

Two-wire loop power supply signal conditioning module  
HART signal transmission available



## FEATURES

- Loop power collection
- High linearity of 0.1% Full Scale
- High isolation test voltage of 2kVAC (60s, 1mA)
- Compact SIP9 size measures 26 x 9.5 x 12.5mm
- Extremely low temperature coefficient of typical 50PPM/°C
- Operating ambient temperature range -40°C to +85°C
- HART Signal Transmission is available
- ESD protection to ±4kV (no external components)

*TW147HL is a specific signal conditioning module for smart field instruments with HART (Highway Addressable Remote Transducer). The module powers the front-end equipment through the back-stage current loop collection mode and transmitting the PWM input signal to an industry standard isolated 4-20mA output current. The module also offers an isolated micro-power which can be used for the peripheral devices. In addition, the module can realize the half duplex communication of the field and control area by means of an integrated HART signal channel, which greatly reduces the cost for wiring between the field and the control area also shown in detail in Design Reference. This accurate PWM input signal to 4-20mA current conversion can be used in a variety of analog instrument input ports such as PLC and DCS systems, or similar. In addition, this module has extremely small SIP9 form factor with excellent temperature drift characteristics of less than 50PPM/ °C across the entire -40 °C to +85 °C operating temperature range. This module adopts unique electromagnetic isolation mode that allows it to withstand 2kVAC isolation test voltage between input and output.*

## Selection Guide

Certification	Part No.	Power Supply Input Typ. (VDC)	Input Signal(Duty Cycle)	Linearity Output Range(mA)*	Isolated Power Output (VDC)
EN	TW147HL	10-24	0-100%	4-20	3.3

Notes: \* Refer to product characteristics curve for correlation between input and output

## Input Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Power Input	Input Voltage		10	--	24	VDC
Signal Input	Frequency	Operating temperature range of -40°C to +85°C, VIH-VIL=3.3V	100	--	1000	Hz
	Duty Cycle	Operating temperature range of -40°C to +85°C, VIH-VIL=3.3V	0	--	100%	--
	Edge Time	500Hz; Ta=25°C ;	--	--	100	nS
	PWM Amplitude	VIH-VIL	3	--	5	V
	Input Amplitude Over Range	Ta=25°C	--	--	7	V

## Output Specifications

Item	Operating Conditions		Min.	Typ.	Max.	Unit
Isolated Power Output	Output Voltage	Output current of isolated power supply full loads	Nominal -3%	Nominal value	Nominal +3%	V
	Output Current	Operating temperature range of -40°C to +85°C	--	--	4	mA
	Short Circuit Protection	Ta=25°C	Continuous short-circuit protection (resumes to normal operation after short is removed)			
Single Output	Output Signal		Reference selection guide (minimum signal range is 3.7-4mA)			
	Load Capacity	Output signal@22mA	RL≤(Vin-Vin(min))/0.022 & RL<550, Vin refers to actual power supply voltage; Vin (min) refers to the minimum supply voltage			
	Load Regulation	24V power supply, 0-250 Ω load	±0.05% Full Scale/100 Ω			--
	Ripple & Noise	20MHz bandwidth (Max.), 250 Ω /0.01 μF load, Ta=25°C	--	30	--	mVp-p

### Transmission Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
linearity	Ta=25°C	-0.1%FS	--	+0.1%FS	—
Temperature Coefficient	Operating temperature range of -40°C to +85°C	--	50	100	PPM/°C
Response Time	Ta=25°C	--	--	1	s
Communication	Operating temperature range of -40°C to +85°C	Supports HART communication with recommended circuit (See Design Reference)			

### General Specifications

Item	Operating Conditions	Min.	Typ.	Max.	Unit
Electric Isolation	Two- port isolation (signal input to signal output)				
Isolation Test	Electric strength test for 1 minute with a leakage current <1mA, humidity <70%	2	--	--	kVAC
Insulation Resistance	At 500VDC	100	--	--	MΩ
Operating Temperature		-40	--	+85	°C
Transportation and Storage Temperature		-40	--	+85	°C
Maximum Case Temperature	Ta=25°C, 24V Power supply, 250Ω load	--	--	+50	°C
Safety Standard		EN62368-1 (Report)			
Safety Class		CLASS III			
Application Environment		The presence of dust, severe vibration, shock and corrosive gas may cause damage to the product.			

### Mechanical Specifications

Case Material	Black plastic, flame-retardant heat- resistant
Package	SIP9
Weight	6.0g(Typ.)
Cooling Method	Free air convection

### Electromagnetic Compatibility (EMC)

Immunity	ESD	IEC/EN61000-4-2	Contact ±4kV	perf. Criteria B
	RS	IEC/EN61000-4-3	3V/m	perf. Criteria A
	EFT	IEC/EN61000-4-4	Two-wire loop port ±2kV (see Fig. 5 for recommended circuit)	perf. Criteria B
	Surge	IEC/EN61000-4-5	Two-wire loop port ±1kV (see Fig. 5 for recommended circuit)	perf. Criteria B
	CS	IEC/EN61000-4-6	3 Vr.m.s	perf. Criteria A

### Product Characteristic Curve

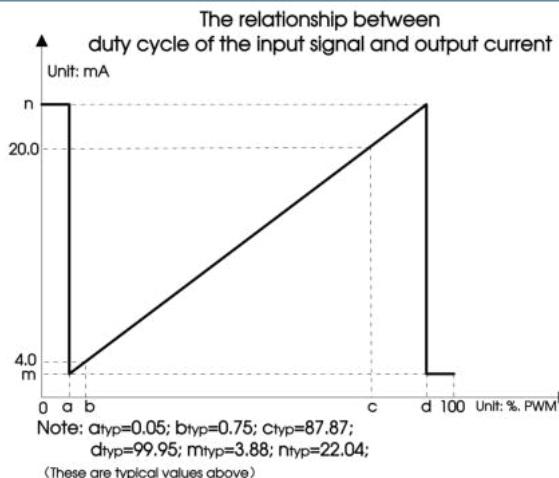


Fig.1 input signal duty cycle and output current relationship

### Application Precautions

1. Carefully read and follow the instructions before use; contact our technical support if you have any question;
2. Do not use the product in hazardous areas;
3. Use only DC power supply source for this product and 220V AC power supply is prohibited;
4. It is strictly forbidden to disassemble the product privately in order to avoid product failure or malfunction.

### AFTER-SALES SERVICE

1. Factory inspection and quality control are strictly enforced before shipping any product; please contact your local representative or our technical support if you experience any abnormal operation or possible failure of the module;
2. The products have a 3-year warranty period, from the date of shipment. The product will be repaired or exchanged free of charge within the warranty period for any quality problem that occurs under normal use.

### Applied circuit

See *Application Notes for Signal conditioning module application manual*.

### Design Reference

#### 1. Typical application

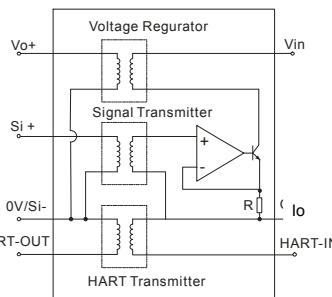


Fig. 2 Functional diagram of Signal conditioning module

#### 2. Product application wiring diagram

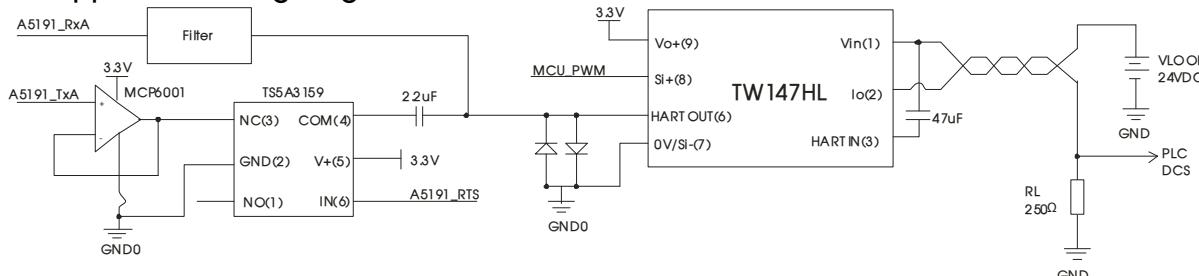


Fig. 3 Field area HART communication application

### Functional Description

Figure 3 shows a typical application of the TW147HL Signal conditioning module. MCU system, HART modem IC A5191 and the Signal conditioning module TW147HL work together to establish the communication between smart field devices and control systems.

Note: A5191 Onsemi chip is an IC with HART modulation and demodulation.

### Signal Access Description

A5191\_TxA: Connect A5191 chip TxA pin, A5191\_RxA: Connect A5191 chip RxA pin

A5191\_RTS: Connect A5191 chip RTS pin, MCU\_PWM: Connect MCU chip PWM pin

Filter: Filter for receiving (for further details please refer to Onsemi A5191 chip technical manual).

### How it Works

PWM signal isolation transmission and conversion: Si+ pin receives the PWM signal input, that is isolated within the module. Then, after reduction, filtering and Voltage to Current conversion, the resulting output is a 4-20mA current signal on the output side.

HART signal sending: When HART signal is sending, it is modulated into FSK (Frequency Shift Keying) signals. The FSK signal output is through the A5191 chip's TxA pin. Because of the weak A5191 drive capability, we use MCP6001 to follow the voltage and then we use a TS5A3159 as a low voltage analog switch. The A5191 chip's RTS pin is the control the switch which is "low" level, when sending HART signals. The analog switch NC connect with COM pin. During this time, the FSK signal is sent to the HART\_OUT pin and after being isolated, the FSK signal will be sent to two wire port to finish the HART signal sending (when continuously sending HART signals, the total circuit loss is about 0.6mA, with a static loss of about 0.1mA).

HART signal detection: The A5191 chip's RTS pin should be "high" level when detecting a HART signal. With the analog switch off now, the HART signal from the two-wire port will be coupled into HART\_IN pin through a 47uF capacitor and after being isolated, the signal is sent to HART\_OUT pin (the analog switch must turn off, otherwise HART\_OUT pin cannot receive HART signal). Then the A5191 RxA pin can receive the HART signal through the filter.

The whole system which is shown in Figure 2, provides a solution for the transmission of a sensor signal into a 4-20mA standard current output signal and a HART communication between smart field devices and control systems. The big advantage is that all the connections between field area and control area can be realized using two analog wires only, thus keeping the cost for systems as low as possible. The

output of module can match the input of common instruments by sampling resistance  $RL$ .

In case the HART communication function is not being used, HART modem IC A5191, MCP6001 and TS5A3159 can all be removed from the system, and the HART\_IN PIN and HART\_OUT PIN of TWxxxHL module are not connected and left open circuit.

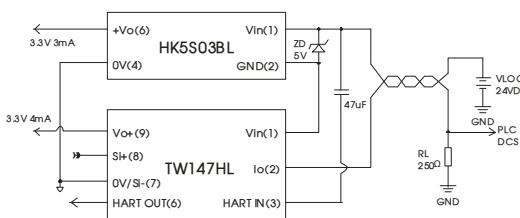
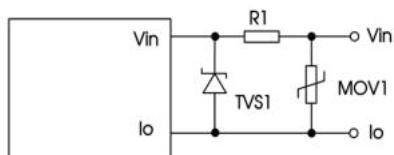


Fig. 4 Power capacity expansion program of field area

### Functional Description

Figure 4 shows another typical application of a TW147HL module for expanding power supply to field area, a power module HK5S03BL is being added into the system. The TW147HL's power supply capacity of 4mA is being extended to 7mA just by adding the HK5S03BL module.

### 3. EMC compliance, recommended circuit

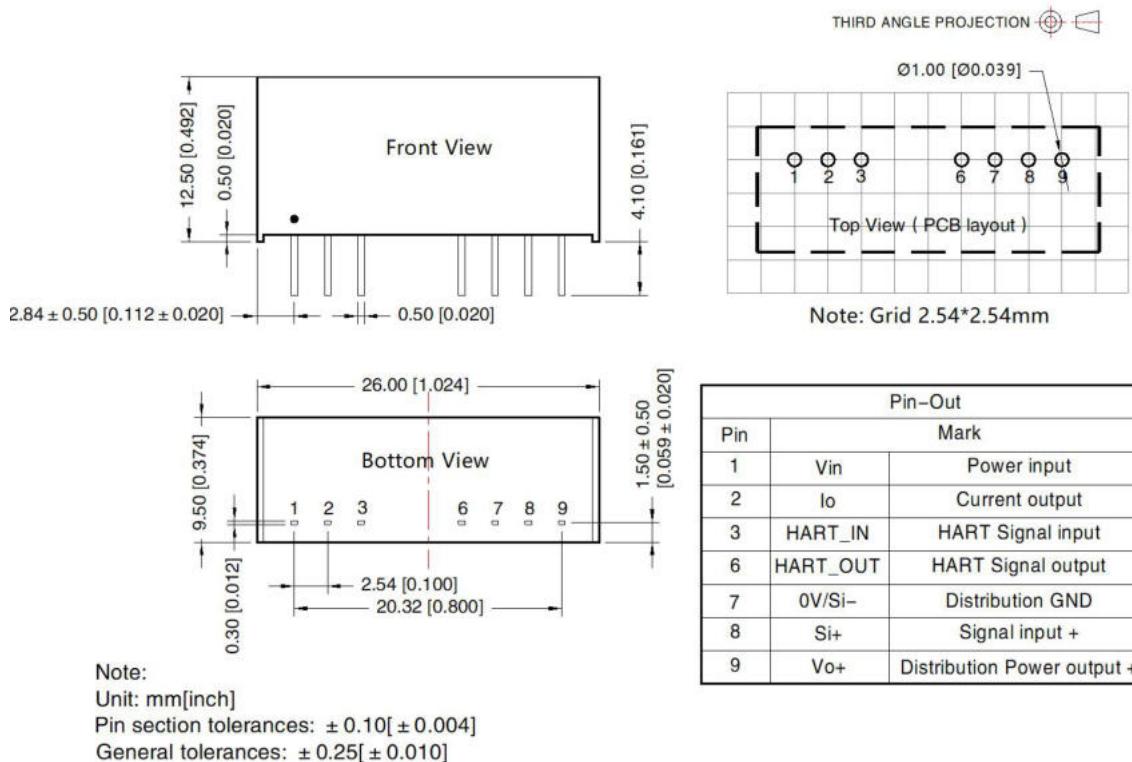


Component	Recommended part, value
MOV1	S07k30
R1	12Ω/2W
TVS1	SMCJ30A

Fig. 5

4. For additional information please refer to application notes on [www.mornsun-power.com](http://www.mornsun-power.com)

## Dimensions and Recommended Layout



Notes:

1. For additional information on Product Packaging please refer to [www.mornsun-power.com](http://www.mornsun-power.com). The Packaging bag number: 58210006;
2. Unless otherwise specified, parameters in this datasheet were measured under the conditions of  $T_a=25^{\circ}\text{C}$ , humidity<75%RH with nominal input voltage and rated output load;
3. All index testing methods in this datasheet are based on company corporate standards;
4. The above are the performance indicators of the product models listed in this datasheet. Some indicators of non-standard models will exceed the above requirements. For details, please contact our technical staff;
5. We can provide product customization service;
6. Products are related to laws and regulations: see "Features" and "EMC";
7. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units.

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