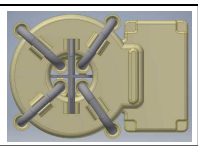
VACUUMSCHMELZE

Specification

Item no.: T60404-N4641-X820

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



Date: 16.11.2022

K-No.: 30583

Customer: Standard type

Description

- Fluxgate current sensor with toroidal core
- PCB mounting

Patents: EP2571128 / US9397494 / CN103001175 // EP2813856

Characteristics

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

Applications

Mainly used for stationary and mobile applications:

- Wallbox
- IC-CPD

Electrical data – Ratings

		min.	typ.	max.	Unit
I_P	Primary nominal RMS current (1phase / 3phase)		32	40	A
$I_{\Delta N1}$	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
$I_{\Delta N2,\ tolerance}$	Trip tolerance 2 (PIN X30-OUT)	20		30(1) / 60(2)	mA rms
$S_{PWM-OUT}$	Scaling factor of the DC component $I_{\Delta N1}$ **(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

Accuracy – Dynamic performance data

$I_{\Delta N,max}$	Measuring range (peak)	-300		+300	mA
X	Resolution (@ $I_{\Delta N}$, Θ_A = 25°C)		< 0.2		mA
t_r	Response times		According to IEC62752:2016(3)		
f_{BW} (Fig.4)	Frequency range	DC		2	kHz

General data

ϑ_A	Ambient operation temperature	-40		85	°C
$\vartheta_{Storage}$	Ambient storage temperature(4)	-40		85	°C
m	Mass		32		g
V_{CC}	Supply voltage	4.8	5	5.2	V
I_{CC}	Supply current		33		mA rms
$S_{clear,\ pp}$	Clearance (primary to primary)(5)		4.22mm		
$S_{creep,\ pp}$	Creepage (primary to primary)(5)		5.65mm		
$S_{clear,\ ps}$	Clearance (primary to secondary)(6)		6.53mm		
$S_{creep,\ ps}$	Creepage (primary to secondary)(6)		7.75mm		
FIT	EN/IEC 61709 / SN 29500(7)		<2200		fit

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

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

(5) **Can only be achieved with the isolator; all values acc. to applied standards.**

(6) **Designed, manufactured and tested in accordance with IEC60664-1:2020. The isolation coordination is according to: Reinforced insulation, Insulation material group 1, Pollution degree 2 and overvoltage category III.**

(7) **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:

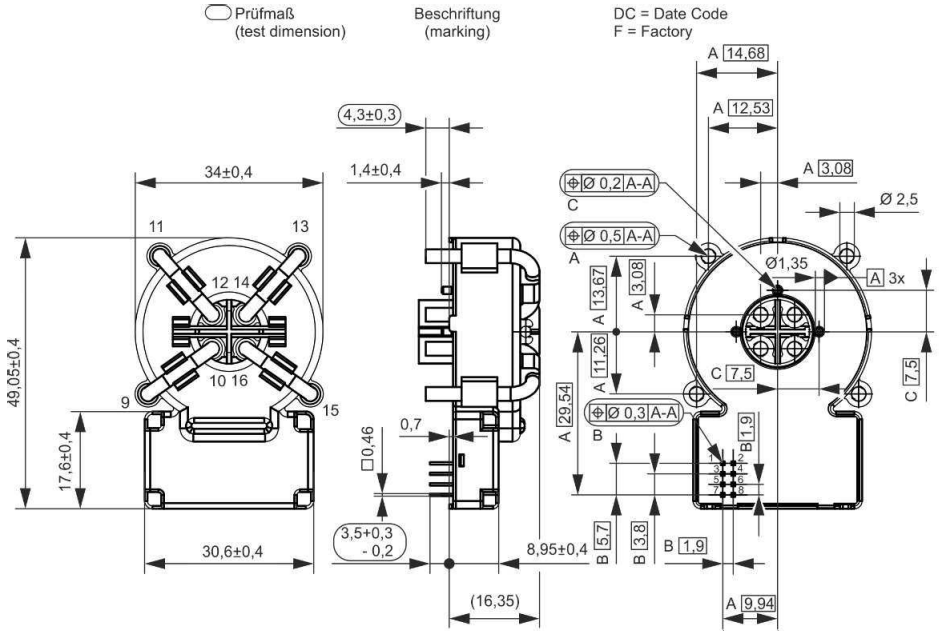
The Sensor is sensitive to AC and DC current and can be used for fault current detection in wallbox applications or personnel protection systems for EV. The Sensor detects AC/DC fault current according to IEC62752:2016. In the event of a DC fault current, PIN 3 will change its state from a low level (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 application diagram. CN-22-157

Editor.: MC-PD-CS	Designer: SF		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. 11-14: ø = 2.5mm

Marking:

benvac
4641-X820
F DC

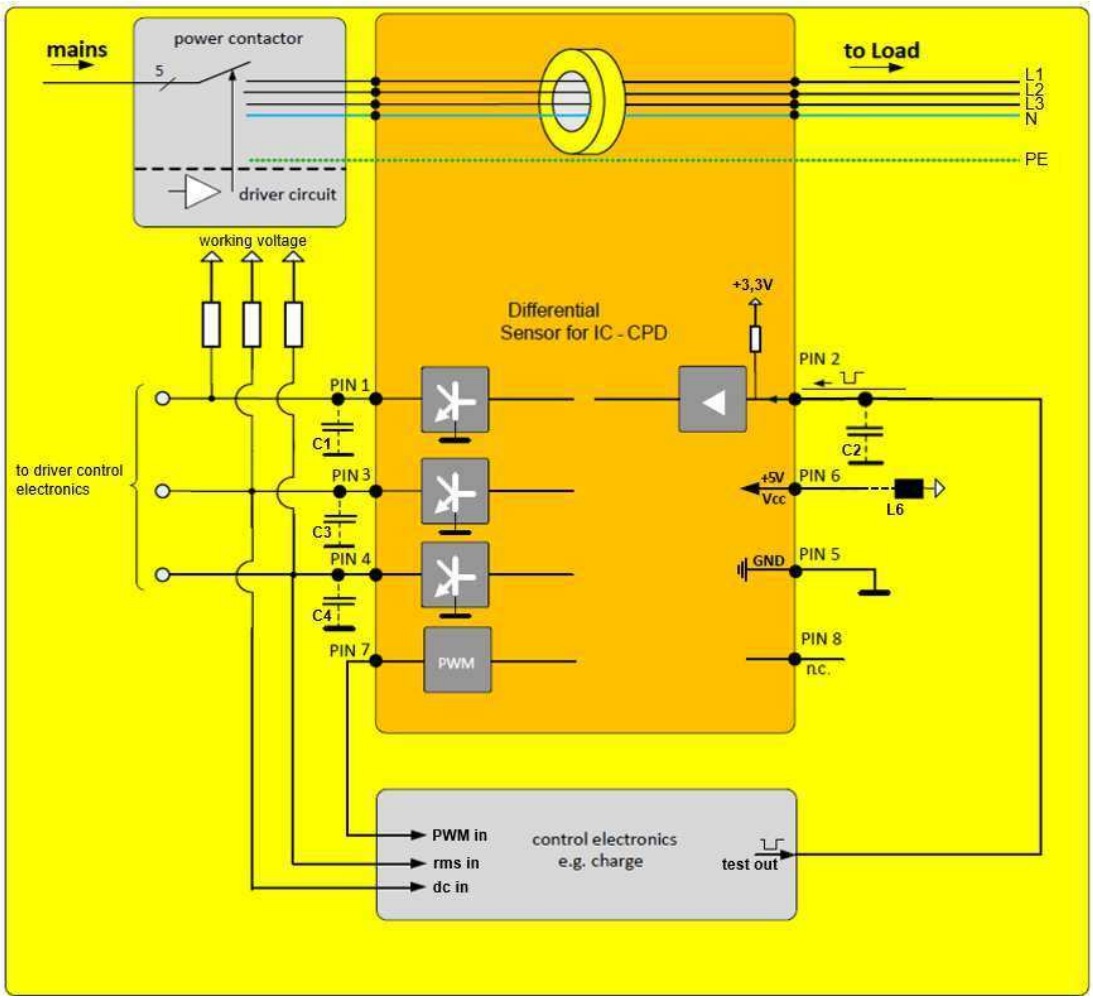
Content of Data-Matrix-Code is: benvac, 4641-X820, F, DC

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 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 0V…5V.
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 $S_{PWM-OUT}$ = 3.33%/mA
PIN 8 → N.C.	Not connected
PIN 9 – 16	For primary wires connection

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 maximum ratings[8]:

		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		6	V
U_{MAX}	Maximum rated voltage of primary conductors			440	V
$V_{TEST-IN, high}$	TEST-IN Input Voltage, high level	0		0.6	V
$V_{TEST-IN, low}$	TEST-IN Input Voltage, low level	2.5		5	V

[8] 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	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	24	30	mA
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 Following tests differ from M3238: 4.5a: Damp heat, steady state. Duration: 1000h	passed	
ESD	Air- and contact discharge; U=±2000V, R=1500Ω, C=100pF Acc. to Human Body Model JESD22-A114	±2.0	kV

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. PIN 9-14 5 pulse ➔ polarity +, 5 pulse ➔ polarity -	5.5	kV rms
$\hat{U}_{W,\ prim\text{-}prim}$	M3064	Impulse test (1.2µs/50µs waveform) PIN 9 vs. PIN 11, PIN 11 vs. PIN 13, PIN 13 vs. PIN 15, PIN 15 vs. PIN 9 5 pulse ➔ polarity +, 5 pulse ➔ polarity -	4.0	kV rms
U_d	M3014	Test voltage, 60s PIN 1-8 vs. PIN 9-14	1.5	kV rms
$U_{d,\ prim\text{-}prim}$	M3014	Test voltage between primary conductors, 5s PIN 9 vs. PIN 11,PIN 11 vs. PIN 13, PIN 13 vs. PIN 15, PIN 15 vs. PIN 9	1.5	kV rms
U_{PDE}	M3024	Partial discharge voltage (extinction) PIN 1-8 vs. GND *acc. to table 24	1.2	kV rms
U_{PD} x 1.875	M3024	Partial discharge voltage (extinction) PIN 1-8 vs. GND *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:

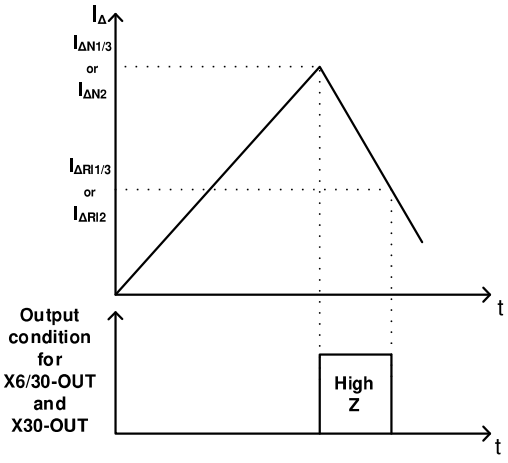
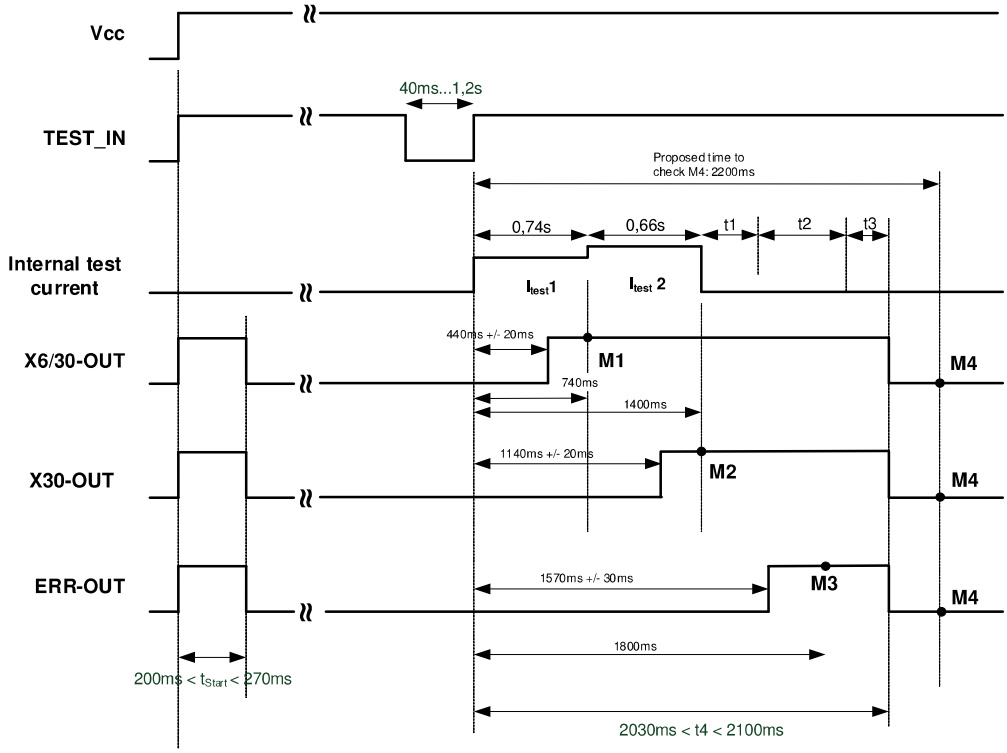


Fig. 1: Meaning of switching recovery level

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 $I_{\Delta RI1}/I_{\Delta RI2}$.



t1 = 120ms	**Check for welded contacts.**
t2 = 500ms	**Time for offset calibration.**
t3 =10ms to 80ms	**Time required to store the offset calibration value. Depends on the difference to the value already stored in memory.**
M1...M4	**points in time to check output levels**

Fig. 2: Power-Up timing diagram

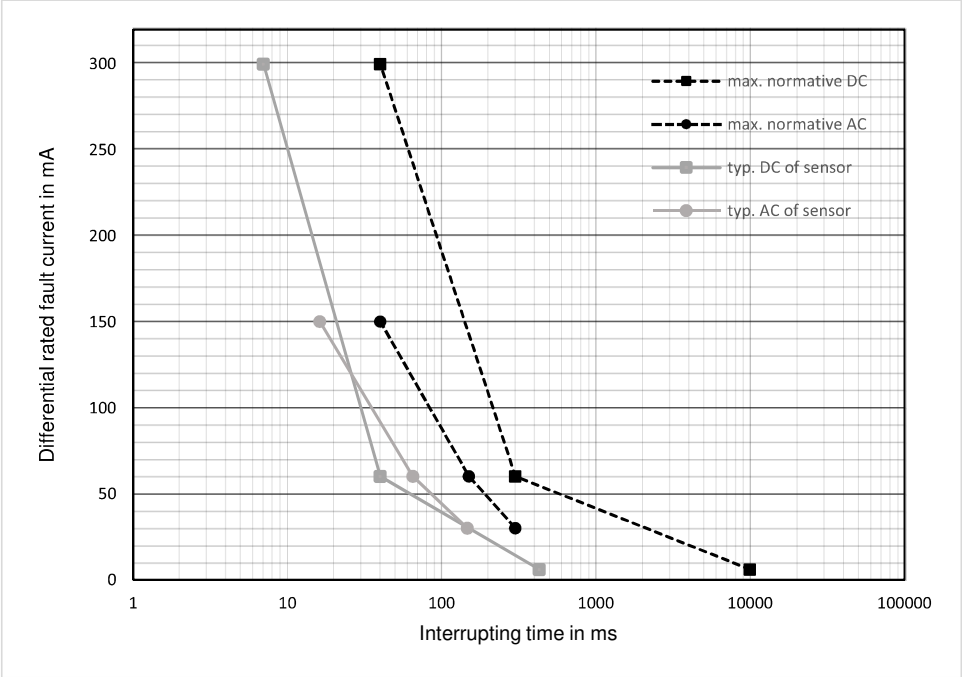


Fig. 3: Interrupting Time according to IEC62752 (E)-1:2016 and typical values of sensor

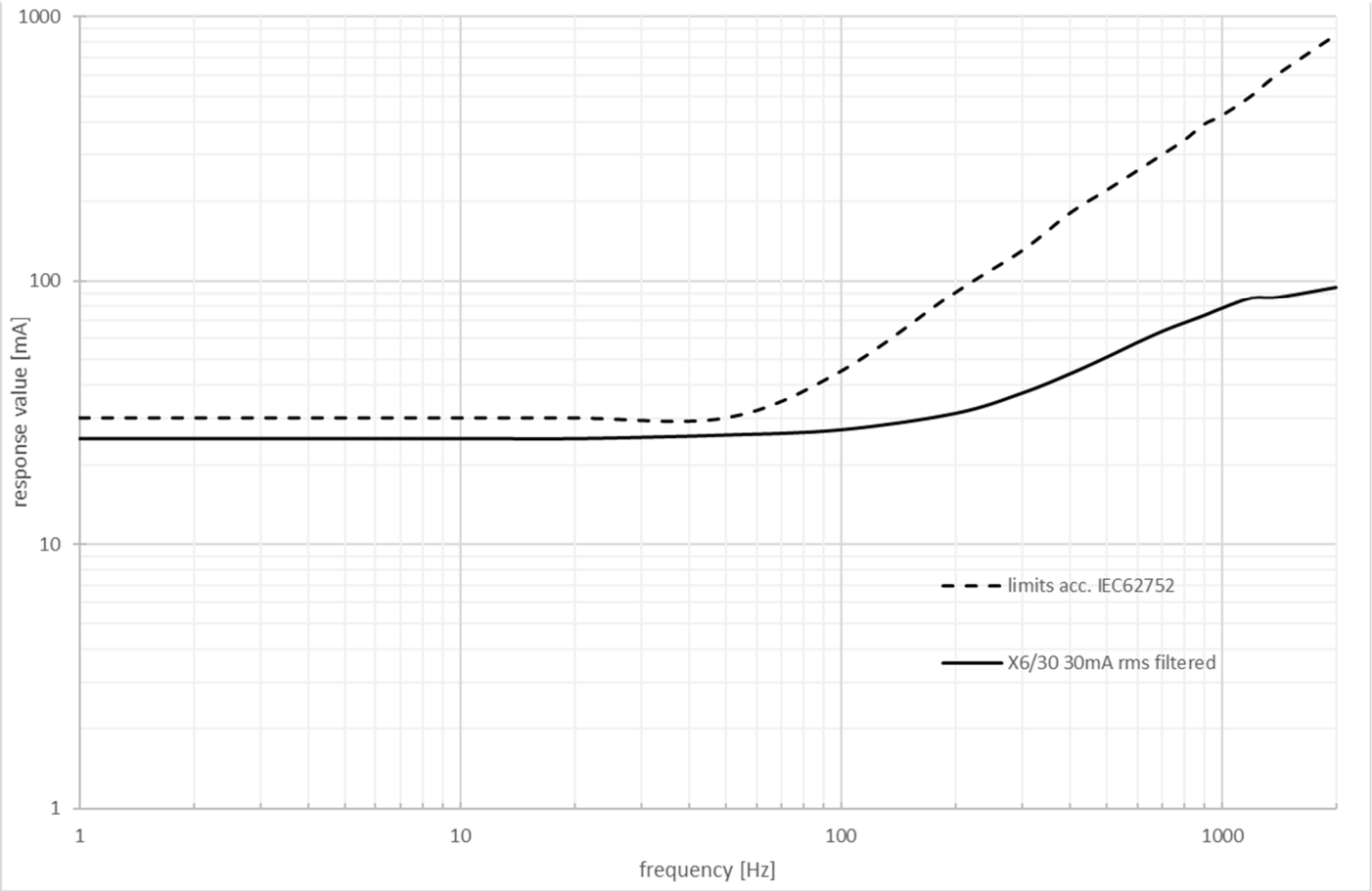


Fig. 4: IEC62752 response value over frequency

X6/30-OUT	X30-OUT	ERROR-OUT	State
GND	GND	GND	Normal condition
High impedance	GND	GND	$I_{\Delta N1} \geq 6mA_{DC}$
High impedance	High impedance	GND	$I_{\Delta N3} \geq 30mA_{rms}$
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