

Current Sensing Module for detecting AC/DC Leakage current

Description

The Senko Micro SC410 series provides economical and precise solutions for AC, DC, pulsed leakage current sensing with galvanic separation between the primary circuit and the secondary circuit in PV inverter, and battery systems. The device package allows for easy implementation by the customer.

SC410 Series AC/DC Leakage Current Sensor is a new type of open-loop flux gate current sensor developed from the application of flux gate magnetic modulation principle, excellent stability in tiny currents measurement, with a highly galvanic isolation between primary and secondary circuit. It can detect small ac and dc leakage current to <1mA. Compare to other products, it's small size, good linearity, high immunity to external interference, and has power-down protection and polarity protection.

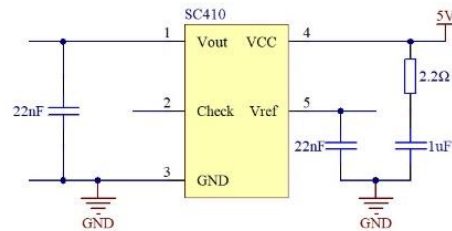
The devices processed via 168 hours room temperature aging and eight hours high temperature aging. It keeps excellent performance and stable operating in harsh working conditions.

Features

- Open loop current transducer
- Voltage output
- Single supply voltage
- PCB mounting.
- High accuracy
- Very low offset drift over -40°C~85 °C temperature range
- Wide aperture
- High over load capability
- High insulation capability
- Low cost, high integration
- Magnetic core material: Nanocrystalline 1K107

Typical Application

- Support 0 ~ ±80A Load current, AC or DC



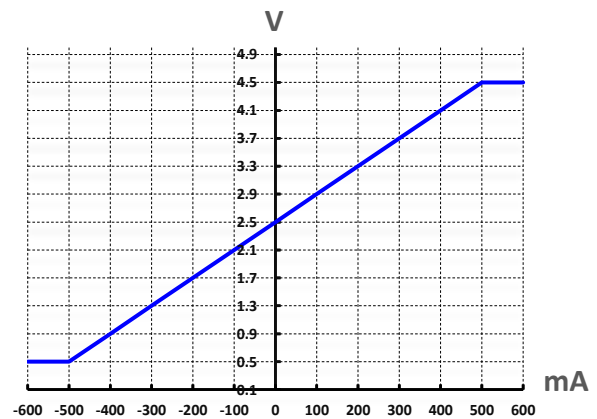
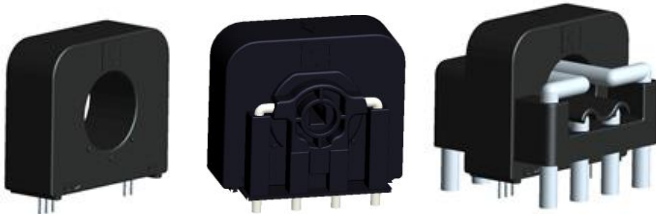
1. Check=0V, Vout will be used as normal.
2. Check=5V, Vout will output 2.7V equal to 50mA leakage current.

Typical Package

H Type

W42 Type

W44 Type



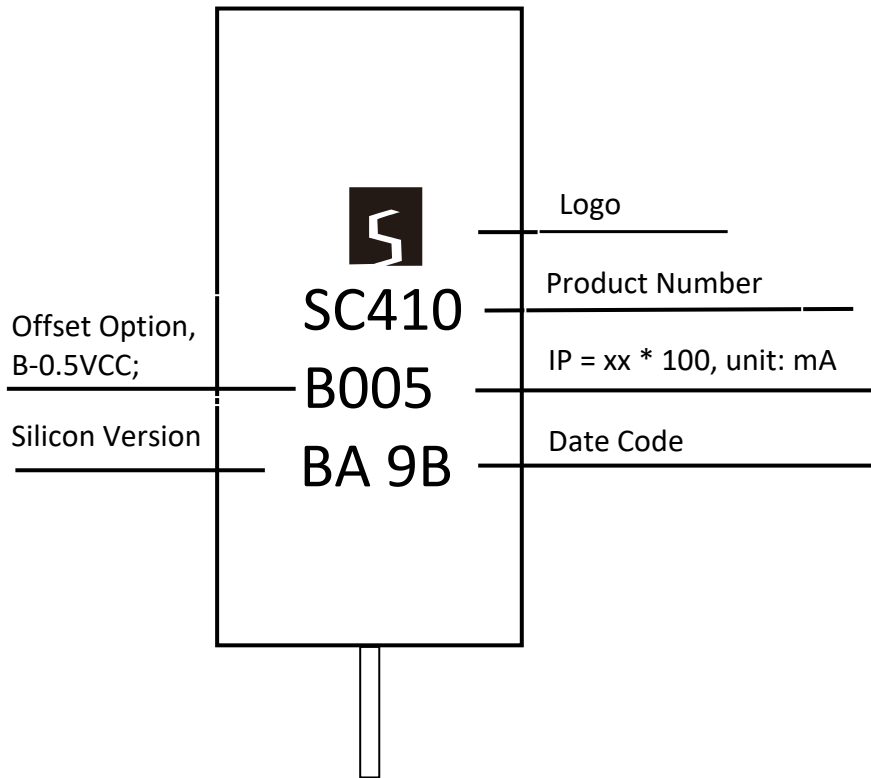
$$V_{out} = 2.5 \pm \text{Sens} * I_{leak} / 1000$$

Order Information

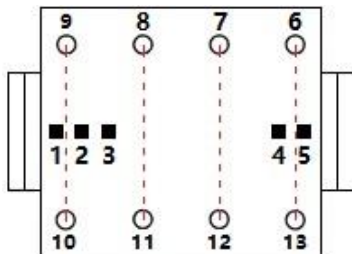
| Part Number | IP Range (A) | Zero Offset (V) | Sens. @ VCC = 5V (mV/mA) | Packaging Code | Temp. Range |
|---------------|--------------|-----------------|--------------------------|----------------|-----------------|
| SC410-B05-H | ±0.5 | 2.5 | 4 | H | E (-40~85°C) |
| SC410-B05-W42 | ±0.5 | | 4 | W42 | |
| SC410-B08-H | ±0.85 | | 2.353 | H | |
| SC410-B08-W44 | ±0.85 | | 2.353 | W44 | |
| SC410-B10-H | ±1.0 | | 2 | H | |
| SC410-B10-W44 | ±1.0 | | 2 | W44 | |
| SC410-B15-H | ±1.5 | | 1.333 | H | |
| SC410-B15-W44 | ±1.5 | | 1.333 | W44 | |

*Any custom requirement, email to fae@senkomicro.com

Mark Description



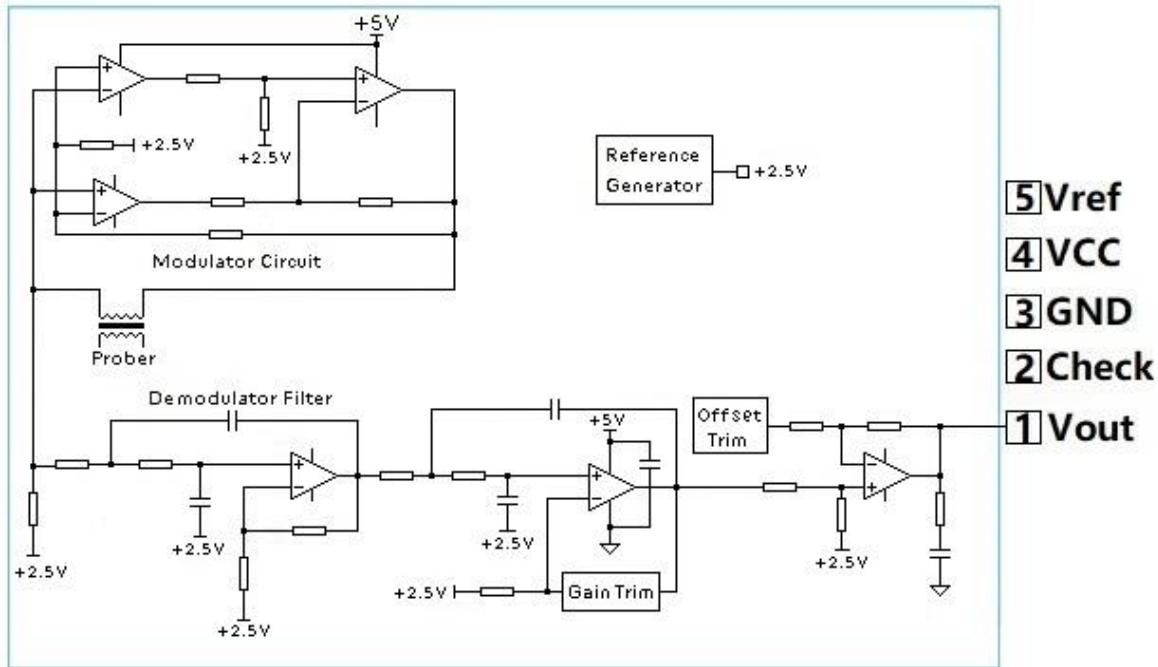
Pin Configuration



(Bottom View)

| Pin Number | Pin Name | Description |
|------------|----------|---|
| 1 | Vout | Output voltage, $V_{out} = 2.5 \pm \text{Sens} * I_{leak} / 1000$ |
| 2 | Check | Disable / Enable Self-check function. Set Check to 0V or NC, function disabled, Vout would be normal. Set Check to 5V, function enabled, Vout should be 2.7V equal to 50mA leakage current. |
| 3 | GND | Ground |
| 4 | VCC | 5.0V Power supply |
| 5 | Vref | Reference voltage, 2.5V Output |
| 6~13 | P6~P13 | Primary current for U/V/W/G shunt |

Functional Block Diagram



Absolute Maximum Ratings

Absolute maximum ratings are limiting values to be applied individually, and beyond which the serviceability of the circuit may be impaired. Functional operability is not necessarily implied. Exposure to absolute maximum rating conditions for an extended period of time may affect device reliability.

| Symbol | Characteristic | Notes | Rating | Unit |
|---------------------------|---------------------------------------|----------------|---------|------|
| V _{CC} | Supply voltage | | 6.0 | V |
| V _{RCC} | Reverse Supply Voltage | | -0.1 | V |
| V _{IOUT} | Output voltage | | 6.0 | V |
| V _{RIOUT} | Reverse Output Voltage | | -0.1 | V |
| I _P | Overcurrent Transient Tolerance | 1 pulse, 100us | 100 | A |
| I _{IOUT(Source)} | Output Current Source | | 5 | mA |
| I _{IOUT(Sink)} | Output Current Sink | | 5 | mA |
| T _A | Nominal Operating Ambient Temperature | Range E | -40~85 | °C |
| T _{J(max)} | Maximum Junction Temperature | | 105 | °C |
| T _{stg} | Storage Temperature | | -55~150 | °C |
| I _p | W42 package type DC RMS IP range | | 40 | A |
| | W44 package type DC RMS IP range | | 160 | A |

Common Operating Characteristics

Note: Over full range of T_A=-40°C ~ 85°C, C_{bypass}=1uF, C_{load}=22nF, V_{CC}=5.0V, unless otherwise specified.

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|-------------------------------|----------------------|--|-------|-----|-------|-------|
| Supply Voltage | V _{CC} | Operating | 4.75 | 5 | 5.25 | V |
| Supply Current | I _{CC} | V _{CC} = 5.0 V, output open | | | 26 | mA |
| Output Capacitance Load | C _{LOAD} | V _{IOUT} to GND | | 22 | | nF |
| Primary Conductor Resistance | R _{PRIMARY} | T _A = 25°C | | 0.1 | | mΩ |
| Frequency Bandwidth | f | -3 dB, T _A =25°C; I _P =10 A peak-to-peak | | 0.7 | 2 | kHz |
| Nonlinearity | E _{LIN} | Over full range of I _P | | 0.3 | 1 | % |
| Power supply bypass capacitor | C _{bypass} | Normal operating | | 1 | | uF |
| Vref capacitance load | C _{ref} | | | 22 | | nF |
| Check current | I _{ck} | | | 50 | | mA |
| V _{IOUT} @ 0A | V _{OQ} | I _P =0A, T _A =25°C | 2.475 | 2.5 | 2.525 | V |

X-B05 Individual Performance Characteristics

Note: $T_J(\text{max})$ is not exceeded $T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$, $C_{\text{Bypass}} = 1\mu\text{F}$, $C_{\text{Load}} = 22\text{nF}$, $V_{\text{CC}} = 5.0\text{V}$, unless otherwise specified

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|--------------------------------------|----------------------------|---|-----|---------|---------|-------|
| Optimized residual measure rms Range | IP | $V_{\text{out}} @ IP = 4.5\text{V}$, $V_{\text{out}} @ -IP = 0.5\text{V}$ | | 500 | | mA |
| Sensitivity | Sens | Over full of $T_A = 25^\circ\text{C}$ | | 4 | | mV/mA |
| Noise | $V_{\text{NOISE(PP)}}$ | Peak-to-peak, $T_A = 25^\circ\text{C}$, programmed Sensitivity, 0.5kHz bandwidth | | 10 | | mV |
| Zero Current Output Slope | $\Delta I_{\text{OUT(Q)}}$ | $T_A = -40 \sim 25^\circ\text{C}$ | | 0.3 | | mV/°C |
| | | $T_A = 25 \sim 85^\circ\text{C}$ | | 0.3 | | mV/°C |
| Total Output Error | E_T | $T_A = 25^\circ\text{C}$, output filtered | | ± 1 | ± 2 | % |
| Total Output Error over temp. | E_{TOT} | $T_A = -40 \sim 85^\circ\text{C}$, output filtered | | ± 2 | ± 4 | % |

X-B08 Individual Performance Characteristics

Note: $T_J(\text{max})$ is not exceeded $T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$, $C_{\text{Bypass}} = 1\mu\text{F}$, $C_{\text{Load}} = 22\text{nF}$, $V_{\text{CC}} = 5.0\text{V}$, unless otherwise specified

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|--------------------------------------|----------------------------|---|-----|---------|---------|-------|
| Optimized residual measure rms Range | IP | $V_{\text{out}} @ IP = 4.5\text{V}$, $V_{\text{out}} @ -IP = 0.5\text{V}$ | | 850 | | mA |
| Sensitivity | Sens | Over full of $T_A = 25^\circ\text{C}$ | | 2.353 | | mV/mA |
| Noise | $V_{\text{NOISE(PP)}}$ | Peak-to-peak, $T_A = 25^\circ\text{C}$, programmed Sensitivity, 0.5kHz bandwidth | | 10 | | mV |
| Zero Current Output Slope | $\Delta I_{\text{OUT(Q)}}$ | $T_A = -40 \sim 25^\circ\text{C}$ | | 0.3 | | mV/°C |
| | | $T_A = 25 \sim 85^\circ\text{C}$ | | 0.3 | | mV/°C |
| Total Output Error | E_T | $T_A = 25^\circ\text{C}$, output filtered | | ± 1 | ± 2 | % |
| Total Output Error over temp. | E_{TOT} | $T_A = -40 \sim 85^\circ\text{C}$, output filtered | | ± 2 | ± 4 | % |

X-B10 Individual Performance Characteristics

Note: $T_J(\text{max})$ is not exceeded $T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$, $C_{\text{Bypass}} = 1\mu\text{F}$, $C_{\text{Load}} = 22\text{nF}$, $V_{\text{CC}} = 5.0\text{V}$, unless otherwise specified

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|--------------------------------------|----------------------------|---|-----|---------|---------|-------|
| Optimized residual measure rms Range | IP | $V_{\text{out}} @ IP = 4.5\text{V}$, $V_{\text{out}} @ -IP = 0.5\text{V}$ | | 1000 | | mA |
| Sensitivity | Sens | Over full of $T_A = 25^\circ\text{C}$ | | 2 | | mV/mA |
| Noise | $V_{\text{NOISE(PP)}}$ | Peak-to-peak, $T_A = 25^\circ\text{C}$, programmed Sensitivity, 0.5kHz bandwidth | | 10 | | mV |
| Zero Current Output Slope | $\Delta I_{\text{OUT(Q)}}$ | $T_A = -40 \sim 25^\circ\text{C}$ | | 0.3 | | mV/°C |
| | | $T_A = 25 \sim 85^\circ\text{C}$ | | 0.3 | | mV/°C |
| Total Output Error | E_T | $T_A = 25^\circ\text{C}$, output filtered | | ± 1 | ± 2 | % |
| Total Output Error over temp. | E_{TOT} | $T_A = -40 \sim 85^\circ\text{C}$, output filtered | | ± 2 | ± 4 | % |

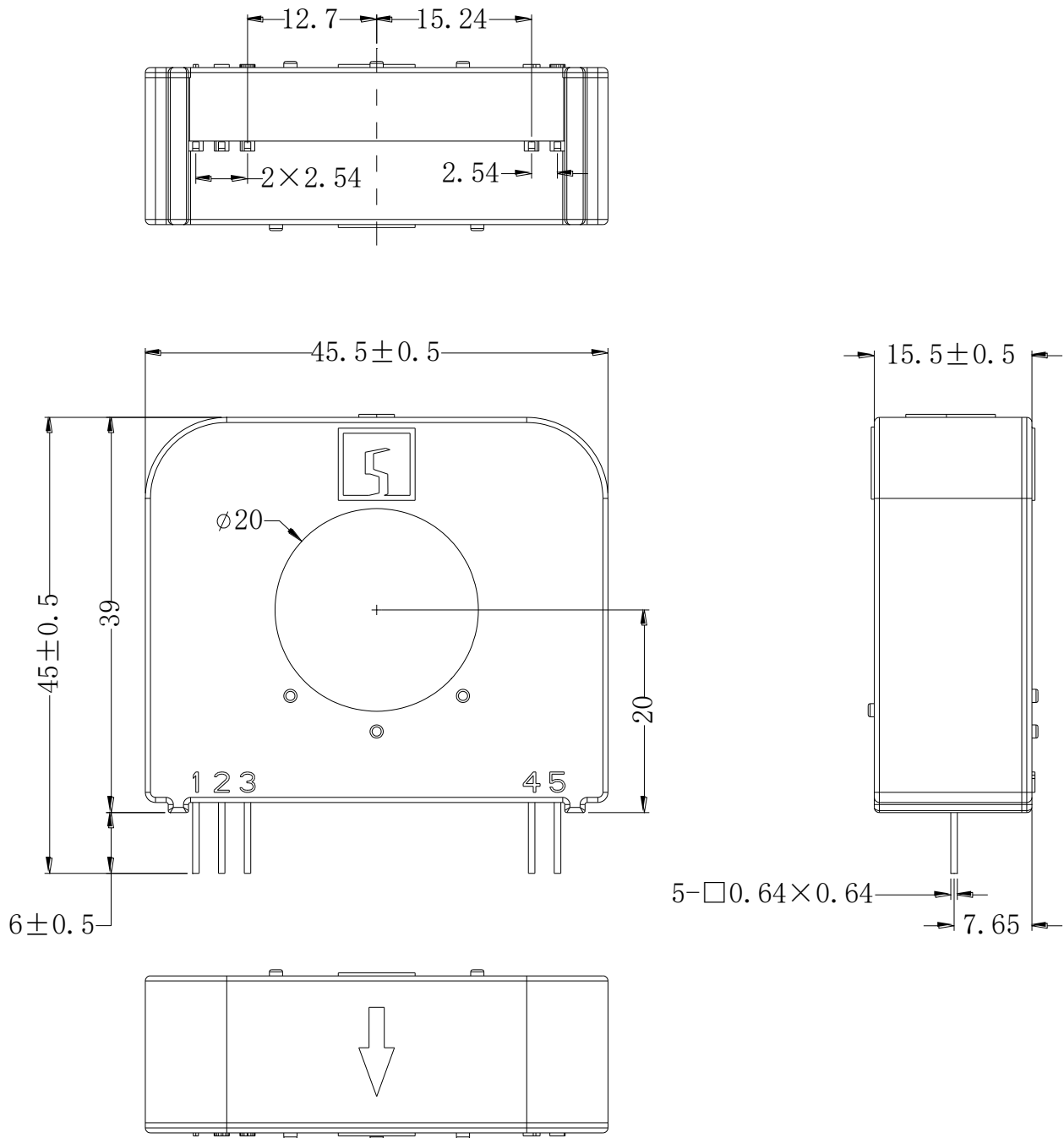
X-B15 Individual Performance Characteristics

Note: $T_J(\text{max})$ is not exceeded $T_A = -40^\circ\text{C} \sim 85^\circ\text{C}$, $C_{\text{Bypass}} = 1\mu\text{F}$, $C_{\text{Load}} = 22\text{nF}$, $V_{\text{CC}} = 5.0\text{V}$, unless otherwise specified

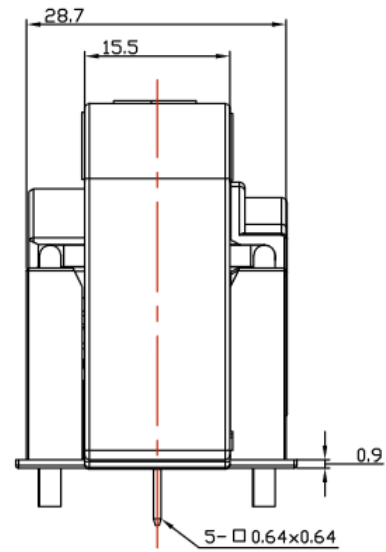
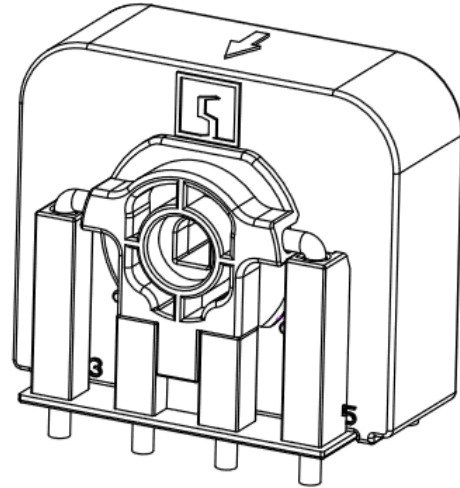
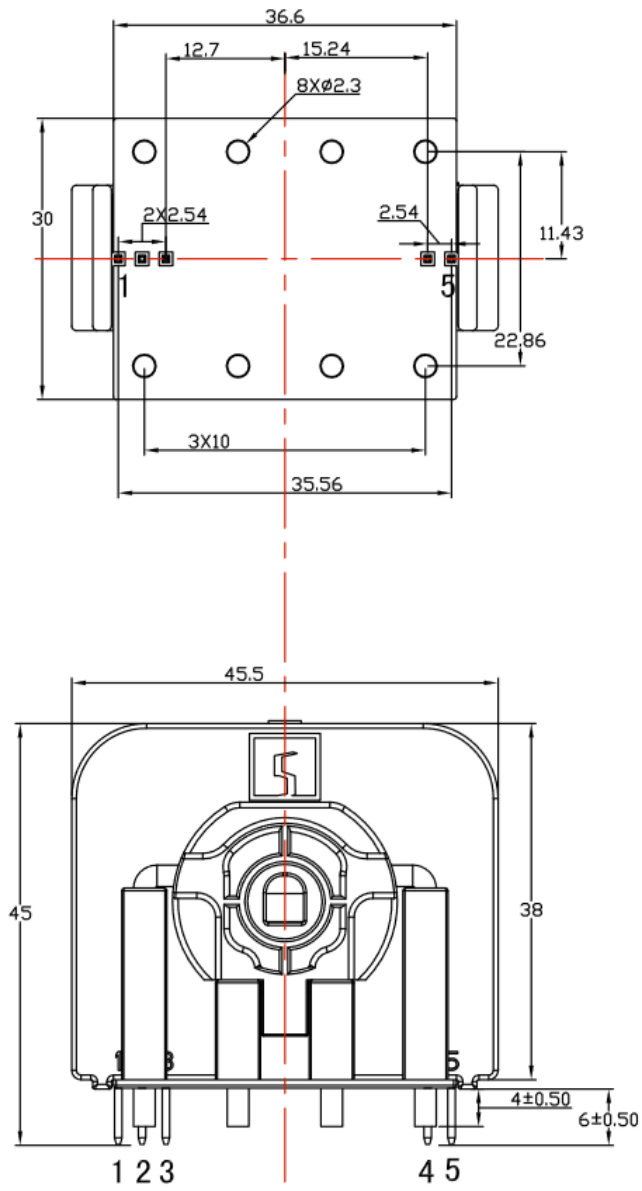
| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|--------------------------------------|----------------------------|---|-----|---------|---------|-------|
| Optimized residual measure rms Range | IP | $V_{\text{out}} @ IP = 4.5\text{V}$, $V_{\text{out}} @ -IP = 0.5\text{V}$ | | 1500 | | mA |
| Sensitivity | Sens | Over full of $T_A = 25^\circ\text{C}$ | | 1.333 | | mV/mA |
| Noise | $V_{\text{NOISE(PP)}}$ | Peak-to-peak, $T_A = 25^\circ\text{C}$, programmed Sensitivity, 0.5kHz bandwidth | | 10 | | mV |
| Zero Current Output Slope | $\Delta I_{\text{OUT(Q)}}$ | $T_A = -40 \sim 25^\circ\text{C}$ | | 0.3 | | mV/°C |
| | | $T_A = 25 \sim 85^\circ\text{C}$ | | 0.3 | | mV/°C |
| Total Output Error | E_T | $T_A = 25^\circ\text{C}$, output filtered | | ± 1 | ± 2 | % |
| Total Output Error over temp. | E_{TOT} | $T_A = -40 \sim 85^\circ\text{C}$, output filtered | | ± 2 | ± 4 | % |

Package Information

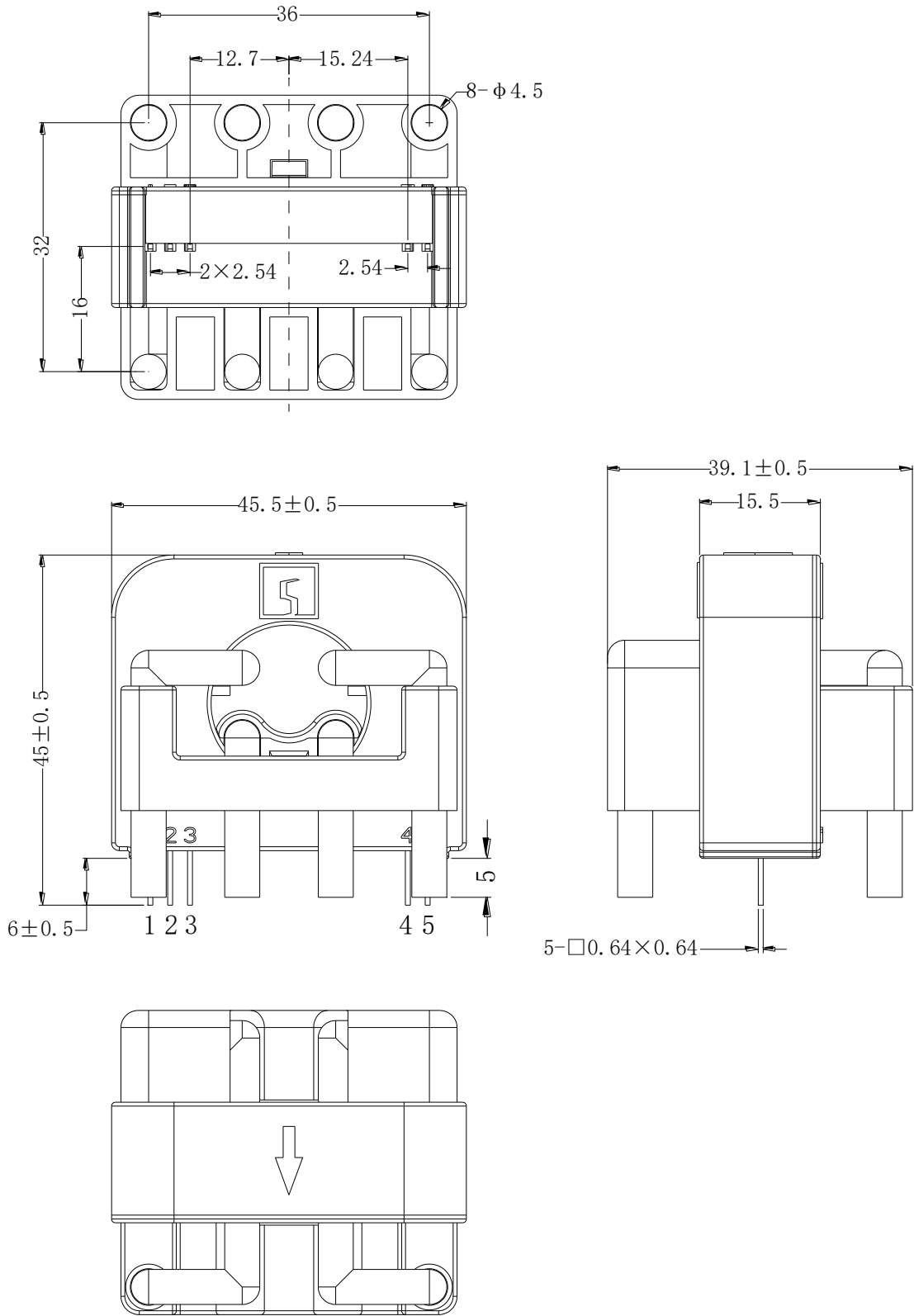
H Type (through hole)



W42 Type (4 Wires and $\phi=2.3\text{mm}$)



W44 Type (4 Wire and $\phi=4.5\text{mm}$)



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Revision Table

| Revision | Change | Page | Author | Date |
|----------|--|------|--------|---------|
| 1.0 | Initial draft | | Jon | 2016.07 |
| 1.1 | Add W type package | | Jon | 2017.08 |
| 1.2 | Add dimension of W42 type | | Hao | 2018.05 |
| 1.3 | Update diagram and package type | | Jon | 2018.05 |
| 1.4 | Change IP capability, add output voltage | | Hao | 2018.06 |
| 1.5 | Add core material description | | Hao | 2018.06 |
| 1.6 | Add packaging CAD | | Jon | 2018.06 |
| 1.7 | Update package dimension | | Kevin | 2019.02 |
| 1.8 | Add SC410-B10 | | Kevin | 2019.04 |
| 1.9 | Check and change Package information | | Jon | 2019.05 |
| 2.0 | Revise Mark description | 2 | Tom | 2019.11 |