

## 2-wire Passive I/V Conversion Isolation Transmitter

2-wire Passive 4-20mA to Voltage Signal Isolation Converter

### ISO 4-20MA-O Series

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### Introduction

Sunyuan ISO 4-20mA-O is a kind of low cost small size 2-wire passive 4-20mA to voltage conversion IC, it can convert active 4-20mA signal input into voltage signal output. In designing the converter, 2-wire input loop powered technique is adopted, and the external power supply is not required which simplifies customers' design plan and reduce customers' cost. Inside the conversion IC, current signal conversion circuit, power inverting circuit, subtraction circuit and buffered output circuit are integrated. Very low input equivalent impedance enables the IC to collect current signals from sensor signal output loop circuit and when the input is 30mA signal the voltage drop is  $\leq$ 9V. That 2-wire passive 4-20ma to voltage conversion IC achieves long-distance non-distorted transmission without external power supply.

**ISO 4-20mA-O** Series are mainly applied in low cost 4-20mA current to voltage signal design, no external power supply which makes it easy in wire connection, and achieves low power consumption, low heat and high performance. The main features of that conversion IC are: 2-wire loop powered without external power supply, subtraction circuit and amplification buffered output circuit are integrated into the IC, high reliability and easy to use. The converter convert 4-20mA output signal from sensor, PLC, it means that the transmission of electric power, so there is power consumption internally. In that conditions, it requires that 4-20mA source signal should be able to drive 450Ω load, thus the converter IC can operate normally. In industrial site applications, most of meters and instruments, sensors, PLC, DCS, etc have the capacity to drive 450Ω load.

In industrial site, in some conditions only one piece of IV conversion sampling resistance is enough to convert current signal into voltage signal. That kind of circuit is easy but not much reliable. First, when the signal is in zero point, there is zero current in sampling resistance, for example, convert 4-0mA into max. 5VDC, in the zero point, it is 1V after conversion, that 1V voltage can be processed by microprocessor software if available. In that case, the available voltage left 5-1=4VDC, it is not 5VDC. The max. input voltage of microprocessor (A/D) is it's power supply, usually 5VDC, so it is much more complicated in deal with such simple input conversion circuits, in order to get the A/D conversion bits, it will increase the IC costs accordingly. The simplest method in dealing with the problems above is that adding a subtraction and buffered processing circuit made by operational



amplifier in the input terminal of microprocessor, that circuit is convenient to process zero signal and save the microprocessor resource to ensure that all the resource is used in signal conversion especially in A-D conversion applications.

Sunyuan low cost small size I/V converter ISO 4-20MA-O is designed to solved the problems above in industrial site. That 4-20mA to voltage conversion IC not only realize the conversion between current and voltage signal, it also operates in low heat and passive mode to meet the application requirements in A/D interface data acquisition and signal conversion. It greatly reduce user's cost and the internal resource consumption in choosing microprocessor and provide simplest solutions to the developers.

### Max. Rated Value

(If the product operates in the max. rated vale in the long time, may affect the durability, if exceed the max. values, may cause un-repairable damage.)

| Continuous isolation voltage                                 | 3KVDC/rms     |  |  |
|--|---------------|--|--|
| Junction Temperature (Max. Range of ambient temperature)     | - 45℃ ~ + 85℃ |  |  |
| Lead Temperature (Continuous time <10S)                      | <b>+300</b> ℃ |  |  |
| Output Voltage Load Min (Min. Load of voltage signal output) | 5ΚΩ           |  |  |

### **General Parameters**

| Linearity Accuracy error grade 0.1, 0.2      | hysteresis error of instrument < 0.5% |
|--|---------------------------------------|
| Auxiliary power supplyNo                     | Isolation between input and output    |
| Operating temperature                        | Insulation resistance≥20MΩ            |
| Operating humidity10~90% (non-condensation)  | Withstand voltage3KV(60HZ / S),       |
|  | Leakage current 1mA                   |
| Storage temperature45∼ +85°C                 | Withstand impulse voltage3KV,         |
| Storage humidity 10 ~ 95% (non-condensation) | 1.2/50us (peak value)                 |

### **Technical Parameters**

| Parameters                  | Conditions    | Min. | Тур.   | Max. | Unit         |
|-----------------------------|---------------|------|--------|------|--------------|
| Isolation volt. AC, 50Hz    | 10S           | 3000 |        |      | VDC          |
| Insulation resistance       |               |      | 10¹²‖1 |      | ΩllPf        |
| Leakage current             | 240Vrms, 50Hz |      | 0.5    |      | uA           |
| Temperature drift           |               |      | ±50    | ±100 | <b>PPm/℃</b> |
| Non-linearity               |               |      | ±0.2   | ±0.5 | %FSK         |
| Load capacity               | Vout=5VDC     | 5    | 10     |      | ΚΩ           |
| Input signal voltage range  |               | 9    | 24     | 36   | VDC          |
| Input impedance             | lin=20mA      |      | 450    |      | Ω            |
| Output signal voltage range | RL:5KΩ        | 0    |        | 5    | VDC          |
| Output linearity range      |               | 0    |        | 5    | V            |
| Output current lo           |               | 0.5  |        | 1.2  | mA           |
| Output signal ripple        | No filtering  |      | 10     | 20   | mVRMS        |
| Frequency response time     | \/o=5\/       |      | 100    | 200  | KN-          |
| (Small signal bandwidth)    | V0-5V         |      | 100    | 200  | ΝΠΖ          |
| Response time               |               |      | 10     | 20   | mS           |
| Ambient temperature         |               | -25  | 25     | 70   | °C           |
| Storage temperature         |               | -55  |        | 105  | °C           |

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## **Model Selection**

| ISO |
|-----|
|-----|

<u>4-20mA</u> - <u>O</u>

| IN/OUT     | Input signal | ( |
|------------|--------------|---|
| Non-isolat | ion          |   |

Output voltage signal O2.5: 0-2.5V O4:0-5V O3.3: 0-3.3V O6: 1-5V O8:Customized

### Model Selection Examples

- E.g.1: Input signal 4-20 mA, output signal 0-5V; Model No.: ISO 4-20mA-O4
- E.g.2: Input signal 4-20 mA, output signal 1-5V; Model No.: ISO 4-20mA-O6
- E.g.3: Input signal 4-20 mA, output signal 0-2.5V; Model No.: ISO 4-20mA-O2.5
- E.g.4: Input signal 4-20 mA, output signal 0-3.3V; Model No.: ISO 4-20mA-O3.3

## **PIN Definition & Description**





## **PIN Description SIP 12PIN**

| Input + | Input - | None | Output<br>GND | Output<br>GND | Output<br>GND | Output + | None |
|---------|---------|------|---------------|---------------|---------------|----------|------|
| lin+    | lin-    | NC   | GND           | GND           | GND           | Vout+    | NC   |
| 1       | 2       | 3~7  | 8             | 9             | 10            | 11       | 12   |

## Dimension & Typical Applications



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### DIN3 ISO 4-20MA-O Series Single Channel Low Cost Small Size Standard DIN35 Rail-mounted Product Terminal Description

DIN3 ISO 4-20mA-O is a kind of 4-20ma current loop to voltage converters with super slim (12.5mm in thickness) 35mm rail-mounted base. ISO 4-20mA-O series IC is integrated into the PCB, and wiring terminals are used as auxiliary power supply and signal input/output connections. The converter is easy to use and zero&gain adjustments are not required. Due to size limitations, DIN3 series small size rail-mounted products only have 1-in 1-out conversion function.



DIN3 SY 4-20mA-O Series standard 35mm rail-mounted I/V converter pin definition

| Input - | Input+ | None | None | None | None | Output- | Output+ |
|---------|--------|------|------|------|------|---------|---------|
| lin-    | lin+   | NC   | NC   | NC   | NC   | Vout-   | Vout+   |
| 1       | 2      | 3    | 4    | 5    | 6    | 7       | 8       |

### DIN3 SY 4-20mA-O Series External Dimension & Typical applications





DIN3 系列小体积单路无源隔离器外形尺寸



4-20mA 转 0-5V 典型应用接线图1



4-20mA 转 0-5V 典型应用接线图2



# Multi-channel Standard 35mm DIN Rail-mounted DIN 1X1/1X2/2X2 ISO 4-20mA-O Series Dimension & Wring Diagram

Sunyuan I Type standard DIN35 Rail-mounted multi-channel dual-isolation IV converter has several sets of ISO 4-20mA-O series IC modules inside. The converters can be 1-input 1-output (DIN1X1), 2-input 2-output (DIN 2X2), 3-input 3-output (DIN3X3) to achieve multi-channel 2-wire 4-20ma current to voltage conversion. Zero and full adjustment is not required, internal anti-surge protection or suppression circuit is added to make sure that the products is much more reliable.



DIN 1X1/2X2/3X3(无源型) 多路隔离转换器

DIN1X1/2X2/3X3 Passive Multi-channel Isolation Converter

### DIN 1X1 / DIN 2X2 / DIN 3X3 SY 4-20mA-0 Series Dimension & Terminal Definition

| Pin | Pin Functio  | on Description    |  |  |  |  |
|-----|--------------|-------------------|--|--|--|--|
| 1   | Signal in1 + | Input signal #1+  |  |  |  |  |
| 2   | Signal in1 - | Input signal #1-  |  |  |  |  |
| 3   | Signal in2 + | Input signal #2+  |  |  |  |  |
| 4   | Signal in2 - | Input signal #2-  |  |  |  |  |
| 5   | Signal in3 + | Input signal #3+  |  |  |  |  |
| 6   | Signal in3 - | Input signal #3-  |  |  |  |  |
| 7   | Vout3 -      | Output signal #3- |  |  |  |  |
| 8   | Vout3+       | Output signal #3+ |  |  |  |  |
| 9   | Vout2 -      | Output signal #2- |  |  |  |  |
| 10  | Vout2+       | Output signal #2+ |  |  |  |  |
| 11  | Vout1 -      | Output signal #1- |  |  |  |  |
| 12  | Vout1+       | Output signal #1+ |  |  |  |  |





Note: The specification is subject to change without notice.

Two-wire passive 4-20mA to voltage signal 10KV high isolation transmitter

Two-wire passive current loop IV conversion 10KV high isolation transmitter: ISOH 4-20mA-O series

### Features

® се <sub>RoHs</sub> ISO 2008 SUNYUANSZ

•Unique high-efficiency signal loop power-taking technology, no external working power supply

•Two-wire 4-20mA standard analog input, isolation amplifier Converted to Analog voltage signal such as 0-2.5V/0-3.3V/0-5V /1-5V.

•Very low input impedance, voltage drop  $\leq 10V$  when meet inputting 20mA signal.

•Accuracy level: 0.1, 0.2, 0.5

•Extremely high linearity over the full range, nonlinearity error < 0.2%

- Between signal input and output: 10000VAC high isolation
- Industrial temperature range:  $-40 \sim +85 \text{ }^\circ\text{C}$

•Small size single row SIP 16Pin, meets the UL94V-0 flame retardant package

### Typical application

•Two-wire passive 4-20mA loop voltage sampling acquisition isolation implementation.

•Industrial field analog signal AD sampling conversion and remote transmission

- •Sensor and transmitter 4-20mA signal isolation and IV conversion
- •Signal acquisition isolation and anti-interference between PLC and DCS input channels

•Multi-channel analog acquisition ground loop isolation and interference suppression

•Reliable transmission and reception monitoring between instrumentation signals and sensors

- •Analog signal data acquisition isolation and long-line distortion-free transmission
- •Power instrumentation, medical equipment monitoring isolation barrier

•DC, high voltage monitoring and isolation safety barrier for electric power and rail transit

### Summarize

**SunYuan ISOH 4-20mA-O** is the highest isolation voltage 10KVAC in the industry fied, small size (16pin single-line SIP16 Pin) low cost, two-wire passive 4-20mA to voltage signal isolation converter module. The voltage signal value can be converted by sampling acquisition isolation in a two-wire passive 4-20mA current loop without a separate power supply. The IC adopts two-wire input loop power supply mode, unique high-efficiency signal loop power-taking technology and no external working power supply, which can greatly simplify the user's system design and reduce the user wiring cost. The internet of IC including a current signal modulation and demodulation circuit, a signal coupling isolation conversion circuit, a power supply inverter circuit, a subtraction circuit, a buffer processing output circuit, etc., and a small input equivalent resistance enables the IC to be used from instruments, PLCs, and sensors. The current signal is collected in the signal loop (the voltage drop is  $\leq 10V$  when the input 20mA signal is reached), and the collected current signal is loolated and converted into a voltage signal. It is convenient to realize the AD acquisition and conversion of the industrial field MCU microcontroller, DCS, FCS and other control systems. It meets the needs of the user's site without the need for an external auxiliary power supply or IV conversion transmitter to achieve long-distance, distortion-free transmission of signals.

**ISOH 4-20mA-O** is often used for the isolation conversion of two-wire passive 4-20mA current to voltage signals. It has low power consumption and low heat generation (basically no temperature rise)high reliability. The internet mainly including the subtraction circuit and the amplifier buffer output circuit. These circuits bring the advantages of simplicity and reliability and also bring the limitations of use. Both the product and the 4-20 mA signal output from the sensor are isolated and transmitted from the other. From another definition it is the transmission of electric power, so there must be power loss inside. This loss is expressed in the product of the input current value and its own input voltage drop. In this



### ISO Series Analog Signal Acquisition IC

case, the 4-20 mA source must have the ability to drive a 500  $\Omega$  load for the product to function properly. At present, from the practical application experience of industrial sites, most of the field instruments and sensors, PLC / DCS, etc. can meet the ability of 4-20mA signal output to drive 500 $\Omega$  load.

In industrial field applications, some circuits can convert the input current signal into a voltage signal using only one I/V conversion sampling resistor. This circuit is simple but not practical. First of all, when the actual meaning is zero signal, there will be a zero current flowing through the sampling resistor. If the input current is converted to the maximum 5V voltage according to the 4~20mA input current, the zero point happens to be 1V. This 1V is sufficient in the MCU resources. At that time, it can be subtracted by the microcontroller software, but the useful voltage will leave 5-1=4VDC instead of 5VDC. Since the maximum input voltage of the A/D of the MCU is the supply voltage of the MCU, this voltage is usually 5 VDC, so it is very trouble to deal with this simple input conversion circuit. In order to achieve the number of A/D conversions, the cost of the chip will increase. A simple way to solve the above problem is to configure a subtraction and buffer processing circuit composed of an operational amplifier before the input of the single-chip microcomputer. Increasing this level of circuit can make the processing of the zero point more convenient, without consuming the internal resources of the single-chip microcomputer, especially the single-chip microcomputer. When the A/D interface is used to accept such a zero signal and the input is not zero voltage value, the resources of the A/D conversion bit number can be fully applied to the useful signal.

**ISOH 4-20mA-O** series enables high-precision, high-linearity 10KV anti-EMC high-isolation transmission and I/V conversion between industrial field sensors and instrumentation, PLC and DCS. Products include IC PCB package and DIN35 Rail-mounted packaging, It is widely used in track voltage monitoring, generator or motor safe operation monitoring, power transmission and distribution remote monitoring, instrumentation and sensor signal transceiver, medical equipment safety barrier, industrial automation control, nuclear power equipment etc other fields.

The Maximum product rating ((long-term operation in the maximum rated environment affects the service life of the product, and irreparable damage may occur beyond the maximum value.)

| Continuous Isolation                   | Voltage (The maximum continuous isolation voltage       | between Input and output) |  |  |  |
|--|---|---------------------------|--|--|--|
| 10000Vrms                              |   |                           |  |  |  |
| Junction Temperature                   | ( Maximum working temperature range )                   | - 40 ~ +85 ℃              |  |  |  |
| Lead Temperature                       | ( Pin highest soldering temperature / duration $<10S$ ) | +300°C/<10S               |  |  |  |
| Output voltage signal minimum load 5KΩ |   |                           |  |  |  |

#### General parameters

| Accuracy, linearity error level 0.1, 0.2grade   | Backlash< 0.5%  |  |  |  |
|---|---|--|--|--|
| Auxilary power supply NO                        | Isolatoin Signal input/output, two isolation            |  |  |  |
| Working temperature $-40 \sim +85^{\circ}C$     | Insulation resistance $ \ge 20 M\Omega$                 |  |  |  |
| Working humidity10 $\sim$ 60% (No condensation) | Pressure resistance-10KV(50HZ / S), Leakage current 1mA |  |  |  |
| Storage temperature $-45 \sim +85^{\circ}C$     | Withstand voltage 10KVAC, 1.2/50us (peak)               |  |  |  |
| Storage humidity10 ~ 95% (No condensation)      |   |  |  |  |

### Technical Parameters

| F <sup>®</sup> Rohs ISO 2008<br>SUNYUANSZ   |                  |              | ISO Seri              | es Analog Signal | Acauisition I                  |
|---|------------------|--------------|-----------------------|------------------|--------------------------------|
| Parameters                                  | Condition        | Min<br>value | Typic<br>value        | Max value        | Unit                           |
| Isolation voltage AC, 50Hz                  | 60S              |              | 10000                 |                  | VAC                            |
| Insulation resistance                       |                  |              | $10^{12} \parallel 1$ |                  | $\Omega \parallel \mathrm{Pf}$ |
| Leakage current                             | 240Vrms, 50Hz    |              | 0.5                   |                  | uA                             |
| Temperature drift                           |                  |              | ±50                   | ±100             | PPm/°C                         |
| Nonlinearity                                |                  |              | ±0.2                  | ±0.5             | %FSK                           |
| load capacity                               | Vout=5VDC        | 5            | 10                    |                  | KΩ                             |
| Input signal voltage range                  |                  | 9            | 24                    | 36               | VDC                            |
| input resistance                            | Iin=20mA, Out=5V | 450          | 500                   |                  | Ω                              |
| Output signal voltage range                 | RL:5KΩ           | 0            |                       | 5                | VDC                            |
| Output linear range                         |                  | 0            |                       | 5                | V                              |
| Output current Io                           |                  | 0.5          |                       | 1.2              | mA                             |
| Output signal ripple                        | No filtering     |              | 10                    | 20               | mVRMS                          |
| Frequency response (small signal bandwidth) | Vo=5V            |              | 100                   | 200              | Hz                             |
| Response time                               |                  |              | 10                    | 20               | mS                             |
| Working temperature                         |                  | -40          |                       | 85               | °C                             |
| Storage temperature                         |                  | -55          |                       | 105              | °C                             |

Selection definition:



Eg 3: input signal: 4-20 mA; output signal: 0-2.5V; 10KVAC isolation;

**Eg 4:** input signal: 4-20 mA ; output signal: 0-3.3V; 10KVAC isolation; Pin definition and function description





Model number: ISOH 4-20mA-O2.5

Model number: ISOH 4-20mA-O3.3

| signal<br>Input<br>Positive<br>end | signal<br>Input<br>Negative<br>end | signal<br>Input<br>Negative<br>end | Empty foot | signal<br>Output<br>Ground | signal<br>Output<br>Ground | signal<br>Output<br>Positive<br>end | Empty foot |
|------------------------------------|------------------------------------|------------------------------------|------------|----------------------------|----------------------------|-------------------------------------|------------|
| Iin+                               | Iin-                               | Iin-                               | NC         | GND                        | GND                        | Vout+                               | NC         |
| 1                                  | 2                                  | 3                                  | 4~12       | 13                         | 14                         | 15                                  | 16         |

### Pin function description (single-row in-line: SIP16 Pin)

Product dimensions and typical application diagram



### High-voltage isolation safety detection method



### High-voltage isolation safety test method and precautions

Connect the wiring as shown in the figure above and set the rated high voltage of the high voltage tester according to the product isolation voltage parameter specification. Please pay attention to personal safety when testing, beware of electric shock!Test environment: room temperature TA = 25 ° C, air humidity < 75%</li>
Ligh-voltage test operators must wear rubber-insulated gloves with rubber insulation pads on the ground to prevent high-voltage electric shock.

3. The instrument case of the high voltage tester must be grounded reliably and should not be detected in high temperature, humid and dusty environments.

4. When connecting the measured object, the high voltage tester must ensure that the high voltage output value is "0" and the detection function key is "reset" to prevent contact with other objects.

5. Do not touch the object to be tested, the test line or the high voltage output when the instrument is in the high voltage test state and before the end of the high voltage discharge.

- 6、The product isolation withstand voltage test method is as shown in the above figure, short-circuit the input and output pins respectively, and load the rated voltage value for 1 minute.
- 7. According to the rated isolation voltage value of the product, the output voltage value of the tester is adjusted from 0 to the rated value and kept for a minute.

8. The insulation voltage test itself is a destructive test of the insulator, and the high voltage test should be performed as little as possible for the same product. If there are multiple tests between different customers, the general requirements are as follows: the batch product is tested according to the rated voltage value of the specification for the first time, and the test voltage value should be reduced by 0.7 times of the rated value each time. The number of high-voltage tests, otherwise the product will be irreparable damage during multiple high-voltage tests.