

K-no.:

**50 A Current Sensor-Module**

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: 24.02.2014

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
- Low response time
- Wide frequency bandwidth
- Compact design

**Applications**

Mainly used for stationary operation in industrial  
applications:

- AC variabel speed drives and servo motor  
drives
- Static converters for 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   | 50         | A        |
| $R_M$    | Measuring resistance             | 15 ... 200 | $\Omega$ |
| $I_{SN}$ | Secondary nominal r.m.s. current | 25         | mA       |
| $K_N$    | Turns ratio                      | 1 : 2000   |          |

**Accuracy – Dynamic performance data**

|                        |                                             | min.     | typ. | max. | Unit    |
|------------------------|---------------------------------------------|----------|------|------|---------|
| $I_{P,max}$            | Max. measuring range @ $R_M=15 \Omega$      | -165     |      | +165 | 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 | 0,05 | mA      |
| $t_r$                  | Response time                               |          |      | 3    | $\mu s$ |
| $\Delta t (I_{P,max})$ | Delay time at $di/dt = 100 A/\mu s$         |          |      | 1    | $\mu s$ |
| $f$                    | Frequency bandwidth                         | DC...100 |      |      | 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                                             |             |          | 30          | g          |
| $V_C$ | Supply voltage                                   | $\pm 14,25$ | $\pm 15$ | $\pm 15,75$ | V          |
| $I_C$ | Current consumption                              |             |          | 18          | mA         |
| $V_b$ | Rated voltage acc. to EN50178                    |             |          |             |            |
|       | Reinforced insulation                            |             |          |             |            |
|       | Insulation material group 1, Pollution degree 2, |             |          |             |            |
|       | Rated voltage: Mains supply (effective)          |             | 600      | V           |            |
|       | Non Mains supply (DC)                            |             | 800      | V           |            |
|       | Creepage and clearance distance                  |             | 8        | mm          |            |

**Max.duration of peak currents at defined temperatures**

|             |     |     |     |            |
|-------------|-----|-----|-----|------------|
| $T_A$       | 50  | 70  | 85  | $^\circ C$ |
| $I_P$       | 120 | 100 | 50  | A          |
| $I_{P,max}$ | 165 | 165 | 160 | A          |
| $R_M$       | 15  | 15  | 20  | $\Omega$   |

All data marked with \* is verified by final inspection, other values are typetested.

| Date     | Name | Issue | Amendment                                               |
|----------|------|-------|---------------------------------------------------------|
| 24.02.14 | KRe. | 84    | Marking changed acc to UL. 4644X101 → 4644-X101. CN-848 |
| 07.08.13 | KRe. | 84    | Mechanical outline: marking with UL-sign. CN-635        |

|                       |                         |                      |                        |
|-----------------------|-------------------------|----------------------|------------------------|
| Hrsg.: KB-E<br>editor | Bearb.: Le.<br>designer | KB-PM: KRe.<br>check | freig.: HS<br>released |
|-----------------------|-------------------------|----------------------|------------------------|

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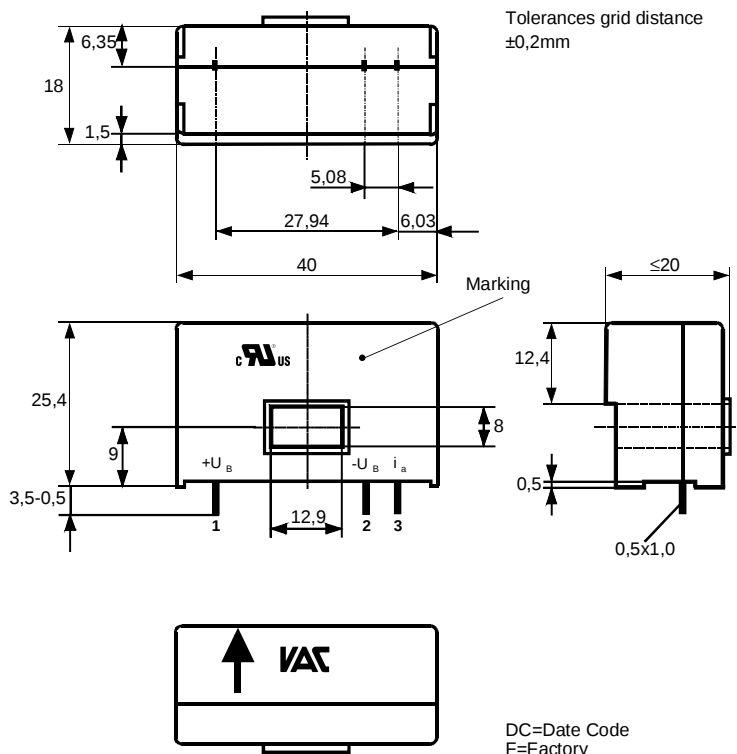
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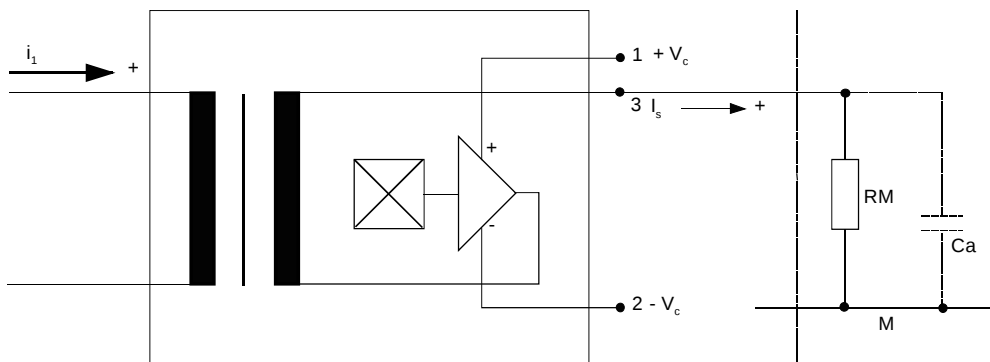
**Customers Part no.:**
**Page** 2 **of** 2

**Mechanical outline (mm):**

General tolerances DIN ISO 2768-c

**Connections:**

**Marking:**

 UL-sign  
 4644-X101  
 F DC

**Schematic diagram**

 Additional indications are obtainable on request.  
 This specification is no declaration of warranty acc. BGB §443 dar.

 Hrsg.: KB-E  
 editor

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 designer

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### Electrical Data

|                           |                                                                                         | min. | typ. | max.     | Unit     |
|---------------------------|-----------------------------------------------------------------------------------------|------|------|----------|----------|
| $V_{Ctot}$                | Maximum supply voltage (without function)                                               |      |      | $\pm 18$ | V        |
| $R_S$                     | Secondary coil resistance @ $T_A = 85^\circ\text{C}$                                    |      |      | 120      | $\Omega$ |
| $X_{Ti}$                  | Temperature drift of X @ $T_A = -40 \dots +85^\circ\text{C}$                            |      |      | 0,1      | %        |
| $I_{0ges}$                | Offset current (including $I_0$ , $I_{0T}$ , $I_{0H}$ )                                 |      |      | 0,05     | mA       |
| $I_{0T}$                  | Offset current drift $I_0$                                                              |      |      | 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 @ $I_P = 0$ ,<br>caused by primary current $3 \times I_{PN}$         |      |      | 0,075    | mA       |
| $i_{oss}$                 | Offset ripple                                                                           |      |      | 1        | mA       |
| $\Delta I_0 / \Delta V_C$ | Supply voltage rejection ratio                                                          |      |      | 0,01     | mA/V     |
| $C_k$                     | Maximum possible coupling capacity<br>primary – secondary                               |      |      | 9        | pF       |
|                           | Mechanical Stress according to M3209/3<br>Settings: 10 – 2000 Hz, 1 min/Oktave, 2 hours |      |      | 2g       |          |

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

|                 |     |          |                                                         |                         |
|-----------------|-----|----------|---------------------------------------------------------|-------------------------|
| $K_N (N1/N2)^*$ | (V) | M3011/6: | Transformation ratio ( $I_1 = 5A$ , 40-80 Hz)           | $= 1 : 2000 \pm 0,5 \%$ |
| $I_0^*$         | (V) | M3226:   | Offset current                                          | $< 0,05$ mA             |
| $V_d^*$         | (V) | M3014:   | Test voltage, rms, 1s<br>Pin 1 - 3 to Primary conductor | 3 kV                    |

### Type Testing

|                                                                      |            |                                                         |
|----------------------------------------------------------------------|------------|---------------------------------------------------------|
| <u>HV transient test according to M3064</u>                          | Settings : | $V_{d,max} = 8$ kV                                      |
| Pin 1 - 3 to Primary conductor                                       |            | $R_i = 60 \Omega$                                       |
|                                                                      |            | 1,2 $\mu\text{s}$ / 50 $\mu\text{s}$ -waveform          |
|                                                                      |            | 3 in a cycle of $t = 10$ seconds with changing polarity |
| <u>Test voltage and partial discharge voltage according to M3024</u> | $V_d =$    | 4,4 kV 60s                                              |
| Pin 1 - 3 to Primary conductor                                       | $V_e \geq$ | 1,0 kV                                                  |

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| Datum                 | Name                   | Index | Änderung                                                                        |
|-----------------------|------------------------|-------|---------------------------------------------------------------------------------|
| 24.02.14              | KRe                    | 84    | Date updated. CN-848                                                            |
| 07.08.13              | KRe.                   | 84    | Applicable documents: UL-File E169271 added. VDE-registration cancelled. ÄA-635 |
| Hrsg.: KB-E<br>editor | Bearb: Le.<br>designer |       | KB-PM: KRe.<br>check                                                            |
|                       |                        |       | freig.: HS<br>released                                                          |

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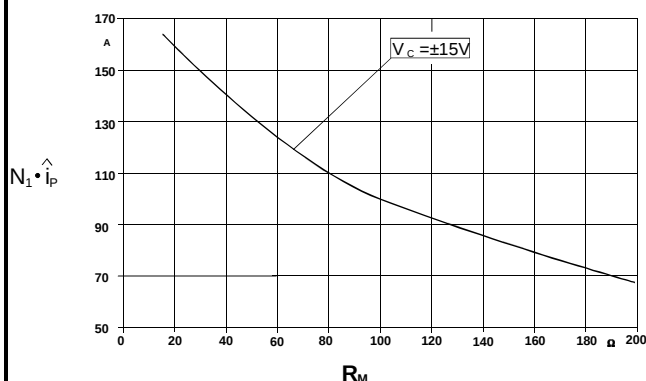
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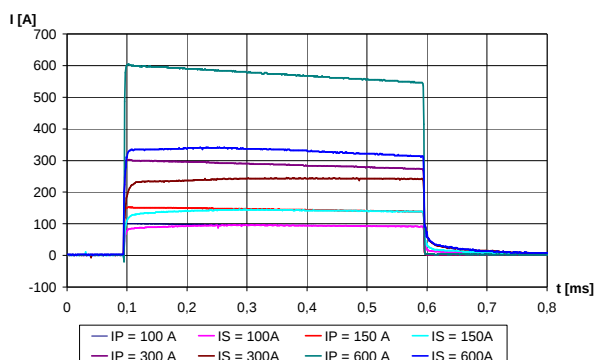
### Limit curve of measurable current $\hat{I}_p(R_M)$

@ temperature of the component  $\leq 85^\circ\text{C}$  turns ratio 1 : 2000



### Maximum measuring range (µs-range)

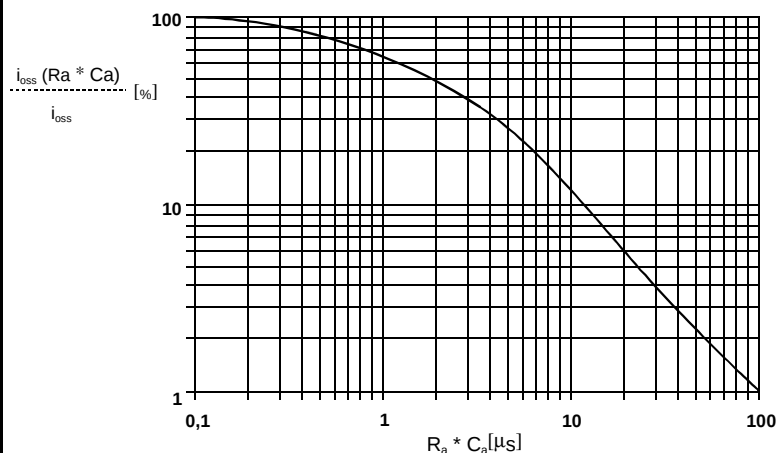
Pulse behaviour at pulse duration= 500µs



The value for  $I_{p,max}$  indicated in the Specification is valid for currents from a few ms on. For shorter duration (e.g. short circuit current) the currents are transformed directly and can therefore be higher than  $I_{p,max}$ . This will curtail the accuracy but can be used for kick-offs.

### Example : Avariable Offset ripple reduction means a low pass

The offset ripple can be reduced by an external low pass. Therefore a capacitance  $C_a$  must be switched parallel to  $R_M$ . The diagram shows the remaining value of the offset ripple ( $i_{oss}(R_M \cdot C_a)$ ) relative to the value without external capacitance ( $i_{oss}$ ). In this case the response time is lengthened. It is calculated for :



$$t_r' \leq t_r + 2,5 \cdot R_M \cdot C_a \text{ bzw. } f_g = \frac{1}{2\pi \cdot R_M \cdot C_a}$$

### Applicable documents

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

Constructed, manufactured and tested in accordance with EN 50178 (VDE 0160) and agrees with the standards.

Enclosures according to IEC529: IP50.

UL - file E169271, category XORU2 (transformers, construction only - component), UL 508

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designer

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

$X_{ges}(I_{PN})$ : 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  $I_{SB}$  ist he output DC value of an input DC current of the same magnitude as the (positive) rated current ( $I_0 = 0$ )

$\epsilon_L$ : 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  $F_i$  ( $I_0 = 0$ ).

$X_{Ti}$ : Temperature drift of the rated value orientated output term.  $I_{SN}$  (cf. Notes on  $F_i$ ) in a specified temperature range, obtained by:

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

$I_{0H}$ : Zero variation after overloading with a DC of fourfold 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  $di_1/dt = 100 \text{ A}/\mu\text{s}$ .

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