

K-No.: 24577

**1 – 5 – 8 – 12 – 25 A 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: 15.07.2010

Customer: Standard type

Customers Part no.:

Page 1 of 2

**Description**

- Closed loop (compensation) Current Sensor with magnetic field 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 r.m.s. current	25	A
$R_M$	Measuring resistance $V_C = \pm 12V$	70 ... 200	$\Omega$
	$V_C = \pm 15V$	100...400	$\Omega$
$I_{SN}$	Secondary nominal r.m.s. current	25	mA
$K_N$	Turns 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 @ $I_{PN}$ , $T_A = 25^\circ C$		0.1	0.5	%
$\epsilon_L$	Linearity			0.1	%
$I_0$	Offset current @ $I_P = 0$ , $T_A = 25^\circ C$		0.02	0.1	mA
$t_r$	Response time			1	$\mu s$
$\Delta t (I_{P,max})$	Delay time at $di/dt = 100 A/\mu s$			1	$\mu s$
f	Frequency bandwidth	DC...200			kHz

**General data**

		min.	typ.	max.	Unit
$T_A$	Ambient operating temperature	-40		+85	$^\circ C$
$T_S$	Ambient storage temperature	-40		+85	$^\circ C$
m	Mass		13,5		g
$V_C$	Supply voltage	$\pm 11.4$	$\pm 12$ or $\pm 15$	$\pm 15.75$	V
$I_C$	Current consumption at RT		17	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
$V_{work}$	Working voltage (tabel 7 acc. to EN61800-5-1)				
	overvoltage category 3	RMS		600	V
	overvoltage category 2	RMS		1020	V
$U_{PD}$	Rated discharge voltage	peak value		1000	V

**Maximal continuous and peak currents at defined temperatures**
**Supply voltage  $\pm 12V$ :**

$T_A$	50 $^\circ C$	60 $^\circ C$	70 $^\circ C$	85 $^\circ C$
$I_P$	50 A	40 A	30 A	25 A
$I_{P,max}$	83 A	82 A	81 A	80 A
$R_M$	70 $\Omega$	70 $\Omega$	70 $\Omega$	70 $\Omega$

**Supply voltage  $\pm 15V$ :**

$T_A$	50 $^\circ C$	60 $^\circ C$	70 $^\circ C$	85 $^\circ C$
$I_P$	50 A	40 A	30 A	25 A
$I_{P,max}$	88 A	87 A	86 A	85 A
$R_M$	100 $\Omega$	100 $\Omega$	100 $\Omega$	100 $\Omega$

Date	Name	Issue	Amendment
15.07.10	Le	83	Current consumption at RT max=22mA added. AA-872
27.08.09	Le	83	Glitch rejection improved, marking changed. AA-681

Hrsg.: KB-E editor	Bearb.: Le. designer			KB-PM IA: Ga. check	freig.: HS released
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Page 2 of 2

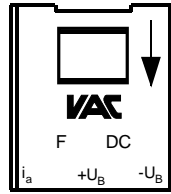
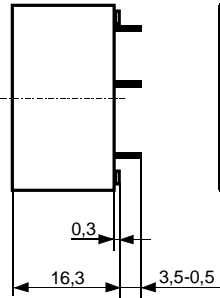
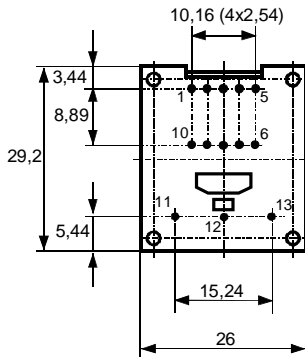
**Mechanical outline (mm):**

General tolerances DIN ISO 2768-c

Toleranz der Stiftabstände ±0,3mm  
(Tolerances grid distance)

Stift Nr.1-10 = Ø1,0  
Nr.11,12,13 = 0,88x0,60

Ziffern 1 - 13 nicht aufgedruckt  
Numbers 1 - 13 not imprinted



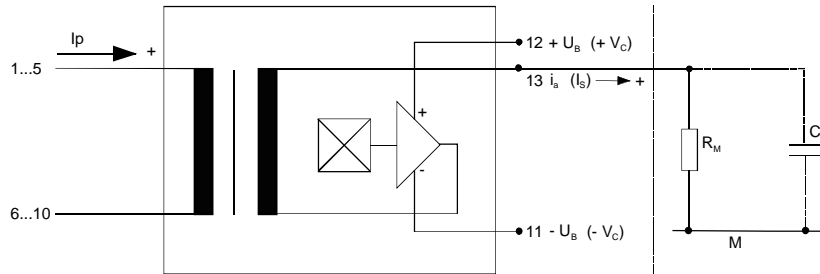
DC = Date Code  
F = Factory

Connections:

Marking:

**VAC**  
4646X300-83  
F DC

**Schematic diagram**



**Possibilities of wiring for  $V_C = \pm 15V$  (@  $T_A = 85^\circ C$ ,  $R_M = 100 \Omega$ )**

primary windings	primary current RMS	primary current maximal	output current RMS	turns ratio	primary resistance	wiring
$N_P$	$I_P$ [A]	$\hat{I}_{P,max}$ [A]	$I_S(I_P)$ [mA]	$K_N$	$R_P$ [mW]	
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	

Temperature of the primary conductor should not exceed 110°C  
Additional indications are obtainable on request.  
This specification is no declaration of warranty acc. BGB §443 dar.

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**Electrical Data (investigate by a type checking)**

		min.	typ.	max.	Unit
$V_{Ctot}$	Maximum supply voltage (without function) $\pm 15.75$ to $\pm 18$ V: for 1s per hour			$\pm 18$	V
$R_S$	Secondary coil resistance @ $T_A=85^\circ\text{C}$			63	$\Omega$
$R_p$	Primary coil resistance per turn @ $T_A=25^\circ\text{C}$			1	m $\Omega$
$X_T$	Temperature drift of X @ $T_A = -40 \dots +85^\circ\text{C}$			0.1	%
$I_{0ges}$	Offset current (including $I_0, I_{0t}, I_{0T}$ )			0.15	mA
$I_{0t}$	Long term drift Offset current $I_0$		0.05		mA
$I_{0T}$	Offset current temperature drift $I_0$ @ $T_A = -40 \dots +85^\circ\text{C}$		0.05		mA
$I_{0H}$	Hysteresis current @ $I_p=0$ (caused by primary current $3 \times I_{pN}$ )		0.03	0.1	mA
$\Delta I_0/\Delta V_C$	Supply voltage rejection ratio			0.01	mA/V
$i_{loss}$	Offset ripple* (with 1 MHz- filter first order)			0.400	mA
$i_{loss}$	Offset ripple* (with 100 kHz- filter first order)		0.025	0.100	mA
$i_{loss}$	Offset ripple* (with 20 kHz- filter first order)		0.005	0.015	mA
$C_k$	Maximum possible coupling capacity (primary – secondary)			6	pF
	Mechanical Stress according to M3209/3 Settings: 10 – 2000 Hz, 1 min/Decade, 2 hours An exceptionally high rate of on/off – switching of the supply voltage Accelerates the aging process of the sensor.			10g	

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

$K_N(N_1/N_2)$	(V)	M3011/6	Transformation ratio ( $I_p=25\text{A}$ , 40-80 Hz)	$1...5 : 1000 \pm 0,5$	%
$I_0$	(V)	M3226	Offset current	< 0.1	mA
$V_d$	(V)	M3014:	Test voltage, rms, 1 s pin 1 – 10 vs. pin 11 – 13	1.8	kV
$V_e$	(AQL 1/S4)		Partial discharge voltage acc.M3024 (RMS) with $V_{vor}$ (RMS)	1100 1375	V V

**Type Testing** (Pin 1 - 10 to Pin 11 – 13)

$V_W$			HV transient test according to M3064 (1,2 $\mu\text{s}$ / 50 $\mu\text{s}$ -wave form)	8	kV	
$V_d$			Testing voltage to M3014	(5 s)	3.6	kV
$V_e$			Partial discharge voltage acc.M3024 (RMS) with $V_{vor}$ (RMS)	1100 1375	V V	

Datum	Name	Index	Änderung
15.07.10	Le	83	Date updated.
27.08.09	Le	83	Amend only Datasheet, here Date updated. AA-681

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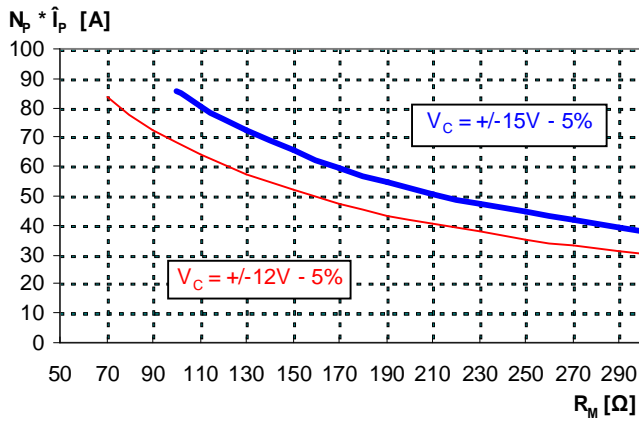
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Page 2 of 3

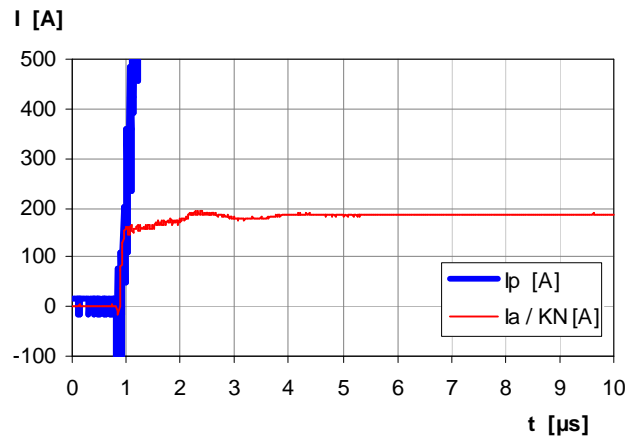
**Limit curve of measurable current  $\hat{I}_P(R_M)$**

@ ambient temperature  $\leq 85^\circ\text{C}$



**Maximum measuring range ( $\mu\text{s}$ -range)**

Output current behaviour of a 3kA current pulse  
@  $V_C = \pm 15V$  und  $R_M = 100\Omega$



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.

The offset ripple can be reduced by an external low pass. Simplest solution is a passive low pass filter of 1st order with

$$f_g = \frac{1}{2p \cdot R_M \cdot C_a}$$

In this case the response time is enlarged.

It is calculated from:

$$t'_r \leq t_r + 2,5R_M C_a$$

**Applicable documents**

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

Constructed and manufactured and tested in accordance with EN 61800.

Housing and bobbin material UL-listed: Flammability class 94V-0.

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Page 3 of 3

**Explanation of several of the terms used in the tablets (in alphabetical order)**

 I<sub>0H</sub>: Zero variation after overloading with a DC of tenfold the rated value ( $R_M = R_{MN}$ )

 I<sub>0t</sub>: Long term drift of I<sub>0</sub> after 100 temperature cycles in the range -40 bis 85 °C.

 t<sub>r</sub>: Response time, measured as delay time at I<sub>P</sub> = 0,9 · I<sub>Pmax</sub> between a rectangular current and the output current.

 Δt (I<sub>Pmax</sub>): Delay time between I<sub>Pmax</sub> and the output current i<sub>a</sub> with a primary current rise of di<sub>1</sub>/dt = 100 A/μs.

 U<sub>PD</sub> Rated discharge voltage (recurring peak voltage separated by the insulation) proved with a sinusoidal voltage V<sub>e</sub>  

$$U_{PD} = \sqrt{2} \cdot V_e / 1,5$$

 V<sub>vor</sub> Defined voltage is the RMS value of a sinusoidal voltage with peak value of 1,875 · U<sub>PD</sub> required for partial discharge test in IEC 61800-5-1

$$V_{vor} = 1,875 \cdot U_{PD} / \sqrt{2}$$

 V<sub>sys</sub> System voltage RMS value of rated voltage according to IEC 61800-5-1

 V<sub>work</sub> Working voltage voltage according to IEC 61800-5-1 which occurs by design in a circuit or across insulation

 X<sub>ges</sub>(I<sub>PN</sub>): The sum of all possible errors over the temperature range by measuring a current I<sub>PN</sub>:

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

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

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

 where I<sub>SB</sub> is the output DC value of an input DC current of the same magnitude as the (positive) rated current (I<sub>0</sub> = 0)

 X<sub>Ti</sub>: Temperature drift of the rated value orientated output term. I<sub>SN</sub> (cf. Notes on F<sub>i</sub>) in a specified temperature range, obtained by:

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

 ε<sub>L</sub>: Linearity fault defined by 
$$e_L = 100 \cdot \left| \frac{I_P}{I_{PN}} - \frac{I_{Sx}}{I_{SN}} \right|$$

 Where I<sub>P</sub> is any input DC and I<sub>Sx</sub> the corresponding output term. I<sub>SN</sub>: see notes of F<sub>i</sub> (I<sub>0</sub> = 0).

This "Additional information" is no declaration of warranty according BGB §443.

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