

Features

- **1.4V Maximum Dropout at Full Load Current**
- **Fast Transient Response**
- **Output Current Limiting**
- **Built-in Thermal Shutdown**
- **Good Noise Rejection**
- **3-Terminal Adjustable or Fixed 1.2V, 1.5V**
- **Packages: SOT-223, TO-252-3**
- **Lead Free and Green Devices Available (RoHS Compliant)**

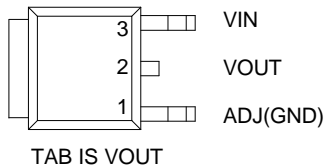
General Description

The APL1117A is a low dropout positive adjustable or fixed-mode regulator with minimum of 1A output current capability. The product is specifically designed to provide well-regulated supply for low voltage IC applications such as high-speed bus termination and low current 3.3V logic supply. The APL1117A is also well suitable for other applications such as VGA cards. It is guaranteed to have lower than 1.4V dropout at full load current, which makes it an ideal to provide well-regulated outputs of 1.2V to 5.0V with 6.4V to 12V input supply.

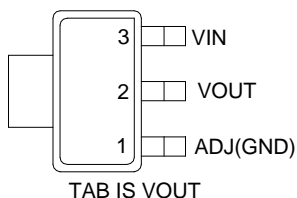
The APL1117A is available in TO-252-3 and SOT-223 packages to meet your need.

Pin Configuration

**TO-252-3
(Top View)**



**SOT-223
(Top View)**




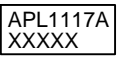
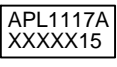


Applications

- **PC Peripheral**
- **Communication**

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>APL1117A □□□□-□□□□</p> <ul style="list-style-type: none"> □□□□ - Assembly Material □□□□ - Handling Code □□□□ - Temperature Range □□□□ - Package Code □□□□ - Voltage Code 	<p>Package Code U : TO-252-3 V : SOT-223 Temperature Range E : -20 to 70 °C Handling Code TR : Tape & Reel Voltage Code 12 : 1.2V 15 : 1.5V Blank : Adjustable Version Assembly Material G : Halogen and Lead Free Device</p>
APL1117A U :	 XXXXX - Date Code
APL1117A 12U :	 XXXXX - Date Code
APL1117A 15U :	 XXXXX - Date Code
APL1117A V :	 XXXXX - Date Code
APL1117A 15V :	 XXXXX - Date Code

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-020D 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).

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Rating	Unit
V _{IN}	DC Supply Voltage	-0.3 to 13	V
T _J	Maximum Junction Temperature	150	°C
T _{STG}	Storage Temperature Range	-65 to +150	°C
T _{SDR}	Maximum Lead Soldering Temperature, 10 Seconds	260	°C

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Characteristics (Note 2)

Symbol	Parameter	Typical Value	Unit
θ _{JA}	Junction to Ambient Thermal Resistance (Copper Area 10mmx10mm)	55 70	°C/W
θ _{JC}	Junction to Case Thermal Resistance	10 15	°C/W

Note 2 : The maximum allowable power dissipation at any T_A (ambient temperature) is calculated using: P_D (max) = (T_J - T_A) / θ_{JA}; T_J = 125°C. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

Recommended Operating Conditions

Symbol	Parameter	Range	Unit
V_{IN}	DC Supply Voltage	$V_{OUT}+1.5V$ to 12	V
V_{OUT}	Regulator Output Voltage (Adjustable Version)	1.25 to 10.5	V
I_{OUT}	Output Load Current	0 to 1	A
T_A	Operating Ambient Temperature	-20 to 70	°C
T_J	Operating Junction Temperature	-20 to 125	°C

Electrical Characteristics

Unless otherwise noted, these specifications apply over $C_{IN} = 10\mu F$, $C_{OUT} = 10\mu F$, and $T_A = 25^\circ C$, $I_{OUT} = 10mA$.

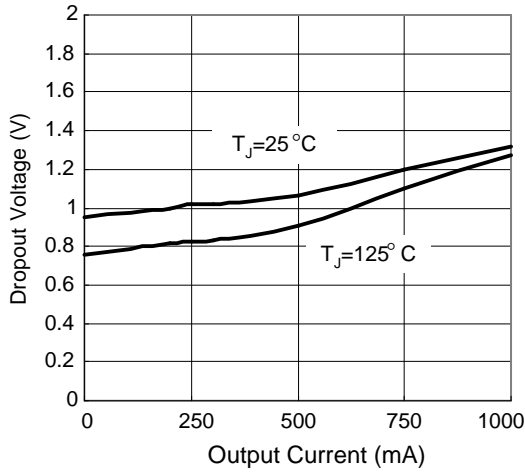
Symbol	Parameter	Test Conditions	APL1117A			Unit
			Min.	Typ.	Max.	
V_{REF}	Reference Voltage	$V_{IN} - V_{OUT} = 1.5V$	1.225	1.250	1.275	V
V_{OUT}	Output Voltage	APL1117A-12 $2.7V \leq V_{IN} \leq 12V$	1.176	1.200	1.224	V
		APL1117A-15 $3V \leq V_{IN} \leq 12V$	1.470	1.500	1.530	
REG_{LINE}	Line Regulation	APL1117A $1.5V \leq (V_{IN} - V_{OUT}) \leq 12V, I_{OUT} = 10mA$	-	0.15	0.5	%
		APL1117A-12 $2.7V \leq V_{IN} \leq 12V, I_{OUT} = 10mA$	-	1.8	6	
		APL1117A-15 $3V \leq V_{IN} \leq 12V, I_{OUT} = 10mA$	-	2.2	7.5	mV
REG_{LOAD}	Load Regulation	$(V_{IN} - V_{OUT}) = 1.5V, 10mA \leq I_{OUT} \leq 1A$ (Note3)	-	-	1	%
V_D	Dropout Voltage	$I_{OUT} = 1A$ (Note4)	-	1.3	1.4	V
I_{LIMIT}	Current Limit	$(V_{IN} - V_{OUT}) = 5V$	1100	-	-	mA
I_{OUT}	Minimum Load Current	$T_J = -20$ to $125^\circ C$	-	5	10	mA
PSRR	Ripple Rejection	$F = 120Hz, V_{IN} = V_{OUT} + 3V, I_{OUT} = 1A, C_{OUT} = 22\mu F$	-	60	70	dB

Note 3 : Load regulations are measured at a constant junction temperature by low duty cycle pulse testing.

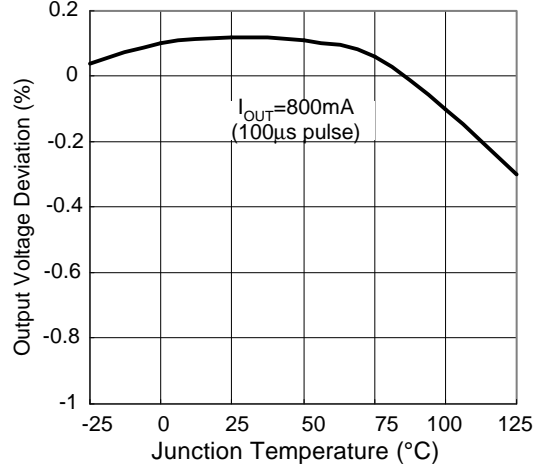
Note 4 : Dropout voltage is specified over the full output current range of the device. Dropout voltage is defined as the minimum input/output differential measured at the specified output current. Test points and limits are also shown on the Dropout Voltage curve.

Typical Operating Characteristics

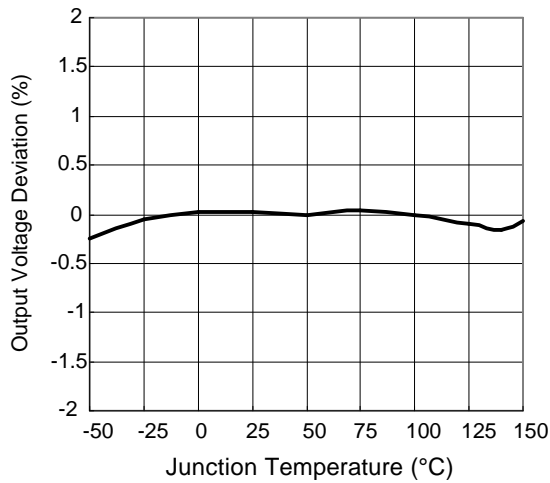
Dropout Voltage vs. Output Current



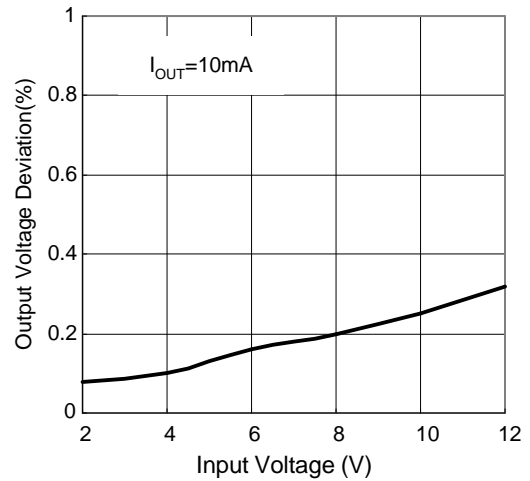
Load Regulation vs. Junction Temperature



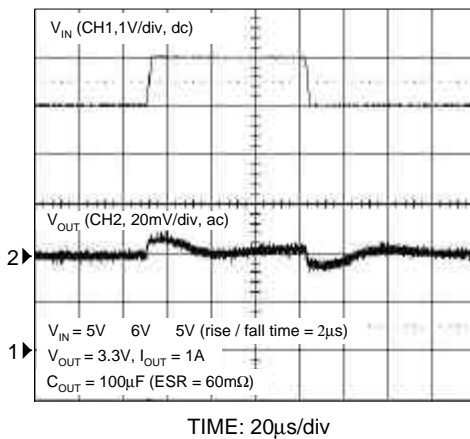
Output Voltage vs. Junction Temperature



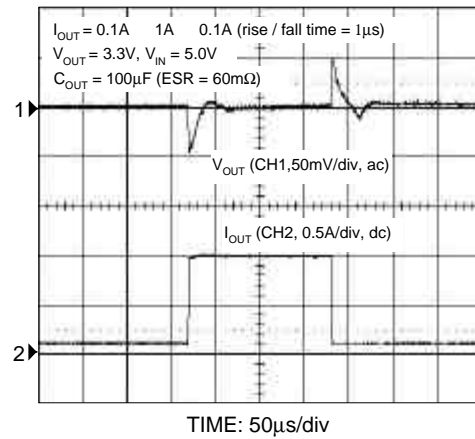
Line Regulation



Line Transient Response



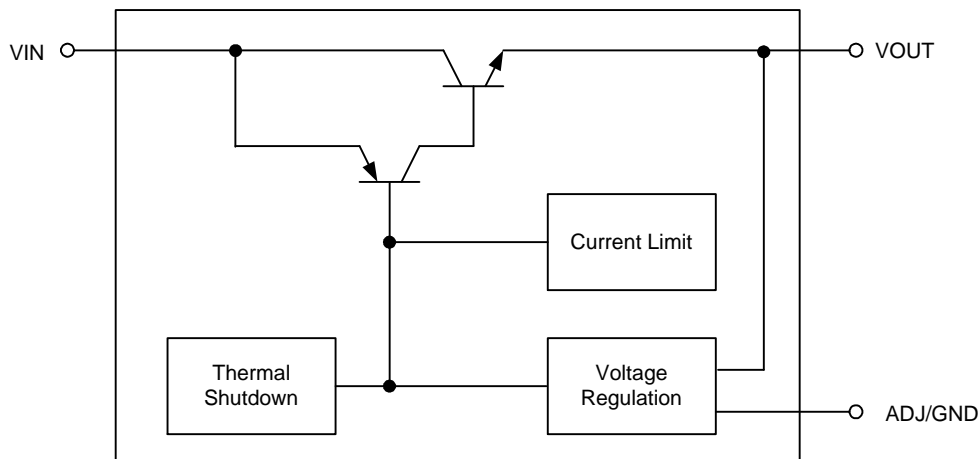
Load Transient Response



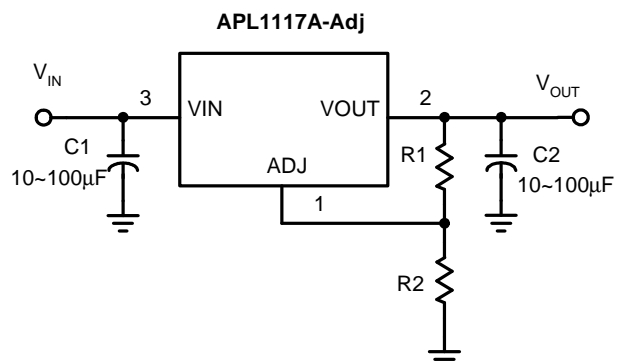
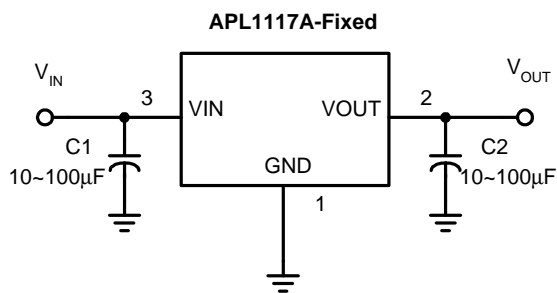
Pin Description

PIN		FUNCTION
NO.	NAME	
1	ADJ (GND)	A resistor divider from this pin to the VOUT pin and ground sets the output voltage. (GND only for Fixed-Mode)
2	VOUT	The output of the regulator. A minimum of 10μF capacitor (0.15Ω ≤ ESR ≤ 20Ω) must be connected from this pin to the ground to insure stability
3	VIN	The input pin of regulator. Typically a large storage capacitor (0.15Ω ≤ ESR ≤ 20Ω) is connected from this pin to the ground to insure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be 1.4V higher than VOUT in order for the device to regulator properly.

Block Diagram



Typical Application Circuits



$$V_{OUT} = 1.250V \times (1 + R2/R1)$$

$$V_{REF} / R2 \text{ must be greater than } 10mA$$

Application Information

Output Voltage

The output voltage of the APL1117A-ADJ can be adjusted with a resistive divider from output voltage to ADJ pin to ground (see Figure1), and the internal reference voltage is 1.25V. The following equation can be used to calculate the output voltage:

$$V_{OUT} = 1.25V \times \left(1 + \frac{R2}{R1}\right) + I_{ADJ} \times R2$$

Where the I_{ADJ} is a constant current flows through R2 and represents a small error. Because the I_{ADJ} is very small, it can usually be ignored. Note that the APL1117A-ADJ needs a minimum load current of 10mA to present the output voltage. For fixed voltage devices, the R1 and R2 are included in the device.

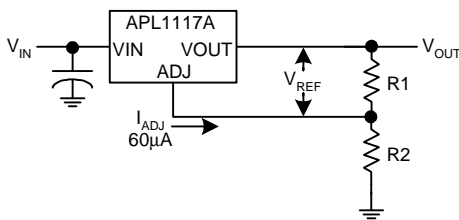


Figure 1. Basic Adjustable Regulator

Load Regulation

When the adjustable regulator is used, load regulation will be limited by the resistance of the wire connecting the regulator to the load. The datasheet specification for load regulation is measured at the output pin of the device. The best load regulation is obtained when the top of the resistor divider (R1) is tied directly to the output pin of the device, but to the load. For fixed voltage devices, the top of R1 is internally connected to the output, and the ground pin can be connected to low side of the load. If R1 is connected to the load, R_p is multiplied by the divider ratio, the effective resistance between the regulator and the load would be:

$$R_p \times \left(1 + \frac{R2}{R1}\right), R_p = \text{Parasitic Line Resistance}$$

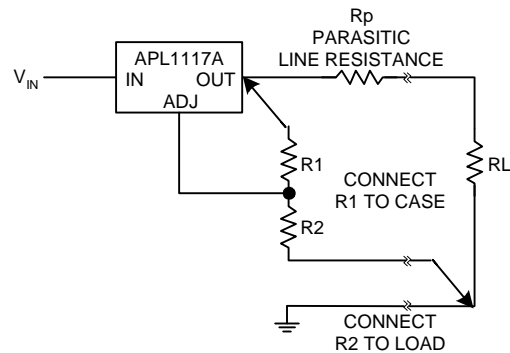


Figure 2. Connections for The Best Load Regulation

Input Capacitor

An input capacitor of 10µF or greater is recommended. Tantalum or aluminum electrolytic capacitors can be used for bypassing. Larger Values will improve ripple rejection by bypassing the input to the regulator.

Output Capacitor

The APL1117A requires an output capacitor to maintain stability and improve transient response. Proper capacitor selection is important to ensure proper operation. The APL1117A output capacitor selection depends upon the ESR (equivalent series resistance) of the output capacitor to maintain stability. When the output capacitor is 10µF or greater, the output capacitor should have an ESR between 0.15Ω to 20Ω. This will improve transient response as well as promote stability. A low-ESR solid tantalum capacitor works extremely well and provides good transient response and stability over temperature.

Aluminum electrolytics can also be used, as long as the ESR of the capacitor is less than 1Ω. The value of the output capacitor can be increased without limit. Higher capacitance values help to improve transient response and ripple rejection and reduce output noise.

Ripple Rejection

The curves for Ripple Rejection were generated by using an adjustable device with the adjust pin bypassed. With a 22µF bypassing capacitor, 60dB ripple rejection is obtainable at any output level. The impedance of the adjust pin capacitor, at the ripple frequency, should be < R1. R1

Application Information (Cont.)

Ripple Protection (Cont.)

is normally in the range of 100Ω to 200Ω. The size of the required adjust pin capacitor is a function of the input ripple frequency. At 120Hz, with $R1=100\Omega$, the adjust pin capacitor should be 13μF. For fixed voltage devices and adjustable devices without an adjust pin capacitor, the output ripple will increase as the ratio of the output voltage to the reference voltage (V_{OUT}/V_{REF}).

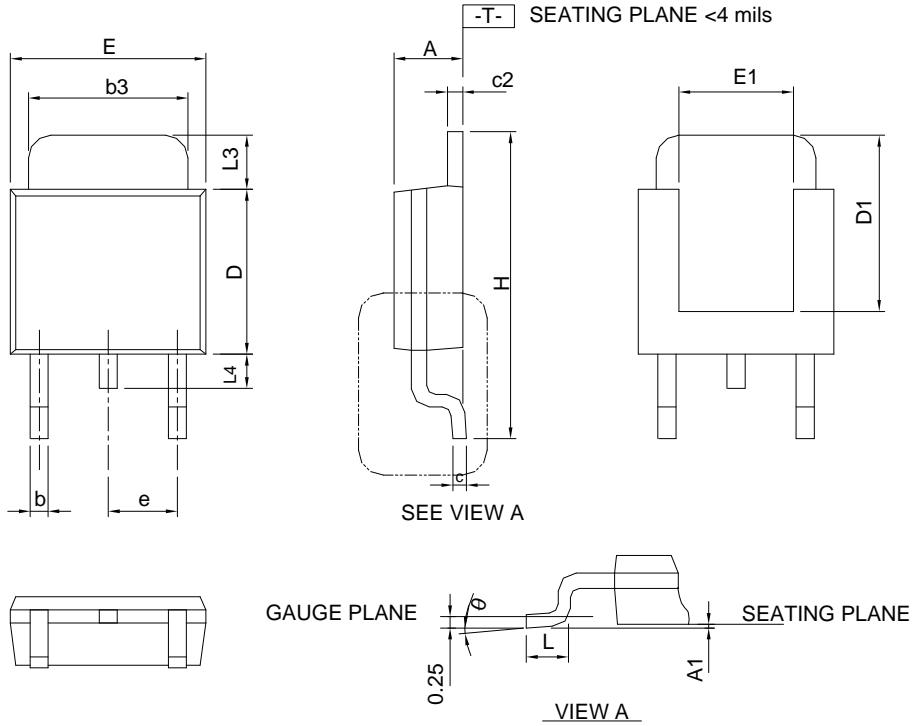
Thermal Consideration

The APL1117A regulators have thermal protection to limit junction temperature to 150°C. However, device functionality is only guaranteed to a maximum junction temperature of +125°C.

Both of the thermal resistance of the case to circuit board and the rate of air flow control the APL1117A's maximum power dissipation. The power dissipation across the device is $P_D = I_{OUT} (V_{IN} - V_{OUT})$ and the maximum power dissipation is: $P_{DMAX} = (T_J - T_A) / (\theta_{JC} + \theta_{CA})$, where $T_J - T_A$ is the temperature difference between the junction and ambient air, θ_{JC} is the thermal resistance of the package, and θ_{CA} is the thermal resistance through the printed circuit board, copper traces, and other materials to the ambient air ($\theta_{JC} + \theta_{CA} = \theta_{JA}$). The VOUT pin (Tab) of the APL1117A provides a channeling heat away. If power dissipation is large, connect the VOUT pin to a large plane, which can improve the problem of over heat of IC.

Package Information

TO-252-3

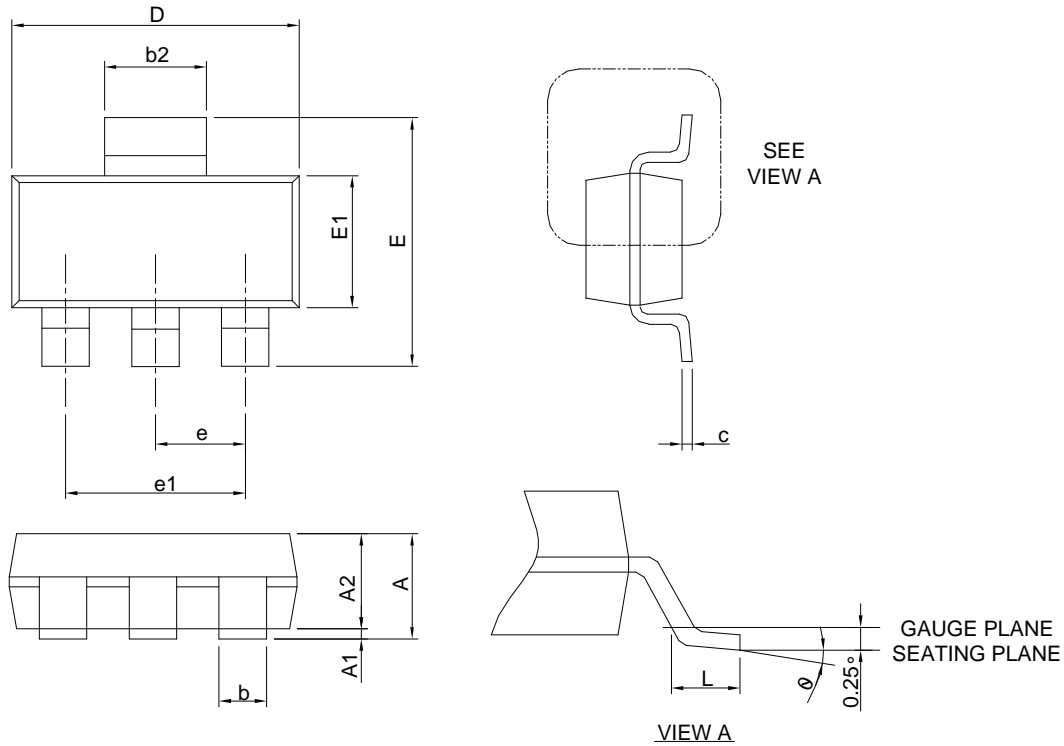


DIMENSIONS	TO-252-3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1		0.13		0.005
b	0.50	0.89	0.020	0.035
b3	4.95	5.46	0.195	0.215
c	0.46	0.61	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.33	6.22	0.210	0.245
D1	4.57	6.00	0.180	0.236
E	6.35	6.73	0.250	0.265
E1	3.81	6.00	0.150	0.236
e	2.29 BSC		0.090 BSC	
H	9.40	10.41	0.370	0.410
L	0.90	1.78	0.035	0.070
L3	0.89	2.03	0.035	0.080
L4		1.02		0.040
θ	0°	8°	0°	8°

Note : Follow JEDEC TO-252 .

Package Information

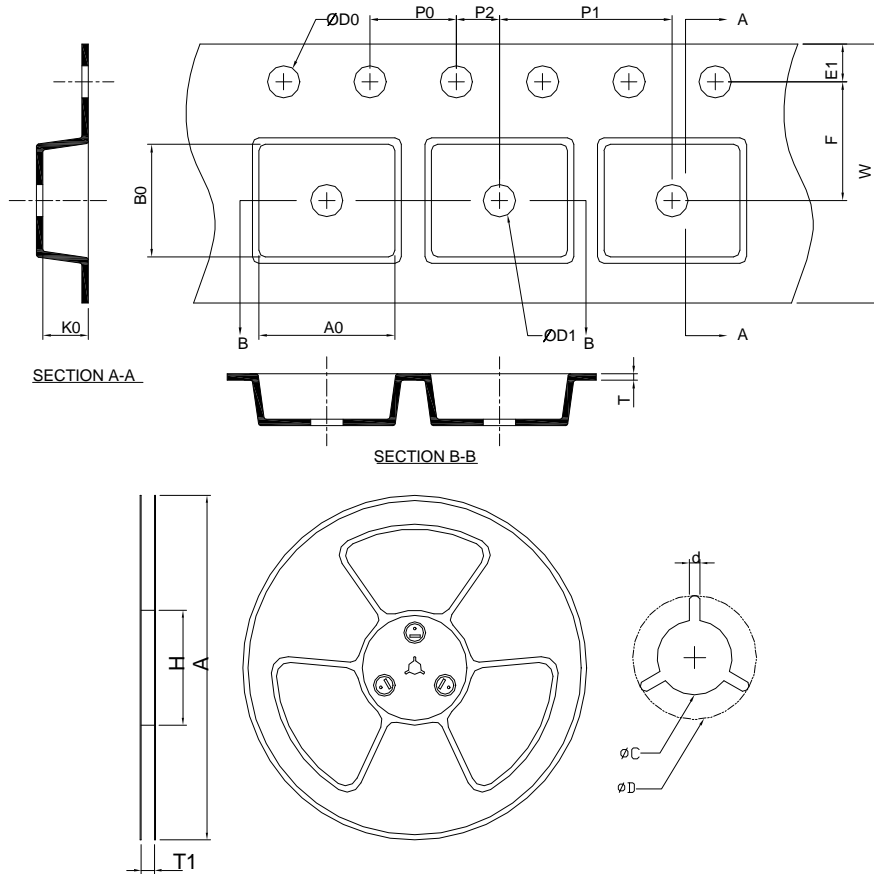
SOT-223



SYMBOL	SOT-223			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.80		0.071
A1	0.02	0.10	0.001	0.004
A2	1.50	1.70	0.059	0.067
b	0.66	0.84	0.026	0.033
b2	2.90	3.10	0.114	0.122
c	0.23	0.33	0.009	0.013
D	6.30	6.70	0.248	0.264
E	6.70	7.30	0.264	0.287
E1	3.30	3.70	0.130	0.146
e	2.30 BSC		0.091 BSC	
e1	4.60 BSC		0.181 BSC	
L	0.75		0.030	
θ	0°	10°	0°	10°

Note : 1. Follow from JEDEC TO-261 AA.
 2. Dimension D and E1 are determined at the outermost extremes of the plastic exclusive of mold flash, tie bar burrs, gate burrs, and interlead flash, but including any mismatch between the top and bottom of the plastic body.

Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
SOT-223	320.0 ±0.00	50 MIN.	12.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.00 ±0.30	1.75 ±0.10	5.50 ±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.00 ±0.10	8.00 ±0.10	2.00 ±0.50	1.5+0.10 -0.00	1.5 MIN.	0.6+0.00 -0.40	6.90 ±0.20	7.50 ±0.20	2.10 ±0.20
Application	A	H	T1	C	d	D	W	E1	F
TO-252-3	330.0 ±0.00	50 MIN.	16.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	16.0 ±0.30	1.75 ±0.10	7.50 ±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	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	6.80 ±0.20	10.40 ±0.20	2.50 ±0.20

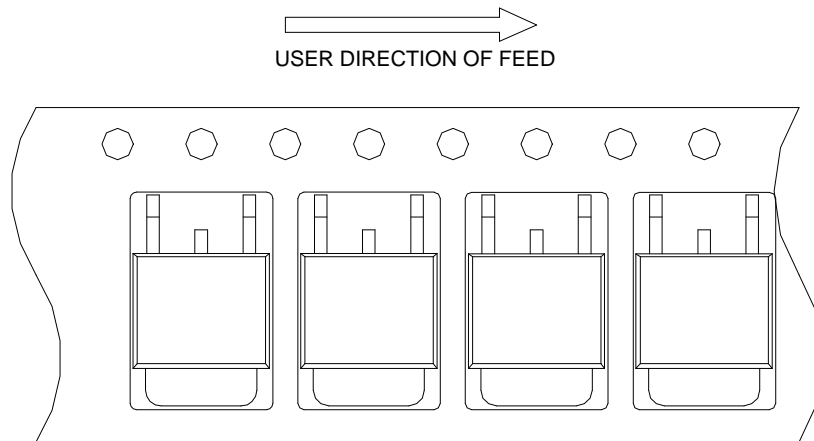
(mm)

Devices Per Unit

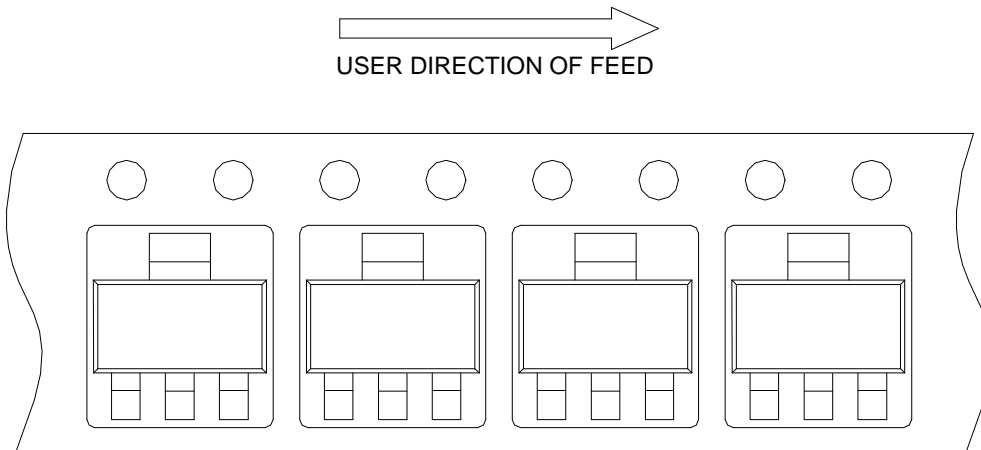
Package Type	Unit	Quantity
SOT-223	Tape & Reel	2500
TO-252-3	Tape & Reel	2500

Taping Direction Information

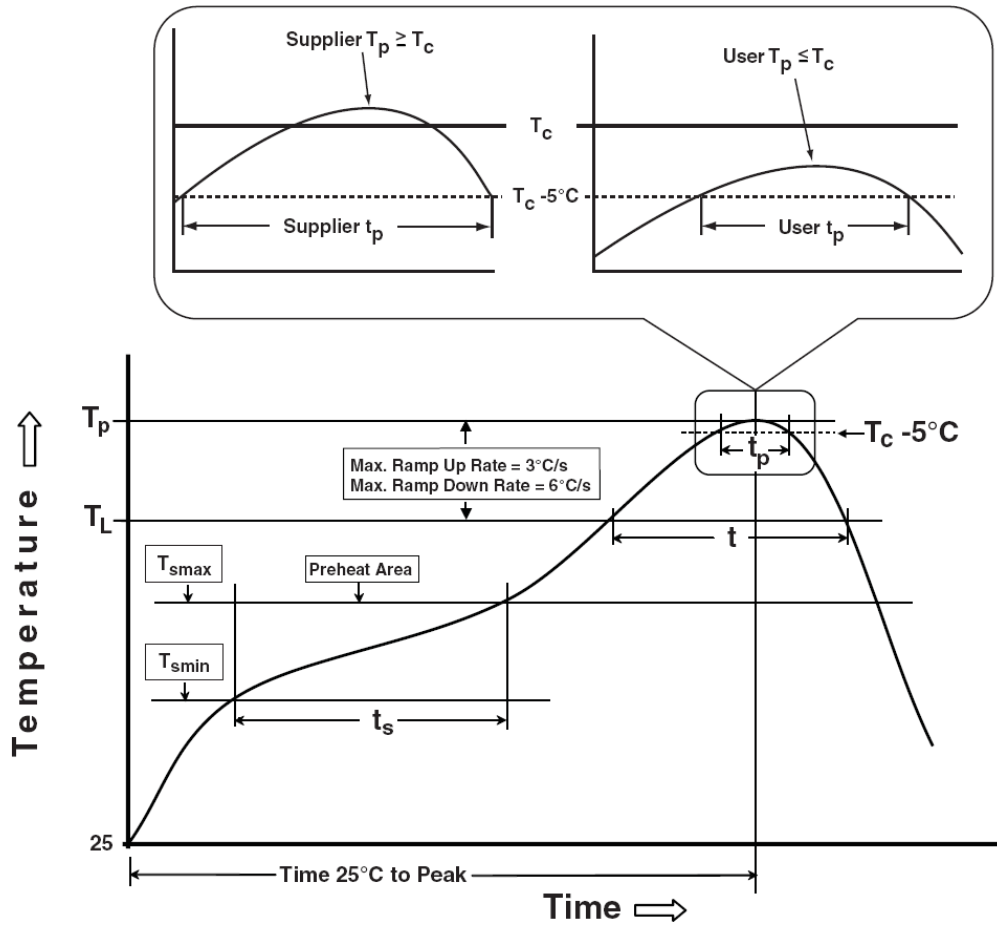
TO-252-3



SOT-223



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_l)	60-150 seconds	60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.

* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum.
 ** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.

Classification Reflow Profiles (Cont.)

Table 1. SnPb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (Tc)

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HOLT	JESD-22, A108	1000 Hrs, Bias @ T _j =125°C
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C
HBM	MIL-STD-883-3015.7	VHBM 2KV
MM	JESD-22, A115	VMM 200V
Latch-Up	JESD 78	10ms, 1 _{tr} 100mA

Customer Service

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