

## N-Channel Enhancement Mode MOSFET

### Features

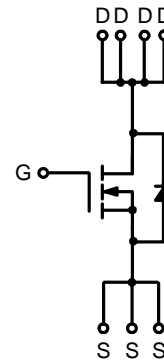
- 30V/60A,  
 $R_{DS(ON)} = 7.5m\Omega$  (typ.) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 11.5m\Omega$  (typ.) @  $V_{GS} = 4.5V$
- Super High Dense Cell Design
- Avalanche Rated
- Reliable and Rugged
- Lead Free Available (RoHS Compliant)

### Pin Description




### Applications

- Power Management in Notebook Computer, or Desktop Computer.



N-Channel MOSFET

### Ordering and Marking Information

<p>APM4350 □□-□□□</p> <div style="margin-left: 20px;"> <p>└─ Lead Free Code</p> <p>└─ Handling Code</p> <p>└─ Temp. Range</p> <p>└─ Package Code</p> </div>	<p>Package Code                  KP : KPAK</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>APM4350 KP :</p> <div style="border: 1px solid black; padding: 2px; display: inline-block; text-align: center;">                   APM4350                  XXXXX             </div>	<p>XXXXX - Date Code</p>

Note: ANPEC lead-free products contain molding compounds 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 ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Rating	Unit
<b>Common Ratings</b> ( $T_A = 25^\circ\text{C}$ Unless Otherwise Noted)			
$V_{DSS}$	Drain-Source Voltage	30	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	$^\circ\text{C}$
$I_S$	Diode Continuous Forward Current	$T_C = 25^\circ\text{C}$ 50	A
$I_{DP}$	300 $\mu\text{s}$ Pulse Drain Current Tested	$T_C = 25^\circ\text{C}$ 140	A
		$T_C = 100^\circ\text{C}$ 80	
<b>Mounted on Large Heat Sink</b>			
$I_D$	Continuous Drain Current	$T_C = 25^\circ\text{C}$ 60	A
		$T_C = 100^\circ\text{C}$ 35	
$P_D$	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>			
$I_D$	Continuous Drain Current	$T_A = 25^\circ\text{C}$ 13.5	A
		$T_A = 100^\circ\text{C}$ 8.5	
$P_D$	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 Ambient	50	$^\circ\text{C/W}$
<b>Mounted on PCB of Minimum Footprint</b>			
$I_D$	Continuous Drain Current	$T_A = 25^\circ\text{C}$ 10	A
		$T_A = 100^\circ\text{C}$ 6	
$P_D$	Maximum Power Dissipation	$T_A = 25^\circ\text{C}$ 1.5	W
		$T_A = 100^\circ\text{C}$ 0.5	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	75	$^\circ\text{C/W}$

## Electrical Characteristics (T<sub>A</sub> = 25°C Unless Otherwise Noted)

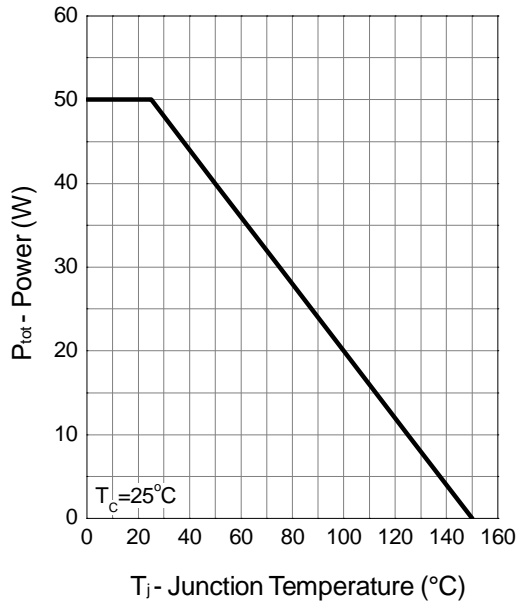
Symbol	Parameter	Test Condition	APM4350KP			Unit
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> =0V, I <sub>DS</sub> =250μA	30			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	V <sub>DS</sub> =24V, V <sub>GS</sub> =0V T <sub>j</sub> =85°C			1 30	μA
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> =30A		7.5	9	mΩ
		V <sub>GS</sub> =4.5V, I <sub>DS</sub> =15A		11.5	14.5	
<b>Diode Characteristics</b>						
V <sub>SD</sub> <sup>a</sup>	Diode Forward Voltage	I <sub>SD</sub> =15A, V <sub>GS</sub> =0V		0.75	1.1	V
t <sub>rr</sub>	Reverse Recovery Time	I <sub>DS</sub> =15A, dI <sub>SD</sub> /dt=100A/μs		11		ns
Q <sub>rr</sub>	Reverse Recovery Charge			3		nC
<b>Gate Charge Characteristics<sup>b</sup></b>						
Q <sub>g</sub>	Total Gate Charge	V <sub>DS</sub> =15V, V <sub>GS</sub> =10V, I <sub>DS</sub> =30A		28	39	nC
Q <sub>gs</sub>	Gate-Source Charge			4		
Q <sub>gd</sub>	Gate-Drain Charge			9		
<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		1.6		Ω
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> =0V, V <sub>DS</sub> =15V, Frequency=1.0MHz		1660		pF
C <sub>oss</sub>	Output Capacitance			260		
C <sub>rss</sub>	Reverse Transfer Capacitance			170		
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		18	33	ns
t <sub>r</sub>	Turn-on Rise Time			15	28	
t <sub>d(OFF)</sub>	Turn-off Delay Time			47	86	
t <sub>f</sub>	Turn-off Fall Time			22	41	

Note :

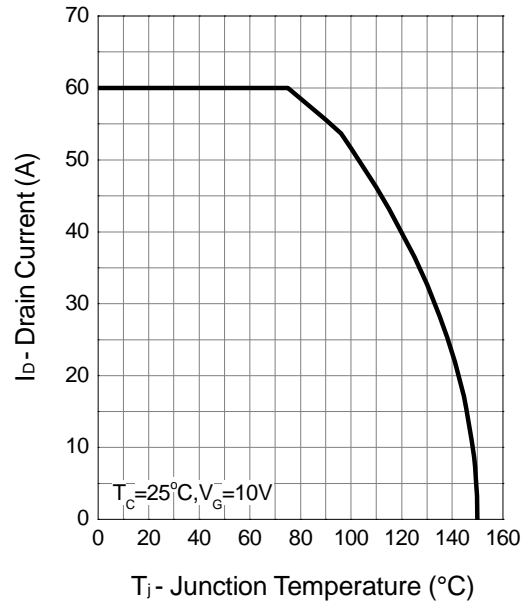
- a : Pulse test ; pulse width≤300μs, duty cycle≤2%.
- b : Guaranteed by design, not subject to production testing.

## Typical Characteristics

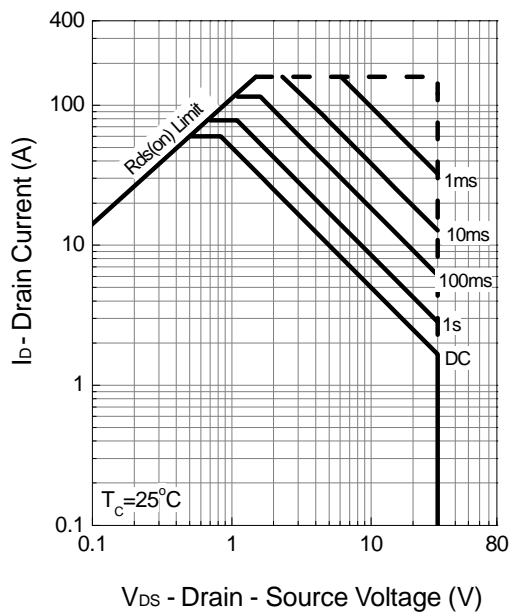
Power Dissipation



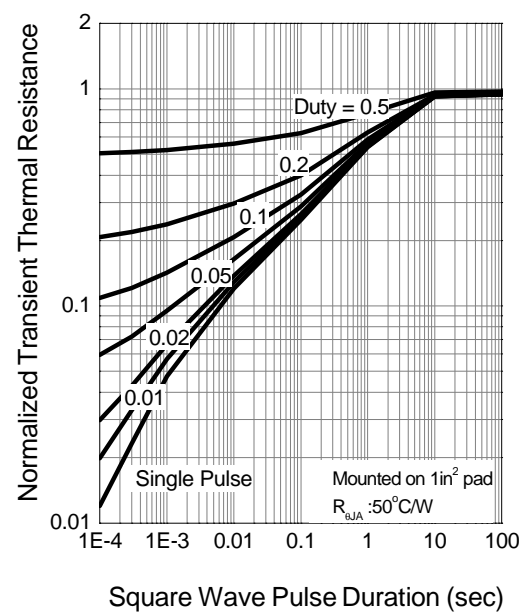
Drain Current



Safe Operation Area

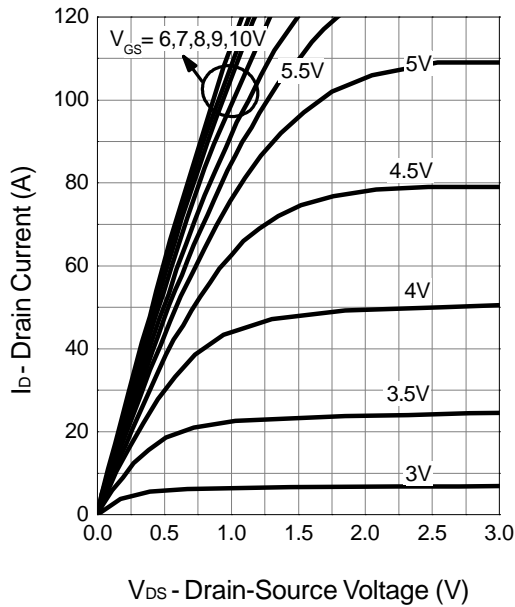


Thermal Transient Impedance

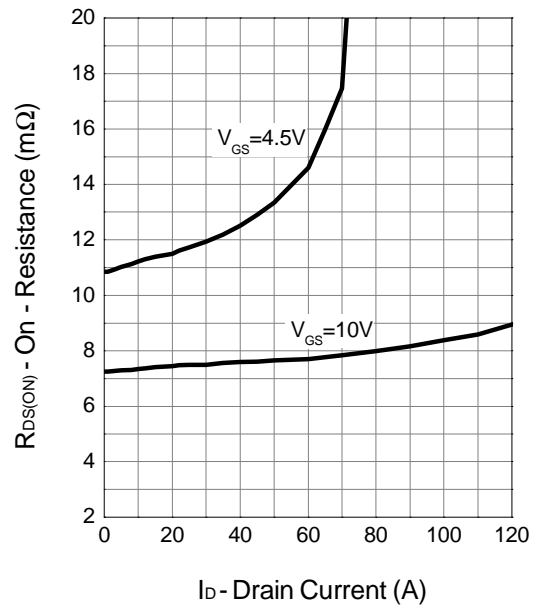


Typical Characteristics (Cont.)

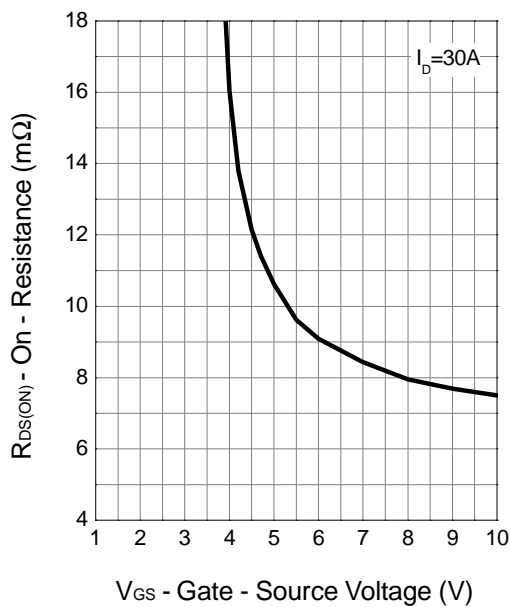
Output Characteristics



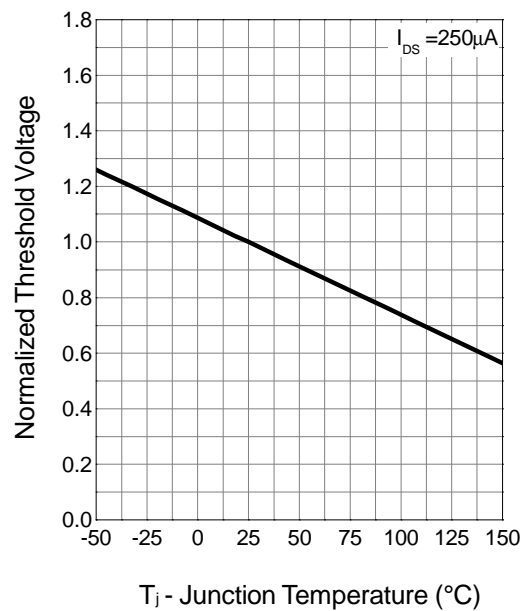
Drain-Source On Resistance



Gate-Source On Resistance

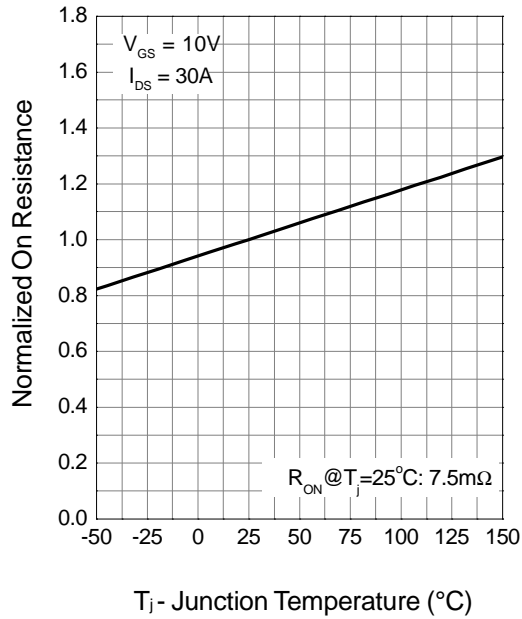


Gate Threshold Voltage

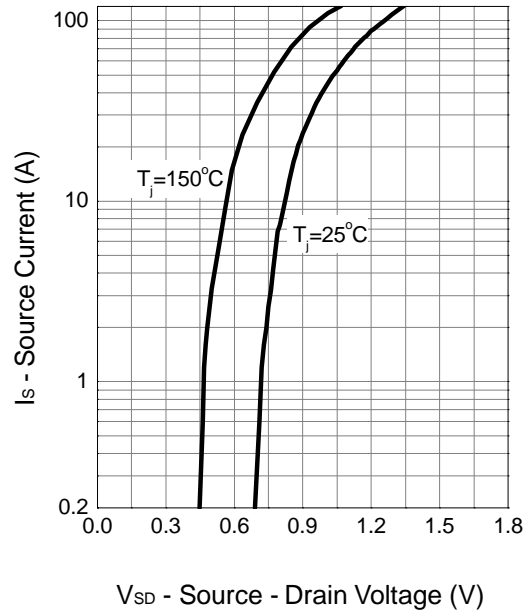


Typical Characteristics (Cont.)

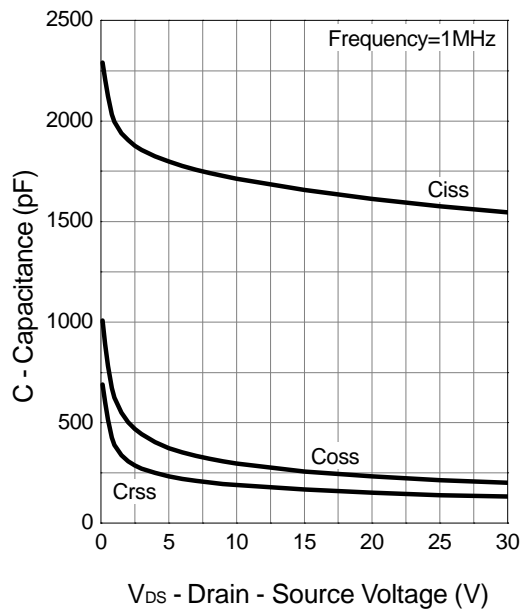
Drain-Source On Resistance



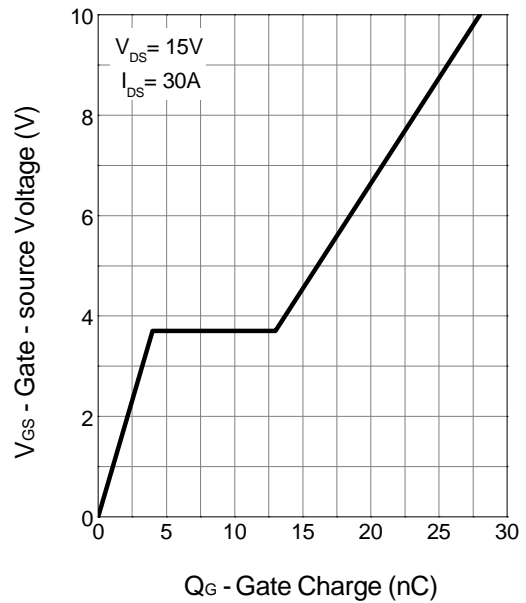
Source-Drain Diode Forward



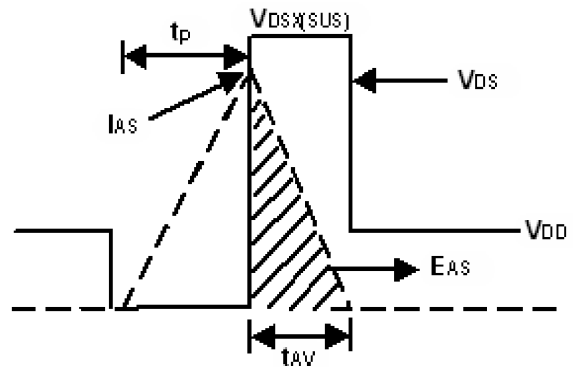
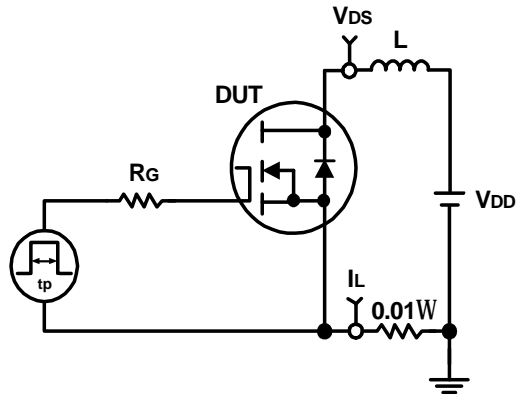
Capacitance



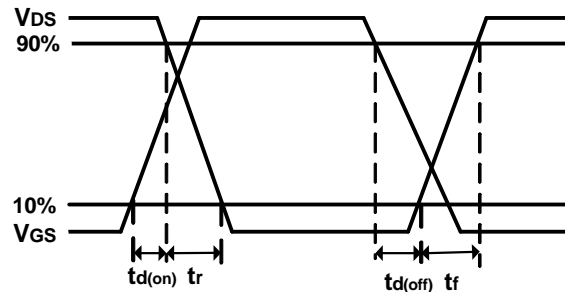
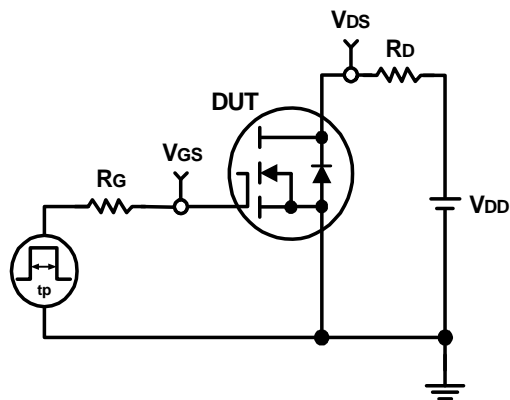
Gate Charge



## Avalanche Test Circuit and Waveforms

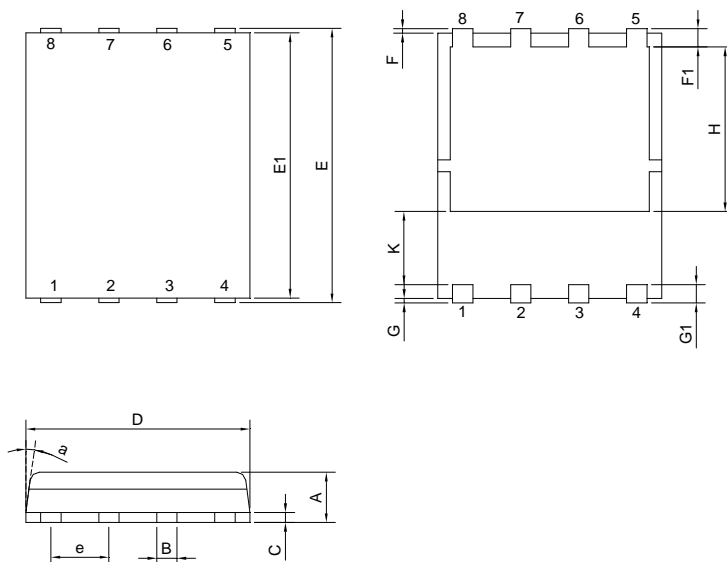


## Switching Time Test Circuit and Waveforms



## Packaging Information

KPAP (Reference JEDEC Registration MS-012)



Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.00	1.20	0.039	0.047
B	0.38	0.51	0.015	0.020
C	0.19	0.25	0.007	0.010
D	4.80	5.00	0.189	0.197
E	5.90	6.10	0.232	0.240
E1	5.696	5.796	0.224	0.228
e	1.27 BSC		0.050 BSC	
F	0.052	0.152	0.002	0.006
F1	0.352	0.452	0.014	0.018
G	0.052	0.152	0.002	0.006
G1	0.352	0.452	0.014	0.018
H	3.491	3.691	0.137	0.145
K	1.60	-	0.063	-
a	0°	12°	0°	12°

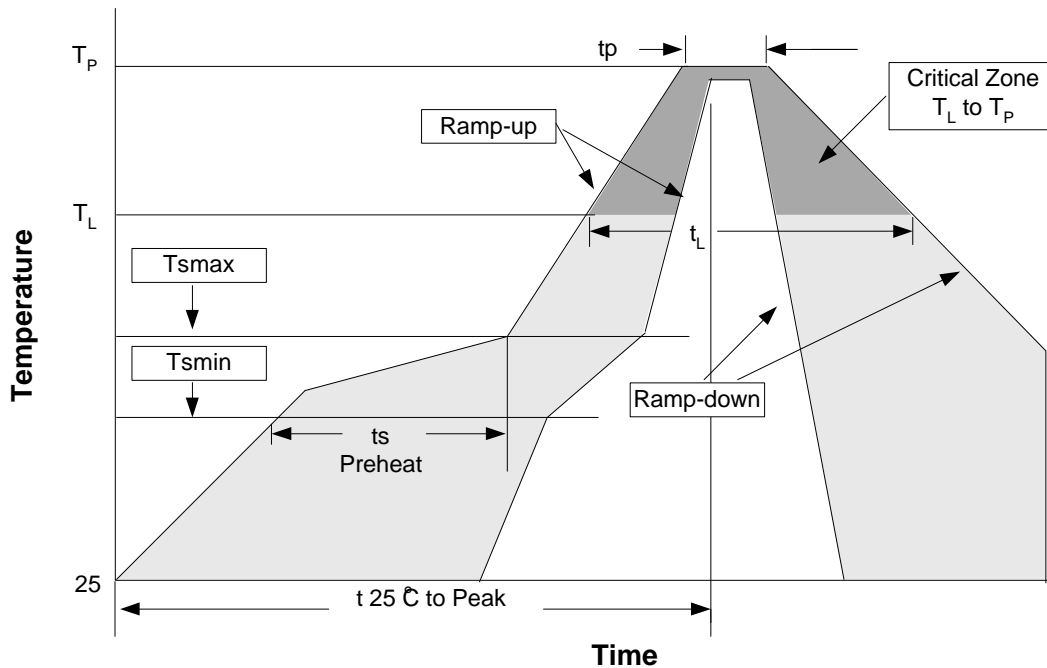
## Physical Specifications

Terminal Material	Solder-Plated Copper (Solder Material : 90/10 or 63/37 SnPb, 100%Sn).
Lead Solderability	Meets EIA Specification RS186-91, 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	
	Large Body	Small Body	Large Body	Small Body
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> ) - Temperature Max (T <sub>smax</sub> ) - Time (min to max) (t <sub>s</sub> )	100°C 150°C 60-120 seconds		150°C 200°C 60-180 seconds	
T <sub>smax</sub> to T <sub>L</sub> - Ramp-up Rate			3°C/second max	
Time maintained above: - Temperature (T <sub>L</sub> ) - Time (t <sub>L</sub> )	183°C 60-150 seconds		217°C 60-150 seconds	
Peak Temperature (T <sub>p</sub> )	225 +0/-5°C	240 +0/-5°C	245 +0/-5°C	250 +0/-5°C
Time within 5°C of actual Peak Temperature (t <sub>p</sub> )	10-30 seconds	10-30 seconds	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.

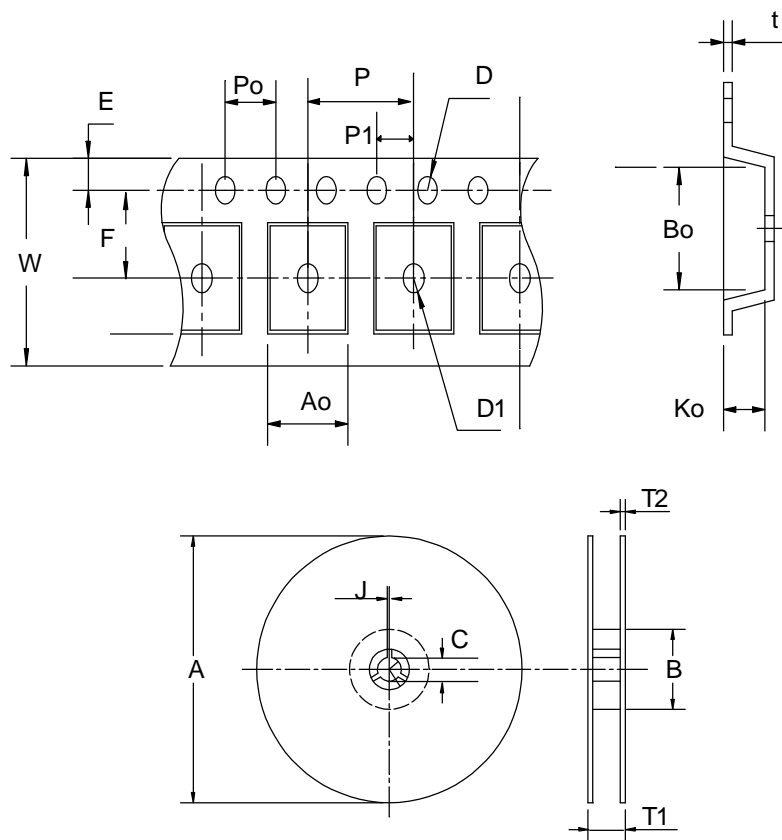
### Package Reflow Conditions

pkg. thickness $\geq$ 2.5mm and all bags	pkg. thickness < 2.5mm and pkg. volume $\geq$ 350mm <sup>3</sup>	pkg. thickness < 2.5mm and pkg. volume < 350mm <sup>3</sup>
Convection 220 +5/-0 C		Convection 235 +5/-0 C
VPR 215-219 C		VPR 235 +5/-0 C
IR/Convection 220 +5/-0 C		IR/Convection 220 +5/-0 C

### 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 & Reel Dimensions



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

Application	A	B	C	J	T1	T2	W	P	E
SOP- 8	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	0.3±0.013

**Cover Tape Dimensions**

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

**Customer Service**

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