ISOMETER® iso685-…-B
Insulation monitoring device for unearthed AC, AC/DC and DC systems (IT systems)
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Insulation monitoring device for unearthed AC, AC/DC and DC systems (IT systems)

Device features
- ISOMETER® for IT AC systems with galvanically connected rectifiers or inverters and for IT DC systems (IT = unearthed systems)
- Automatic adaptation to the existing system leakage capacitance
- Combination of AMP®plus and other profile-specific measurement methods
- Two separately adjustable response value ranges of 1 kΩ...10 MΩ
- High-resolution graphic LC display for excellent readability and recording of the device status
- Connection monitoring (monitoring of the measuring lines)
- Automatic device self test
- Graphical representation of the insulation resistance over time (isoGraph)
- History memory with real-time clock (buffer for three days) for storing 1023 alarm messages with date and time
- Current or voltage output 0(4)...20 mA, 0…400 μA, 0…10 V, 2…10 V (galvanically separated), which is analogous to the measured insulation value of the system
- Freely programmable digital inputs and outputs
- Remote setting via the Internet or Intranet (Webserver/Option: COMTRAXX® Gateway).
- Worldwide remote diagnosis via the Internet
- RS-485/BS (Bender sensor bus) for communication with other Bender devices
- ISOnet: Internal separation of the ISOMETER® from the IT system to be monitored (e.g. if several IT systems are interconnected)
- BCOM, Modbus TCP and web server

Product description
The ISOMETER® is an insulation monitoring devices in accordance with IEC 61557-8 for IT systems. The devices are universally applicable in AC, 3(N)AC, AC/DC and DC systems. AC systems may include extensive DC-supplied loads (such as rectifiers, inverters, variable-speed drives).

Application
- AC, DC or AC/DC main circuits
- AC/DC main circuits with directly connected DC components, such as rectifiers, converters, variable-speed drives
- UPS systems, battery systems
- Heaters with phase control
- Systems including switch-mode power supplies
- coupled IT systems with high leakage capacitances

Function
The insulation monitoring device continuously monitors the entire insulation resistance of an IT system during operation and triggers an alarm when the value falls below a preset response value. To obtain a measurement the device has to be connected between the IT system (unearthed system) and the protective earth conductor (PE). A measuring current in the μA range is superimposed onto the system which is recorded and evaluated by a microprocessor-controlled measuring circuit. The measuring time is dependent on the selected measurement profiles, the system leakage capacitance, the insulation resistance and possible system-related disturbances.

To ensure proper functioning of connection monitoring, the device requires the setting of the system type 3AC, AC or DC and the required use of the appropriate terminals L1/+, L2, L3/-.

The insulation monitoring device iso685-...-B is able to measure the insulation resistance reliably and precisely in all common IT systems (unearthed systems). Due to various applications, system types, operating conditions, application of variable-speed drives, high system leakage capacitances etc., the measurement technique must be able to meet varying requirements in order to ensure an optimised response time and relative uncertainty. Therefore different measuring profiles can be selected with which the device can optimally adjusted.

If the preset response value falls below the value of Alarm 1 and/or Alarm 2, the associated alarm relays will switch, the LEDs ALARM 1 or ALARM 2 light and the measured value is shown on the LC display (in case of insulation faults in DC systems, a trend graph for the faulty conductor L+/L- is displayed). If the fault memory is activated, the fault message will be stored. Pressing the RESET button resets the insulation fault message, provided that the current insulation resistance displayed at the time of resetting is at least 25 % above the actual response value. As additional information, the quality of the measuring signal and the time required to update the measured value are shown on the display. A poor signal quality (1-2 bars) may be an indication that the wrong measurement profile has been selected.

The ISOMETER® has an internal system isolating switch, which makes it possible to operate several ISOMETER®s in coupled IT systems. For this purpose, the ISOMETER®s are connected via an Ethernet bus. The integrated ISOnet function ensures that only one ISOMETER® is actively measuring at a time, while the other devices are completely isolated from the system and waiting in standby mode for measuring permission.

The ISOMETER® is able to synchronise itself with other ISOMETER®s. This makes it possible to monitor capacitive coupled IT systems without interfering with each other.
Interfaces

- Communication protocol Modbus TCP
- BCOM for Bender device communication via Ethernet
- BS bus for communication of Bender devices (RS-485)
- Integrated web server for reading out measured values and for parameter setting

Device variants

**iso685-D-B**
This device variant features a high-resolution graphic LC display and operating controls for direct operation of the device functions. It cannot be combined with an FP200.

**iso685-S-B**
This device variant features neither a display nor operating controls. It can only be used in combination with the FP200 and it is operated via this front panel.

Option "W"
The ISOMETER®s with and without integrated display are available with option „W“ for extreme climatic and mechanical conditions (ISOMETER® iso685W-D-B and iso685W-S-B).

Measurement method

**AMPPlus** The iso685-…-B series uses the patented AMPPlus measurement method. This measurement method allows concise monitoring of modern power supply systems, also in case of extensive, directly connected DC components and high system leakage capacitances.

Standards

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

- DIN EN 61557-8 (VDE 0413-8):2015-12
- IEC 61557-8:2014-12
- DIN EN 61557-8 Ber 1 (VDE 0413-8 Ber 1):2016-12

Certifications

Operating elements

1 - **ON** The LED “ON” lights when the device is turned on.
2 - **SERVICE** The LED “SERVICE” lights when there is either a device fault or a connection fault, or when the device is in maintenance mode.
3 - **ALARM 1** The LED “ALARM 1” lights when the insulation resistance of the IT system falls below the set response value R_{an1}.
4 - **ALARM 2** The LED “ALARM 2” lights when the insulation resistance of the IT system falls below the set response value R_{an2}.
5 - **Display** The device display shows information regarding the device and the measurements.
6 - **NAV** Navigates up in a list or increases a value.
7 - **MENU** Opens the device menu
8 - **ESC** Cancels the current process or navigates one step back in the device menu.
9 - **RESET** Resets alarms.
10 - **<** Navigates backwards (e.g. to the previous setting step) or selects a parameter.
11 - **TEST** Starts the device self test.
12 - **>** Navigates forwards (e.g. to the next setting step) or selects a parameter.
13 - **DATA** Indicates data and values.
14 - **V** Navigates down in a list or reduces a value.
15 - **INFO** Shows information.
16 - **OK** Confirms an action or a selection.
1 - Connection to an AC system $U_n$  
2 - Connection to a DC system $U_n$  
3 - Linked with two IT systems which can be interconnected via a coupling switch. Information regarding the state of the coupling switch is not necessary.  
4 - Connection to a 3(N)AC system  
5 - Connection to the IT system to be monitored (L1/+, L2, L3/-)  
6 - Separate connection of KE, E to PE  
7 - (K1) Alarm relay 1, available changeover contacts  
8 - (K2) Alarm relay 2, available changeover contacts  
9 - Switchable resistor R for RS-485 bus termination  
10 - Ethernet interface  
11 - Digital interface  
* - For systems > 690 V and with overvoltage category III a fuse for the connection to the system to be monitored must be provided.  
   Recommendation: 2A screw-in fuses.

**Provide line protection!**  
According to DIN VDE 0100-430, a line protection shall be provided for the supply voltage.

**NOTE**  
According to DIN VDE 0100-430, devices for protection against a short-circuit can be omitted for the coupling of terminals L1/+, L2 and L3/- to the IT system ≤ 690 V to be monitored if the wiring is carried out in such a manner as to reduce the risk of a short-circuit to a minimum. Ensure short-circuit-proof and earth-fault-proof wiring.

The connecting lines L1/+, L2, L3/- to the system to be monitored must be carried out as spur lines. No load current may be conducted through the terminals.

**For UL applications:**  
Use 60/70°C copper lines only!  
UL and CSA application require the supply voltage to be protected via 5 A fuses.
### Digital interface X1

<table>
<thead>
<tr>
<th>Digital interface</th>
<th>Terminal</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>Input 1</td>
<td></td>
</tr>
<tr>
<td>I2</td>
<td>Input 2</td>
<td></td>
</tr>
<tr>
<td>I3</td>
<td>Input 3</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>RS-485 A</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>RS-485 B</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>+24 V</td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>Output 1</td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>Output 2</td>
<td></td>
</tr>
<tr>
<td>M+</td>
<td>Analogue output</td>
<td></td>
</tr>
<tr>
<td>Ground</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Dimension diagram iso685-…-B

Dimensions in mm

### Dimension diagram Panel cut-out FP200

Dimensions in mm

### Connection to FP200
Technical data

Insulation coordination according to IEC 60664-1/IEC 60664-3

Definitions:
- Measuring circuit (IC1) L1/+, L2, L3/−
- Supply circuit (IC2) A1, A2
- Output circuit 1 (IC3) 11, 12, 14
- Output circuit 2 (IC4) 21, 22, 24
- Control circuit (IC5) (E, KE), (X1, ETH, X3, X4)

Rated voltage
1000 V

Overvoltage category
III

Rated impulse voltage:
- IC1/(IC2-5) 8 kV
- IC2/(IC3-5) 8 kV
- IC3/(IC4-5) 8 kV
- IC4/IC5 4 kV

Rated insulation voltage:
- IC1/(IC2-5) 1000 V
- IC2/(IC3-5) 250 V
- IC3/(IC4-5) 250 V
- IC4/IC5 250 V

Measuring circuit (IC1) L1/+, L2, L3/−

Supply voltage

Supply via A1+/−, A2/−:
- Supply voltage range Uu
  AC/DC 24…240 V
- Tolerance of Uu
  ±30…±15 %
- Maximum permissible input current of Uu
  650 mA
- Frequency range of Uu
  DC 50…400 Hz 6)
- Tolerance of the frequency range of Uu
  ±5 % ±15 %
- Power consumption, typically DC
  ≤ 12 W
- Power consumption, typically DC 60 Hz
  ≤ 12 W/21 VA
- Power consumption, typically 400 Hz
  ≤ 12 W/45 VA

Supply via X1:
- Supply voltage Uu
  DC 24 V
- Tolerance of Uu
  DC 20…+25 %

IT system being monitored

Nominal system voltage range Un
- AC 0…690 V
- DC 0…1000 V
- AC/DC 0…600 V (for UL applications)

Tolerance of Un
- DC 0…203 V

Frequency range of Un
- DC 0.1…460 Hz

Max. AC voltage Un in the frequency range fn = 0.1…4 Hz
- U. max = 50 V/Hz² *(1 + fn²)

Response values
- Response value Rmin (alarm 1) 1 kΩ…10 MΩ
- Response value Rmax (alarm 2) 1 kΩ…10 MΩ
- Relative uncertainty (acc. to IEC 61557-8) profile dependent, ±15 %, at least ±1 kΩ
- Hysteresis 25 %, at least 1 kΩ

Time response
- Response time tRmin at Rs = 0.5 x Rrated (Rs = 10 kΩ) and Cmin = 1 μF according to IEC 61557-8
  profile dependent, typ. 4 s (see diagrams in manual)
- Response time tRmax at Cmin = 1 μF
  profile dependent, typ. 2 s (see diagram in manual)

Start-up delay tstart-up
- 0…120 s

Measuring circuit

Measuring voltage Un, profile dependent, ±10 V, ±50 V (see profile overview)

Measuring current In, profile dependent, ≥ 403 μA

Internal resistance Rn In ≥ 124 kΩ

Internal resistance on decoupled systems (inactive by IC2, inactive by ISOnet or cut-off) typ. 50 MΩ

Permissible extraneous DC voltage Uni ≤ 1200 V

Permissible system leakage capacitance Cn profile dependent, 0…1000 μF

Measuring ranges

Measuring range G, 0.1…600 Hz
- Tolerance measurement of G
  ±1 % ±0.1 Hz
- Voltage range measurement of G
  AC 0…690 V

Measuring range Uu
- Tolerance measurement of Uu
  ±5 % ±1.5 V
- Voltage range measurement of Uu
  AC/DC > 10 V

Measuring range Cn
- Tolerance measurement of Cn
  ±10 % ±10 μF
- Frequency range measurement of Cn
  DC 30…400 Hz

Min. insulation resistance measurement of Cn
- Depending on the profile and coupling mode, typ. > 10 kΩ

Display

Indication
- graphic display 127 x 127 pixels, 40 x 40 mm 2)

Display range measured value
- 0.1 kΩ…20 MΩ

Operating uncertainty (according to IEC 61557-8)
- ±15 %, at least ±1 kΩ

LEDs

ON (operation LED) green
SERVICE yellow
ALARM 1 yellow
ALARM 2 yellow

In-/Outputs (X1-Interface)

Cable length X1 (unshielded cable) ≤ 10 m
- Cable length X1 (shielded cable, shield connected to earth (PE) on one end, recommended: Y(YF mm 2x6),8) ≤ 100 m
- Total max. supply output current via X1 to X3/GND for each output
  max. 1 A
- Total max. supply output current via A1/A2 on X1
  max. 200 mA
- Total max. supply output current via A1/A2 on X1 between 16.8 V and 40 V
  Un=0.010 A = 10 mA + 7 mA/V * U − 0.010 A
  (negative values are not allowed for Un=0.010 A)

Digital Inputs (I1, I2, I3)

Number
- 3

- Operating mode, adjustable active high, active low
- Functions
  - off, test, deactivate device, start initial measurement
- Voltage
  Low DC 0…5 V, High DC 11…32 V
- Tolerance Voltage
  ±10 %

Digital Outputs (Q1, Q2)

Number
- 2

- Operating mode, adjustable active, passive
- Functions
  - off, Ins. alarm 1, Ins. alarm 2, connection fault, DC- alarm 6, DC+ alarm 6, symmetrical alarm, device fault, common alarm, measurement complete, device inactive, DC offset alarm
- Voltage
  passive DC 0…32 V, active DC 0/19…32 V

Analogue Output (M+)

Number
- 1

- Operating mode
  linear, midpoint point 28 kΩ/120 kΩ
- Functions
  insulation value, DC offset
- Current
  0…20 mA (> 600 Ω), 4…20 mA (< 600 Ω), 0…400 μA (< 4 kΩ)
- Voltage
  0…10 V (> 1 kΩ), 2…10 V (> 1 kΩ)
- Tolerance related to the current/voltage final value
  ±20 %
Technical data (continued)

Interfaces

Field bus:
Interface/protocol: web server/Modbus TCP/BCOM
Data rate: 10/100 Mbit/s, autodetect
Max. amount Modbus requests: < 100/1
Cable length: ≤ 100 m
Connection: RJ45
IP address: DHCP/manual, 192.168.0.5
Network mask: 255.255.255.0
B Comedy address: system-1-0
Function: communication interface

ISOnet:
Number ISOnet devices: ≤ 20
Max. nominal system voltage range ISOnet: AC 690 V, DC 1000 V

Sensor bus:
Interface/protocol: RJ-450/BS
Data rate: 5.6 kbit/s
Cable length: ≤ 1200 m
Cable: twisted pair, one end of shield connected to PE
Connection: terminals X1, A, X1, B

Cable length: ≤ 100 m
Cable: twisted pair, one end of shield connected to PE

Connection terminals X1, A, X1, B

Electrical endurance under rated operating conditions, number of cycles: 10,000

Contact data acc. to IEC 60947-5-1:
Utilisation category: AC-13, AC-14, DC-12, DC-12, DC-12
Rated operational voltage: 230 V
Rated operational current: 5 A
Rated insulation voltage: 2000 m NN
Rated operational voltage: 110 V
Minimum contact rating: 1 mA at AC/DC, ≤ 10 V

Environment/EMC

EMC: IEC 61326-2-4

Ambient temperatures:
Operating temperature: -25...+55 °C
Transport: -40...+85 °C
Long-term storage: -40...+70 °C

Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3): 3K5 (condensation and formation of ice possible)
Transport (IEC 60721-3-2): 2K3
Long-term storage (IEC 60721-3-1): 1K4

Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3): 3M4
Transport (IEC 60721-3-2): 2M2
Long-term storage (IEC 60721-3-1): 1M3
Area of application: ≤ 3800 m NN

Connection

Connection type: pluggable screw-type terminal or push-wire terminal

Screw-type terminals:
Nominal current: ≤ 10 A
Tightening torque: 0.3...0.6 Nm (3...7 lb-in)
Conductor sizes: AWG 24-12
Stripping length: ≤ 7 mm

Flexible with ferrules, with/without plastic sleeve: 0.25...2.5 mm²
Multiple conductor, rigid: 0.2...1 mm²
Multiple conductor, flexible: 0.2...1.5 mm²
Multiple conductor, flexible with ferrule without plastic sleeve: 0.25...1.5 mm²
Multiple conductor, flexible with TWIN ferrule with plastic sleeve: 0.5...1.5 mm²

Push-wire terminals:
Nominal current: ≤ 10 A
Conductor sizes: AWG 24-12
Stripping length: 10 mm
Flexible with ferrules, with/without plastic sleeve: 0.25...2.5 mm²
Flexible with TWIN ferrule with plastic sleeve: 0.25...0.75 mm²

Push-wire terminals X1:
Nominal current: ≤ 10 A
Conductor sizes: AWG 24-16
Stripping length: 10 mm
Flexible with ferrules, with/without plastic sleeve: 0.25...1.5 mm²
Flexible with TWIN ferrule with plastic sleeve: 0.25...0.75 mm²

Other

Operating mode: continuous operation
Mounting (0 °) display-oriented, cooling slots must be ventilated vertically
Degree of protection internal components: IP40
Degree of protection terminals: IP20
DIN rail mounting acc. to IEC 60715
Screw fixing: 3 x M4 with mounting clip
Enclosure material: polycarbonate
Flammability class: V-0
ANSI code: 64
Dimensions (W x H x D): 108 x 93 x 110 mm
Weight: < 390 g

Option „W“ data different from the standard version:
Rated operational current of switching elements: max. 3 A (for UL applications)

Ambient temperatures:
Operating temperature: -40...+70 °C
Transport: -40...+85 °C
Long-term storage: -40...+70 °C

Classification of climatic conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3): 3K5 (condensation and formation of ice possible)
Transport (IEC 60721-3-2): 2K3
Long-term storage (IEC 60721-3-1): 1K4

Classification of mechanical conditions acc. to IEC 60721:
Stationary use (IEC 60721-3-3): 3M4
Transport (IEC 60721-3-2): 2M2
Long-term storage (IEC 60721-3-1): 1M3
Area of application: ≤ 3800 m NN

1) At a frequency > 200 Hz, the connection of X1 must be insulated. Only permanently installed devices which at least have overvoltage category CAT2 (300V) may be connected.
2) Indication limited outside the temperature range -25...+55 °C.
3) U, [Volt] = supply voltage ISOMETER®
4) For U, ≥ 50 V only.
5) This is a class A product. In a domestic environment, this product may cause radio interference. In this case, the user may be required to take corrective actions.
6) Recommendation: Devices mounted at 0 ° (display-oriented, cooling slots must be ventilated vertically).
For devices mounted at an angle of 45 °, the max. working temperature is reduced by 10 °C.
For devices mounted at an angle of 90 °, the max. working temperature is reduced by 20 °C.
## Ordering Information

### Nominal System Voltage Range $U_n$, Supply Voltage $U_S$

<table>
<thead>
<tr>
<th>Display</th>
<th>Option &quot;W&quot;</th>
<th>Type</th>
<th>Art. no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>iso685-D-B</td>
<td>-</td>
<td>B91067020</td>
</tr>
<tr>
<td>DC</td>
<td>iso685W-D-B</td>
<td>-</td>
<td>B91067020W</td>
</tr>
<tr>
<td>AC</td>
<td>iso685-S-B</td>
<td>-0°C</td>
<td>B91067220</td>
</tr>
<tr>
<td>DC</td>
<td>iso685W-S-B</td>
<td>-0°C</td>
<td>B91067220W</td>
</tr>
</tbody>
</table>

### Accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Art. no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A set of screw terminals¹)</td>
<td>B91067901</td>
</tr>
<tr>
<td>A set of push-wire terminals</td>
<td>B91067902</td>
</tr>
<tr>
<td>Enclosure accessories (terminal cover, 2 mounting clips)¹)</td>
<td>B91067903</td>
</tr>
<tr>
<td>Transparent cover 144x72 (IP65) for FP200²)</td>
<td>B98060005</td>
</tr>
</tbody>
</table>

¹) included in the scope of delivery
²) If the “transparent front cover 144x72 (IP65)” is used, the cutout in the control cabinet must be increased in height from 66 mm to 68 mm (+0.7 / -0 mm).

### Suitable System Components

<table>
<thead>
<tr>
<th>Description</th>
<th>Type</th>
<th>Art. no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Device version without display</td>
<td>iso685-S-B</td>
<td>B91067120</td>
</tr>
<tr>
<td>Display for front panel mounting</td>
<td>FP200</td>
<td>B91067904</td>
</tr>
</tbody>
</table>

Suitable measuring instruments on request!