

## High Sensitivity Hall Effect Sensor IC with FG Output

### Features

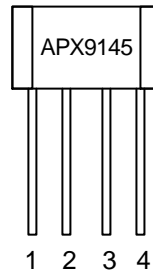
- On-chip Hall Sensor
- Build-in Output Zener Diodes to Clamp the Peak Output Voltage
- Build-in Frequency Generation Output
- High Output Sinking Capability up to 400mA
- High Sensitivity Hall Effect Sensor IC:  $\pm 65G$
- 4 pin TO-92M Package
- Lead Free Available (RoHS Compliant)

### General Description

The APX9145 is an integrated Hall Effect Sensor IC with frequency generation output for electric commutation of DC brushless motor applications.

The APX9145 is available in a low cost TO-92M4 package.

### Pin Outs



Front View

- 1 : FG
- 2 : DO
- 3 : DOB
- 4 : GND

### Applications

- Brushless DC Fan

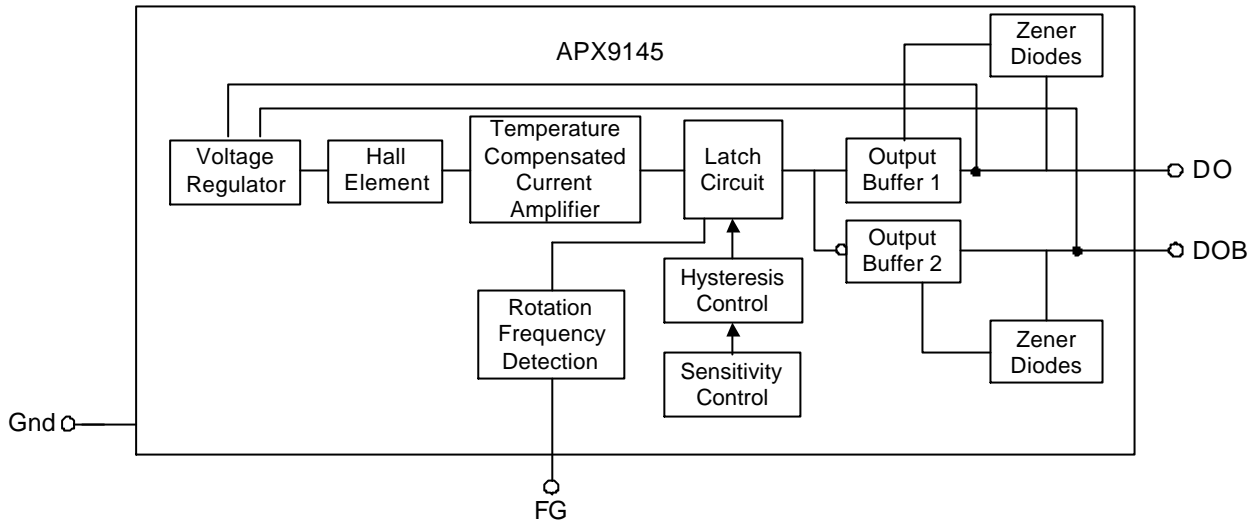
### Ordering and Marking Information

<p>APX9145 □ □ - □ □ □</p> <ul style="list-style-type: none"> <li>□ □ □ : Lead Free Code</li> <li>□ □ : Handling Code</li> <li>□ : Temp. Range</li> <li>□ : Package Code</li> </ul>	<p>Package Code E : TO - 92M4</p> <p>Operating Ambient Temp. Range E : - 20 to 70°C</p> <p>Handling Code PB : Plastic Bag      TB : Tape &amp; Box TR : Tape &amp; Reel</p> <p>Lead Free Code L : Lead Free Device      Blank : Original Device</p>
<p>APX9145 E : <span style="border: 1px solid black; padding: 2px;">APX 9145 XXXXX</span></p>	<p>XXXXX - Date Code</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 and compatible with both SnPb and lead-free soldering operations. 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 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.

**Block Diagram**



**Pin Description**

PIN		Description
No.	Name	
1	FG	Open collector pin for rotation frequency detection
2	DO	Coil output / Power input
3	DOB	Coil output / Power input
4	GND	IC ground

**Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Symbol	Parameter	Rating	Unit
$V_{CC}$	Supply Voltage (DO/DOB Voltage)	25	V
$V_{OFF}$	FG Pin Off Voltage	25	V
$I_{FG}$	FG Sink Current	10	mA
$I_{OUT}$	Output Current	500	mA
$P_D$	Maximum Power Dissipation	500	mW
$T_J$	Junction Temperature Range	-20 to 150	°C
$T_{STG}$	Storage Temperature Range	-65 to 150	
$T_{SOL}$	Soldering Temperature (10 Sec.)	260	

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.

**Recommended Operating Conditions** ( $T_A = 25^\circ\text{C}$ )

Symbol	Parameter	Rating	Unit
$V_{CC}$	Supply voltage (DO/DOB Voltage)	3.7 to 20	V
$I_{OUT}$	Maximum Output Sink Current	400	mA
$I_{FG}$	Maximum FG Sink Current	5	mA
$V_{OFF}$	Maximum FG Pin Off Voltage	20	V
$T_J$	Operating Ambient Temperature	-20 to 70	$^\circ\text{C}$
$T_A$	Junction Temperature Range	-20 to 125	$^\circ\text{C}$

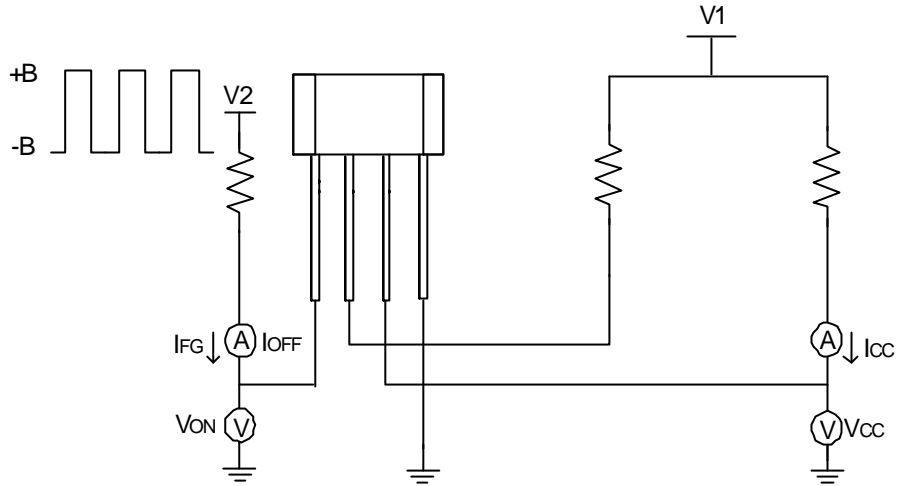
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC}=12\text{V}$  unless otherwise noted)

Symbol	Parameter	Test Condition	APX9145			Unit
			Min.	Typ.	Max.	
$V_{SAT}$	Output Saturation Voltage	$I_{OUT} = 400\text{mA}$		700	900	mV
$I_{CC}$	Supply Current			11	15	mA
$I_{OFF}$	FG OFF Leakage Current				1	$\mu\text{A}$
$V_{ON}$	FG ON Saturation Voltage	$I_{FG} = 5\text{mA}$		0.2	0.4	V
$V_{clamp}$	Clamp Output Voltage			33		V
$t_r$	Output Rise Time	$R_L = 200\Omega$ , $C_L = 10\text{pF}$		0.4		$\mu\text{S}$
$t_f$	Output Fall Time	$R_L = 200\Omega$ , $C_L = 10\text{pF}$		0.1		$\mu\text{S}$
$t_d$	Propagation Delay Time	$R_L = 200\Omega$ , $C_L = 10\text{pF}$		2		$\mu\text{S}$

**Magnetic Characteristics** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC}=12\text{V}$  unless otherwise noted)

Symbol	Parameter	Test Condition	APX9145			Unit
			Min.	Typ.	Max.	
Bop	Magnetic Operate Points		10		65	Gauss
Brp	Magnetic Release Points		-65		-10	Gauss

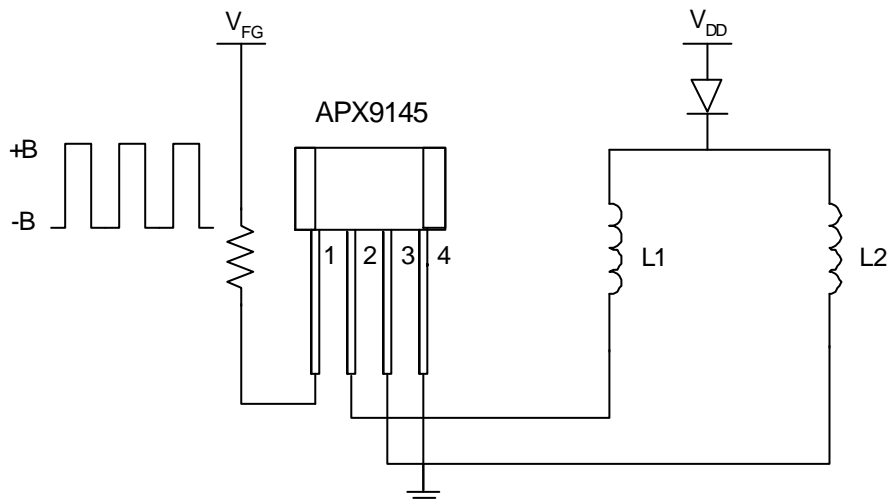
### Test Circuit



- Note 1: Measure  $V_{CC}$ ,  $I_{CC}$  when DO is off.
- Note 2: Measure  $V_{ON}$ ,  $I_{FG}$  when FG is on.
- Note 3: Measure  $I_{OFF}$  when FG is off.

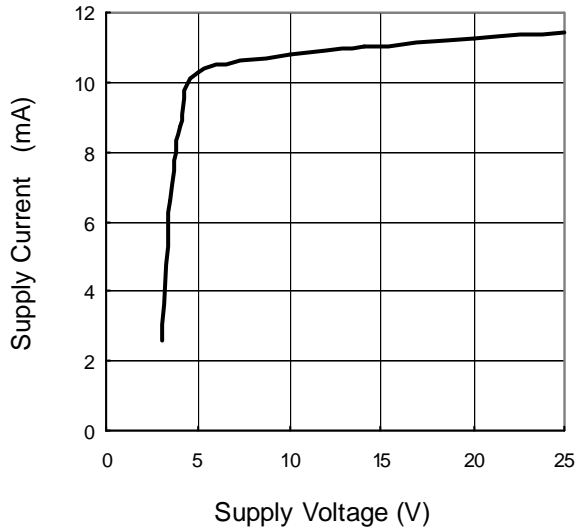
### Application Circuit

Typical DC brushless fan application circuit

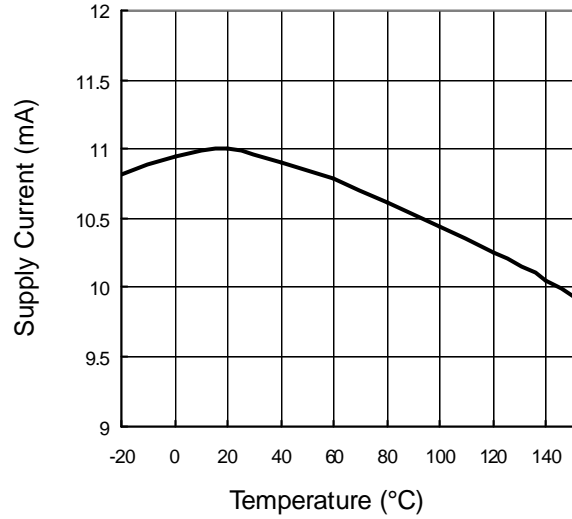


**Typical Characteristics** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 12\text{V}$  unless otherwise noted)

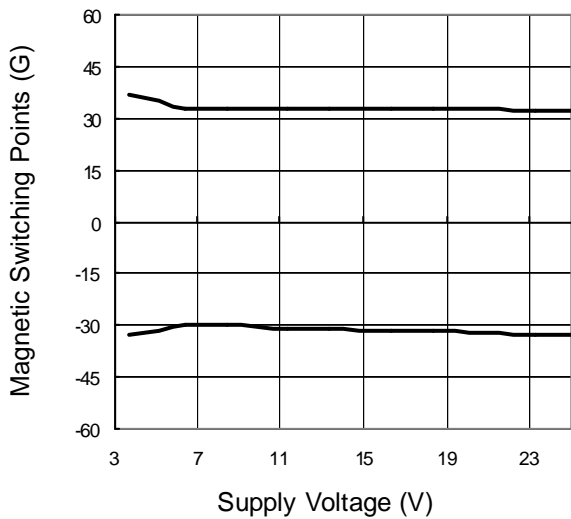
Supply Current vs. Supply Voltage



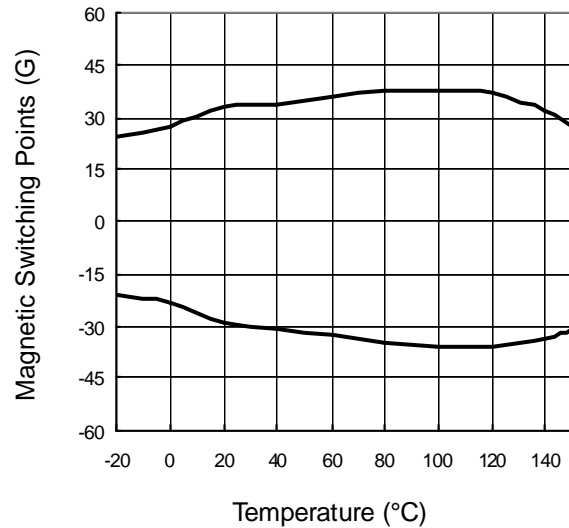
Supply Current vs. Temperature



Magnetic Switching Points vs. Supply Voltage

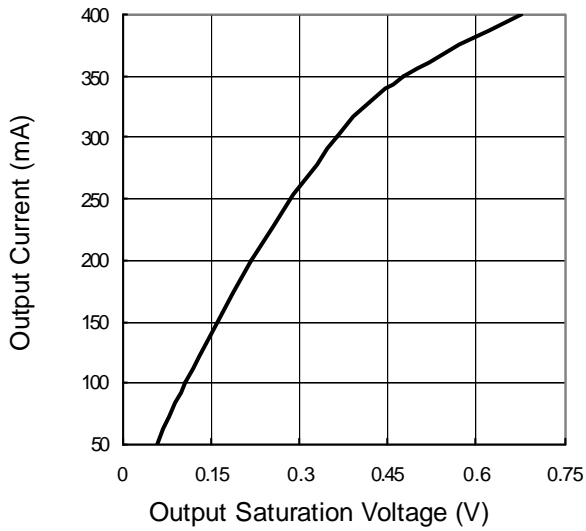


Magnetic Switching Points vs. Temperature

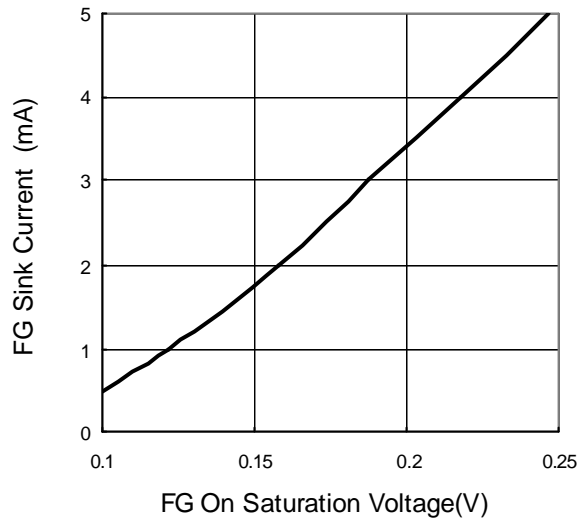


Typical Characteristics (Cont.)

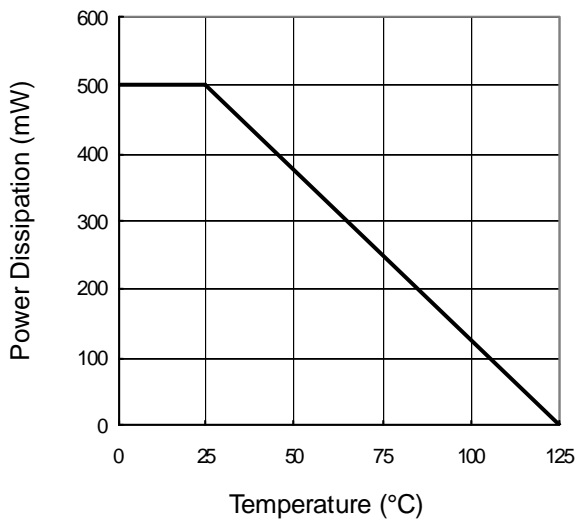
Output Current vs. Output Saturation Voltage



FG Sink Current vs FG On Saturation Voltage

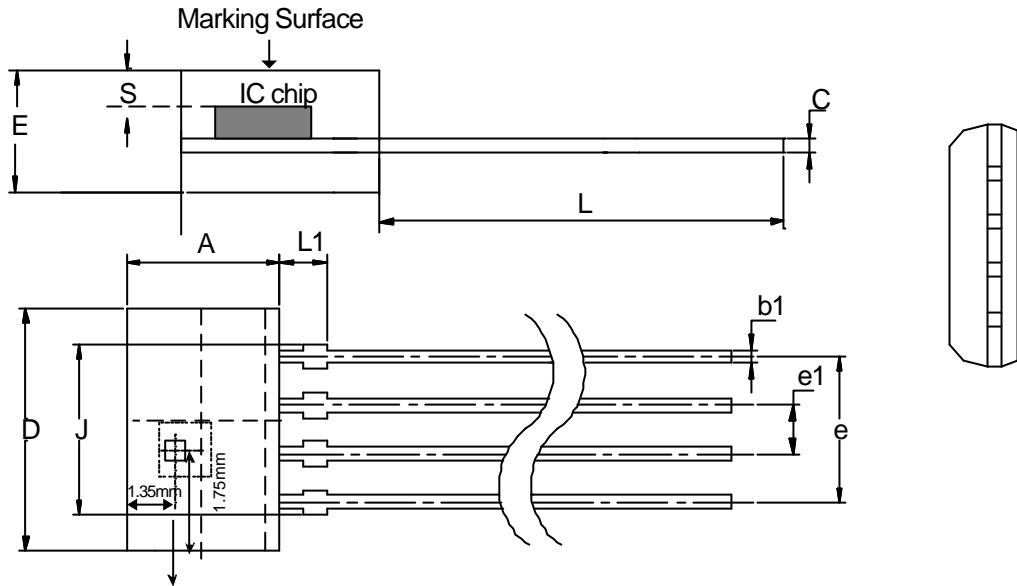


Power Dissipation vs. Temperature



Package Information

TO-92M4



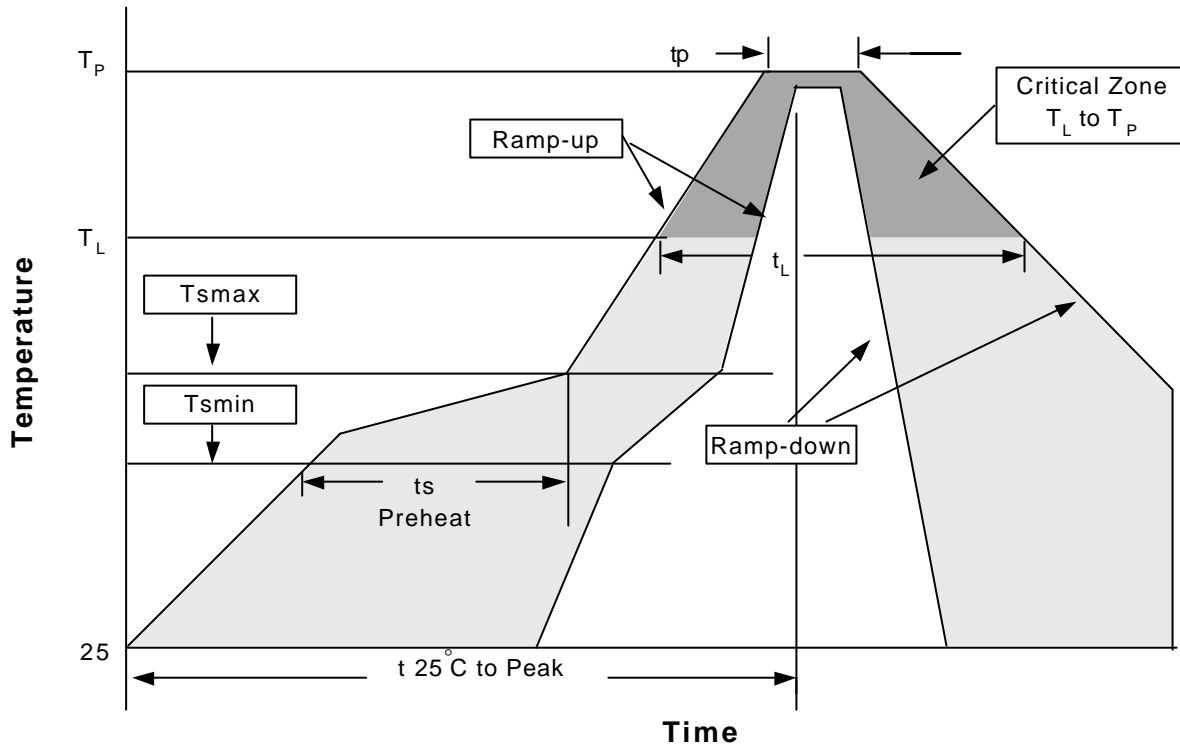
Sensitive Area (0.286<sup>x</sup> 0.286mm<sup>2</sup>)  
 Position of Hall Sensor  
 reference to the top-left of package  
 x= 1.35±0.1mm  
 y= 1.75±0.1mm

Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	3.60	3.70	0.141	0.145
b1	0.35	0.41	0.014	0.016
C	0.351	0.411	0.014	0.016
D	5.17	5.27	0.203	0.207
e	3.78	3.84	0.148	0.150
e1	1.24	1.30	0.049	0.051
E	1.50	1.60	0.059	0.063
J	4.04	4.34	0.158	0.170
L	14.0	15.0	0.549	0.588
L1	1.342	1.542	0.053	0.060
S	0.45	0.55	0.018	0.022

## Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb), 100%Sn
Lead Solderability	Meets EIA Specification RSI86-91, ANSI/J-STD-002 Category 3.

### Reflow Condition (IR/Convection or VPR Reflow)



### 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>smin</sub> )	100°C	150°C
- Temperature Max (T <sub>smax</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.

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 <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

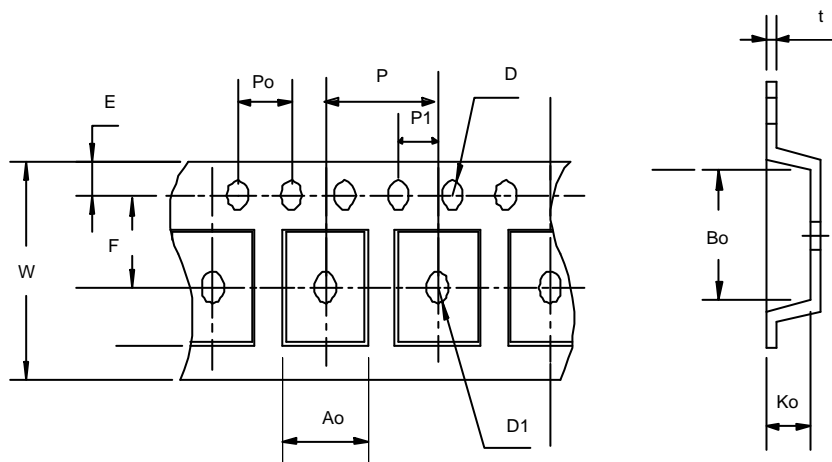
Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

\*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.

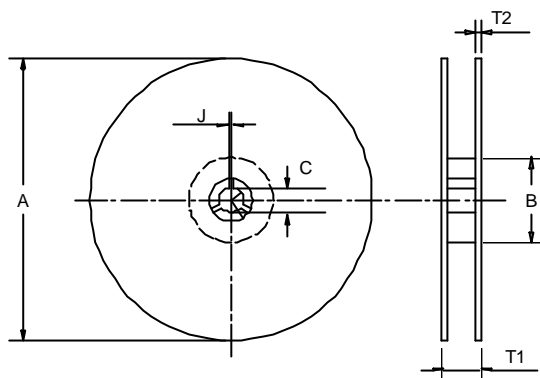
## Reliability test program

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 <sub>r</sub> > 100mA

## Carrier Tape & Reel Dimensions



### Carrier Tape & Reel Dimensions (Cont.)



Application	A0	A1	A2	A3	B0	B1	B2	C0	C1
TO-92	3.18~12	90±1	76±1	30±1	90±1	31±1	76±1	5.8	3.8
	C2	D	D1	D2	F1=F2	F1-F2	M	H	H1
	7.8	4.0±0.2	0.36~0.53	9.0 MAX	2.5+0.2 -0.1	±0.3	2.5±0.5	16±0.5	9±0.5
	H2	H2A	H3	H4	H5=H0+M	L	L1	P	P1
	0.5 MAX	0.5 MAX	27.0 MAX	20.0 MAX	18.5±0.5	11.0 MAX	2.5 MIN	12.7±0.3	6.35±0.4
	P2	T	T1	T2	T3	T4	W	W1	W2
	50.8±0.5	0.55 MAX	1.42 MAX	0.36~0.68	15	1.7	18.0±0.2	6.0±0.2	≤1

(mm)

### Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
TO-92	17.5~19	5.0~7.0	2000

(mm)

### Customer Service

**Anpec Electronics Corp.**

Head Office :

No.6, Dusing 1st Road, SBIP,

Hsin-Chu, Taiwan, R.O.C.

Tel : 886-3-5642000

Fax : 886-3-5642050

Taipei Branch :

7F, No. 137, Lane 235, Pac Chiao Rd.,

Hsin Tien City, Taipei Hsien, Taiwan, R. O. C.

Tel : 886-2-89191368

Fax : 886-2-89191369