

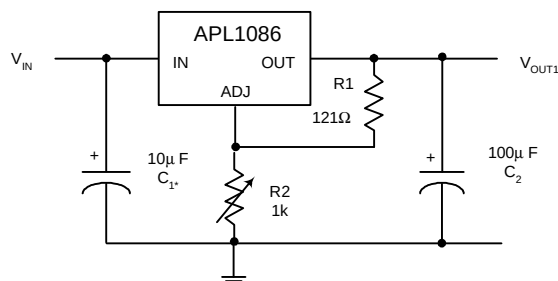
1.5A Low Dropout Fast Response Positive Adjustable Regulator and Fixed 1.8V, 2.5V, 2.85V, and 3.3V

Features

- **Guaranteed Output Voltage Accuracy within 2%**
- **Fast Transient Response**
- **Guaranteed Dropout Voltage at Multiple Currents**
- **Load Regulation : 0.1% Typ.**
- **Line Regulation : 0.03% Typ.**
- **Low Dropout Voltage : 1.3V Typ. at $I_{OUT}=1.5A$**
- **Current Limit : 1.5A Min. at $T_J=125^\circ C$**
- **On-Chip Thermal Limiting : $150^\circ C$ Typ.**
- **Adjustable Output : 1.25~10.7V**
- **Standard 3-pin SOT-223, TO-252, TO-220, and TO-263 Power Packages**
- **Lead Free and Green Devices Available (RoHS Compliant)**

Simplified Application Circuits

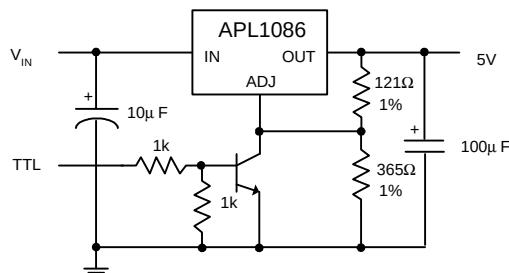
1.25V to 10.7V Adjustable Regulator



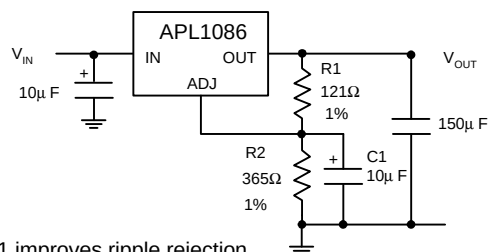
* Needed if device is far from filter capacitors

$$V_{OUT} = 1.250V \times \frac{R1 + R2}{R1}$$

5V Regulator with Shutdown



Improving Ripple Rejection



* C1 improves ripple rejection.
X_C should be approximately equal to R1 at ripple frequency

General Description

The APL1086 is a low dropout three-terminal adjustable regulators with 1.5A output current capability. In order to obtain lower dropout voltage and faster transient response, which is critical for low voltage applications, the APL1086 has been optimized.

The device is available in an adjustable version and fixed output voltages of 1.8V, 2.5V, 2.85V, and 3.3V, the output available voltage range is from 1.25 to 10.7V with an input supply below 12V. Dropout voltage is guaranteed at a maximum of 1.45V at 1.5A.

Current limit is trimmed to ensure specified output current and controlled short-circuit current. On-chip thermal limiting provides protection against any combination of overload that would create excessive junction temperatures.

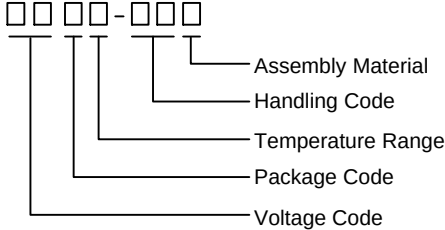
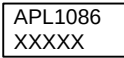
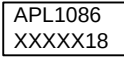
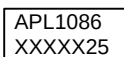
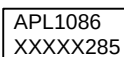
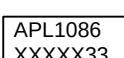
The APL1086 is available in the industry standard 3-pin SOT-223, TO-252, TO-220, or TO-263 power packages.

Applications

- **Active SCSI Terminators**
- **Low Voltage Logic Supplies**
- **Battery-Powered Circuitry**
- **Post Regulator for Switching Power Supply**

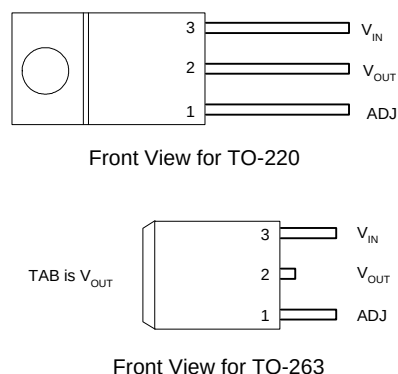
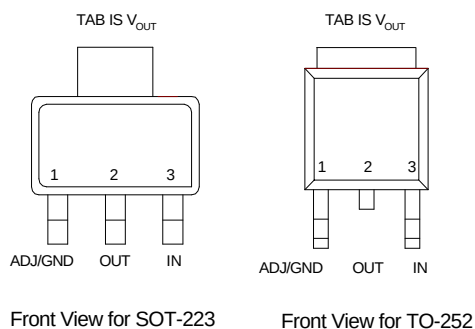
ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Ordering and Marking Information

APL1086 - 	Package Code F : TO-220 G : TO-263 U : TO-252 V : SOT-223 Operating Ambient Temperature Range C : 0 to 70 °C Handling Code TU : Tube TR : Tape & Reel Voltage Code 18 : 1.8V 25 : 2.5V 285 : 2.85V 33 : 3.3V Blank : Adjustable Version Assembly Material G : Halogen and Lead Free Device
APL1086 F/G/U :  XXXXX - Date Code	APL1086 V :  XXXXX - Date Code
APL1086 -18F/G/U:  XXXXX - Date Code	APL1086- 18V :  XXXXX - Date Code
APL1086 -25F/G/U:  XXXXX - Date Code	APL1086- 25V :  XXXXX - Date Code
APL1086 -285F/G/U:  XXXXX - Date Code	APL1086- 285V :  XXXXX - Date Code
APL1086 -33F/G/U:  XXXXX - Date Code	APL1086- 33V :  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-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).

Pin Configurations



Absolute Maximum Ratings (Note 1,2)

Symbol	Parameter	Rating	Unit
V_I	Input Voltage	15	V
P_D	Power Dissipation, $T_A=25^{\circ}\text{C}$ SOT-223 TO-252	1.7 2	W
θ_{JA}	Thermal Resistance from Junction to Ambient in Free Air SOT-223 TO-252	60 50	$^{\circ}\text{C/W}$
T_J	Operating Junction Temperature Range	0 to 150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-65 to +150	$^{\circ}\text{C}$
T_L	Maximum Lead Soldering Temperature, 10 Seconds	260	$^{\circ}\text{C}$

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:

$P_D (\text{max}) = (T_J - T_A) / \theta_{JA}$; $T_J = 125^{\circ}\text{C}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

Electrical Characteristics

Symbol	Parameter	Test Conditions	APL1086			Unit
			Min.	Typ.	Max.	
V_{REF}	Reference Voltage	$10\text{mA} \leq I_{OUT} \leq 1.5\text{A}$, $1.4\text{V} \leq (V_{IN} - V_{OUT}) \leq 9.75\text{V}$, $T_J = 0 \sim 125^{\circ}\text{C}$	1.225	1.250	1.275	V
V_{OUT}	Output Voltage APL1086-18	$T_J = 25^{\circ}\text{C}$, $I_{OUT} = 0\text{mA}$, $T_J = 0 \sim 125^{\circ}\text{C}$, $0 \leq I_{OUT} \leq 1.5\text{A}$, $3.5\text{V} \leq V_{IN} \leq 9\text{V}$,	1.782 1.764	1.800 1.800	1.818 1.836	V
	APL1086-25	$T_J = 25^{\circ}\text{C}$, $I_{OUT} = 0\text{mA}$, $T_J = 0 \sim 125^{\circ}\text{C}$, $0 \leq I_{OUT} \leq 1.5\text{A}$, $4\text{V} \leq V_{IN} \leq 9\text{V}$,	2.475 2.450	2.500 2.500	2.525 2.550	
	APL1086-28	$T_J = 25^{\circ}\text{C}$, $I_{OUT} = 0\text{mA}$, $T_J = 0 \sim 125^{\circ}\text{C}$, $0 \leq I_{OUT} \leq 1.5\text{A}$, $4.25\text{V} \leq V_{IN} \leq 9\text{V}$,	2.822 2.792	2.850 2.850	2.878 2.910	
	APL1086-33	$T_J = 25^{\circ}\text{C}$, $I_{OUT} = 0\text{mA}$, $T_J = 0 \sim 125^{\circ}\text{C}$, $0 \leq I_{OUT} \leq 1.5\text{A}$, $4.75\text{V} \leq V_{IN} \leq 9\text{V}$,	3.267 3.235	3.3003 300	3.333 3.365	
REG_{LINE}	Line Regulation APL1086	$T_J = 0 \sim 125^{\circ}\text{C}$ $I_{OUT} = 10\text{mA}$, $1.5\text{V} \leq V_{IN} - V_{OUT} \leq 9\text{V}$ (Note3)	-	0.03	0.2	% mV
	APL1086-18	$I_{OUT} = 0\text{mA}$, $3.5\text{V} \leq V_{IN} \leq 9\text{V}$ (Note3)	-	1	6	
	APL1086-25	$I_{OUT} = 0\text{mA}$, $4\text{V} \leq V_{IN} \leq 9\text{V}$ (Note3)	-	1	6	
	APL1086-28	$I_{OUT} = 0\text{mA}$, $4.25\text{V} \leq V_{IN} \leq 9\text{V}$ (Note3)	-	1	6	
	APL1086-33	$I_{OUT} = 0\text{mA}$, $4.75\text{V} \leq V_{IN} \leq 9\text{V}$ (Note3)	-	1	6	
REG_{LOAD}	Load Regulation APL1086	$T_J = 0 \sim 125^{\circ}\text{C}$ $(V_{IN} - V_{OUT}) = 3\text{V}$, $0 \leq I_{OUT} \leq 1.5\text{A}$ (Note3)	-	0.1	0.4	% mV
	APL1086-18	$V_{IN} = 3.5\text{V}$, $0 \leq I_{OUT} \leq 1.5\text{A}$ (Note3)	-	1	10	
	APL1086-25	$V_{IN} = 4\text{V}$, $0 \leq I_{OUT} \leq 1.5\text{A}$ (Note3)	-	1	10	
	APL1086-28	$V_{IN} = 4.25\text{V}$, $0 \leq I_{OUT} \leq 1.5\text{A}$ (Note3)	-	1	10	
	APL1086-33	$V_{IN} = 4.75\text{V}$, $0 \leq I_{OUT} \leq 1.5\text{A}$ (Note3)	-	1	10	

Electrical Characteristics (Cont.)

Symbol	Parameter	Test Conditions	APL1086			Unit
			Min.	Typ.	Max.	
V_D	Dropout Voltage	$I_{OUT}=1.5A$, $T_J=0\sim125^{\circ}C$ (Note4)	-	1.3	1.45	V
I_{LIMIT}	Current Limit	$(V_{IN}-V_{OUT})=5V$, $T_J=25^{\circ}C$	1500	-	-	mA
I_{ADJ}	Adjust Pin Current	$(V_{IN}-V_{OUT})=3V$, $I_{OUT}=10mA$, $T_J=0\sim125^{\circ}C$	-	60	120	μA
ΔI_{ADJ}	Adjust Pin Current Change	$T_J=0\sim125^{\circ}C$, $10mA \leq I_{OUT} \leq 1.5A$, $1.4V \leq (V_{IN}-V_{OUT}) \leq 7.75V$	-	0.2	5	μA
I_O	Minimum Load Current	$T_J=0\sim125^{\circ}C$, $(V_{IN}-V_{OUT})=7.75V$, (Note 5)	-	1.7	-	mA
PSRR	Ripple Rejection	$F_{RIPPLE}=120Hz$, $V_{RIPPLE}=1V_{P-P}$, $(V_{IN}-V_{OUT})=3V$, $T_J=0\sim125^{\circ}C$	60	75	-	dB
T_R	Thermal Regulation	$T_J=25^{\circ}C$, 30ms Pulse	-	0.01	0.02	%/ W
T_S	Temperature Stability		-	0.5	-	%
L_S	Long -Term Stability	$T_J=125^{\circ}C$, 1000Hrs.	-	0.3	-	%
V_N	RMS Output Noise	$T_J=25^{\circ}C$, $10Hz \leq F \leq 10kHz$, (% of V_{OUT})	-	0.003	-	%
θ_{JC}	Thermal Resistance from Junction to Case	at Tab, SOT-223	-	15	-	$^{\circ}C/ W$
		at Tab, TO-252	-	6	-	
OT	Over Temperature Point		-	150	-	$^{\circ}C$
	Quiescent Current	$T_J=0\sim125^{\circ}C$,	-			mA
	APL1086-18	$V_{IN} \leq 9V$	-	5.5	10	
	APL1086-25	$V_{IN} \leq 9V$	-	5.5	10	
	APL1086-28	$V_{IN} \leq 9V$	-	5.5	10	
	APL1086-33	$V_{IN} \leq 9V$	-	5.5	10	

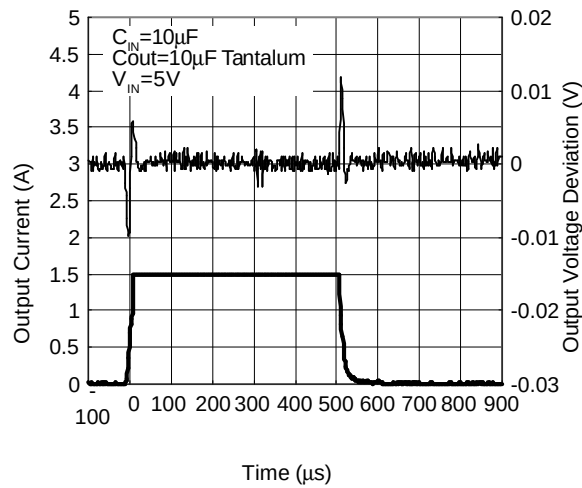
Note 3: See thermal regulation specifications for changes in output voltage due to heating effects. Load line regulations are measured at a constant junction temperature by low duty cycle pulse testing.

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.

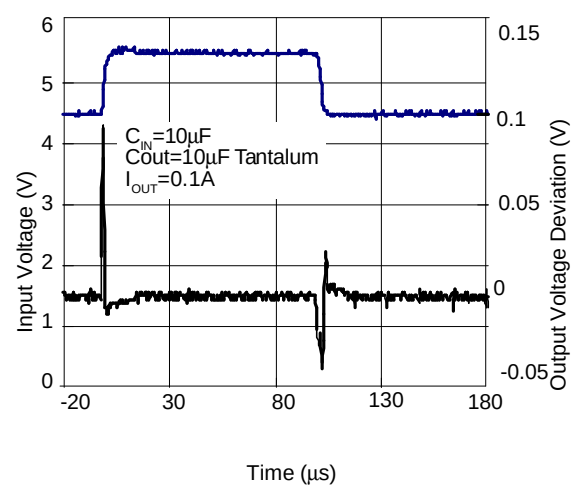
Note 5: Minimum load current is defined as the minimum output current required to maintain regulation.

Typical Operating Characteristics

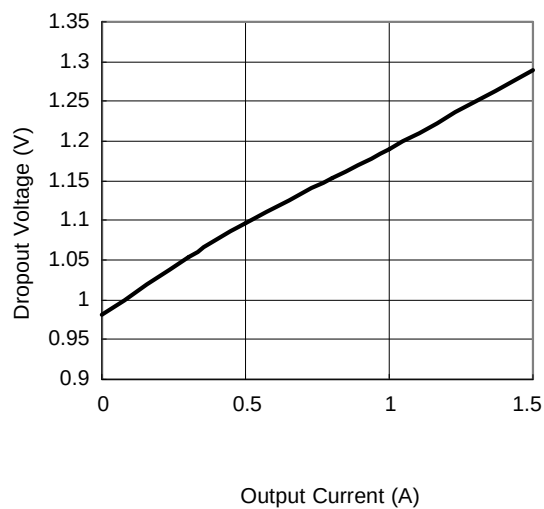
Load Transient Response



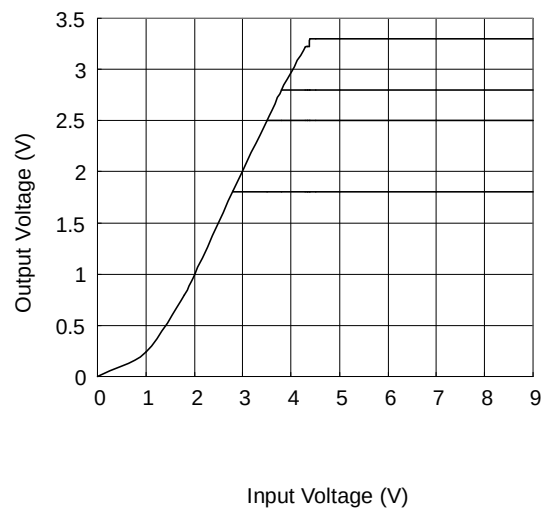
Line Transient Response



Dropout Voltage vs. Output Current

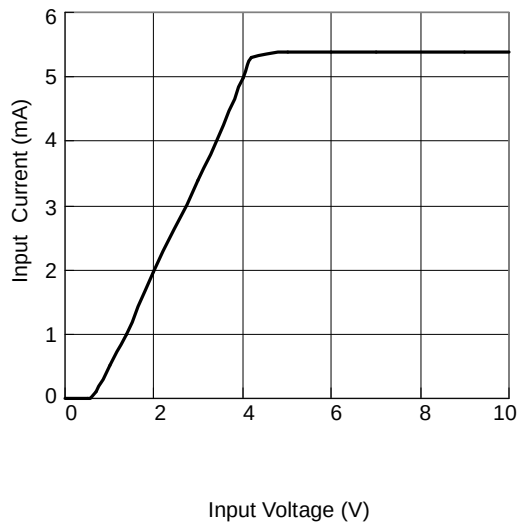


Output Voltage vs. Input Voltage

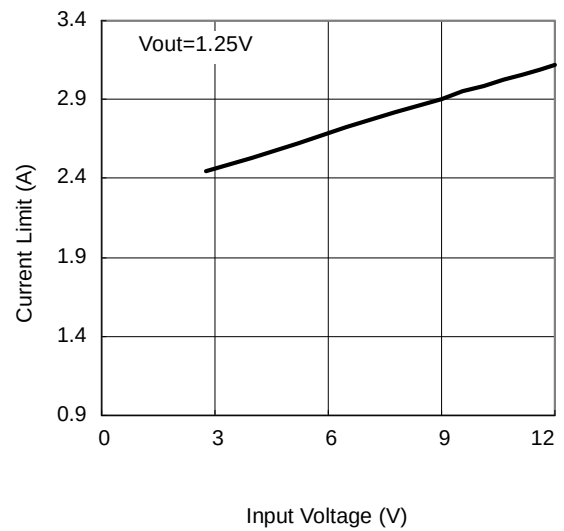


Typical Operating Characteristics (Cont.)

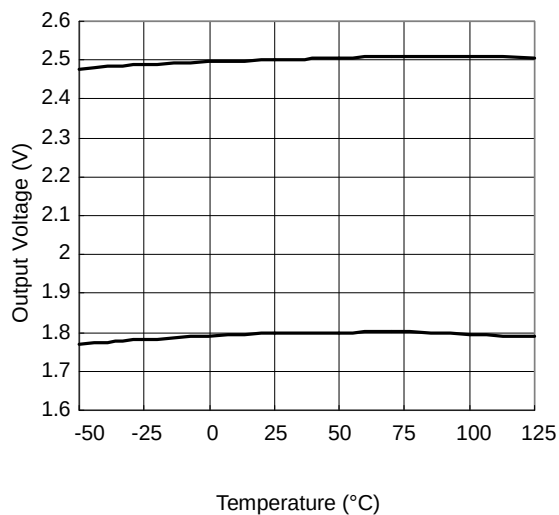
Input Current vs. Input Voltage



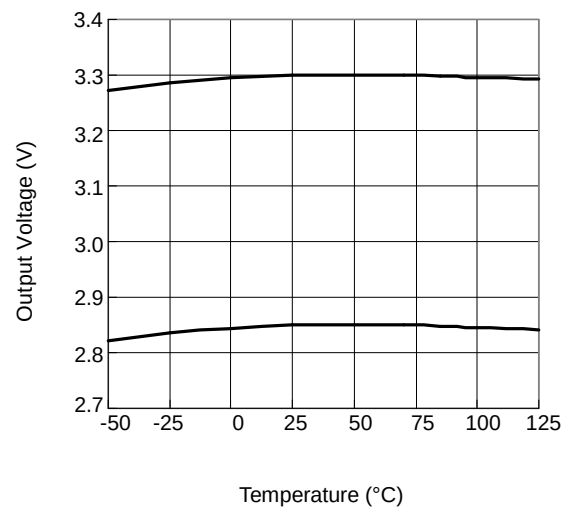
Current Limit vs. Input Voltage



Output Voltage vs. Temperature

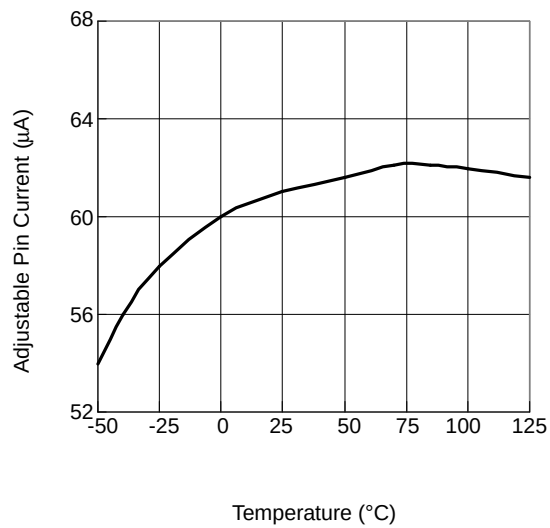


Output Voltage vs. Temperature

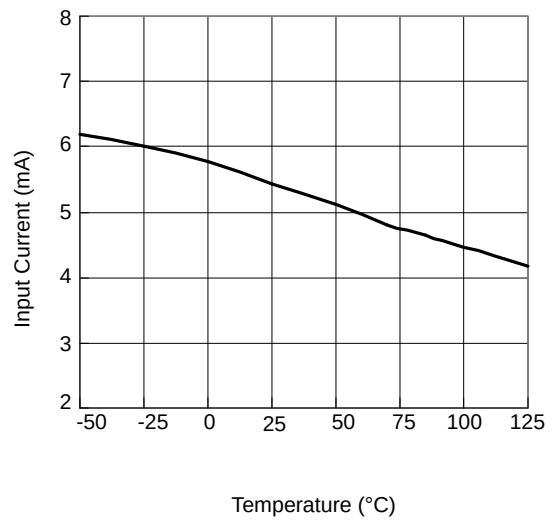


Typical Operating Characteristics (Cont.)

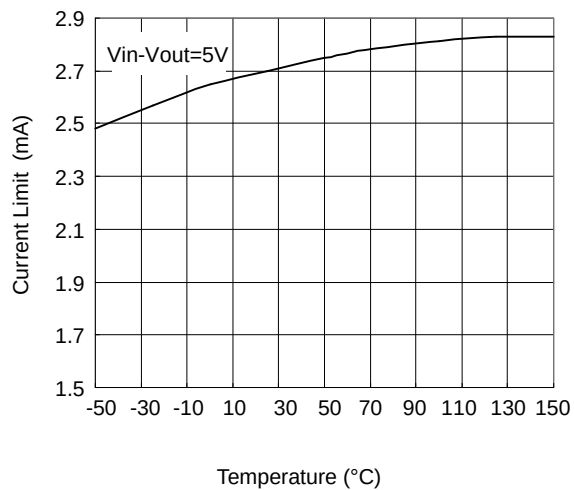
Adjustable Pin Current vs. Temperature



Input Current vs. Temperature

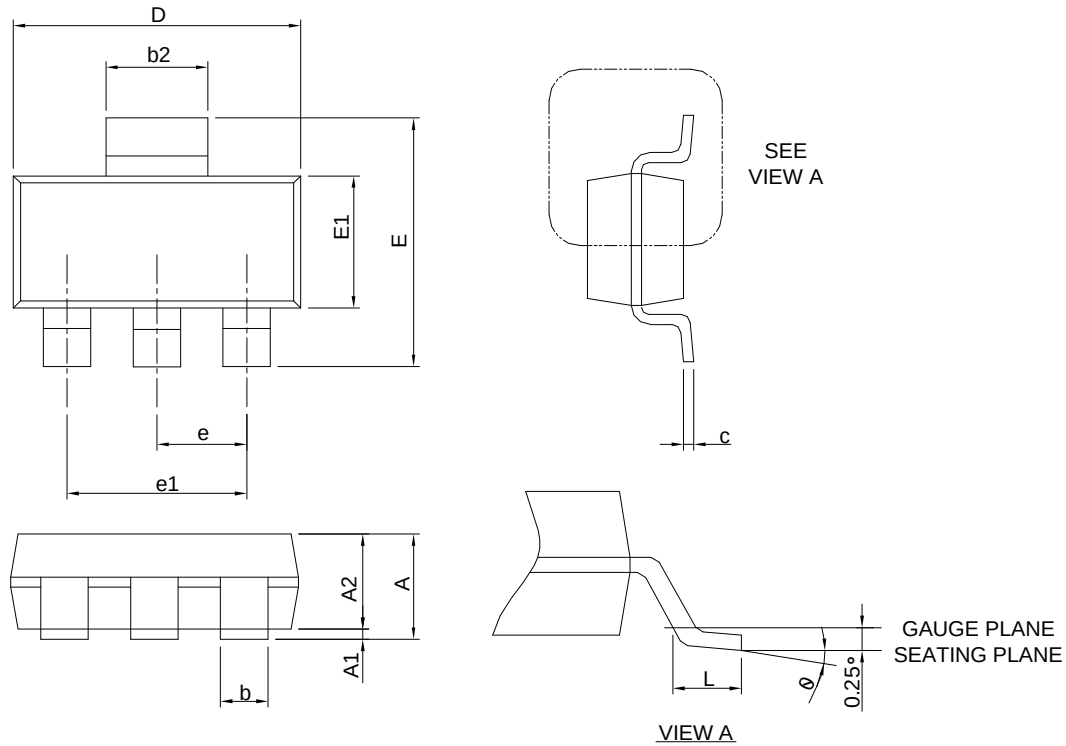


Current Limit vs. Temperature



Package Information

SOT-223



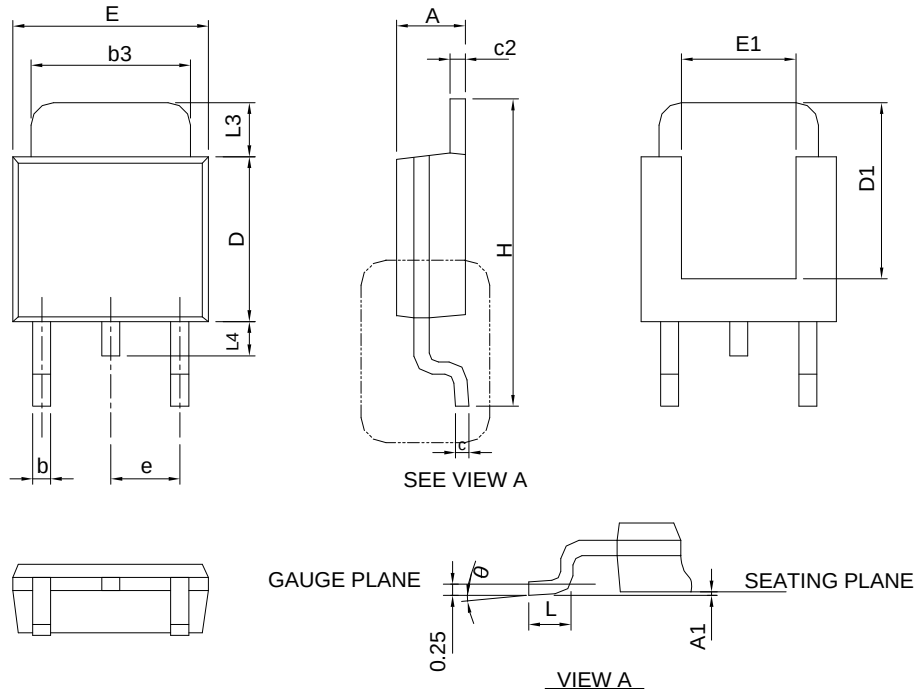
SYMBOL	SOT-223			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.80		0.071
A1	0.02	0.10	0.001	0.004
A2	1.50	1.70	0.059	0.067
b	0.66	0.84	0.026	0.033
b2	2.90	3.10	0.114	0.122
c	0.23	0.33	0.009	0.013
D	6.30	6.70	0.248	0.264
E	6.70	7.30	0.264	0.287
E1	3.30	3.70	0.130	0.146
e	2.30 BSC		0.091 BSC	
e1	4.60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

Package Information

TO-252-3

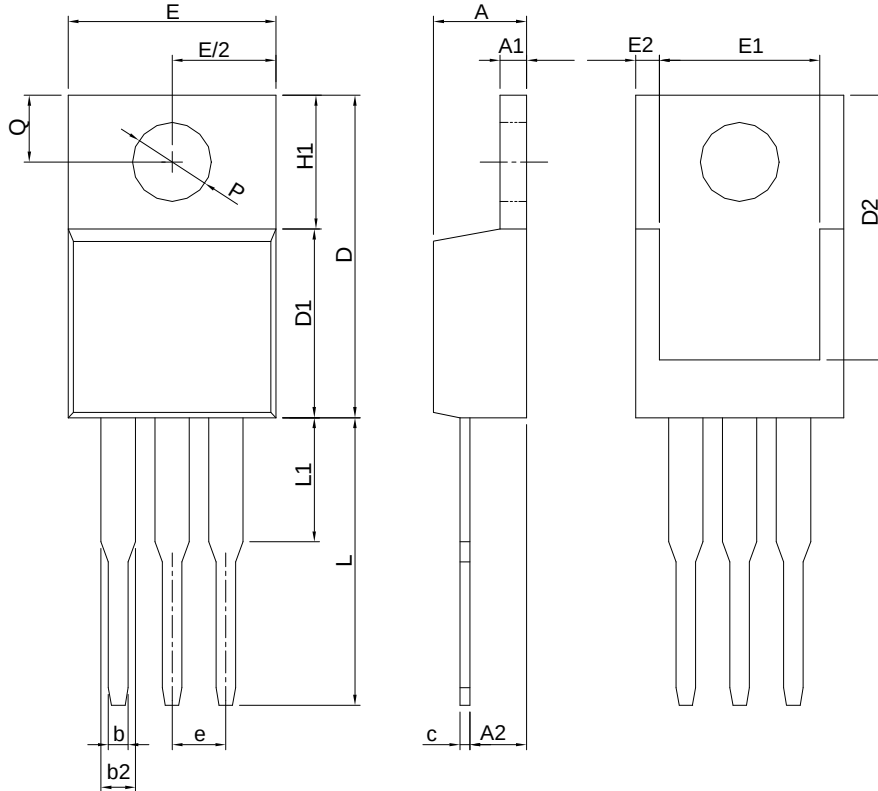


SYMBOL	TO-252-3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.39	0.086	0.094
A1		0.13		0.005
b	0.50	0.89	0.020	0.035
b3	4.95	5.46	0.195	0.215
c	0.46	0.61	0.018	0.024
c2	0.46	0.89	0.018	0.035
D	5.33	6.22	0.210	0.245
D1	4.57	6.00	0.180	0.236
E	6.35	6.73	0.250	0.265
E1	3.81	6.00	0.150	0.236
e	2.29 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

TO-220

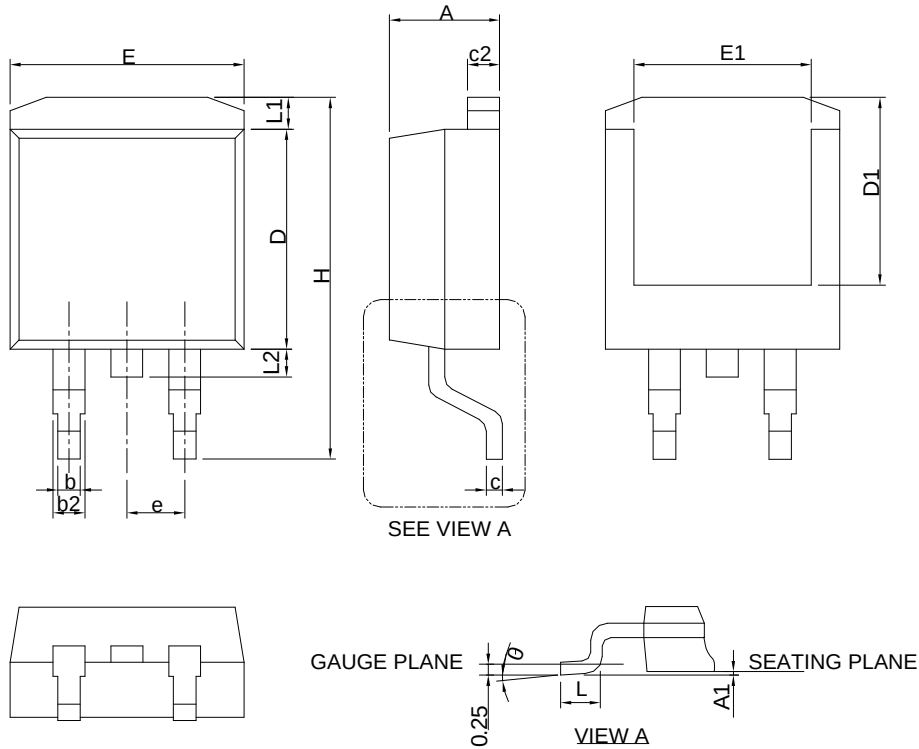


SYMBOL	TO-220			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	3.56	4.83	0.140	0.190
A1	0.51	1.40	0.020	0.055
A2	2.03	2.92	0.080	0.115
b	0.38	1.02	0.015	0.040
b2	1.14	1.78	0.045	0.070
c	0.36	0.61	0.014	0.024
D	14.22	16.51	0.560	0.650
D1	8.38	9.02	0.330	0.355
D2	12.19	12.88	0.480	0.507
E	9.65	10.67	0.380	0.420
E1	6.86	8.89	0.270	0.350
E2		0.76		0.030
e	2.54 BSC		0.100 BSC	
H1	5.84	6.86	0.230	0.270
L	12.70	14.73	0.500	0.580
L1		6.35		0.250
P	3.53	4.09	0.139	0.161
Q	2.54	3.43	0.100	0.135

Note: Follow JEDEC TO-220 AB.

Package Information

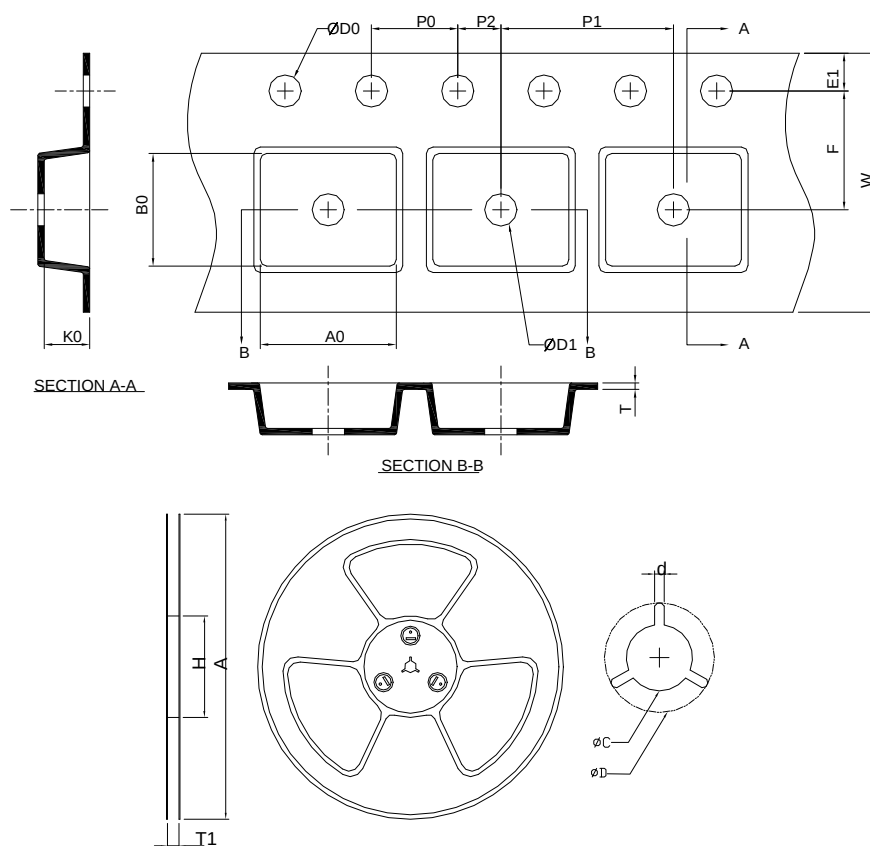
TO-263-3



SYMBOL	TO-263			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	4.06	4.83	0.160	0.190
A1	0.00	0.25	0.000	0.010
b	0.51	0.99	0.020	0.039
b2	1.14	1.78	0.045	0.070
c	0.38	0.74	0.015	0.029
c2	1.14	1.65	0.045	0.065
D	8.38	9.65	0.330	0.380
D1	6.00	9.00	0.236	0.354
E	9.65	11.43	0.380	0.450
E1	6.22	9.00	0.245	0.354
e	2.54 BSC		0.100 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1		1.68		0.066
L2		1.78		0.070
θ	0°	8°	0°	8°

Note : Follow JEDEC TO-263 AB.

Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
TO-263	330.0 $\pm$ 2.00	50 MIN.	24.4 $\pm$ 2.00 -0.00	13.0 $\pm$ 0.50 -0.20	1.5 MIN.	20.2 MIN.	24.0 $\pm$ 0.30	1.75 $\pm$ 0.10	11.5 $\pm$ 0.10
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0 $\pm$ 0.10	16.0 $\pm$ 0.10	2.0 $\pm$ 0.10	1.5 $\pm$ 0.10 -0.00	1.5 MIN.	0.6 $\pm$ 0.00 -0.40	10.8 $\pm$ 0.20	16.1 $\pm$ 0.20	5.2 $\pm$ 0.20
Application	A	H	T1	C	d	D	W	E1	F
TO-252	330.0 $\pm$ 2.00	50 MIN.	16.4 $\pm$ 2.00 -0.00	13.0 $\pm$ 0.50 -0.20	1.5 MIN.	20.2 MIN.	16.0 $\pm$ 0.30	1.75 $\pm$ 0.10	7.50 $\pm$ 0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0 $\pm$ 0.10	8.0 $\pm$ 0.10	2.0 $\pm$ 0.05	1.5 $\pm$ 0.10 -0.00	1.5 MIN.	0.6 $\pm$ 0.00 -0.40	6.80 $\pm$ 0.20	10.40 $\pm$ 0.20	2.50 $\pm$ 0.20
Application	A	H	T1	C	d	D	W	E1	F
SOT-223	320.0 $\pm$ 2.00	50 MIN.	12.4 $\pm$ 2.00 -0.00	13.0 $\pm$ 0.50 -0.20	1.5 MIN.	20.2 MIN.	12.00 $\pm$ 0.30	1.75 $\pm$ 0.10	5.50 $\pm$ 0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.00 $\pm$ 0.10	8.00 $\pm$ 0.10	2.00 $\pm$ 0.50	1.5 $\pm$ 0.10 -0.00	1.5 MIN.	0.6 $\pm$ 0.00 -0.40	6.90 $\pm$ 0.20	7.50 $\pm$ 0.20	2.10 $\pm$ 0.20

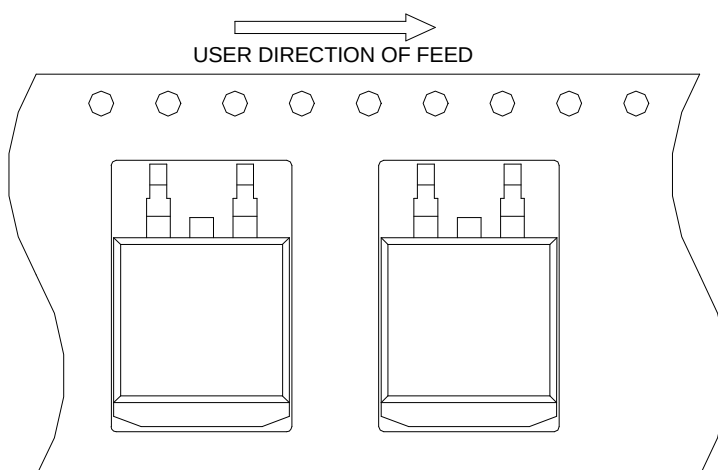
(mm)

Devices Per Unit

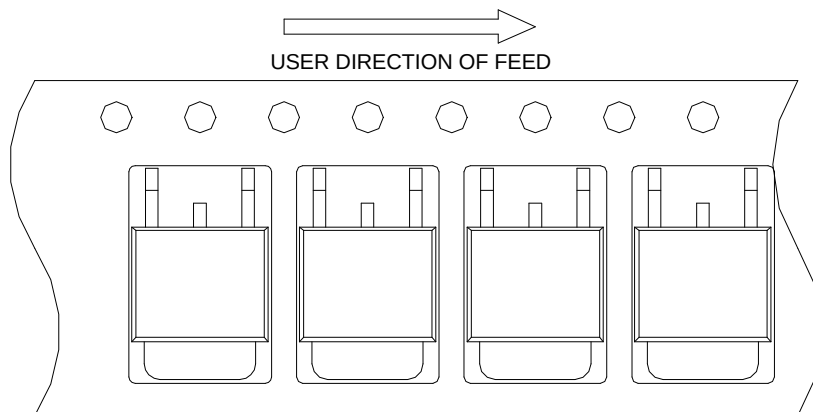
Package Type	Unit	Quantity
TO-263	Tape & Reel	800
TO-252	Tape & Reel	2500
SOT-223	Tape & Reel	2500

Taping Direction Information

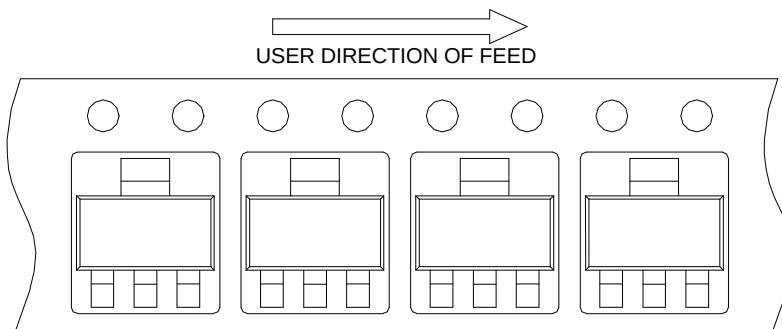
TO-263

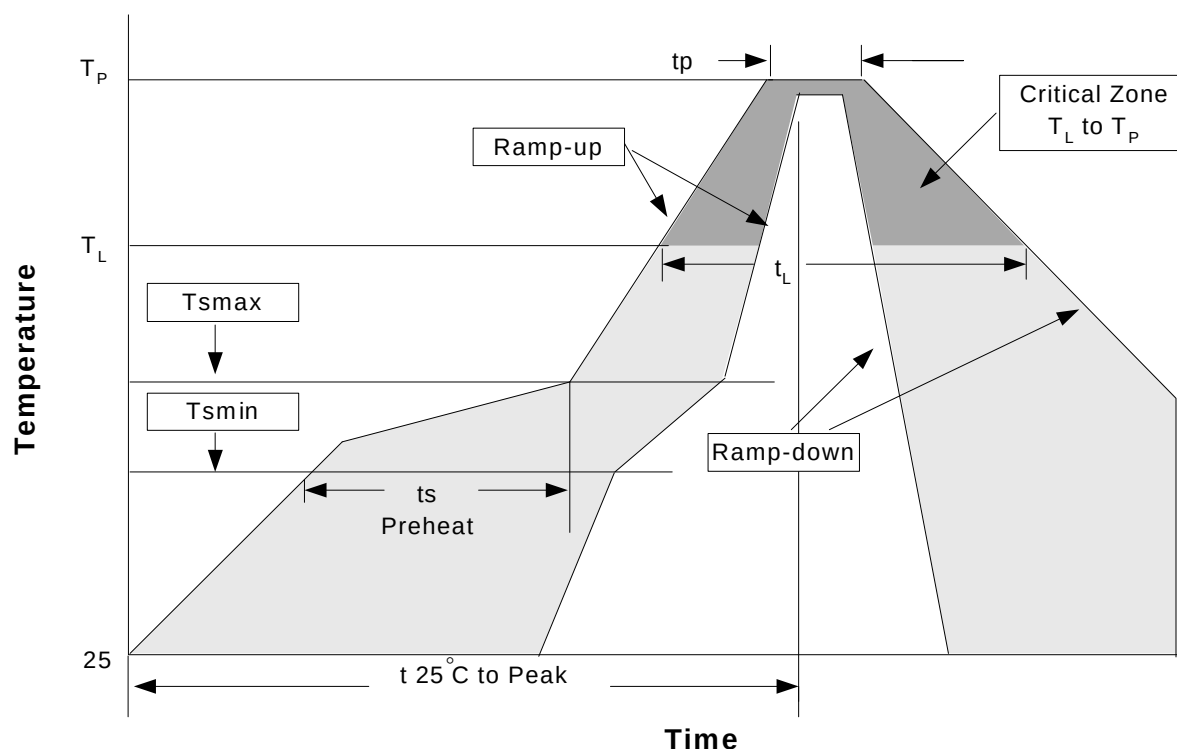


TO-252



SOT-223



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, $I_r > 100\text{mA}$

Classification 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 (T_{smin})	100°C	150°C
- Temperature Max (T_{smax})	150°C	200°C
- Time (min to max) (t_s)	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature (T_L)	183°C	217°C
- Time (t_L)	60-150 seconds	60-150 seconds
Peak/Classification Temperature (T_P)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (t_p)	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 ³ <350	Volume mm ³ 350
<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 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.

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