**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

Customer: Standard type

Date: 28.06.2021

**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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- Printed circuit board mounting
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**Electrical data - Ratings**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{PN}</td>
<td>A</td>
<td>Primary nominal RMS current</td>
</tr>
<tr>
<td>I_{DN}</td>
<td>A</td>
<td>Differential rated RMS current</td>
</tr>
<tr>
<td>V_{OUT}</td>
<td>V</td>
<td>Output voltage @ I_{AP}</td>
</tr>
<tr>
<td>V_{OUT}(0)</td>
<td>V</td>
<td>Output voltage @ I_P=0A, θ_A=25°C</td>
</tr>
<tr>
<td>V_{OUT}(Error)</td>
<td>V</td>
<td>Internal reference voltage</td>
</tr>
<tr>
<td>V_{REF}</td>
<td>V</td>
<td>External reference voltage range</td>
</tr>
<tr>
<td>K_{N}</td>
<td></td>
<td>Transformation ratio</td>
</tr>
</tbody>
</table>

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 VREF is set external to 0..0.1V an internal test current is generated.

**Accuracy – Dynamic performance data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_{AP,max}</td>
<td>A</td>
<td>Max. measuring range (differential current)</td>
</tr>
<tr>
<td>X</td>
<td>%</td>
<td>Accuracy @ I_{AN}, θ_A = 25°C</td>
</tr>
<tr>
<td>εL</td>
<td>%</td>
<td>Linearity</td>
</tr>
<tr>
<td>V_{O} (V_{OUT}-V_{REF})</td>
<td>mV</td>
<td>Offset voltage @ I_P = 0A, θ_A = 25°C</td>
</tr>
<tr>
<td>ΔV_{O}/ΔT</td>
<td>mV/°C</td>
<td>Temperature drift of V_{OUT} @ I_P=0A, θ_A</td>
</tr>
<tr>
<td>t_r</td>
<td>μs</td>
<td>Response time @ 90% of I_{DN}</td>
</tr>
<tr>
<td>f_{BW}</td>
<td>kHz</td>
<td>Frequency bandwidth</td>
</tr>
</tbody>
</table>

**General data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ_A</td>
<td>°C</td>
<td>Ambient operation temperature</td>
</tr>
<tr>
<td>θ_S</td>
<td>°C</td>
<td>Ambient storage temperature (acc. to M3101)</td>
</tr>
<tr>
<td>m</td>
<td>g</td>
<td>Mass</td>
</tr>
<tr>
<td>V_C</td>
<td>V</td>
<td>Supply voltage</td>
</tr>
<tr>
<td>I_C</td>
<td>mA</td>
<td>Supply current at I_P = 0A and RT</td>
</tr>
</tbody>
</table>

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

Date

28.06.2021

Name

DJ

Issue

81

Amendment

Further standards: UL 508, file E317483, category NMTR2 / NMTR8. And add UL sign to mechanical dimension and marking info box in datasheet. CN-21-221

Hrg.: R&D-PD NPI D

Bearb.: DJ

MC-PM: NSch.

check

freig.: SB

Released
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: 28.06.2021

Customer: Standard type

Customers Part no:

Page 2 of 4

Mechanical outline (mm):

General tolerances DIN ISO 2768-c

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

Marking:
UL-sign
4646-X921
F DC

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

Schematic diagram:

- Int_REF
- 470
- 10k
- 42.4k
- OUT
- 470
- 22nF
- 40k
- GND

Hrg.: R&D-PD NPI D
Bearb.: DJ
designer

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check

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released

VACUUMSCHMELZE

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<table>
<thead>
<tr>
<th>Customer: Standard type</th>
<th>Customers Part no:</th>
<th>Page 3 of 4</th>
</tr>
</thead>
</table>

**Date: 28.06.2021**

**Electrical data:**

<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>maximum supply voltage (without function)</td>
<td>6</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>( I_C )</td>
<td>Supply current with primary current</td>
<td>15mA + ( I_{0})</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>( I_{\text{OUT,SC}} )</td>
<td>Short circuit output current</td>
<td>( \pm10 )</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>( R_S )</td>
<td>Secondary coil resistance @ ( \theta_s = 85°C )</td>
<td>( 80 )</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>( R_{\text{Test}} )</td>
<td>Test winding resistance @ ( \theta_s = 25°C )</td>
<td>( 0.9 )</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>( R_{P1,P2} )</td>
<td>Primary wire resistance @ ( \theta_s = 25°C )</td>
<td>( 0.24 )</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>( R_{\text{REF}} )</td>
<td>Internal resistance of reference input</td>
<td>( 470 )</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>( R_{\text{OUT}} )</td>
<td>Output resistance of ( V_{\text{OUT}} )</td>
<td>( 470 )</td>
<td>( \Omega )</td>
<td></td>
</tr>
<tr>
<td>( \Delta X/\Delta \theta )</td>
<td>Temperature drift of ( X ) @ ( \theta_s = -40°C ... 85°C )</td>
<td>( 400 )</td>
<td>ppm/K</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{REF}}/\Delta \theta )</td>
<td>Temperature drift of ( V_{\text{REF}} ) @ ( \theta_s = -40°C ... 85°C )</td>
<td>( 5 )</td>
<td>50 ppm/K</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{O}}/\Delta V_C )</td>
<td>Sum of any offset drift including:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{O}} )</td>
<td>Long term drift of ( V_0 )</td>
<td>( 12 )</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{O}} )</td>
<td>Temperature drift of ( V_0 ) @ ( \theta_s = -40°C ... 85°C )</td>
<td>( 10 )</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>( \Delta V_{\text{O}}/\Delta V_C )</td>
<td>Supply voltage rejection ratio</td>
<td>( 10 )</td>
<td>mV/V</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{CH}} )</td>
<td>Hysteresis of ( V_{\text{OUT}} ) @ ( \theta_s = 0 ) (after an overload of 1000x ( I_{\text{0}} ))</td>
<td>( 75 )</td>
<td>125</td>
<td>mV</td>
</tr>
<tr>
<td>( V_{\text{CH},\text{Demag}} )</td>
<td>Hysteresis after Degaussing</td>
<td></td>
<td>25</td>
<td>mV</td>
</tr>
<tr>
<td>( V_{\text{OSS}} )</td>
<td>Offsetripple (without external filter)</td>
<td>( 70 )</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{OSS}} )</td>
<td>Offsetripple (with 20 kHz-Filter, first order)</td>
<td>( 20 )</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{OSS}} )</td>
<td>Offsetripple (with 1 kHz-Filter, first order)</td>
<td>( 6 )</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>( V_{\text{OSS}} )</td>
<td>Mechanical stress according to M3209/3</td>
<td></td>
<td>1.5</td>
<td>g</td>
</tr>
<tr>
<td>( V_{\text{OSS}} )</td>
<td>Settings: 10-2000Hz, 1min/Octave, 2 hours</td>
<td></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_{\text{OUT}} ) (SC) (100%)</td>
<td>Output voltage vs. reference</td>
<td>( 729 ) ... ( 751 ) mV</td>
</tr>
<tr>
<td>( V_0 ) (100%)</td>
<td>Offset voltage (( V_{\text{OUT}}-V_{\text{REF}} ))</td>
<td>( \pm25 ) mV</td>
</tr>
<tr>
<td>( V_{\text{OUT(test current)}} ) (100%)</td>
<td>Output voltage @ ( V_{\text{REF}} = 0V )</td>
<td>( 250 ) ± ( 60 ) mV</td>
</tr>
<tr>
<td>( U_{d} ) (100%)</td>
<td>Test voltage, 1s, Pin 1-4 vs. Pin 5-10</td>
<td>( 1.8 ) kV RMS</td>
</tr>
<tr>
<td>( U_{PD} )</td>
<td>Partial discharge voltage (extinction)</td>
<td>( 1.5 ) kV RMS</td>
</tr>
</tbody>
</table>

**Type Tests:**

(Precondition acc. to M3236)

<table>
<thead>
<tr>
<th>Test</th>
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<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( U_{W} )</td>
<td>Impulse test (1.2µs/50µs wave form)</td>
<td>( 6 ) kV</td>
</tr>
<tr>
<td>( U_{W} ), prim-prim</td>
<td>Impulse test (1.2µs/50µs wave form)</td>
<td>( 6 ) kV</td>
</tr>
<tr>
<td>( U_{d} )</td>
<td>Test voltage, 60s</td>
<td>( 3.6 ) kV RMS</td>
</tr>
<tr>
<td>( U_{d} ), prim-prim</td>
<td>Test voltage between primary conductors, 60s</td>
<td>( 3.6 ) kV RMS</td>
</tr>
<tr>
<td>( U_{PD} )</td>
<td>Partial discharge voltage (extinction)</td>
<td>( 1.5 ) kV RMS</td>
</tr>
</tbody>
</table>

**Other instructions**

- Current direction: A positive output voltage appears at point \( V_{\text{OUT}} \), 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.
- Further standards: UL 508, file E317483, category NMTR2 / NMTR8

* IEC 61800-5-1:2007

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Explanation of several terms used in the tables:

- **V₀**: Long term drift of V₀ after 100 temperature cycles in the range -40°C to 85°C.
- **tᵣ**: Response time, measured as a delay time at I₀P = 0.9 * I₀N between a rectangular primary current and the output current or voltage.
- **tᵣa**: Reaction time, measured as a delay time at I₀P = 0.1 * I₀N between a rectangular primary current and the output current or voltage.
- **X₁₀₀(I₀N)**: The sum of all possible errors over the temperature range by measuring a current I₀N:
  \[X₁₀₀(I₀N) = 100 \times \left| \frac{V_{OUT}(I₀N)-V_{OUT}(0)}{0.74V} - 1 \right| \%\]
- **X**: Permissible measurement error in the final inspection at RT, defined by
  \[X = 100 \times \left| \frac{V_{OUT}(I₀N)-V_{OUT}(0)}{0.74V} - 1 \right| \%\]
- **ΔX₀**: Linearity fault defined by:
  \[\epsilon_L = 100 \times \left| \frac{I₀P}{I₀N} \right| \%\]
  Where I₀P is any input DC current and V_OUT the corresponding output term. (V₀ = 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.

\[V_{OUT} = V_{REF} \pm \left(\frac{5V}{R + R_{Test}} \cdot 20\right)\frac{I₀N}{I₀N}\]