SM1691OSCS

Single N-Channel Enhancement Mode MOSFET
with Schottky Diode

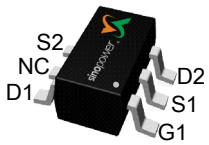
Features

- **Channel 1 (NMOS)**
  60V/0.26A,
  $R_{DS(ON)}$= 2.2Ω(max.) @ V_{GS}=10V
  $R_{DS(ON)}$= 2.6Ω(max.) @ V_{GS}=4.5V
- **Channel 2 (Schottky Diode)**
  40V/0.35A,
  V_f= 0.4V(max.) @ I_F=0.02A
  V_f= 0.6V(max.) @ I_F=0.2A
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)
- NMos With Gate ESD Protection
- Moisture Sensitivity Level MSL1 (per JEDEC J-STD-020D)

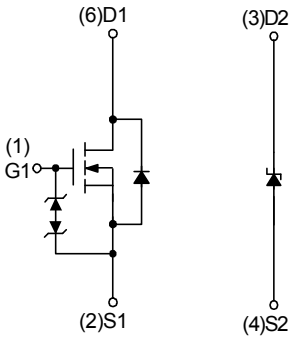
Applications

- Load switch.
- High-speed line driver.
- Switching circuits.

Pin Description



Top View of SOT-363



N-MOSFET Schottky Diode

Ordering and Marking Information

SM1691OS □□□-□□ □

- Assembly Material
- Handling Code
- Temperature Range
- Package Code

Package Code
CS : SOT-363
Operating Junction Temperature Range
C : -55 to 150 °C
Handling Code
TR : Tape & Reel
Assembly Material
G : Halogen and Lead Free Device

SM1691OS CS : M91X

X - 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).

SINOPOWER 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°C unless otherwise noted)

- **Channel 1**

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_A=25°C	0.1	A
I_D	Continuous Drain Current	T_A=25°C	0.26	A
		T_A=70°C	0.21	
I_{DM} [a]	Pulsed Drain Current	T_A=25°C	1	A
P_D	Maximum Power Dissipation	T_A=25°C	0.25	W
		T_A=70°C	0.16	
$R_{\theta JA}$ [b]	Thermal Resistance-Junction to Ambient	Steady State	500	°C/W

- **Channel 2**

Symbol	Parameter		Rating	Unit
Common Ratings				
V_{RRM}	Peak Repetitive Reverse Voltage		40	V
V_{RWM}	Working Peak Reverse Voltage		40	
V_R	DC Reverse Voltage		40	V
V_{RMS}	RMS Reverse Voltage		28	V
I_S	Diode Continuous Forward Current	T_A=25°C	0.35	A
I_{SM} [a]	Non-Repetitive Peak Forward Current	T_A=25°C	1.5	A
P_D	Maximum Power Dissipation	T_A=25°C	0.25	W
		T_A=70°C	0.16	
$R_{\theta JA}$ [b]	Thermal Resistance-Junction to Ambient		500	°C/W

Note a：Pulse width limited by max. junction temperature.
Note b：Surface Mounted on 1in^2 pad area.

Copyright © Sinopower Semiconductor, Inc.

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

- **Channel 1**

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	2.5	V
I_{GSS}	Gate Leakage Current	V_{GS}=±20V, V_{DS}=0V	-	-	±10	μA
$R_{DS(ON)}$ [d]	Drain-Source On-state Resistance	V_{GS}=10V, I_{DS}=100mA	-	1.8	2.2	Ω
		V_{GS}=4.5V, I_{DS}=50mA	-	2	2.6	Ω
Diode Characteristics						
V_{SD} [c]	Diode Forward Voltage	I_{SD}=100mA, V_{GS}=0V	-	0.8	1.3	V
t_{rr}	Reverse Recovery Time	I_{SD}=1A, dI_{SD}/dt=100A/μs	-	13	-	ns
Q_{rr}	Reverse Recovery Charge		-	8	-	nC
Dynamic Characteristics [c]						
C_{iss}	Input Capacitance	V_{GS}=0V, V_{DS}=30V, Frequency=1.0MHz	-	24	32	pF
C_{oss}	Output Capacitance		-	5.5	-	
C_{rss}	Reverse Transfer Capacitance		-	2.5	-	
$t_{d(ON)}$	Turn-on Delay Time	V_{DD}=30V, R_L=300Ω, I_{DS}=0.1A, V_{GEN}=10V, R_G=6Ω	-	3	6	ns
t_r	Turn-on Rise Time		-	7	13	
$t_{d(OFF)}$	Turn-off Delay Time		-	10	18	
t_f	Turn-off Fall Time		-	12	22	
Gate Charge Characteristics [d]						
Q_g	Total Gate Charge	V_{DS}=30V, V_{GS}=10V, I_{DS}=1A	-	1.6	2.3	nC
Q_{gs}	Gate-Source Charge		-	0.6	-	
Q_{gd}	Gate-Drain Charge		-	0.1	-	

Copyright © Sinopower Semiconductor, Inc.

Electrical Characteristics (Cont.)

- **Channel 2**

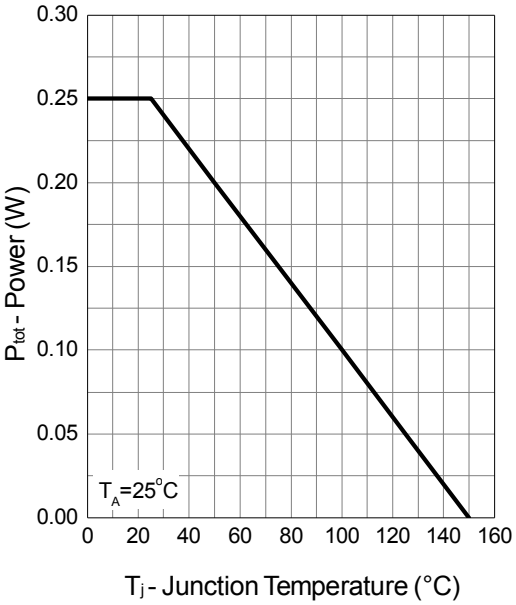
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Diode Characteristics						
V_{BR}	Reverse Breakdown Voltage	I_{BR}=250μA	40	-	-	V
V_F [c]	Diode Forward Voltage	I_F=0.02A	-	-	0.4	V
		I_F=0.2A	-	-	0.6	V
I_R	Reverse Current	V_{BR}=32V	-	-	5	μA
C_T	Total Capacitance	V_{BR}=20V, Frequency=1.0MHz	-	4.6	-	pF
t_{rr}	Reverse Recovery Time	I_F=1A, dI_F/dt=100A/μs, V_{BR}=25V	-	4.1	-	ns
Q_{rr}	Reverse Recovery Charge		-	1	-	nC

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

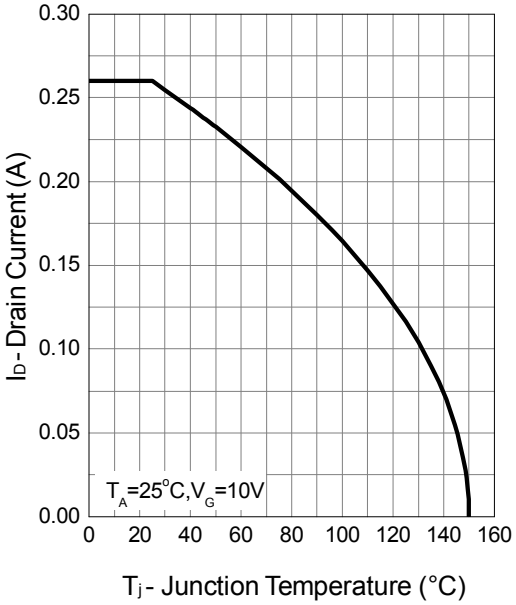
Copyright © Sinopower Semiconductor, Inc.

Channel 1 Typical Operating Characteristics

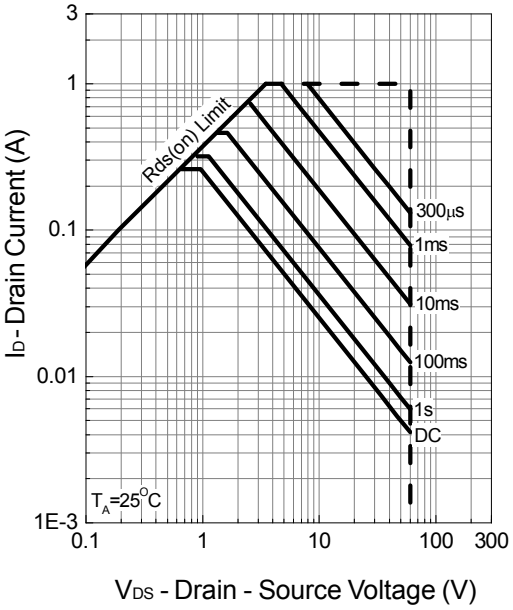
Power Dissipation



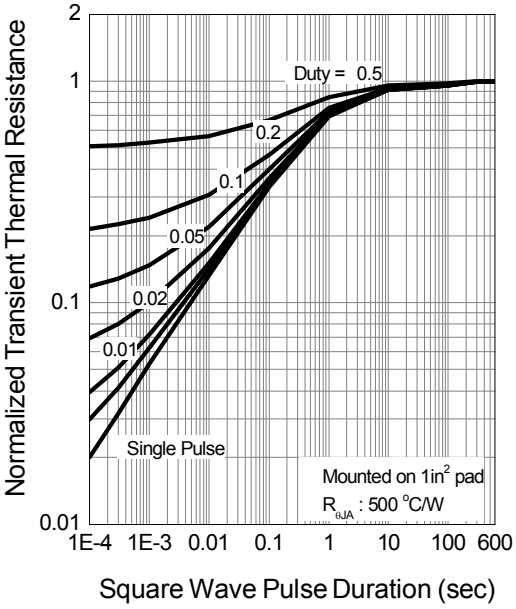
Drain Current



Safe Operation Area



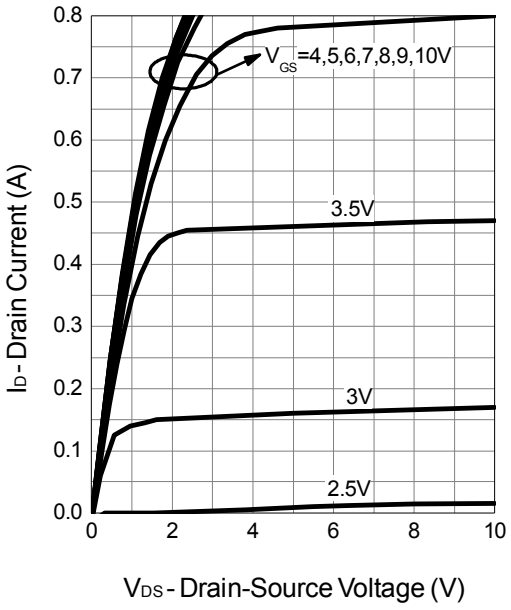
Thermal Transient Impedance



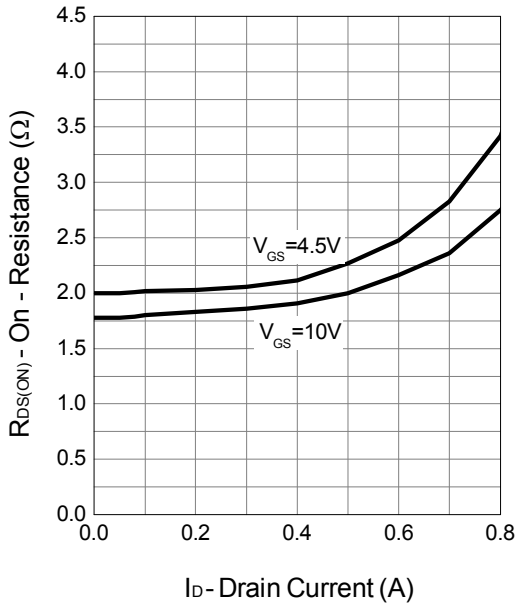
Copyright © Sinopower Semiconductor, Inc.

Channel 1 Typical Operating Characteristics (Cont.)

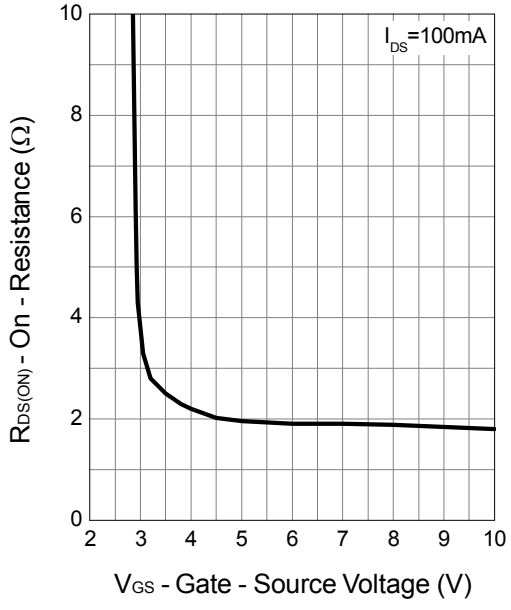
Output Characteristics



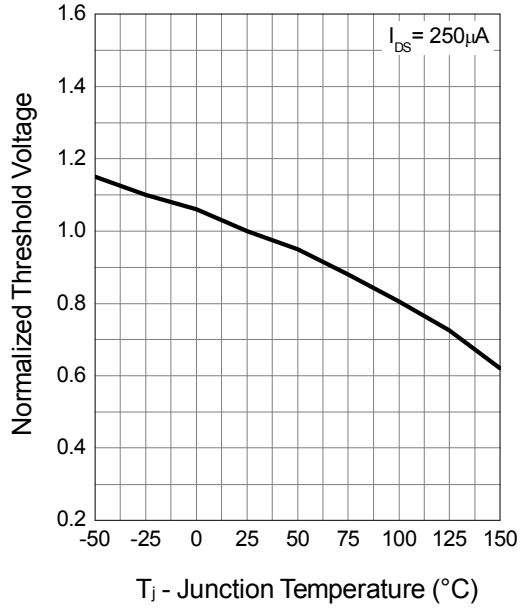
Drain-Source On Resistance



Gate-Source On Resistance



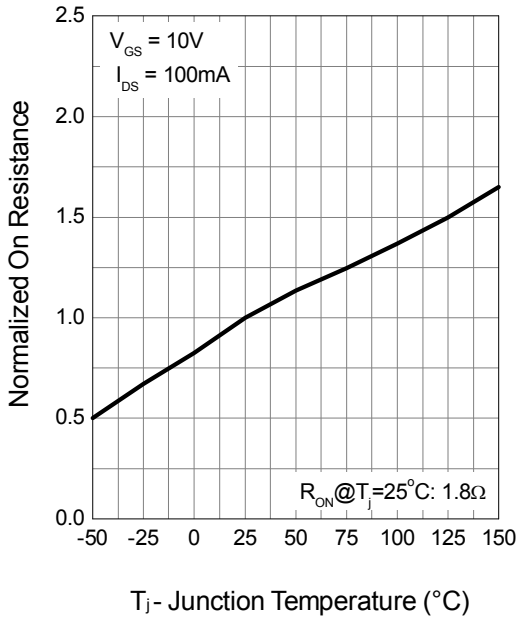
Gate Threshold Voltage



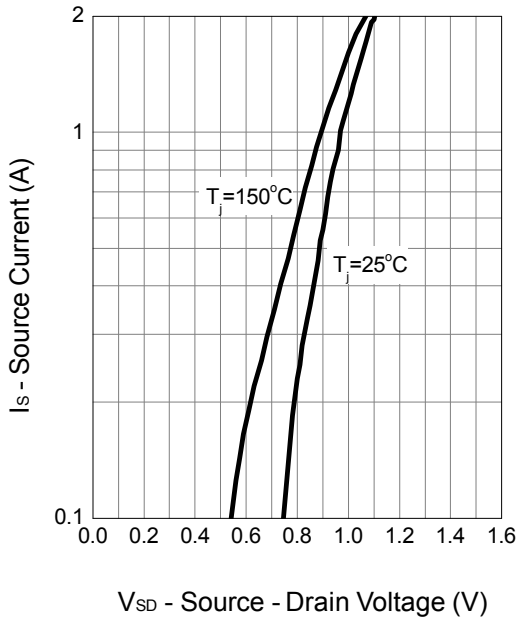
Copyright © Sinopower Semiconductor, Inc.

Channel 1 Typical Operating Characteristics (Cont.)

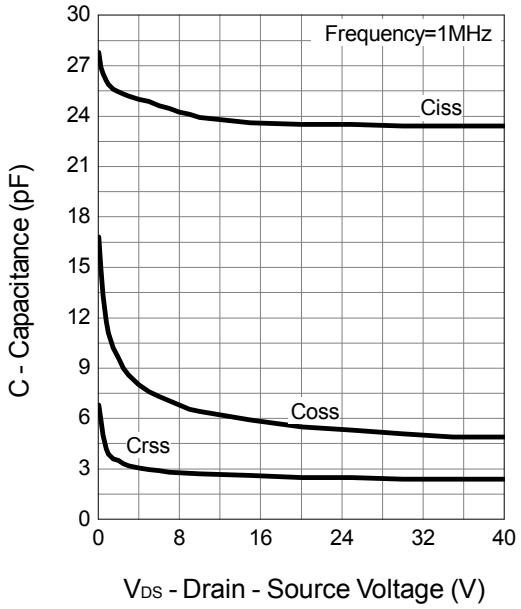
Drain-Source On Resistance



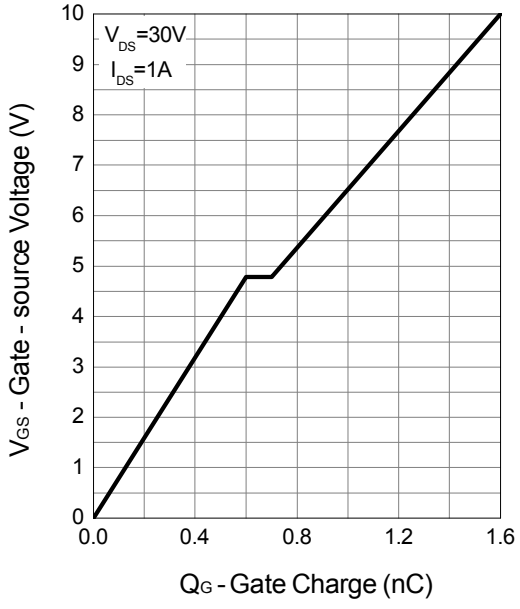
Source-Drain Diode Forward



Capacitance



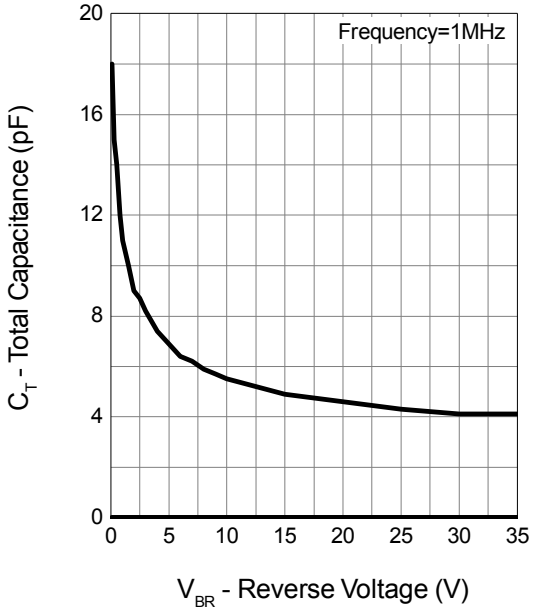
Gate Charge



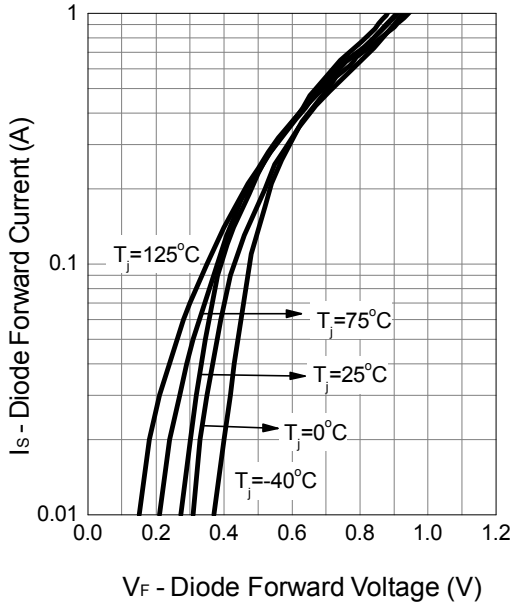
Copyright © Sinopower Semiconductor, Inc.

Channel 2 Typical Operating Characteristics

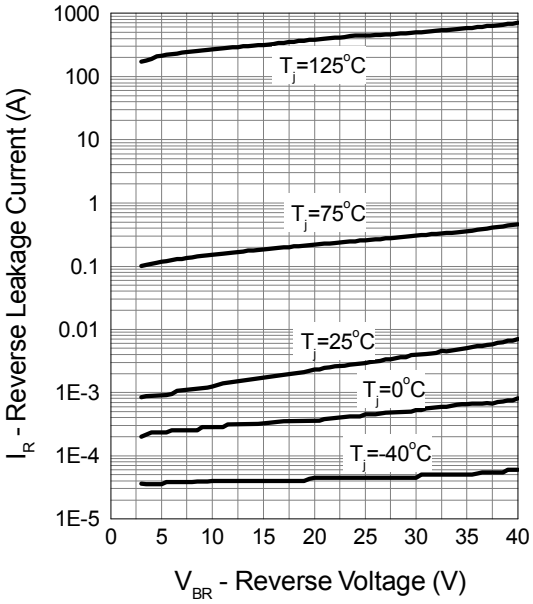
Capacitance



Source-Drain Diode Forward

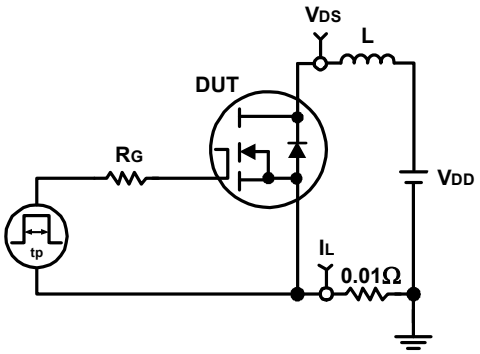


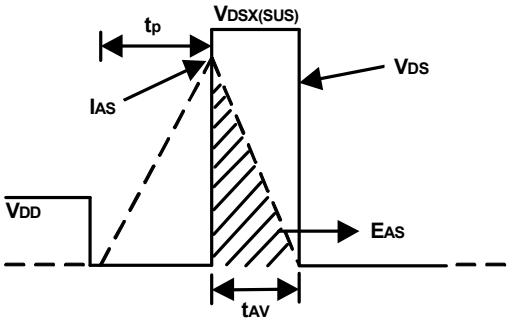
Body Diode Reverse Leakage Current



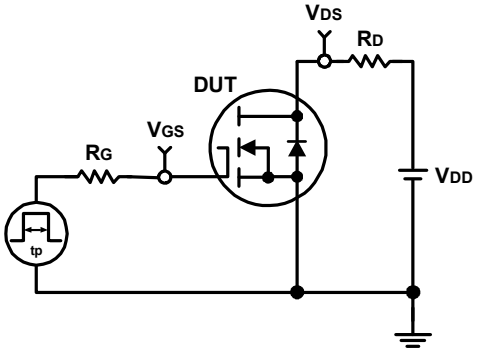
Copyright © Sinopower Semiconductor, Inc.

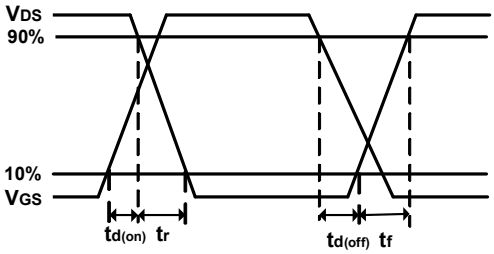
Avalanche Test Circuit and Waveforms





Switching Time Test Circuit and Waveforms





Copyright © Sinopower Semiconductor, Inc.

Disclaimer

Sinopower Semiconductor, Inc. (hereinafter “Sinopower”) has been making great efforts to development high quality and better performance products to satisfy all customers’ needs. However, a product may fail to meet customer’s expectation or malfunction for various situations.

All information which is shown in the datasheet is based on Sinopower’s research and development result, therefore, Sinopower shall reserve the right to adjust the content and monitor the production.

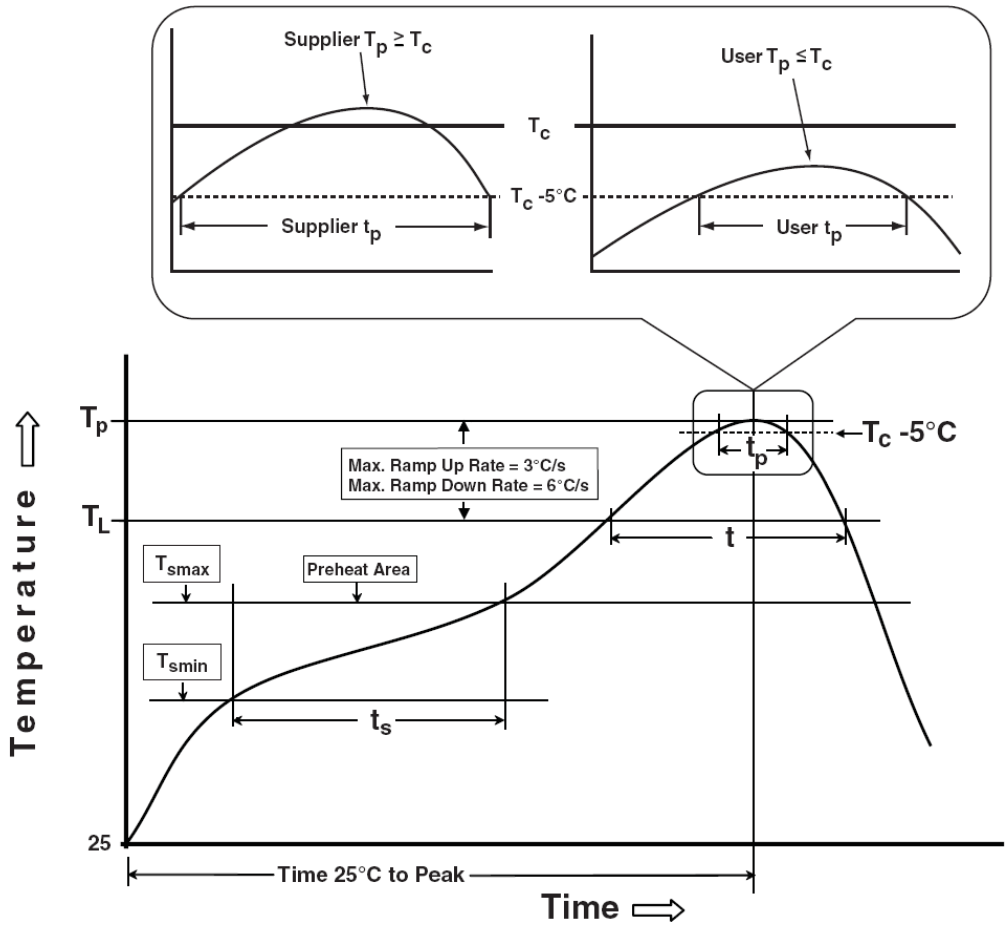
In order to unify the quality and performance, Sinopower has been following JEDEC while defines assembly rule. Notwithstanding all the suppliers basically follow the rule for each product, different processes may cause slightly different results.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the products. Sinopower does not grant customers explicitly or implicitly, any license to use or exercise intellectual property or other rights held by Sinopower and other parties. Sinopower shall bear no responsible whatsoever for any dispute arising from the use of such technical information.

The products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability, such as the failure or malfunction of which any may result in a direct threat to human life or a risk of human injury. Sinopower shall bear no responsibility in any way for use of any of the products for the above special purposes. If a product is intended to use for any such special purpose, such as vehicle, military, or medical controller relevant applications, please contact Sinopower sales representative before purchasing.

Copyright © Sinopower Semiconductor, Inc.

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