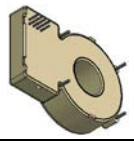
VACUUMSCHMELZE	**Specification**	**Item no.: T60404-N4641-X904**
K-No.: 30028	**Differential Current Sensor for stationary applications acc. to the standard IEC62955** 	Date: 10.03.2020
Customer: Standard type		Page 1 of 7

Description
- Fluxgate current sensor with toroidal core
- PCB mounting

Characteristics
- Excellent accuracy
- AEC-Q qualified components
- Switching open-collector outputs
- Compact design

Applications
Mainly used for stationary and mobile applications:
- IC-CPD
- Wallbox

Electrical data – Ratings		**min.**	**typ.**	**max.**	**Unit**
I_P	Primary nominal RMS current (1phase / 3phase)			80 / 40	A
$I_{\Delta N1}$	Rated residual operating current 1		6		mA DC
$I_{\Delta N1,\ tolerance}$	Trip tolerance 1	4	5	6	mA DC
$S_{PWM-OUT}$	Scaling factor of the DC component $I_{\Delta N1}$ **(for monitoring purpose only!)**		3.33		%/mA
$I_{\Delta RI,1}$ (Fig.1)	Recovery current level for $I_{\Delta N1}$ (absolute value DC)		2.5		mA
Accuracy – Dynamic performance data					
$I_{\Delta N,max}$	Max. measuring range (peak)	-300		+300	mA
X	Resolution (@ $I_{\Delta N}$, Θ_A = 25°C)		< 0.2		mA
f_{BW} ($I_{\Delta N1}$)	Frequency range		DC		
General data					
ϑ_A	Ambient operation temperature	-40		85	°C
$\vartheta_{Storage}$	Ambient storage temperature(4)	-40		85	°C
m	Mass		21		g
V_{CC}	Supply voltage	4.8	5	5.2	V
I_{CC}	Consumption current	38		45	mA
$S_{clear,\ ps}$	Clearance (primary to secondary)	not applicable if isolated cable is used(5)			
$S_{creep,\ ps}$	Creepage (primary to secondary)	not applicable if isolated cable is used(5)			
FIT	EN/IEC 61709 / SN 29500(6) (MIL-HDBK-217F)(6)		1529 (6349)		fit
SW	Firmware		D596 V1.08		

(3) **Switching time of a standard relay (t = 20ms) is considered.**

(4) **see VAC M-sheet 3101; storage temperature inside cardboard packaging**

(5) **Constructed, manufactured and tested in accordance with IEC60664-1:2007**
Isolated wires are preferred to fulfill the insulation coordination acc. to IEC 62955:2018, it is necessary to use insulated primary conductors that meet the requirements of the basic insulation for the rated voltage. If isolated primary conductors are used, the isolation coordination is acc. to: Reinforced insulation, Insulation material group 1, Pollution degree 2 and overvoltage category III.

(6) **The results are valid under following conditions: 55°C mean component ambient temperature by continuous operation (8760h per year); Environment condition: ground mobile, no dust or harmful substances, according to IEC61709; Fit equals one failure per 10^9 component hours.**

General description of sensor function:

The sensor is sensitive to DC currents and can be used for fault current detection in EV-charging applications according IEC 62955:2018. In the event of a DC fault current, PIN3 and PIN4 will change its state from a low level to a high impedance state.
Error conditions (e.g. an internal error) are signaled on PIN 1 (ERROR-OUT).

The sensor only fulfills the switch-off characteristic of the IEC62955 standard (monitoring the residual current). An additional driver-circuit must be used for driving RCBO, RCCB or circuit breaker as defined in IEC62955. The sensor's outputs are limited to max. 40V/50mA!

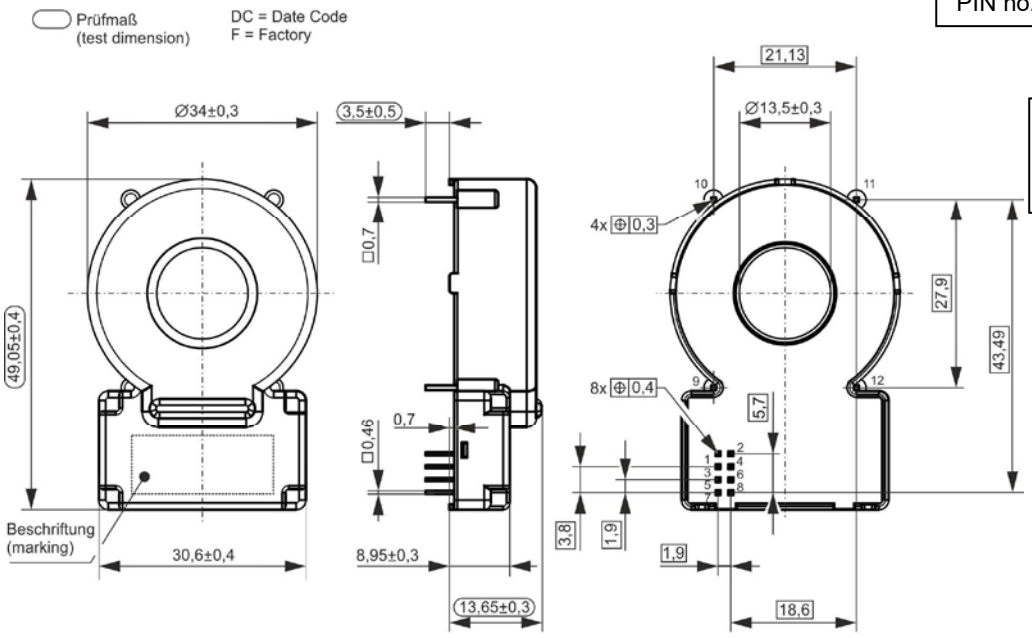
Datum	Name	Index	Änderung
		81	

Editor.: R&D-PD-NPI D	Designer: MB		MC-PM: BZ			Released by: SB

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

Connections:

PIN no. 1-8: 0.46mm x 0.46mm
PIN no. 9-12: 0.7mm x 0.7mm



Marking:

benvac
4641-X904
F DC

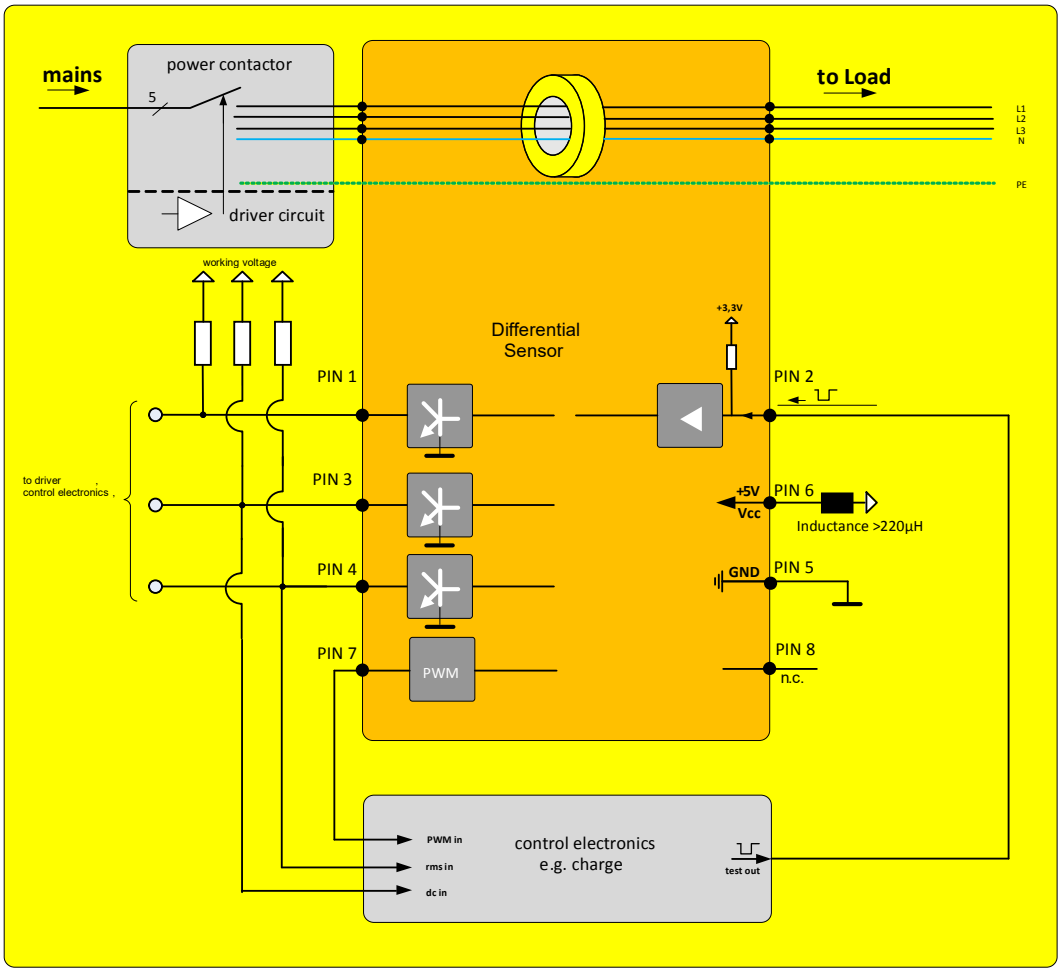
Content of Data-Matrix-Code is: VAC, 4641-X904, F, DC

Datecode Format: [YWW]
Example: J04: 2017, Week 4

PIN description:

PIN no.	Description
PIN 1 → ERROR-OUT (open collector output)	If no system fault is detected, the output PIN 1 is a low level (GND). If a system fault is detected, PIN 1 is high impedance. In this case, PINs 3 and 4 will be set to a high impedance state (see tab. 1).
PIN 2 → TEST-IN (refer to Fig. 2)	A function test including an offset measurement (this value is stored in EEPROM for further calculation) is activated if this PIN is connected to GND for a period of 30ms to 1.2s. If the PIN is set to GND less than 30ms or more than 1.2s, no function test will be performed. **Attention:** During the functional test and offset measurement, no differential current may flow. To ensure high accuracy of the sensor this test should be activated at regular intervals (e.g. at startup, before measuring…). If a push-pull switch is used, the voltage range must be 0V…5V.
PIN 3 → X6-OUT (open collector output)	If the residual current is below DC 6mA and no system fault occurs the output on PIN 3 is a low level (GND). In any other case output PIN 3 is in a high impedance state.
PIN 4 → X30-OUT (open collector output)	If PIN 3 is high impedance, PIN 4 will also be set to high impedance (see tab. 1).
PIN 5 → GND	Ground connection
PIN 6 → VCC	Positive supply voltage
PIN 7 → PWM-OUT	Acc. to the DC component of residual current a duty-cycle with f=8kHz is generated. This is for monitoring purposes only and is not safety function! Refer to $S_{PWM-OUT}$ = 3.33%/mA
PIN 8 → N.C.	Not connected

Typical application diagram:



Absolute maximum Ratings[6]:

		Min	Typ.	Max	Unit
V_{CE}	Collector-Emitter voltage (PINs 1, 3 and 4)			40	V
I_C	Collector current (PINs 1, 3 and 4)			50	mA
V_{CC}	Maximum supply voltage (without function)	-0.3		7	V
U_{MAX}	Maximum rated voltage of primary conductors (AC rms)			250	V
$V_{TEST-IN, low}$	TEST-IN Input Voltage, low level	0		0.6	V
$V_{TEST-IN, high}$	TEST-IN Input Voltage, high level	2.5		5	V

[5] Stresses above these ratings may cause permanent damage.
Exposure to these conditions for extended periods may degrade device reliability.
Functional operation of the device at these or any other conditions beyond those specified is not supported.

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

		Min.	Max.	Unit
Vcc	Supply voltage	4.9	5.1	V
Icc	Supply current	38.0	45.0	mA
TEST-IN (SC)	TEST-IN voltage	2.8	3.4	V
X6-OUT (normal)	X6-OUT voltage	0	0.6	V
X30-OUT (normal)	X30-OUT voltage	0	0.6	V
ERROR-OUT (normal)	ERROR-OUT voltage	0	0.6	V
X6-OUT (activated)	X6-OUT voltage activated @5V, 1kΩ (pull-up)*	4.9	5.1	V
X30-OUT (activated)	X30-OUT voltage activated @5V, 1kΩ (pull-up)*	4.9	5.1	V
ERROR-OUT (activated)	ERROR-OUT voltage activated @5V, 1kΩ (pull-up)*	4.9	5.1	V
TC1	Trip current 1 – X6	4.1	5.4	mA
TC2	Trip current 2 – X6	-5.4	-4.1	mA
PWM-OUT (frequency)	PWM-OUT frequency	7.8	8.2	kHz
PWM-OUT (duty-cycle)	PWM-OUT duty-cycle @6mA DC	18	22	%
LV1	Limit values of break time - X6-OUT@6mA DC	0	700	ms
LV2	Limit values of break time - X6-OUT@30mA DC	0	500	ms
NTC1	X6-OUT & X30-OUT@50mA,50Hz	0	0,6	V

* the maximum values of collector-emitter voltage and current see “Absolute maximum ratings”

Product Tests:

	Acc. to VAC sheet M3238 Following tests differ from M3238: 4.5a: Damp heat, steady state. Duration: 1000 h	passed	
PD	IEC61000-4-1, EN60270, M3024 UPDE M3024, Partial discharge voltage (extinction) *acc. to table 24	1.5	kV rms
ESD	Air- and contact discharge; U=±2000V, R=1500Ω, C=100pF Acc. to Human Body Model JESD22-A114	±2.0	kV
EMC	IEC61000-4-3 (Radiated, radio-frequency, electromagnetic field immunity) 20V/m 80MHz – 1GHz 80%AM 1kHz, recommend with the use of inductance of >220µH in series of Vcc input.	passed	
	IEC61000-4-6 (Immunity to conducted disturbances), recommend with the use of inductance of >220µH in series of Vcc input.	passed	
	IEC61000-6-4 (Emission standard for industrial environments, conducted disturbances)	Should be done in end application	
A(f), Φ(f)	Amplitude and phase response over frequency 1% of I_{PN} or $I_{\Delta n}$	passed	
Impulse test	Monitoring of CS function during the current phase test 100A to 5kA	passed	

Requalification Tests: (replicated every year, Precondition acc. to M3238)

$\hat{U}_{W,\ prim\text{-}sec}$	M3064	Impulse test (1.2µs/50µs waveform) PIN 1-8 vs. insulated primary wire 5 pulse ➔ polarity +, 5 pulse ➔ polarity -	8.0	kV
U_d	M3014	Test voltage, 60s PIN 1-8 vs. insulated primary wire	1.5	kV rms
U_{PDE}	M3024	Partial discharge voltage (extinction) PIN 1-8 vs. insulated primary wire *acc. to table 24	1.2	kV rms
U_{PD} x 1.875	M3024	Partial discharge voltage (extinction) PIN 1-8 vs. insulated primary wire *acc. to table 24	1.5	kV rms

* IEC 61800-5-1:2007

Other instructions:

- Temperature of the primary conductor should not exceed 105°C.
- Vcc during Test-IN function test must be at least 4.8V
- Fall- and rise-time of Vcc 2…50µs/V

Figures:

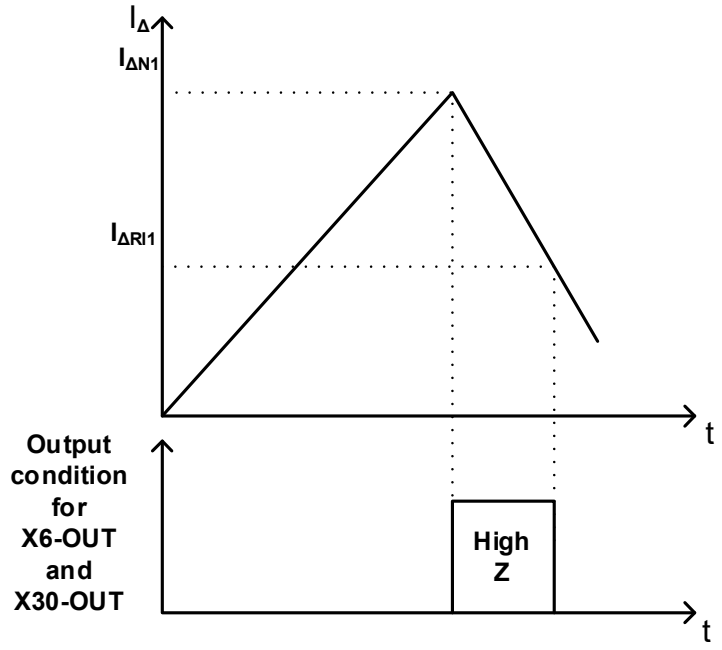
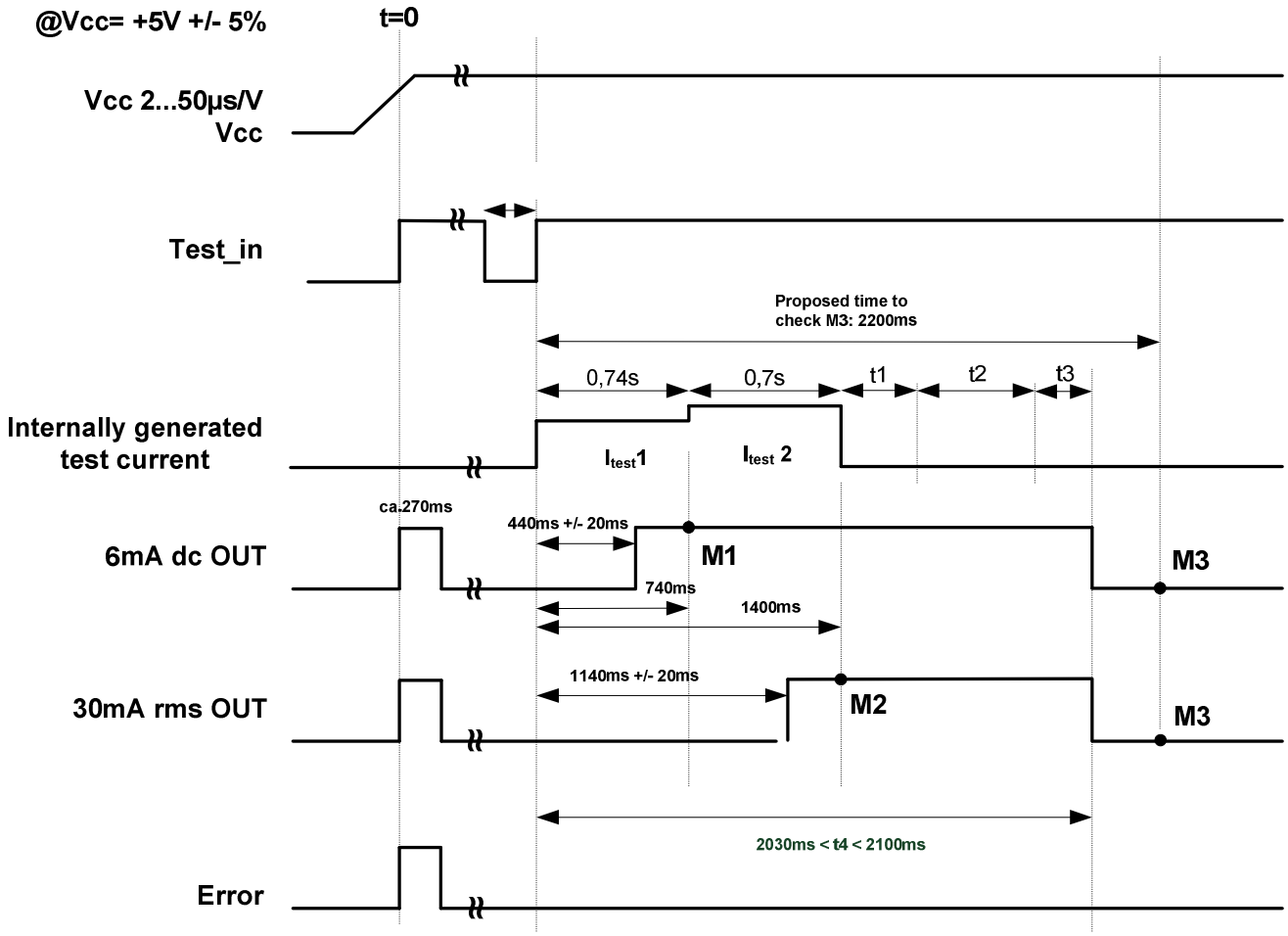


Fig. 1: Meaning of switching recovery level

If the trip-level $I_{\Delta N1}$ is accomplished the output X6-OUT/X30-OUT will change it state from low-level (GND) to high impedance. Depending on the existence of the differential curent I_Δ, the outputs X6-OUT/X30-OUT will remain in this state until I_Δ fell below recovery threshold $I_{\Delta RI1}$.



t1 = 10ms or 100ms — **Optional time to check for welded contacts. 10ms if check is disabled.**

t2 = 500ms — **Time for offset calibration (if it was requested).**

t3 = 0ms to 50ms — **Optional time required to store the offset calibration value. Depends on the difference to the value already stored in memory.**

Fig. 2: Power-Up timing diagram

X6-OUT	X30-OUT	ERROR-OUT	State
low level	low level	low level	Normal condition
low level	low level	low level	$I_\Delta < 30mA_{AC}$
High impedance	High impedance	low level	$I_\Delta \geq 6mA_{DC}$
High impedance	High impedance	High impedance	Error, system fault
All other conditions not mentioned in the table are not possible. If these conditions occur, the sensor is in unknown state and describes an Error.			

Table 1: Possible output states

	6mA	60mA	200mA
Standard values acc. to IEC62955:2018	10s	0.3s	0.1s
Typical values of sensor	0.45s	0.06s	0.035s

Table 2: Maximum and typical values of break time for residual direct currents

Sales and distribution:

Type VAC	Type Bender	Art. No.
T60404-N4641-X904	RDC121-4	B94042493

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