

# BL9195

## 300mA 3-Pin, Ultra Fast, Ultra Low Dropout High PSRR CMOS LDO Regulator

### FEATURES

- Ultra-Fast Response in Line/Load Transient
- Low Dropout: 210mV @ 300mA
- Wide Operating Voltage Range: 2V to 6V
- Wide Output Voltage Range: 1.2V to 5V
- Low Temperature Coefficient
- Current Limiting Protection
- Thermal Shutdown Protection
- Only 1 $\mu$ F Output Capacitor Required for Stability
- High Power Supply Rejection Ratio
- Custom Voltage Available
- Available in 3-Lead SOT23, SOT89 and SOT223 Package

### APPLICATIONS

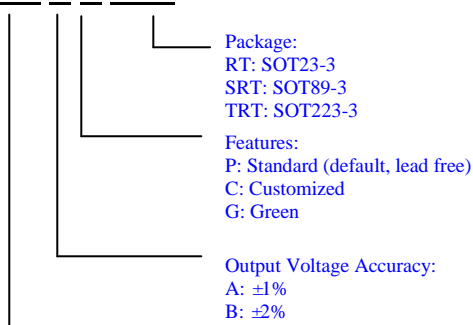
- Cellular and Smart Phones
- Battery-Powered Equipment
- Laptop, Palmtops, Notebook Computers
- Hand-Held Instrument
- PCMCIA Cards
- MP3/MP4/MP5 Players
- Portable Information Appliances

### DESCRIPTION

The BL9195 is designed for portable RF and wireless applications with demanding performance and space requirements. The BL9195 performance is optimized for battery-powered systems to deliver ultra low noise and low quiescent current. Regulator ground current increases only slightly in dropout, further prolonging the battery life. The BL9195 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices. The other features include ultra low dropout voltage, high output accuracy, current limiting protection, and high ripple rejection ratio. Available in 3-lead SOT23, SOT89 and SOT223 packages.

### ORDERING INFORMATION

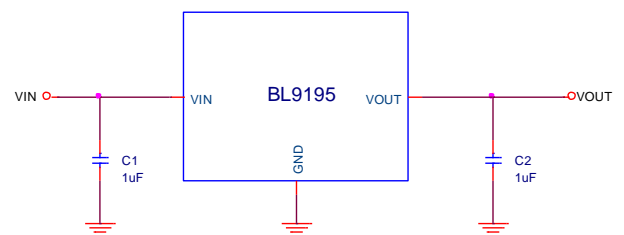
BL9195 XX X X XXX



Output Voltage:  
12: 1.2V 13: 1.3V 15: 1.5V 18: 1.8V  
25: 2.5V 27: 2.7V 28: 2.8V 285: 2.85V  
30: 3.0V 32: 3.2V 33: 3.3V 50: 5.0V  
CT: custom fixed output (50mV step)

### TYPICAL APPLICATION

BL9195 SOT23-3/SOT89-3/SOT223-3



#### Application hints:

Output capacitor ( $C2 \geq 2.2\mu\text{F}$ ) is recommended in BL9195-1.2V, BL9195-1.3V, BL9195-1.5V and BL9195-1.8V application to assure circuit stability.

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### Absolute Maximum Rating <sup>(Note 1)</sup>

Input Supply Voltage ( $V_{IN}$ )	-0.3V to +6.5V	Operating Temperature Range <sup>(Note2)</sup>	-40°C to 85°C
Output Voltage	-0.3V to $V_{IN}+0.3V$	Storage Temperature Range	-65°C to 125°C
Output Current	300mA	Lead Temperature (Soldering, 10s)	300°C
Maximum Junction Temperature	125°C		

### Package Information

Part Number	Top Mark	Top Mark	Temp Range
BL9195-1.2V	G A Y W <sup>(Note3)</sup>	BL9195 <sup>(Note4)</sup> YWSS A	-40°C to +85°C
BL9195-1.3V	G B Y W	BL9195 YWSS B	-40°C to +85°C
BL9195-1.5V	G C Y W	BL9195 YWSS C	-40°C to +85°C
BL9195-1.8V	G D Y W	BL9195 YWSS D	-40°C to +85°C
BL9195-2.5V	G E Y W	BL9195 YWSS E	-40°C to +85°C
BL9195-2.7V	G F Y W	BL9195 YWSS F	-40°C to +85°C
BL9195-2.8V	G G Y W	BL9195 YWSS G	-40°C to +85°C
BL9195-2.85V	G H Y W	BL9195 YWSS H	-40°C to +85°C
BL9195-3.0V	G I Y W	BL9195 YWSS I	-40°C to +85°C
BL9195-3.2V	G J Y W	BL9195 YWSS J	-40°C to +85°C
BL9195-3.3V	G K Y W	BL9195 YWSS K	-40°C to +85°C
BL9195-5.0V	G L Y W	BL9195 YWSS L	-40°C to +85°C

### Thermal Resistance <sup>(Note 5)</sup>:

Package	$\Theta_{JA}$	$\Theta_{JC}$
SOT23-3	250°C/W	130°C/W
SOT89-3	160°C/W	45°C/W
SOT223-3	60°C/W	20°C/W

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

**Note 2:** The BL9195 is guaranteed to meet performance specifications from 0°C to 70°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

**NOTE3:** Y: Year of wafer manufacturing W: Week of wafer manufacturing.

Y	0	1	2	3	4	...
Year	2010	2011	2012	2013	2014	.....

W	01	2	...	26	27	28	...	52
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Week	A	B	...	Z	a	b	...	z
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Note 4: Y: Year of assembly manufacturing W: Week of assembly manufacturing  
SS: Lot ID (the 7<sup>th</sup> and 8<sup>th</sup> number of Lot numbers)

Y	0	1	2	3	4	...
Year	2010	2011	2012	2013	2014	.....

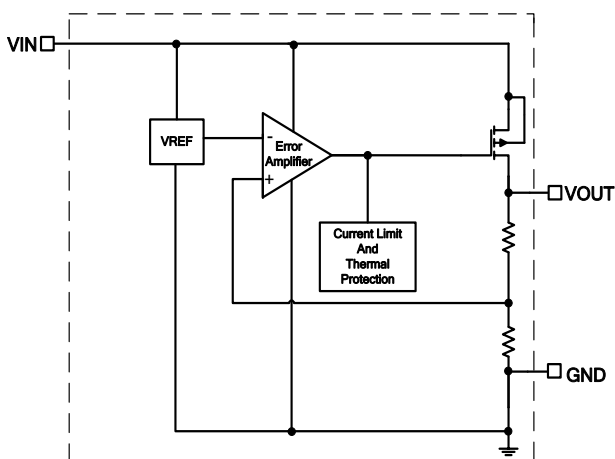
W	01	2	...	26	27	28	...	52
Week	A	B	...	Z	$\bar{A}$	$\bar{B}$	...	$\bar{Z}$

Note 5: Thermal Resistance is specified with approximately 1 square of 1 oz copper.

### Pin Description

PIN-NUMBER			NAME	FUNCTION
SOT23-3	SOT223-3	SOT89-3		
1		1	GND	Ground
3		2	VIN	Power Input Voltage
2		3	VOUT	Output Voltage

### Block Diagram



### Electrical Characteristics (Note 6)

( $V_{IN}=3.6V$ ,  $C_{IN}=C_{OUT}=1\mu F$ ,  $T_A=25^\circ C$ , unless otherwise noted.)

Parameter	Symbol	Conditions	MIN	TYP	MAX	unit
Input Voltage	$V_{IN}$		2		6	V
Output Voltage Accuracy (Note 7)	$\Delta V_{OUT}$	$V_{IN}=3.6V$ , $I_{OUT}=1mA$	-1 -2		+1 +2	%
Current Limit	$I_{LIM}$	$R_{LOAD}=1\Omega$	400	430		mA
Quiescent Current	$I_Q$	$I_{OUT}=0mA$		90	130	$\mu A$
Dropout Voltage	$V_{DROP}$	$I_{OUT}=200mA$ , $V_{OUT}=2.8V$		130	180	mV
		$I_{OUT}=300mA$ , $V_{OUT}=2.8V$		210	300	
Line Regulation (Note 8)	$\Delta V_{LINE}$	$V_{IN}=3.6V$ to $5.5V$ $I_{OUT}=1mA$		0.05	0.17	%/V
Load Regulation (Note 9)	$\Delta V_{LOAD}$	$1mA < I_{OUT} < 300mA$			2	%/A
Output Voltage Temperature Coefficient (Note 10)	$TC_{VOUT}$	$I_{OUT}=1mA$		$\pm 60$		ppm/ $^\circ C$
Output Noise Voltage	$e_{NO}$	10Hz to 100KHz, $I_{OUT}=200mA$		100		$\mu V_{RMS}$
Power Supply Rejection Ratio	$f=217Hz$	$I_{OUT}=100mA$	PSRR		-78	dB
	$f=1KHz$				-72	
	$f=10KHz$				-52	
Thermal Shutdown Temperature	$T_{SD}$	Shutdown, Temp increasing		165		$^\circ C$
Thermal Shutdown Hysteresis	$T_{SDHY}$			30		$^\circ C$

**Note 6:** 100% production test at  $+25^\circ C$ . Specifications over the temperature range are guaranteed by design and characterization.

**Note 7:** This IC includes two kinds of output voltage accuracy versions. A:  $\pm 1\%$ , B:  $\pm 2\%$ .

**Note 8:** Line regulation is calculated by 
$$\Delta V_{LINE} = \left( \frac{V_{OUT1} - V_{OUT2}}{\Delta V_{IN} \times V_{OUT(normal)}} \right) \times 100$$

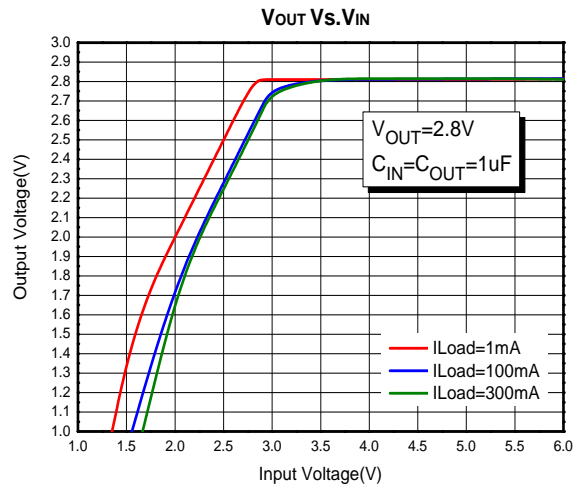
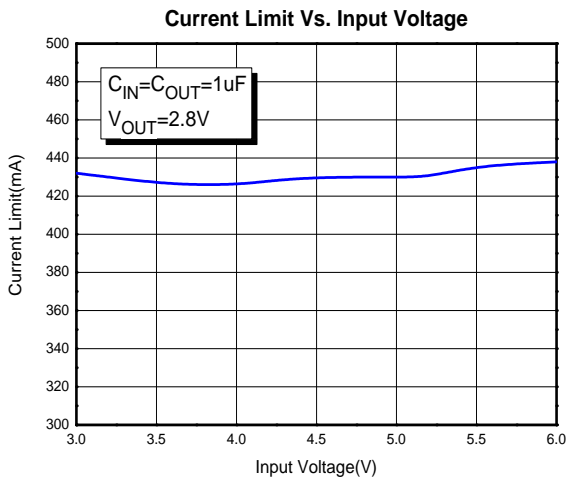
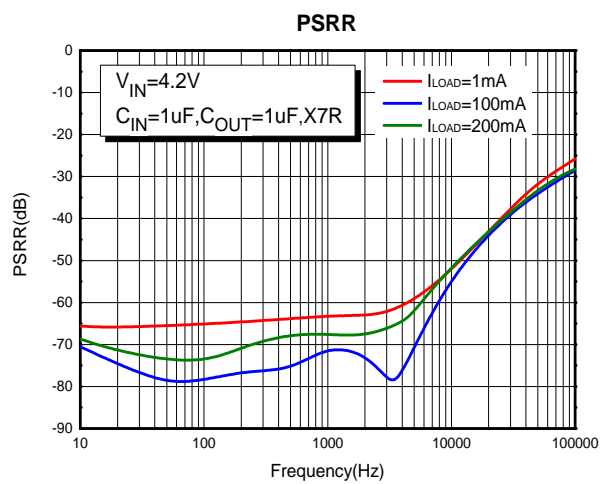
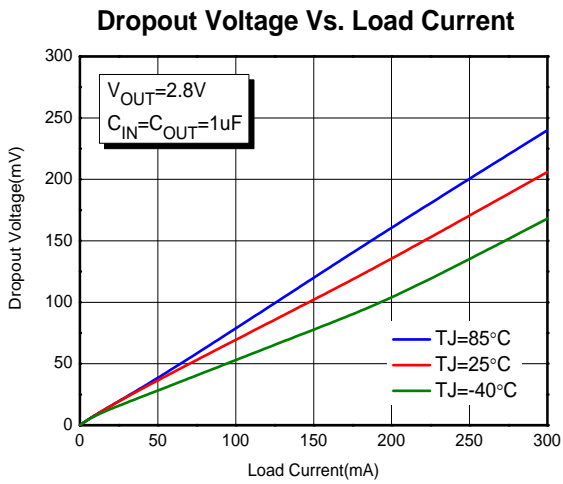
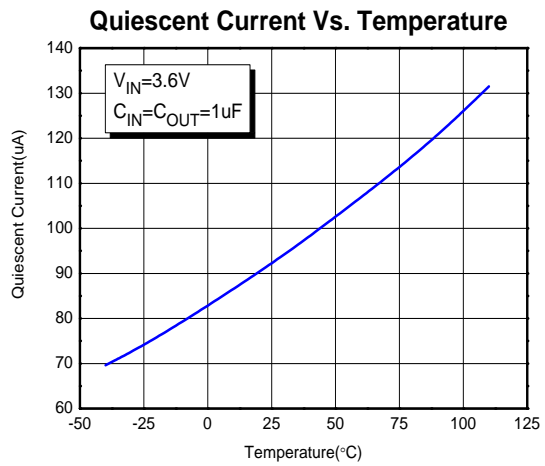
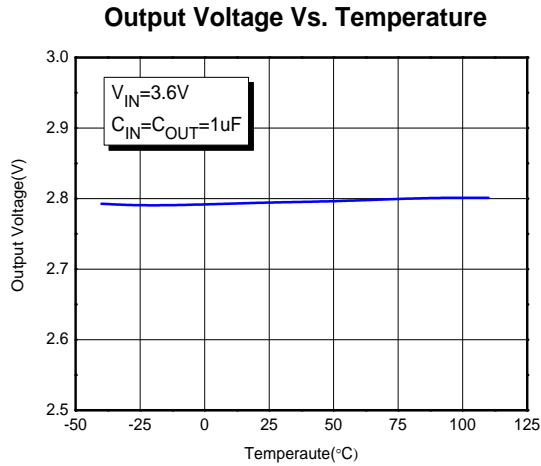
Where  $V_{OUT1}$  is the output voltage when  $V_{IN}=5.5V$ , and  $V_{OUT2}$  is the output voltage when  $V_{IN}=3.6V$ ,  $\Delta V_{IN}=1.9V$ .  $V_{OUT(normal)}=2.8V$ .

**Note 9:** Load regulation is calculated by 
$$\Delta V_{LOAD} = \left( \frac{V_{OUT1} - V_{OUT2}}{\Delta I_{OUT} \times V_{OUT(normal)}} \right) \times 100$$

Where  $V_{OUT1}$  is the output voltage when  $I_{OUT}=1mA$ , and  $V_{OUT2}$  is the output voltage when  $I_{OUT}=300mA$ .  $\Delta I_{OUT}=0.299A$ ,  $V_{OUT(normal)}=2.8V$ .

**Note 10:** The temperature coefficient is calculated by 
$$TC_{VOUT} = \frac{\Delta V_{OUT}}{\Delta T \times V_{OUT}}$$

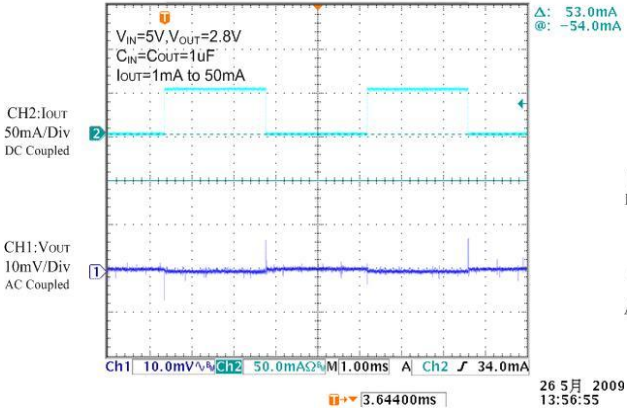
### Typical Performance Characteristics



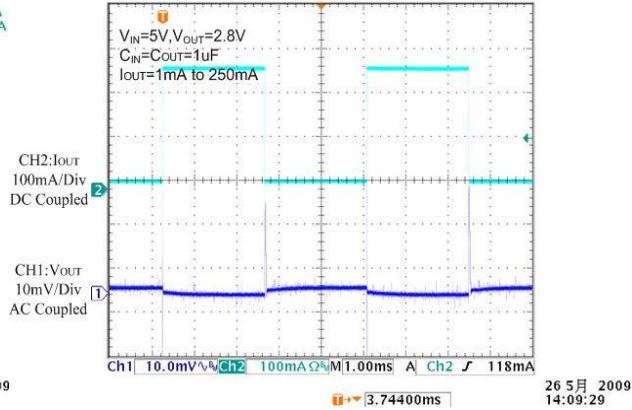
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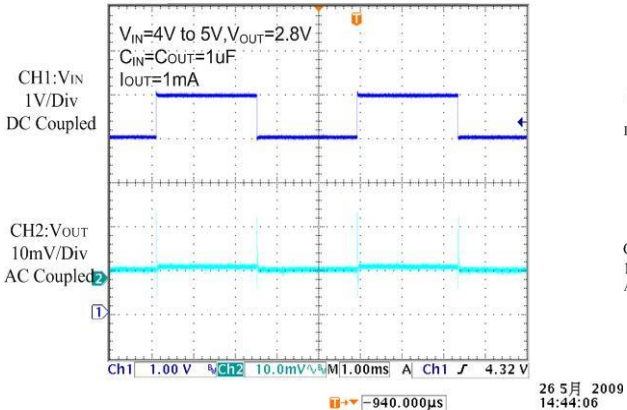
Load Transient Response



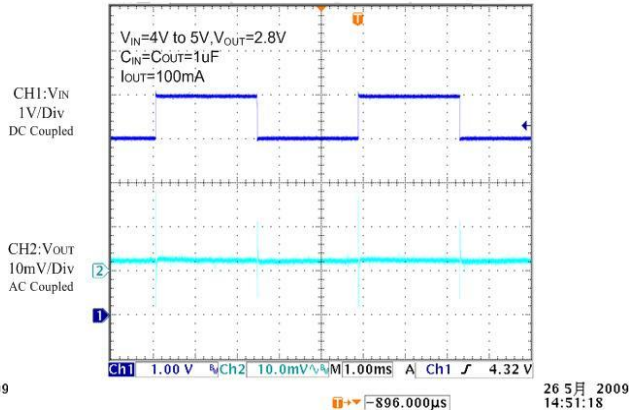
Load Transient Response



Line Transient Response



Line Transient Response



### Applications Information

Like any low-dropout regulator, the external capacitors used with the BL9195 must be carefully selected for regulator stability and performance. Using a capacitor whose value is  $> 1\mu\text{F}$  on the BL9195 input and the amount of capacitance can be increased without limit. The input capacitor must be located a distance of not more than 0.5 inch from the input pin of the IC and returned to a clean analog ground. Any good quality ceramic or tantalum can be used for this capacitor. The capacitor with larger value and lower ESR (equivalent series resistance) provides better PSRR and line-transient response. The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDOs application. The BL9195 is designed specifically to work with low ESR ceramic output capacitor in space-saving and performance consideration. Using a ceramic capacitor whose value is at least  $1\mu\text{F}$  with ESR is  $> 25\text{m}\Omega$  on the BL9195 output ensures stability. The BL9195 still works well with output capacitor of other types due to the wide stable ESR range. Output capacitor of larger capacitance can reduce noise and improve load transient response, stability, and PSRR. The output capacitor should be located not more than 0.5 inch from the  $V_{\text{OUT}}$  pin of the BL9195 and returned to a clean analog ground.

### Thermal Considerations

Thermal protection limits power dissipation in BL9195. When the operation junction temperature exceeds  $165^\circ\text{C}$ , the OTP circuit starts the thermal shutdown function turn the pass element off. The pass

element turns on again after the junction temperature cools by  $30^\circ\text{C}$ .

For continue operation, do not exceed absolute maximum operation junction temperature  $125^\circ\text{C}$ . The power dissipation definition in device is:

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

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula:

$$P_D(\text{MAX}) = (T_J(\text{MAX}) - T_A) / \theta_{\text{JA}}$$

Where  $T_J(\text{MAX})$  is the maximum operation junction temperature  $125^\circ\text{C}$ ,  $T_A$  is the ambient temperature and the  $\theta_{\text{JA}}$  is the junction to ambient thermal resistance. For recommended operating conditions specification of BL9195, where  $T_J(\text{MAX})$  is the maximum junction temperature of the die ( $125^\circ\text{C}$ ) and  $T_A$  is the maximum ambient temperature. The junction to ambient thermal resistance ( $\theta_{\text{JA}}$  is layout dependent) for SOT-23-3 package is  $250^\circ\text{C}/\text{W}$ , SOT89-3 package is  $160^\circ\text{C}/\text{W}$ , SOT-223-3 package is  $60^\circ\text{C}/\text{W}$  on standard JEDEC 51-3 thermal test board. The maximum power dissipation at  $T_A = 25^\circ\text{C}$  can be calculated by following formula:

$$P_D(\text{MAX}) = (125^\circ\text{C} - 25^\circ\text{C}) / 160 = 667\text{mW} \text{ (SOT89-3)}$$

$$P_D(\text{MAX}) = (125^\circ\text{C} - 25^\circ\text{C}) / 250 = 400\text{mW} \text{ (SOT23-3)}$$

$$P_D(\text{MAX}) = (125^\circ\text{C} - 25^\circ\text{C}) / 60 = 1666\text{mW} \text{ (SOT223-3)}$$

The maximum power dissipation depends on operating ambient temperature for fixed  $T_J(\text{MAX})$  and thermal resistance  $\theta_{JA}$ . It is also useful to calculate the junction of temperature of the BL9195 under a set of specific conditions. In this example let the Input voltage  $V_{IN}=3.3\text{V}$ , the output current  $I_O=300\text{mA}$  and the case temperature  $T_A=40^\circ\text{C}$  measured by a thermal couple during operation. The power dissipation for the  $V_{OUT}=2.8\text{V}$  version of the BL9195 can be calculated as:

$$P_D = (3.3\text{V} - 2.8\text{V}) \times 300\text{mA} + 3.6\text{V} \times 100\mu\text{A} \\ = 150\text{mW}$$

And the junction temperature,  $T_J$ , can be calculated as follows:

$$T_J = T_A + P_D \times \theta_{JA} = 40^\circ\text{C} + 0.15\text{W} \times 250^\circ\text{C/W} \\ = 40^\circ\text{C} + 37.5^\circ\text{C} = 77.5^\circ\text{C} < T_J(\text{MAX}) = 125^\circ\text{C}$$

For this operating condition,  $T_J$  is lower than the absolute maximum operating junction temperature,  $125^\circ\text{C}$ , so it is safe to use the BL9195 in this configuration.

### Layout considerations

To improve ac performance such as PSRR, output noise, and transient response, it is recommended that the PCB be designed with separate ground planes for  $V_{IN}$  and  $V_{OUT}$ , with each ground plane connected only at the GND pin of the device.



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## Package Description

### 1. SOT23-3

Package	SOT-23-3	Devices per reel	3000	Unit	mm
Package dimension:					
<p>The drawing shows the SOT-23-3 package with the following dimensions:</p> <ul style="list-style-type: none"><li>Top view: Total width <math>2.9 \pm 0.2</math> mm, distance from center to pin 3 <math>0.4 \pm 0.1</math> mm, distance between pins 1 and 2 <math>1.9 \pm 0.2</math> mm, and individual pin offset <math>0.95</math> mm.</li><li>Side view: Total height <math>2.8 \pm 0.3</math> mm, distance from top to pin 3 <math>1.6 \pm 0.2</math> mm, maximum width <math>1.4</math> mm, distance from top to pin 1/2 <math>1.1</math> mm (tolerance <math>+0.2 / -0.1</math>), pin 1/2 width <math>0.8</math> mm, and pin 1/2 height <math>0.2</math> mm (minimum).</li><li>Perspective view: Shows the package with pins 1, 2, and 3.</li></ul>					

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## 2. SOT89-3

Package	SOT-89-3	Devices per reel	1000	Unit	mm
Package dimension:					
<p>The drawing shows three views of the SOT-89-3 package. The top view shows a rectangular body with a width of <math>4.5 \pm 0.1</math> mm and a length of <math>1.6 \pm 0.2</math> mm. A circular feature with a diameter of <math>\varnothing 1.0</math> mm is centered on the body. The height of the body is <math>2.5 \pm 0.1</math> mm, and the total height including the pins is <math>4.25</math> mm MAX. The pins are labeled 1, 2, and 3, with a minimum height of <math>0.8</math> mm. The side view shows a height of <math>1.5 \pm 0.1</math> mm and a width of <math>0.4 \pm 0.1</math> mm. The bottom view shows a width of <math>1.5 \pm 0.1</math> mm and a height of <math>0.42 \pm 0.2</math> mm. A central feature has a height of <math>0.47 \pm 0.1</math> mm.</p>					

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## 3. SOT223-3

Package	SOT223-3	Device per reel	2500	Unit	mm																																																																											
<table border="1"> <thead> <tr> <th rowspan="2">SYMBOL</th> <th colspan="3">MILLIMETER</th> </tr> <tr> <th>MIN</th> <th>NOM</th> <th>MAX</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>1.50</td> <td>1.65</td> <td>1.80</td> </tr> <tr> <td>A1</td> <td>0.03</td> <td>0.06</td> <td>0.09</td> </tr> <tr> <td>A2</td> <td>1.45</td> <td>1.60</td> <td>1.75</td> </tr> <tr> <td>A3</td> <td>0.80</td> <td>0.90</td> <td>1.00</td> </tr> <tr> <td>b</td> <td>0.69</td> <td>—</td> <td>0.78</td> </tr> <tr> <td>b1</td> <td>0.68</td> <td>0.71</td> <td>0.74</td> </tr> <tr> <td>c</td> <td>0.30</td> <td>—</td> <td>0.35</td> </tr> <tr> <td>c1</td> <td>0.29</td> <td>0.30</td> <td>0.31</td> </tr> <tr> <td>D</td> <td>6.30</td> <td>6.50</td> <td>6.70</td> </tr> <tr> <td>D1</td> <td colspan="3">3.00REF</td> </tr> <tr> <td>E</td> <td>6.80</td> <td>7.00</td> <td>7.20</td> </tr> <tr> <td>E1</td> <td>3.40</td> <td>3.50</td> <td>3.60</td> </tr> <tr> <td>e</td> <td colspan="3">2.30BSC</td> </tr> <tr> <td>L</td> <td>0.90</td> <td>—</td> <td>—</td> </tr> <tr> <td>L1</td> <td colspan="3">1.75BSC</td> </tr> <tr> <td><math>\theta</math></td> <td>0</td> <td>—</td> <td>7°</td> </tr> <tr> <td><math>\theta 1</math></td> <td colspan="3">37.5 REF</td> </tr> </tbody> </table>						SYMBOL	MILLIMETER			MIN	NOM	MAX	A	1.50	1.65	1.80	A1	0.03	0.06	0.09	A2	1.45	1.60	1.75	A3	0.80	0.90	1.00	b	0.69	—	0.78	b1	0.68	0.71	0.74	c	0.30	—	0.35	c1	0.29	0.30	0.31	D	6.30	6.50	6.70	D1	3.00REF			E	6.80	7.00	7.20	E1	3.40	3.50	3.60	e	2.30BSC			L	0.90	—	—	L1	1.75BSC			$\theta$	0	—	7°	$\theta 1$	37.5 REF		
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