# ADC Sampling Differential Signal Isolation Amplifier IC

SH Series 6kV Isolation Amplifier for Shunt Differential Signal Current Sensing

## Product Features

- Differential Input Voltage Range: ±50mV or ±250mV, with selectable gain options
- Low Nonlinearity and Temperature Drift: 0.05% nonlinearity, ±1.5ppm/°C (Typ.)
- Low Gain Error and Temperature Drift: ±0.2% gain error (Max.), ±50ppm/°C temperature coefficient (Max.)
- Output Signal Options: ±2.05V / ±3.3V / ±5V / ±10V
- Low Cost and Compact Design: Standard DIP-14 pin flame-retardant package for easy integration
- Built-in Isolated DC/DC Power Supply: High Common Mode Transient Immunity (CMTI) >100kV/μs
- 6000VDC Triple Isolation Protection: 6000VDC reinforced isolation between auxiliary power supply
- Single DC Power Supply Options: 3.3V / 5V / 12V / 15V / 24V DC supply
- Flexible Installation Options: Available in DIN35 rail mounting or PCB solder-mounted module versions
- Industrial Wide Temperature Range:Reliable operation from -40°C to +85°C in harsh industrial environments

## Typical Applications

- Industrial Motor Control and Drives
- Isolated Switching Power Supplies
- Uninterruptible Power Supplies (UPS)
- EV Charging Stations and Solar Inverters
- Motor Control ADC Front-End Sampling Isolation
- Energy Storage System (ESS) Control
- Server and Communication Power Supplies
- Industrial Variable Frequency Drives (VFD) and Servo Systems
- Industrial Control Equipment and New Energy Vehicle (NEV) Three-Electric Systems

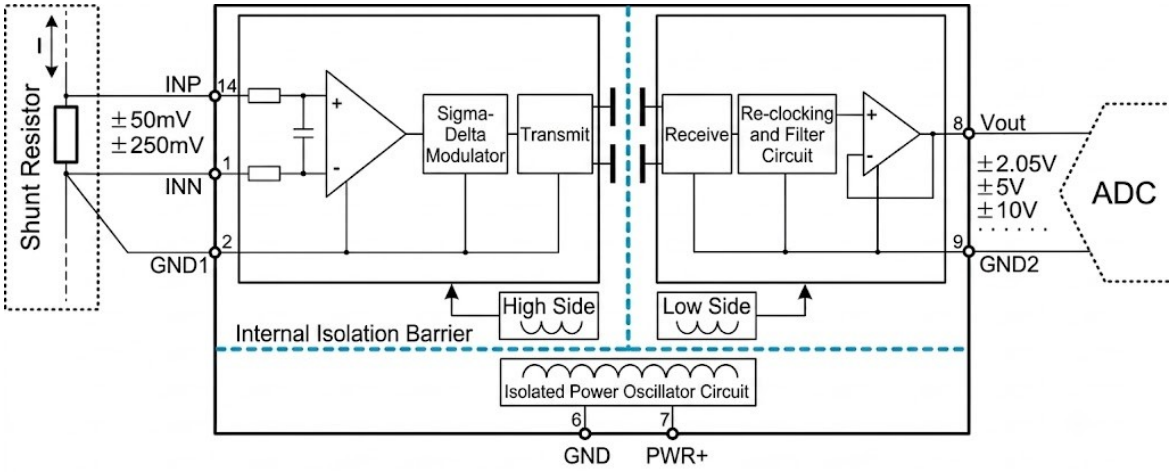
## Product Overview

**SunYuan SH** Series ADC Sampling Differential Signal Isolation Amplifier IC is an enhanced isolated amplifier with a built-in three-port isolated DC/DC power supply, specially designed for 6kV isolated shunt differential current sensing in industrial control systems.The SH Series integrates selectable gain configuration, differential analog signal input, and single-ended analog voltage output, supporting common full differential input signals such as ±50mV and ±250mV.The primary function of the SH Series ADC sampling differential signal isolation amplifier is to accurately amplify the weak millivolt-level voltage signals generated by current shunts in high-voltage or ground potential difference environments, and safely transmit the amplified signals to low-voltage data acquisition systems through electrical isolation.By providing reinforced isolation, the device effectively blocks high common-mode voltage interference, prevents damage caused by high-voltage transients, and eliminates ground loop noise, ensuring reliable and high-precision current measurement in demanding industrial applications.

The SunYuan SH Series Isolation Amplifier integrates an independent isolated power supply, high-precision differential operational amplifier, and capacitor-enhanced isolation barrier, providing a complete high-performance solution for precision DC current sensing and ADC signal isolation applications.With a single DC power supply, the SH Series can directly measure the small differential voltage generated across the shunt resistor in control systems and output a standard analog voltage signal, without requiring external isolated power supplies, additional operational amplifiers, or potentiometer-based signal conditioning circuits.The device provides complete three-port electrical isolation between the low-voltage power supply side, high-voltage sensing side, and signal output side. This advanced isolation structure effectively eliminates common-mode interference, ground loop noise, and high-voltage coupling issues in demanding applications such as industrial DC buses, power battery systems, and high-voltage variable frequency drives.The SH Series

is a cost-effective, highly reliable, and high-precision isolated DC current measurement solution, designed as an ideal alternative to conventional non-isolated operational amplifiers, external isolation modules, and Hall-effect current sensors.The integrated 6kV high-isolation DC/DC distributed power supply allows the device to operate from a single low-voltage supply, eliminating the need for an additional isolated power supply on the high-voltage sensing side. This significantly simplifies circuit design, reduces component count, and minimizes PCB space requirements.Featuring low input offset voltage, low gain drift, and excellent temperature stability, the SH Series maintains high measurement accuracy across the entire industrial temperature range. Its high Common-Mode Transient Immunity (CMTI) ensures accurate and reliable current measurement even in high-power switching environments, such as power converters and motor control systems.

The SH Series Isolation Amplifier provides flexible installation options with both PCB mounting and DIN35 rail mounting designs. The DIN rail version supports multiple channel configurations, including 1-in/1-out, 1-in/2-out, and 2-in/2-out, enabling reliable signal isolation, distribution, and amplification for industrial current monitoring systems.With excellent environmental durability against humidity, vibration, and temperature extremes (-40°C to +85°C), the SH Series delivers stable performance in demanding industrial environments.It is widely deployed in motor control, power conversion, energy storage, EV charging, renewable energy, industrial automation, communication power, and new energy vehicle systems.




**Simplified Application & Functional Block Diagram**

Maximum Ratings (Long-term operation in an environment with maximum ratings will affect the product's life span, and non-repairable damage will occur if the maximum values are exceeded.)

| | |
|---|---|
| Continuous Isolation Voltage （Maximum continuous isolation voltage for auxiliary power, signal input, and output terminals） | 6KVDC |
| PWR（Maximum Input Range for Auxiliary Power Supply Voltage） | ±25%/VDD |
| INP、INN（Analog Input Voltage） | -5~+5V |
| Iin（Input Current for Pins Other Than Power Supply Pins） | -10~+10mA |
| Junction Temperature （Maximum operating temperature range） | - 40℃ ~ + 85℃ |
| Lead Temperature （Maximum pin soldering temperature and duration <10S） | +300℃ |
| Output Voltage Load Min（Minimum Load When Outputting a Voltage Signal） | 1KΩ |

Recommended Working Conditions

| Parameter | Description | Min | Typical | Max | Unit |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| Power Supply Voltage | VDD | 3 | | 24 | V |
| Differential Input Voltage Range (Clamped) | VIN=±250mV=VINP-VINN | -320 | | 320 | mV |
| | VIN=±50mV=VINP-VINN | -64 | | 64 | mV |
| Differential Input Voltage Range (Linear) | VIN=±250mV=VINP-VINN | -250 | | 250 | mV |
| | VIN=±50mV=VINP-VINN | -50 | | 50 | mV |
| Maximum Common-Mode Limit Voltage | （VINP-VINN）/ 2 to GND1 | -2 | | 5 | V |
| ESD Ratings (Electrostatic Discharge) | HBM Human Body Model | -4000 | | 4000 | V |
| | CDM Device Charging Mode | -2000 | | 2000 | V |
| Operating Ambient Temperature | $T_A$ | -40 | 25 | 85 | ℃ |

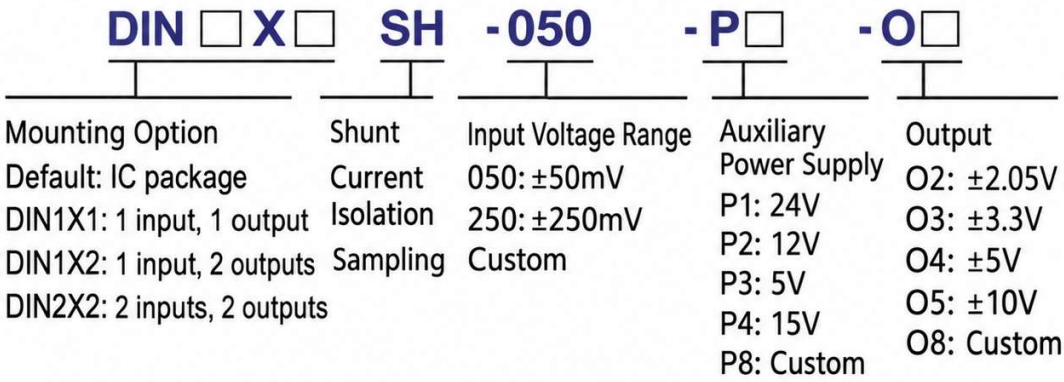
Technical Specifications

| Parameter Name | Test Conditions | Min | Typical lue | Max | Unit |
|---|---|---|---|---|---|
| $V_{IOTM}$（Maximum Transient Isolation Voltage） | $V_{TEST} = V_{IOTM}$，t=60s | | 6000 | 7071 | VDC |
| $V_{IOWM}$（Maximum Operating Isolation Voltage） | AC Voltage | | | 1500 | VRMS |
| | DC Voltage | | | 2121 | VDC |
| $R_{IO}$（Insulation Impedance） | $V_{IO}$=500V at $T_A$=25℃ | | $10^{12}$ ‖ 1 | | Ω ‖ pF |
| GAIN | VIN=±50mV | | 41 | 200 | V/V |
| | VIN=±250mV | | 8.2 | 40 | V/V |
| $E_G$（Gain Error） | Initial value，TA=25℃ | -0.2 | ±0.1 | 0.2 | % |
| $TCE_G$（Gain Error Temperature Drift） | | -30 | ±5 | 30 | ppm/℃ |
| NL（Nonlinearity） | | -0.05 | ±0.03 | 0.05 | %FSR |
| Vos（Input Offset Voltage） | Initial value，$T_A$=25℃ $V_{INP}$=$V_{INN}$=GND1 | -1 | | 1 | mV |
| CMRR（Input Common-Mode Rejection Ratio） | $F_{IN}$=0HZ | | -85 | | dB |
| | $F_{IN}$=10KHZ | | -85 | | dB |
| $I_{IB}$（Input Current） | INP = INN = GND1; IIB = (IIBP +IIBN) / 2IIBN) / 2 | -13 | -10 | -7 | uA |
| $I_{IO}$（Input Imbalance Current） | $I_{IO}$ = IIBP – IIBN; INP = INN = GND1 | | ±5 | | nA |
| SNR（Signal-to-Noise Ratio） | VIN=0.5V, fIN=1kHz, BW=10kHz | | 86 | | dB |
| | VIN=0.5V, fIN=10kHz,BW=100kHz | | 77 | | dB |
| BW（Output Bandwidth） | | | 10 | 50 | KHz |

| | | | | | | |
|---|---|---|---|---|---|---|
| CMTI （ Common-Mode Transient Immunity） | | GND1 – GND2| = 2 kV | 95 | 150 | | KV/us |
| Signal Output Ripple | | No filtering | | 5 | | mVRMS |
| Auxiliary Power Supply | Voltage | Constant-Voltage Power | 3.3 | | 24 | VDC |
| | Power Consum | | | 0.25 | | W |
| Operating Temperature | | | -40 | | 85 | ℃ |
| Storage Temperature | | | -55 | | 105 | ℃ |

**Note: Users with special requirements regarding the product's voltage and current signal load capacity should specify this when placing an order.**

## Model Selection:




**Selection Examples**

**Example 1：** Signal Input: ±50 mV; Signal Output: ±5 V; Auxiliary Power Supply: 24 VDC; Modular PCB with soldered IC packages.

Model number: SH-050-P1-O4

**Example 2：** Signal Input: ±250 mV; Signal Output: ±2.05 V; Auxiliary Power Supply: 12 VDC; IC package soldered onto a modular PCB.

Model number： SH-250-P2-O2

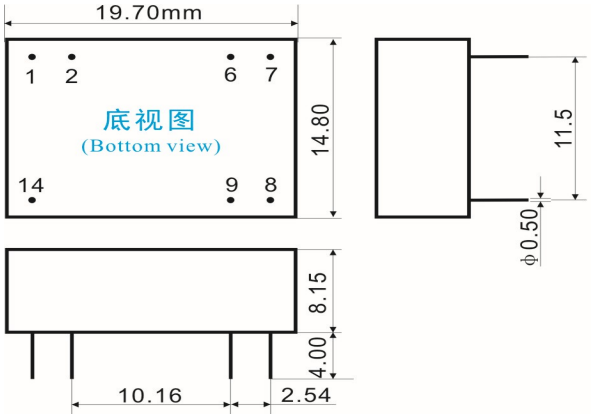
**Example 3：** Signal Input: ±250 mV; Signal Output: ±10 V; Auxiliary Power Supply: 5 VDC; One-in, one-out DIN 35 rail mounting.

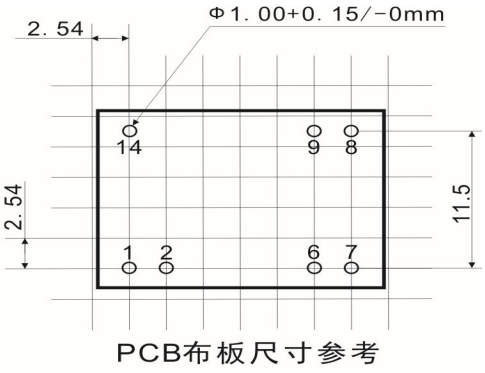
Model number： DIN 1X1 SH-250-P3-O5

**Example 4：** Signal Input: ±250 mV; Signal Output: ±3.3 V; Auxiliary Power Supply: 5 VDC; Two-input, two-output DIN 35 rail mounting.

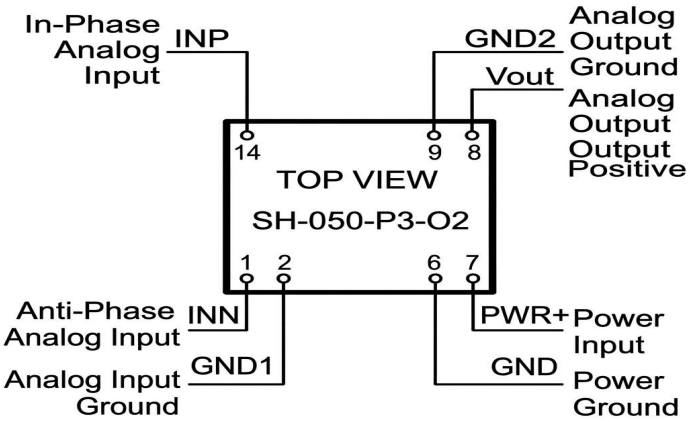
Model number： DIN 2X2 SH-250-P3-O3

## Dimensions and PCB Layout Reference (Standard DIP-14)




**Pin Function Descriptions:**





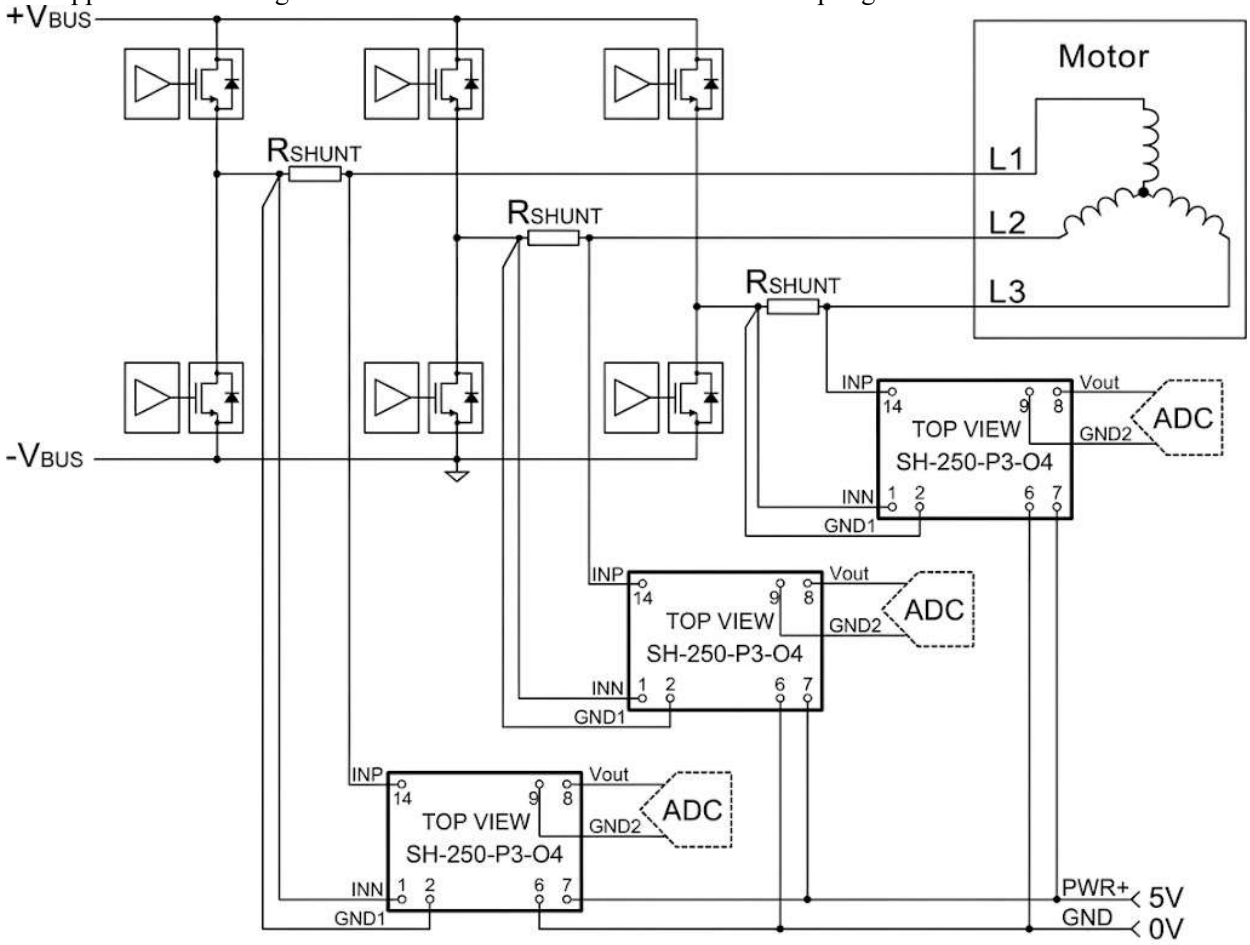


| No. | Symbol | Function | No. | Symbol | Function |
|---|---|---|---|---|---|
| **1** | INN | Inverting Analog Input | **8** | Vout | Analog output is positive |
| **2** | GND1 | Analog Input Ground | **9** | GND2 | Analog Output Ground |
| **3** | NC | Empty Feet | **10** | NC | Empty Feet |
| **4** | NC | Empty Feet | **11** | NC | Empty Feet |
| **5** | NC | Empty Feet | **12** | NC | Empty Feet |
| **6** | GND | Power Supply Input Ground | **13** | NC | Empty Feet |
| **7** | PWR+ | Power Input (Positive) | **14** | INP | In-phase analog input |

## Typical Applications

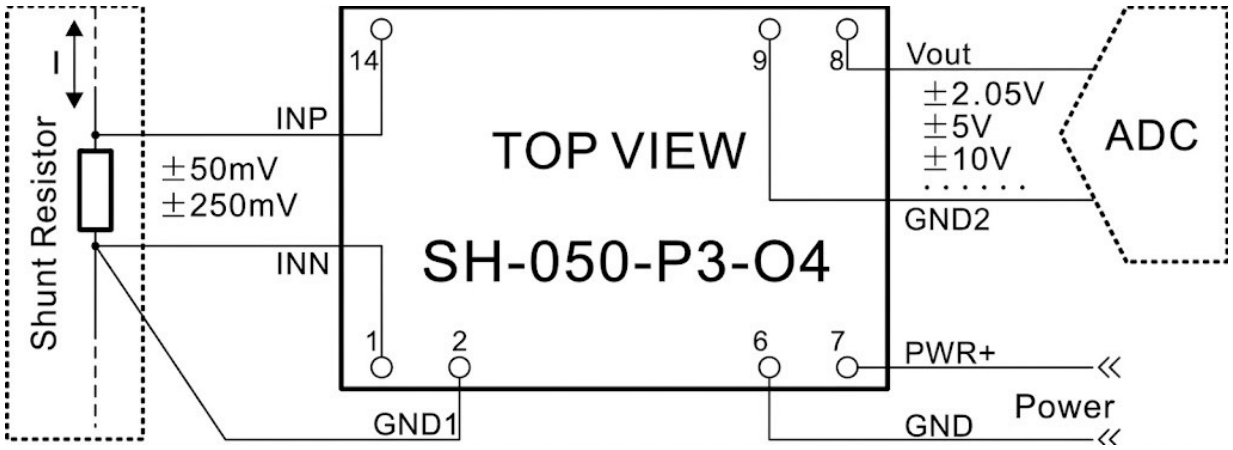
1、SH Series modules are used to amplify the voltage drop across the shunt resistor (Rshunt) and then transmit it to the low-voltage side for processing by the control circuit. The SH Series modules' differential inputs and high CMTI ensure reliable and accurate measurements in high-noise, high-power switching applications such as industrial motor drives. During switching, the voltage from Rshunt to -VBUS can vary from 0 V to the high bus voltage; therefore, isolation is

essential. The SH Series modules support electrical isolation up to 6 kV DC, making them well-suited for high-voltage industrial applications. The figure below illustrates multi-channel current sampling in an inverter.




Current Sensing Using SH-Series Shunt-Sampling Isolation Amplifiers in the Inverter Circuit

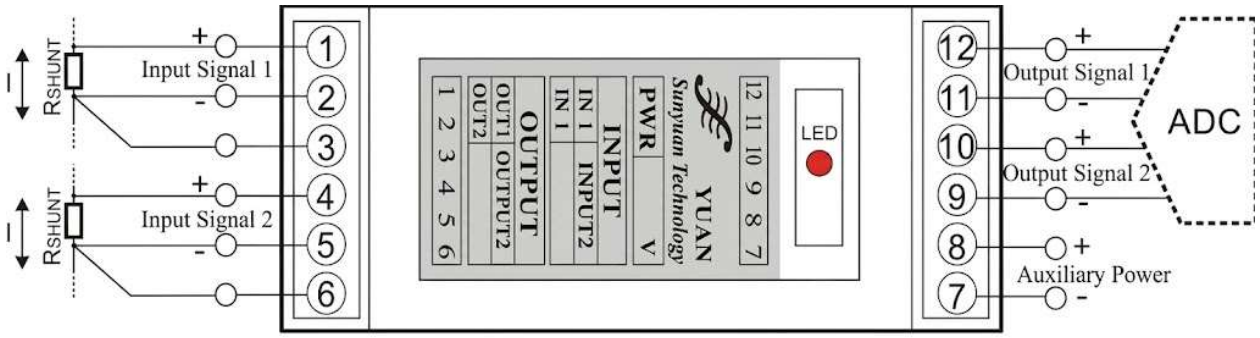
2、The figure below shows a typical application of single-channel current sensing. The high-voltage sampling terminal, low-voltage power supply terminal, and signal output terminal are completely isolated, eliminating crosstalk between high-voltage ground, power ground, and signal ground. This makes it suitable for floating busbar, floating battery pack, and high-voltage inverter applications. For the high-voltage side GND1, it can be directly shorted to INN, or connected to other points in the circuit provided that the common-mode voltage remains within the recommended range. If a four-terminal sampling resistor is used, INP and INN must be connected via a Kelvin connection to the internal pins of the sampling resistor.




**Typical Applications for DIN35 Rail-Mounted Single-Channel / Multi-Channel Current-Sampling Isolated**

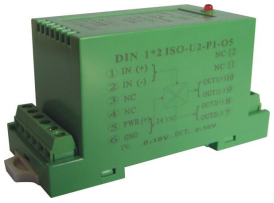
**Amplifiers**

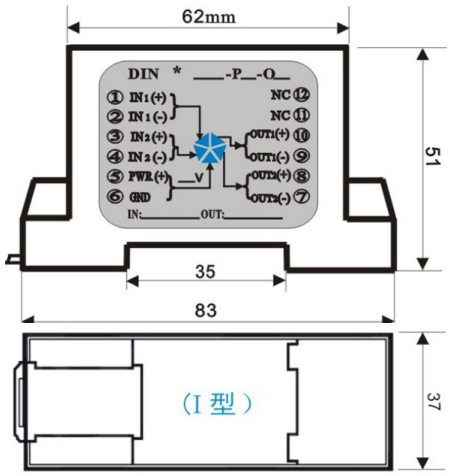
The shunt current-sampling isolation amplifiers in the SH Series of integrated isolated power supplies can also be configured for single-channel or multi-channel standard DIN 35 rail mounting. These DIN rail-mounted current-sampling isolation amplifiers incorporate one or more SH Series modules and are equipped with protection circuits—including overvoltage, overcurrent, and reverse-polarity protection—at the power input, signal input, and signal output terminals. This design facilitates direct on-site wiring by users and supports single- and multi-channel analog signal isolation amplification and monitoring functions between the shunt current sampler and the controller, including DIN 1x1 (one input, one output), DIN 1X2 (one input, two outputs), and DIN 2X2 (two inputs, two outputs) configurations, among others, for single-channel and multi-channel analog signal isolation, amplification, acquisition, and monitoring between shunt-based current sampling devices and controllers.



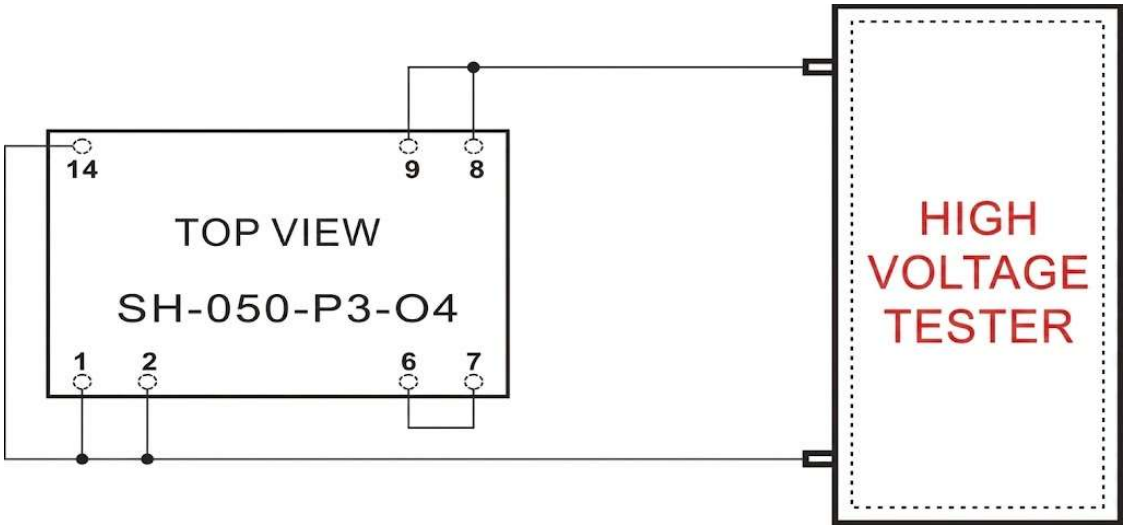

DIN 1X1 / 1X2 / 2X2 Single/Multi-channel Isolation Amplifier Pin Function and Connection Diagram

| Pin | Pin Functions | |
|---|---|---|
| **1** | Signal in1 + | Positive Terminal of Input Signal 1 |
| **2** | Signal in1 - | Negative terminal of Input Signal 1 |
| **3** | Signal in1 GND | Input Signal 1 Terminal |
| **4** | Signal in2 + | Positive terminal of Input Signal 2 |
| **5** | Signal in2 - | Negative terminal of input signal 2 |
| **6** | Signal in2 GND | Input Signal 2 Ground |
| **7** | Power GND | Auxiliary Power Negative Terminal |
| **8** | Power in | Positive Terminal of the Auxiliary Power Supply |
| **9** | Out2 - | Negative terminal of Output Signal 2 |
| **10** | Out2+ | Positive terminal of Output Signal 2 |
| **11** | Out1 - | Negative terminal of Output Signal 1 |
| **12** | Out1+ | Positive terminal of Output Signal 1 |






High-Voltage Isolation Safety Testing Methods




**High-Voltage Isolation Safety Test Procedures and Precautions**

1. Connect the wiring as shown in the figure above, and set the rated high-voltage value of the high-voltage tester according to the product's isolation voltage specifications. Pay close attention to personal safety during testing to prevent electric shock!

Test Environment: Room temperature TA = 25°C, relative humidity < 75%

2. The operator performing the high-voltage test must wear rubber insulated gloves, and a rubber insulated mat must be placed on the floor to prevent high-voltage electric shock.

3. The housing of the high-voltage tester must be reliably grounded; do not perform testing in high-temperature, humid, or dusty environments.

4. When connecting the high-voltage tester to the device under test, ensure that the high-voltage output is set to "0" and the test function key is in the "Reset" state; do not touch any other objects.

5. While the instrument is in high-voltage test mode or before high-voltage discharge has completed, it is strictly prohibited to touch the device under test, the test leads, or the high-voltage output terminals.

6. The isolation withstand voltage test method for the product is shown in the figure above: short-circuit the input and output pins separately, apply the rated voltage, and test for 1 minute.

7. Based on the product's rated isolation voltage, use the manual mode to adjust the tester's output voltage, gradually increasing it from 0 to the rated value and holding it for one minute.

8. Insulation voltage testing is inherently a destructive test for insulating materials; therefore, the number of high-voltage tests performed on a single product should be minimized. If multiple inspections and certifications are required by different customers, the general requirement is as follows: for the first test of a batch of products, test at the rated voltage specified in the datasheet; for subsequent tests, reduce the test voltage to 0.7 times the rated value and correspondingly reduce the number of high-voltage tests. Failure to do so may result in irreparable damage to the product during repeated high-voltage testing.。