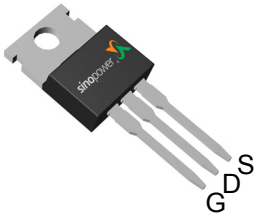
N-Channel Enhancement Mode MOSFET

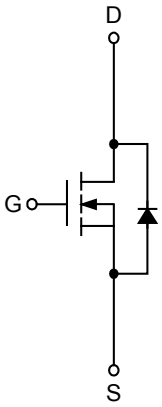
Features

- 60V/69A
  $R_{DS(ON)}$=8.6mΩ(max.)@V_{GS}=10V
  $R_{DS(ON)}$=12mΩ(max.)@V_{GS}=4.5V
- 100% UIS + R_g Tested
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

Pin Description



TO-220



N-Channel MOSFET

Applications

- Secondary Side Synchronous Rectification.
- DC-DC Converter.
- Motor Control.
- Load Switching.

Ordering and Marking Information

SM6165NH □□-□□ □ Assembly Material Handling Code Temperature Range Package Code	Package Code F : TO-220 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TU : Tube Assembly Material G : Halogen and Lead Free Device
SM6165NH F : SM6165NH 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 leadfree 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°C Unless Otherwise Noted)

Symbol	Parameter		Rating	Unit
Common Ratings				
V_{DSS}	Drain-Source Voltage		60	V
V_{GSS}	Gate-Source Voltage		±20	
T_J	Maximum Junction Temperature		150	°C
T_{STG}	Storage Temperature Range		-55 to 150	
I_S	Diode Continuous Forward Current	T_C=25°C	34	A
I_D	Continuous Drain Current	T_C=25°C	69	A
		T_C=100°C	43	
I_{DM}	Pulsed Drain Current	T_C=25°C	276 [a]	
P_D	Maximum Power Dissipation	T_C=25°C	73.5	W
		T_C=100°C	29.4	
$R_{\theta JC}$	Thermal Resistance-Junction to Case	Steady state	1.7	°C/W
I_D	Continuous Drain Current	T_A=25°C	11.3	A
		T_A=70°C	9.1	
P_D	Maximum Power Dissipation	T_A=25°C	2	W
		T_A=70°C	1.28	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	Steady state	62.5	°C/W
I_{AS} [b]	Avalanche Current, Single pulse	L=0.5mH	18	A
E_{AS} [b]	Avalanche Energy, Single pulse	L=0.5mH	81	mJ

Note a：Pulse width limited by max. junction temperature.
Note b：UIS tested and pulse width limited by maximum junction temperature 150°C (initial temperature T_j=25°C).

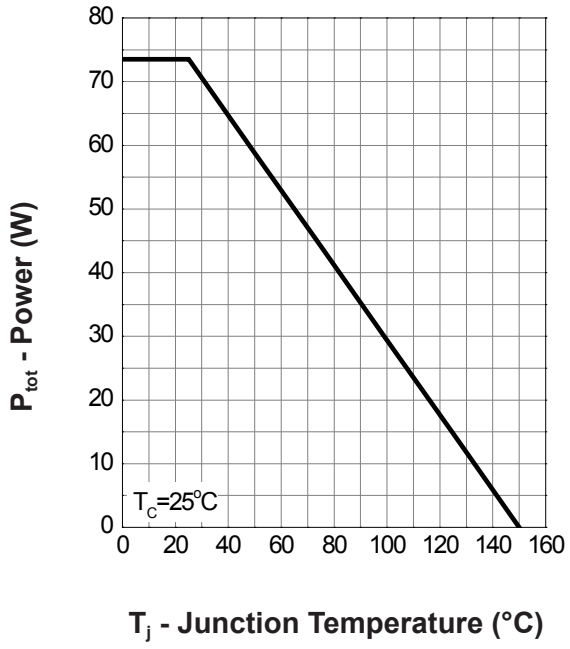
Electrical Characteristics (T_A = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_{DS}=250μA	60	-	-	V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS}=48V, V_{GS}=0V	-	-	1	μA
		T_J=85°C	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_{DS}=250μA	1	2	3	V
I_{GSS}	Gate Leakage Current	V_{GS}=±20V, V_{DS}=0V	-	-	±100	nA
$R_{DS(ON)}$ [c]	Drain-Source On-state Resistance	V_{GS}=10V, I_{DS}=20A	-	7.2	8.6	mΩ
		V_{GS}=4.5V, I_{DS}=15A	-	9.2	12	
Diode Characteristics						
V_{SD} [c]	Diode Forward Voltage	I_{SD}=20A, V_{GS}=0V	-	0.8	1.3	V
t_{rr}	Reverse Recovery Time	I_{SD}=20A, dI_{SD}/dt=100A/μs	-	30	-	ns
Q_{rr}	Reverse Recovery Charge		-	29	-	nC
Dynamic Characteristics [d]						
R_G	Gate Resistance	V_{GS}=0V,V_{DS}=0V,F=1MHz	-	1	-	Ω
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=30V, Frequency=1.0MHz	-	1500	1950	pF
C_{oss}	Output Capacitance		-	280	-	
C_{rss}	Reverse Transfer Capacitance		-	40	-	
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=30V, R_L=30Ω, I_{DS}=1A, V_{GEN}=10V, R_G=6Ω	-	9	16	ns
t_r	Turn-on Rise Time		-	5	9	
$t_{d(OFF)}$	Turn-off Delay Time		-	29	52	
t_f	Turn-off Fall Time		-	30	54	
Gate Charge Characteristics [d]						
Q_g	Total Gate Charge	V_{DS}=30V, V_{GS}=4.5V, I_{DS}=20A	-	11.7	-	nC
Q_g	Total Gate Charge	V_{DS}=30V, V_{GS}=10V, I_{DS}=20A	-	25	35	
Q_{gs}	Gate-Source Charge		-	5.1	-	
Q_{gd}	Gate-Drain Charge		-	3.8	-	

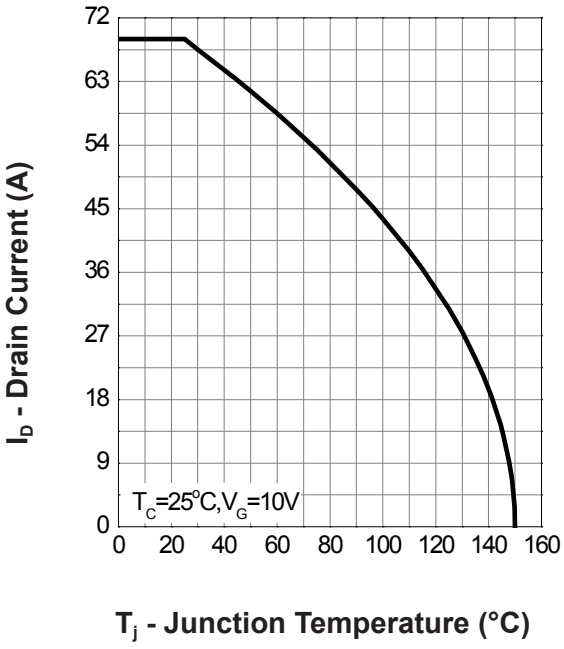
Note c：Pulse test ; pulse width≤300μs, duty cycle≤2%.
Note d：Guaranteed by design, not subject to production testing.

Typical Operating Characteristics

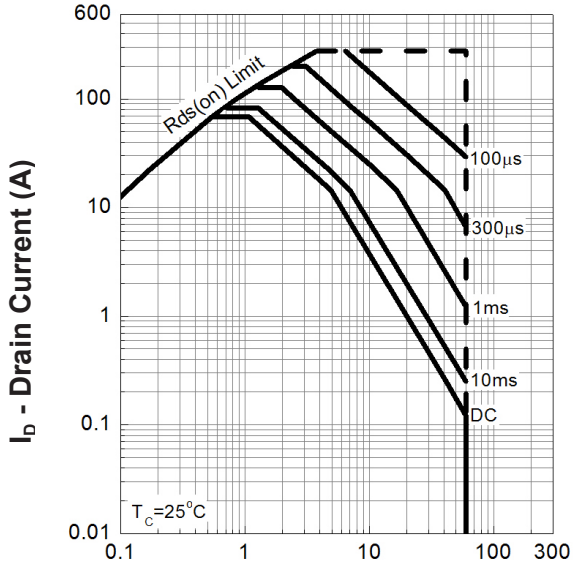
Power Dissipation



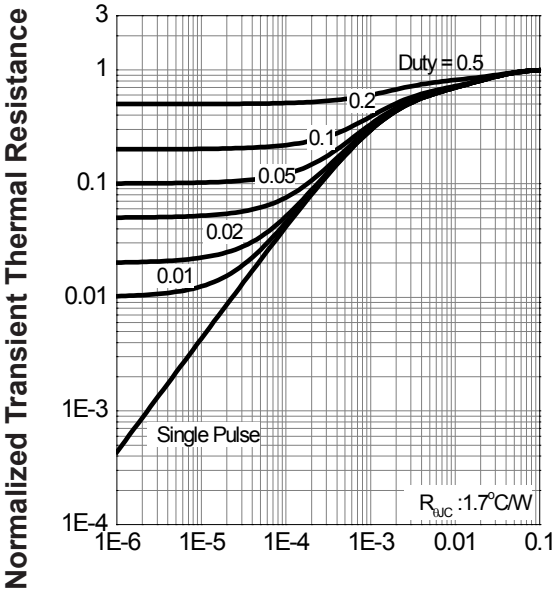
Drain Current



Safe Operation Area

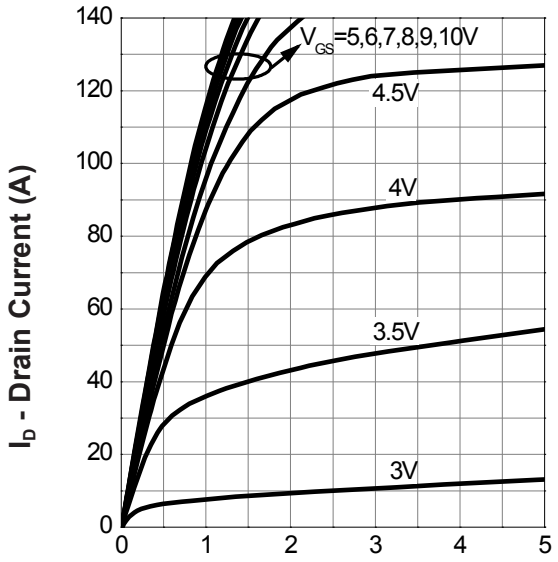


Thermal Transient Impedance

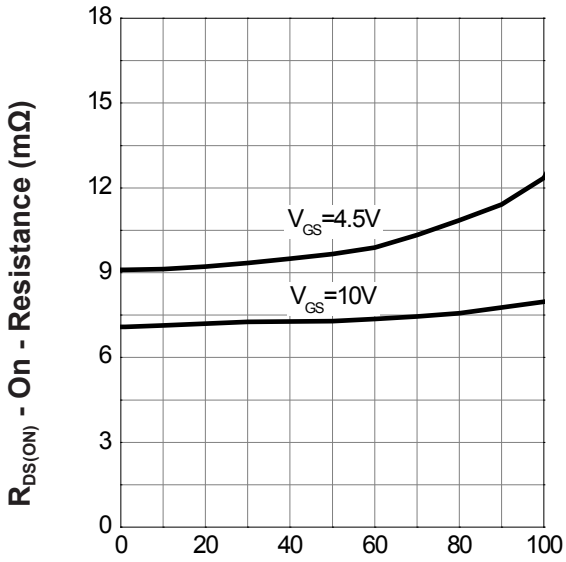


Typical Operating Characteristics(Cont.)

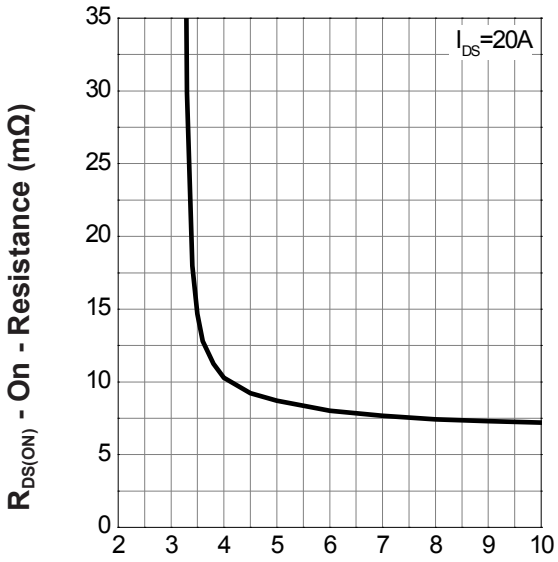
Output Characteristics



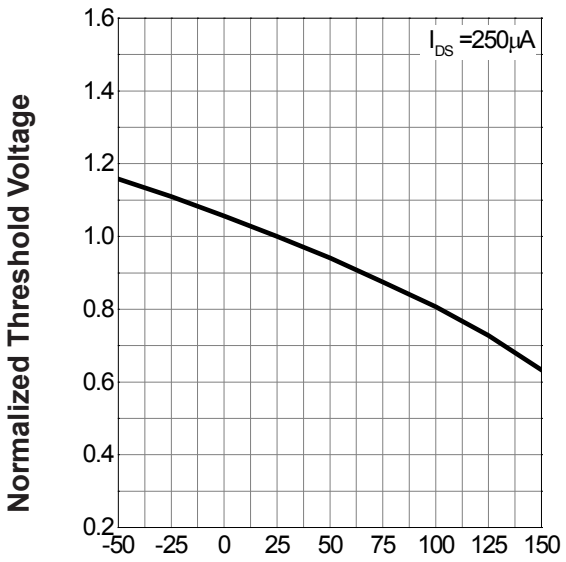
Drain-Source On Resistance



Gate-Source On Resistance

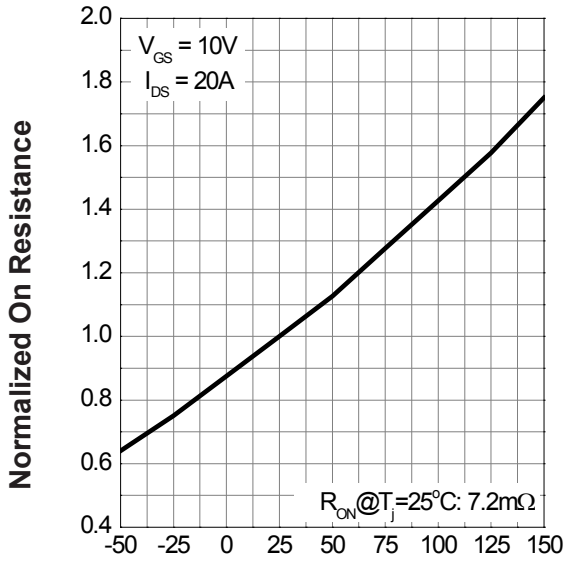


Gate Threshold Voltage

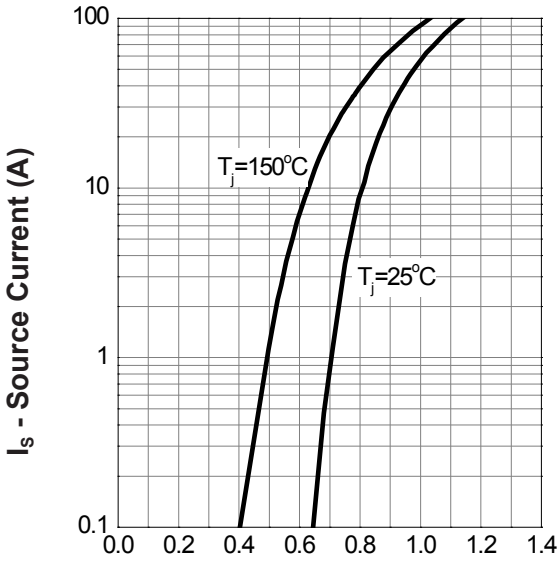


Typical Operating Characteristics(Cont.)

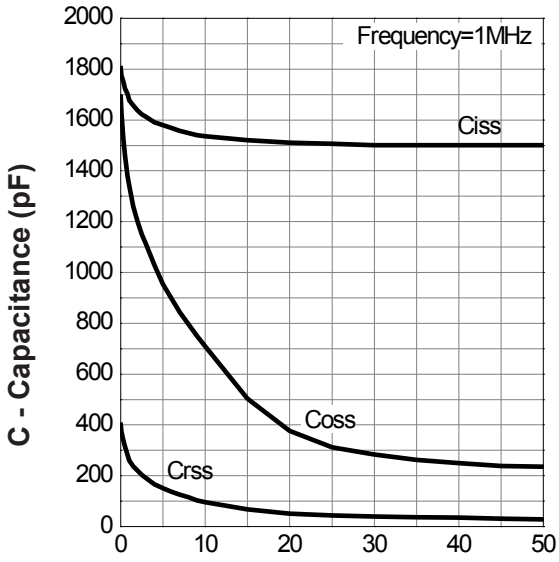
Drain-Source On Resistance



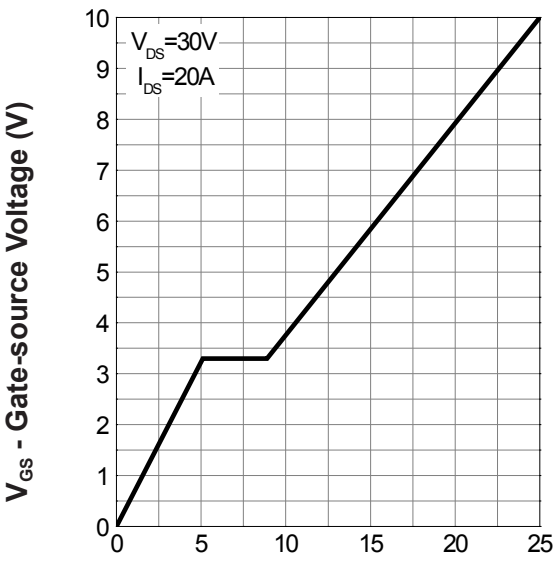
Source-Drain Diode Forward



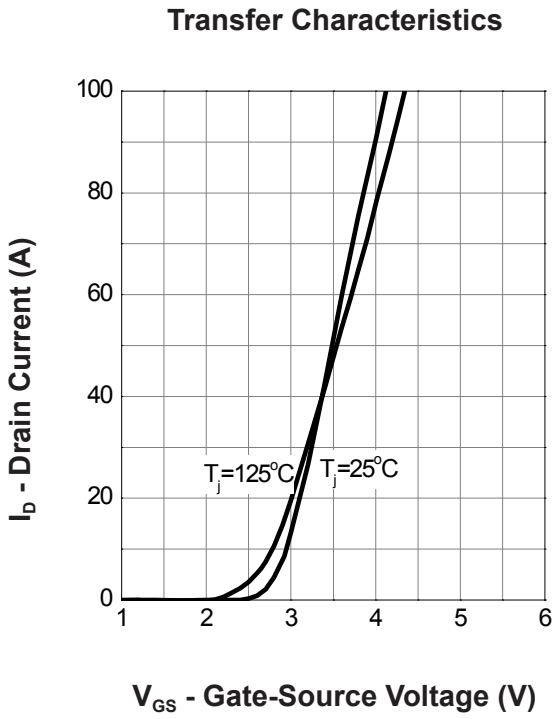
Capacitance



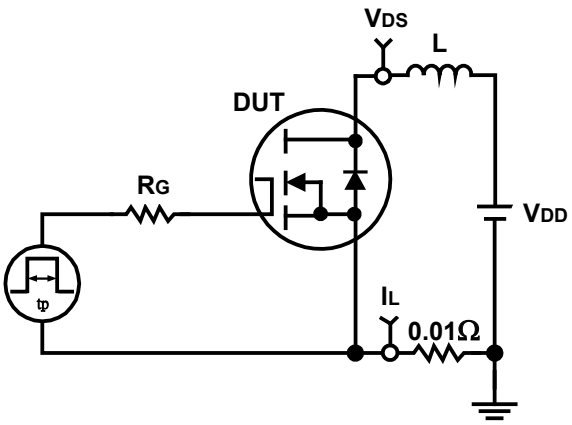
Gate Charge

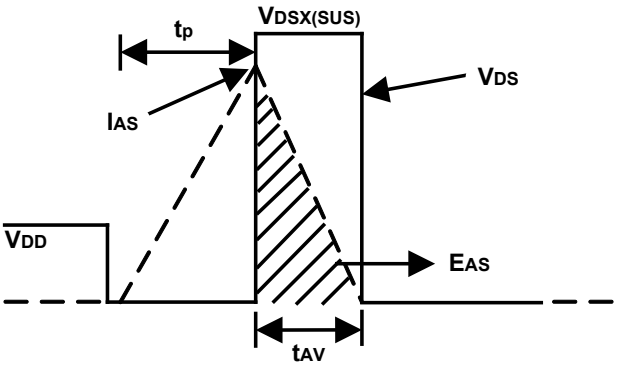


Typical Operating Characteristics(Cont.)

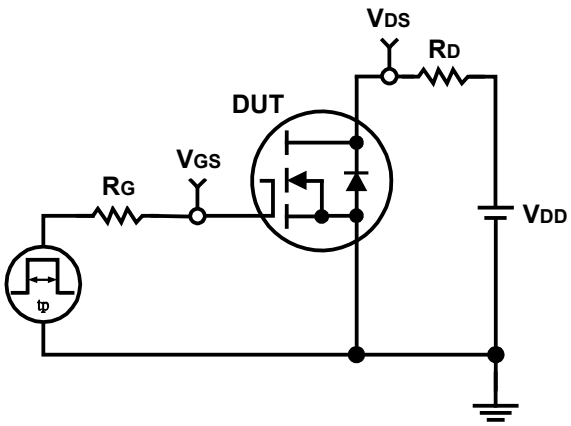


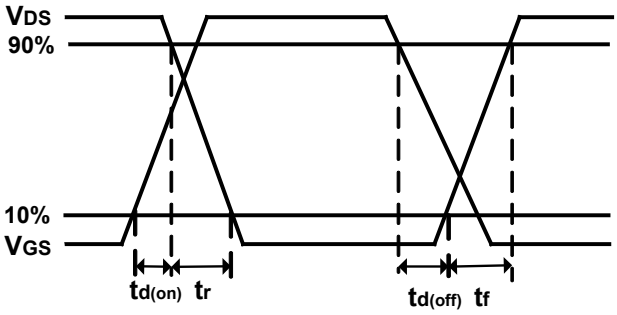
Avalanche Test Circuit and Waveforms





Switching Time Test Circuit and Waveforms





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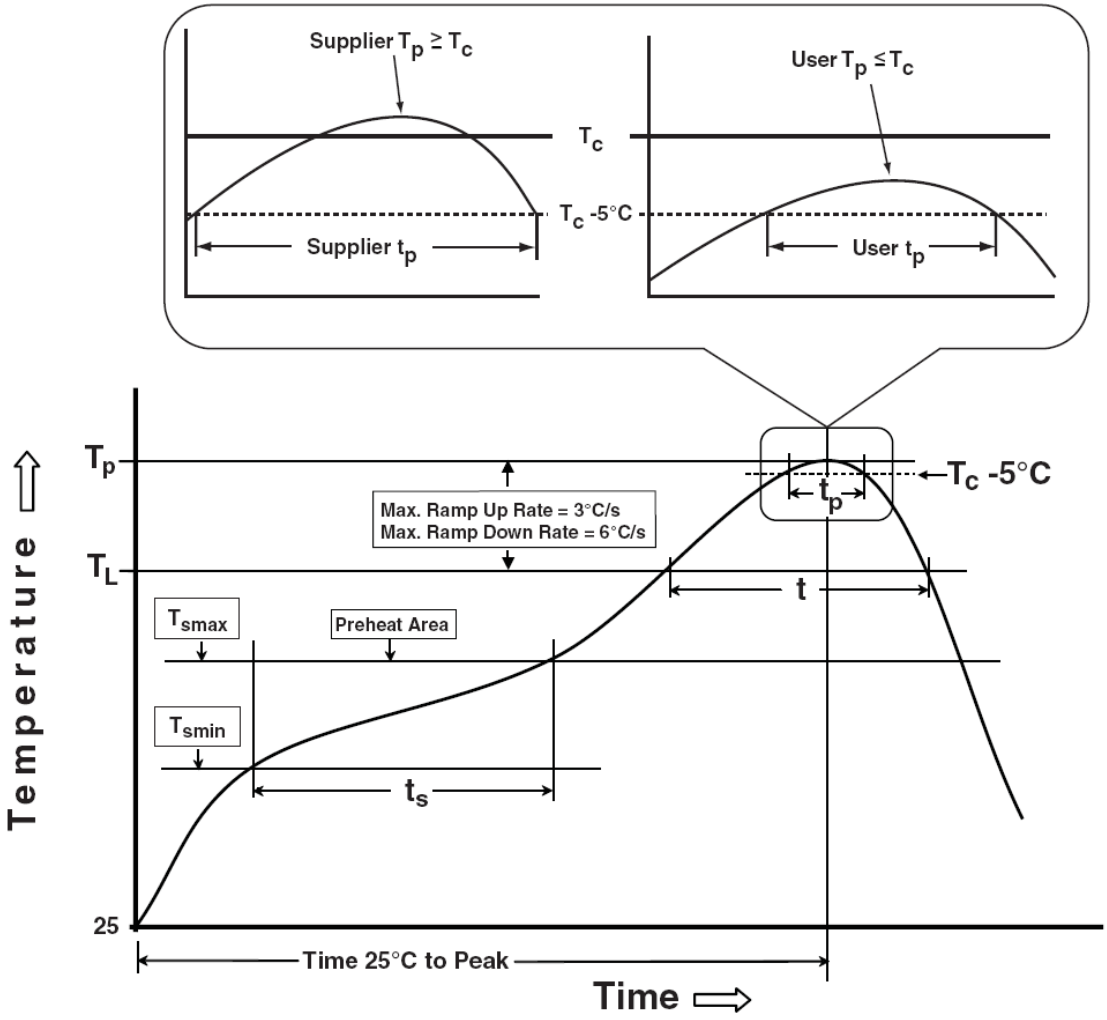
Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak Temperature min (T_{smin}) Temperature max (T_{smax}) Time (T_{smin} to T_{smax}) (t_s)	100 °C 150 °C 60-120 seconds	150 °C 200 °C 60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183 °C 60-150 seconds	217 °C 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 (Tc)

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 (Tc)

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 @ Tjmax
HTGB	JESD-22, A108	1000 Hrs, 100% of VGS max @ Tjmax
PCT	JESD-22, A102	168 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	500 Cycles, -65°C~150°C

Customer Service

Sinopower Semiconductor Inc.

5F, No. 6, Dusing 1St Rd., Hsinchu Science Park,
Hsinchu, 30078, Taiwan
TEL: 886-3-5635818 Fax: 886-3-5635080