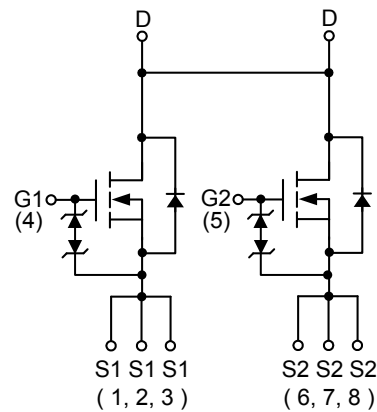
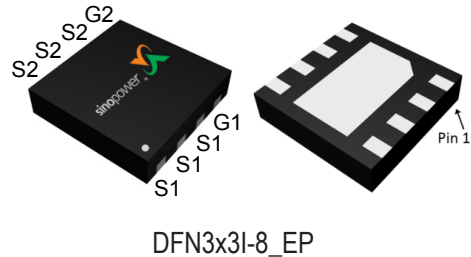


Pin Description

- 20V/15A
- $R_{DS(ON)}=5.5m\Omega(max.)@V_{GS}=4.5V$
- $R_{DS(ON)}=5.9m\Omega(max.)@V_{GS}=4V$
- $R_{DS(ON)}=6m\Omega(max.)@V_{GS}=3.8V$
- $R_{DS(ON)}=6.5m\Omega(max.)@V_{GS}=3.1V$
- $R_{DS(ON)}=7.7m\Omega(max.)@V_{GS}=2.5V$
- 100% UIS + R_g Tested
- ESD Protection
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)



Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems.
- One Cell Li-ion Battery Pack.

Ordering and Marking Information

SM9973DS □□□-□□□ Assembly Material Handling Code Temperature Range Package Code	Package Code QG : DFN3x3I-8_EP Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device
SM9973DS QG :	SM 9973DS XXXXX ● XXXXX - Lot Code

Note : SINOPOWER lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. SINOPOWER lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020D for MSL classification at lead-free peak reflow temperature. SINOPOWER 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 ($T_A=25^{\circ}\text{C}$ 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	0.9	A
I _D	Continuous Drain Current	T _A =25°C	15	A
		T _A =70°C	12	
I _{DM} ^b	Pulsed Drain Current	T _A =25°C	60	
P _D	Maximum Power Dissipation	T _A =25°C	1.9	W
		T _A =70°C	1.2	
R _{θJA} ^a	Thermal Resistance-Junction to Ambient	t ≤ 10s	35	°C/W
		Steady state	65	
I _{AS} ^c	Avalanche Current, Single pulse	L=0.1mH	21	A
E _{AS} ^c	Avalanche Energy, Single pulse	L=0.1mH	22	mJ

Note a : Surface mounted on 1in^2 pad area, steady state $t = 999\text{s}$.

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

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

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

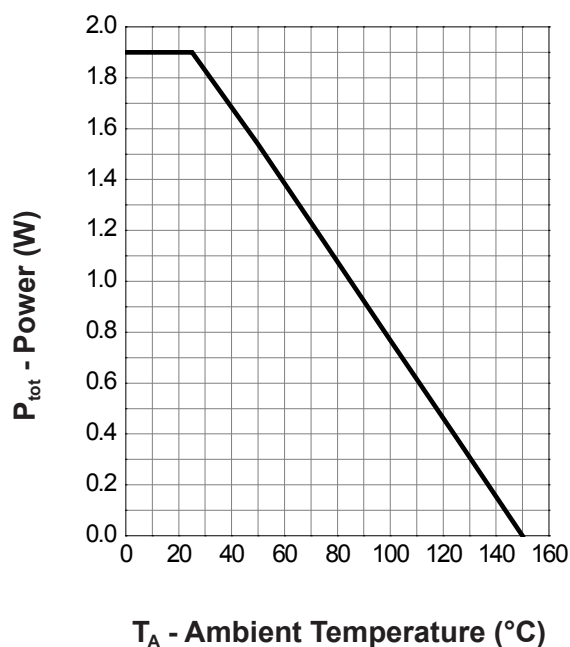
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =250μA	20	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =16V, V _{GS} =0V T _J =85°C	-	-	1 30	μA
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =250μA	0.4	0.75	1.1	V
I _{GSS}	Gate Leakage Current	V _{GS} =±12V, V _{DS} =0V	-	-	±10	μA
R _{DS(ON)} ^d	Drain-Source On-state Resistance	V _{GS} =4.5V, I _{DS} =3A	3.3	4.4	5.5	mΩ
		V _{GS} =4V, I _{DS} =3A	3.1	4.5	5.9	
		V _{GS} =3.8V, I _{DS} =3A	3.2	4.6	6	
		V _{GS} =3.1V, I _{DS} =3A	3.5	5	6.5	
		V _{GS} =2.5V, I _{DS} =3A	3.7	5.7	7.7	
Gfs	Forward Transconductance	V _{DS} =5V, I _{DS} =3A	-	18.5	-	S
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =1A, V _{GS} =0V	-	0.75	1.1	V
t _{rr}	Reverse Recovery Time	I _{SD} =3A, dI _{SD} /dt=100A/μs	-	300	-	ns
t _a	Charge Time		-	110	-	
t _b	Discharge Time		-	190	-	
Q _{rr}	Reverse Recovery Charge		-	930	-	nC
Dynamic Characteristics ^e						
R _G	Gate Resistance	V _{GS} =0V,V _{DS} =0V,F=1MHz	-	9	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =10V, Frequency=1.0MHz	-	1580	2054	pF
C _{oss}	Output Capacitance		-	260	-	
C _{rss}	Reverse Transfer Capacitance		-	170	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =10V, R _L =10Ω, I _{DS} =1A, V _{GEN} =10V, R _G =6Ω	-	10.6	20	ns
t _r	Turn-on Rise Time		-	16.3	30	
t _{d(OFF)}	Turn-off Delay Time		-	850	1530	
t _f	Turn-off Fall Time		-	355	639	
Gate Charge Characteristics ^e						
Q _g	Total Gate Charge	V _{DS} =10V, V _{GS} =10V, I _{DS} =3A	-	35	49	nC
Q _g	Total Gate Charge	V _{DS} =10V, V _{GS} =4.5V, I _{DS} =3A	-	17	23.8	
Q _{gth}	Threshold Gate Charge		-	1.3	-	
Q _{gs}	Gate-Source Charge		-	2.4	-	
Q _{gd}	Gate-Drain Charge		-	4.2	-	

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

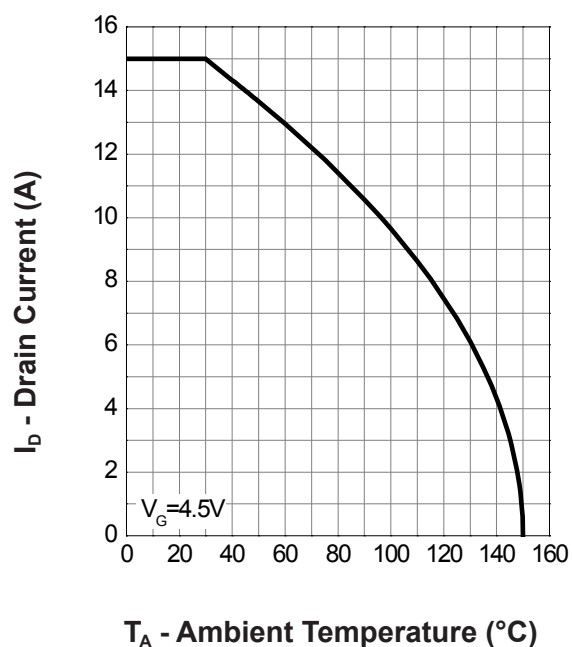
Note e : Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

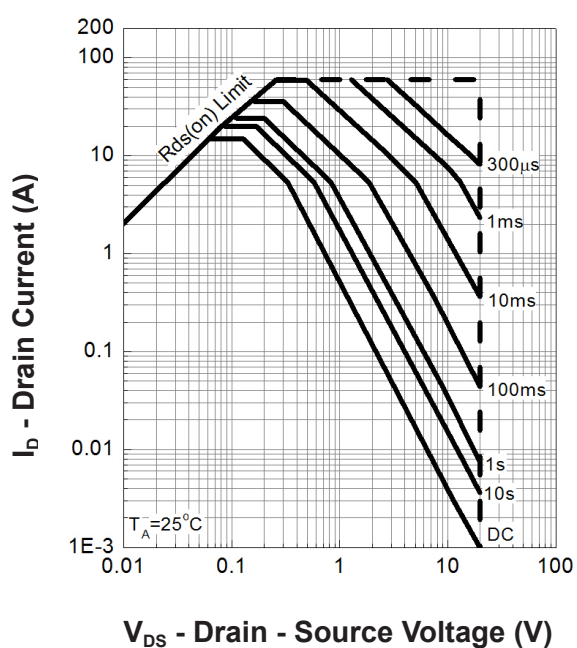
Power Dissipation



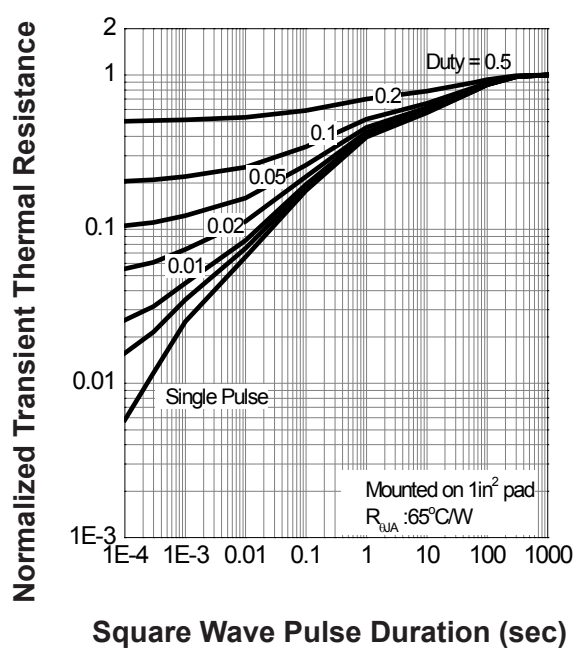
Drain Current



Safe Operation Area

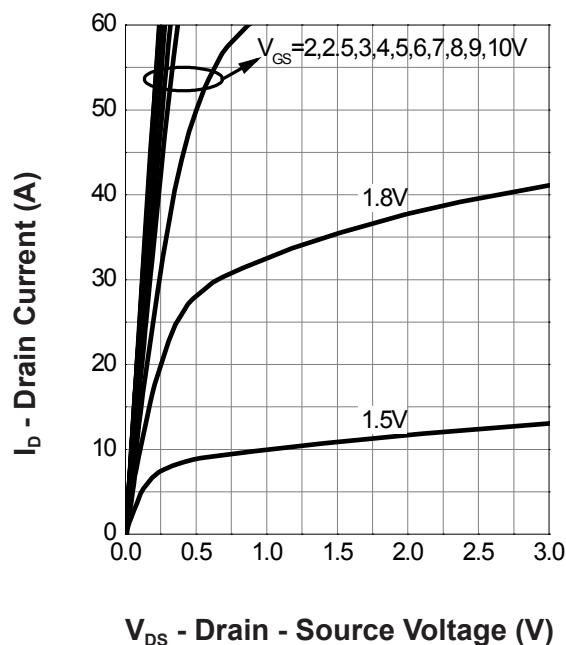


Thermal Transient Impedance

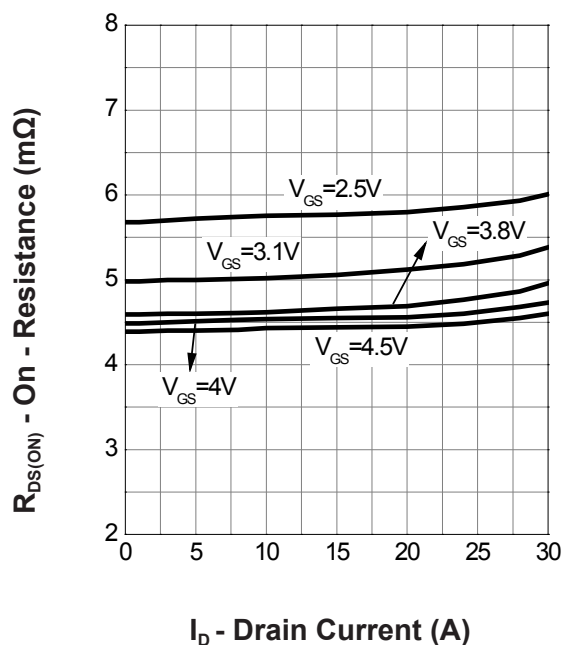


Typical Operating Characteristics(Cont.)

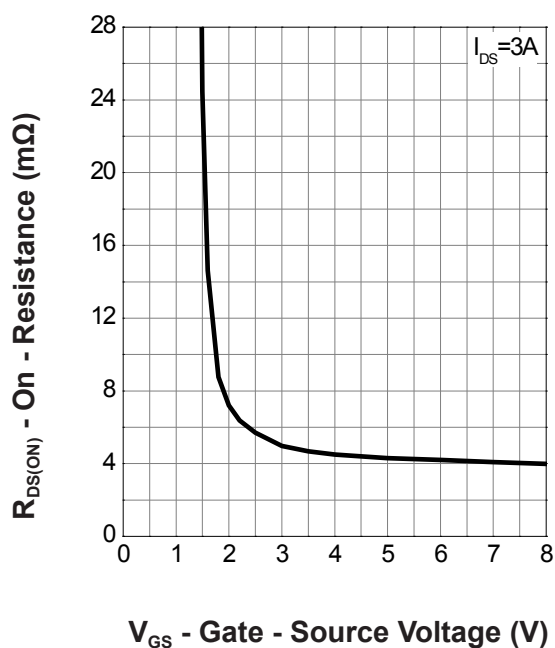
Output Characteristics



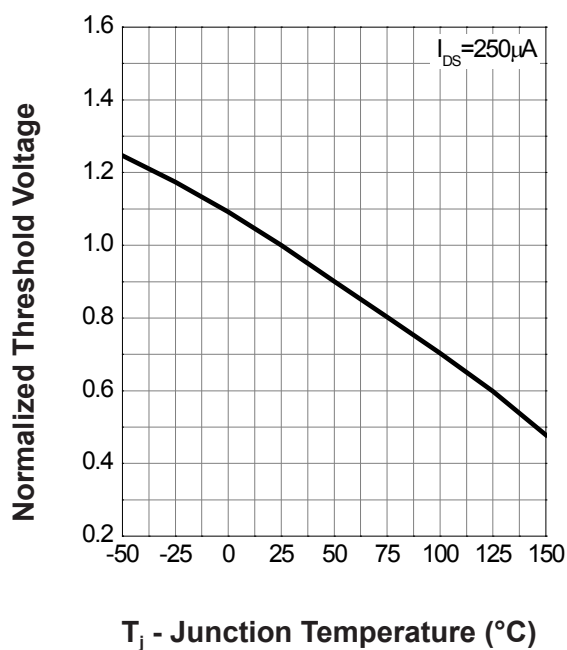
Drain-Source On Resistance



Gate-Source On Resistance

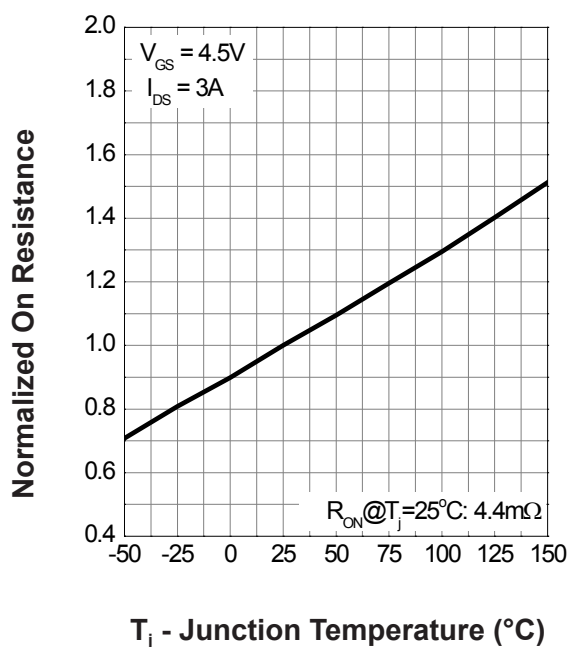


Gate Threshold Voltage

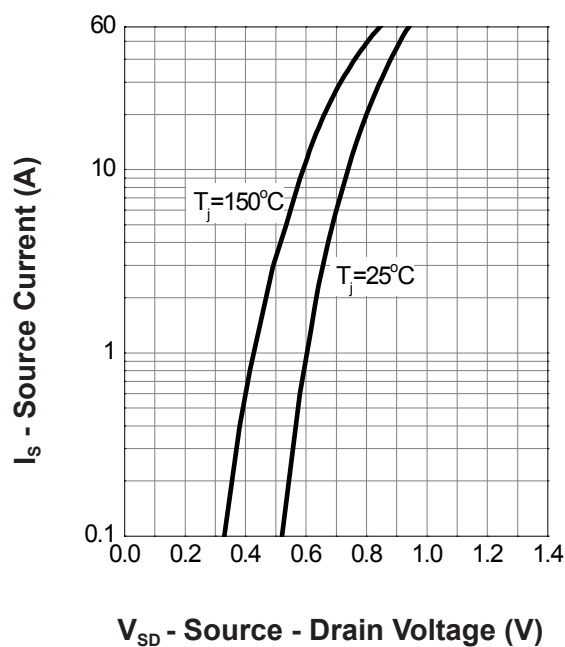


Typical Operating Characteristics(Cont.)

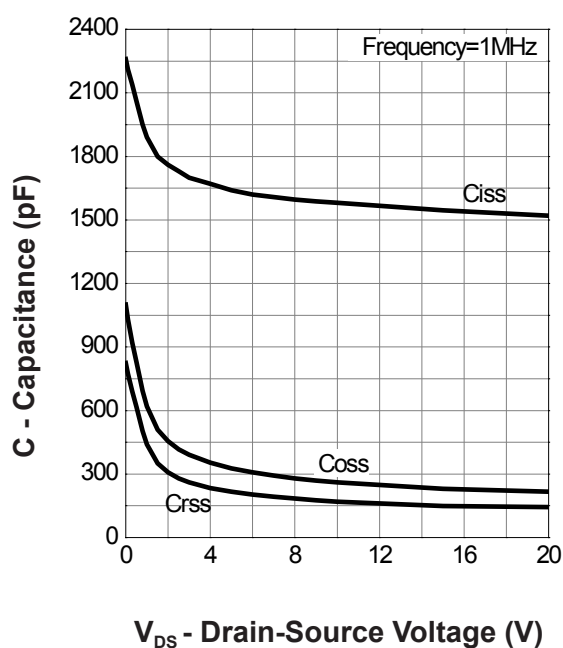
Drain-Source On Resistance



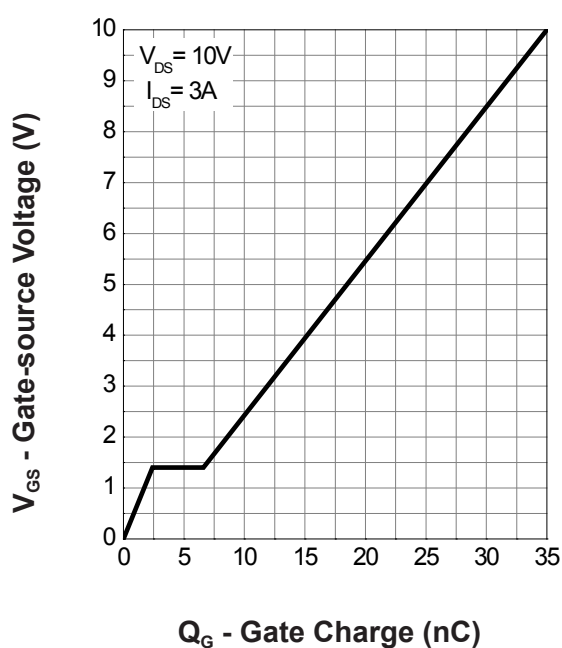
Source-Drain Diode Forward



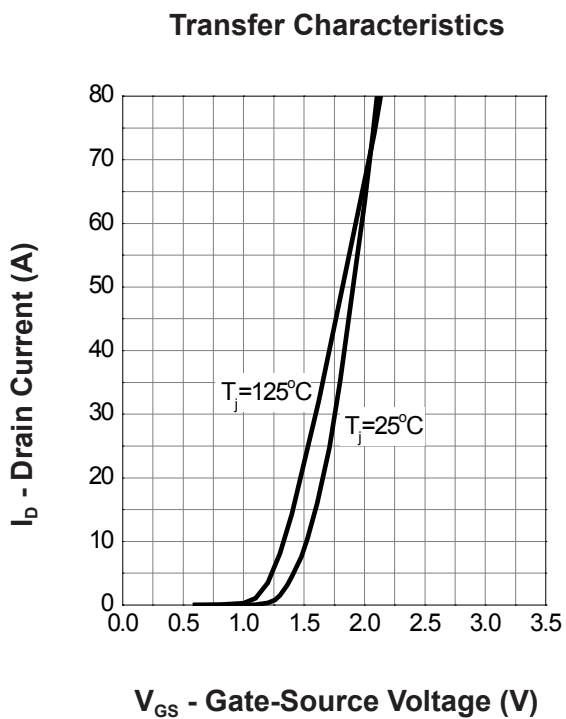
Capacitance



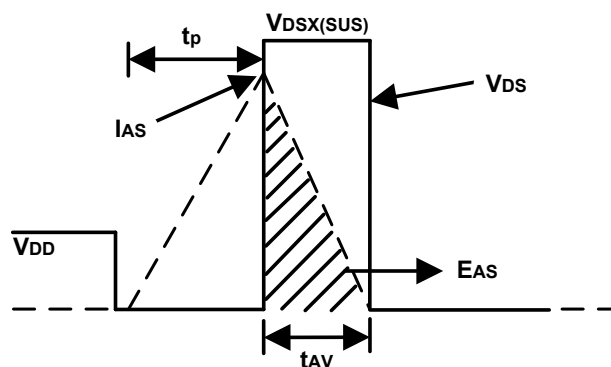
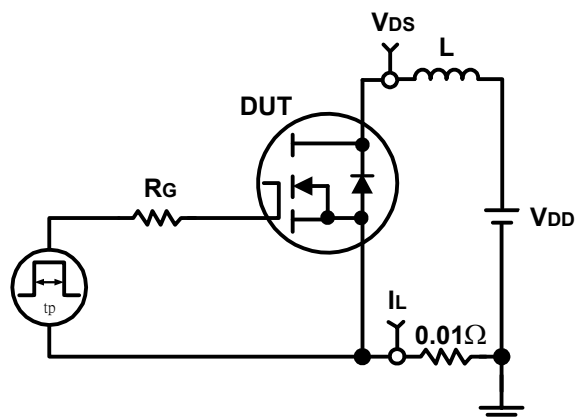
Gate Charge



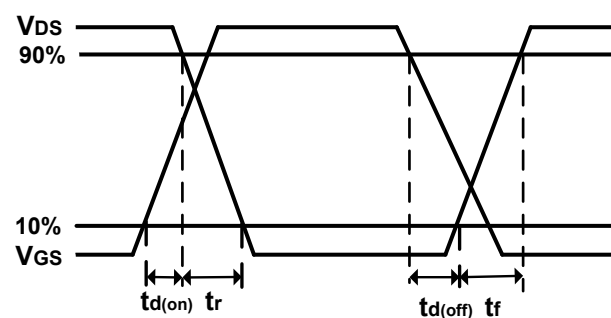
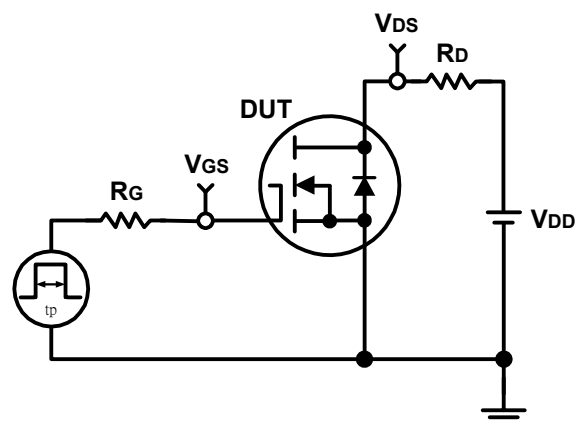
Typical Operating Characteristics(Cont.)



Avalanche Test Circuit and Waveforms



Switching Time Test Circuit and Waveforms



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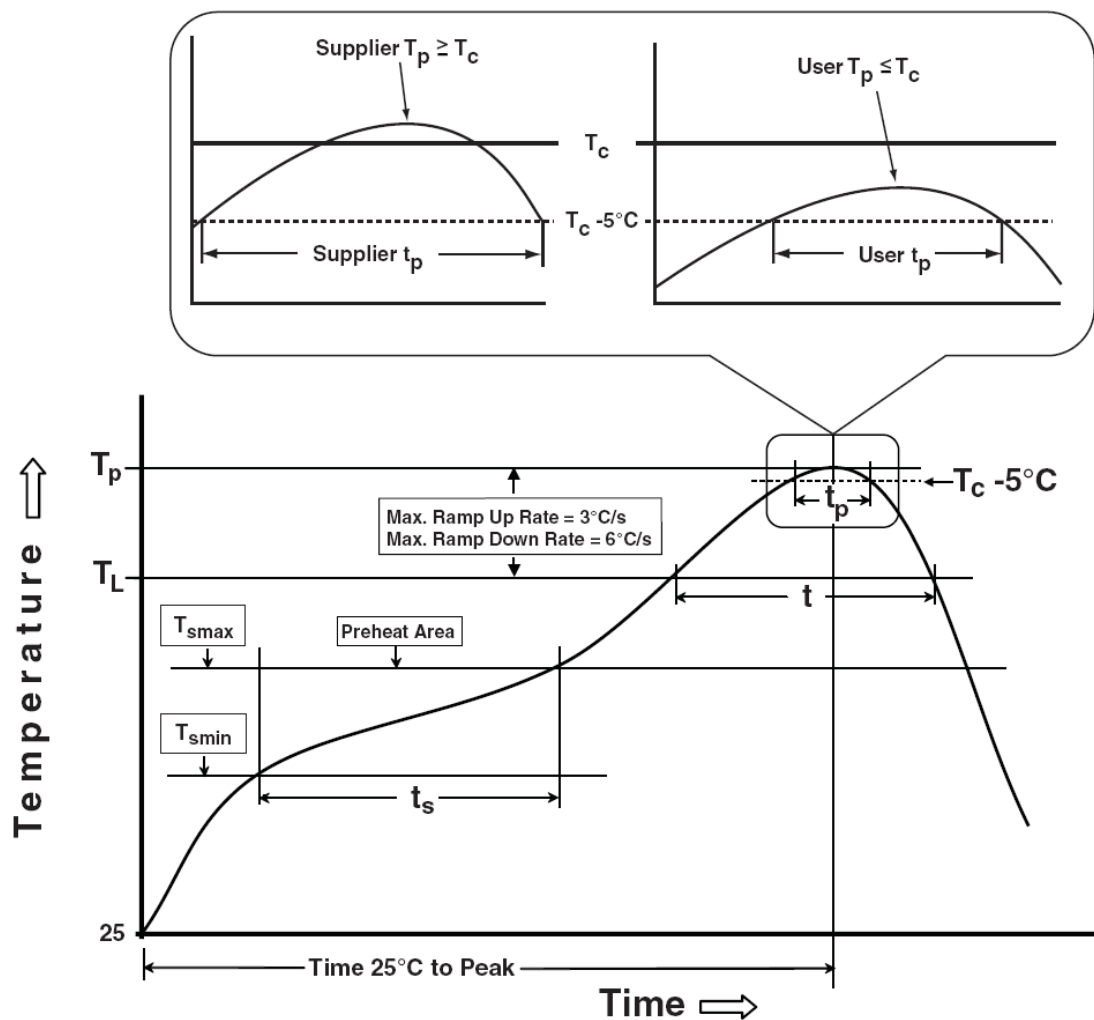
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Classification Profile



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

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