Three-phase AC/DC Hall Current Sensor CYHCS-B31S

The CYHCS-B31S three-phase Hall current sensor uses the Hall effect principle to measure three-phase AC, DC, or pulsating DC current signals in automotive low-voltage high power supply circuits in real time. It has the advantages of high accuracy, wide bandwidth, low offset drift, no insertion loss, and fast response, and can be used in automotive starter generators, inverters, HEV/EV, DC/DC converters, and other applications.

Product Features	Applications
• High Accuracy • High Linearity • Low power consumption • Window structure • Sensor output electrically isolated from measured current leads • No insertion loss • Current overload capability	• Automotive Starter Generators • Uninterruptible Power Supply (UPS) • DC/DC converters • Frequency Conversion Devices • Electric Locomotives • Inverters • Power Network Monitoring

Table 1 Absolute maximum ratings

parameter	Symbol	Unit	Value			Precautionary Note
			Min	Typ.	Max	
Supply voltage	V_{DD}	V	-0.3		+10	Exceeding the absolute maximum rating may cause permanent damage to the product, and exposure of the sensor to the absolute maximum rating for more than a certain period will affect the reliability of the sensor.
Output voltage	V_{OUT}	V	-0.3		+10	
Output current	I_{OUT}	mA	-50		±70	
Operating Temperature Range	T_A	°C	-40		+150	
Storage temperature range	T_S	°C	-55		+165	

Table 2 Normal operating parameters

Parameter	Symbol	Unit	Value			Test conditions
			Min	Typ.	Max	
Measuring range of primary current	I_{PN}	A	-900		+900	
Sensitivity	S	mV/A		2.222		
Supply voltage	V_{DD}	V	4.75	5.0	5.25	
Supply current	I_{DD}	mA		45	50	V_{DD}=5V, no output load
Output voltage (analog)	V_{OUT}	V	$(V_{DD} / 5) \times (U_O + S \times I_P)$			
Output Offset Voltage	U_O	V		2.5		V_{DD}=5V
Output Load Resistance	R_L	kΩ	4.7	10	220	
Output Load Capacitance	C_L	nF	1	10	47	
Output Resistance	R_{OUT}	Ω		1	5	V_{OUT}= V_{DD}/2, R_L=6kΩ
Accuracy	E_R	%	-1		1	T_A =25℃， V_{DD}=5V, I_{PN}
Linearity	E_L	%	-1		1	T_A =25℃， V_{DD}=5V, I_{PN}
Response Time	T_R	µs			6	V_{DD}=5V， I_{PN}=20Arms
Frequency Bandwidth	BW	kHz	40			-3dB
Phase Change	△Φ	°		-4		DC~1kHz
Out-of-phase output voltage error	TC_{Uo}	mV			±10	-40℃~+125℃
Sensitivity Output Drift	TC_S	%		±2		-40℃~+125℃
Sensor Output Drift	TC_{Vout}	%		±2.5		-40℃~+125℃

Table 2 Normal operating parameters (continue)

Parameter	Symbol	Unit	Value			Test condition
			Min	Typ.	Max	
Working Temperature	T_A	°C	-40		+125	
Storage Temperature	T_S	°C	-40		+125	
DC Output Voltage Ripple	V_{no}	mV		10		DC
Insulation Resistance	R_{ins}	MΩ	500			1000VDC,500V/s, ISO 16750-2
Isolation Withstanding Voltage	V_d	kV			3	ISO 16750-2
Sensor Weight	M	g	95	105	115	

Table 3 Environmental adaptation parameters

Test Items	Test standard	Test condition
High temperature and high humidity	JESD 22-A101	T_A=85℃, 85%RH, 1000h, V_{DD}=5.25V, I_P =0A， Monitor Sensor Output
High and low temperature storage	ISO 16750-4	T_A= -40℃/+125℃, 1000h, V_{DD}=5.25V， I_P =0A， Monitor Sensor Output
Temperature cycling	IEC 60068-2-14	T_A=-40℃~+125℃，500 cycles; V_{DD}=5.25V, I_P=0A， Monitor Sensor Output
Temperature Shock	IEC 60068-2-14	T_A=-40℃/+125℃，1000 cycles
Alternating humidity and heat	IEC 60068-2-38	T_A=65℃/25℃，80%～96%RH，10 days
Sine wave vibration	ISO 16750-3	T_A=-40℃/95℃，22h/axis，100Hz~440Hz，sweep rate ≤0.5oct/min； V_{DD}=5.25V, I_P =0A， monitor sensor output
Random vibration	ISO 16750-3	T_A=-40℃/95℃，22h/axis，100Hz~440Hz，sweep rate ≤0.5oct/min； V_{DD}=5.25V， I_P =0A，monitor sensor output
Mechanical Vibration	ISO 16750-3	T_A=-40℃/95℃, 22h/axis, 96.6m/S²rms/axis, V_{DD}=5.25V, I_P =0A，monitor sensor output
Static Immunity ESD	ISO 10605	Terminal contact discharge ±4kV and ±6kV, air discharge ±15kV, 150pF/330Ω, Requirements: Sensor function or performance is temporarily degraded or lost under conditions V_{DD} = 5V, I_P = 0, but self-recovery.
Radiated Immunity RI	ISO 11452-2	400MHz~1GHz, 100V/m, Requirements: Sensor function or performance is temporarily degraded or lost under conditions V_{DD} = 5V, I_P = 0, but self-recovery.
High current injection immunity BCI	ISO 11452-2	1MHz~400MHz, amplitude adjustment 100mA, Requirements: Sensor function or performance is temporarily degraded or lost under conditions V_{DD} = 5V, I_P = 0, but self-recovery.
Radiated Emission RE	CISPR 25 Section 6.5 Table 7	Type 5 test method, frequency set to 150kHz~2.5GHz，R＆D
Magnetic Field Immunity MFI	ISO 11452-8	16.67Hz/50μT, 50Hz/50μT, 60Hz/50μT, 150Hz/25 μT, 180Hz/25μT, Requirements: Sensor function or performance is temporarily degraded or lost under conditions V_{DD} = 5V, I_P = 0, but self-recovery.

Input Current and Output Voltage Relationship

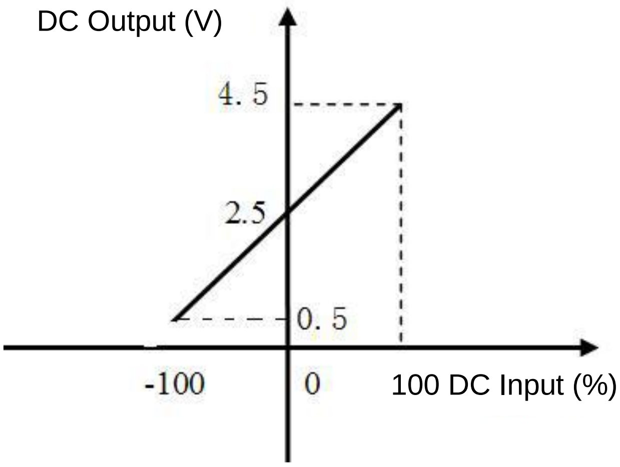


Figure 1 @V_{DD} =5V, I_{PN} = ±900A,

V_{OUT}=(V_{DD} / 5) x (U_O + S x I_P), 在 I_P=450A 时， V_{OUT}=5/5 x (2.5V +2.222 x450/1000)=3.5V

Operating Method

Connect the test circuit as shown in Fig. 2 according to the definition of the sensor terminal to test the output performance of the sensor.

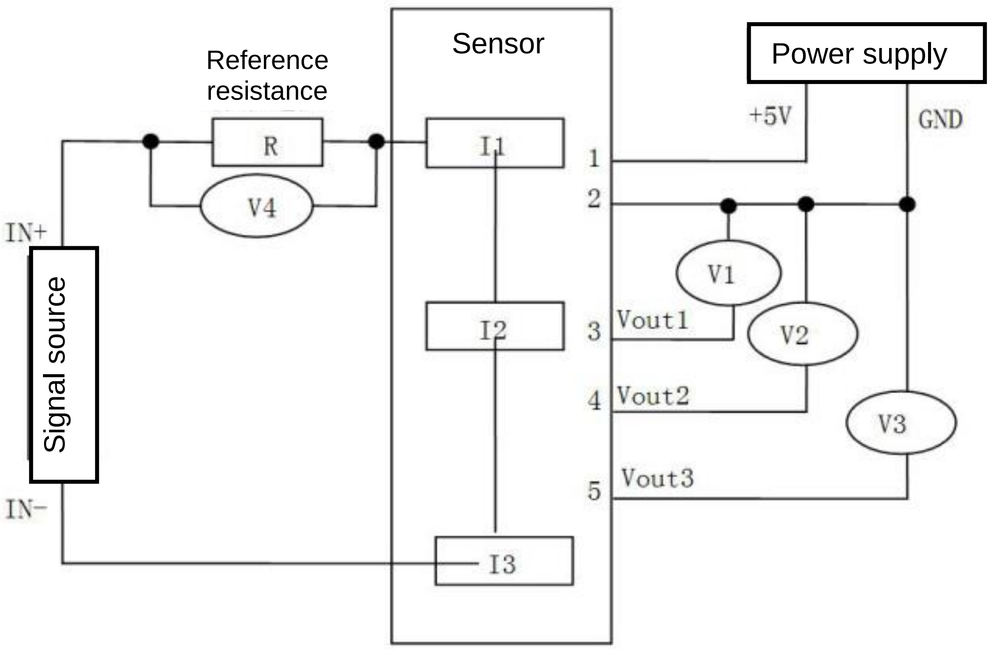


Figure 2 Sensor peripheral wiring diagram

Note：

1. The measured input current is converted to voltage by a standard resistor R and monitored with a multimeter V4. The three-phase output voltage signal is monitored with a multimeter V1/V2/V3 voltage step.
2. The sensor uses a special customized automobile eyelet terminal output.

Dimensions

Product dimensions are as shown in Figure 3, with a tolerance of ±0.3 for external dimensions and ±0.2 for positioning holes, in mm.

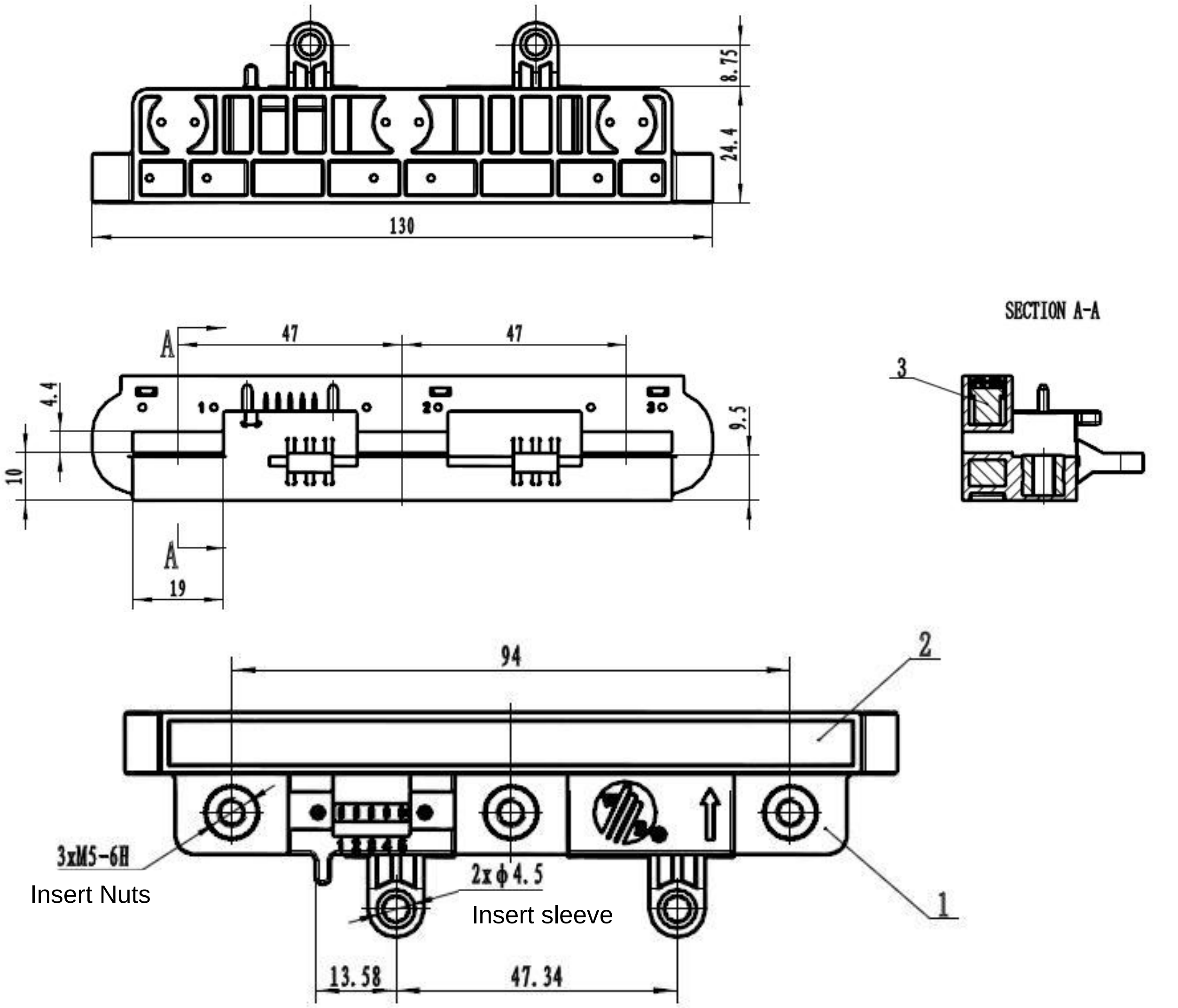
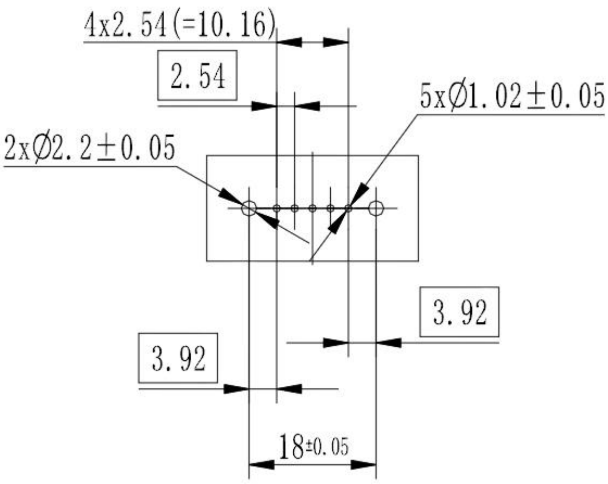


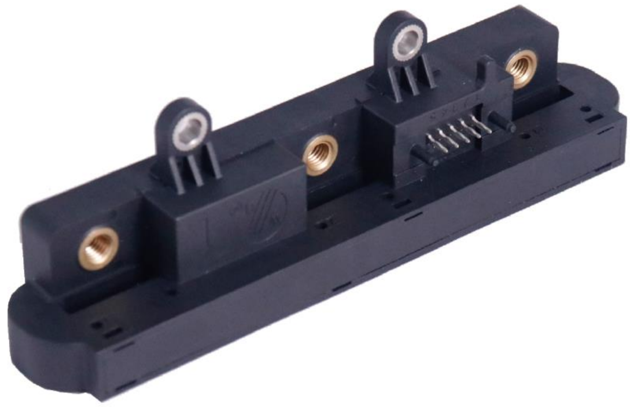
Figure 3 External Dimensions of the sensor

Note：

1. Primary Current: The primary current is installed on the driver board by inserting it through holes 1, 2, and 3 in the direction of the arrows marked on the case. Refer to Fig. 6 for installation details.
2. Terminals: A 5-position pin with a pitch of 2.54 mm is used to input the power supply and output the measured current.
3. Material: PBT-GF30 (black) for the plastic part; CuSn6/Sn (eyelet pins) for the output terminal.
4. PCBA: Maximum Insertion Force 500N, Minimum Holding Force 125N after installation.
5. Recommended aperture size for PCB connection in mm.

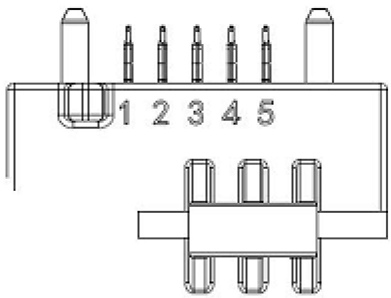
PCB Mounting Dimensions





Hole size is after plating
Cu thickness 25~50µm
Sn thickness 1~2µm
Pad dimensions refer to standard IEC60352-5.

Figure 4 PCB Mounting Hole Dimensions Reference Diagram



terminal number	terminal definition	Remarks
1	V_{DD} (+5V)	Power supply
2	GND	Ground
3	Output 1	Voltage output of phase 1
4	Output 2	Voltage output of phase 2
5	Output 3	Voltage output of phase 13

Figure 5 Terminal Definition Diagram

Installation

The terminal of the sensor of this model is connected to the driver circuit board of the device using the pin terminal of the automobile eyelet with a pitch of 2.54mm and Φ0.64mm. The current to be measured is routed through the holes of the sensor and fixed to the user device through the screw holes at the top of the sensor housing, as shown in Fig. 6 in green. The green part is the CYHCS-B31S three-phase Hall current sensor.

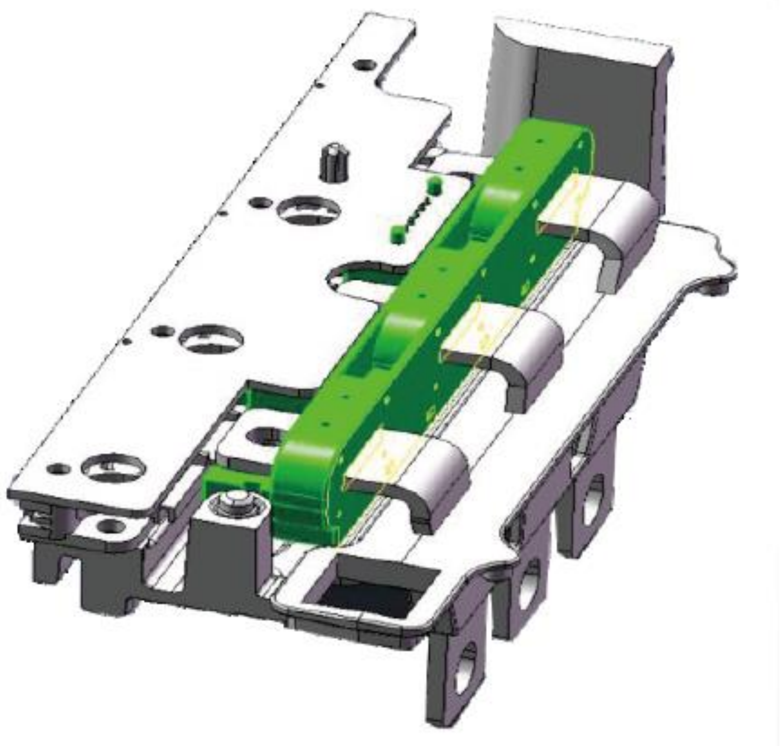


Figure 6 Schematic diagram of sensor mounting structure

Notes:

1. Be sure to connect the power supply terminals and output terminals correctly, and do not misconnect them.
2. Measuring accuracy is best when the busbar (current lead to be measured) completely fills the aperture.
3. The output is in phase when the direction of the current in the primary lead is in the same direction as the arrow marked on the sensor housing.