

### Features

- 1.2V to 6V Input Voltage Range
- Low Quiescent Current : less than 1.5 mA
- High Accuracy Detection Threshold :  $\pm 1.5\%$
- Fixed Trimmed Reset Thresholds for 1.5V, 1.75V, 2.32V, 2.63V, 2.93V, 3.08V, 3.9V, 4.38V.
- Reset Timeout Period 250ms
- Available Output Configurations
  - Open-Drain Output
  - CMOS Active High Output
  - CMOS Active Low Output
- SOT-23, SOT-23-5, and SOT-89 Packages
- No External Components
- Lead Free and Green Devices Available  
(RoHS Compliant)

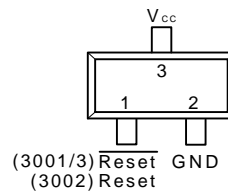
### Applications

- Computers
- Cell Phones
- Portable Electronics
- mP Power Supply Monitoring

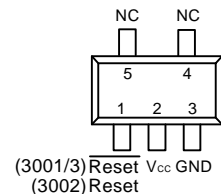
### General Description

The APR3001/2/3 are designed to monitor voltage supplies in  $\mu\text{P}$  and digital systems. The quiescent current is extremely low, typically 1.5  $\mu\text{A}$ , making it ideal for portable battery operated equipment. The APR3001/2/3 are operated by monitoring the system power supply voltage. When the input voltage drops below a fixed threshold, the device asserts a reset signal for a fixed time period after  $V_{\text{CC}}$  rises above the fixed threshold. The APR3001/2/3 series are available with three output stage versions : APR3001 push-pull active low output, APR3002 push-pull active high output and APR3003 open drain active low output. They are also designed to reject fast line transient glitches on  $V_{\text{CC}}$ . The APR3001/2/3 come in a miniature SOT-23, SOT-23-5, and SOT-89 packages.

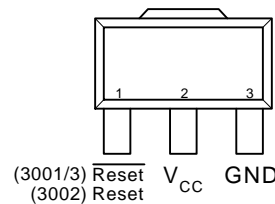
### Pin Configuration



SOT-23 (Top View)



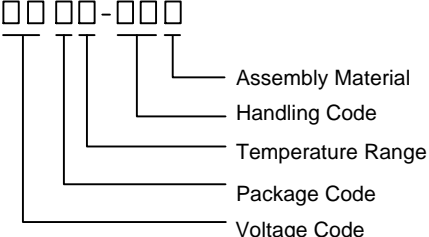
SOT-23-5 (Top View)



SOT-89 (Top View)

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>APR3001/2/3 - □□□□-□□□□</p>  <p>Assembly Material Handling Code Temperature Range Package Code Voltage Code</p>	<p>Package Code A : SOT-23    B : SOT-23-5    D : SOT-89 Temperature Range I : -40 to 85 °C Handling Code TR : Tape &amp; Reel Voltage Code : 15 : 1.5V ~ 43 : 4.38V Assembly Material L : Lead Free Device G : Halogen and Lead Free Device</p>
<p>APR3001/2/3 A/B : □□/□□XX □□□□□□ □□□□□□ □□□□□□                  Date Code      Voltage Code    A:1.5V B:1.75V C:2.32V D:2.63V E:2.93V F:3.08V G:3.9V H:4.38V</p>	
<p>APR3001/2/3 -15 D :      □□□□□□ □□□□□□ □□□□□□                  APR3001/2/3                  XXXXX 15</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).

**Absolute Maximum Ratings**

Symbol	Parameter	Rating	Unit	
V <sub>CC</sub>	V <sub>CC</sub> to GND	-0.3 to 6	V	
V <sub>RESET</sub>	RESET to GND (Push-Pull Output)	-0.3 to V <sub>CC</sub> +0.3	V	
	RESET to GND (Open Drain Output)	-0.3 to 6		
I <sub>MAX</sub>	Maximum Continuous Input Current	20	mA	
I <sub>RESET</sub>	RESET/RESET Current	20	mA	
dV <sub>CC</sub> /dt	Rate of Rise of V <sub>CC</sub>	100	V/μs	
T <sub>J</sub>	Junction Temperature Range	-40 to 150	°C	
T <sub>L</sub>	Lead Soldering Temperature, 10 Seconds	260	°C	
R <sub>TH,JA</sub>	Thermal Resistance – Junction to Ambient	SOT-23	357	°C/W
		SOT-23-5	357	
		SOT-89	180	
P <sub>D</sub>	Power Dissipation	Internally Limited	W	

**Part Number Description**

PART NUMBER	PART DESCRIPTION
APR3001	Reset Output Push Pull Active Low with Delay
APR3002	Reset Output Push Pull Active High with Delay
APR3003	Reset Output Open Drain Active Low with Delay

## Pin Description

PIN		FUNCTION
NO.	NAME	
1	RESE $\bar{T}$ (APR3001/3)	RESE $\bar{T}$ output remains low while VCC is below the reset threshold and remains so for a fixed time period after VCC raises above the reset threshold
	RESET (APR3002)	RESET output remains high while VCC is below the reset threshold and remains so for a fixed time period after VCC raises above the reset threshold.
2	GND	Ground connection
3	VCC	Supply Voltage (+1.2V to +6V)

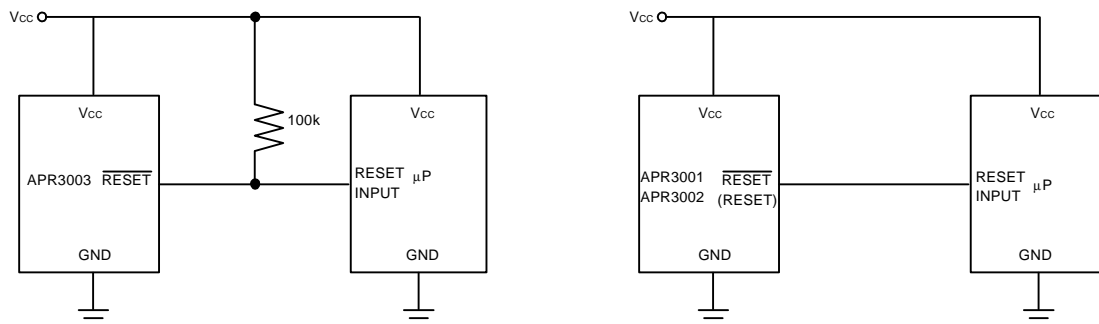
Note: The pin sequence here might not be correct for all different package types, and please refer pin configuration in page1 for correct pin assignment.

## Electrical Characteristics

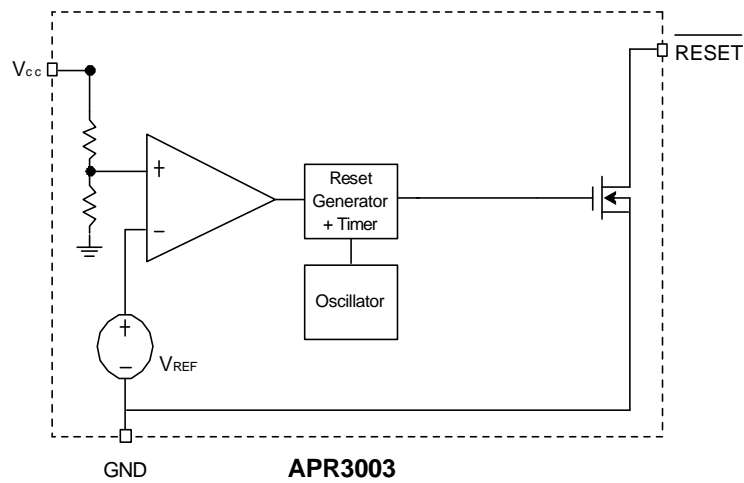
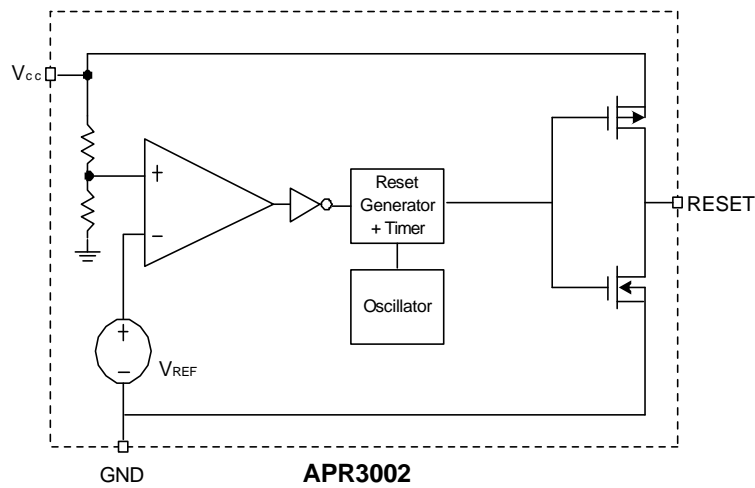
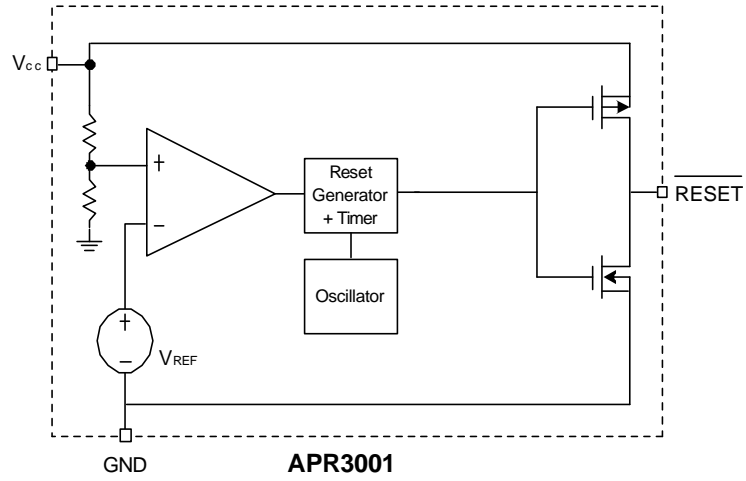
$V_{IN} = 5V$ ,  $T_A = -40$  to  $85^\circ C$  unless otherwise noted. Typical values are at  $T_A = 25^\circ C$ ,  $V_{CC} = 5V$  for 4.38V versions,  $V_{CC} = 3.3V$  for 3.08/2.93V versions,  $V_{CC} = 3.0V$  for 2.63V. versions and  $V_{CC} = 2.5V$  for 2.32V versions,  $V_{CC} = 2.0V$  for 1.75V versions,  $V_{CC} = 1.8V$  for 1.5V versions.

Symbol	Parameter	Test Conditions	APR3001/2/3			Unit
			Min.	Typ.	Max.	
$V_{CC}$	Supply Voltage		1.2	-	6	V
$I_{CC}$	Supply Current	$V_{CC} = 1.5V \sim 6V$	-	1.5	4	$\mu A$
		$T_A = -40$ to $85^\circ C$	-	3	5	
$V_{TH}$	Reset Threshold	$T_A = 25^\circ C$	-	$\pm 1.5\%$	-	
		$T_A = -40$ to $85^\circ C$	-	$\pm 2\%$	-	
$V_{HYST}$	Hysteresis Range		-	20	-	mV
$T_{RTP}$	Reset Timeout Period		150	250	350	ms
$V_{OL}$	Reset Output Low	$I_{SINK} = 1.2mA$	-	-	0.5	V
$V_{OH}$	Reset Output High	$I_{SOURCE} = 0.6mA$	$0.8 \cdot V_{CC}$	-	-	
$T_D$	$V_{CC}$ to Reset Delay	$V_{CC} = V_{TH}$ to $(V_{TH} - 100mV)$	-	25	-	$\mu S$
$I_{LE}$	Reset Output Leakage		-	-	0.5	$\mu A$

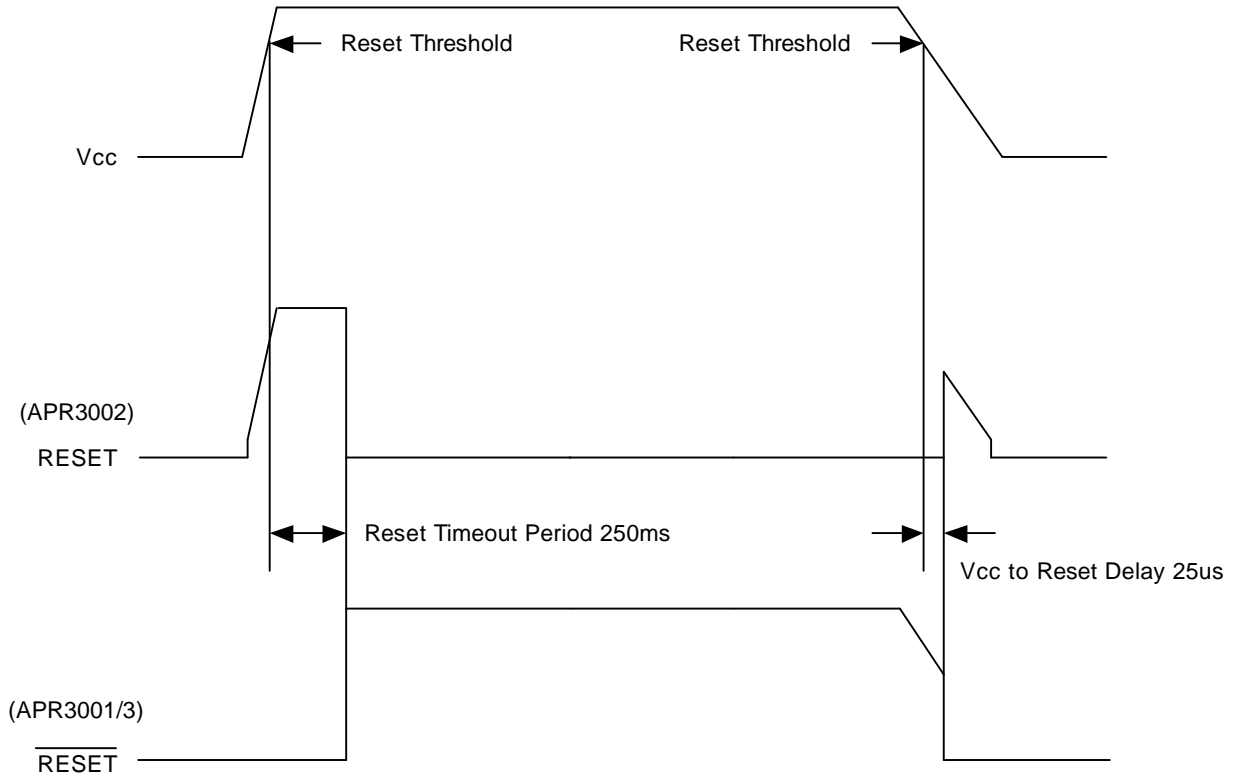
## Typical Application Circuit



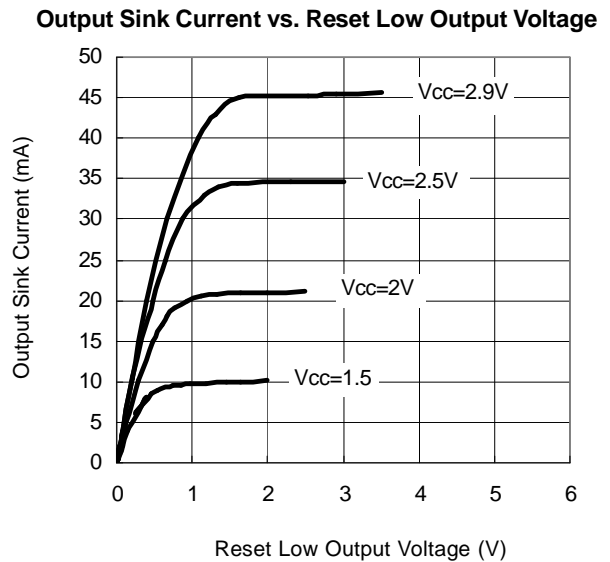
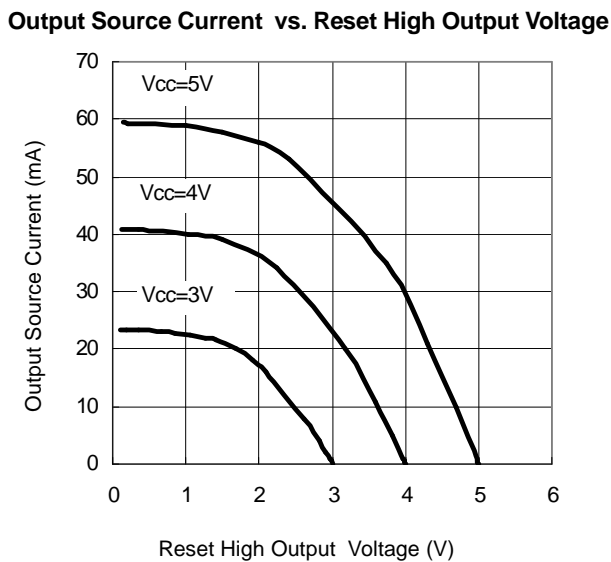
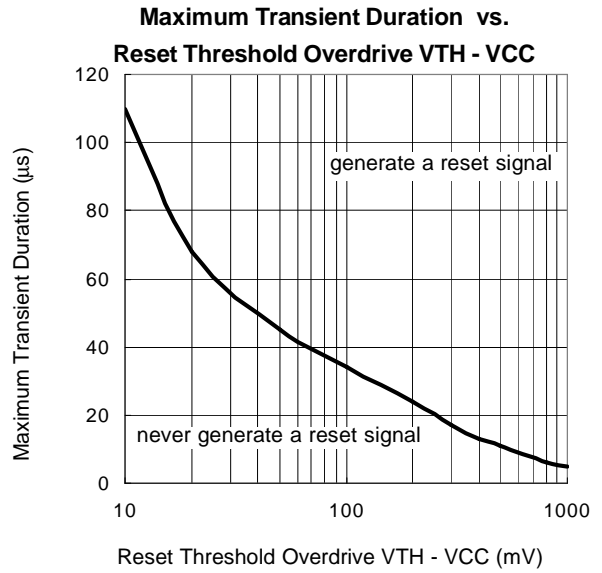
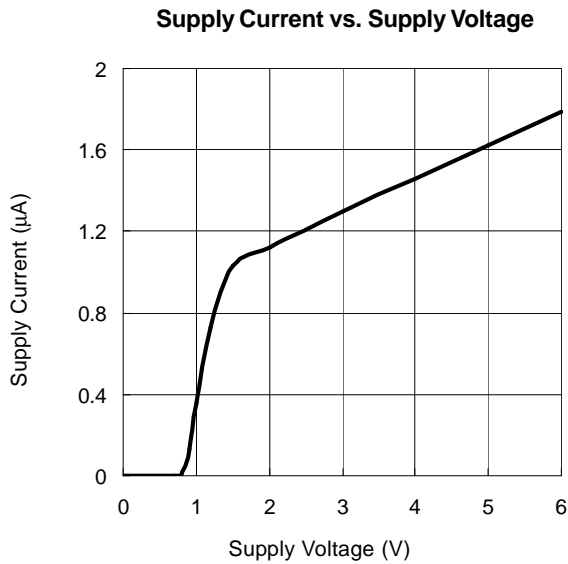
Block Diagram



Timing Chart

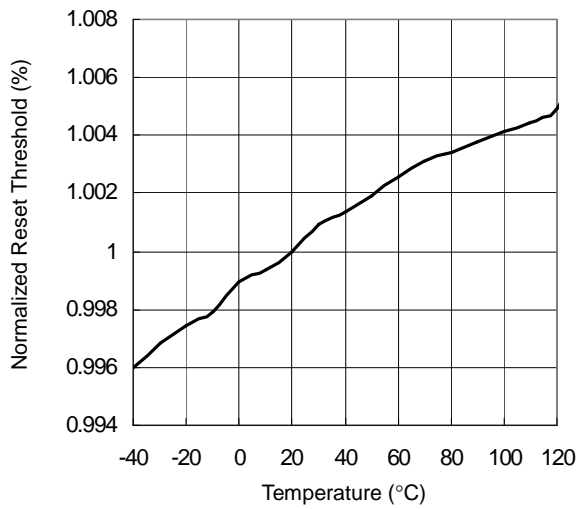


### Typical Operating Characteristics

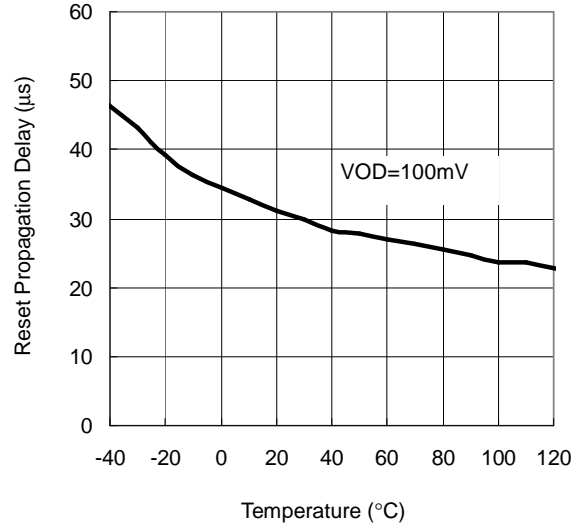


Typical Operating Characteristics (Cont.)

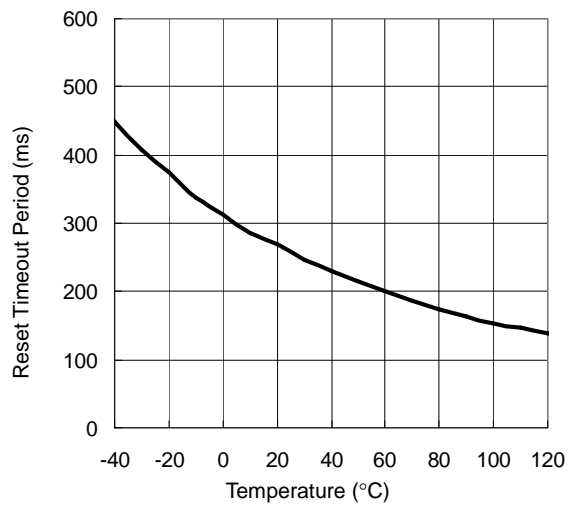
Normalized Reset Threshold vs. Temperature



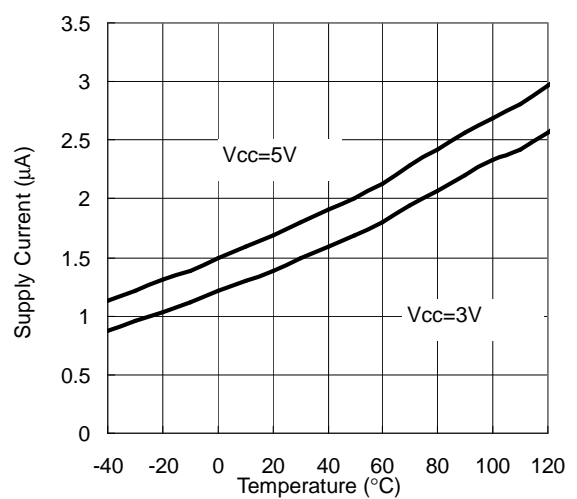
Reset Propagation Delay vs. Temperature



Reset Timeout Period vs. Temperature

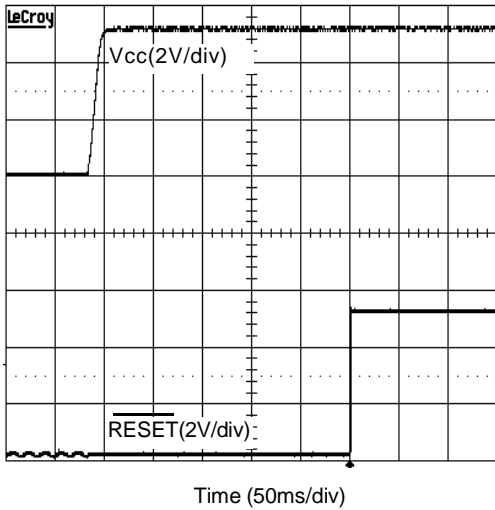


Supply Current vs. Temperature

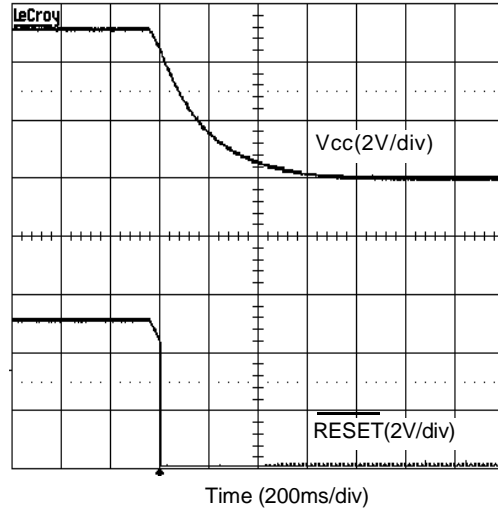


### Typical Operating Characteristics (Cont.)

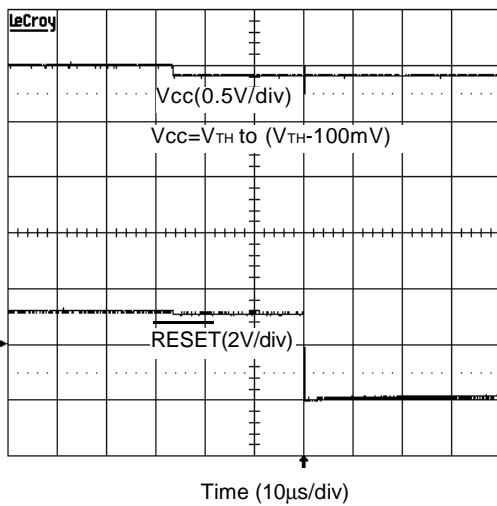
Power Up



Power Down



Vcc to RESET Delay





## Application Information

### VCC Transient Rejection

The APR3001/2/3 have the function to reject the transient glitches from the power line. The Maximum Transient Duration vs. Reset Threshold Overdrive shows at Typical Characteristics. The transient voltage with the duration under the curve will not generate a reset signal, e.g. a transient of 100mV below the reset threshold voltage have the duration more than 35 $\mu$ s, it will generate a reset signal. Connect a 0.1 $\mu$ F bypass capacitor to the VCC pin can improve the transient immunity.

### Reset Output

The APR3001/2/3 have 3 output stage versions: APR3001 is an active low push-pull output. When the VCC drops below the reset threshold, the  $\overline{\text{RESET}}$  output generates a low signal. APR3002 is an active high push-pull output. When the VCC drops below the reset threshold, the RESET output generates a high signal (see Timing Chart). APR3003 is an active low open drain output, the  $\overline{\text{RESET}}$  output must be connected a pull-up resistor to a supply voltage that is lower than 6V, it suits to use in multiple voltage systems (see Figure 2). The APR3001 RESET output is valid until the VCC=1.2V; when it is below 1.2V, the IC is shutdown, and the output becomes a floating state. If it is a trouble, a resistor should be connected from reset output to the ground to keep the reset output low (see Figure 1). For The APR3002, a pull-up resistor to the VCC is required to keep the valid reset output for VCC below 1.2V.

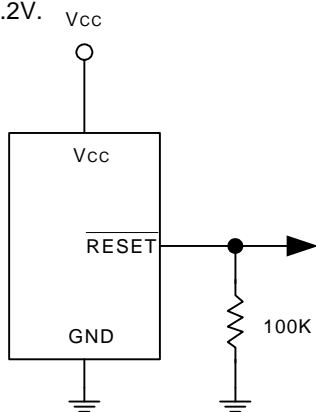


Figure 1. Ensuring RESET Valid to VCC = 0 V

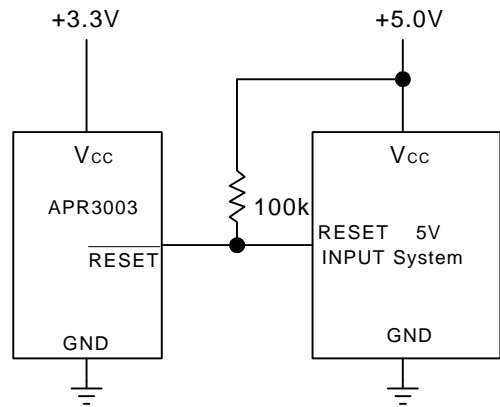
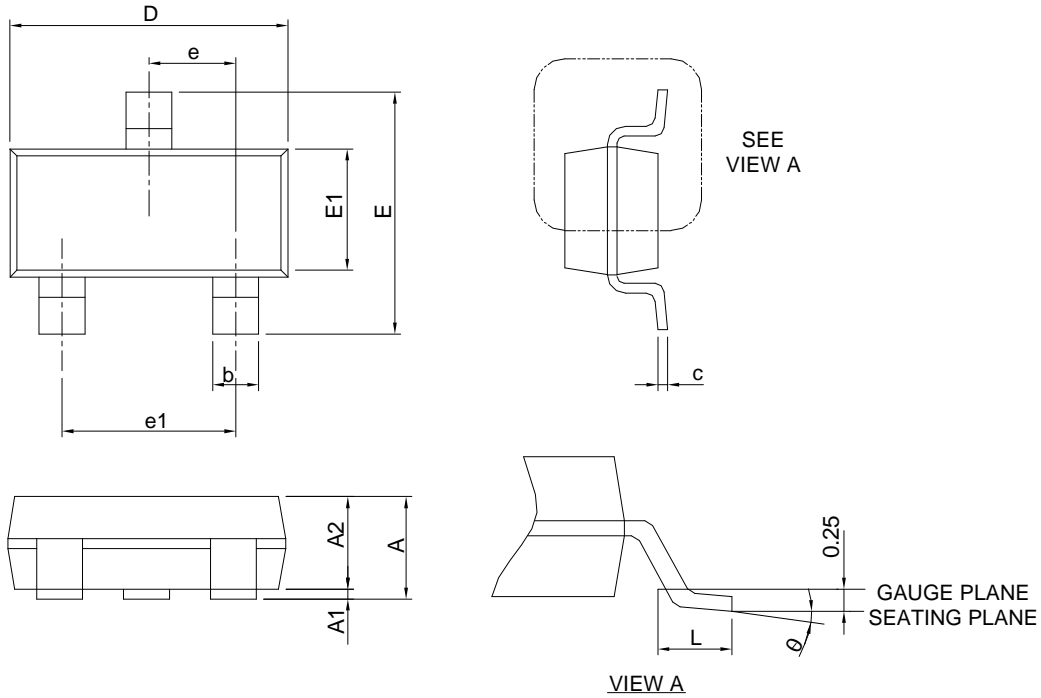


Figure 2. APR3003 Open Drain Output with Multiple Supplies

Package Information

SOT-23-3

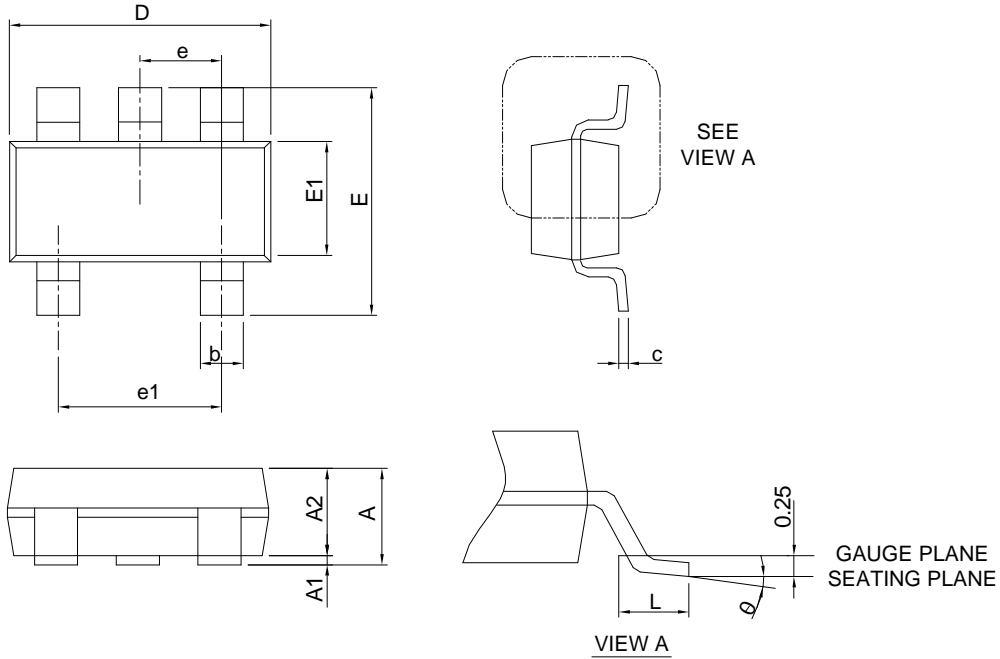


SYMBOL	SOT-23-3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30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

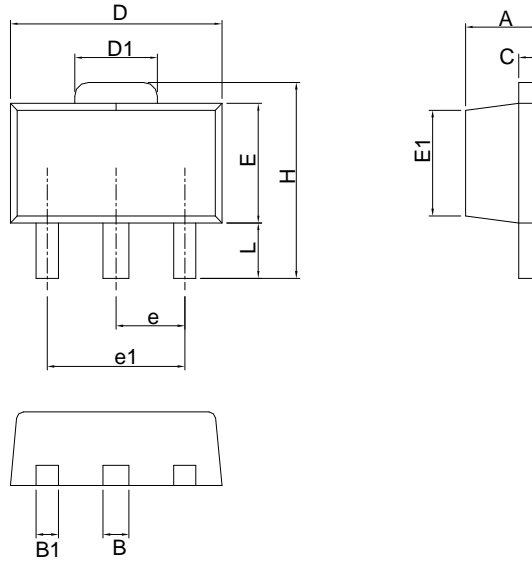


SYMBOL	SOT-23-5			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30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

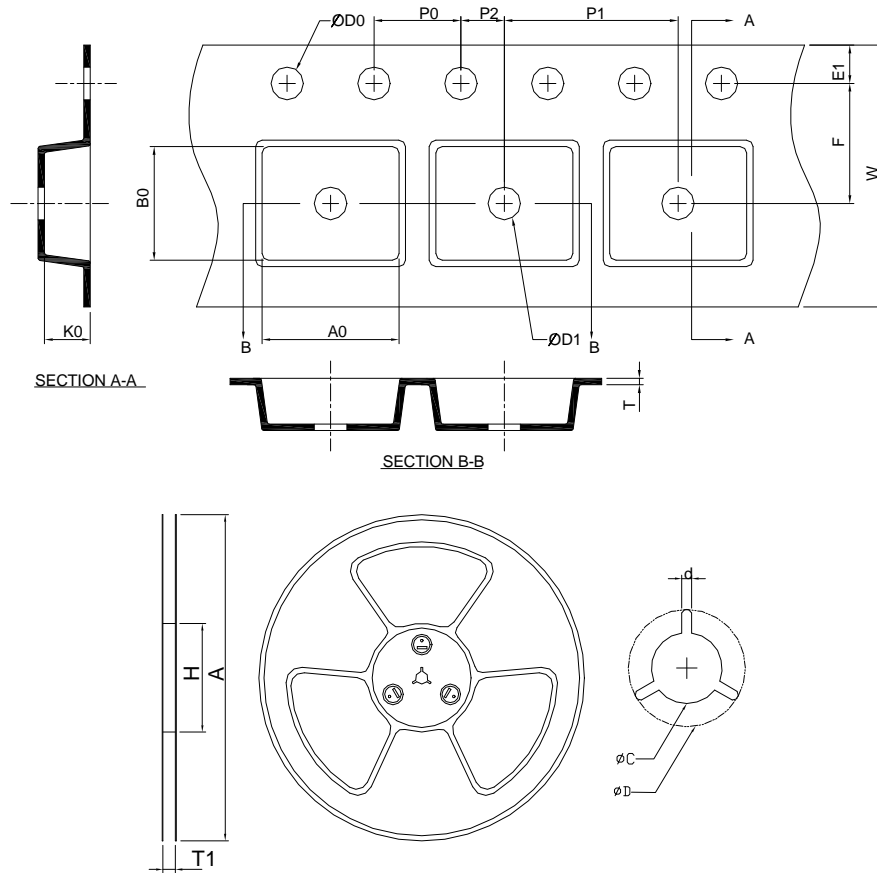
SOT-89



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 ±2.00	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
	P0	P1	P2	D0	D1	T	A0	B0	K0
	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 ±2.00	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
	P0	P1	P2	D0	D1	T	A0	B0	K0
	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 ±2.00	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
	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	4.80 ±0.20	4.50 ±0.20	1.80 ±0.20

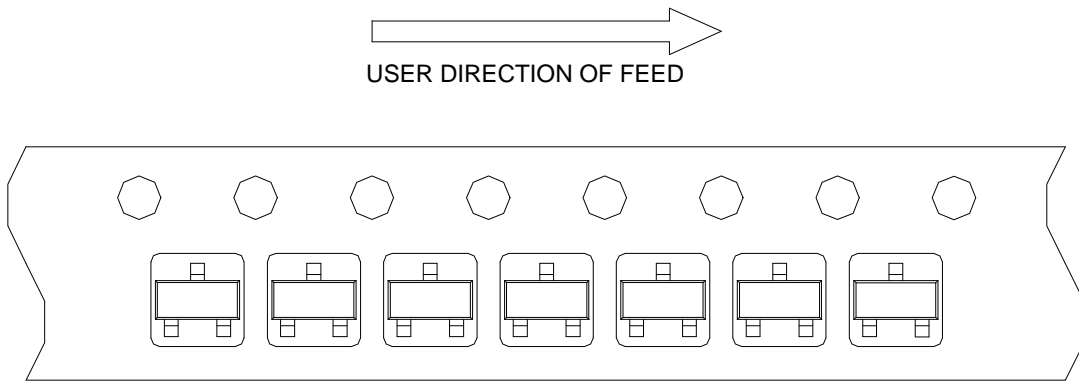
(mm)

**Devices Per Unit**

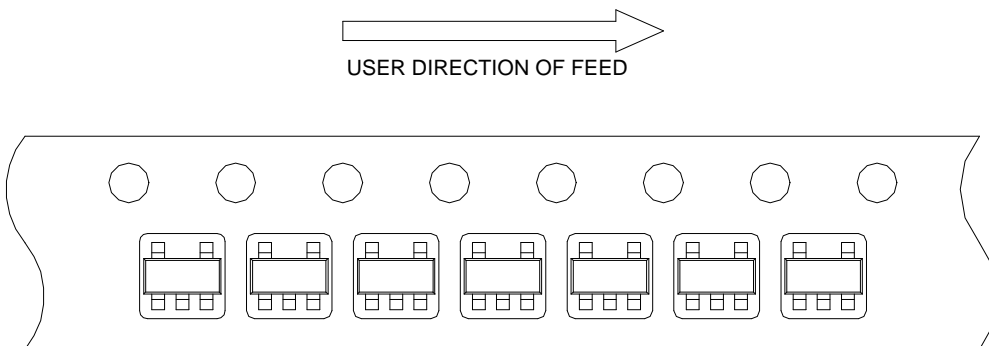
Package Type	Unit	Quantity
SOT-23-3	Tape & Reel	3000
SOT-23-5	Tape & Reel	3000
SOT-89	Tape & Reel	1000

**Taping Direction Information**

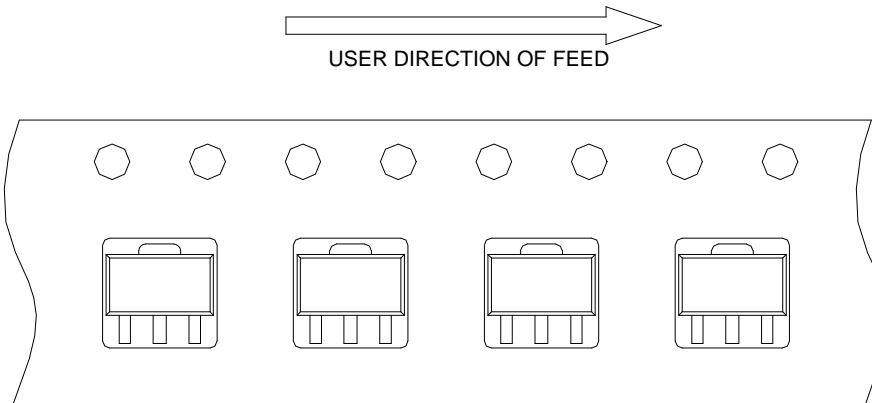
SOT-23-3



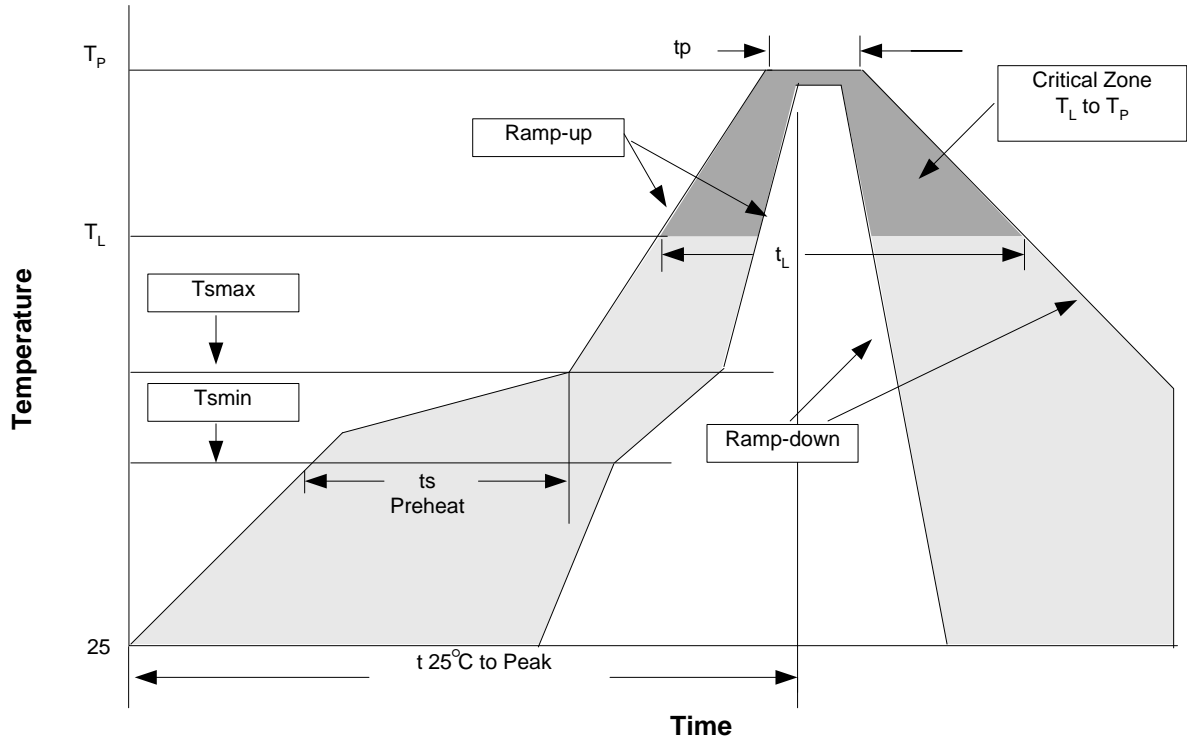
SOT-23-5



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>min</sub> )	100°C	150°C
- Temperature Max (T <sub>max</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.

Note: 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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