SYCS108-3

High Bandwidth, High Accuracy Galvanically Isolated Hall Current Sensor IC

General Description

The SYCS108-3 is a family of high accuracy galvanically isolated Hall-effect current sensor ICs which typical bandwidth is 700 kHz. It uses non-contact differential Hall array internally for bidirectional or unidirectional currents sensing from 10A to 50A, and outputs the analog voltage proportional to the DC or AC current. Current is sensed differentially in order to reject external common-mode fields.

A precise, proportional output voltage is provided by the high accuracy, good linearity, low temperature drift Hall IC, which is programmed for accuracy at the factory.

The SYCS108-3 is available in a compact SOP8 package with low primary conductor resistance for power loss, which allows for easy implementation.

The SYCS108-3 is suitable for high frequency, insulation, small size with low heat generation applications, including automotive, industrial, and communications systems.

Features

- Hall open-loop linear differential current sensor
- 3.3V single supply
- Wide current sensing range:
  - Bidirectional: ±10 ~ ±50A
  - Unidirectional: 20 ~ 50A
- 700 kHz typical bandwidth, typical response time 1μs
- UL 62368-1 Ed3 certified
  - Dielectric Strength Test Voltage = 2400V_{RMS}
  - Working Voltage for Basic Isolation = 297V_{RMS}
- Low primary conductor resistance for power loss
- Factory-trimmed for high accuracy
- Compact SOP8 Package

Applications

- EV/HEV charger and DC-DC power supply
- Photovoltaic inverter power supply and UPS
- Motor control and frequency converter
- Communication and server power supply

Typical Application

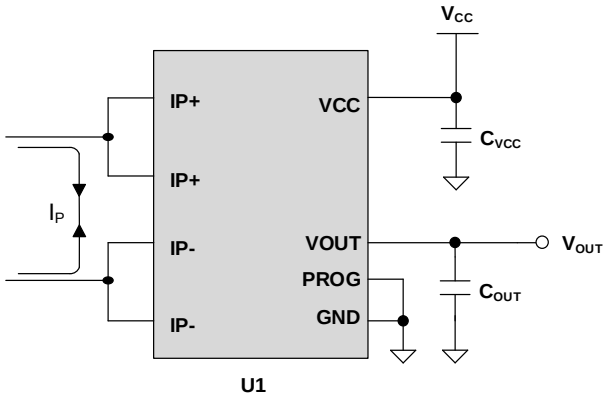
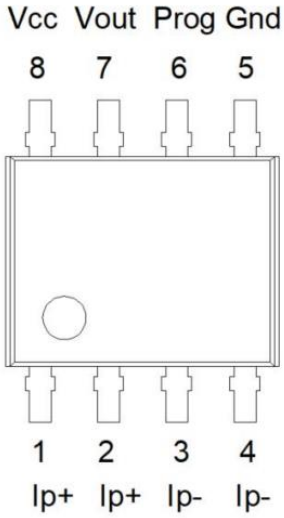


Figure 1. Typical Application Circuit

Ordering Information

Part Number	Architecture	I_P(A)	Sensitivity(mV/A)	V_{QVO}(V)	T_A(°C)
SYCS108K-010BR-3	Bidirectional	±10	132	V_{CC}/2	-40~125
SYCS108K-020BR-3	Bidirectional	±20	66	V_{CC}/2	-40~125
SYCS108K-030BR-3	Bidirectional	±30	44	V_{CC}/2	-40~125
SYCS108K-040BR-3	Bidirectional	±40	33	V_{CC}/2	-40~125
SYCS108K-050BR-3	Bidirectional	±50	26.4	V_{CC}/2	-40~125
SYCS108K-020UR-3	Unidirectional	20	132	V_{CC}/10	-40~125
SYCS108K-030UR-3	Unidirectional	30	88	V_{CC}/10	-40~125
SYCS108K-050UR-3	Unidirectional	50	52.8	V_{CC}/10	-40~125

Pinout (Top View)



(SOP8)

Pin Number	Pin Name	Pin Description
1,2,	IP+	Positive terminals for sensing current.
3,4	IP-	Negative terminals for sensing current.
5	GND	Ground.
6	PROG	Factory-trimmed pin. Connect this pin to GND.
7	VOUT	Analog output pin.
8	VCC	Power supply pin.

Block Diagram

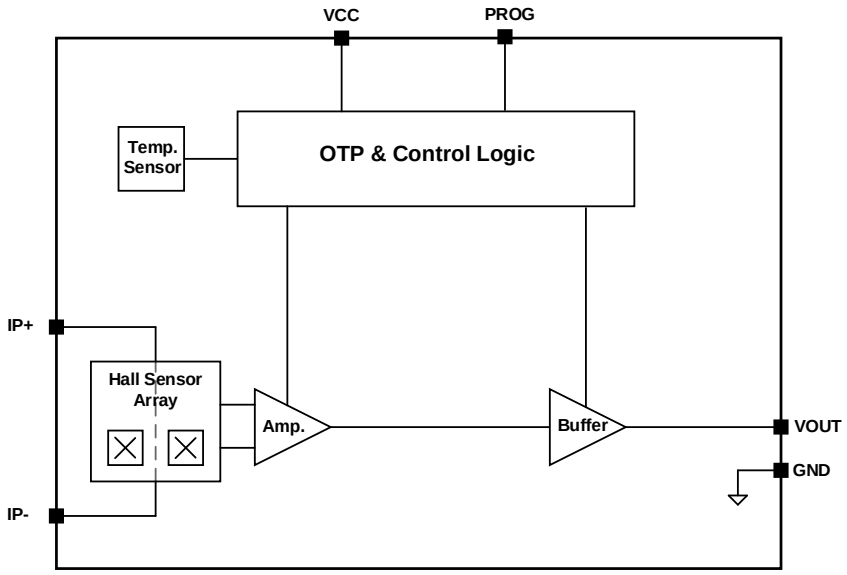


Figure 2. Block Diagram

Absolute Maximum Ratings (Note 1)

Supply Input Voltage ---------- -0.3 to 4.6V

PROG, VOUT ---------- 0.15 to V_{CC}-0.15V

Junction Temperature Range ---------- -40 to 165°C

Lead Temperature Range (Soldering, 10 sec.) ---------- 260°C

Storage Temperature Range ---------- -55 to 150°C

Recommended Operating Conditions (Note 2)

Supply Input Voltage ---------- 3.0 to 3.6V

Ambient Temperature Range ---------- -40 to 125°C

Isolation Characteristics

Characteristic	Symbol	Notes	Rating	Unit
Dielectric Strength Test Voltage (Note 3)	V_{ISO}	Agency type-tested for 60 seconds per UL standard 62368-1 Ed3	2400	V_{RMS}
Working Voltage for Basic Isolation	V_{WVBI}	For basic (single) isolation per UL standard 62368-1 Ed3	420	V_{PK}
			297	V_{RMS}
Clearance Distance	D_{CL}	Min distance from IP pin to signal pin(air)	4.2	mm
Creepage Distance	D_{CR}	Min distance from IP pin to signal pin (molded body)	4.2	mm

Electrical Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage	V_{CC}		3.14	3.3	3.46	V
Supply Current	I_{CC}	R_L ≥ 10kΩ		16		mA
Power on Delay Time	T_{POD}	T_A=25°C			1000	μs
Zero Current Output Voltage	V_{QVO}	SYCS-xxxBR, T_A = 25°C		V_{CC}/2		V
		SYCS-xxxUR, T_A = 25°C		V_{CC}/10		V
Output Voltage Range @I_P	V_{OUT}-V_{QVO}	SYCS-xxxBR, T_A = 25°C		±1.32		V
		SYCS-xxxUR, T_A = 25°C		2.64		V
Zero Current Output Ratiometry Error	E_{RAT}		-0.3		0.3	%
Output Load Resistance	R_L	V_{OUT} to V_{CC} or GND	5			kΩ
Output Load Capacitance	C_L	V_{OUT} to GND			10	nF
Response Time	t_{RES}	T_A=25°C, C_L=1nF		1		μs
Bandwidth	BW	Small signal –3dB, C_L=1nF, T_A=25°C		700		kHz
DC Output Impedance	R_{OUT}	T_A = 25°C			20	kΩ
Moisture Sensitivity Level	MSL			3		

Note 1: Stresses beyond the “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Note 2: The device is not guaranteed to function outside its operating conditions.

Note 3: 60-second test is only for UL test; Tested in production against UL 62368-1 Ed3.

SYCS108K-010BR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		-10		10	A
Sensitivity	Sens			132		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/2		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-020BR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		-20		20	A
Sensitivity	Sens			66		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/2		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-020UR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		0		20	A
Sensitivity	Sens			132		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/10		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-030BR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		-30		30	A
Sensitivity	Sens			44		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/2		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-030UR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		0		30	A
Sensitivity	Sens			88		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/10		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-040BR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		-40		40	A
Sensitivity	Sens			33		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/2		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-050BR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		-50		50	A
Sensitivity	Sens			26.4		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/2		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

SYCS108K-050UR-3 Performance Characteristics

(VCC = 3.3V, C_{VCC} = 0.1μF, T_A = -40 to 125°C, unless otherwise specified)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Nominal Performance						
Current Sensing Range	I_P		0		50	A
Sensitivity	Sens			52.8		mV/A
Zero Current Output Voltage	V_{QVO}	I_P=0A		V_{CC}/10		V
Accuracy Performance						
Sensitivity Error	E_{SENS}	T_A=25°C;	-1		1	%
Voltage Offset Error	V_{OE}	I_P=0A，T_A = 25°C	-10	±5	10	mV
		I_P=0A，T_A = -40 to 125°C	-30	±15	30	mV
Linearity Error	E_{LIN}	Full scale of I_P	-1	0.5	1	%
Total Output Error	$E_{TOT, H}$	Full scale of I_P, T_A = 25 to 125°C	-2		2	%
	$E_{TOT, H2}$	Full scale of I_P, T_A = 25 to 85°C	-1.5		1.5	%
	$E_{TOT, L}$	Full scale of I_P, T_A = –40 to 25°C		±3		%

Operation

The SYCS108-3 is a family of high accuracy galvanically isolated current sensor ICs. It offers various output modes for measuring bidirectional or unidirectional current from 10A to 50A, which output the analog voltage proportional to the AC or DC current. The typical bandwidth is 700 kHz.

The SYCS108-3 is available in a compact SOP8 package.

Application Information

Power Supply Capacitor (C_{VCC})

To minimize the potential noise, place a typical X5R or better grade ceramic capacitor as close to the IN and GND pins as possible. In this case, a 100nF or higher low ESR ceramic capacitor is recommended.

Output Capacitor (C_{OUT})

The output capacitor is selected to handle the output noise requirements. An X5R or better grade ceramic capacitor close to the VOUT and GND pins can work well. To achieve better filtering results, a resistor (R_{OUT}) can be added.

The values of C_{OUT} and R_{OUT} are depended on the application. For most applications, a 1nF ceramic capacitor can operate well. The maximum equivalent output load capacitance value cannot be greater than C_L.

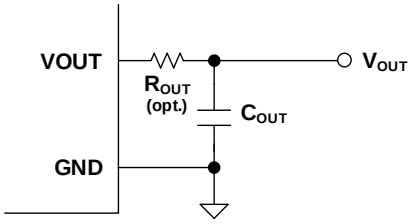


Figure 3. Output Capacitor

Sensitivity (Sens)

Sensitivity is the slope of the reference output voltage line, which refers to the output voltage (V_{OUT}) change with the input primary current (IP) change. V_{QVO} is the quiescent voltage output.

$$V_{OUT} = V_{QVO} + Sens \times I_P$$

Sensitivity Error (E_{SENS})

The sensitivity error (E_{SENS}) is the relative deviation (%) of the sensitivity.

$$E_{SENS} = \frac{Sens_{\ M} - Sens_{\ TYP}}{Sens_{\ TYP}} \times 100\ \ (\%)$$

Response Time (t_{RES})

Response time (t_{RES}) is defined as the time delay from t_1 to t_2 as shown below. Here t_1 and t_2 are the moments when the input primary current (I_P) and output voltage (V_{OUT}) reach 90%, respectively.

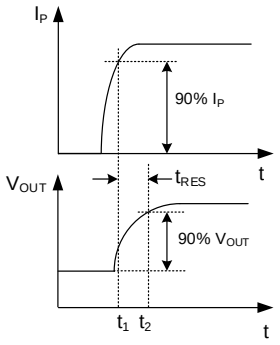


Figure 4. Response Time

Quiescent Voltage Output (V_{QVO})

The quiescent voltage output (V_{QVO}) is the output voltage with zero input primary current (I_P=0A), which is related to the V_{CC}.
For the bidirectional current sensor IC,

$$V_{QVO} = \frac{1}{2} \times V_{CC}$$

For the unidirectional current sensor IC,

$$V_{QVO} = \frac{1}{10} \times V_{CC}$$

Voltage Offset Error (V_{OE})

The voltage offset error (V_{OE}) is the error of the quiescent voltage output (V_{QVO}) caused by the non-magnetic reasons, such as the noise of the hall component and the internal operational amplifier itself.

Zero Current Output Ratiometric Error (E_{RAT})

When the supply voltage V_{CC} changes from the typical value ($V_{CC,\,TYP}$) to $V_{CC,\,MIN} < V_{CC,\,M} < V_{CC,\,MAX}$ there will be a certain deviation between the measured zero current output ($V_{QVO,\,M}$) and its ideal value ($V_{QVO,\,TYP}$), which is defined as follows:

$$E_{RAT} = (1 - \frac{V_{QVO,M}}{V_{CC,M}} \times \frac{V_{CC,TYP}}{V_{QVO,TYP}}) \times 100\%$$

Linearity Error (E_{LIN})

The linearity error (E_{LIN}) is the maximum positive or negative error between the measured output voltage and the ideal value within the sensing range.

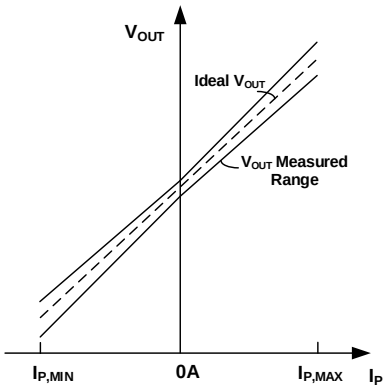


Figure 5. Linearity Error

Total Output Error (E_{TOT})

The total output error (E_{TOT}) is the error of the output voltage divided by the maximum output dynamic range. The relationship is shown as below:

$$E_{TOT} = \frac{V_{OUT,M} - V_{OUT,TYP}}{Sens_{TYP} \times I_{P,MAX}} \times 100\%$$

Where, $V_{OUT,\ M}$ is the measured output voltage of hall current sensor; $V_{OUT,\ TYP}$ is the ideal output voltage as shown below; The maximum input current ($I_{P,\ MAX}$) multiplied by the ideal sensitivity (Sens $_{TYP}$) is the maximum output dynamic range.

$$V_{OUT,TYP} = V_{QVO,TYP} + Sens_{TYP} \times I_P$$

The main factors causing total output errors (E_{TOT}) at high and low currents are sensitivity error (E_{SENS}) and voltage offset error (V_{OE}), respectively.

Layout Design

The layout design of the SYCS108-3 is relatively simple. For the best performance, the attention should be paid to heat dissipation and traces.

1. It is best to place C_{VCC} and C_{OUT} close to the IC to achieve better filtering performance.
2. It is best practice for the current to approach the IC parallel to the current-carrying pins, and for the current-carrying trace to not creep towards the center of the package.
3. In some practical application, if there is an instantaneous pulse peak of more than 6.5V on the VCC pin, it is recommended to install a TVS (Transient Voltage Suppressor) diode between VCC pin and GND pin to absorb the spike energy.
4. It is important to implement proper current path planning, as this constitutes a critical measure for effective magnetic interference suppression. The recommended PCB layout is as below. In terms of details, for better performance, it is recommended to use PCB with minimum 2-ounce copper foil, at least 4-layer board, and place thermal vias near primary current pins.

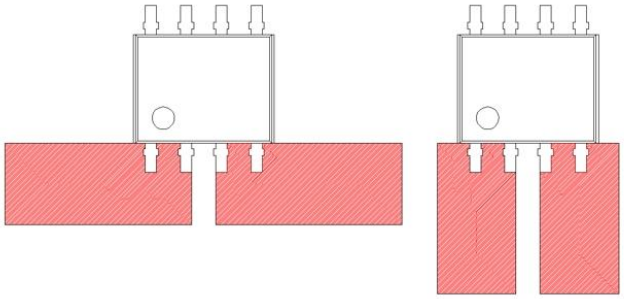


Figure 6. Recommended PCB Layout

Bad PCB layout will degrade isolation performance. The following design is NOT recommended.

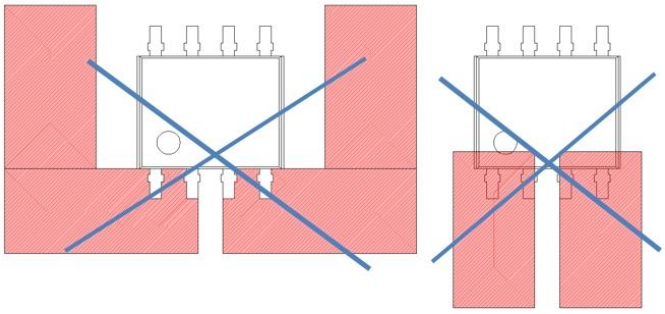
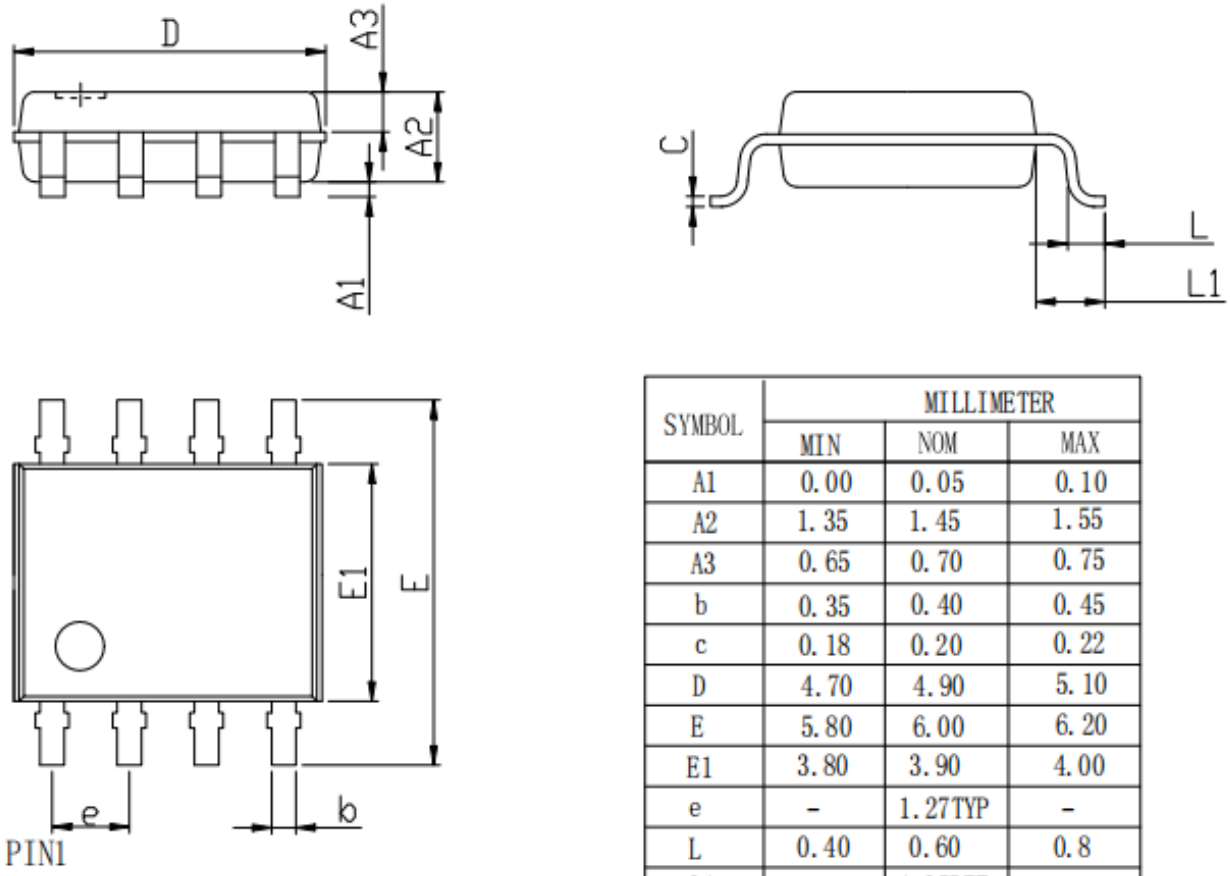


Figure 7. Not Recommended PCB Layout

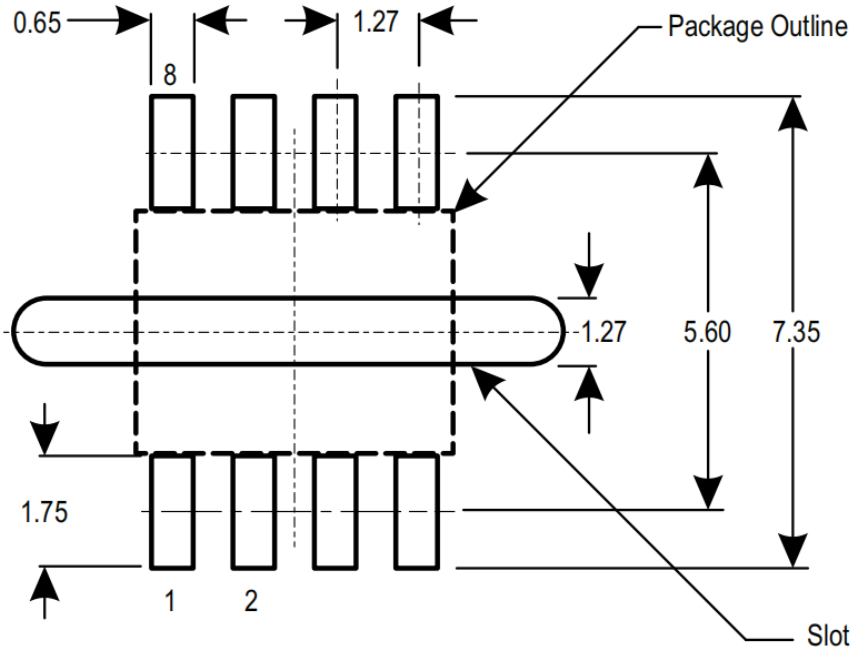
Package Outline & PCB Layout Design



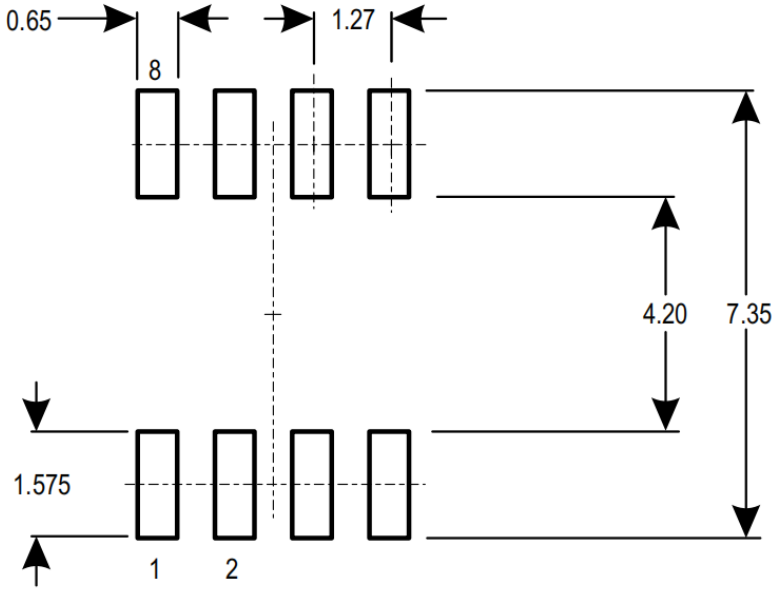
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A1	0.00	0.05	0.10
A2	1.35	1.45	1.55
A3	0.65	0.70	0.75
b	0.35	0.40	0.45
c	0.18	0.20	0.22
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	-	1.27TYP	-
L	0.40	0.60	0.8
L1	-	1.05REF	-

Notes: All dimension in millimeter and exclude mold flash & metal burr.

Recommended PCB Layout Design



C PCB Layout Reference View 1

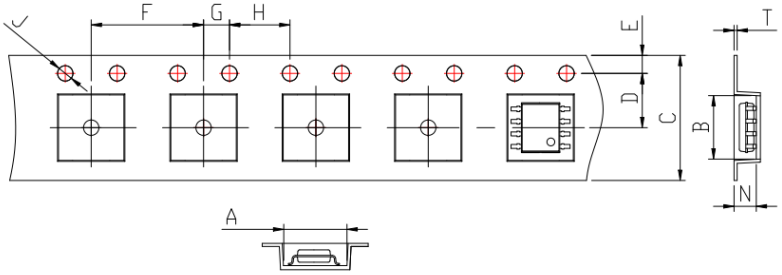


C PCB Layout Reference View 2

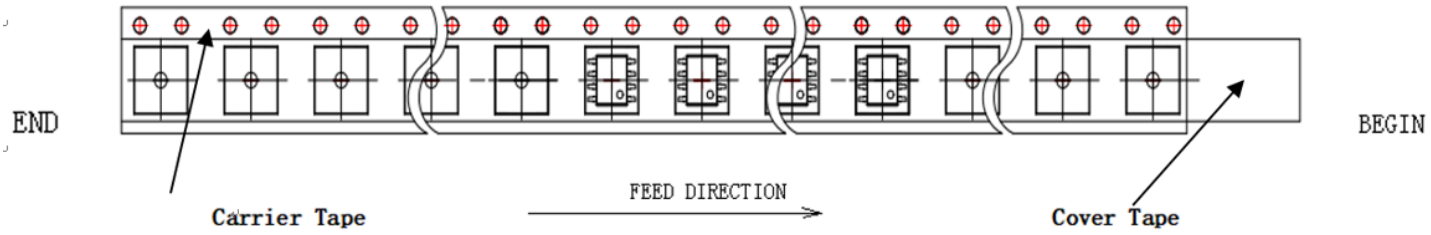
For PCB assemblies that cannot support a slotted design, the above stretched footprint may be used.

Tape and Reel Information

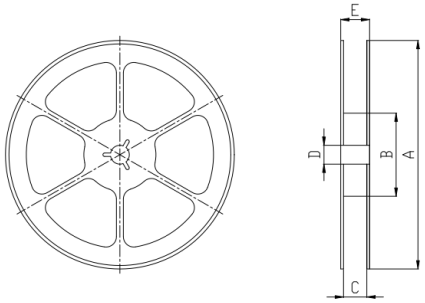
Tape Dimensions and Orientation



Dimension(mm)												
A	B	C	D	E	F	G	H	J	K	N	T	10-P
6.5	5.35	12	5.5	1.75	8	2	4	1.6	2.10	-	0.22	40



Reel Dimensions



Dimension(mm)				
A	B	C	D	E
Φ180	Φ60	13	Φ13	17

Storage Conditions

1. We suggest that the element must be stored at an appropriate temperature 5 ~ 40°C and Relative humidity 40 ~ 60%RH.

2. Please keep the element away from the following circumstance: (Because store the products under the following circumstance, will cause appearance damage, characteristic defectiveness and inferior assembly etc)

1) Under high temperature, high humidity circumstance for long time

2) With corrosive gas, oxidation gas, acidity / alkalinity circumstance.

3) dusty circumstance

3. Long-term storage may result in poor lead solderability and degraded electrical performance.

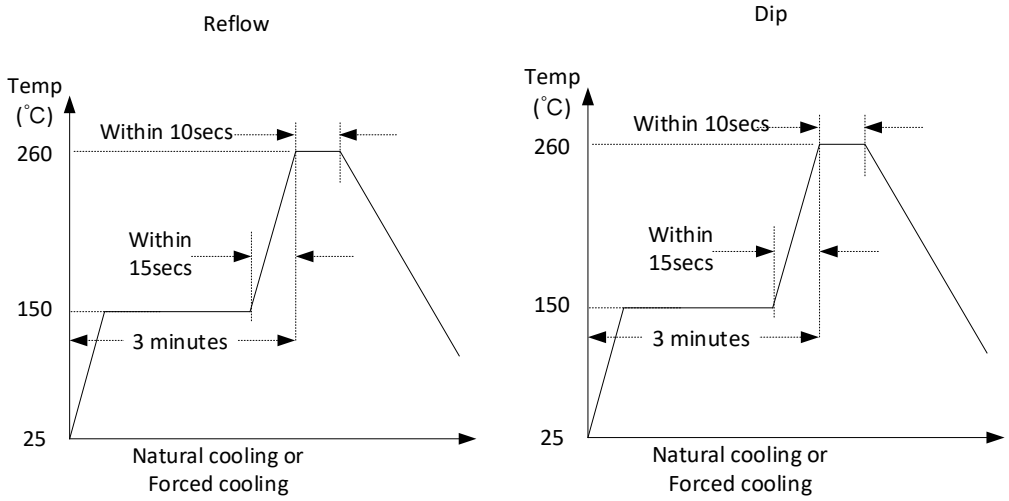
4. After unpacking, it should be stored in a dry environment with a relative humidity of less than 60% and a temperature controlled between 5°C and 30°C. It is recommended to complete welding within 168 hours after unpacking. If it exceeds 168 hours, it is recommended to re bake before use or repackage.

Soldering method and Guarantee temperature

1) Soldering Method

Method	Method Description	Temperature
Reflow soldering	Soldering at high temperature environment	MAX260°C within 10secs
Dip soldering	Soldering at dipping solder sink	MAX260°C within 10secs
Hand soldering	Soldering lead of element by searing-iron	MAX350°C within 3secs

2) Guarantee Temperature Range



Guarantee Value (at Max. temperature)

Method	Reflow	Dip
Temperature	260°C	260°C
Time	10 seconds	10 seconds

Revision History

The revision history provided is for informational purposes only and is believed to be accurate; however, not warrantied. Please make sure that you have the latest revision.

Revision Number	Revision Date	Description	Pages changed
1.0	Mar. 24, 2025	Initial Release	
1.0A	Sept.10, 2025	Add 40BR-3 information	

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