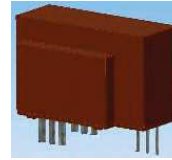


K-No.: 26392

### 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: 16.01.2023

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	$V_C = \pm 12V$	10...200	$\Omega$
		$V_C = \pm 15V$	22...400	$\Omega$
$I_{SN}$	Secondary nominal RMS current		25	mA
$K_N$	Transformation ratio		1...3:1000	

#### Accuracy – Dynamic performance data

		min.	typ.	max.	Unit
$I_{P,max}$	Max. measuring range				
	@ $V_C = \pm 12V$ , $R_M = 10\Omega$ ( $t_{max} = 10sec$ )	$\pm 120$			A
	@ $V_C = \pm 15V$ , $R_M = 22\Omega$ ( $t_{max} = 10sec$ )	$\pm 130$			A
X	Accuracy @ $I_{PN}$ , $\theta_A = 25^\circ C$		0.1	0.5	%
$\epsilon_L$	Linearity			0.1	%
$I_o$	Offset current @ $I_P = 0A$ , $\theta_A = 25^\circ C$		0.02	0.1	mA
$t_r$	Response time		500		ns
$t_{ra}$	Reaction time at $di/dt = 100 A/\mu s$		200		ns
$f_{BW}$	Frequency bandwidth	DC...200			kHz

#### General data

$\vartheta_A$	Ambient operation temperature	-40		85	$^\circ C$
$\vartheta_S$	Ambient storage temperature	-40		90	$^\circ C$
m	Mass		12		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		mA
* $S_{clear}$	Clearance (component without solder pad)	10.2			mm
* $S_{creep}$	Creepage (component without solder pad)	10.2			mm
* $U_{sys}$	System voltage			600	$V_{RMS}$
* $U_{AC}$	Working voltage			1000	$V_{RMS}$
* $U_{PD}$	Rated discharge voltage			1414	$V_S$
	Max. Potential difference acc. to UL 508			600	$V_{AC}$

\* Constructed, manufactured and tested in accordance with IEC 61800-5-1:2007 (primary to secondary)  
Reinforced insulation, Insulation material group 1, Pollution degree 2, Overvoltage category III

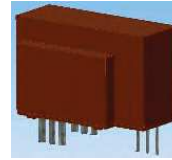
Date	Name	Issue	Amendment
16.01.2023	FS	81	Sheet 1) Typo. Response and Reaction time changed from $\mu s$ to ns. Minor change
05.03.2018	KRe	81	Sheet 4) other instruction changed ( PCBA is covered with conformal coating added). CN-18-044

Hrg.: R&D-PD NPI editor	Bearb.: DJ designer	KB-PM: Sn. check	freig.: SB released
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K-No.: 26392

### 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)



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Customers Part no:

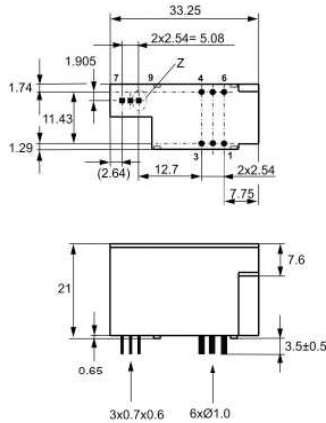
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#### Mechanical outline (mm):

General tolerances DIN ISO 2768-c

Connections:

Pin Nr. 1-6: Ø1,0mm  
Pin Nr. 7-9: 0,7 x 0,6mm



Marking:

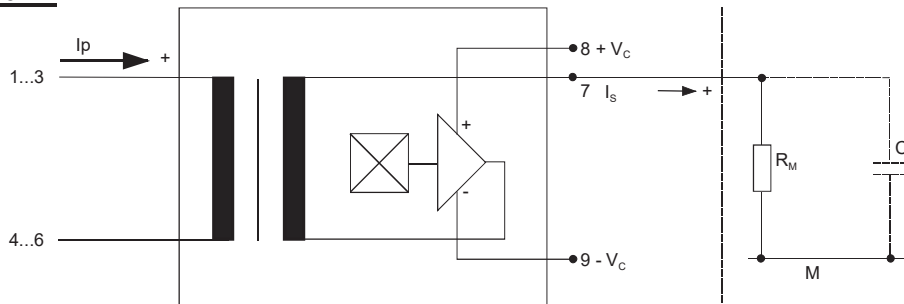
**C** **FA** **US**  
4648-X400  
F DC

Explanation:

DC = Date Code  
F = Factory

Current direction: A positive output current appears at point  $I_s$ , if primary current flows in direction of the arrow.

#### Schematic diagram:



#### Possibility of wiring for $V_C = \pm 15V$ (@ $\theta_A = 85^\circ C$ , $R_M = 22\Omega$ )

Primary-windings	Primary current RMS	Primary current peak	Output current RMS	Transformation-ratio	Primary-resistance	circuit
$N_P$	$I_P$ [A]	$\hat{I}_{P,max}$ [A]	$I_S(I_P)$ [mA]	$K_N$	$R_P$ [mΩ]	
1	25	130	25	1:1000	0,3	
2	10	65	20	2:1000	1,35	
3	8	43	24	3:1000	2,4	

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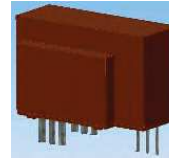
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### 25A Current Sensor

For the electronic measurement of currents:  
DC, AC, pulsed, mixed with a galvanic Isolation  
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<b>Electrical data</b> (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 @ $T_A = 85^\circ C$			88	$\Omega$
$R_P$	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 $I_P = 3 \times I_{PN}$ )		0.04	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/oct, 2 hours			10	g

#### Routine-Tests: (Measurement after temperature balance of the samples at room temperature, SC = significant characteristic)

$K_N$ (SC)	(100%) M3011/6:	Transformation ratio		$3:1000 \pm 0,5 \%$	
$I_o$	(100%) M3226:	Offset current		< 0.1	mA
$U_P$	(100%) M3014:	Test voltage, 1s		2.5	kV <sub>RMS</sub>
$U_{PDE}$	(AQL 1/S4)	Partial discharge voltage (extinction)		1.5	kV <sub>RMS</sub>
$U_{PD}^*1.875$	M3024:	*acc. table 24		1.875	kV <sub>RMS</sub>

#### Type-Tests: (Precondition acc. to M3236)

$\hat{U}_W$		HV transient test acc. table 18,19 (1,2 $\mu$ s / 50 $\mu$ s-Waveform)		8	kV
$U_P$		Test voltage acc. to M3014, 5s		5	kV <sub>RMS</sub>
$U_{PDE}$		Partial discharge voltage (extinction)		1.5	kV <sub>RMS</sub>
$U_{PD}^*1.875$		*acc. table 24		1.875	kV <sub>RMS</sub>

\*IEC 61800-5-1:2007

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editor

Bearb.: DJ  
designer

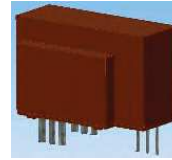
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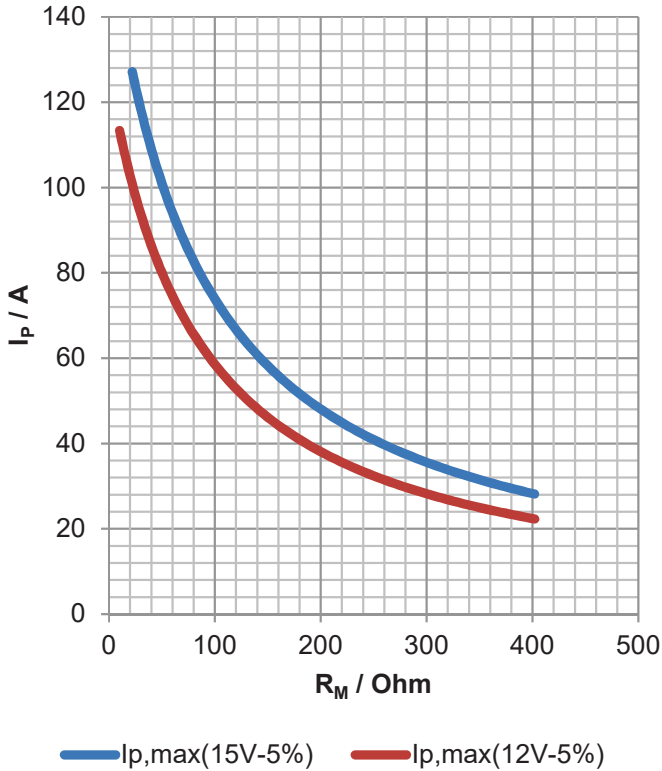
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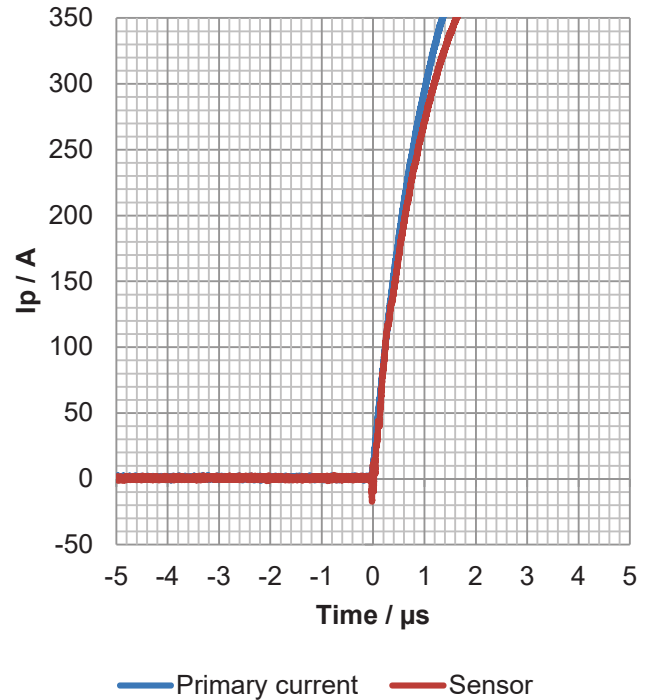
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**Limit curve of measurable current of N4648-X400**



**4648-X400, R<sub>m</sub> = 10Ω, I<sub>p</sub> = 500A**



Fast increasing currents (higher than the specified I<sub>p,max</sub>), 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

- An exceptionally high rate of on/off – switching of the power supply voltage accelerates the aging process of the sensor
- Constructed, manufactured and tested in accordance with IEC 61800-5-1:2007.
- Temperature of the primary conductor should not exceed 100°C.
- Housing and bobbin material UL-listed: Flammability class 94V-0.
- PCBA is covered with conformal coating

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editor

Bearb.: DJ  
designer

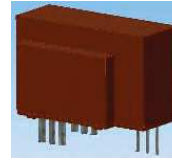
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#### Explanation of several terms used in the tables:

$I_{OH}$ : 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  $di/dt = 100\text{A}/\mu\text{s}$ )

$X_{ges}(I_{PN})$ : 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. ( $I_o = 0$ ).

