

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	Ω
		$V_C = \pm 15V$	100...500	Ω
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				
	@ $V_C = \pm 12V$, $R_M = 70\Omega$ ($t_{max} = 10sec$)	± 80			A
	@ $V_C = \pm 15V$, $R_M = 100\Omega$ ($t_{max} = 10sec$)	± 85			A
X	Accuracy @ $I_P = 0A$, $T_A = 25^\circ C$		0,1	0,5	%
ϵ_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	μs
t_{ra}	Reaction time at $di/dt = 100 A/\mu s$			1	μs
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

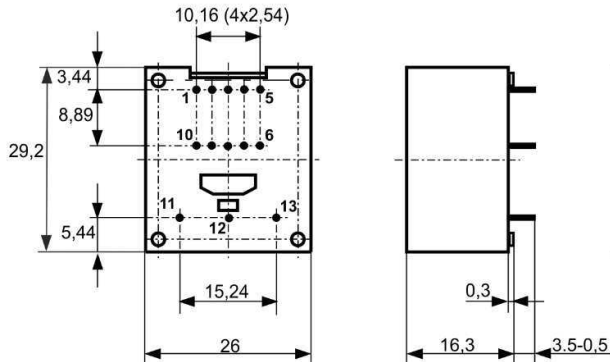
Tolerance grid distance $\pm 0,3\text{mm}$

DC = Date Code
F = Factory

Numbers 1 -13 not imprinted

Connections:

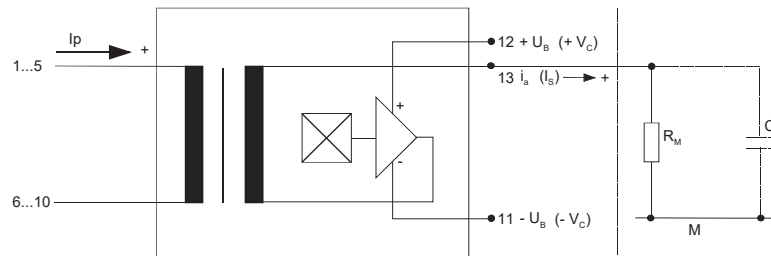
Pin Nr. 1-10: $\varnothing 1,0\text{mm}$
Pin Nr. 11-13: $0,88 \times 0,6$



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 Ω]	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			± 18	V
R_S	Secondary coil resistance @ $T_A = 85^\circ C$			63	Ω
R_P	Primary coil resistance per turn @ $T_A = 25^\circ C$			1	m Ω
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 μs / 50 μs -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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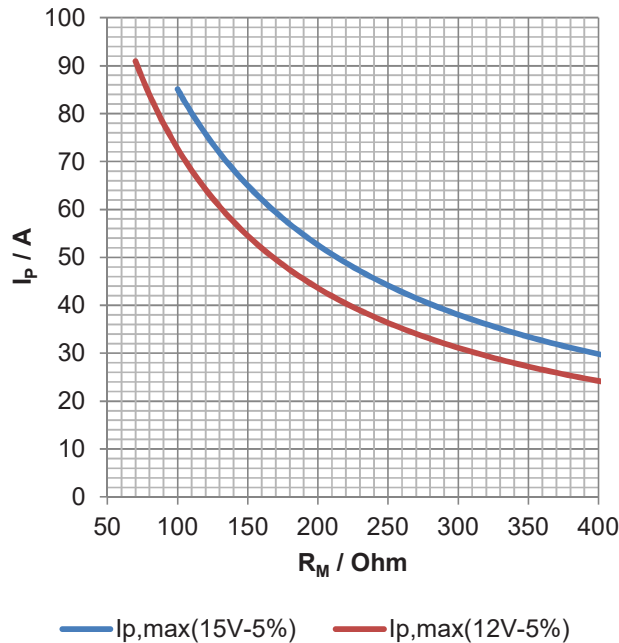
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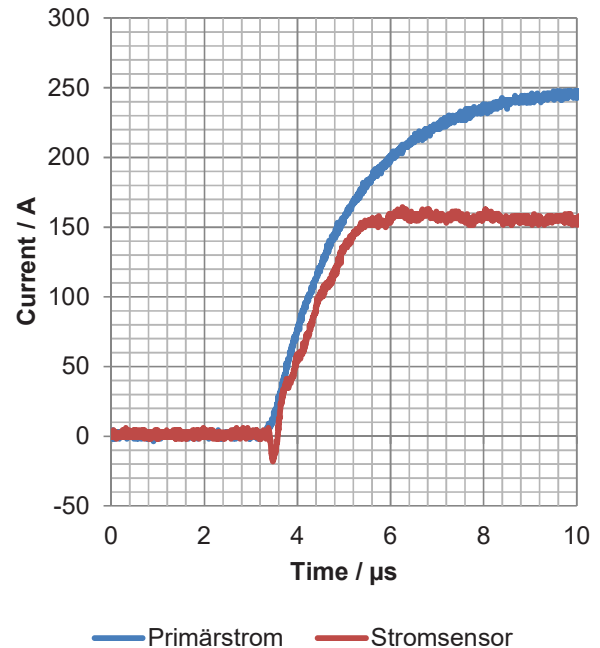
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Limit curve of measurable current
 $I_p(R_M)$



Maximum measuring range (μs -range)
Output current behaviour of a 250A current pulse



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 1st 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°C to 85°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:

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

ϵ_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. ($I_o = 0$).

