

## N-Channel Enhancement Mode MOSFET


### Features

- 25V/16A,  
 $R_{DS(ON)}=7.5m\Omega(\text{typ.}) @ V_{GS}=10V$   
 $R_{DS(ON)}=10m\Omega(\text{typ.}) @ V_{GS}=4.5V$
- Super High Dense Cell Design
- Avalanche Rated
- Reliable and Rugged
- Thermal Pad Exposed with Standard SOP-8 Outline
- Lead Free Available (RoHS Compliant)

### Pin Description

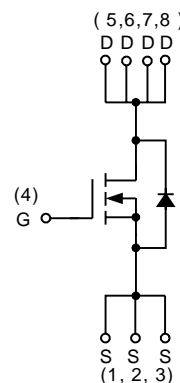


SOP – 8 Exposed

 = Thermal Pad  
 (connected to Drain plane for better heat dissipation)

### Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems



N-Channel MOSFET

### Ordering and Marking Information

<p>APM4220 <span style="border: 1px solid black; padding: 2px;">□□-□□□</span></p> <p style="margin-left: 20px;"> <span style="border: 1px solid black; padding: 2px;">□□</span> : Lead Free Code  <span style="border: 1px solid black; padding: 2px;">□□</span> : Handling Code  <span style="border: 1px solid black; padding: 2px;">□</span> : Temp. Range  <span style="border: 1px solid black; padding: 2px;">□□□</span> : Package Code                 </p>	<p>Package Code                      KA : SOP-8-P</p> <p>Operating Junction Temp. Range                      C : -55 to 150°C</p> <p>Handling Code                      TU : Tube    TR : Tape &amp; Reel</p> <p>Lead Free Code                      L : Lead Free Device    Blank : Original Device</p>
<p>APM4220 KA : <span style="border: 1px solid black; padding: 2px;">: APM4220 XXXXX</span></p>	<p style="text-align: right;">XXXXXX - Date Code</p>

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte in 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.

## Absolute Maximum Ratings

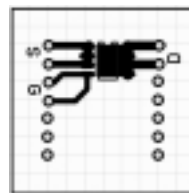
Symbol	Parameter	Rating	Unit	
<b>Common Ratings</b> ( $T_A=25^\circ\text{C}$ Unless Otherwise Noted)				
$V_{DSS}$	Drain-Source Voltage	25	V	
$V_{GSS}$	Gate-Source Voltage	$\pm 20$		
$T_J$	Maximum Junction Temperature	150	$^\circ\text{C}$	
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ\text{C}$	
<b>Mounted on Large Heat Sink</b>				
$P_D$	Maximum Power Dissipation	$T_C=25^\circ\text{C}$	50	W
		$T_C=100^\circ\text{C}$	20	
$R_{\theta JC}$	Thermal Resistance-Junction to Case	2.5	$^\circ\text{C/W}$	
<b>Mounted on PCB of 1in<sup>2</sup> Pad Area</b> ①				
$I_{DP}$	300 $\mu\text{s}$ Pulse Drain Current Tested	$T_A=25^\circ\text{C}$	50	A
		$T_A=100^\circ\text{C}$	25	
$I_D$	Continuous Drain Current	$T_A=25^\circ\text{C}$	16	A
		$T_A=100^\circ\text{C}$	8	
$P_D$	Maximum Power Dissipation	$T_A=25^\circ\text{C}$	3	W
		$T_A=100^\circ\text{C}$	1.2	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	40	$^\circ\text{C/W}$	
<b>Mounted on PCB of Minimum Footprint</b> ②				
$I_{DP}$	300 $\mu\text{s}$ Pulse Drain Current Tested	$T_A=25^\circ\text{C}$	50	A
		$T_A=100^\circ\text{C}$	25	
$I_D$	Continuous Drain Current	$T_A=25^\circ\text{C}$	13	A
		$T_A=100^\circ\text{C}$	6	
$P_D$	Maximum Power Dissipation	$T_A=25^\circ\text{C}$	2.5	W
		$T_A=100^\circ\text{C}$	1	
$R_{\theta JA}$	Thermal Resistance-Junction to Minimum Footprint	50	$^\circ\text{C/W}$	

Notes:

①. The value of  $R_{\theta JA}$  is when the device mounted on 1in<sup>2</sup> pad with 2oz. Copper,  $t \leq 10\text{s}$ .



②. The value of  $R_{\theta JA}$  is when the device mounted on minimum pad with 2oz. Copper,  $t \leq 10\text{s}$ .



## Electrical Characteristics (T<sub>A</sub> = 25°C unless otherwise noted)

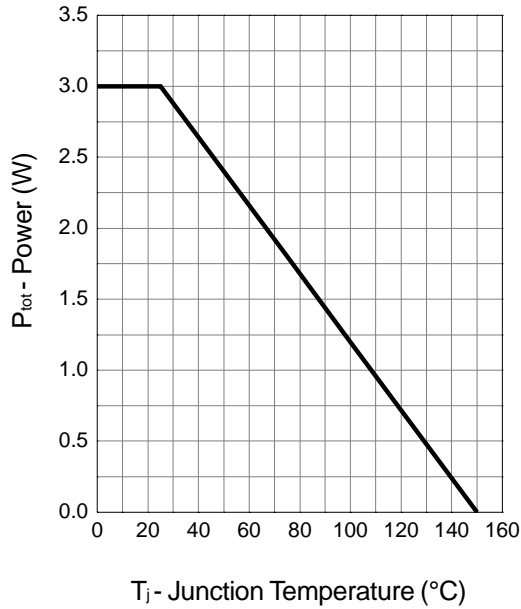
Symbol	Parameter	Test Condition	APM4220KA			Unit
			Min.	Typ.	Max.	
<b>Drain-Source Avalanche Ratings</b>						
E <sub>AS</sub>	Avalanche Energy, Single Pulsed	I <sub>D</sub> =15A, V <sub>DD</sub> =15V			50	mJ
<b>Static Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA	25			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =20V, V <sub>GS</sub> =0V			1	μA
		V <sub>DS</sub> =20V, V <sub>GS</sub> =0V T <sub>A</sub> =25°C			30	
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>DS</sub> =250μA	1.3	1.8	2.5	V
I <sub>GSS</sub>	Gate Leakage Current	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V			±100	nA
R <sub>DS(ON)</sub> <sup>a</sup>	Drain-Source On-state Resistance	V <sub>GS</sub> =10V, I <sub>DS</sub> =16A		7.5	9	mΩ
		V <sub>GS</sub> =4.5V, I <sub>DS</sub> =14A		10	12	
V <sub>SD</sub> <sup>a</sup>	Diode Forward Voltage	I <sub>SD</sub> =3A, V <sub>GS</sub> =0V		0.8	1.3	V
<b>Gate Charge Characteristics<sup>b</sup></b>						
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =10V, V <sub>GS</sub> =4.5V, I <sub>DS</sub> =12A		20	26	nC
Q <sub>gs</sub>	Gate-Source Charge			4.8		
Q <sub>gd</sub>	Gate-Drain Charge			8.4		
<b>Dynamic Characteristics<sup>b</sup></b>						
R <sub>G</sub>	Gate Resistance	V <sub>GS</sub> =0V, V <sub>DS</sub> =0V, f=1MHz		2		Ω
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, Frequency=1.0MHz		1785		pF
C <sub>oss</sub>	Output Capacitance			500		
C <sub>rss</sub>	Reverse Transfer Capacitance			300		
t <sub>d(ON)</sub>	Turn-on Delay Time	V <sub>DD</sub> =15V, R <sub>L</sub> =15Ω, I <sub>DS</sub> =1A, V <sub>GEN</sub> =10V, R <sub>G</sub> =6Ω		10	19	ns
T <sub>r</sub>	Turn-on Rise Time			7	13	
t <sub>d(OFF)</sub>	Turn-off Delay Time			69	95	
T <sub>f</sub>	Turn-off Fall Time			32	46	

**Notes:**

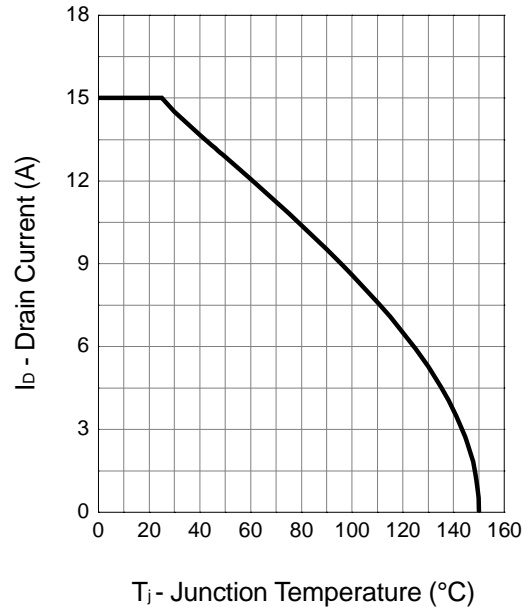
- a: Pulse test ; pulse width ≤300μs, duty cycle ≤ 2%.
- b: Guaranteed by design, not subject to production testing.

## Typical Characteristics

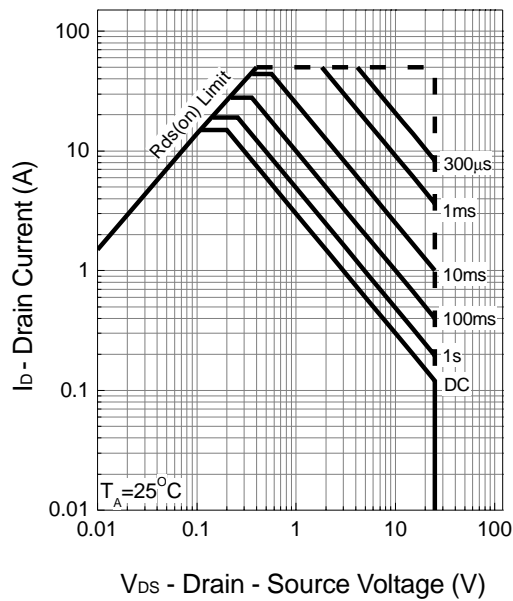
Power Dissipation



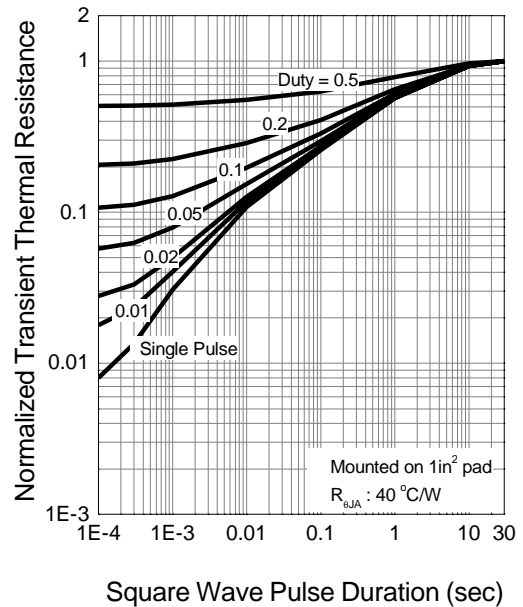
Drain Current



Safe Operation Area

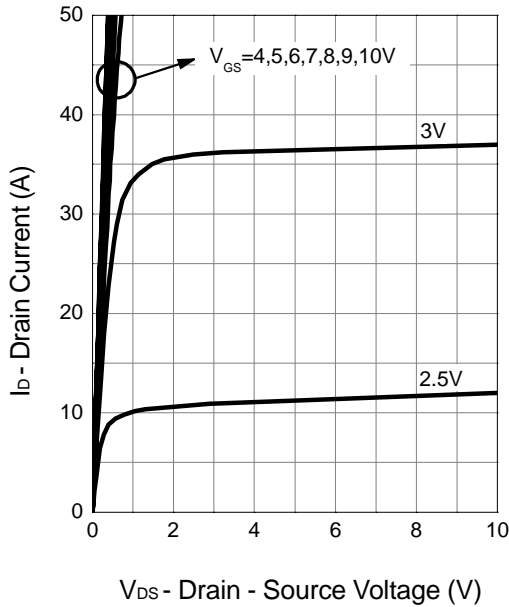


Thermal Transient Impedance

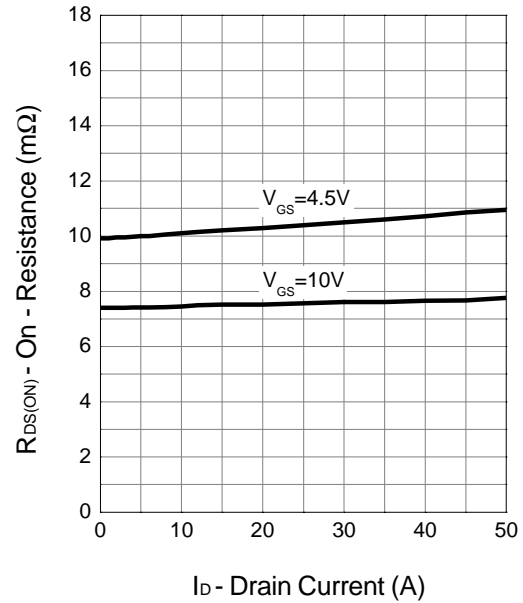


Typical Characteristics (Cont.)

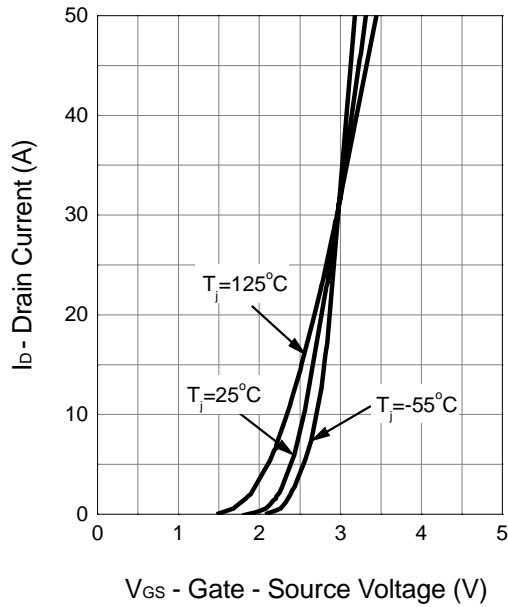
Output Characteristics



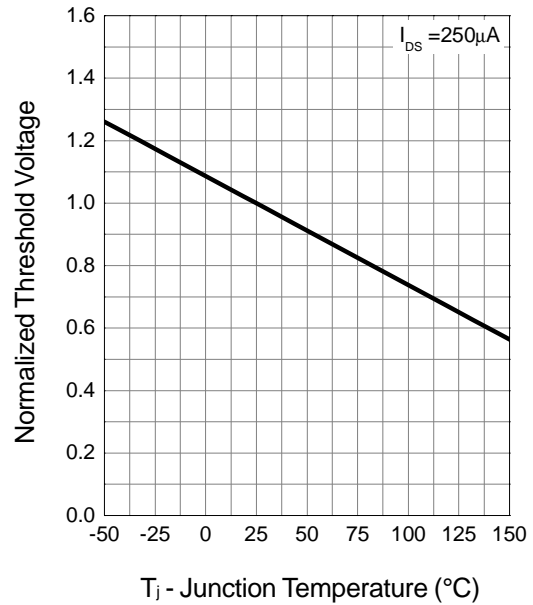
Drain-Source On Resistance



Transfer Characteristics

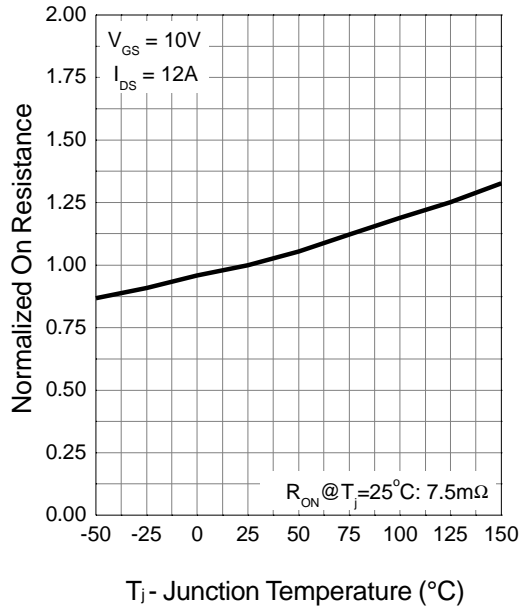


Gate Threshold Voltage

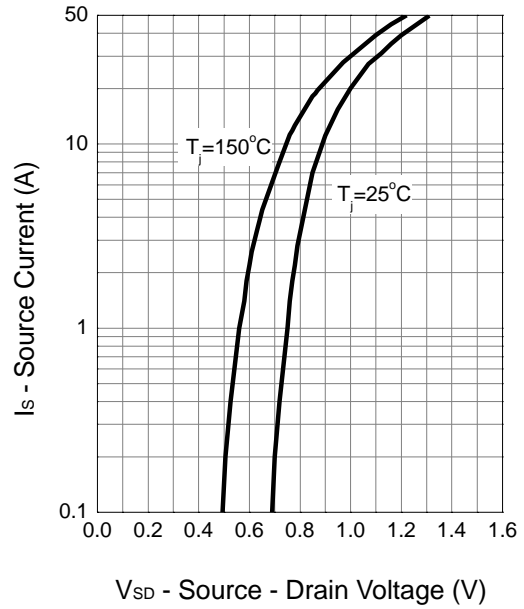


Typical Characteristics (Cont.)

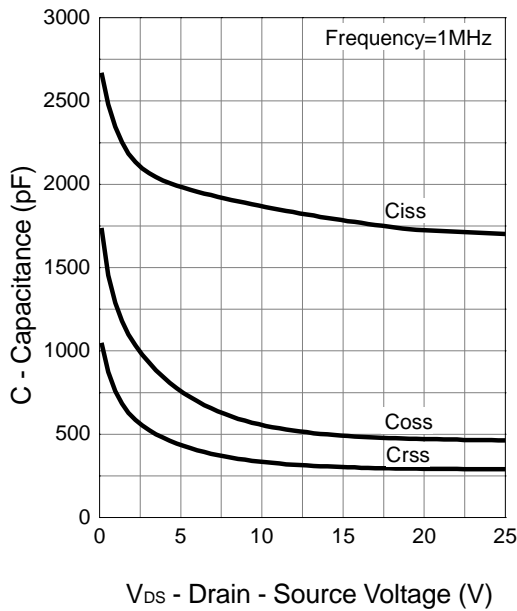
Drain-Source On Resistance



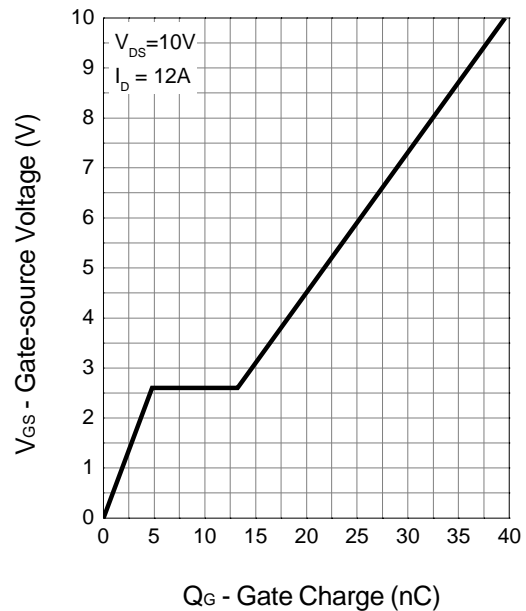
Source-Drain Diode Forward



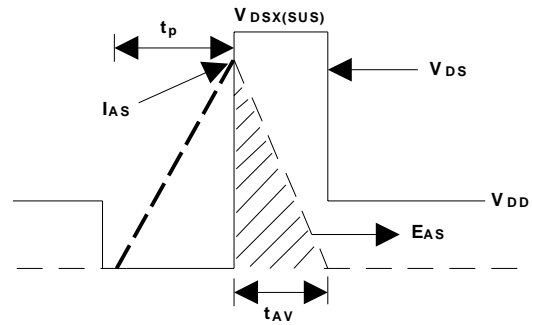
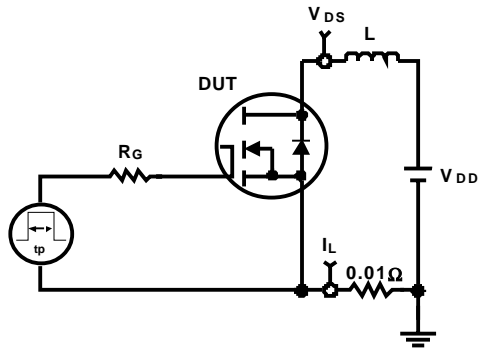
Capacitance



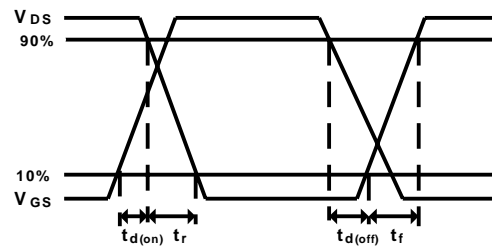
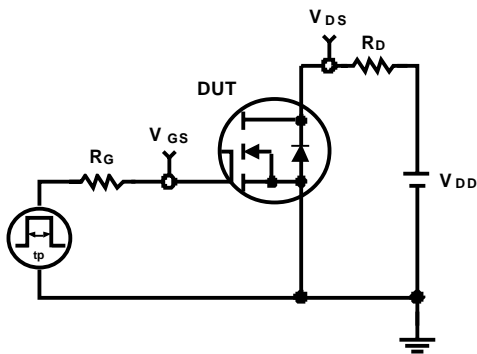
Gate Charge



## Avalanche Test Circuit and Waveforms

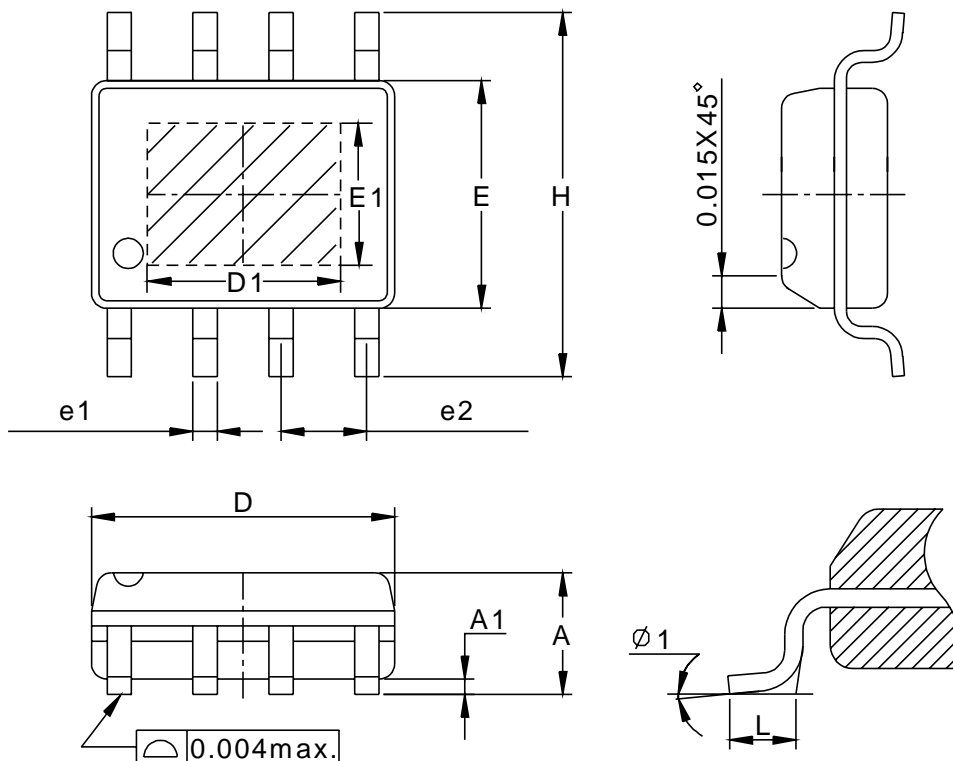


## Switching Time Test Circuit and Waveforms



## Packaging Information

SOP-8-P pin ( Reference JEDEC Registration MS-012)



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.80	5.00	0.189	0.197
D1*	3.34	3.84	0.132	0.151
E	3.80	4.00	0.150	0.157
E1*	2.23	2.68	0.088	0.106
H	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
e1	0.33	0.51	0.013	0.020
e2	1.27BSC		0.50BSC	
φ 1	8°		8°	

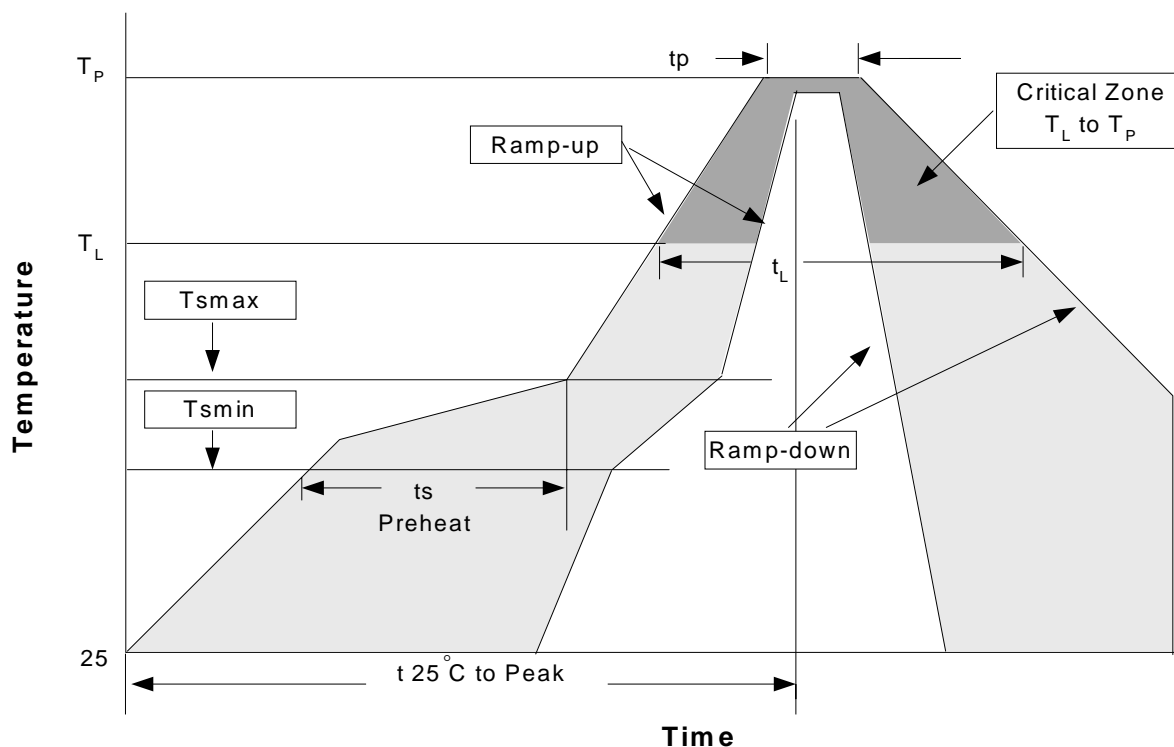
\* Thermal pad dimension



## 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 ( $T_L$ to $T_p$ )	3°C/second max.	3°C/second max.
Preheat <ul style="list-style-type: none"> <li>- Temperature Min (<math>T_{smin}</math>)</li> <li>- Temperature Max (<math>T_{smax}</math>)</li> <li>- Time (min to max) (<math>t_s</math>)</li> </ul>	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: <ul style="list-style-type: none"> <li>- Temperature (<math>T_L</math>)</li> <li>- Time (<math>t_L</math>)</li> </ul>	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.

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

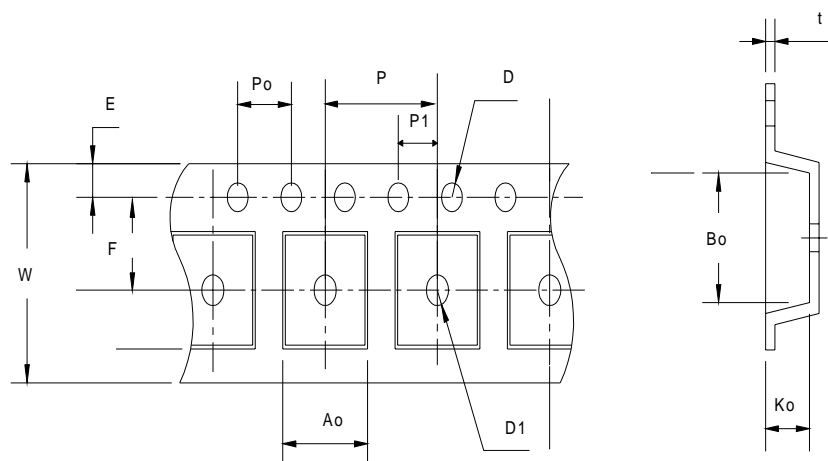
Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

\*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.

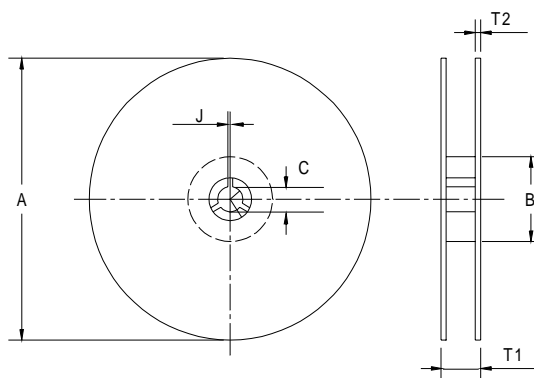
## Reliability Test Program

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

## Carrier Tape



**Carrier Tape(Cont.)**



Application	A	B	C	J	T1	T2	W	P	E
SOP- 8-P	330 ± 1	62 +1.5	12.75+ 0.15	2 ± 0.5	12.4 ± 0.2	2 ± 0.2	12± 0. 3	8± 0.1	1.75±0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	5.5± 1	1.55 +0.1	1.55+ 0.25	4.0 ± 0.1	2.0 ± 0.1	6.4 ± 0.1	5.2± 0. 1	2.1± 0.1	.3±0.013

(mm)

**Cover Tape Dimensions**

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOP- 8-P	12	9.3	2500

**Customer Service**

**Anpec Electronics Corp.**

Head Office :

5F, No. 2 Li-Hsin 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