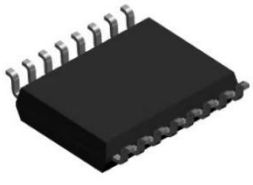
Current Sensor

Product Series: STK-616BML

Part number:
STK-616B-6.5MLB5
STK-616B-13MLB5
STK-616B-15MLB5
STK-616B-28MLB5
STK-616B-56MLB5
STK-616B-65MLB5

Version: Ver 3.7



Sinomags Technology Co., Ltd

Web site: www.sinomags.com

CONTENT

1. Description

The STK-616BM series current sensor is based on TMR (tunnel magneto resistance) technology and open-loop design. It is suitable for DC, AC, pulsed and any kind of irregular current measurement under the isolated conditions.

Typical applications

- AC Variable speed drives
- Inverter
- AC/DC, DC/DC power supplies
- Switched model power supplies (SMPS)

General parameter

Parameter	Symbol	Unit	Value
Working temperature	T_A	˚C	-40 ~ 125
Storage temperature	T_stg	˚C	-40 ~ 125
Mass	m	g	0.5

Absolute maximum rating

Parameter	Symbol	Unit	Value
Supply voltage	Vcc	V	6
ESD rating (HBM)	U_ESD	kV	4
Junction temperature	T_J	˚C	150

Remark 1: 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.

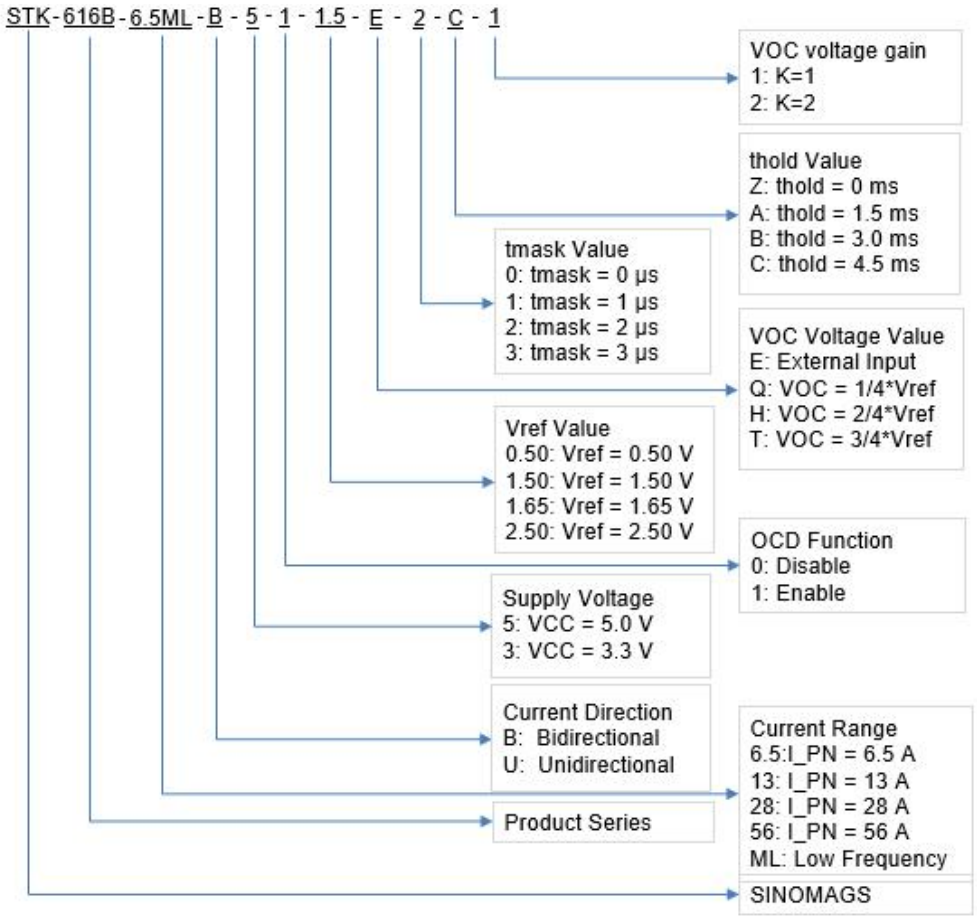
Isolation parameter

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC test 50Hz/1 min	U_d	kV	3.6	
Impulse withstand voltage 1.2/50μs	$\hat{U}_w$	kV	6	
Clearance distance (pri. -sec)	D_{cl}	mm	8	Determined by customer's layout
Creepage distance (pri. -sec)	D_{cr}	mm	8	

Selection guide

Part Number	Meas. Range (A)	Sensitivity (mV/A)	Vcc (V)	T_A (°C)
STK-616B-6.5MLB5-1-1.5-E-2-C-1	±6.5A	200	5	-40 ~ 125
STK-616B-13MLB5-1-1.5-E-2-C-1	±13A	100	5	-40 ~ 125
STK-616B-13MLB5-1-1.5-E-2-C-2	±13A	100	5	-40 ~ 125
STK-616B-13MLB5-1-1.5-E-3-C-1	±13A	100	5	-40 ~ 125
STK-616B-13MLB5-1-1.5-E-3-C-2	±13A	100	5	-40 ~ 125
STK-616B-15MLB5-1-1.5-E-2-C-1	±15A	90	5	-40 ~ 125
STK-616B-28MLB5-1-1.5-E-2-C-1	±28A	48	5	-40 ~ 125
STK-616B-35MLB5-1-1.5-E-2-C-1	±35A	38.5	5	-40 ~ 125
STK-616B-56MLB5-1-1.5-E-2-C-1	±56A	24	5	-40 ~ 125
STK-616B-65MLB5-1-1.5-E-2-C-1	±65A	20.5	5	-40 ~ 125

2. Part number definition



3. Temperature vs current

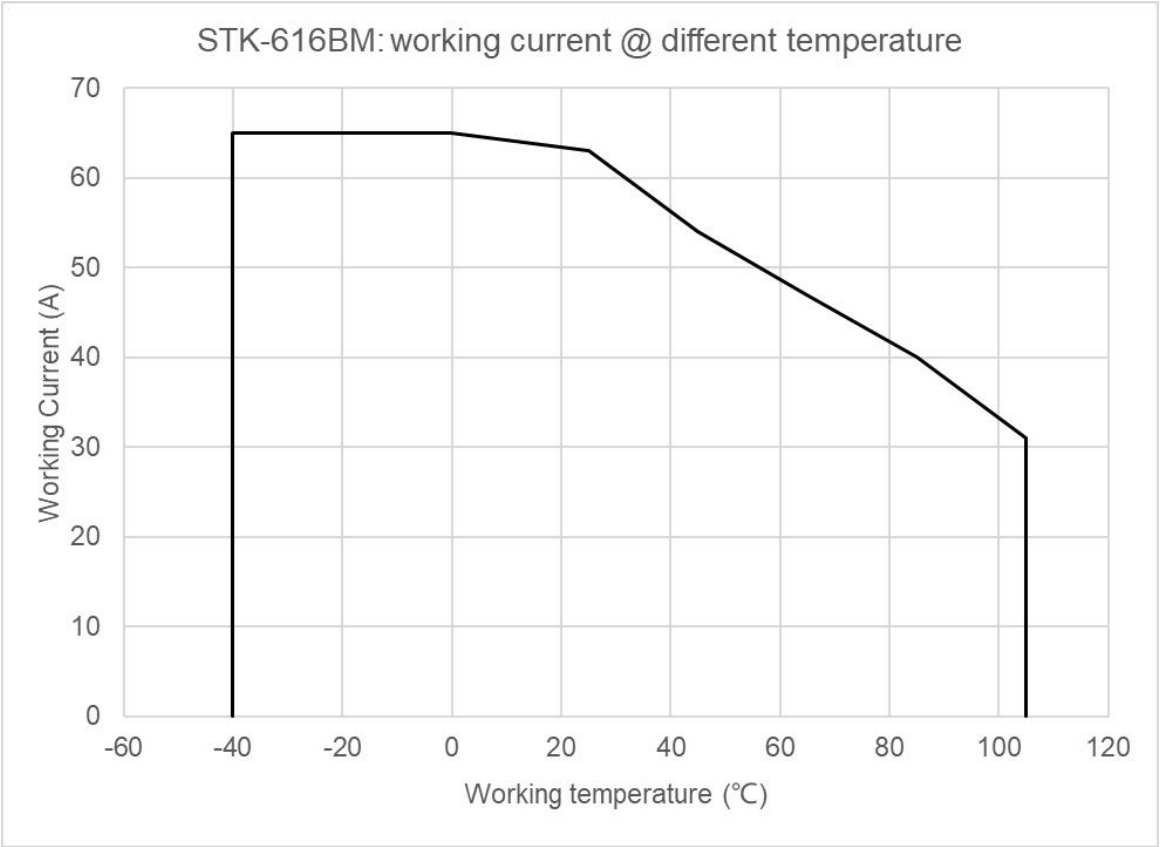


Figure 1 the recommended working current at different working surrounding temperature. Tested by using a standard demo test board, with 4 layers of copper conductors, where the thickness for each layer is 2 oz, the total thickness of demo board is 1.6 mm.

4. Functional block diagram

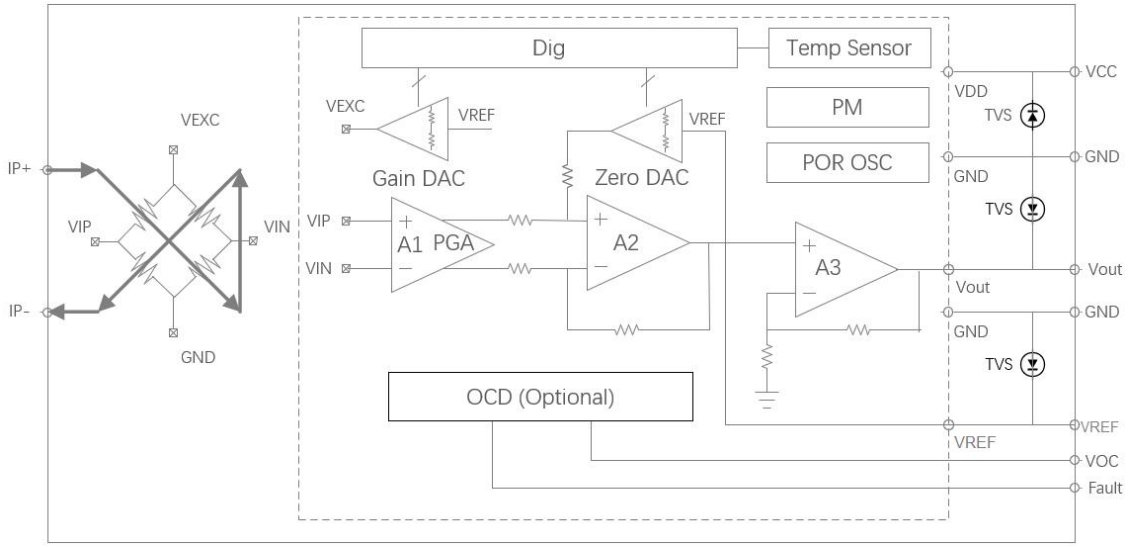


Figure 2 the functional block diagram for the STK-616BM series products.

Remark 2: A1, A2 and A3 represent the operational amplifiers of the current sensor.

5. Electrical data STK-616B-6.5MLB5

Condition：T_A = 25℃, Vcc = 5 V, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
General parameters						
Primary nominal current	I_PN	A	-6.5		6.5	STK-616B-6.5MLB5
Supply voltage	Vcc	V	4.5	5	5.5	
Current consumption	Icc	mA		6	10	
Primary conductor resistance	R_IP	mΩ		0.85		
Quiescent voltage@0A	Voff	V	1.45	1.5	1.55	
Output Specifications	R_out	Ω	1		30	
Theoretical gain	G_th	mV/A		200		STK-616B-6.5MLB5
OCD function (if applicable)						
OCD range	VOC	V	0.3		2	K = 1
			0.3		1.8	K = 2
Fault error		%		5%		% of OCD
OCD Hysteresis	IHYS	%		10%		% of OCD
OCD Fault Mask	tmask	μs	0	1	3	0, 1, 2, 3 μs
OCD Fault Mask error	tmask_error	ns		125		
OCD Fault Hold Time	thold	ms		4.5		0, 1.5, 3, 4.5 ms
Accuracy performance						
Rated linearity	Non_L	%I_PN		±1.5		±I_PN
Step response time	t_res	μs		0.9		@90% of I_PN
Frequency bandwidth	BW	MHz		0.6		@-3dB
Output voltage noise, I_{IN} = 0 A ,100 Hz ～120 kHz	Vnoise	mVpp		6		STK-616B-6.5MLB5
Accuracy @ 25℃	X	% I_PN		±1.5		@ 0.5*I_PN
Thermal drift of G_th	GAIN_T	% G_th		±1.5		@ -40~105℃ drift related to the value @25℃

6. Electrical data STK-616B-XXMLB5

Condition：T_A = 25℃, Vcc = 5 V, unless otherwise noted

Parameter	Symbol	Unit	Min	Typ	Max	Comment
General parameters						
Primary nominal current	I_PN	A	-13		13	STK-616B-13MLB5
			-15		15	STK-616B-15MLB5
			-28		28	STK-616B-28MLB5
			-35		35	STK-616B-35MLB5
			-56		56	STK-616B-56MLB5
			-65		65	STK-616B-65MLB5
Supply voltage	Vcc	V	4.5	5	5.5	
Current consumption	Icc	mA		6	10	
Primary conductor resistance	R_IP	mΩ		0.85		
Quiescent voltage@0A	Voff	V	1.45	1.5	1.55	
Output Specifications	R_out	Ω	1		30	
Theoretical gain	G_th	mV/A		100		STK-616B-13MLB5
				90		STK-616B-15MLB5
				48		STK-616B-28MLB5
				38.5		STK-616B-35MLB5
				24		STK-616B-56MLB5
				20.5		STK-616B-65MLB5
OCD function (if applicable)						
OCD range	VOC	V	0.3		2	K = 1
			0.3		1.8	K = 2
Fault error		%		5%		% of OCD
OCD Hysteresis	IHYS	%		10%		% of OCD
OCD Fault Mask	tmask	μs	0	1	3	0, 1, 2, 3μs
OCD Fault Mask error	tmask_error	ns		125		
OCD Fault Hold Time	thold	ms		4.5		0, 1.5, 3, 4.5ms
Accuracy performance						
Rated linearity	Non_L	%I_PN		±1.5		±I_PN
Step response time	t_res	μs		0.9		@90% of I_PN
Frequency bandwidth	BW	MHz		0.6		@-3dB
Output voltage noise, I_{IN} = 0 A ,100 Hz ～120 kHz	Vnoise	mVpp		6		I_PN = 13, 15, 28 A
				3		I_PN = 35, 56, 65 A
Accuracy @ 25℃	X	% I_PN		±1.5		@ 0.5*I_PN
Thermal drift of G_th	GAIN_T	% G_th		±1.5		@ -40~105℃ drift related to the value @25℃
Thermal drift of Voff	Voff_T	mV		±15		
Total Accuracy	X_TRange	% I_PN		±3.5		

7. Dimensions

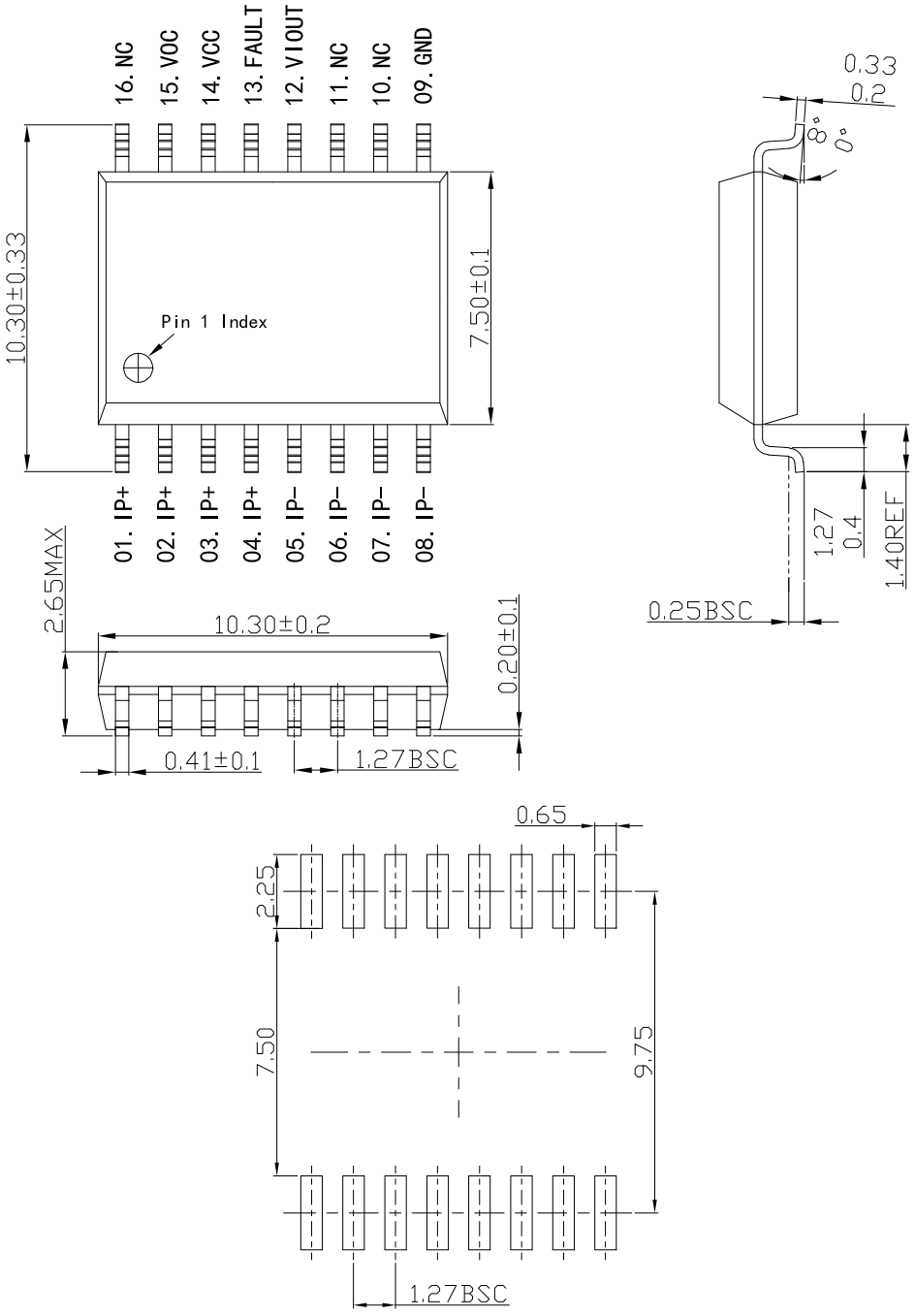


Figure 3 dimensions of STK-616BM series current sensors. The unit is mm.

8. Pin definitions

Pin definition for product with OCD function

PIN	Symbol	Description
1,2,3,4	IP+	Primary conductor pin (+)
5,6,7,8	IP-	Primary conductor pin (-)
9	GND	Ground pin (GND)
10	NC	No connection
11	NC	No connection
12	VIOUT	Sensor output pin
13	FAULT	Over current detection alarm output, the pin is open leakage output. Normally, the output of fault pin is high level.
14	VCC	Power supply pin
15	VOC	Over current detection threshold input pin
16	NC	No connection

9. PCB layout recommendation

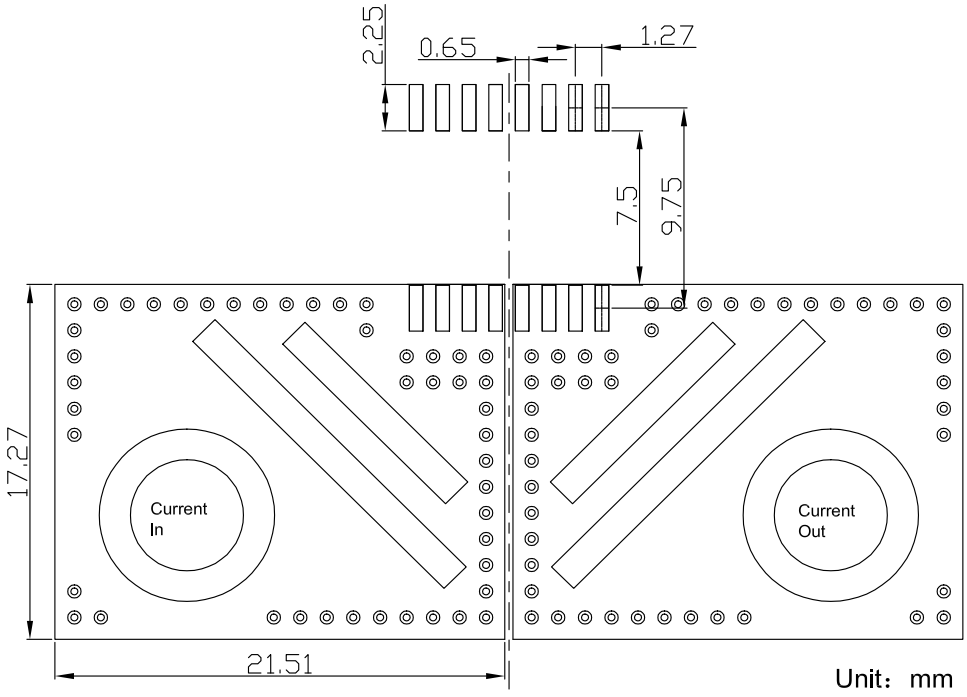


Figure 4 the recommended footprint of the SMT PCB layout for the STK-616BM series products. The unit is mm.

10. Frequency bandwidth

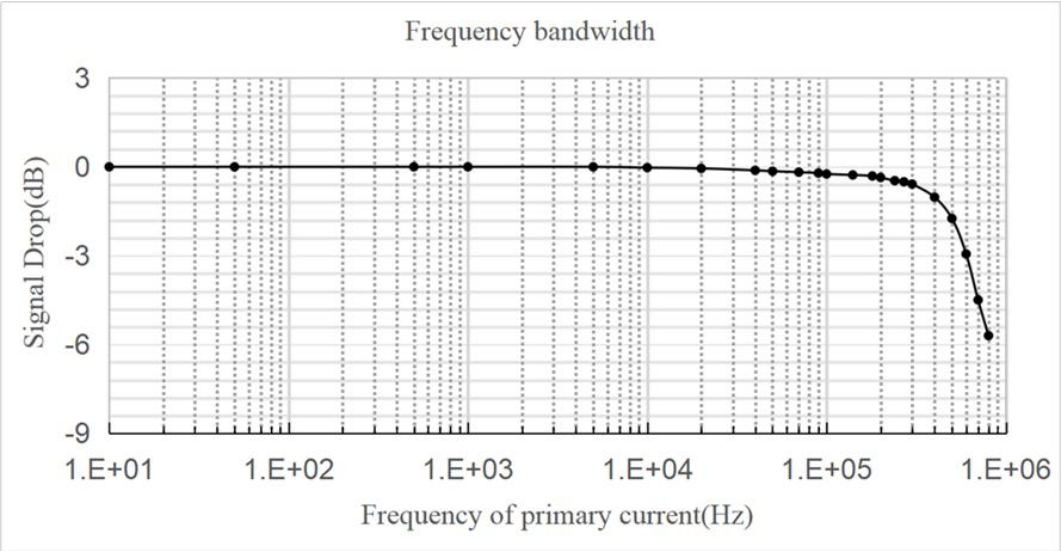


Figure 5 the frequency band width of the STK-616BML series products. the upper limit of the -3 dB band width is 600 kHz.

11. Step response time

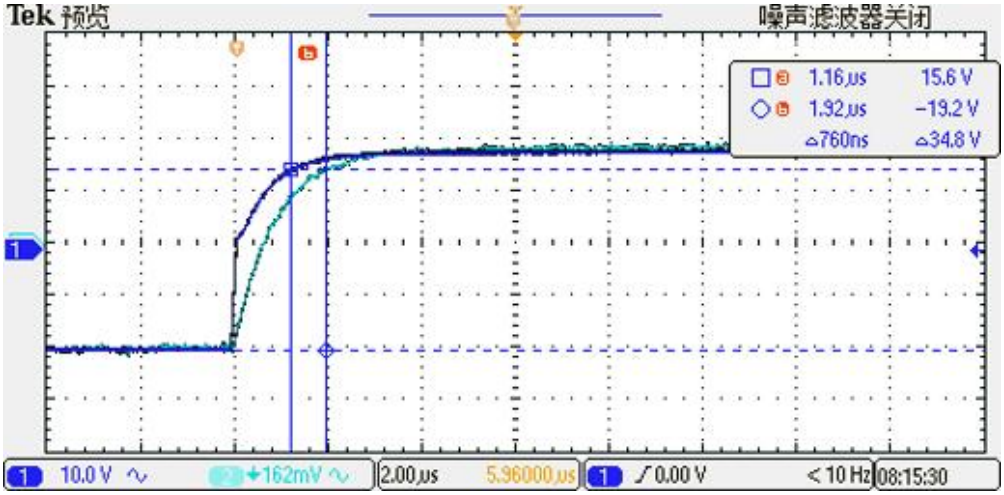


Figure 6 the typical frequency response of STK-616BML series current sensor. The response time from 90% of the primary current to 90% of the secondary output is 0.9 µs.

12. Typical application of STK-616BML

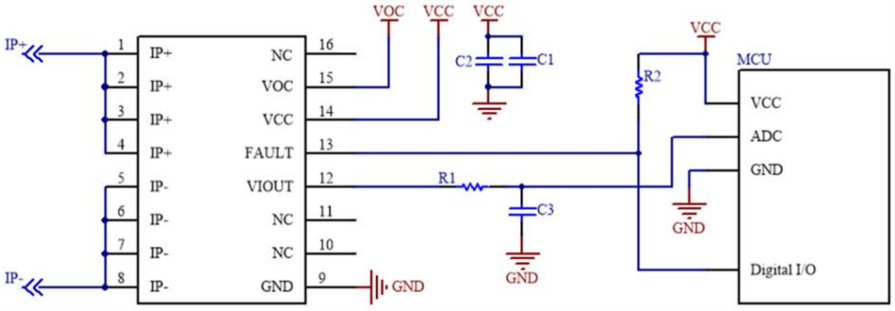


Figure 7 the reference application circuit for the STK-616BML series products.

13. Examples of OCD function

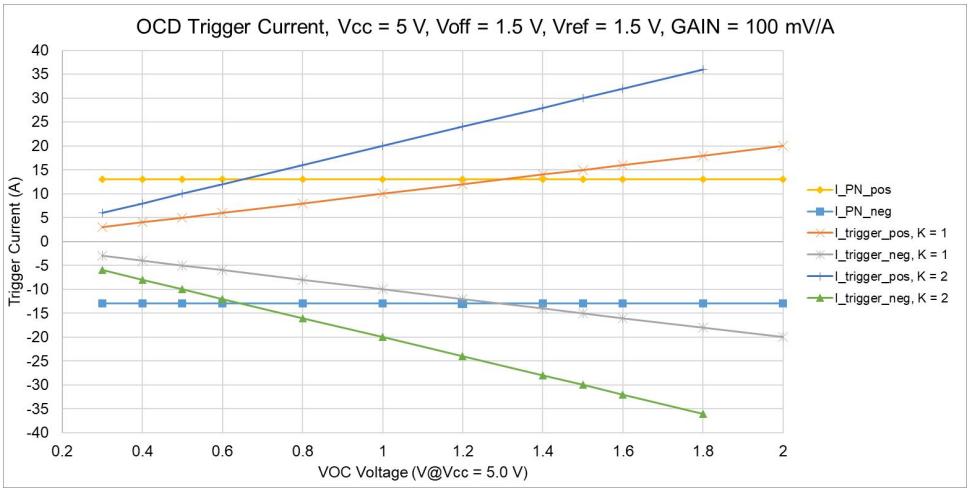


Figure 8 the relationship of trigger current and VOC setting for the STK-616B-13MLB5, with Vcc = 5 V. I_trigger_pos represents the forward over-current protection trigger current. I_trigger_neg represents the negative over-current protection trigger current. I_PN_pos represents the forward primary nominal current. I_PN_neg represents the negative primary nominal current. K is OCD coefficient, with typical values of 1, 2. I_PN is shown in the electrical data table.

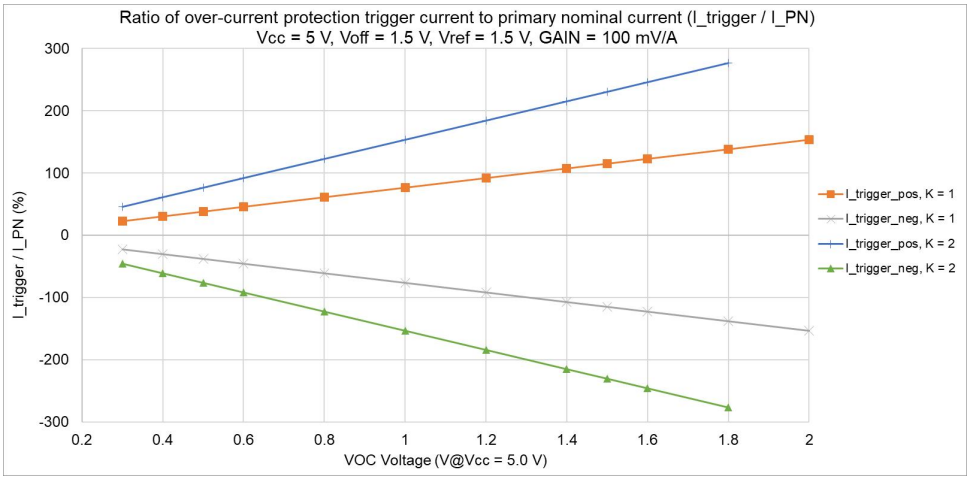


Figure 9 the ratio (I_trigger / I_PN) of over-current protection trigger current to primary nominal current for the STK-616B-13MLB5, with Vcc = 5 V. I_trigger represents the over-current protection trigger current of the current sensor.

14. 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 and the trigger current are shown as fellows.

a) Vcc = 5 V, Vref = 1.5 V, Voff = 1.5 V, K = 1.
   ①. 0.3 V ⩽ VOC ⩽ 2 V;
   ②. V_trigger = Vref ± K * VOC / G3;
   ③. I_trigger = (Vref ± K * VOC - Voff) / G_th;

b) Vcc = 5 V, Vref = 1.5 V, Voff = 1.5 V, K = 2
   ①. 0.3 V ⩽ VOC ⩽ 1.8 V;
   ②. V_trigger = Vref ± K * VOC / G3;
   ③. I_trigger = (Vref ± K * VOC - Voff) / G_th;

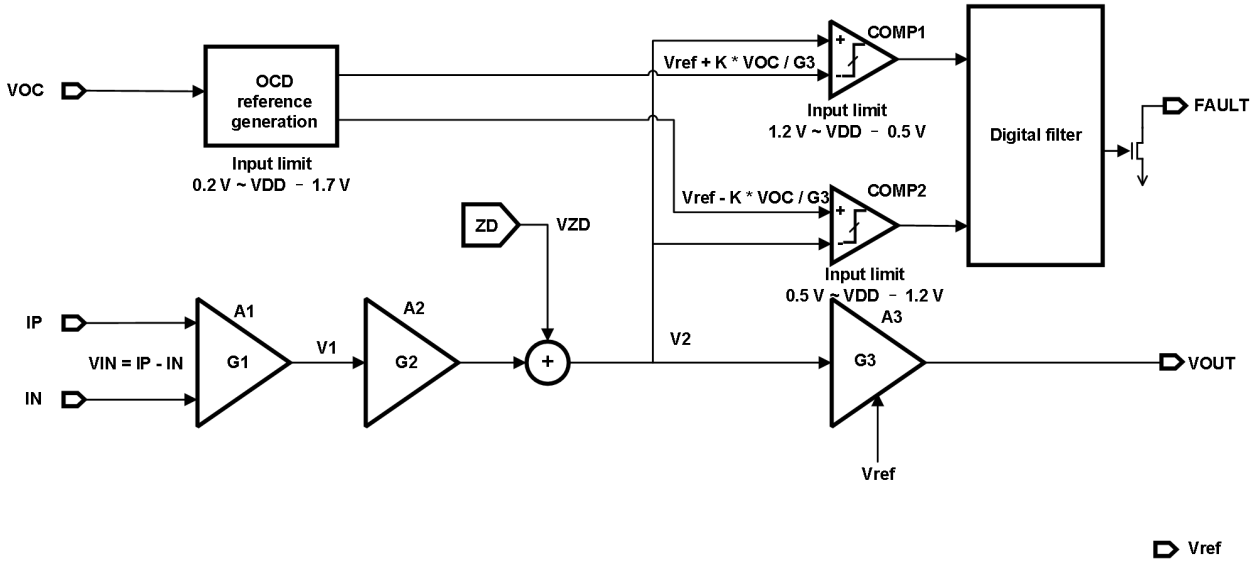


Figure 10 the functional block diagram for STK-616BM on OCD function with conditions of Vcc = 5 V, Voff = 1.5 V, Vref = 1.5V.

Remark 3: V_trigger represents the over-current protection trigger voltage of comparator 1 (COMP1) and comparator 2 (COMP2). I_trigger represents the over-current protection trigger current of the current sensor. Vref is the reference level of the sensor, with the typical value of 1.5 V. G3 is the gain coefficient of the A3 operational amplifier in Figure 2 and Figure 10. G3 is set up by factory. G_th is shown in the electrical data table.

According to the above definition, the relationship between the triggering voltage and the settings of Vcc and VOC when G3 is a fixed value is as follows.

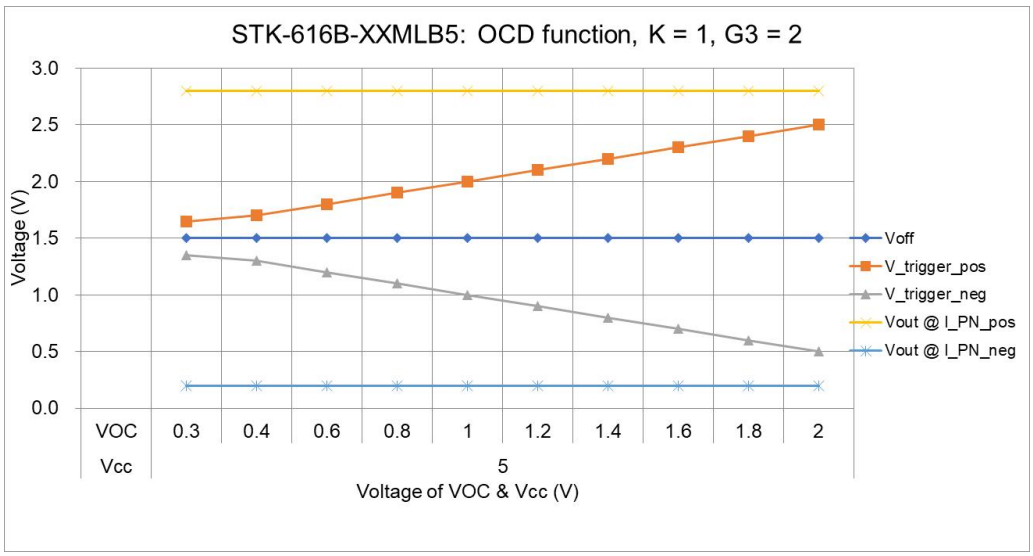


Figure 11 the OCD function for STK-616B-XXMLB5, with K = 1, G3 = 2. V_trigger_pos represents the forward over-current protection trigger voltage of comparator 1 (COMP1). V_trigger_neg represents the negative over-current protection trigger voltage of comparator 2 (COMP2).

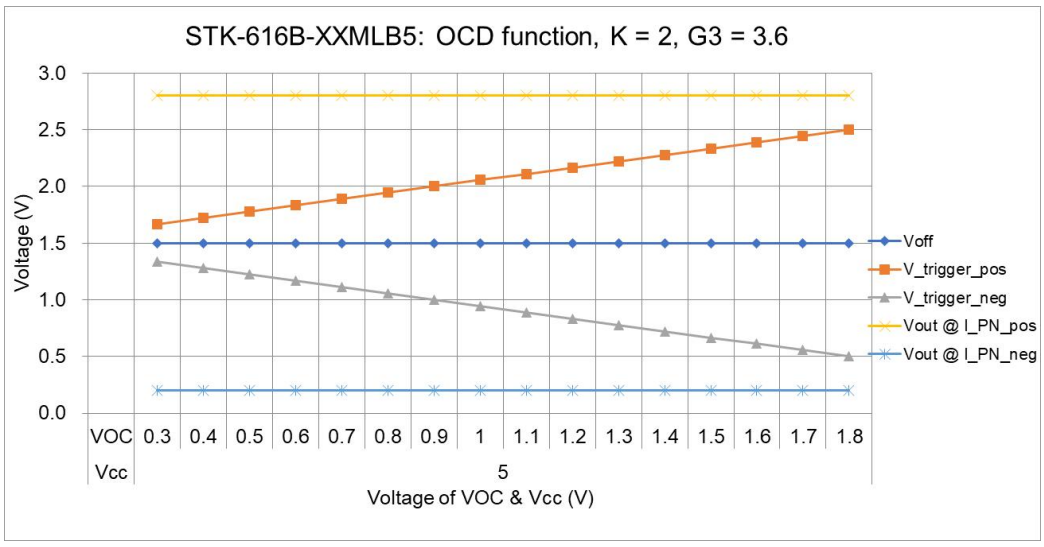


Figure 12 the OCD function for STK-616B-XXMLB5, with K = 2, G3=3.6.

With conditions: Vcc = 5.0 V, Vref = 1.5 V (factory setting), Voff = 1.5 V. The STK-616BM current sensor can provide a protection trigger current higher than I_PN.

15. Package materials information

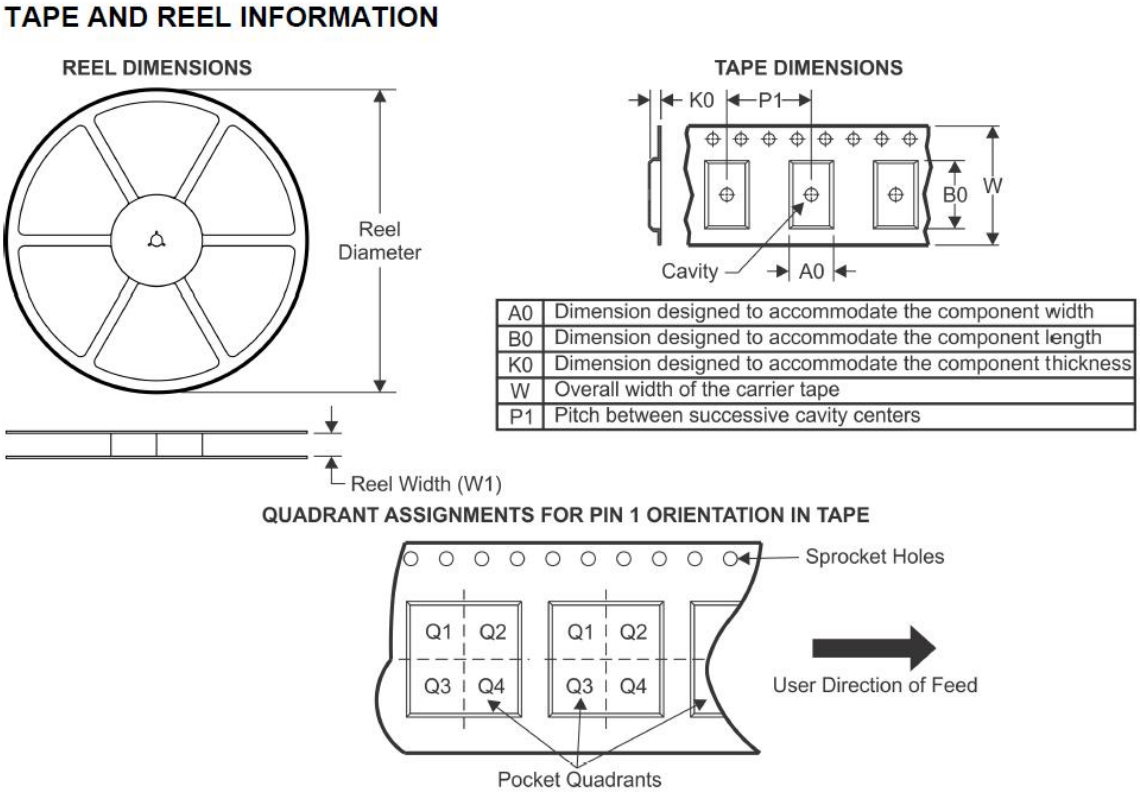


Figure 13 package materials information.