

N-Channel Enhancement Mode MOSFET

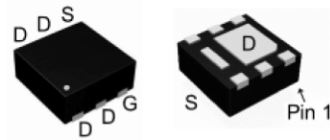
Features

- 20V/9A,
 $R_{DS(ON)} = 10.9m\Omega(max.) @ V_{GS} = 4.5V$
 $R_{DS(ON)} = 15.5m\Omega(max.) @ V_{GS} = 2.5V$
 $R_{DS(ON)} = 26m\Omega(max.) @ V_{GS} = 1.8V$
- 100% UIS + R_g Tested
- Reliable and Rugged
- Lead Free and Green Devices Available
(RoHS Compliant)

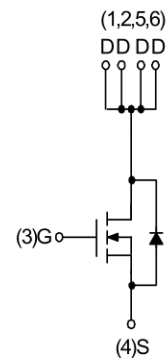
Applications

- Li-Ion Battery Pack.
- DC-DC Buck Converters.

Pin Description



DFN2x2A-6_EP



N-Channel MOSFET

Ordering and Marking Information

VP5539QT □□□-□□□ □□□ — Assembly Material □□ — Handling Code □ — Temperature Range □ — Package Code	Package Code VJ : DFN2x2A-6_EP Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material J : Halogen and Lead Free Device
VP5539QTVJ : 2206A XXXXX	XXXXXX - Lot Code

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ Unless Otherwise Noted)

Symbol	Parameter		Rating	Unit
Common Ratings				
V _{DSS}	Drain-Source Voltage		20	V
V _{GSS}	Gate-Source Voltage		±12	
T _J	Maximum Junction Temperature		150	°C
T _{STG}	Storage Temperature Range		-55 to 150	
I _S	Diode Continuous Forward Current	T _A =25°C	1.2	A
I _D	Continuous Drain Current	T _A =25°C	9.0	A
		T _A =70°C	7.2	
I _{DM} ^a	Pulsed Drain Current	T _A =25°C	36	A
P _D ^b	Maximum Power Dissipation	T _A =25°C	1.32	W
		T _A =70°C	0.8	
R _{θJA} ^b	Thermal Resistance-Junction to Ambient	t ≤ 10s	54	°C/W
		Steady State	95	°C/W
I _{AS} ^c	Avalanche Current, Single pulse	L=0.1mH	16	A
E _{AS} ^c	Avalanche Energy, Single pulse	L=0.1mH	13	mJ

Note a : Pulse width limited by max. junction temperature.

Note b : $R_{\theta JA}$ steady state $t=999\text{s}$.

Note c : UIS tested and pulse width limited by maximum junction temperature 150°C (initial temperature $T_J=25^\circ\text{C}$)

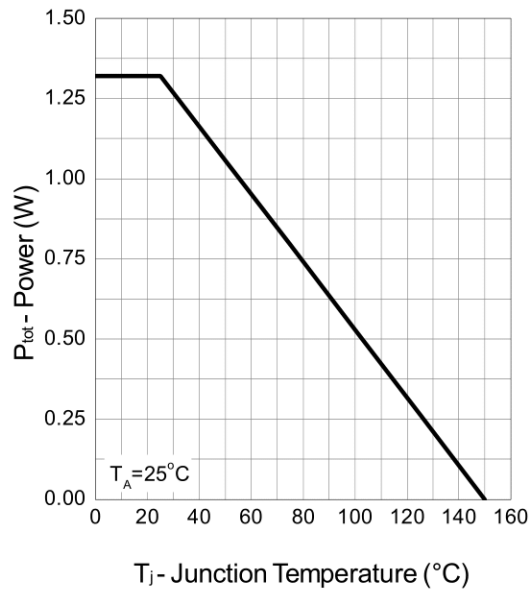
Electrical Characteristics (T_A = 25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250μA	20	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =16V, V _{GS} =0V T _J =85°C	-	-	1 30	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	0.5	0.75	1	V
I _{GSS}	Gate Leakage Current	V _{GS} =±12V, V _{DS} =0V	-	-	±100	nA
R _{DS(ON)} ^d	Drain-Source On-state Resistance	V _{GS} =4.5V, I _{DS} =9A	-	9.1	10.9	mΩ
		T _J =125°C	-	12.5	-	
		V _{GS} =2.5V, I _{DS} =8A	-	12.1	15.5	
		V _{GS} =1.8V, I _{DS} =7.3A	-	19	29	
Gfs	Forward Transconductance	V _{DS} =5V, I _{DS} =8A	-	24	-	S
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =1.5A, V _{GS} =0V	-	0.72	1.1	V
t _{rr}	Reverse Recovery Time	V _{DD} =15V, F _{WD} =5A	-	10.2	-	ns
Q _{rr}	Reverse Recovery Charge	I _{Induct} I=0.1mH	-	4.1	-	nC
Dynamic Characteristics						
R _G	Gate Resistance	V _{GS} =0V, V _{DS} =0V, F=1MHz	-	1.5	2.7	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =10V, Frequency=1.0MHz	-	780	1015	pF
C _{oss}	Output Capacitance		-	170	-	
C _{rss}	Reverse Transfer Capacitance		-	120	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =10V, R _L =10Ω, I _{DS} =1A, V _{GEN} =4.5V, R _G =1Ω	-	10.6	-	ns
t _r	Turn-on Rise Time		-	15	-	
t _{d(OFF)}	Turn-off Delay Time		-	17.2	-	
t _f	Turn-off Fall Time		-	4	-	
Gate Charge Characteristics						
Q _g	Total Gate Charge	Vds=10V, Vgs=4.5V, Ids=9A	-	8.9	11.5	nC
Q _{gs}	Gate-Source Charge		-	0.52	-	
Q _{gd}	Gate-Drain Charge		-	3.8	-	

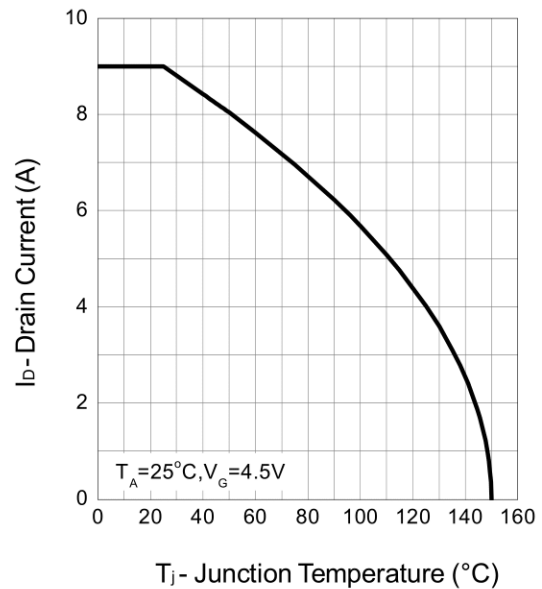
Note d : Pulse test ; pulse width≤300μs, duty cycle≤2%.

Typical Operating Characteristics

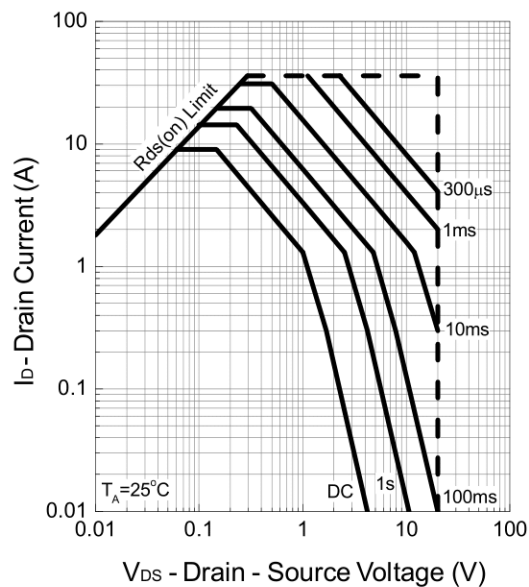
Power Dissipation



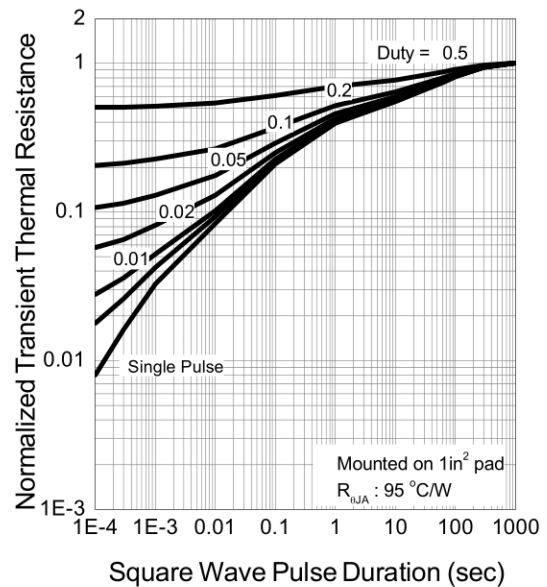
Drain Current



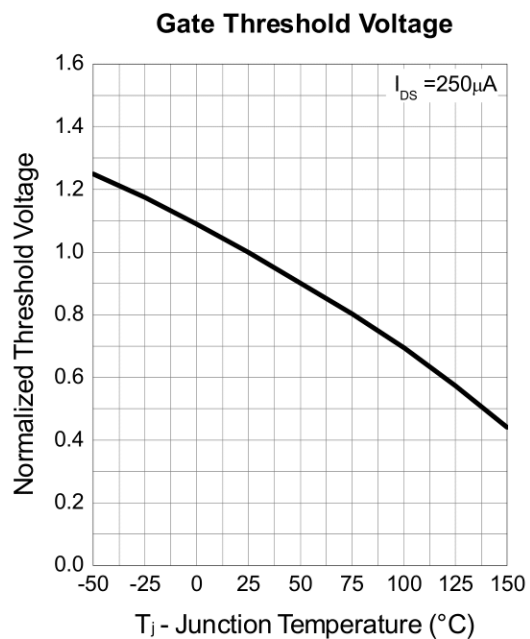
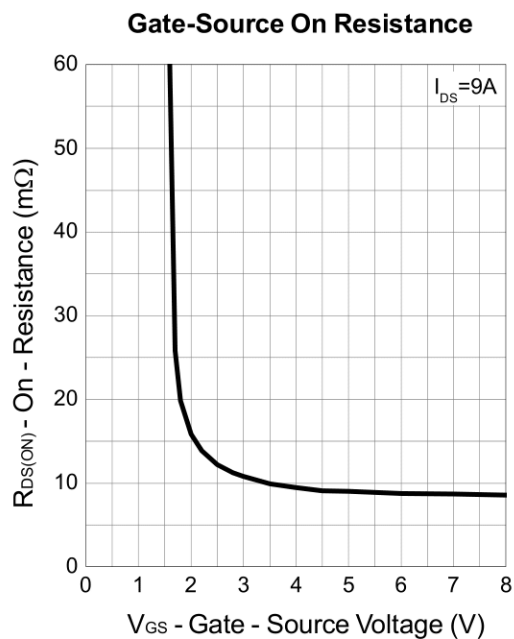
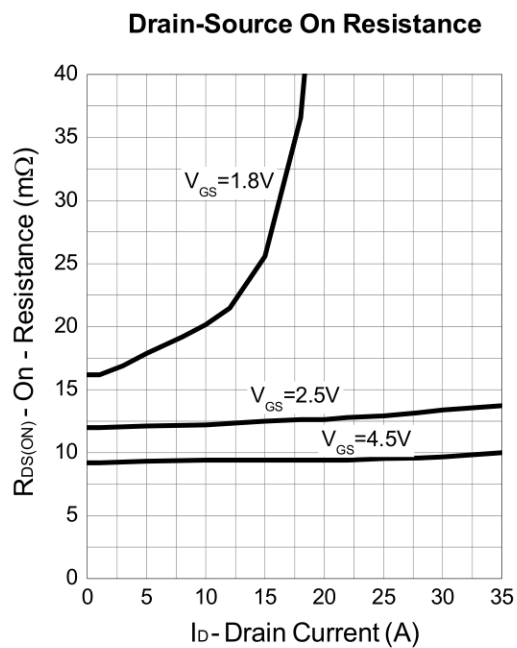
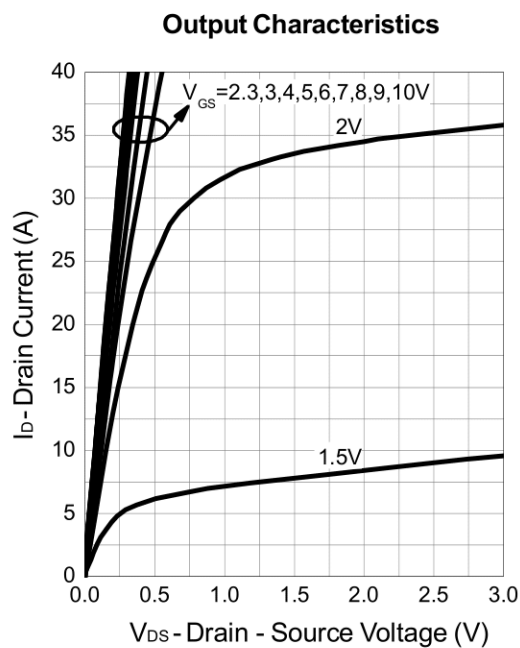
Safe Operation Area



Thermal Transient Impedance

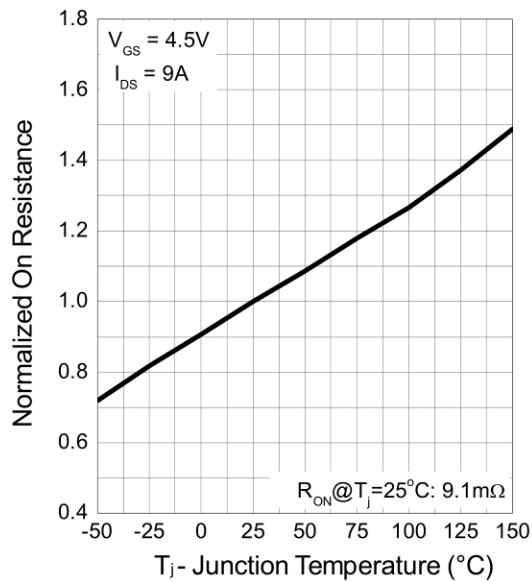


Typical Operating Characteristics (Cont.)

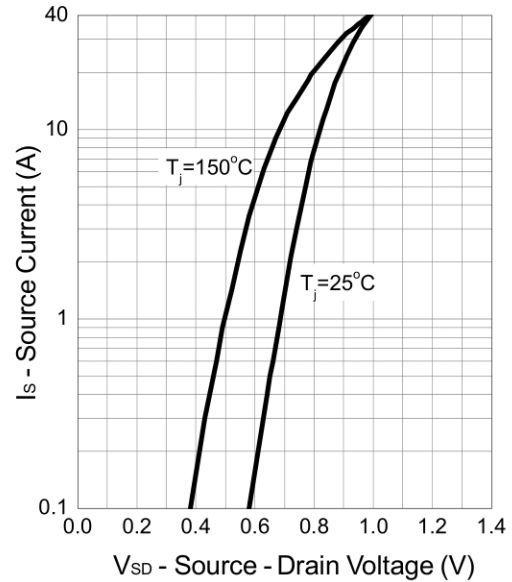


Typical Operating Characteristics (Cont.)

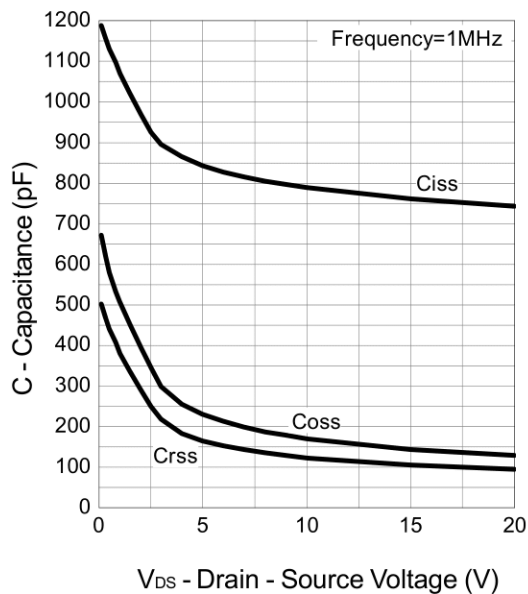
Drain-Source On Resistance



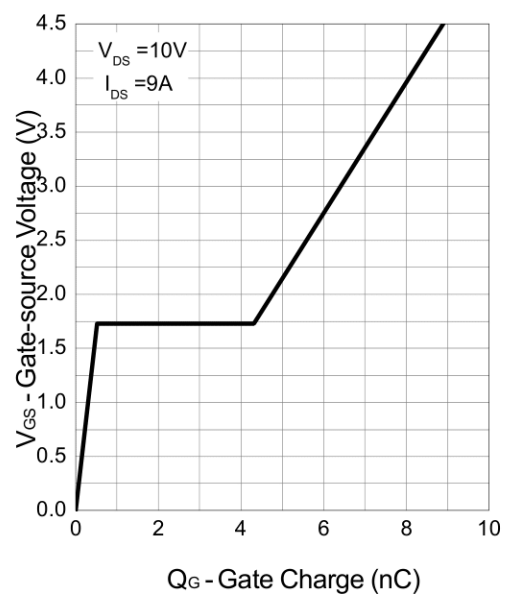
Source-Drain Diode Forward

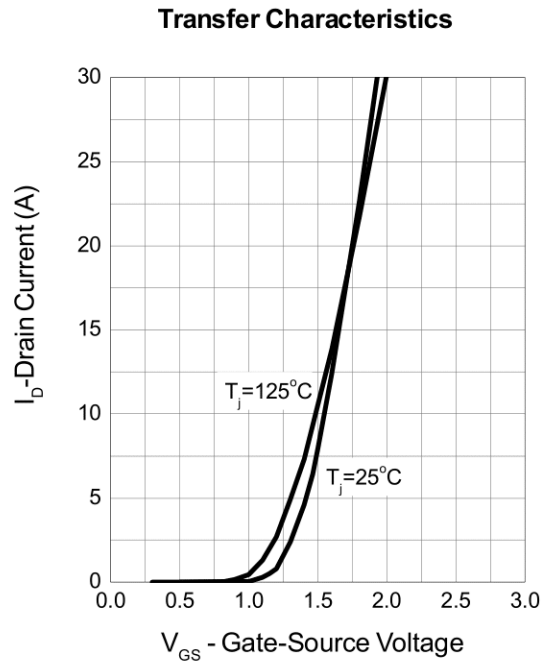


Capacitance

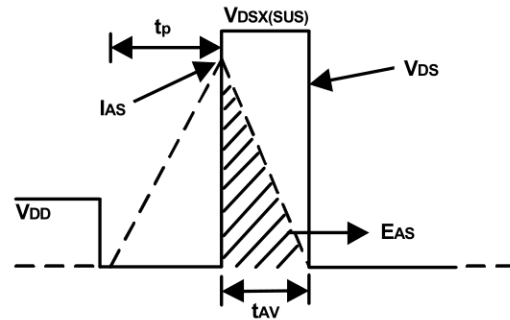
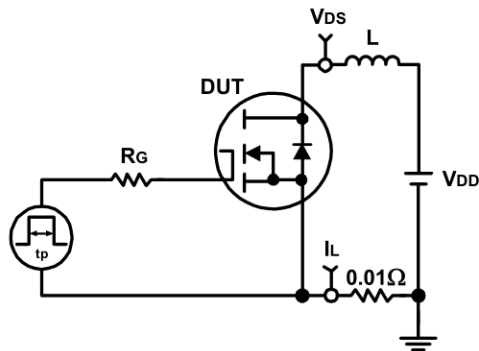


Gate Charge

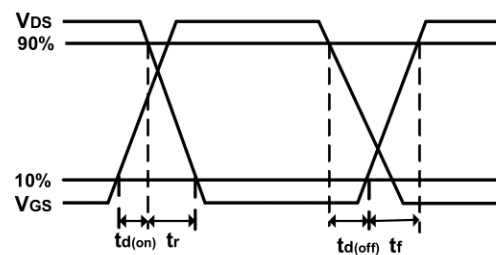
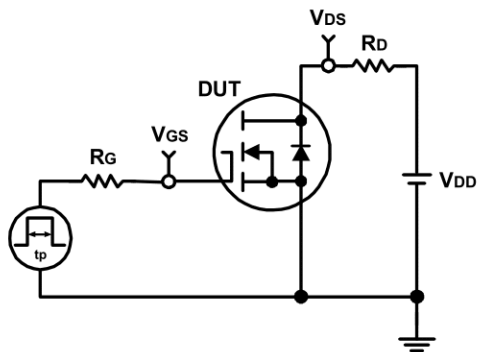


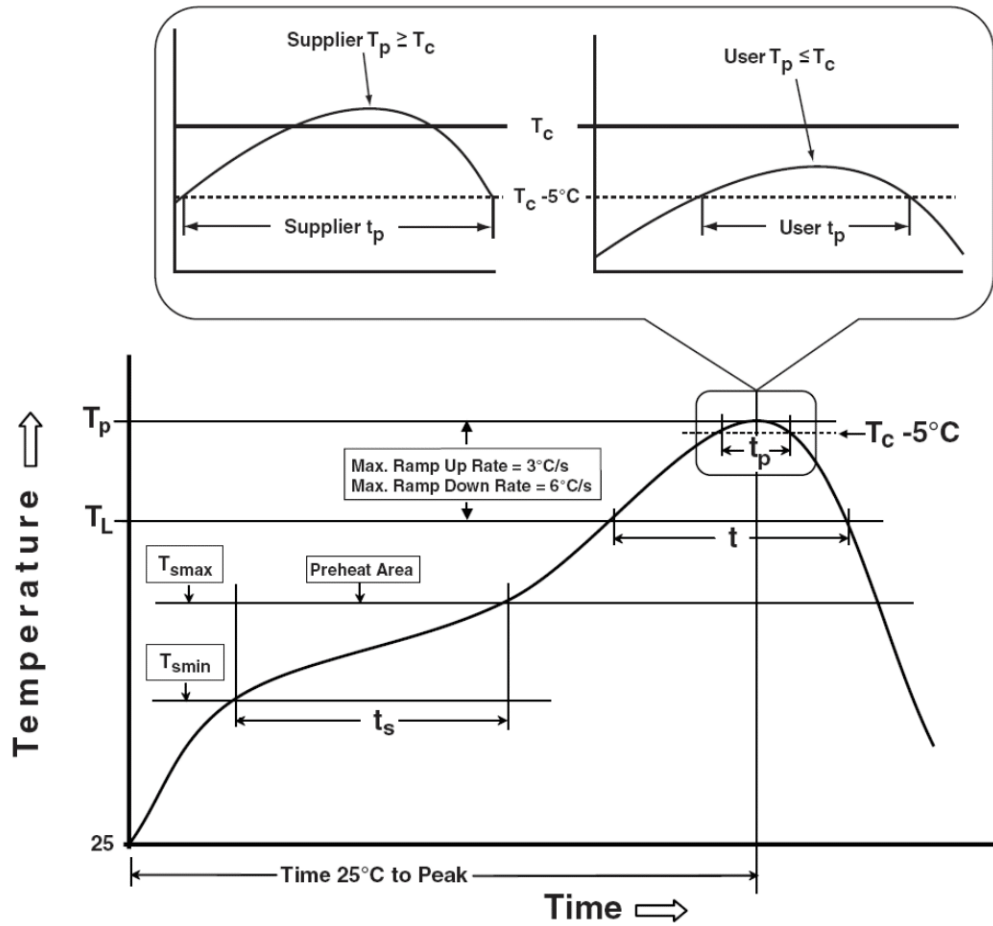
Typical Operating Characteristics (Cont.)

Avalanche Test Circuit and Waveforms



Switching Time Test Circuit and Waveforms



Classification Profile

Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (t_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_p)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	60-150 seconds
Peak package body Temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_p)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum.		
** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1. SnPb Eutectic Process – Classification Temperatures (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (T_c)

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

Reliability Test Program

Test item	Method	Description
SOLDERABILITY	JESD-22, B102	5 Sec, 245°C
HTRB	JESD-22, A108	1000 Hrs, 80% of VDS max @ T_{jmax}
HTGB	JESD-22, A108	1000 Hrs, 100% of VGS max @ T_{jmax}
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C