

Item no.: T60404-N4641-X901

Differential Current Sensor for IC-CPD acc. to the standard UL2231



Date: 28.03.2019

K-No.: 26756

Customer: Standard type | Customers Part no: RCMB 121-2

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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:

 Personnel Protection Systems for EV acc. to UL2231

Electrical data	<u> – Ratings</u>	min.	typ.	max.	Unit
I P	Primary nominal RMS current (1phase / 3phase)			80 / 40	Α
I _{ΔN1}	Rated residual operating current 1		5		mA rms
I _{ΔN2}	Rated residual operating current 2		20		mA rms
I _{ΔN1, tolerance}	Trip tolerance 1	4	5	6(1) / 12(2)	mA rms
I _{ΔN2, tolerance}	Trip tolerance 2	15		20(1) / 70(2))	mA rms
S _{PWM-OUT}	Scaling factor of the rms component I _{ΔN1} (for monitoring purpose only!)		2		%/mA
I _{ΔRI,1/2} (Fig.1)	Recovery current level for I _{ΔN1} /I _{ΔN2} (absolute value rms)		2.5 / 10		mA

(1) f = dc to 1kHz (2) f = 1kHz to 2kHz

Accuracy - Dynamic performance data

I _{∆N,max}	Measuring range (peak)	-300	mA			
X	Resolution (@ $I_{\Delta N}$, $\Theta_A = 25$ °C)	< 0.2		mA		
t _r (Fig.3)	Response time	< (20/I _{\(\Delta\)}) ^{1,43} -10	ms (According to UI	_2231-2 Ed. 2)		
f _{BW} (Fig. 4)	Frequency range	DC	2	kHz		
General data						
9 _A	Ambient operation temperature	-40	85	°C		
9 Storage	Ambient storage temperature ⁽³⁾	-40	85	°C		
m	Mass	21		g		
Vcc	Supply voltage	4.8 5	5.2	V		
Icc	Supply current	38	45	mA rms		
S _{clear}	Clearance	not applicab	not applicable if isolated cable is used ⁴			
Screep	Creepage	not applicab	le if isolated cable is	s used ⁴		
FIT	EN/IEC 61709 / SN 29500 ⁽⁵⁾ (MIL-HDBK-217F) ⁽⁵⁾	· ·	29 49)	fit		

⁽³⁾ see M_sheet 3101; storage temperature inside cardboard packaging

General description of sensor function:

The Sensor is sensitive to AC and DC current and can be used for fault current detection in IC-CPD applications. The Sensor detects fault currents according to UL2231-2 Ed.2. In the event of a 5mA rms fault current, PIN 3 will change its state from a low level (GND) to high impedance state. In the event of an 20mA rms fault current, PINs 3 and 4 will change state from a low level (GND) to a high impedance state. Error conditions (e.g. an internal error) are signaled by PIN 1 (ERROR-OUT) which changes state to high impedance.

Datum	Name	Index	Änderung					
28.03.19	BZ	83	Sheet 2, Marking	eet 2, Marking changed from VAC to benvac. CN-19-062				
21.08.18	BZ	82	Sheet 4, Product	eet 4, Product Test M3238 updated. CN-18-158				
Editor.: I	R&D-PD-I	NPI D	Designer: MB		MC-PM: BZ			Released by: SB

⁽⁴⁾ Isolated wires are preferred. If isolated primary conductors are used, the isolation coordination is according to: Reinforced insulation, Insulation material group 1, Pollution degree 2, Sea-Level ≤ 4000m and overvoltage category II.

⁽⁵⁾ 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.



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Mechanical outline (mm):

Specification

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) Prüfmaß

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Connections:

PIN no. 1-8: 0.46mm x 0.46mm

PIN no. 9-12: 0.7mm x 0.7mm

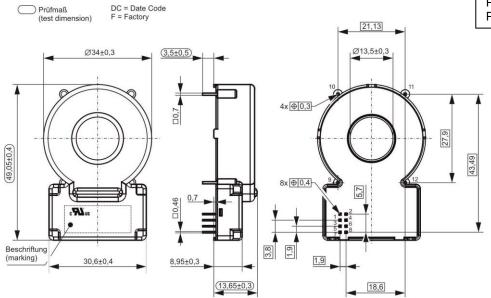
Marking:

UL- benvac sign 4641-X901 DC



Content of Data-Matrix-Code is: benvac 4641-X901, F, DC

Datecode Format: [WWY] 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 at low level (GND). If a system fault is detected, PIN is at high impedance state. In this case, PINs 3 and 4 will be set to a high impedance state too (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 40ms to 1.2s. If the PIN is set to GND less than 40ms or more than 1.2s, no function test will be performed. Attention: During the functional test and offset measurement, no differential current shall flow.
	To ensure high accuracy of the sensor this test shall be activated at regular intervals (e.g. at startup, before measuring).
	If a push-pull switch is used, the voltage range must be 0V5V.
PIN 3 → X5-OUT (open collector output)	If the residual current is below 5mA rms 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. If PIN 4 is high impedance, PIN 3 will also be set to high impedance (see tab. 1).
PIN 4 → X20-OUT (open collector output)	If the residual current is below the 20mA rms and no system fault occurs the output on PIN 4 is a low level (GND). In any other case PINs 3 and 4 is in a high impedance state (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 shall not be used to switch the power relay. Refer to SPWM-OUT = 2%/mA
PIN 8 → N.C.	Not connected

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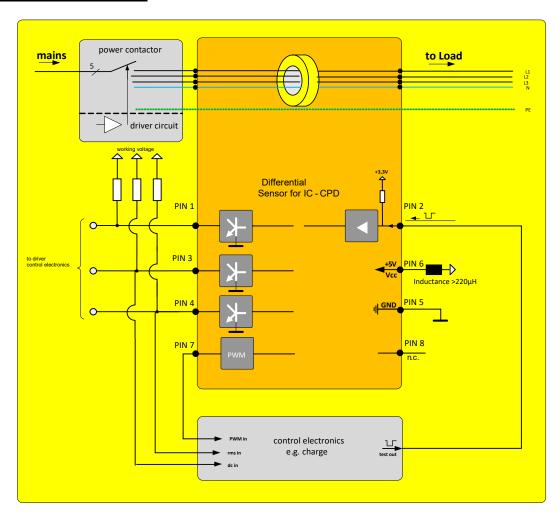
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Typical application diagram:



Absolute maximum Ratings⁽⁶⁾:

Vce	Collector-Emitter voltage (PINs 1, 3 and 4)		40	V
Ic	Collector current (PINs 1, 3 and 4)		50	mA
Vcc	Maximum supply voltage (without function)	-0.3	7	V
U _{MAX}	Maximum rated voltage of primary conductors		250	V
V _{TEST-IN, low}	TEST-IN Input Voltage, low level	0	0.6	V
VTEST-IN, high	TEST-IN Input Voltage, high level	2.5	5	V

⁽⁶⁾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.

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

,	·	Min.	ັMax.	Únit
Vcc	Supply voltage	4.9	5.1	V
lcc	Supply current	38.0	45.0	mA
TEST-IN (SC)	TEST-IN voltage	2.8	3.4	V
X5-OUT (normal)	X5-OUT voltage	0	0.6	V
X20-OUT (normal)	X20-OUT voltage	0	0.6	V
ERROR-OUT (normal)	ERROR-OUT voltage	0	0.6	V
X5-OUT (activated)	X5-OUT voltage activated @5V, 1kΩ (pull-up)*	4.9	5.1	V
X20-OUT (activated)	X20-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 – X5	4.1	5.4	mA
TC2	Trip current 2 – X20	14	20	mA
PWM-OUT (frequency)	PWM-OUT frequency	7.8	8.2	kHz
PWM-OUT (duty-cycle)	PWM-OUT duty-cycle @6mA DC	11	13	%
LV1	Limit values of break time - X5-OUT@6mA, 60Hz	0	700	ms
LV2	Limit values of break time - X5-OUT@30mA, 60Hz	0	700	ms
LV3	Limit values of break time - X20-OUT@20mA, 60Hz	0	1000	ms
LV4	Limit values of break time - X20-OUT@100mA, 60Hz	0	100	ms

^{*} the maximum values of collector-emitter voltage and current see "Absolute maximum ratings"

Pr	OC	luc	:t	Tes	ts:

	Acc. to customer specification Following tests differ from M3238: 3.4a: Rapid change of temperature for 300 cycles 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
	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	
EMC	CISPR 14-1 (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	
Α , Φ	Amplitude and phase response over frequency 1% of I _{PN} or I _{∆n}	passed	
Impulse test	Monitoring of CS function during the current phase test 100A to 5kA	passed	

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

		<u> </u>		
Ûw, prim-sec	M3064	Impulse test (1.2µs/50µs waveform) PIN 1-8 vs. insulated primary wire 5 pulse → polarity +, 5 pulse → polarity -	5.5	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.
- -Housing and bobbin material UL-listed, flammability class 94V-0.
- -Vcc during Test-IN function test must be in rated range.
- -Fall- and rise-time of Vcc: t > 10μs/V
- -Further standards UL 2231 E-file No. 488116, category FFUQ2 / FFUQ8

Figures:

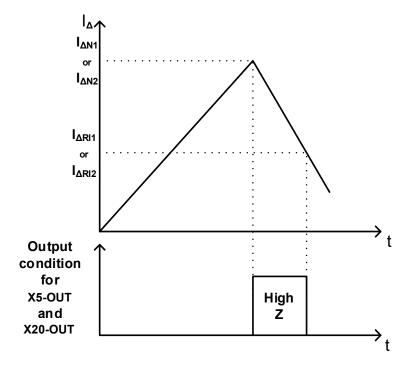


Fig. 1: Meaning of switching recovery level

If the trip-level $I_{\Delta N1}/I_{\Delta N2}$ is accomplished the corresponding output X5-OUT/X20-OUT will change its state from low-level (GND) to high impedance. Depending on the existence of the differential curent I_{Δ} , the outputs X5-OUT/X20-OUT will remain in their states until I_{Δ} is below the recovery threshold $I_{\Delta R11}/I_{\Delta R12}$.

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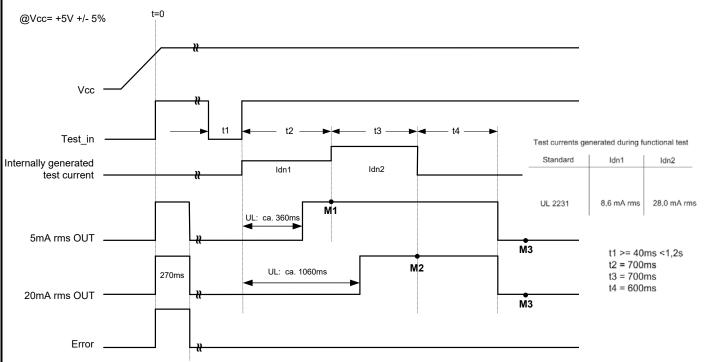


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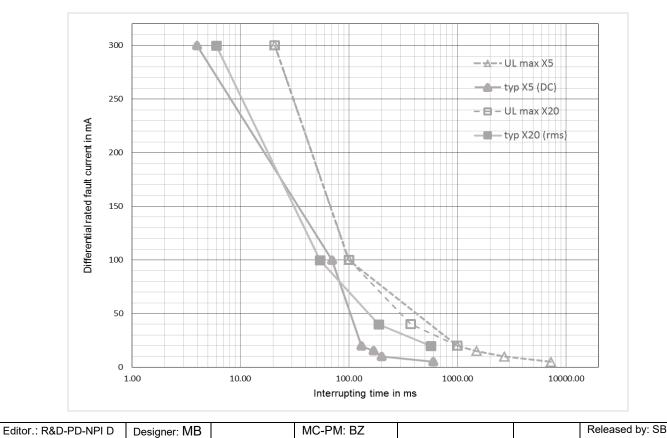
After activating the test sequence, the end product has to monitor the correct state of the switching outputs being used at the following points in time

M1: check that 5mA rms OUT is disabled (latest time)

M2: check that 20mA rms OUT is disabled

M3: check that 20mA rms OUT resp. 5mA rms OUT is enabled

Fig. 2: Power-Up timing diagram





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Fig. 3: Interrupting Time according to UL2231-2 Ed.2, page 30, fig. 6 and typical values of sensor

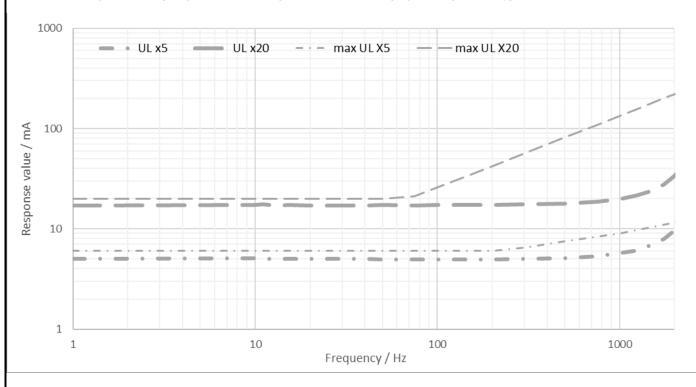


Fig. 4: UL2231 response value over frequency

X5-OUT	X20-OUT	ERROR-OUT	State		
GND	GND	GND	Normal condition		
High impedance	GND	GND	$I_{\Delta N1} \ge 5mA_{rms}$		
High impedance	High impedance	GND	$I_{\Delta N2} \ge 20 \text{mA}_{rms}$		
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 an unknown state and describes an Error.					

Table 1: Possible output states

Sales and distribution:

Type VAC	Type Bender	Art. No.
T60404-N4641-X901	RCMB121-2	B94042491



Bender GmbH & Co. KG • Londorfer Straße 65 • 35305 Grünberg • Germany Tel.: +49 6401 807-0 • info@bender.de • www.bender.de

eMobility • emobility@bender.de • www.bender.de/loesungen/emobility

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