

K-No.: 26322

### 25A Current Sensor

For the electronic measurement of currents:  
DC, AC, pulsed, mixed with a galvanic isolation  
between the primary circuit (high power) and the  
secondary circuit (electronic circuit)



Date: 07.05.2018

Customer: Standard type

Customers Part no:

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#### Description

- Closed loop (compensation)  
Current Sensor with magnetic probe
- Printed circuit board mounting
- Casing and materials UL-listed

#### Characteristics

- excellent accuracy
- very low offset current
- very low temperature dependency and offset current drift
- very low hysteresis of offset current
- short response time
- wide frequency bandwidth
- compact design
- reduced offset ripple

#### Applications

Mainly used for stationary operation in industrial applications:

- AC variable speed drives and servo motor drives
- static converters for DC motor drives
- Battery supplied applications
- Switched Mode Power Supplies (SMPS)
- Power supplies for welding applications
- Uninterruptable Power Supplies (UPS)

#### Electrical data - Ratings

$I_{PN}$	Primary nominal RMS current		25	A
$R_M$	Measuring resistance	$V_C = \pm 12V$	70...200	$\Omega$
		$V_C = \pm 15V$	100...500	$\Omega$
$I_{SN}$	Secondary nominal RMS current		25	mA
$K_N$	Transformation ratio		1...5:1000	

#### Accuracy – Dynamic performance data

		min.	typ.	max.	Unit
$I_{P,max}$	Max. measuring range				
	@ $V_C = \pm 12V$ , $R_M = 70\Omega$ ( $t_{max} = 10sec$ )	$\pm 80$			A
	@ $V_C = \pm 15V$ , $R_M = 100\Omega$ ( $t_{max} = 10sec$ )	$\pm 85$			A
X	Accuracy @ $I_P = 0A$ , $T_A = 25^\circ C$		0,1	0,5	%
$\epsilon_L$	Linearity			0,1	%
$I_O$	Offset current @ $I_P = 0A$ , $T_A = 25^\circ C$		0,02	0,1	mA
$t_r$	Response time			1	$\mu s$
$t_{ra}$	Reaction time at $di/dt = 100 A/\mu s$			1	$\mu s$
f	Frequency bandwidth	DC		200	kHz

#### General data

$T_A$	Ambient operation temperature	-40		85	$^\circ C$
$T_S$	Ambient storage temperature	-40		85	$^\circ C$
m	Mass		13,5		g
$V_C$	Supply voltage	$\pm 11,4$	$\pm 12/\pm 15$	$\pm 15,75$	V
$I_C$	Supply current at $I_P = 0A$ and RT		15	22	mA
	Constructed and manufactured and tested in accordance with EN 61800-5-1 (Pin 1 - 10 to Pin 11 - 13) Reinforced insulation, Insulation material group 1, Pollution degree 2				
$S_{clear}$	Clearance (component without solder pad)		10,2		mm
$S_{creep}$	Creepage (component without solder pad)		10,2		mm
$V_{sys}$	System voltage			600	$V_{RMS}$
$V_{work}$	Working voltage (table 7 acc. to EN 61800-5-1)			1020	$V_{RMS}$
					overvoltage category 2
$U_{PD}$	Rated discharge voltage			1000	$V_S$
	Max. potential difference acc. to UL 508		RMS	600	$V_{AC}$

Date	Name	Issue	Amendment
07.05.2018	DJ	82	Typo: $R_{Cu}$ 100-400 Ohm to 100-500 Ohm. Minor change.

Hrg.: R&D-PD NPI D  
editor

Bearb.: DJ  
designer

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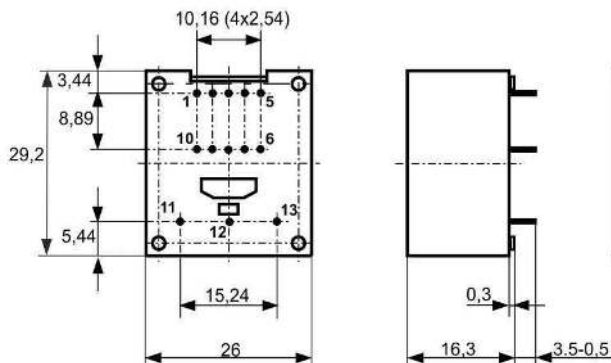
#### Mechanical outline (mm):

General tolerances DIN ISO 2768-c

Tolerance grid distance  $\pm 0,3\text{mm}$

DC = Date Code  
F = Factory

Numbers 1 -13 not imprinted



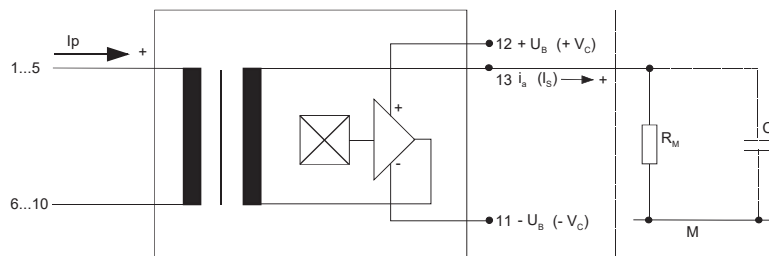
Connections:

Pin Nr. 1-10:  $\varnothing 1,0\text{mm}$   
Pin Nr. 11-13:  $0,88 \times 0,6$

Marking:

**VAC**  
4648-X300  
UL-sign F DC

#### Schematic diagram:



#### Possibility of wiring for $V_C = \pm 15\text{V}$ (@ $T_A = 85^\circ\text{C}$ , $R_M = 100\Omega$ )

primary-windings $N_P$	Primary current RMS $I_P$ [A]	Primary current maximal $\hat{I}_{P,max}$ [A]	output current r.m.s. $I_S(I_P)$ [mA]	turns ratio $K_N$	primary-resistance $R_P$ [m $\Omega$ ]	wiring
1	25	85	25	1:1000	0,2	
2	12	42,5	24	2:1000	0,83	
3	8	28	24	3:1000	2	
4	6	21	24	4:1000	3,5	
5	5	17	25	5:1000	5	
5	1	17	5	5:1000	5	

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#### Electrical data (investigate by a type checking)

		min.	typ.	max.	Unit
$V_{C,tot}$	maximum supply voltage (without function) $\pm 15,75V$ to $\pm 18V$ : for 1s per hour			$\pm 18$	V
$R_S$	Secondary coil resistance @ $T_A = 85^\circ C$			63	$\Omega$
$R_P$	Primary coil resistance per turn @ $T_A = 25^\circ C$			1	m $\Omega$
$X_{TI}$	Temperature drift of X @ $T_A = -40^\circ C \dots 85^\circ C$			0,1	%
$I_{O,ges}$	Offset current (including $I_O, I_{Ot}, I_{OT}$ )			0,15	mA
$I_{Ot}$	Long term drift offset current von $I_O$		0,05		mA
$I_{OT}$	Offset current temperature drift $I_O$ @ $T_A = -40^\circ C \dots 85^\circ C$		0,05		mA
$I_{OH}$	Hysteresis current @ $I_P = 0A$ (caused by $I_P = 3 \times I_{PN}$ )		0,03	0,1	mA
$\Delta I_O / \Delta V_C$	Supply voltage rejection ratio			0,01	mA/V
$i_{OSS}$	Offsetripple* (with 1 MHz-Filter, first order)			0,4	mA
$i_{OSS}$	Offsetripple* (with 100 kHz-Filter, first order)		0,025	0,15	mA
$i_{OSS}$	Offsetripple* (with 20 kHz-Filter, first order)		0,001	0,04	mA
$C_k$	Maximum possible coupling capacity (primary - secondary)			6	pF
	Mechanical stress according to M3209/3 Settings: 10-2000Hz, 1min/dek, 2 Std.			10	g

#### Inspection (Measurement after temperature balance of the samples at room temperature)

$K_N$ (SC)	(V)	M3011/6:	Transformation ratio ( $I_P=25A, 40-80Hz$ )	$5:1000 \pm 0,5$	%
$I_O$	(V)	M3226:	Offset current	< 0,1	mA
$V_d$	(V)	M3014:	Test voltage, RMS, 1s Pin 1-10 vs. Pin 11-13	1,8	kV
$V_e$	(AQL 1/S4)		Partial discharge voltage acc. to M3024	1100	$V_{RMS}$
$V_{vor}$			with $V_{vor}$	1375	

#### Type testing: (Pin 1-10 vs. Pin 11-13)

$V_W$		HV transient test acc. to M3064 (1,2 $\mu s$ / 50 $\mu s$ -Waveform) 5 pulses $\rightarrow$ polarity +, 5 pulses $\rightarrow$ polarity -		8	kV
$V_d$		Test voltage acc. to M3014	(5s)	3,6	kV
$V_e$		Partial discharge voltage acc. to M3024		1100	$V_{RMS}$
$V_{vor}$		with $V_{vor}$		1375	

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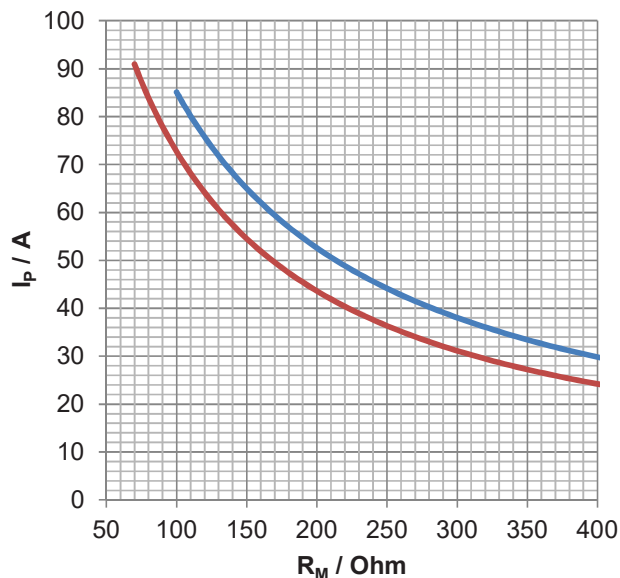
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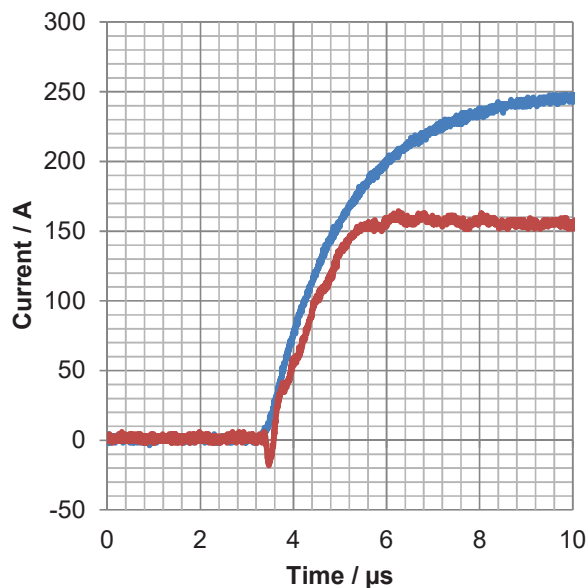
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**Limit curve of measurable current**  
 $I_p(R_M)$



—  $I_{p,max}(15V-5\%)$  —  $I_{p,max}(12V-5\%)$

**Maximum measuring range ( $\mu s$ -range)**  
Output current behaviour of a 250A current pulse



— Primärstrom — Stromsensor

Fast increasing currents (higher than the specified  $I_{p,max}$ ), e.g. in case of a short circuit, can be transmitted because the currents are transformed directly and be limited by diodes only.

### \*Possible way to reduce the Offset ripple by a Low-Pass-Filter

The offset ripple can be reduced by an external low pass. Simplest solution is a passive low pass filter of 1<sup>st</sup> order with cutoff frequency:

$$f_g = \frac{1}{2 * \pi * R_M * C_a}$$

In this case the response time is enlarged:

$$t_r' \leq t_r + 2,5R_M C_a$$

### Other instructions

- Current direction: A positive output current appears at point  $I_s$ , if primary current flows in direction of the arrow.
- Constructed, manufactured and tested in accordance with EN61800.
- Temperature of the primary conductor should not exceed 100°C.
- Housing and bobbin material UL-listed: Flammability class 94V-0.
- Further standards UL 508, file E317483, category NMTR2 / NMTR8

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#### Explanation of several terms used in the tables:

$I_{OH}$ : Zero variation after overloading with a DC of tenfold the rated value. ( $R_M=R_{MN}$ )

$I_{ot}$ : Long term drift of  $I_o$  after 100 temperature cycles in the range  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

$t_r$ : Response time, measured as a delay time at  $I_P = 0.9 * I_{Pmax}$  between a rectangular primary current and the output current.

$t_{ra}$ : Reaction time, measured as a delay time at  $I_P = 0.1 * I_{Pmax}$  between a rectangular primary current and the output current. (with  $di/dt = 100\text{A}/\mu\text{s}$ )

$U_{PD}$ : Rated discharge voltage (recurring peak voltage separated by the insulation) proved with a sinusoidal voltage  $V_e$

$$U_{PD} = \frac{\sqrt{2} * V_e}{1,5}$$

$V_{vor}$ : Defined voltage is the RMS value of a sinusoidal voltage with peak value of  $1,875 * U_{PD}$  required for partial discharge test in EN61800-5-1

$$V_{vor} = \frac{1,875 * U_{PD}}{\sqrt{2}}$$

$V_{sys}$ : System voltage: RMS value of rated voltage according to EN 61800-5-1

$V_{work}$ : Working voltage: voltage according EN 61800-5-1, which occurs by design in a circuit or across insulation.

$X_{ges}(I_{PN})$ : The sum of all possible errors over the temperature range by measuring a current  $I_{PN}$ :

$$X_{ges} = 100 * \left| \frac{I_S * (I_{PN})}{K_N * I_{PN}} - 1 \right|$$

$X$ : Permissible measurement error in the final inspection at RT, defined by

$$X = 100 * \left| \frac{I_{SB}}{I_{SN}} - 1 \right|$$

where  $I_{SB}$  is the output DC value of an input DC current of the same magnitude as the (positive) rated current ( $I_o=0$ ).

$X_{Ti}$ : Temperature drift of the rated value orientated output term.  $I_{SN}$  in a specified temperature range, obtained by:

$$X_{Ti} = 100 * \left| \frac{I_{SB}(T_{A2}) - I_{SB}(T_{A1})}{I_{SN}} \right|$$

$\epsilon_L$ : Linearity fault defined by:  $\epsilon_L = 100 * \left| \frac{I_P}{I_{PN}} - \frac{I_{Sx}}{I_{SN}} \right|$

Where  $I_P$  is any input DC current and  $I_{Sx}$  the corresponding output term. ( $I_o = 0$ ).

