SA21345N

40V, 150mA LDO

General Description

The SA21345N is a 150mA high current capacity linear regulator. It fixes the output voltage at 5V, and features ultra-low ground current and low dropout voltage. The SA21345N with fully protection includes over current limit, output short-circuit protection and over temperature operation.

The SA21345N is available in SO8E package.

Ordering Information

SA21345 □(□□ □)

Package Code

Optional Spec Code

Ordering Number	Package type	Note
SA21345NFCP	SO8E	

Features

- Wide Input Voltage Range: 4V to 36V
- Fixed 5V Output Voltage
- Adjustable Output FB voltage Accuracy: 2%
- Low Dropout Voltage of (150mV@150mA)
- Ultra-low Quiescent Current
- Extremely Low Shutdown Current
- Stability with Tantalum or Ceramic Capacitors
- Excellent Load and Line Regulation
- 150mA Maximum Load Current for SO8E
- Enable Control Input
- Over Current Limit Protection
- Thermal Shutdown Protection
- Compact Package: SO8E
- RoHS Compliant and Halogen Free
- Automotive AEC-Q100 Grade 1 Qualified

Applications

- Automotive LED Lighting ECU
- Automotive Body Modules

Typical Application

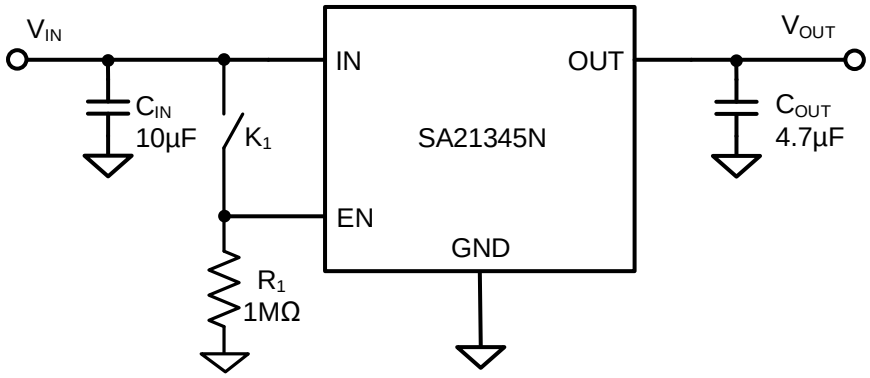
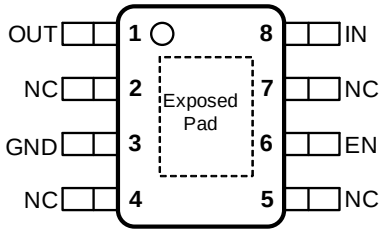


Figure1. Schematic Diagram

Pinout (top view)



(SO8E)

Top mark: **GQM*xyz*** (Device code: GQM, ***x=year code, y=week code, z= lot number code***)

Pin Name	Pin number	Pin Description
OUT	1	Output pin, decoupled with a 4.7μF MLCC capacitor to GND.
NC	2, 4, 5, 7	No Connection.
GND	3	Ground pin.
EN	6	Enable control. Pull high to enable the chip. Do not leave it floating.
IN	8	Input pin, decoupled with at least a 10μF MLCC capacitor to GND.
Exposed Pad	-	The exposed pad should be connected to ground plane for better thermal performance.

Function Block

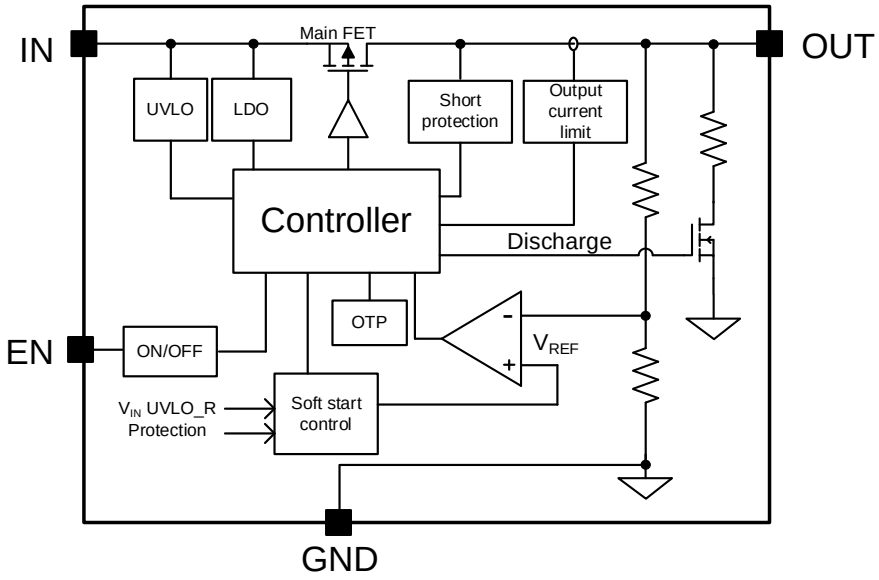


Figure2. Block Diagram

Absolute Maximum Ratings (Note 1)

IN, EN to GND ---------- -0.3V to 40V
OUT to GND ---------- -0.3V to 8V
Power Dissipation, P_D @ T_A = 25°C SO8E ---------- 3.3W
Package Thermal Resistance (Note 2)
θ_{JA} ---------- 30°C/W
θ_{JC} ---------- 20°C/W
Junction Temperature---------- -40°C to 150°C
Lead Temperature (Soldering, 10 sec.) ---------- 260°C
Storage Temperature Range ---------- -65°C to 150°C

Recommended Operating Conditions (Note 3)

IN ---------- 4V to 36V
EN ---------- 4V to 36V
OUT ---------- 0V to 8V
Ambient Temperature Range ---------- -40°C to 125°C

Electrical Characteristics

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage	V_{IN}		4		36	V
Input Voltage UVLO Threshold	V_{ULVO}	V_{IN} rising		3.3	4	V
UVLO Hysteresis	$V_{UVLO,HYS}$			200		mV
Output Voltage	V_{OUT}	T_J= -40°C ~ 125°C	4.9	5	5.1	V
		T_J= 25°C	4.95	5	5.05	V
Line Regulation	ΔV_{LNR}	I_{OUT} = 10mA, 5.5V≤ V_{IN} ≤ 36V		1	1.5	mV/V
Load Regulation	ΔV_{LDR}	V_{IN}=6V, 10mA ≤ I_{OUT} ≤ 150mA		0.25	0.5	%
Dropout Voltage	ΔV_{DROP}	V_{IN}=4.5V, I_{OUT}=10mA		10	20	mV
		V_{IN}=4.5V, I_{OUT}=150mA		150	300	mV
Quiescent Current	I_Q	I_{OUT}=0mA V_{IN}=(V_{OUT}+1V) ~ 36V		15	22	μA
Shutdown Current	I_{SHDN}	V_{EN}=0V, V_{IN}=24V			5	μA
Current Limit	I_{LMT}	Force V_{OUT} = 4.5V	600			mA
Output Short Protection Threshold	V_{SHORT}	Force V_{OUT} from 5V to 0V	0.4	0.8	1.5	V
Output Short Off Time	$t_{SHORT,OFF}$			16		ms
Power Supply Rejection Ratio (Note 4)	PSRR	Frequency = 100Hz, C_{OUT}=4.7μF, I_{OUT}=10mA, T_A=25°C		60		dB
		Frequency = 100kHz, C_{OUT}=4.7μF, I_{OUT}=10mA, T_A=25°C		35		dB
Enable Input Logic-High Voltage	V_{EN_H}		1.5			V
Enable Input Logic-Low Voltage	V_{EN_L}				0.4	V
Output Discharge Resistor	R_{DIS}			600		Ω

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Soft-start Time	t_{SS}			1		ms
Thermal Shutdown Temperature (Note 4)	T_{SD}			150		℃
Thermal Shutdown Hysteresis (Note 4)	T_{HYS}			20		℃

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.

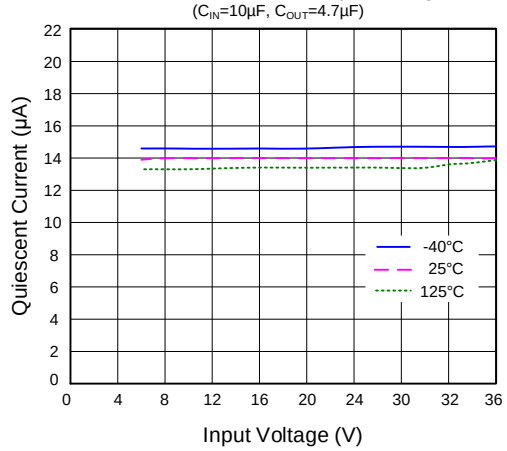
Note 2: θ_{JA} is simulated in the natural convection at T_A=25°C on a Silergy evaluation board following JEDEC51-2 thermal measurement standard.

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

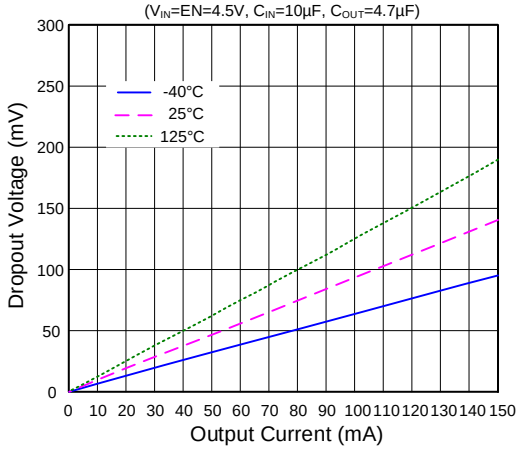
Note 4: Guaranteed by design.

Typical Performance Characteristics

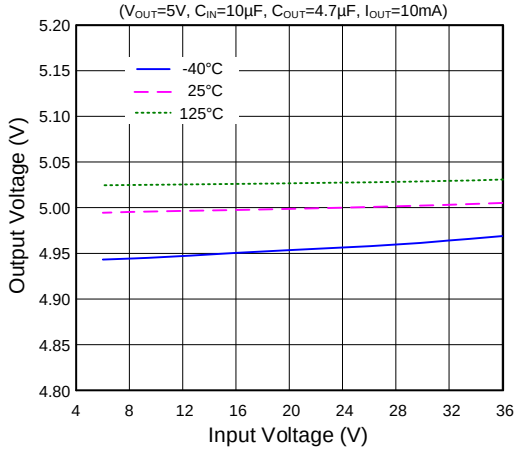
Quiescent Current vs. Input Voltage
(C_{IN}=10μF, C_{OUT}=4.7μF)



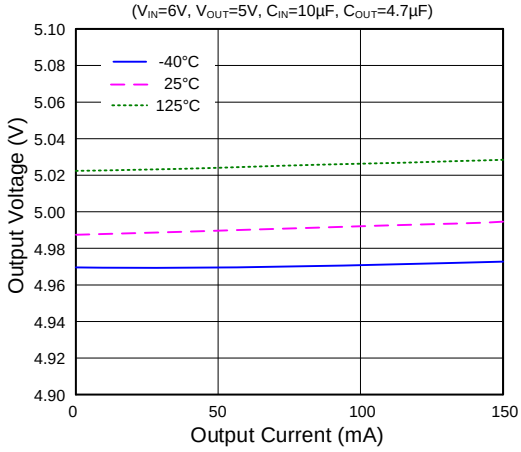
Dropout Voltage vs. Output Current
(V_{IN}=EN=4.5V, C_{IN}=10μF, C_{OUT}=4.7μF)



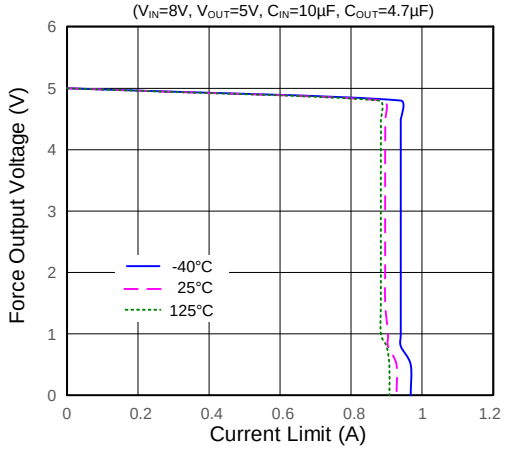
Output Voltage vs. Input Voltage
(V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=10mA)



Output Voltage vs. Output Current
(V_{IN}=6V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF)

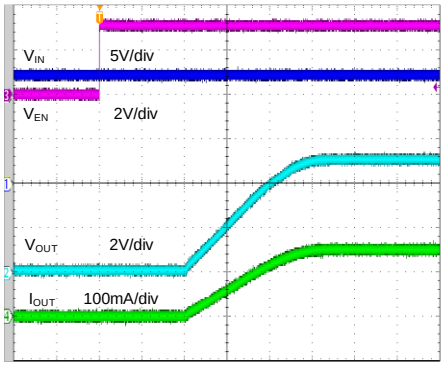


Force Output Voltage vs. Current Limit
(V_{IN}=8V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF)



Startup from Enable

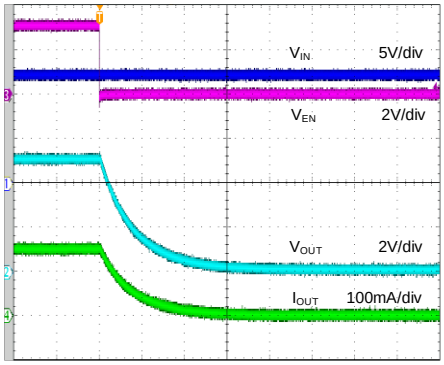
(V_{IN}=12V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=150mA)



Time (400μs/div)

Shutdown from Enable

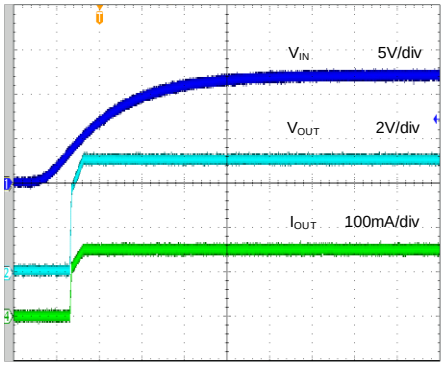
(V_{IN}=12V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=150mA)



Time (200μs/div)

Startup from V_{IN}

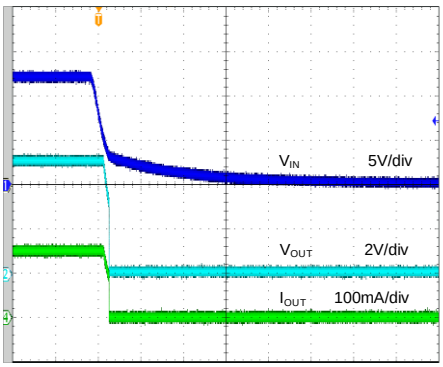
(V_{IN}=12V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=150mA)



Time (20ms/div)

Shutdown from V_{IN}

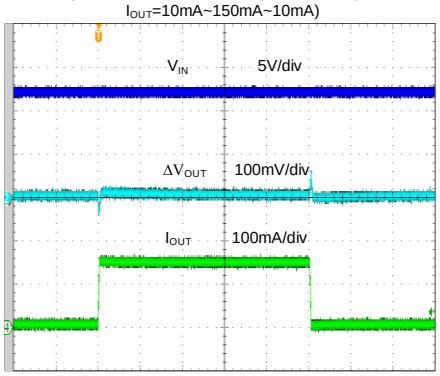
(V_{IN}=12V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF, I_{OUT}=150mA)



Time (100ms/div)

Load Transient

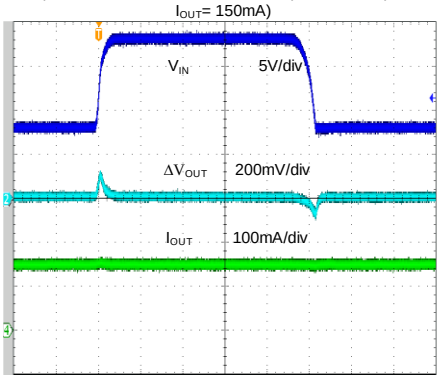
(V_{IN}=12V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF,
I_{OUT}=10mA~150mA~10mA)



Time (1ms/div)

Line Transient

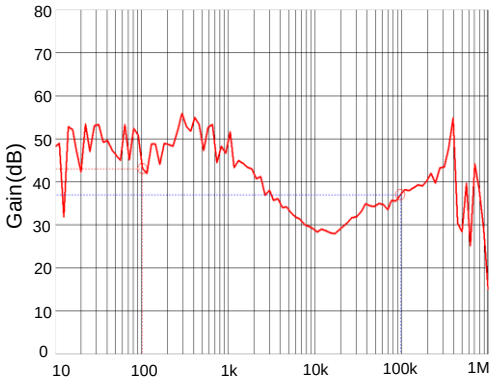
(V_{IN}=8V~18V~8V, V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF,
I_{OUT}= 150mA)



Time (400μs/div)

PSRR

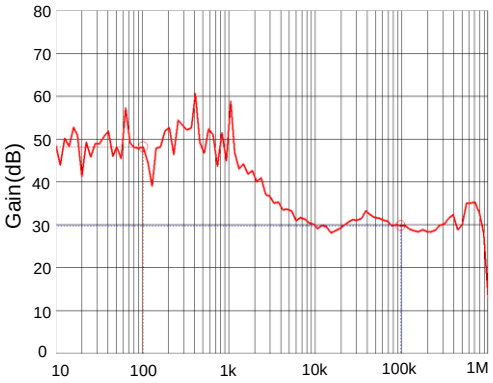
(V_{IN}=8V, V_{OUT}=5V, C_{IN}=Null, C_{OUT}=4.7μF, I_{OUT}=10mA)



Frequency(Hz)

PSRR

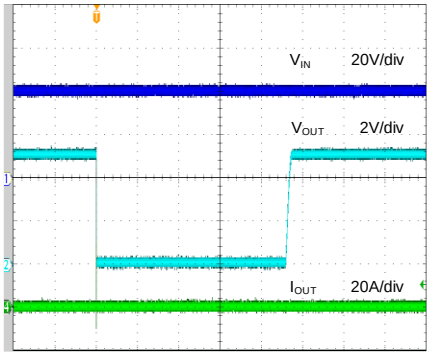
(V_{IN}=8V, V_{OUT}=5V, C_{IN}=Null, C_{OUT}=4.7μF, I_{OUT}=150mA)



Frequency(Hz)

Short Protection

(V_{IN}=40V,V_{OUT}=5V, C_{IN}=10μF, C_{OUT}=4.7μF,
I_{OUT}=Null~ Short Circuit~ Null)



Time (10ms/div)

Applications Information

The SA21345N is an automotive grade, 150mA high-current capacity linear regulator with ultra-low ground current and low drop out voltage. The SA21345N has a fixed 5V output voltage. The device offers protective features, including an over-current limit, output short protection, and over-temperature operation.

Input Capacitor C_{IN}:

To minimize the potential noise problem and improve power-supply rejection(PSRR) and transient response, place a typical X5R or better grade ceramic capacitor really close to the IN and GND pins. Care should be taken to minimize the loop area formed by CIN, and IN/GND pins. In this case, a 10μF low ESR ceramic capacitor is recommended.

Output Capacitor C_{OUT}:

For stable operation over the full temperature range, a 4.7μF low-ESR ceramic capacitor is recommended. Use larger output capacitor values such as 22μF to reduce noise, improve load-transient response and PSRR.

Over Temperature Protection (OTP):

The SA21345N 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 IC will resume normal operation

Output Short Circuit Protect:

If V_{OUT} drop below than 0.8V, the short circuit protection mode will be initiated, and the device will be shut down for approximately 16ms. The device will then restart with a complete soft-start cycle. If the short circuit condition remains another 'hic-cup' cycle of shutdown and restart will continue indefinitely unless the OTP threshold is reached.

Thermal Considerations:

The SA21345N can deliver a current of up to 150mA over the full operating temperature range. However, the maximum output current must be derated at higher ambient temperature. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across 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.

PCB Layout Guide:

For best performance of the SA21345N, the following guidelines must be strictly followed:

1. Keep all power trace as short and wide as possible. And it is desirable to use 2-layer or 4-layer board for thermal performance and better capability of current flow.

2. Place input/output capacitor close to the IC for better transient performance.

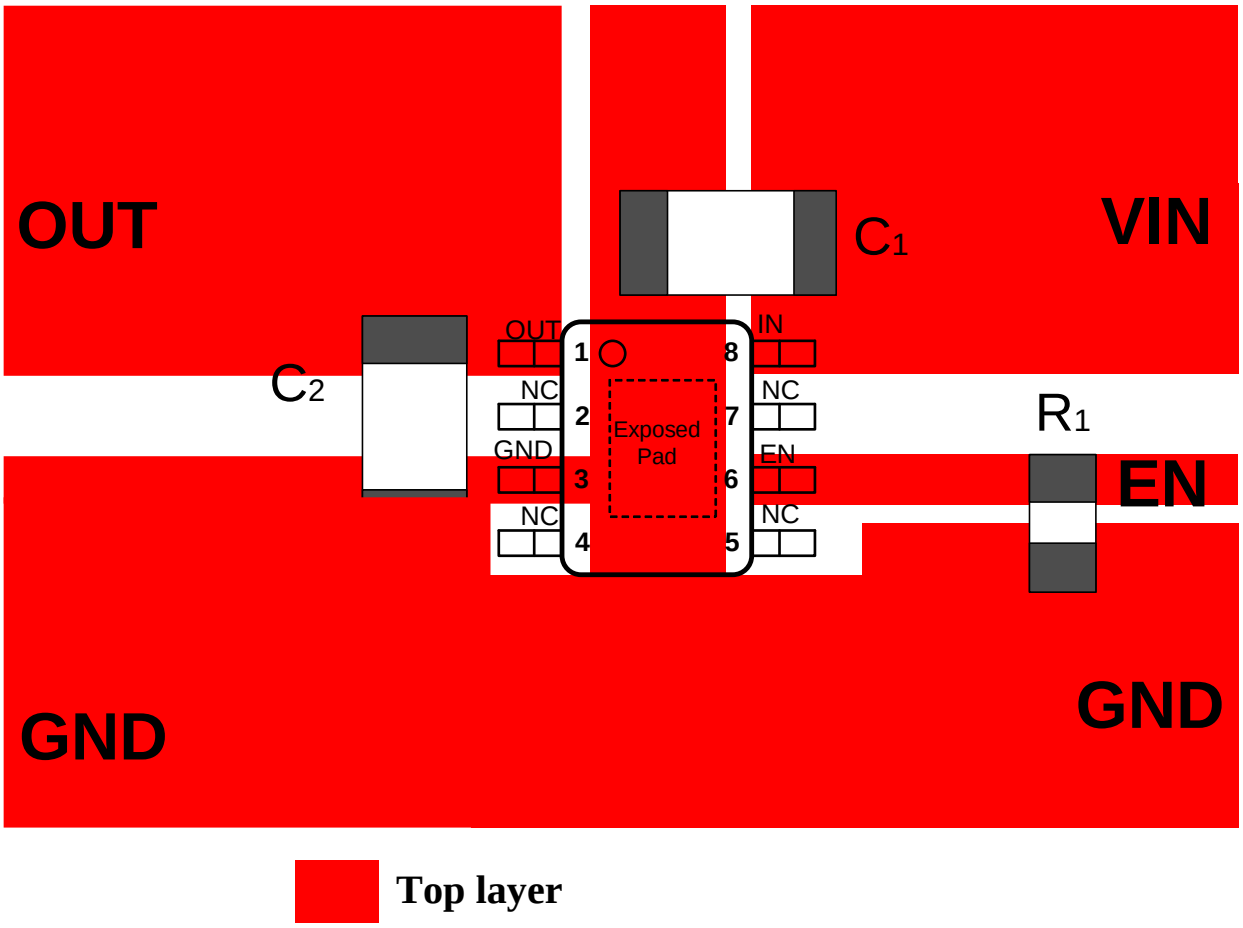
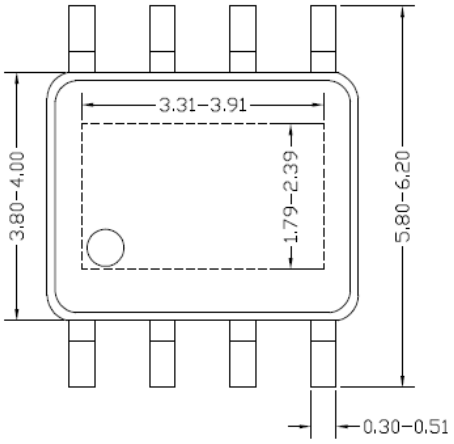
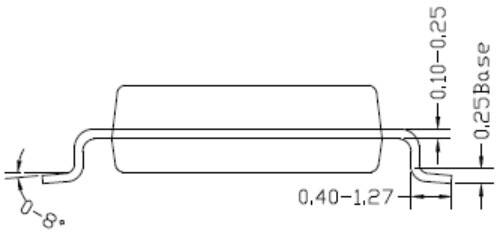


Figure3. PCB Layout Suggestion

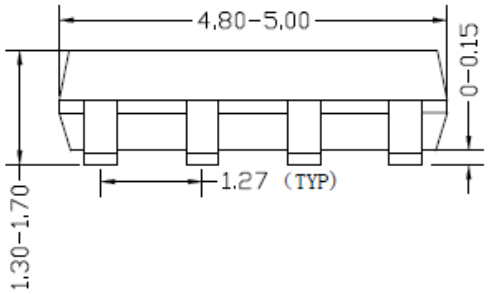
SO8E Package Outline & PCB Layout



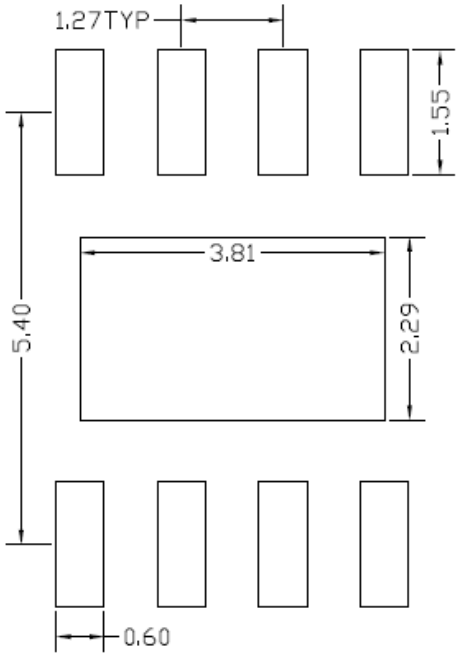
Top view



Side view



Front view



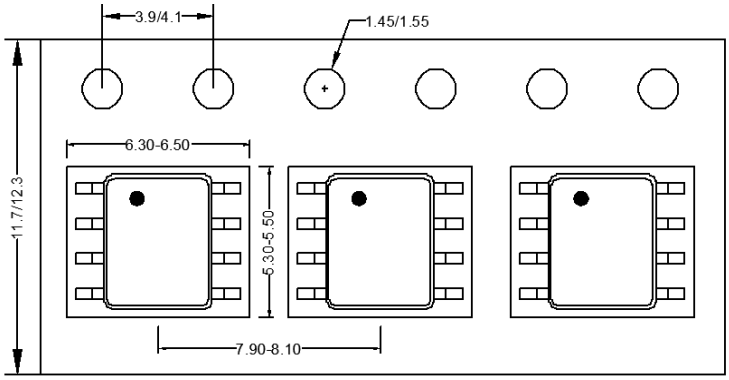
Recommended PCB Layout
(Reference Only)

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

Taping & Reel Specification

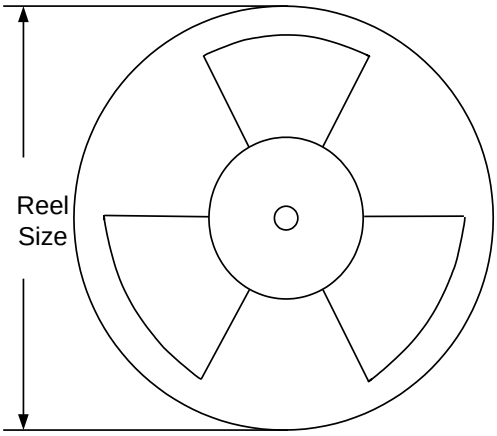
1. Taping orientation

SO8E



Feeding direction ⟶

2. Carrier Tape & Reel specification for packages



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

Others: NA

Revision History

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

Date	Revision	Change
Mar. 14, 2024	Revision 1.0A	Add “ Automotive AEC-Q100 Grade 1 Qualified” in Page 1
Oct.27, 2023	Revision 1.0	Initial Release

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