Low Dropout Regulators

Description

SL9350 Series are a high accuracy, low noise, high speed, low dropout CMOS Linear regulator with high ripple rejection and fast discharge function. The device offers a new level of cost effective performance in cellular phones, surveillance system, Bluetooth, wireless and other portable electronic devices.

SL9350 Series can provide product selections of output value in the range of 1.2V~3.6V by every 0.1V step.

The current limiter's fold-back circuit also operates as a short circuit protection and an output current limiter at the output pin.

The SL9350 Series are available in standard SOT-23、SOT-89、SOT-23-3 SOT23-5 and DFN1x1-4L packages. Standard products are Pb-free and Halogen-free.

Features

- Maximum Output Current: 400mA(@V_{IN}-V_{OUT}=0.5V)
- Output Voltage Range: 1.2V~3.6V(customized by every 0.1V step)
- Low Quiescent Current: 50uA(Typ.)
- Low Dropout Voltage: 220mV@I_{OUT}=200mA
- 0.01%/V Line Regulation
- 75dB PSRR @ 1KHz
- Standby Current: < 1μA
- VOUT fast discharge

Applications

- Digital cameras
- Cellphones
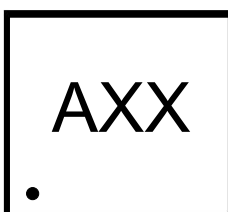- Bluetooth and wireless handsets
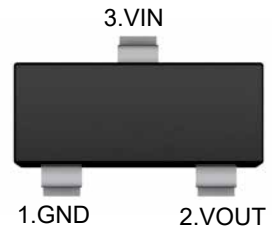- Other portable electronic devices

Marking Code

1.SOT

9350
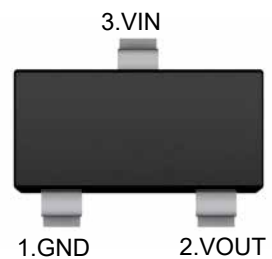-XX
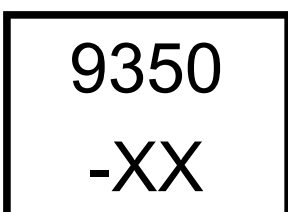
XX:Output Voltage
e.g. 3.0:3.0V 3.3:3.3V

2.DFN

AXX
.

A: Product Code
XX:Output Voltage
e.g. 30:3.0V 33:3.3V
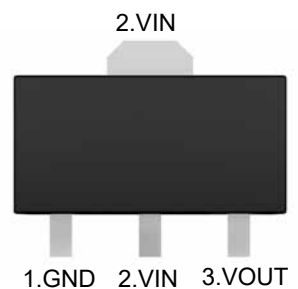
SOT-23

3.VIN

1.GND   2.VOUT

SOT-23-3

3.VIN

1.GND   2.VOUT

SOT-89

2.VIN

1.GND 2.VIN 3.VOUT

SOT-23-5

5. VOUT   4. NC

1.VIN   2.GND   3.EN
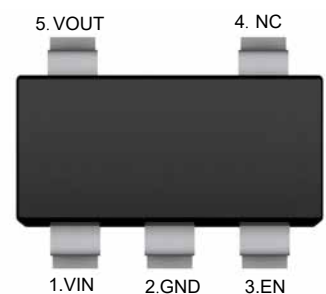
DFN1x1-4L
Bottom View

2.GND   3.EN

GND

1.VOUT   4.VIN
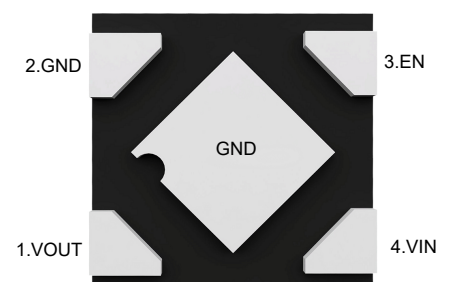
Functional Pin Description

Pin Name	Pin Function
VIN	Power Input Voltage
GND	Ground
EN	Chip Enable (Active High). Note that this pin is high impedance
NC	NO Connected
VOUT	Output Voltage

Ordering Information

SL9350☐ ☐☐ ☐

- Package Type
  SA:SOT-23   SQ:SOT-89
  SC:SOT-23-3 SE:SOT-23-5
  DE:DFN1x1-4L

- Output Voltage
  12 : 1.2V 15 : 1.5V 18 : 1.8V
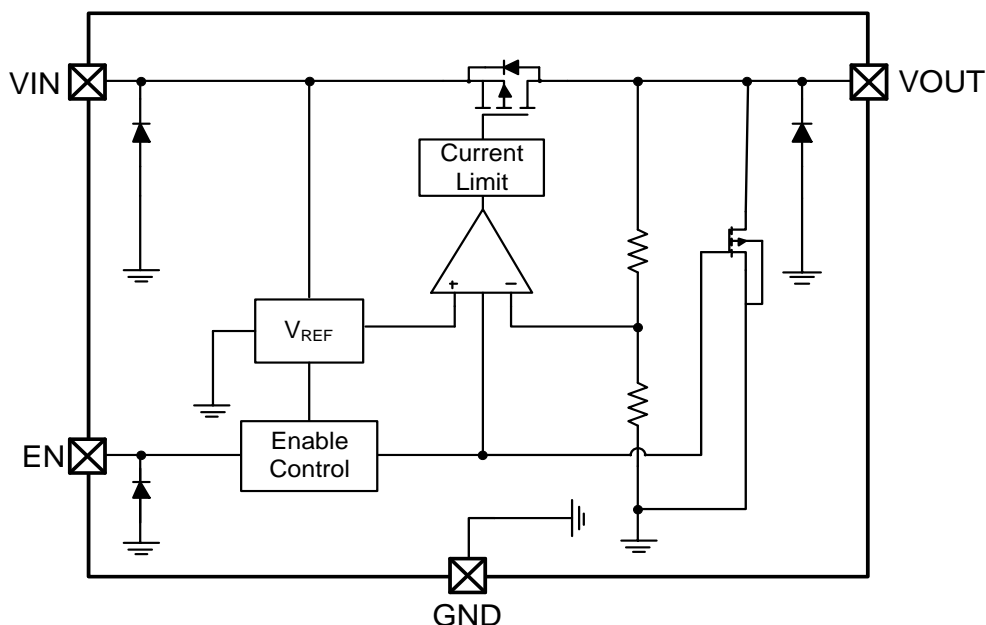 22 : 2.2V 25 : 2.5V 26 : 2.6V
  27 : 2.7V 28 : 2.8V 29 : 2.9V
  30 : 3.0V 33 : 3.3V 36 : 3.6V

- Output current tap
  L : 300mA

Function Block Diagram

Absolute Maximum Ratings [Note1]

Ratings at 25℃ ambient temperature unless otherwise specified.

Parameter		Value	Unit
Maximum Input Voltage		-0.3~8	V
Output Current		400	mA
Power Dissipation	SOT-23	400	mW
	SOT-89	600	mW
	SOT-23-3	450	mW
	SOT-23-5	450	mW
	DFN1x1-4L	550	mW
Thermal Resistance,Junction-to-Ambient	SOT-23	250	°C/W
	SOT-89	165	°C/W
	SOT-23-3	220	°C/W
	SOT-23-5	220	°C/W
	DFN1x1-4L	180	°C/W
Junction Temperature		-40 ~ +125	°C
Operating Ambient Temperature		-40 ~ +85	°C
Storage Temperature Range		-55~ +150	°C
Lead Temperature&Time		260°C,10S	--

Note1: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect.

Recommended Operating Conditions

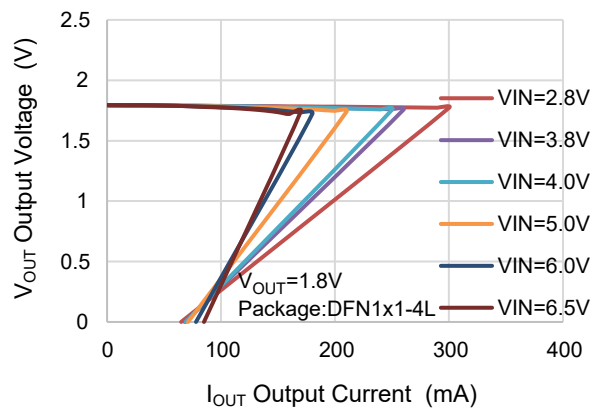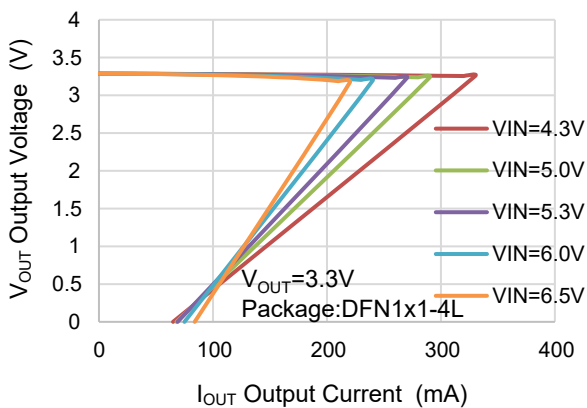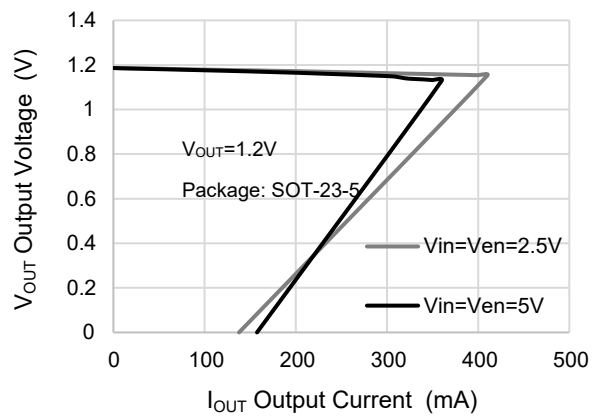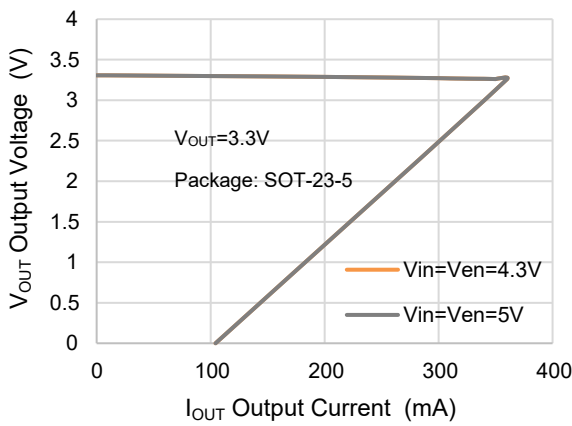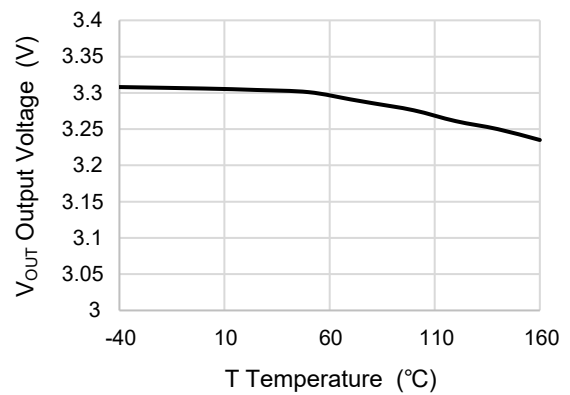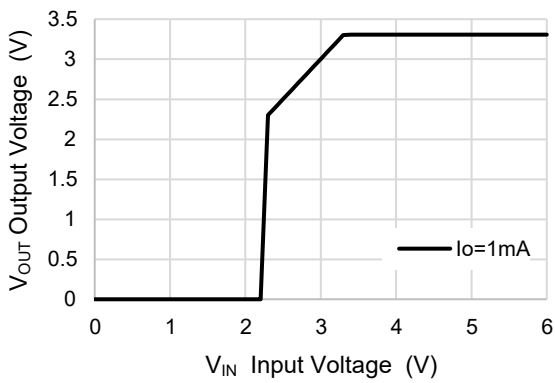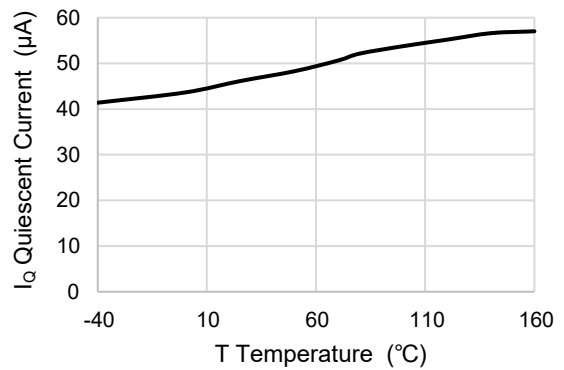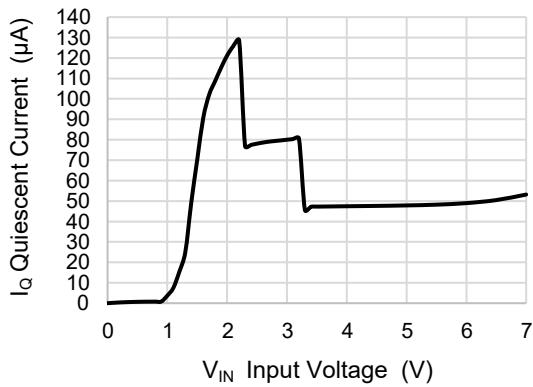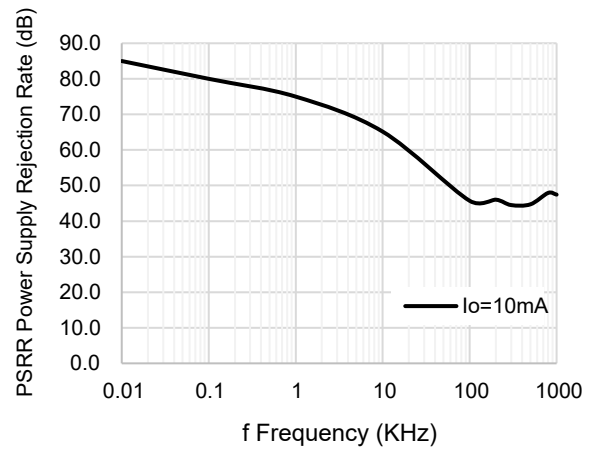| Parameter	Value	Unit
Supply Voltage	2.5~6.5	V
Maximum Output Current	300	mA
Operating Ambient Temperature	-40 ~ +85	°C

Typical Application Circuit
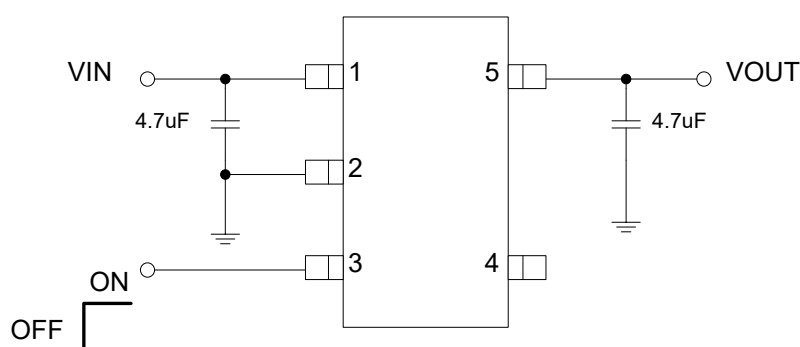
Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $T_A=25°C$, unless otherwise noted.)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage	V_{IN}		2.5	--	6.5	V
Output Voltage Accuracy	ΔV_{OUT}	$V_{OUT}<1.8V$ $V_{IN}=2.7V$, $I_{OUT}=1mA$	-3	--	+3	%
		$V_{OUT}≥1.8V$, $I_{OUT}=1mA$	-2	--	+2	%
Quiescent Current	I_Q	$V_{IN}=5V$, $I_{OUT}=0mA$	--	50	--	µA
Dropout Voltage	V_{DROP}	$V_{OUT}≥2.5V$, $I_{OUT}=200mA$	--	220	250	mV
		$V_{OUT}≥2.5V$, $I_{OUT}=300mA$	--	320	350	mV
Line Regulation	ΔV_{LINE}	$V_{IN}=2.7~5.5V$, $I_{OUT}=1mA$	--	0.01	0.15	%/V
Load Regulation	ΔV_{LOAD}	$V_{OUT}>1.8V$, $I_{OUT}=1~300mA$	--	40	70	mV
		$V_{OUT}≤1.8V$, $I_{OUT}=1~200mA$				
Short Circuit/Start Carrying Current	I_{SHORT}	$V_{EN}=V_{IN}$, VOUT Short to GND with 1Ω	--	100	--	mA
Current Limit	I_{LIMIT}	$V_{IN}=V_{OUT}+1V$	--	360	--	mA
Standby Current	$I_{Standby}$	$V_{EN}=0$	--	--	1	µA
Power Supply Rejection Rate	PSRR	$V_{IN}=5V_{DC}+0.5V_{P-P}$ f=1KHz, $I_{OUT}=10mA$	--	75	--	dB
		$V_{IN}=5V_{DC}+0.5V_{P-P}$ f=1MHz, $I_{OUT}=10mA$	--	45	--	dB
EN Logic High Voltage	V_{ENH}	$V_{IN}=5.5V$, $I_{OUT}=1mA$	1.2	--	V_{IN}	V
EN Logic Low Voltage	V_{ENIL}	$V_{IN}=5.5V$, $V_{OUT}=0V$	--	--	0.4	V
EN Input Current	I_{EN}	$V_{EN}=0~5.5V$	--	--	1.0	µA
Output Noise Voltage	eN	10Hz to 100KHz, $C_{OUT}=1µF$	--	100	--	$µV_{RMS}$
Output Discharge Resistance	R_{DIS}	$V_{IN}=5.0V$, $V_{EN}=0V$	--	160	--	Ω

Typical Electrical Curves

C_{IN}=4.7uF, C_{OUT}=4.7uF, V_{IN}=4.3V, V_{OUT}=3.3V T_A=25°C, Package is SOT-23-5(unless otherwise noted)

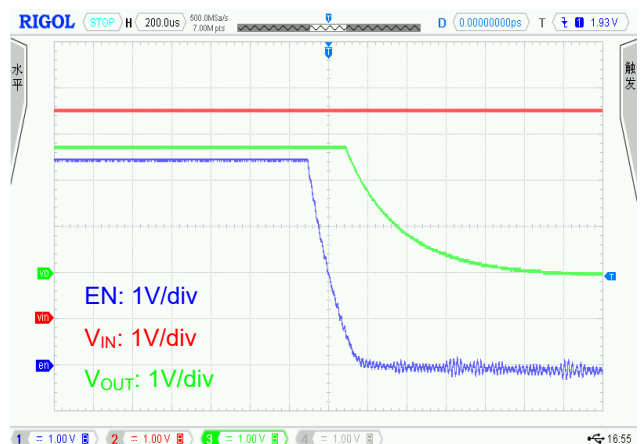I_{LIMIT} Current Limit (mA) vs V_{IN} Input Voltage (V), V_{OUT}=3.3V

I_{LIMIT} Current Limit (mA) vs V_{IN} Input Voltage (V), V_{OUT}=1.8V

V_{Drop} Dropout Voltage (mV) vs I_{OUT} Output Current (mA)

PSRR Power Supply Rejection Rate (dB) vs f Frequency (KHz), Io=10mA
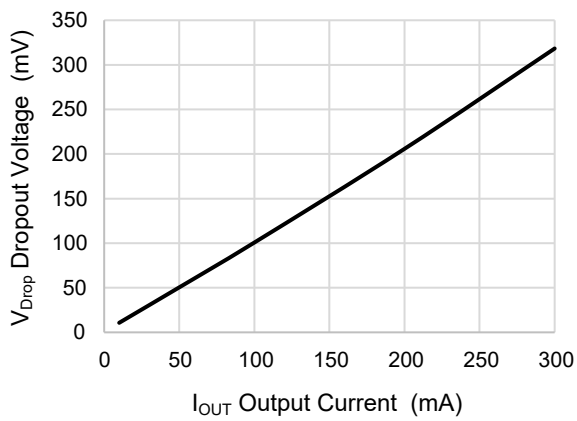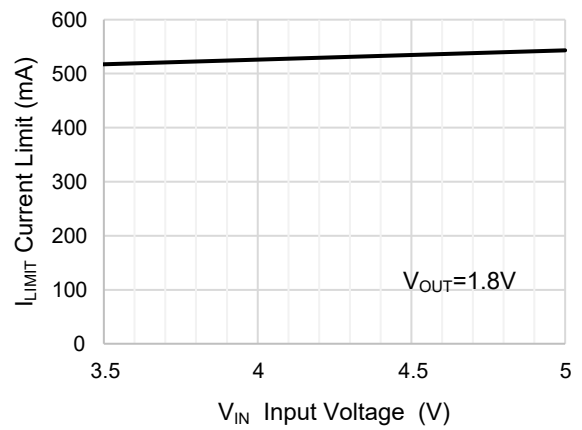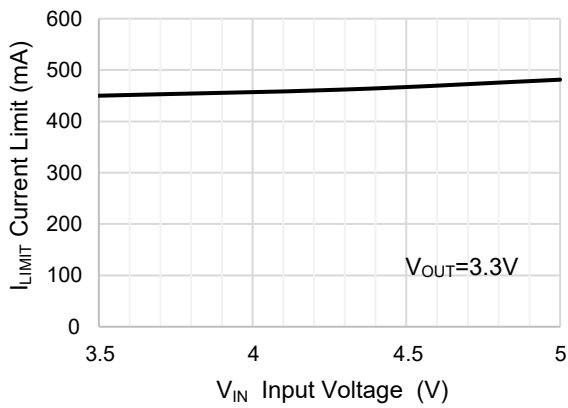
EN ON / OFF

V_{EN}=0V to 4.5V I_{OUT}=10mA

EN: 1V/div
V_{IN}: 1V/div
V_{OUT}: 1V/div

V_{EN}=4.5V to 0V I_{OUT}=10mA

EN: 1V/div
V_{IN}: 1V/div
V_{OUT}: 1V/div
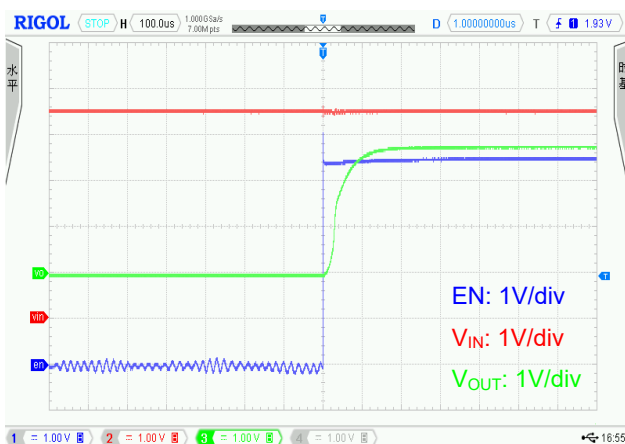
Power ON / OFF

V_{IN}=0V to 4.5V I_{OUT}=10mA

V_{IN}: 1V/div
V_{OUT}: 1V/div
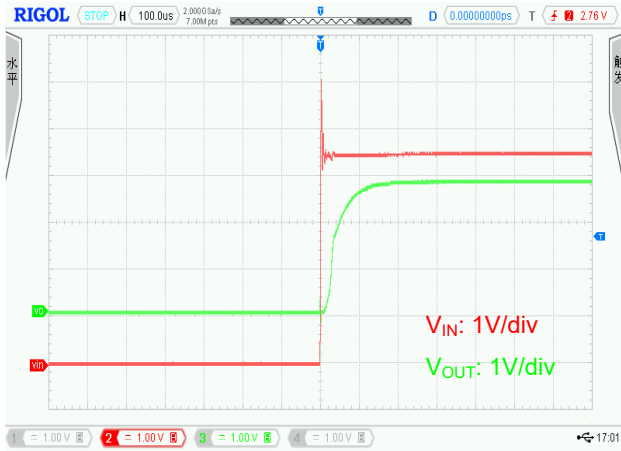
V_{IN}=4.5V to 0V I_{OUT}=10mA

V_{IN}: 1V/div
V_{OUT}: 1V/div

Line Transient

V_{IN}=4V to 5V I_{OUT}=10mA

V_{IN}: 1V/div
V_{OUT}: 100mV/div
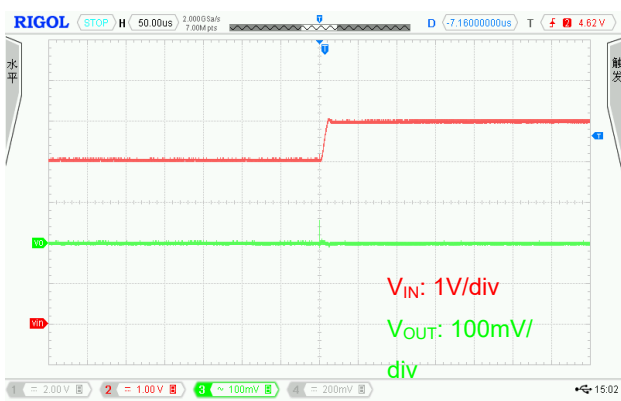
V_{IN}=5V to 4V I_{OUT}=10mA

V_{IN}: 1V/div
V_{OUT}: 100mV/div
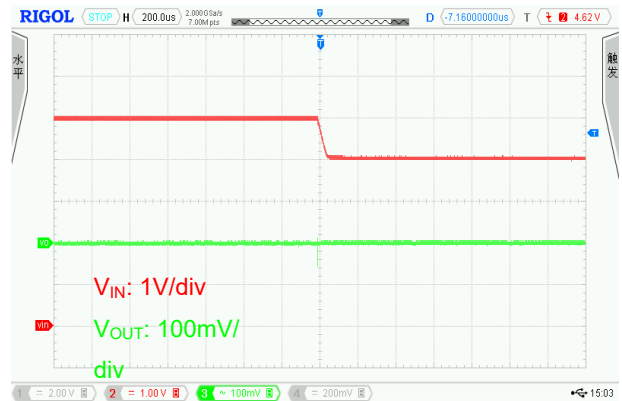
Load Transient

CH1: I_{OUT} CH2: V_{IN} CH3: V_{OUT}

V_{IN}=4.3V, V_{OUT}=3.3V I_{OUT}=1mA to

Cin: 4.7uF, Co: 1uF

V_{IN}=4.3V, V_{OUT}=3.3V I_{OUT}=1mA to 100mA
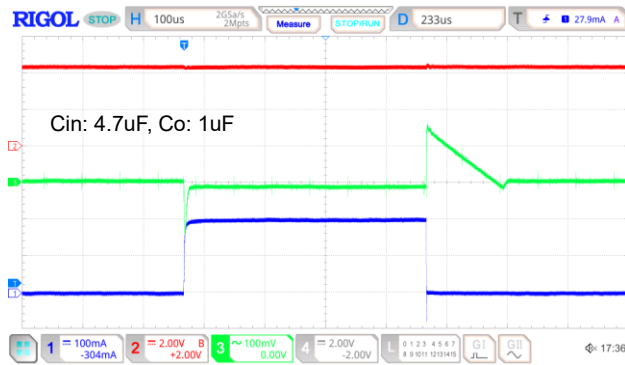
Cin: 4.7uF, Co: 1uF

V_{IN}=4.3V, V_{OUT}=3.3V I_{OUT}=1mA to 200mA

Cin: 4.7uF, Co: 1uF

V_{IN}=4.3V, V_{OUT}=3.3V I_{OUT}=1mA to 300mA

Cin: 4.7uF, Co: 1uF

V_{IN}=4.3V, V_{OUT}=3.3V I_{OUT}=1mA to 200mA

Cin: 4.7uF, Co: 4.7uF

V_{IN}=4.3V, V_{OUT}=3.3V I_{OUT}=1mA to 300mA

Cin: 4.7uF, Co: 4.7uF
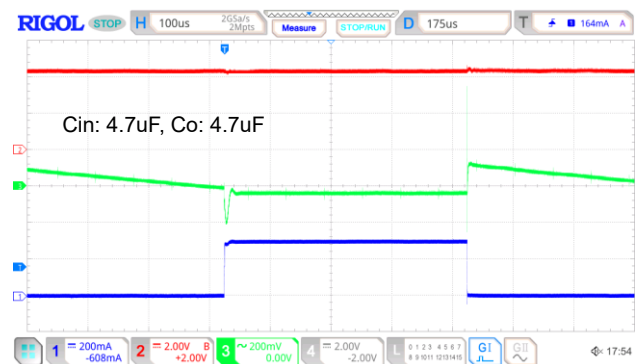
V_{IN}=2.8V, V_{OUT}=1.2V I_{OUT}=1mA to 300mA

Cin: 1uF, Co: 1uF

V_{IN}=3.3V, V_{OUT}=1.2V I_{OUT}=1mA to 300mA

Cin: 1uF, Co: 1uF
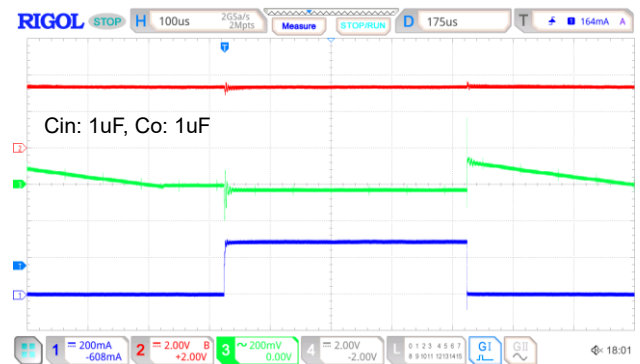
V_{IN}=4V, V_{OUT}=1.2V I_{OUT}=1mA to 300mA

Cin: 1uF, Co: 1uF
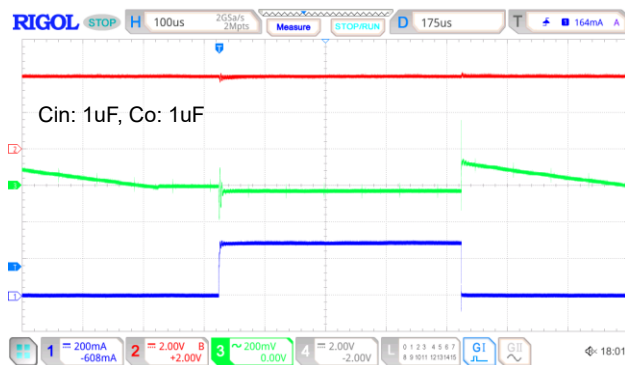
V_{IN}=5V, V_{OUT}=1.2V I_{OUT}=1mA to 300mA

Cin: 1uF, Co: 1uF
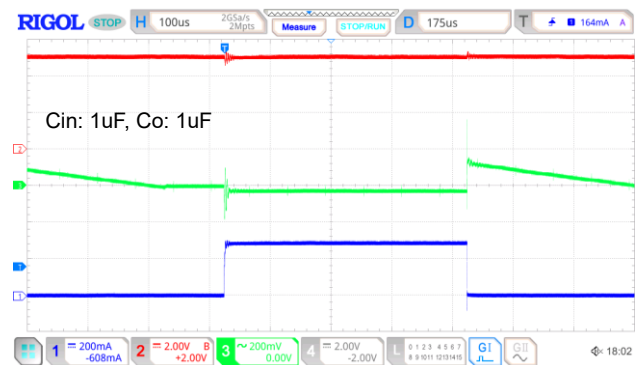
Function Descriptions

A minimum of 1uF capacitor must be connected from Vout to ground to insure stability. Input capacitor of 1uF is recommended to ensure the input voltage does not sag below the minimum dropout voltage during load transient event. Vin pin must always be dropout voltage higher than Vout in order for the device to regulate properly.

Application Information

SL9350 Series requires input and output decoupling capacitors. The device is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance. Please note that linear regulators with a low dropout voltage have high internal loop gains, which require care in guarding against oscillation caused by insufficient decoupling capacitors.

Capacitor Selection

Normally, use a 1μF capacitor on the input and a 1μF capacitor on the output of the SL9350 Series. Larger input capacitor values and lower ESR (X5R, X7R) provide better supply noise rejection and transient response. A higher value output capacitor (4.7μF) may be necessary if large, fast transients are anticipated and the device is located several inches from the power source.

Input-Output (Dropout) Voltage

A regulator's minimum input-to-output voltage differential (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the device uses a PMOS, its dropout voltage is a function of drain to source on resistance, RDS (on), multiplied by the load current:

$$VDROP = VIN - VOUT = RDS (on) \times IOUT$$

Current Limit and Thermal Shutdown Protection

In order to prevent overloading or thermal condition from damaging the device, SL9350 Series has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during overloading or over temperature condition.

Thermal Considerations

The SL9350 Series can deliver a current of up to 300mA over the full operating junction temperature range. However, the maximum output current must be controlled at higher ambient temperature to ensure the junction temperature does not exceed 150°C. 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.

$$PD = (VIN - VOUT) \times IOUT$$

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

$$PD (max) = (Tj (max) - Ta) / R\theta JA$$

Where Tj (max) is the maximum junction temperature of the die (150°C) and Ta is the maximum ambient temperature.

PCB Layout

An input capacitance of $\cong 4.7μF$ is required between the SL9350 Series input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input voltage spikes caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire. Otherwise, the actual voltage at the Vin pin may exceed the absolute maximum rating. The output capacitor also must be located a distance of not more than 1cm from output to a clean analog ground. Because it can filter out the output spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire.
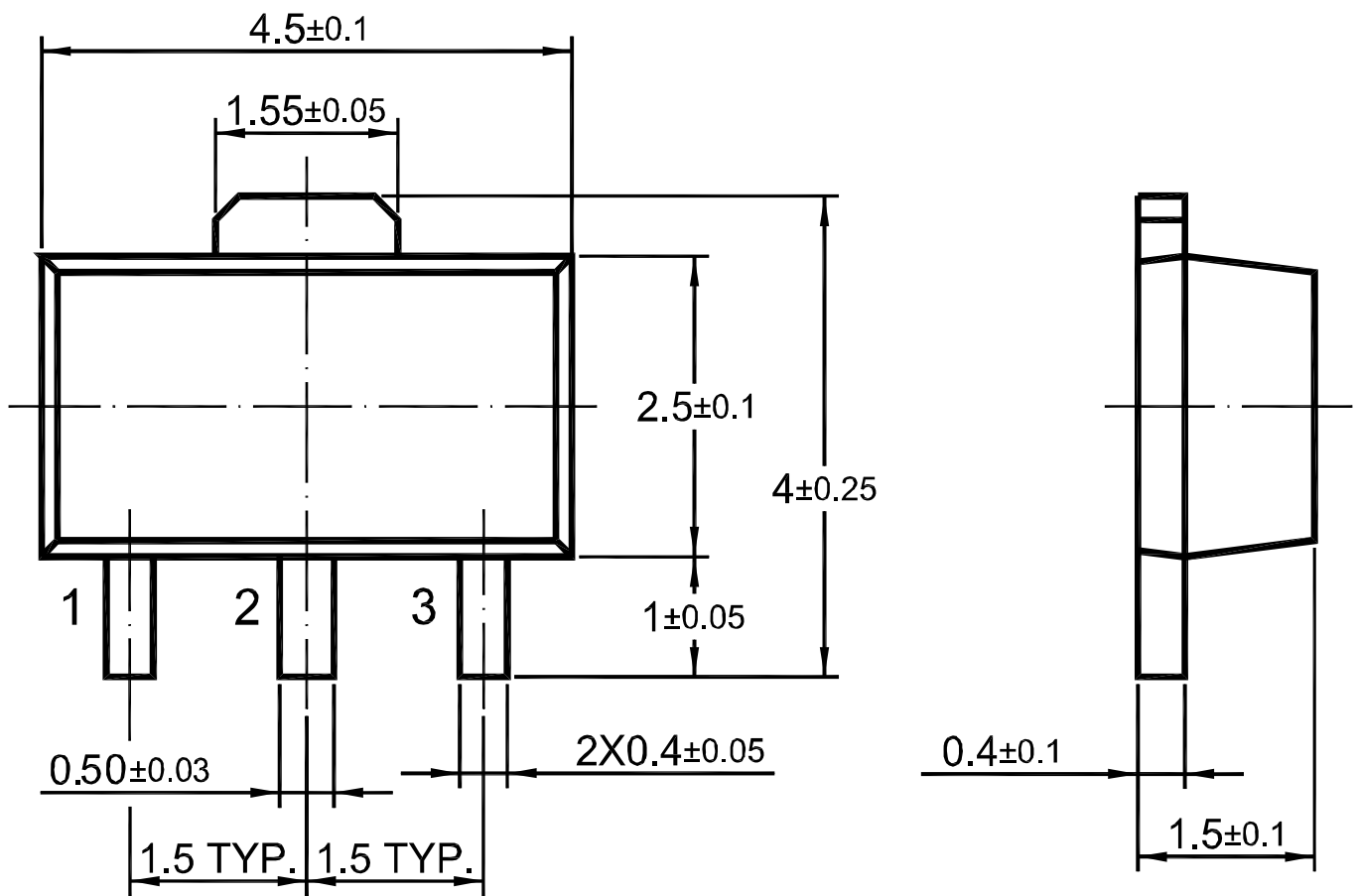
Package Outline

SOT-23
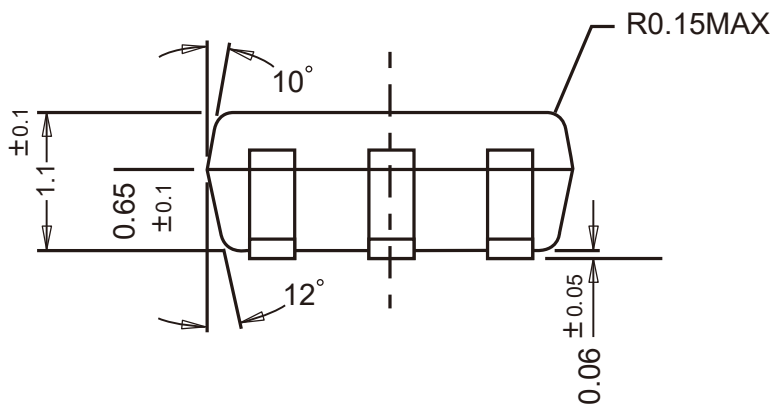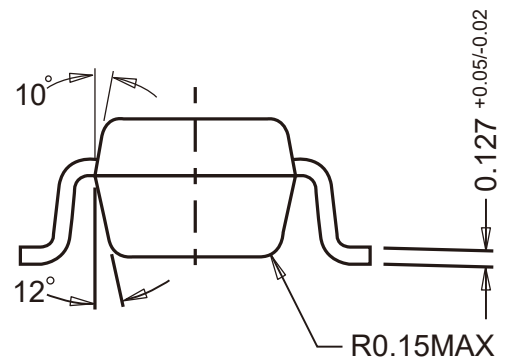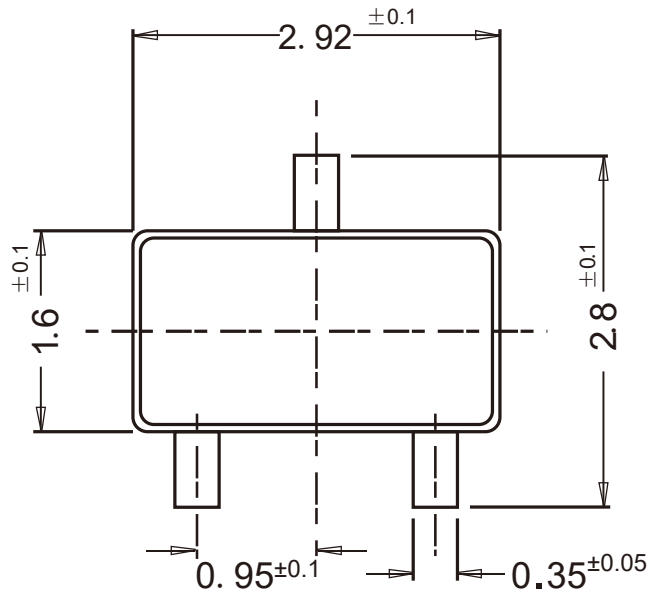
Dimensions in mm

SEE VIEW
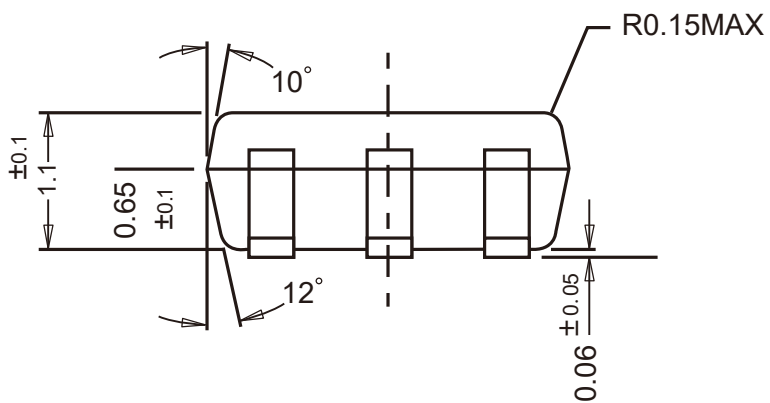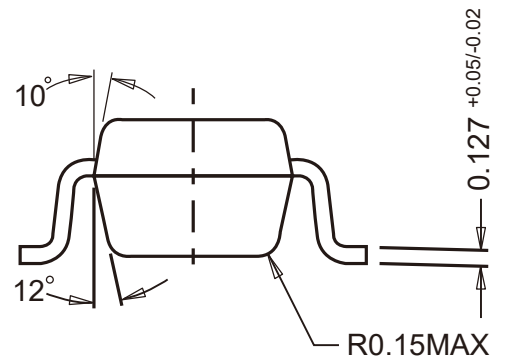
VIEW C
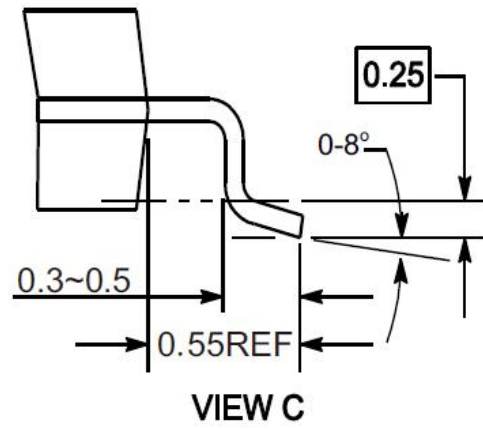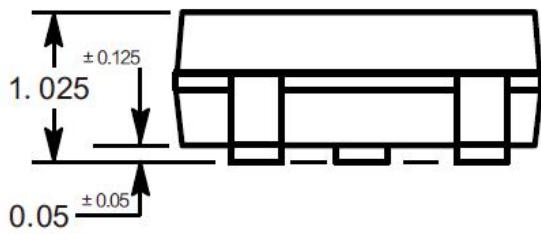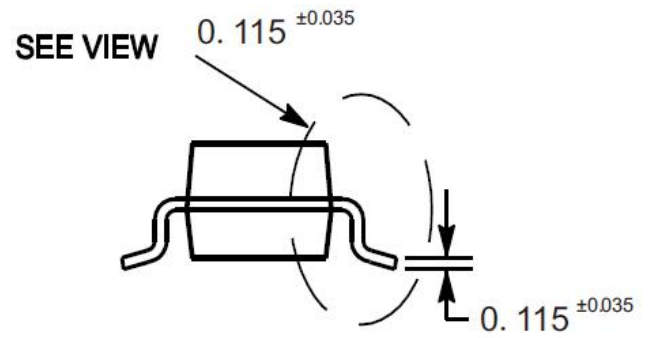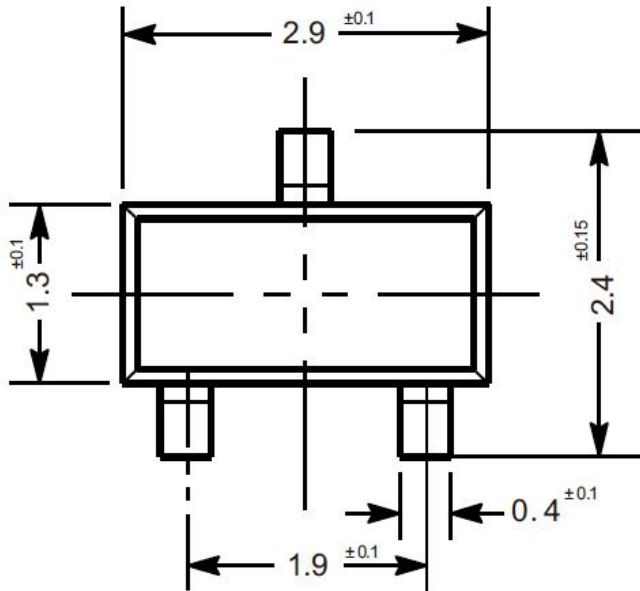
Package Outline
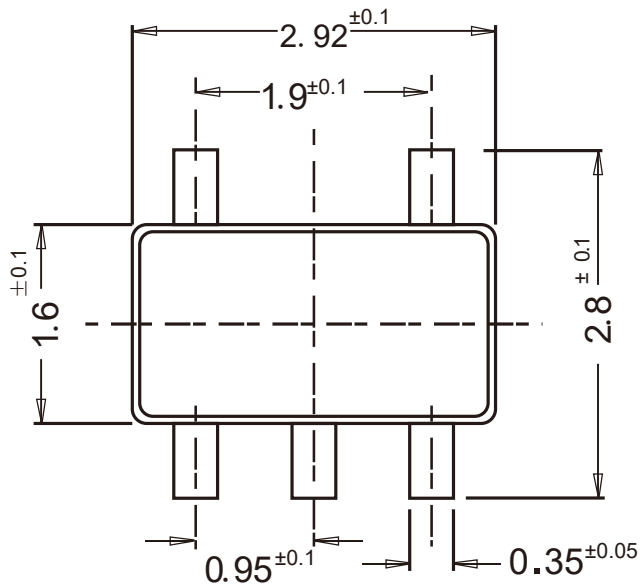
SOT-89

Dimensions in mm

Package Outline

SOT-23-3
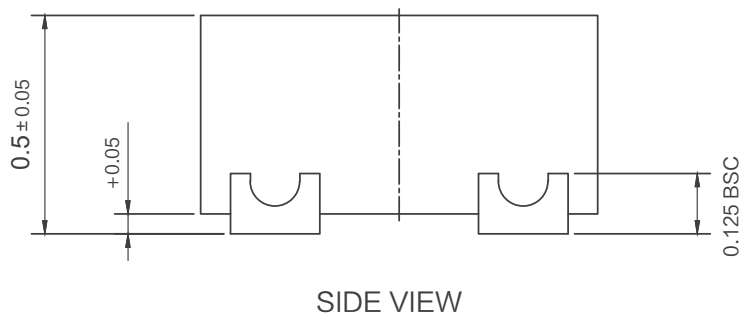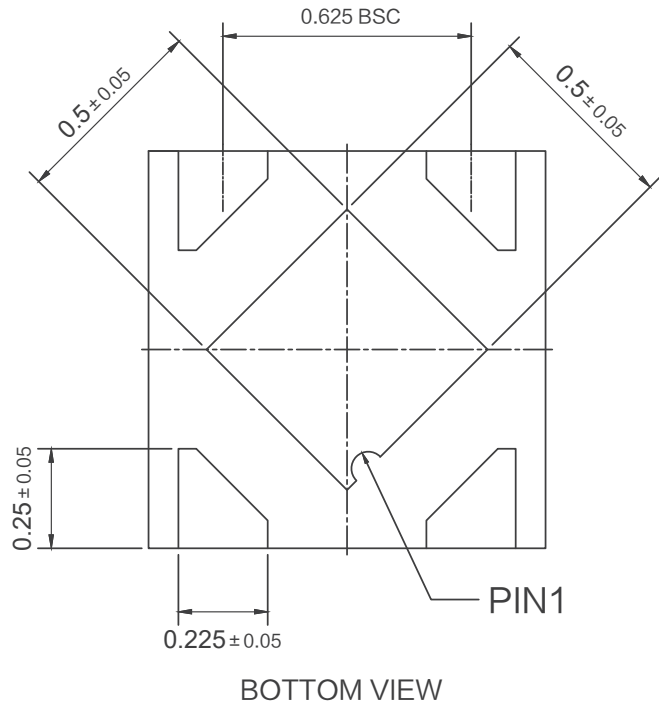
Dimensions in mm

Package Outline

SOT-23-5
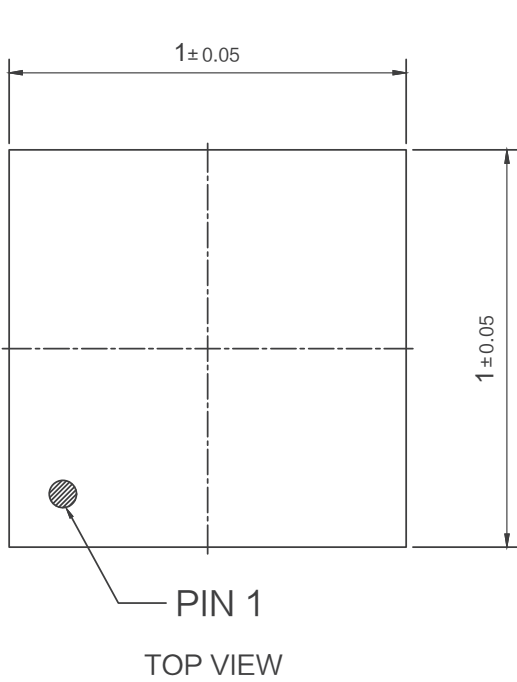Dimensions in mm

Package Outline

DFN1x1-4L

Dimensions in mm

TOP VIEW

BOTTOM VIEW

SIDE VIEW

PIN 1

PIN1

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