SY2A27357A

36V, 300mA LDO Regulator

General Description

The SY2A27357A is an automotive grade, low-dropout voltage regulator for high input voltage and ultra-low quiescent current applications.

The SY2A27357A provides resistor adjustable output voltage and low drop out (300mV at 300mA). It offers protection features including over-current protection, thermal shutdown, and stable operation with low ESR ceramic or tantalum capacitors due to the optimized internal compensation.

The SY2A27357A is available in a compact SO8E package.

Features

- Wide Input Voltage Range: 4V to 36V
- 300mA Maximum Load Current
- Low Dropout Voltage (300mV@300mA)
- Low Quiescent Current (7 μA typ.)
- Low Shutdown Current (5μA max.)
- Stable with Tantalum or Ceramic Capacitors
- Excellent Load and Line Regulation
- Enable Control Input
- Over Current Protection
- Thermal Shutdown
- Compact SO8E Package
- Automotive AEC-Q100 Grade 1 Qualified

Applications

- Battery Powered Applications
- Automotive Applications
- Gateway Applications
- Remote Keyless Entry Systems
- SMPS Post-Regulator/ DC-DC Modules

Typical Application

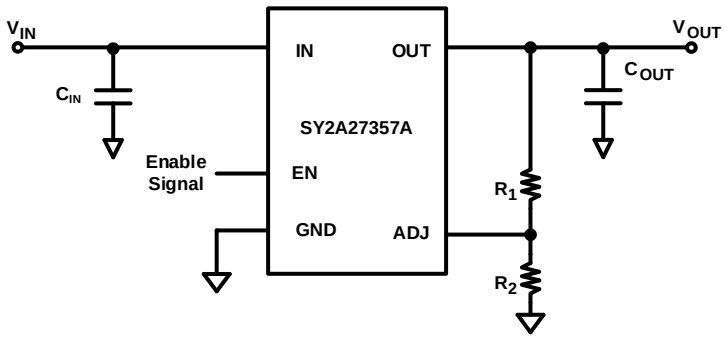


Figure 1. Schematic Diagram

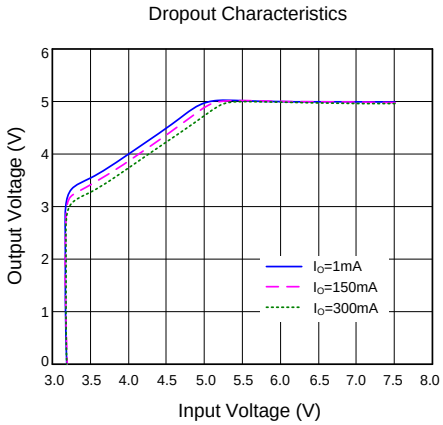


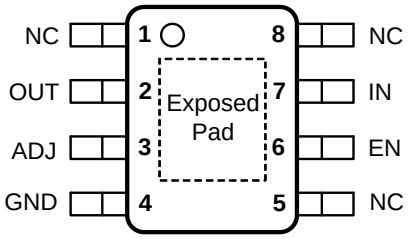
Figure 2. Dropout Characteristics

Ordering Information

Ordering Part Number	Package Type	Top Mark
SY2A27357AFCA	SO8E RoHS Compliant and Halogen Free	**CSZ*xyz***

x=year code, y=week code, z= lot number code

Pinout (top view)



Pin Name	Pin Number	Pin Description
NC	1, 5, 8	Not connected.
OUT	2	Output pin. Bypass this pin to the ground pin with a 2.2μF output capacitor.
ADJ	3	Output voltage feedback pin. Enables adjusting the output voltage using a resistor voltage divider network. V_{OUT}=0.6×(1+R1/R2).
GND	4	Ground pin.
EN	6	Enable pin. Pull it low to shut down or pull it high to enable; do not leave floating.
IN	7	Power supply input. Bypass this pin to the ground pin with a 10μF capacitor.
	Exposed Pad	The exposed pad should be connected to the ground plane for improving the thermal performance.

Block Diagram

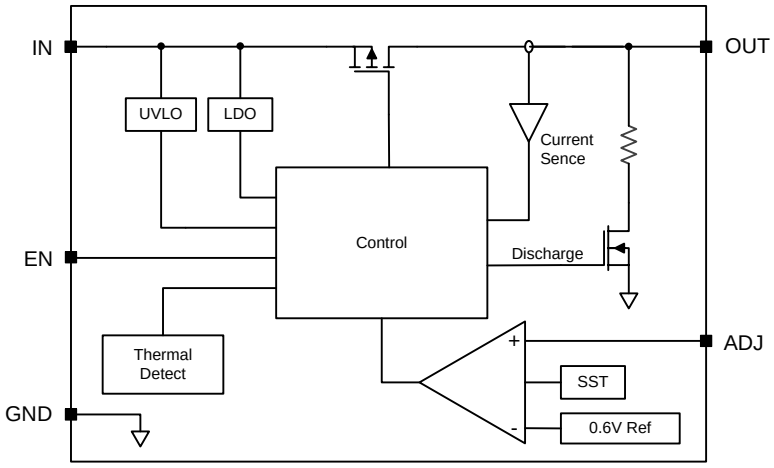


Figure 3. Block Diagram

Absolute Maximum Ratings

Parameter (Note1)	Min	Max	Unit
IN to GND	-0.3	40	V
OUT, EN, ADJ to GND	-0.3	0.3+V_{IN}	
Lead Temperature (Soldering, 10 sec.)		260	°C
Junction Temperature, Operating	-40	150	
Storage Temperature	-65	150	

Thermal Information

Parameter (Note2)	Typ	Unit
θ_{JA} Junction-to-ambient Thermal Resistance	30	°C/W
θ_{JC} Junction-to-case Thermal Resistance	20	
P_D Power Dissipation T_A=25°C	3.3	W

Recommended Operating Conditions

Parameter (Note3)	Min	Max	Unit
IN	4	36	V
Ambient Temperature	-40	125	°C

Electrical Characteristics

(V_{IN}=12V, V_{OUT}=3.3V, V_{EN}=V_{IN}, T_A=-40°C~125°C unless otherwise specified, the values are guaranteed by test design or statistical correlation.)

Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
Input Voltage	V_{IN}	I_{OUT}=10mA	4		36	V
Reference Voltage	V_{REF}		582	600	618	mV
Line Regulation	ΔV_{LNR}	V_{IN}=(V_{OUT}+0.3V) to 36V, I_O=10mA		1	1.5	mV/V
Load Regulation	ΔV_{LDR}	I_O=10mA to 300mA		0.25	1	%
Dropout Voltage	V_{IN}-V_{OUT}	I_O=10mA		10	20	mV
		I_O=150mA		150	300	mV
		I_O=300mA		300	550	mV
Quiescent Current	I_Q	No Load		7	14	μA
Shutdown Current	I_{SHDN}	V_{EN}=0V, V_{IN}=24V			5	μA
Output Current	I_O	V_{IN}=V_{OUT}+0.6V	0		300	mA
Output Current Limit	I_{LIM}	V_{IN}=6V, VOUT=0.9×V_{OUT}(normal)	300		900	mA
Power-supply Rejection Ratio	PSRR	f=1kHz, C_{OUT}=10μF		60		dB
		f=150kHz, C_{OUT}=10μF		30		dB
Input UVLO Threshold	V_{UVLO}	V_{IN} rising	2.9	3.3	4	V
UVLO Hysteresis	V_{UVLO_HYS}			0.1		V
Shutdown Discharge Resistance	R_{DIS}			600		Ω
Enable Input Logic-High Voltage	V_{EN_H}	V_{IN} =5V	1.5			V
Enable Input Logic-Low Voltage	V_{EN_L}	V_{IN} =5V			0.4	V

Parameter	Symbol	Test Conditions	Min	Typical	Max	Unit
Thermal Shutdown Temperature (Note 4)	T_{SD}			150		°C
Thermal Shutdown Hysteresis (Note 4)	T_{HYS}			20		°C

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: θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective two-layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

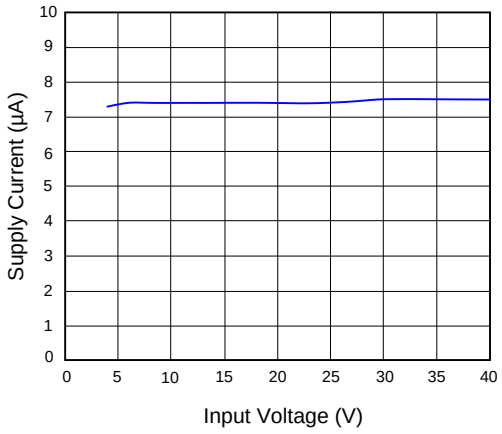
Note 3: The device is not guaranteed to function outside its operating conditions.

Note 4: Guaranteed by design.

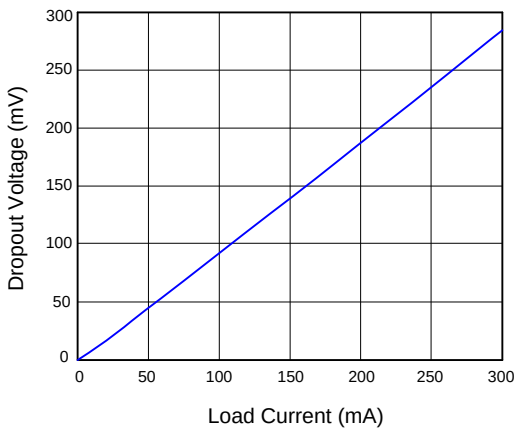
Note 5: Operating lifetime is derated for junction temperatures greater than 125°C.

Typical Performance Characteristics

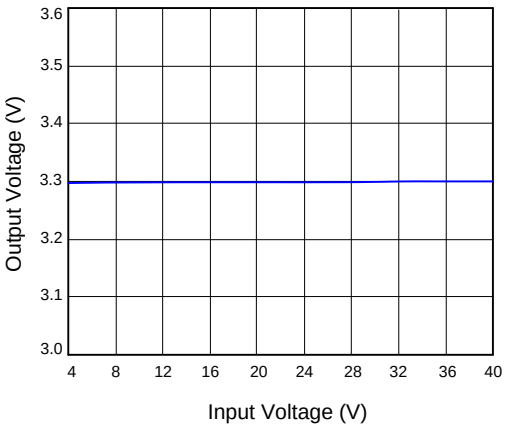
Supply Current vs. Input Voltage
(C_{IN}=10μF, C_{OUT}=2.2μF)



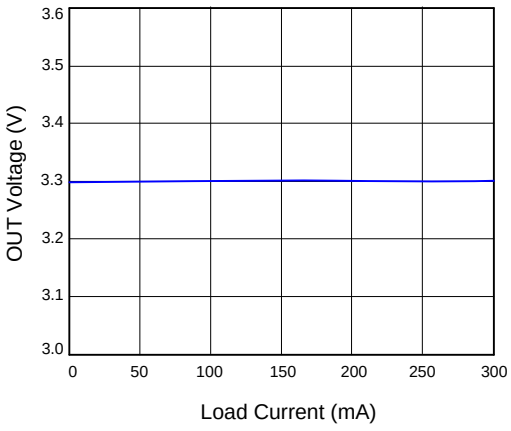
Dropout Voltage vs. Load Current
(V_{IN}=12V, ADJ=0.5V, C_{IN}=10μF, C_{OUT}=2.2μF)



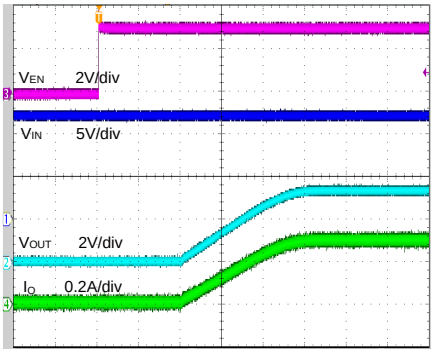
Output Voltage vs. Input Voltage
(V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=10mA)



OUT Voltage vs. Load Current
(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF)

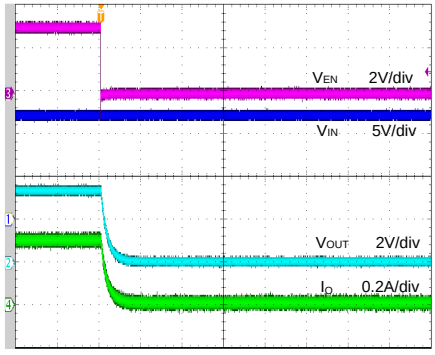


Startup from Enable
(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=300mA)



Time (400μs/div)

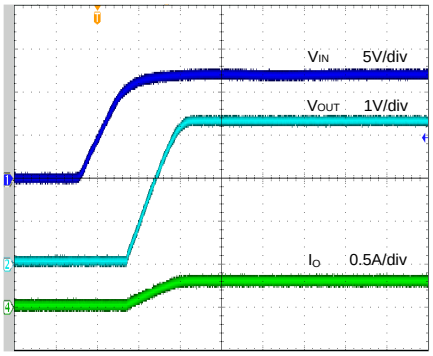
Shutdown from Enable
(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=300mA)



Time (400μs/div)

Startup from V_{IN}

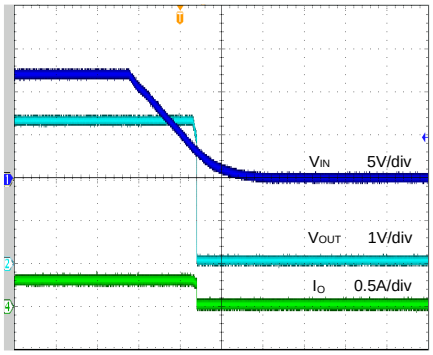
(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=300mA)



Time (800μs/div)

Shutdown from V_{IN}

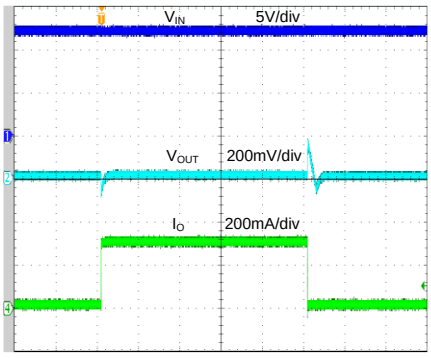
(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=300mA)



Time (10ms/div)

Load Transient

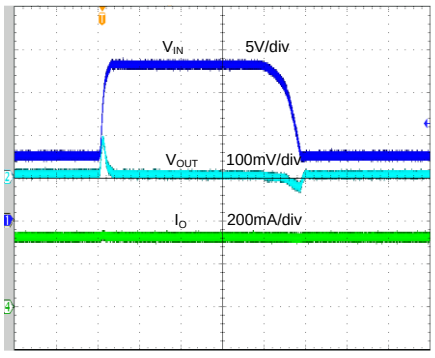
(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=10mA～300mA～10mA)



Time (200μs/div)

Line Transient

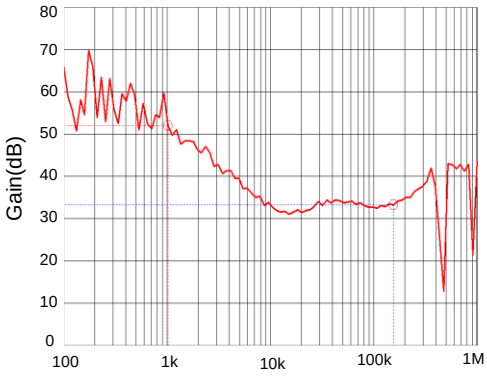
(V_{IN}=8V~18V~8V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=300mA)



Time (400μs/div)

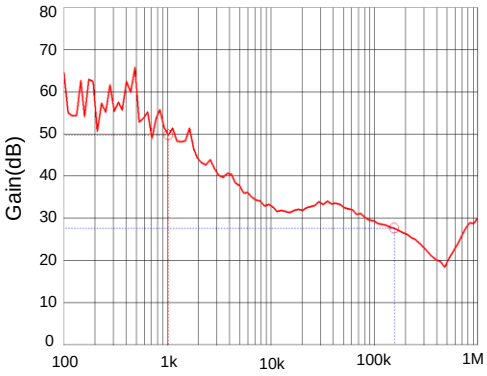
PSRR

(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=Null, C_{OUT}=2.2μF, I_{OUT}=10mA)



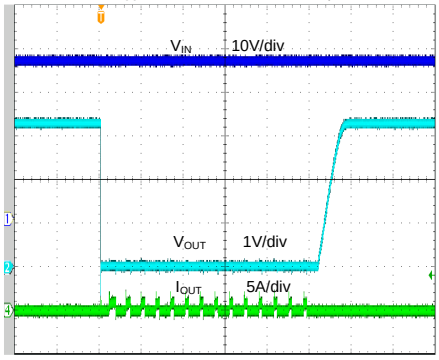
PSRR

(V_{IN}=12V, V_{OUT}=3.3V, C_{IN}=Null, C_{OUT}=2.2μF, I_{OUT}=300mA)



Short Protect

(V_{IN}=36V, V_{OUT}=3.3V, C_{IN}=10μF, C_{OUT}=2.2μF, I_{OUT}=Null～Short Circuit～Null)



Time (2ms/div)

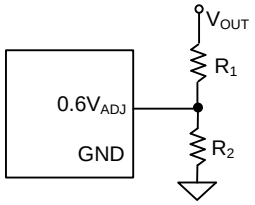
Application Information

The SY2A27357A is a 300mA linear regulator with a low dropout voltage. Like any low-dropout regulator, the SY2A27357A requires input and output decoupling capacitors. The SY2A27357A has an adjustable output which can be set by using two external resistors. The device offers protection features, including over-current limit, output short and over-temperature protections.

Feedback Resistor Dividers R_1 and R_2:

Choose R_1 and R_2 to program the proper output voltage. To minimize the power consumption under light loads, choosing large resistance values for both R1 and R2 is recommended. A value of between 10kΩ and 10MΩ is highly recommended for both resistors. If V_{OUT} is 3.3V and R_1=1.6MΩ is selected, then using following equation, R_2 can be calculated to be 357kΩ:

$$R_2 = \frac{0.6V}{V_{OUT}-0.6V} R_1 .$$



Input Capacitor C_{IN}:

An input capacitor with a value of 10μF and a voltage rating 20% higher than the maximum input voltage between the device input and ground pin is recommended. A typical X5R or better ceramic capacitor is recommended for most applications. This input capacitor must be located close to the device to minimize the input noise.

Output Capacitor C_{OUT}:

The SY2A27357A is designed specifically to work with very small ceramic output capacitors for transient stability. A 2.2μF, low-ESR output capacitor is recommended for most applications. Larger capacitance and lower ESR improves the load transient response and PSRR.

Dropout Voltage:

The SY2A27357A has a very low dropout voltage due to its low $R_{DS(ON)}$ of the main PMOS, which determines the lowest usable supply.

$V_{DROPOUT}=V_{IN}-V_{OUT}=R_{DS(ON)}\times I_{OUT}$

Over Temperature Protection (OTP)

The SY2A27357A includes over-temperature protection (OTP) circuitry to prevent overheating due to excessive power dissipation. This will turn off the device when the junction temperature exceeds 150°C. Once the junction temperature cools down by approximately 20°C the device will resume normal operation.

Output Short Circuit Protection

If V_{OUT} drops below 16% of the OUT set point, the short circuit protection mode will be initiated, and the device will be shut down immediately. The device will then restart with a complete soft-start cycle. If the short circuit condition remains, another 'hiccup' cycle of shutdown and restart will continue indefinitely, or until the condition disappears.

Thermal Considerations:

The SY2A27357A can deliver a current of up to 300mA over the full operating temperature range. However, the maximum output current must be derated at a higher ambient temperature. During all possible conditions, the junction temperature must be within the range specified under the operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across the regulator.

$P_D=(V_{IN}-V_{OUT})\times I_{OUT}+V_{IN}\times I_{GND}$

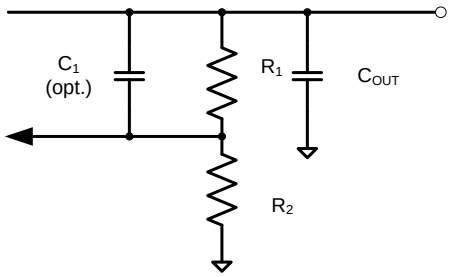
The final operating junction temperature for any set of condition can be estimated by the following thermal equation:

$P_{D(MAX)}=(T_{J(MAX)}-T_A)/\theta_{JA}$

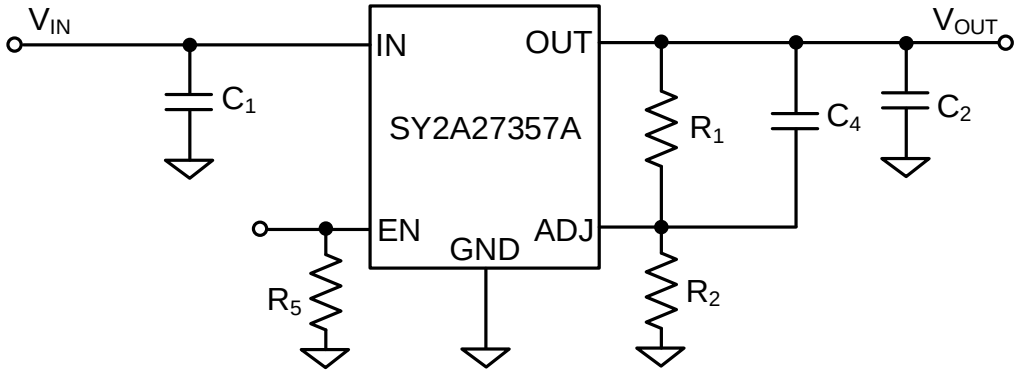
Where $T_{J(MAX)}$ is the maximum junction temperature of die and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) footprint is 30°C/W for SO8E package.

Load Transient Considerations:

The SY2A27357A integrates the compensation components to achieve good stability and fast transient responses. In some applications, adding a small ceramic cap in parallel with R_1 may further speed up the load transient responses and is thus recommended for applications with large load transient step requirements.



Application Schematic



BOM List

Reference Designator	Description	Part Number	Manufacturer
C_1	10μF/50V, 1206, X5R	GRM31CR61H106K	Murata
C_2	2.2μF/25V, 1206, X5R	GRM31CR61E225K	Murata
C_4	Null		
R_1	1.6MΩ		
R_2	357kΩ		
R_5	1MΩ		

PCB Layout Guide:

For best performance of the circuit the following guidelines must be followed:

1. Keep all power traces as short and wide as possible. A 2-layer- or 4-layer board is recommended for improved thermal performance and current flow capability.
2. Place the input/output capacitors close to the device for better transient performance.
3. Connect a large copper area to the Exposed Pad to improve power dissipation.7

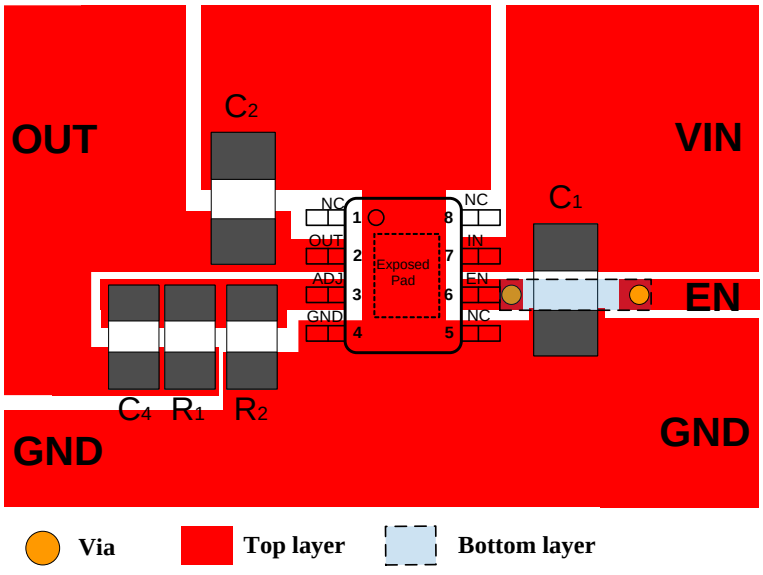
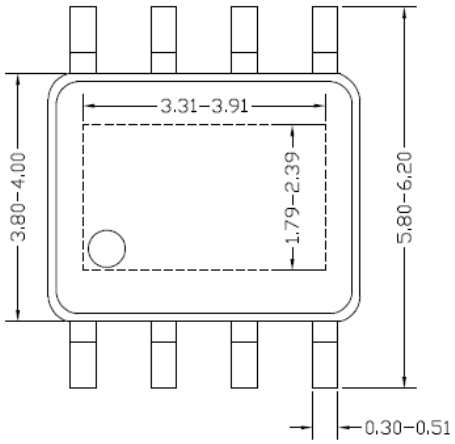
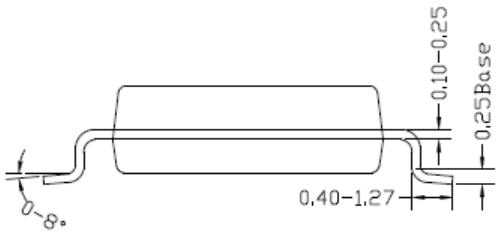


Figure 4. PCB Layout Suggestion

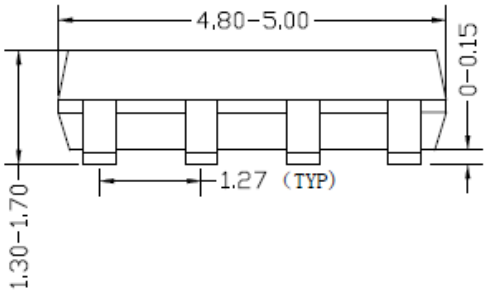
SO8E Package Outline & PCB layout



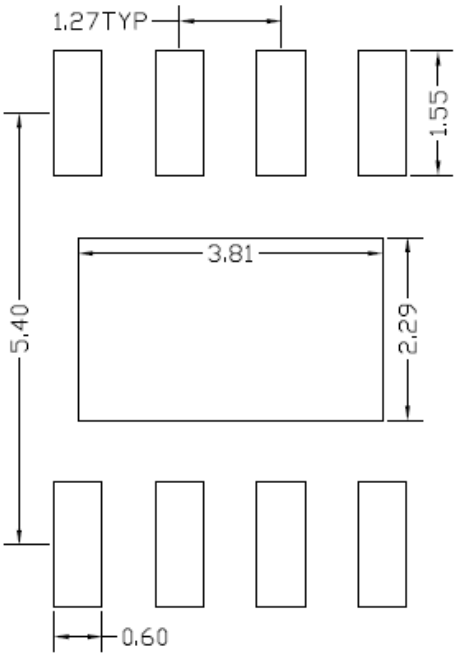
Top view



Side view



Front view

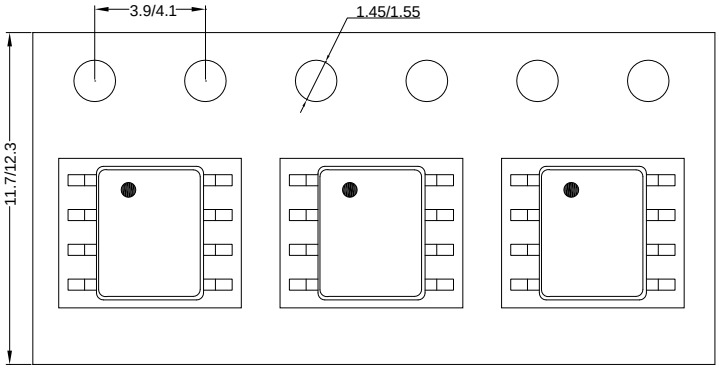


Recommended PCB Layout
(Reference Only)

Note: All dimensions are in millimeters and exclude mold flash and metal burr.

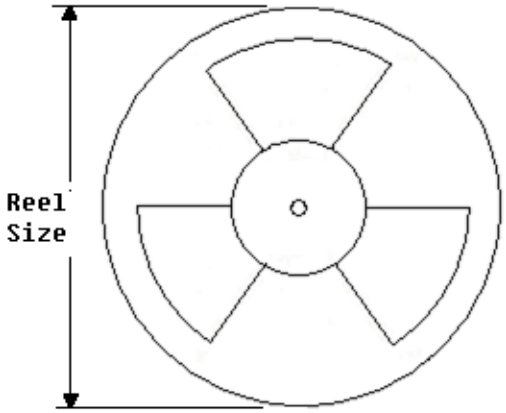
Taping & Reel Specification

1. SO8E Taping Orientation



Feeding direction ⟶

2. Carrier Tape & Reel Specification for Packages



Package type	Tape width (mm)	Pocket pitch(mm)	Reel size (Inch)	Trailer length(mm)	Leader length (mm)	Qty per reel
SO8E	12	8	13"	400	400	2500

3. Others: NA

Revision History

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

Date	Revision	Change
Oct.20, 2023	Revision 1.0	Language improvements for clarity.
Apr.13, 2022	Revision 0.9B	Update the Input UVLO Threshold in EC table (page4)
Sep.08, 2021	Revision 0.9A	Update the package outline drawing.
Nov.30, 2020	Revision 0.9	Initial Release

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