Specification

Item no.: T60404-N4646-X921

K-No.: 26621

300mA Differential Current Sensor for 5V Supply Voltage

For the electronic measurement of current: DC, AC, pulsed ..., with galvanic isolation between the primary and the secondary circuit

Date: 09.02.2017

Customer: Standard type

Customer Part no:

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**Description**

- Closed loop (compensation)
  - Current Sensor with magnetic probe
- Printed circuit board mounting
- Casing and materials UL-listed

**Characteristics**

- excellent accuracy
- very low offset current
- very low temperature dependency and offset 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:
- Solar inverter

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**Electrical data - Ratings**

- \( I_{PN} \) Primary nominal RMS current 50 A
- \( I_{AN} \) Differential rated RMS current 0.3 A
- \( V_{OUT} \) Output voltage \( @ I_{P} \) \( V_{REF} \pm (0.74 \times I_{AN}/I_{PN}) \) V
- \( V_{OUT}(0)^1 \) Output voltage \( @ I_{P}=0A, T_A=25^\circ C \) \( V_{REF} \pm 0.025 \) V
- \( V_{OUT}(\text{Error}) \) in case of error (current sensor) \( V_{OUT} < 0.5V \) is set \(< 0.5 \) V
- \( V_{REF} \) internal reference voltage 2.5 \pm 0.005 V
- \( V_{REF}(\text{test current})^2 \) Reference voltage (external) 0 … 0.1 V
- \( V_{OUT}(\text{test current}) \) Output voltage \( @ V_{REF}=0 \ldots 0.1V \) \( V_{OUT}(0) + 0.25 \pm 0.06 \) V
- \( K_N \) Transformation ratio 1:1 : 20 : 1000

1) with switching on and after “test current” the sensor is degaussed by an internal AC-current for about 110ms. In this time the output is set to \( V_{OUT} < 0.5V \).

2) If \( V_{REF} \) is set external to 0…0.1V an internal test current is generated.

**Accuracy – Dynamic performance data**

- \( I_{P,max} \) Max. measuring range (differential current) \pm 0.85 A
- \( X \) Accuracy \( @ I_{AN}, T_A = 25^\circ C \) \pm 1.5 %
- \( \varepsilon_L \) Linearity \pm 1 %
- \( V_O = (V_{OUT}-V_{REF}) \) Offset voltage \( @ I_{P} = 0A, T_A = 25^\circ C \) \pm 25 mV
- \( \Delta V_O/\Delta T \) Temperature drift of \( V_{OUT} @ I_{P}=0A, T_A \) 0.1 mV/°C
- \( t_r \) Response time \( @ 90\% \) of \( I_{AN} \) 35 µs
- \( f_{SW} \) Frequency bandwidth DC…8 kHz

**General data**

- \( \theta_A \) Ambient operation temperature -40 85 °C
- \( \theta_S \) Ambient storage temperature (acc. to M3101) -40 85 °C
- \( m \) Mass 60 g
- \( V_C \) Supply voltage 4.75 5 5.25 V
- \( I_C \) Supply current \( @ I_{P} = 0A \) and \( RT \) 15 mA

1) \( S_{\text{clear}} \) Clearance (component without solder pad) 8.5 mm
1) \( S_{\text{creep}} \) Creepage (component without solder pad) 10.0 mm
1) \( U_{\text{sys}} \) System voltage *determines impulse voltage acc. table 7 600 \( V_{RMS} \)
1) \( U_{\text{AC}} \) Working voltage *acc. table 10 1000 \( V_{RMS} \)
1) \( U_{\text{PD}} \) Rated discharge voltage *acc. table 24 with \( U_{PD}=U_{AC}\sqrt{2} \) 1414 \( V_{PEAK} \)

1) Constructed and manufactured and tested in accordance with IEC 61800-5-1:2007
Reinforced Insulation, Pollution degree 2, Overvoltage category III, Insulation material group I

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Date

Name Issue Amendment

81

Hrg.: KB-E
Bearb.: DJ
KB-PM: KRe.
freig.: BEF
editor designer check released

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300mA Differential Current Sensor for 5V Supply Voltage
For the electronic measurement of current: DC, AC, pulsed, ..., with galvanic isolation between the primary and the secondary circuit.

Connections:
- Pin 5-10: 0.7mm x 0.7mm
- Pin 1-4: Ø2.8mm

Marking:
- 4646-X921
- F DC

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- Pin 1-4: Ø2.8mm
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**Customer: Standard type**

**Customers Part no:**

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### Electrical data:

(Investigate by a type checking)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{C,\text{max}}$</td>
<td>6</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_C$</td>
<td>15mA+I_{App}*K_{N+}V_{OUT}/R_L</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{OUT,SC}$</td>
<td>±10</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_S$</td>
<td>80</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{\text{Test}}$</td>
<td>0.9</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{P1,P2}$</td>
<td>0.24</td>
<td>mΩ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{\text{REF}}$</td>
<td>470</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{\text{OUT}}$</td>
<td>470</td>
<td>Ω</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta X/\Delta \theta$</td>
<td>400</td>
<td>ppm/K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta V_{\text{REF}}/\Delta \theta$</td>
<td>5</td>
<td>50</td>
<td>ppm/K</td>
<td></td>
</tr>
<tr>
<td>$\Delta V_{O}/\Delta V_C$</td>
<td>32</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{O1}$</td>
<td>12</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{O2}$</td>
<td>10</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta V_{O}/\Delta V_C$</td>
<td>10</td>
<td>mV/V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OH}$</td>
<td>75</td>
<td>125</td>
<td>25</td>
<td>mV</td>
</tr>
<tr>
<td>$V_{OH,\text{Demag}}$</td>
<td>Hysteresis after Degaussing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OSS}$</td>
<td>70</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OSS}$</td>
<td>20</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{OSS}$</td>
<td>6</td>
<td>mV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta V_{O}/\Delta V_C$</td>
<td>1.5</td>
<td>g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_{d}$</td>
<td>1.875</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_{VDE}$</td>
<td>1.875</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$U_{PD}$</td>
<td>1.875</td>
<td>kV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Routine Tests:

(Measurement after temperature balance of the samples at room temperature, SC=significant characteristic)

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{OUT}$ (SC)</td>
<td>(100%) M3011/6: Output voltage vs. reference</td>
<td>729 ... 751 mV</td>
</tr>
<tr>
<td>$V_{O}$</td>
<td>(100%) M3226: Offset voltage ($V_{OUT}$-$V_{REF}$)</td>
<td>±25 mV</td>
</tr>
<tr>
<td>$V_{OUT,\text{test current}}$</td>
<td>(100%) Output voltage @ $V_{REF} = 0V$</td>
<td>250 ± 60 mV</td>
</tr>
<tr>
<td>$U_{d}$</td>
<td>(100%) M3014: Test voltage, 1s, Pin 1-4 vs. Pin 5-10</td>
<td>1.8 kV_{RMS}</td>
</tr>
<tr>
<td>$U_{PD}$</td>
<td>(AQL 1/S4) Partial discharge voltage (extinction) *acc. table 24</td>
<td>1.5 kV_{RMS}</td>
</tr>
</tbody>
</table>

### Type Tests:

(Precondition acc. to M3236)

<table>
<thead>
<tr>
<th>Test</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U_W$</td>
<td>M3064: Impulse test (1.2µs/50µs wave form) Pin 1-4 vs. Pin 5-10</td>
<td>6 kV</td>
</tr>
<tr>
<td>$U_{W,\text{prim-prim}}$</td>
<td>M3064: Impulse test (1.2µs/50µs wave form) Pin 1 vs. Pin 13,14 and Pin 14 vs. Pin 1,2</td>
<td>6 kV</td>
</tr>
<tr>
<td>$U_d$</td>
<td>M3014: Test voltage, 60s Pin 1-4 vs. Pin 5-10</td>
<td>3.6 kV_{RMS}</td>
</tr>
<tr>
<td>$U_{d,\text{prim-prim}}$</td>
<td>M3014: Test voltage between primary conductors, 60s Pin 1 vs. Pin 13,14 and Pin 14 vs. Pin 1,2</td>
<td>3.6 kV_{RMS}</td>
</tr>
<tr>
<td>$U_{PD}$</td>
<td>(1.875) Partial discharge voltage (extinction) *acc. table 24</td>
<td>1.5 kV_{RMS}</td>
</tr>
</tbody>
</table>

### Other instructions

- Current direction: A positive output voltage appears at point $V_{OUT}$, if primary current flows in direction of the arrow.
- Temperature of the primary conductor should not exceed 105°C.
- Housing and bobbin material UL-listed: Flammability class 94V-0.

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Explanation of several terms used in the tables:

\( V_{\text{O}t} \)  \quad Long term drift of \( V_{\text{O}} \) after 100 temperature cycles in the range -40°C to 85°C.

\( t_r \)  \quad Response time, measured as a delay time at \( I_{\Delta P} = 0.9 \times I_{\Delta N} \) between a rectangular primary current and the output current or voltage.

\( t_{ra} \)  \quad Reaction time, measured as a delay time at \( I_{\Delta P} = 0.1 \times I_{\Delta N} \) between a rectangular primary current and the output current or voltage.

\( X_{\text{ges}(I_{\Delta N})} \)  \quad The sum of all possible errors over the temperature range by measuring a current \( I_{\Delta N} \):

\[
X_{\text{ges}(I_{\Delta N})} = 100 \times \left| \frac{V_{\text{OUT}(I_{\Delta N})} - 2.5V}{0.74V} - 1 \right| \%
\]

\( X \)  \quad Permissible measurement error in the final inspection at RT, defined by

\[
X = 100 \times \left| \frac{V_{\text{OUT}(I_{\Delta N})} - V_{\text{OUT}(0)}}{0.74V} - 1 \right| \%
\]

\( \Delta X_{\theta} \)  \quad \( \Delta X_{\theta} = X_{\theta_{\text{max}}} - X_{\theta_{\text{min}}} \)

\( \varepsilon_L \)  \quad Linearity fault defined by:

\[
\varepsilon_L = 100 \times \left( \frac{I_{\Delta P}}{I_{\Delta N}} \right) \frac{V_{\text{OUT}(I_{\Delta P})} - V_{\text{OUT}(0)}}{V_{\text{OUT}(I_{\Delta N})} - V_{\text{OUT}(0)}} \%
\]

Where \( I_{\Delta P} \) is any input DC current and \( V_{\text{OUT}} \) the corresponding output term. (\( V_O = 0 \)).

Application Information

The external test current can be generated with the use of a resistor \( R \) and a switch \( X \) or something similar (Transistor, Mosfet, etc.). The resistor determine the current at a given voltage and so the output voltage can be calculated.

\[
V_{\text{OUT}} = V_{\text{REF}} \pm \frac{5V}{R + \frac{R_{\text{Test}}}{I_{\Delta N}}} \cdot 20
\]