| VACUUMSCHMELZE | SPECIFICATION | Item no.: T60404-N4646-X653 |
|---|---|---|

| K-no.: 24509 | **6 A Current Sensor modul for 5V-Supply voltage**<br>For electronic current measurement:<br>DC, AC, pulsed, mixed ..., with a galvanic isolation between primary circuit (high power) and secondary circuit (electronic circuit) | Date: 20.11.2013 |
|---|---|---|
| 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
- Short response time
- Wide frequency bandwidth
- Compact design
- Reduced offset ripple

**Applications**

Mainly used for stationary operation in industrial applications:
- AC variable 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
- Uninterruptible Power Supplies (UPS)

## Electrical data – Ratings

| | | | |
|---|---|---|---|
| $I_{PN}$ | Primary nominal r.m.s. current | 6 | A |
| $V_{out}$ | Output voltage @ $I_P$ | 2.5 ± (0.625*$I_P$/$I_{PN}$) | V |
| $V_{out}$ | Output voltage @ $I_P$=0, $T_A$=25°C | 2.5 ± 0.0104 | V |
| $V_{Ref}$ | Reference voltage | 2.5 ± 0.005 | V |
| $K_N$ | Turns ratio | 1…3 : 2000 | |

## Accuracy – Dynamic performance data

| | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|
| $I_{P,max}$ | Max. measuring range | ±20 | | | |
| X | Accuracy @ $I_{PN}$, $T_A$= 25°C | | | 0.7 | % |
| $\varepsilon_L$ | Linearity | | | 0.1 | % |
| $V_{out}$ -2,5V | Offset voltage @ $I_P$=0, $T_A$= 25°C | | | ±10,4 | mV |
| $\Delta V_{out}$ /2,5V/$\Delta$T | Temperature drift of $V_{out}$ @ $I_P$=0, $T_A$= -40…85°C | | 26 | 51 | ppm/K |
| $t_r$ | Response time @ 90% von $I_{PN}$ | | 300 | | ns |
| $\Delta t$ ($I_{P,max}$) | Delay time at di/dt = 100 A/µs | | 200 | | ns |
| f | Frequency bandwidth | DC…200 | | | kHz |

## General data

| | | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|---|
| $T_A$ | Ambient operating temperature | | -40 | | +85 | °C |
| $T_S$ | Ambient storage temperature | | -40 | | +85 | °C |
| m | Mass | | | 12 | | g |
| $V_C$ | Supply voltage | | 4.75 | 5 | 5.25 | V |
| $I_C$ | Current consumption | | | 15 | | mA |
| | Constructed and manufactored and tested in accordance with EN 61800-5-1 (Pin 1 - 6 to Pin 7 – 9)<br>Reinforced insulation, Insulation material group 1, Pollution degree 2 | | | | | |
| $S_{clear}$ | Clearance (component without solder pad) | | 7,5 | | | mm |
| $S_{creep}$ | Creepage (component without solder pad) | | 8,0 | | | mm |
| $V_{sys}$ | System voltage | overvoltage category 3 | RMS | | 300 | V |
| $V_{work}$ | Working voltage | (tabel 7 acc. to EN61800-5-1) overvoltage category 2 | RMS | | 650 | V |
| $U_{PD}$ | Rated discharge voltage | | peak value | | 1320 | V |
| Max. potential difference acc. to UL 508 | | | RMS | | 600 | $V_{AC}$ |

| Date | Name | Issue | Amendment |
|---|---|---|---|
| 20.11.13 | KRe. | 83 | Max. Potential… added, Clearance from 7 to 7,5 and creepage from 7 to 8,0. Offset voltage ±25 to ±10.4 |
| | | | Vout fom ±0.025 to ±0.0104. f = DC…100 to f = DC…200 kHz. Marking changed UL-sign+ 4646–X653 CN-865 |

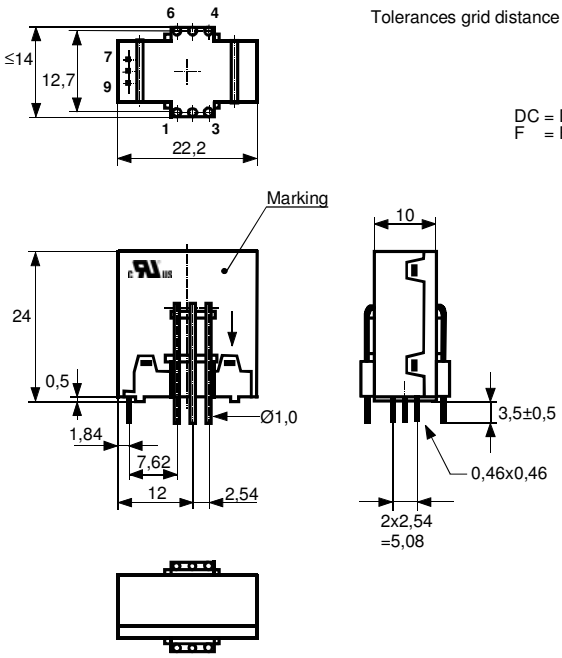
| Hrsg.: KB-E (editor) | Bearb: Le. (designer) | | KB-PM: KRe (check) | | | freig.: HS (released) |
|---|---|---|---|---|---|---|

| VACUUMSCHMELZE | **SPECIFICATION** | **Item no.:** | **T60404-N4646-X653** |
|---|---|---|---|
| K-no.: 24509 | **6 A Current Sensor modul for 5V-Supply voltage**<br>For electronic current measurement:<br>DC, AC, pulsed, mixed ..., with a galvanic isolation between primary circuit (high power) and secondary circuit (electronic circuit) | | Date: 20.11.2013 |
| Customer: Standard type | | Customers Part no.: | Page 2 of 2 |

**Mechanical outline (mm):**

General tolerances DIN ISO 2768-c

Tolerances grid distance ±0,2mm



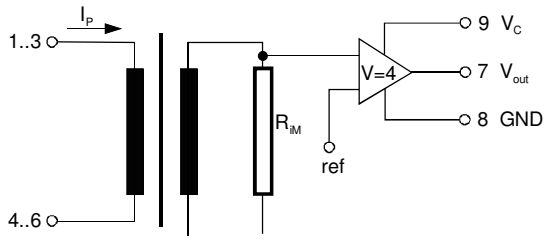

DC = Date Code
F = Factory

Connections:
1...6: ∅ 1 mm
7...9: 0,46*0,46 mm

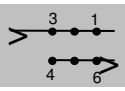
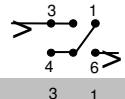
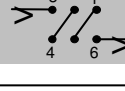
Marking:

UL-sign
4646-X653
F DC

**Schematic diagram**




**Possibilities of wiring** (@ $T_A$ = 85°C)

| primary windings | primary current RMS | maximal | output voltage RMS | turns ratio | primary resistance | wiring |
|---|---|---|---|---|---|---|
| $N_P$ | $I_P$ [A] | $\hat{I}_{P,max}$ [A] | $V_{out}$ ($I_{PN}$) [V] | $K_N$ | $R_P$ [mΩ] | |
| 1 | 6 | ±20 | 2.5±0.625 | 1:2000 | 0.33 |  |
| 2 | 3 | ±10 | 2.5±0.625 | 2:2000 | 1.5 |  |
| 3 | 2 | ±6.7 | 2.5±0.625 | 3:2000 | 3 |  |

Temperature of the primary conductor should not exceed 110°C.
Additional information is obtainable on request.
This specification is no declaration of warranty acc. BGB §443 dar.

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

| VACUUMSCHMELZE | **Additional Information** | **Item No.: T60404-N4646-X653** |
|---|---|---|

| K-No.: 24509 | **6 A Current Sensor Modul for 5V-supply voltage**<br>For the electronic measurement of currents:<br>DC, AC, pulsed, mixed ..., with a galvanic<br>Isolation between the primary circuit<br>(high power) and the secondary circuit | Date: 20.11.2013 |
|---|---|---|
| Customer: | Customers Part No.: | Page 1 of 2 |

## Electrical Data

| | | min. | typ. | max. | Unit |
|---|---|---|---|---|---|
| $V_{Ctot}$ | Maximum supply voltage (without function) | | | 7 | V |
| $I_C$ | Supply Current with primary current | | 15mA +$I_p$*$K_N$+$V_{out}$/$R_L$ | | mA |
| $I_{out,SC}$ | Short circuit output current | | ±20 | | mA |
| $R_P$ | Resistance / primary winding @ $T_A$=25°C | | 1 | | mΩ |
| $R_S$ | Secondary coil resistance @ $T_A$=85°C | | | 67 | Ω |
| $R_i$,($V_{out}$) | Output resistance of $V_{out}$ | | | 1 | Ω |
| $R_L$ | External recommended resistance of $V_{out}$ | 1 | | | kΩ |
| $C_L$ | External recommended capacitance of $V_{out}$ | | | 500 | pF |
| $\Delta X_{Ti}/\Delta T$ | Temperature drift of X @ $T_A$ = -40 ... +85 °C | | | 40 | ppm/K |
| $\Delta V_0 = \Delta(V_{out}$ -2.5V) | Sum of any offset drift including: | | 9 | 20 | mV |
| $V_{0t}$ | Long term drift of $V_0$ | | 3 | | mV |
| $V_{0T}$ | Temperature drift von $V_0$ @ $T_A$ = -40 ...+85°C | | 8 | | mV |
| $V_{0H}$ | Hysteresis of $V_{out}$ @ $I_P$=0 (after an overload of 10 x $I_{PN}$) | | 7.5 | mV | |
| $\Delta V_0/\Delta V_C$ | Supply voltage rejection ratio | | | 1 | mV/V |
| $v_{oss}$ | Offsetripple (with 1 MHz- filter first order) | | | 100 | mV |
| $v_{oss}$ | Offsetripple (with 100 kHz- filter firdt order) | | 10 | 20 | mV |
| $v_{oss}$ | Offsetripple (with 20 kHz- filter first order) | | 2.5 | 5 | mV |
| $C_k$ | Maximum possible coupling capacity (primary – secondary) | | 5 | 10 | pF |
| | Mechanical stress according to M3209/3<br>Settings: 10 – 2000 Hz, 1 min/Decade, 2 hours | | | 30g | |

## Inspection[1)] (Measurement after temperature balance of the samples at room temperature)

| | | | | | |
|---|---|---|---|---|---|
| $V_{out}$ ($I_P$=$I_{PN}$) | (V) | M3011/6: | Output voltage<br>vs. internal reference ($I_P$=6A, 40-80Hz) | 625±0.7% | mV |
| $V_{out}$–2.5V ($I_P$=0) | (V) | M3226: | Offset voltage | ± 0.025 | V |
| $V_d$ | (V) | M3014: | Test voltage, rms, 1 s<br>pin 1 – 6 vs. pin 7 – 9 | 1.5 | kV |
| $V_e$ | (AQL 1/S4) | | Partial discharge voltage acc.M3024 (RMS)<br>with $V_{vor}$ (RMS) | 1400<br>1750 | V<br>V |

## Type Testing[1)] (Pin 1 - 6 to Pin 7 - 9)

Designed according standard EN 50178 with insulation material group 1

| | | | |
|---|---|---|---|
| $V_W$ | HV transient test according to M3064 (1,2 µs / 50 µs-wave form) | 8 | kV |
| $V_d$ | Testing voltage to M3014 (5 s) | 3 | kV |
| $V_e$ | Partial discharge voltage acc.M3024 (RMS)<br>with $V_{vor}$ (RMS) | 1400<br>1750 | V<br>V |

[1)] preliminary data

## Applicable documents

Current direction: A positive output current appears at point $I_S$, by primary current in direction of the arrow.
Enclosures according to IEC529: IP50.

Further standards UL 508 ; file E317483, category NMTR2 / NMTR8

| Datum | Name | Index | Änderung |
|---|---|---|---|
| 20.11.13 | KRe | 83 | Vctot changed from 6 at 7V, Vout Offset voltage von ± 0.025 at ± 0.0104 V. Applicable documents: |
| | | | Further standards added. CN-865 |

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

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

$t_r$: Response time (describe the dynamic performance for the specified measurement range), measured as delay time at $I_P = 0{,}9 \cdot I_{PN}$ between a rectangular current and the output voltage $V_{OUt}$ ($I_p$)

$\Delta t$ ($I_{Pmax}$): Delay time (describe the dynamic performance for the rapid current pulse rate e.g short circuit current) measured between $I_{Pmax}$ and the output voltage $V_{out}(I_{Pmax})$ with a primary current rise of $di_P/dt \geq 100$ A/µs.

$U_{PD}$ Rated discharge voltage (recurring peak voltage separated by the insulation) proved with a sinusoidal voltage $V_e$

$U_{PD} = \sqrt{2} * V_e / 1{,}5$

$V_{vor}$ Defined voltage is the RMS valve of a sinusoidal voltage with peak value of 1,875 * $U_{PD}$ required for partial discharge test in IEC 61800-5-1

$V_{vor} = 1{,}875 * U_{PD} / \sqrt{2}$

$V_{sys}$ 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

$V_0$: Offset voltage between $V_{out}$ and the rated reference voltage of $V_{ref}$ = 2,5V.
$V_o = V_{out}(0) - 2{,}5V$

$V_{0H}$: Zero variation of $V_o$ after overloading with a DC of tenfold the rated value

$V_{0t}$: Long term drift of $V_o$ after 100 temperature cycles in the range -40 bis 85 °C.

X: Permissible measurement error in the final inspection at RT, defined by

$$X = 100 \cdot \left| \frac{V_{out}(I_{PN}) - V_{out}(0)}{0{,}625\text{V}} - 1 \right| \%$$

$X_{ges}(I_{PN})$: Permissible measurement error including any drifts over the temperature range by the current measurement $I_{PN}$

$$X_{ges} = 100 \cdot \left| \frac{V_{out}(I_{PN}) - 2{,}5V}{0{,}625\text{V}} - 1 \right| \% \quad \text{or} \quad X_{ges} = 100 \cdot \left| \frac{V_{out}(I_{PN}) - V_{ref}}{0{,}625\text{V}} - 1 \right| \%$$

$\varepsilon_L$: Linearity fault defined by

$$\varepsilon_L = 100 \cdot \left| \frac{I_P}{I_{PN}} - \frac{V_{out}(I_P) - V_{out}(0)}{V_{out}(I_{PN}) - V_{out}(0)} \right| \%$$

This “Additional information“ is no declaration of warranty according BGB §443.