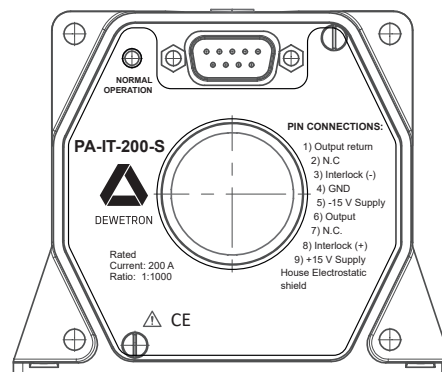


PA-IT-200-S

CURRENT TRANSDUCER

FOR ULTRA-HIGH PRECISION MEASUREMENT OF CURRENT: DC, AC, PULSED..., WITH GALVANIC SEPARATION BETWEEN PRIMARY AND SECONDARY..

$$I_{PM} = 200 \text{ A}$$



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
- ▶ Optically insulated output (photocoupler type) indicates transducer state
- ▶ LED indicator confirms normal operation

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
- ▶ 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 DOMAINS

- ▶ Industrial
- ▶ Laboratory
- ▶ Medical

INSULATION COORDINATION

Parameter	Symbol	Unit	Value	Comment
Rated insulation RMS voltage	U_b	V	2000	Basic insulation according to IEC 61010-1 – Over voltage CAT III – Pollution degree 2
			600	Reinforced insulation according to IEC 61010-1 – Over voltage CAT III – Pollution degree 2
			1000	Basic insulation according to EN 50178 – Over voltage CAT III – Pollution degree 2
			600	Reinforced insulation according to EN 50178 – Over voltage CAT III – Pollution degree 2
RMS voltage for AC insulation test 50/60 Hz, 1 min	U_d	kV	5.4	Between primary and secondary + shield
		V _{DC}	200	Between secondary and shield
		V _{DC}	300	Between secondary and status output
Impulse withstand voltage 1.2/50 μ s	\hat{U}_w	kV	9.9	-
Clearance (pri.–sec.)	d_{cl}	mm	11	Shortest distance through air
Creepage distance (pri.–sec.)	d_{cp}	mm	11	Shortest path along device body
Comparative tracking index	CTI	V	600	-

If insulated cable is used for the primary circuit, the voltage category could be improved with the following table (for single insulation) (IEC 61010-1 standard):

Cable insulated (primary)	Category
▶ HAR03	▶ 2150 V CAT III
▶ HAR05	▶ 2250 V CAT III
▶ HAR07	▶ 2350 V CAT III

ENVIRONMENTAL AND MECHANICAL CHARACTERISTICS

Parameter	Symbol	Unit	Min.	Typ	Max.	Comment
Ambient operating temperature	T_A	°C	-40	-	+50	-
Ambient storage temperature	T_S	°C	-40	-	+85	-
Relative humidity	RH	%	+20	-	+80	Non condensing
Dimensions	See drawing on page 7					
Mass	m	kg	-	0.3	-	-

ELECTRIC DATA

At $T_A = 25\text{ °C}$, $\pm U_C = \pm 15\text{ V}$, unless otherwise noted.

Parameter	Symbol	Unit	Min.	Typ	Max.	Comment	
Primary continuous direct current	$I_{PN\ DC}$	A	-200	-	200	-	
Primary nominal RMS current	I_{PN}	A	-	-	141	-	
Primary current, measuring range	I_{PM}	A	-200	-	200	-	
Measuring resistance over operating current temperature and supply voltage range	R_M	Ω	0	-	30	See graph on page 6	
Secondary current	I_S	mA	-200	-	200	-	
Conversion ratio	K_N	-	-	1:1000	-	-	
Resistance of secondary winding	R_S	Ω	-	20	-	-	
Overload capability ¹⁾	\hat{I}_P	A	-1000	-	1000	@ Pulse of 100 ms	
Supply voltage DC	U_C	V	± 14.25	± 15	± 15.75		
Current consumption	I_C	mA	-	-	80	Add I_S for total current consumption	
Output RMS noise	0...10 Hz ²⁾	V_{no}	ppm	-	-	0.1	-
	0...100 Hz ²⁾			-	-	1	
	0...1 kHz ²⁾			-	-	2	
	0...10 kHz ²⁾			-	-	8	
	0...50 kHz ²⁾			-	-	15	
Re-injected RMS noise on primary bus bar	-	μV	-	-	5	0...50 kHz	
Electrical offset current + self magnetization + effect of earth magnetic field ²⁾	I_{OE}	ppm	-	-	80	-	
Temperature coefficient of I_{OE} ²⁾	TCI_{OE}	ppm/K	-	-	2	10...50 °C	
Offset stability ²⁾	-	ppm/month	-	-	1	-	
Linearity error ²⁾	ϵ_L	ppm	-	-	3	-	
Step response time to 90 % of $I_{PN\ DC}$	t_r	μs	-	-	1	di/dt of 100 A/ μs	
di/dt accurately followed	di/dt	A/ μs	100	-	-	-	
Frequency bandwidth (± 1 dB)	BW	kHz	0	150	-	Small-signal bandwidth, 0.5 % of I_{PM}	
Frequency bandwidth (± 3 dB)	BW	kHz	0	500	-		

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 current (I_S) of 200 mA.

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 110 % of I_{PNDC} 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:

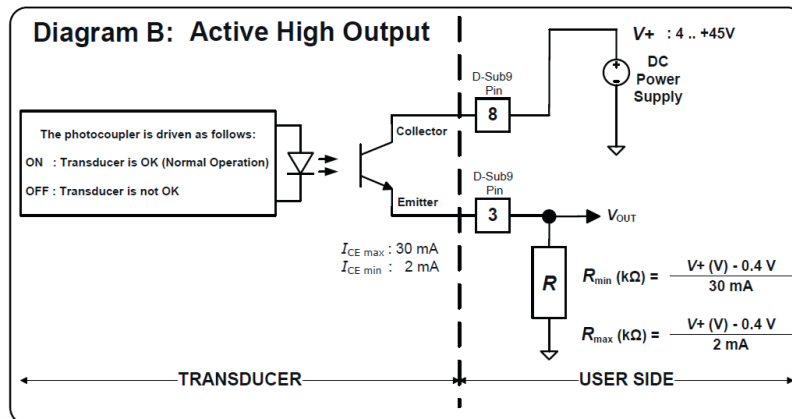
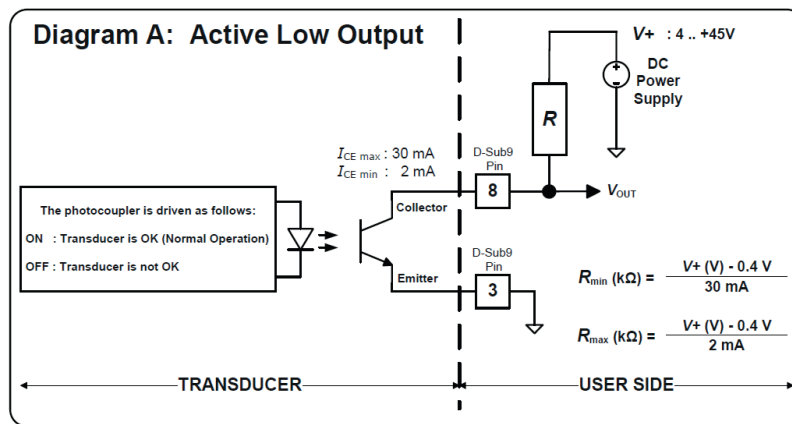
- ▶ The secondary current generated is a low frequency signal between -200 mA and 200 mA.
- ▶ The signal V_{OUT} (operation status between pin 3 and 8 of the D-SUB connector) switches to V+ or GND depending on how it is wired. Hence, the output transistor is switched off (i.e., no current from collector 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 nominal range between $-I_{PNDC}$ and $+I_{PNDC}$. Then the signal V_{OUT} switches to V+ or GND and the green LED indicator (normal operation status) is again lit.

NOTICE

To ensure a safe recovery from saturation, the maximum burden resistor allowed is 30 Ω .

STATUS/INTERLOCK PORT WIRING



The following table shows how the output signal V_{OUT} acts depending on how it is wired.

Case	V_{OUT}	Description
Diagram A	<0.2 V	The transducer is OK (normal operation).
	V+	The transducer is not OK (overload mode or supply fault).
Diagram B	<0.2 V	The transducer is not OK (overload mode or supply fault).
	V+	The transducer is OK (normal operation).

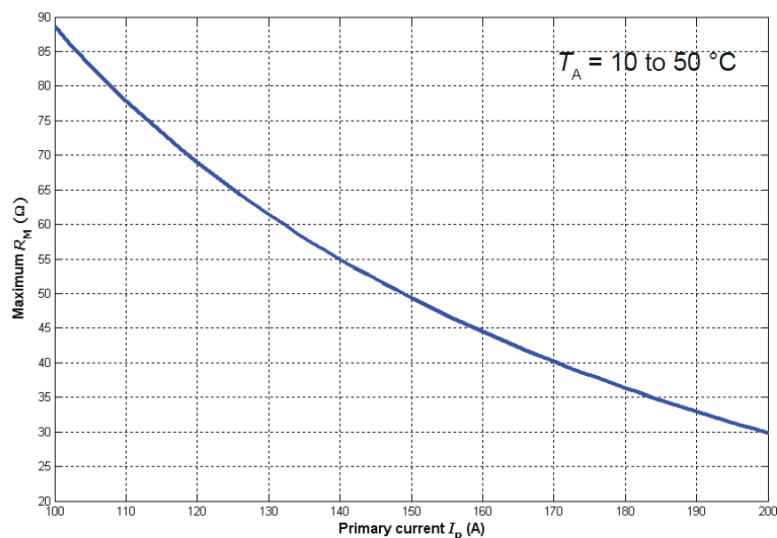
Some recommended standard values of R :

Power supply voltage V+	R_{min} (k Ω)	R_{max} (k Ω)	R standard values $\pm 5\%$
5 V	0.153	2.3	180 Ω , 1 k Ω or 2.2 k Ω
12 V	0.386	5.8	470 Ω , 2.2 k Ω or 4.7 k Ω
24 V	0.786	11.8	1 k Ω , 2.2 k Ω or 10 k Ω

ELECTRICAL DATA - STATUS PORT

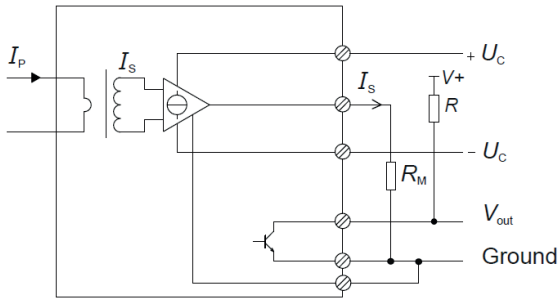
Parameter	Symbol	Unit	Min.	Typ.	Max.	Comment
Collector-emitter voltage, off-state	$V_{CE\ off}$	V	4	-	45	-
Collector-emitter current, on-state	I_{CE}	mA	2	-	30	-
Reverse collector-emitter voltage, off-state	$V_{CER\ off}$	V	-	-	5	-
Collector-emitter voltage, on-state	$V_{CE\ on}$	V	-	-	0.2	-

MAXIMUM MEASURING RESISTOR VS. PRIMARY CURRENT AND TEMPERATURE



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:

$$I_s = K_N \cdot I_p + \text{error}$$

In which

$$\text{error} = I_{OE} \text{ at } 25^\circ\text{C} + I_{OT}(T_A) + \varepsilon_L \cdot I_{PM} \cdot K_N$$

Where

$$I_{OT}(T_A) = TC_{IE} \cdot |T_A - 25^\circ\text{C}| \cdot I_{PM} \cdot K_N$$

I_s : secondary current (A)

K_N : conversion ratio (1:1000)

I_p : primary current (A)

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

T_A : ambient operating temperature ($^\circ\text{C}$)

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:

$$\text{error} = \sqrt{\sum (\text{error_component})^2}$$

LINEARITY

To measure linearity, the primary current (DC) is cycled from 0 to I_{PM} , then to $-I_{PM}$ and back to 0 (equally spaced $I_{PM}/10$ steps). 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.

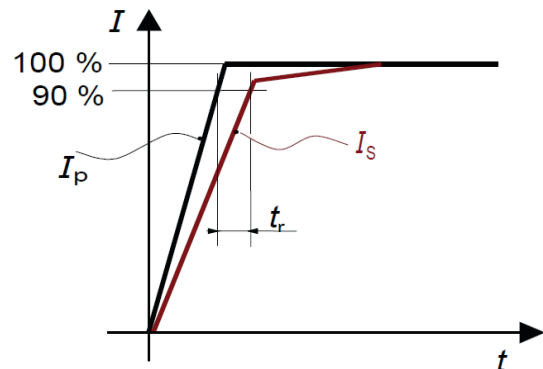
ELECTRICAL OFFSET

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.

RESPONSE TIME

The response time t_r is shown in the next figure. It depends on the primary current di/dt and it is measured at nominal current.



PA-IT-200-S

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 of injury due to electrical shock

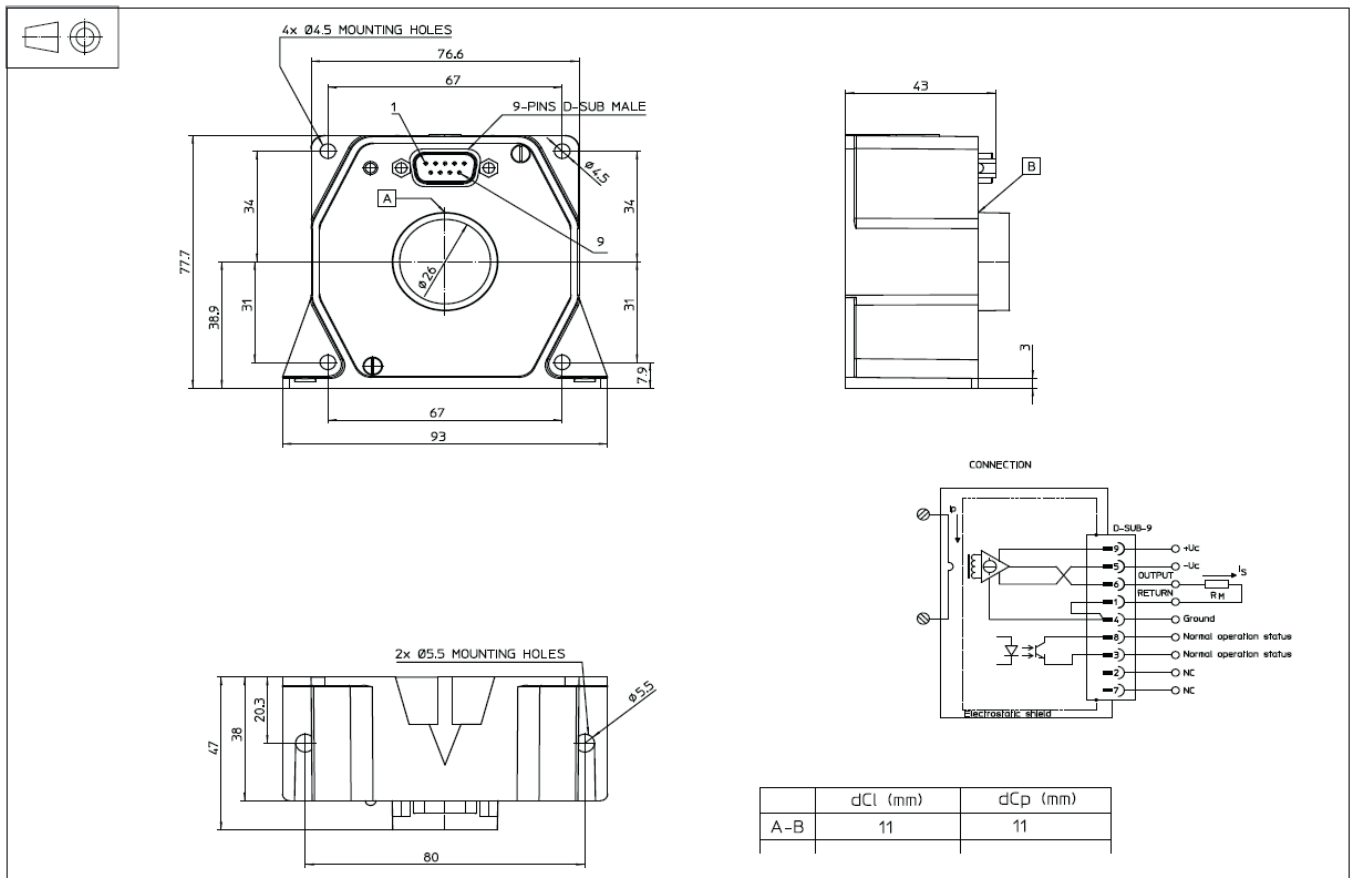
When operating the transducer, certain parts of the module can carry hazardous voltage (e.g. primary connection, power supply). Ignoring this warning can lead to injury and/or cause serious damage.



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.

DIMENSIONS



CONNECTION

- ▶ Normal operation status (pins 3 and 8)
- ▶ Normal operation means:
 - $\pm 15\text{ V}$ ($\pm U_c$) present
 - zero detector is working
 - compensation current $\leq 110\%$ of I_{PNDC}
 - 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.
- ▶ Pin 4 should be connected to cable and connector shield to maintain lowest output noise.
- ▶ Temperature of the primary conductor should not exceed $50\text{ }^\circ\text{C}$.

MECHANICAL CHARACTERISTICS

- ▶ General tolerance $\pm 0.3\text{ mm}$
- ▶ Transducer fastening
 - Straight mounting 2 holes $\varnothing 5.5\text{ mm}$
2x M5 steel screws
Recommended fastening torque 3.7 Nm
 - Flat mounting 4 holes $\varnothing 4.5\text{ mm}$
4x M4 steel screws
Recommended fastening torque 2.8 Nm
- ▶ Connection of secondary connector on D-SUB-9, connector UNC 4-40
- ▶ All mounting recommendations are given for a standard mounting. Screws with flat and spring washers.
- ▶ Primary through hole $\varnothing \leq 26\text{ mm}$
- ▶ Installation of the transducer must be done unless otherwise specified on the datasheet, according to the manufacturer's [Transducer Generic Mounting Rules](#).