VACUUMSCHMELZE	**SPECIFICATION**	**Item no.:**	**T60404-N4646-X410**

K-No.: 24616	**50 A Current Sensor** For the electronic measurement of currents: DC, AC, pulsed, mixed ..., with a galvanic Isolation between the primary circuit (high power) and the secondary circuit (electronic circuit)	Date: 20.01.2022
Customer: Standard type	Customers Part no.:	

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
- Low 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
- Uninterruptable Power Supplies (UPS)

Electrical data – Ratings[1)]

I_{PN}	Primary nominal r.m.s. current	50	A
R_M	Measuring resistance V_C=± 12V	10 ... 200	Ω
	V_C=± 15V	22 … 400	Ω
I_{SN}	Secondary nominal r.m.s. current	50	mA
K_N	Turns ratio	1…3 : 1000	

Accuracy – Dynamic performance data[1)]

		min.	typ.	max.	Unit
$I_{P,max}$	Max. measuring range				
	@ V_C = ±12V, R_M = 10 Ω (t_{max} = 10sec)	±112			A
	@ V_C = ±15V, R_M = 22 Ω (t_{max} = 10sec)	±128			A
X	Accuracy @ I_{PN}, T_A= 25°C		0.1	0.5	%
ε_L	Linearity			0.1	%
I_0	Offset current @ I_P=0, T_A= 25°C		0.02	0.1	mA
t_r	Response time		500		ns
Δt ($I_{P,max}$)	Delay time at di/dt = 100 A/µs		200		ns
f	Frequency bandwidth	DC...200			kHz

General data[1)]

		min.	typ.	max.	Unit
T_A	Ambient operating temperature	-40		+85	°C
T_S	Ambient storage temperature	-40		+90	°C
m	Mass		13.5		g
V_C	Supply voltage	±11.4	±12 or ±15	±15.75	V
I_C	Current consumption		18,5		mA
	Constructed and manufactored and tested in accordance with EN 61800-5-1 (Pin 1 - 6 to Pin 7 – 9)				
	Reinforced insulation, Insulation material group 1, Pollution degree 2				
S_{clear}	clearance (component without solder pad)	10.2			mm
S_{creep}	creepage (component without solder pad)	10.2			mm
V_{sys}	System voltage overvoltage category 3	RMS		600	V
V_{work}	Working voltage (table 7 acc. to EN61800-5-1)	RMS		1020	V
U_{PD}	Rated discharge voltage	peak value		1400	V
Max. potential difference acc. to UL 508		RMS		600	V_{AC}

Date	Name	Isuue	Amendment
20.01.2022	NSch.	81	Applicable document changed on sheet 4. „The color of the plastic material… added. Minor change
18.04.13	KRe	81	Mechanical outline: marking with UL-sign. and max. potential difference added. CN-660

Hrsg.: KB-E editor	Bearb: Le designer		KB-PM IA: KRe. check			freig.: SB released

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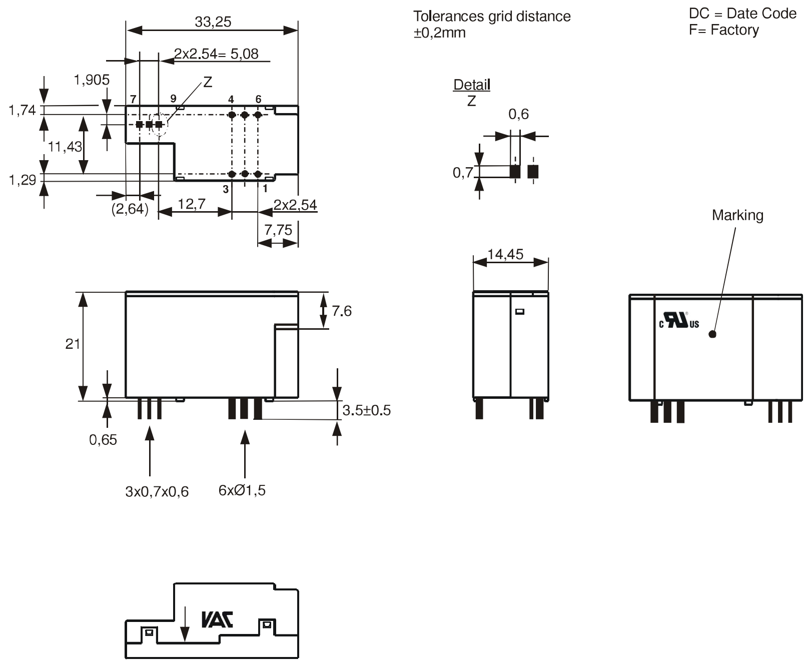
Mechanical outline (mm): General tolerances DIN ISO 2768-c

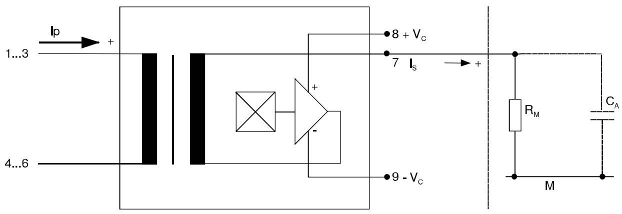


Connections:
1...6: ∅ 1,5 mm
7...9: 0,6x0,7 mm

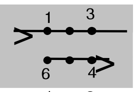
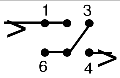
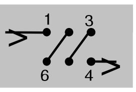
Marking:

UL-sign
4646X410
F DC

Schematic diagram



Possibilities of wiring for V_C = ±15V (@ T_A = 85°C, R_M = 22 Ω)

primary windings N_P	primary current RMS I_P [A]	primary current maximal $\hat{I}_{P,max}$ [A]	output current RMS $I_S(I_P)$ [mA]	turns ratio K_N	primary resistance R_P [mΩ]	wiring
1	50	128	50	1:1000	0,12	
2	20	64	40	2:1000	0,54	
3	15	43	45	3:1000	1,1	

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Electrical Data (investigate by a type checking)

		min.	typ.	max.	Unit
V_{Ctot}	Maximum supply voltage (without function) ±15.75 … ±18 V: for 1s per hour			±18	V
R_S	Secondary coil resistance @ T_A=85°C			88	Ω
R_p	Primary coil resistance per turn @ T_A=25°C			0.36	mΩ
X_{Ti}	Temperature drift of X @ T_A = -40 ... +85 °C			0.1	%
I_{0ges}	Offset current (including I_0, I_{0t}, I_{0T})			0.15	mA
I_{0t}	Long term drift Offset current I_0		0.05		mA
I_{0T}	Offset current temperature drift I_0 @ T_A = -40 ...+85°C		0.05		mA
I_{0H}	Hyteresis current @ I_P=0 (caused by primary current 3 x I_{PN})		0.04	0.1	mA
$\Delta I_0/\Delta V_C$	Supply voltage rejection ratio			0.01	mA/V
i_{oss}	Offset ripple* (with1 MHz- filter first order)			0,15	mA
i_{oss}	Offset ripple* (with 100 kHz- filter first order)		0.03	0.05	mA
i_{oss}	Offset ripple* (with 20 kHz- filter first order)		0.007	0.01	mA
C_k	Maximum possible coupling capacity (primary – secondary)		4		pF
	Mechanical Stress according to M3209/3 Settings: 10 – 2000 Hz, 1 min/Oktave, 2 hours			10g	

An exceptionally high rate of on/off – switching of the supply voltage accelerates the aging process of the sensor.

Inspection (Measurement after temperature balance of the samples at room temperature)

$K_N(N_1/N_2)$	(V)	M3011/6	Transformation ratio (I_P=3*10A, 40-80 Hz)	1…3 : 1000 ± 0.5	%
I_0	(V)	M3226	Offset current	< 0.1	mA
$V_{P,eff}$	(V)	M3014	Test voltage, rms, 1s Pin 1 - 6 to Pin 7 - 9	2.5	kV
V_e	(AQL 1/S4)		Partial discharge voltage acc. M3024 (RMS)	1500	V
			with V_{vor} (RMS)	1875	V

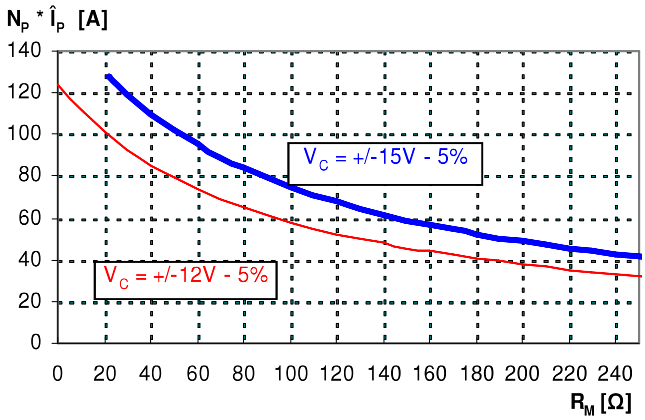
Type Testing (Pin 1 - 6 to Pin 7 – 9)

Designed according standard EN 61800 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 acc. M3014 (RMS)	(5 s)	5	kV
V_e	Partial discharge voltage acc. M3024 (RMS)		1500	V
	with V_{vor} (RMS)		1875	V

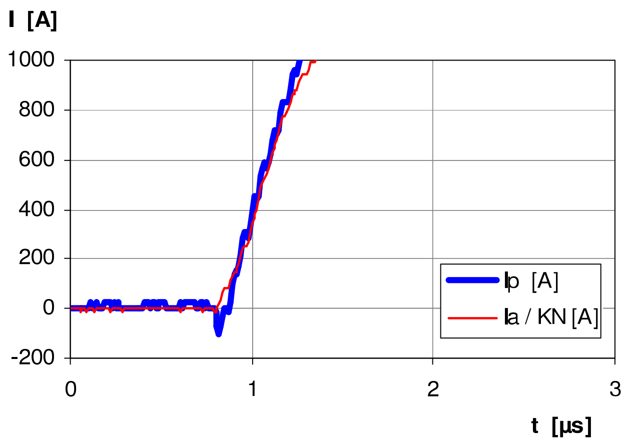
Limit curve of measurable current $\hat{I}_P(R_M)$

@ ambient temperature $T_A \leq 85$ °C



Maximum measuring range (µs-range)

Output current behaviour of a 3kA current pulse
@ $V_C = \pm 15$V und $R_M = 25\Omega$



Fast increasing currents (higher than the specified $I_{p,max}$), e.g. in case of a short circuit, can be transmitted because the currents are transformed directly.

Offsetripple reduction

The offset ripple can be reduced by an external low pass. Simplest solution is a passive low pass filter of 1st order with

$$f_g = \frac{1}{2\pi \cdot R_M \cdot C_a}$$

In this case the response time is enlarged.
It is calculated from:

$$t_r' \leq t_r + 2{,}5 R_M C_a$$

Applicable documents

Current direction: A positive output current appears at point I_S, by primary current in direction of the arrow.
Constructed and manufactored and tested in accordance with EN 61800.
Further standards UL 508 ; file E317483, category NMTR2 / NMTR8
Temperature of the primary conductor should not exceed 100°C.
„The color of the plastic material is not specified and the current sensor can be supplied in different colors (e.g. brown, black, white, natural). This has no effect on the specifications or UL approval."

Explanation of sever al of the terms used in the tablets (in alphabetical order)

I_{0H}: Zero variation of I_o after overloading with a DC of tenfold the rated value ($R_M = R_{MN}$)

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

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

Δt (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 current i_a with a primary current rise of di_1/dt = 100 A/µs.

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

$$X_{ges} = 100 \cdot \left| \frac{I_S(I_{PN})}{K_N \cdot I_{PN}} - 1 \right| \%$$

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

$$X = 100 \cdot \left| \frac{I_{SB}}{I_{SN}} - 1 \right| \%$$

where I_{SB} is the output DC value of an input DC current of the same magnitude as the (positive) rated current ($I_o = 0$)

X_{Ti}: Temperature drift of the rated value orientated output term. I_{SN} (cf. Notes on F_i) in a specified temperature range, obtained by:

$$X_{Ti} = 100 \cdot \left| \frac{I_{SB}(T_{A2}) - I_{SB}(T_{A1})}{I_{SN}} \right| \%$$

ε_L: Linearity fault defined by $\varepsilon_L = 100 \cdot \left| \frac{I_P}{I_{PN}} - \frac{I_{Sx}}{I_{SN}} \right| \%$

Where I_P is any input DC and I_{Sx} the corresponding output term. I_{SN}: see notes of F_i ($I_o = 0$).