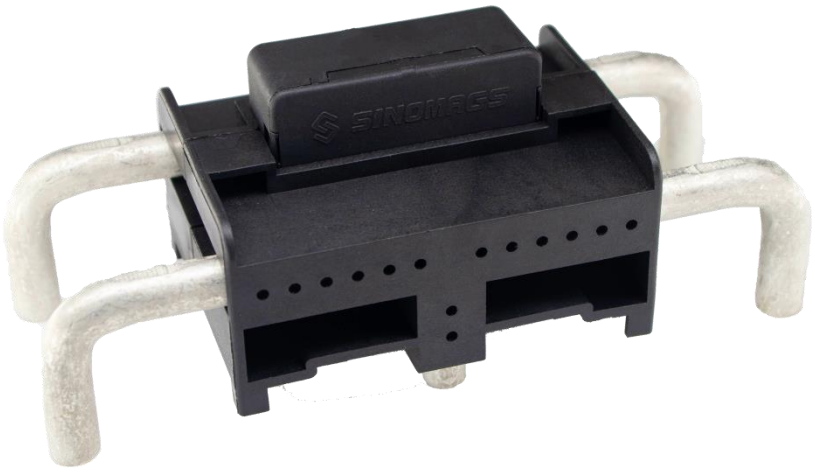
Sinomags Product Datasheet

# CURRENT SENSOR

PRODUCT SERIES： SFG-X.XP/P3

PRODUCT PART NUMBER： SFG-1.5P/P3, SFG-3.0P/P3, SFG-5.0P/P3

Version： Ver 3.1



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# CONTENT

# 1. Description

## Features

- Closed loop (compensated) current transducer
- Voltage output
- Insulation voltage for 4 kVAC
- Single supply voltage
- PCB mounting.

## Advantages

- High accuracy
- High overload capability
- High insulation capability
- High separation ability
- Low temperature drift
- Degauss and test functions

## Applications

- Residual current measurement
- Leakage current measurement in PV inverters
- First human contact protection of PV arrays
- Failure detection in power sources
- Leakage current detection in stacked DC sources
- Communication power.

# 2. Absolute parameter: SFG-X.XP/P3

## Absolute maximum ratings

| Parameter | Symbol | Unit | Value |
|---|---|---|---|
| Maximum Supply voltage | $Vc_{max}$ | V | 7 |
| Maximum Primary conductor temperature | $T_{B\ max}$ | ℃ | 110 |
| Maximum overload capability (100 μs, 500 A/μs) | $\hat{I}_{P\ max}$ | A | 3300 |
| Maximum Voltage between test winding and secondary pins | $V_{d\ max}$ | V | 35 |
| Maximum Current of test winding | $I_{T\ max}$ | mA | 300 |

## Ratings

| Parameter | Symbol | Unit | Value |
|---|---|---|---|
| Primary involved potential | | V AC/DC | 1000 |
| Primary current @ $T_{Amax}$=105℃ | $I_P$ | A | 250 |
| Primary current @ $T_{Amax}$=85℃ | $I_P$ | A | 300 |
| Secondary supply voltage | $U_C$ | V DC | 5 |
| Output voltage | $V_{out}$ | V | 0 to 5 |

## Isolation parameters

| Parameter | Symbol | Unit | Value | Remark |
|---|---|---|---|---|
| RMS voltage for AC | $V_d$ | kV | 4 | test 50 Hz/1 min |
| Impulse withstand voltage | $V_w$ | kV | 10.1 | 1.2/50μs |
| Clearance distance (pri. –pri.) | $d_{Cl}$ | mm | 11 | Shortest distance through air |
| Creepage distance (pri. – pri.) | $d_{Cp}$ | mm | 11 | Shortest path along device body |
| Clearance distance (pri. –sec.) | $d_{Cl}$ | mm | 12.1 | When mounted on PCB with recommended layout |
| Creepage distance (pri. –sec.) | $d_{Cp}$ | mm | 12.1 | When mounted on PCB with recommended layout |
| Comparative tracking index | CTI | V | 600 | |
| Application example | | V | 600 CAT III, PD2 | Reinforced insulation, non uniform field |
| Application example | | V | 1500 CAT III, PD2 | Basic insulation, non uniform field |

## Environmental and mechanical characteristics

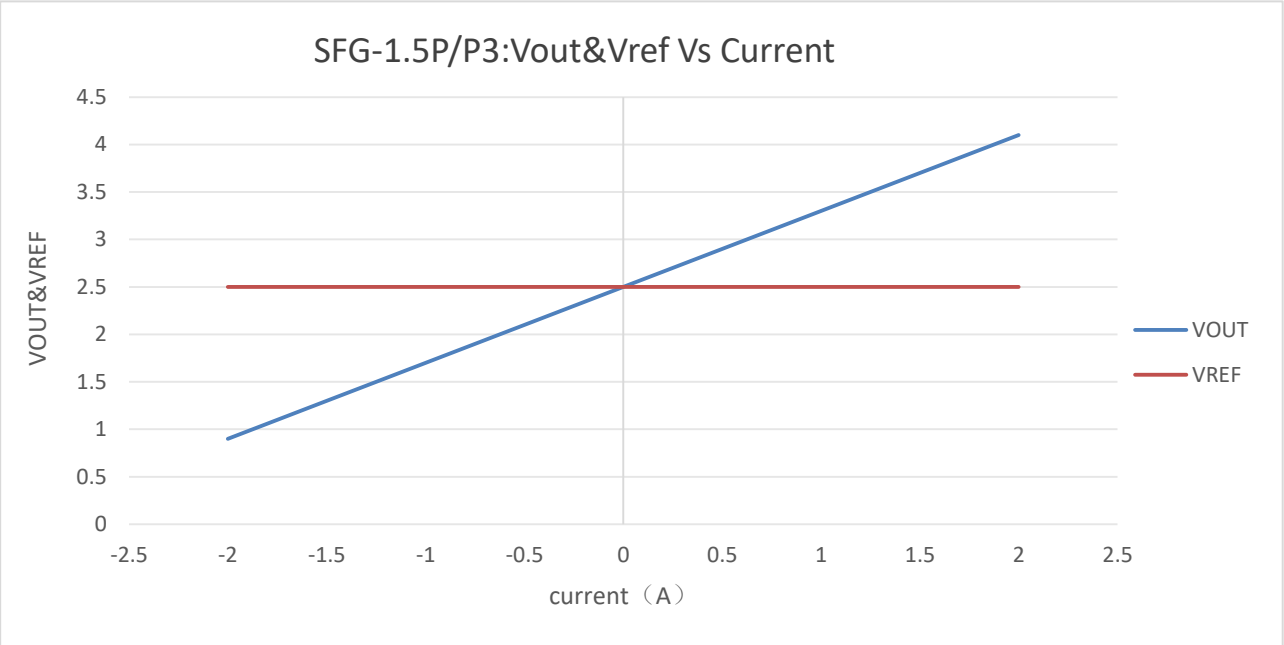
| Parameter | Symbol | Unit | Min | Typ | Max | Comment |
|---|---|---|---|---|---|---|
| Ambient operating temperature | $T_A$ | ℃ | -40 | | 105 | |
| Ambient storage temperature | $T_S$ | ℃ | -40 | | 105 | |
| Mass | m | g | | 300 | | |
| standard | EN 50178, IEC 61010, UL 508 | | | | | |

## 3. Electrical data: SFG-1.5P/P3

At $T_A$ = 25 ℃, $V_C$ = 5 V.

| Parameters | Symbol | Unit | Min | Typ | Max | Remark |
|---|---|---|---|---|---|---|
| Primary nominal residual rms current | $I_{PN}$ | A | | 1.5 | | |
| Primary residual current, measuring range | $I_{PM}$ | A | -2 | | 2 | |
| Supply voltage | $V_C$ | V | 4.75 | 5 | 5.25 | |
| Current consumption | $I_C$ | mA | | 17.5 | 21.6 | $I_P$(mA) / Na<br>$N_a$ = 1000 turns<br>- 40°C …105°C |
| Output voltage referred to $V_{ref}$ (Test current) | $V_{out}$ | V | 0.12 | | 0.5 | |
| Reference voltage @ $I_P$ = 0 | $V_{ref}$ | V | 2.495 | 2.5 | 2.505 | Internal reference |
| External reference voltage | $V_{REF}$ | V | 2.3 | | 4 | Internal reference of $V_{ref}$ input = 499 Ω |
| Electrical offset current referred to primary | $I_{OE}$ | mA | -30 | 4.2 | 30 | |
| Temperature coefficient of VOE @ $I_P$ = 0 | $TCV_{OE}$ | ppm/K | | | ±570 | ppm/K of 2.5 V<br>−40 … 105 °C |
| Theoretical sensitivity | Gth | V/A | | 0.8 | | |
| Sensitivity error | $\varepsilon_G$ | % | -1.6 | 0.5 | 1.6 | $R_L$ > 500 kΩ |
| Temperature coefficient of G | TCG | ppm/K | | | ±400 | - 40°C …105°C |
| Linearity error | $\varepsilon_L$ | % | | 0.5 | 1 | |
| Number of turns (test winding) | $N_T$ | | | 20 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Reaction time @ 10 % of $I_{PRN}$ | $t_{ra}$ | μs | | 5 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Step response time to 90 % of $I_{PN}$ | $t_r$ | μs | | 50 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Frequency bandwidth (−3dB) | BW | kHz | | 15 | | $R_L$ > 500 kΩ |
| Noise(1 Hz ~ 10 kHz) | $V_{no}$ | mV rms | | 10 | | $R_L$ > 500 kΩ |
| Accuracy@ $I_{PN}$ @TA = 25℃ | $X_{25℃}$ | % of $I_{PN}$ | | ±1.9 | | |
| Accuracy@ $I_{PN}$ @TA = 105℃ | $X_{105℃}$ | % of $I_{PN}$ | | ±3.2 | | |

## 4. Output voltage VS primary current of SFG-1.5P/P3

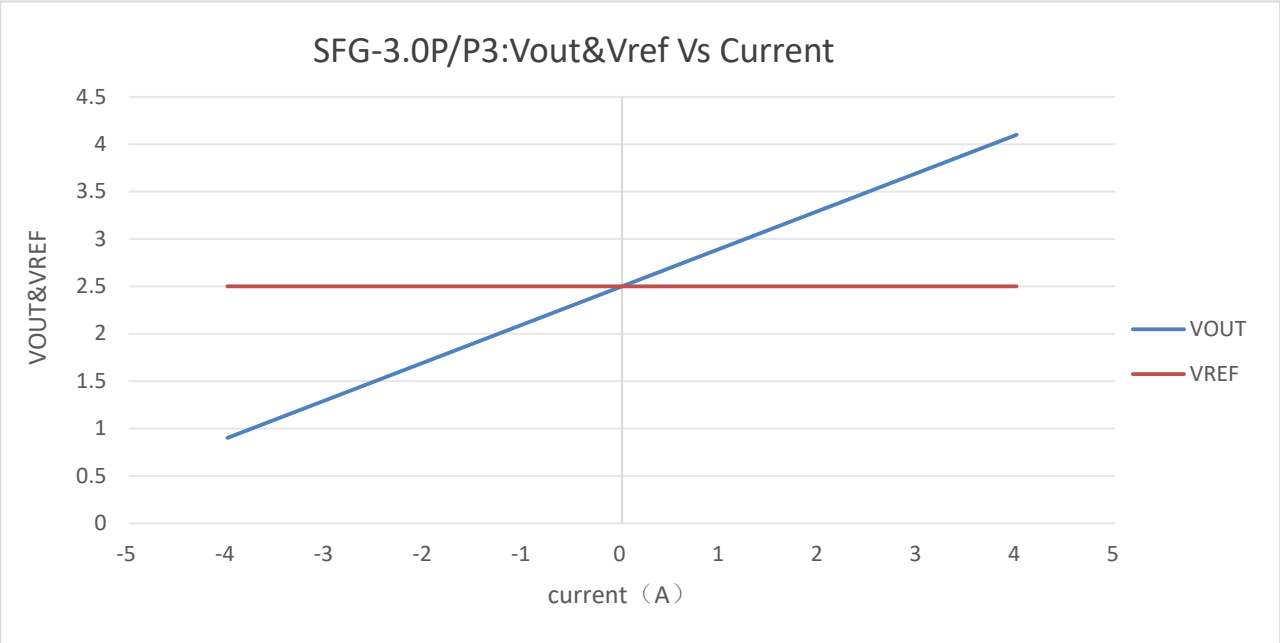


## 5. Electrical data: SFG-3.0P/P3

At $T_A$ = 25 ℃, $V_C$ = 5 V.

| Parameters | Symbol | Unit | Min | Typ | Max | Remark |
|---|---|---|---|---|---|---|
| Primary nominal residual rms current | $I_{PN}$ | A | | 3 | | |
| Primary residual current, measuring range | $I_{PM}$ | A | -5 | | 5 | |
| Supply voltage | $V_C$ | V | 4.75 | 5 | 5.25 | |
| Current consumption | $I_C$ | mA | | 17.5 | 21.6 | $I_P$(mA) / Na<br>$N_a$ = 1000 turns<br>- 40°C …105°C |
| Reference voltage @ $I_P$ = 0 | $V_{ref}$ | V | 2.495 | 2.5 | 2.505 | Internal reference |
| External reference voltage | $V_{REF}$ | V | 2.3 | | 4 | Internal reference of $V_{ref}$ input = 499 Ω |
| Electrical offset current referred to primary | $I_{OE}$ | mA | -24 | 7 | 24 | |
| Electrical offset voltage | $V_{oe}$ | mV | -25 | | 25 | ($V_{out}$ – $V_{ref}$)<br>@ 0 A |
| Temperature coefficient of VOE @ $I_P$ = 0 | $TCV_{OE}$ | ppm/K | | | 570 | ppm/K of 2.5 V<br>−40 … 105 °C |
| Theoretical sensitivity | Gth | V/A | | 0.4 | | |
| Sensitivity error | $\varepsilon_G$ | % | -1.6 | 0.5 | 1.6 | $R_L$ > 500 kΩ |
| Temperature coefficient of G | TCG | ppm/K | | ±400 | | - 40°C …105°C |
| Linearity error | $\varepsilon_L$ | % | | 0.5 | 1 | |
| Number of turns (test winding) | $N_T$ | | | 20 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Reaction time @ 10 % of $I_{PRN}$ | $t_{ra}$ | μs | | 5 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Step response time to 90 % of $I_{PN}$ | $t_r$ | μs | | 40 | | $R_L$ > 500 kΩ |
| Frequency bandwidth (−3dB) | BW | kHz | | 15 | | $R_L$ > 500 kΩ |
| Noise(1 Hz ~ 10 kHz) | $V_{no}$ | mV rms | | 10 | | |
| Accuracy@ $I_{PN}$ @TA = 25℃ | $X_{25℃}$ | % of $I_{PN}$ | | ±1.9 | | |
| Accuracy@ $I_{PN}$ @TA = 105℃ | $X_{105℃}$ | % of $I_{PN}$ | | ±3.2 | | |

## 6. Output voltage VS primary current of SFG-3.0P/P3

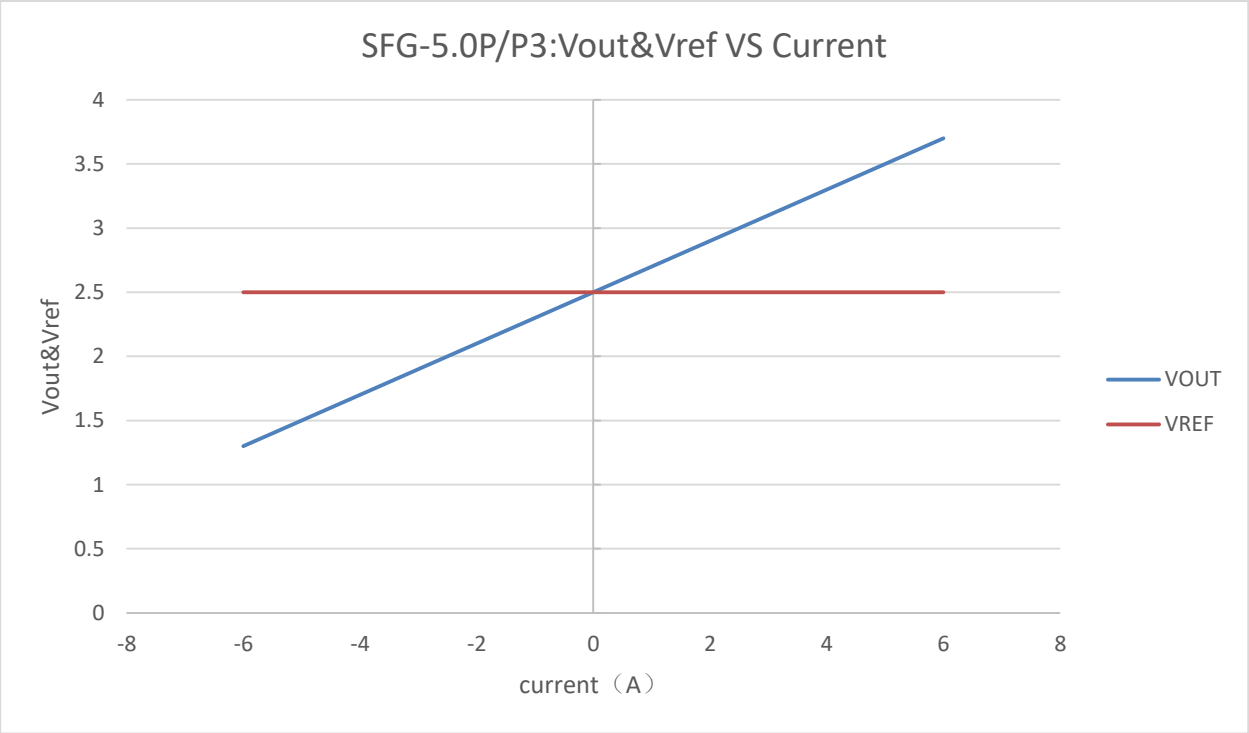


# 7. Electrical data: SFG-5.0P/P3

At $T_A$ = 25 ℃, $V_C$ = 5 V.

| Parameters | Symbol | Unit | Min | Typ | Max | Remark |
|---|---|---|---|---|---|---|
| Primary nominal residual rms current | $I_{PN}$ | A | | 5 | | |
| Primary residual current, measuring range | $I_{PM}$ | A | -8 | | 8 | |
| Supply voltage | $V_C$ | V | 4.75 | 5 | 5.25 | |
| Current consumption | $I_C$ | mA | | 17.5 | 21.6 | $I_P$(mA) / Na<br>$N_a$ = 1000 turns<br>- 40°C …105°C |
| Reference voltage @ $I_P$ = 0 | $V_{ref}$ | V | 2.495 | 2.5 | 2.505 | Internal reference |
| External reference voltage | $V_{REF}$ | V | 2.3 | | 4 | Internal reference of $V_{ref}$ input = 499 Ω |
| Electrical offset current referred to primary | $I_{OE}$ | mA | -35 | 12 | 35 | |
| Electrical offset voltage | $V_{oe}$ | mV | -25 | | 25 | ($V_{out}$ – $V_{ref}$)<br>@ 0 A |
| Temperature coefficient of VOE @ $I_P$ = 0 | $TCV_{OE}$ | ppm/K | | | 570 | ppm/K of 2.5 V<br>−40 … 105 °C |
| Theoretical sensitivity | Gth | V/A | | 0.2 | | |
| Sensitivity error | $\varepsilon_G$ | % | -1.6 | 0.5 | 1.6 | $R_L$ > 500 kΩ |
| Temperature coefficient of G | TCG | ppm/K | | ±400 | | - 40°C …105°C |
| Linearity error | $\varepsilon_L$ | % | | 0.5 | 1 | |
| Number of turns (test winding) | $N_T$ | | | 20 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Reaction time @ 10 % of $I_{PRN}$ | $t_{ra}$ | μs | | 5 | | $R_L$ > 500 kΩ,<br>di/dt > 5 A/μs |
| Step response time to 90 % of $I_{PN}$ | $t_r$ | μs | | 40 | | $R_L$ > 500 kΩ |
| Frequency bandwidth (−3dB) | BW | kHz | | 15 | | $R_L$ > 500 kΩ |
| Noise(1 Hz ~ 10 kHz) | $V_{no}$ | mV rms | | 10 | | |
| Accuracy@ $I_{PN}$ @TA = 25℃ | $X_{25℃}$ | % of $I_{PN}$ | | ±1.9 | | |
| Accuracy@ $I_{PN}$ @TA = 105℃ | $X_{105℃}$ | % of $I_{PN}$ | | ±3.2 | | |

## 8. Output voltage VS primary current of SFG-5.0P/P3




## 9. Frequency band width

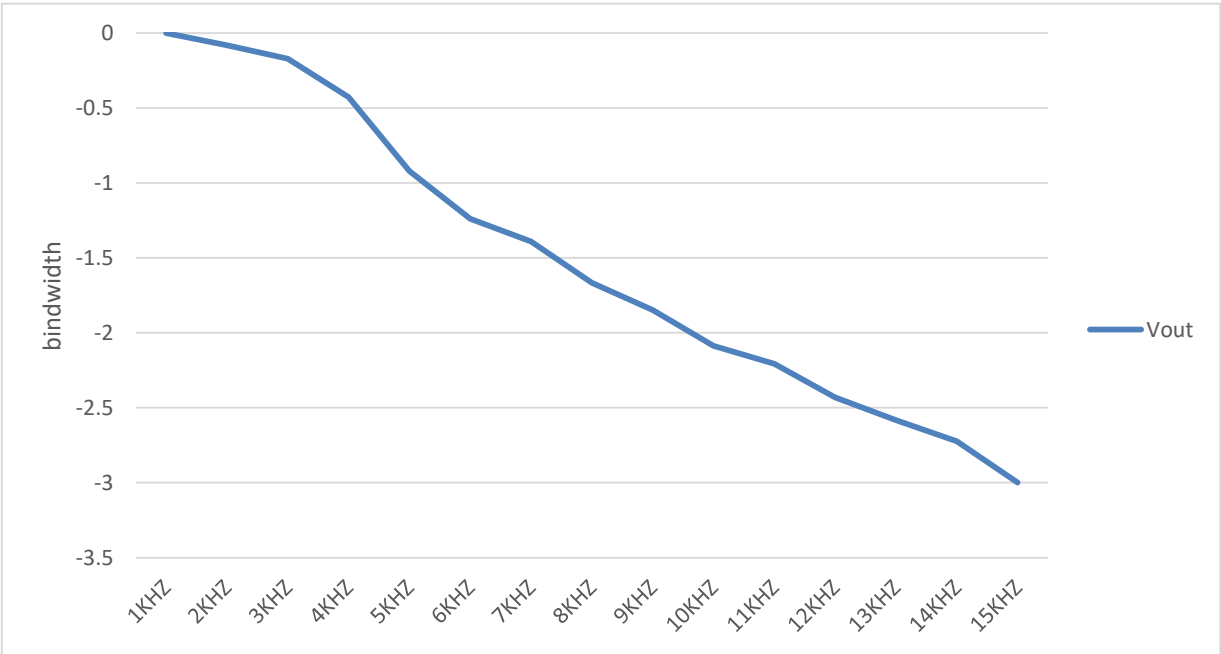



Fig.1 the frequency band width of SFG-3.0P/P3&SFG-5.0P/P3 series current sensors.

## 10. Step response time

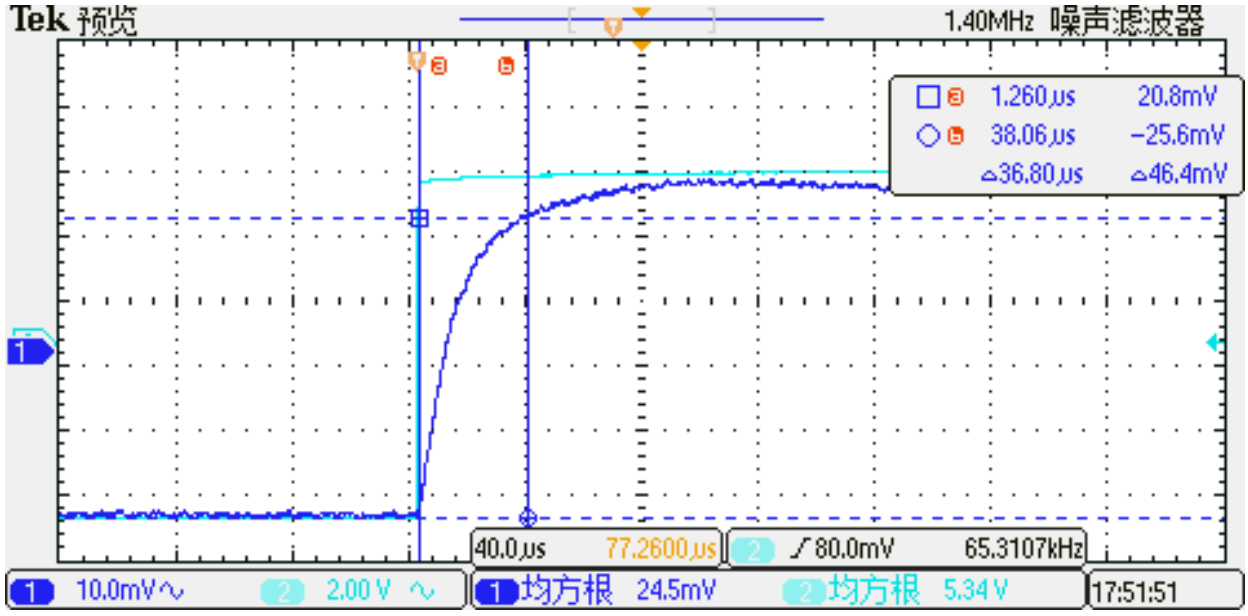



Fig.2 is the step response time of SFG-3.0P/P3 current sensors. The light blue is primary current, while the dark blue is output signal of current sensor. The step response time is less than 40μs.

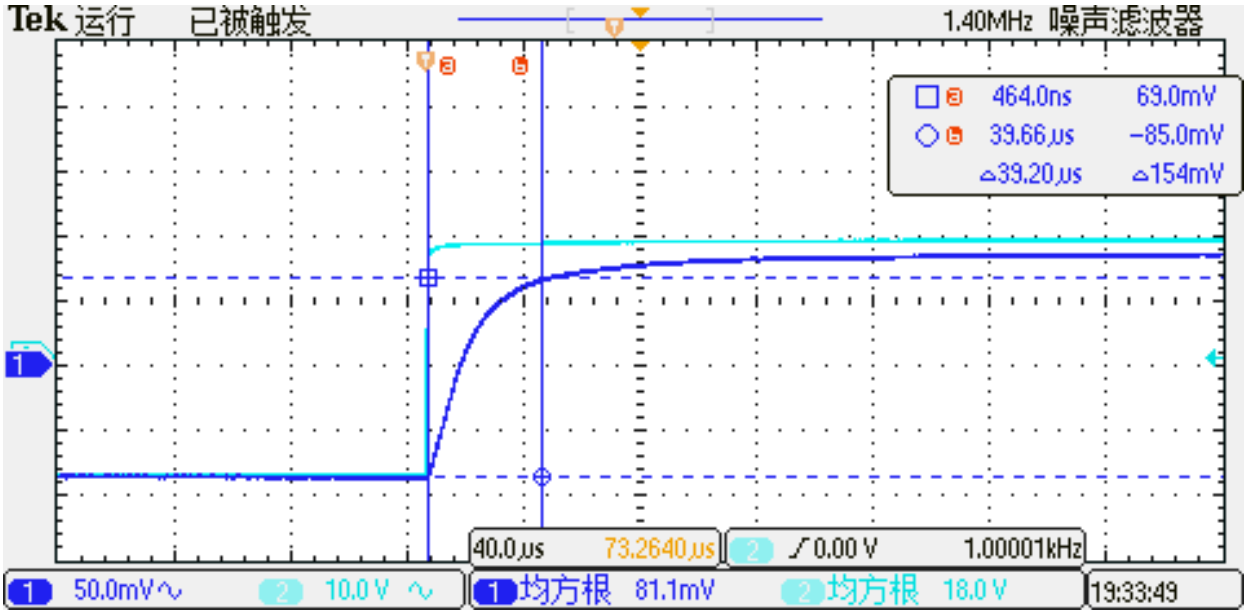
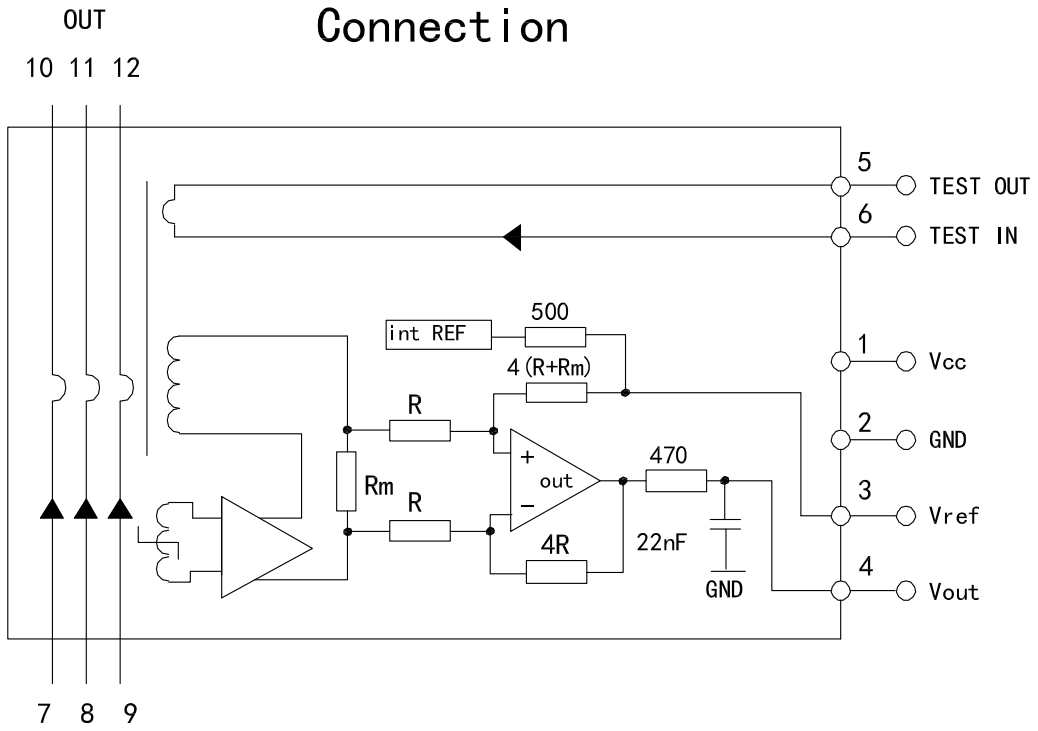



Fig3 is the step response time of SFG-5.0P/P3 current sensors. The light blue is primary current, while the dark blue is output signal of current sensor. The step response time is less than 40μs.

# 11. SFG- P/P3 Application information

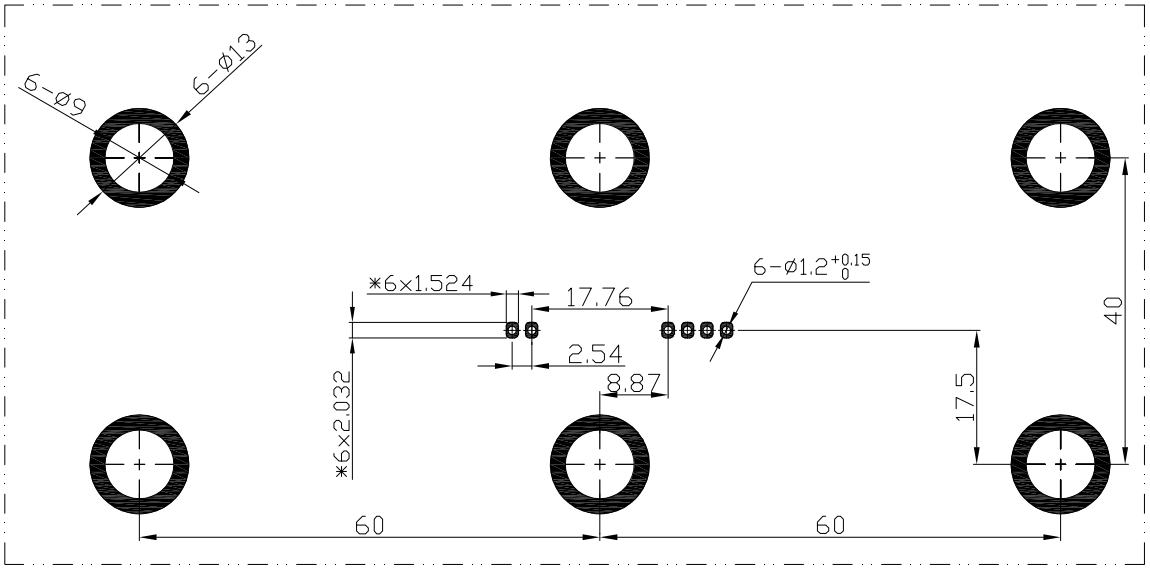



## Test winding

A test winding is wound around the compensation winding. It allows simulating a primary residual current to test the function of the transducer. The output voltage $V_{out}$ referred to $V_{ref}$ for a test current IT is below.

$V_{out} - V_{ref} = G_{th} * I_T$ (test current) * 20

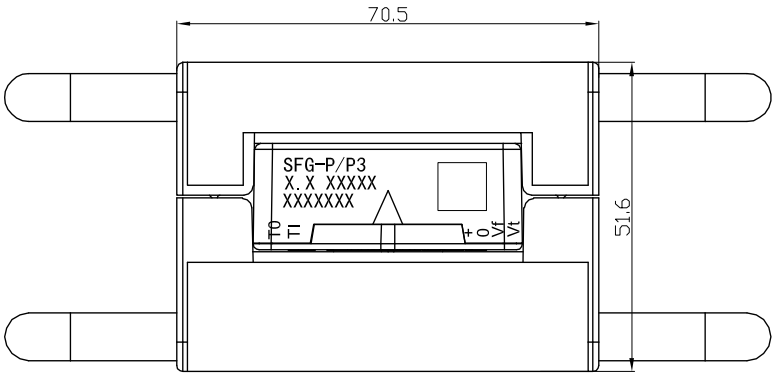
## 12. SFG- P/P3 PCB footprint




**Assembly on PCB**

- No Primary in shadow area
- Maximum PCB thickness 2.4 mm
- Wave-soldering：260°C @ 10 s
- Recommended PCB hole diameter 1.2 mm for secondary pin.

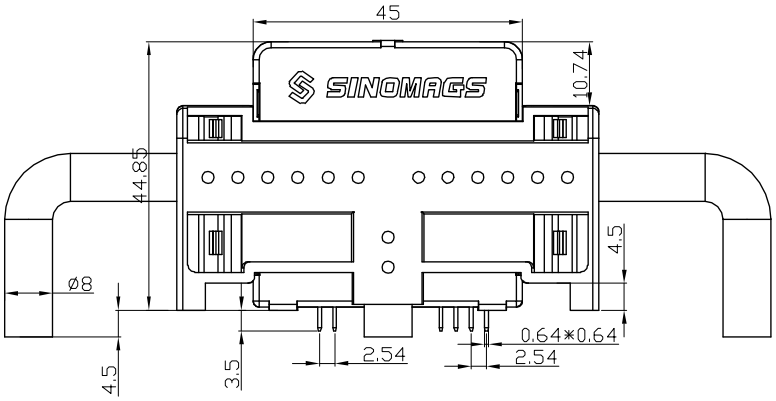
# 13. SFG- P/P3 Dimensions

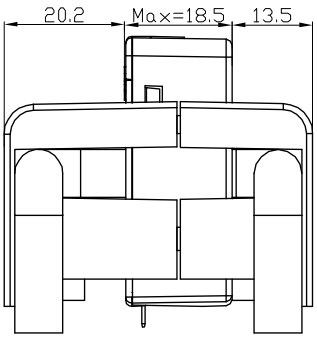


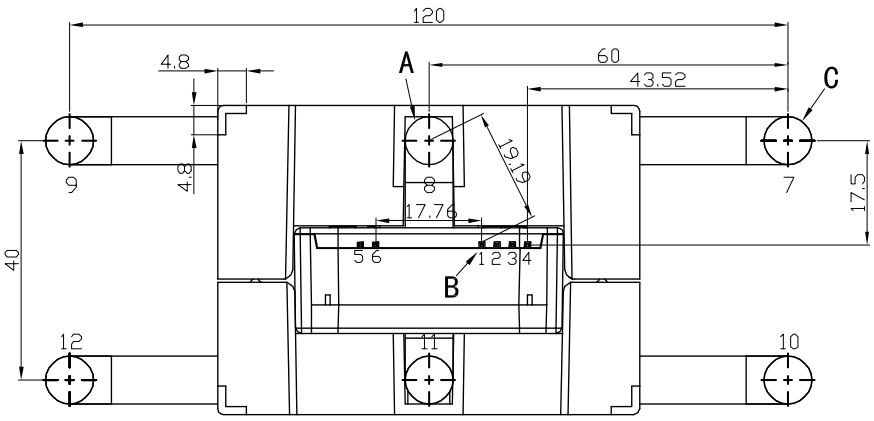

| | $D_{CI}$ | $D_{CP}$ |
|---|---|---|
| A-B | 15.1 | — |
| A-C | 11 | 12 |
| A-D | 15 | 15 |

D is secondary inside the transducer

| On the customer's PCBA | | |
|---|---|---|
| | $D_{CI}$ | $D_{CP}$ |
| A-B | 12.1 | 12.1 |
| A-C | 11 | 47 |




Terminals:

| | | | |
|---|---|---|---|
| 1 | Vcc | 7 | Ip+ |
| 2 | GND | 8 | Ip+ |
| 3 | Vref | 9 | Ip+ |
| 4 | Vout | 10 | Ip- |
| 5 | Test Out | 11 | Ip- |
| 6 | Test In | 12 | Ip- |

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