

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.:

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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
- 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
- Uninterruptible 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 | Ω |
| | $V_C = \pm 15V$ | 100...400 | Ω |
| 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 | | | | |
| | @ $V_C = \pm 12V$, $R_M = 70 \Omega$ ($t_{max} = 10sec$) | ± 80 | | | A |
| | @ $V_C = \pm 15V$, $R_M = 100 \Omega$ ($t_{max} = 10sec$) | ± 85 | | | 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 | | | 1 | μs |
| $\Delta t (I_{P,max})$ | Delay time at $di/dt = 100 A/\mu s$ | | | 1 | μs |
| 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 | ± 11.4 | ± 12 or ± 15 | ± 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) | | | | 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 Ω | 70 Ω | 70 Ω | 70 Ω |

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 Ω | 100 Ω | 100 Ω | 100 Ω |

| 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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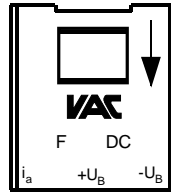
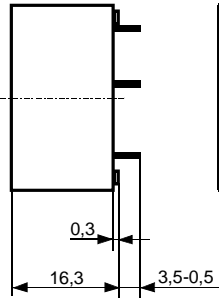
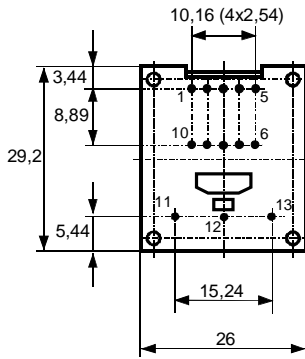
Mechanical outline (mm):

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



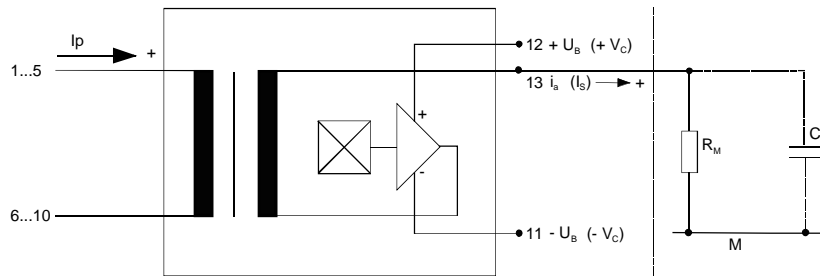
DC = Date Code
F = Factory

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) ± 15.75 to ± 18 V: for 1s per hour | | | ± 18 | V |
| R_S | Secondary coil resistance @ $T_A=85^\circ\text{C}$ | | | 63 | Ω |
| R_p | Primary coil resistance per turn @ $T_A=25^\circ\text{C}$ | | | 1 | m Ω |
| 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 μs / 50 μs -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 | Hrsg.: KB-E editor | Bearb.: Le designer | KB-PM IA KRe. check | freig.: HS released |
|----------|------|-------|---|-----------------------|------------------------|------------------------|------------------------|
| 15.07.10 | Le | 83 | Date updated. | | | | |
| 27.08.09 | Le | 83 | Amend only Datasheet, here Date updated. AA-681 | | | | |

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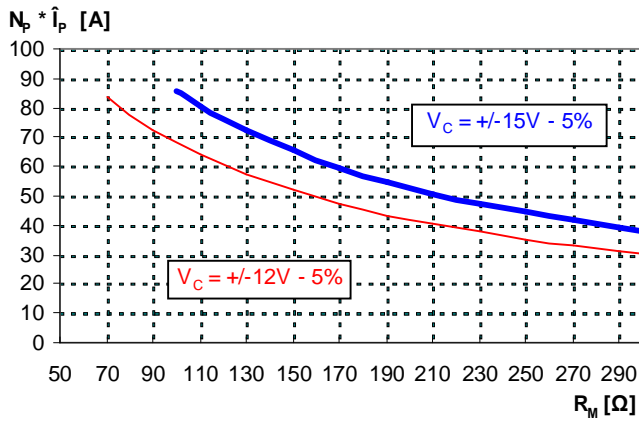
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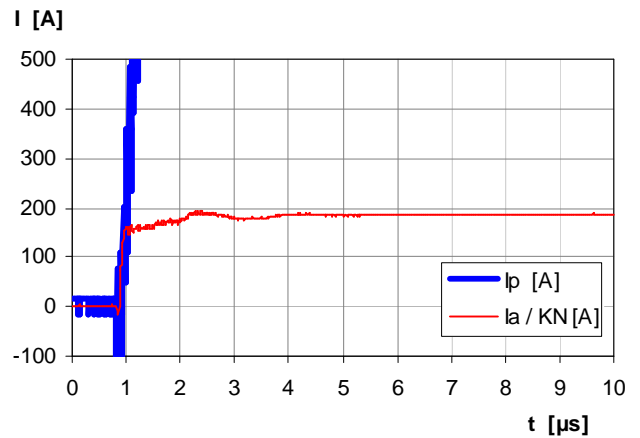
Limit curve of measurable current $\hat{I}_P(R_M)$

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



Maximum measuring range (μs-range)

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



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

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

I_{0t} : Long term drift of I_0 after 100 temperature cycles in the range -40 bis 85 °C.

t_r : Response time, 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 between I_{Pmax} and the output current i_a with a primary current rise of $di_1/dt = 100 A/\mu s$.

U_{PD} Rated discharge voltage (recurring peak voltage separated by the insulation) proved with a sinusoidal voltage V_e
 $U_{PD} = \sqrt{2} \cdot V_e / 1,5$

V_{vor} Defined voltage is the RMS value of a sinusoidal voltage with peak value of $1,875 \cdot U_{PD}$ required for partial discharge test in IEC 61800-5-1

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

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

V_{work} Working voltage voltage according to IEC 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} :

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

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 ($I_0 = 0$)

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 ($I_0 = 0$).

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

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