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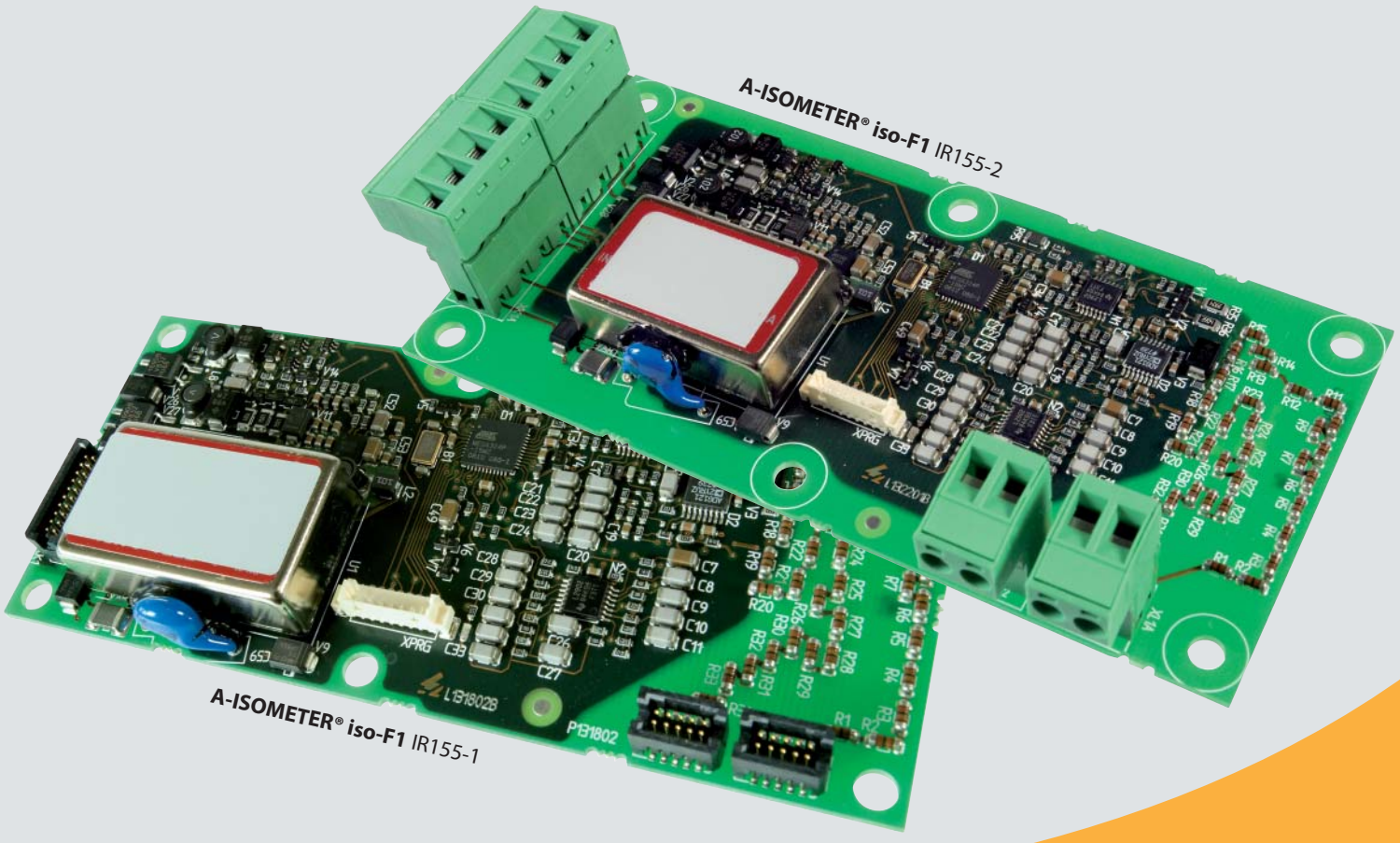
A-ISOMETER® iso-F1 (IR155-1 / IR155-2)

Insulation monitoring device for unearthed DC power supplies (IT systems) in electric vehicles (e.g. with hybrid drive)

Preliminary data sheet



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BENDER Group

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(IR155-1 / IR155-2)

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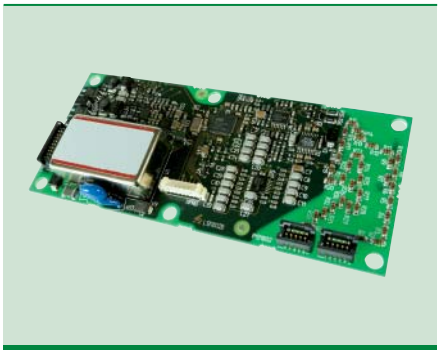
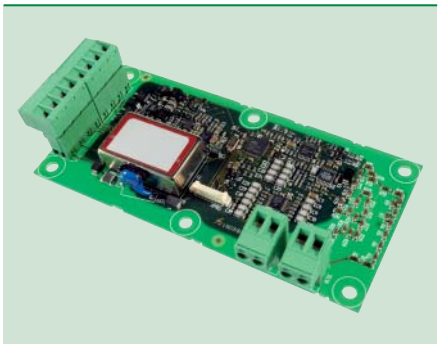


A-ISOMETER® iso-F1 IR155-1



A-ISOMETER® iso-F1 IR155-2
Version with connector

Device features

- Insulation monitoring for unearthed DC systems (IT systems) 0…800 V
- Automatic adaptation to the existing system leakage capacitance
- Optimised measurement technique for low-frequency control processes
- Electrically isolated PWM output for the kΩ measuring value
- Optocoupler output for signalling the device status
- Connection monitoring to reference earth (vehicle mass)
- Automatic device self test
- Certonal coating
- Two measurement methods
- Permanently set response value for the insulation resistance of 100 kΩ

Product description

The A-ISOMETER® iso-F1 monitors the insulation resistance between the active conductors of an electrical drive system (U_n = DC 0…800 V) and the reference earth (vehicle mass). The patented measurement method is used to monitor the condition of the insulation on the DC side as well as on the AC side of an electric vehicle with drive system and to signal insulation faults reliably even under high system interferences which can be caused by motor control processes.

Due to its space-saving design and an optimised measurement technique, the device is optimal for use in hybrid electric vehicles. The device meets the increased requirements with regard to the environmental conditions (e.g. temperatures).

Function

The A-ISOMETER® iso-F1 generates a pulsating measuring voltage which is superimposed on the IT system being monitored via the terminals L+ / L- and KE / E. The currently measured condition of the insulation is available as a pulse-width-modulated signal at the terminals M+ / M-.

The connection between the A-ISOMETER® iso-F1 (KE / E) and the reference earth (vehicle mass) is continuously monitored. Thus, two separate conductors have to be laid between the device and the reference earth (vehicle mass) (KE / control earth and E / reference earth).

Once the supply voltage U_S is connected, the device automatically carries out a self test. Any faults in the connecting wires or functional faults are automatically recognised and signalled. Once the self test is complete (20…30 s), the measurement of the condition of the insulation is started. During operation, a self test is carried out automatically every five minutes. The interfaces will not be influenced by the automatic self test.

Measurement methods (DCP, PCP)

The A-ISOMETER® iso-F1 utilises two measurement methods, which can be selected with the soldering jumper JP1.

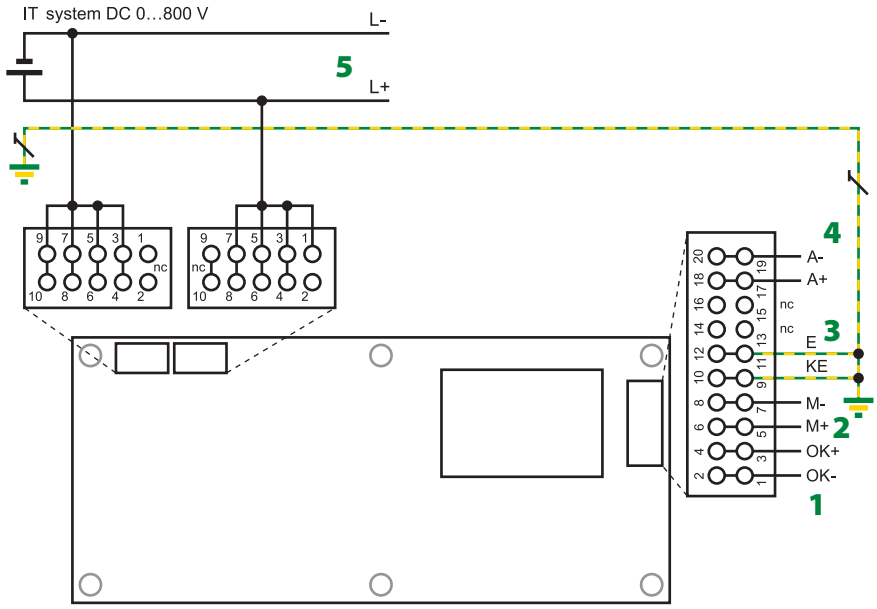
DCP, Direct Current Pulse: A measuring method where the measuring pulse is automatically adapted to the existing system leakage capacitance C_e of max. 1 µF and the measured value of the insulation resistance R_F is outputted. Low-frequency interferences may result in a prolonged measuring time (see curve).

PCP, Phase Correlation Pulse: This mesurement method uses a defined measuring pulse to determine the insulation impedance Z_F up to the maximum permissible system leakage capacitance C_e of 100 nF. In case of strong interferences in the measuring frequency range, measurement variations may occur (see curve). This measurement method is particularly suitable for very dynamic operating conditions (braking, acceleration).

Messages

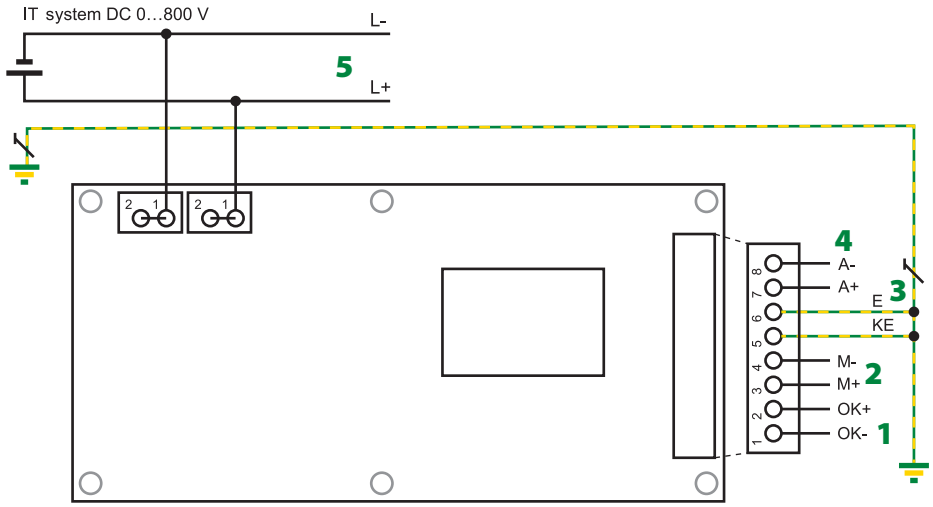
Function	OK+, OK-		M+ / M-	
	Messages	Output status	PWM output	Status
Earth connection (KE / E) faulty	Alarm	high-resistance	0 %	high-resistance
Device error	Alarm	high-resistance	0 %	high-resistance
Failure supply voltage	Alarm	high-resistance	0 %	high-resistance
Insulation resistance $R_F \leq 100$ kΩ	Alarm	high-resistance	Output	Dutycycle

Wiring diagrams



A-ISOMETER® iso-F1 IR155-1

1 - Optocoupler output OK+ / OK – for status indication
2 - Optocoupler output M+ / M- for measured value output (PWM)
3 - KE and E separately connected to reference earth (vehicle mass)
4 - Supply voltage U_S (DC 9…18 V)
5 - Connection of the DC system to be monitored, connect terminal L- to conductor L-, and terminal L+ to conductor L+



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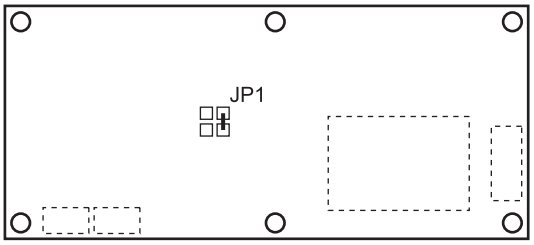
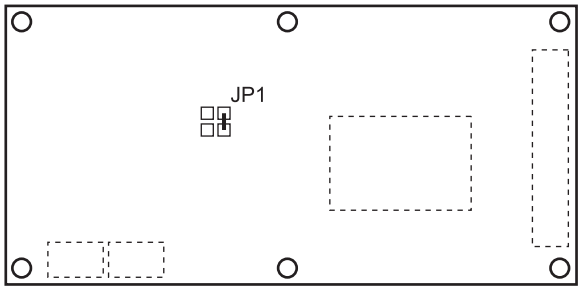
Changing the method of measurement

PCP measurement method after closing the soldering jumper JP1

A-ISOMETER® iso-F1 IR155-1

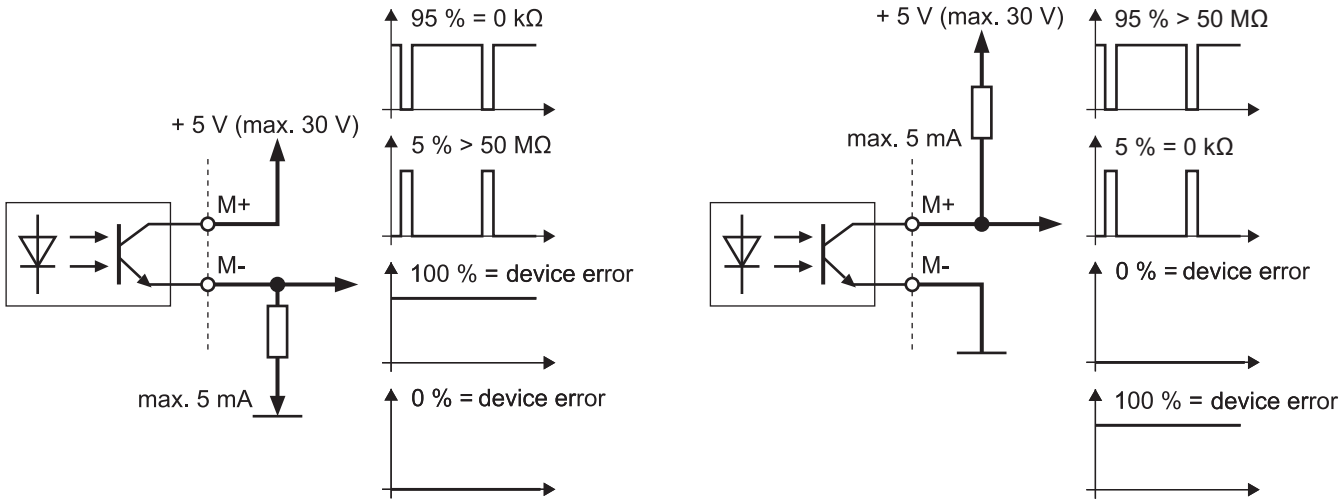


A-ISOMETER® iso-F1 IR155-2



Optocoupler output M+, M-

a) External circuitry

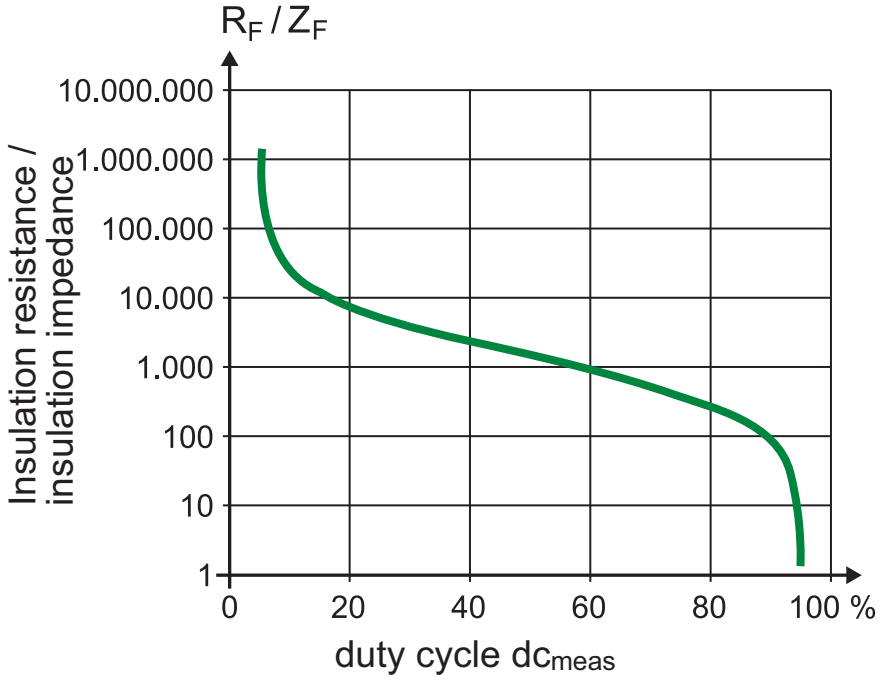


b) Calculation of the insulation resistance / insulation impedance

$$R_F = \frac{dc_{max} \cdot 1200\ k\Omega}{dc_{meas} - 5\ \%} - 1200\ k\Omega \qquad Z_F = \frac{dc_{max} \cdot 1200\ k\Omega}{dc_{meas} - 5\ \%} - 1200\ k\Omega$$

dc = duty cycle
R_F = insulation resistance Z_F = insulation impedance
dc_{max} = 90 %
dc_{meas} = 5 %…95 %

c) Frequency characteristics



Optocoupler output OK + / OK –

see table "Messages"

Technical data

Insulation coordination acc. to IEC 60664-1

Rated insulation voltage	800 V
Rated impulse voltage / pollution degree	6 kV / II
Protective separation (reinforced insulation) between	(L+, L-) – (M+, M-, A+, A-, OK+, OK-, E, KE)
Voltage test	DC 3.5 kV

Supply voltage / IT system being monitored

Nominal system voltage U_n	DC 0…800 V
Supply voltage U_S	DC 9…18 V
Power consumption	≤ 1.5 W

Response values

Response value R_{an} / Z_{an} (alarm indication: OK-, OK+)	100 kΩ
Relative uncertainty of measurement	+ / - 15 % (100 kΩ…10 MΩ)
Hysteresis	25 %

Measuring range

Insulation resistance R_F (DCP)	0 kΩ…50 MΩ
Insulation impedance Z_F at 2 Hz (PCP)	0 kΩ…50 MΩ
Relative uncertainty of measurement	+ / - 15 % (100 kΩ…10 MΩ)
Uncertainty of measurement 0…100 kΩ	+ / - 10 kΩ

Specified time

Response time t_{an} at R_F = 100 kΩ, C_e = 1 µF, U_n stable (DCP)	≤ 20 s
Response time t_{an} at Z_F = 100 kΩ, C_e = 100 nF, U_n stable (PCP)	≤ 20 s

Measuring circuit

Measuring voltage U_m	+ / - 40 V
Measuring current I_m	≤ 40 µA
Internal DC resistance R_i	≥ 1000 kΩ
System leakage capacitance C_e (DCP)	≤ 1 µF
System leakage capacitance C_e (PCP)	≤ 100 nF
Impedance Z_i at 50 Hz	≥ 1000 kΩ

Function

Alarm messages and device error messages:	E / KE connections interrupted	→ M+ / M- = 0 %
	Supply failure	→ M+ / M- = 0 %
	Device failure (self test)	→ M+ / M- = 0 %
LED reactions:	Constant shining	→ Internal self test
	1 Hz flashing	→ Proper system conditions
	2 Hz flashing	→ Insulation value lower than 100 kΩ
	4 Hz flashing	→ Device error or open E / KE connection

Output

Interface OK+, OK -	Optocoupler
Operating principle	N / C operation
Output status	low-resistance: no device error high-resistance: device error / alarm insulation condition
Switching voltage	max. 30 V
Switching current	max. 5 mA
Switching resistance $R_{OK+ / OK-}$	high-resistance >100 kΩ (120 °C), > 10 MΩ (25 °C) low-resistance < 200 Ω (120 °C), < 100 Ω (25 °C)
Interfaces M+, M-	Optocoupler
Function	Measuring value via PWM signal
Operating principle	Duty cycle 5 % = > 50 MΩ Duty cycle 50 % = 1200 kΩ Duty cycle 95 % = 0 kΩ Duty cycle 0 % = device error (OK- / OK+) Duty cycle 100 % = device error (OK- / OK+) R_F = (90 % * 1200 kΩ) / (dc % - 5 %) - 1200 kΩ Z_F = (90 % * 1200 kΩ) / (dc % - 5 %) - 1200 kΩ dc % = duty cycle (5 %…95 %)
Fundamental frequency PWM	225 Hz
Output current	max. 5 mA
Max voltage	max. 30 V
Output resistance optocoupler $R_{M+ / M-}$	Duty cycle 0 %, >100 kΩ (120°C), > 10 MΩ (25 °C) Duty cycle 100 %, < 200 Ω (120 °C) , < 100 Ω (25 °C)

Functional and device characteristics

Automatic self test (optocouplers do not switch)	for detecting device errors
Self test, automatically activated	after power on and every 5 minutes
Connection fault E-KE	continuously monitored, detecting time < 20 s
Detected device error during the self test	Output status of (OK+, OK-) high-resistance Duty cycle of (M+, M-) 0 %

Environmental conditions / EMC

EMC		acc. to 61326
Continuous ambient temperature		- 46 °C…105 °C
High ambient temperature (3h)		105 °C…125 °C
Vibrations	100 Hz	0.00797 g^2 / Hz
	200 Hz	0.17157 g^2 / Hz
	300 Hz	0.54279 g^2 / Hz
	650 Hz	0.00965 g^2 / Hz
	1000 Hz	0.02080 g^2 / Hz
		24 h in each axis
Shock		43 g, 1 / 2 sine, 11 ms, five times in each direction

Connection

Connectors (IR155-1)	Samtec Micro Mate 1 x TFML-110-02-S-D-LC (A+, A-, M+, M-, OK+, OK-, E, KE) 2 x TFML-105-02-S-D-LC (L+, L-)
Screw-type terminals (IR155-2)	Phoenix Contact 1 x MKDS 3 / 8 (A+, A-, M+, M-, OK+, OK-, E, KE) 2 x MKDS 3 / 2 (L+, L-)

General data

Operating mode / mounting	Continuous operation / any position
PCB dimensions (L x W x H) (IR155-1)	113 mm x 50 mm x 15 mm
PCB dimensions (L x W x H) (IR155-2)	125 mm x 60 mm x 19.5 mm
Enclosure	without
Mounting method	Screw mounting M4
IR155-1	Only plastic screws including insulating washers between PCB and mounting points.
IR155-2	Metal screws including locking washers between screw and PCB. Torx, T20 with a max. tightening torque of 10 Nm. Screw and washer kit attached. The max. diameter of the mounting points is 10mm.
Before mounting the device, ensure sufficient insulation between the device and the vehicle resp. the mounting points (min. 8 mm to other parts).	
Deflection	max. 1% of the length resp. width of the PCB.
Coating	Certonal
Weight	50 + / - 10 g

Factory setting

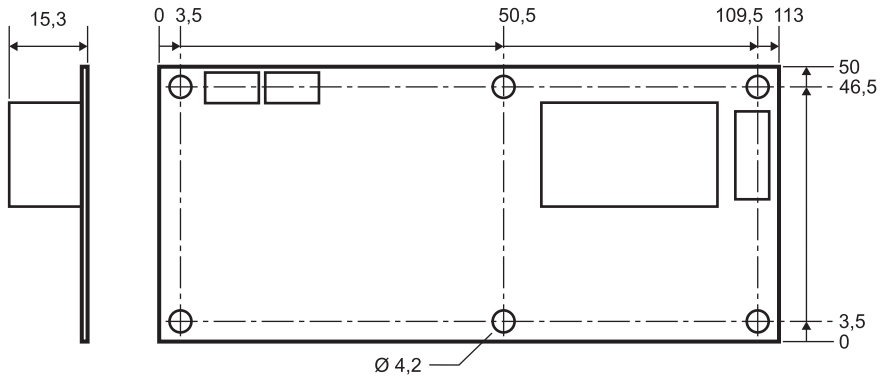
Measurement method (JP1: open)	DCP

Ordering information			
Type	**Nominal voltage**	**Supply voltage**	**Art. No.**
IR155-1	DC 0…800 V	DC 9…18 V	B 9106 8133
IR155-2	DC 0…800 V	DC 9…18 V	B 9106 8134

Dimension diagrams

Dimensions in mm

A-ISOMETER® iso-F1 IR155-1



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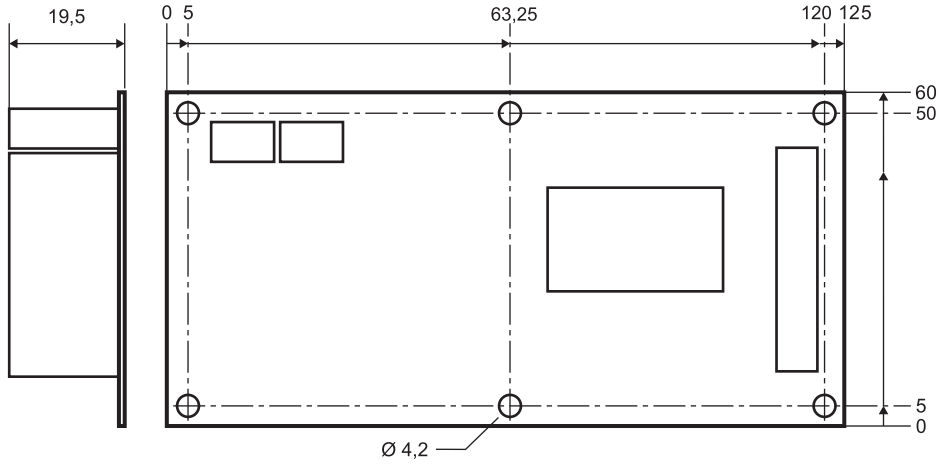

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