4-20mA to HART 2-Wire Programmable Transmitter IC

Two-Wire Passive 4-20mA to HART Bus Communication Module: SY 4-20mA-HART

Product Features

- Integrated modular design, suitable for built-in installation in sensors, transmitters, and instruments.
- Two-wire loop-powered design, connected in series with the existing transmitter to add HART bus signaling.
- Configurable output for loop current and primary variables via HART signals.
- Supports communication with host systems or field communicators for remote value reading and configuration.
- Cost-effective, compact, and high precision, with room-temperature accuracy up to 0.1% FCS.
- Standard SIP 12-Pin flame-retardant package for easy soldering onto compact PCBs.
- Industrial-grade operating temperature range: -40℃ to +85℃, ensuring high reliability.

Typical Applications

- Digital and smart monitoring upgrades for traditional transmitters and instruments
- Automation and remote control retrofitting for industrial field control equipment
- Operational measurement, monitoring, and remote control for power and gas equipment
- Control point monitoring for petroleum, chemical, environmental protection, and mining systems
- HART signal transmission and output for temperature, pressure, flow, and liquid level
- Fieldbus operating data acquisition for PLC and DCS systems
- Product development for instruments, medical facilities, and industrial control equipment

Overview

The SunYuan SY 4-20mA-HART is a cost-effective, compact, two-wire programmable 4-20mA to HART bus transmitter IC. Designed with loop-powered operation, it performs A/D conversion on the 4–20mA analog signal within online instrument and transmitter loops, generating a HART signal linearly migrated according to the configured range. When requested by a HART master, this HART signal is superimposed onto the 4–20mA analog signal and transmitted to the host for data acquisition.Featuring built-in reverse-polarity and overcurrent protection circuits, this integrated module is ideal for upgrading traditional transmitters and instruments to digital, smart control devices. It is widely applied in petrochemical, environmental monitoring, mining, and other industries for smart, remote monitoring of physical variables such as temperature, pressure, flow, and liquid level.In traditional industrial fields, physical parameters (e.g., temperature, pressure, flow rate, speed) are converted into analog current signals via sensor transmitters and sent directly to PLCs/DCSs, lacking digital capability for configuration and remote calibration. Integrating this two-wire programmable transmitter IC—capable of generating HART signals superimposed on the 4-20mA current loop—enables digital control upgrades. It allows remote monitoring and calibration across various HART-enabled master devices, including transmitters, instruments, PLCs/DCSs, and host computers.

The SY 4-20mA-HART transmitter IC features a two-wire, passive loop-powered wiring configuration. It is designed to add HART signal modulation and demodulation onto the 4–20mA analog signal transmitted between sensors, transmitters, and PLCs/DCSs/HART hosts, providing a digital interface for traditional transmitters.No external DC power supply is required for operation; the module is directly embedded into instruments and equipment by connecting it in series with the 4–20mA current loop. Through a HART master or field communicator, users can set multiple parameters—such as zero point, full scale, range, and units—enabling convenient field calibration and range migration.

The current signal and the read measurement value of the SY 4-20mA-HART loop exhibit a linear corresponding relationship, with a configurable maximum range limit of 60000 and a minimum limit of -60000. For example, given an input signal of 4–20mA and a configured lower/upper range limit of 0–10000, the relationship is mapped as follows: 4mA corresponds to a reading of 0, 12mA corresponds to 5000, and 20mA corresponds to 10000. Other measurement ranges follow the same proportional logic.

Technical Parameters

1、Operating Conditions：

1） Input Signal: 4–20mA analog signal from 2-wire sensors or transmitters (minimum 3mA, maximum 40mA).

2）Power Supply: 4–20mA current loop-powered; no external power supply required.

3）Module Voltage Drop: < 8VDC

4）Temperature Range:：Rated Operating Range: -20℃ to +60℃

Limit Operating Range: -40℃ to +85℃

5）Relative Humidity: 20% to 90% RH

6）Shock & Vibration: Complies with Class II instrument requirements for environmental testing specified by the Ministry of Electronics Industry.

2、HART Communication Mode：

Supports standard HART 5 protocol and universal commands.

3、Output Range Settable Limits：±60000

4、Polarity Conversion：Values output as negative numbers below the zero point and positive numbers above the zero point; output data does not clip at the maximum range limit.

5、Accuracy：0.1% F.S. (at room temperature).

6、Temperature Drift Error：≤50PPM / ℃

7、Mechanical Dimensions & Packaging：33.1×15.5×10.5 mm；Package Type: Standard SIP 12-Pin, encapsulated in flame-retardant plastic housing with polyester resin.

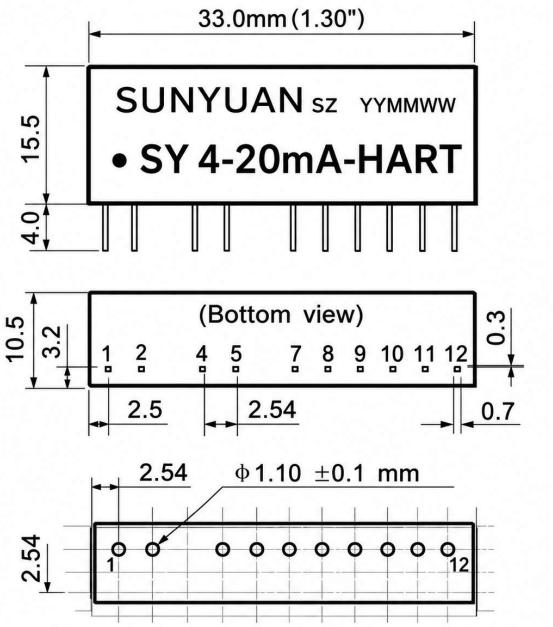
Precautions

1、 Input Current Protection: The input current signal should generally not exceed 60mA. An input current reaching 100mA will cause irreversible damage to the module. (When testing or connecting to a current loop, it is recommended to connect a resistor of 200Ω or higher in series within the loop for protection.)

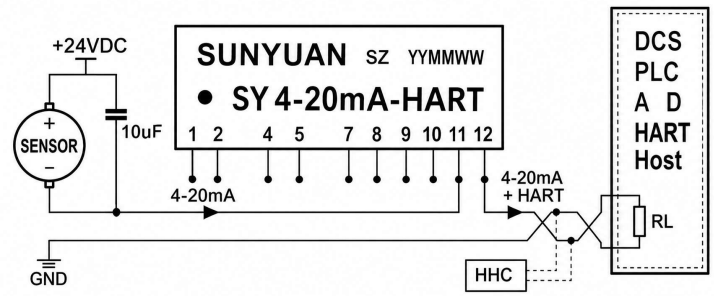
2、Environmental Conditions: Do not use in humid or corrosive gas environments. If such application is mandatory, proper sealing and anti-corrosion protection must be implemented; otherwise, the service life will be reduced or the module may be completely damaged.

Dimensions and Pin Descriptions





IC Package SIP12-Pin PCB Layout Reference



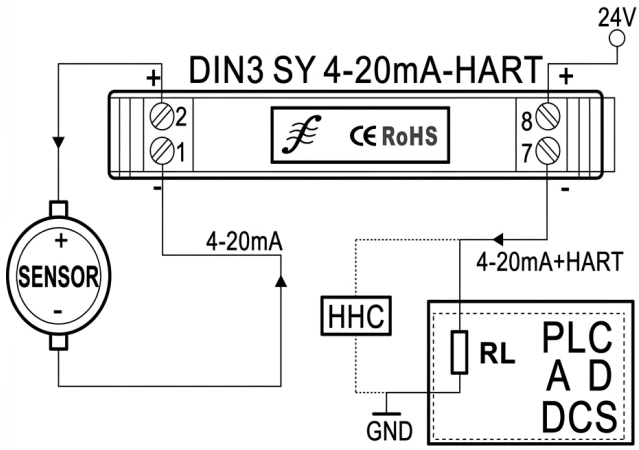
SY 4-20mA-HART Isolated Transmitter
Typical Application Diagram

Pin Configuration & Descriptions (SIP 12-Pin)

MP	NC	MP	NC	MP	Current output negative	Current input positive
NC		**NC**		**NC**	**IO+**	**V+**
1-2	**3**	**4-5**	**6**	**7-10**	**11**	**12**

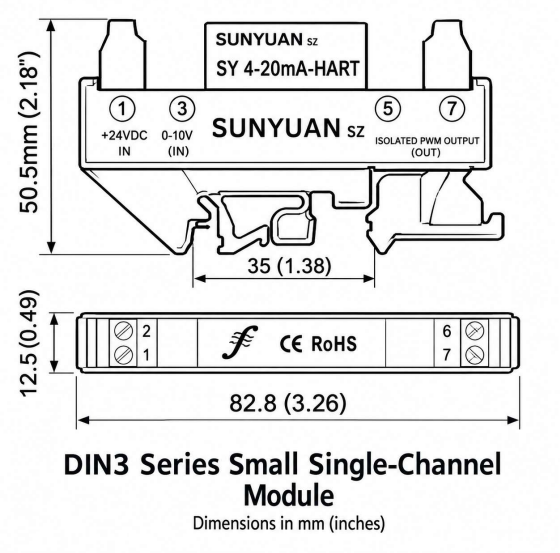
Typical Wiring Diagram for DIN3 Small-Footprint Rail-Mount Two-Wire Programmable 4-20mA to HART Bus Communication Module

This two-wire programmable 4-20mA to HART bus communication module can also be configured for single-channel standard DIN 3 rail-mounting, facilitating direct on-site wiring for users. Due to its compact footprint and cost-effective design, this product does not include built-in protection circuits (such as overvoltage, overcurrent, or reverse polarity protection) at the signal input and communication output terminals. Users should install external protective devices based on specific site environmental conditions.



DIN3 SY 4-20mA-HART TYPICAL APPLICATION WIRING DIAGRAM

Physical Dimensions for DIN3 Rail-Mount Package



DIN3 Series Small Single-Channel Module

Dimensions in mm (inches)



Pin Function Descriptions for DIN3 Rail-Mount Product

Sensor Negative	Sensor Positive	NC	Current output negative	Current input positive
SI-	**SI+**	**NC**	**IO-**	**V+**
1	**2**	**3-6**	**7**	**8**

Model Selection Example

SY 4-20mA-HART- A4

Input Current Signal Value
A4：4—20mA
A8：User-defined

Selection Example 1： Signal Input：4-20mA；
Model Number： SY 4-20mA-HART-A4

Selection Example2： Signal Input：4-24mA。
Model Number： SY 4-20mA-HART-A8

Ordering and Model Selection Guidelines

Please read this manual carefully in its entirety before placing an order to ensure that this product is suitable for your specific application and to select the correct model.
When placing an order, it is recommended that you specify your parameter requirements in advance so that the product can be calibrated before shipment, allowing you to use it immediately upon receipt.

Instructions for Use

1.Installation
The module-format product features a SIP 12-Pin (Single In-line Package 12-Pin) enclosure. Please refer to the Physical Dimensions and Pin Function Descriptions section for PCB layout design and installation. The DIN3 rail-mount product installs directly onto a standard 35mm DIN rail (DIN35) for field operation.

2. External Wiring Connections (Please refer to Physical Dimensions and Pin Descriptions)
The programmable 4-20mA to HART bus communication module operates in a two-wire loop-powered configuration and requires two external connection wires: the two analog signal (current loop) input pins, which are connected in series into the original transmitter's current loop. The rail-mounted package includes two additional terminals for connecting to the original transmitter, for a total of 4 terminals. **Please ensure correct power supply polarity; reverse connection may damage the circuit.**

3.Configuration Method: Configuration is performed via a HART host (master) or a HART communicator (handheld terminal). Please refer to the HART communicator user manual for detailed operating instructions.

HART Communication Mode

An Introduction to the HART Protocol
HART (Highway Addressable Remote Transducer) is an industrial standard communication protocol

used between control systems and field-smart transmitters. Developed by Rosemount Inc. in 1986, it was revised and expanded in the following years before being released globally as an open standard by the HART Communication Foundation.

Compared with other fieldbus protocols that support digital signal transmission exclusively, the defining feature of HART-compliant smart transmitters is that they retain the standard 4–20mA analog control signal while simultaneously transmitting digital communication signals. This allows them to directly replace legacy analog instruments, making them the ideal choice for retrofitting existing analog equipment. Compared to purely analog instruments, HART smart instruments provide easier commissioning, lower maintenance effort, and higher accuracy without significantly increasing costs, giving them strong market competitiveness during the current transition era. Worldwide, over 70% of newly installed field transmitters comply with the HART protocol standard. Although adoption began later domestically and HART smart transmitters currently account for a lower market share, their deployment has grown rapidly in recent years due to extensive industry promotion.

The physical layer of the HART communication protocol overlays a Frequency Shift Keying (FSK) signal based on the Bell 202 standard onto the 4–20mA analog signal. It uses two distinct frequencies, 1200 Hz and 2200 Hz, to represent binary 1 and 0, respectively, with a fixed communication baud rate of 1200 bps. Because the average value of the dual-frequency sine wave overlaid on the DC current is zero, it does not interfere with the 4–20mA analog signal.
The HART data link layer defines the frame structure, communication modes, and user interface primitives of communication data. The HART communication protocol operates on a master-slave architecture, meaning field devices respond only when queried by a master device. The HART protocol allows up to two master devices on a single communication link: the primary master is typically a computer or control room system (e.g., DCS/PLC), while the secondary master is typically a handheld communicator.

The SY 4-20mA-HART supports standard HART Universal Commands:

Read Primary Variable (PV)
Read Primary Variable Current and Percent of Range
Read Dynamic Variables and Primary Variable Current
Read Device Identification
Read Message
Read Tag, Descriptor, and Date
Read Primary Variable Sensor Information
Read Primary Variable Output Information
Read Final Assembly Number
Write Message
Write Tag, Descriptor, and Date
Write Final Assembly Number
Write Primary Variable Damping Value
Write Primary Variable Range Values
Set Primary Variable Upper Range Value (URV)
Set Primary Variable Lower Range Value (LRV)

Write Primary Variable Units

For detailed configuration operations, please refer to the Rosemount 475 Field Communicator or HART Host Controller User Manual.