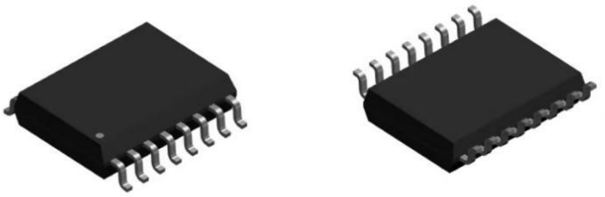
Current Sensor

Product Series: STK-616TML

Part number: STK-616T-20MLB3

Version: Ver 1.0



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CONTENT

1. Description

The STK-616TM 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.

- The product is packaged in standard SOIC16 form.
- AEC-Q100,automotive qualified.

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	℃	-40 ~ 125
Storage temperature	T_stg	℃	-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	℃	150

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.

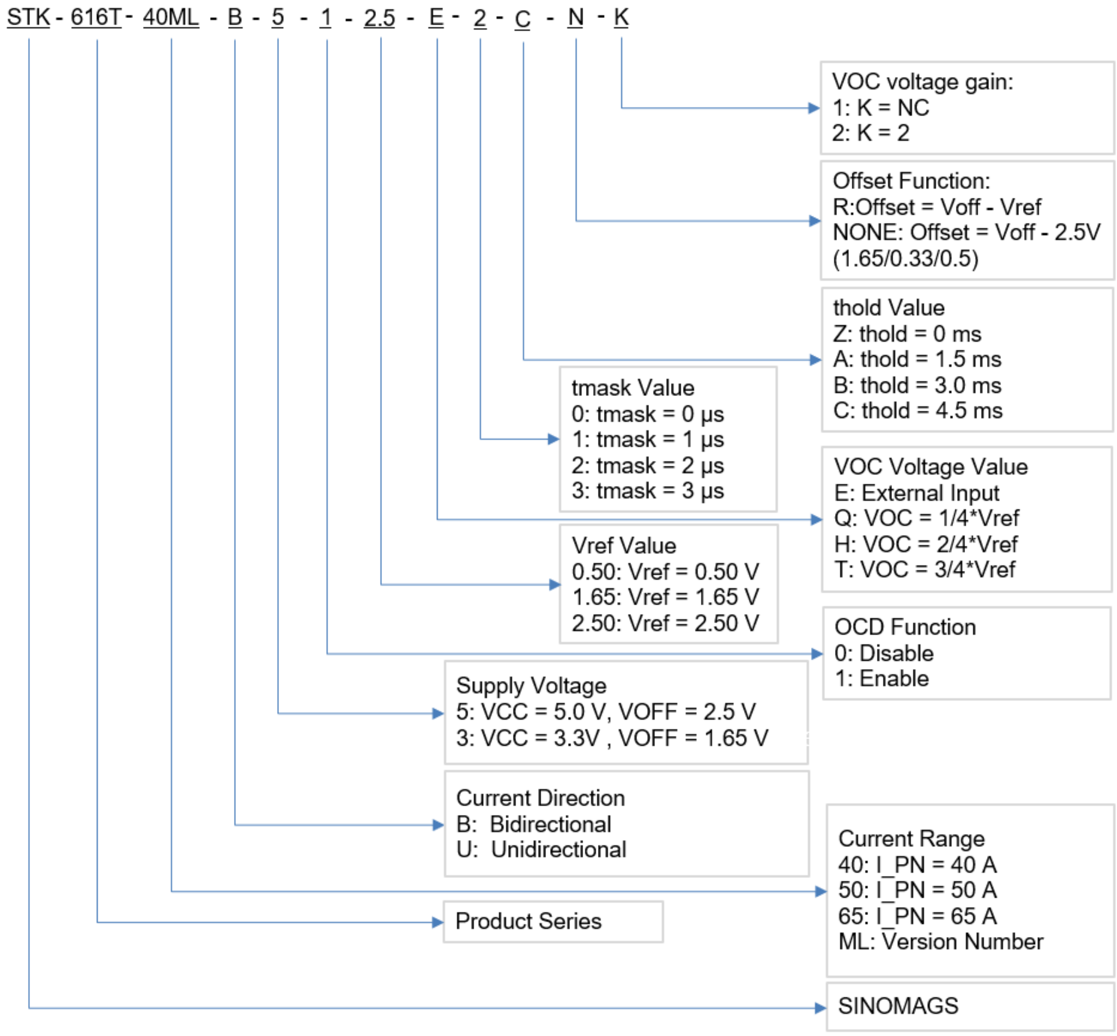
Isolation parameter

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC test 50Hz/1 min	Ud	kV	3.6	
Impulse withstand voltage 1.2/50μs	Ûw	kV	6	
Clearance distance (pri. -sec)	Dci	mm	8	Determined by customer's layout
Creepage distance (pri. -sec)	Dcp	mm	8	
Comparative tracking index	CTI		PLC 0	

Measuring current table

Product	Meas. Range I_pn (A)	Sensitivity (mV/A)	Vcc (V)	T (℃)
STK-616T-20MLB3-1-1.65-E-0-Z-R	±20A	66	3.3	-40 ~ 125

2. Part number definition



3. Temperature vs Current

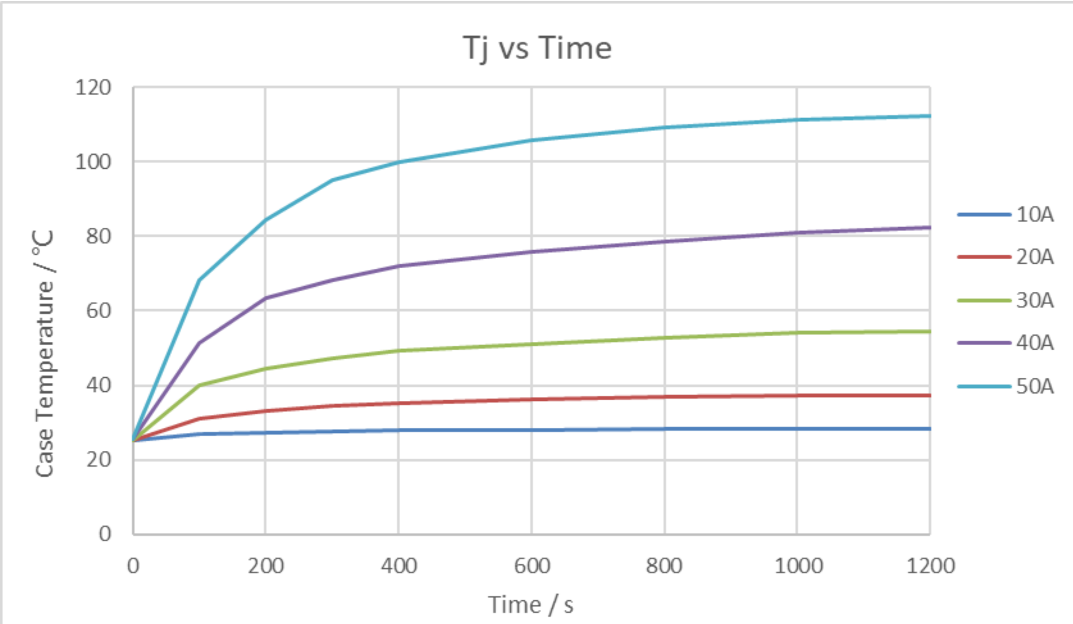


Figure 1. Relationship between STK-616TM Case temperature and amount of input current

Remark 1：Figure 1 shows the results of current & temperature measurement. 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. This result is a reference data. Tc is changed much by the board layout and the heat dissipation. Please confirm it in your evaluation environment.

4. Functional Block Diagram

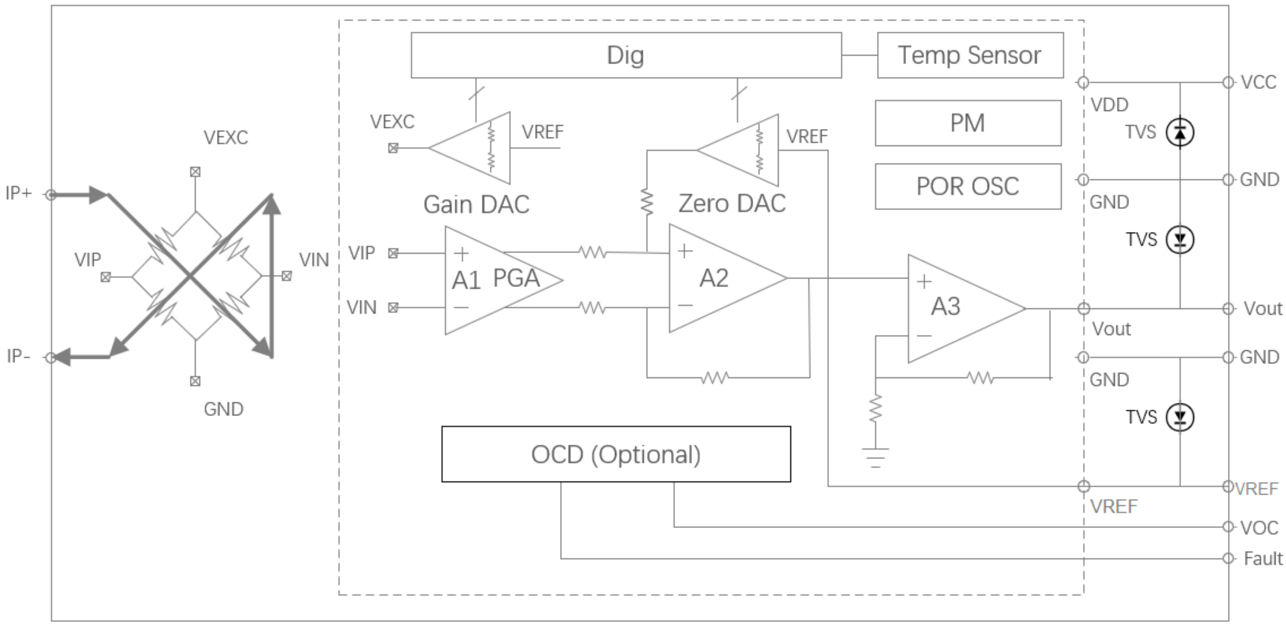


Figure 2 the functional block diagram for the STK-616TM series products.

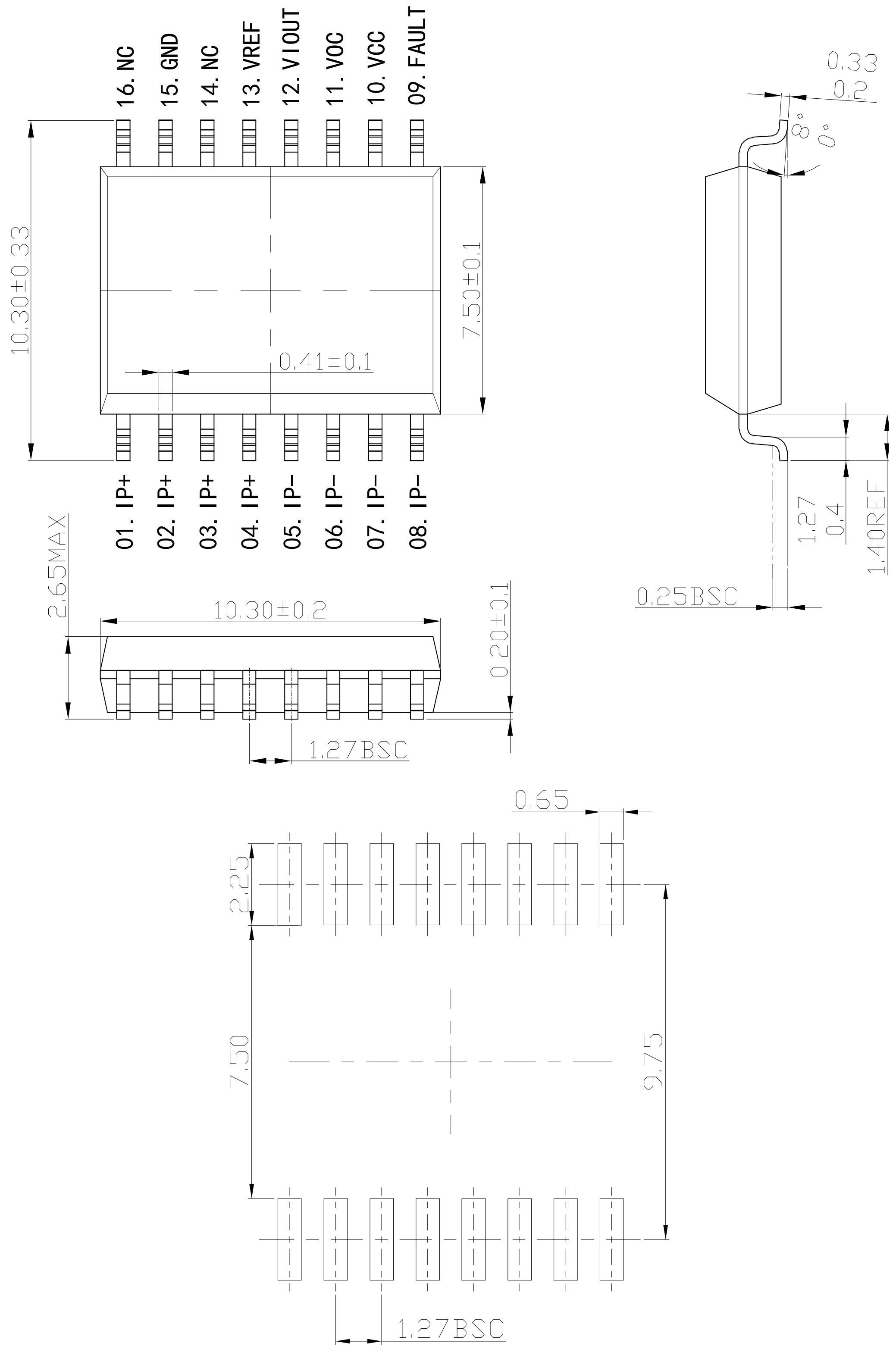
Remark 2: A1, A2 and A3 represent the operational amplifiers of the current sensor.

5. Electrical data STK-616T-XXMLB3

Condition：T_A = 25℃, Vcc = 3.3 V

Parameter	Symbol	Unit	Min	Typ	Max	Comment
General parameters						
Primary nominal current	I_pn	A	-20		20	STK-616T-20MLB3
Supply voltage	Vcc	V	3.15	3.3	3.45	
Current consumption	Icc	mA		7	12	
Primary conductor resistance	R_IP	mΩ		0.85		
Quiescent voltage@0A	Voff	V	1.6	1.65	1.7	
Reference voltage	Vref	V	1.6	1.65	1.7	
Electrical offset voltage	Offset	mV		±10		Voff - Vref
Output Specifications	R_out	Ω	1		30	
	R_ref		1		80	
Theoretical gain	G_th	mV/A		66		STK-616T-20MLB3
OCD function (if applicable)						
OCD range	VOC	V	0.3		1.6	K=1
			0.3		1.6	K=2
FAULT error		%		5%		% of OCD
OCD Hysteresis	IHYS	%		10%		% of OCD
OCD Fault Mask	tmask	μs		2		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 error@25℃	Non-L	%I_pn		±1.5		±I_pn
Step response time	t_res	μs		0.9		@90% of I_pn STK-616T-XXMLBX
Frequency bandwidth	BW	MHz		0.6		@-3dB STK-616T-XXMLBX
Output voltage noise	Vnoise	mVpp		10		STK-616T-XXMLB3 @1.4 MHz
				20		STK-616T-10MLB3 @1.4MHz
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		

6. Dimension & Pin definitions with OCD function



PCB Layout Reference View

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

7. 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	FAULT	Over current detection alarm output, the pin is open leakage output. Normally, the output of fault pin is high level.
10	VCC	Power supply pin
11	VOC	Over current detection threshold input pin
12	VIOUT	Sensor output pin
13	VREF	Reference pin, output function
14	NC	No connection
15	GND	Ground pin (GND)
16	NC	No connection

8. PCB layout recommendation

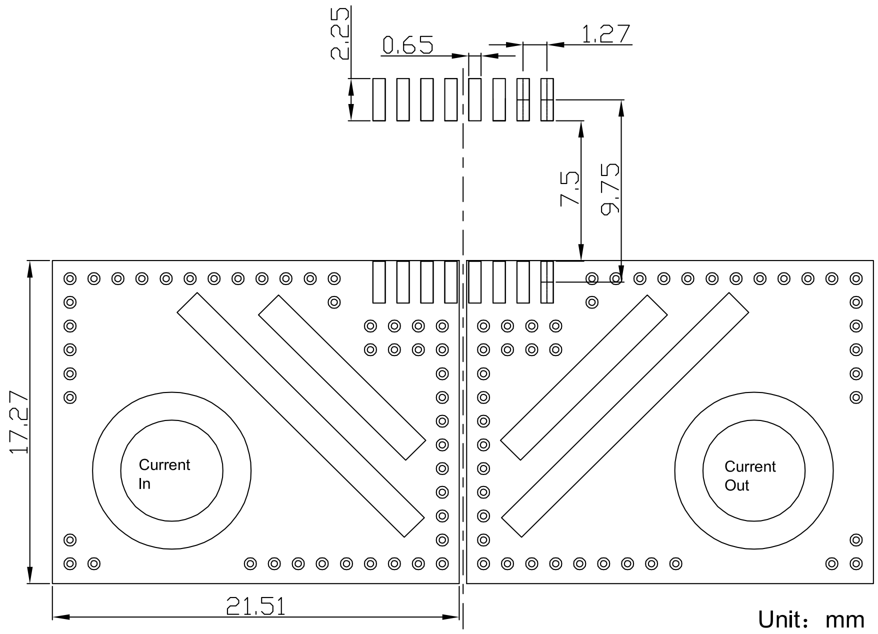


Figure 4 the recommended footprint of the SMT PCB layout for the STK-616TM series products. The unit is mm.

9. Frequency bandwidth of STK-616T-XXMLBX

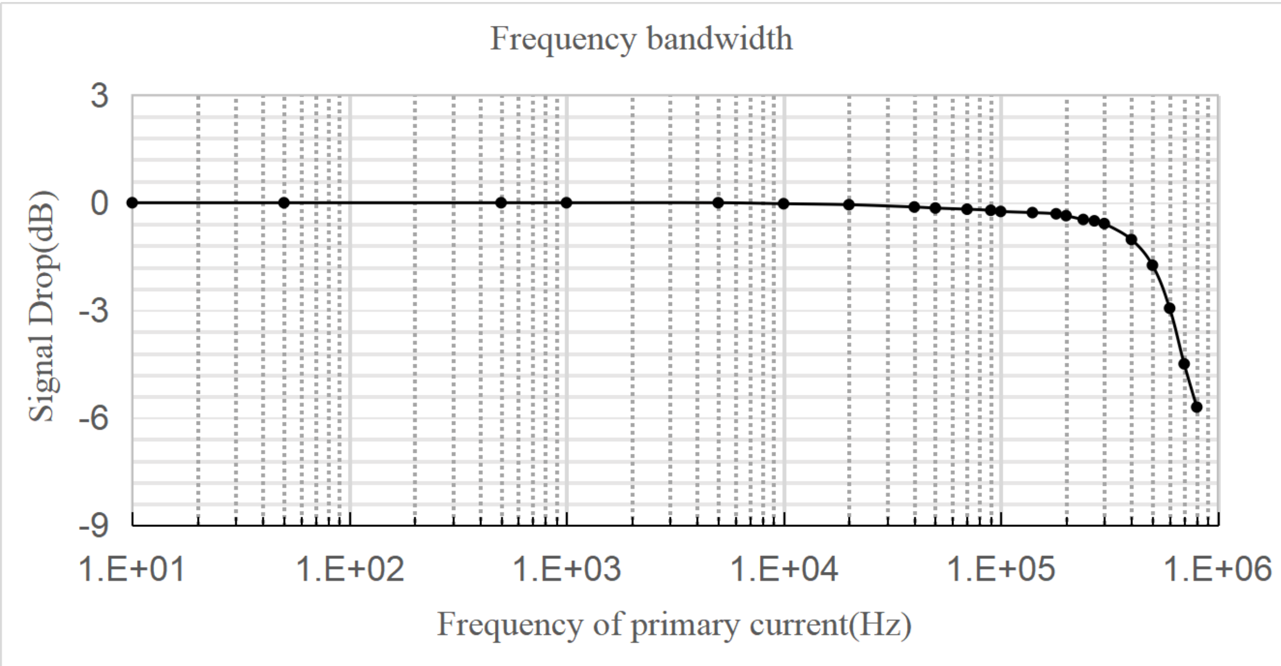


Figure 5 the frequency band width of the STK-616TM series products. the upper limit of the -3 dB band width is 0.6 MHz.

10. Step response time of STK-616T-XXMLBX

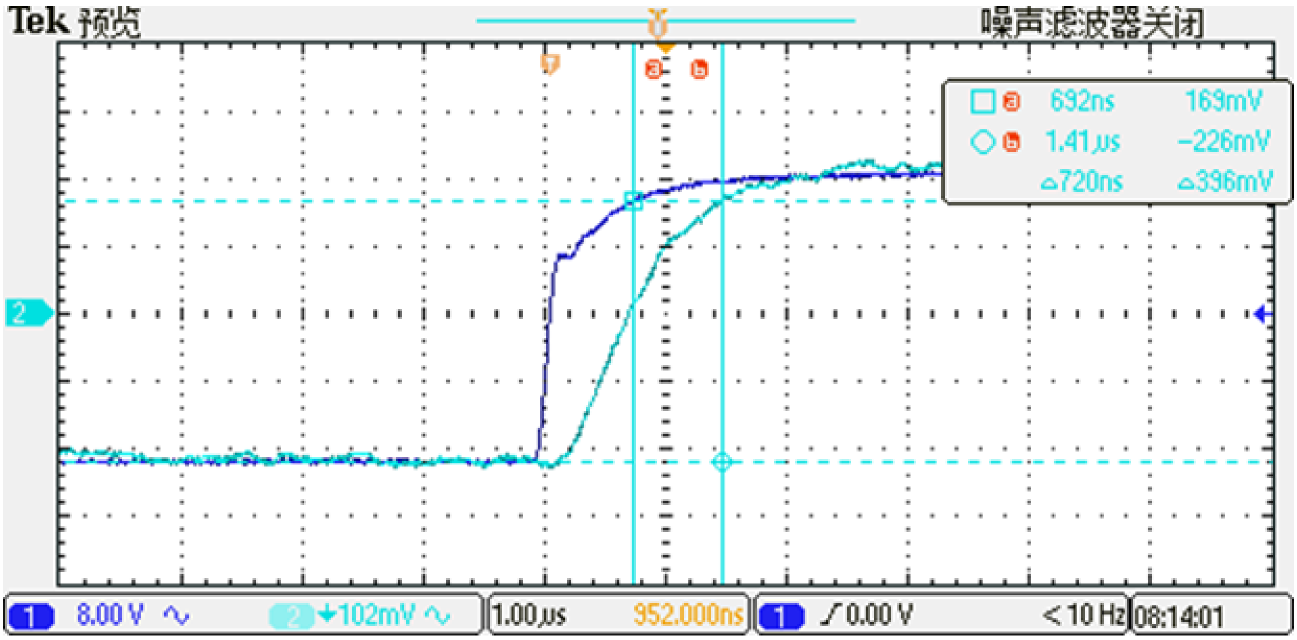


Figure 6 the typical high frequency response of STK-616TM current sensor. The response time from 90% of the primary current to 90% of the secondary output is 0.9μs.

11. Typical Application of STK-616TML

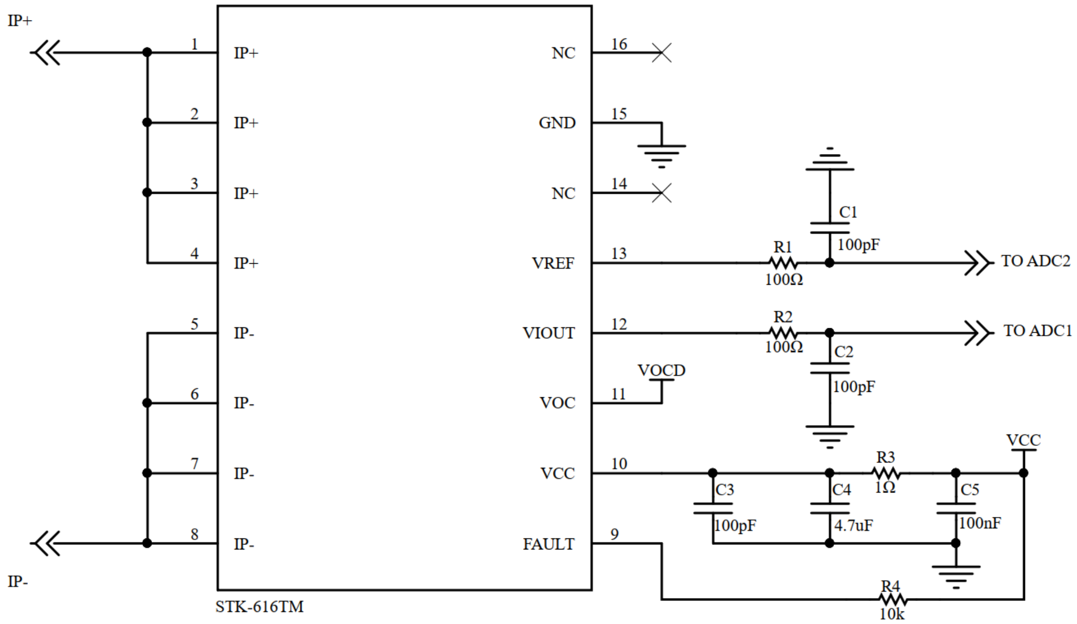


Figure 7 the reference application circuit for the STK-616TM series products.

Remark 3: R4 = 10 kΩ, recommended C1 = 100 pF, C2 = 100 pF, C3 = 100 pF, C4 = 4.7 μF，C5 = 100 nF. 100 pF of C1 and C2 does not affect the response speed of the chip. R1 and C1 constitute RC filter circuit ($f \approx 1 / (2\pi RC)$). The bandwidth of the STK-616TML is 0.6 MHz, and RC filter circuit above 0.6 MHz cannot realize a bandwidth above 1.5 MHz. If the VREF pin is not used, it can be left empty. If there is a need for an external capacitor, it is necessary to ensure that the capacitance value is greater than 100nf.

Remark 4: The VREF and VOUT pins cannot be connected directly to a capacitor. if a capacitor is required in the circuit, connect a resistor in series before the capacitor. It is recommended to select a series resistance of 100 Ω or more.

12. Examples of OCD function

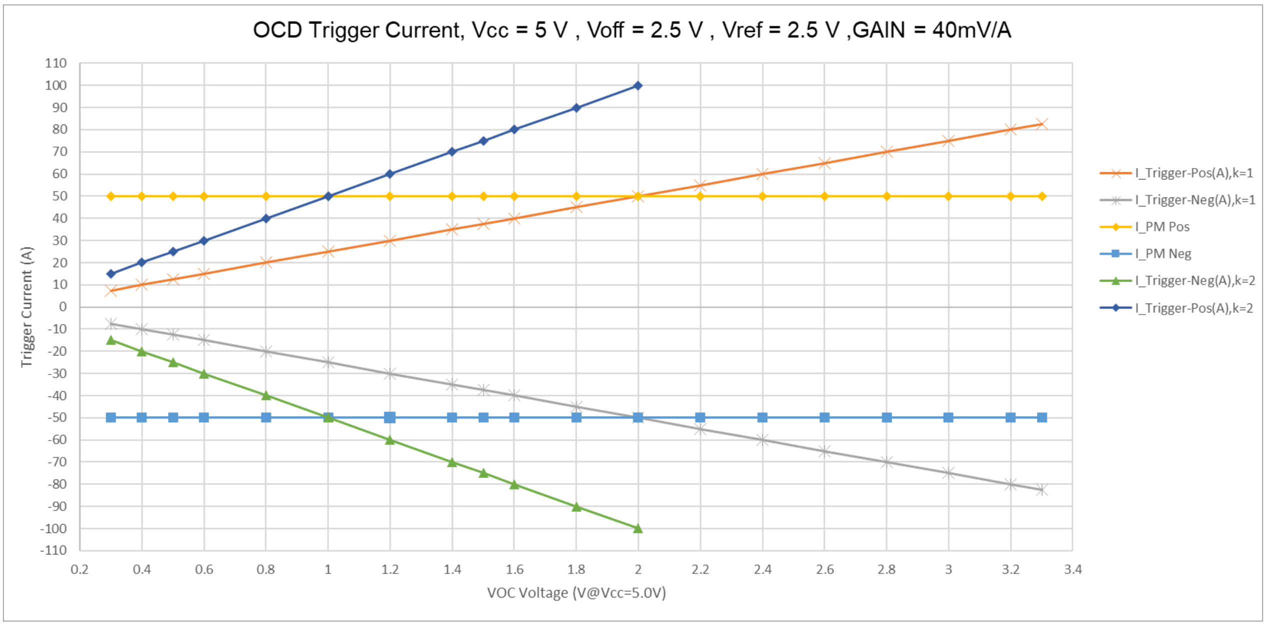


Figure 8 the relationship of trigger current and VOC setting for the STK-616T-50MLB5, with Vcc = 5 V. I_trigger_pos represents the forward over-current protection trigger current. I_trigger_neg represents the negative over-current protection trigger current. I_PN_pos represents the forward primary nominal 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.

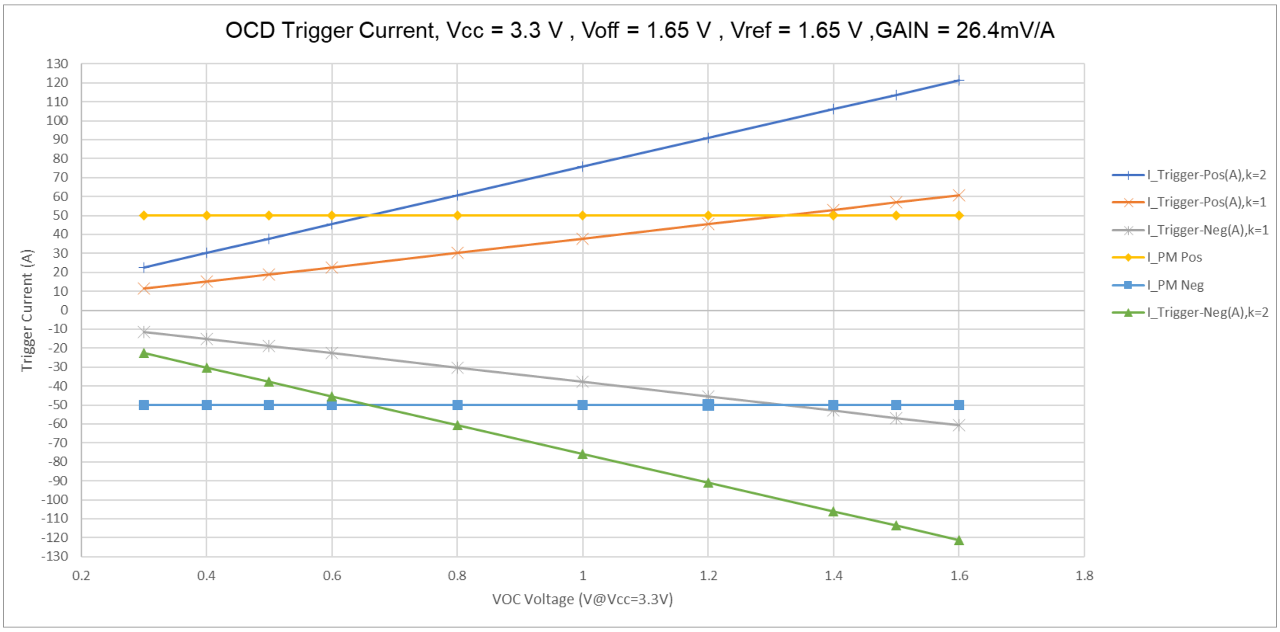


Figure 9 the relationship of trigger current and VOC setting for the STK-616T-50MLB3, with Vcc = 3.3 V. I_trigger_pos represents the forward over-current protection trigger current. I_trigger_neg represents the negative over-current protection trigger current. I_PN_pos represents the forward primary 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.

13. 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) Vref = 2.5 V,K=1
   ①. 0.3 V ≦ VOC ≦ 3.3 V;
   ②. Trigger voltage = Vref +/- VOC;
   ③. Trigger current = (Vref +/- VOC -Voff) / G_th;

b) Vref = 1.65 V,K=1
   ①. 0.3 V ≦ VOC ≦ 1.6 V;
   ②. Trigger voltage = Vref +/- VOC;
   ③. Trigger current = (Vref +/- VOC -Voff) / G_th

c) Vref = 0.5 V,K=1
   ①. 0.2 V ≦ VOC ≦ 0.5 V;
   ②. Trigger voltage = Vref + 8*VOC;
   ③. Trigger current = (Vref + VOC -Voff) / G_th

d) Vref = 2.5 V,K=2
   ①. 0.5 V ≦ VOC ≦ 2 V;
   ②. Trigger voltage = Vref +/- K*VOC;
   ③. Trigger current = (Vref +/- K*VOC -Voff) / G_th;

e) Vref = 1.65 V,K=2
   ①. 0.3 V ≦ VOC ≦ 1.6 V;
   ②. Trigger voltage = Vref +/- K*VOC;
   ③. Trigger current = (Vref +/- K*VOC -Voff) / G_th

f) Vref = 0.5 V,K=2
   ①. 0.2 V ≦ VOC ≦ 0.5 V;
   ②. Trigger voltage = Vref + 8*VOC;
   ③. Trigger current = (Vref +8*VOC -Voff) / G_th

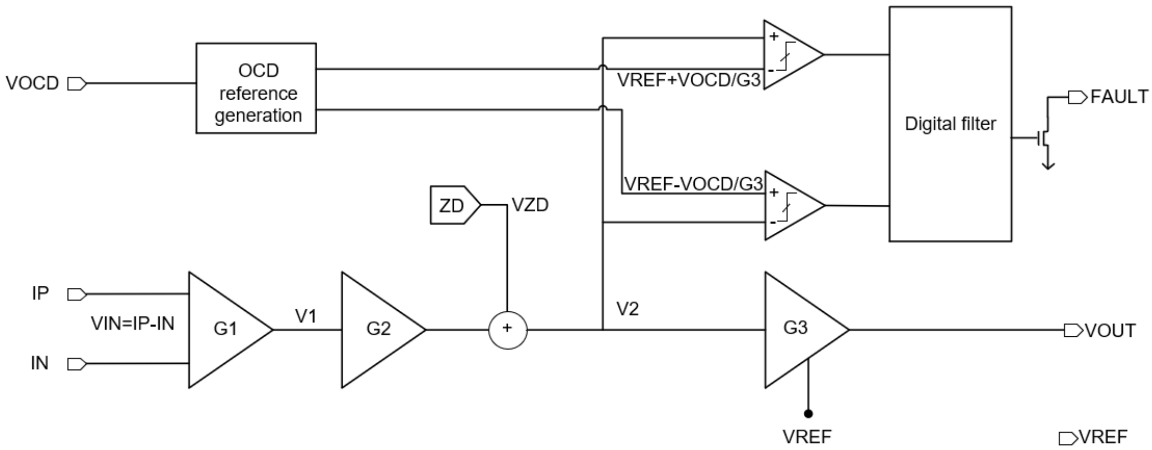


Figure 10 the functional block diagram for STK-616TM on OCD function with conditions of Vcc = 5 V, Voff = 2.5 V, Vref = 2.5V.

14. PACKAGE MATERIALS INFORMATION

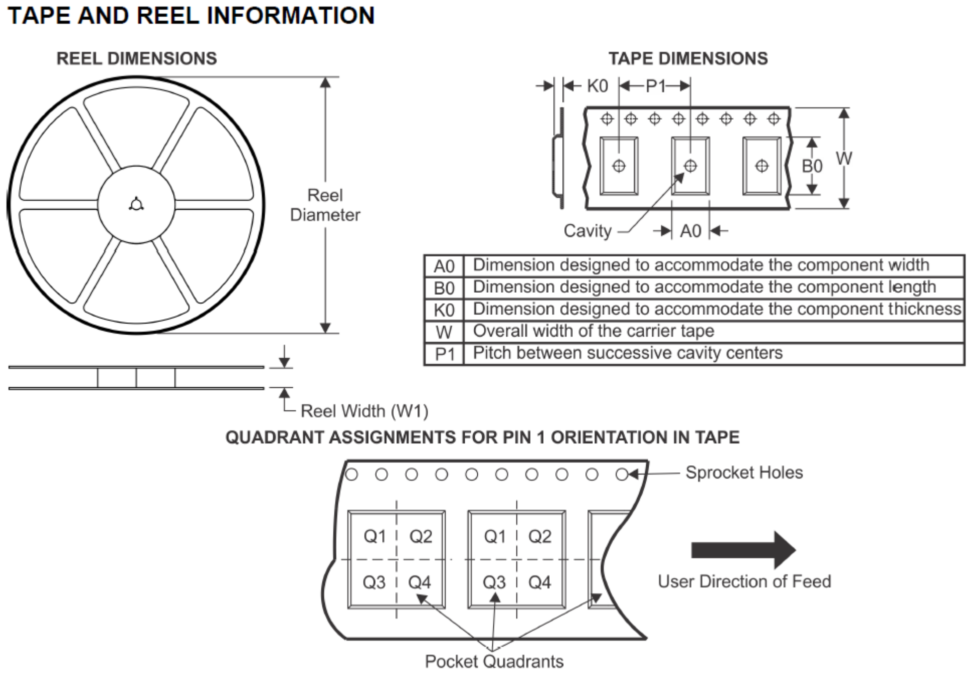


Figure 11 package materials information.