

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

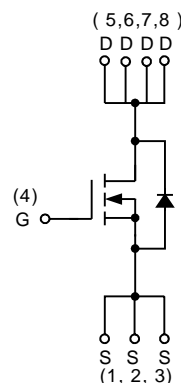


SOP – 8 Exposed

 = 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 □□-□□□</p> <p style="margin-left: 20px;"> □□ : Lead Free Code □□ : Handling Code □□ : Temp. Range □□ : 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 & Reel</p> <p>Lead Free Code L : Lead Free Device Blank : Original Device</p>
<p>APM4220 KA : : APM4220 XXXXX</p>	<p>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

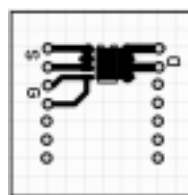
Symbol	Parameter	Rating	Unit	
Common Ratings ($T_A=25^{\circ}\text{C}$ Unless Otherwise Noted)				
V_{DSS}	Drain-Source Voltage	25	V	
V_{GSS}	Gate-Source Voltage	± 20		
T_{J}	Maximum Junction Temperature	150	$^{\circ}\text{C}$	
T_{STG}	Storage Temperature Range	-55 to 150	$^{\circ}\text{C}$	
Mounted on Large Heat Sink				
P_{D}	Maximum Power Dissipation	$T_{\text{C}}=25^{\circ}\text{C}$	50	W
		$T_{\text{C}}=100^{\circ}\text{C}$	20	
$R_{\theta\text{JC}}$	Thermal Resistance-Junction to Case	2.5	$^{\circ}\text{C/W}$	
Mounted on PCB of 1in² Pad Area ^①				
I_{DP}	300 μs Pulse Drain Current Tested	$T_{\text{A}}=25^{\circ}\text{C}$	50	A
		$T_{\text{A}}=100^{\circ}\text{C}$	25	
I_{D}	Continuous Drain Current	$T_{\text{A}}=25^{\circ}\text{C}$	16	A
		$T_{\text{A}}=100^{\circ}\text{C}$	8	
P_{D}	Maximum Power Dissipation	$T_{\text{A}}=25^{\circ}\text{C}$	3	W
		$T_{\text{A}}=100^{\circ}\text{C}$	1.2	
$R_{\theta\text{JA}}$	Thermal Resistance-Junction to Ambient	40	$^{\circ}\text{C/W}$	
Mounted on PCB of Minimum Footprint ^②				
I_{DP}	300 μs Pulse Drain Current Tested	$T_{\text{A}}=25^{\circ}\text{C}$	50	A
		$T_{\text{A}}=100^{\circ}\text{C}$	25	
I_{D}	Continuous Drain Current	$T_{\text{A}}=25^{\circ}\text{C}$	13	A
		$T_{\text{A}}=100^{\circ}\text{C}$	6	
P_{D}	Maximum Power Dissipation	$T_{\text{A}}=25^{\circ}\text{C}$	2.5	W
		$T_{\text{A}}=100^{\circ}\text{C}$	1	
$R_{\theta\text{JA}}$	Thermal Resistance-Junction to Minimum Footprint	50	$^{\circ}\text{C/W}$	

Notes:

①. The value of $R_{\theta\text{JA}}$ is when the device mounted on 1in² pad with 2oz. Copper, $t \leq 10\text{s}$.



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



Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

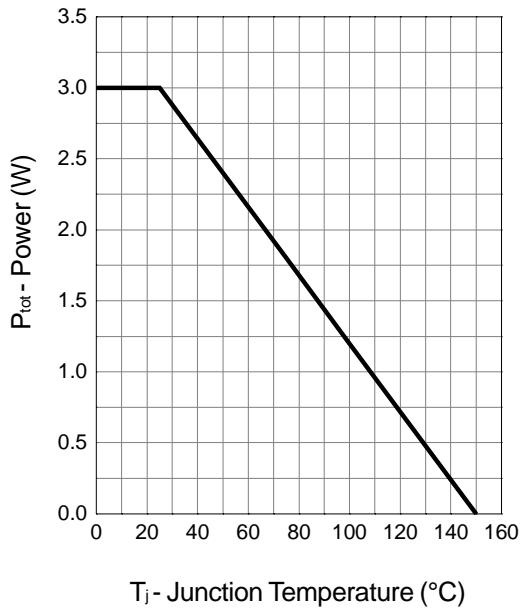
Symbol	Parameter	Test Condition	APM4220KA			Unit
			Min.	Typ.	Max.	
Drain-Source Avalanche Ratings						
E_{AS}	Avalanche Energy, Single Pulsed	$I_D=15\text{A}, V_{DD}=15\text{V}$			50	mJ
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}, I_{DS}=250\mu\text{A}$	25			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=20\text{V}, V_{GS}=0\text{V}$			1	μA
		$V_{DS}=20\text{V}, V_{GS}=0\text{V}$ $T_A=25^\circ\text{C}$			30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$	1.3	1.8	2.5	V
I_{GSS}	Gate Leakage Current	$V_{GS}=\pm 20\text{V}, V_{DS}=0\text{V}$			± 100	nA
$R_{DS(ON)}^a$	Drain-Source On-state Resistance	$V_{GS}=10\text{V}, I_{DS}=16\text{A}$		7.5	9	m Ω
		$V_{GS}=4.5\text{V}, I_{DS}=14\text{A}$		10	12	
V_{SD}^a	Diode Forward Voltage	$I_{SD}=3\text{A}, V_{GS}=0\text{V}$		0.8	1.3	V
Gate Charge Characteristics^b						
Q_g	Total Gate Charge	$V_{DS}=10\text{V}, V_{GS}=4.5\text{V}, I_{DS}=12\text{A}$		20	26	nC
Q_{gs}	Gate-Source Charge			4.8		
Q_{gd}	Gate-Drain Charge			8.4		
Dynamic Characteristics^b						
R_G	Gate Resistance	$V_{GS}=0\text{V}, V_{DS}=0\text{V}, f=1\text{MHz}$		2		Ω
C_{iss}	Input Capacitance	$V_{GS}=0\text{V}, V_{DS}=15\text{V},$ Frequency=1.0MHz		1785		pF
C_{oss}	Output Capacitance			500		
C_{rss}	Reverse Transfer Capacitance			300		
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=15\text{V}, R_L=15\Omega,$ $I_{DS}=1\text{A}, V_{GEN}=10\text{V},$ $R_G=6\Omega$		10	19	ns
T_r	Turn-on Rise Time			7	13	
$t_{d(OFF)}$	Turn-off Delay Time			69	95	
T_f	Turn-off Fall Time			32	46	

Notes:

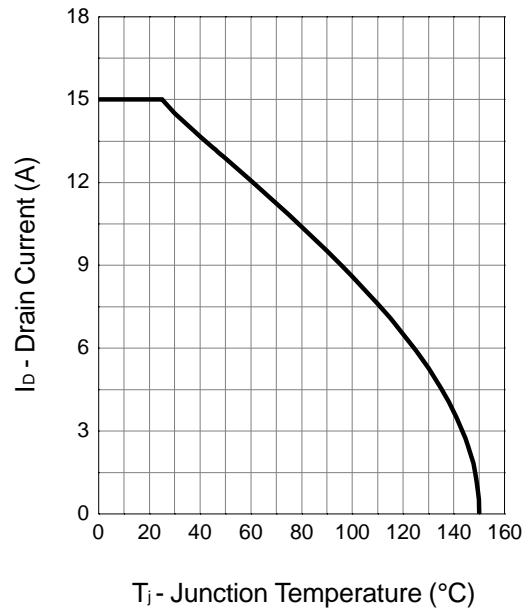
- a: Pulse test ; pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.
- b: Guaranteed by design, not subject to production testing.

Typical Characteristics

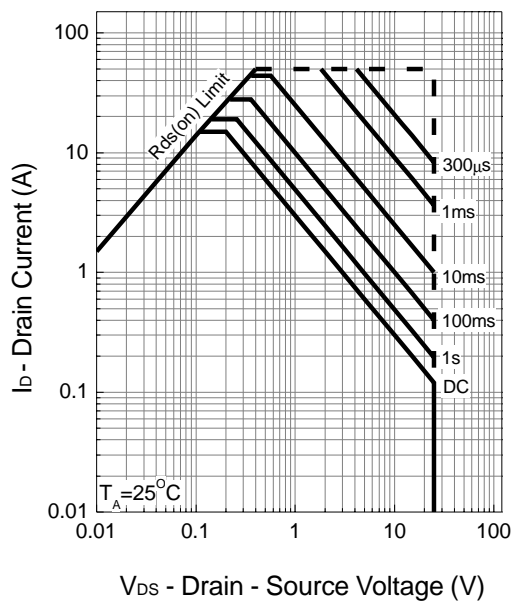
Power Dissipation



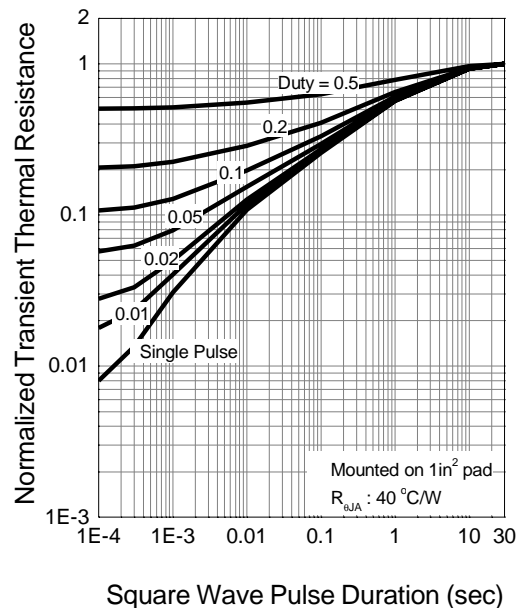
Drain Current



Safe Operation Area

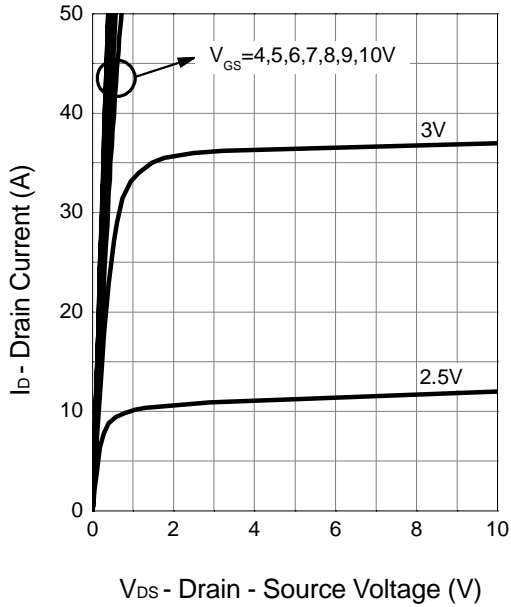


Thermal Transient Impedance

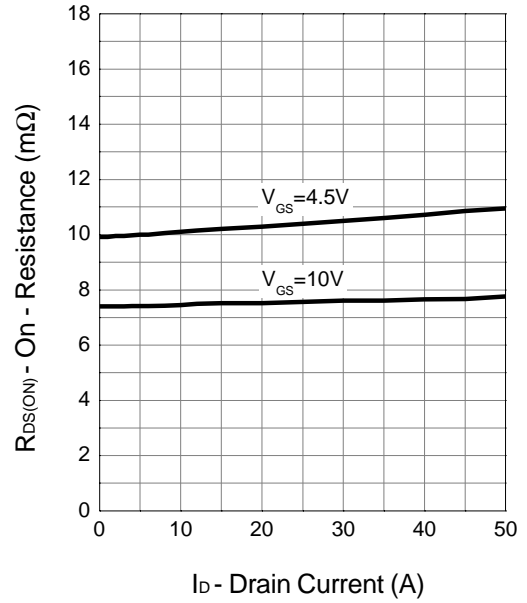


Typical Characteristics (Cont.)

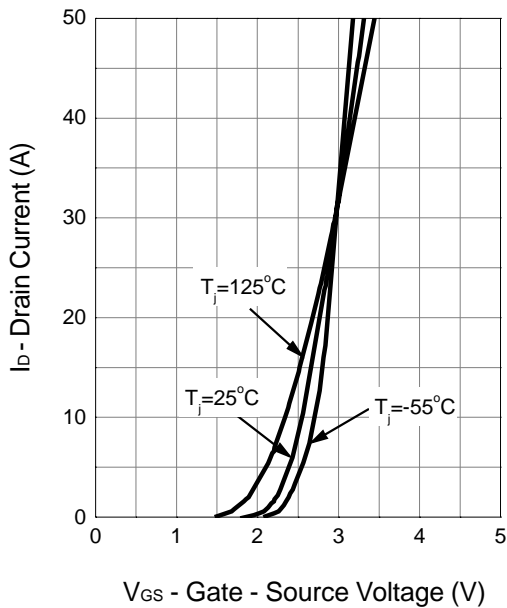
Output Characteristics



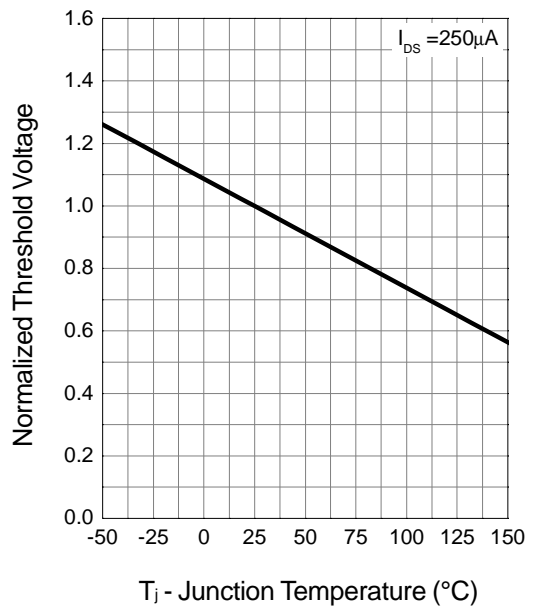
Drain-Source On Resistance



Transfer Characteristics

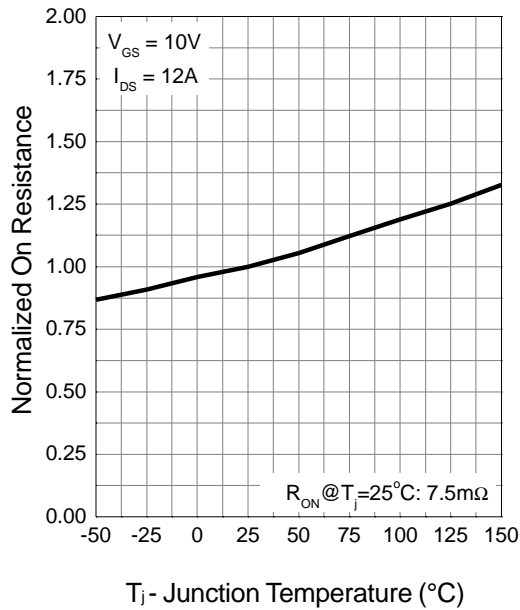


Gate Threshold Voltage

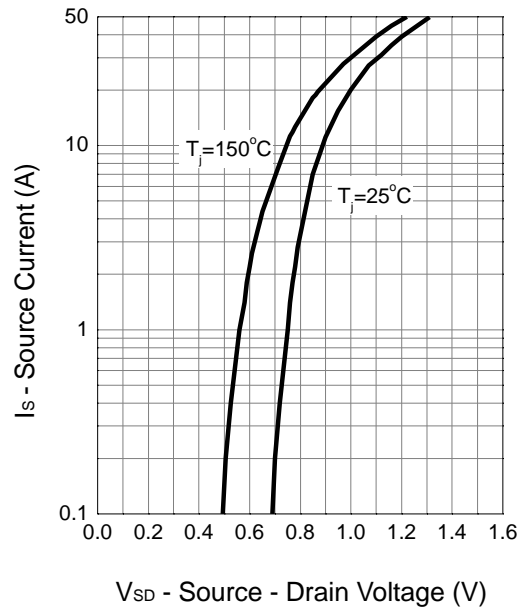


Typical Characteristics (Cont.)

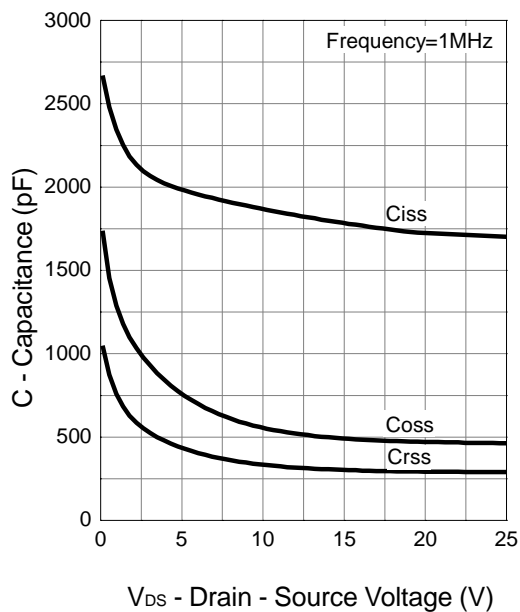
Drain-Source On Resistance



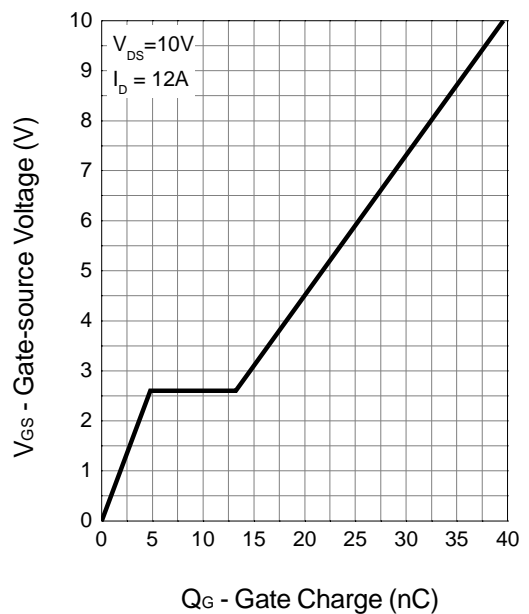
Source-Drain Diode Forward



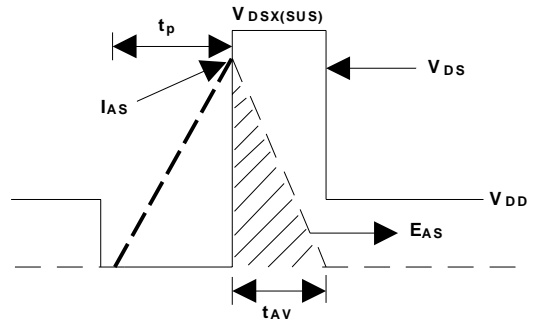
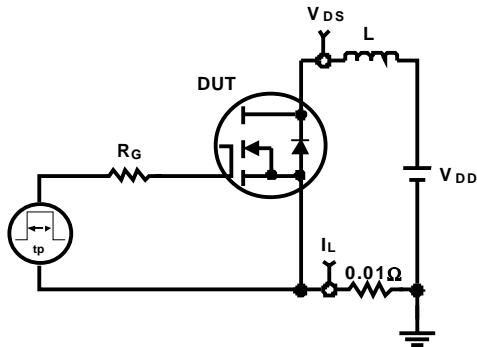
Capacitance



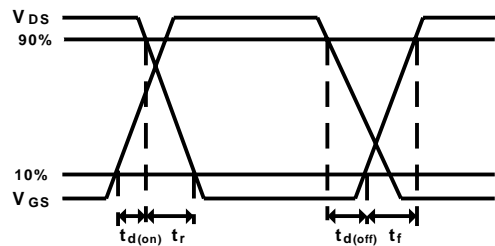
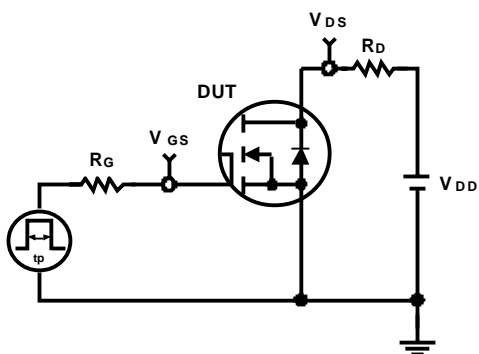
Gate Charge



Avalanche Test Circuit and Waveforms

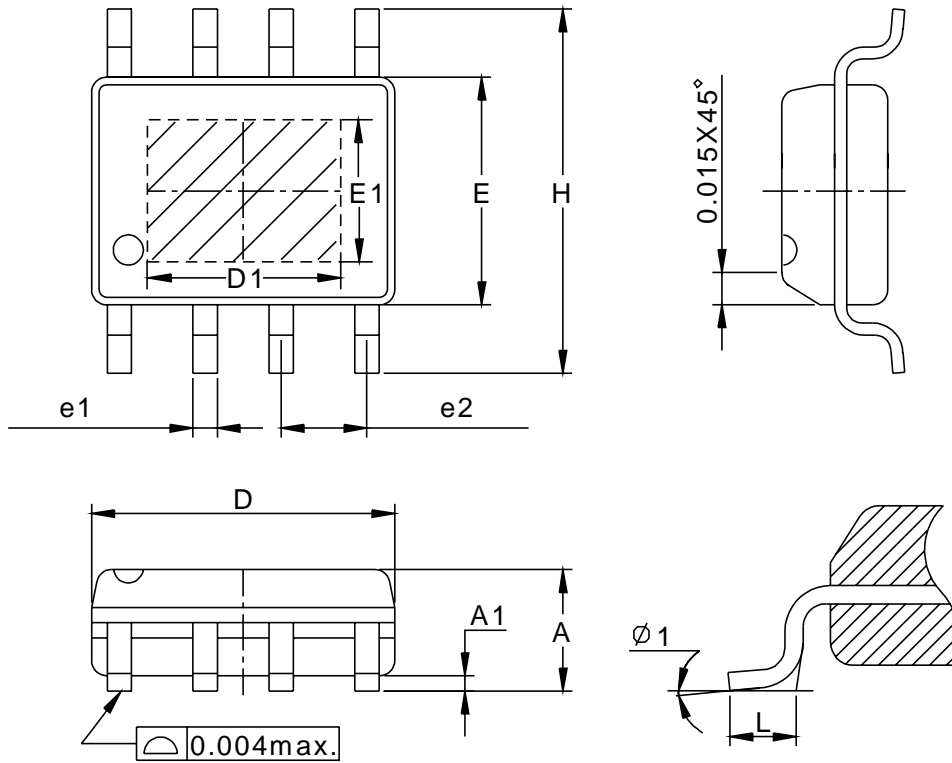


Switching Time Test Circuit and Waveforms



Packaging Information

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



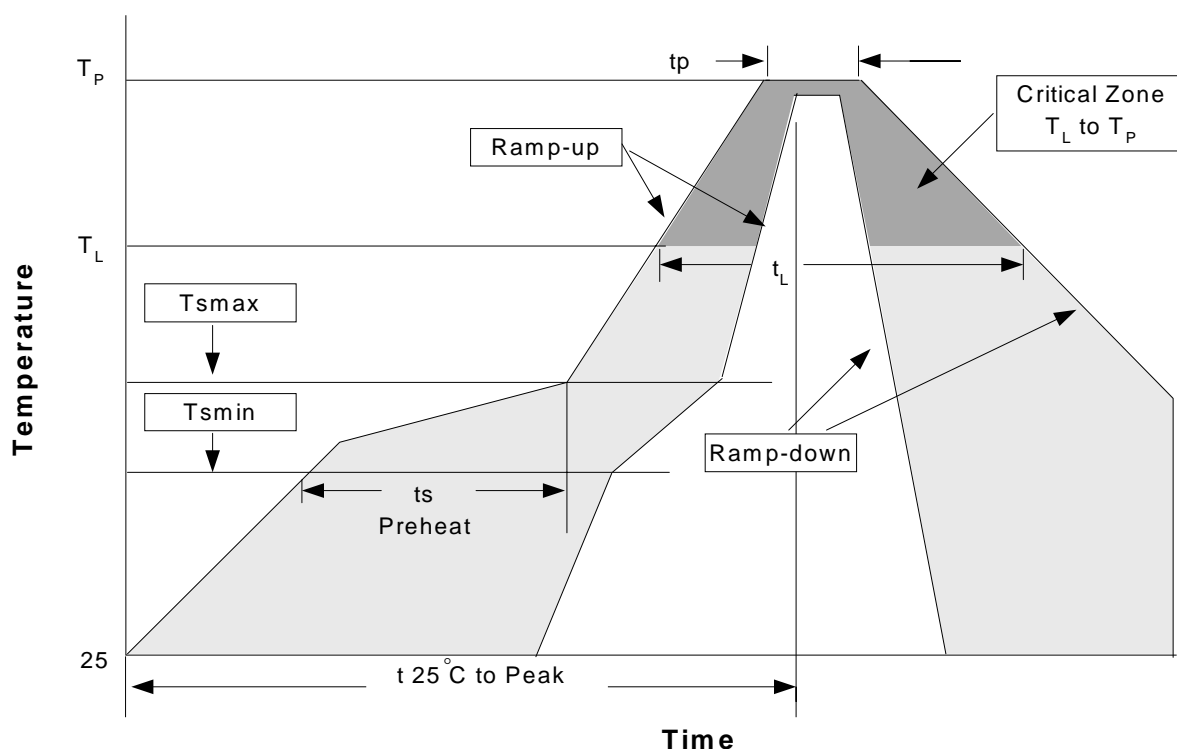
Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.80	5.00	0.189	0.197
D1*	3.34	3.84	0.132	0.151
E	3.80	4.00	0.150	0.157
E1*	2.23	2.68	0.088	0.106
H	5.80	6.20	0.228	0.244
L	0.40	1.27	0.016	0.050
e1	0.33	0.51	0.013	0.020
e2	1.27BSC		0.50BSC	
φ 1	8°		8°	

* 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"> - Temperature Min (T_{smin}) - Temperature Max (T_{smax}) - Time (min to max) (t_s) 	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: <ul style="list-style-type: none"> - Temperature (T_L) - Time (t_L) 	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 ³ <350	Volume mm ³ ≥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

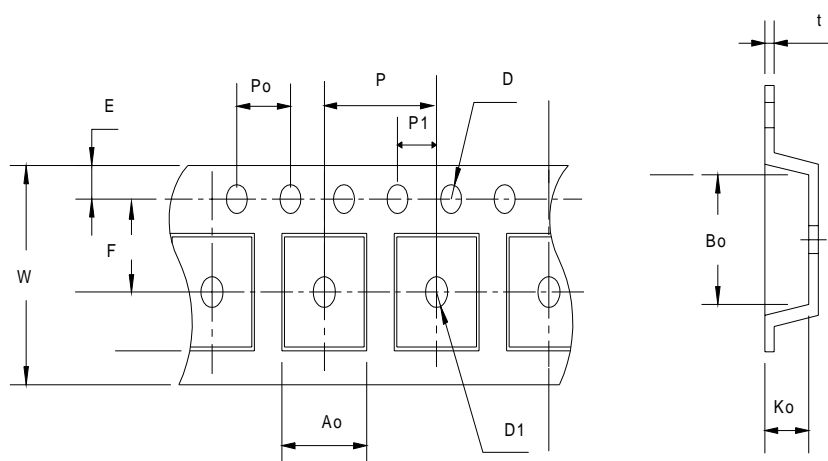
Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

*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.

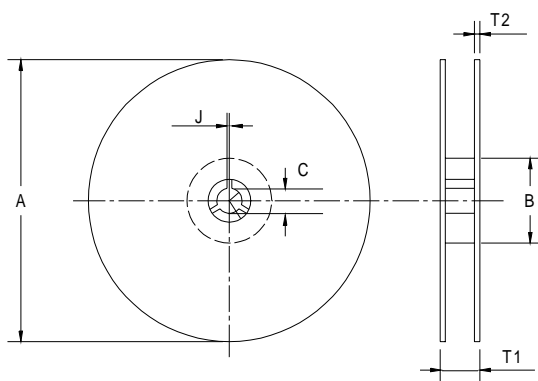
Reliability Test Program

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	$.3 \pm 0.013$

(mm)

Cover Tape Dimensions

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

Customer Service

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