

Item no.: T60404-N4641-X805

Differential Current Sensor with tripping characteristic acc. to the partly standard IEC62752:2016



Date: 16.11..2022

K-No.:30616

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Description

Fluxgate current sensor with toroidal core

PCB mounting

Characteristics

- Excellent accuracy
- Switching open-collector outputs
- Compact design

Patents: EP2571128 / US9397494 / CN103001175 // EP2813856

Applications

Mainly used for stationary and mobile applications:

- IC-CPD acc. to IEC62752
- Wallbox

Electrical data	<u>– Ratings</u>	min.	typ.	max.	Unit
I _P	Primary nominal RMS current (1phase / 3phase)		32	40	Α
$I_{\Delta N1}$	Rated residual fault current 1		6		mA dc
$I_{\Delta N2}$	Rated residual fault current 2		30		mA rms
$I_{\Delta N1, tolerance}$	Trip tolerance 1 (PIN X6-OUT)	4		6	mA dc
I _{ΔN2, tolerance}	Trip tolerance 2 (PIN X30-OUT)	20		30(1) / 60(2)	mA rms
S _{PWM-OUT}	Scaling factor of the DC component I _{ΔN1} (for monitoring purpose only!)		3.33		%/mA
$I_{\Delta RI,1/2}$ (Fig.1)	Recovery current level for $I_{\Delta N1}/I_{\Delta N2}$ (absolute value DC/rms)		2.5 / 10		mA

(1) f = rated frequency (2) f = 2kHz

<u>Accuracy – Dynamic performance data</u>

I ΔN,max	Measuring range (peak)	-300	+300	mA
Χ	Resolution (@ $I_{\Delta N}$, $\Theta_A = 25^{\circ}$ C)	< 0.2		mA
tr	Response times	Accor	ding to IEC62752:20	16 ⁽³⁾
f _{BW} (Fig.4)	Frequency range	DC	2	kHz
General data				
9 _A	Ambient operation temperature	-40	85	°C
9 Storage	Ambient storage temperature ⁽⁴⁾	-40	85	°C
m	Mass	21		g
Vcc	Supply voltage	4.8 5	5.2	V
Icc	Supply current	33		mA rms
Sclear, ps	Clearance (primary to secondary)	not applicable	e if insulated cable is	used ⁽⁵⁾
Screep, ps	Creepage (primary to secondary)	not applicable	e if insulated cable is	used ⁽⁵⁾
FIT	EN/IEC 61709 / SN 29500 ⁽⁶⁾	<2	200	fit

 $^{^{(3)}}$ Switching time of a standard relay (IEC: t = 20ms / UL: t = 10ms) is considered.

General description of sensor function:

The Sensor is sensitive to AC and DC current and can be used for fault current detection in wallbox applications or personnel protection systems for EV. The Sensor detects AC/DC fault current according to IEC62752:2016. In the event of a DC fault current, PIN 3 will change its state from a low level (GND) to high impedance state. In the event of an AC fault current, PINs 3 and 4 will change state from a low level (GND) to a high impedance state, see tab.1

Error conditions (e.g. an internal error) are signaled on PIN 1 (ERROR-OUT).

Datum	Name	Index	Änderung				
16.11.2022	SF	81	Change of typical applicat	hange of typical application diagram. CN-22-157			
Editor.: R&D-PD-CS		Designer: SF	MC-PM: BZ	Released by	y: SB		

 $^{^{\}left(4\right)}$ see VAC M-sheet 3101; storage temperature inside cardboard packaging

⁽⁵⁾ Constructed, manufactured and tested in accordance with IEC60664-1:2020 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, 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.



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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

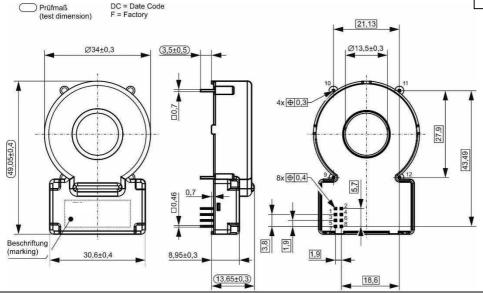
Marking:

benvac 4641-X805 benvac DC



Content of Data-Matrix-Code is: benvac. 4641-X805, 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 → X6/30-OUT (open collector output)	If the residual current is below 6mA dc and no system fault occurs the output on PIN 3 is a low level (GND). If the residual current is below the 30mA rms and no system fault occurs the output on PIN 3 is also a low level (GND). In any other case output PIN 3 is in a high impedance state (see tab. 1).
PIN 4 → X30-OUT (open collector output)	If the residual current is below the 30mA rms and no system fault occurs the output on PIN 4 is a low level (GND). In any other case PIN 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-QUT = 3.33%/mA
PIN 8 → N.C.	Not connected



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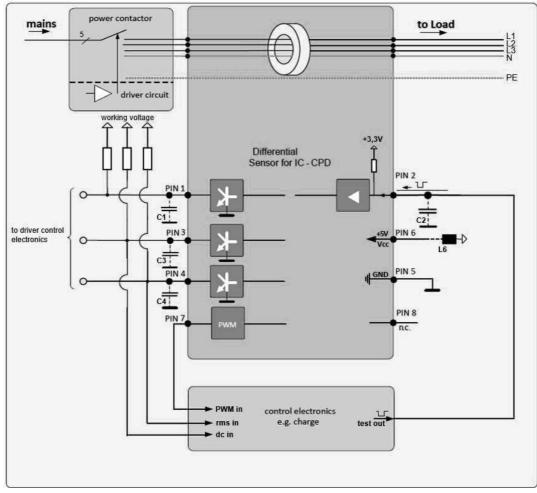
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Typical application diagram:



Recommended: C1, C3, C4 with 100nF to ground and C2 with 10nF to ground as optional EMC improvement. (Components have to be placed close to the device pins)

L6 is not longer recommended for new designs, in existing layouts component L6 should be used with the following parameters:

L6: Inductance ≤220 μH; DC Resistance 1 to 5 Ω

Absolute maximung ratings(7):

		Min.	Typ.	Max.	Unit
Vce	Collector-emitter voltage (PINs 1, 3 and 4)			40	V
lc	Collector current (PINs 1, 3 and 4)			50	mΑ
Vcc	Maximum supply voltage (without function)	-0.3		6	V
U _{MAX}	Maximum rated voltage of primary conductors (AC rms)			250	V
VTEST-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

⁽⁷⁾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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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	16	28	mA
TEST-IN	TEST-IN voltage	2.8	3.4	V
X6/30-OUT (normal)	X6/30-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
X6/30-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 (SC)	Trip current 1 – X6/30	4.5	5.4	mA
TC2 (SC)	Trip current 2 – X6/30	-5.4	-4.5	mA
TC3 (SC)	Trip current 3 – X30@50Hz	20	30	mΑ
TC4 (SC)	Trip current 4 – X30@1000Hz	105	149	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 (SC)	Limit values of break time - X6/30-OUT@6mA DC	0	700	ms
LV2 (SC)	Limit values of break time - X30-OUT@30mA, 50Hz	0	300	ms

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

Product Tests: The EMC product standards can only be fulfilled in the complete application system (more EMC test's can be shown if required).

	Acc. to VAC sheet M3238	passed	
	Following tests differ from M3238:		
	4.5a: Damp heat, steady state. Duration: 1000h		
ESD	Air- and contact discharge; U=±2000V, R=1500Ω, C=100pF acc. to Human Body Model JESD22-A114	±2.0	kV



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Requalifica	Requalification Tests: (replicated every year, Precondition acc. to M3238)					
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.
- Vcc during Test-IN function test must be in rated range.
- Housing and bobbin material UL-listed, flammability class 94V-0.
- Fall- and rise-time of Vcc: t > 20µs/V

Figures:

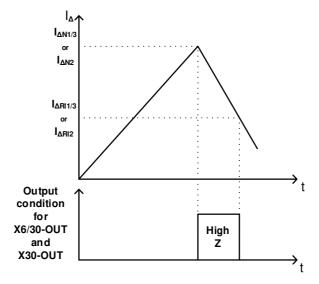


Fig. 1: Meaning of switching recovery level

If the trip-level $I_{\Delta N1}/I_{\Delta N2}$ is accomplished the outputs X6/30-OUT/X30-OUT will change their state from low-level (GND) to high impedance. Depending on the existence of the residual current I_{Δ} , the outputs X6/30-OUT/X30-OUT will remain in this state until I_{Δ} falls below the threshold $I_{\Delta R11}/I_{\Delta R12}$.

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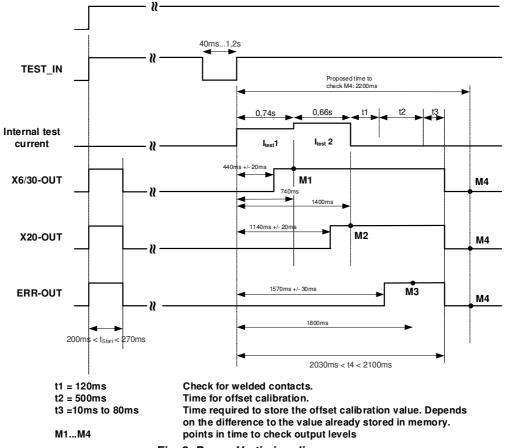


Fig. 2: Power-Up timing diagram

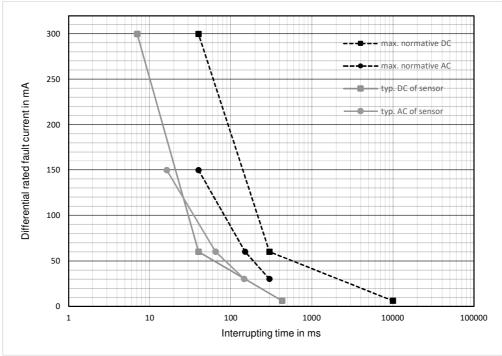


Fig. 3: Interrupting Time according to IEC62752 (E)-1:2016, UL2231-2 Ed.2 and typical values of sensor

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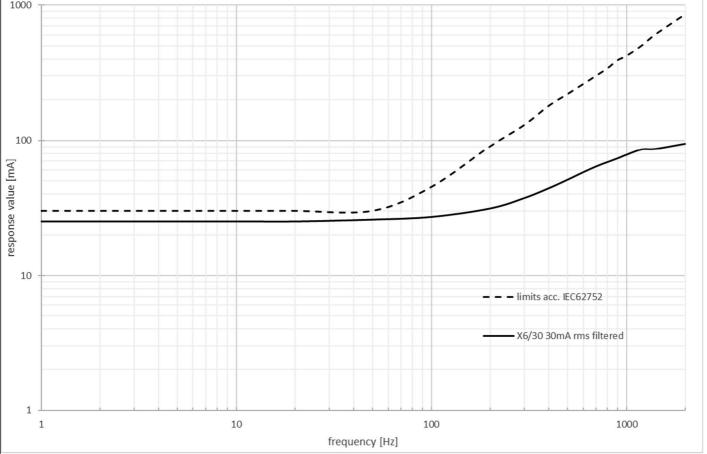


Fig. 4:IEC62752 response value over frequency

X6/30-OUT	X30-OUT	ERROR-OUT	State
GND	GND	GND	Normal condition
High impedance	GND	GND	I _{ΔN1} ≥ 6mA _{DC}
High impedance	High impedance	GND	I _{ΔN3} ≥ 30mA _{rms}
High impedance	High impedance	High impedance	Error, system fault
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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

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