

Dual N-Channel Enhancement Mode MOSFET

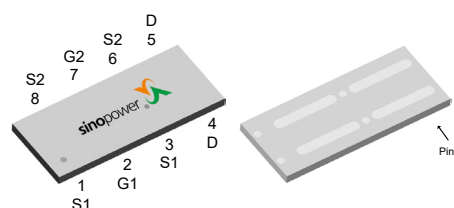
Features

- 30V/23A
 $R_{DS(ON)} = 2.3m\Omega(max.) @ V_{GS} = 10V$
 $R_{DS(ON)} = 3.2m\Omega(max.) @ V_{GS} = 4.5V$
- Reliable and Rugged
- Lead Free and Green Devices Available
(RoHS Compliant)
- Moisture Sensitivity Level MSL1
(per JEDEC J-STD-020D)

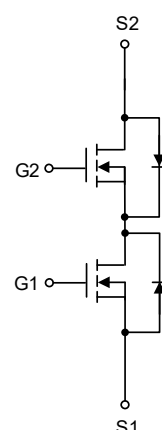
Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems.

Pin Description



WLCSP-A_5.97x2.47-8



N-Channel MOSFET

Ordering and Marking Information

SM9991DS - Assembly Material Handling Code Temperature Range Package Code	Package Code HE : WLCSP-A_5.97x2.47-8 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device
SM9991DS HE : 9991I 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).

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

Symbol	Parameter		Rating	Unit
Common Ratings				
V _{SSS}	Source to Source Voltage		30	V
V _{GSS}	Gate-Source Voltage		±20	
T _J	Maximum Junction Temperature		150	°C
T _{STG}	Storage Temperature Range		-55 to 150	
I _S	Continuous Source Current	T _A =25°C	23	A
		T _A =70°C	19	
I _{SM} ^a	Pulsed Source Current	T _A =25°C	94	
P _D	Maximum Power Dissipation	T _A =25°C	2.3	W
		T _A =70°C	1.5	
R _{θJA} ^b	Thermal Resistance-Junction to Ambient	t ≤ 10s	24	°C/W
		Steady state	55	
I _{AS} ^{c,T8}	Avalanche Current, Single pulse	L=1mH	20	A
E _{AS} ^{c,T8}	Avalanche Energy, Single pulse	L=1mH	200	mJ

Note a : Pulse width limited by maximum junction temperature.

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

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)

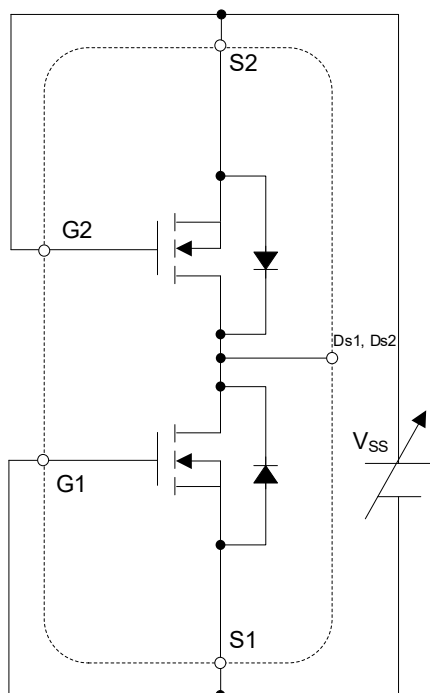
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
BV_{SSS}^{T1}	Source-Source Breakdown Voltage	$V_{GS}=0V, I_{SS}=250\mu A$	30	-	-	V
I_{SSS}^{T1}	Zero Gate Voltage Source Current	$V_{SS}=24V, V_{GS}=0V$	-	-	1	μA
		$T_J=85^{\circ}C$	-	-	30	
$V_{GS(th)}^{T2}$	Gate Threshold Voltage	$V_{GS}=V_{SS}, I_{SS}=250\mu A$	1.2	1.6	2	V
I_{GSS}^{T3}	Gate Leakage Current	$V_{GS}=\pm 20V, V_{SS}=0V$	-	-	± 100	nA
$R_{SS(ON)}^{d,T4}$	Source -Source On-state Resistance	$V_{GS}=10V, I_{SS}=10A$	-	1.9	2.3	m Ω
		$V_{GS}=4.5V, I_{SS}=10A$	-	2.5	3.2	
Diode Characteristics						
$V_{FSS}^{d,T5}$	Diode Forward Voltage	$I_{SS}=1A, V_{GS}=0V$	-	0.66	1.1	V
Dynamic Characteristics ^e						
R_G	Gate Resistance	$V_{GS}=0V, V_{SS}=0V, F=1MHz$	-	1	-	Ω
C_{iss}	Input Capacitance	$V_{GS}=0V,$ $V_{SS}=15V,$ Frequency=1.0MHz	-	7000	9100	pF
C_{oss}	Output Capacitance		-	660	-	
C_{rss}	Reverse Transfer Capacitance		-	340	-	
$t_{d(ON)}^{T6}$	Turn-on Delay Time	$V_{SS}=15V, R_L=15\Omega,$ $I_{SS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$	-	28	51	ns
t_r^{T6}	Turn-on Rise Time		-	19	35	
$t_{d(OFF)}^{T6}$	Turn-off Delay Time		-	137	247	
t_f^{T6}	Turn-off Fall Time		-	62	112	
Gate Charge Characteristics ^{e,T7}						
Q_g	Total Gate Charge	$V_{SS}=15V, V_{GS}=10V,$ $I_{SS}=10A$	-	125	188	nC
Q_g	Total Gate Charge	$V_{SS}=15V, V_{GS}=4.5V,$ $I_{SS}=10A$	-	62	93	
Q_{gth}	Threshold Gate Charge		-	9.7	-	
Q_{gs}	Gate-Source Charge		-	16	-	
Q_{gd}	Gate-Drain Charge		-	22	-	

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

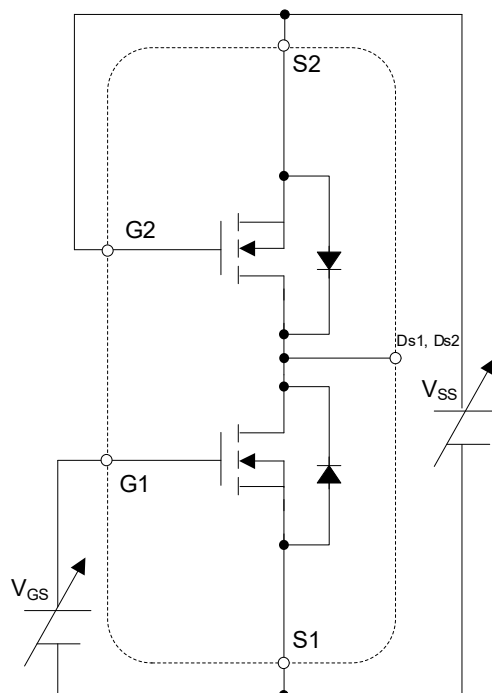
Note e : Guaranteed by design, not subject to production testing.

Note T1-T8 : Test Circuit 1-8.

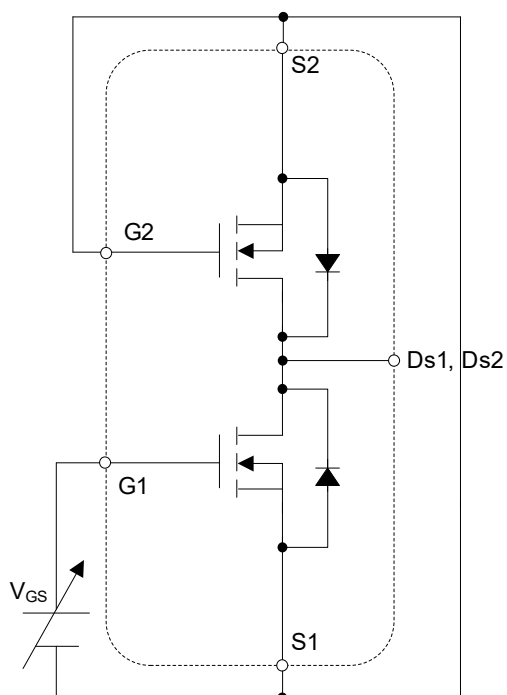
Test Circuit 1 (BV_{SSS} , I_{SSS})



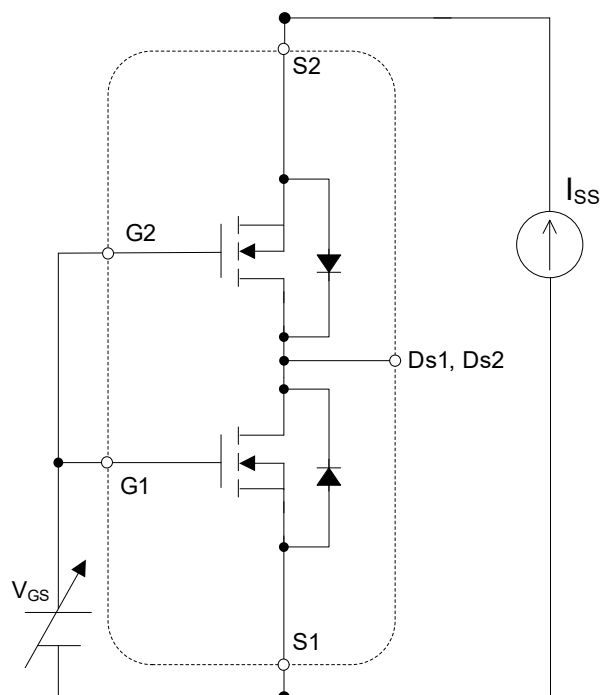
Test Circuit 2 ($V_{GS(th)}$)



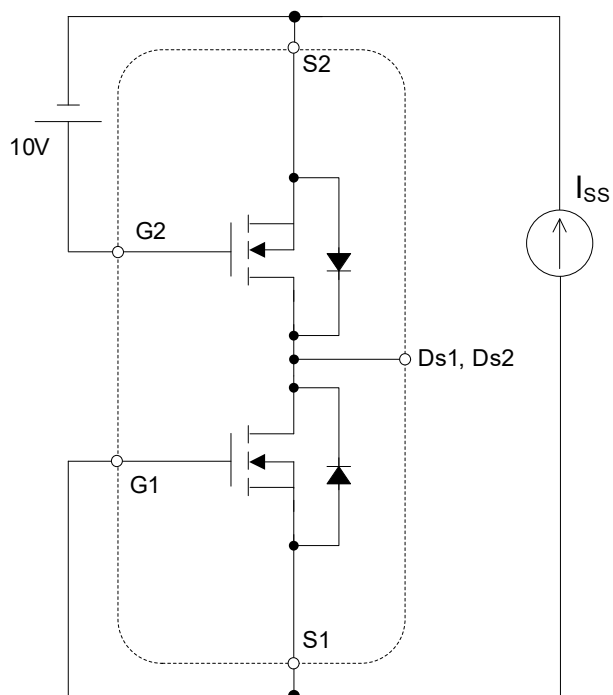
Test Circuit 3 (I_{GSS})



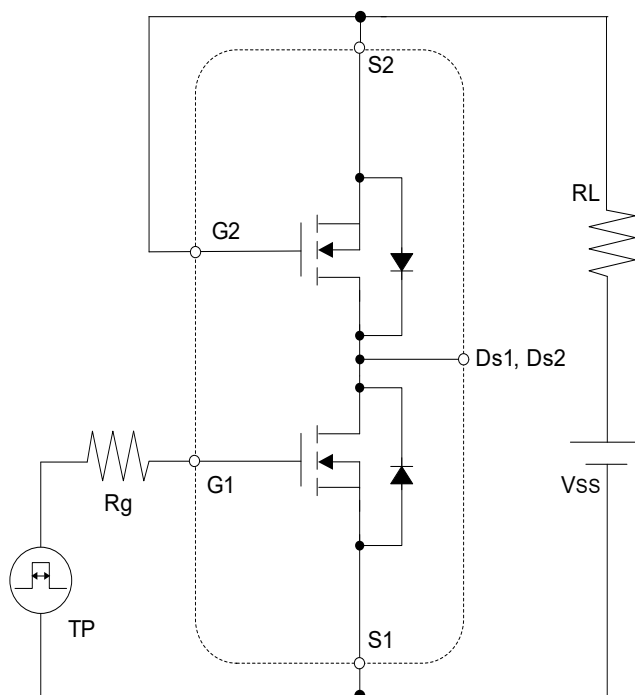
Test Circuit 4 ($R_{SS(ON)}$)



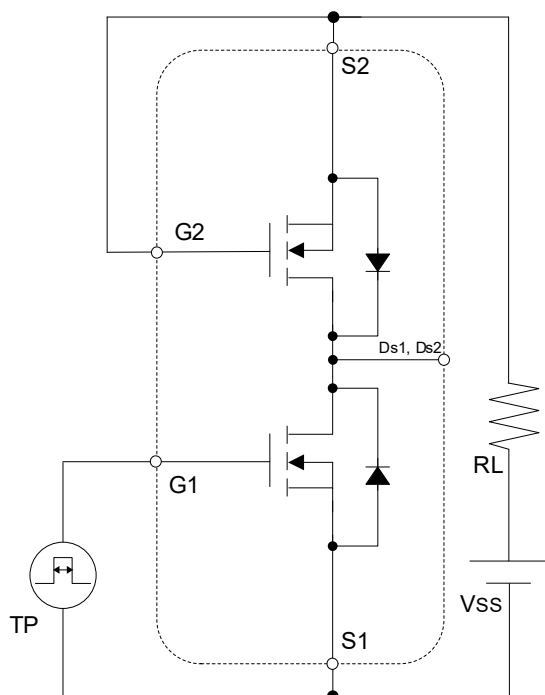
Test Circuit 5 (V_{ss})



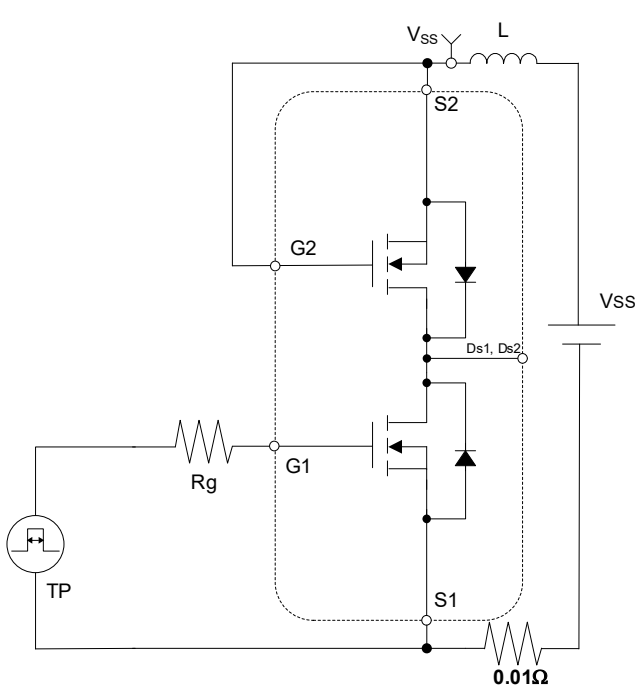
Test Circuit 6 (Switching time)



Test Circuit 7 (Gate Charge)

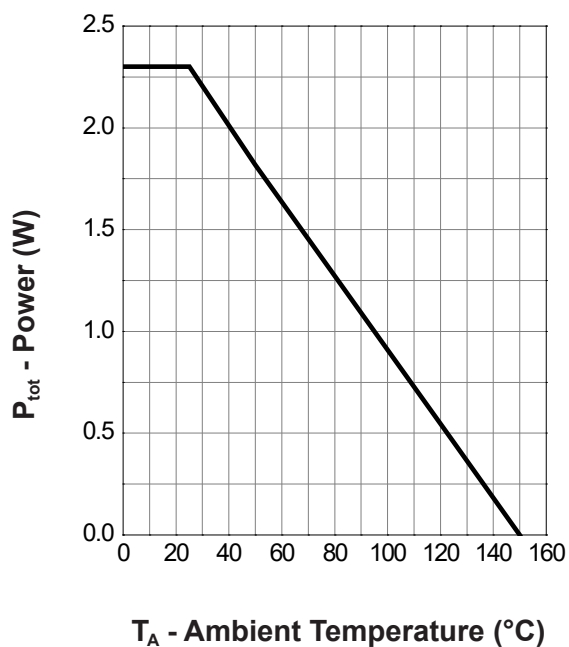


Test Circuit 8 (Avalanche test)

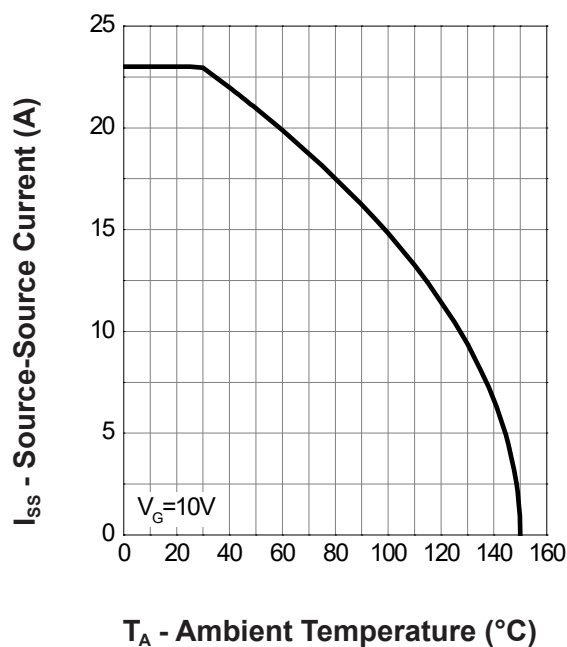


Typical Operating Characteristics

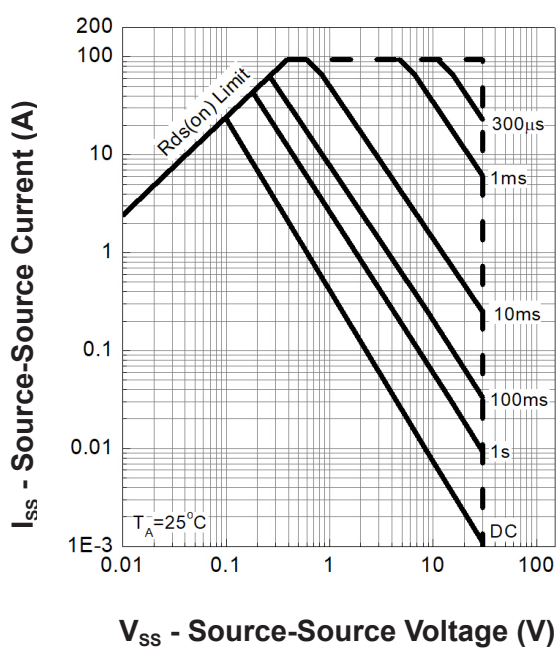
Power Dissipation



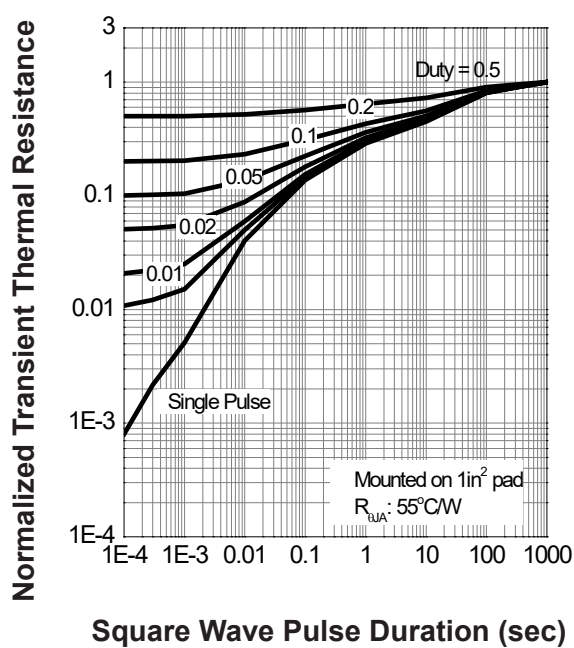
Source-Source Current



Safe Operation Area

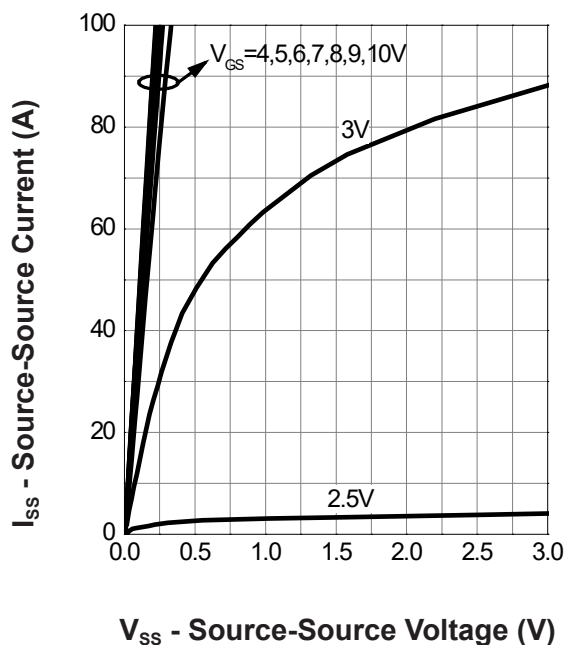


Thermal Transient Impedance

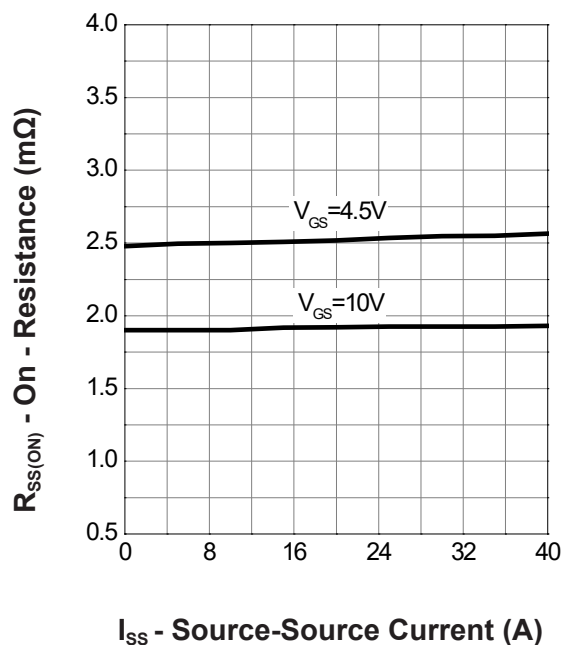


Typical Operating Characteristics(Cont.)

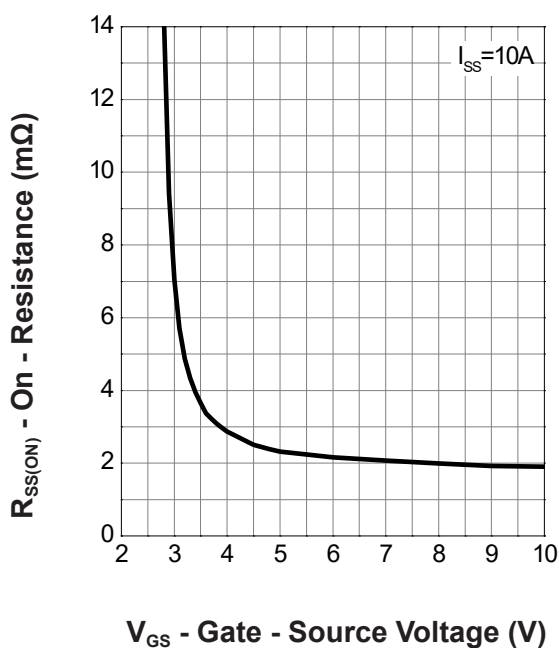
Output Characteristics



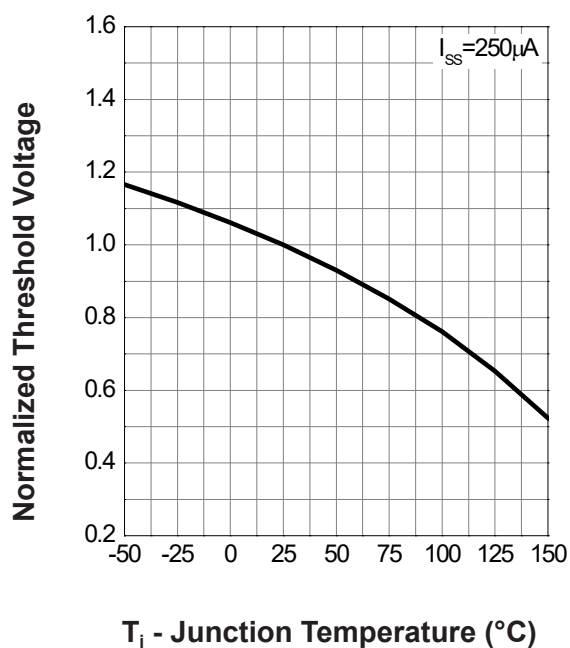
Source-Source On Resistance



Gate-Source On Resistance

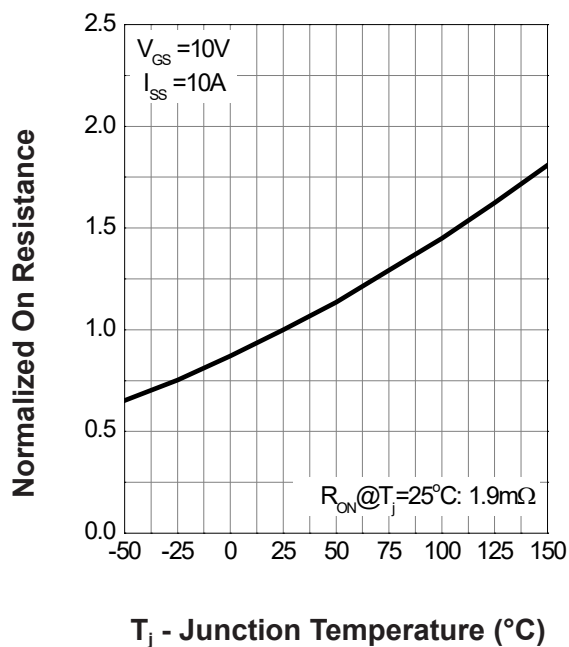


Gate Threshold Voltage

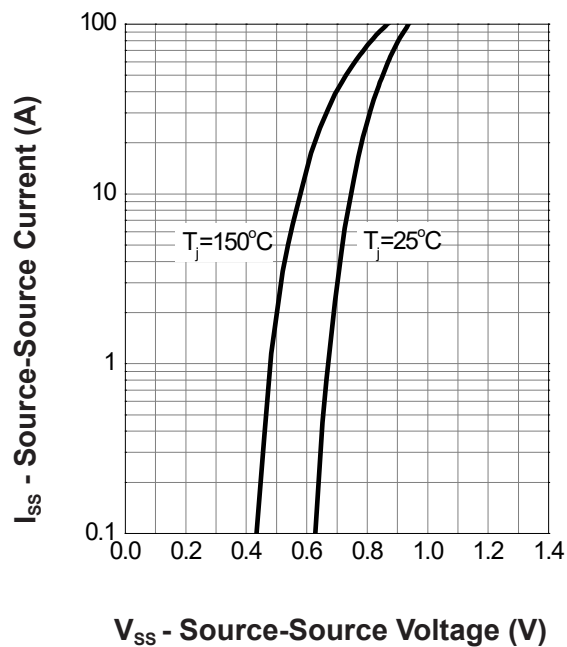


Typical Operating Characteristics(Cont.)

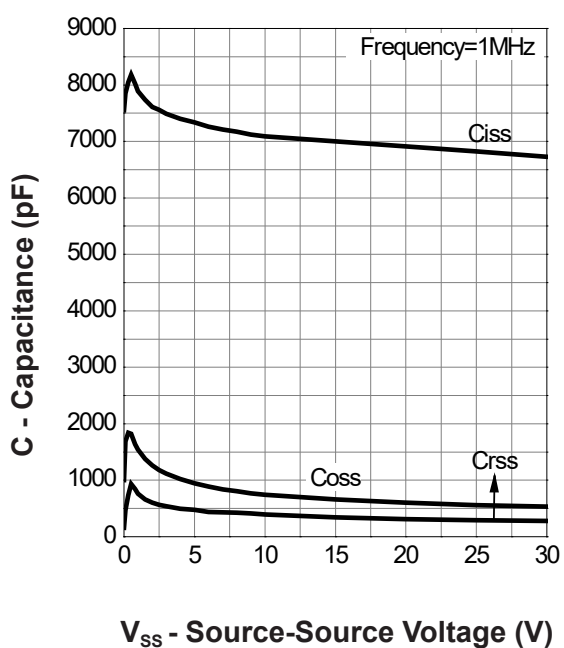
Source-Source On Resistance



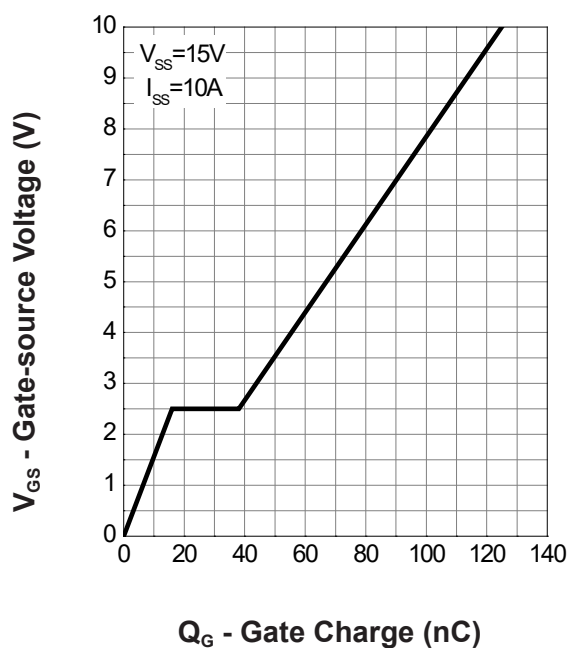
Source-Source Diode Forward



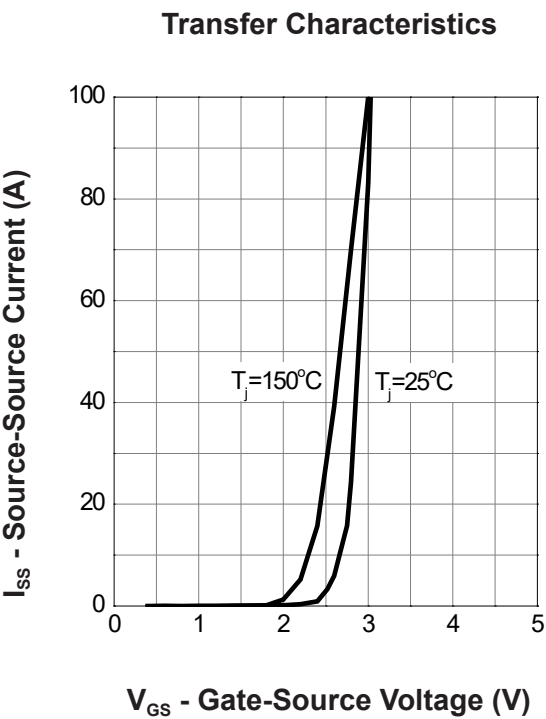
Capacitance



Gate Charge



Typical Operating Characteristics(Cont.)



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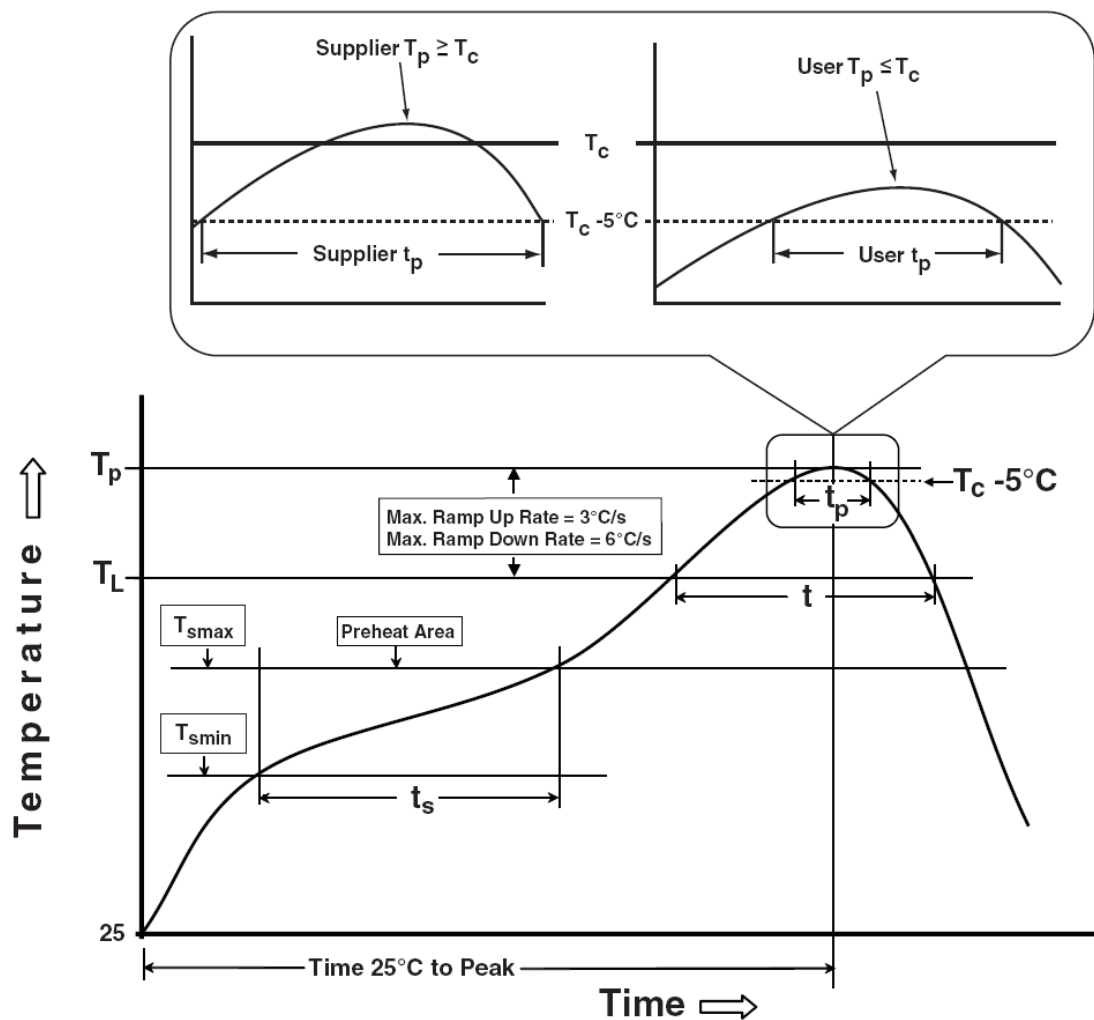
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Classification Profile



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

Customer Service

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