ISOMETER® IRDH275BM-7
Coupling device AGH675S-7 and AGH675S-7MV15

Insulation monitoring device for medium voltage IT systems with galvanically connected rectifiers and converters up to AC/DC 15.5 kV in combination with the coupling devices AGH675S-7 and AGH675S-7MV15

IRDH275BM-7_D00123_07_M_XXEN / 08/2020

Manual EN

Service and support for Bender products

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Table of contents

1 General instructions

1.1 How to use this manual

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

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

1.2 Indication of important instructions and information

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

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

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

Information can help to optimise the use of the product.

1.2.1 Signs and symbols

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

1.3 Training courses and seminars

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

1.4 Delivery conditions

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

The following applies to software products:

"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."

1.5 Inspection, transport and storage

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

1.6 Warranty and liability

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

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

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

1.7 Disposal of Bender devices

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

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

www.bender.de -> Service & support.

1.8 Safety

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

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

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

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

1.9 Device-specific safety information

The basic setting of the device must meet the requirements of the IT system.

Make sure that the operating voltage is correct! *Prior to insulation and voltage tests, the ISOMETER® must be disconnected from the IT system for the duration of the test. In order to check the correct connection of the device, a functional test has to be carried out before starting the system.*

In the event of an alarm message of the ISOMETER®, the insulation fault should be eliminated as quickly as possible. If the device is installed inside a control cabinet, the insulation fault message must be audible and/or visible to attract attention.

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.
***Prevent measurement errors!** When a monitored IT system contains galvanically coupled DC circuits, an insulation fault can only be detected correctly if the rectifier valves (e.g. rectifier diode, thyristors, IGBTs, frequency inverters, …) carry a minimum current of > 10 mA.*

Unspecified frequency range! When connecting to an IT system with frequency components below the specified frequency range, the response times and response values may differ from the indicated technical data. However, depending on the application and the selected measurement method, continuous insulation monitoring is also possible in this frequency range. There is no influence on the insulation monitoring for IT systems with frequency components above the specified frequency range, e.g. within the range of typical switching frequencies of frequency inverters (2…20 kHz).

1.10 Intended use

The ISOMETER® with additional coupling devices is intended for monitoring the insulation resistance of IT systems.

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.

1.11 Directions for installation

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

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).

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 resistance that is suitable for the mains voltage.

Factory setting device variant -7...

ISO SETUP:	Alarm 1 / Alarm 2 (response value)	= 2 MΩ/ 100 kΩ
ISO SETUP:	Operating principle K1/K2	= N/O operation
ISO SETUP:	Memory	= off
ISO ADVANCED:	System leakage capacitance	= 2 µF
ISO ADVANCED:	Coupling device	= AGH: 675S-7
Com SETUP:	Bus adress	= 3 (Slave)

2 Function

2.1 Characteristics IRDH275BM-7 incl. AGH675S-7…

- Device combination for use in medium voltage systems with converters up to AC/DC 15.5 kV (IT = unearthed systems))
- Automatic adaptation to the existing system leakage capacitance
- ***AMP**Plus* measuring principle (European Patent: EP 0 654 673 B1)
- Two separately adjustable ranges of the response value100 kΩ… 10 MΩ (Alarm 1, Alarm 2)
- Info button to display device settings and the system leakage capacitance
- 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 (RS-485 electrically isolated).
- Current output 0 (4)…20mA (galvanically separated) in relation to the measured insulation value.
- Self monitoring with automatic alarm
- Automatic self test, selectable
- Connection for external kΩ indication
- Test and reset button
- Connection external test and reset button
- Two separate alarm relays with two potential-free changeover contacts
- N/O or N/C operation, selectable
- Remote setting of certain parameters via the Internet (Gateway COM465xx additionally required)

2.2 Product description

- The ISOMETER® IRDH275BM-7 and coupling device AGH675S-7 monitor the insulation resistance of IT medium voltage systems up to 7.2 kV.
- The ISOMETER® IRDH275BM-7 and two coupling devices AGH675S-7MV15 monitor the insulation resistance of IT medium voltage systems up to 15.5 kV.

Both combinations are 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 AGH675S-7 is connected in the mid-point of the converter DC intermediate circuit, a maximum of ±7.2 kV against PE may occur.
- When the two coupling devices AGH675S-7MV15 are connected in the mid-point of the converter DC intermediate circuit, a maximum of ±15.5 kV against PE may occur.

The device automatically adapts itself to the existing system leakage capacitance. The IRDH275BM-7 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 description

The combination ISOMETER® IRDH275BM-7 and coupling device AGH675S-7 or two coupling devices AGH675S-7MV15 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 nonvolatile memory (EEPROM) after the setting is completed.

A microprocessor-controlled pulsating AC measuring voltage is superimposed on the IT system to be monitored (***AMP*^Plus**** 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 kΩ 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 kΩ display supplied by the current output 0(4)…20 mA at M+/M- are galvanically isolated.

*) ***AMP*^Plus**** 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 ISOMETER® IRDH275BM-7 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 ⏚ 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.

Alarmmeldung	Beschreibung	Maßnahmen
Connection PE?	No low-resistance connection of the terminals ⏚ and KE to earth (PE)	1. Check wiring of terminal ⏚ and KE to earth (PE) 2. Press TEST button 3. Switch the supply voltage off and on
Device error x	Internal device error	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 ISOMETER® provides 0(4)…20 mA. The current output is galvanically isolated from the device electronics and the RS-485 interface. The ISO SETUP menu 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.

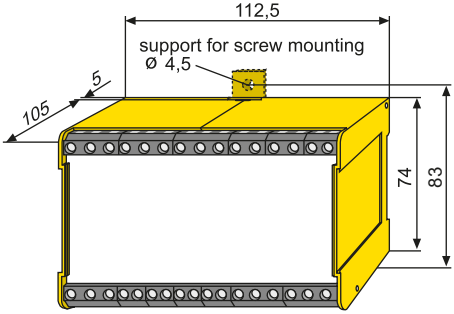
If the 24 V test is activated in the „ISO ADVANCED“ menu, a special time of day can be selected for the execution of the self test in the menu „TEST: 12:00“. Then a self test will be started automatically once a day exactly at the preset time. If the 1 h auto test has been selected, the self test is automatically carried out every full hour.

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

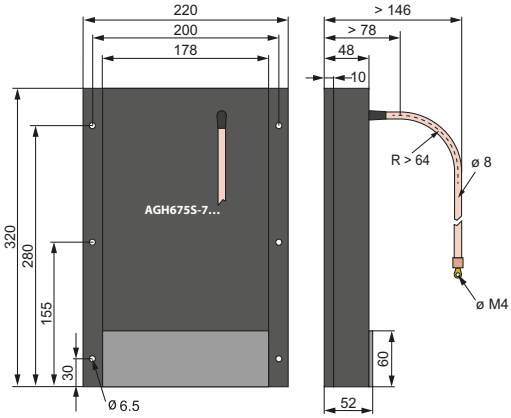
When the input terminals F1/F2 are bridged, the measuring function is stopped and the message „STANDBY“ appears on the display. The currently measured value is blanked and the value > 10 MΩ is indicated. The alarm relays and alarm LEDs no longer provide alarm messages. After opening the function input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

3 Dimensions, installation and connection

3.1 Dimension diagrams



Dimension diagram IRDH275, all dimensions in mm



Dimension diagram AGH675S-7, all dimensions in mm

3.2 Mounting IRDH275

DIN rail mounting according to DIN EN 60715/IEC 60715 or

Screw mounting by means of a plug-in trapezoidal support (Order No.: 990056)

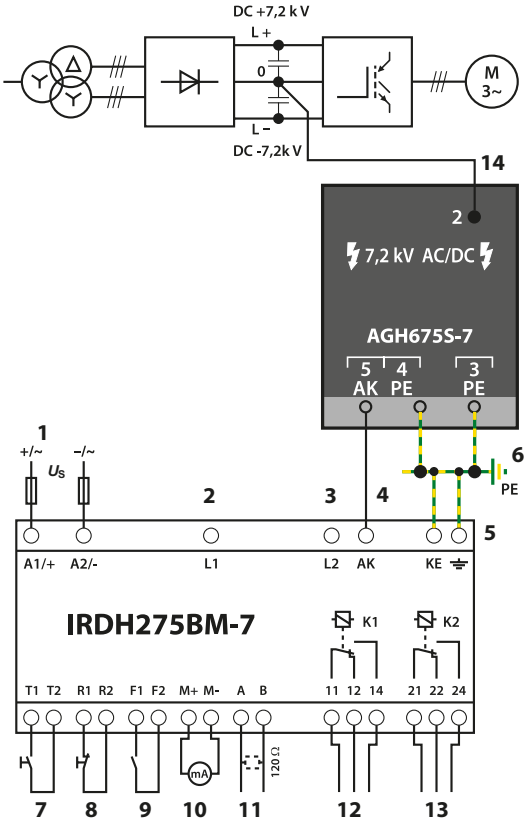
3.3 Installation of the coupling device AGH675S-7…

Danger of electric shock! *The coupling device is operated with voltages above 1000 V, which can be life-threatening in case of direct contact.*

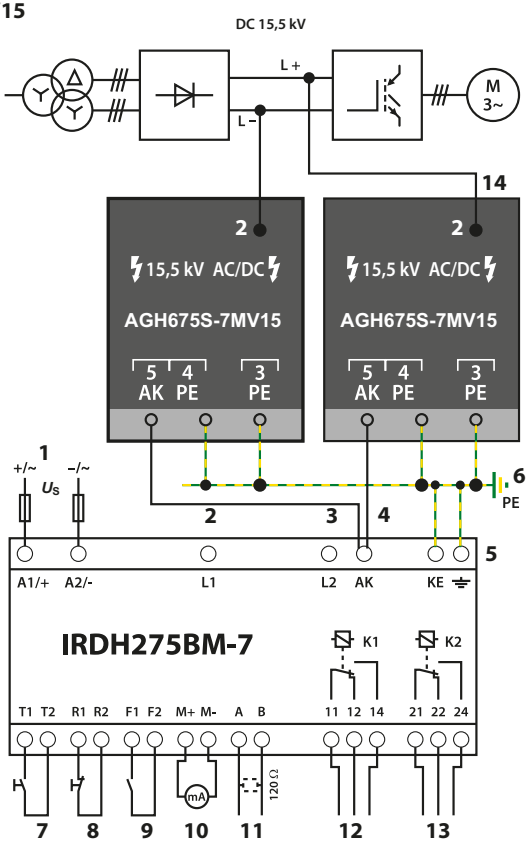
- For operation the coupling devices have to be installed into a „closed electrical operating area“, refer to IEC 61800-5-1:2003
- The coupling device is to be installed in a place where the pollution degree to be expected is ≤ 2, refer to IEC 61800-5-1: 2003, subclause 4.2.6.2.2
- An „Enclosure suitable for high voltage areas“ has to be selected for installation, refer to IEC 61800-5-1: 2003
- The high voltage connection cable must not be directly routed on conductive surfaces that are connected to earth. This avoids partial discharges and prevents damage to the insulation of the high voltage cable between the AGH and the system to be monitored! Either additional insulation layers are required or a clearence of ≥ 10 cm between the cable and the conductive surfaces has to be provided.

3.4 Wiring diagrams (by way of example)

Wiring AGH675S-7



Wiring AGH675S-7MV15



Legend wiring diagrams

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 AGH675S-7 or the two coupling devices AGH675S-7MV15: connect terminal AK to terminal(s) 5 of the coupling device AGH675S-7 (or the two coupling devices AGH675S-7MV15), connection with standard low-voltage cable, maximum voltage at terminal 5: 200 V
5	Separate connection of ⏚ and KE to PE
6	Separate connection of the terminals 3 and 4 of the AGH675S-7 or AGH675S-7MV15 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

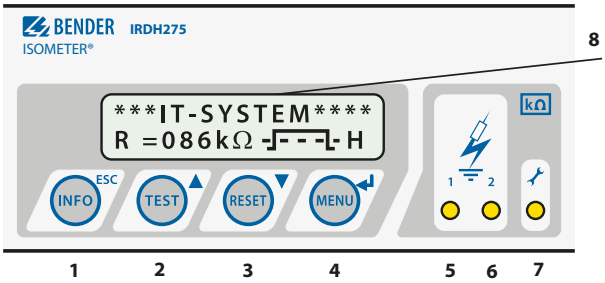
11	Serial interface RS-485 (termination 120 Ω resistor)
12	Alarm relay 1; changeover contacts provided
13	Alarm relay 2 (system fault relay); changeover contacts provided
14	Connection of the coupling device AGH675S-7 to the converter: connect the high voltage cable encapsulated on one end to the mid-point of the DC intermediate circuit. Connection of the two coupling devices AGH675S-7MV15 to the converter: connect the high voltage cable encapsulated on L+ and L-.

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

Only one 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.

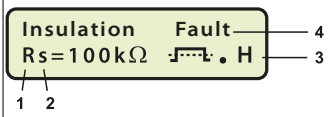
4 Operation and setting

4.1 Operating features and displays IRDH275BM-7



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

4.1.1 Display in the standard mode



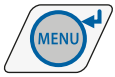
1	Indication of the insulation resistance in kΩ
2	Additional information about the insulation: „+“ = insulation fault L+ „–“ = insulation fault L– „s“ = new measurement has started
3	⌐¬ = polarity of the measuring . = valid bus communication H = new entry in the memory data C = flashing, clock is to be
4	Messages: • Insulation fault • Connection PE? • Device error x • *****STAND*****

4.1.2 Display in the menu mode

	1	Parameter change is permitted
	2	Parameter change is blocked, enabling by a password

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.

Function keys	Basic function	Navigation within the menu
	Retrieval of: • Device name, firmware version • Response values Alarm 1 and Alarm 2 • Setup status (for details refer to the table of the status numbers) • 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..*	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..
	Starts the ISOMETER® self test.	Moving up in the menu, increasing a parameter
	Resets insulation and fault alarm messages stored in the ISOMETER®	Moving down in the menu, reducing a parameter
	Calling up the menu system	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..

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 ISOMETER® can only be reset when the present insulation value is 25 % higher than the set response value.

4.2 Menu structure and menu mode

In the following menu diagrams these symbols are used for the sake of clarity:

↵	ENTER
▲▼	UP/DOWN
ESC	ESCAPE

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

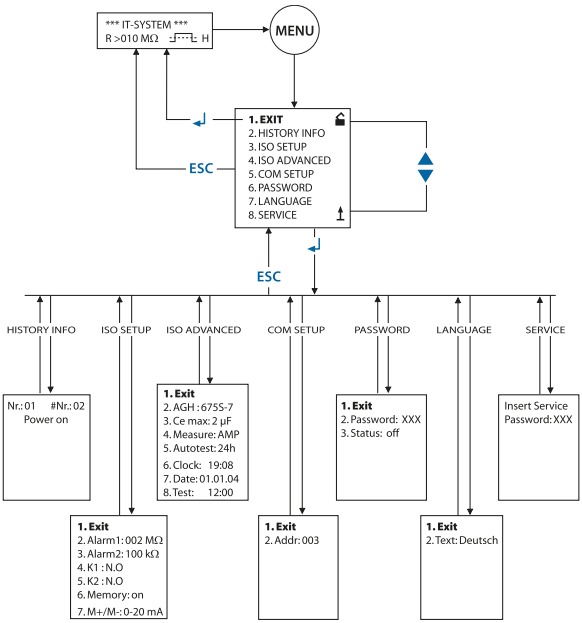
When password protection is activated, indicated by the symbol „padlock closed “ , the first thing to enter is the correct password before the parameters can be changed using the UP/DOWN keys. Entering the correct password once allows all parameters to be changed as long as you do not leave the menu.

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.

Datarecord	Event	Display indication
1	Switch the supply voltage on	Power on
2	Lowest measured insulation value	Rmin
3...99	Response value Alarm 1 released	● Alarm 1
3...99	Response value Alarm 1 cleared	○ Alarm 2
3...99	Response value Alarm 2 released	● Alarm 1
3...99	Response value Alarm 2 cleared	○ Alarm 2
3...99	Error system connection released	● System connection?
3...99	Error system connection cleared	○ System connection?
3...99	Error PE connection released	● PE connection?
3...99	Error PE connection cleared	○ PE connection?

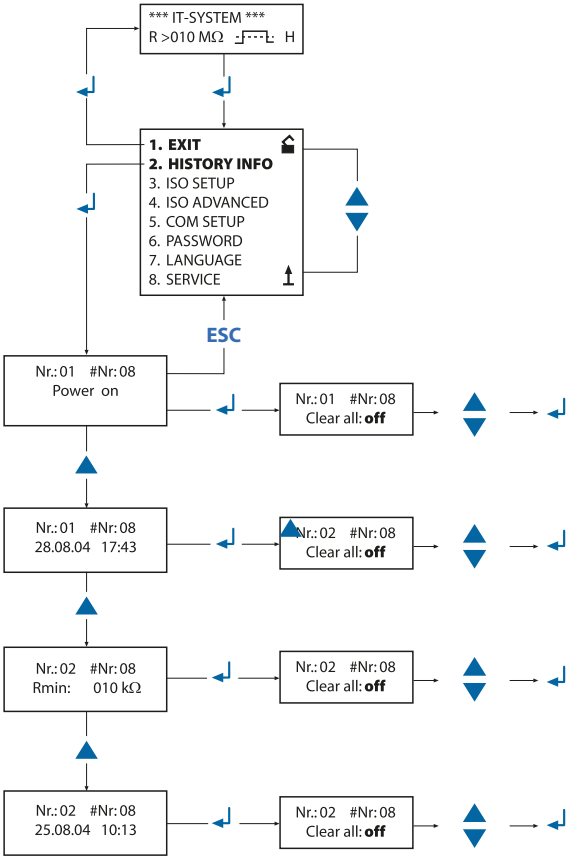
3...99	Device error released	● Device error
3...99	Device error cleared	○ Device error
3...99	System reset (watchdog)	System reset

Before storing the events with the actual date and time stamp, set the realtime clock in the ISO ADVANCED menu.

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 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.

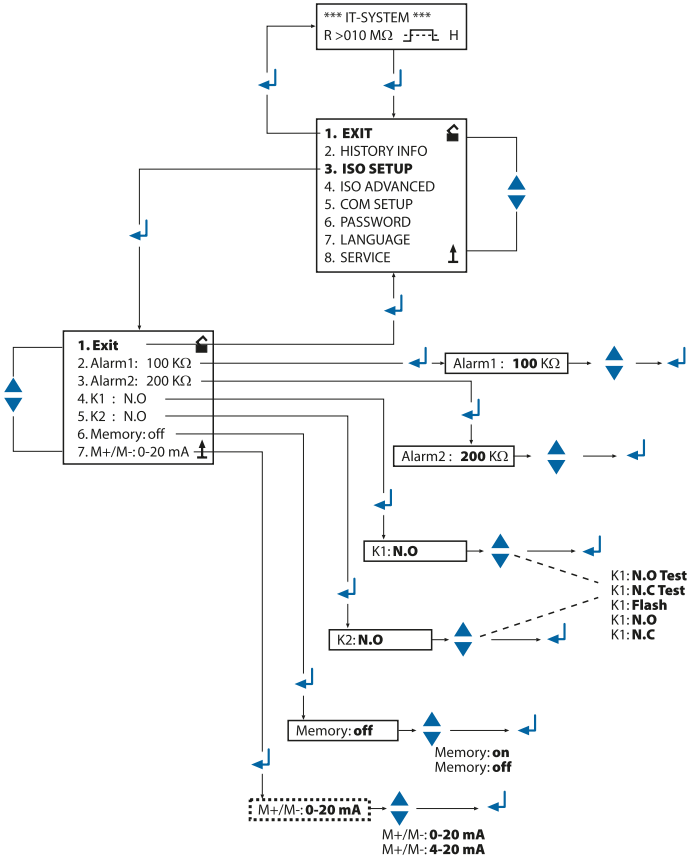
4.4.2 Operating principle of the alarm relays

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)

4.4.3 Diagram ISO SETUP



During the automatic self test, the alarm relays are not switched over.
When a system fault occurs at the ISOMETER®, the relay K2 will automatically be activated as a system fault relay.

4.4.4 Memory settings (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)

4.4.5 Current output for external measuring instruments

Factory setting: 0…20 mA

The current output of the IRDH275BM-7 can be set to „0…20 mA“ or „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	$R_F = \frac{20\ mA \times 2800\ k\Omega}{I} - 2800\ k\Omega$
Funktion 4…20 mA: R_F = insulation fault, I = current in mA	$R_F = \frac{16\ mA \times 2800\ k\Omega}{I - 4\ mA} - 2800\ k\Omega$

The associated characteristic curves are illustrated on page 36.

4.5 Menu ISO ADVANCED: Setting of the extended functions

4.5.1 Coupling devices AGH: 675S-7…

The ISOMETER® is connected to the AGH675S-7 by connecting the terminal AK to terminal 5. The nominal operating range is extended to AC 0…7.2 kV (AGH475S-7) or AC 0…15.5 kV (two AGH475S-7MV). When terminal 2 will be connected to the midpoint of the DC intermediate circuit, a voltage of 14.4 kV is permitted.

4.5.2 Adaptation to the system leakage capacitance $C_e$max

This menu allows to adapt the ISOMETER® to the maximum system leakage capacitance (2 or 5 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 = 2 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.

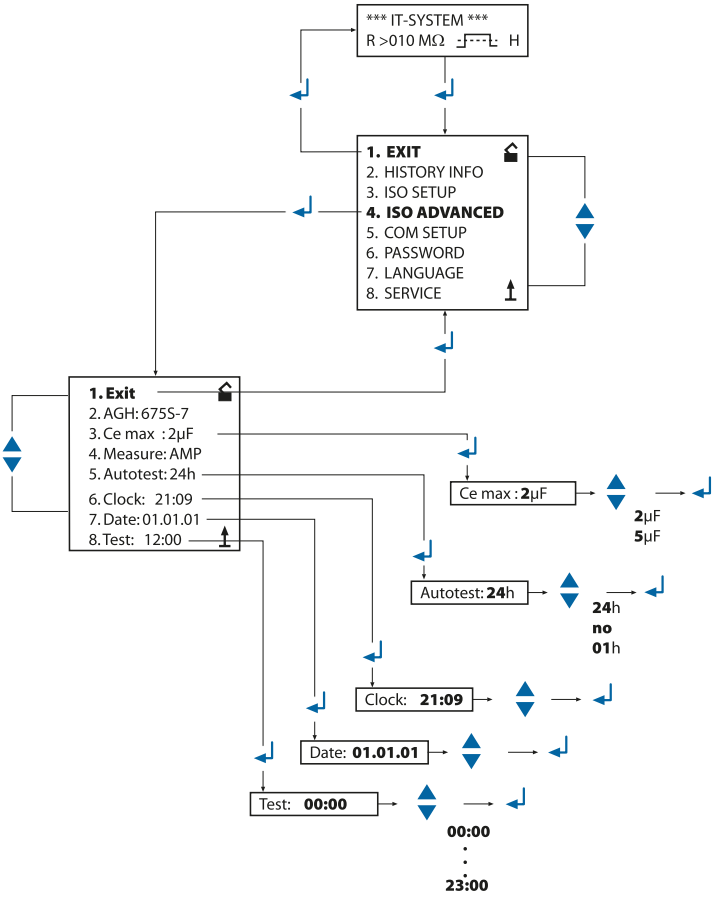
4.5.6 Setting the date (Date)

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)

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

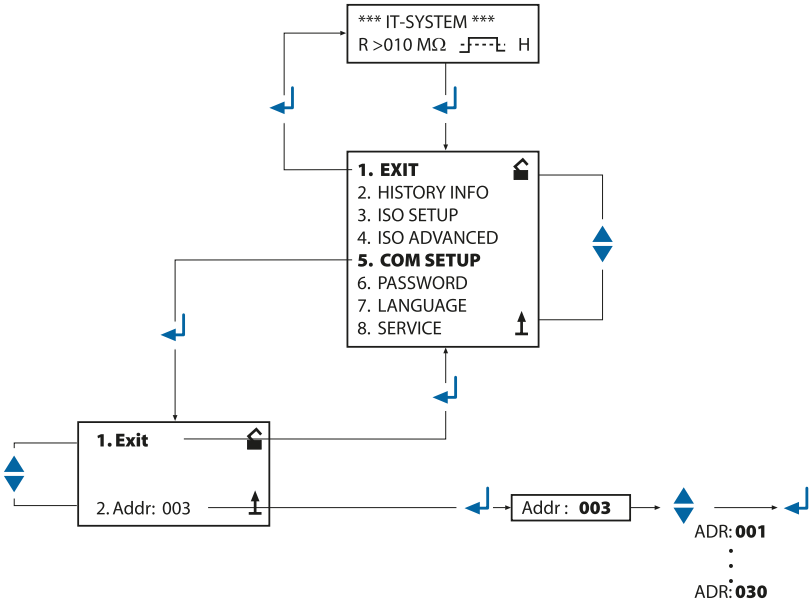
4.6.1 Bus address „Addr:“

This menu item is used to set the BMS bus address of the ISOMETER®. Since there are several 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 ISOMETER®s are operated on one BMS bus, the addresses of other ISOMETER®s must be assigned one after the other, since only one device may represent the Master.

4.6.2 Diagram COM SETUP

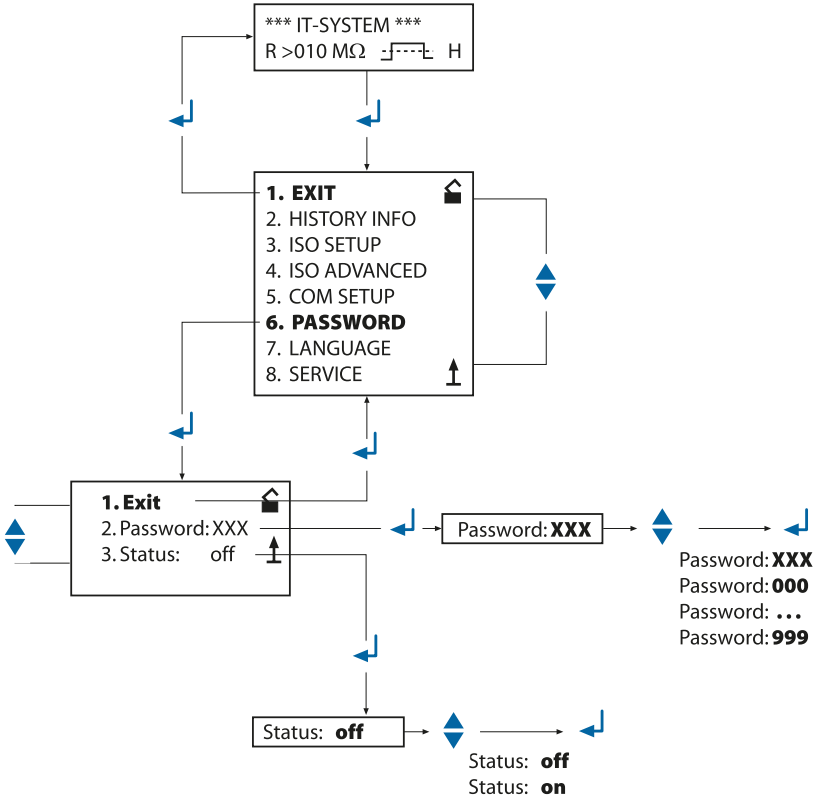


4.7 Menu PASSWORD

4.7.1 Activating and setting the password

This menu can be used to activate a „Password“ query. This protects the 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

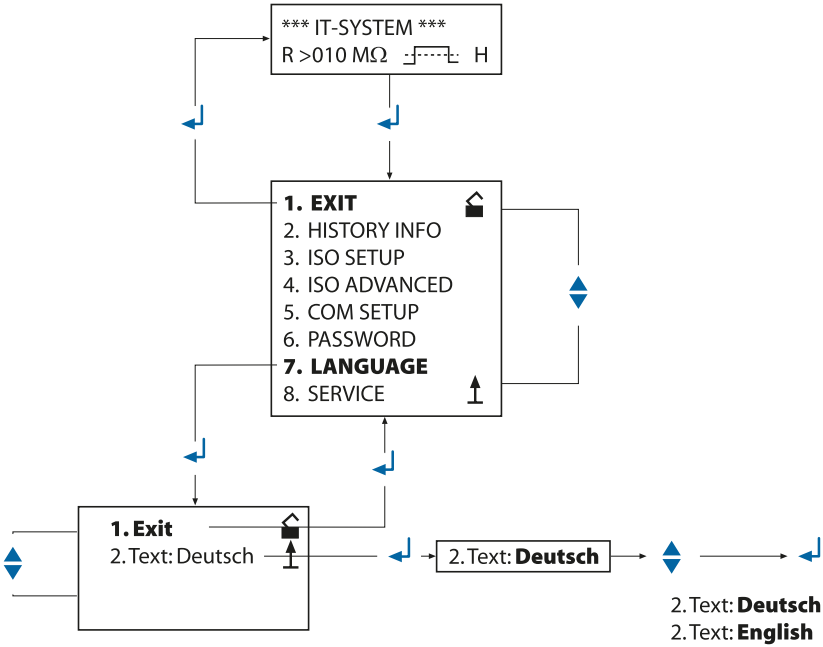


4.8 Menu LANGUAGE

4.8.1 Setting the national language

The menu item „Language“ allows fault messages of the 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 ISOMETER® indicated below can be checked and set from a remote place of use by using a personal computer. In addition, an internet access and COM465xx (BMS <==> Ethernet/TCP/IP) are required.

Remote setting is possible for:

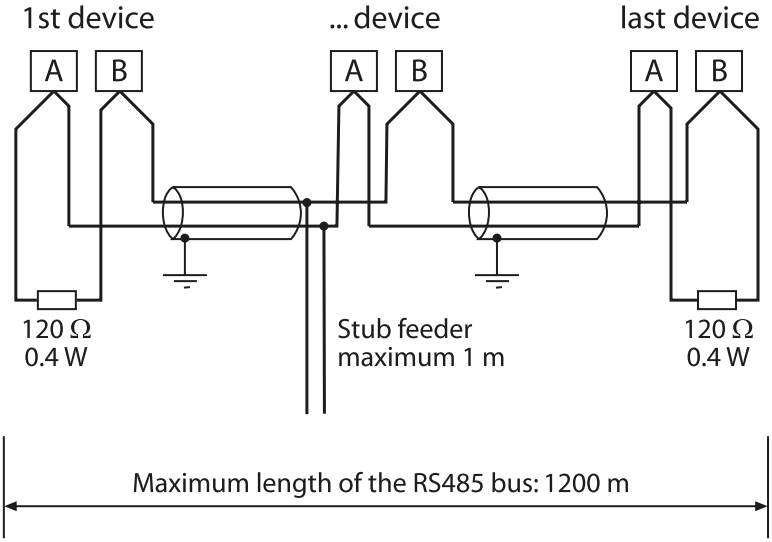
- Response value Alarm 1 (100…10,000 kΩ)
- Response value Alarm 2 (100…10,000 kΩ)
- Operating principle alarm relay K1 (e.g. N/O operation)
- Operating principle alarm relay K2 (e.g. N/O operation)
- Current output ranges for external measuring instruments (0/4…20 mA)
- Maximum system leakage capacitance (2 µF or 5 µF)
- 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 RS-485 interface with BMS protocol

The RS-485 interface which is galvanically isolated from the device electronics and current output serves as a physical transmission medium for the BMS protocol. If several 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 resistor.

An RS-485 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 . Hence, stub feeders in the network must not be terminated. The length of the stub feeders is restricted to 1 meter.

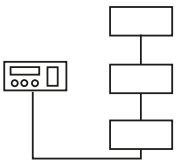


5.2 Topology RS-485 network

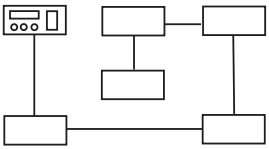
The optimum topology for the RS-485 network is a daisy-chain connection. In this connection, device 1 is connected to device 2, device 2 to device 3, device 3 to device n etc. The RS-485 network represents a continuous path without branches.

5.2.1 Correct arrangement

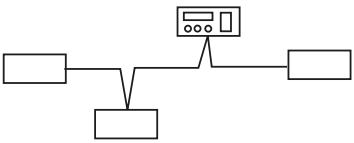
Example 1



Example 2

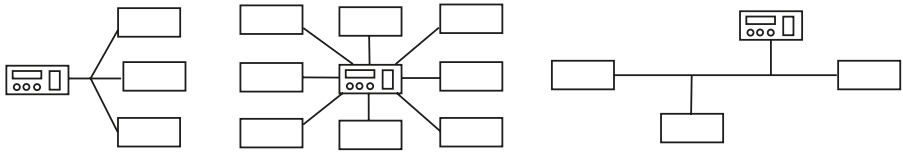


Example 3



5.2.2 Wrong arrangement

Example 1 Example 2 Example 3



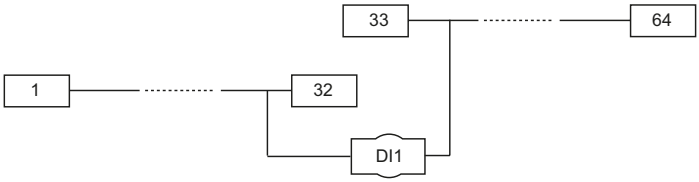
5.2.3 Wiring

A suitable type of cable for the wiring of the RS-485 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 RS-485 repeater DI1.



5.3 BMS protocol

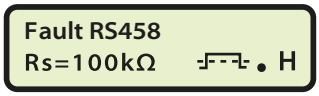
This protocol is an essential part of the Bender Measuring Device Interface. Data transmission generally makes use of ASCII characters. Interface data are:

- 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 RS-485“ is issued by the Master.

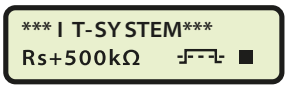


Faults may be caused when:

- 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.

	■ flashing	BMS data received
	■ no flashing	Possible causes of faults: • no Master available in the network • more than one Master available in the network • RS-485 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 ⏚ /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 RS-485 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 RS-485 network or in case of devices without a terminating switch, at the end of the bus, connect a 120 resistor to the terminals A and B.
- Switch the supply voltage US 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 adress ranges

Adresses	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	COM465	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

Malfunctions due to wrong address assignment! Assigning wrong addresses to external devices may cause malfunctions. Assign the addresses in a way that there are no gaps of more than five subsequent addresses (1…30, 31…60, 61…90, 111…119 and 121...151).

6 Technical data IRDH275BM-7 with AGH675S-7…

6.1 Data in tabular IRDH275BM-7

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 AGH675S-7…
Supply voltage U_S (refer to nameplate for other values) ..... DC 19.2…72 V
Power consumption ..... ≤14 VA

Response values

Response value R_{an1} (Alarm 1) ..... 100 kΩ…10 MΩ
Response value R_{an2} (Alarm 2) ..... 100 kΩ…10 MΩ
Relative percentage error 100…500 kΩ ..... ±100 kΩ
Relative percentage error 500 kΩ…10 MΩ ..... 0 %…+20 %
Response time t_{an} ..... ≤ 5 min
Hysteresis ..... 25 %

Measuring circuit

Measuring voltage U_m ..... ≤ 50 V
Measuring current I_m (at $R_F = 0$ Ω) ..... ≤ 21 µA
Internal DC resistance R_i ..... ≥ 2.4 MΩ
Internal impedance Z_i, at 50 Hz ..... ≥ 2.4 MΩ
Permissible extraneous DC voltage U_{fg} ..... with AGH675S-7…
Permissible system leakage capacitance C_e ..... ≤ 5 µF
Factory setting ..... 2 µF

Displays

Display, illuminated ..... two-line display
Characters (number of characters) ..... 2 x 16
Display range, measuring value ..... 50 kΩ…10 MΩ
Relative percentage error 50…500 kΩ ..... ±50 kΩ
Relative percentage error 500 kΩ…10 MΩ ..... ±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 MΩ):
Current output (load) ..... 20 mA (≤ 500 Ω)
Accuracy current output (100 kΩ…10 MΩ) ..... ±10 %, ±100 kΩ

Serial interface

Interface/Protocol IRDH275B RS-485/BMS
Connection ..... terminals A/B
Cable length ..... ≤ 1,200 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 (IEC 60255-23)
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)

Environment/EMC

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 …+55 °C
Storage temperature range	-40 …+70 °C
Climatic class acc. to IEC 60721-3-3	3K23

Connection

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

General Data

Operating mode	continuous operation
Mounting	as indicated on the display
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
Tightening torque	0.5 Nm
Weight approx.	510 g

6.2 Data in tabular AGH675S-7

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

Rated voltage ..... AC 7.2 V

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

All voltage tests were performed with a minimum device distance; see „Chapter Mounting the coupling device AGH675S-7...".

Type test:

Rated impulse voltage (basic insulation) ..... 40 kV
AC voltage test (basic insulation) ..... 20 kV
Partial discharge test ..... 14 kV

Routine test:

AC voltage test ..... 40 kV

Voltage ranges

Nominal voltage range U_n ..... AC, 3(N)AC, DC 0…7.2 kV
Nominal frequency f_n ..... 0…460 Hz

Environment/EMC

Operating temperature (normal operation) ..... -10…+60 °C
Operating temperature (continuous operation with asymetrical earth fault) ..... -10…+55 °C

Classification of climatic conditions acc. to IEC 60721:

Stationary use (IEC 60721-3-3) ..... 3K23 (no condensation, no formation of ice)
Transport (IEC 60721-3-2) ..... 2K11 (no condensation, no formation of ice)
Long-term storage (IEC 60721-3-1) ..... 1K22 (no condensation, no formation of ice)

Classification of mechanical conditions acc. to IEC 60721:

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

Connection

Connection terminal 2 (medium voltage) ..... high-voltage cable (encapsulated on the device side)
Connection, flexible with ring terminal M4
Connection terminal 3, 4, 5 ..... screw-type terminals
Connection, rigid, flexible ..... 0.2…4 mm²/0.2…2.5 mm²
Connection, flexible with connector sleeve ..... 0.25...2.5 mm²

General data

Operating mode ..... continuous operation
Mounting ..... any position
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. ..... ≤ 5100 g

6.3 Data in tabular AGH675S-7MV15

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

Rated voltage ..... AC 15.5 V

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

All voltage tests were performed with a minimum device distance; see „Chapter Mounting the coupling device AGH675S-7...".
Type test:
Rated impulse voltage (basic insulation) ..... 111 kV
AC voltage test (basic insulation) ..... 70 kV
Partial discharge test ..... 29 kV
Routine test:
AC voltage test ..... 40 kV

Voltage ranges
Nominal voltage range U_n ..... AC, 3(N)AC, DC 0...15.5 kV
Nominal frequency f_n ..... 0...460 Hz

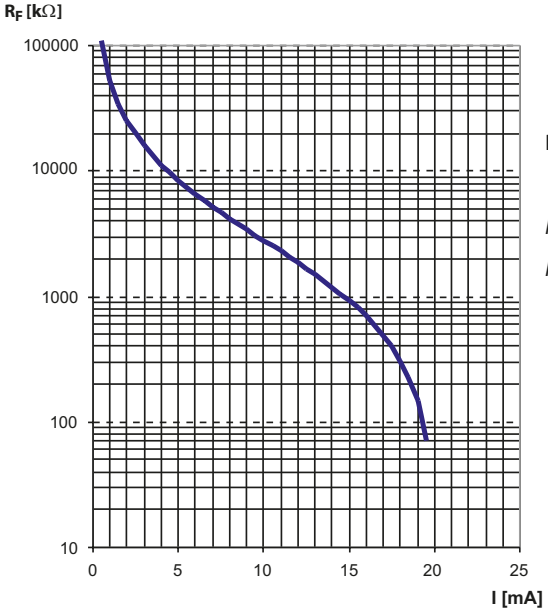
Environment/EMC
Operating temperature (normal operation) ..... -10...+60 °C
Operating temperature (continuous operation with asymetrical earth fault) ..... -10...+55 °C
Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) ..... 3K23 (no condensation, no formation of ice)
Transport (IEC 60721-3-2) 2K11
Long-term storage (IEC 60721-3-1) 1K22
Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3) ..... 3M4 (3M7 Y shaft)
Transport (IEC 60721-3-2) 2M4
Long-term storage (IEC 60721-3-1) 1M12

Connection
Connection terminal 2 (medium voltage) ..... high-voltage cable (encapsulated on the device side)
Connection, flexible with ring terminal M4
Connection terminal 3, 4, 5 ..... screw-type terminals
Connection, rigid, flexible ..... 0.2...4 mm²/0.2...2.5 mm²
Connection, flexible with connector sleeve ..... 0.25...2.5 mm²

General data
Operating mode ..... continuous operation
Mounting ..... any position
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. ..... ≤ 5100 g

6.4 Characteristic curves

Current output 0…20 mA (IRDH275BM-7)

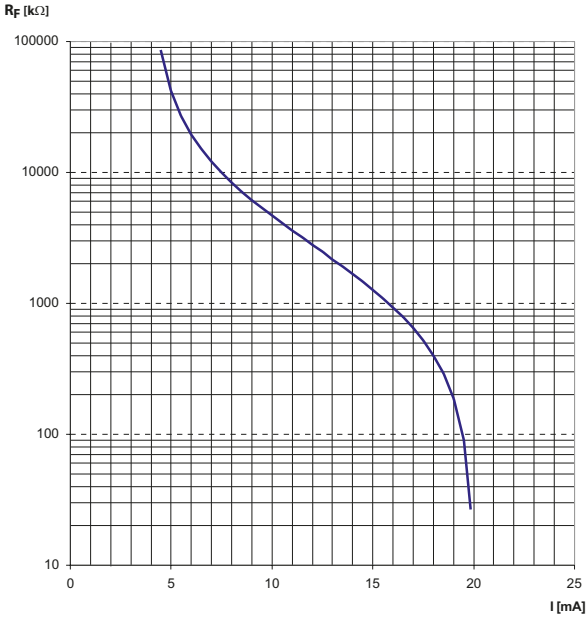


$$R_F = \frac{20\ mA \times 2800\ k\Omega}{I} - 2800\ k\Omega$$

R_F = Insulation fault in kΩ

I = Current output in mA

Current output 0…20 mA (IRDH275BM-7



$$R_F = \frac{16\ mA \times 2800\ k\Omega}{I} - 2800\ k\Omega$$

R_F = Insulation fault in kΩ

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 AGH675S-7			
4	Cemax 0,1 µF**	Cemax 1 µF**	Cemax 2 µF	Cemax 5 µF	
5					
6	Self test every 24 h	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 !				

6.5 Standards and approvals

Standards

The ISOMETER® was designed under consideration of the following standard:

- IEC 61557-8: 2007 + Corrigendum 2007-05
- IEC 61326: 2002-02
- DIN EN 61557-8: 2007-12
- EN 61557-8: 2007
- EN 61326-2-4: 2006-06 Ed. 1.0
- DIN EN 60664-1: 2008-01
- DIN EN 60664-3: 2003-09
- ASTM F1669M-96: 2007
- ASTM F1207M-96: 2007

Approvals see last page
UL: only IRDH275BM-7

6.6 Ordering details

Typ	Nominal voltage U_n	Supply voltage U_s	Cable length	Art.- No.	Manual No.
IRDH275BM-727	-	AC 19,2…55 V 42…460 Hz DC 19,2…72 V	-	B91065120	D00123
AGH675S-7-2000	AC/DC 0…7,2 kV 0…460 Hz	-	2000 mm	B913061	D00095
AGH675S-7-500		-	500 mm	B913060	D00095
AGH675S-7MV15-500	AC/DC 0…15,5 kV 0…460 Hz	-		B913058	D00095

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The Power in Electrical Safety©

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