High Sensitivity Hall Effect Sensor Latch IC

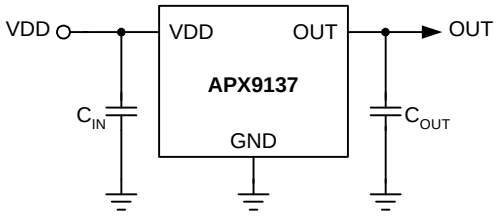
Features

- **On-Chip Hall Sensor**
- **Wide Operating Voltage Range: 2.2V to 24V**
- **Low Operating Supply Current**
- **Built-in Pull-up Resistor**
- **High Sensitivity Hall Effect Sensor IC: ±60G**
- **3 Pin TO-92M3 and SOT-23 Packages**
- **Lead Free and Green Devices Available (RoHS Compliant)**

Applications

- **Brushless DC Motor**
- **Brushless DC Fan**
- **Revolution Counting**
- **Speed Measurement**

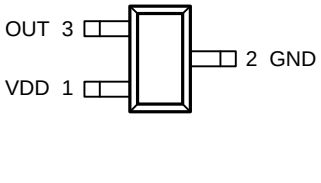
Simplified Application Circuit



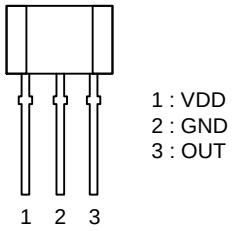
General Description

The APX9137 is an integrated Hall-Effect sensor latch IC designed for electric commutation of three-phase Brushless DC motor applications. The APX9137 is available in a low cost TO-92M3 and SOT-23-3 packages.

Pin Configuration



SOT-23-3
(Top View)



TO-92M3
(Front View)

Ordering and Marking Information

APX9137 □□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code A : SOT-23-3 E : TO-92M3 Temperature Range I : -40 to 150 °C Handling Code TR : Tape & Reel PB : Plastic Bag Assembly Material G : Halogen and Lead Free Device
APX9137 A: X37X	X - Date Code
APX9137 E: APX 9137 XXXXX	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_{DD}	VDD Pin Supply Voltage	-0.3 to 28	V
V_{OUT}	Output Pin Output Voltage	-0.3 to 28	V
I_{OUT}	Maximum Output Pin Sink Current	50	mA
T_J	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65 to 150	°C
T_{SOR}	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

Symbol	Parameter	Typical Value	Unit
θ_{JA}	Thermal Resistance-Junction to Ambient (Note 2) SOT-23-3 TO-92M3	 385 245	°C/W
P_D	Power Dissipation, T_A = 25°C SOT-23-3 TO-92M3	 350 550	mW

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=160°C. Exceeding the maximum allowable power dissipation will result in excessive die temperature.

Recommended Operation Conditions

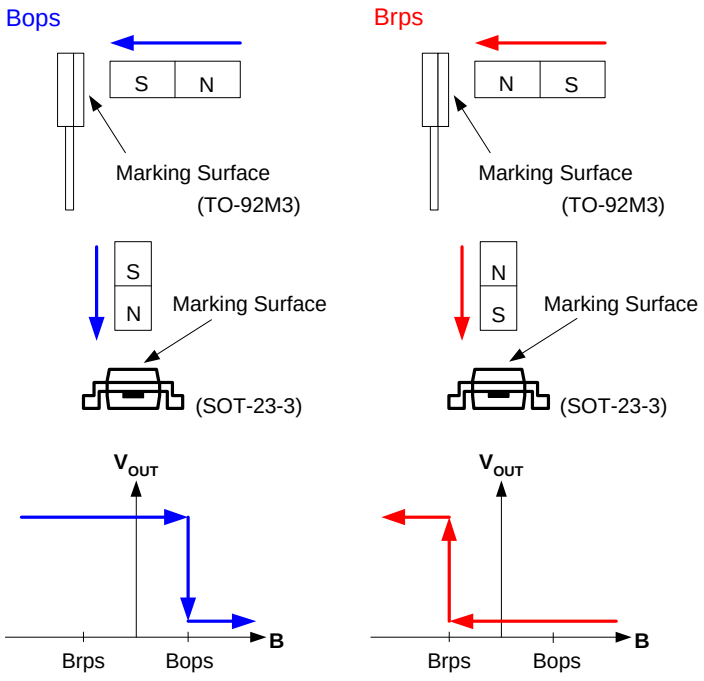
Symbol	Parameter	Range	Unit
V_{DD}	VDD Supply Voltage	2.2 to 24	V
T_A	Operating Ambient Temperature	-40 to 150	°C
T_J	Junction Temperature	-40 to 150	°C

Electrical Characteristics (T_A=25°C, V_{DD}=24V, unless otherwise noted)

Symbol	Parameter	Test Conditions	APX9137			Unit
			Min.	Typ.	Max.	
I_{DD}	VDD Supply Current	V_{DD}=24V, Output Off	-	3	5	mA
V_{SAT}	Output Saturation Voltage	B > Bop, I_{OUT} = 20mA	-	0.2	0.4	V
I_{LEAK}	OUT Pin Leakage Current	B < Brp, V_{OUT} = V_{DD}	-	-	0.1	μA
R_{PULL}	Output Pull-up Resistor		6	-	14	kΩ

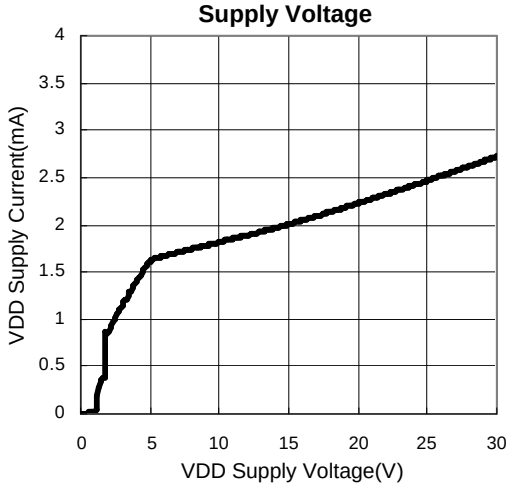
Magnetic Characteristics (T_A=25°C, V_{DD}=24V, unless otherwise noted)

Symbol	Parameter	Test Conditions	APX9137			Unit
			Min.	Typ.	Max.	
Bop	Magnetic Operation Point		10	30	60	Gauss
Brp	Magnetic Release Point		-60	-30	-10	Gauss
Bhys	Magnetic Hysteresis		-	60	-	Gauss

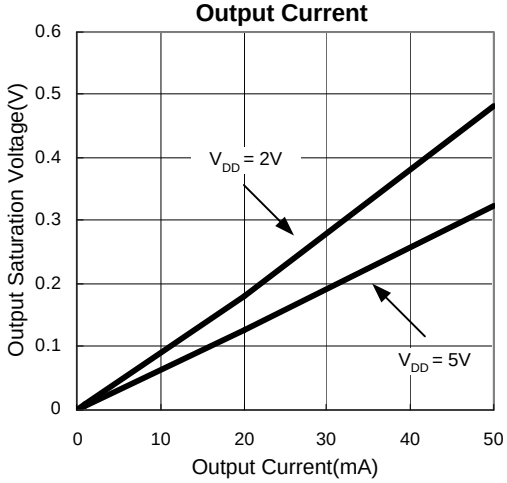


Typical Operating Characteristics

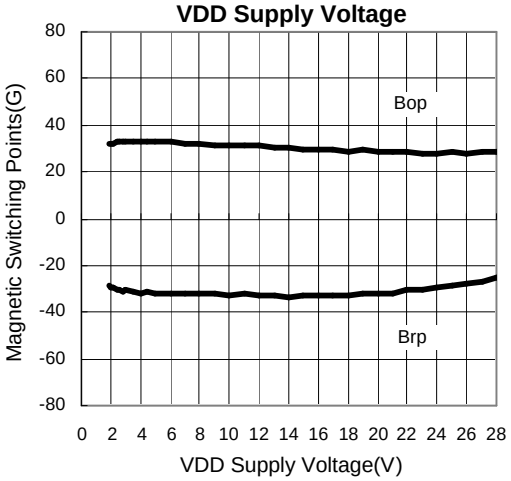
VDD Supply Current vs. VDD Supply Voltage



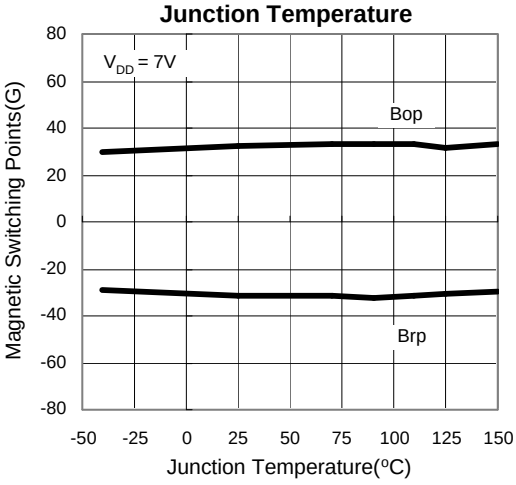
Output Saturation Voltage vs. Output Current



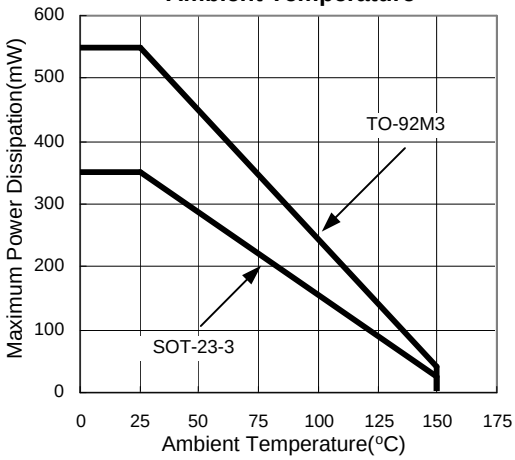
Magnetic Switching Points vs. VDD Supply Voltage



Magnetic Switching Points vs. Junction Temperature



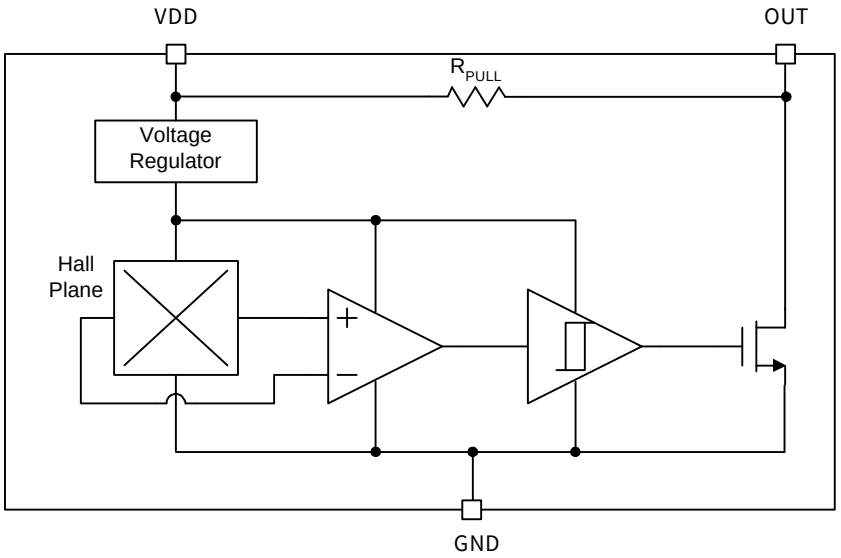
Maximum Power Dissipation vs. Ambient Temperature



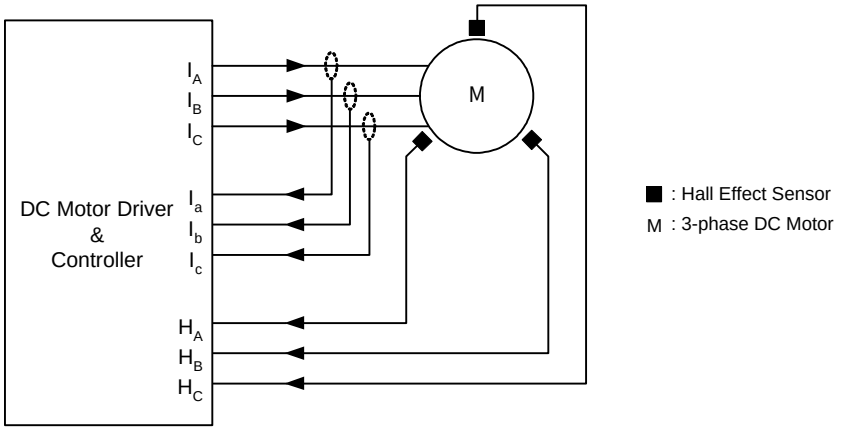
Pin Description

PIN		Function
NO.	NAME	
1	VDD	Supply Voltage Input.
2	GND	Ground of the IC.
3	OUT	Output Stage.

Block Diagram

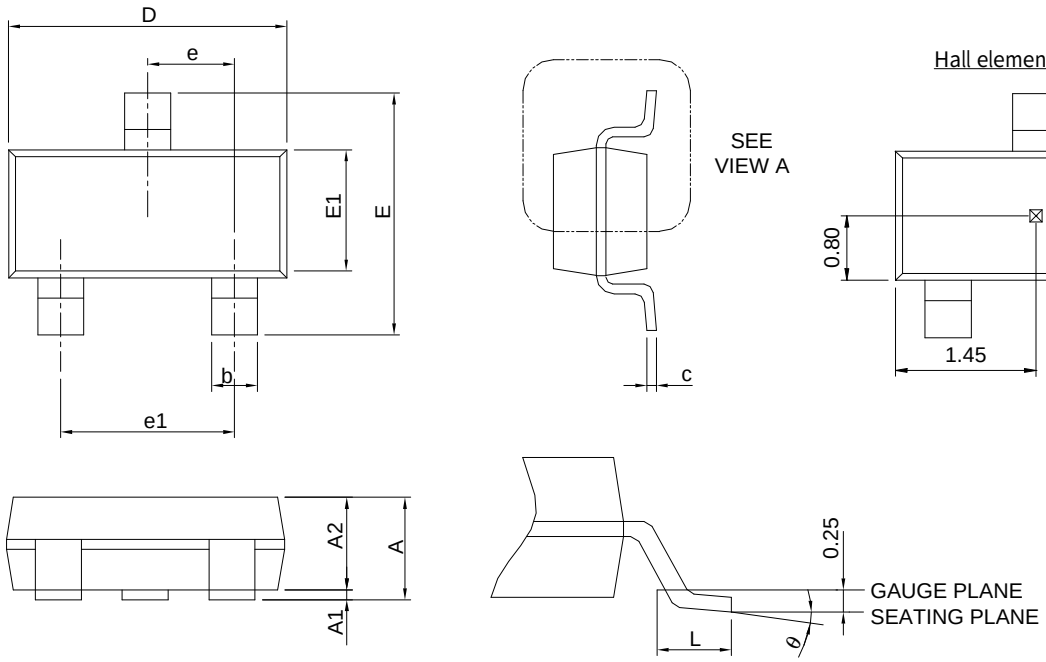


Typical Application Circuit



Package Information

SOT-23-3

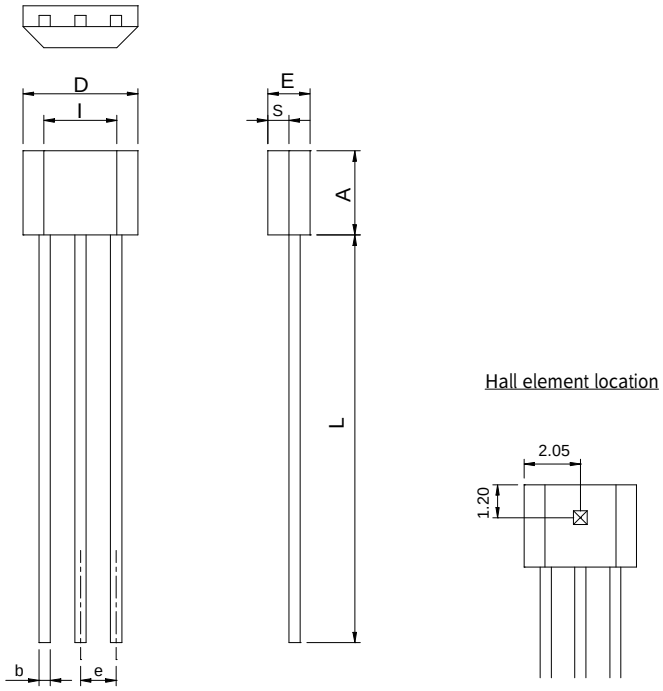


SYMBOL	SOT-23			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.45		0.057
A1	0.00	0.15	0.000	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.012	0.020
c	0.08	0.22	0.003	0.009
D	2.70	3.10	0.106	0.122
E	2.60	3.00	0.102	0.118
E1	1.40	1.80	0.055	0.071
e	0.95 BSC		0.037 BSC	
e1	1.90 BSC		0.075 BSC	
L	0.30	0.60	0.012	0.024
θ	0°	8°	0°	8°

Note : 1. 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.

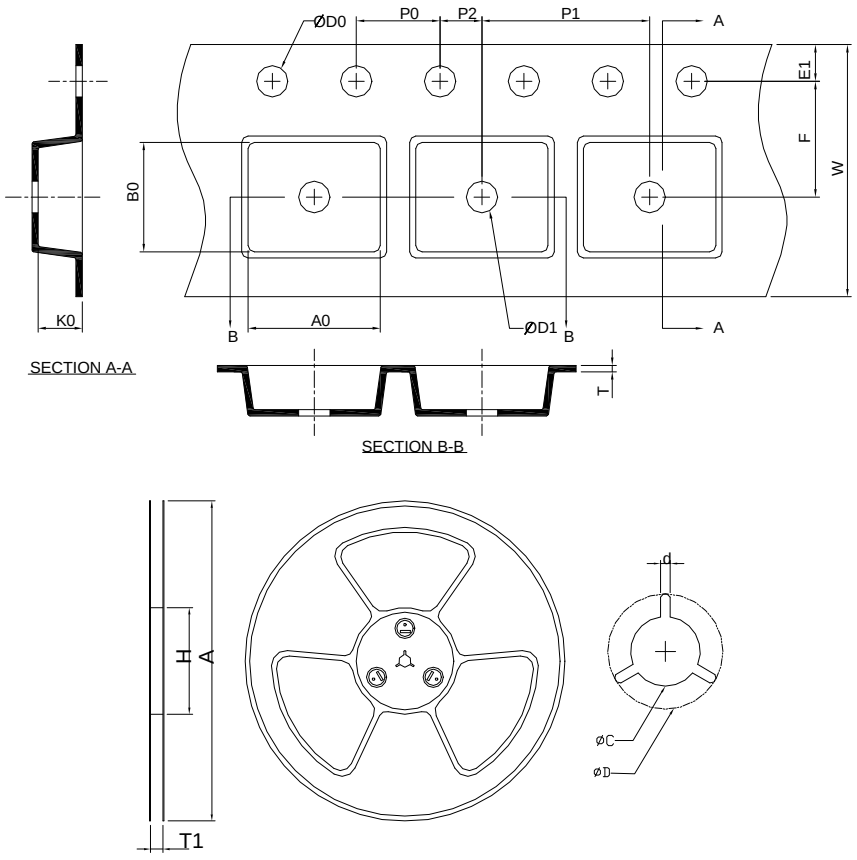
Package Information

TO-92M3



SYMBOL	TO-92M3			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.80	3.20	0.110	0.126
b	0.33	0.43	0.013	0.017
D	3.90	4.30	0.154	0.169
e	1.27 BSC		0.050 BSC	
E	1.40	1.60	0.055	0.063
I	2.40	2.80	0.094	0.110
L	13.60	15.60	0.535	0.614
s	0.63	0.81	0.025	0.032

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

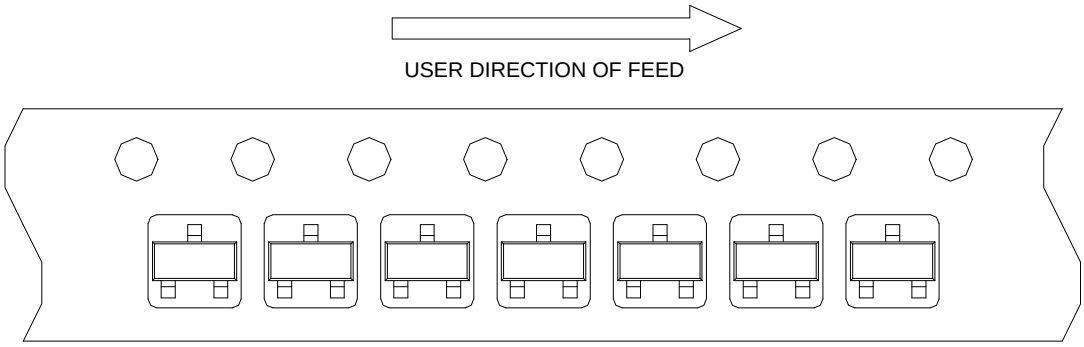
(mm)

Devices Per Unit

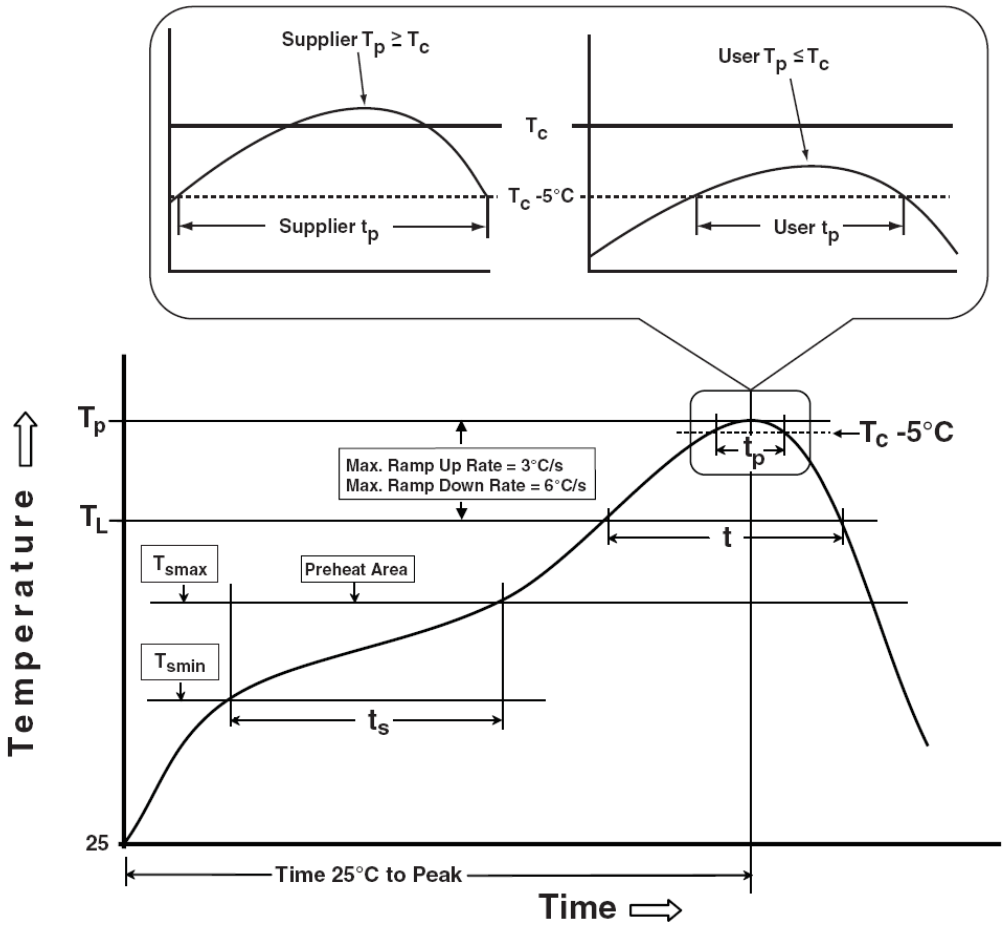
Package Type	Unit	Quantity
SOT-23-3	Tape & Reel	3000
TO-92M3	Plastic Bag	1000

Taping Direction Information

SOT-23-3



Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak Temperature min (T_{smin}) Temperature max (T_{smax}) Time (T_{smin} to T_{smax}) (t_s)	100 °C 150 °C 60-120 seconds	150 °C 200 °C 60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183 °C 60-150 seconds	217 °C 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.		

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

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