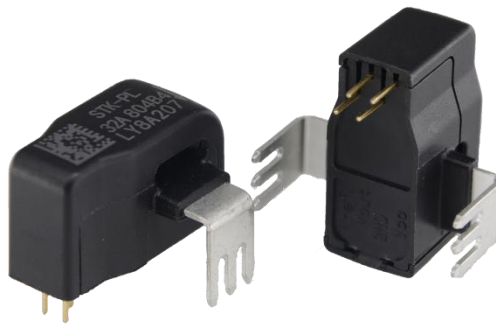


Current Sensor

Product Series: STK-PL/A
STK-10PL/A
STK-20PL/A
Part number: STK-32PL/A
STK-40PL/A
STK-50PL/A

Version: Ver 7.3



Sinomags Technology Co., Ltd

Web site: www.sinomags.com

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1. Summary

The STK-PL/A series is based on TMR (Tunneling-Magnetoresistance) technology and open-loop design. It is suitable for DC, AC, pulsed and any kind of irregular current measurement under the isolated conditions. The nominal current range of the STK-PL/A current sensor consists of 10 A, 20 A, 32 A, 40 A, 50 A.

Typical applications

- PV combiner box
- PV inverter (MPPT & AC)
- motor driver controller
- SMPS & UPS
- Battery management system

Standards

- EN50178:1997
- IEC 61010-1:2010
- IEC 61326-1:2012

General parameter

Parameter	Symbol	Unit	Value
Working temperature	T _A	°C	-40 ~ 105
Storage temperature	T _{stg}	°C	-40 ~ 105
Mass	m	g	10
Current line impedance	Z	mΩ	0.2
Current line temperature rise	Tr	°C	110

Absolute maximum rating

Parameter	Symbol	Unit	Value
Supply voltage (non-destructive)	V _C	V	6.0
ESD rating (HBM)	U _{ESD}	kV	4
ESD rating (CDM)	U _{CDM}	kV	1.5

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.

Ratings

Parameter	Symbol	Unit	Value
Primary involved potential		V AC/DC	600
Ambient operating temperature	T_A	°C	105
Primary current	I_p	A	According to series primary current
Secondary supply voltage	U_c	V DC	5
Output voltage	V_out	V	0.1 ~ 4.9

Isolation parameter

Parameter	Symbol	Unit	Value	Comment
RMS voltage for AC test 50Hz/1 min	U _d	kV	5	
Impulse withstand voltage 1.2/50μs	Ū _w	kV	8	
Clearance distance (pri. -sec)	d _{Cl}	mm	8	Shortest distance through air
Creepage distance (pri. -sec)	d _{Cp}	mm	8	Shortest path along device body
Case material			V0 according to UL 94	
Application example		V	600	Reinforced insulation, CAT III, PD 2, non uniform field according EN 50178, IEC 61010
Application example		V	1000	Basic insulation, CAT III, PD 2, non uniform field according EN 50178, IEC 61010
Application example		V	1500	Basic insulation, CAT III, PD 2, according to IEC 62109-1 Altitude ≤ 3000 m
Application example		V	600	CAT III, PD 2, according to UL 508

2. STK-10PL/A Electrical performance

Condition: $T_A = 25^\circ\text{C}$, $V_{cc} = 5\text{ V}$ (Except special instructions)

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I_{pn}	A		10		
Primary current measuring range	I_{pm}	A	-25		25	
Supply voltage	V_{cc}	V	4.75	5	5.25	
Current consumption	I_{cc}	mA		5	10	
Reference voltage	V_{ref}	V	2.48	2.5	2.52	Output function
Rated output voltage	V_{FS}	V		0.8		$(V_{out} - V_{ref}) @ I_{pn}$
Internal output resistance	R_{out}	Ω		1		Output
Internal output resistance	R_{ref}	Ω		1		Output
Quiescent voltage	V_{off}	V	2.48	2.5	2.52	$V_{out} @ 0\text{ A}$
Electrical offset voltage	V_{oe}	mV	-10		10	$(V_{out} - V_{ref}) @ 0\text{ A}$
Temperature drift of V_{oe}	V_{oe_TRange}	mV	-8		8	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Magnetic offset current	I_{om}	A	-0.25		0.25	@ $\pm 10 \times I_{pn}$
Theoretical gain	G_{th}	mV/A		80		800 mV @ I_{pn}
Error of gain	Err_G	% G_{th}		± 0.5		Trimmed in the factory @ 25°C
Temperature drift of gain	G_{TR}	% G_{th}	-1.0		1.0	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Rated linearity error	$Non-L_{pn}$	% I_{pn}	-0.5		0.5	$\pm I_{pn}$
Linearity error @ I_{pm}	$Non-L_{pm}$	% I_{pm}	-1		1	$\pm I_{pm}$
Reaction time	t_{ra}	μs		0.5	1	@ 10% of I_{pn}
Step response time	t_{res}	μs		1.5	2	@ 90% of I_{pn}
Delay time	t_{delay}	μs		1		400 kHz sine wave
Frequency bandwidth (-3dB)	BW	kHz		400		No RC circuit
Output voltage noise	V_{noise}	mVpp		15		
DC ~ 100 kHz				25		
Accuracy @ 25°C	X	% of I_{pn}	-1		1	@ 25°C
Accuracy @ $-40^\circ\text{C} \sim 105^\circ\text{C}$	X_{TRange}	% of I_{pn}	-2		2	$-40^\circ\text{C} \sim 105^\circ\text{C}$

3. STK-20PL/A Electrical performance

Condition: $T_A = 25^\circ\text{C}$ $V_{cc} = 5\text{ V}$ (Except special instructions)

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I_{pn}	A		20		
Primary current measuring range	I_{pm}	A	-50		50	
Supply voltage	V_{cc}	V	4.75	5	5.25	
Current consumption	I_{cc}	mA		5	10	
Reference voltage	V_{ref}	V	2.48	2.5	2.52	Output function
Rated output voltage	V_{FS}	V		0.8		$(V_{out} - V_{ref}) @ I_{pn}$
Internal output resistance	R_{out}	Ω		1		Output
Internal output resistance	R_{ref}	Ω		1		Output
Quiescent voltage	V_{off}	V	2.48	2.5	2.52	$V_{out} @ 0\text{ A}$
Electrical offset voltage	V_{oe}	mV	-10		10	$(V_{out} - V_{ref}) @ 0\text{ A}$
Temperature drift of V_{oe}	V_{oe_TRange}	mV	-8		8	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Magnetic offset current	I_{om}	A	-0.25		0.25	@ $\pm 10 \times I_{pn}$
Theoretical gain	G_{th}	mV/A		40		800 mV @ I_{pn}
Error of gain	Err_G	% G_{th}		± 0.5		Trimmed in the factory @ 25°C
Temperature drift of gain	G_{TR}	% G_{th}	-1.0		1.0	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Rated linearity error	$Non-L_{pn}$	% I_{pn}	-0.5		0.5	$\pm I_{pn}$
Linearity error @ I_{pm}	$Non-L_{pm}$	% I_{pm}	-1		1	$\pm I_{pm}$
Reaction time	t_{ra}	μs		0.5	1	@ 10% of I_{pn}
Step response time	t_{res}	μs		1.5	2	@ 90% of I_{pn}
Delay time	t_{delay}	μs		1		400 kHz sine wave
Frequency bandwidth (-3dB)	BW	kHz		400		No RC circuit
Output voltage noise	V_{noise}	mVpp		12		
DC ~ 10 kHz				17		
DC ~ 100 kHz						
Accuracy @ 25°C	X	% of I_{pn}	-1		1	@ 25°C
Accuracy @ $-40^\circ\text{C} \sim 105^\circ\text{C}$	X_{TRange}	% of I_{pn}	-2		2	$-40^\circ\text{C} \sim 105^\circ\text{C}$

4. STK-32PL/A Electrical performance

Condition: $T_A = 25^\circ\text{C}$ $V_{cc} = 5\text{ V}$ (Except special instructions)

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I _{pn}	A		32		
Primary current measuring range	I _{pm}	A	-80		80	
Supply voltage	V _{cc}	V	4.75	5	5.25	
Current consumption	I _{cc}	mA		5	10	
Reference voltage	V _{ref}	V	2.48	2.5	2.52	Output function
Rated output voltage	V _{FS}	V		0.8		(V _{out} - V _{ref}) @ I _{pn}
Internal output resistance	R _{out}	Ω		1		Output
Internal output resistance	R _{ref}	Ω		1		Output
Quiescent voltage	V _{off}	V	2.48	2.5	2.52	V _{out} @ 0 A
Electrical offset voltage	V _{oe}	mV	-10		10	(V _{out} - V _{ref}) @ 0 A
Temperature drift of V _{oe}	V _{oe} _TRange	mV	-8		8	-40°C ~ 105°C
Magnetic offset current	I _{om}	A	-0.25		0.25	@ ±10 x I _{pn}
Theoretical gain	G _{th}	mV/A		25		800 mV @ I _{pn}
Error of gain	Err_G	%G _{th}		±0.5		Trimmed in the factory @ 25°C
Temperature drift of gain	G _{TR}	%G _{th}	-1.0		1.0	-40°C ~ 105°C
Rated linearity error	Non-L _{pn}	%I _{pn}	-0.5		0.5	±I _{pn}
Linearity error @ I _{pm}	Non-L _{pm}	%I _{pm}	-1.0		1.0	±I _{pm}
Reaction time	t _{ra}	μs		0.5	1	@ 10% of I _{pn}
Step response time	t _{res}	μs		1.5	2	@ 90% of I _{pn}
Delay time	t _{delay}	μs		1		400 kHz sine wave
Frequency bandwidth (-3dB)	BW	kHz		400		No RC circuit
Output voltage noise	V _{noise}	mVpp		12		
DC ~ 10 kHz				17		
DC ~ 100 kHz						
Accuracy @ 25°C	X	% of I _{pn}	-1		1	@ 25°C
Accuracy @ -40°C ~ 105°C	X_TRange	% of I _{pn}	-2		2	-40°C ~ 105°C

5. STK-40PL/A Electrical performance

Condition: $T_A = 25^\circ\text{C}$ $V_{cc} = 5\text{ V}$ (Except special instructions)

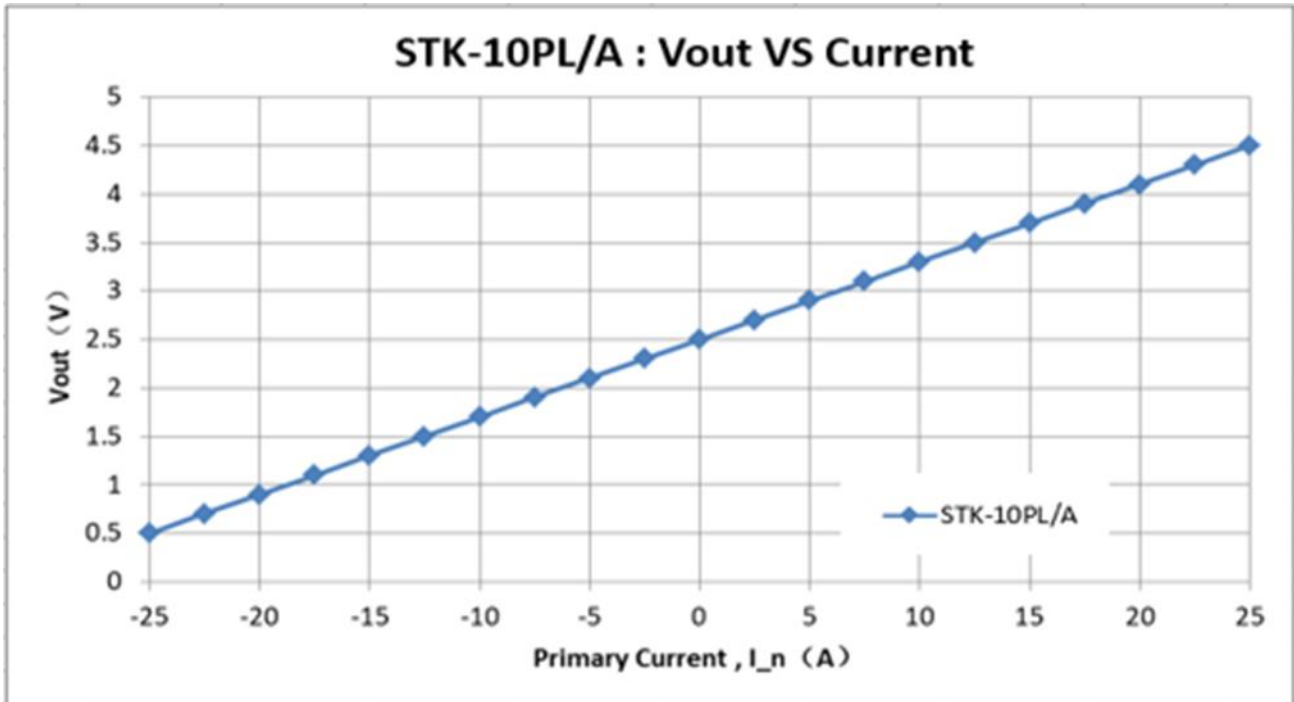
Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I_{pn}	A		40		
Primary current measuring range	I_{pm}	A	-100		100	
Supply voltage	V_{cc}	V	4.75	5	5.25	
Current consumption	I_{cc}	mA		5	10	
Reference voltage	V_{ref}	V	2.48	2.5	2.52	Output function
Rated output voltage	V_{FS}	V		0.8		$(V_{out} - V_{ref}) @ I_{pn}$
Internal output resistance	R_{out}	Ω		1		Output
Internal output resistance	R_{ref}	Ω		1		Output
Quiescent voltage	V_{off}	V	2.48	2.5	2.52	$V_{out} @ 0\text{ A}$
Electrical offset voltage	V_{oe}	mV	-10		10	$(V_{out} - V_{ref}) @ 0\text{ A}$
Temperature drift of V_{oe}	V_{oe_TRange}	mV	-8		8	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Magnetic offset current	I_{om}	A	-0.25		0.25	@ $\pm 10 \times I_{pn}$
Theoretical gain	G_{th}	mV/A		20		800 mV @ I_{pn}
Error of gain	Err_G	% G_{th}		± 0.5		Trimmed in the factory @ 25°C
Temperature drift of gain	G_{TR}	% G_{th}	-1.0		1.0	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Rated linearity error	$Non-L_{pn}$	% I_{pn}	-0.5		0.5	$\pm I_{pn}$
Linearity error @ I_{pm}	$Non-L_{pm}$	% I_{pm}	-1		1	$\pm I_{pm}$
Reaction time	t_{ra}	μs		0.5	1	@ 10% of I_{pn}
Step response time	t_{res}	μs		1.5	2	@ 90% of I_{pn}
Delay time	t_{delay}	μs		1		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		10 15		
Accuracy @ 25°C	X	% of I_{pn}	-1		1	@ 25°C
Accuracy @ $-40^\circ\text{C} \sim 105^\circ\text{C}$	X_{TRange}	% of I_{pn}	-2		2	$-40^\circ\text{C} \sim 105^\circ\text{C}$

6. STK-50PL/A Electrical performance

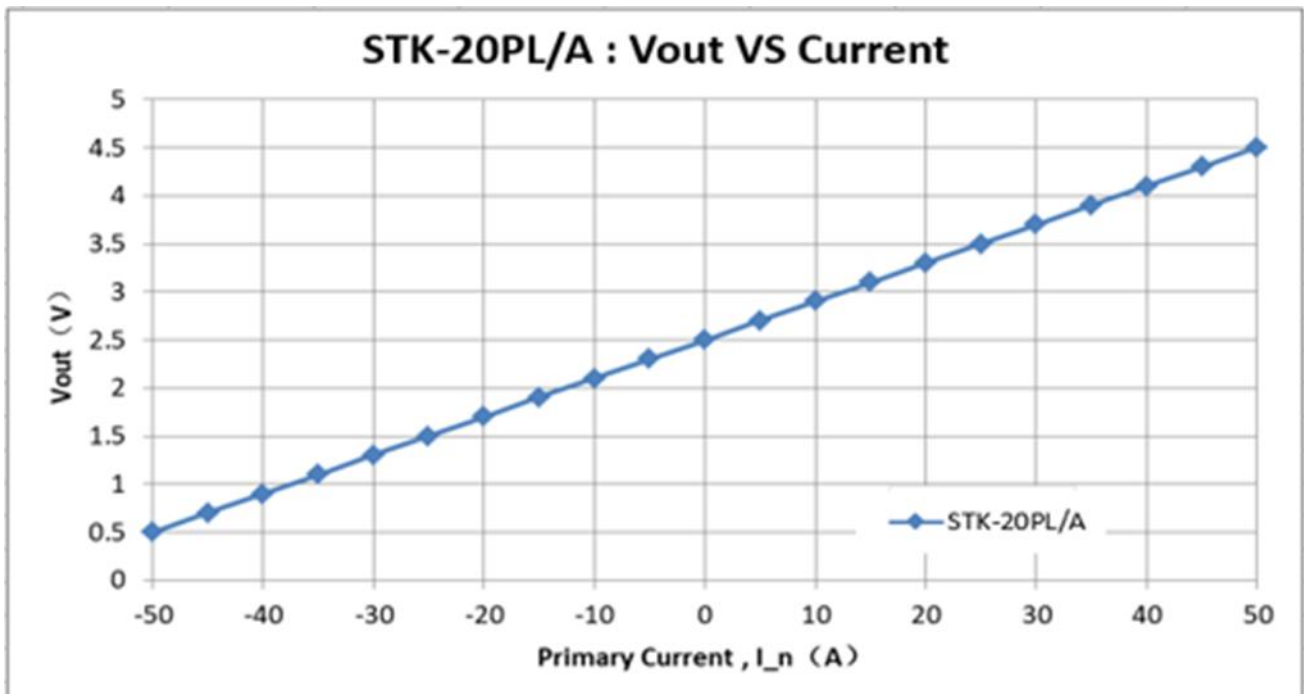
Condition: $T_A = 25^\circ\text{C}$ $V_{cc} = 5\text{ V}$ (Except special instructions)

Parameter	Symbol	Unit	Min	Typ	Max	Comment
Primary nominal current rms	I_{pn}	A		50		
Primary current measuring range	I_{pm}	A	-125		125	
Supply voltage	V_{cc}	V	4.75	5	5.25	
Current consumption	I_{cc}	mA		5	10	
Reference voltage	V_{ref}	V	2.48	2.5	2.52	Output function
Rated output voltage	V_{FS}	V		0.8		$(V_{out} - V_{ref}) @ I_{pn}$
Internal output resistance	R_{out}	Ω		1		Output
Internal output resistance	R_{ref}	Ω		1		Output
Quiescent voltage	V_{off}	V	2.48	2.5	2.52	$V_{out} @ 0\text{ A}$
Electrical offset voltage	V_{oe}	mV	-10		10	$(V_{out} - V_{ref}) @ 0\text{ A}$
Temperature drift of V_{oe}	V_{oe_TRange}	mV	-8		8	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Magnetic offset current	I_{om}	A	-0.25		0.25	@ $\pm 10 \times I_{pn}$
Theoretical gain	G_{th}	mV/A		16		800 mV @ I_{pn}
Error of gain	Err_G	% G_{th}		± 0.5		Trimmed in the factory @ 25°C
Temperature drift of gain	G_{TR}	% G_{th}	-1.0		1.0	$-40^\circ\text{C} \sim 105^\circ\text{C}$
Rated linearity error	$Non-L_{pn}$	% I_{pn}	-0.5		0.5	$\pm I_{pn}$
Linearity error @ I_{pm}	$Non-L_{pm}$	% I_{pm}	-1.5		1.5	$\pm I_{pm}$
Reaction time	t_{ra}	μs		0.5	1	@ 10% of I_{pn}
Step response time	t_{res}	μs		1.5	2	@ 90% of I_{pn}
Delay time	t_{delay}	μs		1		400 kHz sine wave
Frequency bandwidth (-3dB)	BW	kHz		400		No RC circuit
Output voltage noise	V_{noise}	mVpp		10		
DC ~ 10 kHz				15		
DC ~ 100 kHz						
Accuracy @ 25°C	X	% of I_{pn}	-1		1	@ 25°C
Accuracy @ $-40^\circ\text{C} \sim 105^\circ\text{C}$	X_{TRange}	% of I_{pn}	-2		2	$-40^\circ\text{C} \sim 105^\circ\text{C}$

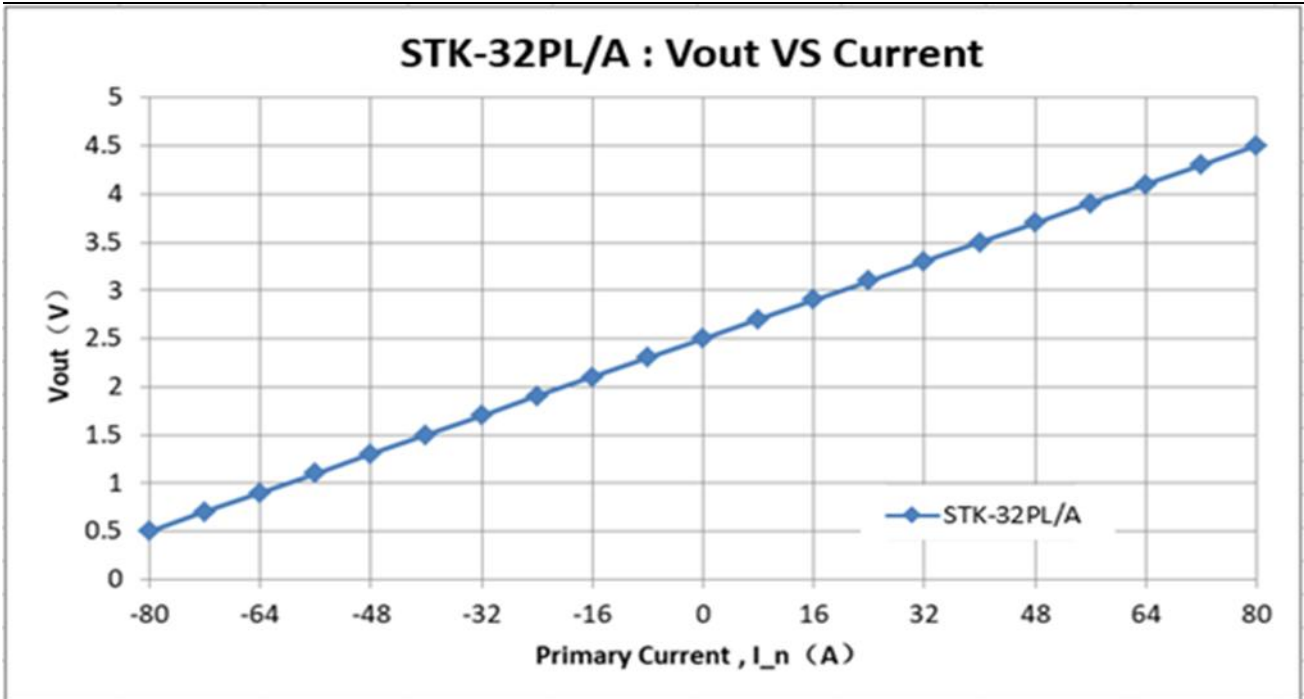
7. Output voltage VS primary current



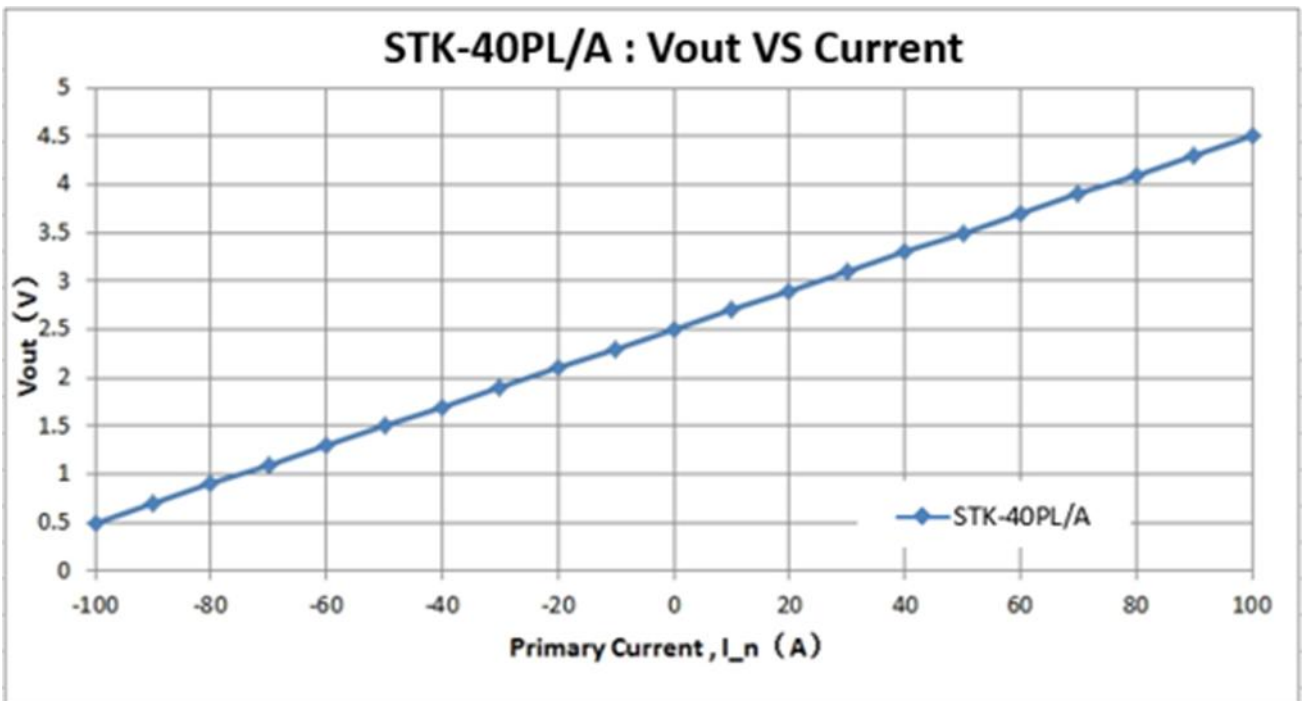
The dependence of Vout of STK-10PL/A on the primary current.



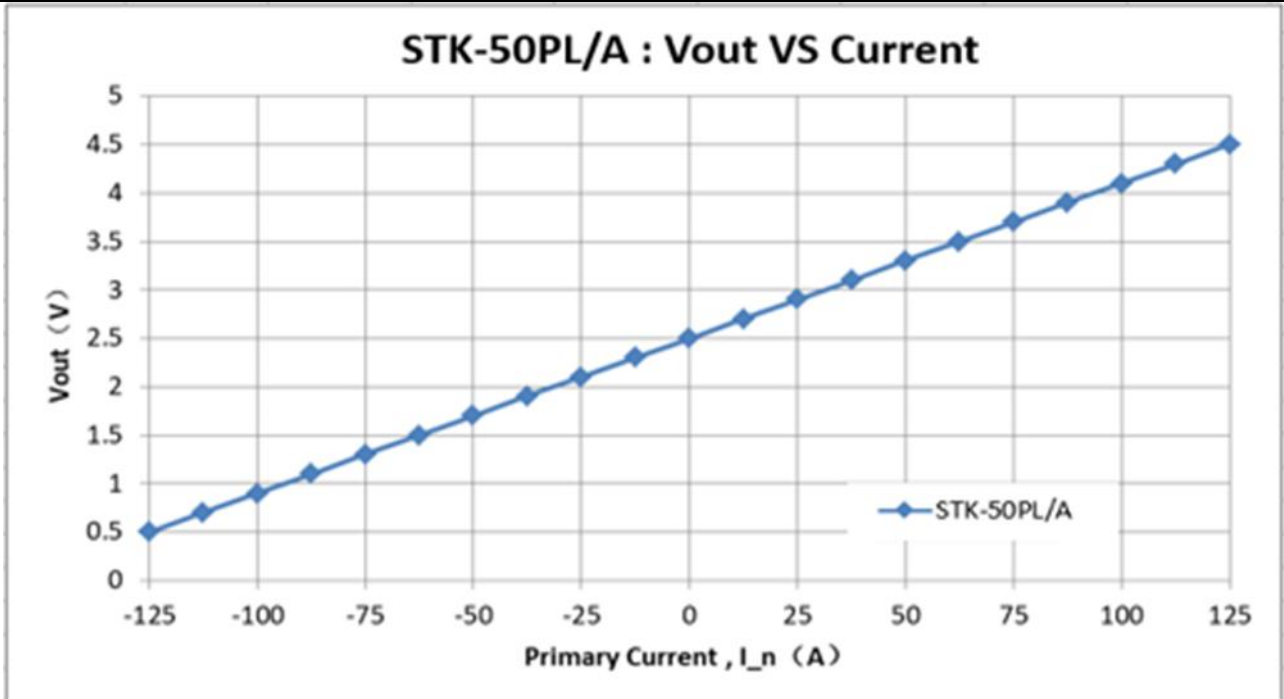
The dependence of Vout of STK-20PL/A on the primary current.



The dependence of Vout of STK-32PL/A on the primary current.

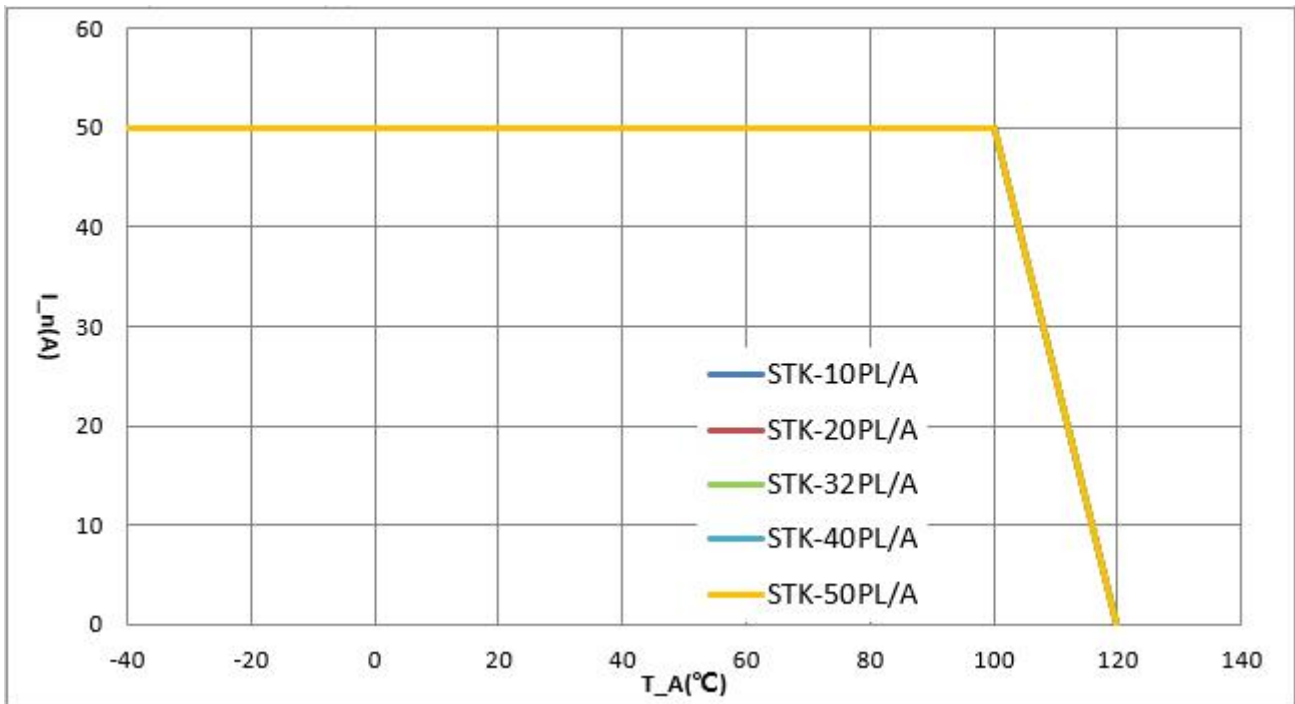


The dependence of Vout of STK-40PL/A on the primary current.



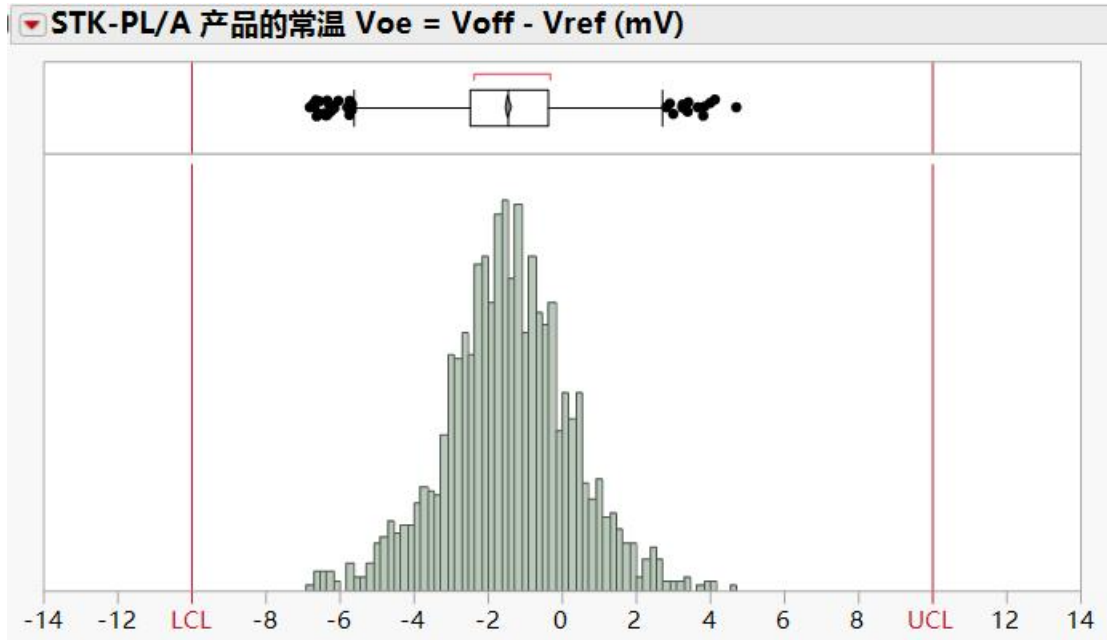
The dependence of Vout of STK-50PL/A on the primary current.

8. Maximum continues DC current

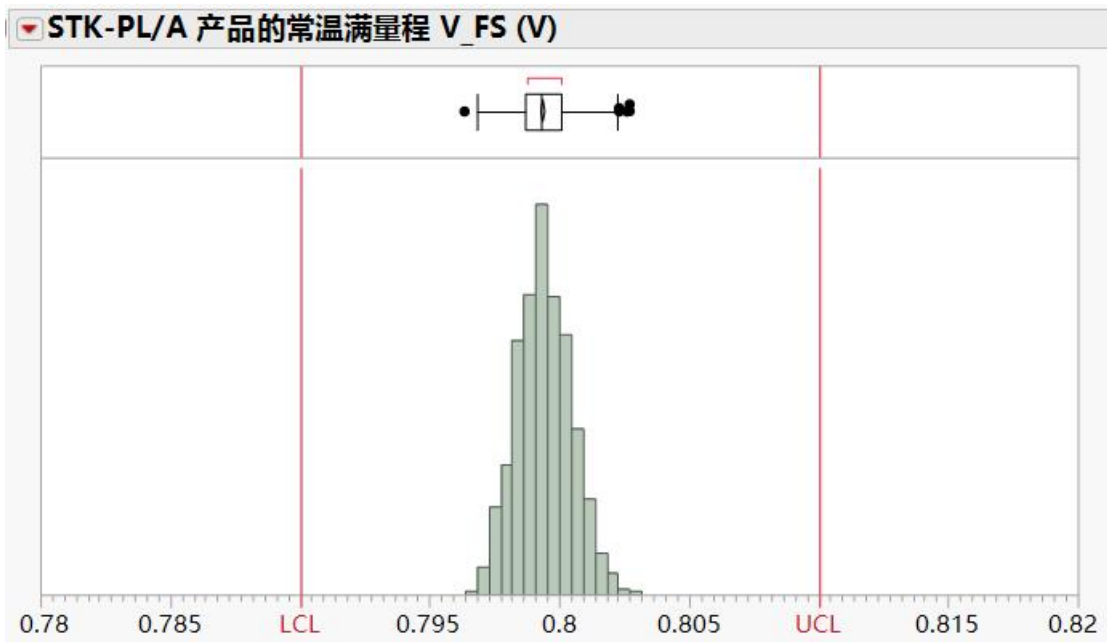


The dependence of maximum continues current of STK-PL/A current on the working temperature.

9. Accuracy at room temperature

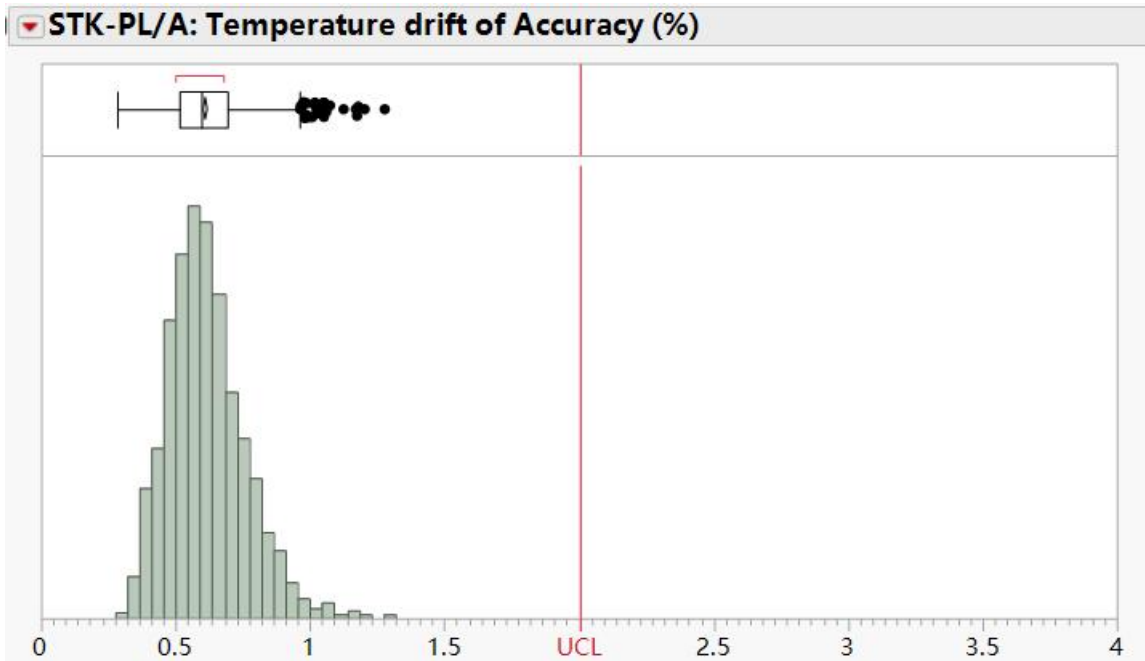


The distribution V_{oe} of STK-PL/A current sensor at 25°C.

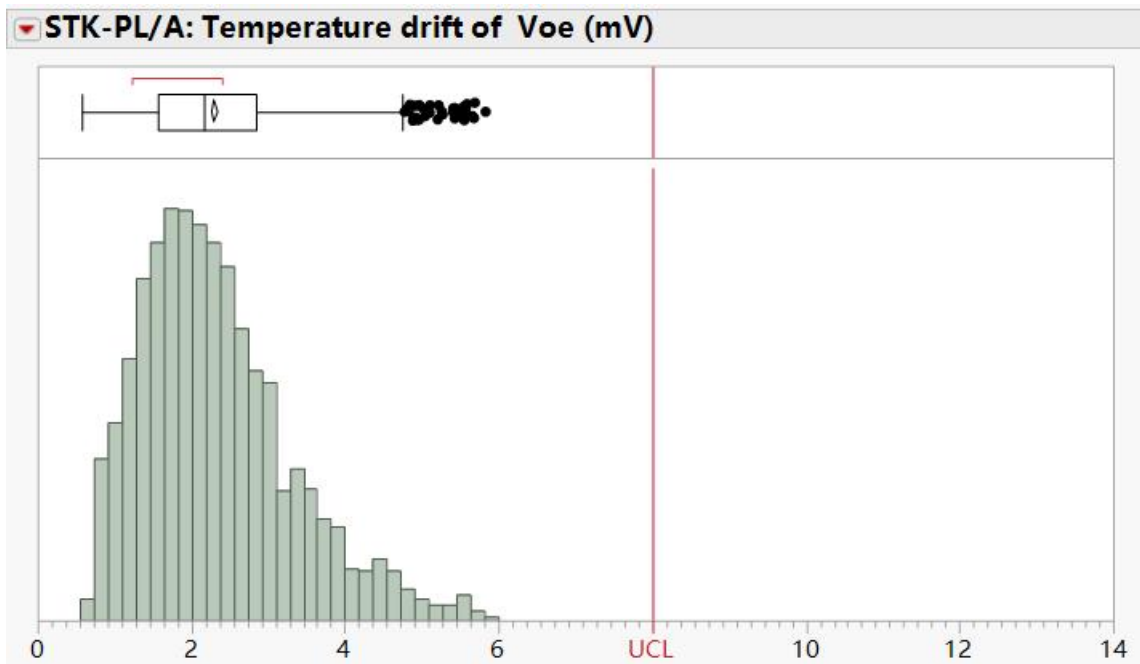


The distribution of V_{FS} OF STK-PL/A current sensor at 25°C.

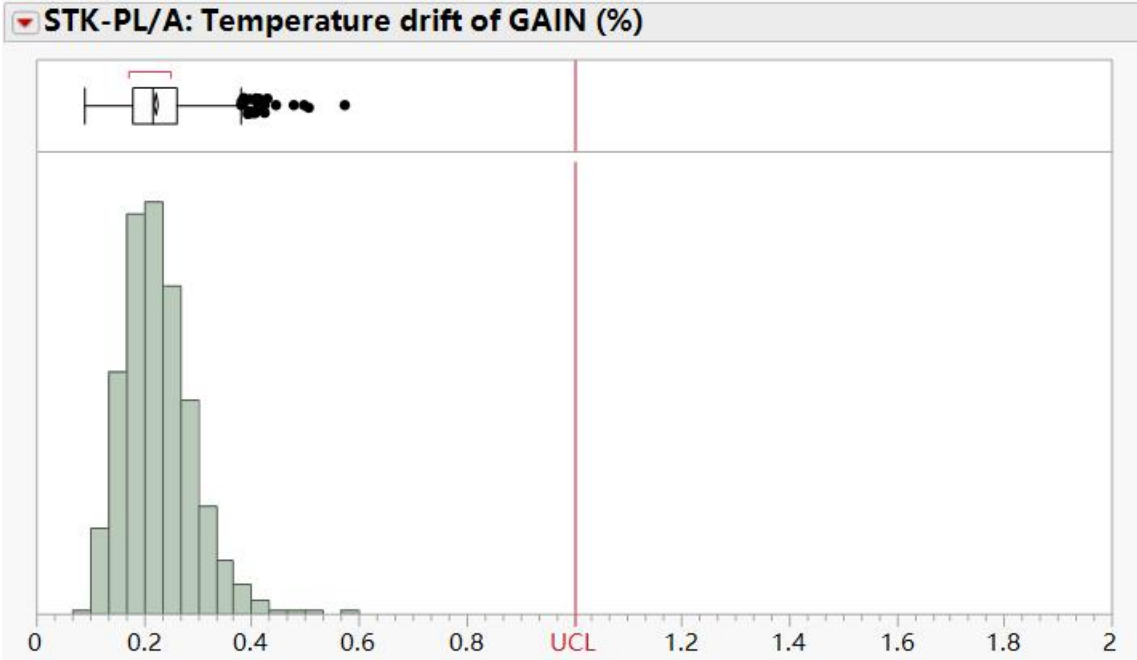
10. Accuracy over temperature



The distribution of temperature drift of accuracy, compared with room temperature, over the temperature range from -40 deg.C to 105 deg.C.

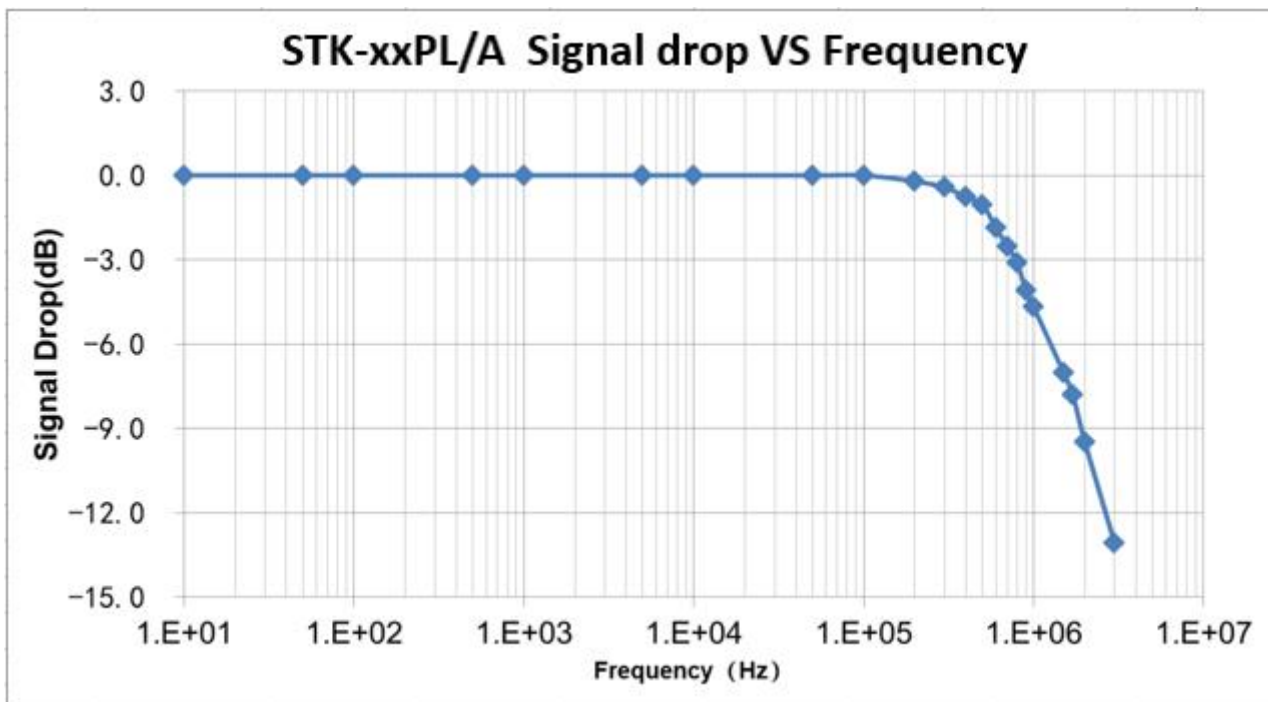


The distribution of temperature drift of Voe, compared with room temperature, over the temperature range from -40 deg.C to 105 deg.C.



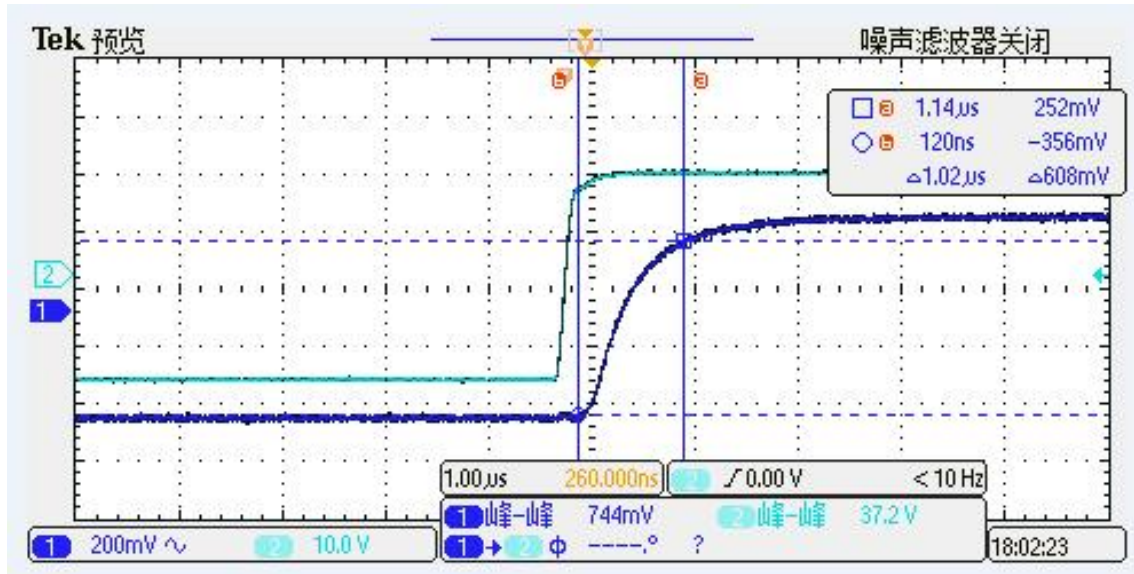
The distribution of temperature drift of GAIN, compared with room temperature, over the temperature range from -40 deg.C to 105 deg.C.

11. Frequency response and bandwidth



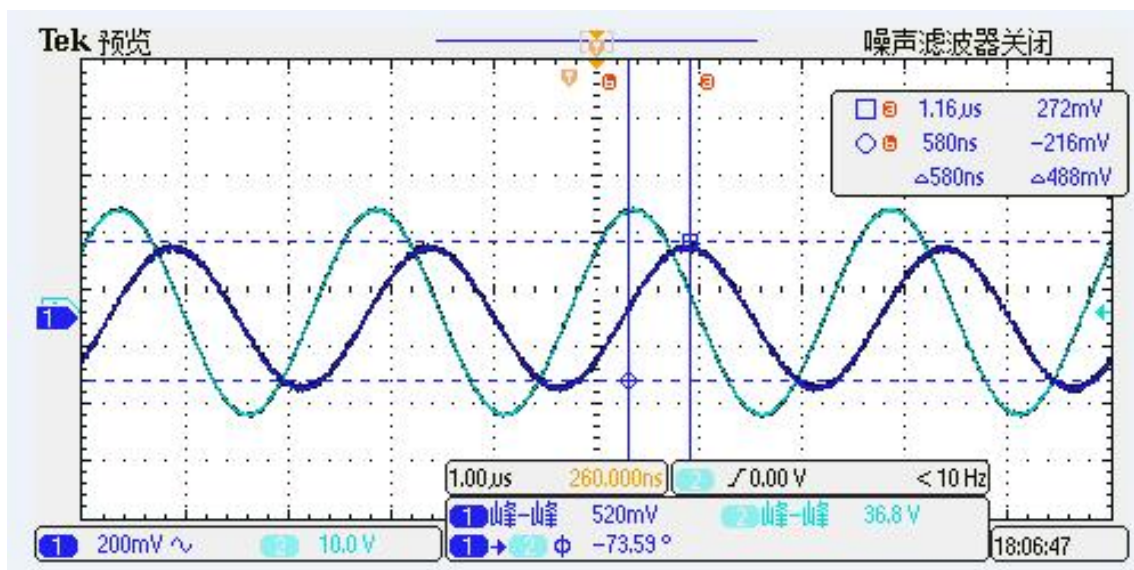
The frequency bandwidth of STK-PL/A series current sensor. The bandwidth of current sensor is DC ~ 400 kHz (-3dB).

12. Step response time



The typical frequency response of STK-xxPL/A current sensor. The response time from 90% of the primary current (light blue) to 90% of the secondary output (dark blue) is less than 1.5 μs

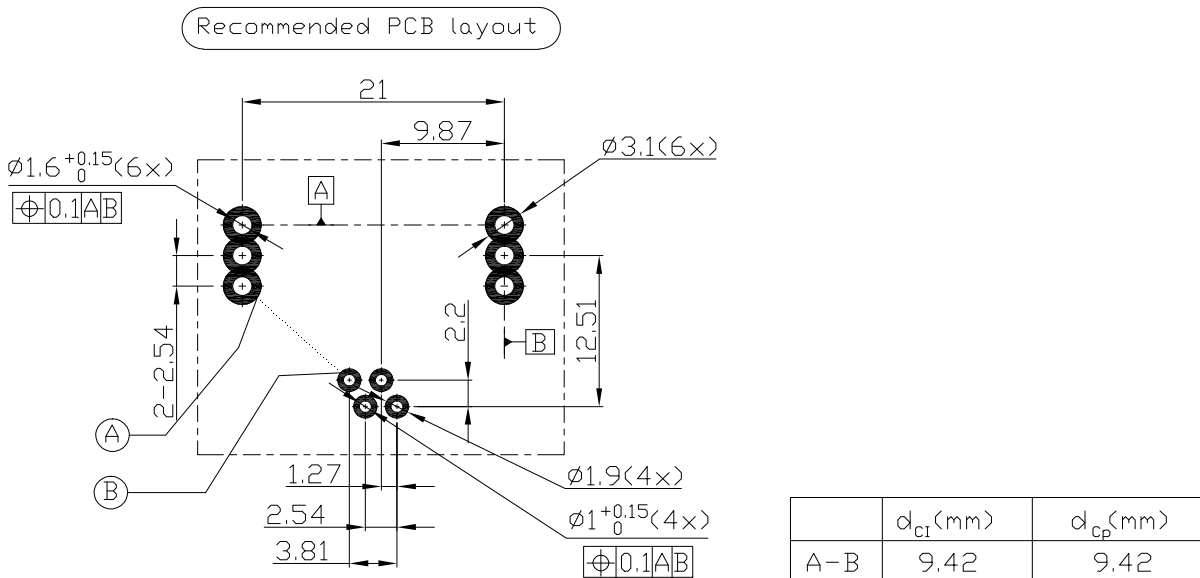
13. Frequency delay performance



When testing 400 kHz sine wave, the typical result of STK-xxPL/A current sensor's output. The response time from the primary current (light blue) to the secondary output (dark blue) is less than 1 μs.

14. Recommended PCB layout

Installation of view: overlooking (unit: mm)



1. Installing angle: Overlook (observe from the side of installing transducer)
2. Recommended bore diameter of primary current line, (diameter of primary current $\times 1.2$) mm
3. Recommended bore diameter of secondary current line, (diameter of secondary current $\times 1.2$) mm
4. The maximum thickness of PCB is 2.5 mm
5. The curve of wave soldering: $260^{\circ}\text{C} \times 10 \text{ s}$

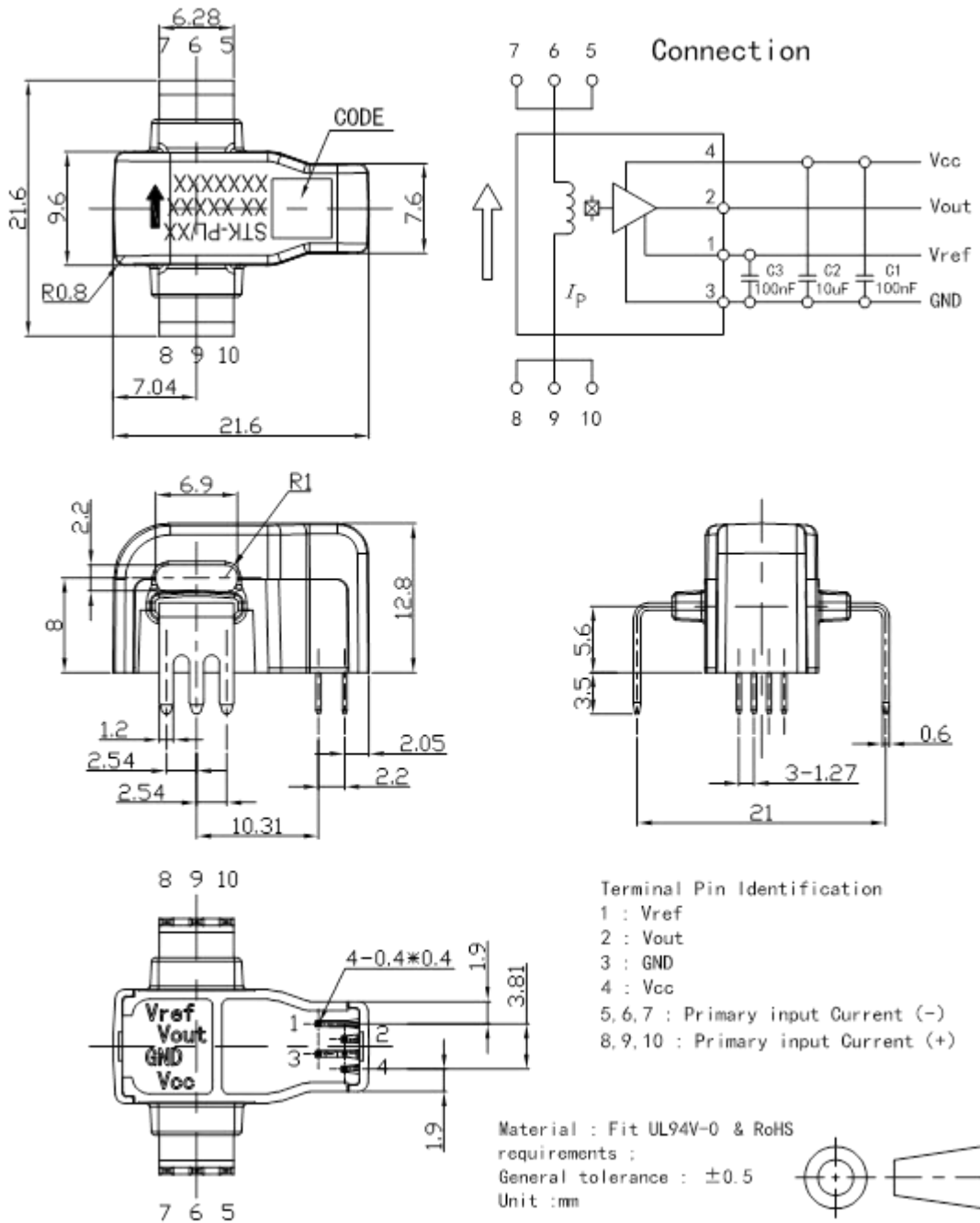


Security:

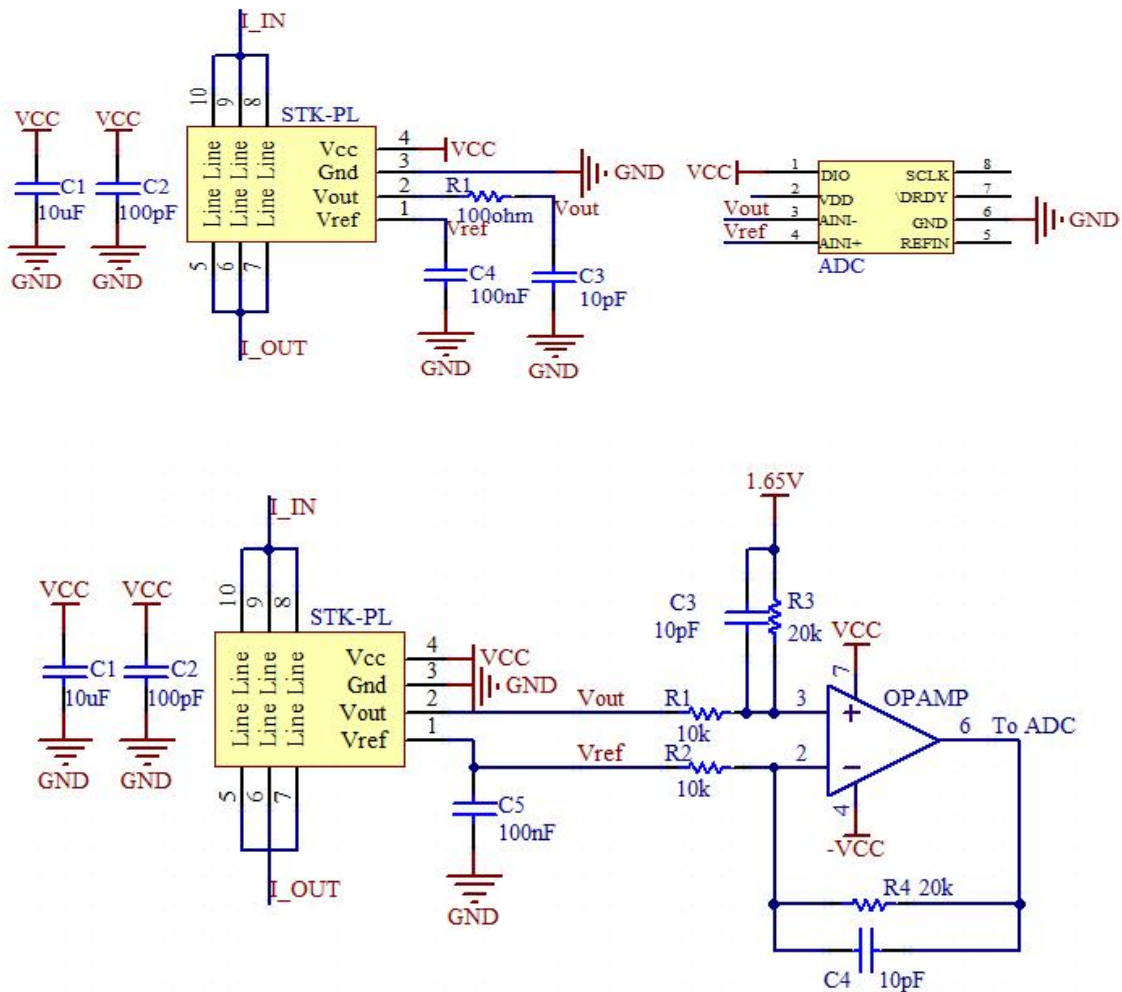
This current sensor must be used in limited-energy secondary circuit according to IEC 61010-1.

- This current sensor must be used in electric/electronic equipment with respect to appliance standards and safety requirement in accordance with the manufacture's operating instructions;
- When operating the current sensor, certain parts of the module can carry hazardous voltage;
- Failure to wiring as shown in the diagram will damage the current sensor;
- Ignoring this warning can lead to serious consequences.
- A protective housing or a additional shield could be used.
- Main supply must be able to disconnected.

15. Dimension & Pin definitions



16. Appendix: typical application circuit



R3 (kohm)	C3 (pF)	Theoretical -3dB $f = 1/(2\pi RC)$ (kHz)	Measured -3dB (kHz)
20	20	398	~ 400
20	81	98	~ 100
20	810	10	~ 10

The frequency characteristics of STK_PL/A 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.

The signal input to ADC is $1.65 + R4/R2 * (Vout - Vref)$ with the conditions: $R1 = R2, R3 = R4, C3 = C4$.