

K-No.: 25459

**100 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: 05.02.2013

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 variabel 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       | 100        | A        |
| $R_M$    | Measuring resistance $V_C = \pm 12V$ | 10 ... 200 | $\Omega$ |
|          | $V_C = \pm 15V$                      | 40 ... 400 | $\Omega$ |
| $I_{SN}$ | Secondary nominal r.m.s. current     | 100        | mA       |
| $K_N$    | Turns ratio                          | 1: 1000    |          |

**Accuracy – Dynamic performance data**

|                        |                                                             | min.      | typ. | max. | Unit    |
|------------------------|-------------------------------------------------------------|-----------|------|------|---------|
| $I_{P,max}$            | Max. measuring range                                        |           |      |      |         |
|                        | @ $V_C = \pm 12V$ , $R_M = 10 \Omega$ ( $t_{max} = 10sec$ ) | $\pm 230$ |      |      | A       |
|                        | @ $V_C = \pm 15V$ , $R_M = 40 \Omega$ ( $t_{max} = 10sec$ ) | $\pm 180$ |      |      | A       |
| X                      | Accuracy @ $I_{PN}$ , $T_A = 25^\circ C$                    |           | 0.1  | 0.5  | %       |
| $\epsilon_L$           | Linearity                                                   |           |      | 0.1  | %       |
| $I_0$                  | Offset current @ $I_P = 0$ , $T_A = 25^\circ C$             |           | 0.04 | 0.1  | mA      |
| $t_r$                  | Response time                                               |           | 1    |      | $\mu s$ |
| $\Delta t (I_{P,max})$ | Delay time at $di/dt = 100 A/\mu s$                         |           | 200  |      | ns      |
| 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        |                      | +90         | $^\circ C$ |
| m           | Mass                                                                                                                                                                      |            | 14                   |             | g          |
| $V_C$       | Supply voltage                                                                                                                                                            | $\pm 11.4$ | $\pm 12$ or $\pm 15$ | $\pm 15.75$ | V          |
| $I_C$       | Current consumption                                                                                                                                                       |            | 18                   |             | mA         |
|             | Constructed and manufactured and tested in accordance with EN 61800-5-1 (primary vs. secondary)<br>Reinforced insulation, Insulation material group 1, Pollution degree 2 |            |                      |             |            |
| $S_{clear}$ | Clearance (component without solder pad)                                                                                                                                  | 12         |                      |             | mm         |
| $S_{creep}$ | Creepage (component without solder pad)                                                                                                                                   | 12         |                      |             | mm         |
| $V_{sys}$   | System voltage                                                                                                                                                            |            |                      | 600         | V          |
| $V_{work}$  | Working voltage                                                                                                                                                           |            |                      |             |            |
|             | (table 7 acc. to EN61800-5-1)                                                                                                                                             |            |                      |             |            |
|             | over voltage category 2                                                                                                                                                   | RMS        |                      | 1000        | V          |
| $U_{PD}$    | Rated discharge voltage                                                                                                                                                   | peak value |                      | 1225        | V          |

**Maximal continuous and peak currents at defined temperatures**

Supply voltage  $\pm 12V$ :

Supply voltage  $\pm 15V$ :

|             |               |               |               |               |
|-------------|---------------|---------------|---------------|---------------|
| $T_A$       | 85 $^\circ C$ | 85 $^\circ C$ | 70 $^\circ C$ | 55 $^\circ C$ |
| $I_P$       | 60 A          | 100 A         | 80 A          | 100 A         |
| $I_{P,max}$ | 235 A         | 149 A         | 241 A         | 246 A         |
| $R_M$       | 10 $\Omega$   | 36 $\Omega$   | 10 $\Omega$   | 10 $\Omega$   |

|             |               |               |               |               |
|-------------|---------------|---------------|---------------|---------------|
| $T_A$       | 85 $^\circ C$ | 85 $^\circ C$ | 70 $^\circ C$ | 55 $^\circ C$ |
| $I_P$       | 50 A          | 100 A         | 100 A         | 100 A         |
| $I_{P,max}$ | 182 A         | 129 A         | 161 A         | 186 A         |
| $R_M$       | 40 $\Omega$   | 70 $\Omega$   | 50 $\Omega$   | 40 $\Omega$   |

| Date                  | Name                   | Issue | Amendment                                                                                                     |
|-----------------------|------------------------|-------|---------------------------------------------------------------------------------------------------------------|
| 05.02.13              | Le                     | 81    | Mechanical outline changed (the reference line at the standoff is just a bit down-eccentric). Lapidary change |
|                       |                        |       |                                                                                                               |
| Hrsg.: KB-E<br>editor | Bearb.: Le<br>designer |       | KB-PM KRe.<br>check                                                                                           |
|                       |                        |       | freig.: HS<br>released                                                                                        |

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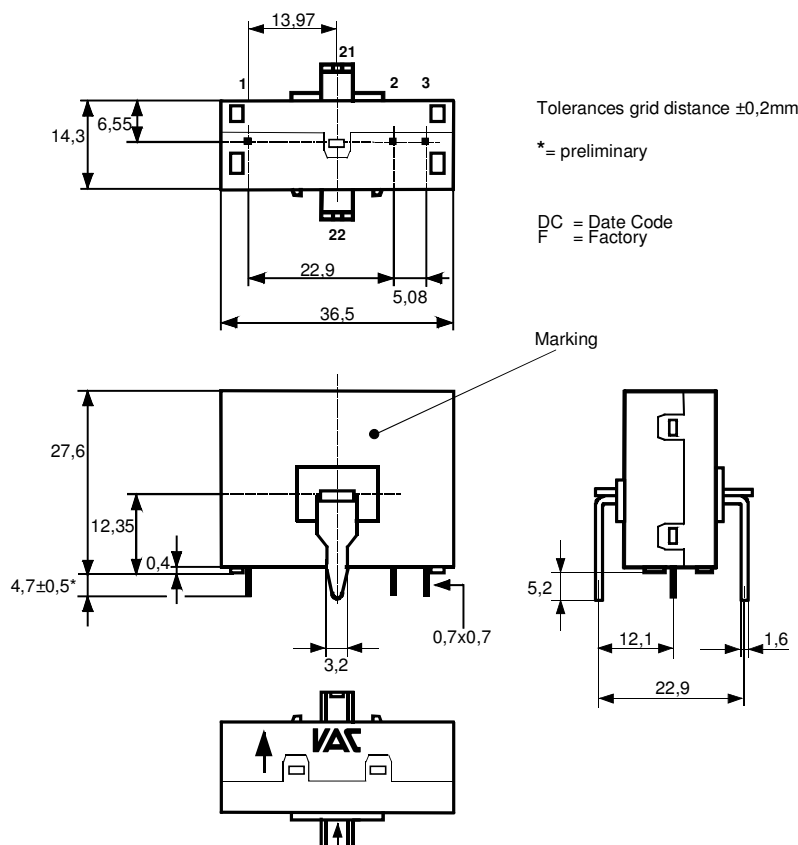
**Date:** 05.02.2013

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**Mechanical outline (mm):**

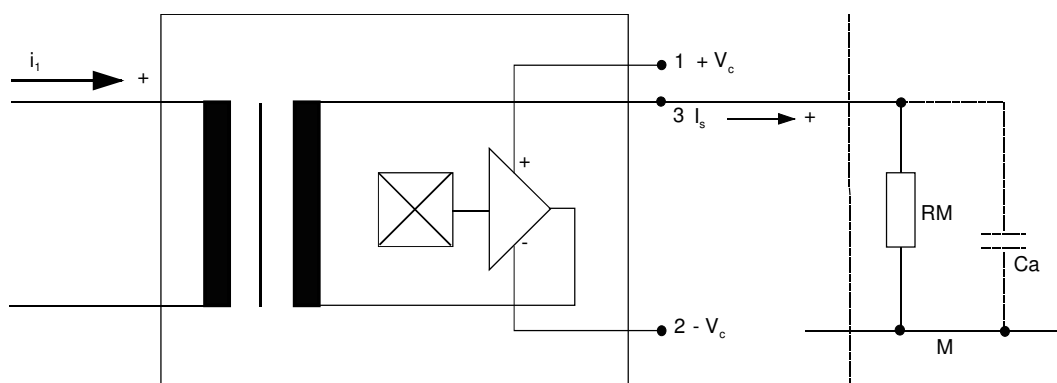
General tolerances DIN ISO 2768-c


**Connections:**

1...3: 0,7 x 0,7 mm

**Marking:**

 4646X112  
 F DC

**Schematic diagram**


Temperature of the primary conductor should not exceed 100 °C  
 Additional indications are obtainable on request.  
 This specification is no declaration of warranty acc. BGB §443 dar.

**Hrsg.:** KB-E  
 editor

**Bearb.:** Le  
 designer

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

|                         |                                                                                         | min. | typ.  | max.     | Unit       |
|-------------------------|-----------------------------------------------------------------------------------------|------|-------|----------|------------|
| $V_{Ctot}$              | Maximum supply voltage (without function)<br>$\pm 15.75$ to $\pm 18$ V: for 1s per hour |      |       | $\pm 18$ | V          |
| $R_S$                   | Secondary coil resistance @ $T_A=85^\circ\text{C}$                                      |      |       | 38.5     | $\Omega$   |
| $R_P$                   | Primary resistance @ $T_A=25^\circ\text{C}$                                             |      | 0,1   |          | m $\Omega$ |
| $X_{Ti}$                | Temperature drift of X @ $T_A = -40 \dots +85^\circ\text{C}$                            |      |       | 0.1      | %          |
| $I_{0ges}$              | Offset current (including $I_0$ , $I_{0t}$ , $I_{0T}$ )                                 |      |       | 0.14     | 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 $10 \times I_{PN}$ )            |      | 0.05  | 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)                                          |      |       | 0.2      | mA         |
| $i_{loss}$              | Offset ripple (with 100 kHz- filter first order)                                        |      | 0.04  | 0.075    | mA         |
| $i_{loss}$              | Offset ripple (with 20 kHz- filter first order)                                         |      | 0.015 | 0.025    | mA         |
| $C_K$                   | Maximum possible coupling capacity (primary – secondary)                                |      | 6     |          | pF         |

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

|                |            |         |                                                                   |                       |        |
|----------------|------------|---------|-------------------------------------------------------------------|-----------------------|--------|
| $K_N(N_1/N_2)$ | (V)        | M3011/6 | Transformation ratio ( $I_P=100\text{A}$ , 40-80 Hz)              | $1 : 1000 \pm 0,5 \%$ |        |
| $I_0$          | (V)        | M3226   | Offset current                                                    | $< 0.1$               | mA     |
| $V_d$          | (V)        | M3014:  | Test voltage, rms, 1 s<br>pin 1 – 3 vs. hole                      | 1.8                   | kV     |
| $V_e$          | (AQL 1/S4) |         | Partial discharge voltage acc.M3024 (RMS)<br>with $V_{vor}$ (RMS) | 1300<br>1625          | V<br>V |

### Type Testing (Pin 1 - 3 to hole)

|       |  |  |                                                                                        |              |        |
|-------|--|--|----------------------------------------------------------------------------------------|--------------|--------|
| $V_W$ |  |  | 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)<br>with $V_{vor}$ (RMS)                      | 1300<br>1625 | V<br>V |

|                       |                       |       |                         |
|-----------------------|-----------------------|-------|-------------------------|
| Datum                 | Name                  | Index | Änderung                |
| 05.02.13              | Le                    | 81    | Date updated.           |
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|                       |                       |       | freig.: HS<br>released  |

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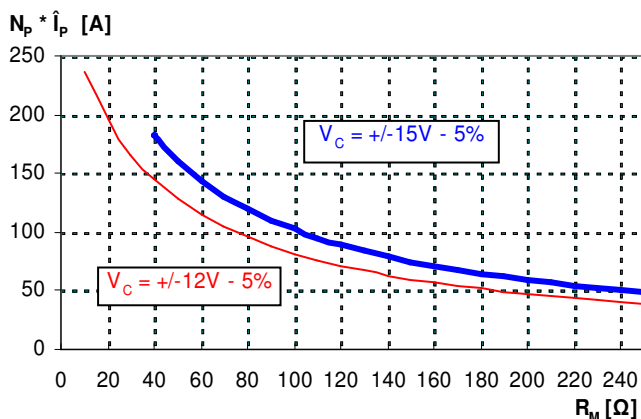
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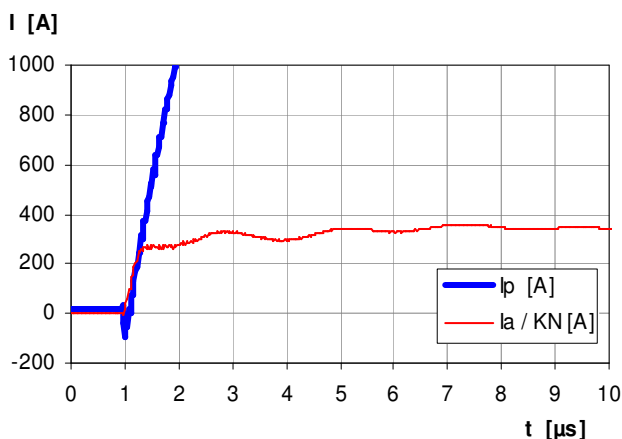
#### Limit curve of measurable current $\hat{I}_p(R_M)$

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



#### Maximum measuring range (μs-range)

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

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

In this case the response time is enlarged.

It is calculated from:

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

#### Applicable documents

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

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  $I_P = 0,8 \cdot I_{Pmax}$  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  $di_1/dt = 100 \text{ A}/\mu\text{s}$ .

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

$V_{vor}$  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  $I_{PN}$ :

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

$X$ : 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:

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

$\epsilon_L$ : Linearity fault defined by  $\epsilon_L = 100 \cdot \left| \frac{I_P}{I_{PN}} - \frac{I_{Sx}}{I_{SN}} \right|$

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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