

MicroPower Microprocessor Reset Circuit

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, 4.63V
- Reset Timeout Period 250ms
- Available Output Configurations
 - Open-Drain Output
 - CMOS Active High Output
 - CMOS Active Low Output
- SOT-23-3, SOT-23-5, and SOT-89 Packages
- No External Components
- Lead Free and Green Devices Available (RoHS Compliant)

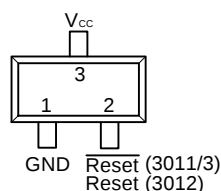
Applications

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

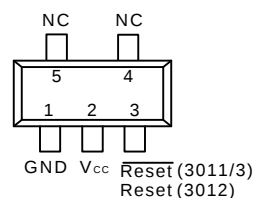
General Description

The APR3011/2/3 are designed to monitor voltage supplies in μ P and digital systems. The quiescent current is extremely low, typically 1.5 μ A, making it ideal for portable battery operated equipment. The APR3011/2/3 operate 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_{CC} rises above the fixed threshold. The APR3011/2/3 series are available with three output stage versions: APR3011 push-pull active low output, APR3012 push-pull active high output, and APR3013 open drain active low output. They are also designed to reject fast line transient glitches on V_{CC} . The APR3011/2/3 come in a miniature SOT-23-3, SOT-23-5, and SOT-89 packages.

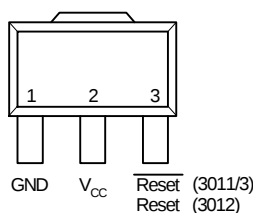
Pin Configuration



SOT-23-3 (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

APR3011/2/3 Assembly Material Handling Code Temperature Range Package Code Voltage Code	Package Code A : SOT-23-3 B : SOT-23-5 D : SOT-89 Temperature Range I : -40 to 85 °C Handling Code TR : Tape & Reel Voltage Code : 15 : 1.5V ~ 46 : 4.63V Assembly Material G : Halogen and Lead Free Device
APR3011/2/3 A/B : 11/2/3X X 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 J:4.63V	
APR3011/2/3 -15 D : APR3011/2/3 XXXXX 15 XXXXXX - 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. 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_{CC}	V_{CC} to GND		-0.3 to 6	V
V_{RESET}	RESET to GND (Push-Pull Output)		-0.3 to $V_{CC} + 0.3$	V
	RESET to GND (Open Drain Output)		-0.3 to 6	
I_{MAX}	Maximum Continuous Input Current		20	mA
I_{RESET}	RESET/RESET Current		20	mA
dV_{CC}/dt	Rate of Rise of V_{CC}		100	V/ μ s
T_J	Junction Temperature Range		-40 to 150	°C
T_L	Lead Temperature Soldering, 10 Seconds		260	°C
$R_{TH,JA}$	Thermal Resistance – Junction to Ambient	SOT-23-3	357	°C/W
		SOT-23-5	357	
		SOT-89	180	
P_D	Power Dissipation		Internally Limited	W

Part Number Description

PART NUMBER	PART DESCRIPTION
APR3011	Reset Output Push Pull Active Low with Delay
APR3012	Reset Output Push Pull Active High with Delay
APR3013	Reset Output Open Drain Active Low with Delay

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.

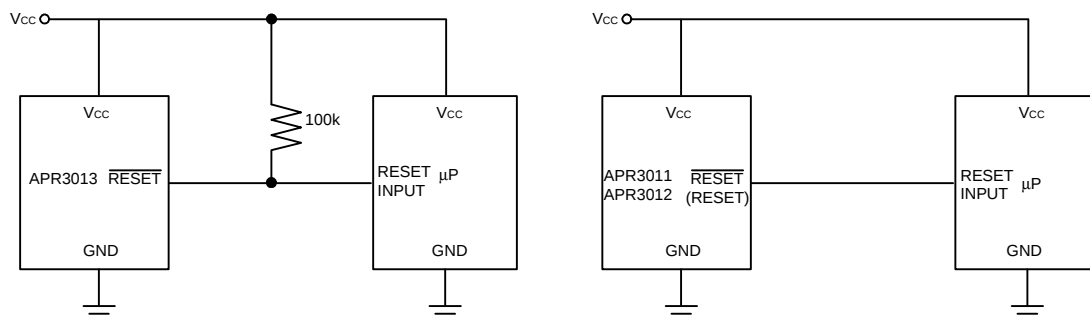
Symbol	Parameter	Test Conditions	APR3011/2/3			Unit
			Min.	Typ.	Max.	
V_{CC}	Supply Voltage		1.2	-	6	V
I_{CC}	Supply Current	$V_{CC}=1.5V\sim6V$	-	1.5	4	μA
		$T_A=-40$ to $85^{\circ}C$	-	3	5	
V_{TH}	Reset Threshold	$T_A=25^{\circ}C$	-	$\pm 1.5\%$	-	
		$T_A=-40$ to $85^{\circ}C$	-	$\pm 2\%$	-	
V_{HYST}	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	-	μS
I_{LE}	Reset Output Leakage		-	-	0.5	μA

Pin Description (Note 1)

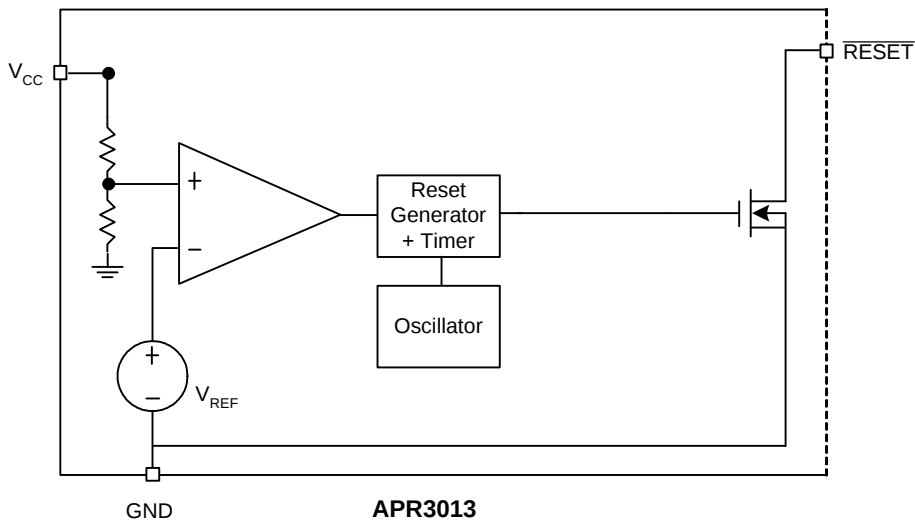
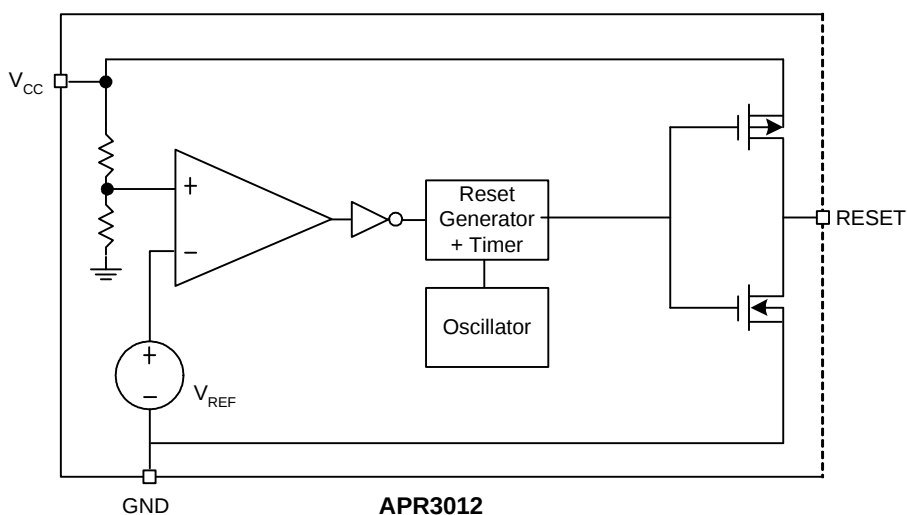
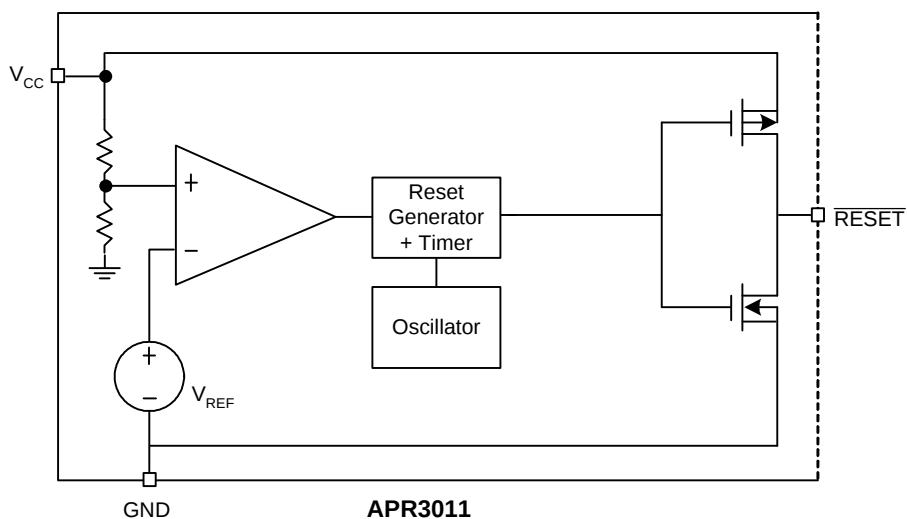
PIN		FUNCTION
NO.	NAME	
1	GND	Ground connection
2	$\overline{RESET}$ (APR3011/3)	RESET output remains low while VCC is below the reset threshold and remains so for a fixed time period after VCC raises above the reset threshold
	RESET (APR3012)	RESET output remains high while VCC is below the reset threshold and remains so for a fixed time period after VCC raises above the reset threshold.
3	V_{CC}	Supply Voltage (+1.2V to +6V)

Note 1: The pin sequence here might not be correct for all different package types, and please refer pin configuration in page1 for correct pin assignment.

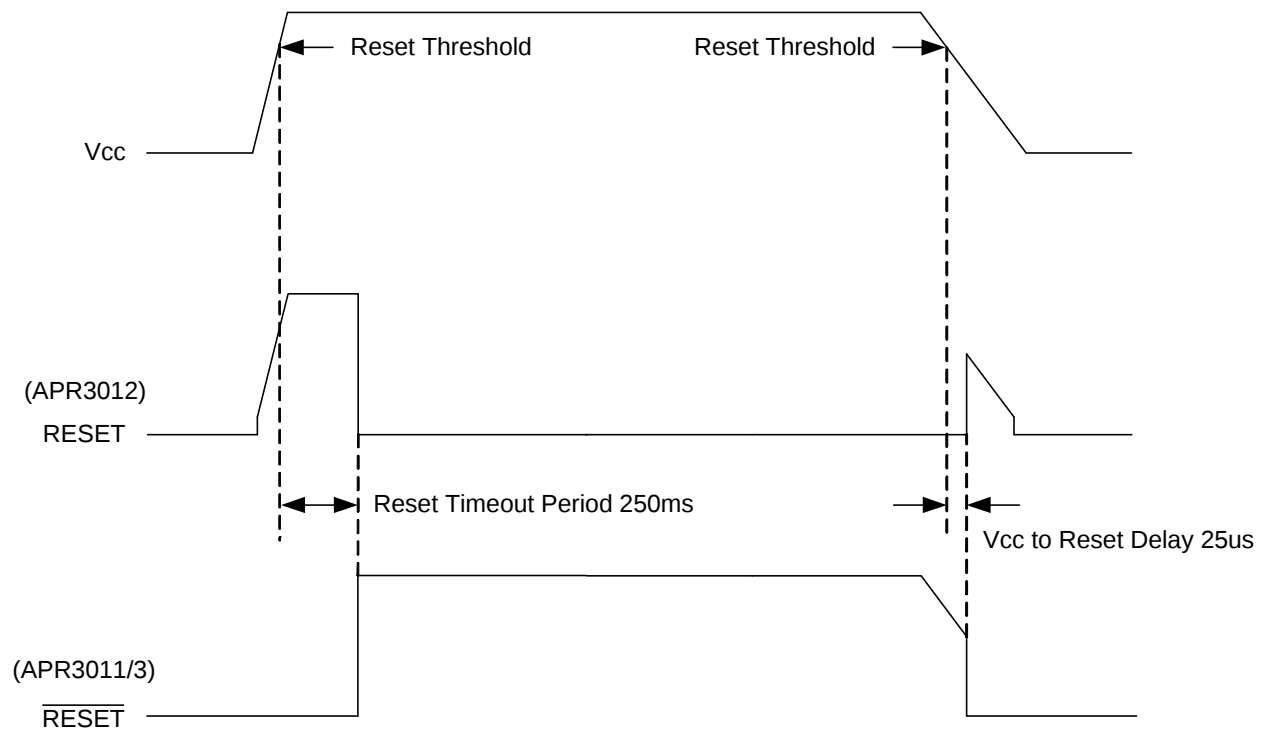
Typical Application Circuit



Block Diagram

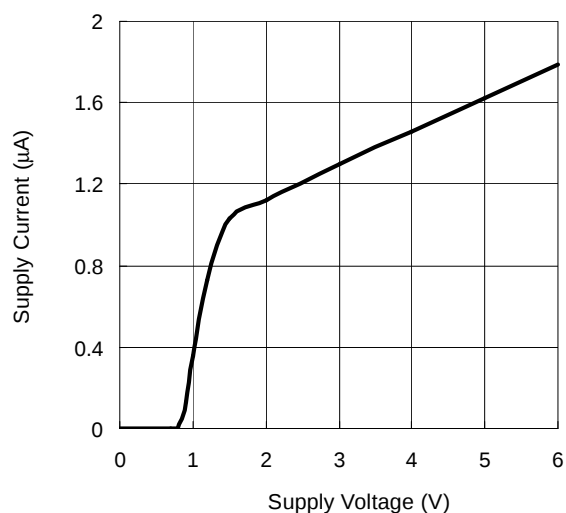


Timing Chart

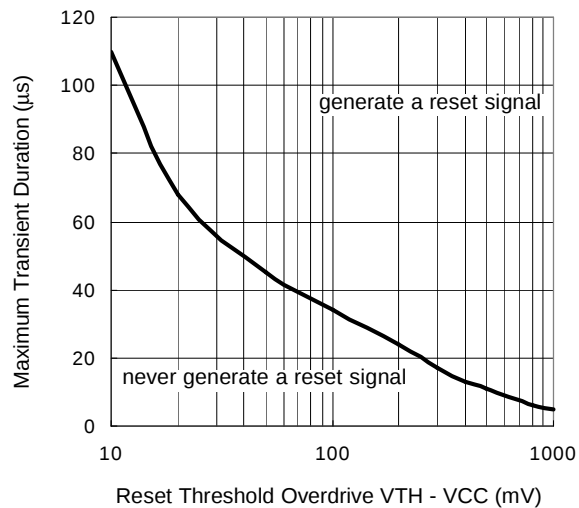


Typical Operating Characteristics

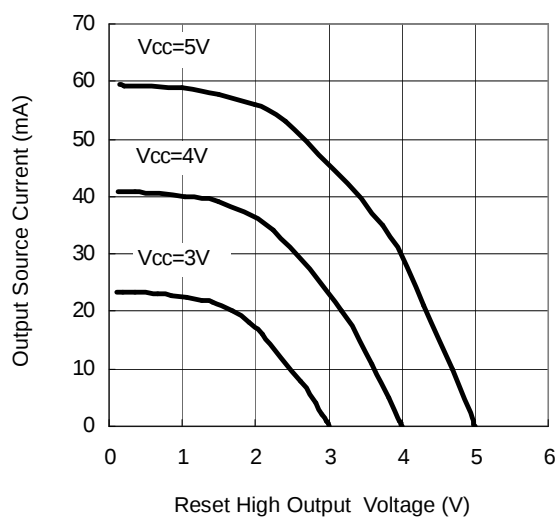
Supply Current vs. Supply Voltage



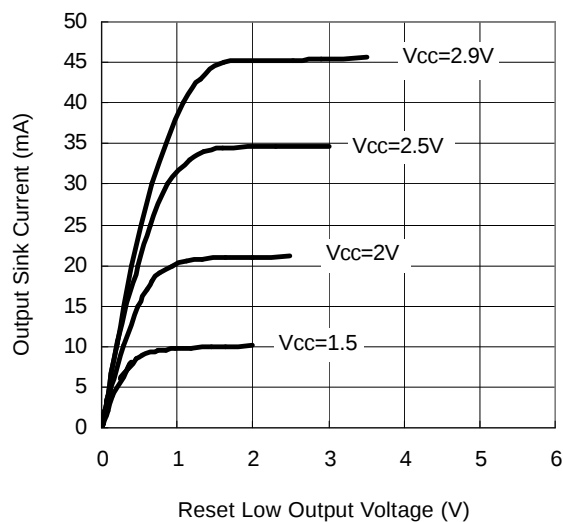
Maximum Transient Duration vs.
Reset Threshold Overdrive $V_{TH} - V_{CC}$



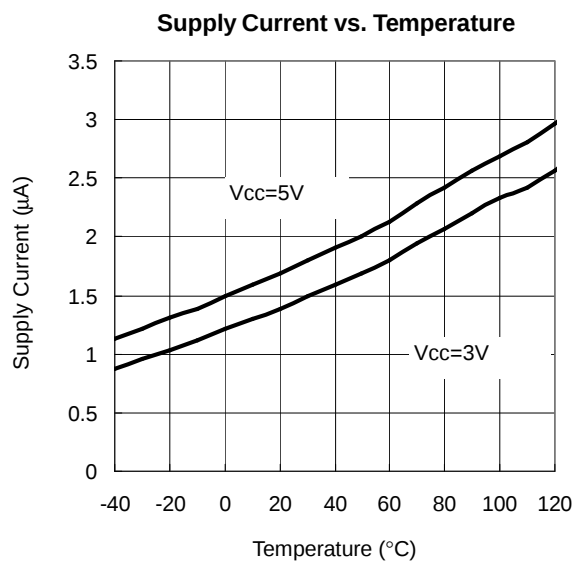
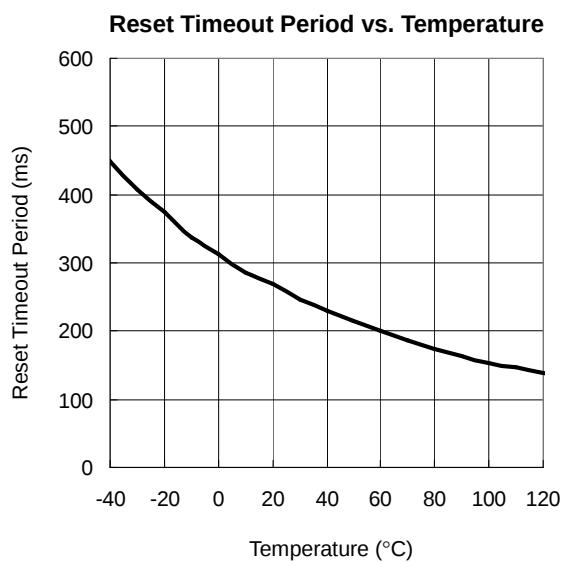
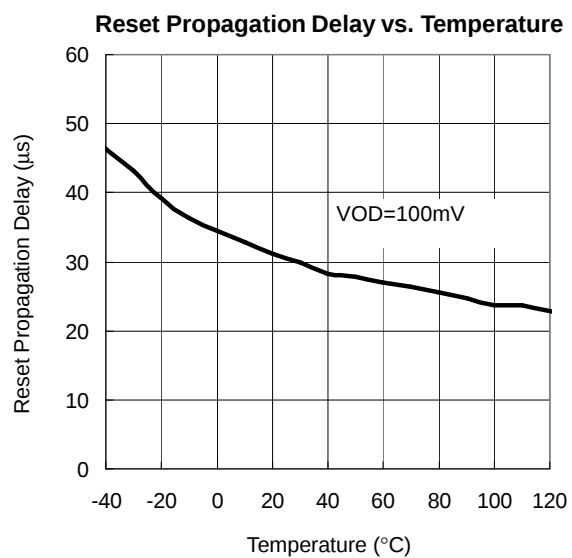
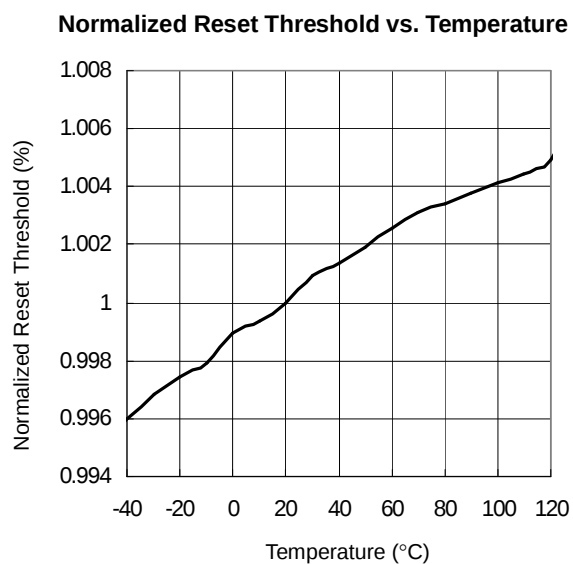
Output Source Current vs. Reset High Output Voltage



Output Sink Current vs. Reset Low Output Voltage

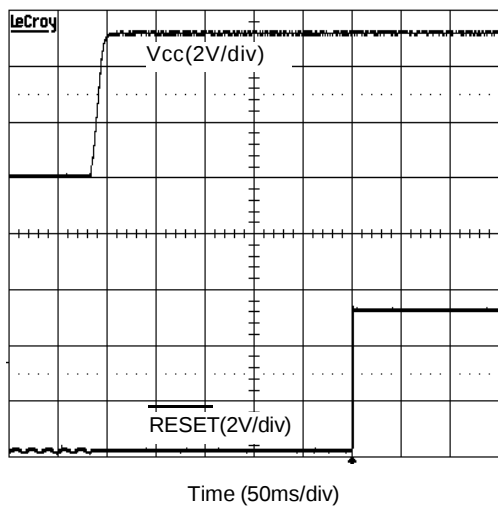


Typical Operating Characteristics (Cont.)

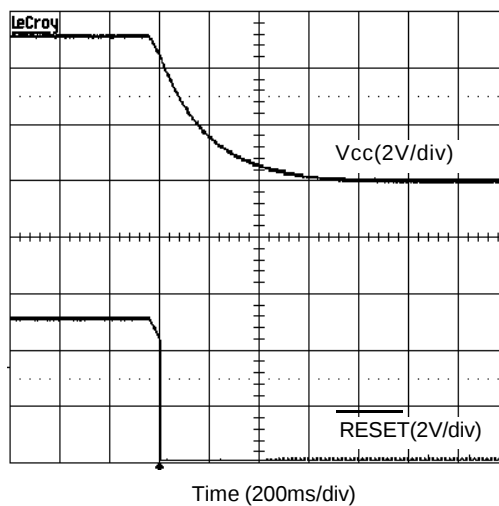


Typical Operating Characteristics (Cont.)

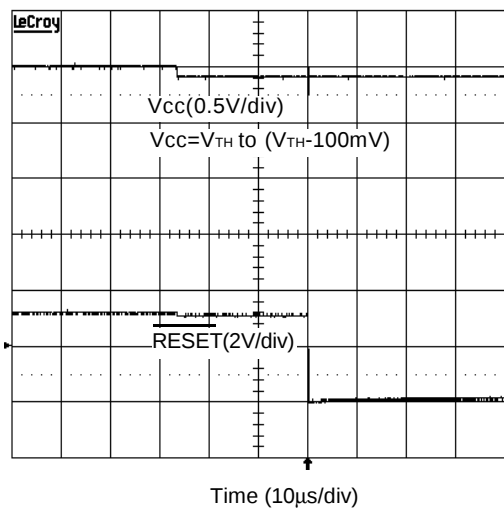
Power Up



Power Down



Vcc to RESET Delay



Application Information

V_{CC} Transient Rejection

The APR3011/2/3 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 has the duration more than 35μs, it will generate a reset signal. Connect a 0.1μF bypass capacitor to the V_{CC} pin can improve the transient immunity.

Reset Output

The APR3011/2/3 have 3 output stage versions: APR3001 is an active low push-pull output. When the V_{CC} drops below the reset threshold, the RESET output generates a low signal. APR3012 is an active high push-pull output. When the V_{CC} drops below the reset threshold, the RESET output generates a high signal (see Timing Chart). APR3013 is an active low open drain output, the 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 APR3011 RESET output is valid until the V_{CC}=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 APR3012, a pull-up resistor to V_{CC} is required to keep the valid reset output for V_{CC} below 1.2V.

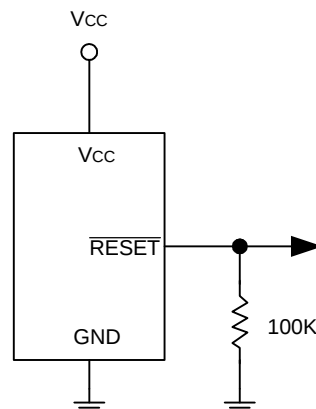


Figure 1. Ensuring RESET Valid to V_{CC} = 0 V

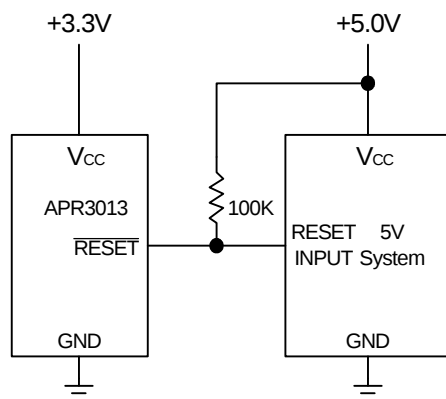
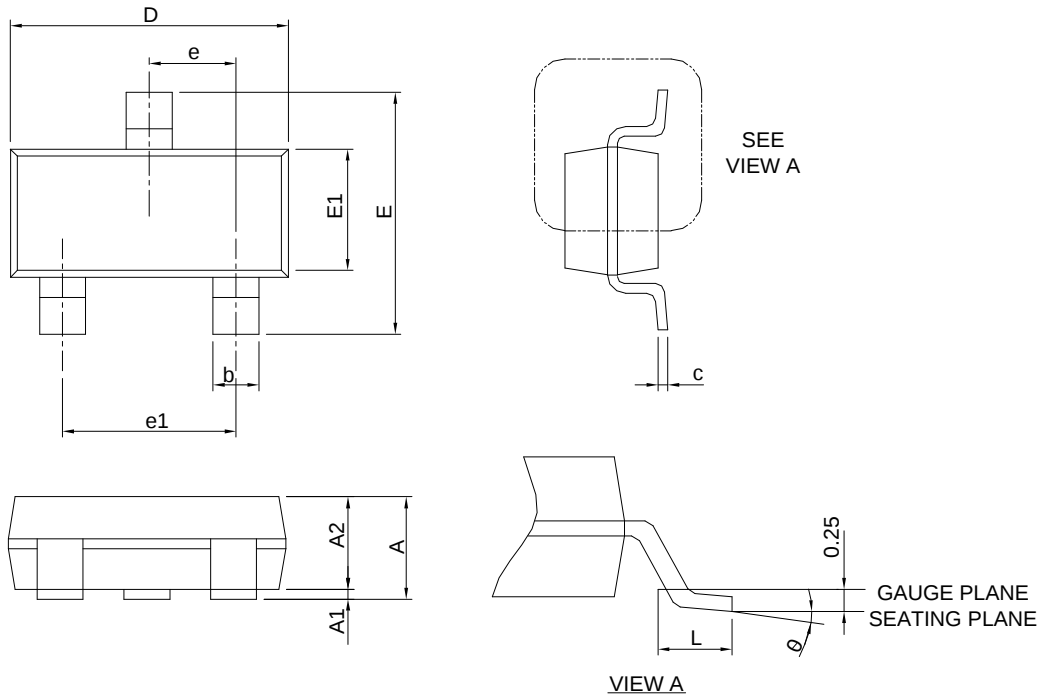


Figure 2. APR3013 Open Drain Output with Multiple Supplies

Package Information

SOT-23-3

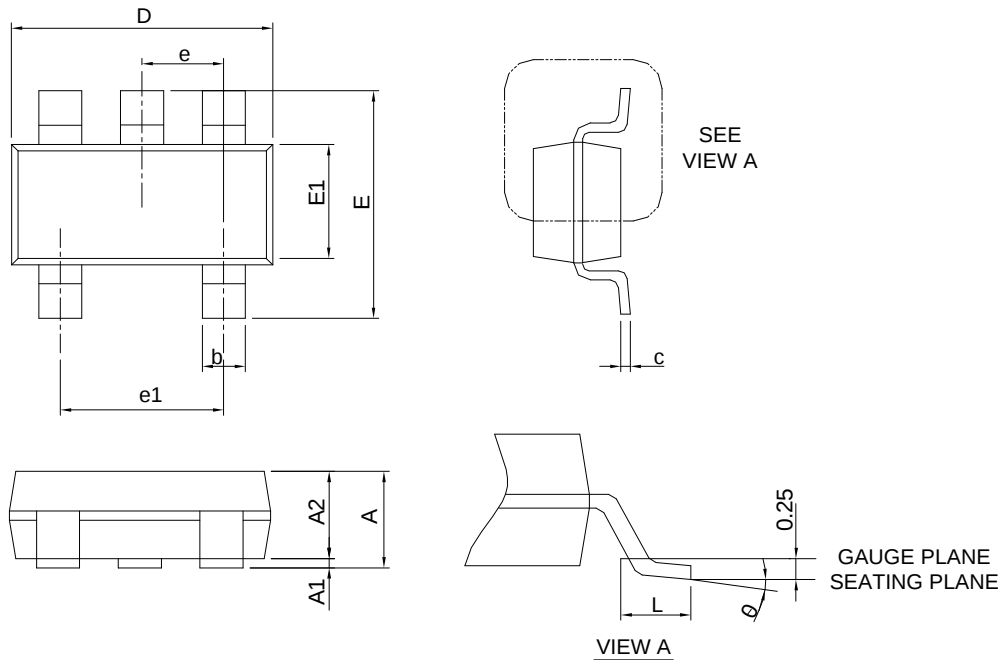


SYMBOL	SOT-23-3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30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



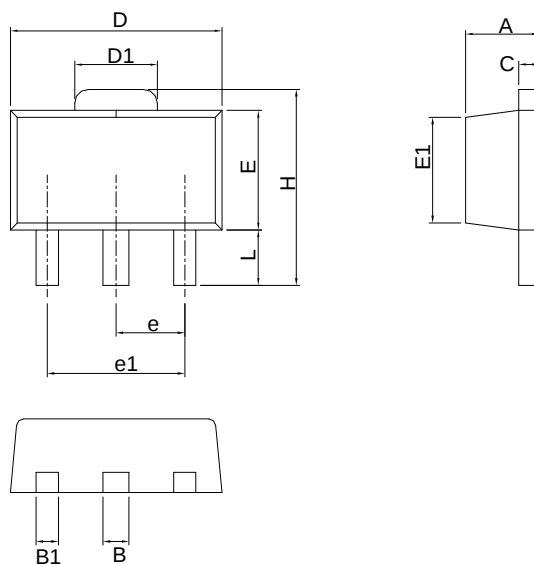
SYMBOL	SOT-23-5			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30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

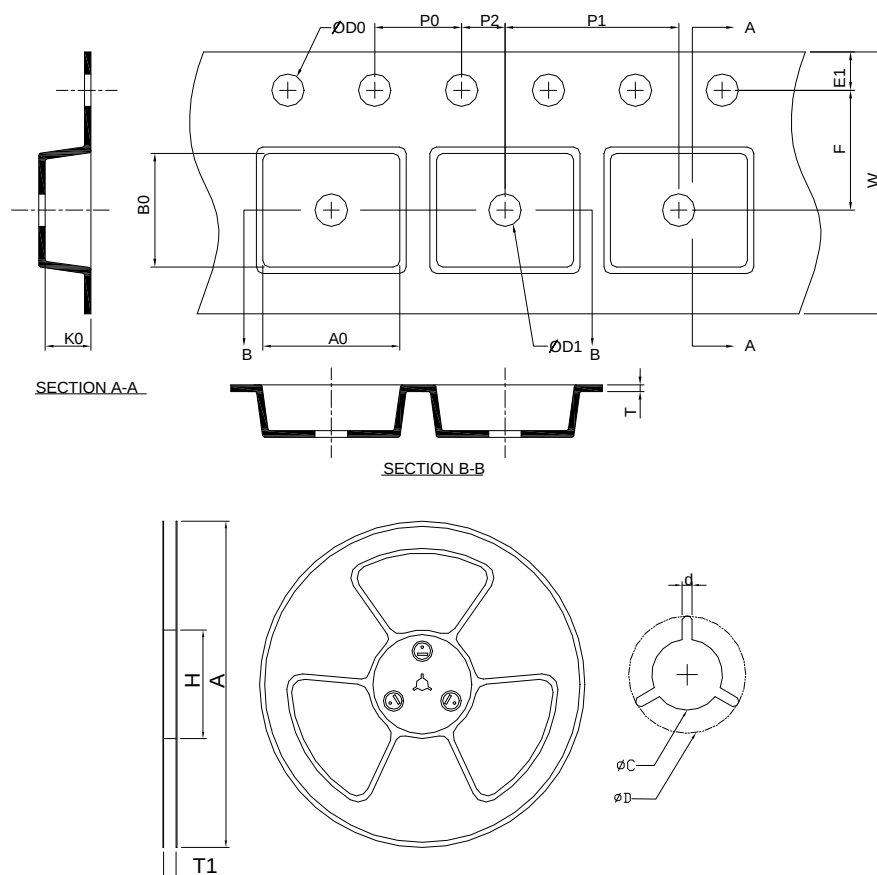
SOT-89



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

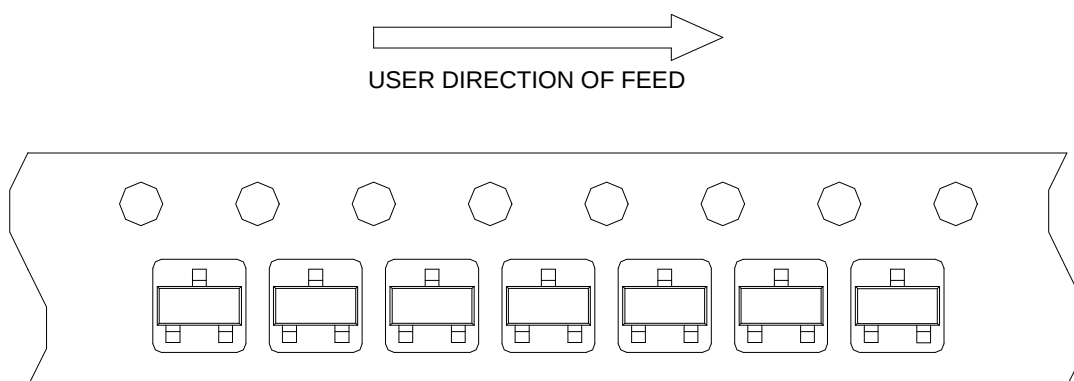
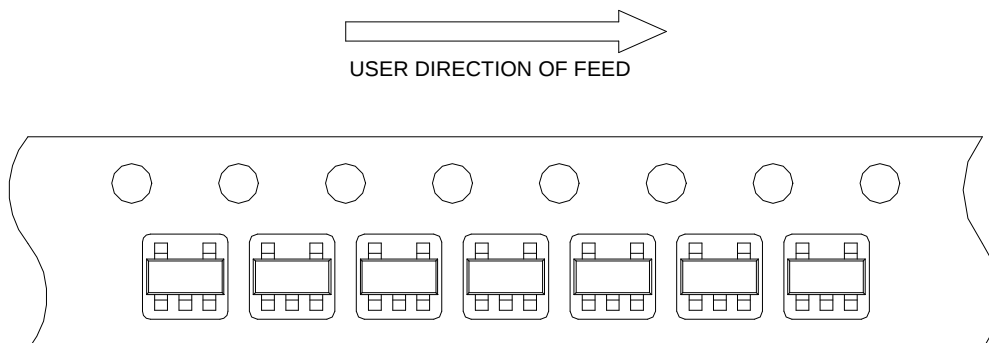
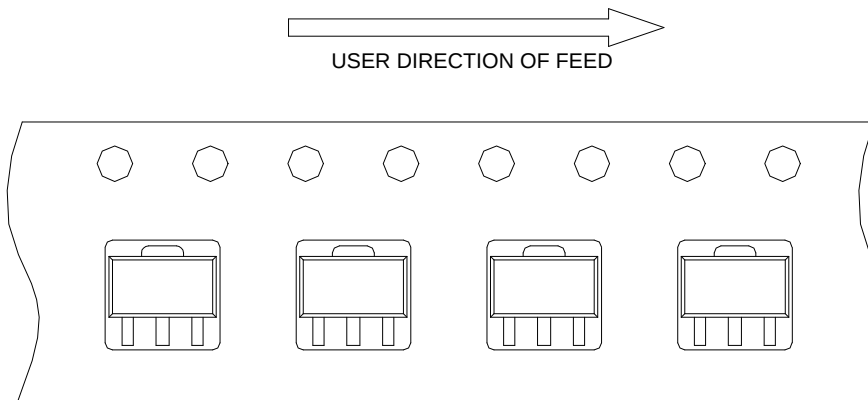


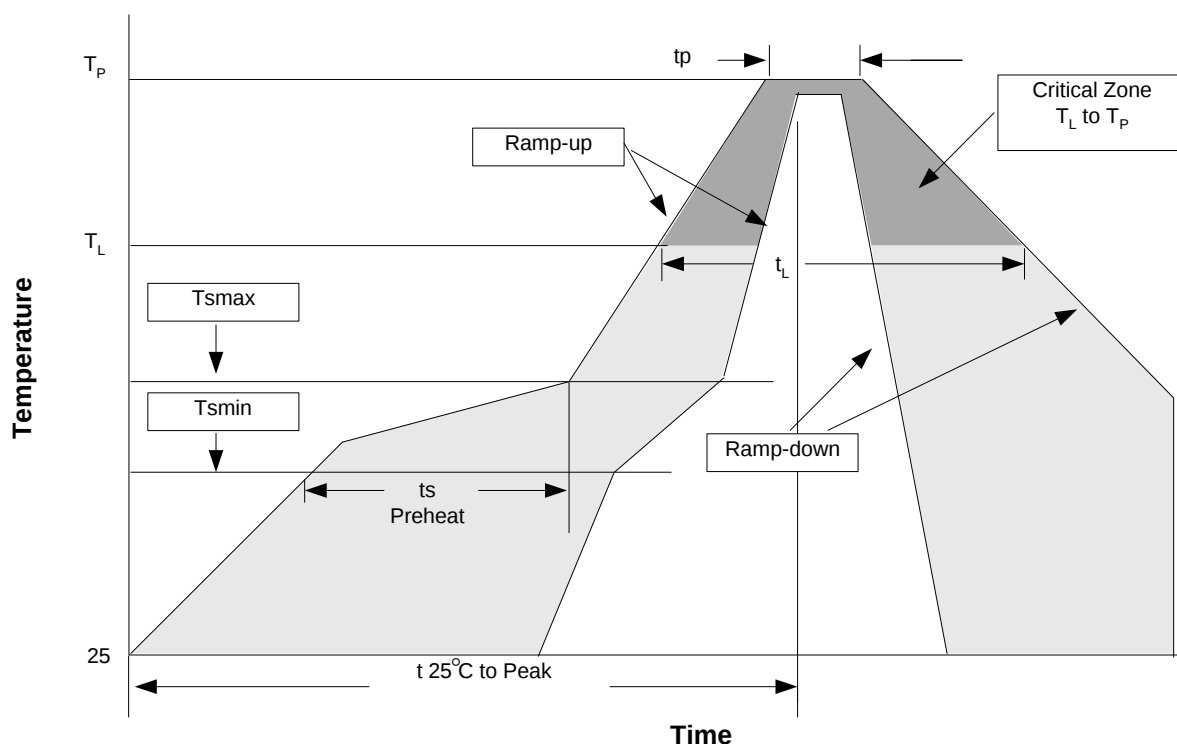
Application	A	H	T1	C	d	D	W	E1	F
SOT-23-3	178.0 ±0.00	50 MIN.	8.4+2.00 -0.00	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	8.0 ±0.30	1.75 ±0.10	3.5 ±0.05
	P0	P1	P2	D0	D1	T	A0	B0	K0
	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.5+0.10 -0.00	1.0 MIN.	0.6+0.00 -0.40	3.20 ±0.20	3.10 ±0.20	1.50 ±0.20
Application	A	H	T1	C	d	D	W	E1	F
SOT-23-5	178.0 ±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
	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 ±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
	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 _{tr} > 100mA

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}) - Temperature Max (T_{smax}) - Time (min to max) (t_s)	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/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.

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 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.

Customer Service

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