

## P-Channel Enhancement Mode MOSFET with Schottky Diode

### Features

#### MOSFET

- 20V/-1.5A ,  
 $R_{DS(ON)}=145m\Omega(\text{typ.}) @ V_{GS}=-4.5V$   
 $R_{DS(ON)}=180m\Omega(\text{typ.}) @ V_{GS}=-2.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free Available (RoHS Compliant)

#### SBD

- Low Forward Voltage

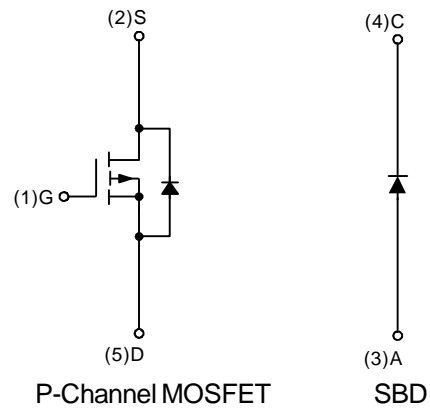
### Applications

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

### Pin Description



Top View of SOT-25



### Ordering and Marking Information

<p>APM2801 <span style="font-family: monospace;">□□-□□□</span></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 B : SOT-25</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>APM2801B :    <span style="border: 1px solid black; padding: 2px 5px;">M81X</span></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 $(T_A = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Rating	Unit	
<b>[MOSFET]</b>				
$V_{DSS}$	Drain-Source Voltage	-20	V	
$V_{GSS}$	Gate-Source Voltage	$\pm 10$		
$I_D$	Continuous Drain Current	$V_{GS} = -4.5\text{V}$	A	
$I_{DM}$	300 $\mu\text{s}$ Pulsed Drain Current			-1.5
$I_S$	Diode Continuous Forward Current	-1	A	
$T_J$	Maximum Junction Temperature	150	$^\circ\text{C}$	
$T_{STG}$	Storage Temperature Range	-55 to 150		
$P_D$	Maximum Power Dissipation	$T_A = 25^\circ\text{C}$	0.83	W
		$T_A = 100^\circ\text{C}$	0.3	
$R_{\theta JA}^*$	Thermal Resistance-Junction to Ambient	150	$^\circ\text{C/W}$	
<b>[SBD]</b>				
$V_{RRM}$	Repetitive Peak Reverse Voltage	20	V	
$I_{FSM}$	Maximum Peak Forward Surge Current	5.5	A	

Note:

\*Surface Mounted on 1in2 pad area,  $t \leq 10\text{sec.}$

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

Symbol	Parameter	Test Condition	APM2801B			Unit
			Min.	Typ.	Max.	
<b>[MOSFET]</b>						
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{V}, I_{DS} = -250\mu\text{A}$	-20			V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -16\text{V}, V_{GS} = 0\text{V}$ $T_J = 85^\circ\text{C}$			-1	$\mu\text{A}$
					-30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_{DS} = -250\mu\text{A}$	-0.45	-0.6	-1	V
$I_{GSS}$	Gate Leakage Current	$V_{GS} = \pm 10\text{V}, V_{DS} = 0\text{V}$			$\pm 100$	nA
$R_{DS(ON)}^a$	Drain-Source On-state Resistance	$V_{GS} = -4.5\text{V}, I_{DS} = -1.5\text{A}$		145	190	m $\Omega$
		$V_{GS} = -2.5\text{V}, I_{DS} = -1\text{A}$		180	235	
$V_{SD}^a$	Diode Forward Voltage	$I_{SD} = -0.5\text{A}, V_{GS} = 0\text{V}$		-0.7	-1.3	V

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

Symbol	Parameter	Test Condition	APM2801B			Unit
			Min.	Typ.	Max.	
<b>[MOSFET]</b>						
<b>Dynamic Characteristics<sup>b</sup></b>						
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=-20V,$ Frequency=1.0MHz		255		pF
$C_{oss}$	Output Capacitance			70		
$C_{rss}$	Reverse Transfer Capacitance			45		
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=-10V, R_L=10\Omega,$ $I_{DS}=-1A, V_{GEN}=-4.5V,$ $R_G=6\Omega$		6	10	ns
$T_r$	Turn-on Rise Time			8	12	
$t_{d(OFF)}$	Turn-off Delay Time			9.8	15	
$T_f$	Turn-off Fall Time			5	10	
<b>Gate Charge Characteristics<sup>b</sup></b>						
$Q_g$	Total Gate Charge	$V_{DS}=-10V, V_{GS}=-4.5V,$ $I_{DS}=-1.5A$		4	6	nC
$Q_{gs}$	Gate-Source Charge			0.6		
$Q_{gd}$	Gate-Drain Charge			0.7		
<b>[SBD]</b>						
$V_R$	Reverse Voltage	$I_R=0.5mA$	20			V
$V_{F1}$	Forward Voltage	$I_F=10mA$			0.4	V
$V_{F2}$		$I_F=500mA$			0.5	V
$I_R$	Reverse Current	$V_R=15V$			200	$\mu A$
$C^b$	Junction Capacitance	$V_R=10V,$ Frequency=1.0MHz		45		pF

**Notes:**

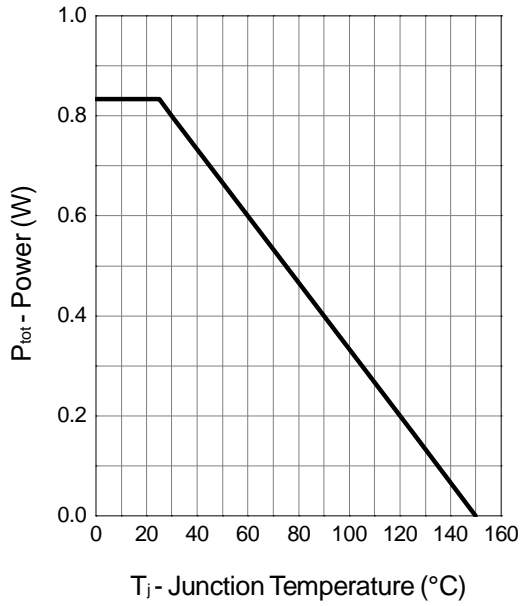
a : Pulse test ; pulse width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ .

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

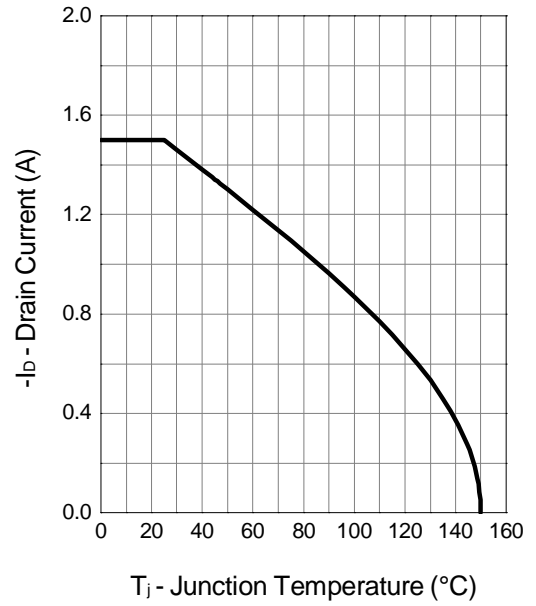
## Typical Characteristics

### P-Channel MOSFET

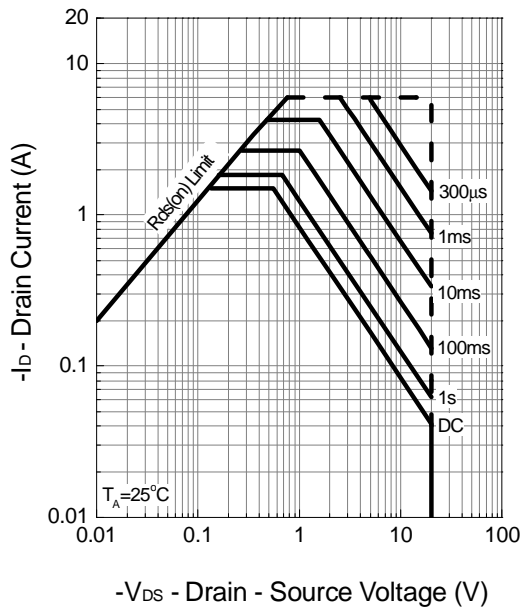
Power Dissipation



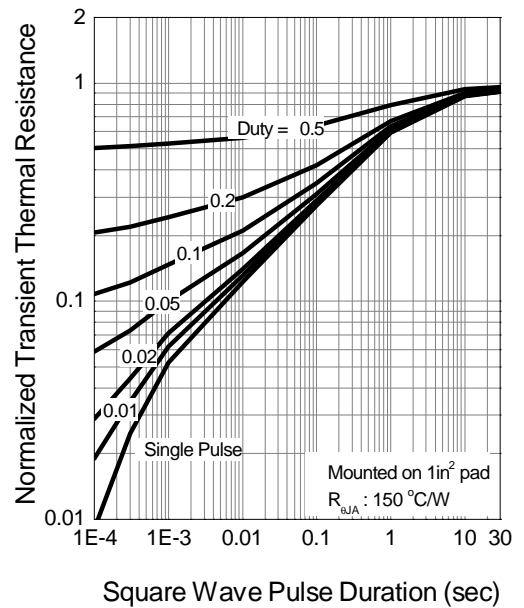
Drain Current



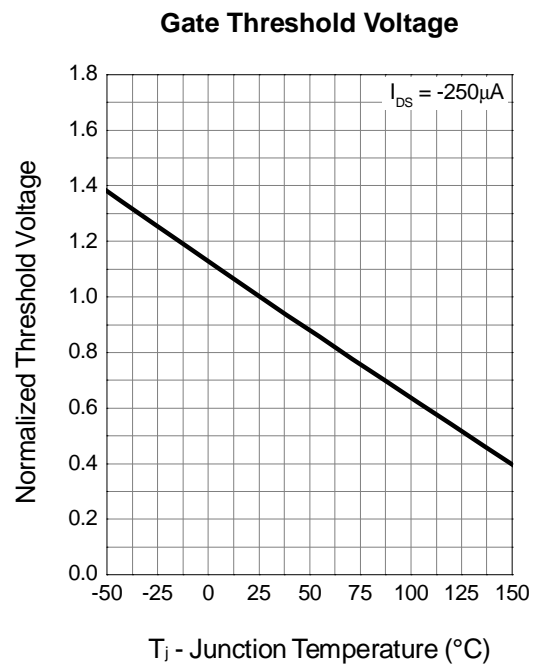
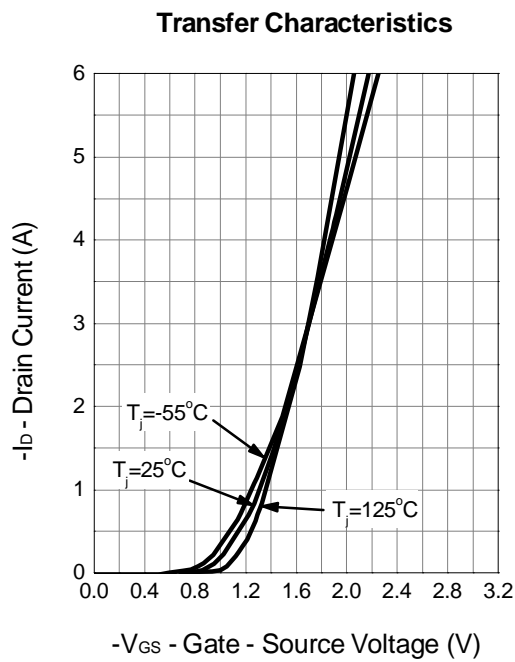
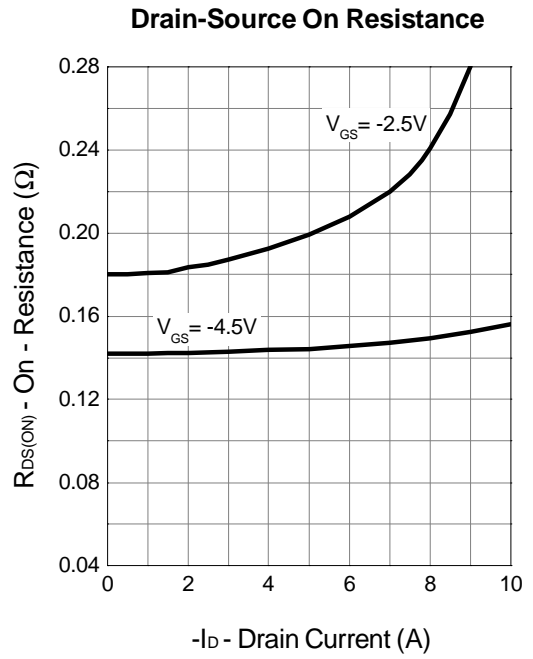
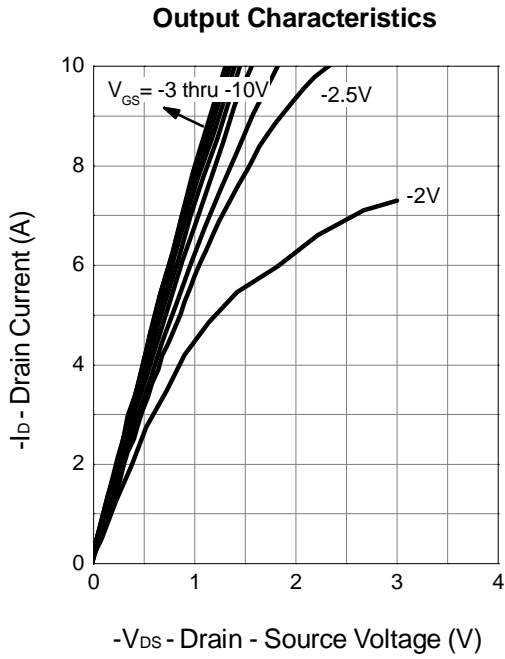
Safe Operation Area



Thermal Transient Impedance

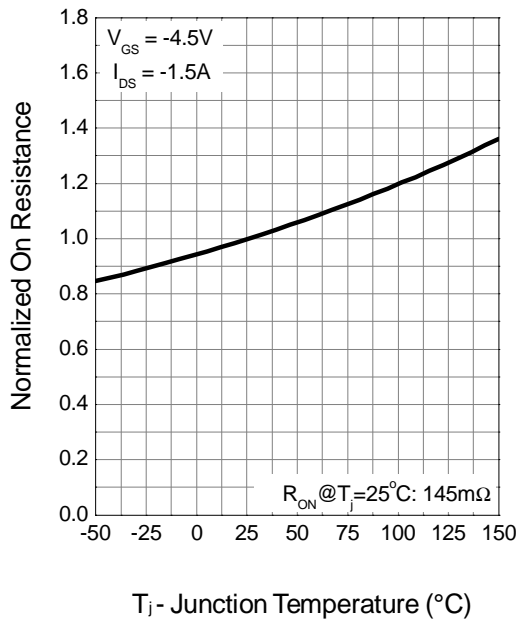


Typical Characteristics (Cont.)

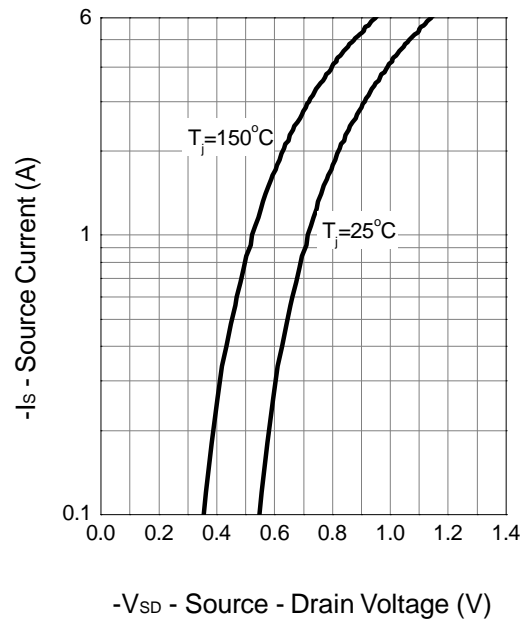


Typical Characteristics (Cont.)

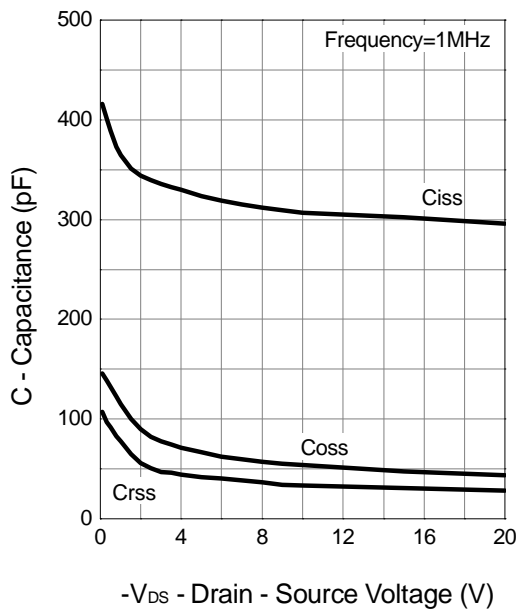
Drain-Source On Resistance



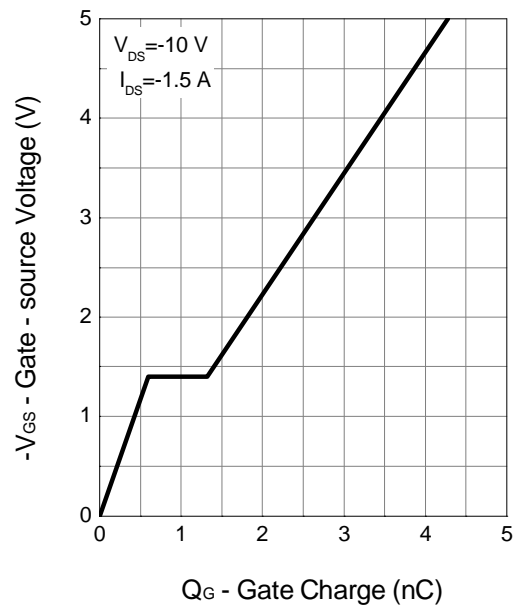
Source-Drain Diode Forward



Capacitance

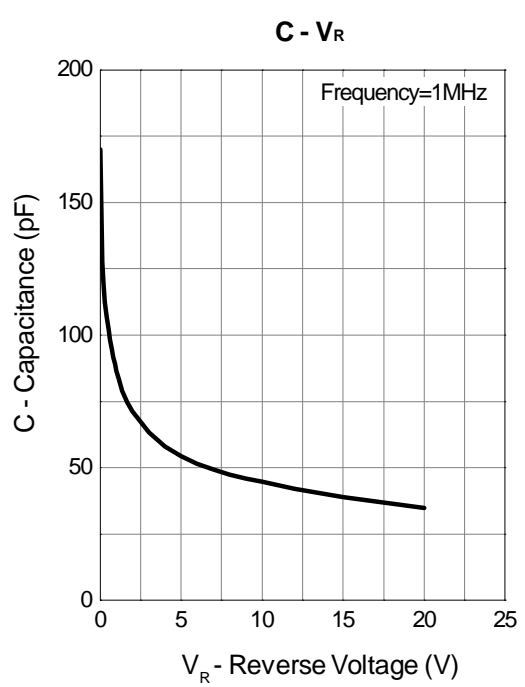
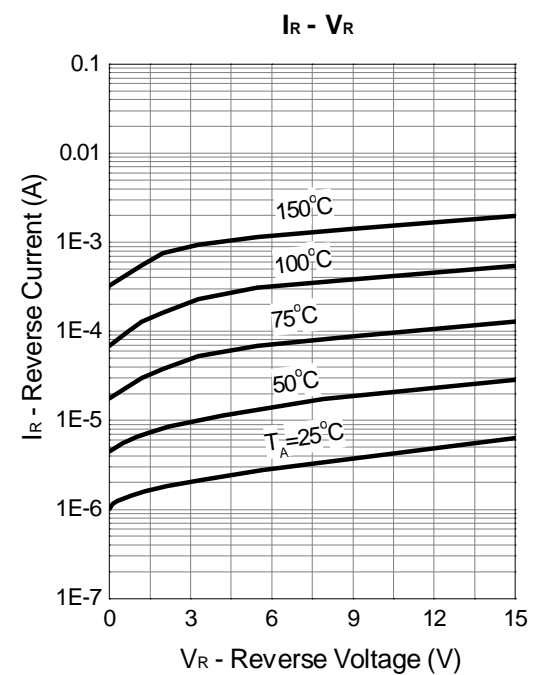
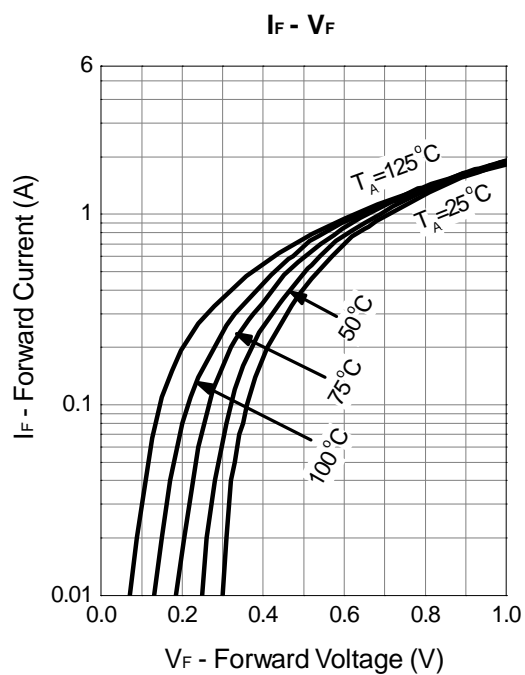


Gate Charge



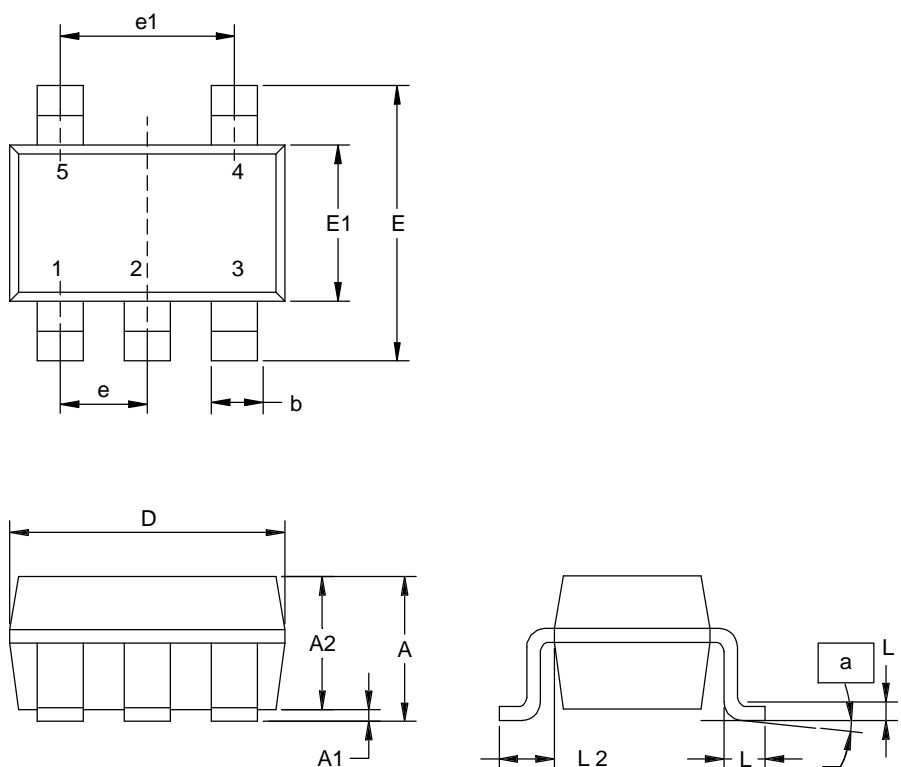
Typical Characteristics (Cont.)

SBD



## Packaging Information

SOT-23-5



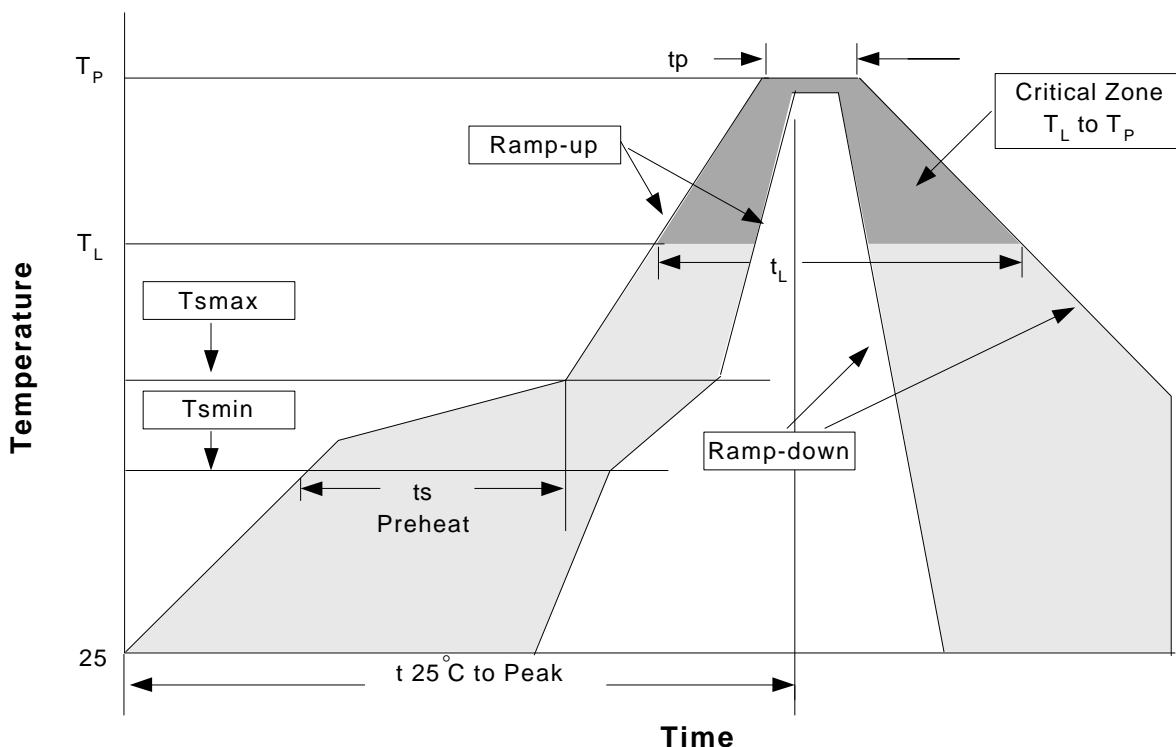
Dim	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.95	1.45	0.037	0.057
A1	0.05	0.15	0.002	0.006
A2	0.90	1.30	0.035	0.051
b	0.30	0.50	0.011	0.019
D	2.8	3.00	0.110	0.118
E	2.6	3.00	0.102	0.118
E1	1.5	1.70	0.059	0.067
e	0.95BSC		0.037BSC	
e1	1.90BSC		0.074BSC	
L	0.35	0.55	0.014	0.022
L1	0.20 BSC		0.008 BSC	
L2	0.5	0.7	0.020	0.028
N	5		5	
$\alpha$	0°	10°	0°	10°



## 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

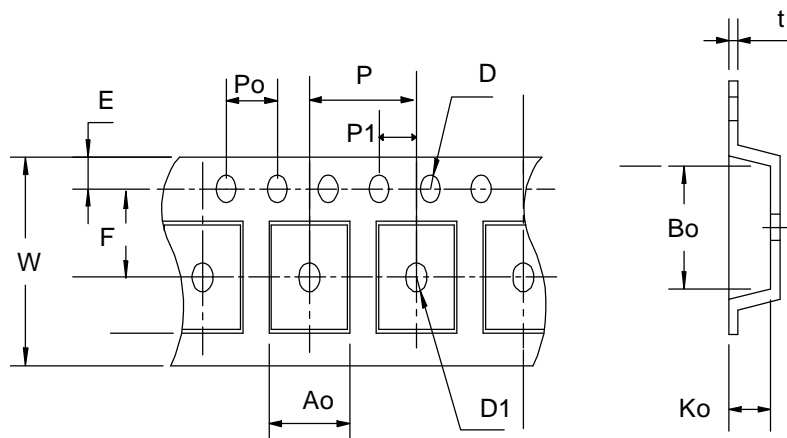
Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 +0°C*	260 +0°C*	260 +0°C*
1.6 mm – 2.5 mm	260 +0°C*	250 +0°C*	245 +0°C*
≥2.5 mm	250 +0°C*	245 +0°C*	245 +0°C*

\*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.

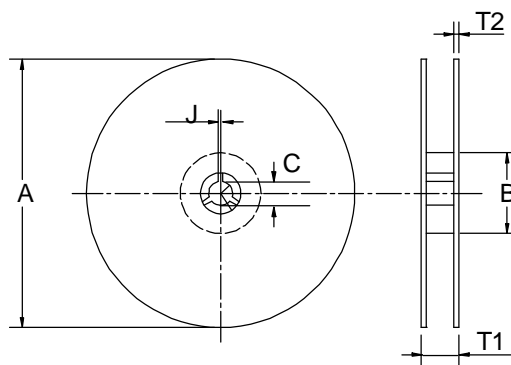
## Reliability Test Program

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 & Reel Dimensions



Carrier Tape & Reel Dimensions (Cont.)



Application	A	B	C	J	T1	T2	W	P	E
SOT-23-5	178±1	72 ± 1.0	13.0 + 0.2	2.5 ± 0.15	8.4 ± 2	1.5± 0.3	8.0+ 0.3 -0.3	4 ± 0.1	1.75± 0.1
	F	D	D1	Po	P1	Ao	Bo	Ko	t
	3.5 ± 0.05	1.5 +0.1	1.5 +0.1	4.0 ± 0.1	2.0 ± 0.1	3.15 ± 0.1	3.2± 0.1	1.4± 0.1	0.2±0.03

(mm)

Cover Tape Dimensions

Application	Carrier Width	Cover Tape Width	Devices Per Reel
SOT-23-5	8	5.3	3000

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