



## Description

PJ9350 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.

PJ9350 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.

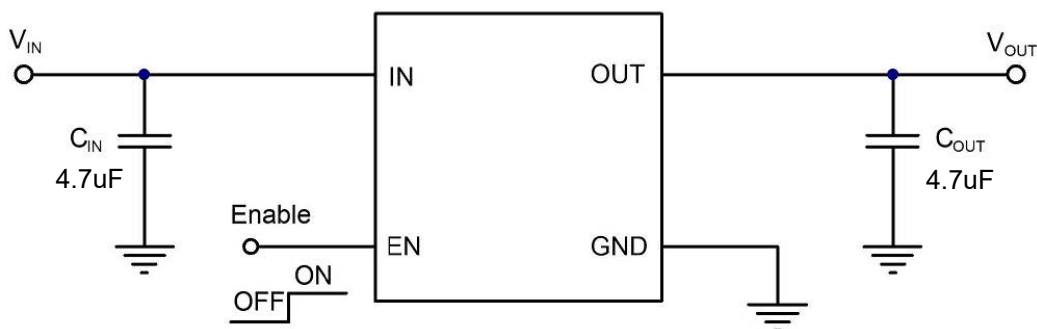
## Features

- Wide Input Voltage Range: 2.5V to 6.5V
- Maximum Output Current: 400mA(@ $V_{IN}-V_{OUT}=0.5V$ )
- Standard Fixed Output Voltage Options: 1.2V~3.6V(customized by every 0.1V step)
- Low Quiescent Current: 50uA(Typ.)
- PSRR=75dB@1KHz
- Low Dropout Voltage: 220mV@ $I_{OUT}=200mA$
- Low Output Voltage Accuracy:  $\pm 2\%$
- VOUT fast discharge
- Fold-back circuit current limit
- Available Packages: SOT-23, SOT-23-3, SOT-89, SOT-23-5 and DFN1x1-4L

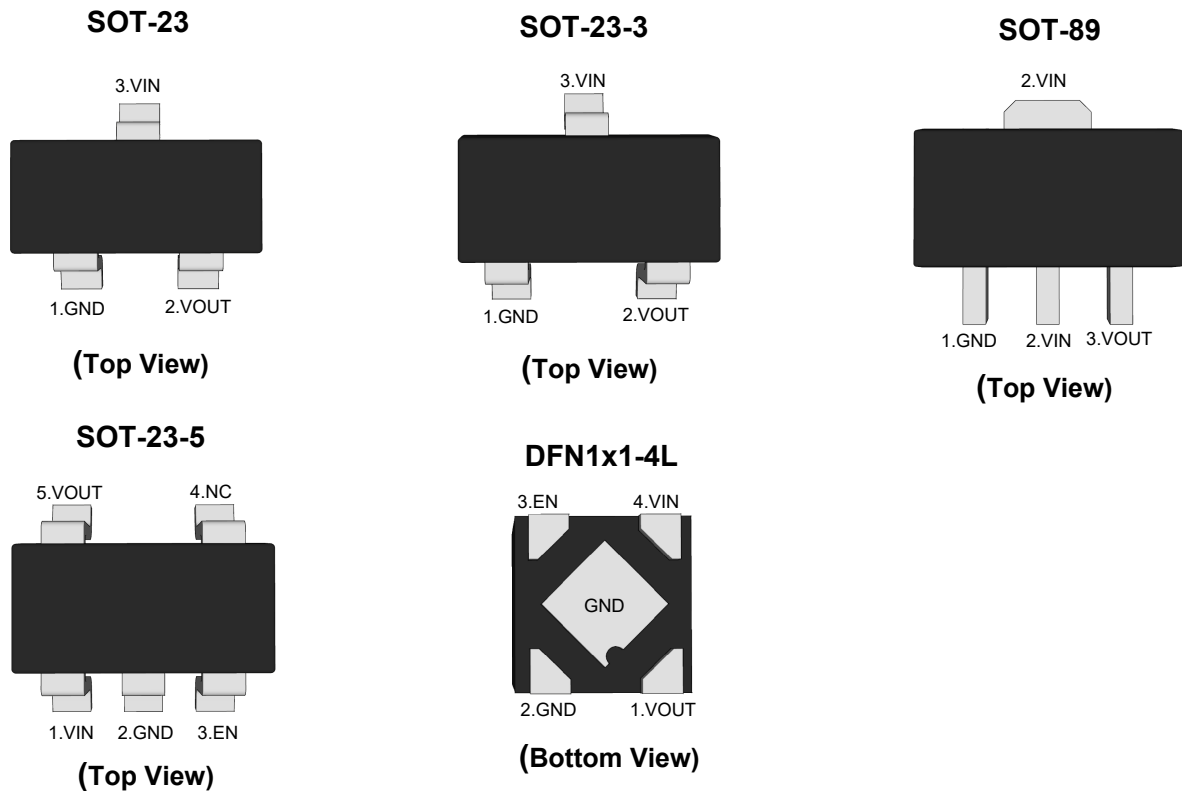
## Applications

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

## Typical Application Circuit



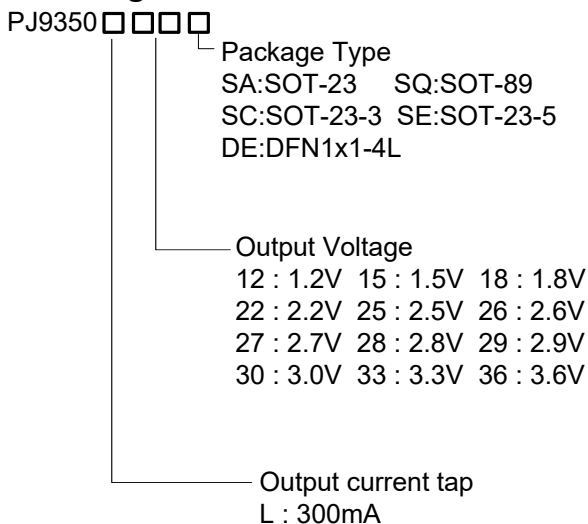
### Pin Distribution



### 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

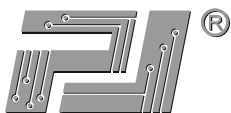
### Ordering Information



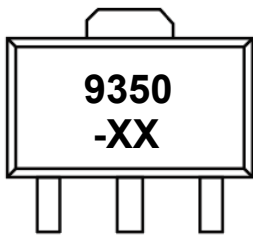
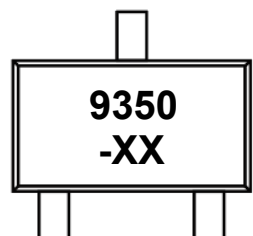


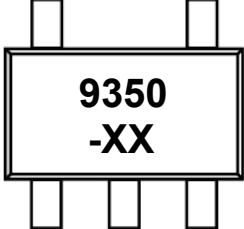
# PJ9350 Series Low Dropout Regulators

Orderable Device	Package	Reel (inch)	Package Qty (PCS)	Eco Plan <sup>Note</sup>	MSL Level	Marking Code
PJ9350L12SA	SOT-23	7	3000	RoHS & Green	MSL1	 <p>XX: Output Voltage e.g. 1.8:1.8V</p>
PJ9350L15SA						
PJ9350L18SA						
PJ9350L22SA						
PJ9350L25SA						
PJ9350L26SA						
PJ9350L27SA						
PJ9350L28SA						
PJ9350L29SA						
PJ9350L30SA						
PJ9350L33SA						
PJ9350L36SA						



# PJ9350 Series Low Dropout Regulators

PJ9350L12SQ	SOT-89	7/13	1000/3000	RoHS & Green	MSL1	 <p>9350 -XX</p> <p>XX: Output Voltage e.g. 1.8:1.8V</p>
PJ9350L15SQ						
PJ9350L18SQ						
PJ9350L22SQ						
PJ9350L25SQ						
PJ9350L26SQ						
PJ9350L27SQ						
PJ9350L28SQ						
PJ9350L29SQ						
PJ9350L30SQ						
PJ9350L33SQ						
PJ9350L36SQ						
PJ9350L12SC	SOT-23-3	7	3000	RoHS & Green	MSL3	 <p>9350 -XX</p> <p>XX: Output Voltage e.g. 1.8:1.8V</p>
PJ9350L15SC						
PJ9350L18SC						
PJ9350L22SC						
PJ9350L25SC						
PJ9350L26SC						
PJ9350L27SC						
PJ9350L28SC						
PJ9350L29SC						
PJ9350L30SC						
PJ9350L33SC						
PJ9350L36SC						

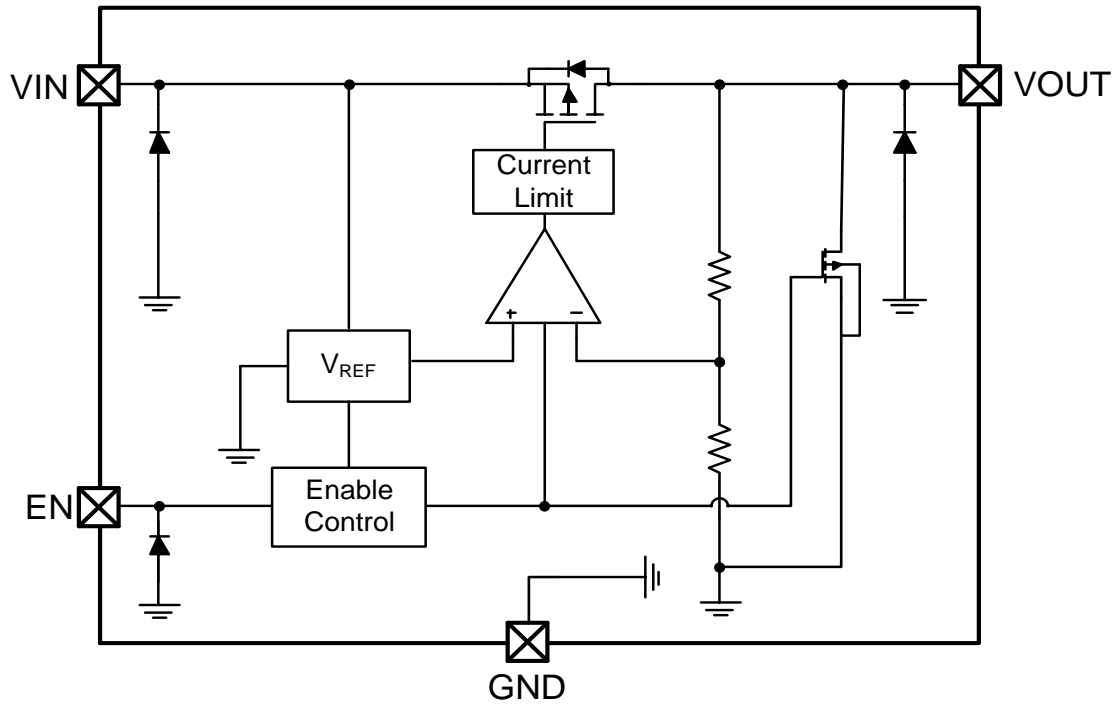
PJ9350L12SE	SOT-23-5	7	3000	RoHS & Green	MSL3	 <p>XX: Output Voltage e.g. 1.8:1.8V</p>
PJ9350L15SE						
PJ9350L18SE						
PJ9350L22SE						
PJ9350L25SE						
PJ9350L26SE						
PJ9350L27SE						
PJ9350L28SE						
PJ9350L29SE						
PJ9350L30SE						
PJ9350L33SE						
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PJ9350L22DE						
PJ9350L25DE						
PJ9350L26DE						
PJ9350L27DE						
PJ9350L28DE						
PJ9350L29DE						
PJ9350L30DE						
PJ9350L33DE						
PJ9350L36DE						

**Note:**

RoHS: PJ defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials.

Green: PJ defines "Green" to mean Halogen-Free and Antimony-Free.

### Function Block Diagram





# PJ9350 Series Low Dropout Regulators

## Absolute Maximum Ratings <sup>Note1</sup>

Ratings at 25°C 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	--
ESD Voltage	HBM	2	KV

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



### Electrical Characteristics

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

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage	$V_{IN}$		2.5	--	6.5	V
Output Voltage Accuracy	$\Delta V_{OUT}$	$V_{OUT} < 1.8V$ , $V_{IN}=2.7V$ , $I_{OUT}=1mA$	-3	--	+3	%
		$V_{OUT} \geq 1.8V$ , $I_{OUT}=1mA$	-2	--	+2	%
Quiescent Current	$I_Q$	$V_{IN}=5V$ , $I_{OUT}=0mA$	--	50	--	$\mu A$
Dropout Voltage	$V_{DROP}$	$V_{OUT} \geq 2.5V$ , $I_{OUT}=200mA$	--	220	250	mV
		$V_{OUT} \geq 2.5V$ , $I_{OUT}=300mA$	--	320	350	mV
Line Regulation	$\Delta V_{LINE}$	$V_{IN}=2.7\sim 5.5V$ , $I_{OUT}=1mA$	--	0.01	0.15	%/V
Load Regulation	$\Delta V_{LOAD}$	$V_{OUT} > 1.8V$ , $I_{OUT}=1\sim 300mA$	--	40	70	mV
		$V_{OUT} \leq 1.8V$ , $I_{OUT}=1\sim 200mA$				
Short Circuit/Start Carrying Current	$I_{SHORT}$	$V_{EN}=V_{IN}$ , $V_{OUT}$ Short to GND with $1\Omega$	--	100	--	mA
Current Limit	$I_{LIMIT}$	$V_{IN}=V_{OUT}+1V$	--	360	--	mA
Standby Current	$I_{Standby}$	$V_{EN}=0$	--	--	1	$\mu A$
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	$I_{EN}$	$V_{EN}=0\sim 5.5V$	--	--	1.0	$\mu A$
Output Noise Voltage	eN	10Hz to 100KHz, $C_{OUT}=1\mu F$	--	100	--	$\mu V_{RMS}$
Output Discharge Resistance	$R_{DIS}$	$V_{IN}=5.0V$ , $V_{EN}=0V$	--	160	--	$\Omega$

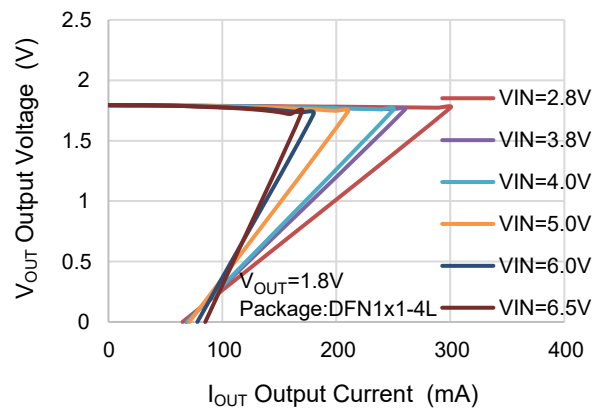
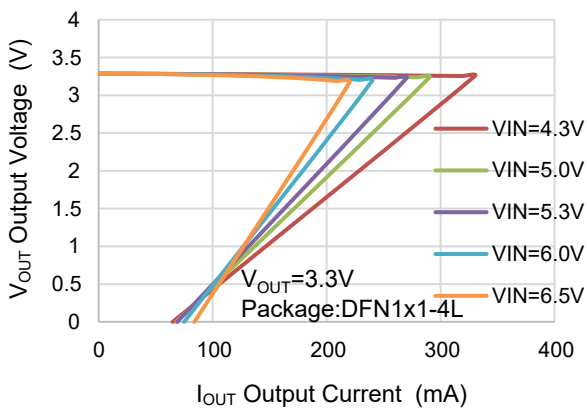
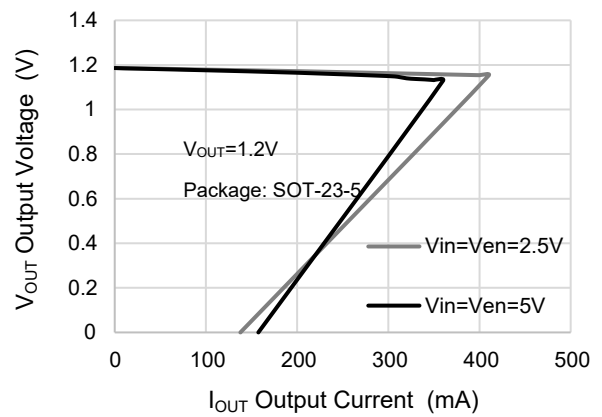
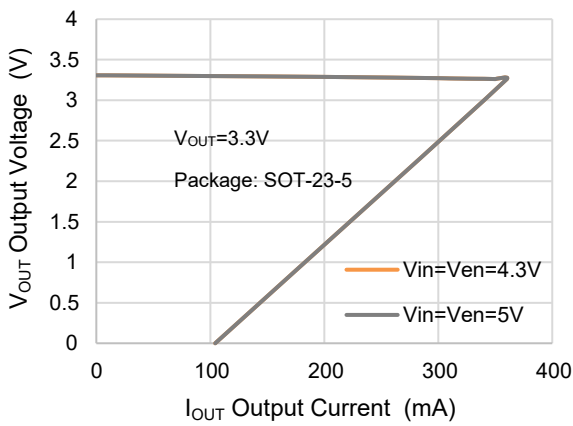
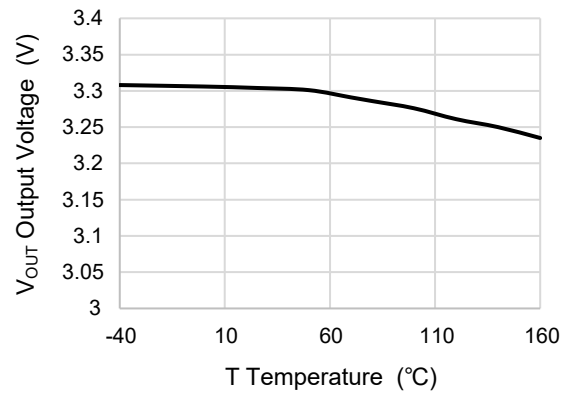
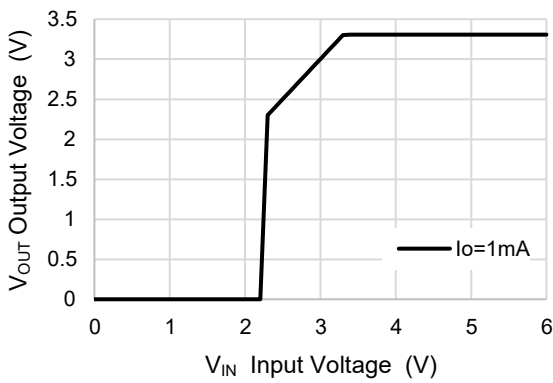
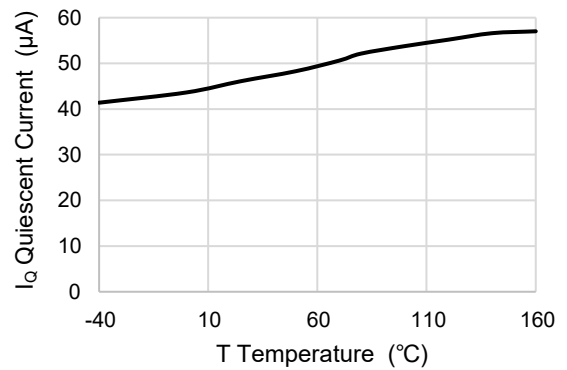
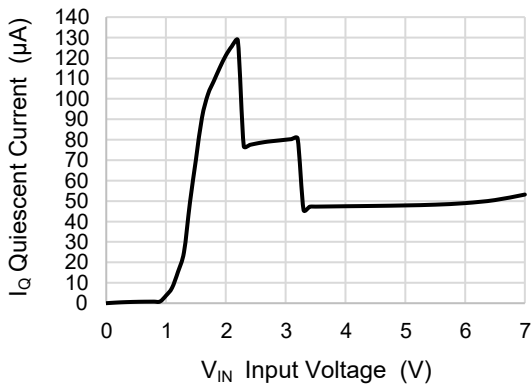




# PJ9350 Series Low Dropout Regulators

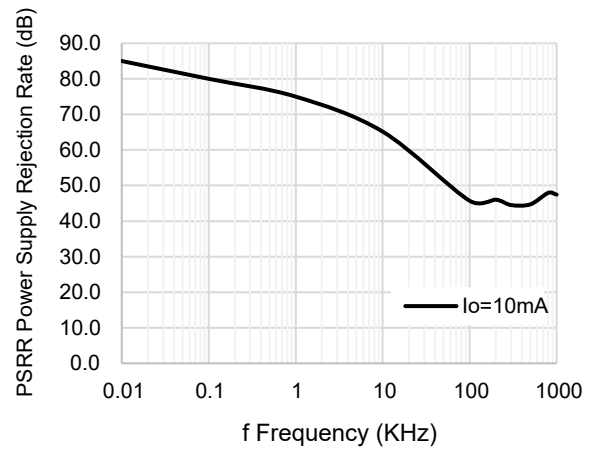
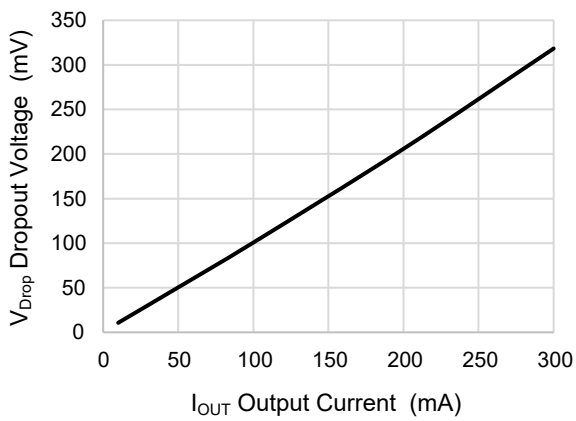
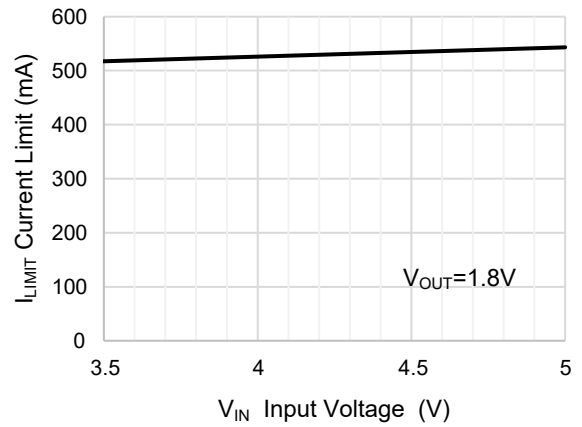
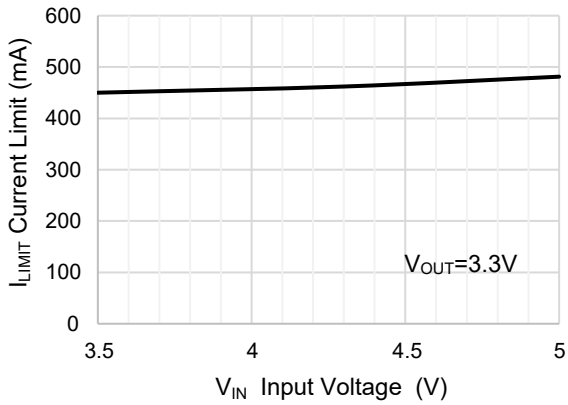
## Typical Electrical Curves

$C_{IN}=4.7\mu F$ ,  $C_{OUT}=4.7\mu F$ ,  $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$   $T_A=25^\circ C$ , Package is SOT-23-5(unless otherwise noted)



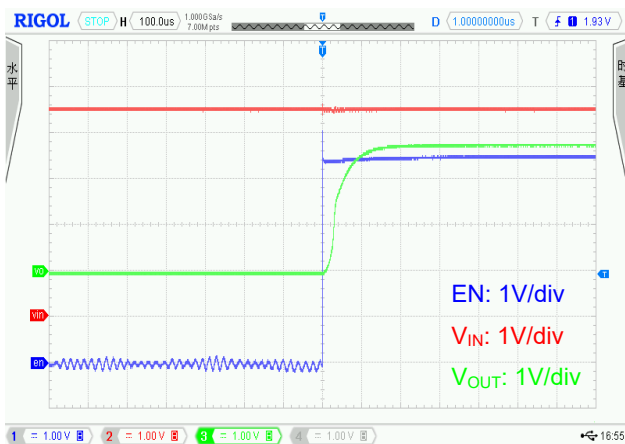


# PJ9350 Series Low Dropout Regulators

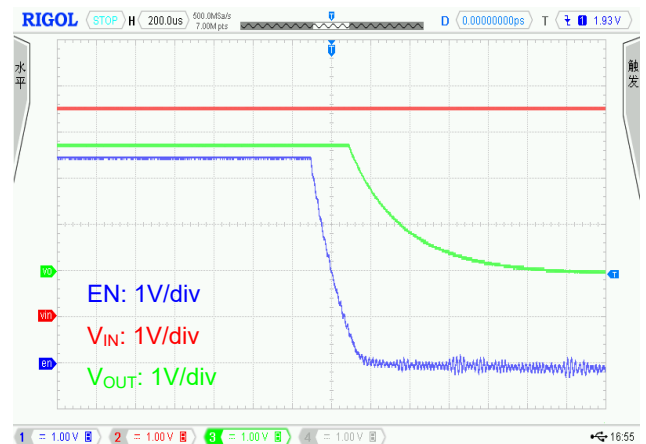


## EN ON / OFF

V<sub>EN</sub>=0V to 4.5V      I<sub>OUT</sub>=10mA



V<sub>EN</sub>=4.5V to 0V      I<sub>OUT</sub>=10mA

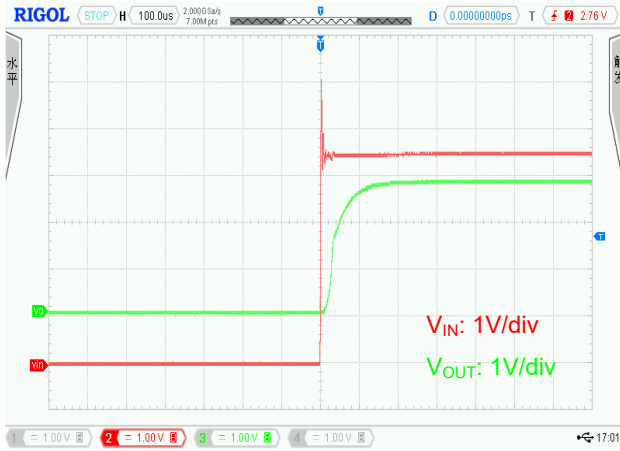




# PJ9350 Series Low Dropout Regulators

## Power ON / OFF

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

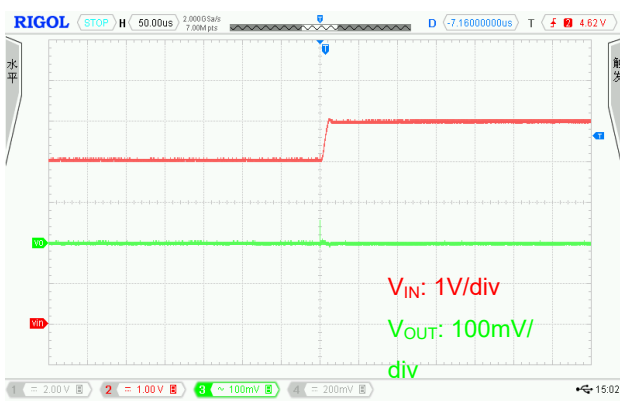


$V_{IN}=4.5V$  to  $0V$        $I_{OUT}=10mA$

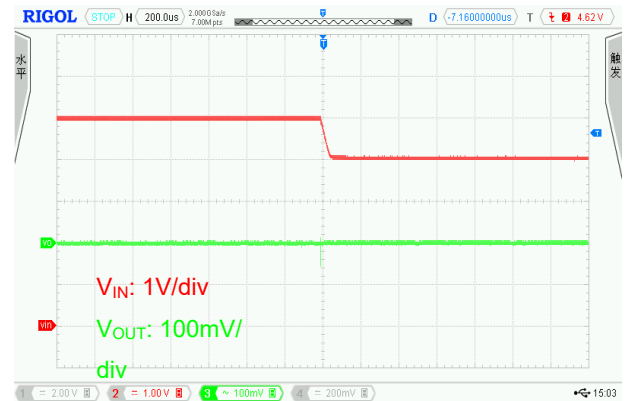


## Line Transient

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



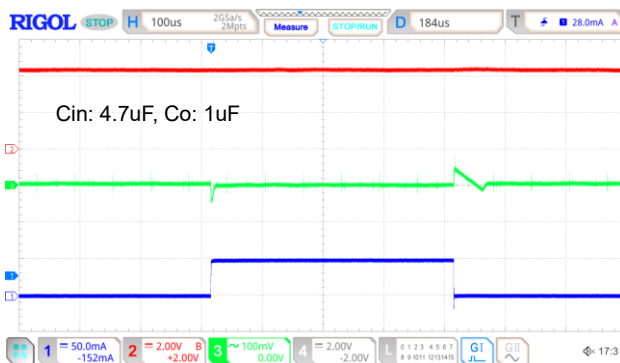
$V_{IN}=5V$  to  $4V$        $I_{OUT}=10mA$



## Load Transient

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

$V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$        $I_{OUT}=1mA$  to  $50mA$



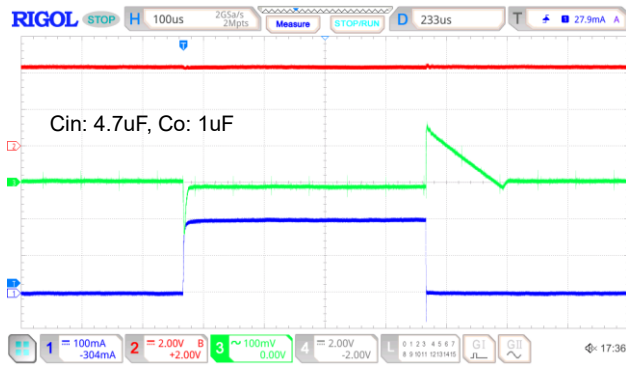
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# PJ9350 Series Low Dropout Regulators

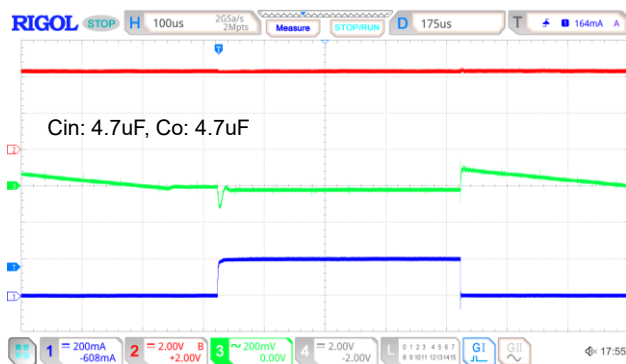
$V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$   $I_{OUT}=1mA$  to  $200mA$



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



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



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



$V_{IN}=2.8V$ ,  $V_{OUT}=1.2V$   $I_{OUT}=1mA$  to  $300mA$



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



$V_{IN}=4V$ ,  $V_{OUT}=1.2V$   $I_{OUT}=1mA$  to  $300mA$



$V_{IN}=5V$ ,  $V_{OUT}=1.2V$   $I_{OUT}=1mA$  to  $300mA$





## Function Descriptions

A minimum of 1 $\mu$ F capacitor must be connected from Vout to ground to insure stability. Input capacitor of 1 $\mu$ F 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

PJ9350 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 1 $\mu$ F capacitor on the input and a 1 $\mu$ F capacitor on the output of the PJ9350 Series. Larger input capacitor values and lower ESR (X5R, X7R) provide better supply noise rejection and transient response. A higher value output capacitor (4.7 $\mu$ F) 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. PJ9350 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 PJ9350 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 about 4.7 $\mu$ F is required between the PJ9350 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.

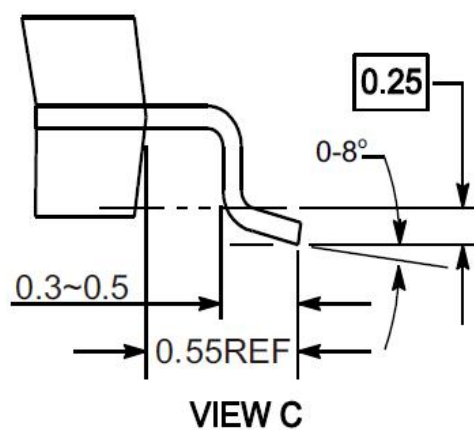
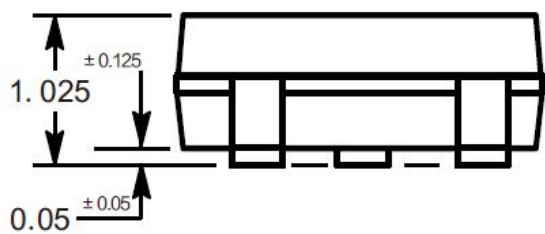
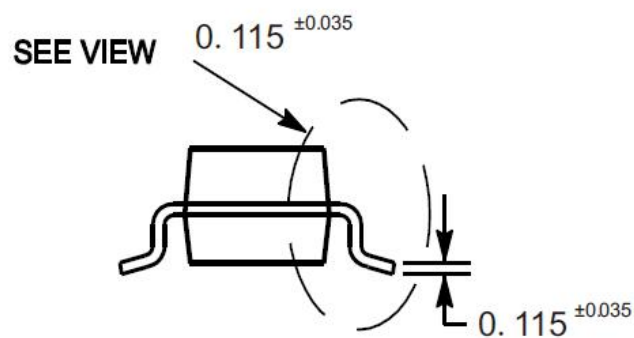
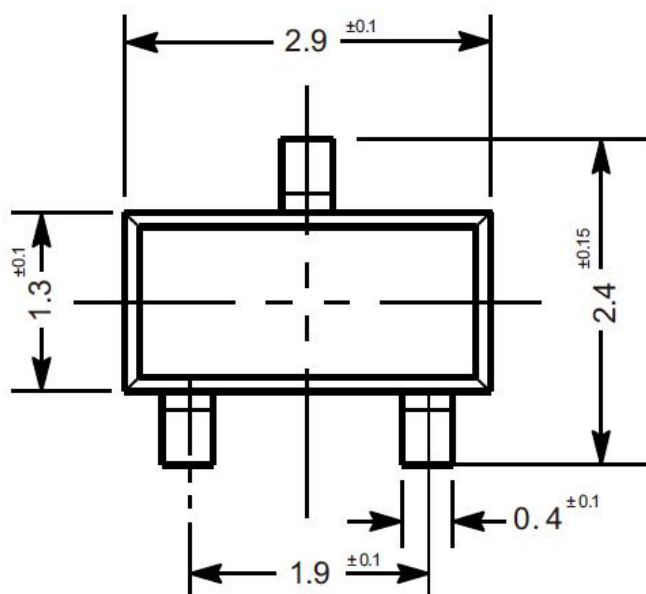


# PJ9350 Series Low Dropout Regulators

## Package Outline

SOT-23

Dimensions in mm

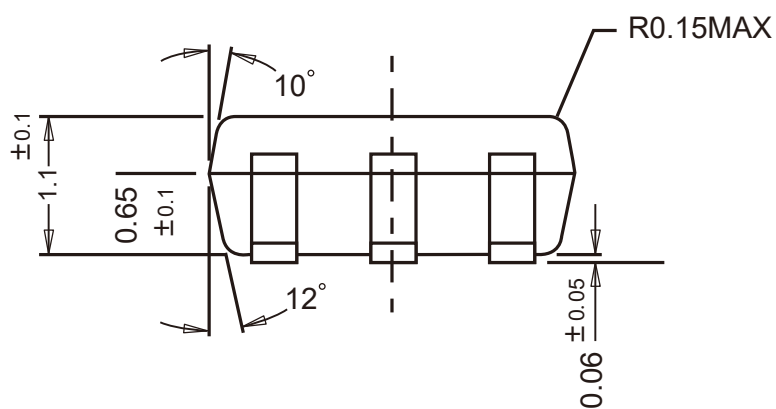
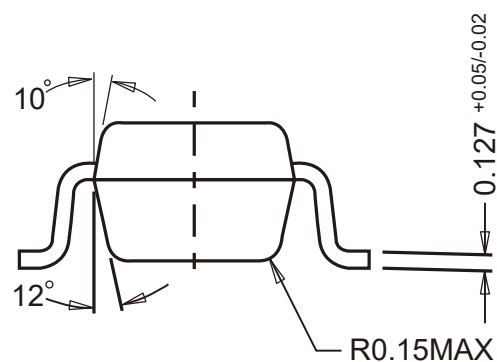
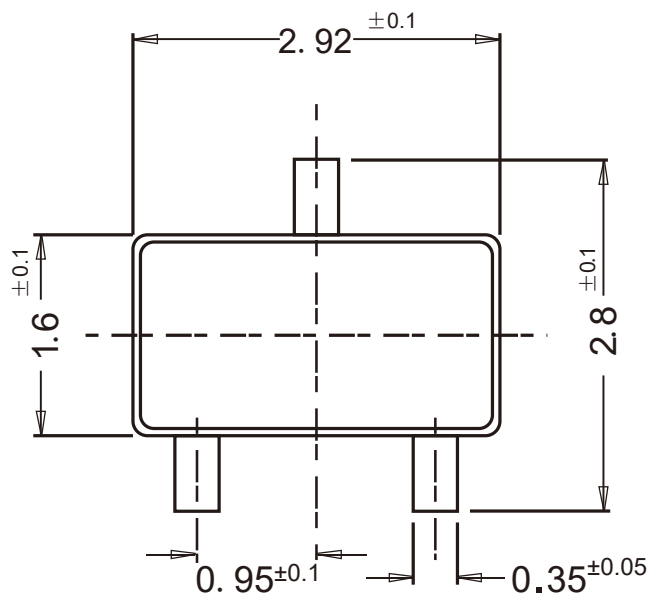




### Package Outline

SOT-23-3

Dimensions in mm

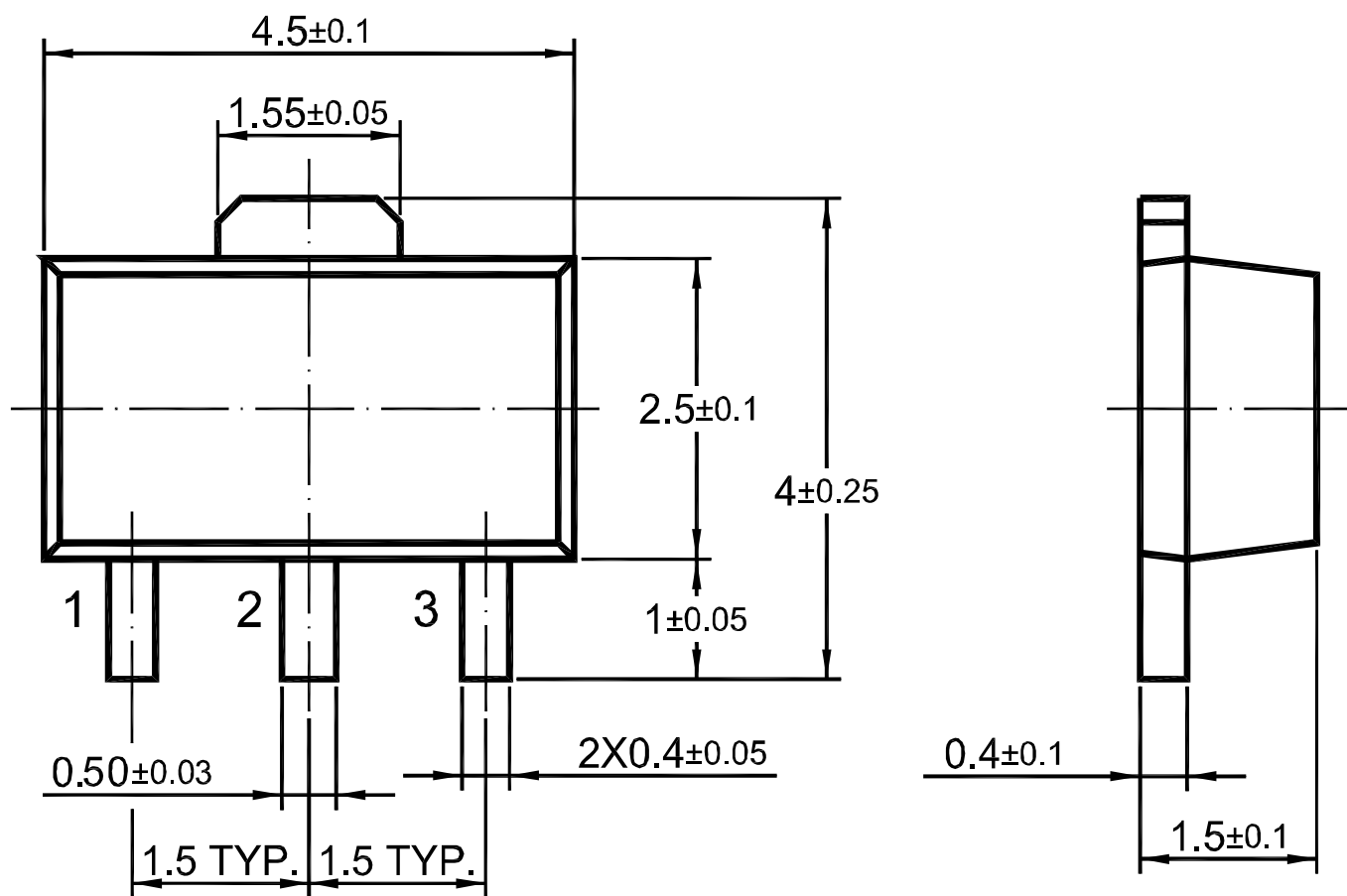




### Package Outline

SOT-89

Dimensions in mm





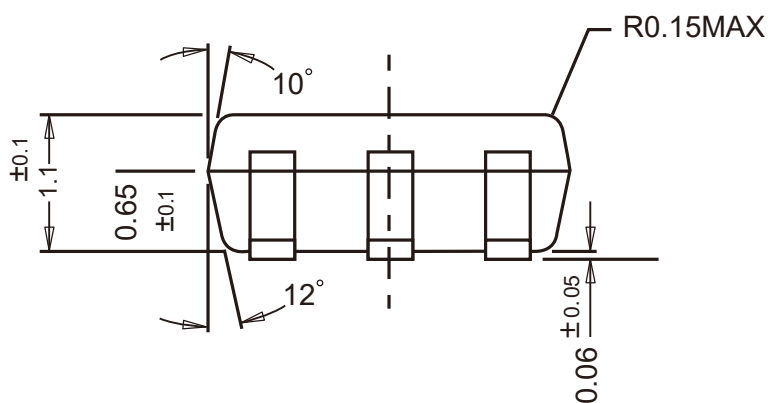
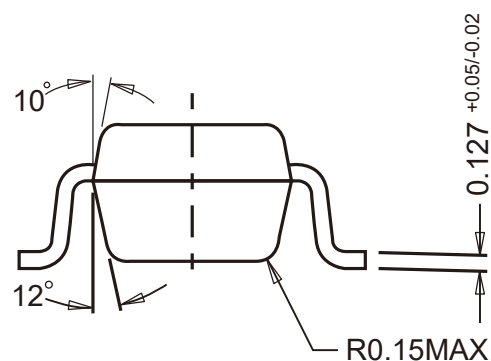
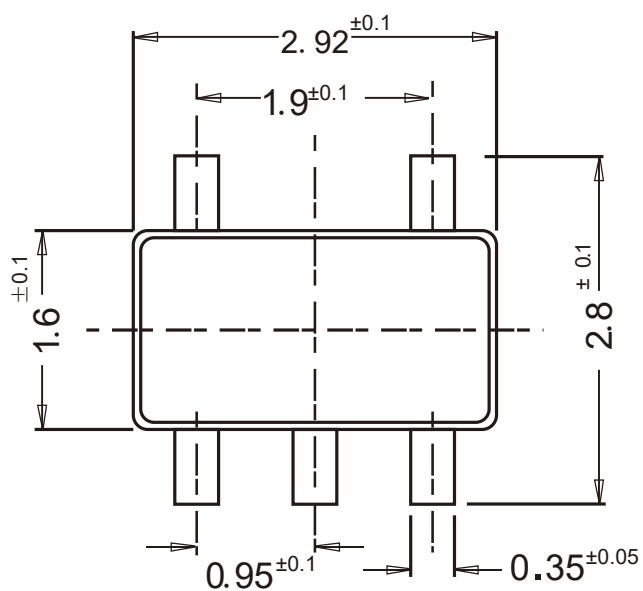


# PJ9350 Series Low Dropout Regulators

## Package Outline

SOT-23-5

Dimensions in mm

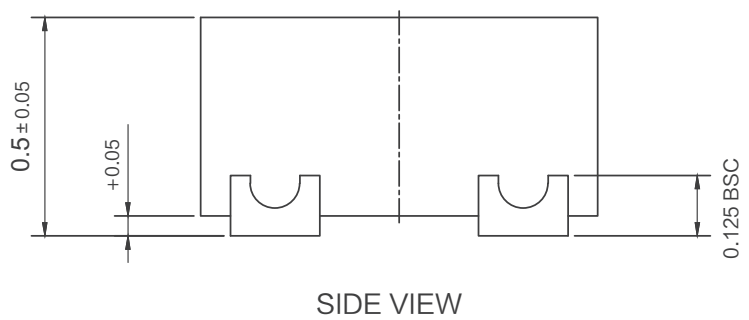
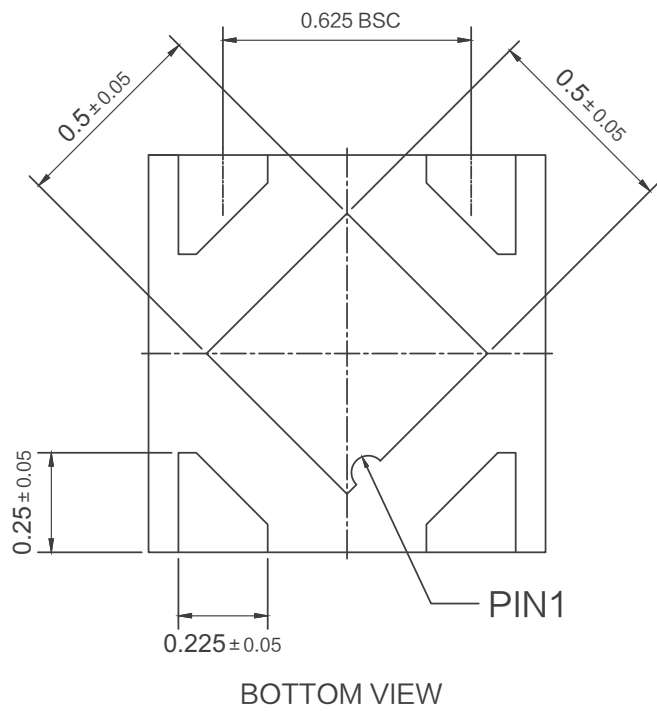
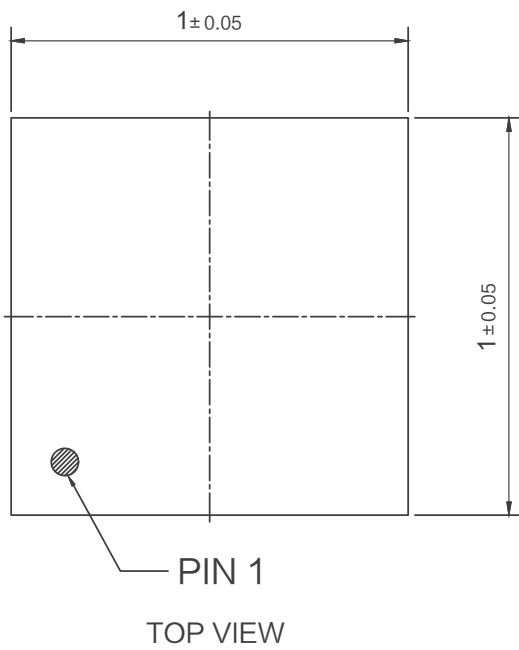




### Package Outline

DFN1x1-4L

Dimensions in mm



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