Low I_Q, Low Dropout 300mA Fixed Voltage Regulator

Features

- Low Quiescent Current : 60µA (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
- SOT23-3, SOT23-5 and SOT89 Packages
- Lead Free Available (RoHS Compliant)

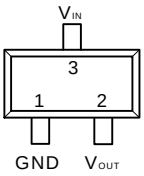
Applications

- 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

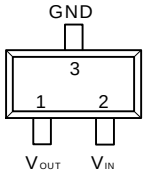
General Description

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 60µA 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-shutdown protection current limit protection to ensure specified output current and controlled short-circuit current. The APL5308/9 regulators come in a miniature SOT23-3, SOT23-5 and SOT89 packages.

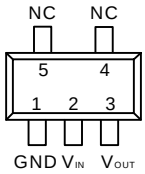
Pin Configuration



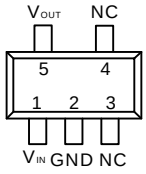
SOT23-3 (Top View)
APL5308



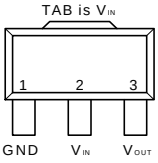
SOT23-3 (Top View)
APL5309



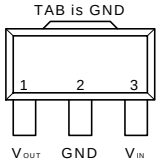
SOT23-5 (Top View)
APL5308



SOT23-5 (Top View)
APL5309



SOT89 (Top View)
APL5308



SOT89 (Top View)
APL5309

Ordering and Marking Information

APL5308/9 - □□ □□ - □□□ Lead Free Code Handling Code Temp. Range Package Code Voltage Code	Package Code A : SOT23-3 B : SOT23-5 D : SOT89 Temp. Range I : -40 to 85 °C C : 0 to 70 °C Handling Code TR : Tape & Reel Voltage Code : 15 : 1.5V ~ 45 : 4.5V Lead Free Code L : Lead Free Device Blank : Original Device
APL5308/9 -15 D : APL5308/9 XXXXX 15	XXXXX - Date Code ; 15 - 1.5V

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS and compatible with both SnPb and lead-free soldiering operations. 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.

Marking Information

SOT23-3 and SOT23-5 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.

Pin Description

PIN		I/O	Description
No.	Name		
1	V_{IN}	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_{OUT}	O	Output pin of the regulator.

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{IN}, V_{OUT}	Input Voltage or Out Voltage	6.5	V
$R_{TH,JA}$	Thermal Resistance – Junction to Ambient	SOT23-3 : 260 SOT23-5 : 260 SOT89 :180	°C/W
$R_{TH,JC}$	Thermal Resistance – Junction to Case	SOT23-3 : 130 SOT23-5 : 130 SOT89 : 60	°C/W
P_D	Power Dissipation	Internally Limited	W
T_{JMAX}	Junction Temperature	150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_L	Lead Temperature (Soldering, 10 second)	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_A (ambient temperature) is calculated using: P_D (max) = $(T_J - T_A) / \theta_{JA}$; T_J = 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_{IN} = 1µF, C_{OUT} = 4.7µF, T_A = -40 to 85°C. Typical values refer to T_A = 25°C.

Symbol	Parameter	Test Conditions	APL5308/9			Unit
			Min.	Typ.	Max.	
V_{IN}	Input Voltage		2.7		6	V
V_{OUT}	Output Voltage	V_{OUT}+1.0V< V_{CC}<6.0V, 0mA< I_{OUT} < I_{MAX}	V_{OUT} -2%	V_{OUT}	V_{OUT} +2%	V
I_{LIMIT}	Circuit Current Limit	V_{IN} = V_{OUT}+1V		650		mA
I_{SHORT}	Short Current	V_{OUT} = 0V		50		mA
I_{OUT}	Load Current	V_{IN} = V_{OUT}+1V	300			mA

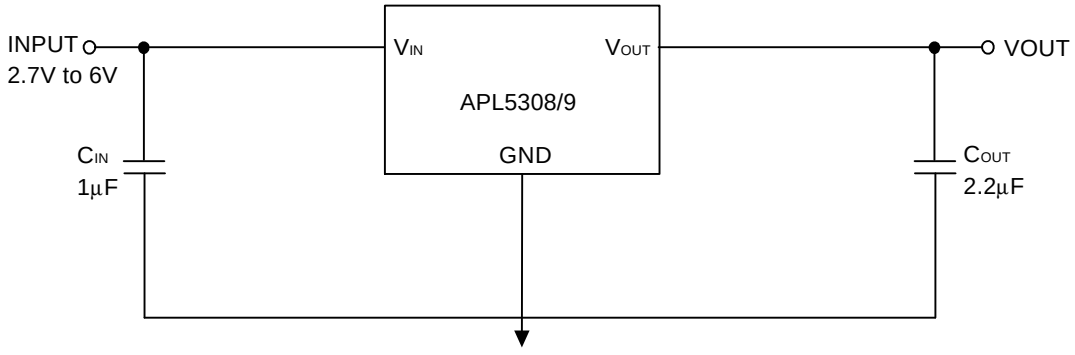
Electrical Characteristics (Cont.)

Unless otherwise noted these specifications apply over full temperature, C_{IN}= 1µF, C_{OUT} = 4.7µF, T_A= -40 to 85°C. Typical values refer to T_A= 25°C.

Symbol	Parameter	Test Conditions		APL5308/9			Unit
				Min.	Typ.	Max.	
REG_{LINE}	Line Regulation	V_{OUT}+1V< V_{CC}<6.0V, I_{OUT} = 1mA			1	10	mV
REG_{LOAD}	Load Regulation	V_{IN} = V_{OUT}+1V, 0mA< I_{OUT} < I_{MAX}			10	25	mV
	Load Transient	V_{IN}= V_{OUT}+1V, I_{OUT} = 1mA-300mA in 1µs			150	250	mV
V_{DROP}	Dropout Voltage(Note3)	I_{OUT} =300mA	1.5V≤V_{OUT}<2.0V		1	1.2	V
			2.0V≤V_{OUT}<2.5V		0.8	0.9	
			2.5V≤V_{OUT}<3V		0.6	0.7	
			3V≤V_{OUT}≤ 3.5V		0.4	0.5	
PSRR	Ripple Rejection	F≤1kHz, 1Vpp at V_{IN} = V_{OUT}+1.0V		45	55		dB
I_Q	Quiescent Current	No load			60	100	µA
		I_{OUT} = 300mA			450	500	
OTS	Over Temperature Shutdown				150		°C
	Over Temperature Shutdown Hysteresis	Hysteresis			30		°C
TC	Output Voltage Temperature Coefficient				50		ppm/°C
T_J	Junction Temperature			0		125	°C
C_{OUT}	Output Capacitor				2.2		µF
	ESR			0.01	0.1	1	Ohm

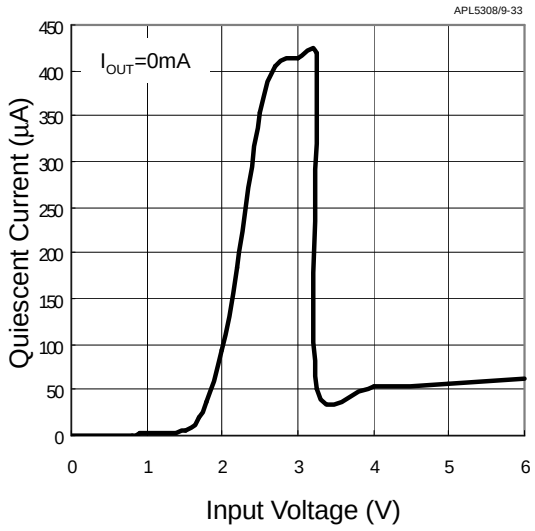
Note 3 : Dropout voltage definition : V_{IN}-V_{OUT} when V_{OUT} is 2% below the value of V_{OUT} for V_{IN} = V_{OUT}+1V.

Typical Application Circuit

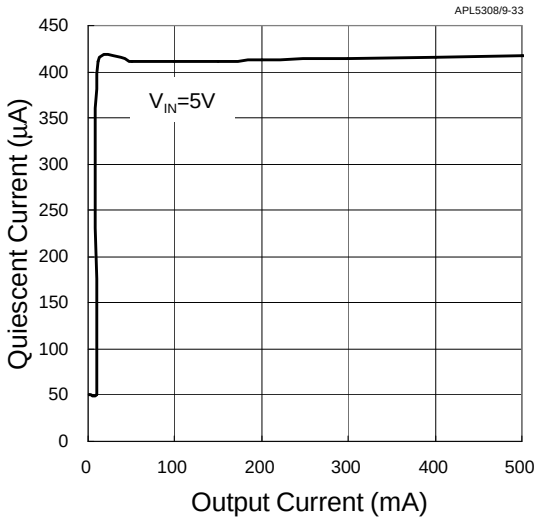


Typical Operating Characteristics

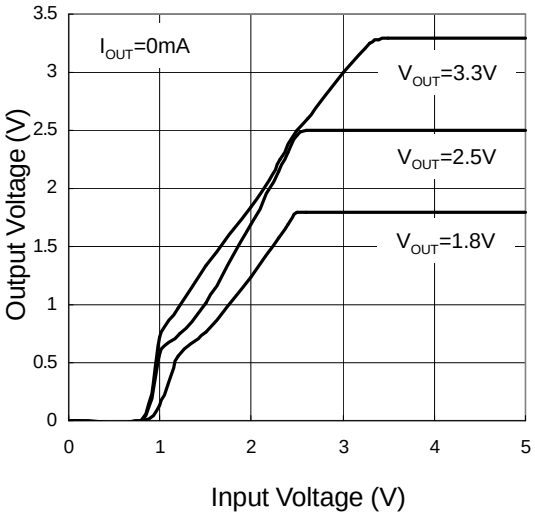
Quiescent Current vs. Input Voltage



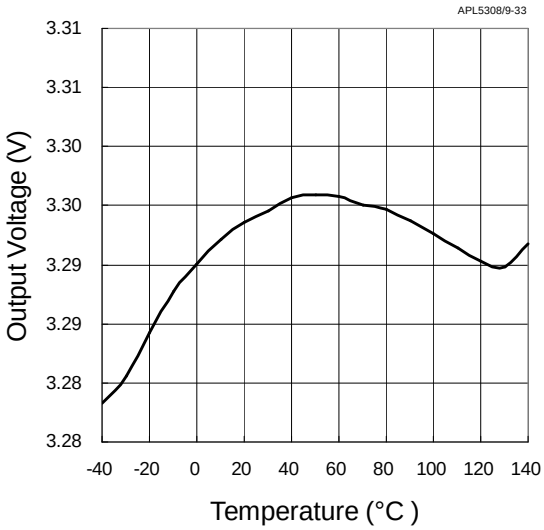
Quiescent Current vs. Output Current



Output Voltage vs. Input Voltage

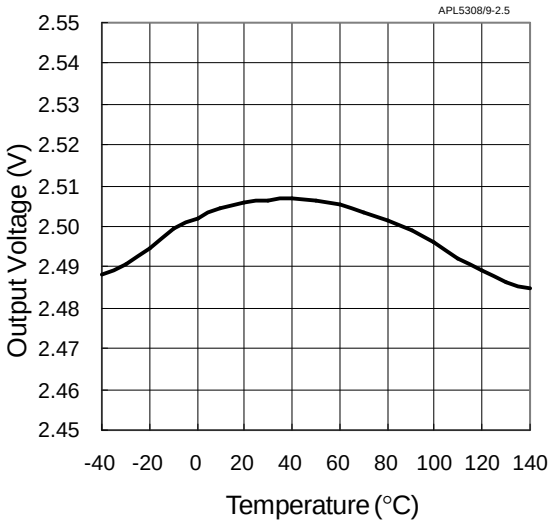


Output Voltage vs. Temperature

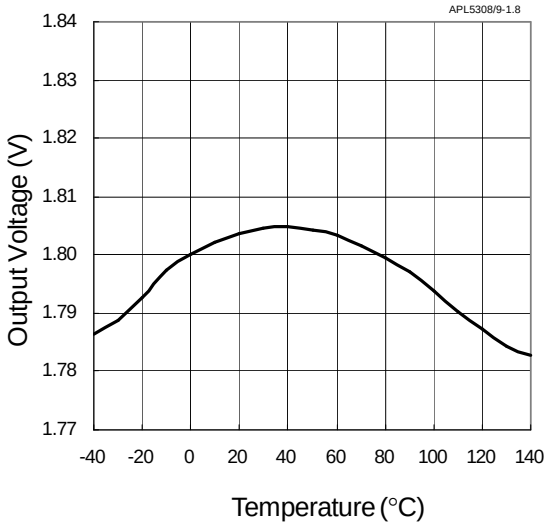


Typical Operating Characteristics (Cont.)

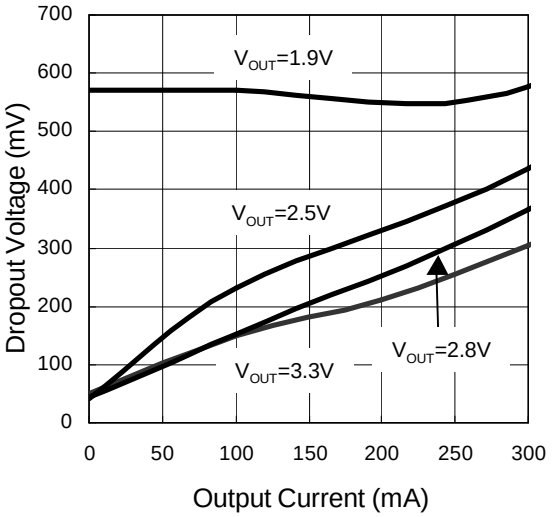
Output Voltage vs. Temperature



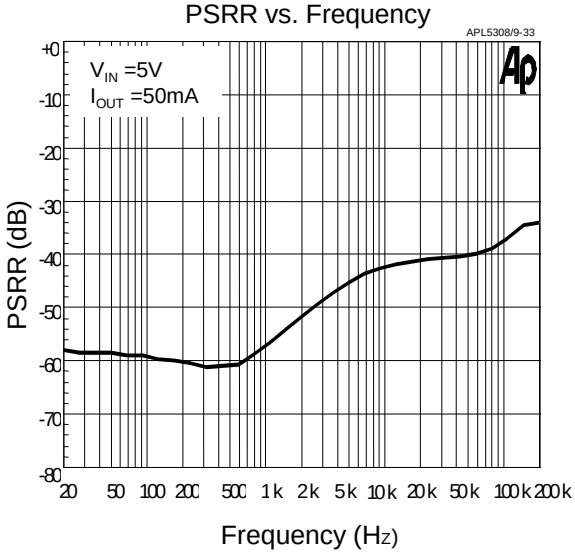
Output Voltage vs. Temperature



Dropout Voltage vs. Output Current

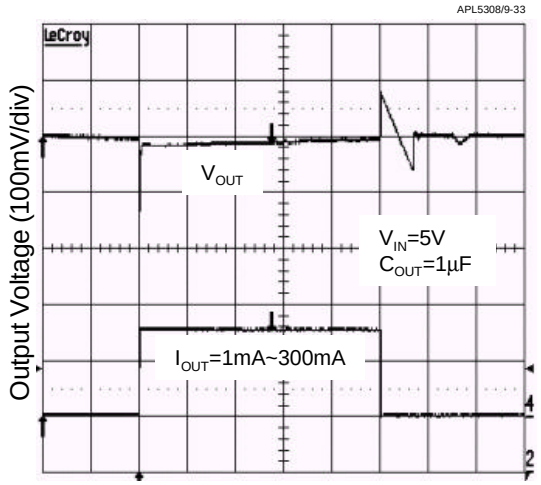


PSRR vs. Frequency

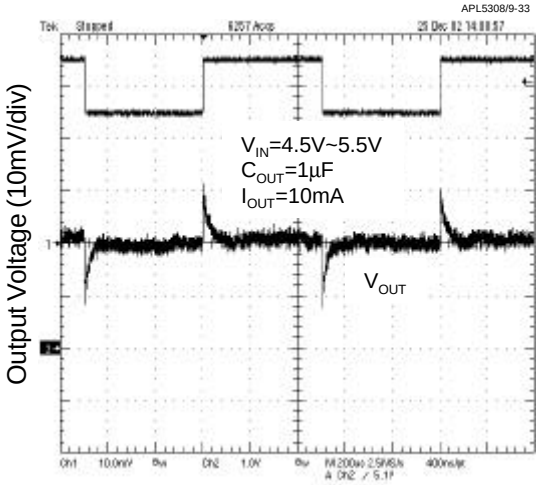


Typical Operating Characteristics (Cont.)

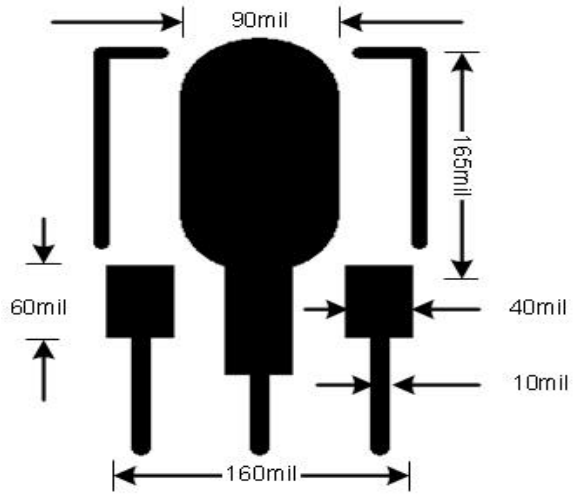
Load-Transient Response



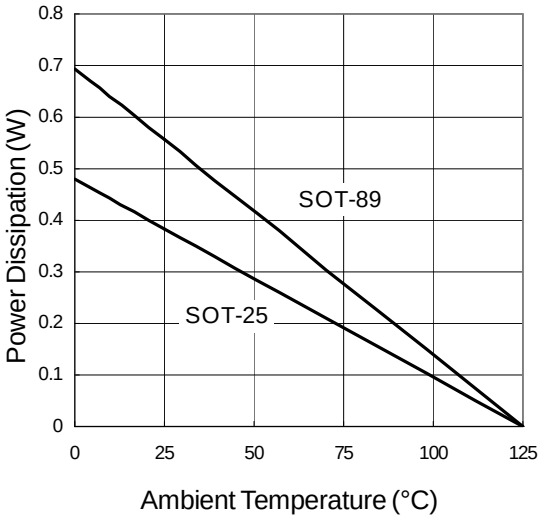
Line-Transient Response



Recommended Minimum Footprint

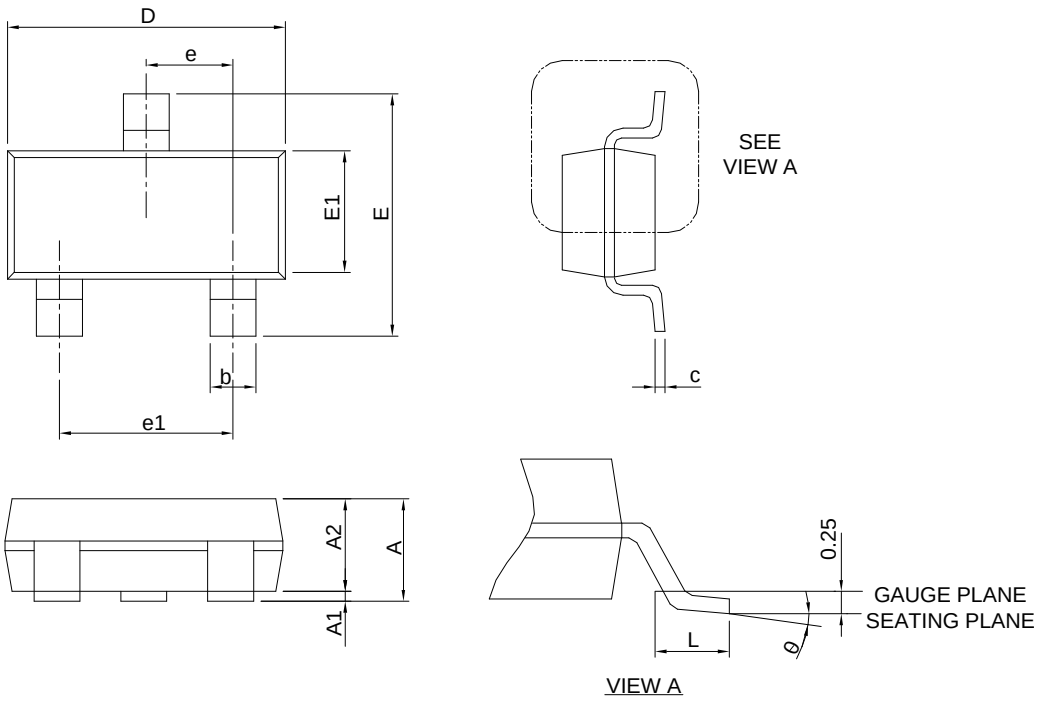


Power Dissipation vs. Ambient Temperature



Package Information

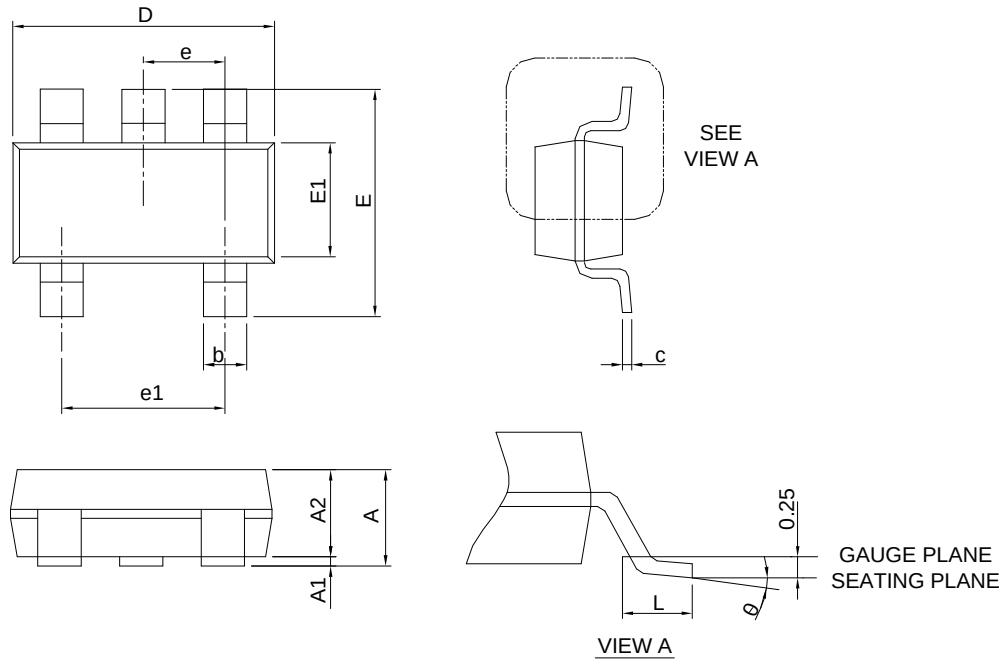
SOT23-3



SYMBOL	SOT23-3			
	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	2.90 BSC		0.114 BSC	
E	2.80 BSC		0.110 BSC	
E1	1.60 BSC		0.063 BSC	
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°

Package Information (Cont.)

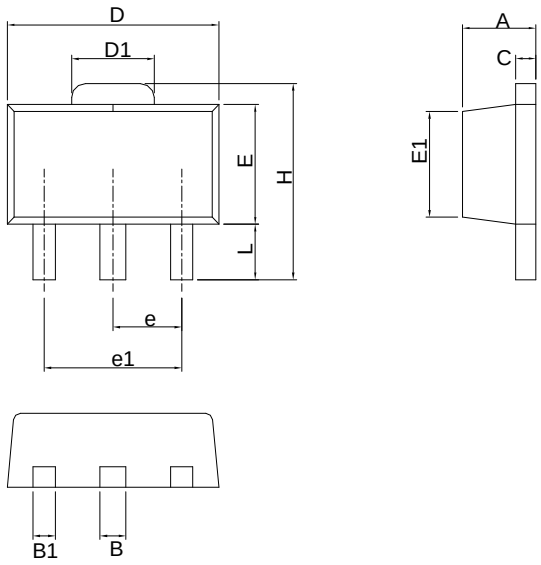
SOT23-5



SYMBOL	SOT23-5			
	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	2.90 BSC		0.114 BSC	
E	2.80 BSC		0.110 BSC	
E1	1.60 BSC		0.063 BSC	
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°

Package Information (Cont.)

SOT89

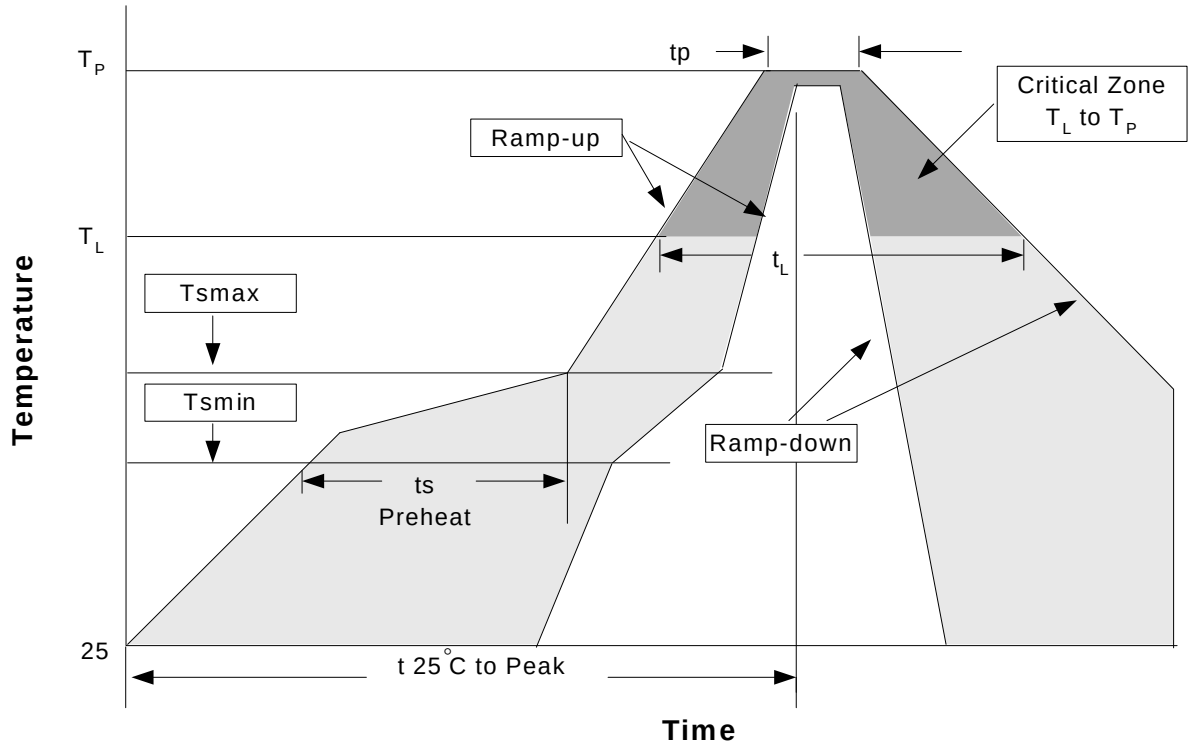


SYMBOL	SOT89			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.40	1.60	0.055	0.063
B	0.44	0.56	0.017	0.022
B1	0.36	0.48	0.014	0.019
C	0.35	0.44	0.014	0.017
D	4.40	4.60	0.173	0.181
D1	1.62	1.83	0.064	0.072
E	2.29	2.60	0.090	0.102
E1	2.13	2.29	0.084	0.090
e	1.50 BSC		0.059 BSC	
e1	3..00 BSC		0.118 BSC	
H	3.94	4.25	0.155	0.167
L	0.89	1.20	0.035	0.047

Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb), 100%Sn
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

Reflow Condition (IR/Convection or VPR Reflow)



Classificatin Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	3°C/second max.	3°C/second max.
Preheat - Temperature Min (Tsmin) - Temperature Max (Tsmax) - Time (min to max) (ts)	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	183°C 60-150 seconds	217°C 60-150 seconds
Peak/Classificatioon Temperature (Tp)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (tp)	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.

Classificatin Reflow Profile (Cont.)

Table 1. SnPb Entectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 ³350
<2.5 mm	240 +0/-5°C	225 +0/-5°C
≥2.5 mm	225 +0/-5°C	225 +0/-5°C

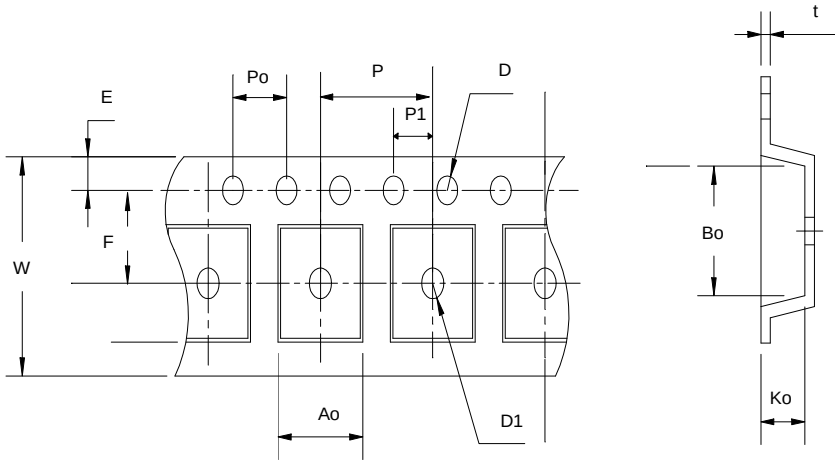
Table 2. Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 350-2000	Volume mm^3 >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.			

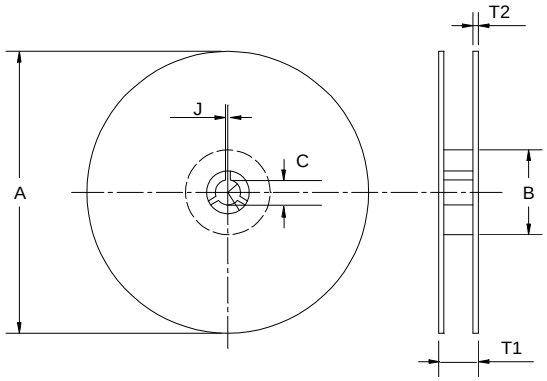
Reliability Test Program

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_{tr} > 100mA

Carrier Tape



Carrier Tape (Cont.)



Application	A	B	C	J	T1	T2	W	P	E
SOT23-3	178±1	60 ± 1.0	12.0	2.5 ± 0.15	9.0 ± 0.5	1.4	8.0+ 0.3 - 0.3	4.0	1.75
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	3.5 ± 0.05	1.5 +0.1	φ0.1MIN	4.0	2.0 ± 0.05	3.1	3.0	1.3	0.2±0.03
Application	A	B	C	J	T1	T2	W	P	E
SOT23-5	178 ±1	72 ± 1.0	13.0 + 0.2	2.5 ± 0.15	8.4 ± 2	1.5 ± 0.3	8.0 ± 0.3	4 ± 0.1	1.75± 0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	3.5 ± 0.05	1.5± 0.1	1.5± 0.1	4.0 ± 0.1	2.0 ± 0.1	3.15 ± 0.1	3.2± 0.1	1.4± 0.1	0.2±0.033
Application	A	B	C	J	T1	T2	W	P	E
SOT89	178 ±1	70 ± 2	13.5 ± 0.15	3 ± 0.15	14 ± 2	1.3 ± 0.3	12 + 0.3 12 - 0.1	8 ± 0.1	1.75± 0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5 ± 0.05	1.5± 0.1	1.5± 0.1	4.0 ± 0.1	2.0 ± 0.1	4.8 ± 0.1	4.5± 0.1	1.80± 0.1	0.3±0.013

(mm)

Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOT23-3	8	5.3	3000
SOT23-5	8	5.3	3000
SOT-89	12	9.3	1000

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