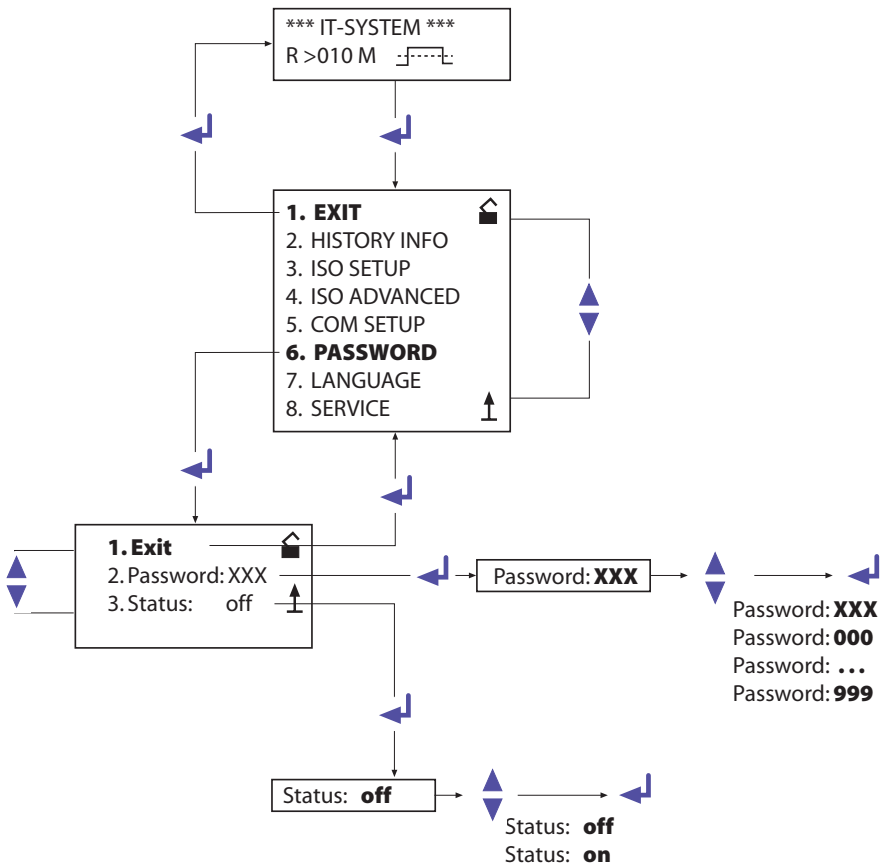


4.7 Menu PASSWORD

4.7.1 Activating and setting the password

This menu can be used to activate a "Password" query. This protects the A-ISOMETER® against unauthorized settings and modifications. The desired password (menu item 2. Password: xxx) can be set with the UP/DOWN keys and confirmed with the ENTER key. The password can be activated in the menu item "3. Status: on" by clicking the ENTER key. The basic setting is "3. Status: off", that means that the password is deactivated.

4.7.2 Diagram PASSWORD

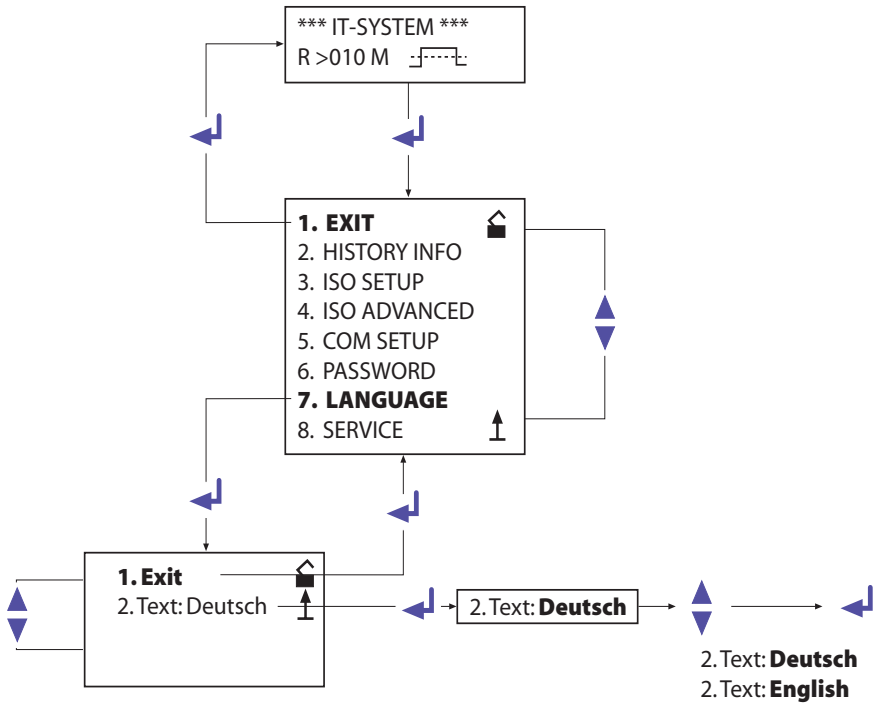


4.8 Menu LANGUAGE

4.8.1 Setting the national language

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

4.8.2 Diagram Language



4.9 Menu SERVICE

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

4.10 Parameterization via Internet

The parameters of the A-ISOMETER® indicated below can be checked and set from a remote place of use by using a personal computer. In addition, a browser (viewing program for Internet application) and our protocol converter FTC470XET (BMS \Leftrightarrow Ethernet/TCP/IP) are required.

Remote setting is possible for:

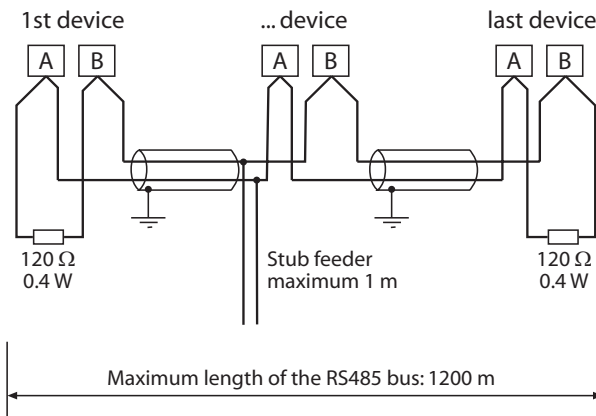
- Response value Alarm 1 (100...10,000 k Ω) (Y1)
- Response value Alarm 2 (100...10,000 k Ω) (Y2)
- Operating principle alarm relay K1 (e.g. N/O operation)
- Operating principle alarm relay K2 (e.g. N/O operation)
- Current output ranges for external measuring instruments (0/4...20 mA)
- Maximum system leakage capacitance (5 μ F or 10 μ F)
- Time for repetition of the automatic self test (off/ 1 h/ 24 h)
- Starting time of the automatic self test (0.00...23.00 h)
- Language of the alarm messages to be displayed (D, GB)
- Setting the fault memory to ON or OFF

5. Serial interfaces

5.1 RS485 interface with BMS protocol

The RS485 interface which is galvanically isolated from the device electronics and current output serves as a physical transmission medium for the BMS protocol. If several A-ISOMETER®s 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 RS485 network that is not terminated, is likely to get instable and may result in malfunctions. 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.

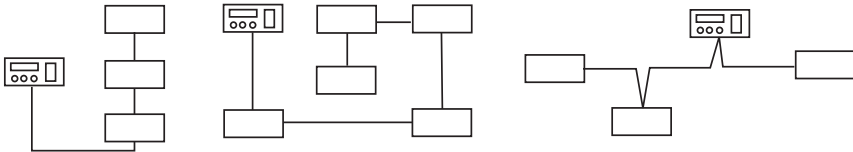


5.2 Topology RS485 network

The optimum topology for the RS485 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 RS485 network represents a continuous path without branches.

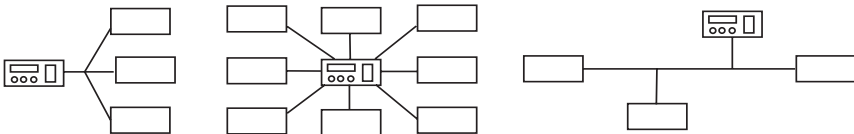
5.2.1 Correct arrangement

Three examples for correct arrangement:



5.2.2 Wrong arrangement

Three examples for wrong arrangement:



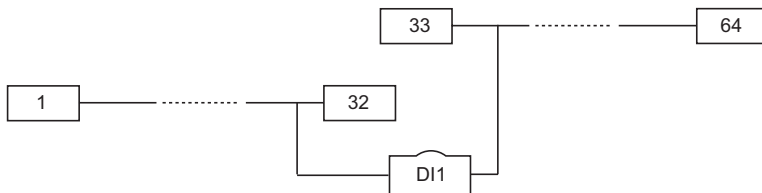
5.2.3 Wiring

A suitable type of cable for the wiring of the RS485 network is: screened cable, core diameter ≥ 0.6 mm

(e.g. J-Y(ST)Y 2x0.6), screen on one side connected to earth (PE).

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 an RS485 repeater DI1.



5.3 BMS protocol

This protocol is an essential part of the Bender Measuring Device Interface. Data transmission generally makes use of ASCII characters.


Interface data are:

- Baud rate: 9600 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 nodes are SLAVES. It is important that only one MASTER is present in each network. All bus nodes 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 IRDH275B devices.

5.3.1 BMS Master

A Master can query all warning and operating messages from a slave. If the bus address 1 has been selected for one IRDH275B, this 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 recognizes incorrect answers from a slave, the fault message "Fault RS485" is issued by the Master.

Fault RS485
Rs=011kΩ  **H**

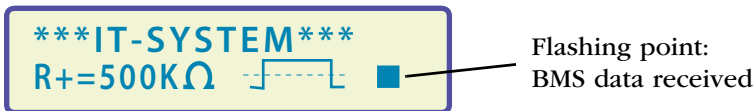
Faults may be caused when:

- 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

5.3.2 BMS Slave

All IRDH275B 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 IRDH275B a BMS address can be selected from the address range 1...30. When assigning the addresses, also other devices such as the EDS47x-12 must be considered.

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



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
- RS485 interface (terminal 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 operator panels, e.g. PRC1470.

Message	Channel	Meaning
Insulation Fault	1	Insulation resistance < setting Alarm 1
Insulation Fault	2	Insulation resistance < setting Alarm 2
Connection PE	4	Connection error \equiv /KE against PE conductor
Device error	5	Internal device error

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

5.3.3 Commissioning of an RS485 network with BMS protocol

- Connect the terminals A and B of all bus nodes in one line
- Switch the terminating resistors on at the beginning and end of the RS485 network or in case of devices without a terminating switch, at the end of the bus, connect a 120 Ω resistor to the terminals A and B.
- Switch the supply voltage U_S on.
- Determine one IRDH275B as the Master and assign address 1.
- Assign the addresses (2...30) subsequently to all other IRDH275B devices and other bus nodes (see table below).
- Check whether a flashing point appears on all devices (BMS commands are being received).

BMS-bus address ranges

Addresses*	Device	Meaning
0		There is no device with address 0 ! Information sent to address 0 applies to all devices connected to the interface (broadcast)
1	PRC1470	Control and indicating device
1...30	IRDH275B/ 375B/575	Insulation monitoring device
1...30	FTC470...	Protocol converter
2...30	EDS47x-12	Insulation fault evaluators (localisation)
31...60	SMO480-12	Signal converter relay
61...90	EDS47xE-12	Insulation fault evaluators (localisation)
111...119	PGH47x	Test device for insulation fault location
121...150	PGH47xE	Test device for insulation fault location



When assigning addresses, take care that there are no gaps greater than five in the respective ranges (1...30, 31...60, 61...90, 111...119 and 121...151).

6. Technical data IRDH275BU-6 with AGH575S-6

6.1 Data in tabular IRDH275BU-6

Insulation coordination acc. to IEC 60664-1

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

Voltage ranges

Nominal voltage range U_n	via AGH575S-6
Supply voltage U_S (refer to nameplate for other values)	AC 88...264 V
Frequency range of U_S	42...460 Hz
Supply voltage U_S (refer to nameplate for other values)	DC 77...286 V
Power consumption	≤ 14 VA

Response values

Response value R_{an1} (Alarm 1)	100 k Ω ...10 M Ω
Response value R_{an2} (Alarm 2)	100 k Ω ...10 M Ω
Relative percentage error	0 %...+20 %
Response time t_{an}	≤ 5 min
Hysteresis	25 %

Measuring circuit

Measuring voltage U_m	≤ 50 V
Measuring current I_m (at $R_f = 0 \Omega$)	$\leq 42 \mu$ A
Internal DC resistance R_f	≥ 1.2 M Ω
Internal impedance Z_f , at 50 Hz	≥ 1.2 M Ω
Permissible extraneous DC voltage U_{fg}	with AGH575S-6
Permissible system leakage capacitance C_e	$\leq 10 \mu$ F
Factory setting	10 μ F

Displays

Display, illuminated	two-line display
Characters (number of characters)	2 x 16
Display range, measuring value	50 k Ω ... 10 M Ω
Relative percentage error	± 10 %

Outputs/inputs

TEST/ RESET button	internal/external
Cable length TEST/RESET button external	≤ 10 m
Current output for measuring instrument SKMP (scale centre point = 1.2 M Ω):	
Current output (load)	20 mA (≤ 500 Ω)
Accuracy current output (100 k Ω ... 10 M Ω)	±10 %

Serial interface

Interface / Protocol IRDH275B	RS485 / BMS
Connection	terminals A/B
Cable length	≤ 1200 m
Recommended cable (screened, screen on one side connected to PE)	J-Y(ST)Y 2 x 0.6
Terminating resistor	120 Ω (0.5 W)
Device address, BMS bus	1...30 (factory setting = 3)

Switching components

Switching components	2 changeover contacts: K1 (Alarm 1), K2 (Alarm 2, system fault)
Operating principle K1, K2 (Alarm 1, Alarm 2)	N/O or N/C operation
Factory setting (Alarm 1/Alarm 2)	N/O operation
Electrical endurance	12 000 switching operations
Contact class	IIB acc. to DIN IEC 60255 part 0-20
Rated contact voltage.....	AC 250 V / DC 300 V
Making capacity.....	AC/DC 5 A
Breaking capacity.....	2 A, AC 230 V, cos phi = 0.4
.....	0,2 A, DC 220 V, L/R = 0.04 s
Minimum contact current at DC 24 V	≥ 2 mA (50 mW)

General data

EMC immunity.....	acc. to EN 61326
EMC emission	acc. to EN 61326
Shock resistance IEC 60068-2-27 (device in operation)	15 g / 11 ms
Bumping IEC 60068-2-29 (during transport)	40 g / 6 ms
Vibration resistance IEC 60068-2-6 (device in operation).....	1 g / 10...150 Hz
Vibration resistance IEC 60068-2-6 (during transport)	2 g / 10...150 Hz
Ambient temperature (during operation)	-10 °C...+55 °C
Storage temperature range.....	-40 °C...+70 °C
Climatic class acc. to IEC 60721-3-3.....	3K5
Operating mode.....	continuous operation
Mounting	as indicated on the display
Connection.....	screw 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
Conductor sizes (AWG).....	24-12
Protection class, internal components (DIN EN 60529)	IP30
Protection class, terminals (DIN EN 60529)	IP20
Type of enclosure	X112, free from halogen
DIN rail mounting	IEC 60715
Flammability class	UL94 V-0
Weight approx.	510 g

6.2 Data in tabular AGH575BU-6

Insulation coordination in consideration of IEC 61800-5-1:2003

Rated voltage AC 3.6 V

Voltage test in consideration of IEC 61800-5-1:2003

Rated impulse voltage AC 40 kV

AC voltage test, duration: 5 s AC 20 kV

Voltage ranges

Nominal voltage range U_n AC/3/(N) AC/DC 0...3.6 V

Nominal frequency 0...460 Hz

General data

Shock resistance IEC 60068-2-27 (device in operation) 15 g / 11 ms

Bumping IEC 60068-2-29 (during transport) 40 g / 6 ms

Vibration resistance IEC 60068-2-6 (device in operation) 1 g / 10...150 Hz

Vibration resistance IEC 60068-2-6 (during transport) 2 g / 10...150 Hz

Ambient temperature (during operation) -10 °C ... +55 °C

Storage temperature range -40 °C ... +70 °C

Climatic class acc. to IEC 60721-3-3 3K5

Operating mode continuous operation

Mounting any position

Connection screw 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

Protection class, internal components (DIN EN 60529) IP64

Protection class, terminals (DIN EN 60529) IP20

Type of enclosure resin-encapsulated block

Screw mounting M5

Flammability class UL94 V-0

Weight approx. 3350 g

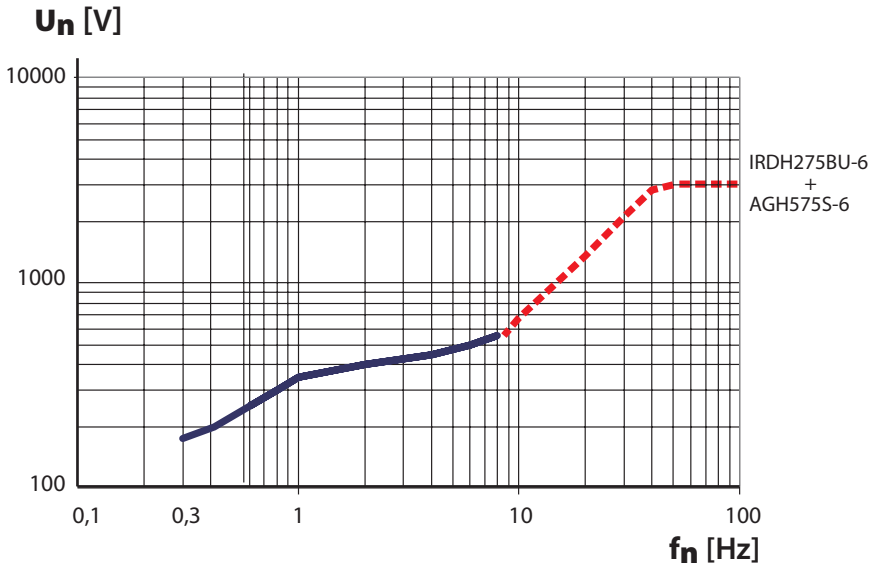
6.3 Standards and approvals

The A-ISOMETER® was designed under consideration of the following standards:

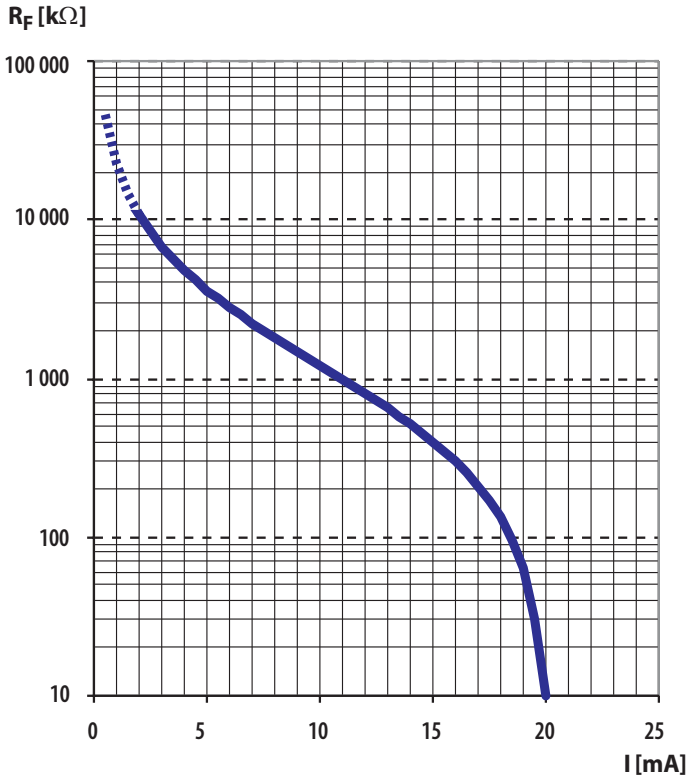
- IEC 61557-8:1997-02
- IEC 61326:2002-02

6.4 Characteristic curves

Max. AC voltage between IT system and PE in the frequency range of < 50 Hz

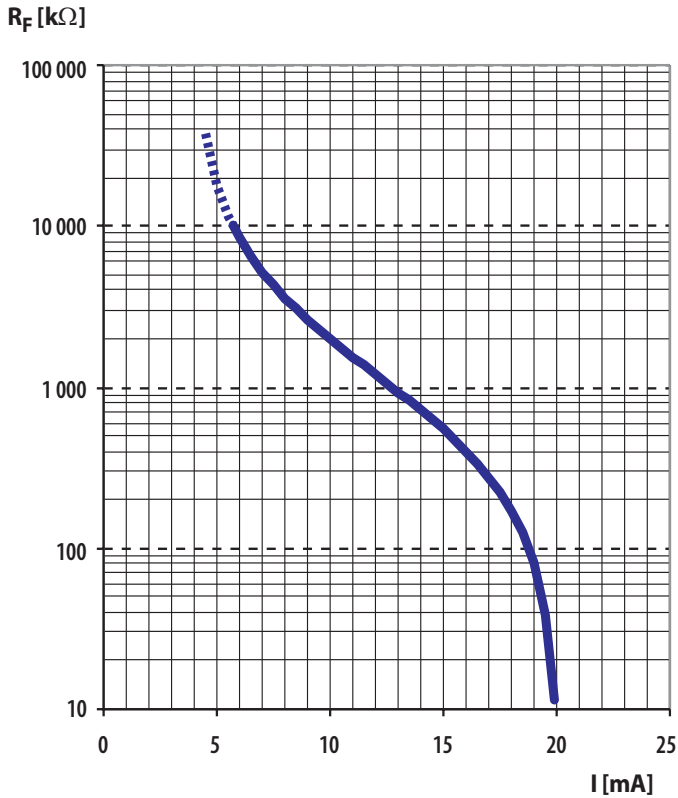


Current output 0...20 mA (IRDH275BU-6)



$$R_F = \frac{20 \text{ mA} \times 1200 \text{ k}\Omega}{I} - 1200 \text{ k}\Omega$$

- R_F = Insulation fault in kΩ
- I = Current output in mA

Current output 4...20 mA (IRDH275BU-6)


$$R_F = \frac{16 \text{ mA} \times 1200 \text{ k}\Omega}{I - 4 \text{ mA}} - 1200 \text{ k}\Omega$$

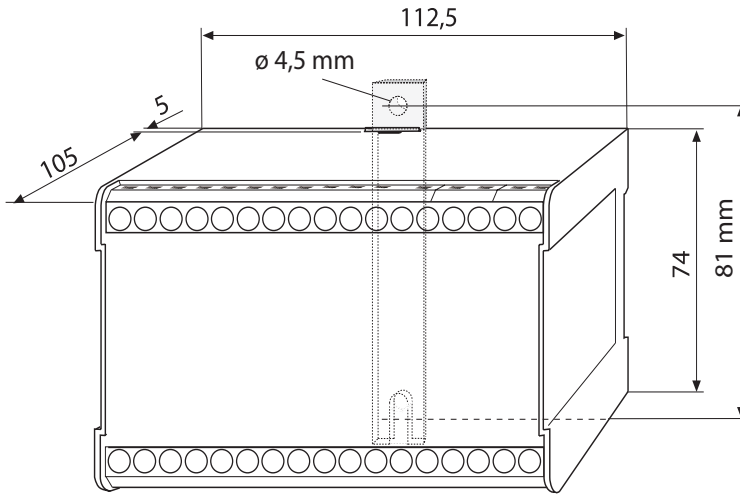
R_F = Insulation fault in $k\Omega$

I = Current output in mA

Status number

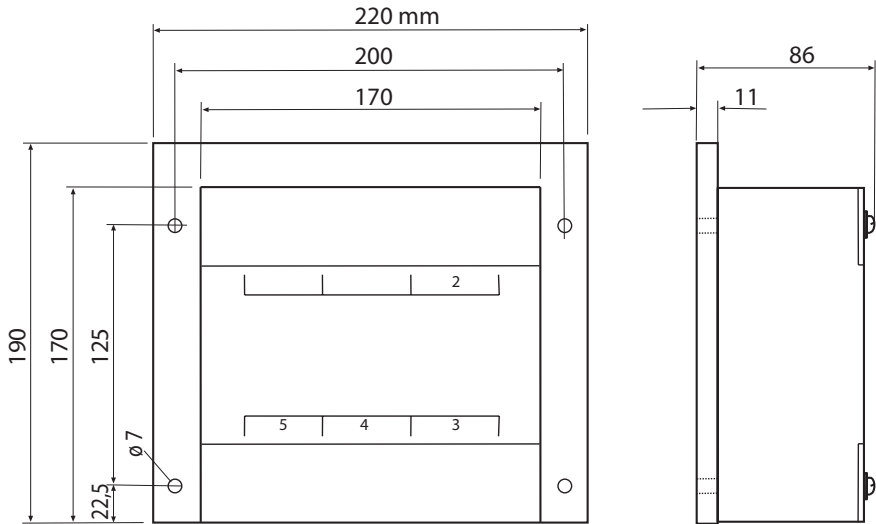
		Value of the respective number			
Position of numbers from the left	0 =	1 =	2 =	3 =	4 =
1	K1: N/O operation Test	K1: N/C operation Test	K1: flashing function	K1: N/O operation	K1: N/C operation
2	K2: N/O operation Test	K2: N/C operation Test	K2: flashing function	K2: N/O operation	K2: N/C operation
3		AK AGH575S-6			
4	Cemax 1 µF **	Cemax 2 µF **	Cemax 5 µF	Cemax 10 µF	
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	AMP 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 **		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 IRDH275



- DIN rail mounting according to IEC 60715
or
- Screw mounting
by means of a plug-in trapezoidal support
Order No.: 990056

Dimension diagram enclosure AGH575S-6



6.5 Ordering details

6.5.1 A-ISOMETER® and coupling device

Type	Nominal voltage U_n	Supply voltage U_s	Art.-No.
IRDH275BU-635	-	AC 88...264 V DC 77...286 V	B 9106 5111
AGH575S-6	AC/DC 0...3.6 kV 0...460 Hz	-	B 913053

6.5.2 Measuring instruments

Type	Measuring range	Dimensions	Art. No.
9620-1421	0...20 mA	96 x 96 mm	B 986 841
9620S-1421	0...20 mA	96 x 96 mm	B 986 842

6.5.3 Label for modified versions

There will only be a label in this field if the A-ISOMETER® is different from the standard version.



INDEX

A

- Activating and setting the password 36
- Alarm LED 1 21
- Alarm LED 2 21
- Alarm messages 43
- Automatic self test 33

B

- Bender Measuring Device Interface 41
- BMS bus
 - correct arrangement 40
 - wrong arrangement 40
- BMS-bus
 - address ranges 44
- BMS-bus address ranges 44
- BMS-Master 41
- BMS-Slave 42

C

- Changing the measuring principle 33
- Characteristic curves 50
- Characteristics IRDH275BU-6 incl. AGH575S-6 11
- Commissioning of a BMS network 43
- Current output 4-20 mA 52

D

- Dimension diagram enclosure
 - AGH575S-6 55
 - IRDH275 54
- Directions for installation 10
- Display in the menu mode 22
- Display in the standard mode 22

E

- Explanations of symbols and warnings 9
- External coupling devices 33
- External RESET button 19
- External TEST button 19

F

- Factory setting 10
- Flashing point 42
- Function 12
- Function input F1/F2 15

I

- INFO key 21
- Inspection, transport and storage 9
- Installation of the coupling device AGH575S-6 17

M

- Measuring instruments 56
- Memory database 28
- Memory setting (on/off) 32
- Menu
 - COM SETUP 35
 - HISTORY INFO 29
 - ISO ADVANCED 33
 - ISO SETUP 30
 - LANGUAGE 37
 - PASSWORD 36
 - SERVICE 38
- Menu structure 27

O

- Operating 21
- Operating features and displays 21
- Ordering details 56

P

- Parameterization via Internet 38
- Product description 12

R

- Real-time clock 14
- RESET button 13, 21
- RS485 interface 39

S

- Self test, A-ISOMETER 21
- Serial interfaces 39
- Setting the bus address for IRDH275B 35
- Setting the date (IRDH275B) 33
- Setting the national language 37
- Setting the real-time clock (Clock) 33
- Standards 49
- Status number 53
- system fault LED 13

T

- Technical data IRDH275 45
- TEST button 21
- Topology (IRDH275B) 40

W

- Wiring 40
- wiring diagram A-ISOMETER 19
- Wrong arrangement 40

Dipl.-Ing. W. Bender GmbH & Co.KG

Londorfer Str. 65 • 35305 Grünberg • Germany

Postfach 1161 • 35301 Grünberg • Germany

Tel.: +49 (0)6401-807-0

Fax: +49 (0)6401-807-259

E-Mail: info@bender-de.com

Internet: <http://www.bender-de.com>

