

## N-Channel Enhancement Mode MOSFET

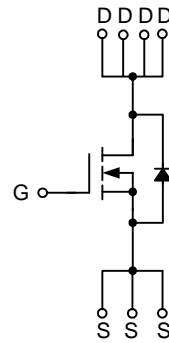
### Features

- 30V/80A,  
 $R_{DS(ON)} = 3.3m\Omega$  (typ.) @  $V_{GS} = 10V$   
 $R_{DS(ON)} = 4.5m\Omega$  (typ.) @  $V_{GS} = 4.5V$
- Super High Dense Cell Design
- Avalanche Rated
- Reliable and Rugged
- Lead Free Available (RoHS Compliant)

### Pin Description



Top View of KPAK




N-Channel

### Applications

- Power Management in Notebook Computer, or Decktop Computer.

### Ordering and Marking Information

<p>APM4356 □□□-□□□</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                  TR : Tape &amp; Reel    TU : Tube</p> <p>Lead Free Code                  L : Lead Free Device</p>
<p>APM4356 KP :</p> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 10px;">  <p style="margin: 0;">APM4356 XXXXX</p> </div>	<p>XXXXX - 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 ( $T_A = 25^\circ\text{C}$ 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	$T_C = 25^\circ\text{C}$ 180	A
		$T_C = 100^\circ\text{C}$ 90	
<b>Mounted on Large Heat Sink</b>			
$I_D$	Continuous Drain Current	$T_C = 25^\circ\text{C}$ 80	A
		$T_C = 100^\circ\text{C}$ 45	
$P_D$	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	$T_A = 25^\circ\text{C}$ 20	A
		$T_A = 100^\circ\text{C}$ 12	
$P_D$	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	$T_A = 25^\circ\text{C}$ 15	A
		$T_A = 100^\circ\text{C}$ 10	
$P_D$	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 ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

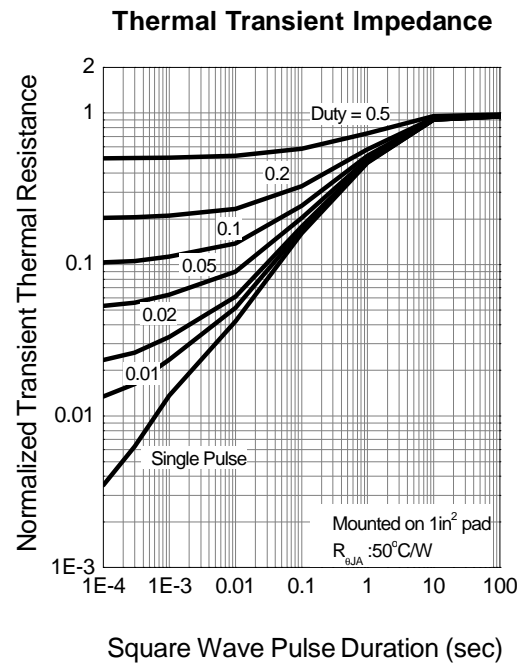
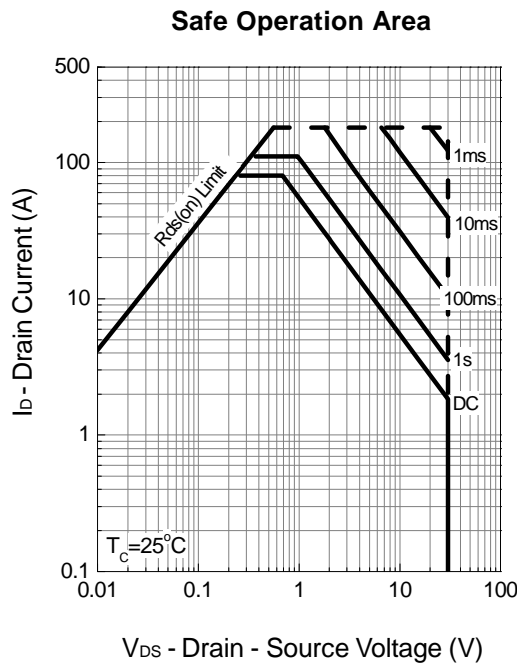
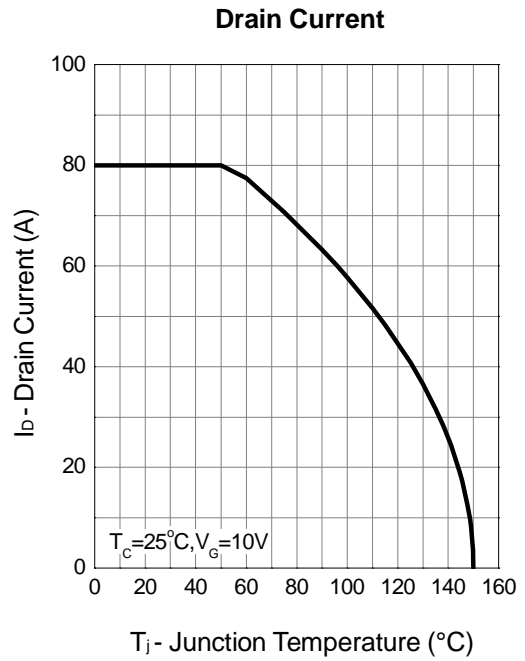
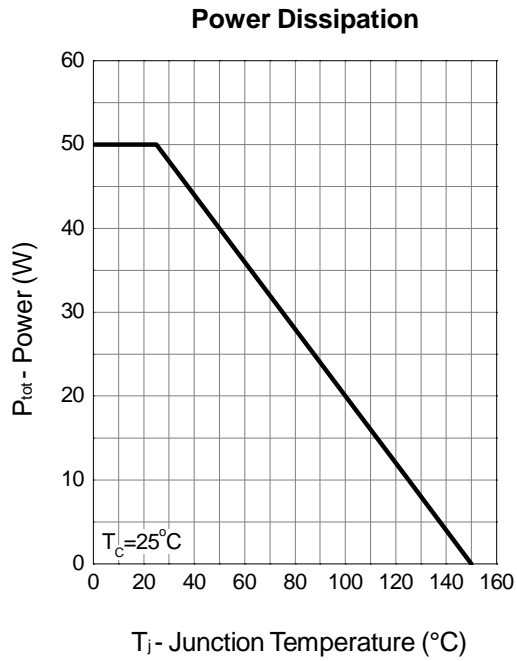
Symbol	Parameter	Test Condition	APM4356KP			Unit
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_{DS}=250\mu A$	30			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=24V, V_{GS}=0V$ $T_J=85^\circ\text{C}$			1	$\mu A$
					30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu A$	1.3	1.8	2.5	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 100$	nA
$R_{DS(ON)}^a$	Drain-Source On-state Resistance	$V_{GS}=10V, I_{DS}=40A$		3.3	4	m $\Omega$
		$V_{GS}=4.5V, I_{DS}=20A$		4.5	5.8	
<b>Diode Characteristics</b>						
$V_{SD}^a$	Diode Forward Voltage	$I_{SD}=20A, V_{GS}=0V$		0.75	1.1	V
$t_{rr}$	Reverse Recovery Time	$I_{DS}=20A, dI_{SD}/dt=100A/\mu s$		54		ns
$Q_{rr}$	Reverse Recovery Charge			30		nC
<b>Gate Charge Characteristics<sup>b</sup></b>						
$Q_g$	Total Gate Charge	$V_{DS}=15V, V_{GS}=10V,$ $I_{DS}=40A$		100	140	nC
$Q_{gs}$	Gate-Source Charge			11		
$Q_{gd}$	Gate-Drain Charge			20		
<b>Dynamic Characteristics<sup>b</sup></b>						
$R_G$	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1\text{MHz}$		1.1		$\Omega$
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=15V,$ Frequency=1.0MHz		5860		pF
$C_{oss}$	Output Capacitance			900		
$C_{rss}$	Reverse Transfer Capacitance			680		
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=15V, R_L=15\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$		27	50	ns
$t_r$	Turn-on Rise Time			20	37	
$t_{d(OFF)}$	Turn-off Delay Time			128	231	
$t_f$	Turn-off Fall Time			58	105	

Note :

a : Pulse test ; pulse width $\leq 300\mu s$ , duty cycle $\leq 2\%$ .

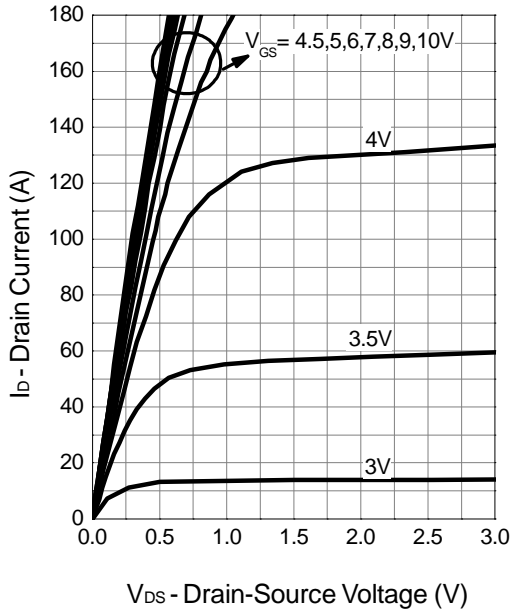
b : Guaranteed by design, not subject to production testing.

Typical Characteristics

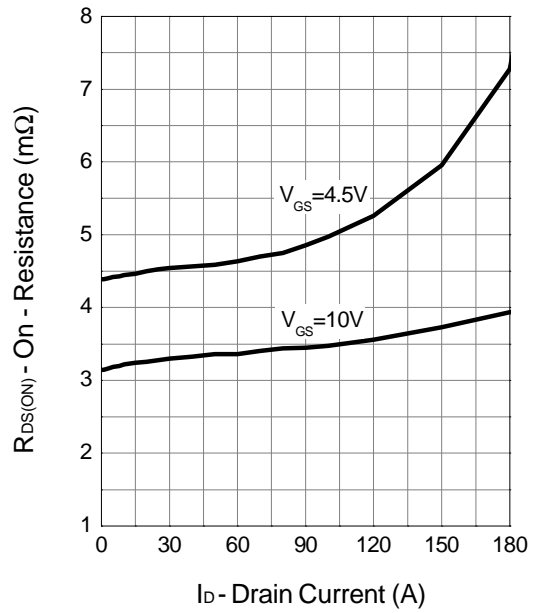


Typical Characteristics (Cont.)

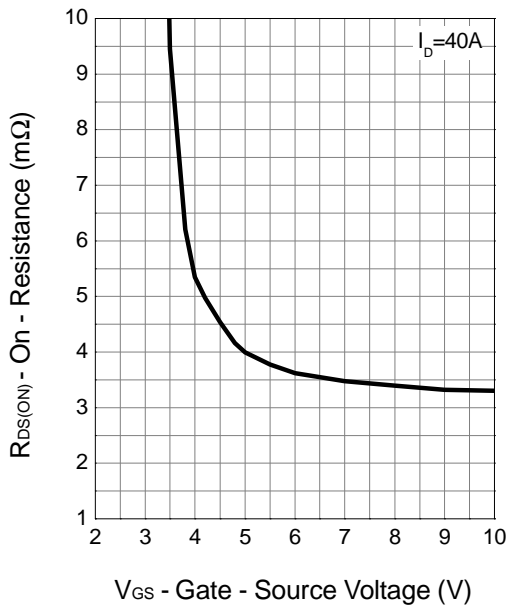
Output Characteristics



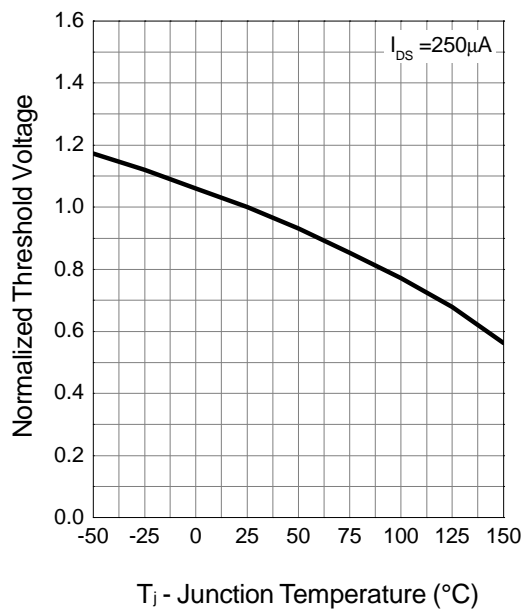
Drain-Source On Resistance



Drain-Source On Resistance

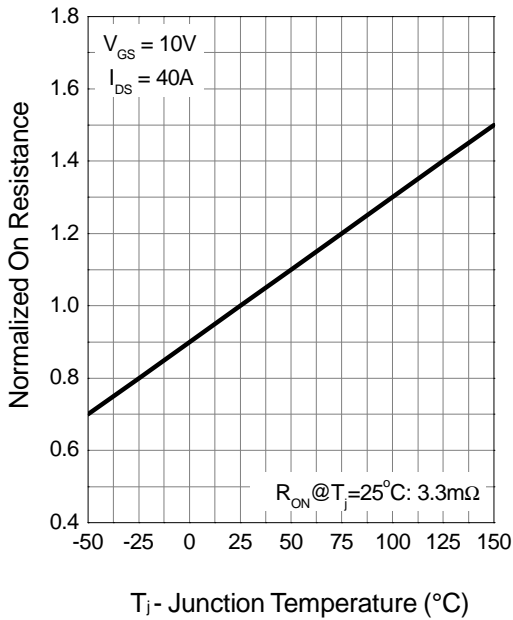


Gate Threshold Voltage

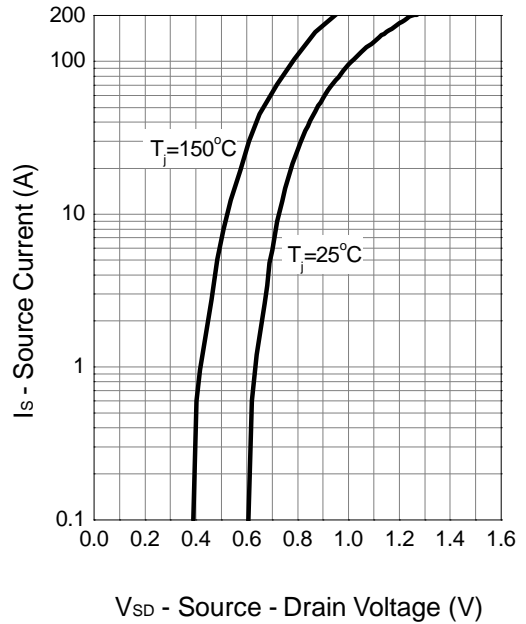


Typical Characteristics (Cont.)

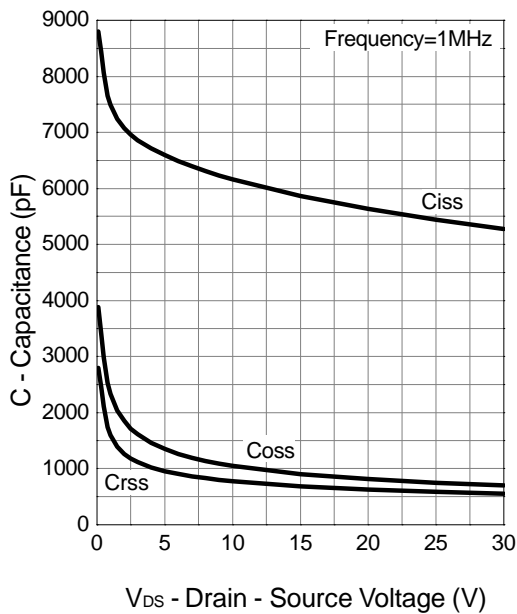
Drain-Source On Resistance



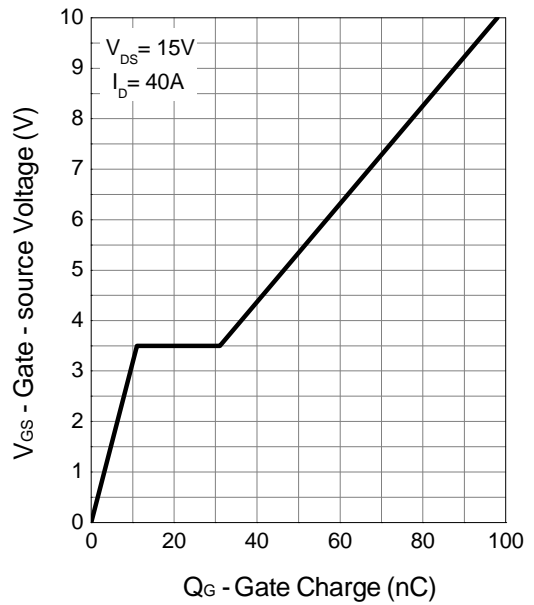
Source-Drain Diode Forward



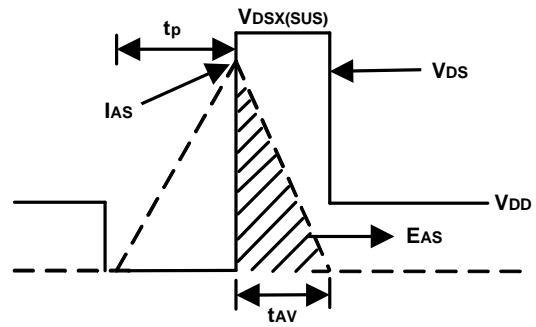
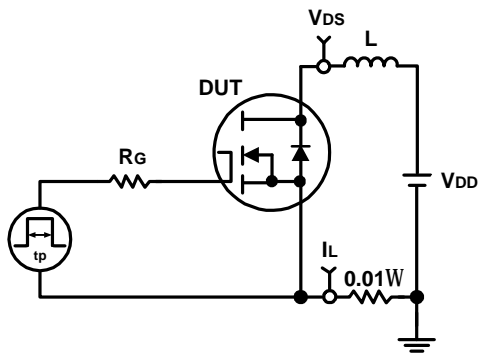
Capacitance



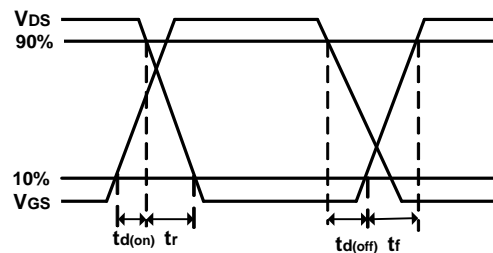
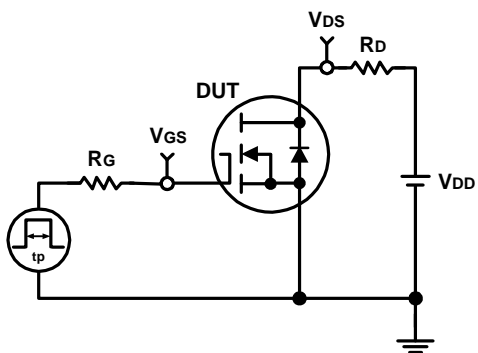
Gate Charge



### Avalanche Test Circuit and Waveforms

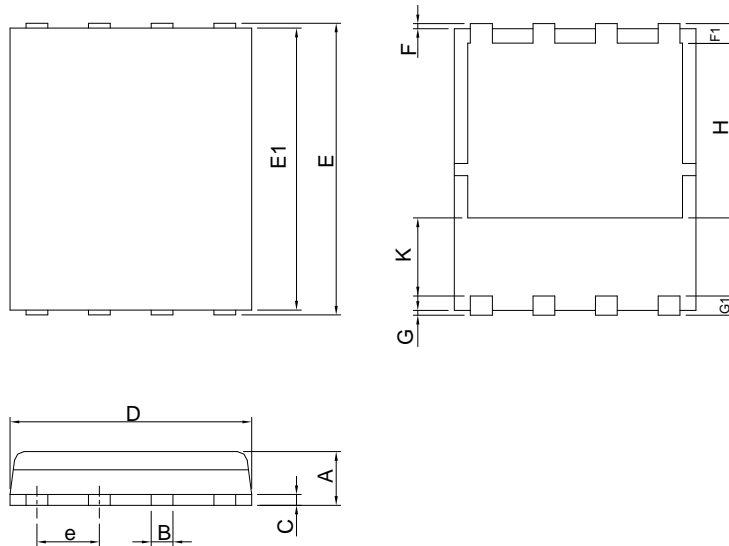


### Switching Time Test Circuit and Waveforms



Package Information

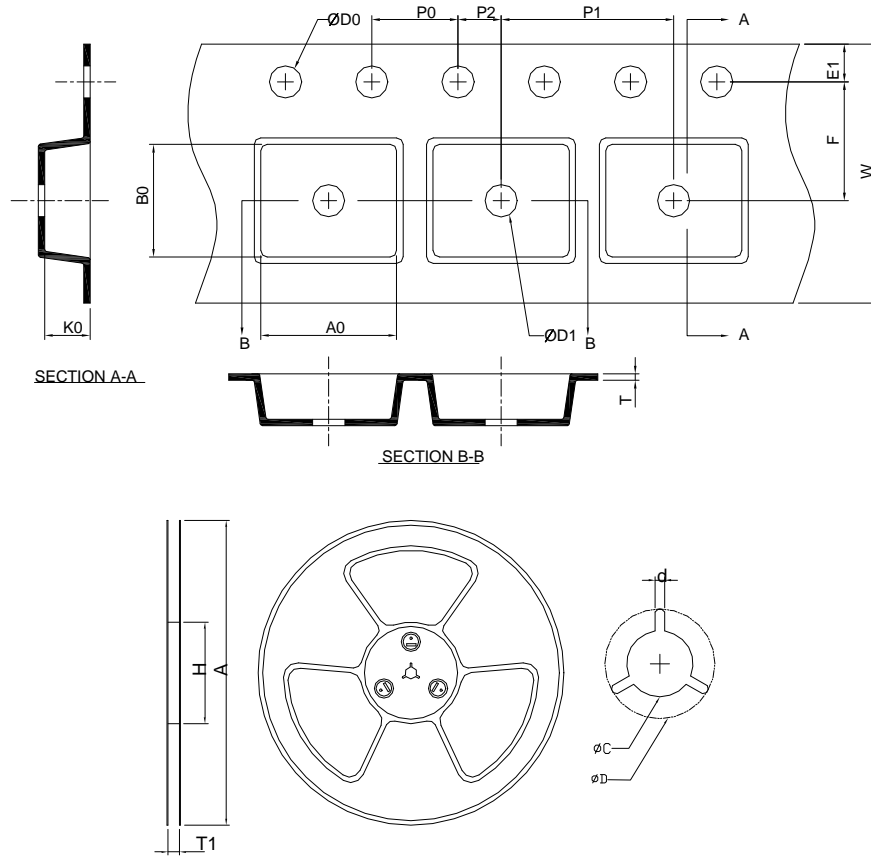
KPAK



SYMBOL	KPAK			
	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	5.70	5.80	0.224	0.228
e	1.27 BSC		0.050 BSC	
F	0.05	0.15	0.002	0.006
F1	0.35	0.45	0.014	0.018
G	0.05	0.15	0.002	0.006
G1	0.35	0.45	0.014	0.018
H	3.49	3.69	0.137	0.145
K	1.60		0.063	



### Carrier Tape & Reel Dimensions



Application	A	H	T1	C	d	D	W	E1	F
KPAK	330.0 ±2.00	50 MIN.	9.2 ±0.10	13.0+0.50 -0.20	1.5 MIN.	20.2 MIN.	12.0 ±0.30	1.75 ±0.10	5.5 ±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	1.5 MIN.	0.3 ±0.05	6.5 ±0.10	5.3 ±0.10	1.4 ±0.10

(mm)

### Devices Per Reel

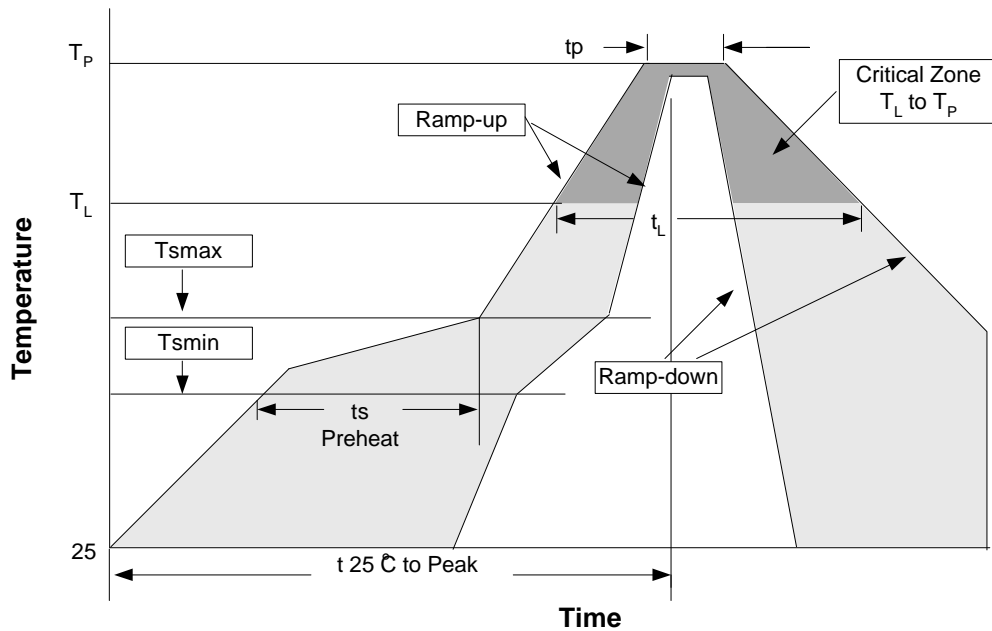
Package Type	Devices Per Reel
KPAK	2500

## 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)

(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		
- Temperature Min ( $T_{smin}$ )	100°C	150°C
- Temperature Max ( $T_{smax}$ )	150°C	200°C
- Time (min to max) ( $t_s$ )	60-120 seconds	60-180 seconds
Time maintained above:		
- Temperature ( $T_L$ )	183°C	217°C
- Time ( $t_L$ )	60-150 seconds	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
ESD	MIL-STD-883D-3015.7	VHBM > 2KV, VMM > 200V
Latch-Up	JESD 78	10ms, 1 <sub>tr</sub> > 100mA

## Customer Service

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