

K-No.: 24616

50 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: 28.01.2008

Customer: Standard type

Customers Part no.:

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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
- Low 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 – Ratings¹⁾

I_{PN}	Primary nominal r.m.s. current	50	A
R_M	Measuring resistance $V_C = \pm 12V$	10 ... 200	Ω
	$V_C = \pm 15V$	22 ... 400	Ω
I_{SN}	Secondary nominal r.m.s. current	50	mA
K_N	Turns ratio	1...3 : 1000	

Accuracy – Dynamic performance data¹⁾

		min.	typ.	max.	Unit
$I_{P,max}$	Max. measuring range				
	@ $V_C = \pm 12V, R_M = 10 \Omega (t_{max} = 10sec)$	± 112			A
	@ $V_C = \pm 15V, R_M = 22 \Omega (t_{max} = 10sec)$	± 128			A
X	Accuracy @ $I_{PN}, T_A = 25^\circ C$		0.1	0.5	%
ϵ_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		500		ns
$\Delta t (I_{P,max})$	Delay time at $di/dt = 100 A/\mu s$		200		ns
f	Frequency bandwidth	DC...200			kHz

General data¹⁾

		min.	typ.	max.	Unit
T_A	Ambient operating temperature	-40		+85	$^\circ C$
T_S	Ambient storage temperature	-40		+90	$^\circ C$
m	Mass		13.5		g
V_C	Supply voltage	± 11.4	± 12 or ± 15	± 15.75	V
I_C	Current consumption		18,5		mA
	Constructed and manufactured and tested in accordance with EN 61800-5-1 (Pin 1 - 6 to Pin 7 - 9) 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 overvoltage category 3		RMS	600	V
V_{work}	Working voltage (table 7 acc. to EN61800-5-1)		RMS	1020	V
U_{PD}	Rated discharge voltage		peak value	1400	V

Date	Name	Issue	Amendment
28.01.08	Le	81	Date changed. Insignificant

Hrsg.: KB-E editor	Bearb.: SA designer	KB-E: Le check	KB-PM: KRe. check	freig.: Heu. released
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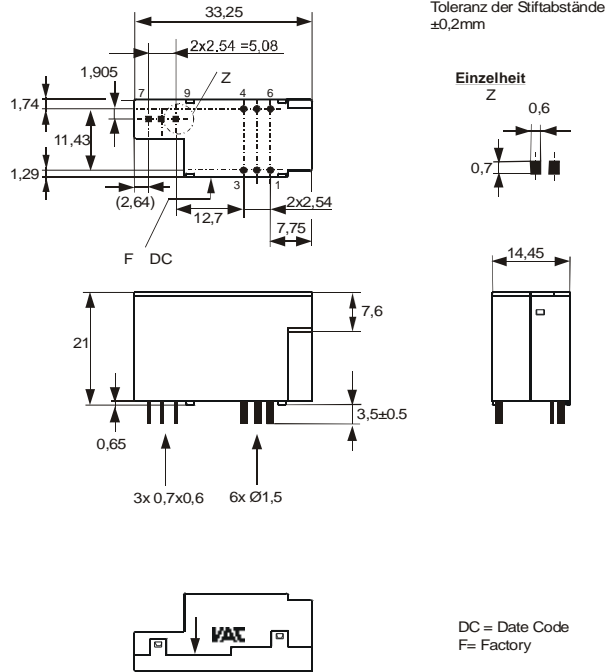
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Mechanical outline (mm):

General tolerances DIN ISO 2768-c

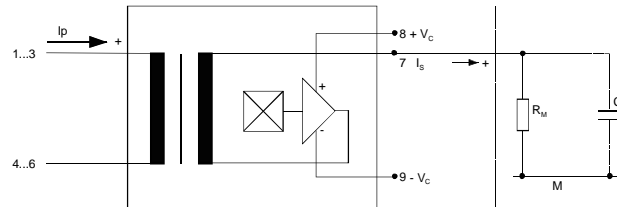


Connections:
1...6: Ø 1,5 mm
7...9: 0,6x0,7 mm

Marking:

VAC
4646X410
F DC

Schematic diagram



Possibilities of wiring for $V_c = \pm 15V$ (@ $T_A = 85^\circ C$, $R_M = 22 \Omega$)

primary windings N_P	primary current RMS I_P [A]	primary current maximal $\hat{I}_{P,max}$ [A]	output current RMS $I_S(I_P)$ [mA]	turns ratio K_N	primary resistance R_P [mW]	wiring
1	50	128	50	1:1000	0,12	
2	20	64	40	2:1000	0,54	
3	15	43	45	3:1000	1,1	

Temperature of the primary conductor should not exceed 100°C.
Additional information is 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) $\pm 15.75 \dots \pm 18$ V: for 1s per hour			± 18	V
R_S	Secondary coil resistance @ $T_A=85^\circ\text{C}$			88	Ω
R_p	Primary coil resistance per turn @ $T_A=25^\circ\text{C}$			0.36	m Ω
X_{Ti}	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 $3 \times I_{PN}$)		0.04	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)			0,15	mA
i_{loss}	Offset ripple* (with 100 kHz- filter first order)		0.03	0.05	mA
i_{loss}	Offset ripple* (with 20 kHz- filter first order)		0.007	0.01	mA
C_k	Maximum possible coupling capacity (primary – secondary)		4		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 ($I_p=3*10A, 40-80$ Hz)	$1 \dots 3 : 1000 \pm 0.5$ %
I_0	(V)	M3226	Offset current	< 0.1 mA
$V_{P,eff}$	(V)	M3014	Test voltage, rms, 1s Pin 1 - 6 to Pin 7 - 9	2.5 kV
V_e	(AQL 1/S4)		Partial discharge voltage acc. M3024 (RMS) with V_{vor} (RMS)	1500 V 1875 V

Type Testing (Pin 1 - 6 to Pin 7 – 9)

Designed according standard EN 61800 with insulation material group 1

V_W	HV transient test according (to M3064) (1,2 μs / 50 μs -wave form)			8	kV
V_d	Testing voltage acc. M3014 (RMS)		(5 s)	5	kV
V_e	Partial discharge voltage acc. M3024 (RMS) with V_{vor} (RMS)			1500 1875	V V

Datum	Name	Index	Änderung
28.01.08	Le	81	Page 3: write error in X_{ges} (I_{PN}). changed. Insignificant

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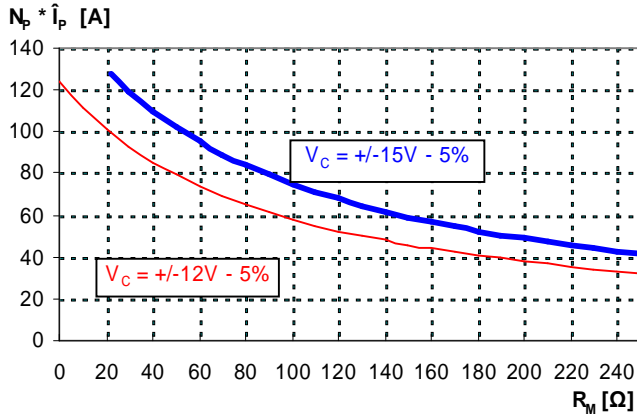
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ME

- A=km
- 1=St
- 2=kg
- 3=g
- 4=l
- 5=m
- 6=m²
- 7=m³
- 3=mm
- 3:Paar

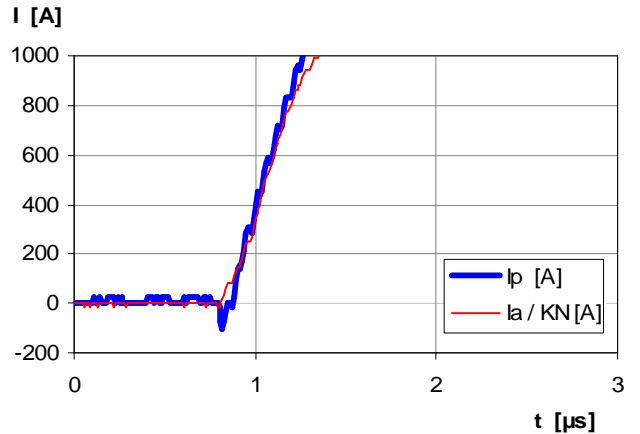
Limit curve of measurable current $\hat{I}_p(R_M)$

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



Maximum measuring range (μs-range)

Output current behaviour of a 3kA current pulse
@ $V_C = \pm 15\text{V}$ und $R_M = 25\Omega$



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.

Offsetripple reduction

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

ME

A=km
1=St
2=kg
3=g
4=l
5=m
6=m²
7=m³
8=mm
9:Paar

I_{0H} : Zero variation of I_o after overloading with a DC of tenfold the rated value ($R_M = R_{MN}$)

I_{0t} : Long term drift of I_o after 100 temperature cycles in the range -40 bis 85 °C.

t_r : Response time (describe the dynamic performance for the specified measurement range), measured as delay time at $I_P = 0,9 \cdot I_{Pmax}$ between a rectangular current and the output current.

$\Delta t (I_{Pmax})$: Delay time (describe the dynamic performance for the rapid current pulse rate e.g short circuit current) measured between I_{Pmax} and the output current i_a with a primary current rise of $di_1/dt = 100 A/\mu s$.

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

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

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_{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} (cf. Notes on F_i) 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_L : Linearity fault defined by $e_L = 100 \cdot \left| \frac{I_P}{I_{PN}} - \frac{I_{Sx}}{I_{SN}} \right| \%$

Where I_P is any input DC and I_{Sx} the corresponding output term. I_{SN} : see notes of F_i ($I_o = 0$).

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