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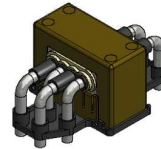For the electronic measurement of current:
DC, AC, pulsed ..., with galvanic isolation between the primary and the secondary circuit

Date: 02.02.2017

Customer: Standard Type | Customers Part no: | Page 1 of 4

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	85	A
$I_{\Delta N}$	Differential rated RMS current	1.0	A
V_{OUT}	Output voltage @ $I_{\Delta P}$	$V_{REF} \pm (1.2V * I_{\Delta P} / I_{\Delta N})$	V
$V_{OUT}(0)$[1]	Output voltage @ $I_{\Delta P}$=0A, θ_A=25°C	$V_{REF} \pm 0.015$	V
V_{OUT}(Error)	in case of error (current sensor) $V_{OUT} < 0.5V$ is set	< 0.5	V
V_{REF}	internal reference voltage @ $I_{\Delta P}$=0A	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 @ $V_{REF} = 0…0.1V$	$V_{OUT}(0) + 0.25 \pm 0.06$	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)	±1.7			A
X	Accuracy @ I_{PN}, $\theta_A = 25°C$			1.5	%
ε_L	Linearity			1	%
V_O $(V_{OUT}-V_{REF})$	Offset voltage @ $I_{\Delta P} = 0A$, $\theta_A = 25°C$			15	mV
$\Delta V_O/\Delta T$	Temperature drift of V_{OUT} @ $I_{\Delta P}$=0A, ϑ_A		0.05		mV/°C
t_r	Response time @ 90% of $I_{\Delta N}$		40		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			105	g
V_C	Supply voltage	4.75	5	5.25	V
I_C	Supply current at $I_{\Delta P} = 0A$ and RT		15		mA
[1, 2]S_{clear}	Clearance (component without solder pad)	3.9			mm
[1, 2]S_{creep}	Creepage (component without solder pad)	4.5			mm
[1]U_{sys}	System Voltage *determines impulse voltage acc. table 7			600	V_{RMS}
[1]U_{AC}	Working voltage *acc. table 10			800	V_{RMS}
[1]U_{PD}	Rated discharge voltage *acc. table 24 with $U_{PD}=U_{AC}*\sqrt{2}$			1132	V_{PEAK}

[1]Constructed and manufactured and tested in accordance with IEC 61800-5-1:2007
Prim - Prim: Functional Insolation, Prim - Sec: Basic Insulation,
Insulation material group 1, Pollution degree 2, Overvoltage category III
[2]According to customers specification

Date	Name	Issue	Amendment
02.02.2017	DJ	82	Page A1, M-sheet M3101 added to the storage temperature line. CN-17-007

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

VAC
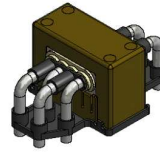VACUUMSCHMELZE

K-No.: 26543	**1 A 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: 02.02.2017

Customer: Standard Type	Customers Part no:	Page 2 of 4

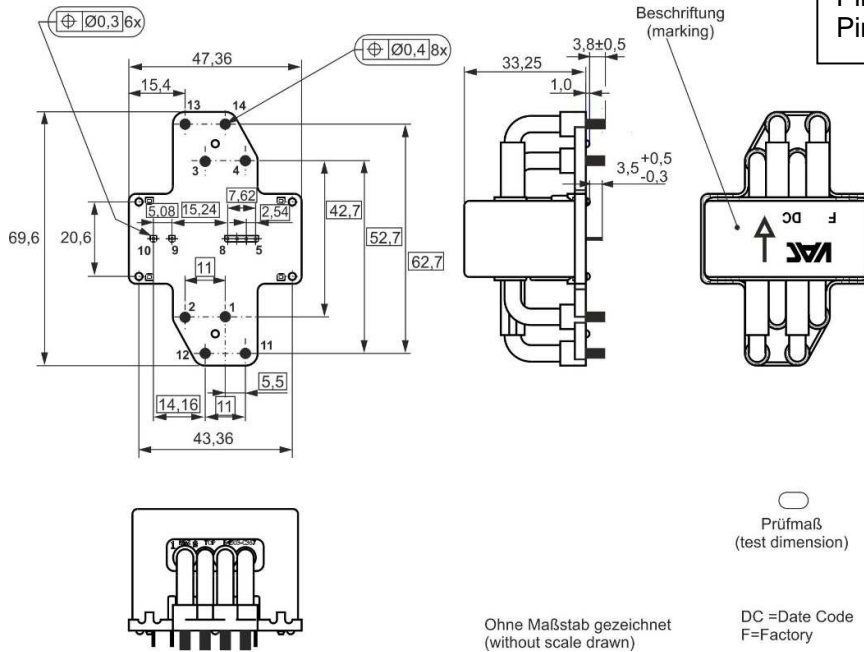## Mechanical outline (mm): General tolerances DIN ISO 2768-c

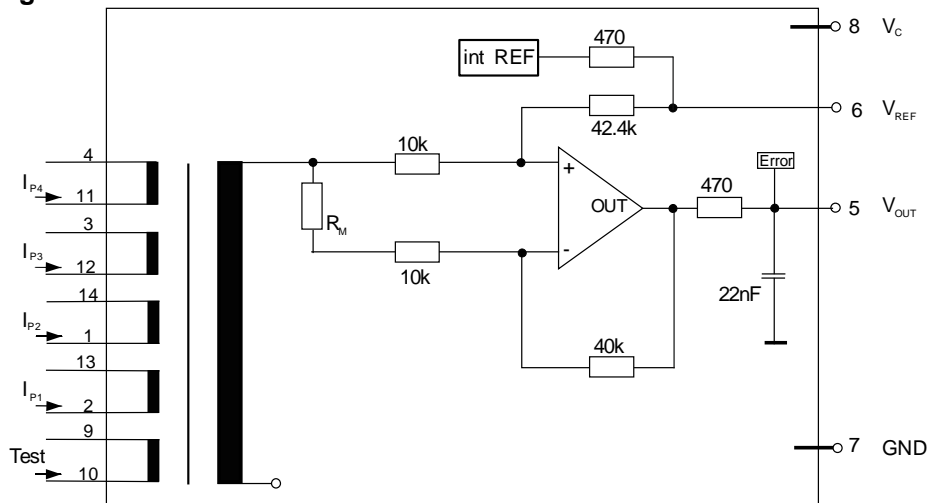Connections:

Pin 5-10: 0.7mm x 0.7mm
Pin 1-4, 11-14: Ø4.5mm

Beschriftung (marking)

Marking:

VAC
4646-X931
F   DC

DC = Date Code
F = Factory

Ohne Maßstab gezeichnet
(without scale drawn)

Prüfmaß
(test dimension)

Current direction: A positive output voltage appears at point V$_{OUT}$, if primary current flows in direction of the arrow.

Schematic diagram:

Schematic labels: int REF, 470, 8 V$_C$, 6 V$_{REF}$, 42.4k, 4, I$_{P4}$ 11, 10k, +, OUT, Error, 470, 5 V$_{OUT}$, R$_M$, 3, I$_{P3}$ 12, 10k, -, 22nF, 14, I$_{P2}$ 1, 13, 40k, I$_{P1}$ 2, 9, Test 10, 7 GND

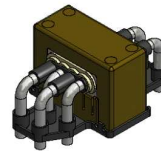| Hrg.: MC-PD editor	Bearb.: DJ designer	MC-PM: ZP check		freig.: BEF released

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Customer: Standard Type	Customers Part no:		Page 3 of 4

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	$16mA+I_{\Delta P}*K_N+V_{OUT}/R_L$			mA
$I_{OUT,SC}$	Short circuit output current		±20		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		0.1		mΩ
$R_{i,REF}$	Internal resistance of reference input		470		Ω
$R_{i,OUT}$	Output resistance of V_{OUT}		470		Ω
$\Delta X_{Ti}/\Delta T$	Temperature drift of X @ ϑ_A = -40°C ... 85°C			400	ppm/K
$\Delta V_{REF}/\Delta T$	Temperature drift of V_{REF} @ ϑ_A = -40°C ... 85°C		5	50	ppm/K
$\Delta V_O = \Delta(V_{OUT}\text{-}V_{REF})$	Sum of any offset drift including:			30	mV
V_{Ot}	Long term drift of V_O			10	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			20	mV/V
V_{OH} $V_{OH, Demag}$	Hysteresis of V_{OUT} @ $I_{\Delta P}$ = 0 (after an overload of 1000x $I_{\Delta N}$) Hysteresis after Degaussing		125	250 40	mV
v_{OSS}	Offsetripple (without external filter)			150	mV
v_{OSS}	Offsetripple (with 20 kHz-Filter, first order)		25		mV
v_{OSS}	Offsetripple (with 1.6 kHz-Filter, first order)		10		mV
	Mechanical stress according to M3209/3 Settings: 10-2000Hz, 1min/Octave, 2 hours		2		g

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

				min.	typ.	max.	Unit
V_{OUT} (SC)	(100%) M3011/6:	Output voltage vs. reference			1182 … 1218		mV
V_O	(100%) M3226:	Offset voltage ($V_{OUT}\text{-}V_{REF}$)				15	mV
U_d	(100%) M3014:	Test voltage, 1s, Pin 1-4 vs. Pin 5-10, *acc. table 21				2.0	kV$_{RMS}$
U_{PDE} U_{PDE}*1.875	(AQL 1/S4) M3024:	Partial discharge voltage (extinction) *acc. table 24 Pin 1-4 vs. Pin 5-10				1.2 1.5	kV$_{RMS}$

Requalification Tests: (replicated every year, Precondition acc. to M3236)

			min.	typ.	max.	Unit
$\hat{U}_W$	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 11,12 and Pin 12 vs. Pin 1,2			6	kV
U_d	M3014	Test voltage, 5s Pin 1-4 vs. Pin 5-10			2.0	kV$_{RMS}$
$U_{d, prim-prim}$	M3014	Test voltage between primary conductors, 5s Pin 1 vs. Pin 11,12 and Pin 12 vs. Pin 1,2			2.0	kV$_{RMS}$
U_{PDE} U_{PDE}*1.875	M3024	Partial discharge voltage (extinction) *acc. table 24			1.2 1.5	kV$_{RMS}$

* IEC 61800-5-1:2007

Other instructions
- Temperature of the primary conductor should not exceed 100°C.
- Housing and bobbin material UL-listed: Flammability class 94V-0.

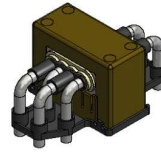| Hrg.: MC-PD editor	Bearb.: DJ designer		MC-PM: ZP check		freig.: BEF released

VAC VACUUMSCHMELZE	**Specification**	**Item no.: T60404-N4646-X931**

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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 $I_{\Delta N}$:

$$X_{ges(I_{\Delta N})} = 100 * \left| \frac{V_{OUT}(I_{\Delta N}) - 2.5V}{1.2V} - 1 \right| \%$$
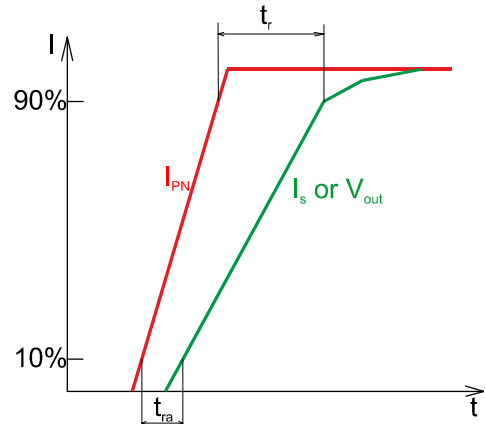
X — Permissible measurement error in the final inspection at RT, defined by

$$X = 100 * \left| \frac{V_{OUT}(I_{\Delta N}) - V_{OUT}(0)}{1.2V} - 1 \right| \%$$

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_P is any input DC current and V_{OUT} the corresponding output term. ($I_O = 0$).

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.

$$V_{OUT} = V_{REF} \pm \frac{1.2 \cdot \frac{5V}{R + R_{Test}} \cdot 20}{I_{\Delta N}}$$