

CURRENT SENSOR

PRODUCT SERIES: STK-HD/C

PRODUCT PART NUMBER: STK-20HD/C
STK-40HD/C

REVISION: Ver 1.2



Sinomags Technology Co., Ltd.

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1. Description

STK-HD/C current sensor is based on the open loop principle and TMR technology. DC, AC, pulses and any kind of irregularities wave can be measured by the current sensor under the isolated conditions.

Typical application

- AC Variable speed drives
- Direct-current dynamo
- PV string current detection
- MPPT
- Switched model power supplies (SMPS)

General parameters

Parameter	Symbol	Unit	Value
Working temperature	T _A	°C	-40 ~ 105
Storage temperature	T _{stg}	°C	-40 ~ 105
Mass	m	g	10

Absolute parameters

Parameters	Symbol	Unit	Value
Supply voltage	V _C	V	6
ESD rating (HBM)	U _{ESD}	kV	4

Remark: the unrecoverable damage may occur when the product works on the conditions over the absolute maximum ratings. Long-time working on the absolute maximum ratings may cause the degradation on performance and reliability.

Isolation parameters

Parameter	Symbol	Unit	Value	Remark
RMS voltage for AC test 50Hz/1 min	U _d	kV	4	
Impulse withstand voltage 1.2/50μs	Ū _w	kV	6	
Clearance distance (pri. -sec)	d _{Cl}	mm	9.6	Shortest distance through air
Creepage distance (pri. -sec)	d _{Cp}	mm	9.6	Shortest path along device body
Electrical clearance	-	mm	9	When mounted on PCB with recommended layout
Case material			V0 according UL 94	to
Comparative tracking index	CTI	V	600	

2. Electrical performance of STK-20HD/C

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I _{pn}	A		20		
Supply voltage	V _{cc}	V	4.9	5	5.1	
Current consumption	I _{cc}	mA		5	10	
Offset voltage	V _{off}	V	2.47	2.5	2.53	V _{out} @ 0 A
Reference voltage	V _{ref}	V	2.48	2.5	2.52	internal voltage
Rated output voltage (V _{out} @I _{pn}) – V _{off}	V _{FS}	V		2		(V _{out} @ ± I _{pn}) - V _{off}
Theoretical gain	G _{th}	mV/A		100		
Internal output resistance	R _{out}	Ω		64		
OCD range ①	VOC	V	0		3.3	
FAULT error	%		10			% of OCD
OCD output mask time ②	T _{mask}	μs		3		
OCD output hold time ③	T _{hold}			∞		
Rated linearity error	Non-L	%I _{pn}		0.7		Within ±I _{pn}
Reaction time	t _{ra}	μs		0.5		@ 10% of I _{pn}
Step response time	t _{res}	μs		1.0		@ 90% of I _{pn}
Delay time	t _{delay}	μs		0.5		400 kHz sine wave
Frequency bandwidth (-3dB)	BW	kHz		400		No RC circuit
Output voltage noise DC ~ 10 kHz DC ~ 100 kHz	V _{noise}	mVpp		8 10		@250kHz Sampling Rate
Primary current, detection threshold ④	I _{pth}	A		3.3* I _{pn}		overcurrent detection OCD
Accuracy @ 25°C	X	% of I _{pn}	-1		1	@ 25°C
Accuracy @ -40°C~105°C⑤	X _{TRange}	% of I _{pn}	-3		3	-40°C ~ 105°C

Remarks:

- ①. The OCD trigger voltage = V_{ref} +/- VOC. VOC voltage can be input by external voltage, but VOC shall be less than V_{cc} - 1.7 V. Refer the sections of “OCD function” & “General information on OCD” for more details.
- ②. The default time for OCD Fault Mask Time is 3 us, while it can be set as 0, 1, 2, 3 us per demand.
- ③. The default time for OCD Fault Hold Time is infinite , while it can be set as 0, 1.5, 3, 4.5 ms per demand.
- ④. STK-HD/C products may be ordered on request with a dedicated setting of the Trigger current . The product has a built-in overcurrent detection function, When the output voltage detected by the product exceeds the threshold, it is judged to be overcurrent and the output of fault pin changes to low level .
- ⑤. Accuracy,X_{TRange} = ((V_{out} @ I_n @ T_x) – (G_{fit}@25°C * I_n+V_{off} @ 25°C)) / V_{FS},The fitting gain of the product at G_{fit}@25 °C is 25 °C.

3. Electrical performance of STK-40HD/C

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I _{pn}	A		40		
Supply voltage	V _{cc}	V	4.9	5	5.1	
Current consumption	I _{cc}	mA		5	10	
Offset voltage	V _{off}	V	2.47	2.5	2.53	V _{out} @ 0 A
Reference voltage	V _{ref}	V	2.48	2.5	2.52	internal voltage
Rated output voltage (V _{out} @I _{pn}) – V _{off}	V _{FS}	V		2		
Theoretical gain	G _{th}	mV/A		50		
Internal output resistance	R _{out}	Ω		64		
OCD range ①	VOC	V	0		3.3	
FAULT error	%		10			% of OCD
OCD output mask time ②	T _{mask}	μs		3		
OCD output hold time ③	T _{hold}			∞		
Rated linearity error	Non-L	%I _{pn}		0.7		Within ±I _{pn}
Reaction time	t _{ra}	μs		0.5		@ 10% of I _{pn}
Step response time	t _{res}	μs		1.0		@ 90% of I _{pn}
Delay time	t _{delay}	μs		0.5		400 kHz sine wave
Frequency bandwidth (-3dB)	BW	kHz		400		No RC circuit
Output voltage noise DC ~ 10 kHz DC ~ 100 kHz	V _{noise}	mVpp		8 10		@250kHz Sampling Rate
Primary current, detection threshold ④	I _{pth}	A		3.3* I _{pn}		overcurrent detection OCD
Accuracy @ 25°C	X	% of I _{pn}	-1		1	@ 25°C
Accuracy @ -40°C~105°C⑤	X _{TRange}	% of I _{pn}	-3		3	-40°C ~ 105°C

Remarks:

①. The OCD trigger voltage = V_{ref} +/- VOC. VOC voltage can be input by external voltage, but VOC shall be less than V_{cc} - 1.7 V. Refer the sections of “OCD function” & “General information on OCD” for more details.

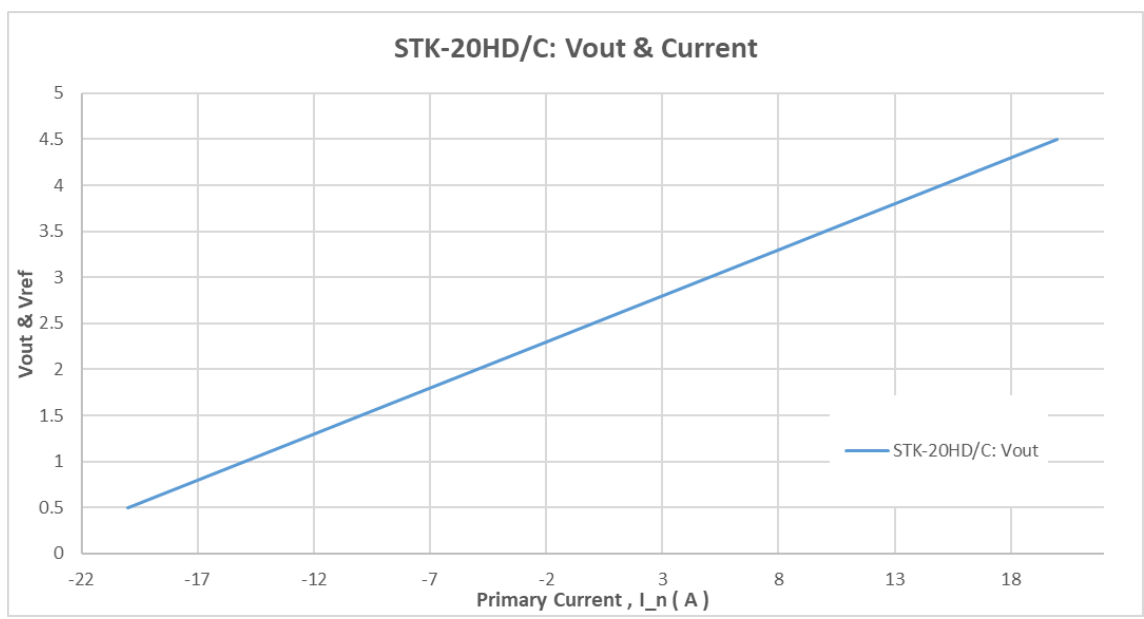
②. The default time for OCD Fault Mask Time is 3 us, while it can be set as 0, 1, 2, 3 us per demand.

③. The default time for OCD Fault Hold Time is infinite, while it can be set as 0, 1.5, 3, 4.5 ms per demand.

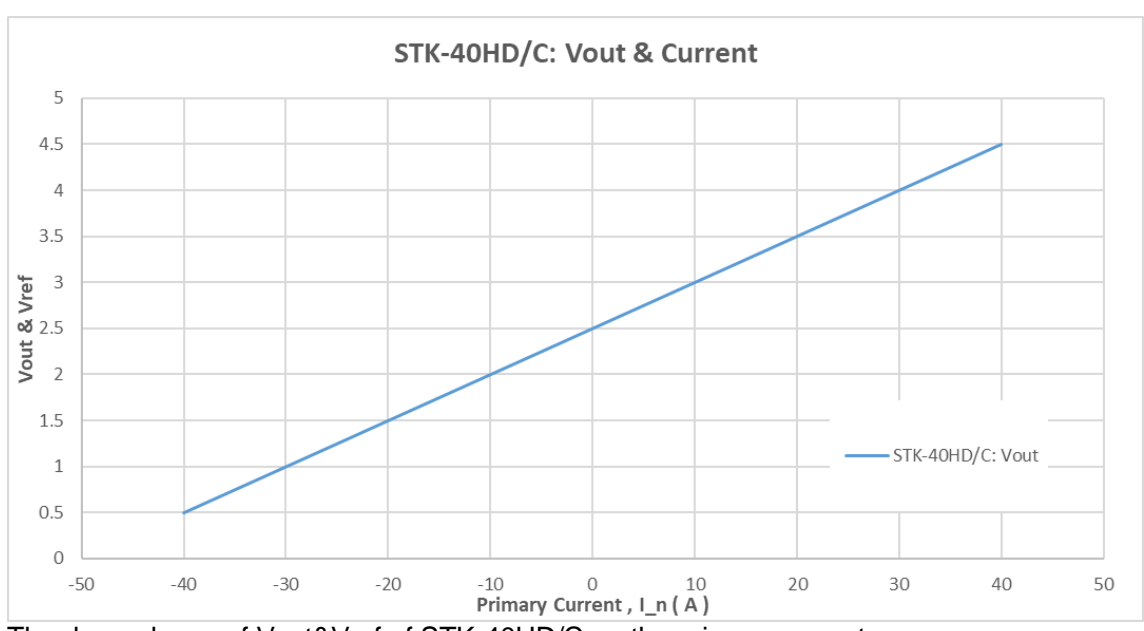
④. STK-HD/C products may be ordered on request with a dedicated setting of the Trigger current. The product has a built-in overcurrent detection function, When the output voltage detected by the product exceeds the threshold, it is judged to be overcurrent and the output of fault pin changes to low level.

⑤. Accuracy, X_{TRange} = ((V_{out} @ I_n @ T_x) - (G_{fit}@25°C * I_n + V_{off} @ 25°C)) / V_{FS}, The fitting gain of the product at G_{fit}@25 °C is 25 °C.

4. Output voltage VS primary current of STK-HD/C

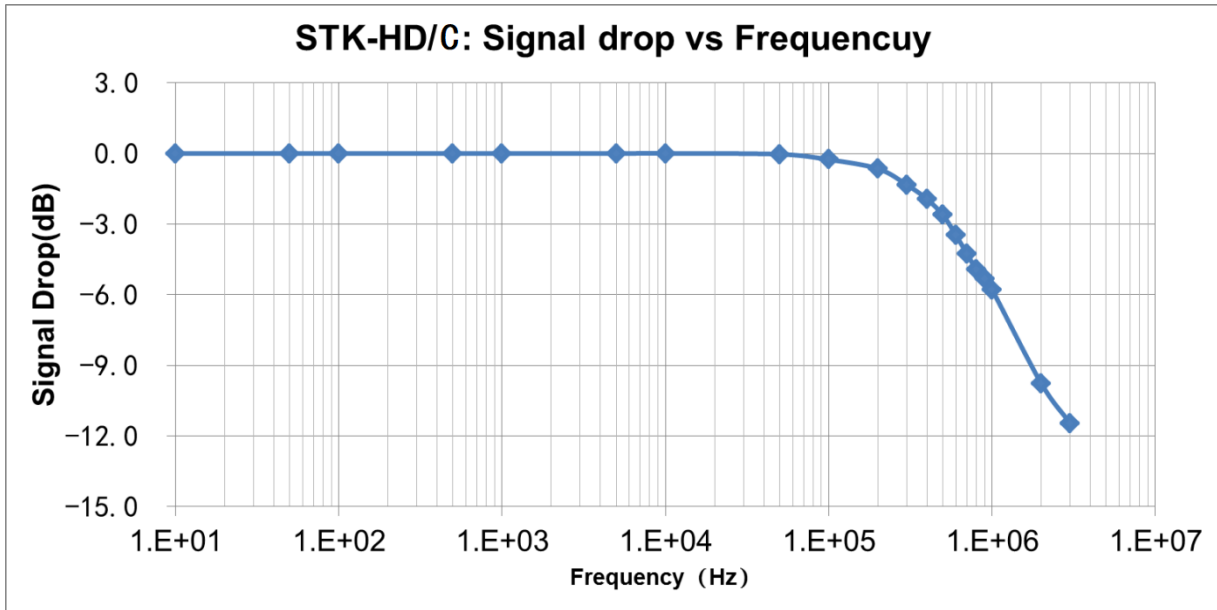


The dependence of Vout&Vref of STK-20HD/C on the primary current.



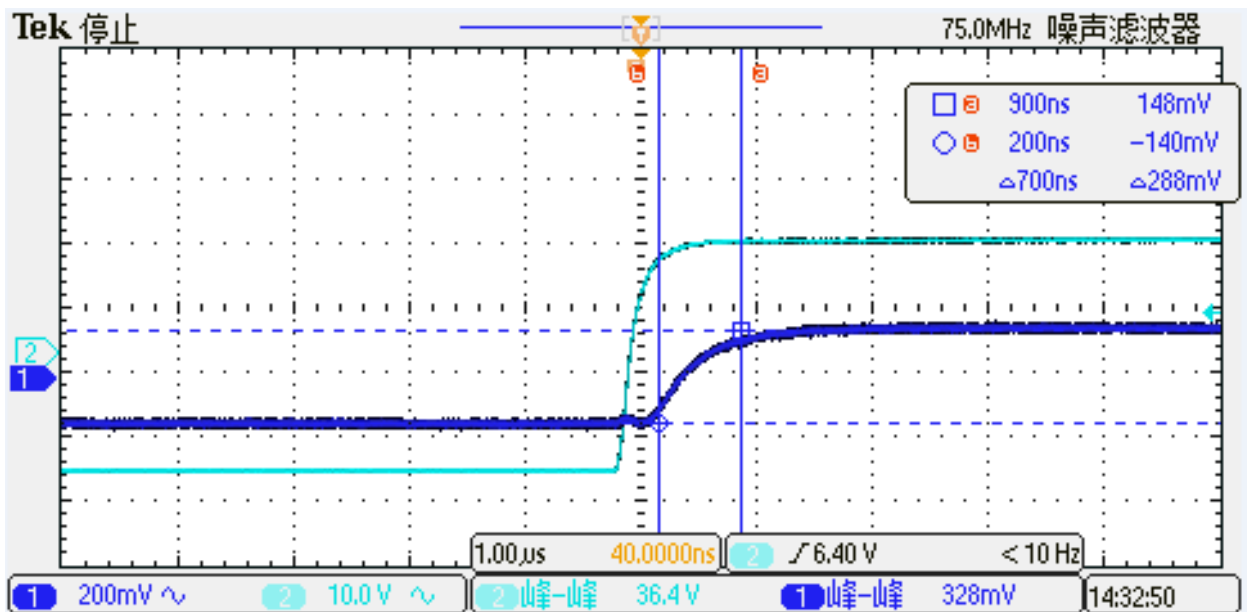
The dependence of Vout&Vref of STK-40HD/C on the primary current.

5. Frequency band width



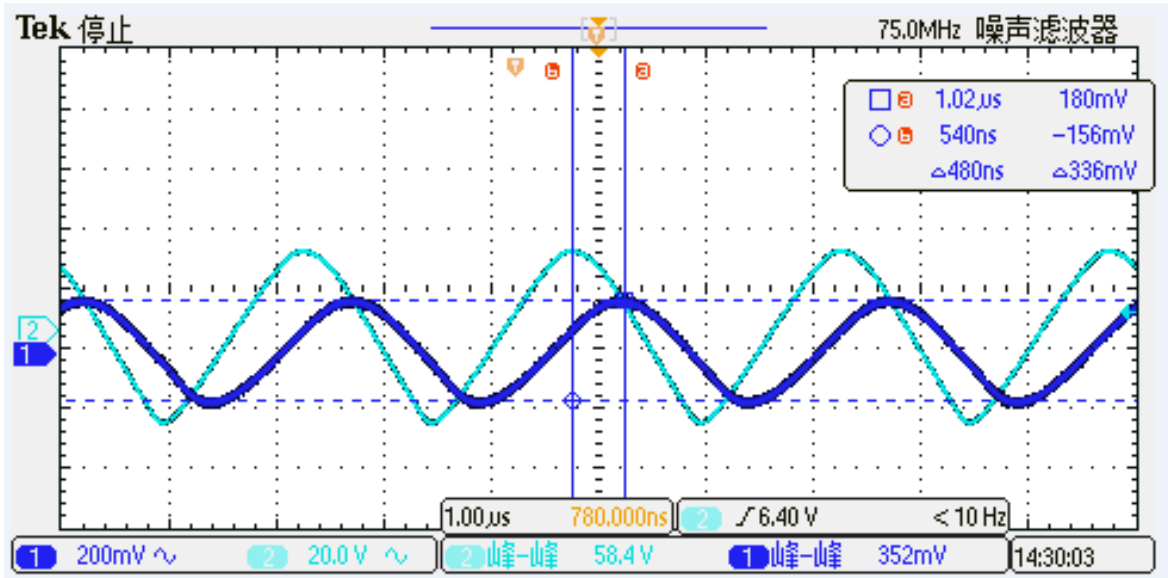
The frequency band width of STK-HD/C series current sensors.

6. Step response time



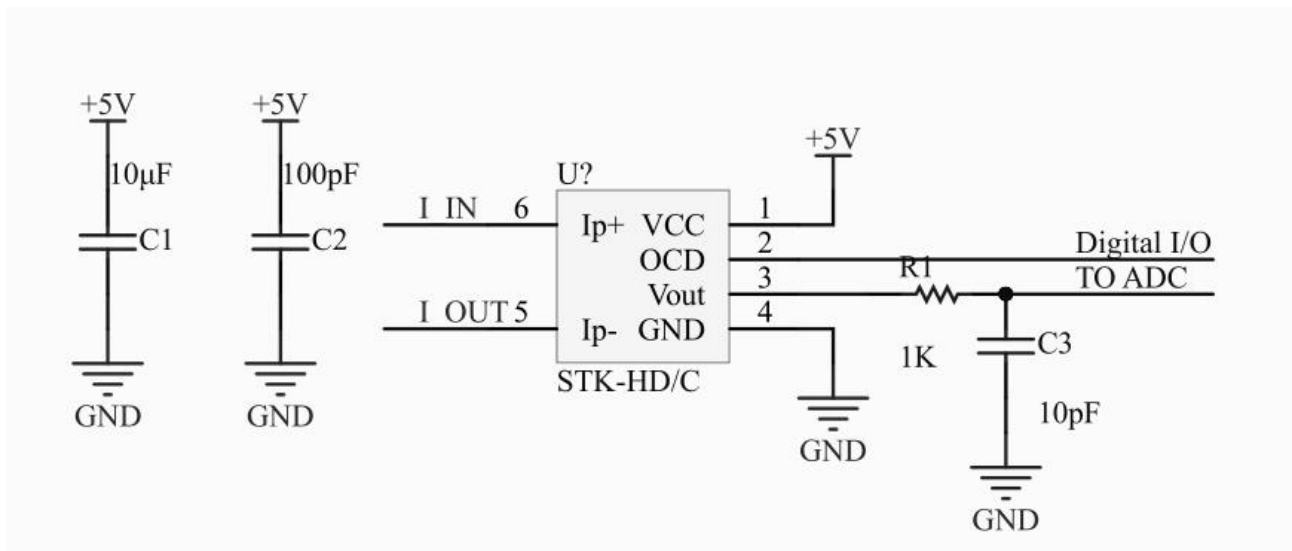
The step response time of STK-HD/C current sensors. The light blue is primary current, while the dark blue is output signal of current sensor. The step response time is less than 1.0µs.

7. Delaytime



When detection the primary current with a frequency of 400 kHz. The delay time from the primary current (light blue) to the output of the sensor (dark blue) is around 0.5 μ s.

8. Typical application circuits for STK-HD/C



Typical application circuits for STK-HD/C current sensor.

R1 (kohm)	C3 (pF)	Theoretical -3dB $f = 1/(2\pi RC)$ (kHz)	Tested -3dB (kHz)
20	20	398	~400
20	81	98	~100
20	810	10	~10

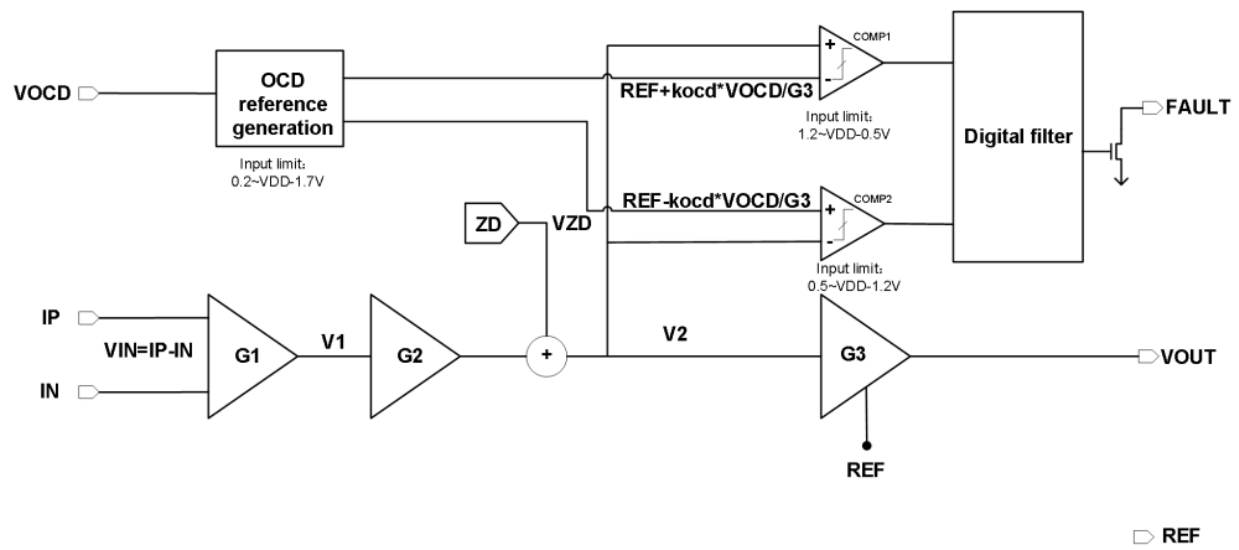
The frequency characteristics of STK-HD/C series current sensor are not affected by the R-C setting (according to recommended R-C setting), therefore the active filter circuit or R-C circuit can be applied to modulate the sensor's frequency characteristics.

9. General information on OCD

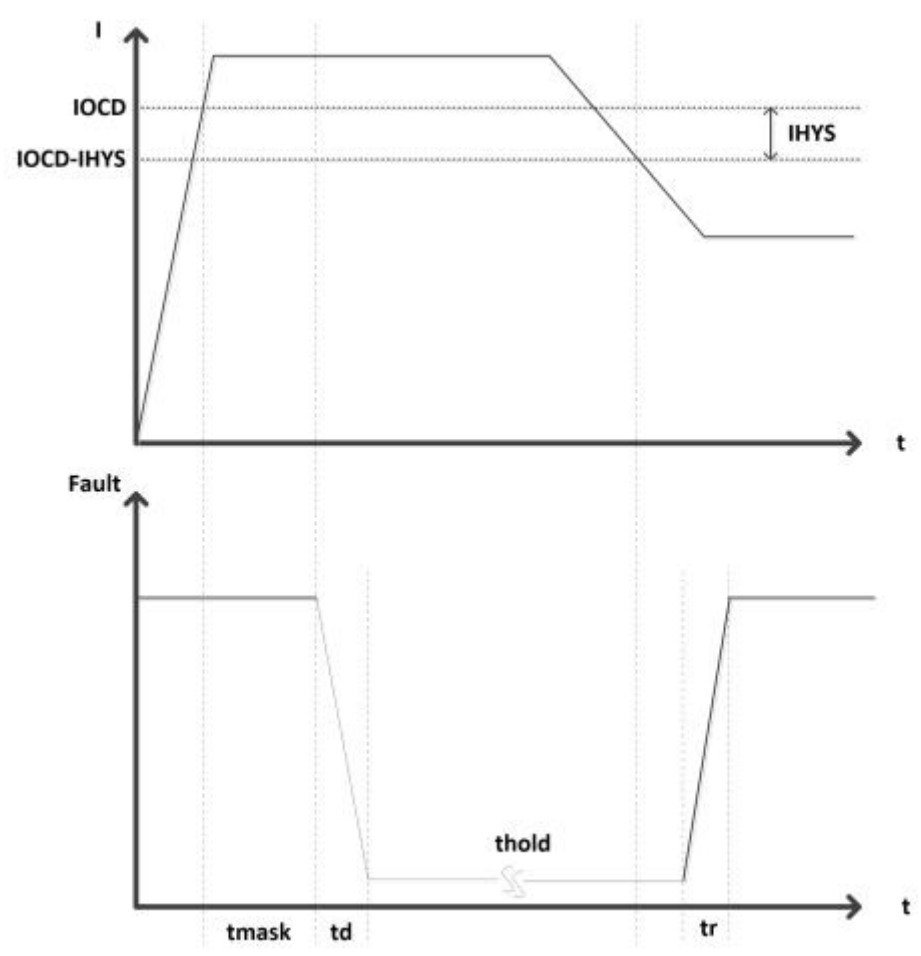
This section describes the general information on OCD function, the specific functions, which are not listed in the section of "electrical data", can be defined per request.

Since the trigger voltage is set after the second amplifier, the OCD function supports that the trigger current can be higher than I_{pn} . The trigger voltage can be defined:

- a) $V_{ref} = 2.5\text{ V}$;
- b) $V_{OC} \leq V_{cc} - 1.7\text{ V}$;
- c) Trigger voltage = $V_{ref} \pm V_{OC} * K_{ocd}$;
- d) Trigger current = $(V_{ref} \pm V_{OC} * K_{ocd} - V_{off}) / G_{th}$;



Functional Block Diagram on OCD function when $V_{ref} = 2.5\text{ V}$ or 1.65 V .

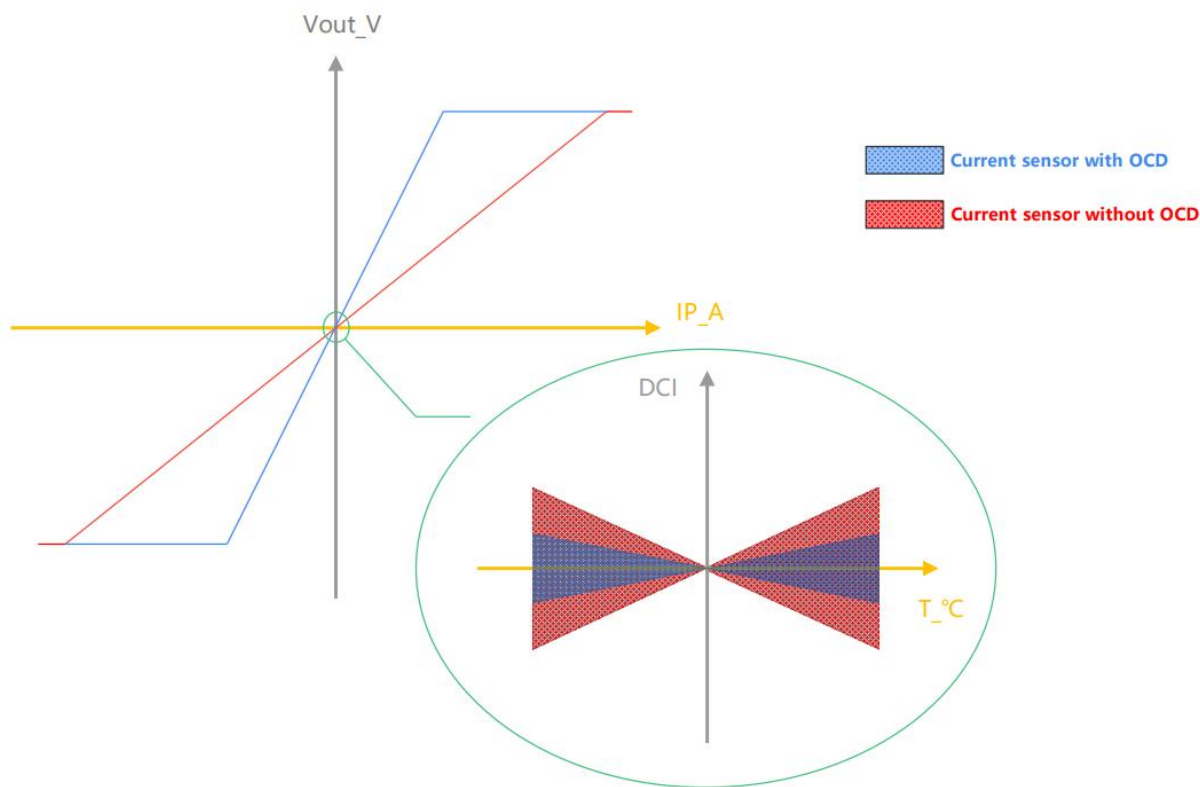
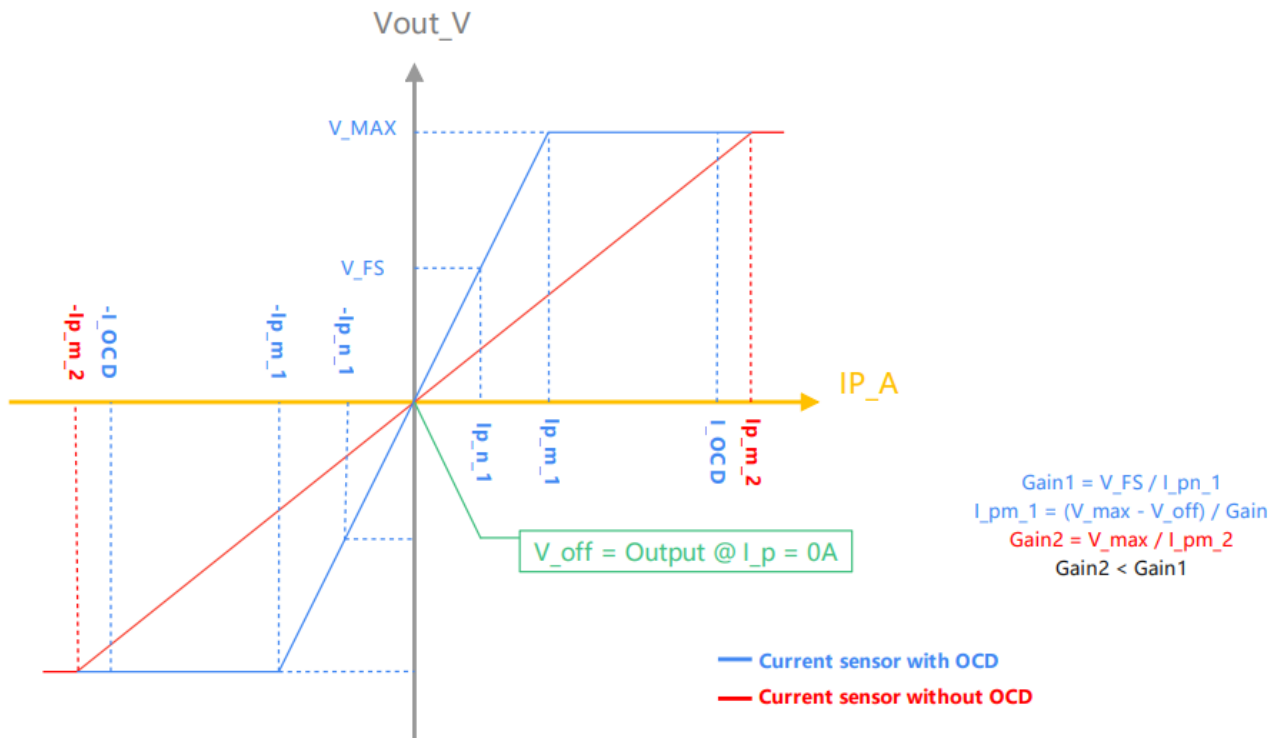


The above plot shows the definition on the time in OCD function. The typical value for tmask & thold is that tmask = 3μs , and thold = ∞ . The overcurrent detection function can also set tmask and thold time:

Tmask:set	Value
1	0μs
2	1μs
3	2μs
4	3μs

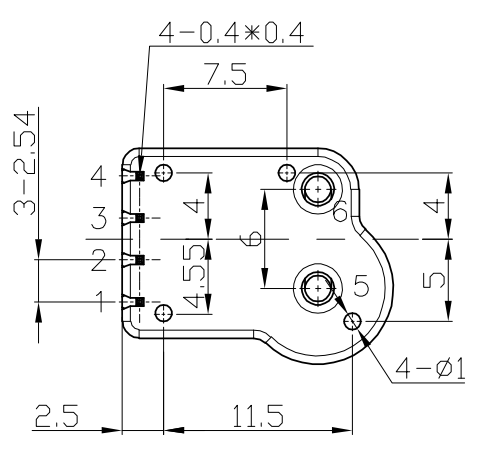
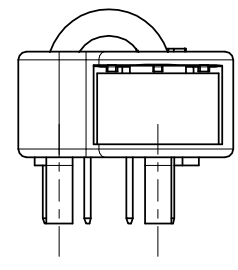
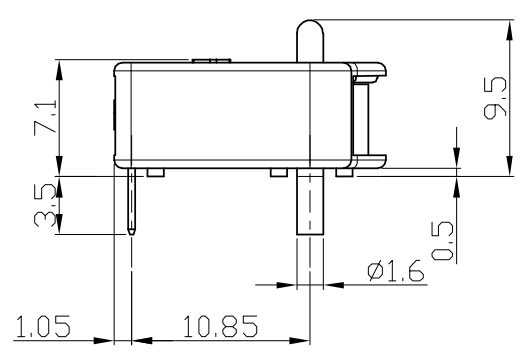
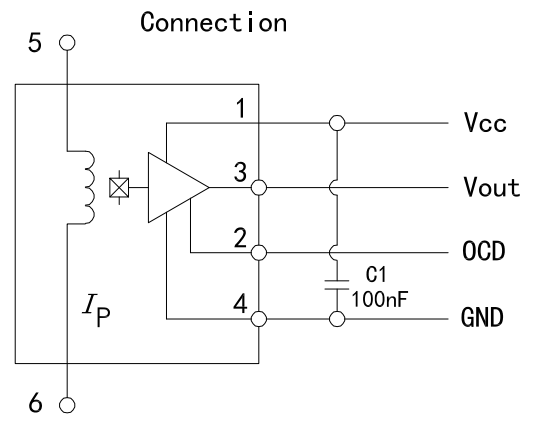
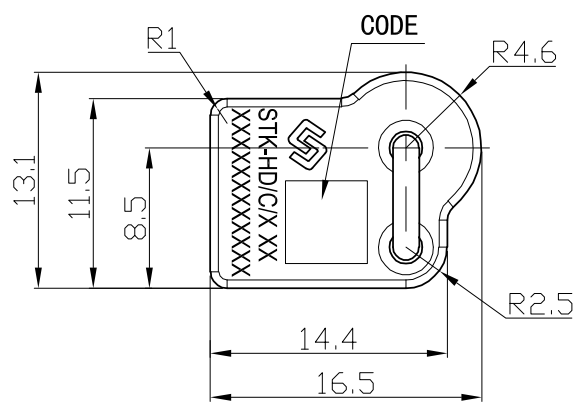
Thold:set	Value
1	0ms
2	1.5ms
3	3ms
4	4.5ms
5	∞

10. OCD function of current sensor



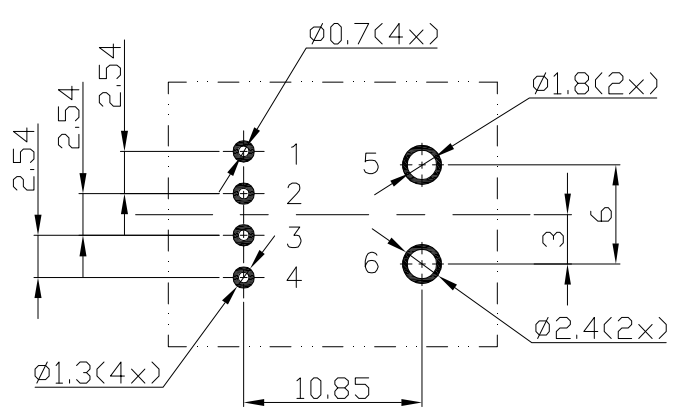
As shown in the figure, products with OCD function can achieve smaller DC component.

11. Dimensions & Pins & Footprint



Terminals

1.	Vcc
2.	OCD
3.	Vout
4.	GND
5.	I _p -
6.	I _p +



Material : Fit UL94V-0 & RoHS requirements ;
 General tolerance : ±0.5
 Unit : mm

