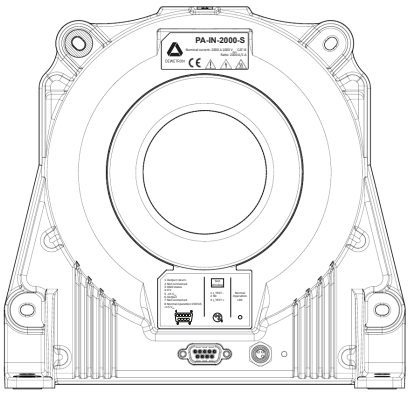
PA-IN-2000-S

CURRENT TRANSDUCER



FOR THE ELECTRONIC MEASUREMENT OF CURRENT: DC, AC, PULSED | WITH GALVANIC SEPARATION BETWEEN THE PRIMARY AND THE SECONDARY CIRCUIT.

I_{PN} = 2000 A

CE RoHS

FEATURES

- Closed loop (compensated) current transducer using an extremely accurate zero flux detector
- Electrostatic shield between primary and secondary circuit
- 9-pin D-SUB male secondary connector
- Status signal to indicate the transducer state
- LED indicator confirms normal operation
- Metal housing to improve immunity to EMC and power dissipation
- Operating temperature –40 °C to 85 °C

APPLICATIONS

- Feedback element in high performance gradient amplifiers for MRI
- Feedback element in high-precision, high-stability power supplies
- Calibration unit
- Energy measurement
- Medical equipment

ADVANTAGES

- Very high accuracy
- Excellent linearity
- Extremely low temperature drift
- Wide frequency bandwidth
- High immunity to external fields
- No insertion losses
- Very low noise on output signal
- Low noise feedback to primary conductor

STANDARDS

- EN 61000-6-2:2005
- EN 61000-6-3:2007
- EN 61010-1:2010

APPLICATION DOMAIN

- Industrial
- Laboratory
- Medical

DEWETRON

INSULATION COORDINATION

Parameter	Symbol	Unit	Value	Comment
Rated insulation RMS voltage	U_{Nm}	V	1000	Basic insulation according to IEC 61010-1, over-voltage CAT III, pollution degree 2
				Reinforced insulation according to IEC 61010-1, overvoltage CAT III, pollution degree 2
RMS voltage for AC insulation test, 50 Hz, 1 min	U_d	kV	6	Between primary and secondary + shield
		V_{DC}	100	Between sondary and test winding
Impulse withstand voltage 1.2/50 µs	U_{Ni}	kV	12.8	-
Clearance (pri.–sec.)	d_{Cl}	mm	21	Shortest distance through air
Creepage distance (pri.–sec.)	d_{Cp}	mm	22	Shortest path along device body
Comparative tracking index	*CTI*	-	250	-

ENVIRONMENTAL AND MECHANICAL CHARACTERISTICS

Parameter	Symbol	Unit	Min.	Typ.	Max.
Ambient operating temperature	T_A	°C	-40	-	+85
Ambient storage temperature	$T_{A\,st}$	°C	-40	-	+85
Relative humidity	*RH*	%	20	-	80
Dimensions	See drawing on page 8				
Mass	*m*	kg	-	4.2	

ELECTRIC DATA

At T_A = 25 °C, $\pm U_C$ = ±15 V_{DC}, unless otherwise noted.

Parameter		Symbol	Unit	Min.	Typ.	Max.		Comment
Primary nominal DC current (continuous)		$I_{PN\,DC}$	A	-2000	-	2000	*	-
Primary nominal RMS current		I_{PN}	A	-	-	2000	*	-
Primary current, measuring range		I_{PM}	A	-3000	-	3000	*	-
Measuring resistance		R_M	Ω	0	-	1		See curve on page 5
Secondary nominal RMS current		I_{SN}	A	-1	-	1	*	-
Number of secondary turns		N_S	-	-	2000	-		-
Resistance of secondary winding		R_S	Ω	-	4	-		-
Maximum withstand primary peak current[1]		$\hat{I}_{P\,max}$	kA	-10	-	10		@ pulse of 100 ms
Supply voltage positive		$+U_C$	V	14.25	15	15.75		-
Supply voltage negative		$-U_C$		-15.75	-15	-14.25		-
Current consumption positive		$+I_C$	mA	180	200	225		Add I_S for total current consumption
Current consumption negative		$-I_C$		80	89	100		
Output RMS noise current	0…10 Hz[2]	I_{no}	ppm	-	0.1	-		-
	0…10 kHz[2]			-	4	-		
	0…160 kHz[2]			-	20	-		

Parameter		Symbol	Unit	Min.	Typ.	Max.		Comment
Output peak-to-peak noise current[2)]		$I_{no\ pp}$	ppm	-	50	-		-
Electrical offset current + self magnetization + effect of earth magnetic field[2)]		I_{OE}	ppm	-10	-	10	*	-
Temperature coefficient of I_{OE} @ I_P = 0 A		TCI_{OE}	ppm/K	-	0.1	-		-
Offset stability[2)]		-	ppm/ month	-1	-	1		-
Linearity error[2)]		ε_L	ppm	-	1	2		-
				-	2	3	*	
Delay time to 90 % of the final output value for $I_{PN\ DC}$ step		$t_{D\ 90}$	µs	-	-	1		d*i*/d*t* of 100 A/µs
Frequency bandwidth	(±1 dB)	*BW*	kHz	-	130	-		Small-signal bandwidth, 0.5 % of I_{PN}
	(±3 dB)			-	140	-		
Test current		I_T	A	-	-	1		-
Number of turns (test winding)		N_T	-	-	200	-		-
Start-up time		t_{start}	s	2	5	15		-

Notes

1) Single pulse only, not AC. The transducer may require a few seconds to return to normal operation when autoreset system is running.

2) All ppm figures refer to full-scale which corresponds to a secondary nominal RMS current of 1 A.

*) Lines with an * in the comment column apply over the -40…85 °C ambient temperature range.

OVERLOAD PROTECTION – ELECTRICAL SPECIFICATION – STATUS

The overload occurs when the primary current I_P exceeds a trip level such that the fluxgate detector becomes completely saturated and, consequently, the transducer will switch from normal operation to overload mode.

This trip level is guaranteed to be greater than I_{PM} and its actual value depends on operating conditions such as temperature and measuring resistance.

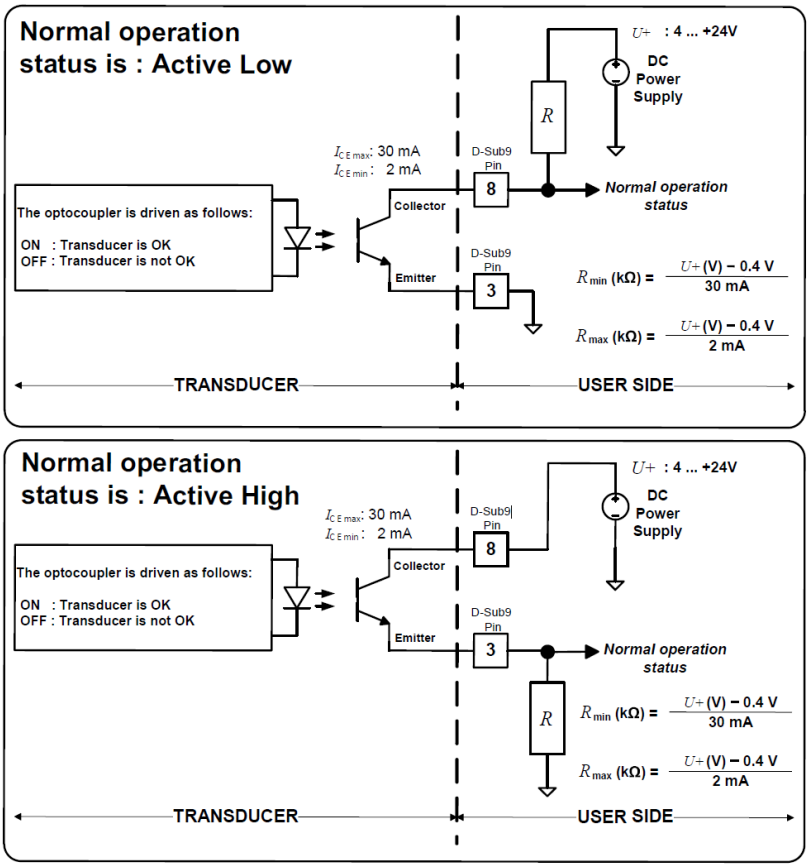
When this happens, the transducer will automatically begin to sweep in order to lock on the primary current again.

The overload conditions are:

- The secondary current I_S generated is a low frequency signal.
- The signal normal operation status (between pin 3 and 8 of the D-SUB connector) switches to V+. In other words, the output transistor is switched off (i.e., no current from collector to emitter). See the status port wiring below.
- The green LED indicator (normal operation status) turns off.

The measuring can resume when the primary current returns in the measuring range between $-I_{PN}$ and $+I_{PN}$. Then the signal normal operation status switches to GND and the green LED indicator (normal operation status) is again lit.

STATUS/INTERLOCK PORT WIRING



The following table shows how the normal operation status acts as below:

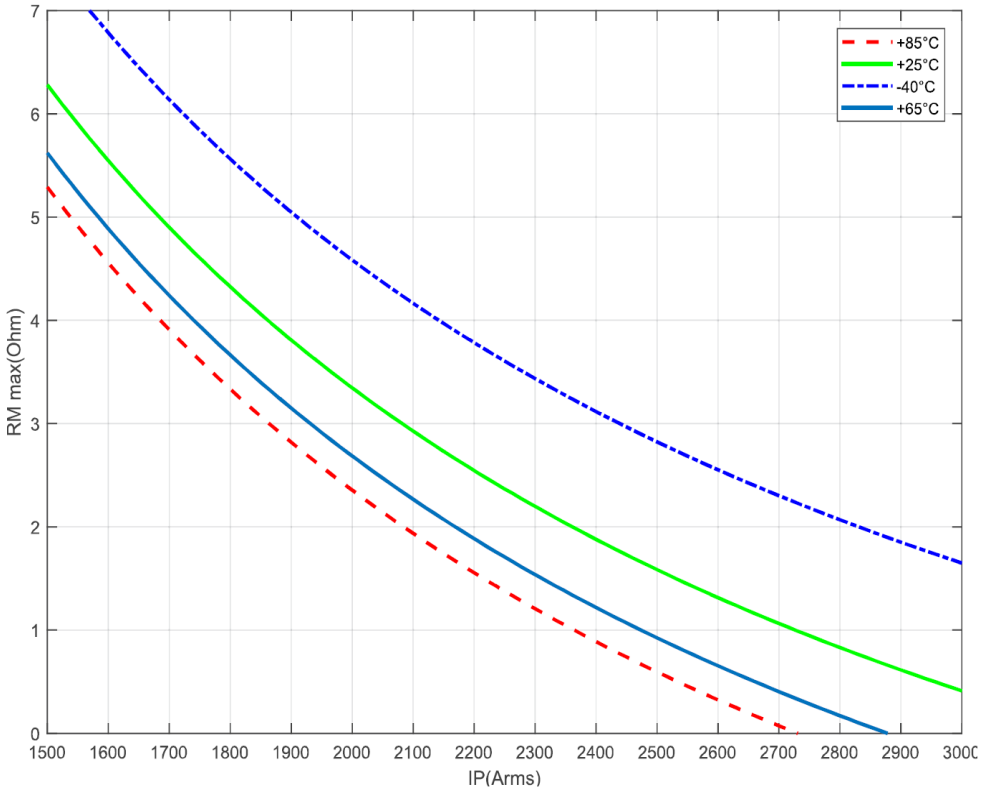
Status	Value	Description
Active low	≈ 0.7 V	The transducer is OK (normal operation)
	U+	The transducer is not OK (overload mode or supply fault)
Active high	*U+*	The transducer is OK (normal operation)
	≈ 0.7 V	The transducer is not OK (overload mode or supply fault)

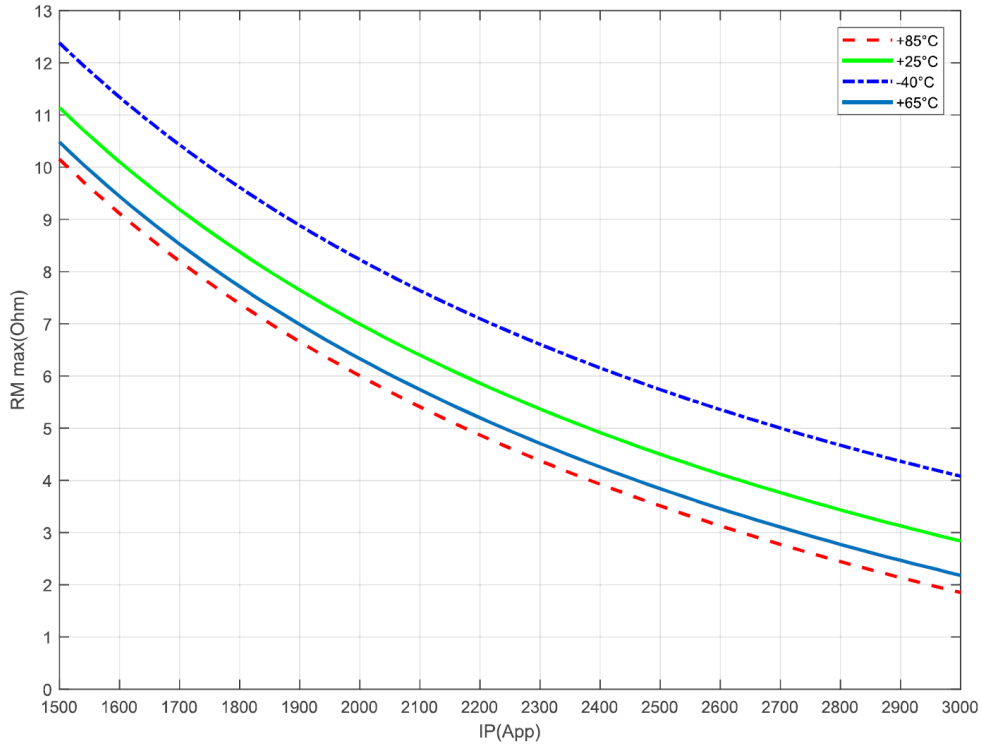
The following table shows how the normal operation status acts as below:

Normal operation status	Description
<0.7 V	The transducer is OK (normal operation)
U+	The transducer is not OK (overload mode or supply fault)

MAXIMUM MEASURING RESISTANCE VERSUS PRIMARY CURRENT AND TEMPERATURE

±U_c = ±14.25 V

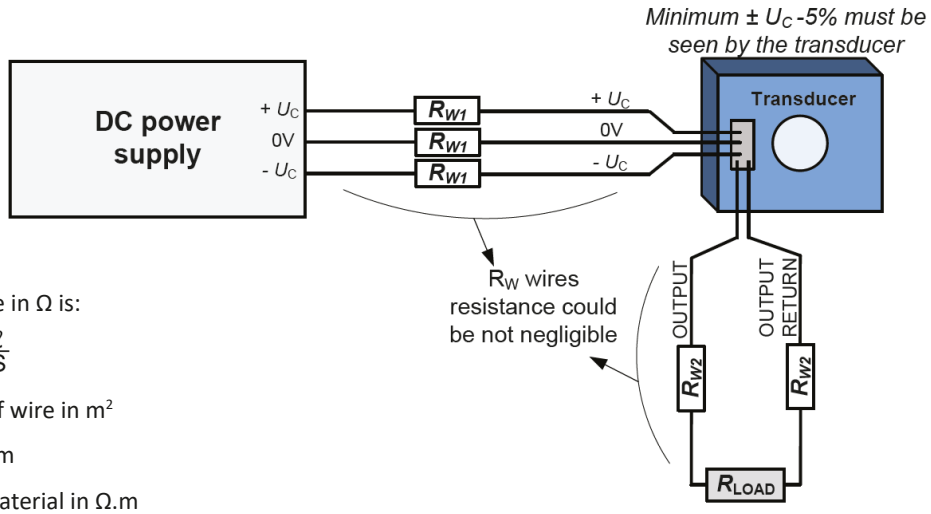




POWER SUPPLY AND LOAD

In order to reach the measuring range according to the maximum measuring resistor, be careful with the setup measurement when wires length are high. It means that:

- the wires resistance could be not negligible
- the voltage at the output of the DC power supply and the voltage at the transducer could be significantly different



R_W wire resistance in Ω is:

$$R_W = \rho \frac{\ell}{S}$$

S: Cross section of wire in m^2

ℓ: Wire length in m

ρ: Resistivity of material in Ω.m

Total measuring resistance is:

$R_M = R_L + 2 \times R_{W1} + 2 \times R_{W2}$

If $R_{W1} = R_{W2} = R_{WIRE}$ then $R_M = R_L + 4 \times R_{WIRE}$

SAFETY

This transducer must be used in limited-energy secondary circuits according to IEC 61010-1.

WARNING

Risk of injury

This transducer must be used in electric/electronic equipment with respect to applicable standards and safety requirements in accordance with the manufacturer's operating instructions.

CAUTION

Risk injury due to electrical shock

When operating the transducer, certain parts of the module can carry hazardous voltage (e.g. primary busbar, power supply). Ignoring this warning can lead to injury and/or cause serious damage.

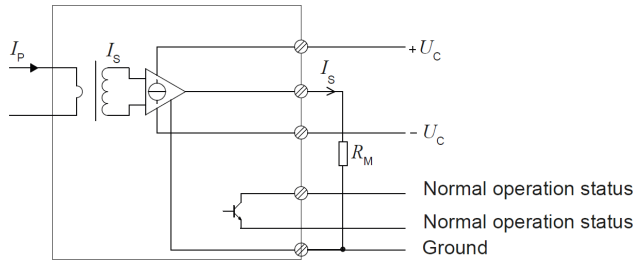
This transducer is a build-in device, whose conducting parts must be inaccessible after installation.

A protective housing or additional shield could be used. Main supply must be able to be disconnected.

DEWETRON

PERFORMANCE PARAMETERS DEFINITION

The schematic used to measure all electrical parameters is shown below:



TRANSDUCER SIMPLIFIED MODEL

The static model of the transducer at temperature T_A is:

$$I_S = N_P/N_S \cdot I_P + \varepsilon$$

In which

$$\varepsilon = I_{OE} \text{ at } 25\,^\circ\text{C} + I_{OT}(T_A) + \varepsilon_L \cdot I_{PM} \cdot N_P/N_S$$

Where

$$I_{OT}(T_A) = TCI_{OE} \cdot |T_A - 25\,^\circ\text{C}| \cdot I_{PM} \cdot N_P/N_S$$

I_S : secondary current (A)

N_P/N_S : turns ratio (1: N_S)

I_P : primary current (A)

I_{PM} : primary current, measuring range (A)

T_A : ambient operating temperature (°C)

I_{OE} : electrical offset current (A)

I_{OT} : temperature variation of I_{OE} at T_A (A)

ε_L : linearity error

This is the absolute maximum error. As all errors are independent, a more realistic way to calculate the error would be to use the following formula:

$$\varepsilon = \sqrt{\sum_{i=1}^{N} \varepsilon_i^2}$$

LINEARITY

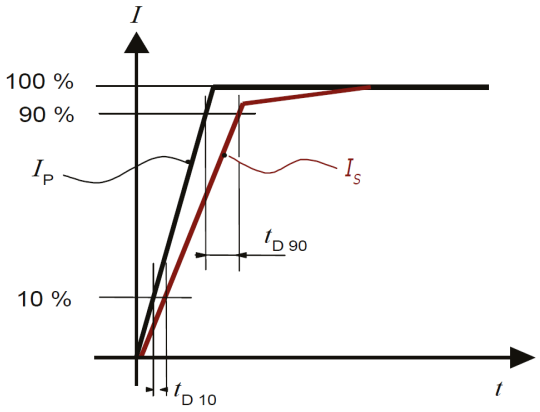
To measure linearity, the primary current (DC) is cycled from 0 to I_{PM}, then to $-I_{PM}$ and back to 0. The linearity error ε_L is the maximum positive or negative difference between the measured points and the linear regression line, expressed in parts per million (ppm) of full-scale which corresponds to the maximum measured value.

ELECTRICAL OFFSET

The electrical offset current I_{OE} is the residual output current when the input current is zero. The temperature variation I_{OT} of the electrical offset current I_{OE} is the variation of the electrical offset from 25 °C to the considered temperature.

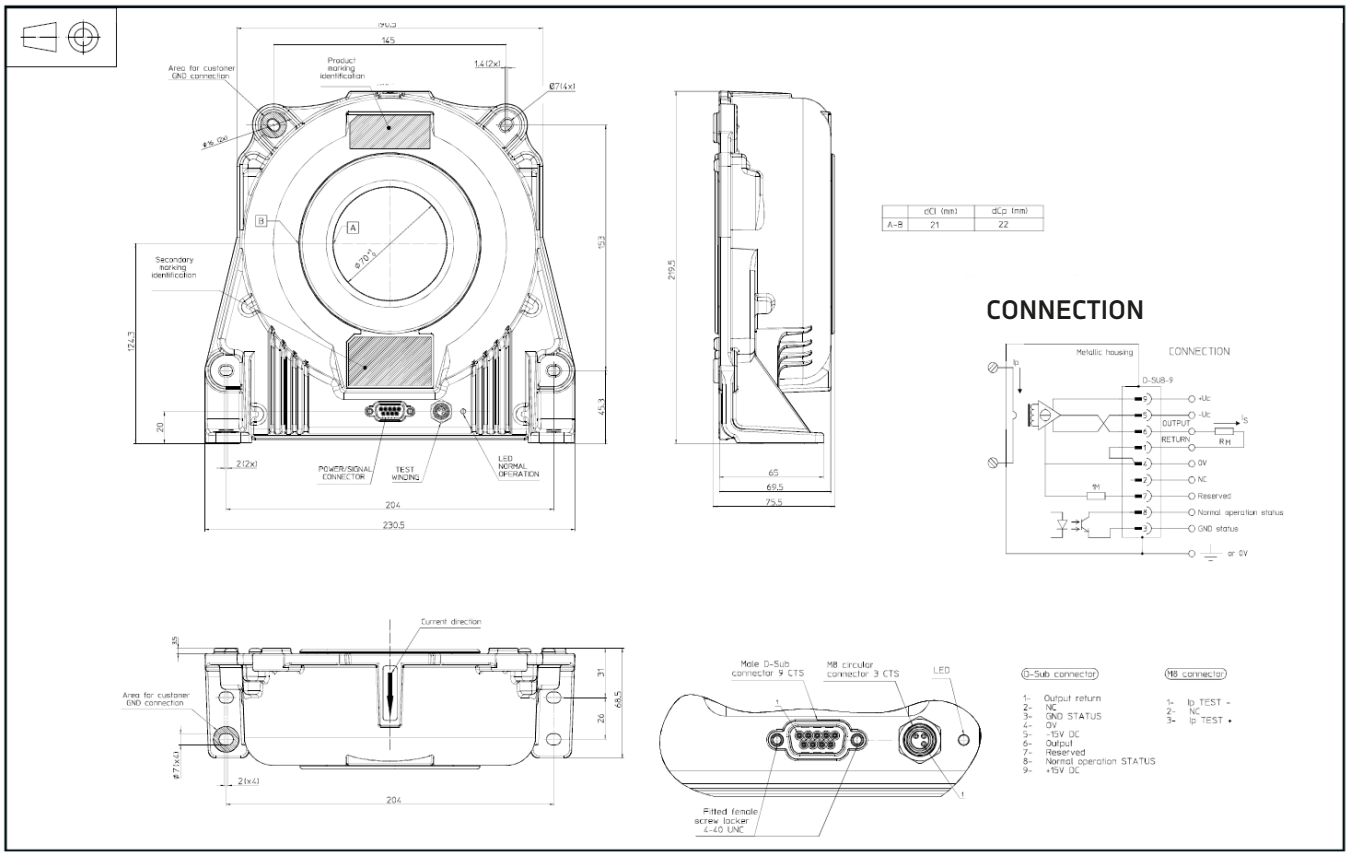
DELAY TIMES

The response time t_{D10} @ 10 % is shown in the next figure. Both slightly depend on the primary current di/dt. They are measured at nominal current.



PA-IN-2000-S

DIMENSIONS



MECHANICAL CHARACTERISTICS

- General tolerance ±0.75 mm
- Transducer fastening
  - Horizontal and vertical mounting: 4 holes Ø 7 mm with 2 slots gap along transducer 4 M6 steel screws
  - Recommended fastening torque: 5.5 Nm
- Connection of secondary: on D-SUB-9, UNC 4-40

- All mounting recommendations are given for a standard mounting. Screws with flat and spring washers.
- Installation of the transducer must be done unless otherwise specified on the datasheet, according to the manufacturer's Transducer Generic Mounting Rules.

CONNECTION

- Normal operation status (pins 3 and 8)
- Normal operation means:
  - ±15 V (±U_C) present
  - zero detector is working
  - compensation current ≤I_{PM} DC
  - green LED indicator is lit

REMARKS

- I_S is positive when I_P flows in the direction of the arrow.
- We recommend that a shielded output cable and plug are used to ensure the maximum immunity against electrostatic fields.
- Temperature of the primary conductor should not exceed 100 °C.
- We recommend to fix the potential of the housing to the ground.