Dual N-Channel Enhancement Mode MOSFET

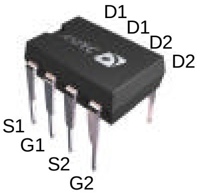
Features

- 60V/4A,
  $R_{DS(ON)}$ = 60mΩ(typ.) @ V_{GS} = 10V
  $R_{DS(ON)}$ = 72mΩ(typ.) @ V_{GS} = 4.5V
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices are Available (RoHS Compliant)

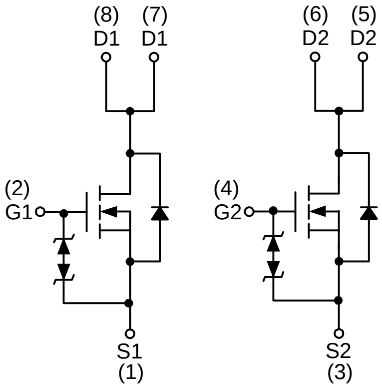
Applications

- Power Management in DC/DC Converter, DC/AC Inverter Systems.

Pin Description



Top View of DIP–8



N-Channel MOSFET

Ordering and Marking Information

APM9948 □□-□□ □ Assembly Material Handling Code Temp. Range Package Code	Package Code J : DIP-8 Operating Junction Temp. Range C : -55 to 150 °C Handling Code TU : Tube Assembly Material L : Lead Free Device G : Halogen and Lead Free Device
APM9948 J : APM9948 XXXXX	XXXXX - Date Code

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. 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 defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

Absolute Maximum Ratings (T_A = 25°C unless otherwise noted)

Symbol	Parameter		Rating	Unit
V_{DSS}	Drain-Source Voltage		60	V
V_{GSS}	Gate-Source Voltage		±20	
I_D*	Continuous Drain Current	V_{GS}=10V	4	A
I_{DM}*	300µs Pulsed Drain Current		16	
I_S*	Diode Continuous Forward Current		2.5	A
T_J	Maximum Junction Temperature		150	°C
T_{STG}	Storage Temperature Range		-55 to 150	
P_D*	Maximum Power Dissipation	T_A=25°C	2.5	W
		T_A=100°C	1	
$R_{\theta JA}$*	Thermal Resistance-Junction to Ambient		50	°C/W

Note:

*Surface Mounted on 1in^2 pad area, t ≤ 10sec.

Electrical Characteristics (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition	APM9948J			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_{DS}=250µA	60			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=48V, V_{GS}=0V			1	µA
		T_A=25°C			30	
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_{DS}=250µA	1	1.9	3	V
I_{GSS}	Gate Leakage Current	V_{GS}=±16V, V_{DS}=0V			±10	µA
$R_{DS(ON)}$ [a]	Drain-Source On-state Resistance	V_{GS}=10V, I_{DS}=4A		60	85	mΩ
		V_{GS}=4.5V, I_{DS}=3A		72	100	
Diode Characteristics						
V_{SD} [a]	Diode Forward Voltage	I_{SD}=2.5A, V_{GS}=0V		0.8	1.1	V
t_{rr}	Reverse Recovery Time	I_{SD}=4A, dI_{SD}/dt=100A/µs		28		ns
Q_{rr}	Reverse Recovery Charge			28		nC

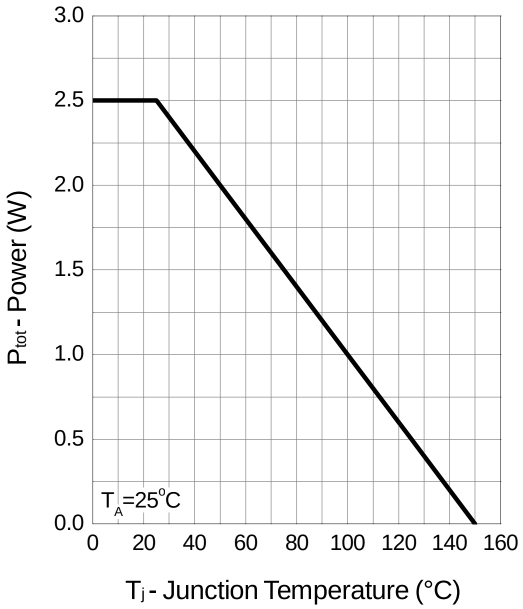
Electrical Characteristics (Cont.) (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Condition	APM9948J			Unit
			Min.	Typ.	Max.	
Dynamic Characteristics [b]						
R_G	Gate Resistance	V_{GS}=0V,V_{DS}=0V,F=1MHz		4.3		Ω
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=30V, Frequency=1.0MHz		610		pF
C_{oss}	Output Capacitance			47		
C_{rss}	Reverse Transfer Capacitance			30		
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=30V, R_L=30Ω, I_{DS}=1A, V_{GEN}=10V, R_G=6Ω		7	14	ns
T_r	Turn-on Rise Time			6	12	
$t_{d(OFF)}$	Turn-off Delay Time			26	48	
T_f	Turn-off Fall Time			4	8	
Gate Charge Characteristics [b]						
Q_g	Total Gate Charge	V_{DS}=30V, V_{GS}=10V, I_{DS}=4A		14.2	20	nC
Q_{gs}	Gate-Source Charge			1.9		
Q_{gd}	Gate-Drain Charge			3.2		

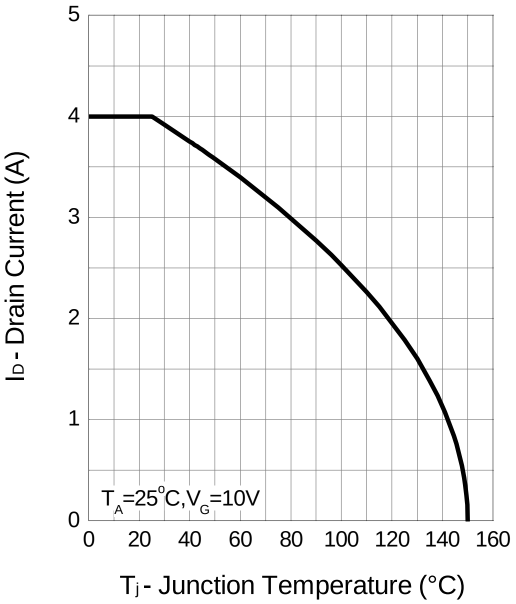
Notes:

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

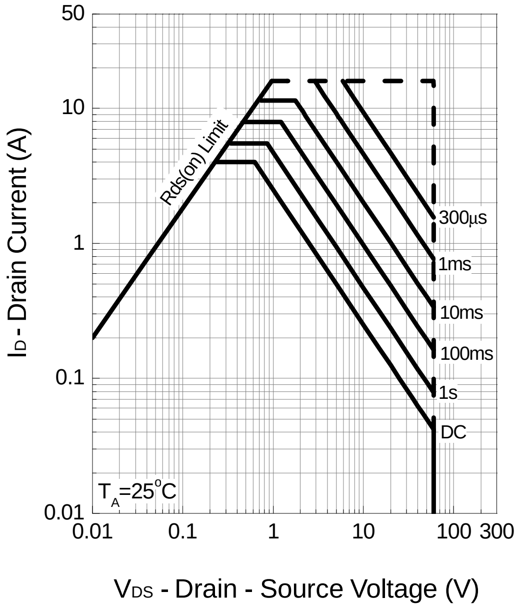
Typical Characteristics



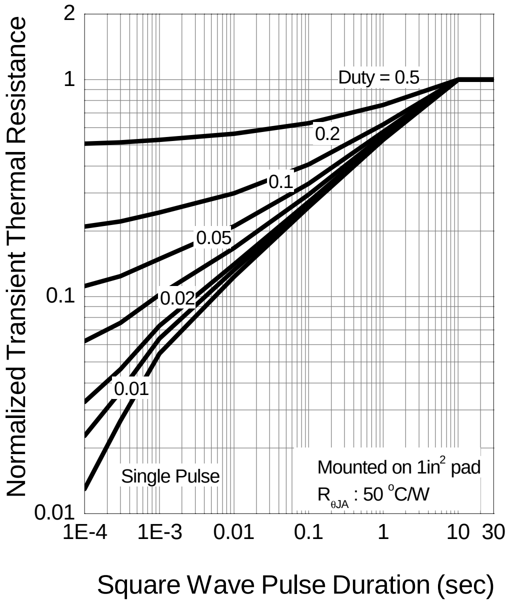
Power Dissipation



Drain Current

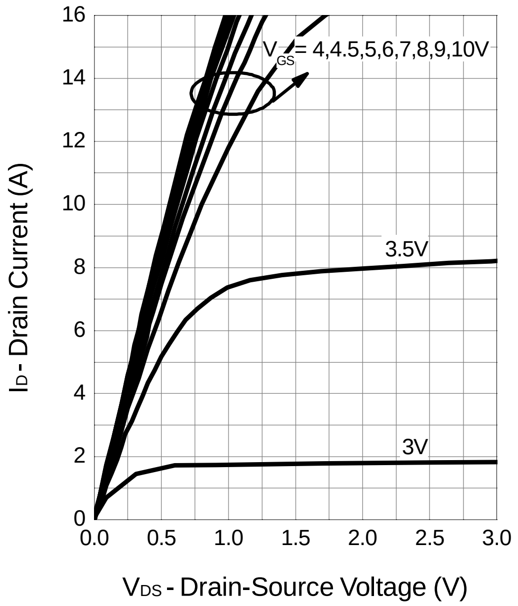


Safe Operation Area

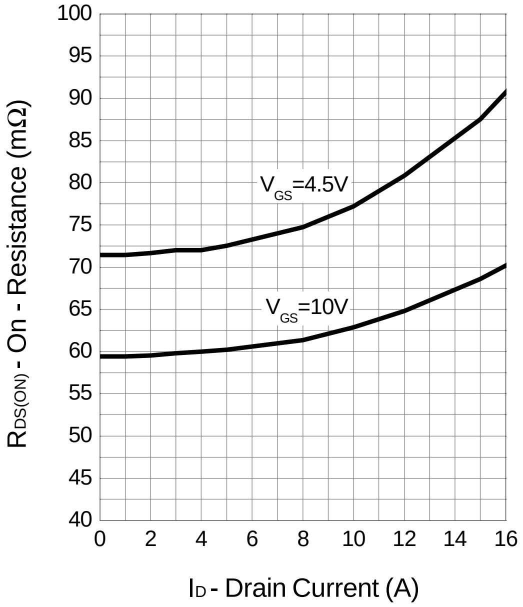


Thermal Transient Impedance

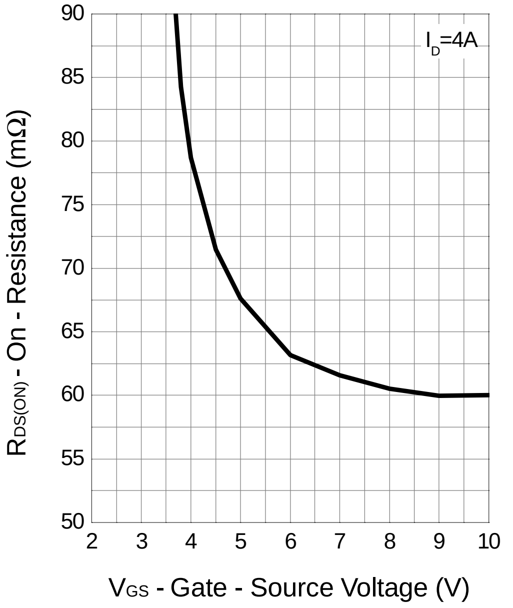
Typical Characteristics (Cont.)



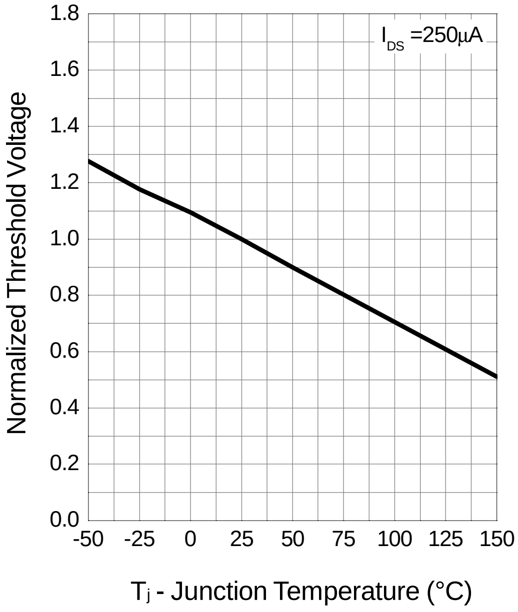
Output Characteristics



Drain-Source On Resistance



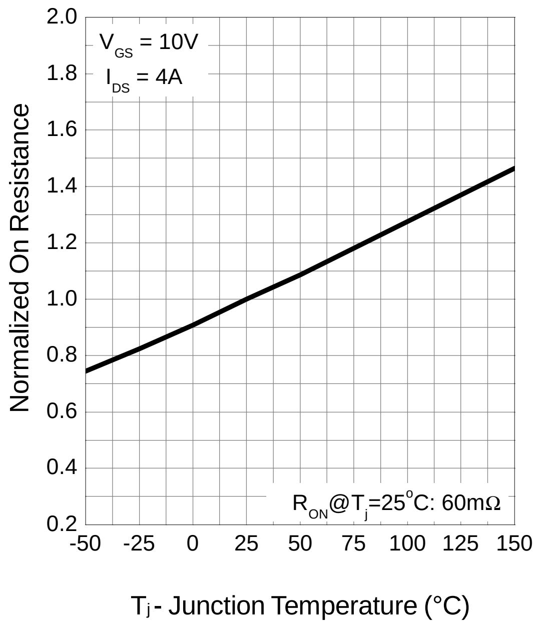
Drain-Source On Resistance



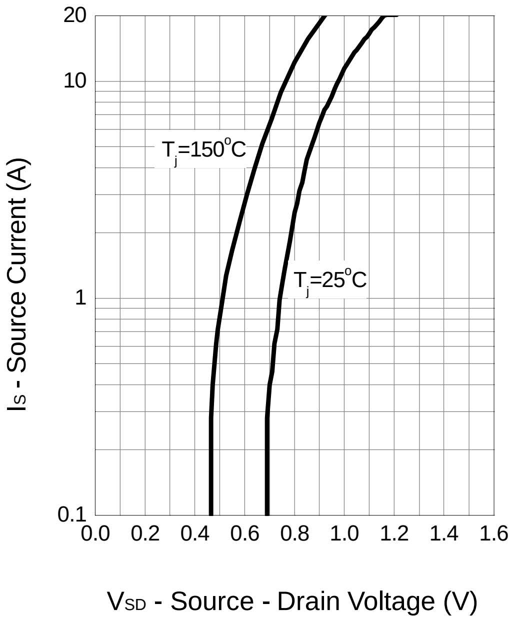
Gate Threshold Voltage

Typical Characteristics (Cont.)

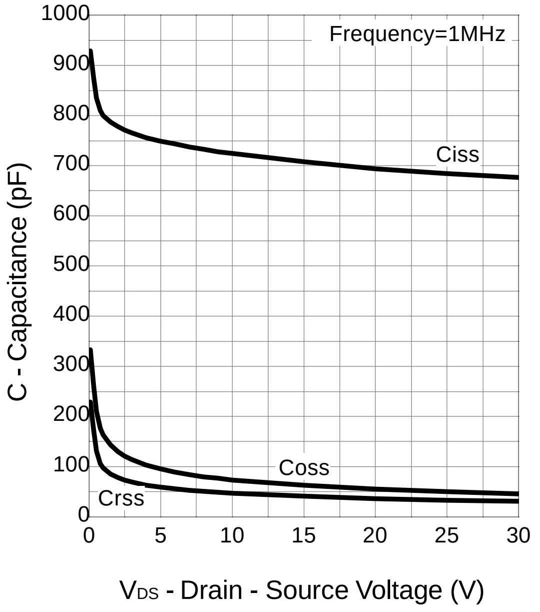
Drain-Source On Resistance



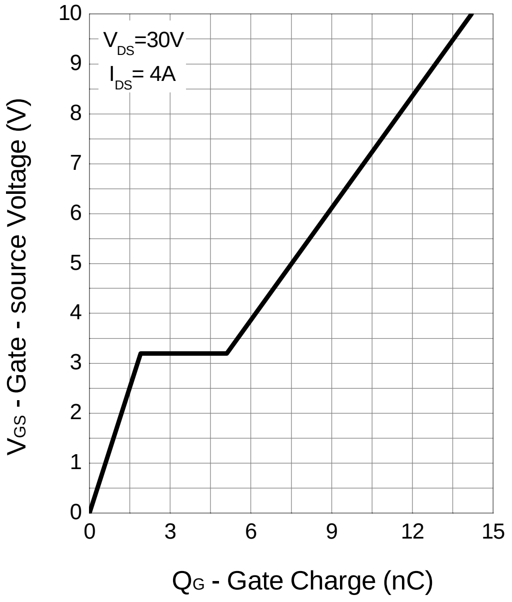
Source-Drain Diode Forward



Capacitance

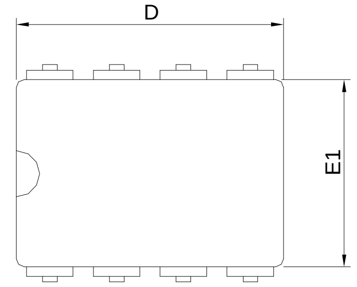


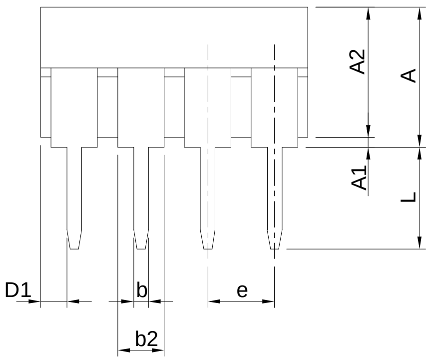
Gate Charge

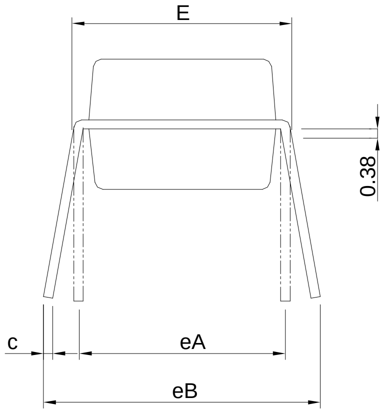


Package Information

DIP-8

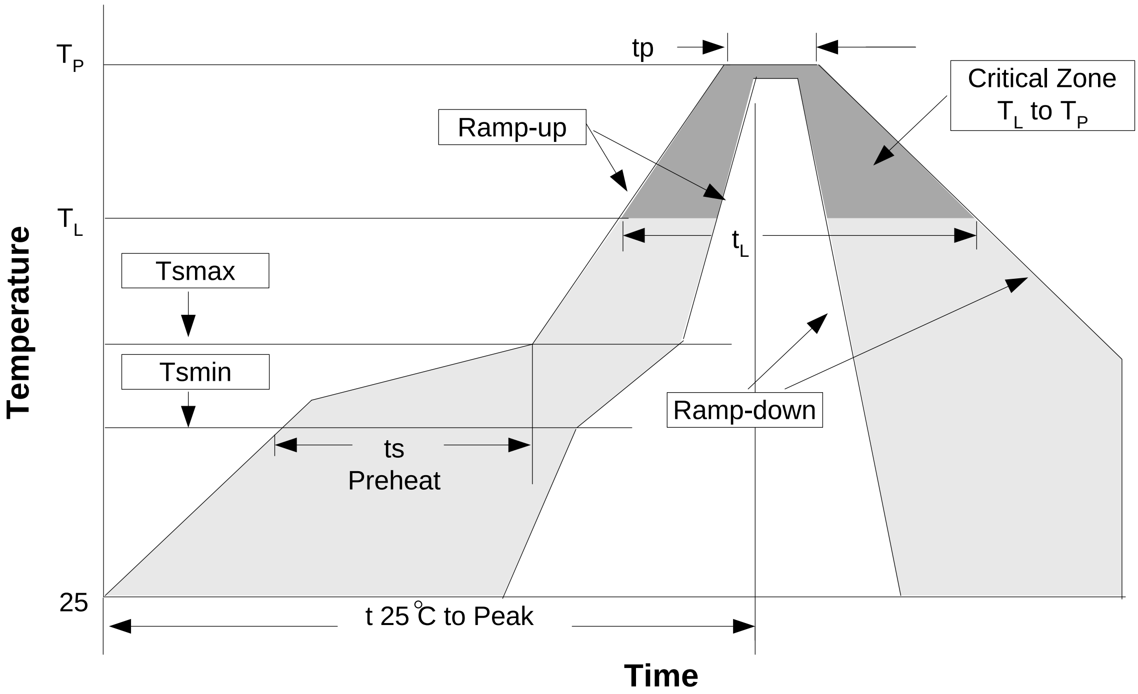






SYMBOL	DIP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		5.33		0.210
A1	0.38		0.015	
A2	2.92	4.95	0.115	0.195
b	0.36	0.56	0.014	0.022
b2	1.14	1.78	0.045	0.070
c	0.20	0.35	0.008	0.014
D	9.01	10.16	0.355	0.400
D1	0.13		0.005	
E	7.62	8.26	0.300	0.325
E1	6.10	7.11	0.240	0.280
e	2.54 BSC		0.100 BSC	
eA	7.62 BSC		0.300 BSC	
eB		10.92		0.430
L	2.92	3.81	0.115	0.150

Reflow Condition (IR/Convection or VPR Reflow)



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

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 (Tsmin) - Temperature Max (Tsmax) - Time (min to max) (ts)	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	183°C 60-150 seconds	217°C 60-150 seconds
Peak/Classification Temperature (Tp)	See table 1	See table 2
Time within 5°C of actual Peak Temperature (tp)	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.

Note: 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 ^{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.

Customer Service

Anpec Electronics Corp.
Head Office :
No.6, Dusing 1st Road, SBIP,
Hsin-Chu, Taiwan, R.O.C.
Tel : 886-3-5642000
Fax : 886-3-5642050
Taipei Branch :
2F, No. 11, Lane 218, Sec 2 Jhongsing Rd.,
Sindain City, Taipei County 23146, Taiwan
Tel : 886-2-2910-3838
Fax : 886-2-2917-3838