**Vacuum Switch**

**Specification**

**Item No.:** T60404-P4640-X102

**K-No.:** 26333

1000 A Current Sensor for ±15V- Supply Voltage

for electric current measurement:
DC, AC, pulsed, mixed ..., with a galvanic isolation between primary circuit (high power) and secondary circuit (electronic circuit)

**Customer:** Standard Type

**Customer part no.:**

**Page 1 of 6**

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**Electrical data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Einheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{PN}$</td>
<td></td>
<td></td>
<td>1000</td>
<td>A</td>
</tr>
<tr>
<td>$R_M$</td>
<td></td>
<td></td>
<td>0...100</td>
<td>Ω</td>
</tr>
<tr>
<td>$I_{SN}$</td>
<td></td>
<td></td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td>$K_N$</td>
<td></td>
<td></td>
<td>(1): 5000</td>
<td></td>
</tr>
</tbody>
</table>

$^1$ connected to sensor output, $R_M$ for $I_{P,max}$ see fig. 1 on page 2

**Accuracy – Dynamic performance data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Einheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{P,max}$</td>
<td></td>
<td></td>
<td>1580</td>
<td>A</td>
</tr>
<tr>
<td>$X$</td>
<td></td>
<td></td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>$\varepsilon_L$</td>
<td></td>
<td></td>
<td>0.4</td>
<td>%</td>
</tr>
<tr>
<td>$I_0$</td>
<td></td>
<td></td>
<td>0.1</td>
<td>mA</td>
</tr>
<tr>
<td>$I_{OH}$</td>
<td></td>
<td></td>
<td>0.1</td>
<td>mA</td>
</tr>
<tr>
<td>$t_r$</td>
<td></td>
<td></td>
<td>&lt;1</td>
<td>μs</td>
</tr>
<tr>
<td>$t_{ra}$</td>
<td></td>
<td></td>
<td>1</td>
<td>μs</td>
</tr>
<tr>
<td>$f_{BW}$</td>
<td></td>
<td></td>
<td>DC...100</td>
<td>kHz</td>
</tr>
</tbody>
</table>

$^2$currents with high slew rates can be measured above $I_{P,max}$ (transformer behavior)

**General data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Einheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\delta_A$</td>
<td>-40</td>
<td>-</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>$\delta_S$</td>
<td>-40</td>
<td>-</td>
<td>+85</td>
<td>°C</td>
</tr>
<tr>
<td>$m$</td>
<td>550</td>
<td>-</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>$U_C$</td>
<td>±13.50</td>
<td>±15</td>
<td>±15.75</td>
<td>V</td>
</tr>
<tr>
<td>$I_{C0}$</td>
<td>27</td>
<td>-</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>$I_{CN}$</td>
<td>190</td>
<td>-</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>$S_{clear}$</td>
<td>20</td>
<td>-</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>$S_{creep}$</td>
<td>20</td>
<td>-</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>$U_{sys}$</td>
<td>1000</td>
<td>-</td>
<td>$V_{RMS}$</td>
<td></td>
</tr>
<tr>
<td>$U_{AC}$</td>
<td>1000</td>
<td>-</td>
<td>$V_{RMS}$</td>
<td></td>
</tr>
<tr>
<td>$U_{PD}$</td>
<td>1414</td>
<td>-</td>
<td>$V_{peak}$</td>
<td></td>
</tr>
</tbody>
</table>

Max. potential difference acc. to UL 508

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**Notes:**

- Constructed and manufactured and tested in accordance with EN 61800-5-1:2007 (Pin 1 - 4 to primary opening)
- Reinforced insulation, Insulation material group 1, Pollution degree 2, Overvoltage category III
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**Date:** 16.01.2017

**Datum Name Index Änderung**

<table>
<thead>
<tr>
<th>Datum</th>
<th>Name</th>
<th>Index</th>
<th>Änderung</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.01.17</td>
<td>Ku</td>
<td>84</td>
<td>Typo: Page A4, pin designation changed. Minor change.</td>
</tr>
<tr>
<td>29.06.16</td>
<td>Ku</td>
<td>84</td>
<td>Sensor optimized. CN-15-727. Typo: $I_{P,max}$ changed</td>
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**Editor:** KB-E

**Bearb.:** Ku.

**KB-PM:** KRe.

**Freig.:** BEF

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1000 A Current Sensor for ±15V- Supply Voltage
for electric current measurement:
DC, AC, pulsed, mixed ..., with a galvanic isolation between
primary circuit (high power) and secondary circuit (electronic circuit)

Date: 16.01.2017

Capability of the sensor for measuring max. peak currents at defined temperatures,
values for supply voltage ±14.25 V (±15 V -5 %):

<table>
<thead>
<tr>
<th>δA</th>
<th>55 °C</th>
<th>55 °C</th>
<th>55 °C</th>
<th>55 °C</th>
<th>85 °C</th>
<th>85 °C</th>
<th>85 °C</th>
<th>85 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM</td>
<td>1 Ω</td>
<td>5 Ω</td>
<td>20 Ω</td>
<td>50 Ω</td>
<td>1 Ω</td>
<td>5 Ω</td>
<td>20 Ω</td>
<td>50 Ω</td>
</tr>
<tr>
<td>IP,max</td>
<td>1780A</td>
<td>1620A</td>
<td>1200A</td>
<td>790A</td>
<td>1620A</td>
<td>1480A</td>
<td>1120A</td>
<td>750A</td>
</tr>
<tr>
<td>Dwell time</td>
<td>&lt; 10min</td>
<td>&lt; 10min</td>
<td>&lt; 10min</td>
<td>∞</td>
<td>&lt; 3min</td>
<td>&lt; 3min</td>
<td>&lt; 3min</td>
<td>∞</td>
</tr>
</tbody>
</table>

Limit curve of measurable current $I_p=f(R_m)$ Values for supply voltage ±14.25 V (±15 V -5 %)

Fig. 1: $I_p=f(R_m)$ @ δA

Absolute maximum conditions:

<table>
<thead>
<tr>
<th>δA</th>
<th>70 °C ≤ δA ≤ 85 °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_p = I_{p,max}$ up to</td>
<td>1800 A DC</td>
</tr>
</tbody>
</table>

Stresses above these conditions may cause permanent damage. Exposure to absolute maximum rating conditions for extended periods will degrade device reliability and lifetime expectancy. Functional operation of the device at these or any other conditions beyond those specified in this specification is not permitted.
**Overload pulse (μs-range)**

Fig. 2: Output current reaction of a 3kA current pulse with $R_m = 10 \Omega$

**Schematic diagram:**

The polarity of the supply voltage is very important! With the wrong polarity, the current sensor will be damaged after a few seconds!
**SPECIFICATION**

**Item No.:** T60404-P4640-X102

**K-No.:** 26333

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**Date:** 16.01.2017

**Customer:** Standard Type

**Customer part no.:**

**Mechanical outline (mm)**

General tolerances DIN ISO 2768-c

**Connections:**

**Connector:**
Molex Minifit (4Pin)

Pin 1: n.c.
Pin 2: +U_{C}
Pin 3: -U_{C}
Pin 4: I_{S} (output current)

**Mechanical outline (mm)**

**Connections:**

**Connector:**
Molex Minifit (4Pin)

Pin 1: n.c.
Pin 2: +U_{C}
Pin 3: -U_{C}
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K-No.: 26333

1000 A Current Sensor for ±15V- Supply Voltage
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Date: 16.01.2017

Customer: Standard Type
Customer part no.: Page 5 of 6

Offset ripple reduction
The offset ripple can be reduced by an external low pass. The simplest solution is a passive low pass filter of 1st order by connecting a capacitor parallel to the burden resistor $R_M$ as shown on page 3. The required capacitance can be calculated as follows:

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

In this case the response time is enlarged. It is calculated from:

$$t' \geq t_r + 2.5 R_M C_a$$

Routine Test
1) (Measurement after temperature balance of the samples at room temperature; SC = significant characteristic)

| $K_{N}(N_1/N_2)$ | (100%) M3011/6 | Transformation ratio ($I_{\text{IN}}=1000\text{A}, 40-80\text{ Hz}$) | 1 : 5000 ± 0.4 % (SC) |
|-------------------|-----------------|-------------------------------------------------|---------------------|}
| $I_0$             | (100%) M3226    | Offset current                                   | < 0.1 mA (SC)       |
| $U_r$             | (100%) M3014    | Test voltage (1s)                                | (RMS) 2.2 kV (SC)   |
| $U_{\text{PDE}}$  | (AQL 1/S4)      | Partial discharge voltage (extinction) (RMS)     | 1500 V              |
| $U_{\text{PD(rms)} \cdot 1.875}$ | *acc. table 24 | *(RMS) 1875 V                                    |                     |

Type Test (Pin 1 - 4 to primary opening)

| $U_W$            | M3064 | HV transient test, *acc. table 18, 19 (1.2 µs / 50 µs-wave form) | 12 kV |
|------------------|-------|-------------------------------------------------|-----|}
| $U_r$            | M3014 | Test voltage (5s)                               | (RMS) 6 kV |
| $U_{\text{PDE}}$| Partial discharge voltage (extinction) (RMS) | 1500 V |
| $U_{\text{PD(rms)} \cdot 1.875}$ | *acc. table 24 | *(RMS) 1875 V | |
| ESD              | EN 61000-4-2 contact / surface | ±8 / ±15 kV | |

* IEC 61800-5-1:2007.

Applicable documents

Constructed and manufactured and tested in accordance with EN 61800-5-1:2007
Further standards: UL 508 ; file E317483, category NMTR2 / NMTR8
**Explanation to parameters used in this datasheet**

**Accuracy**

\[ X_{\text{total}}(I_{PN}) : \text{The sum of all possible errors over the temperature range by measuring a current } I_{PN}. \]

\[ X_{\text{scal}} = 100 \left( \frac{I_S(I_{PN})}{K_N \cdot I_{PN}} - 1 \right) \]

\[ X : \text{Permissible measurement error in the final inspection at RT. } \]

\[ I_{SB} \text{ is the DC output current for a DC primary current with the same value as the (positive) rated current } I_{PN} \text{ (with } I_O = 0) \]

\[ X = 100 \left( \frac{I_{SB}}{I_{SN}} - 1 \right) \]

\[ X_{T1} : \text{Temperature drift of the rated value orientated output term. } \]

\[ I_{SN} \text{ (cf. Notes on } F_1) \text{ in a specified temperature range:} \]

\[ I_{SB} \text{ is the secondary current at temperature } \vartheta_{A1} \text{ or } \vartheta_{A2} \]

\[ X_{T1} = 100 \left( \frac{I_{SB}(\vartheta_{A2}) - I_{SB}(\vartheta_{A1})}{I_{SN}} \right) \]

\[ \varepsilon_L : \text{Linearity fault where } I_P \text{ is any input DC and } I_{Sx} \text{ the corresponding output term. (} I_O = 0). \]

\[ \varepsilon_L = 100 \left( \frac{I_P}{I_{PN}} - \frac{I_{Sx}}{I_{SN}} \right) \]

**Offset and drift**

\[ I_{OH} : \text{Zero variation after overloading with a DC of tenfold the rated value (} R_M = R_{MN} \) \]

\[ I_{Ot} : \text{Long term drift of } I_O \text{ after 100 temperature cycles in the range -40 to 85 °C}. \]

**Dynamic properties**

\[ t_a : \text{Reaction time, measured as a delay time between a rectangular primary current (} \frac{dI}{dt} = 1200A/\mu s) \text{ and the output current } I_S \text{ at } I_P = 0.1 \cdot I_{PN} \]

\[ t_r : \text{Response time, measured as a delay time between a rectangular primary current and the output current } I_S \text{ at } I_P = 0.9 \cdot I_{PN} \]

**Voltage ratings** (according to IEC 61800-5-1:2007)

\[ U_{PD} : \text{Rated discharge voltage (recurring peak voltage separated by the insulation)} \]

\[ U_{sys} : \text{System voltage: RMS value of rated voltage} \]

\[ U_{AC} : \text{Working voltage: RMS voltage which occurs by design in a circuit or across an insulation} \]