Current Sensor

Product Series: STK-600

Version: Ver 4.1

Sinomags Technology Co., Ltd

Web site: www.sinomags.com

CONTENT

1. Introduction

The STK-600 series current sensor is based on TMR (tunnel magnetoresistance) technology, and it has an 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
- Motor driver
- Electric welder power supply
- BMS

General parameter

Parameter	Symbol	Unit	Value
Working temperature	T_A	℃	-40 ~ 125
Storage temperature	T_stg	℃	-40 ~ 125
Mass	m	g	10

Absolute maximum rating

Parameter	Symbol	Unit	Value
Supply voltage (not-destructive)	V_{CC}	V	6
ESD rating (HBM)	U_{ESD}	kV	4

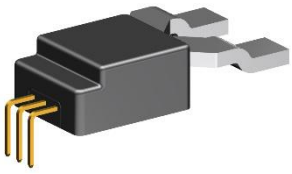
Remark: the unrecoverable damage may occur when the product works on the conditions over the absolute maximum ratings. Long-time working on the absolute maximum ratings may cause the degradation on performance and reliability.

Isolation parameter

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC test 50Hz/1 min	Ud	kV	4	
Clearance distance (pri. -sec)	dCl	mm	8	Shortest distance through air
Creepage distance (pri. -sec)	dCp	mm	8	Shortest path along device body
Case material			V0 according to UL 94	

2. Package: 5-pin package

PFF Leadform



PSF Leadform

3. Features and Benefits

UL certified, File No. E507664.

4. Selection Guide

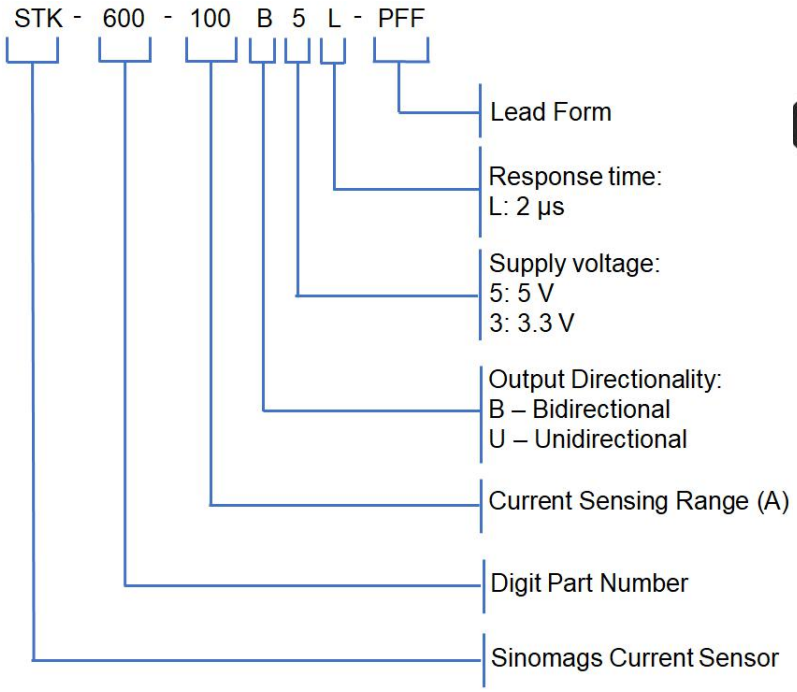
Part Number	Supply Voltage Vcc(V)	Current Range I_PM(A)	Sensitivity (Typ. mV/A)	Response time(μs)	Bandwidth (kHz)	Current Directionality	Top(℃)
STK-600-050B	5	±50	40	4	300	Bidirectional	-40~105
STK-600-100B	5	±100	20	4	300	Bidirectional	-40~105
STK-600-150B	5	±150	13.33	4	300	Bidirectional	-40~105
STK-600-200B	5	±200	10	4	300	Bidirectional	-40~85
STK-600-250B	5	±250	8	4	300	Bidirectional	-40~85
STK-600-300B	5	±300	6.66	4	300	Bidirectional	-40~85
STK-600-350B	5	±350	5.71	4	300	Bidirectional	-40~85
STK-600-400B	5	±400	5	4	300	Bidirectional	-40~85
STK-600-050U	5	50	80	4	300	Unidirectional	-40~105
STK-600-100U	5	100	40	4	300	Unidirectional	-40~105
STK-600-150U	5	150	26.66	4	300	Unidirectional	-40~105
STK-600-200U	5	200	20	4	300	Unidirectional	-40~85
STK-600-250U	5	250	16	4	300	Unidirectional	-40~85
STK-600-300U	5	300	13.33	4	300	Unidirectional	-40~85
STK-600-350U	5	350	11.42	4	300	Unidirectional	-40~85
STK-600-400U	5	400	10	4	300	Unidirectional	-40~85

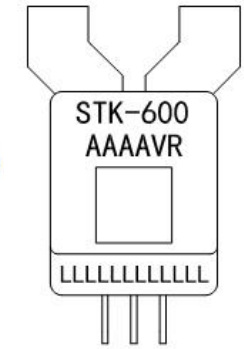
Note1. All series support 3.3V power supply, add suffix 3 to part number. For example, STK-600-XXXX3X.

Note2. The sensitivity of the 3.3V powered product is 66% of the sensitivity of the corresponding 5V powered product. The offset of the bidirectional output of 3.3V power supply is 1.65V, and the offset of the bidirectional output of 5V power supply is 2.5V, the offset of the unidirectional output of 5V power supply is 0.5V, and the offset of the unidirectional output of 3.3V power supply is 0.33V.

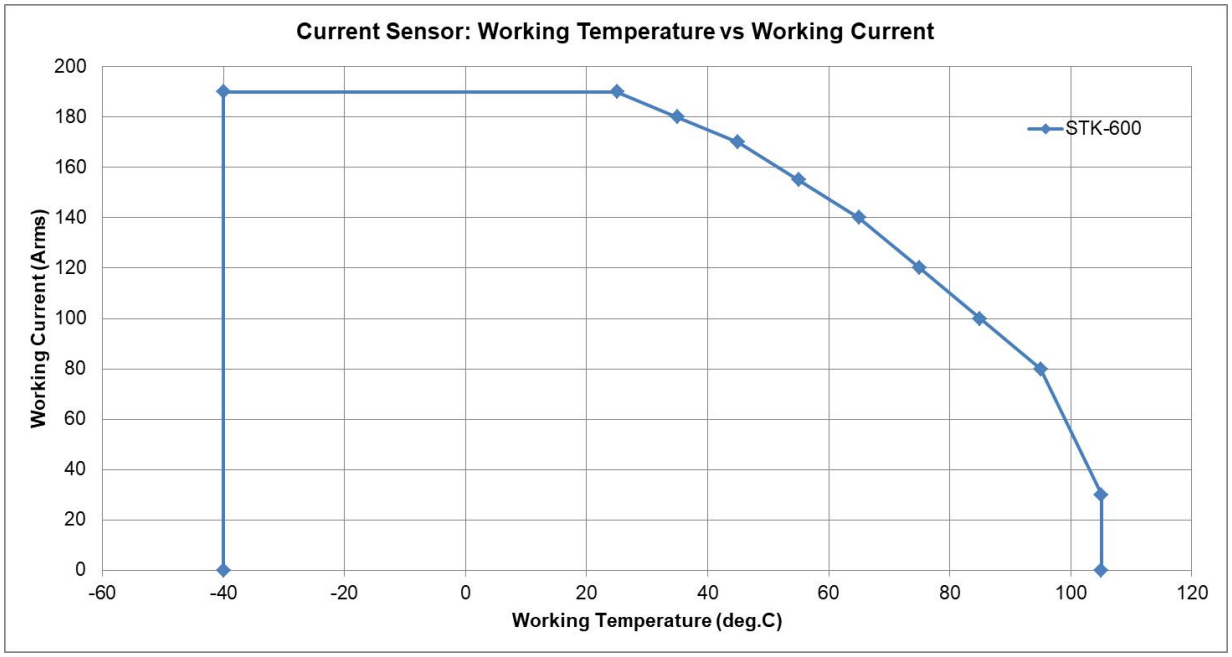
Note3. The typical temperature rise curve measured with the board of 4oz copper on each layer and the thickness of tin plating on the top and bottom layers is 0.2 mm.

5. Product Information





Production information is printed on the package surface by laser marking.



The relationship between working temperature & working current. It is suggested that the temperature of sensor not exceed 105 deg.C for better accuracy.

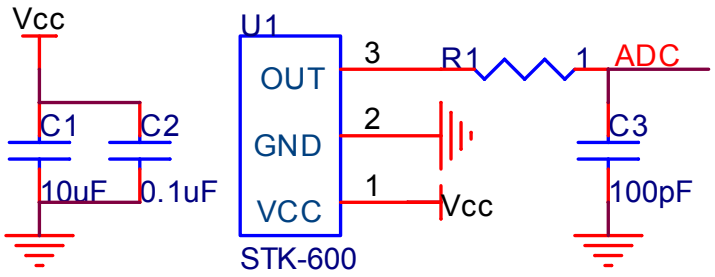
6. Electrical Data

Condition：T_A = 25℃, Vcc = 5V

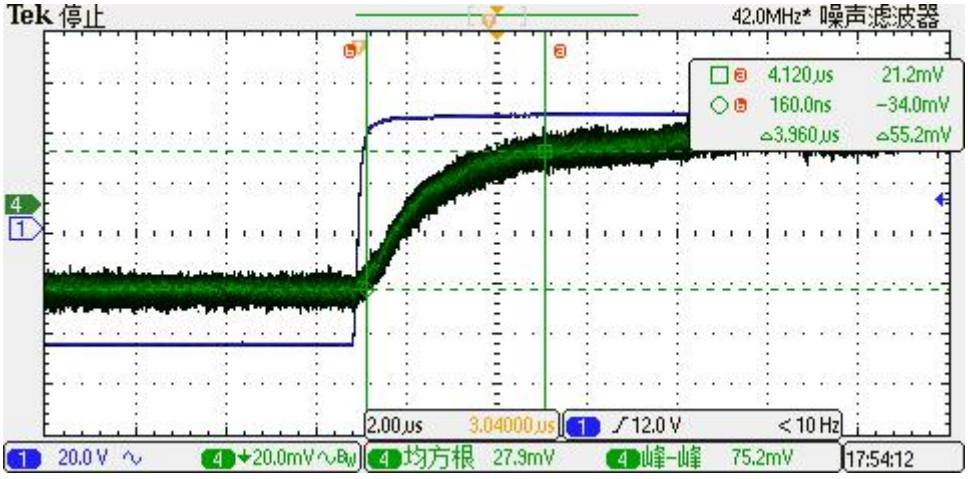
Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current	I_{PN}	A		50		STK-600-050
				100		others
Current range (refer remark)	I_{PM}	A	-50		50	STK-600-050B
			-100		100	STK-600-100B
			-150		150	STK-600-150B
			-200		200	STK-600-200B
			-250		250	STK-600-250B
			-300		300	STK-600-300B
			-350		350	STK-600-350B
			-400		400	STK-600-400B
			0		50	STK-600-050U
			0		100	STK-600-100U
			0		150	STK-600-150U
			0		200	STK-600-200U
			0		250	STK-600-250U
			0		300	STK-600-300U
			0		350	STK-600-350U
			0		400	STK-600-400U
Supply voltage	Vcc	V		5 ± 5%		All
Current consumption	Icc	mA		6		All
Quiescent voltage Vout @ 0 A	$V_{IOUT(Q)}$	V	2.48	2.5	2.52	STK-600-XXXB
			0.48	0.5	0.52	STK-600-XXXU
Peak output voltage (Vout @ ±I_pm) –$V_{IOUT(Q)}$	V_FS	V		± 2		STK-600-XXXB
				4		STK-600-XXXU
Internal output resistance	R_out	Ω		2		All

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Sensitivity	Sens	mV/A		40		STK-600-050B
				20		STK-600-100B
				13.33		STK-600-150B
				10		STK-600-200B
				8		STK-600-250B
				6.66		STK-600-300B
				5.71		STK-600-350B
				5		STK-600-400B
				80		STK-600-050U
				40		STK-600-100U
				26.66		STK-600-150U
				20		STK-600-200U
				16		STK-600-250U
				13.33		STK-600-300U
				11.42		STK-600-350U
				10		STK-600-400U
Rated linearity error	E_{LIN}	% I_{PN}		± 1		± I_{PN}
Step response time @90% of I_{PM}	t_res	μs		4		
Frequency bandwidth (-3dB)	BW	kHz		300		
Output voltage noise DC ~ 10 kHz DC ~ 100 kHz	Vnoise	mVpp		20 30		All except (STK-600-050B STK-600-050U STK-600-100U)
				30 40		STK-600-050B STK-600-050U STK-600-100U
Accuracy @ 25℃	E_{TOT}	% of I_{PM}	-2.4	±1	2.4	All
Accuracy @ -40℃ ~ 105℃	E_{TOT}	% of I_{PM}	-3.5		3.5	STK-600-050 ~ STK-600-150
Accuracy @ -40℃ ~ 85℃	E_{TOT}	% of I_{PM}	-3.5		3.5	STK-600-200 ~ STK-600-400

7. Typical Application Circuit

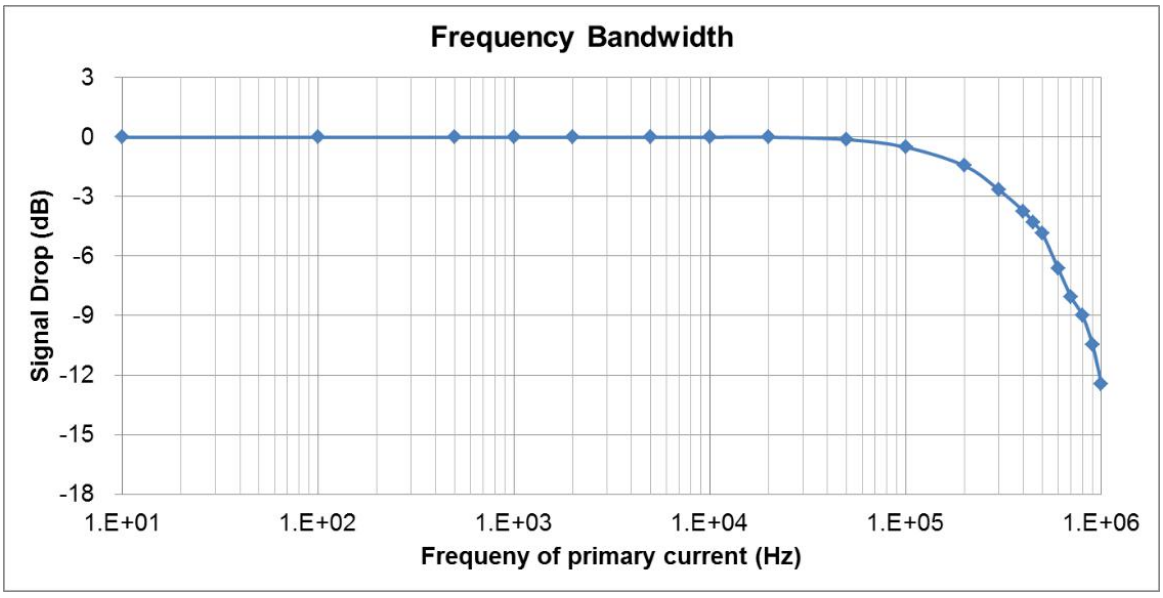


8. Response Time



STK-600-XXXXXL response time

9. Frequency Bandwidth



STK-600-XXXXXL bandwidth

10. Characteristic Definitions

SENSITIVITY (Sens)

The change in sensor output in response to a 1 A change through the primary conductor. The sensitivity is the sensor gain (mV/A) for the full-scale current of the device. The sensitivity is fixed and does not change with the supply voltage.

SENSITIVITY ERROR (E_{Sens})

The sensitivity error is the percent difference between the ideal sensitivity and the measured sensitivity.

$$E_{Sens} = \frac{Sens_{Meas} - Sens_{Ideal}}{Sens_{Ideal}}$$

NONLINEARITY (E_{LIN})

The STK-600 is designed to provide a linear output in response to a ramping current. Consider two current levels: I1 and I2. Nonlinearity is present when there is a difference between the sensitivities measured at I1 and I2. Nonlinearity is calculated separately for the positive (E_{LINpos}) and negative (E_{LINneg})

$$E_{LINpos} = 100(\%) * \{1 - \frac{Sens_{IPOS2}}{Sens_{IPOS1}}\}$$

$$E_{LINneg} = 100(\%) * \{1 - \frac{Sens_{INEG2}}{Sens_{INEG1}}\}$$

applied currents as follows:

and I_{POSx} and I_{NEGx} are positive and negative currents and I_{POSx} =2* I_{POS1} and I_{NEG2} = 2*I_{NEG1}.

$$Sens_{Ix} = \frac{V_{IOUT(Ix)} - V_{IOUT(Q)}}{I_x}$$

$$E_{LIN} = max(E_{LINpos}, E_{LINneg})$$

ZERO CURRENT OUTPUT VOLTAGE (VIOUT(Q))

The output of the sensor when the primary current is zero. When the power supply is 5V, it nominally remains at 2.5V for a bidirectional device and 0.5V for a unidirectional device. When the power supply is 3.3V, it nominally remains at 1.65V for a bidirectional device and 0.5V for a unidirectional device.

TOTAL OUTPUT ERROR (E_{TOT})

The difference between the current measurement from the sensor and the actual current (IP), relative to the actual current. The Total Output Error incorporates all sources of error and is a function of IP.

$$E_{TOT}(I_P) = \frac{V_{IOUT(I_P)} - V_{IOUT(ideal)(I_P)}}{Sens_{ideal} * I_P}$$

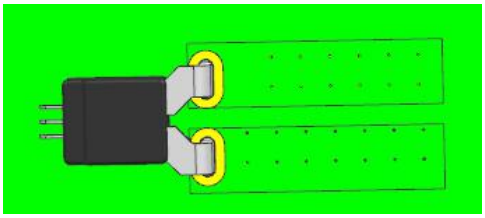
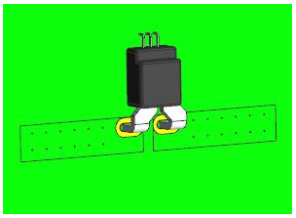
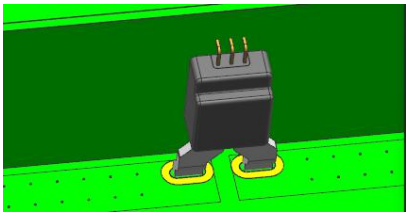
$$V_{IOUT(ideal)(I_P)} = V_{IOUT(Q)} + Sens_{ideal} * I_P$$

11. Applications Information

LAYOUT GUIDELINES

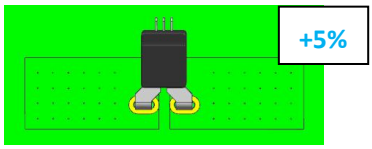
There are a few considerations during PCB layout that will help to maintain high accuracy when using STK-600. STK-600 detects current by measuring the magnetic field generated by the current. STK-600 includes a U-shaped conductor inside and senses a differential field generated by the primary current which can provide immunity to external magnetic fields. Therefore, the sensor will reject any common mode magnetic field originating from outside of its package. However, it is still prudent to avoid exposure to external magnetic fields. Therefore, it's important to consider the effect of externally generated magnetic fields, whether from a magnet component and another current flowing in the system. STK-600 is most sensitive to the magnetic field in the X-Y plane (the plane of the PCB surface). When laying out the PCB, care should be taken to avoid a current passing directly underneath the device itself, because the magnetic field generated by that current will be parallel to the PCB surface.

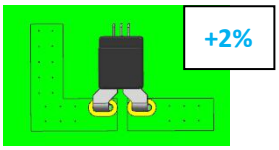
REFERENCE LAYOUT

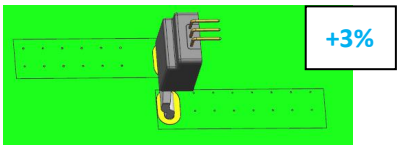




In general, no gain calibration is required in these reference layouts.

GAIN CALIBRATION REQUIRED LAYOUT



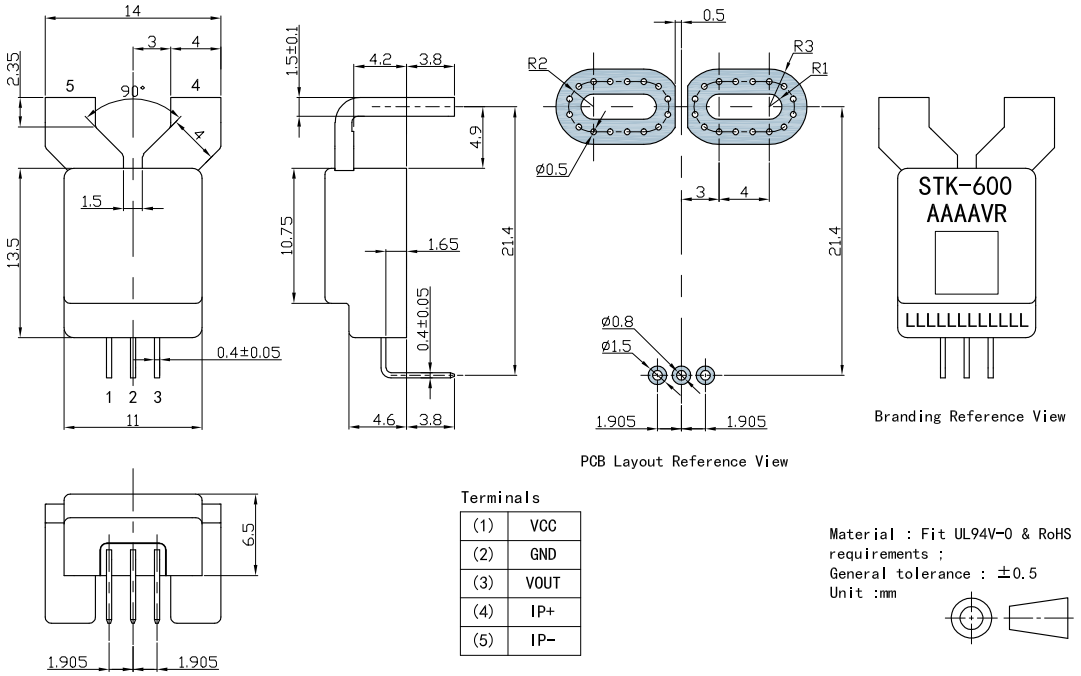




The gain error depends on the size of the current wire and its position relative to the package of the current sensor. The gain error can be calculated according to the electromagnetic theory or measured. If there is a complex PCB wiring under the sensor, please contact FAE to assist with the design. In these above typical layouts, the linearity is good, but the gain needs to be calibrated. The specific gain error value can be obtained by Maxwell equations or specific measurement.

12. Dimension & Pin Definitions

Package, Leadform PFF

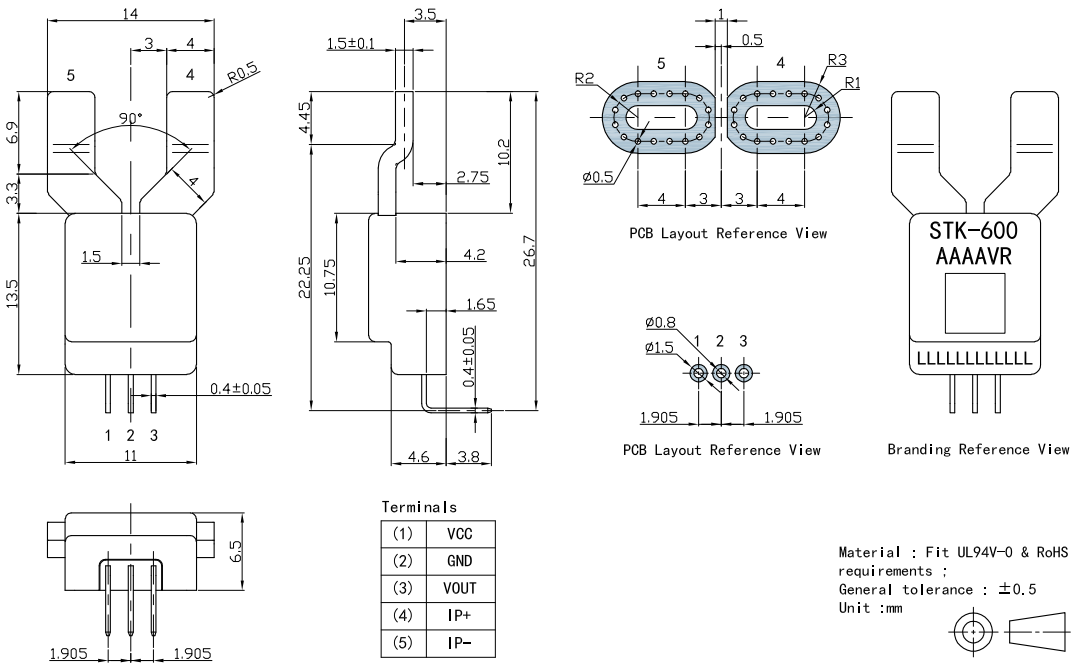


Terminals

(1)	VCC
(2)	GND
(3)	VOUT
(4)	IP+
(5)	IP-

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

Package, Leadform PSF



Terminals

(1)	VCC
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Material : Fit UL94V-0 & RoHS requirements ;
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