

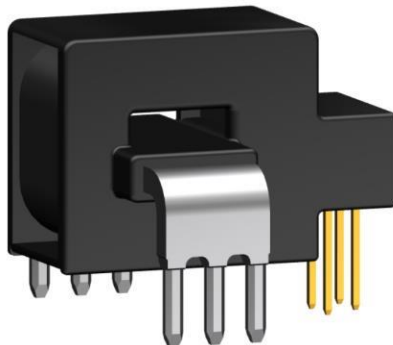
# Current Sensor

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Product Series: STK-PL/Z

Part number: STK-200PL/Z

Version: Ver1.0



Sinomags Technology Co., Ltd

Web site: [www.sinomags.com](http://www.sinomags.com)

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## 1. Summary

The STK-200PL/Z series is based on open-loop technology and design. It is suitable for DC, AC, pulse and any type of irregular current measurement under isolated conditions. The nominal current range of STK-PL/Z current sensors includes 200A.

### 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 <sub>A</sub>   | °C   | -40 ~ 105 |
| Storage temperature | T <sub>stg</sub> | °C   | -40 ~ 105 |
| Mass                | m                | g    | 10        |

### Absolute maximum rating

| Parameter                        | Symbol           | Unit | Value |
|----------------------------------|------------------|------|-------|
| Supply voltage (non-destructive) | V <sub>C</sub>   | V    | 6.0   |
| ESD rating (HBM)                 | U <sub>ESD</sub> | kV   | 4     |
| ESD rating (CDM)                 | U <sub>CDM</sub> | 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**

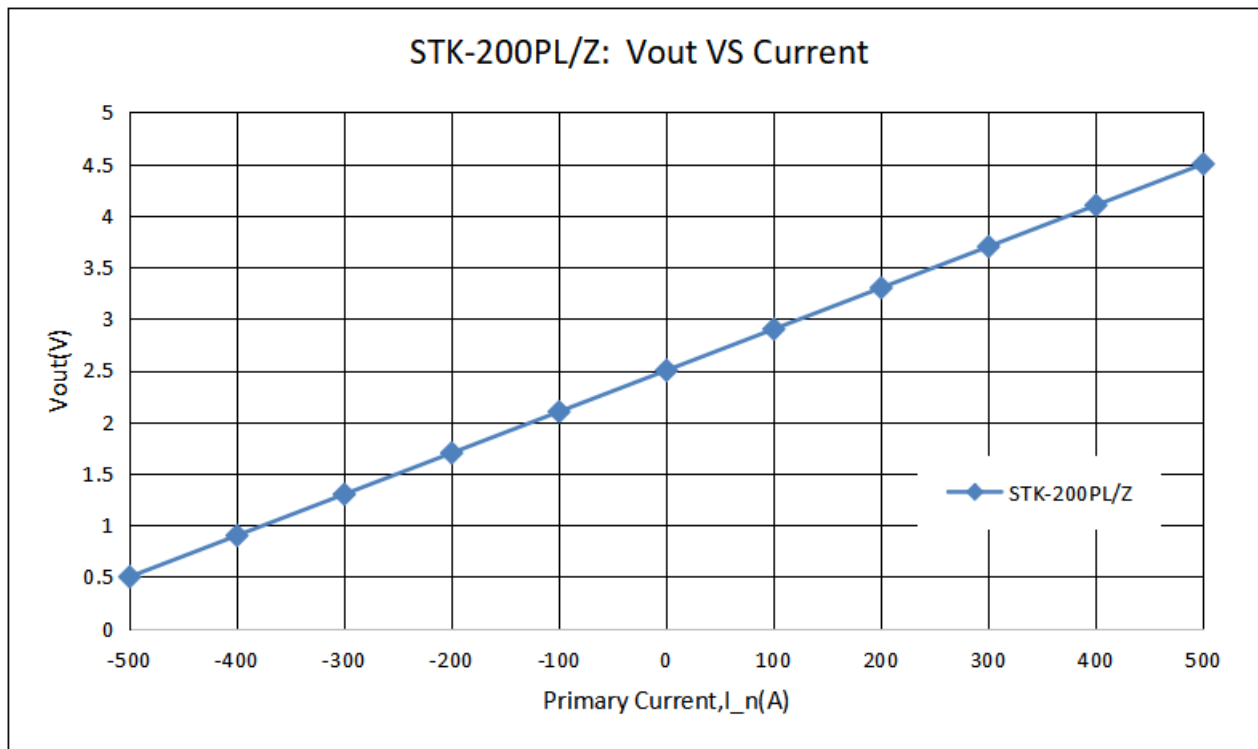
| Parameter                          | Symbol          | Unit | Value                 | Comment   |
|------------------------------------|-----------------|------|-----------------------|---|
| RMS voltage for AC test 50Hz/1 min | U <sub>d</sub>  | kV   | 5                     |   |
| Impulse withstand voltage 1.2/50μs | Ū <sub>w</sub>  | kV   | 8                     |   |
| Clearance distance (pri. -sec)     | d <sub>Cl</sub> | mm   | 8                     | Shortest distance through air   |
| Creepage distance (pri. -sec)      | d <sub>Cp</sub> | 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<br>Altitude ≤ 3000 m        |
| Application example                |                 | V    | 600                   | CAT III, PD 2, according to UL 508  |

## 2. STK-200PL/Z Electrical performance

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

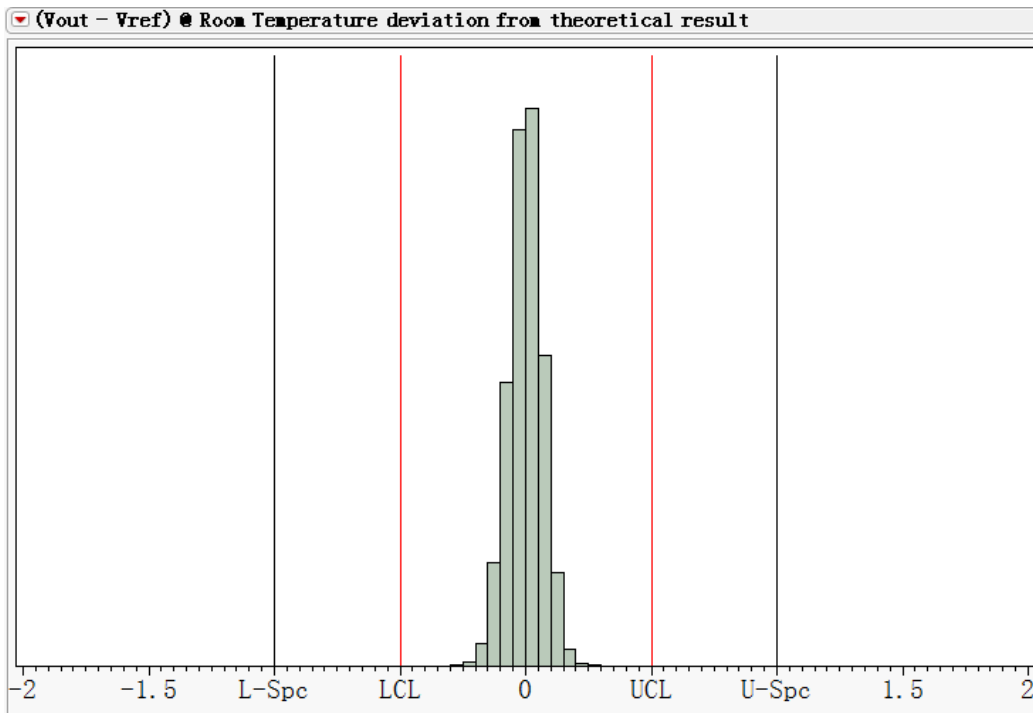
| Parameter   | Symbol           | Unit          | Min   | Typ     | Max  | Comment                                     |
|---|------------------|---------------|-------|---------|------|---|
| Primary nominal current rms                           | $I_{pn}$         | A             |       | 200     |      |   |
| Primary current measuring range                       | $I_{pm}$         | A             | -500  |         | 500  |   |
| 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                            | $R_{out}$        | $\Omega$      |       | 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 $V_{oe}$                         | $V_{oe\_TRange}$ | % $V_{FS}$    | -1.5  |         | 1.5  | $-40^\circ\text{C} \sim 105^\circ\text{C}$  |
| Magnetic offset current                               | $I_{om}$         | A             | -0.25 |         | 0.25 | @ $\pm 10 \times I_{pn}$                    |
| Theoretical gain                                      | $G_{th}$         | mV/A          |       | 4       |      | 800mV @ $I_{pn}$                            |
| Error of gain   | $Err\_G$         | % $G_{th}$    |       | $\pm 1$ |      | Trimmed in the factory @ $25^\circ\text{C}$ |
| 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- $I_{pn}$    | % $I_{pn}$    | -0.5  |         | 0.5  | $\pm I_{pn}$                                |
| Linearity error @ $I_{pm}$                            | Non- $I_{pm}$    | % $I_{pm}$    | -3    |         | 3    | $\pm I_{pm}$                                |
| Reaction time   | $t_{ra}$         | $\mu\text{s}$ |       | 0.4     |      | @ 10% of $I_{pn}$                           |
| Step response time                                    | $t_{res}$        | $\mu\text{s}$ |       | 1.5     | 2.5  | @ 90% of $I_{pn}$                           |
| Delay time  | $t_{delay}$      | $\mu\text{s}$ |       | 0.8     |      | 300 kHz sine wave                           |
| Frequency bandwidth (-3dB)                            | BW               | kHz           |       | 300     |      | No RC circuit                               |
| Output voltage noise                                  | $V_{noise}$      | mVpp          |       | 10      |      |   |
| DC ~ 10 kHz   |                  |               |       | 15      |      |   |
| Accuracy @ $25^\circ\text{C}$                         | X                | % of $I_{pn}$ | -1    |         | 1    | @ $25^\circ\text{C}$                        |
| 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. Output voltage VS primary current



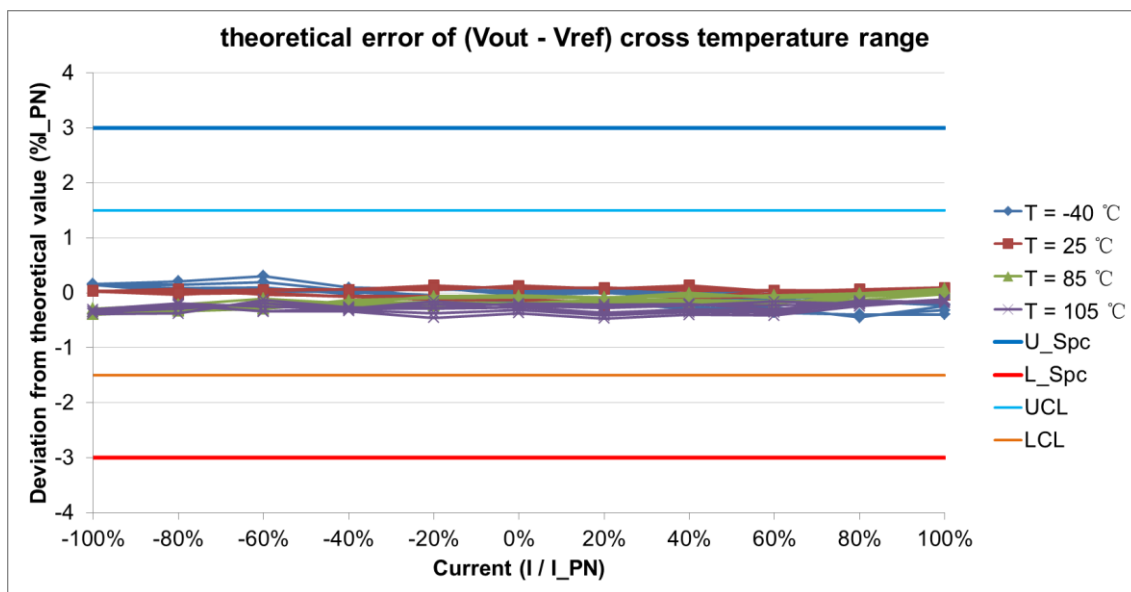
The dependence of Vout of STK-200PL/Z on the primary current.

## 4. Accuracy characteristics in room temperature

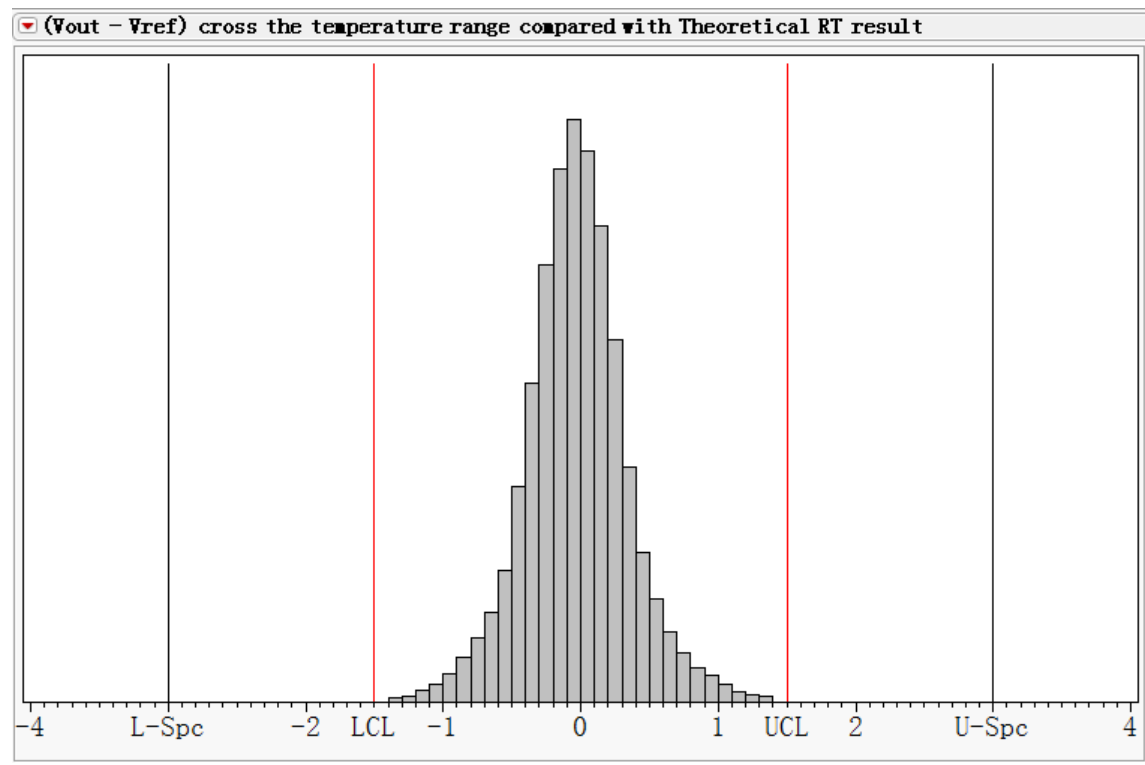


The error of STK-xxPL/Z current sensor at 25°C compared with the standard output,  $((V_{out} - V_{ref})_{measure} @ I_n @ 25^{\circ}C - V_{oe}@25^{\circ}C - G_{th} * I_n) / V_{FS}$ .  $V_{out}$  represents voltage of  $V_{out}$ ,  $V_{ref}$  the voltage of  $V_{ref}$ ,  $I_n$  the primary current,  $V_{oe}$  the  $(V_{out} - V_{ref})@0A$ ,  $G_{th}$  the theoretical gain,  $V_{FS}$  the rated output voltage.

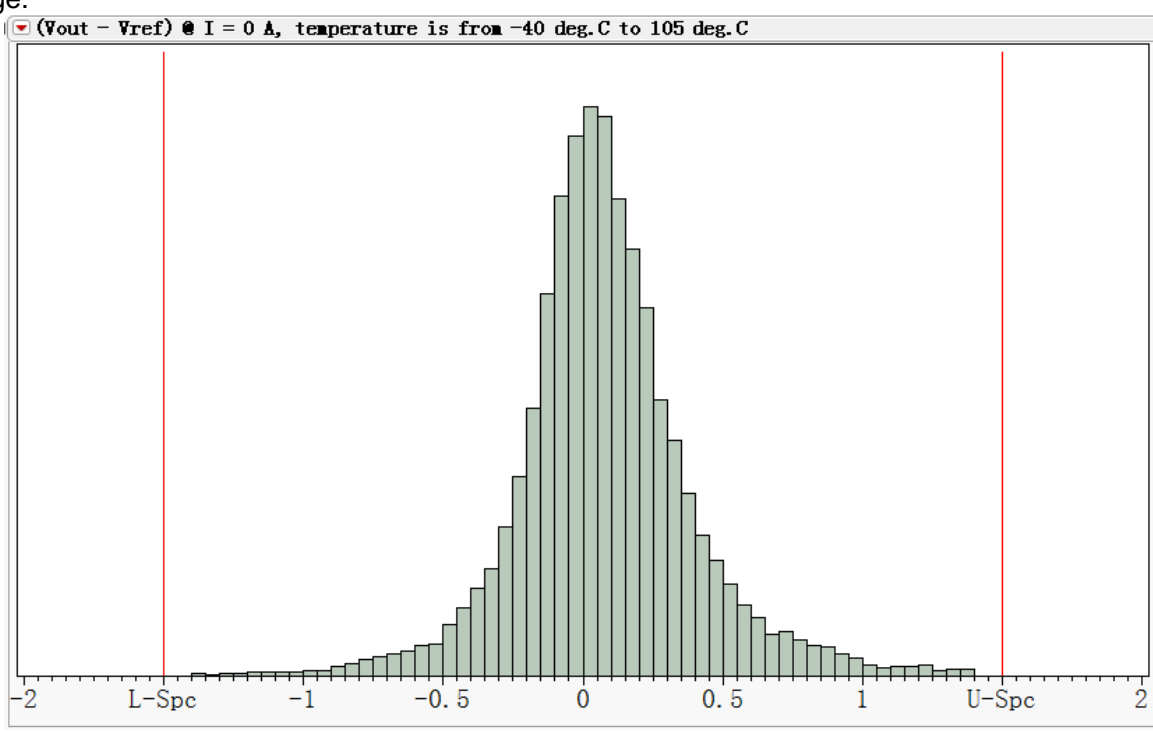
## 5. Accuracy cross temperature



The error of STK-xxPL/Z current sensor at -40°C ~105°C compared with the standard output at room temperature,  $((V_{out} - V_{ref})_{measure} @ I_n @ T_x - V_{oe}@ T_x - G_{th} * I_n) / V_{FS}$ . Where,  $V_{out}$  represents voltage of  $V_{out}$ ,  $V_{ref}$  the voltage of  $V_{ref}$ ,  $I_n$  the primary current,  $T_x$  the present temperature,  $V_{oe}$  the  $(V_{out} - V_{ref})@0A$ ,  $G_{th}$  the theoretical gain,  $V_{FS}$  the rated output voltage.

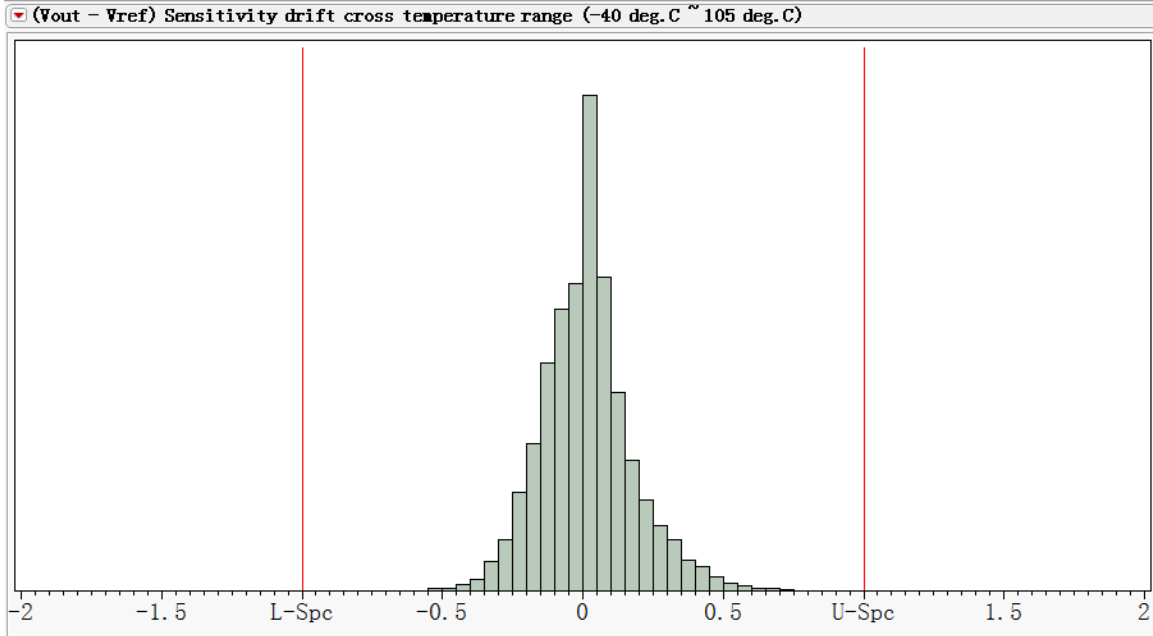


The error of STK-xxPL/Z output ( $V_{out} - V_{ref}$ ) current sensor at  $-40^{\circ}\text{C} \sim 105^{\circ}\text{C}$  compared with the standard output ( $V = G_{th} * I_n$ ),  $((V_{out} - V_{ref}) @ I_n @ T_x - G_{th} * I_n) / V_{FS}$ , Where,  $I_n$  represents present primary current,  $T_x$  the present temperature,  $G_{th}$  the theoretical gain,  $V_{FS}$  the rated output voltage.



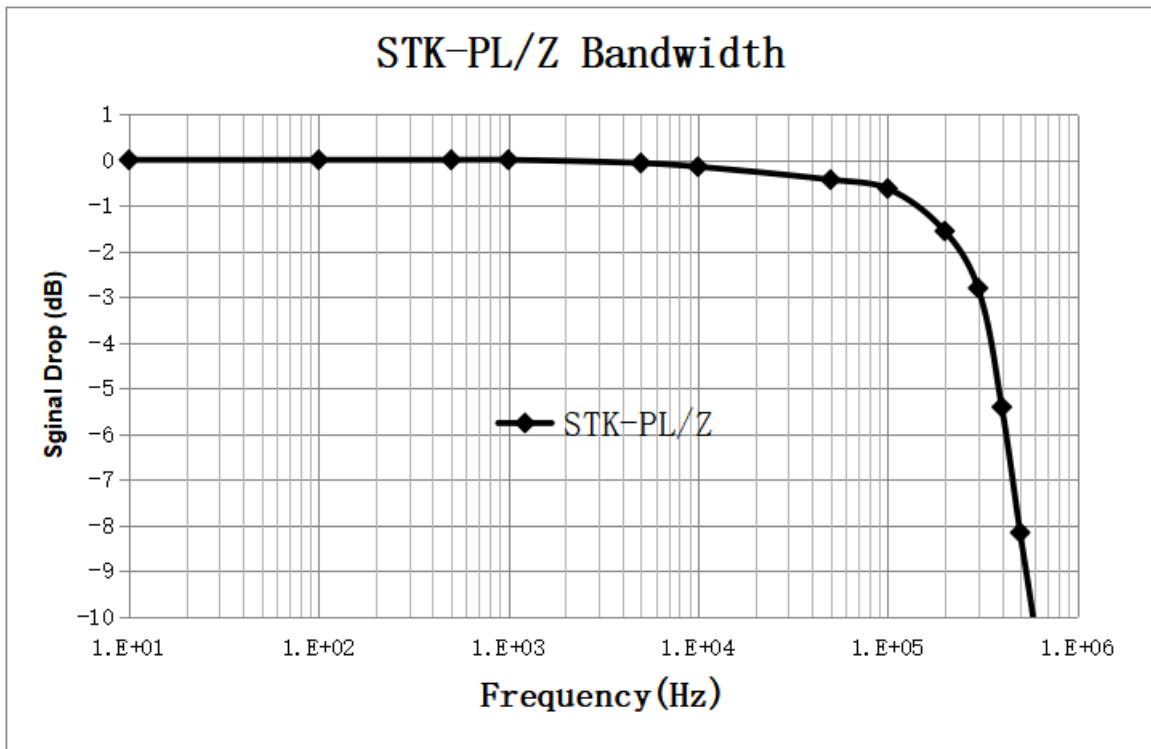
Temperature drift of  $V_{oe}$ ,  $V_{oe\_TRange} = (V_{oe} @ T_x - V_{oe} @ 25^{\circ}\text{C}) / V_{FS}$ .  $T_x$  represents present temperature,  $V_{FS}$  the rated output voltage.





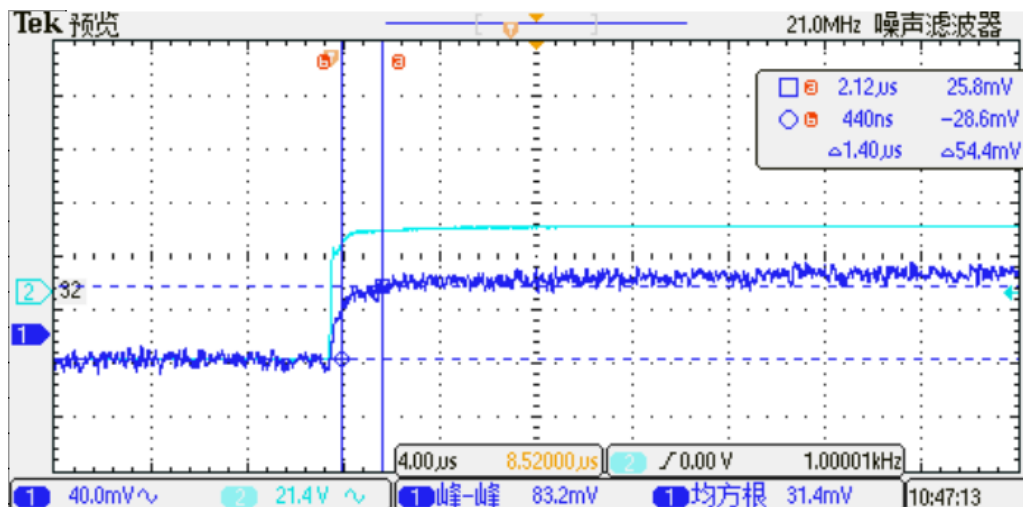
Error of gain,  $Err\_G = \frac{((V_{out} - V_{ref}) @ I_{pn} - (V_{out} - V_{ref}) @ (-I_{pn})) / 2 - V_{FS}}{V_{FS}}$ . Where  $I_{pn}$  represents the rated current,  $-I_{pn}$  the reversed rated current.

## 6. Frequency response and bandwidth



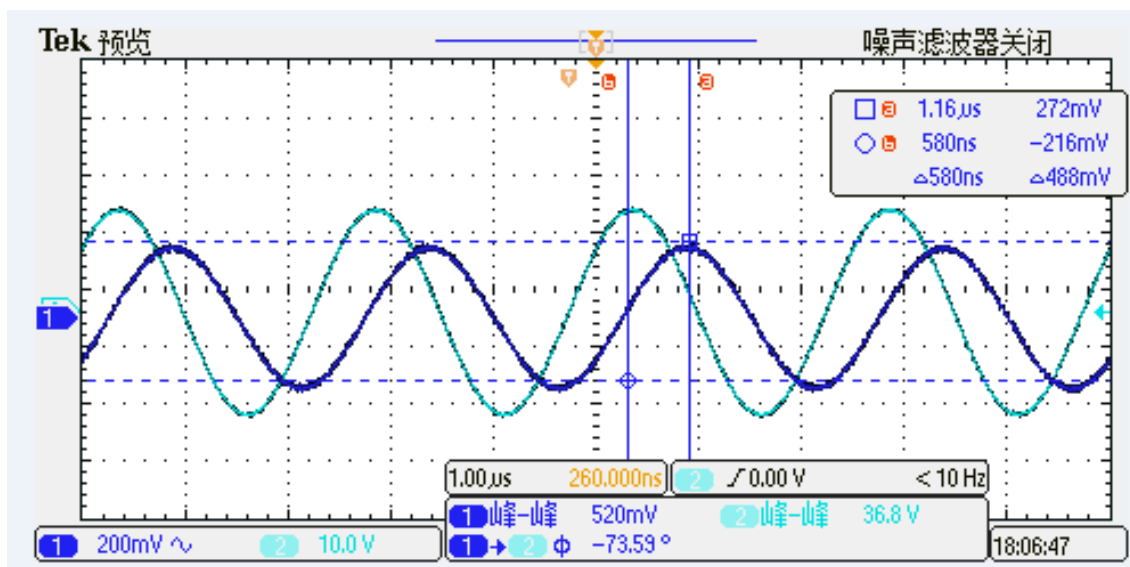
The frequency bandwidth of STK-xxPL/Z series current sensor. The bandwidth of current sensor is DC ~ 300 kHz (-3dB).

## 7. Step response time



The typical frequency response of STK-xxPL/Z 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  $\mu$ s

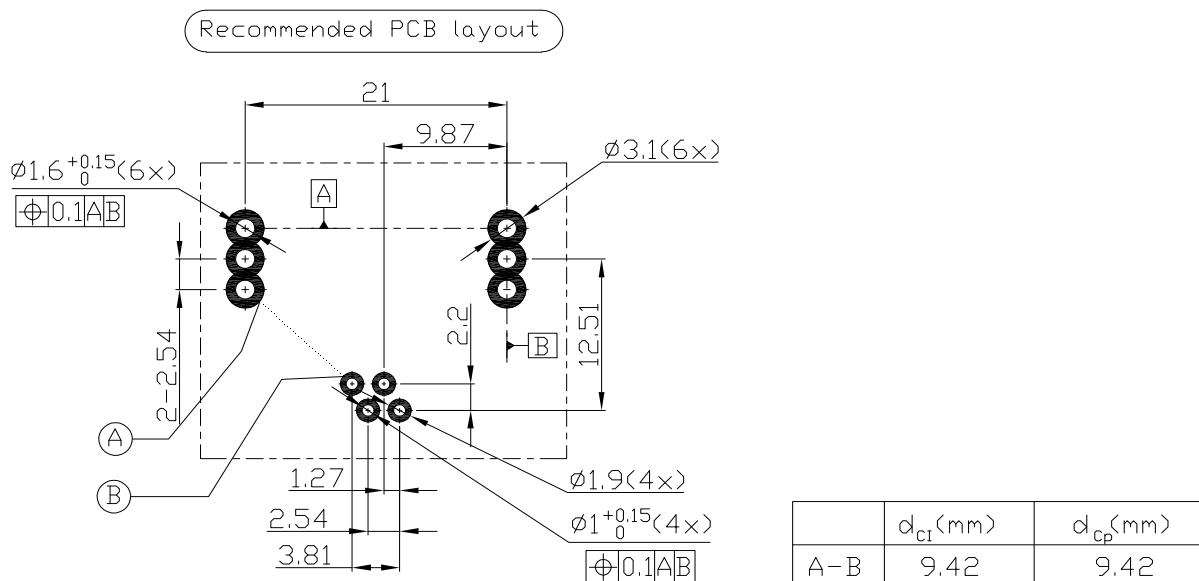
## 8. Frequency delay performance



When testing 300 kHz sine wave, the typical result of STK-xxPL/Z current sensor's output. The response time from the primary current (light blue) to the secondary output (dark blue) is less than 0.8  $\mu$ s.

## 9. 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:  $260^{\circ}\text{C} \times 10 \text{ s}$

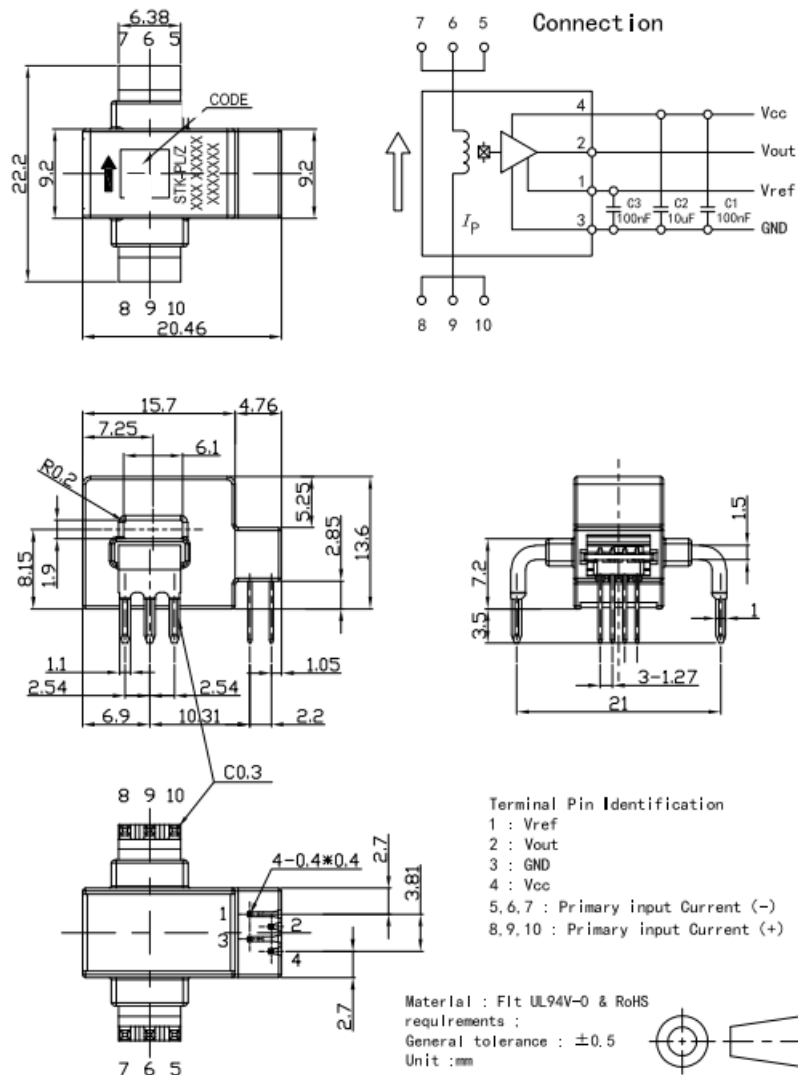


### Security:

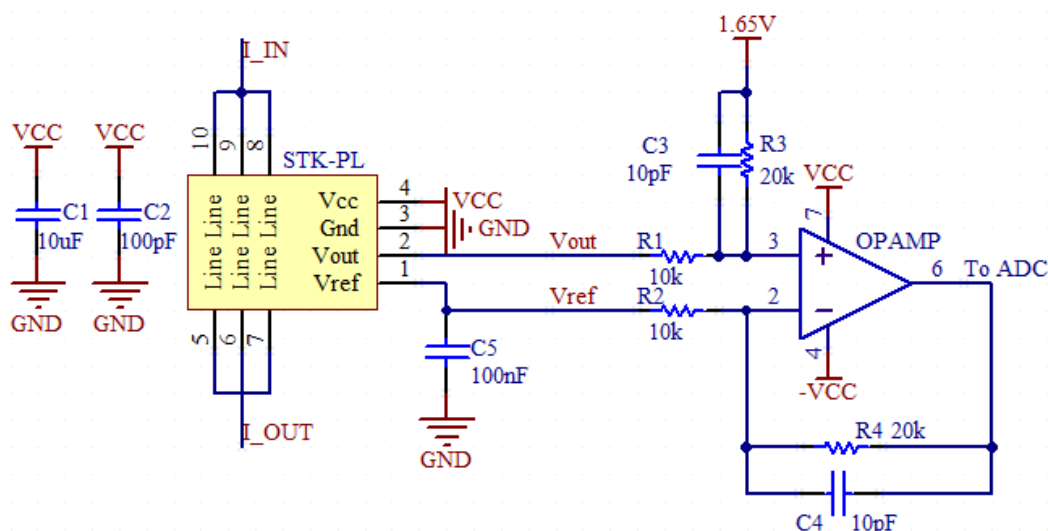
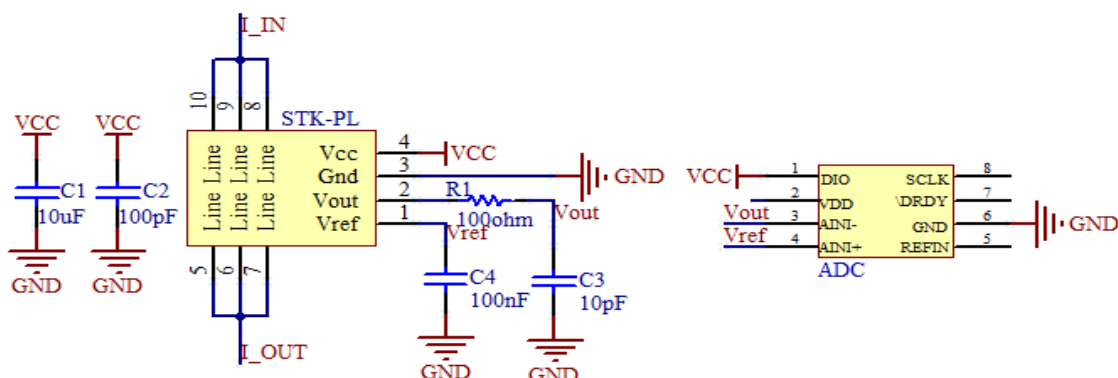
This current sensor must be used in limited-energy secondary circuit according to IEC 61010-1.

- 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.

## 10. Dimension & Pin definitions



## 11. Appendix: typical application circuit



| R3 (kohm) | C3 (pF) | Theoretical -3dB<br>$f = 1/(2\pi RC)$<br>(kHz) | Measured -3dB<br>(kHz) |
|-----------|---------|--|------------------------|
| 20        | 27      | 295  | ~300                   |
| 20        | 81      | 98   | ~ 100                  |
| 20        | 810     | 10   | ~ 10                   |

The frequency characteristics of STK-xxPL/Z 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:  $R1 = R2, R3 = R4, C3 = C4$ .