Fully Integrated & Hall-Effect-Based Current Sensor IC

1. Features

- Differential Hall sensing rejects common-mode fields and nearly zero magnetic hysteresis.
- 1.2 mΩ primary conductor resistance
- Industry-leading noise performance with greatly improved bandwidth through proprietary amplifier and filter design techniques
- High-bandwidth 120 kHz analog output for faster response times in control applications
- Patented integrated digital temperature compensation circuitry allows for near closed loop accuracy over temperature
- 3.75kVRMS isolation for 1 minute according to UL1577
- Small-footprint, low-profile SOP-8L package suitable for space-constrained applications

2. Applications

- Solar invertor
- DCDC
- Motor driver
- OBC of EV

3. Description

The SC4624 is a highly accurate and cost-effective current sensor IC suitable for AC/DC current sensing in a variety of industrial, automotive, commercial, and communications systems. It features a low-offset, linear Hall sensor circuit and a copper conduction path that generates a magnetic field when current flows through it. The integrated Hall IC senses this magnetic field and converts it into a proportional voltage output, which has a positive slope proportional to the current flowing through the primary copper conduction path. The device senses current differentially, rejecting common-mode fields and improving accuracy in magnetically noisy environments.

With its 1.2 mΩ internal resistance, the primary copper conduction path offers low power loss, and the small package size makes it ideal for space-constrained applications, such as motor control, load management, power supplies, and overcurrent fault protection.

Fig.1 Package Outline

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4. Terminal Configuration

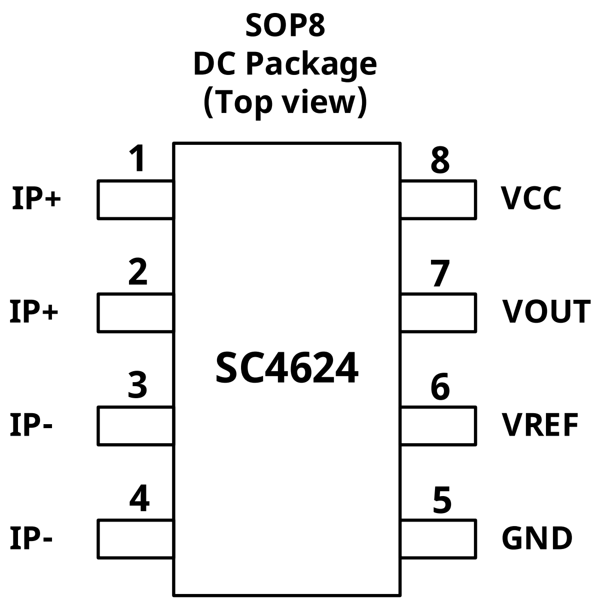


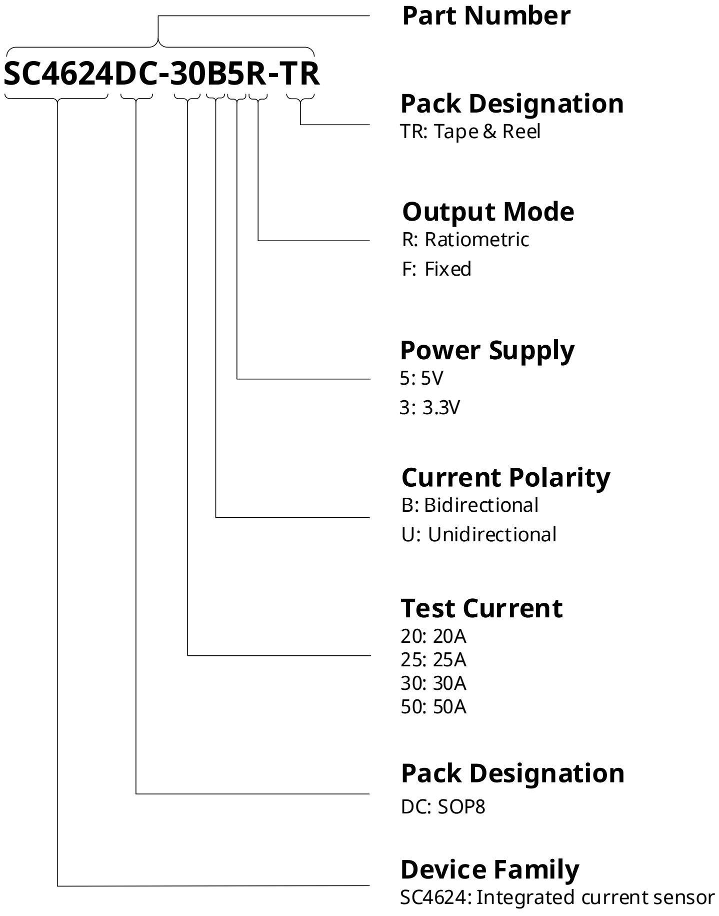
Fig. 2: Terminal Configuration

Terminal		Type	Description
Name	SOP8		
IP+	1		Input of current carrier
IP+	2		Input of current carrier
IP-	3		Output of current carrier
IP-	4		Output of current carrier
GND	5	Ground	GND pin of chip
VREF	6	Output	Reference voltage output
VOUT	7	Output	Analog output
VCC	8	Power	Supply voltage

5. Ordering Information

Ordering Information	Mark	IPR (A)	Sens (Typ) at VCC = 5 V (mV/A)	Ambient, T_A(℃)	Package	Packing	Quantity
SC4624DC-20B5F-TR	SC4624	±20	100	-40~125	SOP-8L	TR	4000/reel
SC4624DC-25B5F-TR	SC4624	±25	80	-40~125	SOP-8L	TR	4000/reel
SC4624DC-30B5F-TR	SC4624	±30	66.7	-40~125	SOP-8L	TR	4000/reel
SC4624DC-50B5F-TR	SC4624	±50	40	-40~125	SOP-8L	TR	4000/reel

Ordering Information Format



6. Absolute Maximum Ratings

over operating free-air temperature range(-40°C-125°C) (unless otherwise noted) [1]

Symbol	Parameter	Test condition	Min.	Max.	Units
V_{CC}	Supply Voltage		0	15	V
V_{RCC}	Reverse Supply Voltage		0	-0.5	V
V_{OUT}	Output Voltage		0	15	V
V_{ROUT}	Reverse Output Voltage		0	-0.5	V
T_A	Operating Ambient Temperature		-40	125	℃
$T_{J(max)}$	Junction Temperature		-	150	℃
T_{Stg}	Storage Temperature		-40	150	℃

Note:

(1) Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

7. ESD Protection

Symbol	Parameter	Test Condition	Min.	Max.	Units
V_{ESD_HBM}	HBM	Human-Body Model(HBM), ESDA-JEDEC JS-001	-4	4	kV
V_{ESD_CDM}	CDM	Charged-Device Model(CDM), ESDA-JEDEC JS-0	-750	750	V

8. Isolation Specifications

SOP-8L PACKAGE SPECIFIC PERFORMANCE

Symbol	Parameter	Comments	Rating	Units
V_{SURGE}	Dielectric Surge Strength Test Voltage	Tested ±5 pulses at 2/minute in compliance to IEC 61000-4-5 1.2μs (rise) / 50μs(width).	6000	V
V_{ISO}	Dielectric Strength Test Voltage	Agency type-tested for 60 seconds per UL standard 60950-1 (edition 2); production- tested at VISO for 1 second, in accordance with UL 60950-1 (edition 2).	3750	V_{RMS}
V_{WVBI}	Working Voltage for Basic Isolation	Maximum approved working voltage for basic (single) isolation according to UL 60950-1 (edition 2)	420	V_{PK} or V_{DC}
			297	V_{RMS}
DCL	Clearance	Minimum distance through air from IP leads to signal leads.	4.2	mm
DCR	Creepage	Minimum distance along package body from IP leads to signal leads.	4.2	mm
CTI	Comparative Tracking Index	Material Group II	400 to 599	V

9. General Electrical Specification

Valid through full operating temperature range, T_A = – 40°C to 125°C, C_{BYPASS} = 0.1 μF, and V_{CC} = 5 V, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Power						
V_{CC}	Supply Voltage		4.5	5	5.5	V
I_{CC}	Supply Current	V_{CC}=5.0V,output open	12.5	14	17.5	mA
t_{po}	Power-on Time	C_{BYPASS}=Open, C_L=1nF, Sens= 2mV/G, B=400G	-	60	-	μs
V_{UVLOH}	UVLO voltage threshold	V_{DD} rising	-	3.6	-	V
V_{UVLOL}		V_{DD} falling	-	3.2	-	V
Output stage						
C_L	Output Capacitance Load	V_{out} to GND	-	1	10	nF
R_L	Output Resistive Load	V_{out} to GND and V_{out} to V_{cc}	4.7	-	-	KΩ
R_{ref}	VREF Resistive Load	V_{ref} to GND and V_{ref} to V_{cc}	100	-	-	KΩ
t_r	Rise Time	T_A = 25°C, C_L = 1nF	-	3.6	-	μs
$t_{RESPONSE}$	Response Time	T_A = 25°C, C_L = 1nF	3	3.7	-	μs
S_R	Output Slew Rate	T_A = 25°C, C_L = 1nF	-	0.4	-	V/μs
$V_{IOUT(Q)}$	Zero Current Output Voltage	Bidirectional; I_P = 0A, T_A = 25°C	2.48	2.50	2.52	V
V_{ref_init}	Reference Output Voltage		2.48	2.50	2.52	V
$V_{SAT(H)}$	Output saturation voltage	RL(DOWN)=10K to GND	4.7	-	-	V
$V_{SAT(L)}$	$V_{SAT(L)}$	RL(UP)=10K to V_{DD}	-	-	0.3	V
Input stage						
R_{IP}	Primary Conductor Resistance	T_A =25°C	-	1.2	-	mΩ
L_{IP}	Primary Conductor Inductance	T_A =25°C	-	2	-	nH
CMFRR	Common-mode Magnetic Field Rejection Ratio	Uniform external magnetic field	-	40	-	dB
Accuracy and Frequency						
f	Frequency Bandwidth	Small signal –3 dB; C_L = 1nF	-	120	-	kHz
I_N	Noise	Input-referenced noise: C_F = 4.7nF, C_L = 1nF, B_W = 18 kHz, T_A = 25°C	-	30	-	mA(rms)
E_{LIN}	Nonlinearity	Over full range of I_P	-1	±0.2	1	%
E_{SYM}	Symmetry	Over full range of I_P	-1	±0.2	1	%

10. Performance Characteristics

Valid through full operating temperature range, T_A = – 40°C to 125°C, C_{BYPASS} = 0.1 µF, and V_{CC} = 5V, unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
SC4624DC-20B5F-TR Performance Characteristics						
I_P	Current-sensing Range		-20	-	20	A
Sens	Sensitivity	Over full range of I_P, T_A = 25°C	-	100	-	mV/A
$V_{OUT(Q)}$	Zero Current Output Voltage	Bidirectional, I_P = 0A, T_A = 25°C	2.49	2.5	2.51	V
V_{OE}	Offset Error	I_P = 0A, T_A = 25°C to 125°C	10	-	20	mV
		I_P = 0A, T_A = -40°C to 25°C	-10	-	10	mV
E_{sens}	Sensitivity Error	I_P = IPR(max), T_A = 25°C to 125°C	-2.5	-	2.5	%
		I_P = IPR(max), T_A = -40°C to 25°C	-0.5	-	4	%
E_{sens_drift}	Sensitivity Error Lifetime Drift		-5	-	5	%
SC4624DC-25B5F-TR Performance Characteristics						
I_P	Current-sensing Range		-25	-	25	A
Sens	Sensitivity	Over full range of I_P, T_A = 25°C	-	80	-	mV/A
$V_{OUT(Q)}$	Zero Current Output Voltage	Bidirectional, I_P = 0A, T_A = 25°C	2.49	2.5	2.51	V
V_{OE}	Offset Error	I_P = 0A, T_A = 25°C to 125°C	10	-	20	mV
		I_P = 0A, T_A = -40°C to 25°C	-10	-	10	mV
E_{sens}	Sensitivity Error	I_P = IPR(max), T_A = 25°C to 125°C	-2.5	-	2.5	%
		I_P = IPR(max), T_A = -40°C to 25°C	-0.5	-	4	%
E_{sens_drift}	Sensitivity Error Lifetime Drift		-5	-	5	%
SC4624DC-30B5F-TR Performance Characteristics						
I_P	Current-sensing Range		-30	-	30	A
Sens	Sensitivity	Over full range of I_P, T_A = 25°C	-	66.7	-	mV/A
$V_{OUT(Q)}$	Zero Current Output Voltage	Bidirectional, I_P = 0A, T_A = 25°C	2.49	2.5	2.51	V
V_{OE}	Offset Error	I_P = 0A, T_A = 25°C to 125°C	10	-	20	mV
		I_P = 0A, T_A = -40°C to 25°C	-10	-	10	mV
E_{sens}	Sensitivity Error	I_P = IPR(max), T_A = 25°C to 125°C	-2.5	-	2.5	%
		I_P = IPR(max), T_A = -40°C to 25°C	-0.5	-	4	%
E_{sens_drift}	Sensitivity Error Lifetime Drift		-5	-	5	%
SC4624DC-50B5F-TR Performance Characteristics						
I_P	Current-sensing Range		-50	-	50	A
Sens	Sensitivity	Over full range of I_P, T_A = 25°C	-	40	-	mV/A
$V_{OUT(Q)}$	Zero Current Output Voltage	Bidirectional, I_P = 0A, T_A = 25°C	2.49	2.5	2.51	V
V_{OE}	Offset Error	I_P = 0A, T_A = 25°C to 125°C	10	-	20	mV
		I_P = 0A, T_A = -40°C to 25°C	-10	-	10	mV
E_{sens}	Sensitivity Error	I_P = IPR(max), T_A = 25°C to 125°C	-2.5	-	2.5	%
		I_P = IPR(max), T_A = -40°C to 25°C	-0.5	-	4	%
E_{sens_drift}	Sensitivity Error Lifetime Drift		-5	-	5	%

11. Detailed Functional Description

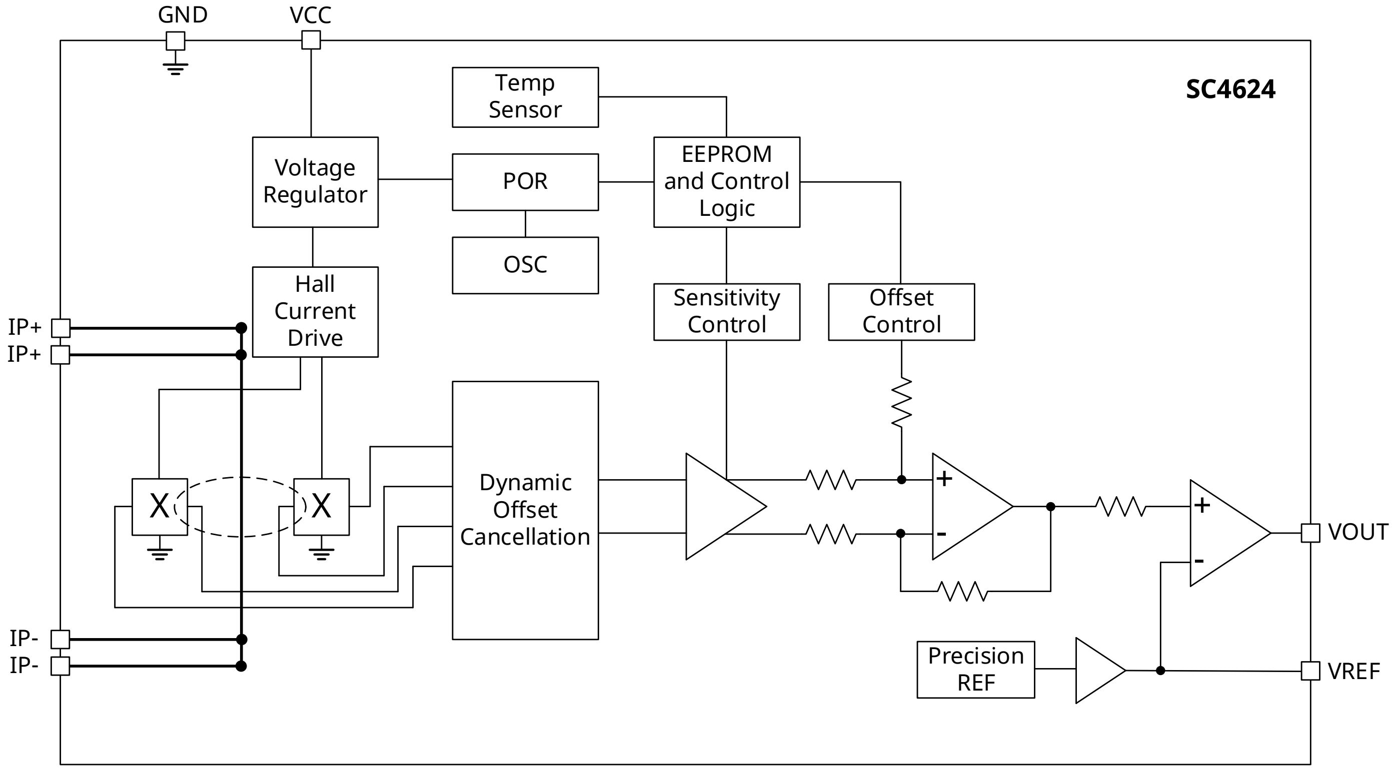


Fig. 3: Function Block Diagram

11.1 Overview

The SC4624 series current sensors are based on the Hall principle and can accurately measure AC/DC current while minimizing measurement costs. These sensors find extensive use in various current monitoring applications, including consumer, industrial, and automotive scenarios. Compared to current transformers, the SC4624 series offers a compact size, which can significantly reduce PCB size. In comparison to shunt resistor + isolated amplifier solutions, the SC4624 series only requires low-side power supply, eliminating the complexity of high-side power supply design.

The internal conductor of the SC4624 generates a magnetic field proportional to the current value, according to Maxwell's equations. The sensor converts this magnetic field value into a voltage output, ensuring a high level of accuracy. Moreover, the sensor has an ultra-small resistor value, ensuring little influence on thermal power consumption.

11.2 Quiescent Output Voltage (V_{OUTQ})

The Quiescent Output Voltage of the SC4624 indicates the output voltage of the IC when there is no magnetic field.

Although the theoretical output voltage of the SC4624 is 2.5V, factors such as offset voltage, sensitivity, packaging stress, and temperature coefficient may cause the actual Quiescent Output Voltage to deviate from the theoretical figure. During factory testing, the actual Quiescent Voltage is modified to be within ±5mV of the theoretical value. The Quiescent Output Voltage is also influenced by the temperature coefficient, which means that as the temperature changes, the Quiescent Output Voltage will also change (this effect is more noticeable when sensitivity is higher). The SC4624 is equipped with temperature sensors that can modify the temperature coefficient of the Quiescent Output Voltage.

11.3 POWER-UP Time (t_{PO})

Power-Up time is a term used to define the time required for the output voltage of a sensor to reach 90% of its target value after the supply voltage reaches 4.5V, at a specific magnetic field strength. This time difference is measured and expressed in micro seconds. The Power-Up time is an important parameter to consider when using magnetic sensors, especially in applications where a quick response is required. The accuracy of the Power-Up time measurement is crucial to ensure reliable and precise operation of the sensor in various conditions.

11.4 Response Time ($t_{RESPONSE}$)

Response time is a term used to define the time difference between the moment when the magnetic field reaches 80% of its target value and the moment when the output voltage of the IC reaches 80% of its target value. This difference is measured and expressed in micro seconds. The Response time is related to the sensitivity of the IC and the size of the output load capacitance. It is an important parameter to consider when using magnetic sensors, especially in applications where a quick response is required. The accuracy of the Response time measurement is crucial to ensure reliable and precise operation of the sensor in various conditions.

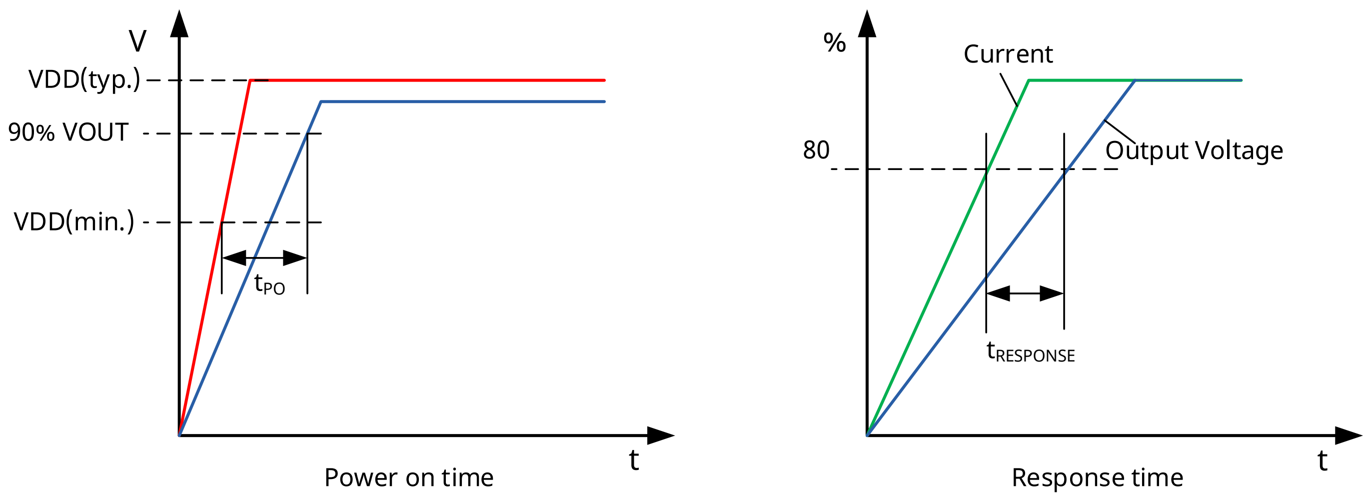


Fig.4 Response time

11.5 Transfer function

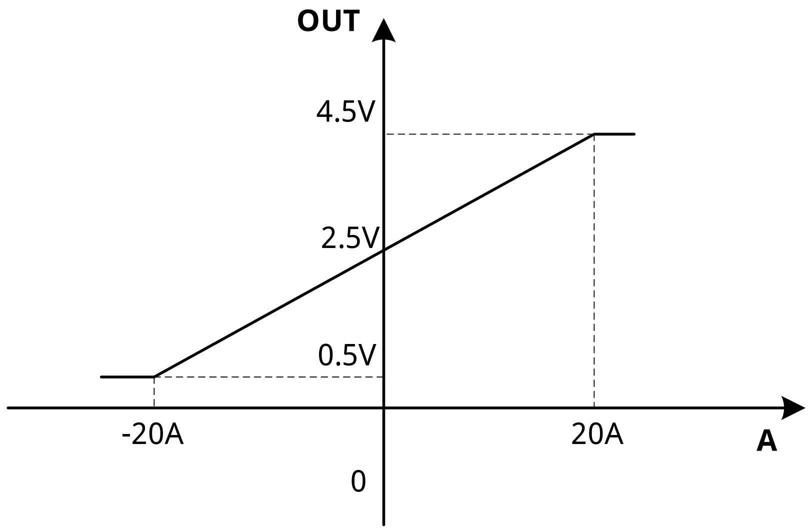


Fig.5 Transfer function

12. Typical Application Circuit

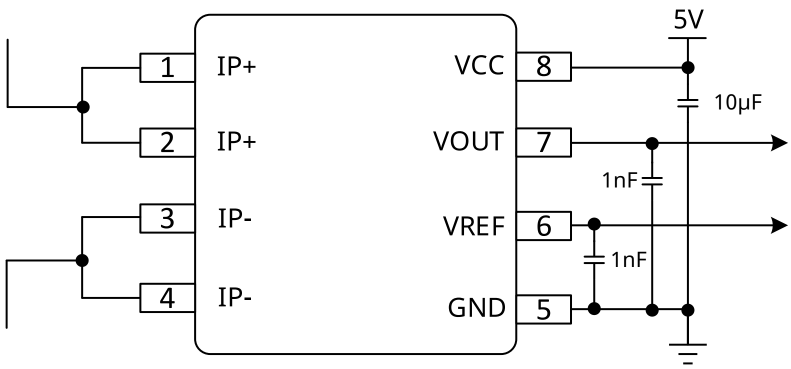


Fig.6 Single-end output application

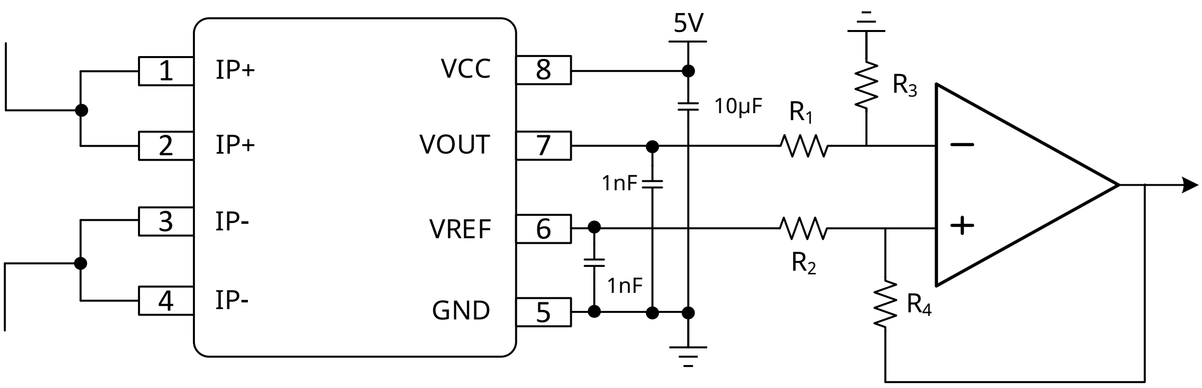
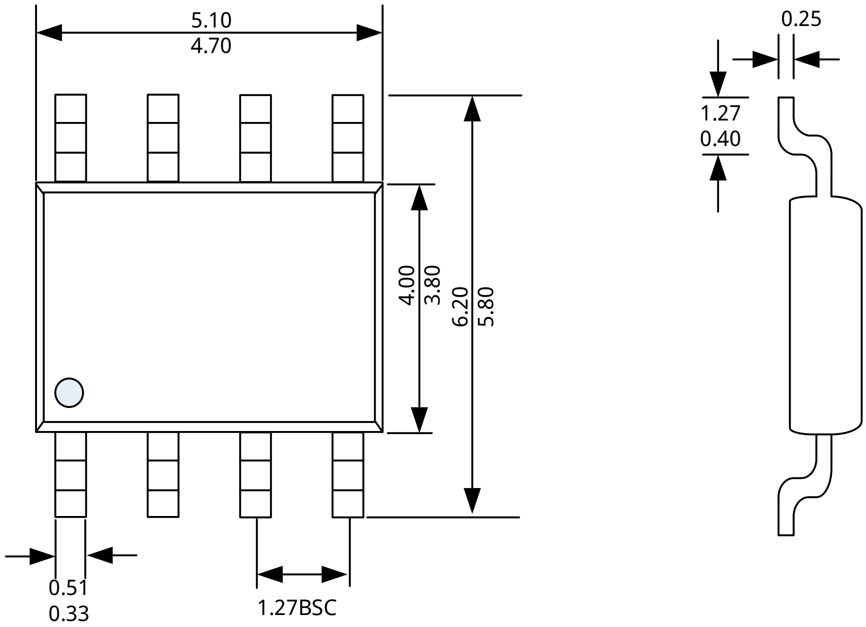


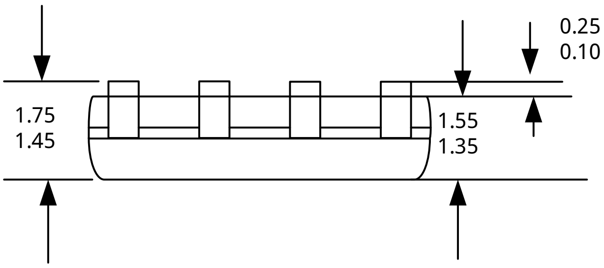
Fig.7 Differential output application

13. Package Information

8-Pin DC Package

Unit：mm





Notes:
1.Exact body and lead configuration at vendor's option within limits shown.
2.Height does not include mold gate flash.
Where no tolerance is specified, dimension is nominal.

14. Revision History

Revision	Date	Description
Rev0.1	2022-08-09	Original datasheet
Rev1.0	2023-05-10	Release 1.0 version
RevA/1.1	2025-02-20	Release Semiment common datasheet format
RevA/1.2	2025-06-30	Update the Ordering Information