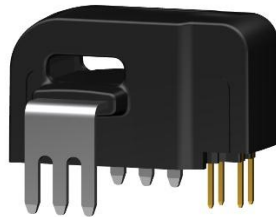


Current Sensor

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

Version: Ver 1.0



Sinomags Technology Co., Ltd

Web site: www.sinomags.com

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1. Summary

The STK-PL/B 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/B 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 |

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) | 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 | |
| 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/B 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 |
| 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 | | @ 10% of I_{pn} |
| Step response time | t_{res} | μs | | 1.5 | | @ 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 ~ 10 kHz | | | | 25 | | |
| 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 | $-40^\circ\text{C} \sim 105^\circ\text{C}$ |

3. STK-20PL/B 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 |
| 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 | | @ 10% of I_{pn} |
| Step response time | t_{res} | μs | | 1.5 | | @ 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 | | | | |
| DC ~ 10 kHz | | | | 12 | | |
| DC ~ 100 kHz | | | | 17 | | |
| 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/B 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 |
| 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 | | 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 | $-40^\circ\text{C} \sim 105^\circ\text{C}$ |
| Rated linearity error | Non- L_{pn} | % I_{pn} | -0.5 | | 0.5 | $\pm I_{pn}$ |
| Linearity error @ I_{pm} | Non- L_{pm} | % I_{pm} | -1.0 | | 1.0 | $\pm I_{pm}$ |
| Reaction time | t_{ra} | μs | | 0.5 | | @ 10% of I_{pn} |
| Step response time | t_{res} | μs | | 1.5 | | @ 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 | | | | |
| DC ~ 10 kHz | | | | 12 | | |
| DC ~ 100 kHz | | | | 17 | | |
| 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 | $-40^\circ\text{C} \sim 105^\circ\text{C}$ |

5. STK-40PL/B Electrical performance

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

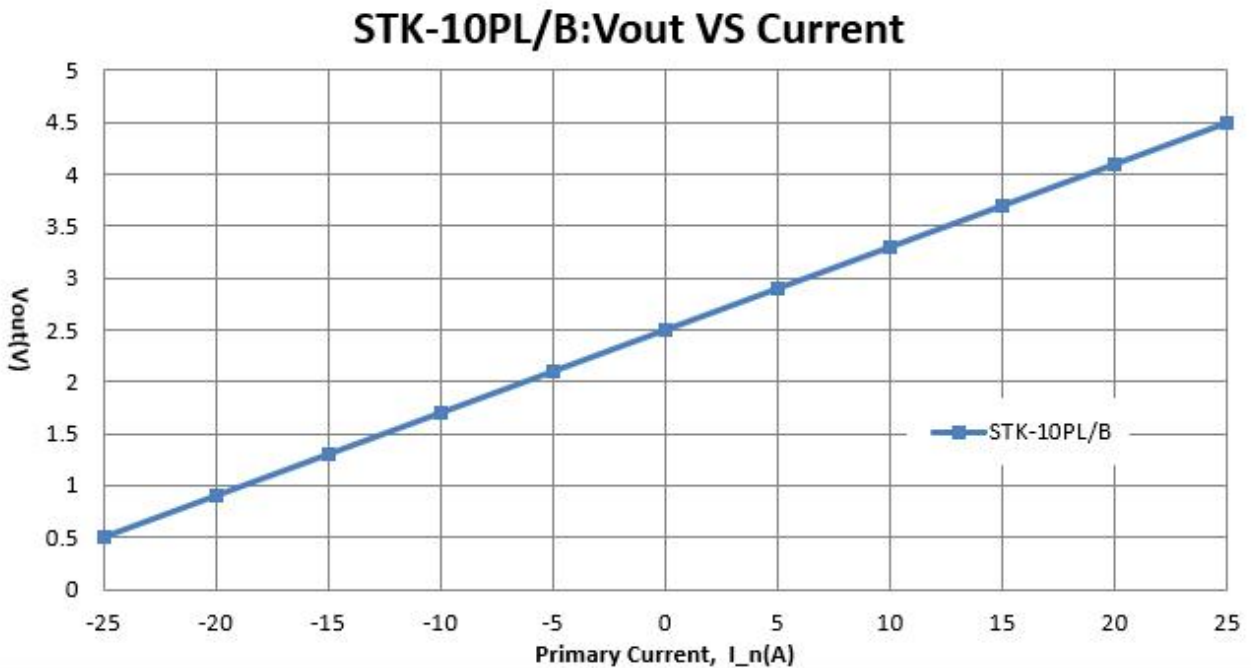
| Parameter | Symbol | Unit | Min | Typ | Max | Comment |
|---|------------------|---------------|-------|-----------|------|---|
| Primary nominal current rms | I_{pn} | A | | 40 | | |
| Primary current measuring range | I_{pm} | A | -100 | | 100 | |
| Supply voltage | V_{cc} | V | 4.75 | 5 | 5.25 | |
| 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 |
| 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 | | @ 10% of I_{pn} |
| Step response time | t_{res} | μs | | 1.5 | | @ 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 | | | | |
| DC ~ 10 kHz | | | | 10 | | |
| DC ~ 100 kHz | | | | 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/B Electrical performance

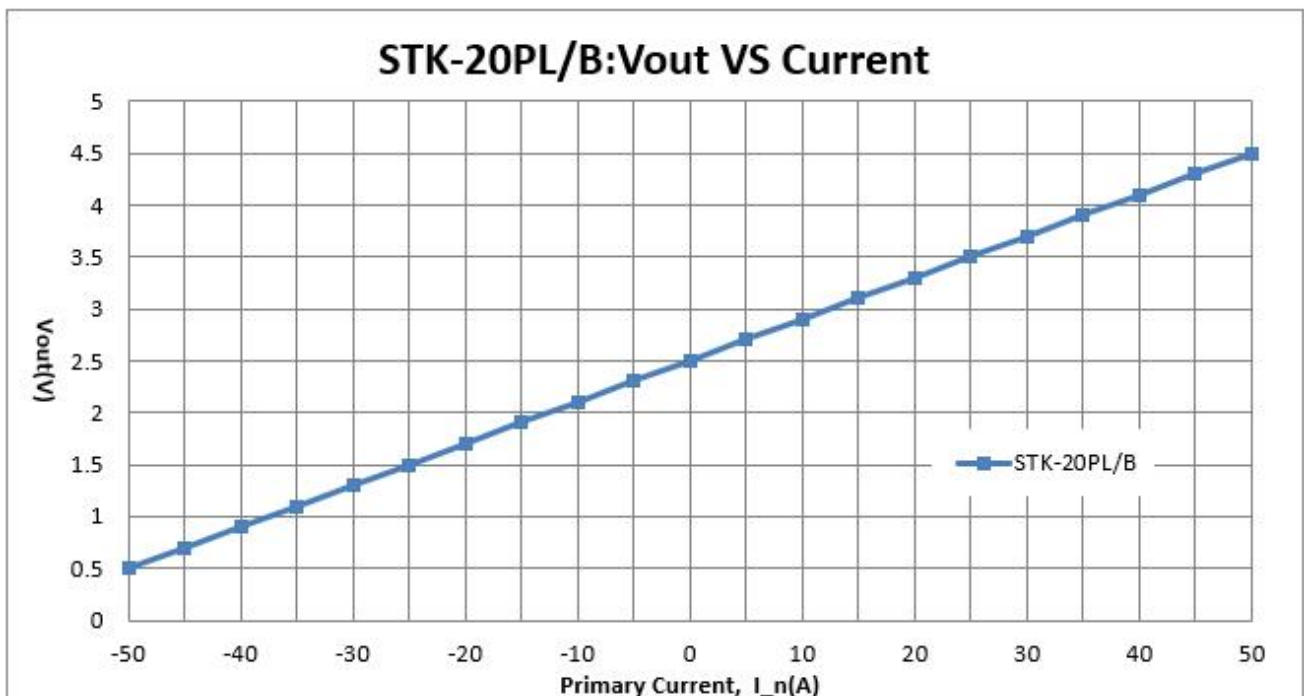
Condition: $T_A = 25^\circ\text{C}$ $V_{cc} = 5\text{ V}$ (Except special instructions)

| 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 |
| 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 | | @ 10% of I_{pn} |
| Step response time | t_{res} | μs | | 1.5 | | @ 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 | | | | |
| DC ~ 10 kHz | | | | 10 | | |
| DC ~ 100 kHz | | | | 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 | $-40^\circ\text{C} \sim 105^\circ\text{C}$ |

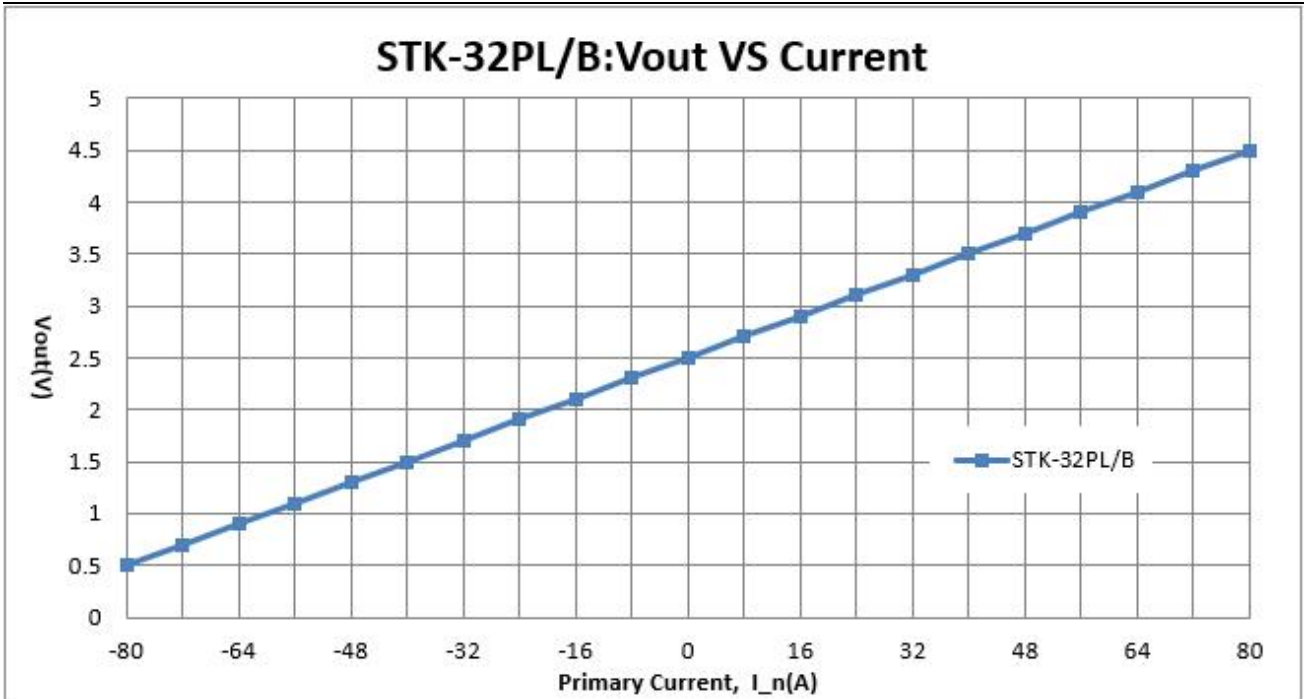
7. Output voltage VS primary current



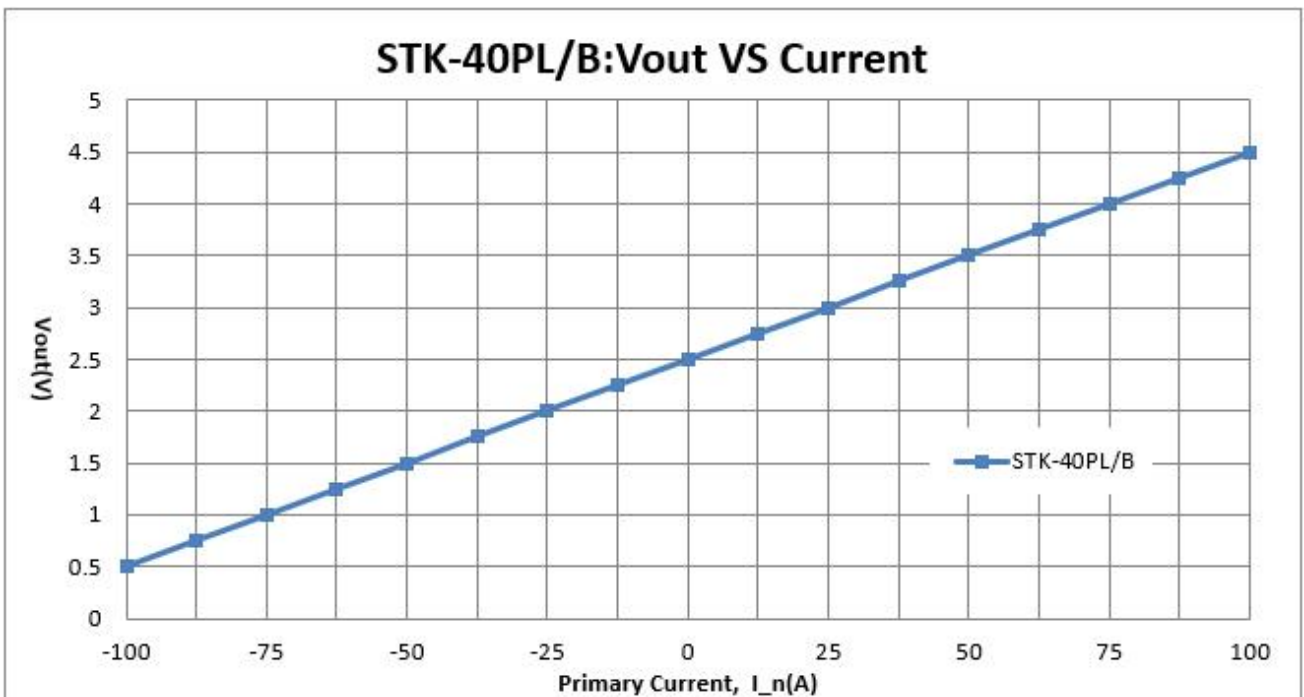
The dependence of V_{out} of STK-10PL/B on the primary current.



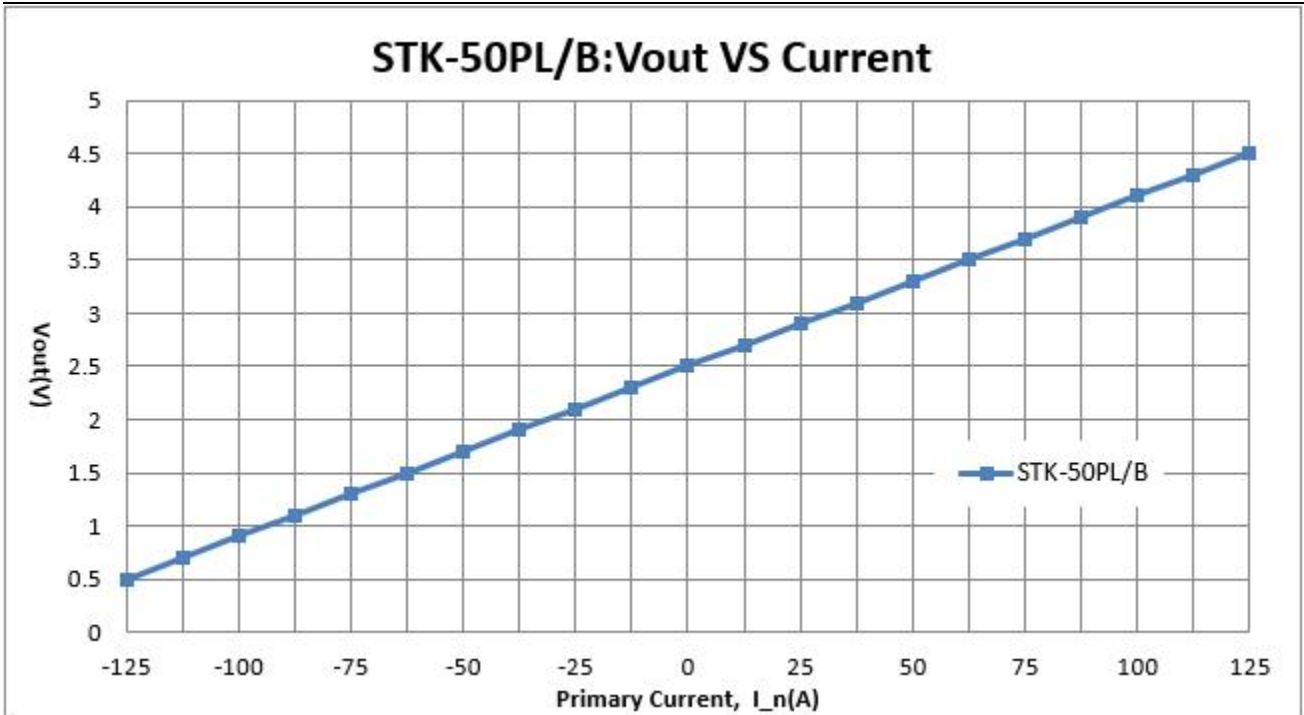
The dependence of V_{out} of STK-20PL/B on the primary current.



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

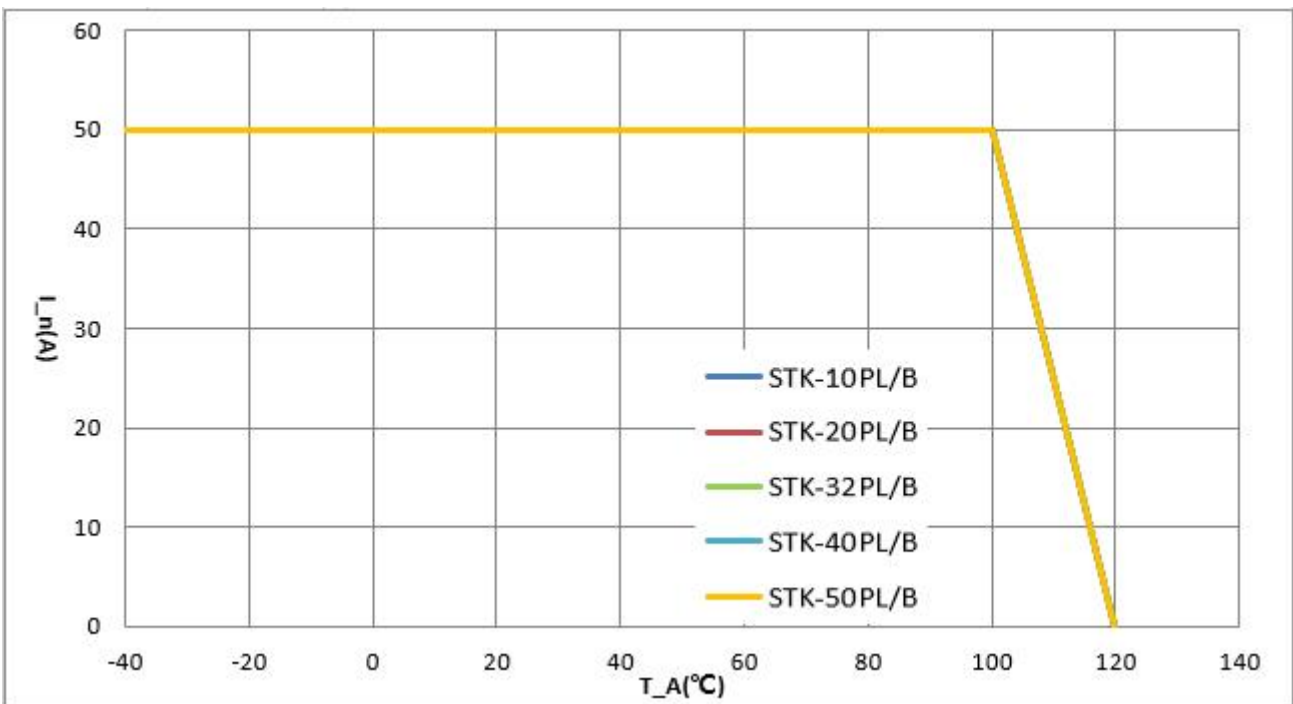


The dependence of Vout of STK-40PL/B on the primary current.



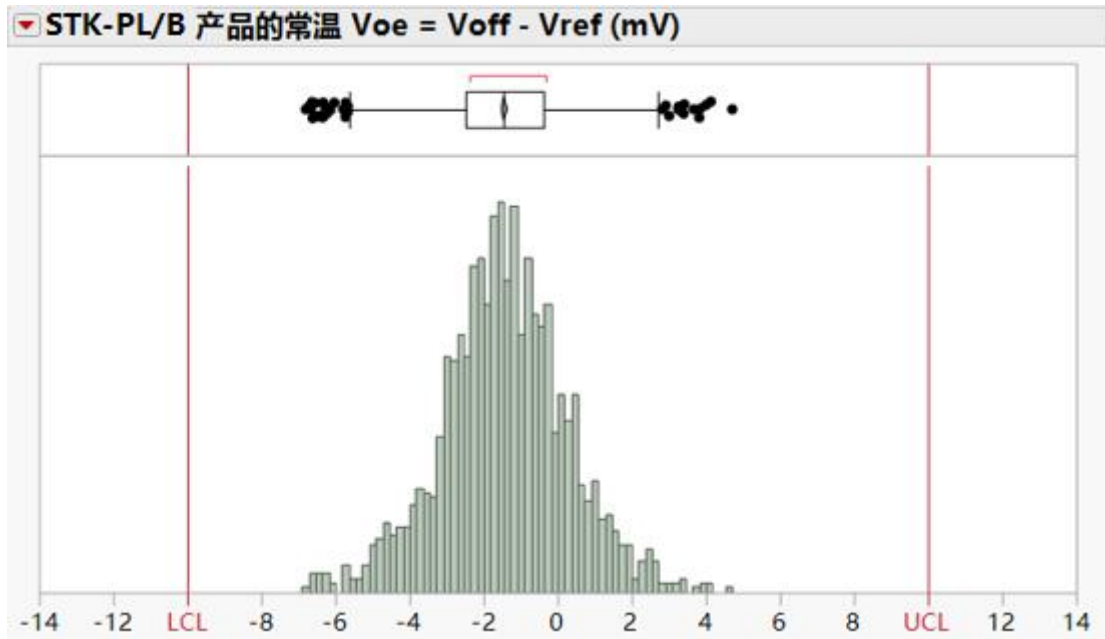
The dependence of Vout of STK-50PL/B on the primary current.

8. Maximum continues DC current

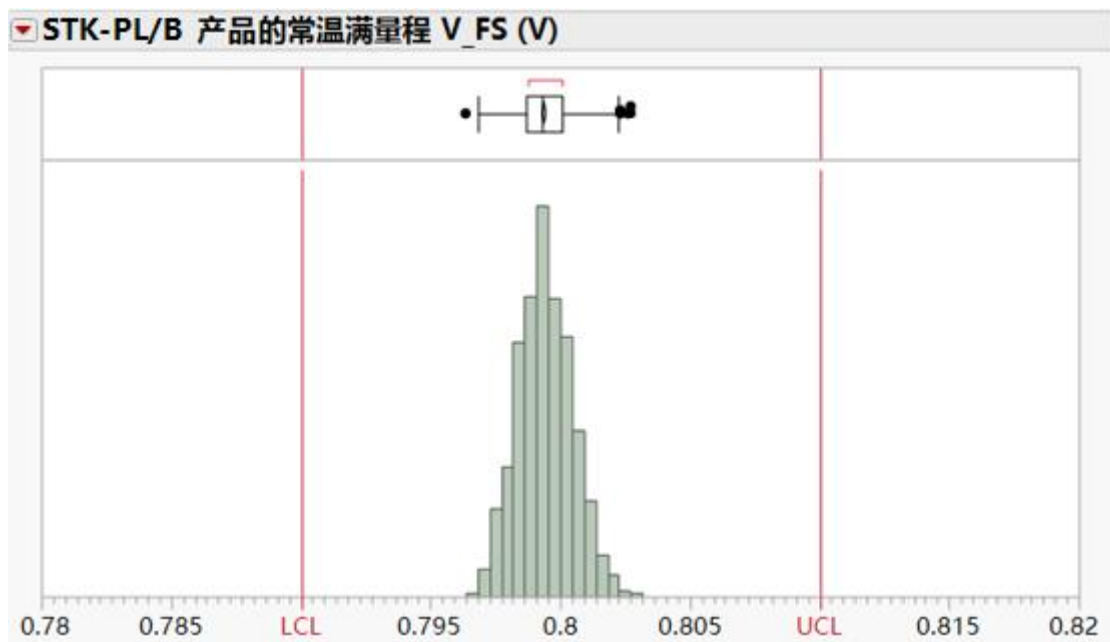


The dependence of maximum continues current of STK-PL/B current on the working temperature.

9. Accuracy at room temperature

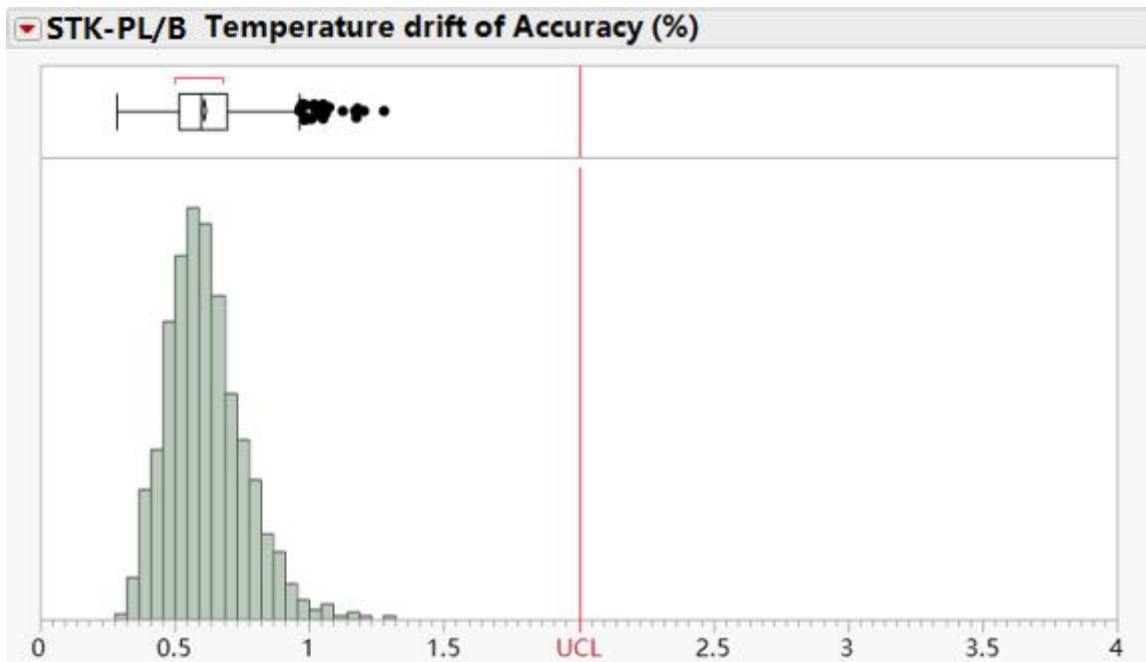


The distribution V_{oe} of STK-PL/B current sensor at 25°C.

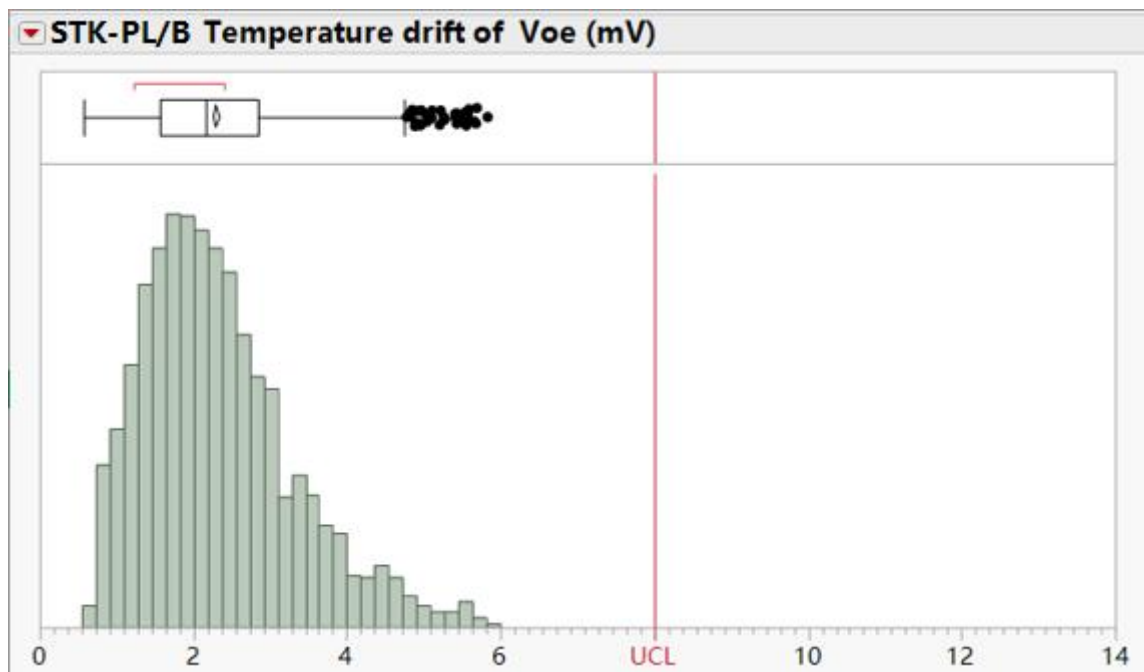


The distribution of V_{FS} OF STK-PL/B current sensor at 25°C.

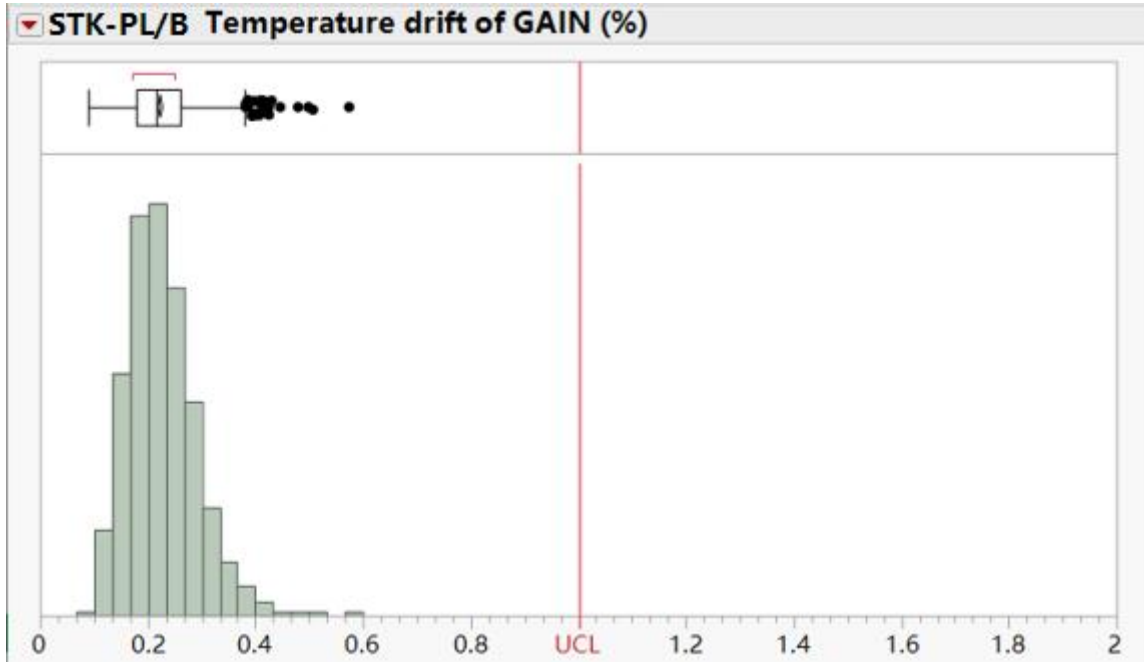
10. Accuracy over temperature



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

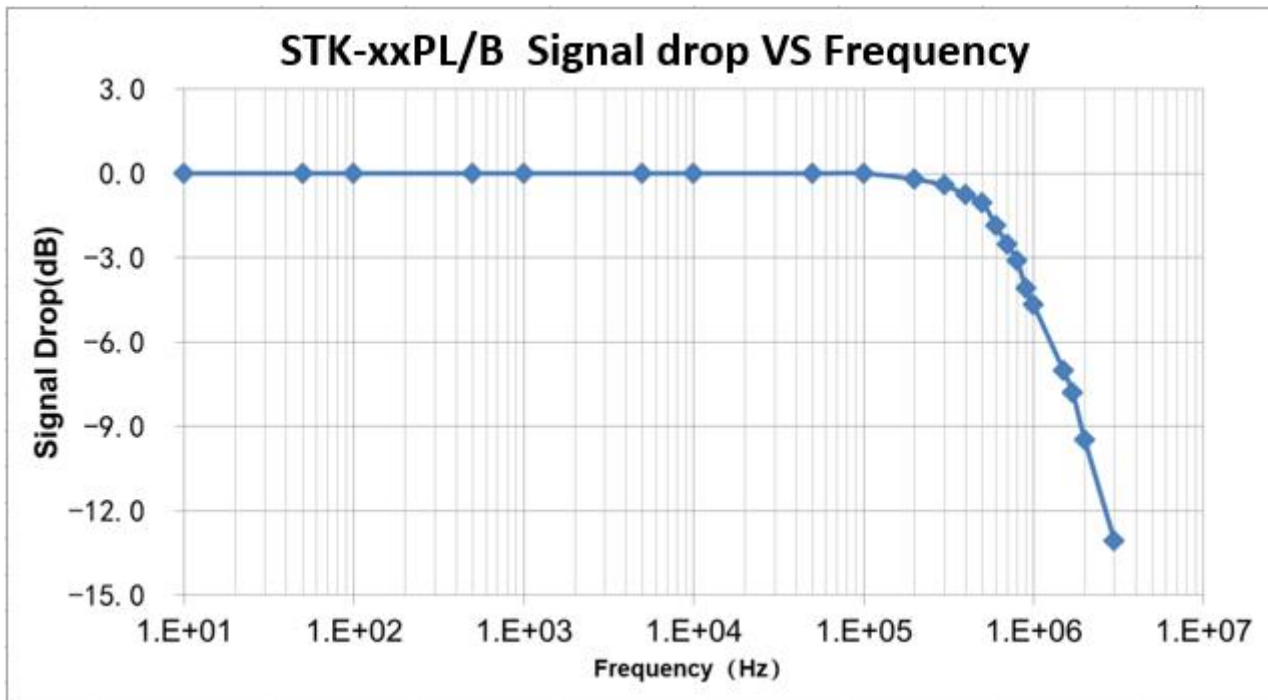


The distribution of temperature drift of Voe, compared with room temperature, over the temperature range from -40 deg.C to 105 deg.C.



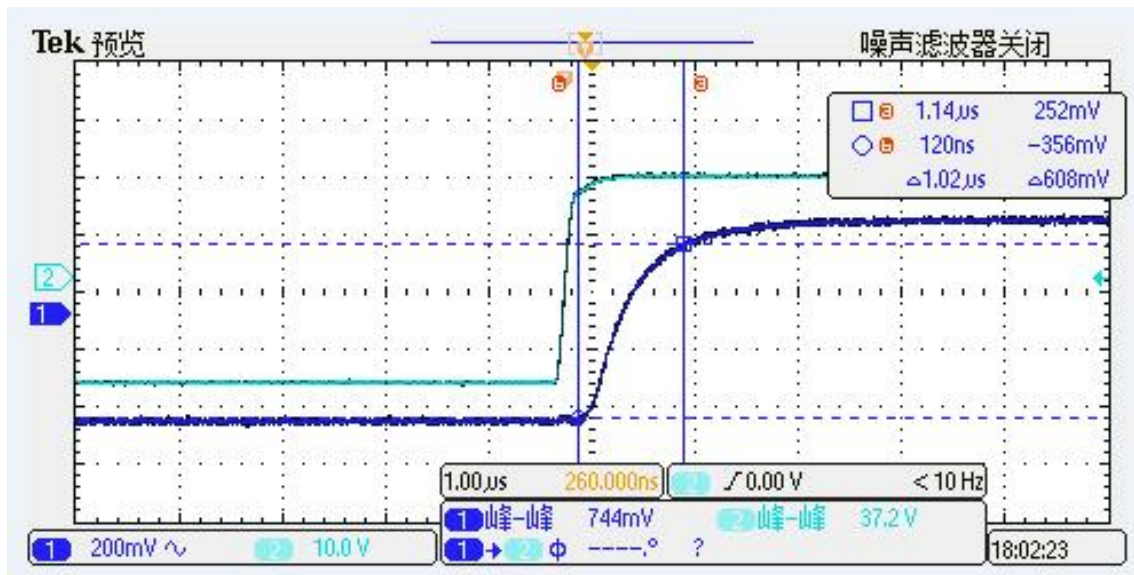
The distribution of temperature drift of GAIN, compared with room temperature, over the temperature range from -40 deg.C to 105 deg.C.

11. Frequency response and bandwidth



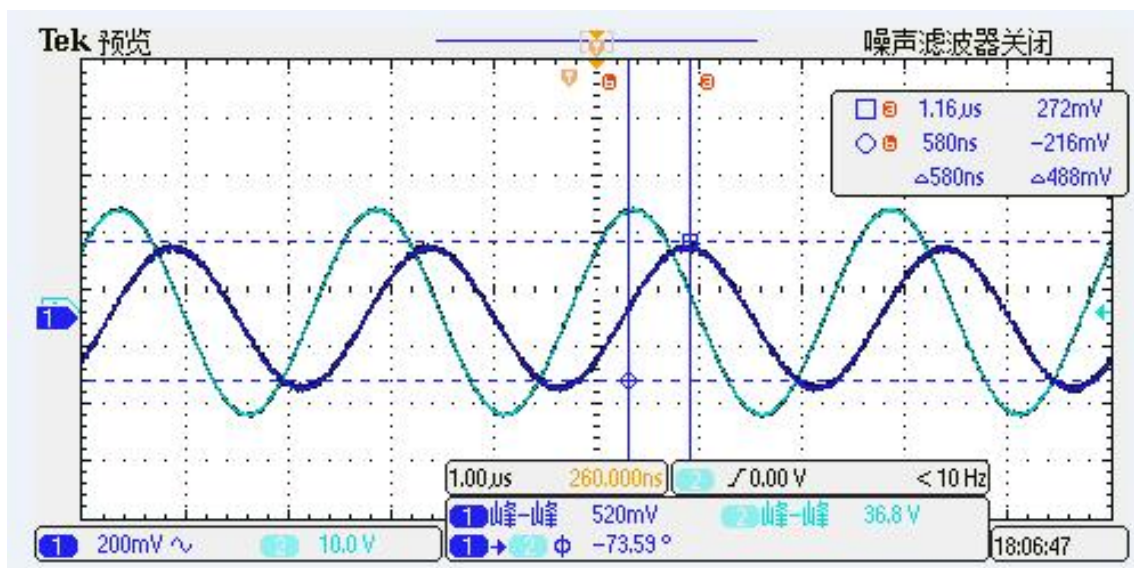
The frequency bandwidth of STK-PL/B series current sensor. The bandwidth of current sensor is DC ~ 400 kHz (-3dB).

12. Step response time



The typical frequency response of STK-xxPL/B 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

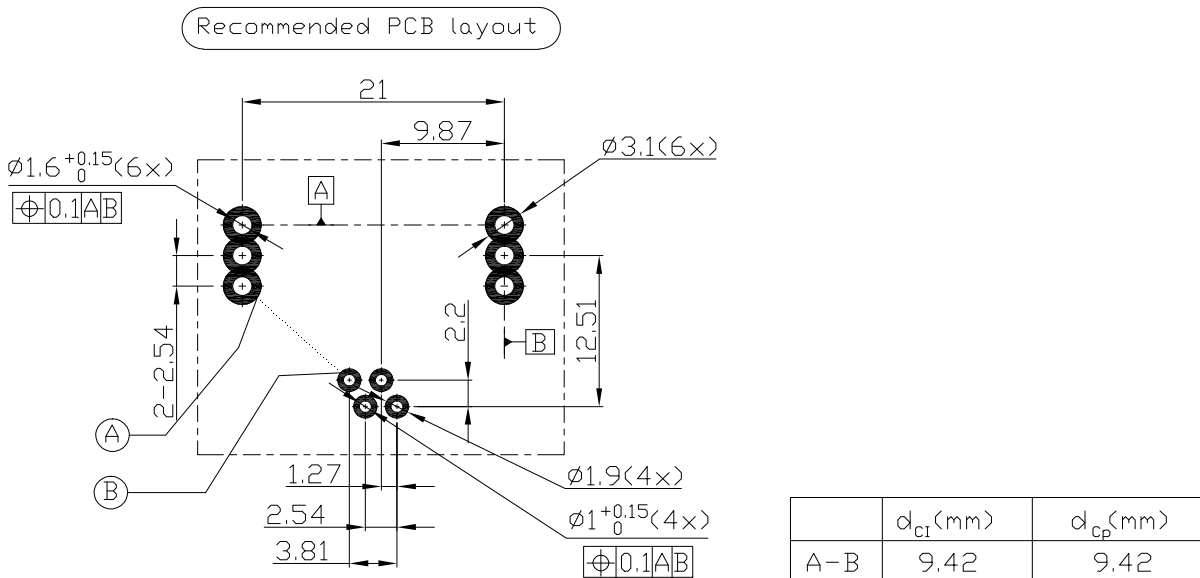
13. Frequency delay performance



When testing 400 kHz sine wave, the typical result of STK-xxPL/B 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: $260^{\circ}\text{C} \times 10 \text{ s}$

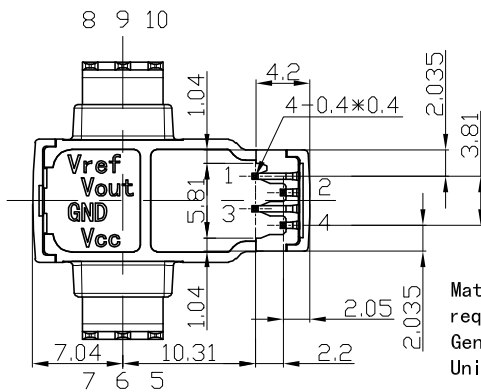
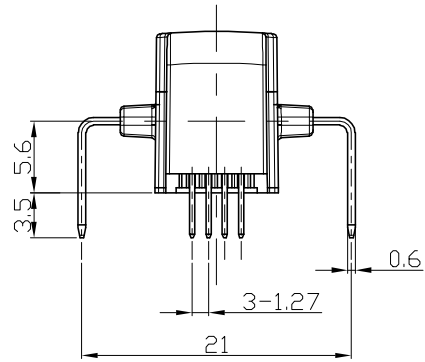
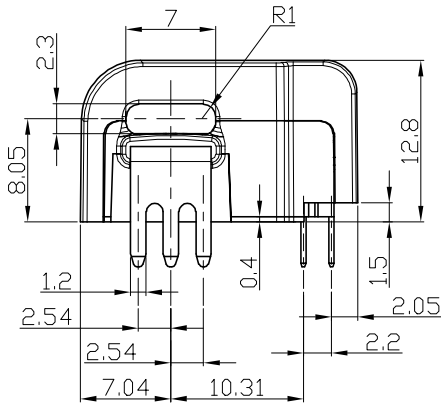
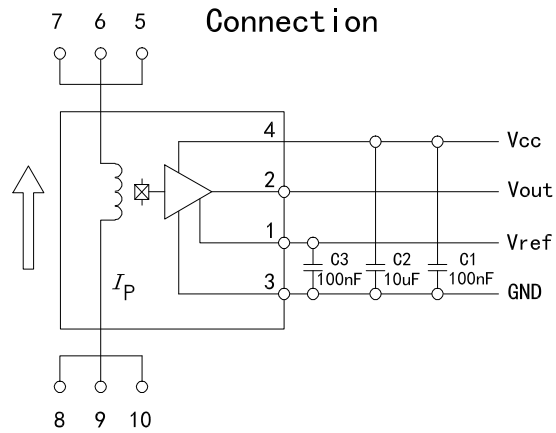
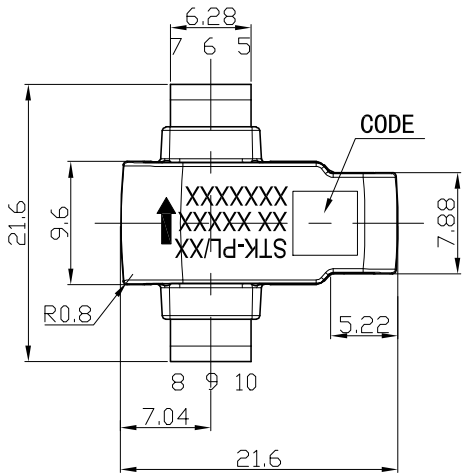


Security:

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

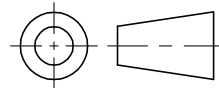
- This current sensor must be used in electric/electronic equipment with respect to appliance standards and safety requirement in accordance with the manufacture's operating instructions;
- When operating the current sensor, certain parts of the module can carry hazardous voltage;
- Failure to wiring 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

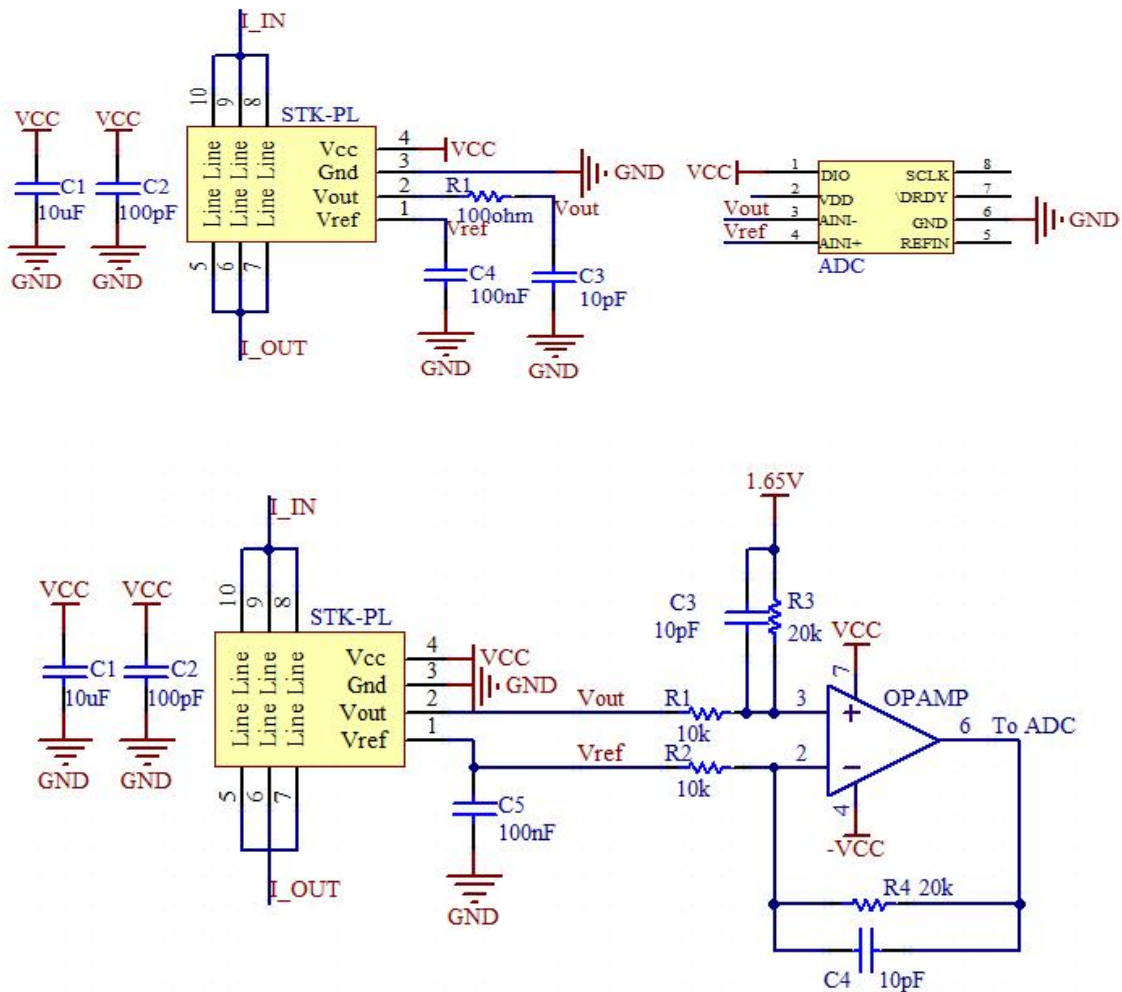


- Terminal Pin Identification**
- 1 : Vref
 - 2 : Vout
 - 3 : GND
 - 4 : Vcc
 - 5, 6, 7 : Primary input Current (-)
 - 8, 9, 10 : Primary input Current (+)

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



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/B 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: $R1 = R2$, $R3 = R4$, $C3 = C4$.