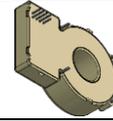


**Differential Current Sensor for IC-CPD
acc. to the standard UL2231**



Date: 28.03.2019

K-No.: 26756

Customer: Standard type

Customers Part no: RCMB 121-2

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:

- Personnel Protection Systems for EV acc. to UL2231

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		5		mA rms
$I_{\Delta N2}$	Rated residual operating current 2		20		mA rms
$I_{\Delta N1, tolerance}$	Trip tolerance 1	4	5	6 ⁽¹⁾ / 12 ⁽²⁾	mA rms
$I_{\Delta N2, tolerance}$	Trip tolerance 2	15		20 ⁽¹⁾ / 70 ⁽²⁾	mA rms
$S_{PWM-OUT}$	Scaling factor of the rms component $I_{\Delta N1}$ (for monitoring purpose only!)		2		%/mA
$I_{\Delta RI, 1/2}$ (Fig.1)	Recovery current level for $I_{\Delta N1}/I_{\Delta N2}$ (absolute value rms)		2.5 / 10		mA

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

Accuracy – Dynamic performance data

$I_{\Delta N, max}$	Measuring range (peak)	-300		+300	mA
X	Resolution (@ $I_{\Delta N}$, $\Theta_A = 25^\circ C$)		< 0.2		mA
t_r (Fig.3)	Response time		< $(20/I_{\Delta})^{1,43} - 10ms$ (According to UL2231-2 Ed. 2)		
f_{BW} (Fig. 4)	Frequency range	DC		2	kHz

General data

ϑ_A	Ambient operation temperature	-40		85	°C
$\vartheta_{Storage}$	Ambient storage temperature ⁽³⁾	-40		85	°C
m	Mass		21		g
V_{CC}	Supply voltage	4.8	5	5.2	V
I_{CC}	Supply current	38		45	mA rms
S_{clear}	Clearance		not applicable if isolated cable is used ⁴		
S_{creep}	Creepage		not applicable if isolated cable is used ⁴		
FIT	EN/IEC 61709 / SN 29500 ⁽⁵⁾ (MIL-HDBK-217F) ⁽⁵⁾		1529 (6349)		fit

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

⁽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 10⁹ component hours.

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 changed from VAC to benvac. CN-19-062
21.08.18	BZ	82	Sheet 4, Product Test M3238 updated. CN-18-158

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

Product Tests:

	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
A , Φ	Amplitude and phase response over frequency 1% of I _{PN} or I _{Δn}	passed
Impulse test	Monitoring of CS function during the current phase test 100A to 5kA	passed

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

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

$\hat{U}_{W, \text{prim-sec}}$	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
$U_{PD} \times 1.875$	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: $t > 10\mu\text{s/V}$
- Further standards UL 2231 E-file No. 488116, category FFUQ2 / FFUQ8

Figures:

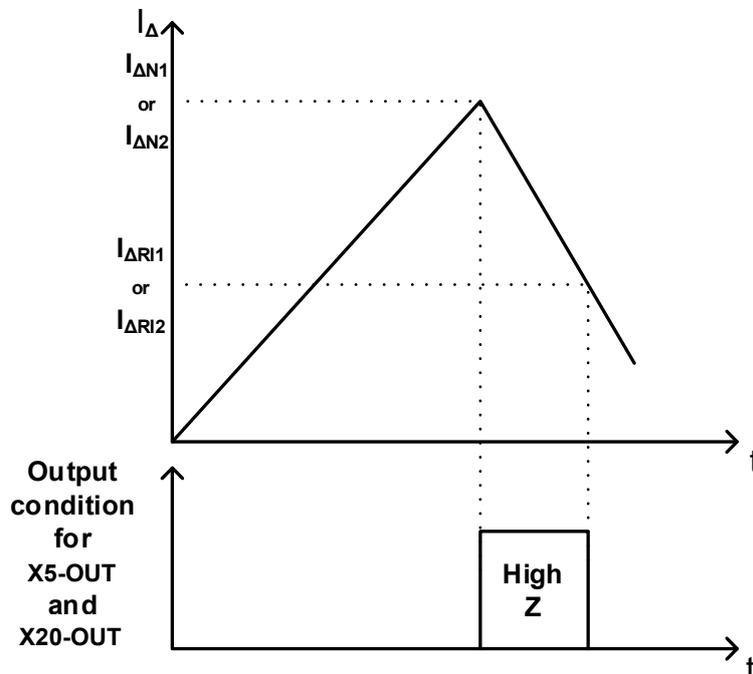
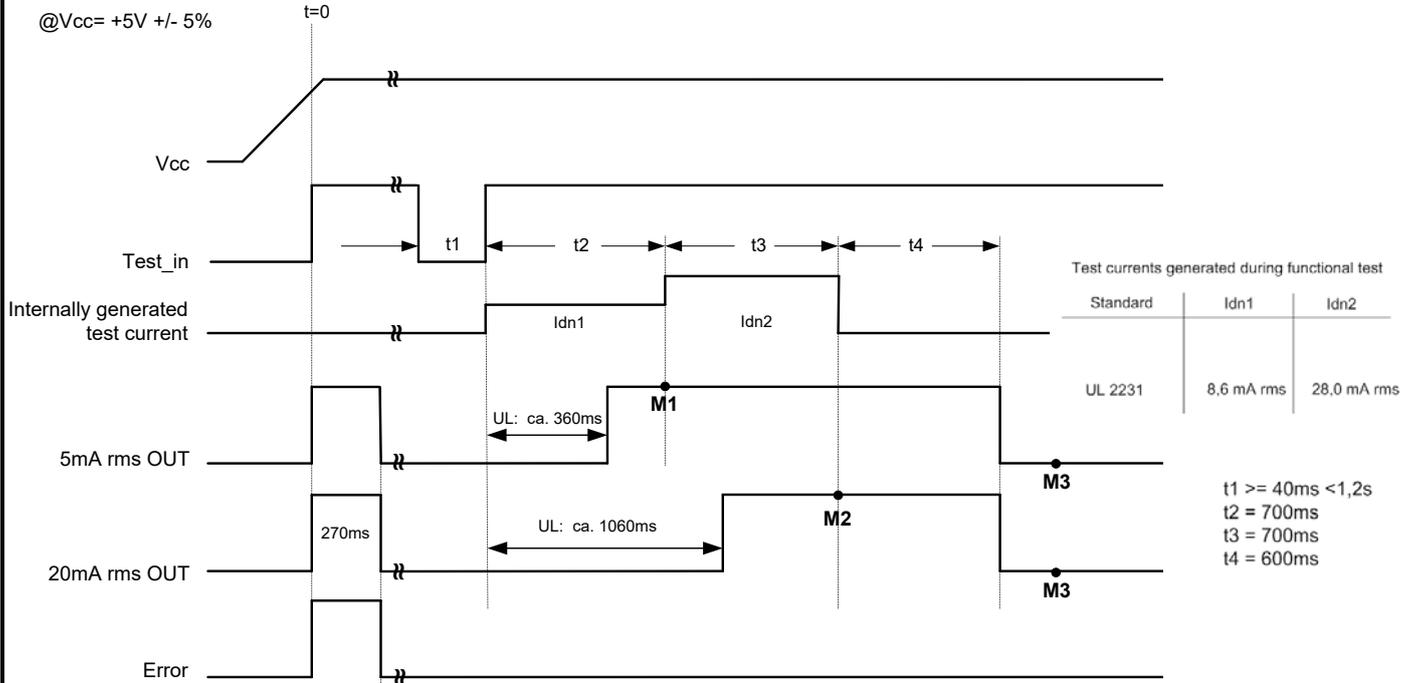


Fig. 1: Meaning of switching recovery level

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 current I_{Δ} , the outputs X5-OUT/X20-OUT will remain in their states until I_{Δ} is below the recovery threshold $I_{\Delta R11}/I_{\Delta R12}$.



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

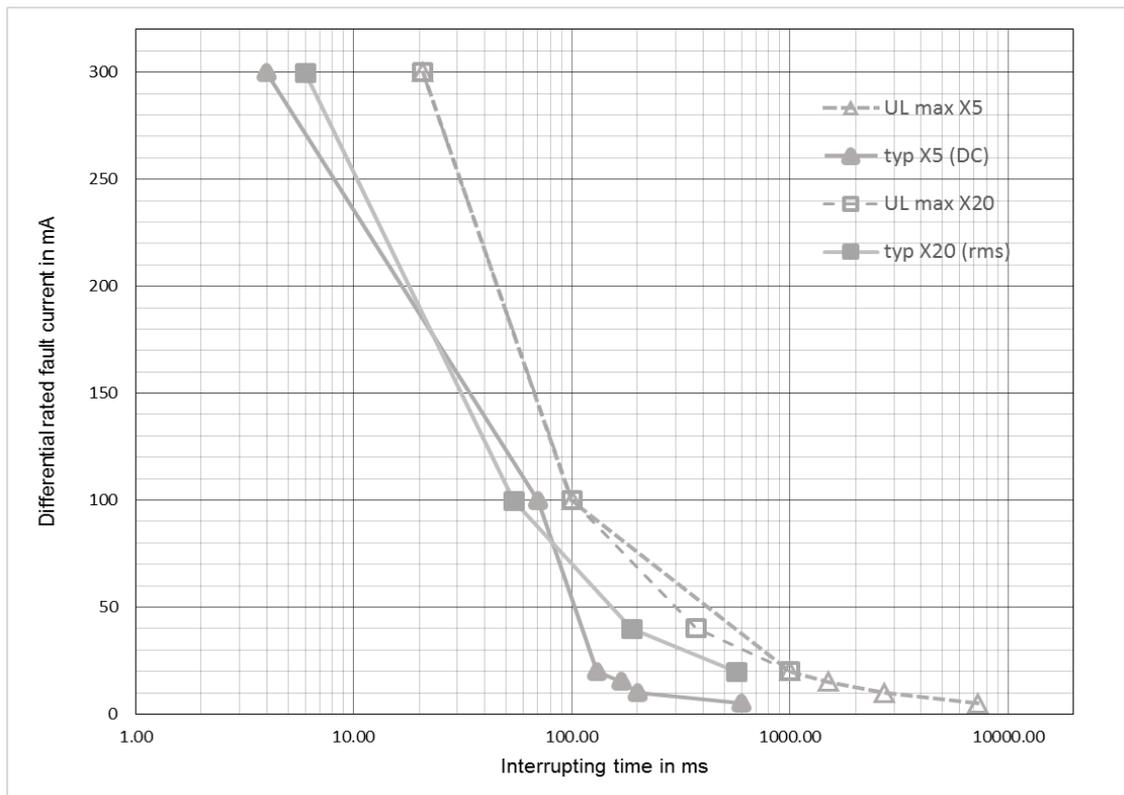


Fig. 3: Interrupting Time according to UL2231-2 Ed.2, page 30, fig. 6 and typical values of sensor

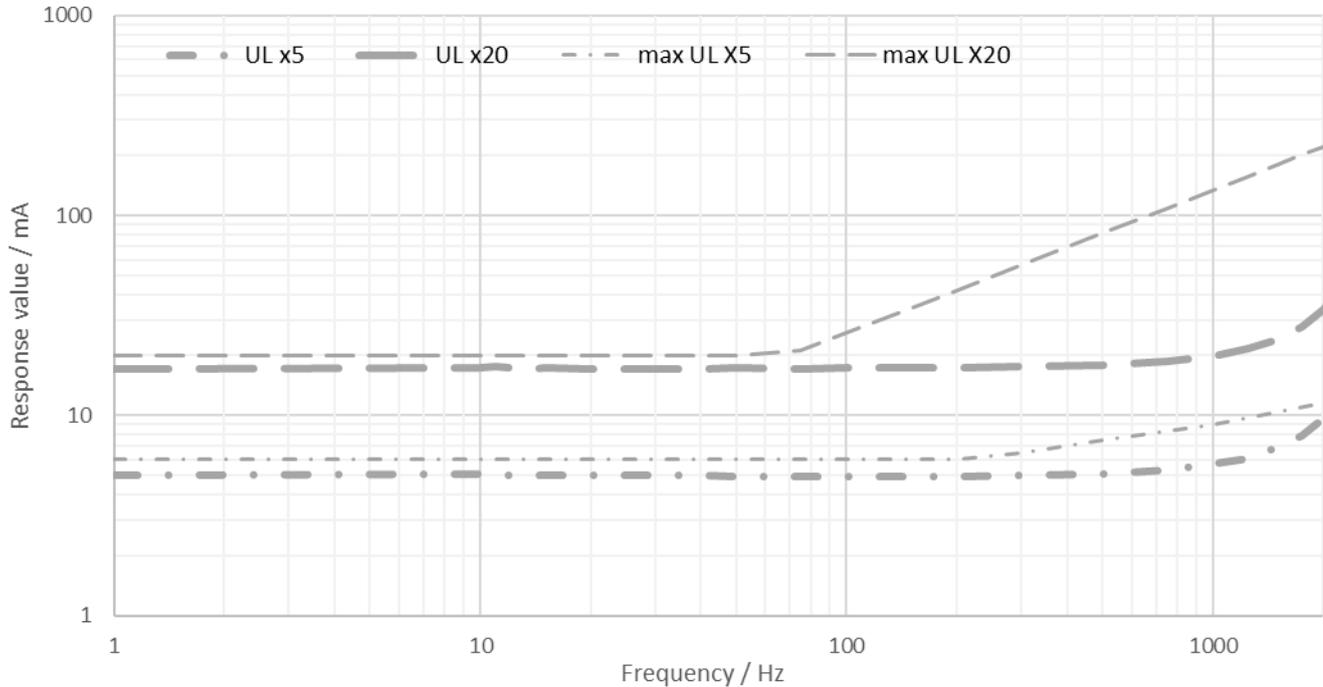


Fig. 4: UL2231 response value over frequency

X5-OUT	X20-OUT	ERROR-OUT	State
GND	GND	GND	Normal condition
High impedance	GND	GND	$I_{\Delta N1} \geq 5mA_{rms}$
High impedance	High impedance	GND	$I_{\Delta N2} \geq 20mA_{rms}$
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



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