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

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

Electrical data - Ratings

I_{PN}	Primary nominal RMS current	50	A
$I_{\Delta N}$	Differential rated RMS current	0.3	A
V_{OUT}	Output voltage @ $I_{\Delta P}$	$V_{REF} \pm (0.74 * I_{\Delta P} / I_{\Delta N})$	V
$V_{OUT}(0)$[1]	Output voltage @ I_P=0A, ϑ_A=25°C	$V_{REF} \pm 0.025$	V
V_{OUT}(Error)	in case of error (current sensor) V_{OUT} < 0.5V is set	< 0.5	V
V_{REF}	internal reference voltage	2.5 ± 0.005	V
	external reference voltage range	1.4 … 3.5	V
V_{REF}(test current)[2]	Reference voltage (external)	0 … 0.1	V
V_{OUT}(test current)[2]	Output voltage @ V_{REF} = 0 … 0.1V	$V_{OUT}(0)$ + 0.25 ± 0.06	V
K_N	Transformation ratio	1:1:1:1 : 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

		min.	typ.	max.	Unit
$I_{\Delta P,max}$	Max. measuring range (differential current)	±0.85			A
X	Accuracy @ $I_{\Delta N}$, ϑ_A = 25°C			±1.5	%
ε_L	Linearity			±1	%
V_O (V_{OUT}-V_{REF})	Offset voltage @ I_P = 0A, ϑ_A = 25°C			±25	mV
$\Delta V_O/\Delta T$	Temperature drift of V_{OUT} @ I_P=0A, ϑ_A		0.1		mV/°C
t_r	Response time @ 90% of $I_{\Delta N}$		35		µs
f_{BW}	Frequency bandwidth	DC…8			kHz

General data

		min.	typ.	max.	Unit
ϑ_A	Ambient operation temperature	-40		85	°C
ϑ_S	Ambient storage temperature (acc. to M3101)	-40		85	°C
m	Mass		75		g
V_C	Supply voltage	4.75	5	5.25	V
I_C	Supply current at I_P = 0A and RT		15		mA
[1)]s_{clear}	Clearance (component without solder pad)	8.5			mm
[1)]s_{creep}	Creepage (component without solder pad)	10.0			mm
[1)]U_{sys}	System voltage *determines impulse voltage acc. table 7			600	V_{RMS}
[1)]U_{AC}	Working voltage *acc. table 10			1000	V_{RMS}
[1)]U_{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

Date	Name	Issue	Amendment
		81	

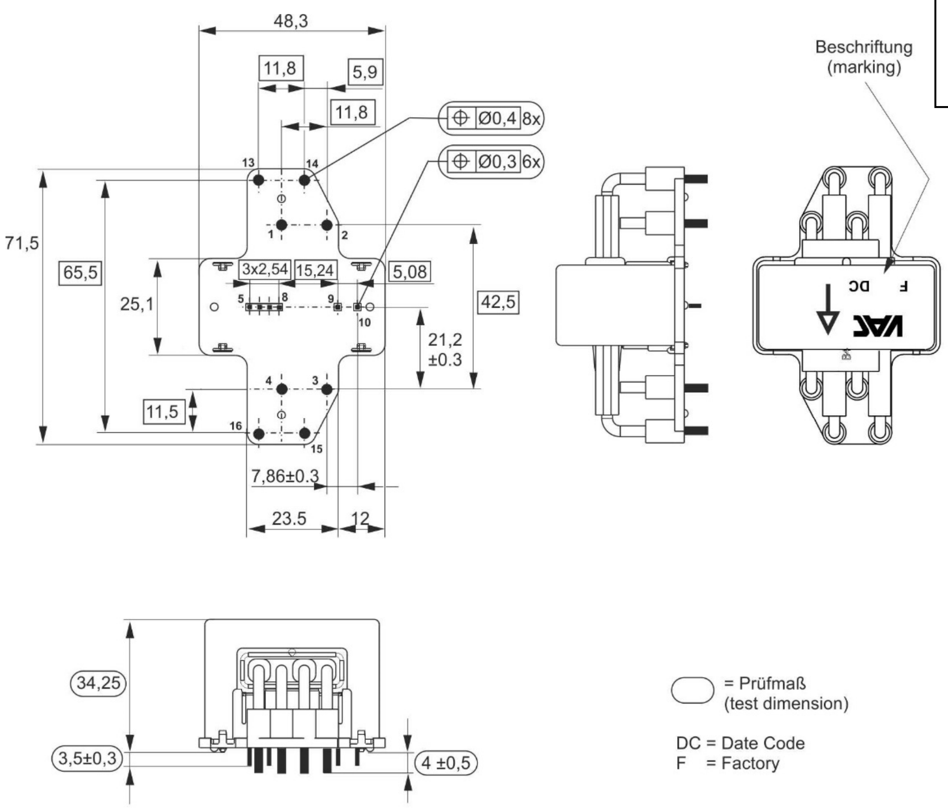
Hrg.: MC-PD editor	Bearb.: DJ designer		MC-PM: KRe. check		freig.: BEF released

VAC VACUUMSCHMELZE	Specification	Item no.: T60404-N4646-X932

K-No.: 26622	**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	Customers Part no:	Page 2 of 4

Mechanical outline (mm): General tolerances DIN ISO 2768-c



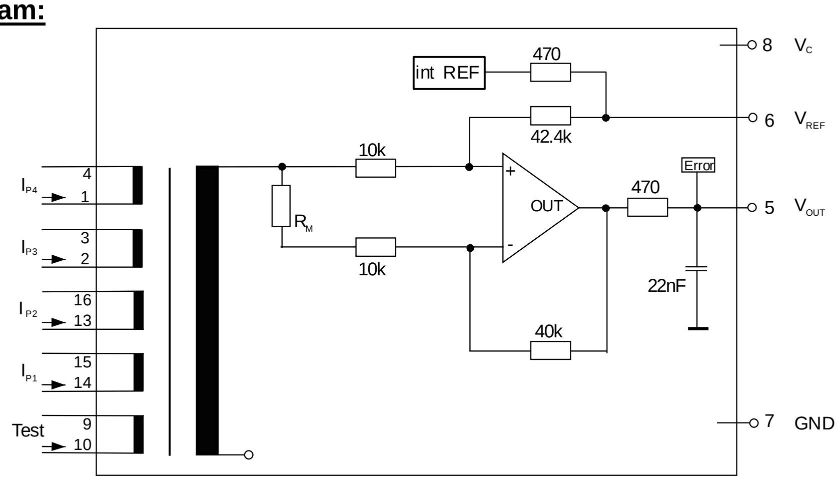
Connections:

Pin 5-10: 0.7mm x 0.7mm
Pin 1-4, 13-16: Ø2.8mm

Marking:

VAC
4646-X932
F DC

Schematic diagram:



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Electrical data: (investigate by a type checking)

		min.	typ.	max.	Unit
$V_{C,max}$	maximum supply voltage (without function)			6	V
I_C	Supply current with primary current	$15mA+I_{\Delta P}*K_N+V_{OUT}/R_L$			mA
$I_{OUT,SC}$	Short circuit output current		±10		mA
R_S	Secondary coil resistance @ θ_A = 85°C			80	Ω
R_{Test}	Test winding resistance @ θ_A = 25°C		0.9		Ω
$R_{P1,P2}$	Primary wire resistance @ θ_A = 25°C		**0.24**		mΩ
$R_{i,REF}$	Internal resistance of reference input		470		Ω
$R_{i,OUT}$	Output resistance of V_{OUT}		470		Ω
$\Delta X_\theta/\Delta\theta$	Temperature drift of X @ ϑ_A = -40°C ... 85°C			400	ppm/K
$\Delta V_{REF}/\Delta\theta$	Temperature drift of V_{REF} @ ϑ_A = -40°C ... 85°C		5	50	ppm/K
$\Delta V_O = \Delta(V_{OUT}-V_{REF})$	Sum of any offset drift including:			32	mV
V_{Ot}	Long term drift of V_O		12		mV
V_{OT}	Temperature drift of V_O @ ϑ_A = -40°C … 85°C		10		mV
$\Delta V_O/\Delta V_C$	Supply voltage rejection ratio		10		mV/V
V_{OH} $V_{OH, Demag}$	Hysteresis of V_{OUT} @ I_P = 0 (after an overload of 1000x $I_{\Delta N}$) Hysteresis after Degaussing		75	125 25	mV
v_{OSS}	Offsetripple (without external filter)		70		mV
v_{OSS}	Offsetripple (with 20 kHz-Filter, first order)		20		mV
v_{OSS}	Offsetripple (with 1 kHz-Filter, first order)		6		mV
	Mechanical stress according to M3209/3 Settings: 10-2000Hz, 1min/Octave, 2 hours		1.5		g

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

V_{OUT} (SC)	(100%) M3011/6:	Output voltage vs. reference	729 … 751	mV
V_O	(100%) M3226:	Offset voltage (V_{OUT}-V_{REF})	±25	mV
V_{OUT}(test current)	(100%)	Output voltage @ V_{REF} = 0V	250 ± 60	mV
U_d	(100%) M3014:	Test voltage, 1s, *acc. table 21	1.8	kV_{RMS}
U_{PDE} $U_{PD}\cdot 1.875$	(AQL 1/S4)	Partial discharge voltage (extinction) *acc. table 24	1.5 1.875	kV_{RMS}

Type Tests: (Precondition acc. to M3236)

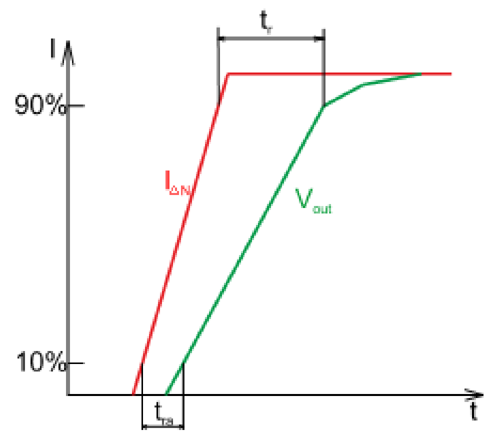
$\hat{U}_W$	M3064:	Impulse test (1.2µs/50µs wave form) Pin 1-4 vs. Pin 5-10	6	kV
$\hat{U}_{W, prim-prim}$	M3064:	Impulse test (1.2µs/50µs wave form) Pin 1 vs. Pin 13,14 and Pin 14 vs. Pin 1,2	6	kV
U_d	M3014:	Test voltage, 60s Pin 1-4 vs. Pin 5-10	3.6	kV_{RMS}
$U_{d, prim-prim}$	M3014:	Test voltage between primary conductors, 60s Pin 1 vs. Pin 13,14 and Pin 14 vs. Pin 1,2	3.6	kV_{RMS}
U_{PDE} $U_{PD}\cdot 1.875$		Partial discharge voltage (extinction) *acc. table 24	1.5 1.875	kV_{RMS}

* IEC 61800-5-1:2007

Other instructions

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

Explanation of several terms used in the tables:



V_{Ot} Long term drift of V_O after 100 temperature cycles in the range -40°C to 85°C.

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

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

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

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

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

$$X = 100 * \left|\frac{V_{OUT}(I_{\Delta N}) - V_{OUT}(0)}{0.74V} - 1\right| \%$$

ΔX_θ $\Delta X_\theta = X_{\theta max} - X_{\theta min}$

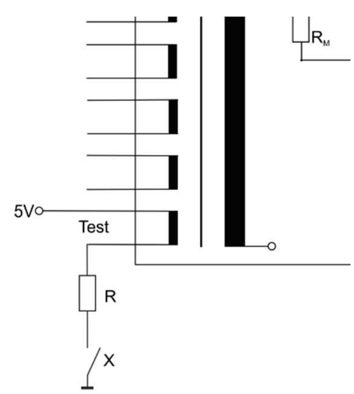
ε_L Linearity fault defined by: $\varepsilon_L = 100 * \left|\frac{I_{\Delta P}}{I_{\Delta N}} - \frac{V_{OUT}(I_{\Delta P}) - V_{OUT}(0)}{V_{OUT}(I_{\Delta N}) - V_{OUT}(0)}\right| \%$

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

RT Room temperature

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.



$$V_{OUT} = V_{REF} \pm \frac{0.74 \cdot \frac{5V}{R + R_{Test}} \cdot 20}{I_{\Delta N}}$$