

## Low $I_Q$ , Low Dropout 300mA Fixed Voltage Regulator

### Features

- **Low Quiescent Current : 60mA (No load)**
- **Low Dropout Voltage : 400mV (@300mA)**
- **Fixed Output Voltage : 1.5V ~ 4.5V by Step 0.1V Increment**
- **Stable with Aluminum, Tantalum, or Ceramic Capacitors**
- **No Protection Diodes Needed**
- **Built-in Thermal Protection**
- **Built-in Current-Limit Protection**
- **Controlled Short Circuit Current : 50mA**
- **Fast Transient Response**
- **Short Setting Time**
- **SOT-23-3, SOT-23-5, and SOT-89 Packages**
- **Lead Free and Green Devices Available (RoHS Compliant)**

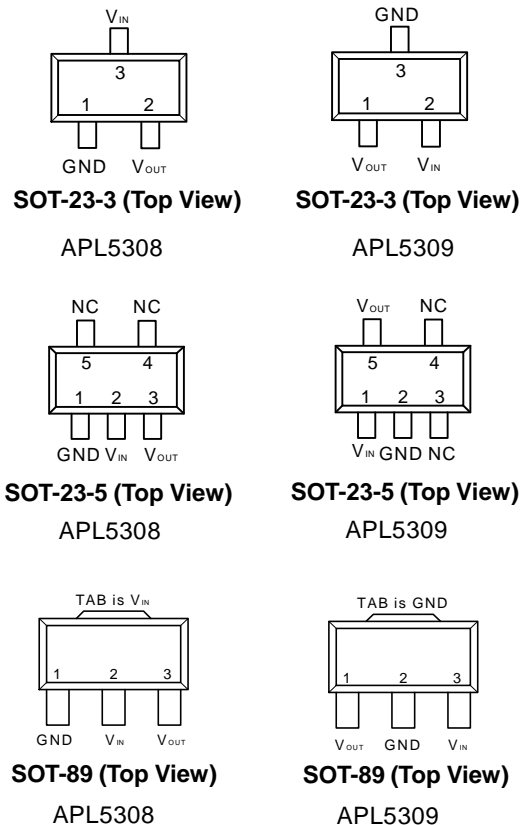
### Applications

- **5V to 3.3~4.5V Linear Regulators**
- **3.3V to 1.5~2.5V Linear Regulators**
- **CD-ROM, CD-R/W, and DVD Player**
- **Networking System, LAN Card, ADSL/Cable**
- **Modem, Cable Set-Top Box**
- **PC Peripherals**

### General Description

The APL5308/9 series are micropower, low dropout linear regulators, which operate from 2.7V to 6V input voltage and deliver up to 300mA. Typical dropout voltage is only 400mV at 300mA loading. Designed for use in battery-powered system, the low 60 $\mu$ A quiescent current makes it an ideal choice. Design with an internal P-channel MOSFET pass transistor, the APL5308/9 maintain a low supply current, independent of the load current and dropout voltage. Other features include thermal-shut-down protection current limit protection to ensure specified output current and controlled short-circuit current. The APL5308/9 regulators come in a miniature SOT-23-3, SOT-23-5, and SOT-89 packages.

### Pin Configuration



ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

## Ordering and Marking Information

<p>APL5308/9 <span style="font-family: monospace;">□□□□-□□□□</span></p> <div style="margin-left: 40px;"> <p>└─ Assembly Material</p> <p>└─ Handling Code</p> <p>└─ Temperature Range</p> <p>└─ Package Code</p> <p>└─ Voltage Code</p> </div>	<p>Package Code  A : SOT-23-3   B : SOT-23-5   D : SOT-89</p> <p>Operating Ambient Temperature Range  I : -40 to 85 °C   C : 0 to 70 °C</p> <p>Handling Code  TR : Tape &amp; Reel</p> <p>Voltage Code :  15 : 1.5V ~ 45 : 4.5V</p> <p>Assembly Material  G : Halogen and Lead Free Device</p>
<p>APL5308/9 15 D :</p> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 20px;"> <p>APL5308/9 XXXXXX 15</p> </div>	<p>XXXXX - Date Code ; 15 - 1.5V</p>

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020C for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

## Marking Information

SOT-23-3 and SOT-23-5 packages

Product Name	Marking	Product Name	Marking
APL5308-15A/B	389X	APL5309-15A/B	399X
APL5308-16A/B	38AX	APL5309-16A/B	39AX
APL5308-17A/B	38BX	APL5309-17A/B	39BX
APL5308-18A/B	38CX	APL5309-18A/B	39CX
APL5308-19A/B	38DX	APL5309-19A/B	39DX
APL5308-20A/B	38EX	APL5309-20A/B	39EX
APL5308-21A/B	38FX	APL5309-21A/B	39FX
APL5308-22A/B	38GX	APL5309-22A/B	39GX
APL5308-23A/B	38HX	APL5309-23A/B	39HX
APL5308-24A/B	38IX	APL5309-24A/B	39IX
APL5308-25A/B	38JX	APL5309-25A/B	39JX
APL5308-26A/B	38KX	APL5309-26A/B	39KX
APL5308-27A/B	38LX	APL5309-27A/B	39LX
APL5308-28A/B	38MX	APL5309-28A/B	39MX
APL5308-29A/B	38NX	APL5309-29A/B	39NX
APL5308-30A/B	38OX	APL5309-30A/B	39OX
APL5308-31A/B	38PX	APL5309-31A/B	39PX
APL5308-32A/B	38QX	APL5309-32A/B	39QX
APL5308-33A/B	38RX	APL5309-33A/B	39RX
APL5308-34A/B	38SX	APL5309-34A/B	39SX
APL5308-35A/B	38TX	APL5309-35A/B	39TX
APL5308-43A/B	38UX	APL5309-43A/B	39UX
APL5308-45A/B	38VX	APL5309-45A/B	39VX

The last character "X" in the marking is for data code.

**Absolute Maximum Ratings** (Note 1, 2)

Symbol	Parameter	Rating	Unit
V <sub>IN</sub> , V <sub>OUT</sub>	Input Voltage or Out Voltage	6.5	V
R <sub>TH,JA</sub>	Thermal Resistance – Junction to Ambient SOT-23-3 SOT-23-5 SOT-89	260 260 180	°C/W
R <sub>TH,JC</sub>	Thermal Resistance – Junction to Case SOT-23-3 SOT-23-5 SOT-89	130 130 60	°C/W
P <sub>D</sub>	Power Dissipation	Internally Limited	W
T <sub>JMAX</sub>	Junction Temperature	150	°C
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 10 Seconds	260	°C

Note 1: Stresses beyond the absolute maximum rating may damage the device and operating in the absolute maximum rating conditions may affect device reliability.

Note 2: The maximum allowable power dissipation at any T<sub>A</sub> (ambient temperature) is calculated using: P<sub>D</sub> (max) = (T<sub>J</sub> - T<sub>A</sub>) / θ<sub>JA</sub>; T<sub>J</sub> = 125°C. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

**Electrical Characteristics**

Unless otherwise noted these specifications apply over full temperature, C<sub>IN</sub> = 1µF, C<sub>OUT</sub> = 4.7µF, T<sub>A</sub> = -40 to 85°C. Typical values refer to T<sub>A</sub> = 25°C.

Symbol	Parameter	Test Conditions	APL5308/9			Unit	
			Min.	Typ.	Max.		
V <sub>IN</sub>	Input Voltage		2.7	-	6	V	
V <sub>OUT</sub>	Output Voltage	V <sub>OUT</sub> +1.0V < V <sub>CC</sub> <6.0V, 0mA < I <sub>OUT</sub> < I <sub>MAX</sub>	V <sub>OUT</sub> -2%	V <sub>OUT</sub>	V <sub>OUT</sub> +2%	V	
I <sub>LIMIT</sub>	Circuit Current Limit	V <sub>IN</sub> = V <sub>OUT</sub> +1V	-	650	-	mA	
I <sub>SHORT</sub>	Short Current	V <sub>OUT</sub> = 0V	-	50	-	mA	
I <sub>OUT</sub>	Load Current	V <sub>IN</sub> = V <sub>OUT</sub> +1V	300	-	-	mA	
REG <sub>LINE</sub>	Line Regulation	V <sub>OUT</sub> +1V < V <sub>CC</sub> <6.0V, I <sub>OUT</sub> = 1mA	-	1	10	mV	
REG <sub>LOAD</sub>	Load Regulation	V <sub>IN</sub> = V <sub>OUT</sub> +1V, 0mA < I <sub>OUT</sub> < I <sub>MAX</sub>	-	10	25	mV	
	Load Transient	V <sub>IN</sub> = V <sub>OUT</sub> +1V, I <sub>OUT</sub> = 1mA-300mA in 1µs	-	150	250	mV	
V <sub>DROP</sub>	Dropout Voltage <sup>(Note3)</sup>	I <sub>OUT</sub> =300mA	1.5V ≤ V <sub>OUT</sub> < 2.0V	-	1	1.2	V
			2.0V ≤ V <sub>OUT</sub> < 2.5V	-	0.8	0.9	
			2.5V ≤ V <sub>OUT</sub> < 3V	-	0.6	0.7	
			3V ≤ V <sub>OUT</sub> ≤ 3.5V	-	0.4	0.5	
PSRR	Ripple Rejection	F ≤ 1kHz, 1Vpp at V <sub>IN</sub> = V <sub>OUT</sub> +1.0V	45	55	-	dB	
I <sub>Q</sub>	Quiescent Current	No load	-	60	100	µA	
		I <sub>OUT</sub> = 300mA	-	450	500		

## Electrical Characteristics (Cont.)

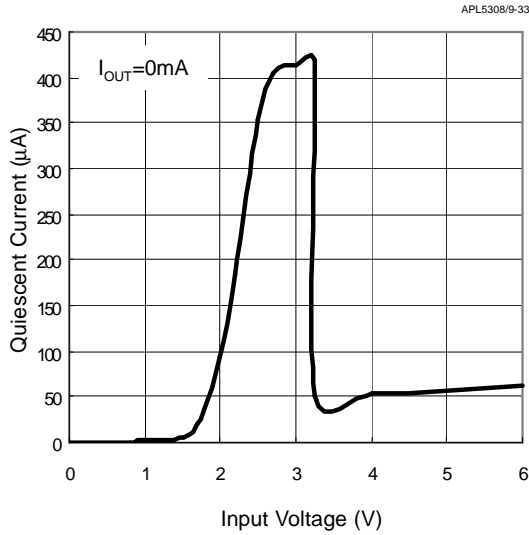
Unless otherwise noted these specifications apply over full temperature,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 4.7\mu F$ ,  $T_A = -40$  to  $85^\circ C$ . Typical values refer to  $T_A = 25^\circ C$ .

Symbol	Parameter	Test Conditions	APL5308/9			Unit
			Min.	Typ.	Max.	
OTS	Over Temperature Shutdown		-	150	-	$^\circ C$
	Over Temperature Shutdown Hysteresis	Hysteresis	-	30	-	$^\circ C$
TC	Output Voltage Temperature Coefficient		-	50	-	ppm/ $^\circ C$
$T_J$	Junction Temperature		0	-	125	$^\circ C$
$C_{OUT}$	Output Capacitor		-	2.2	-	$\mu F$
	ESR		0.01	0.1	1	Ohm

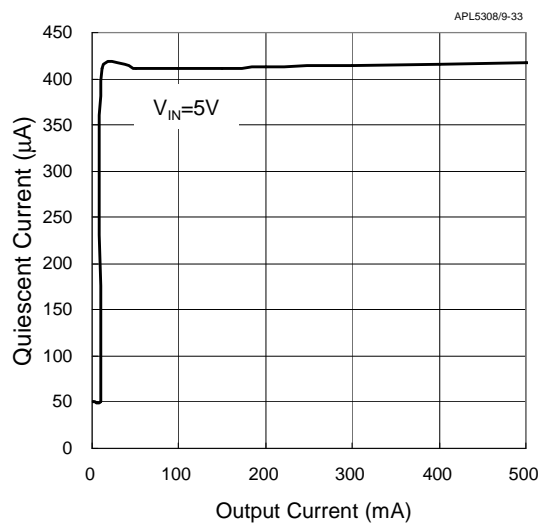
Note 3 : Dropout voltage definition :  $V_{IN} - V_{OUT}$  when  $V_{OUT}$  is 2% below the value of  $V_{OUT}$  for  $V_{IN} = V_{OUT} + 1V$ .

Typical Operating Characteristics

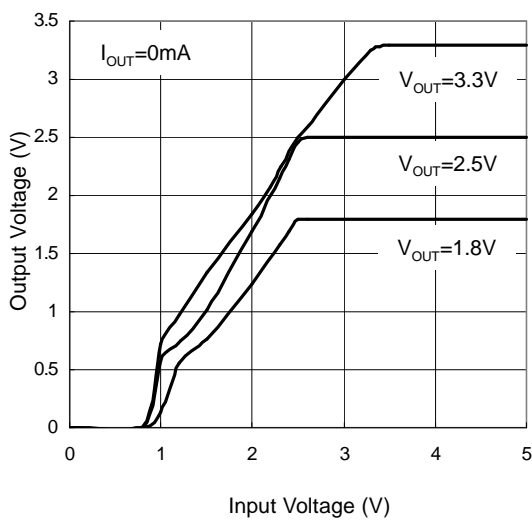
Quiescent Current vs. Input Voltage



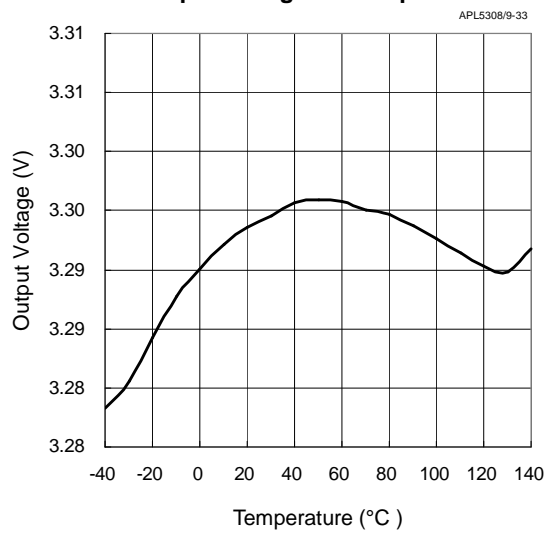
Quiescent Current vs. Output Current



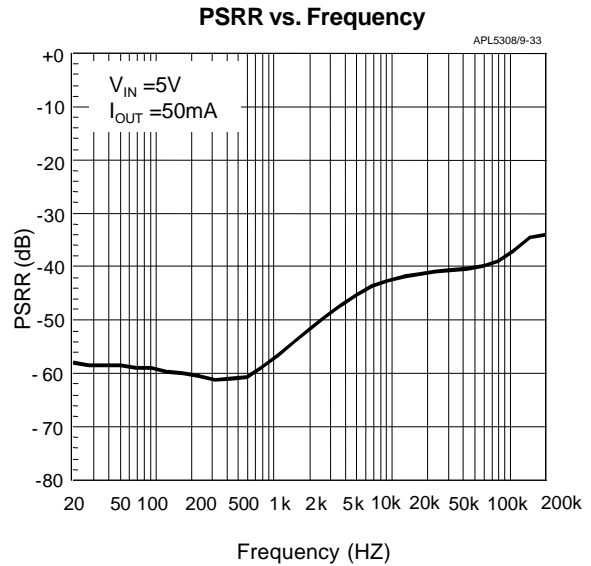
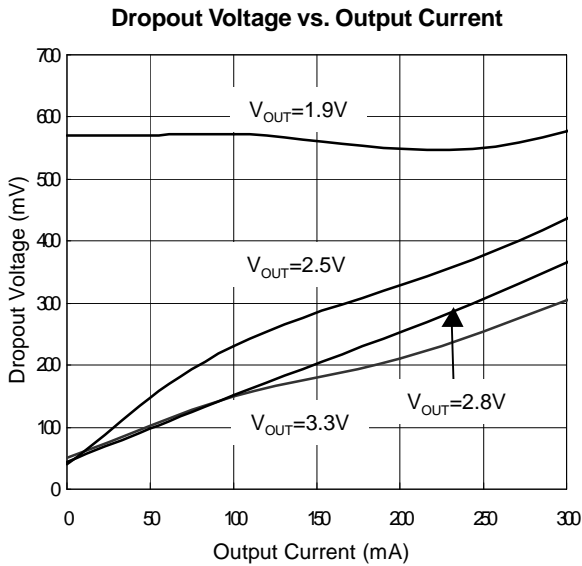
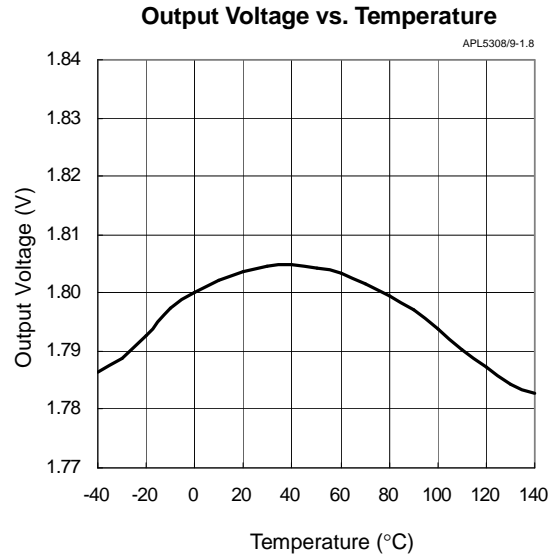
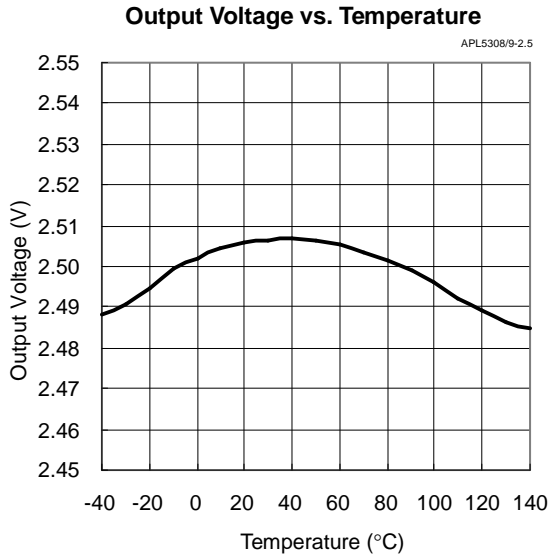
Output Voltage vs. Input Voltage



Output Voltage vs. Temperature

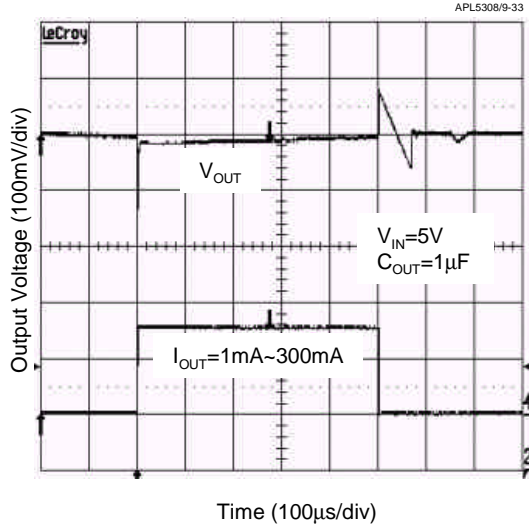


Typical Operating Characteristics (Cont.)

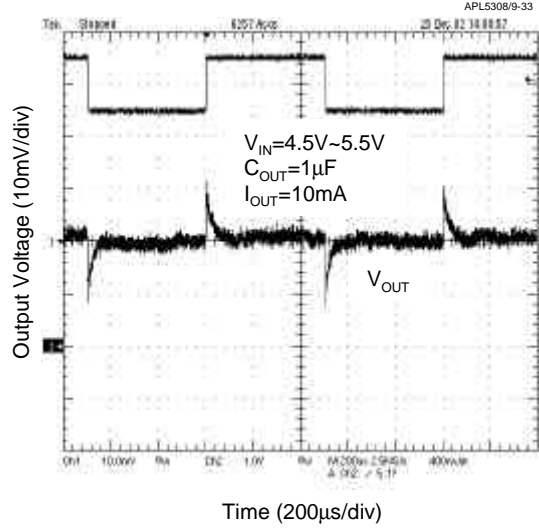


Typical Operating Characteristics (Cont.)

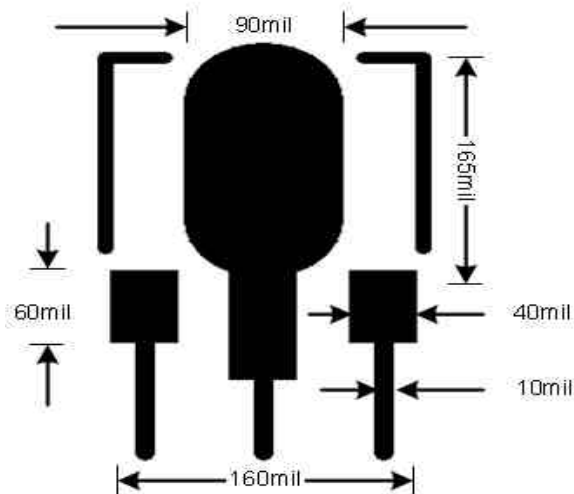
Load-Transient Response



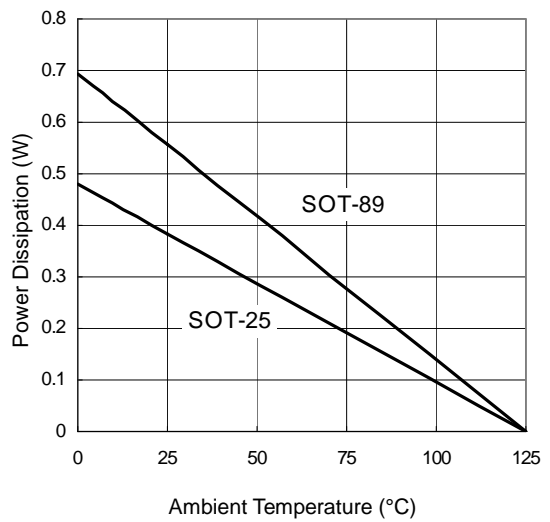
Line-Transient Response



Recommended Minimum Footprint



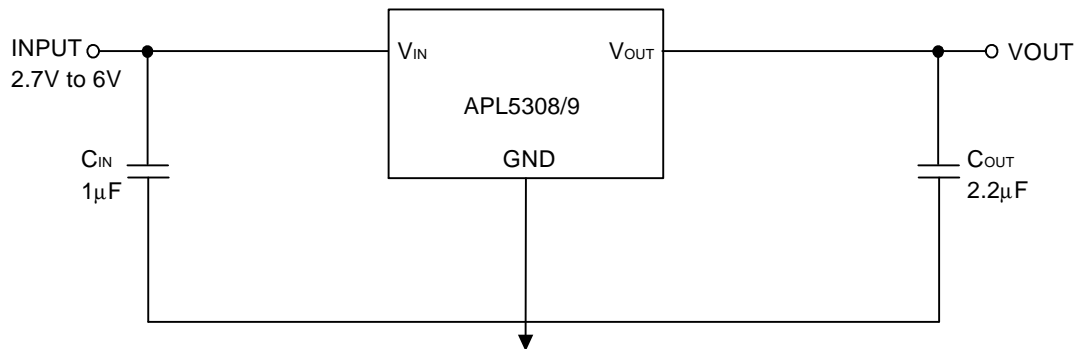
Power Dissipation vs. Ambient Temperature



## Pin Description

PIN		I/O	FUNCTION
NO.	NAME		
1	V <sub>IN</sub>	I	Supply voltage input.
2	GND		Ground pins of the circuitry, and all ground pins must be soldered To PCB with proper power dissipation.
3	V <sub>OUT</sub>	O	Output pin of the regulator.

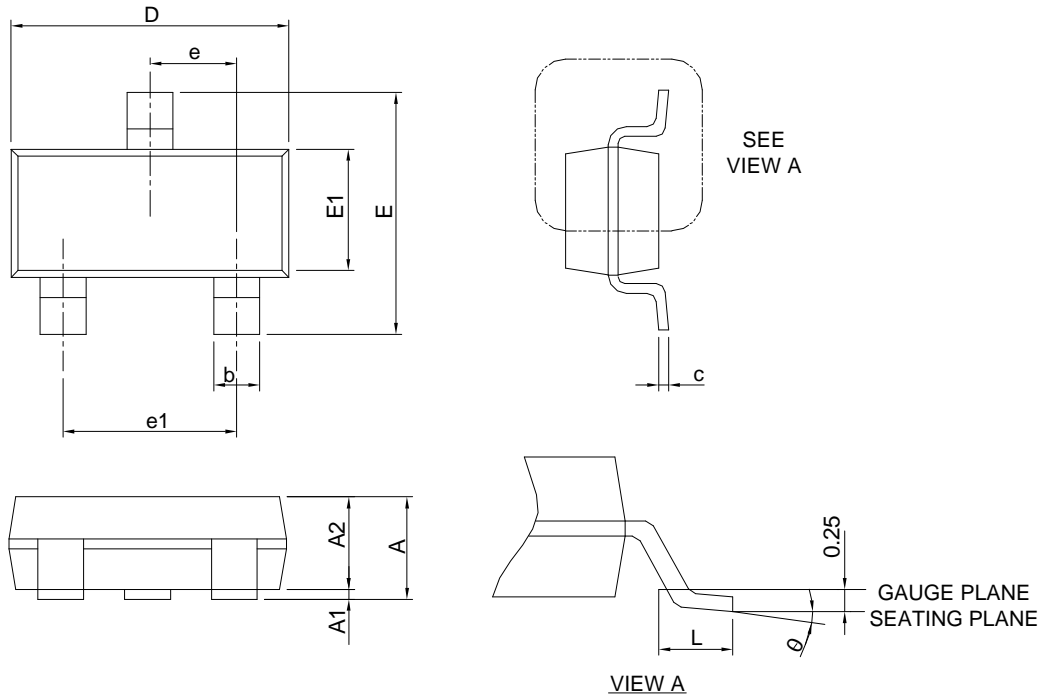
## Typical Application Circuit





Package Information

SOT-23-3

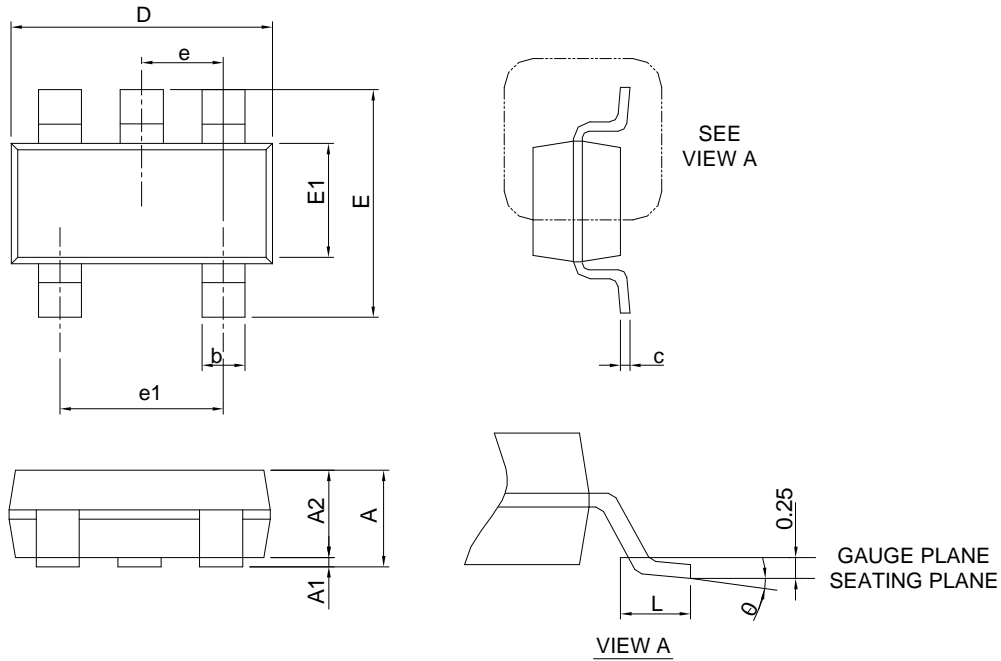


SYMBOL	SOT-23-3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.60	0.012	0.024
θ	0°	8°	0°	8°

Note : Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

Package Information

SOT-23-5

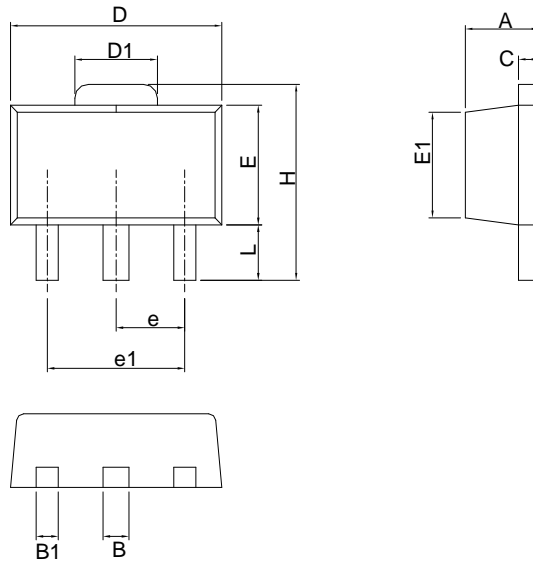


SYMBOL	SOT-23-5			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.60	0.012	0.024
θ	0°	8°	0°	8°

Note : 1. Follow JEDEC TO-178 AA.  
 2. Dimension D and E1 do not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 10 mil per side.

Package Information

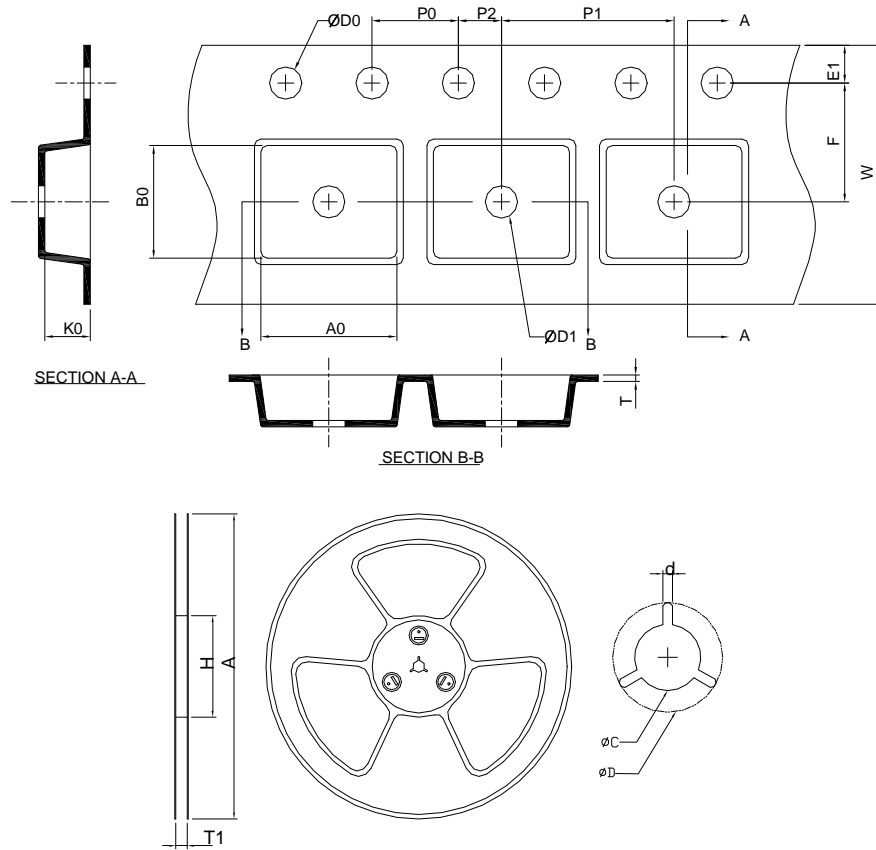
SOT-89



SYMBOL	SOT-89			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.40	1.60	0.055	0.063
B	0.44	0.56	0.017	0.022
B1	0.36	0.48	0.014	0.019
C	0.35	0.44	0.014	0.017
D	4.40	4.60	0.173	0.181
D1	1.62	1.83	0.064	0.072
E	2.29	2.60	0.090	0.102
E1	2.13	2.29	0.084	0.090
e	1.50 BSC		0.059 BSC	
e1	3.00 BSC		0.118 BSC	
H	3.94	4.25	0.155	0.167
L	0.89	1.20	0.035	0.047

Note : Follow JEDEC TO-243 AA.

### Carrier Tape & Reel Dimensions



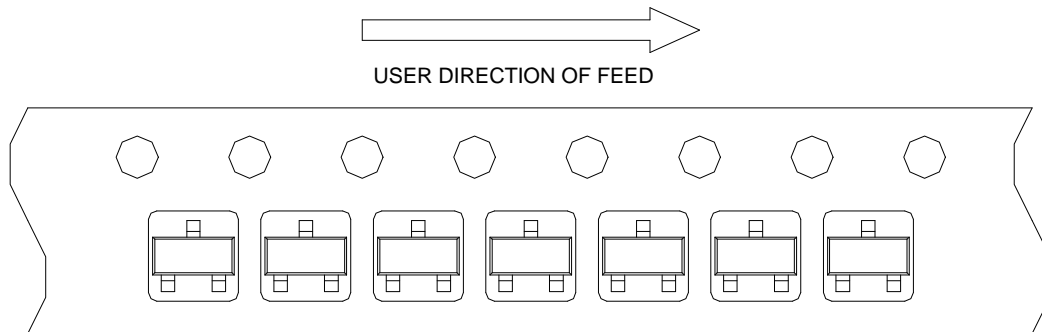
Application	A	H	T1	C	d	D	W	E1	F
SOT-23-3	178.0 ±0.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0 ±0.30	1.75 ±0.10	3.5 ±0.05
	<b>P0</b>	<b>P1</b>	<b>P2</b>	<b>D0</b>	<b>D1</b>	<b>T</b>	<b>A0</b>	<b>B0</b>	<b>K0</b>
	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.5+0.10 -0.00	1.0 MIN.	0.6+0.00 -0.40	3.20 ±0.20	3.10 ±0.20	1.50 ±0.20
Application	A	H	T1	C	d	D	W	E1	F
SOT-23-5	178.0 ±0.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0 ±0.30	1.75 ±0.10	3.5 ±0.05
	<b>P0</b>	<b>P1</b>	<b>P2</b>	<b>D0</b>	<b>D1</b>	<b>T</b>	<b>A0</b>	<b>B0</b>	<b>K0</b>
	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.5+0.10 -0.00	1.0 MIN.	0.6+0.00 -0.40	3.20 ±0.20	3.10 ±0.20	1.50 ±0.20
Application	A	H	T1	C	d	D	W	E1	F
SOT-89	178.0 ±0.00	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0 ±0.30	1.75 ±0.10	5.50 ±0.05
	<b>P0</b>	<b>P1</b>	<b>P2</b>	<b>D0</b>	<b>D1</b>	<b>T</b>	<b>A0</b>	<b>B0</b>	<b>K0</b>
	4.0 ±0.10	8.0 ±0.10	2.0 ±0.05	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	4.80 ±0.20	4.50 ±0.20	1.80 ±0.20

**Devices Per Unit**

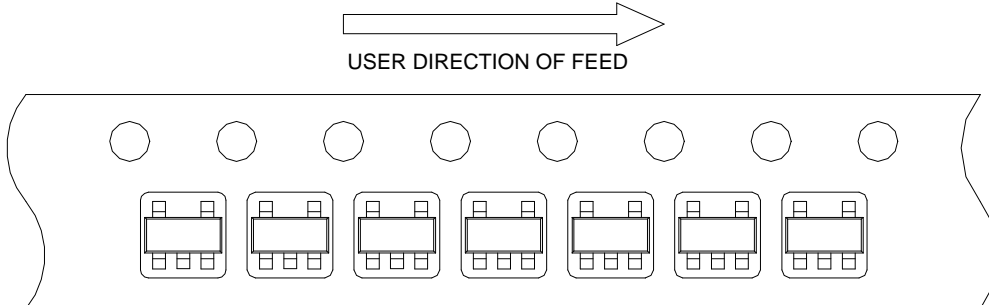
Package Type	Unit	Quantity
SOT 23-3	Tape & Reel	3000
SOT 23-5	Tape & Reel	3000
SOT-89	Tape & Reel	1000

**Taping Direction Information**

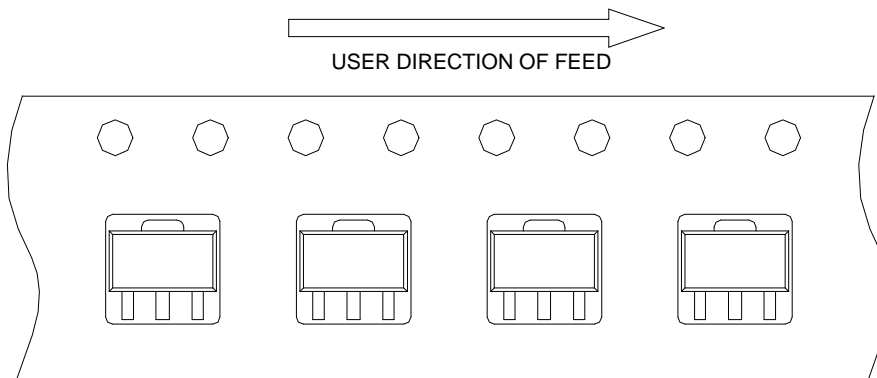
SOT-23-3



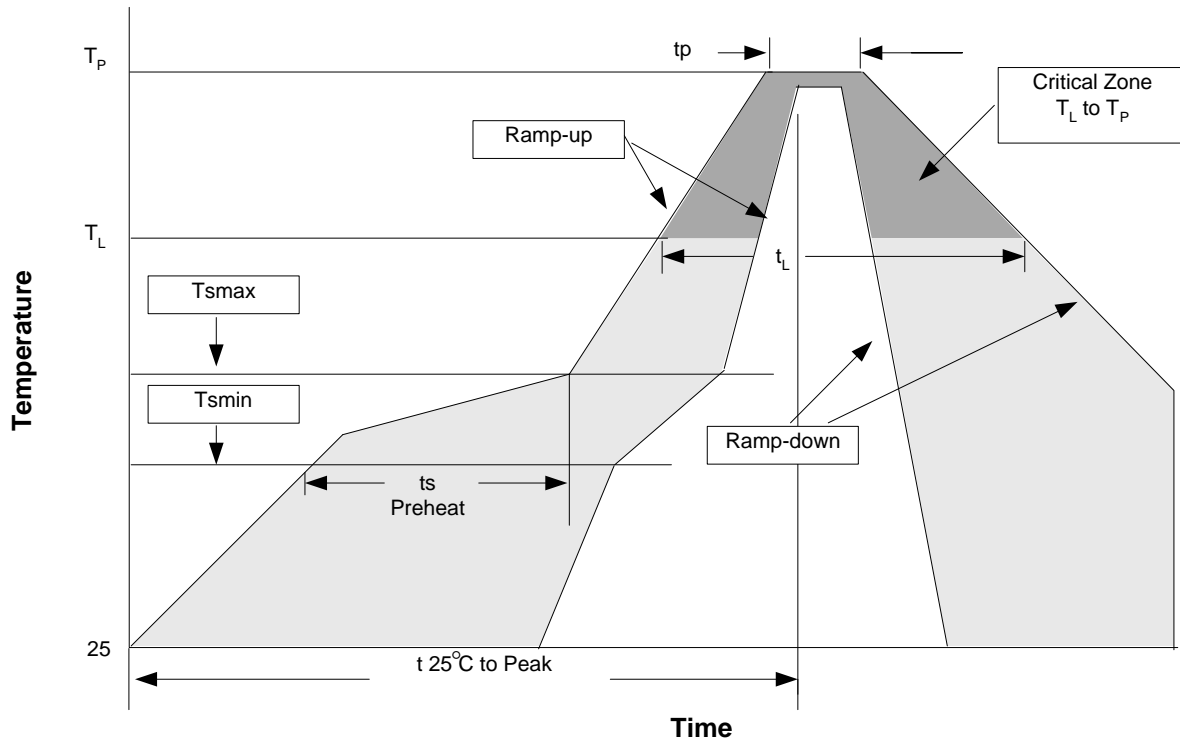
SOT-23-5



SOT-89



**Reflow Condition (IR/Convection or VPR Reflow)**



**Reliability Test Program**

Test item	Method	Description
SOLDERABILITY	MIL-STD-883D-2003	245°C, 5 sec
HOLT	MIL-STD-883D-1005.7	1000 Hrs Bias @125°C
PCT	JESD-22-B,A102	168 Hrs, 100%RH, 121°C
TST	MIL-STD-883D-1011.9	-65°C~150°C, 200 Cycles
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, 1 <sub>tr</sub> > 100mA

**Classification Reflow Profiles**

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T <sub>L</sub> to T <sub>P</sub> )	3°C/second max.	3°C/second max.
Preheat		
- Temperature Min (T <sub>smmin</sub> )	100°C	150°C
- Temperature Max (T <sub>smmax</sub> )	150°C	200°C
- Time (min to max) (t <sub>s</sub> )	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T <sub>L</sub> )	183°C	217°C
- Time (t <sub>L</sub> )	60-150 seconds	60-150 seconds
Peak/Classification Temperature (T <sub>P</sub> )	See table 1	See table 2
Time within 5°C of actual Peak Temperature (t <sub>p</sub> )	10-30 seconds	20-40 seconds
Ramp-down Rate	6°C/second max.	6°C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Notes: All temperatures refer to topside of the package. Measured on the body surface.

**Classification Reflow Profiles (Cont.)**

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

Table 2. Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

\*Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

**Customer Service**

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