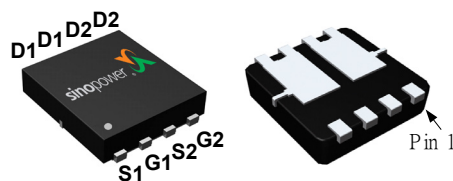


Dual Enhancement Mode MOSFET (N-and P-Channel)

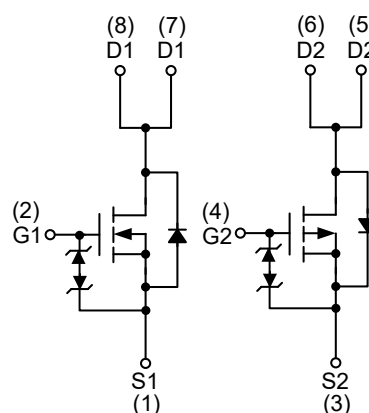
Features

- N Channel : 60V/14.5A,
 $R_{DS(ON)}=51m\Omega(max.)@V_{GS}=10V$
 $R_{DS(ON)}=60m\Omega(max.)@V_{GS}=4.5V$
- P Channel : -60V/-14.5A,
 $R_{DS(ON)}=54m\Omega(max.)@V_{GS}=-10V$
 $R_{DS(ON)}=72m\Omega(max.)@V_{GS}=-4.5V$
- 100% UIS + R_g Tested
- ESD Protection
- Reliable and Rugged
- Lead Free and Green Devices Available
(RoHS Compliant)
- Moisture Sensitivity Level MSL1
(per JEDEC J-STD-020D)

Pin Description



DFN5x6C-8_EP2



N-Channel MOSFET

P-Channel MOSFET

Applications

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

Ordering and Marking Information

SM6113CS - Assembly Material Handling Code Temperature Range Package Code	Package Code KP : DFN5x6C-8_EP2 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device
SM6113CS KP :	 6113CS XXXXX XXXXXX - 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		N Channel	P Channel	Unit
Common Ratings					
V _{DSS}	Drain-Source Voltage		60	-60	V
V _{GSS}	Gate-Source Voltage		±20	±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	7	-7	A
I _D	Continuous Drain Current	T _C =25°C	14.5	-14.5	A
		T _C =100°C	9.2	-9.2	
I _{DM} ^a	Pulse Drain Current Tested	T _C =25°C	58	-58	A
P _D	Maximum Power Dissipation	T _C =25°C	20.8		W
		T _C =100°C	8.3		
R _{θJC}	Thermal Resistance-Junction to Case	Steady State	6		°C/W
I _D	Continuous Drain Current	T _A =25°C	4.1	4.1	A
		T _A =70°C	3.3	-3.3	
P _D	Maximum Power Dissipation	T _A =25°C	1.67		W
		T _A =70°C	1.07		
R _{θJA} ^b	Thermal Resistance-Junction to Ambient	Steady State	75		°C/W
I _{AS} ^c	Avalanche Current, Single pulse	L=0.5mH	8	-15	A
E _{AS} ^c	Avalanche Energy, Single pulse	L=0.5mH	16	56	mJ

Note a : Pulse width limited by maximum junction temperature.

Note b : Surface Mounted on 1in^2 pad area.

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

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

Symbol	Parameter	Test Conditions	N Channel			Unit
			Min.	Typ.	Max.	
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	1.5	2	3	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} =7A	-	42	51	mΩ
		V _{GS} =4.5V, I _{DS} =4A	-	46	60	
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =4A, V _{GS} =0V	-	0.8	1.1	V
t _{rr}	Reverse Recovery Time	I _{SD} =7A, dI _{SD} /dt=100A/μs	-	21	-	ns
Q _{rr}	Reverse Recovery Charge		-	20	-	nC
Dynamic Characteristics ^e						
R _G	Gate Resistance	V _{GS} =0V,V _{DS} =0V,f=1MHz	-	2.8	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =30V, Frequency=1.0MHz	-	550	715	pF
C _{oss}	Output Capacitance		-	60	-	
C _{rss}	Reverse Transfer Capacitance		-	31	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =30V, R _L =30Ω, I _{DS} =1A, V _{GEN} =10V, R _G =6Ω	-	10	18	ns
t _r	Turn-on Rise Time		-	6	11	
t _{d(OFF)}	Turn-off Delay Time		-	21	38	
t _f	Turn-off Fall Time		-	5.3	10	
Gate Charge Characteristics ^e						
Q _g	Total Gate Charge	V _{DS} =30V, V _{GS} =4.5V, I _{DS} =7A	-	4.9	-	nC
Q _g	Total Gate Charge	V _{DS} =30V, V _{GS} =10V, I _{DS} =7A	-	10	14	
Q _{gs}	Gate-Source Charge		-	1.7	-	
Q _{gd}	Gate-Drain Charge		-	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.

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

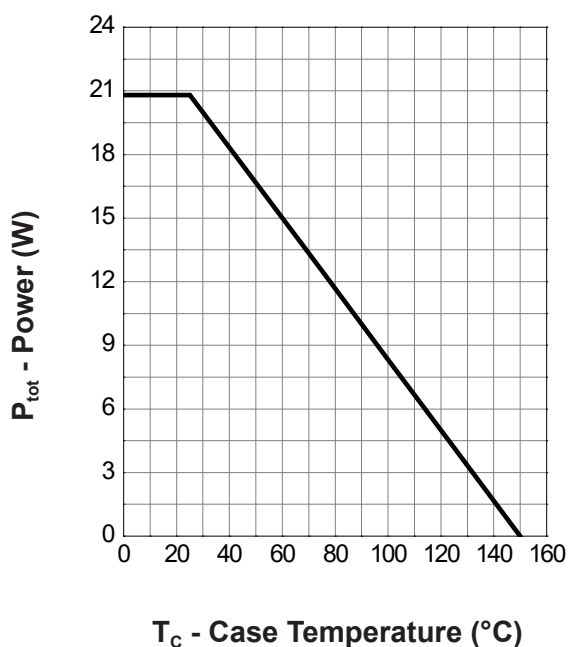
Symbol	Parameter	Test Conditions	P Channel			Unit
			Min.	Typ.	Max.	
Static Characteristics						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _{DS} =-250μA	-60	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} =-48V, V _{GS} =0V	-	-	-1	μA
		T _J =85°C	-	-	-30	
V _{GS(th)}	Gate Threshold Voltage	V _{DS} =V _{GS} , I _{DS} =-250μA	-1.5	-2	-3	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} =-7A	-	45	54	mΩ
		V _{GS} =-4.5V, I _{DS} =-4A	-	55	72	
Diode Characteristics						
V _{SD} ^d	Diode Forward Voltage	I _{SD} =-4A, V _{GS} =0V	-	-0.8	-1.1	V
t _{rr}	Reverse Recovery Time	I _{SD} =-7A, dI _{SD} /dt=100A/μs	-	27	-	ns
Q _{rr}	Reverse Recovery Charge		-	32	-	nC
Dynamic Characteristics ^e						
R _G	Gate Resistance	V _{GS} =0V,V _{DS} =0V,f=1MHz	-	3	-	Ω
C _{iss}	Input Capacitance	V _{GS} =0V, V _{DS} =-30V, Frequency=1.0MHz	-	1170	1520	pF
C _{oss}	Output Capacitance		-	113	-	
C _{rss}	Reverse Transfer Capacitance		-	66	-	
t _{d(ON)}	Turn-on Delay Time	V _{DD} =-30V, R _L =-30Ω, I _{DS} =-1A, V _{GEN} =-10V, R _G =6Ω	-	12	22	ns
t _r	Turn-on Rise Time		-	8	14	
t _{d(OFF)}	Turn-off Delay Time		-	40	72	
t _f	Turn-off Fall Time		-	12	22	
Gate Charge Characteristics ^e						
Q _g	Total Gate Charge	V _{DS} =-30V, V _{GS} =-4.5V, I _{DS} =-7A	-	11.4	-	nC
Q _g	Total Gate Charge	V _{DS} =-30V, V _{GS} =-10V, I _{DS} =-7A	-	23.7	33.2	
Q _{gs}	Gate-Source Charge		-	3.6	-	
Q _{gd}	Gate-Drain Charge		-	4.9	-	

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

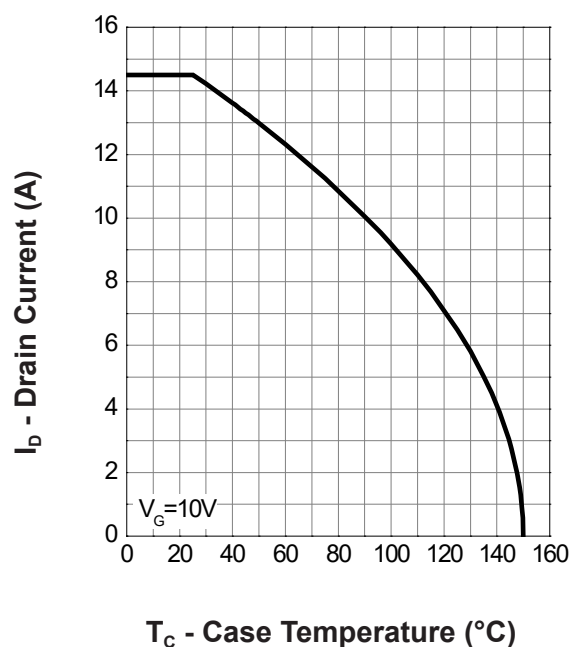
Note e : Guaranteed by design, not subject to production testing.

N Channel Typical Operating Characteristics

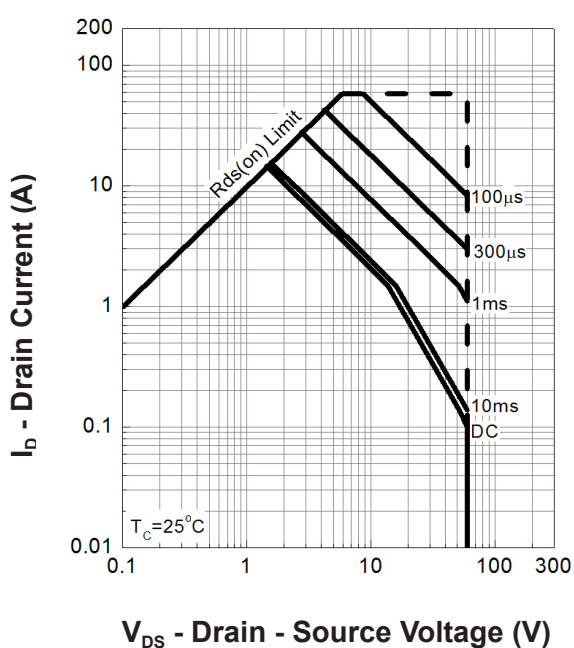
Power Dissipation



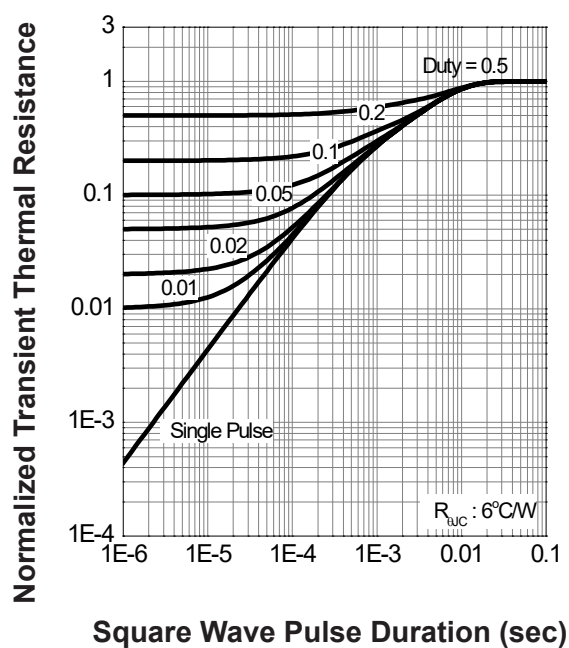
Drain Current



Safe Operation Area

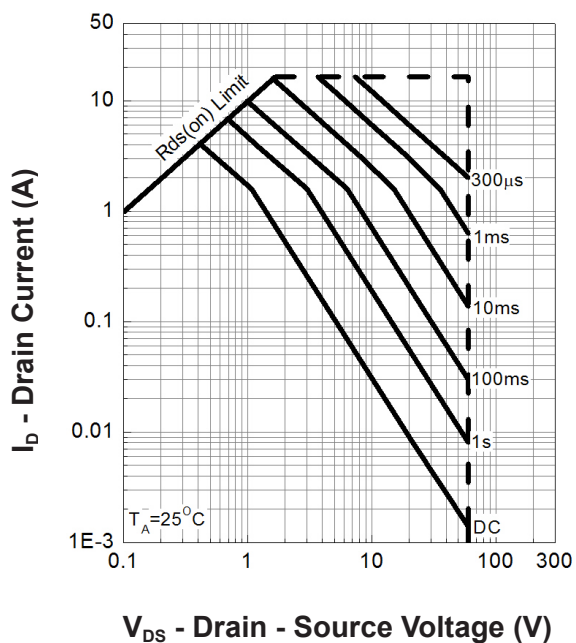


Thermal Transient Impedance

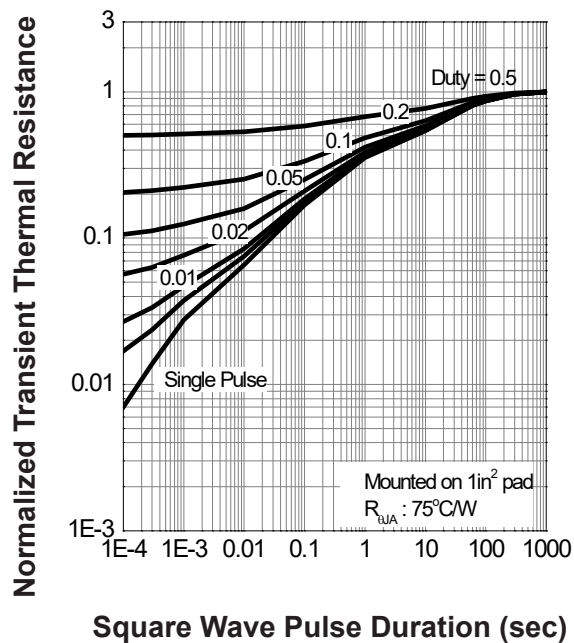


N Channel Typical Operating Characteristics(Cont.)

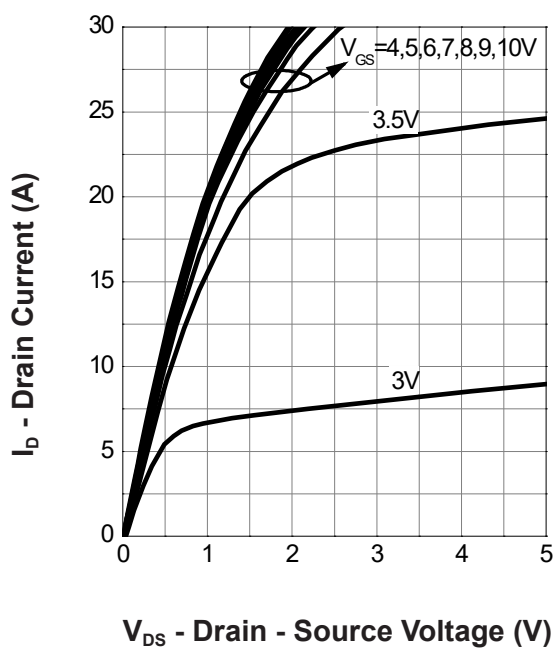
Safe Operation Area



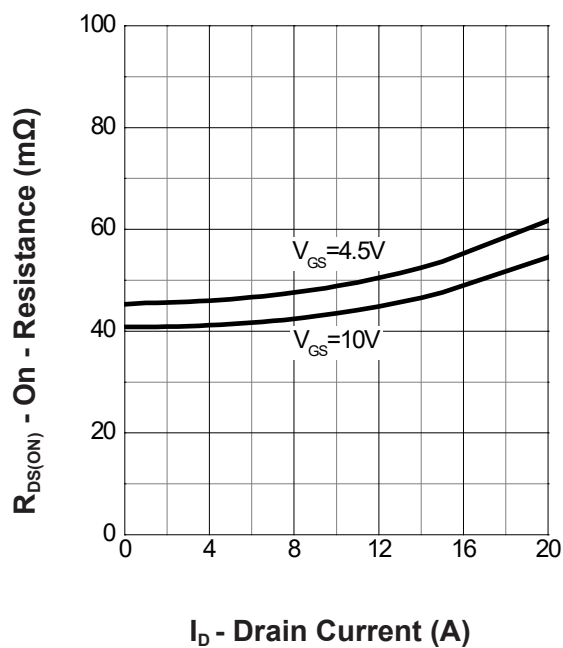
Thermal Transient Impedance



Output Characteristics

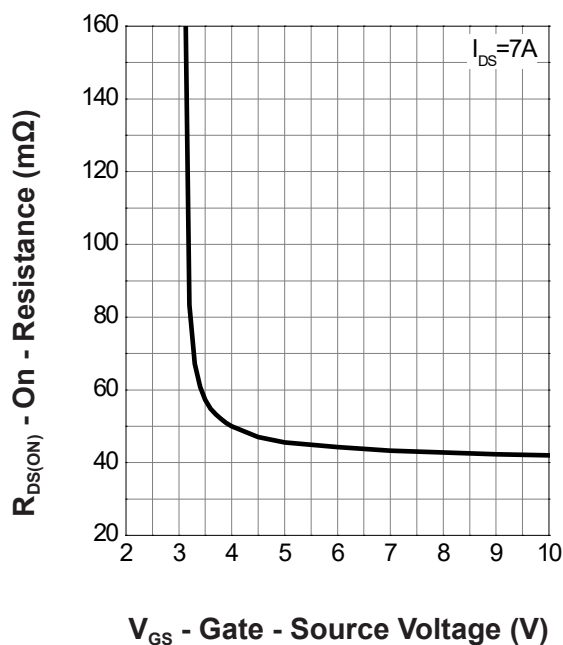


Drain-Source On Resistance

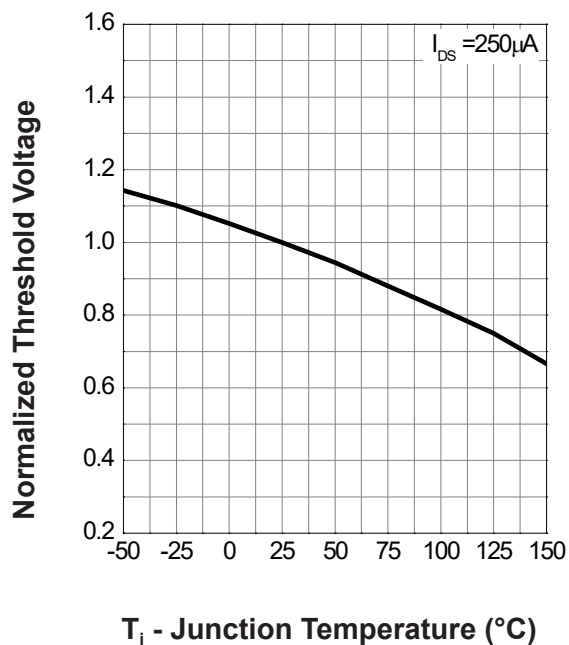


N Channel Typical Operating Characteristics(Cont.)

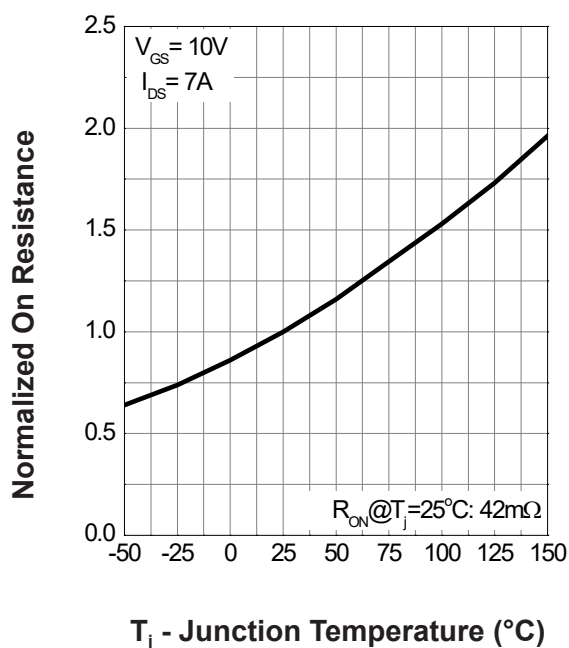
Gate-Source On Resistance



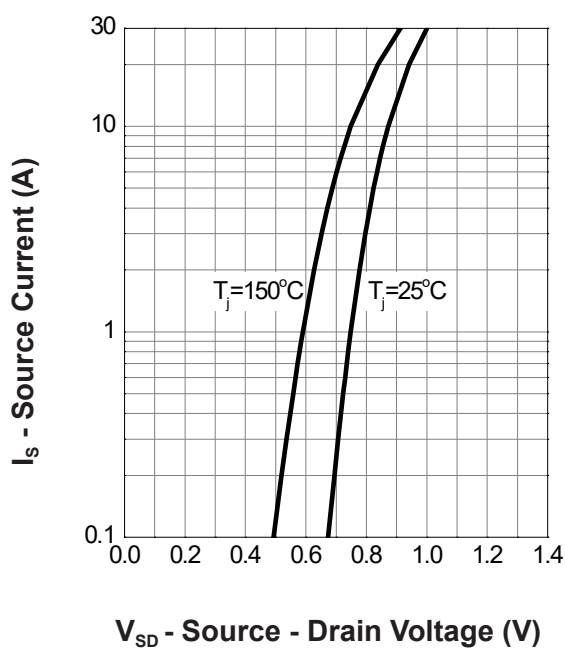
Gate Threshold Voltage



Drain-Source On Resistance

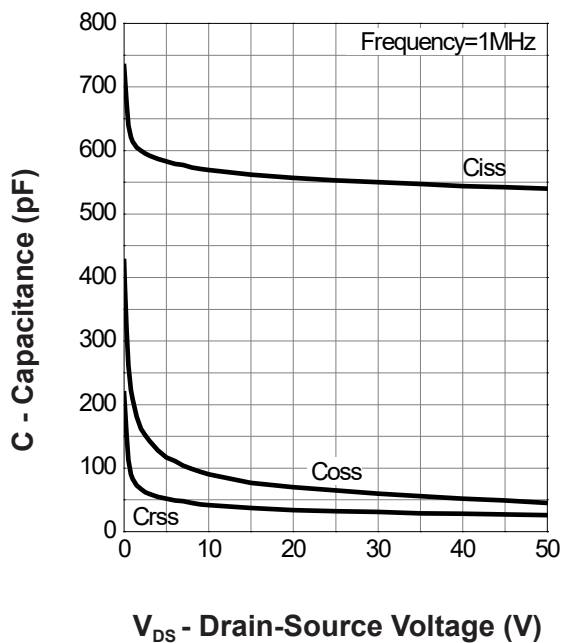


Source-Drain Diode Forward

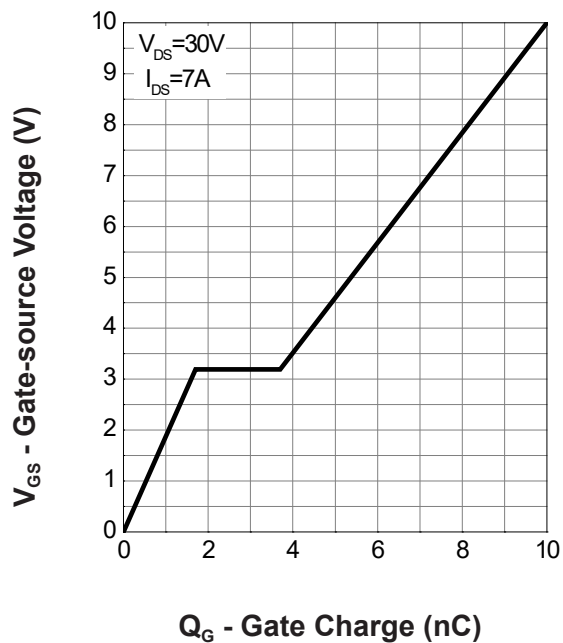


N Channel Typical Operating Characteristics(Cont.)

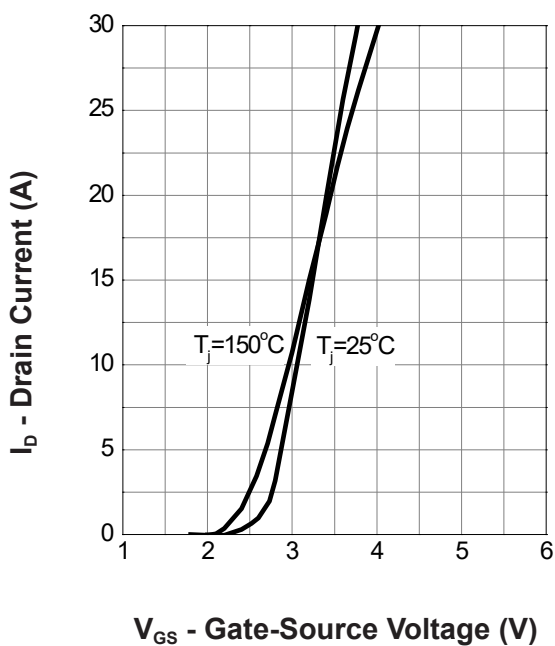
Capacitance



Gate Charge

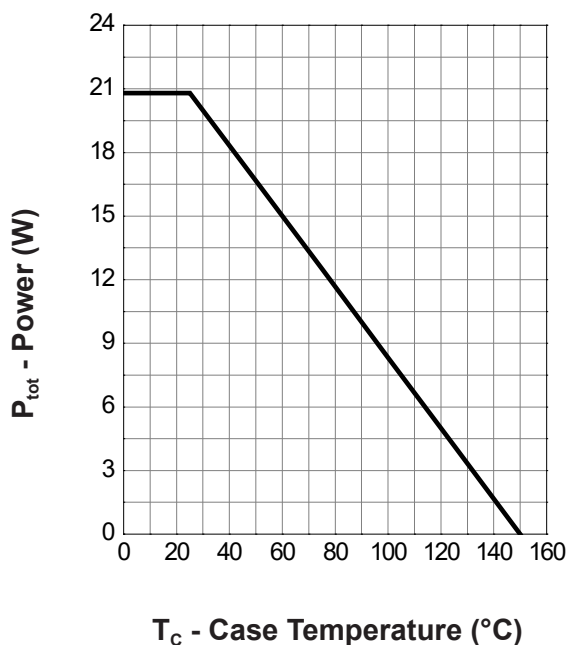


Transfer Characteristics

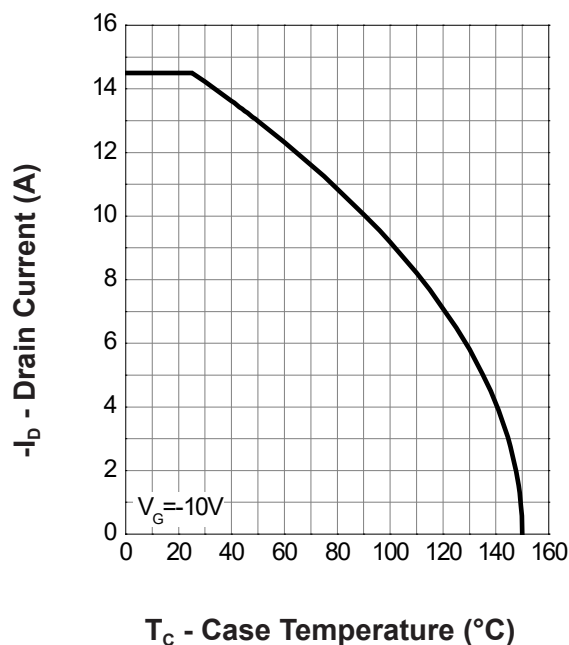


P Channel Typical Operating Characteristics

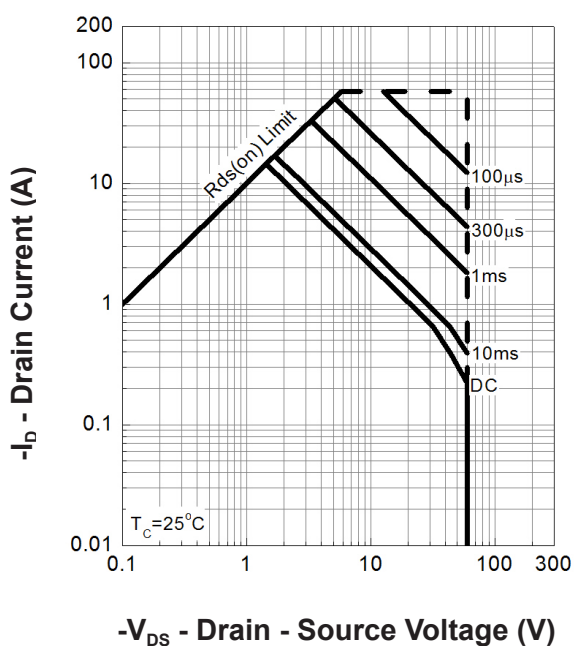
Power Dissipation



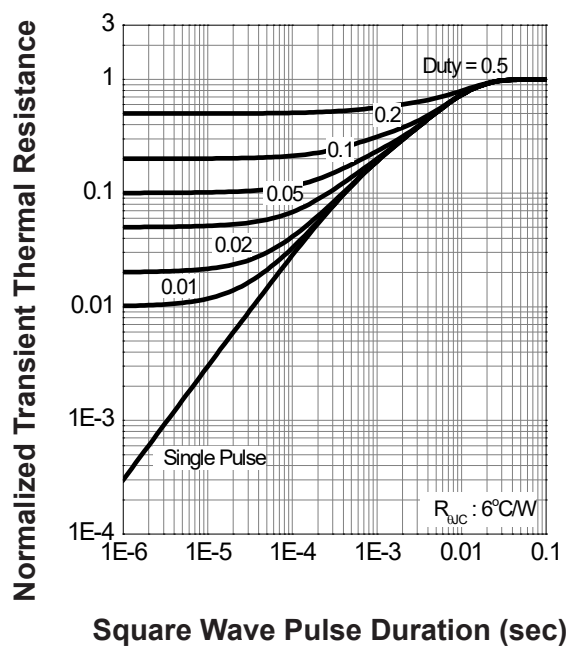
Drain Current



Safe Operation Area

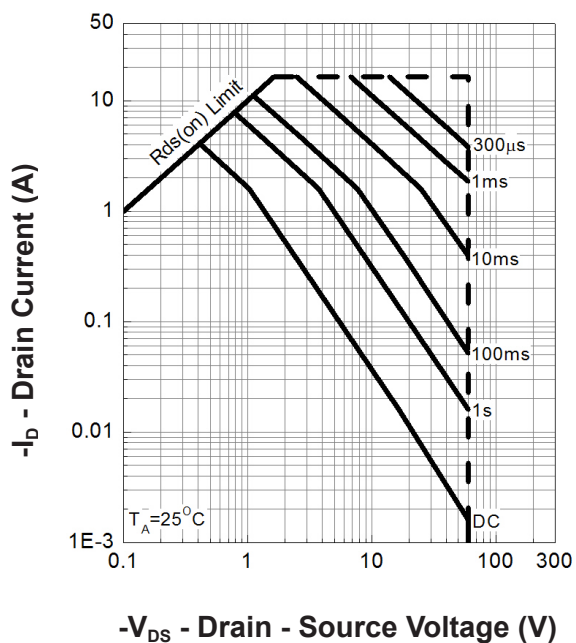


Thermal Transient Impedance

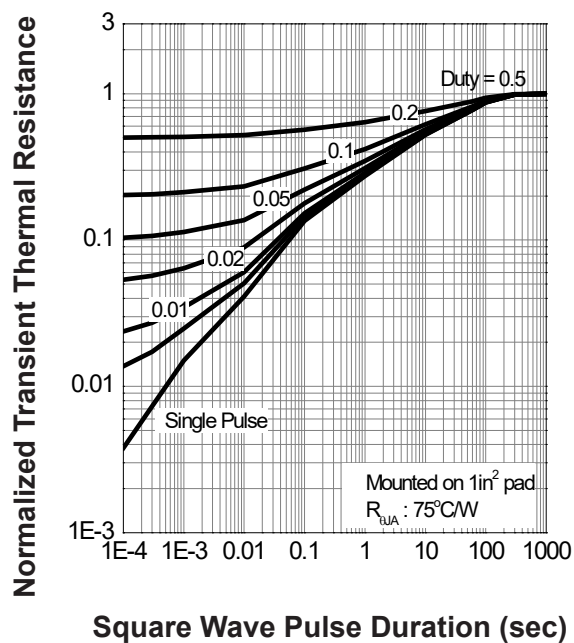


P Channel Typical Operating Characteristics(Cont.)

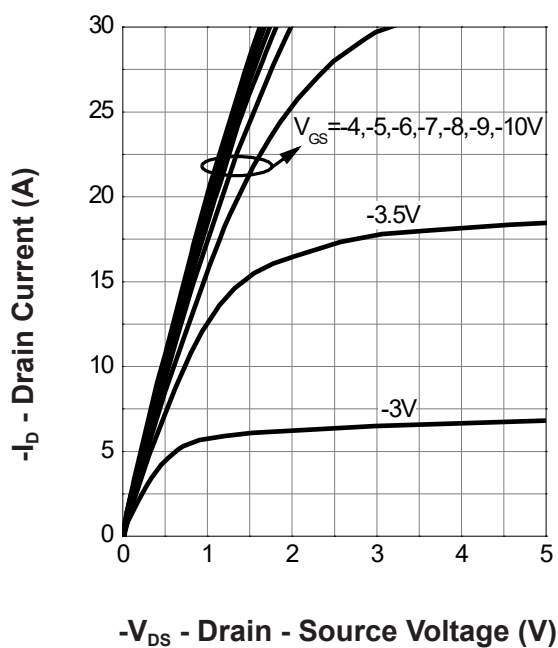
Safe Operation Area



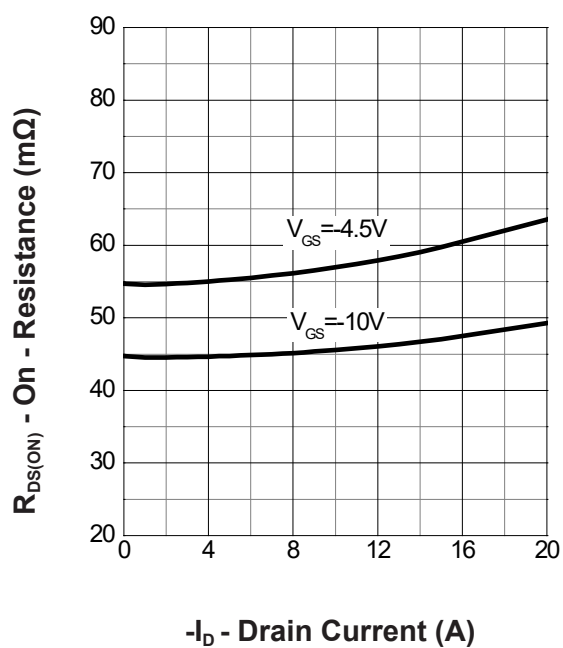
Thermal Transient Impedance



Output Characteristics

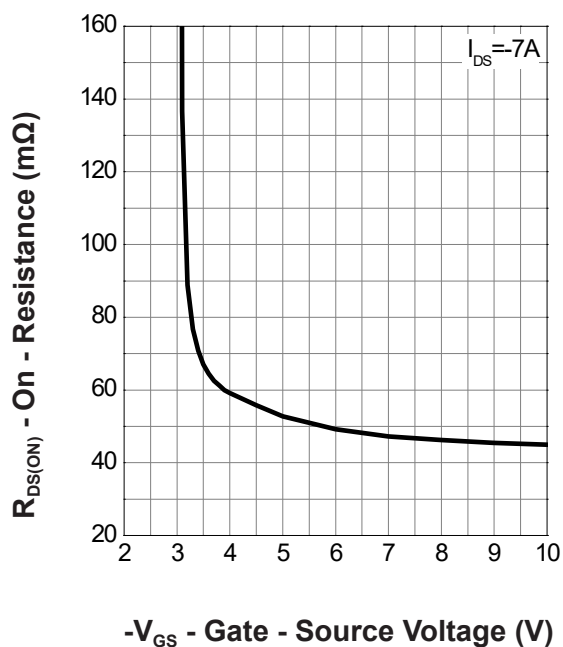


Drain-Source On Resistance

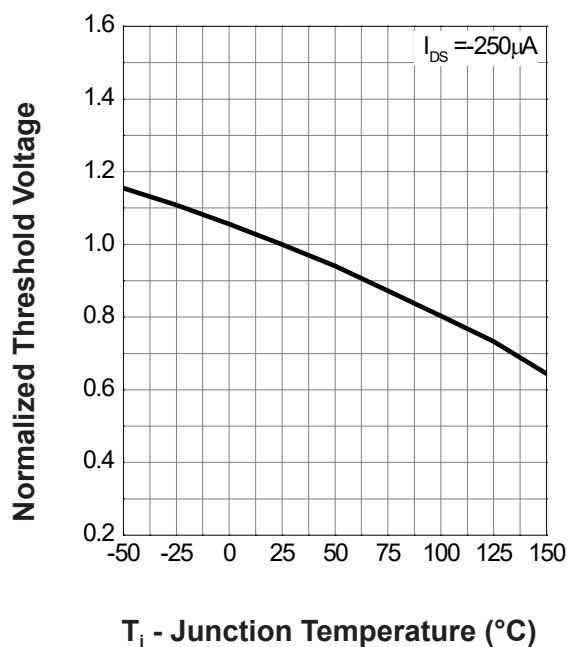


P Channel Typical Operating Characteristics(Cont.)

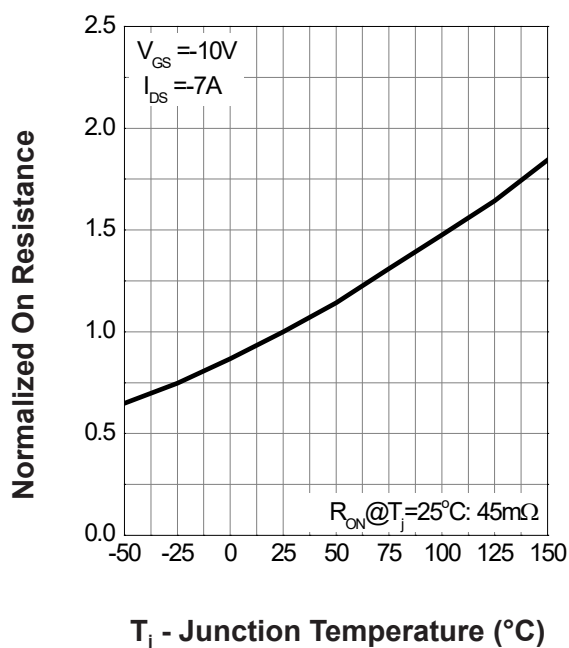
Gate-Source On Resistance



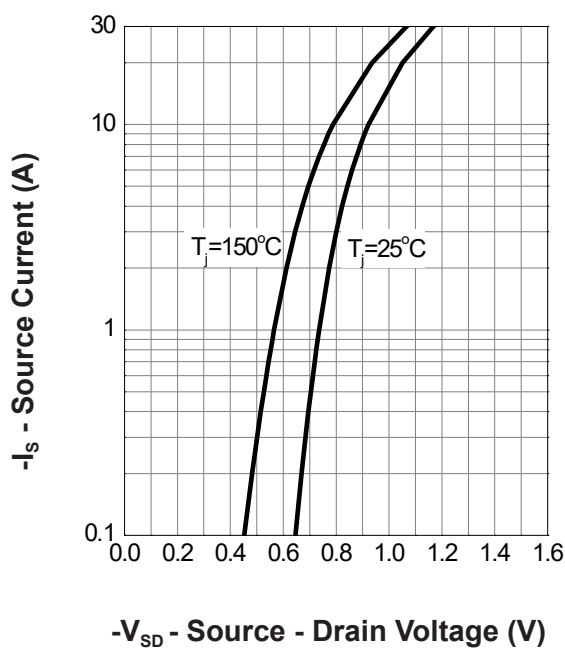
Gate Threshold Voltage



Drain-Source On Resistance

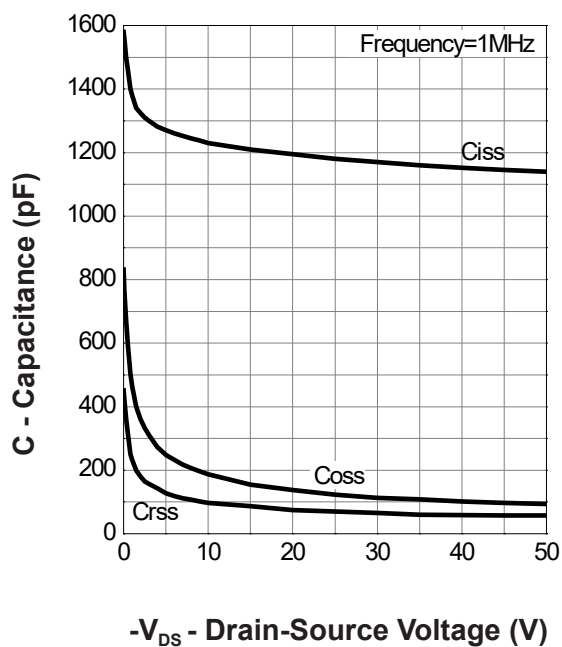


Source-Drain Diode Forward

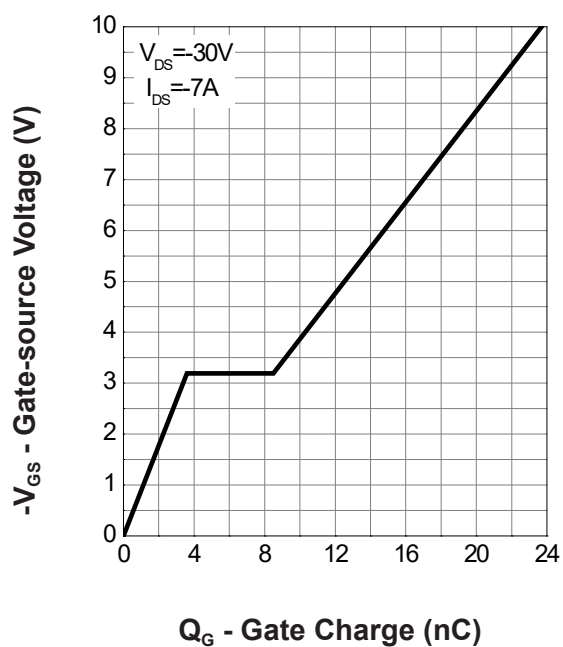


P Channel Typical Operating Characteristics(Cont.)

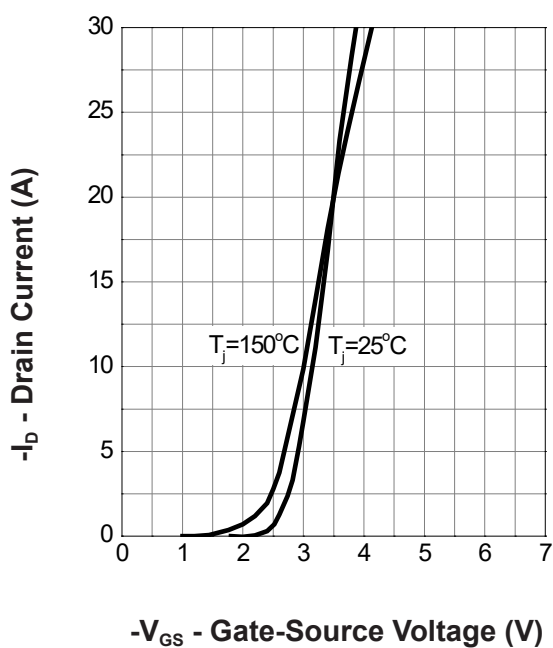
Capacitance



Gate Charge

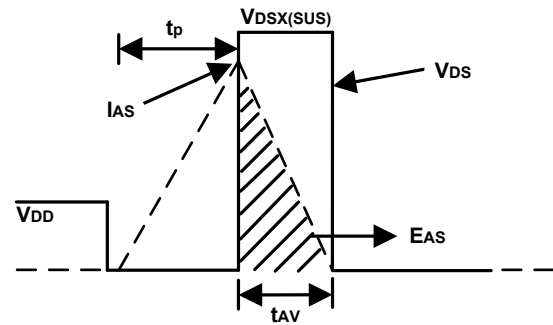
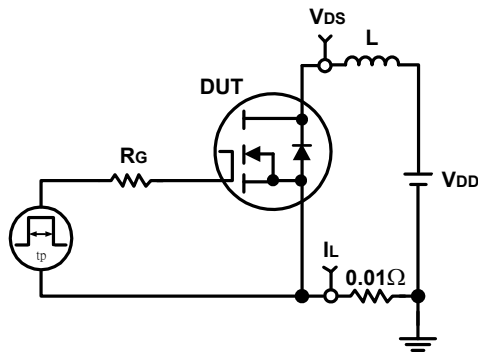


Transfer Characteristics

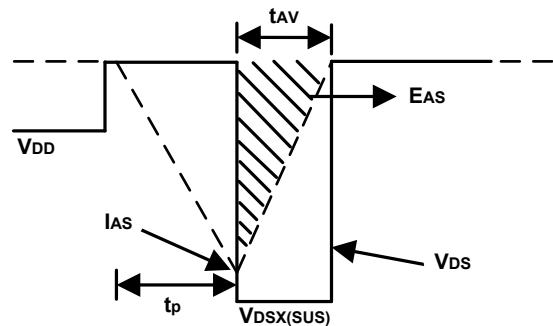
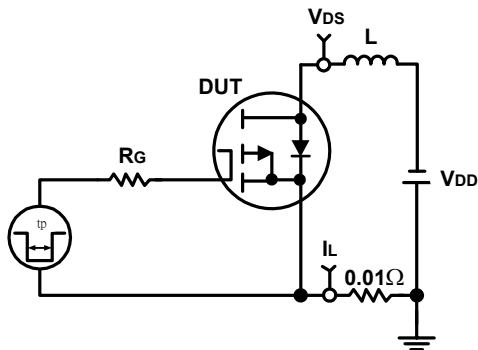


Avalanche Test Circuit and Waveforms

N Channel

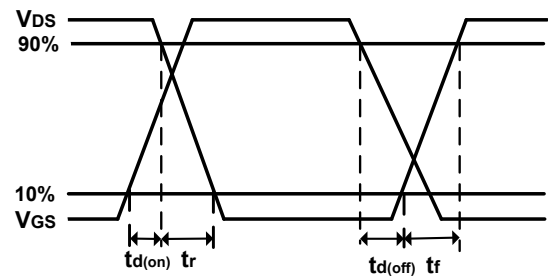
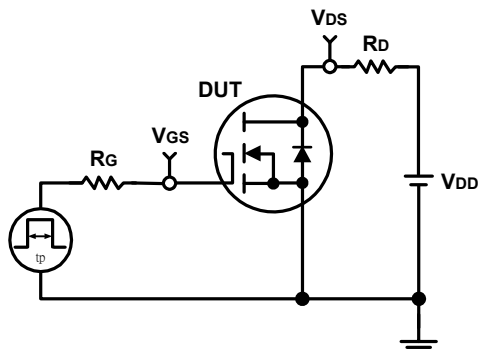


P Channel

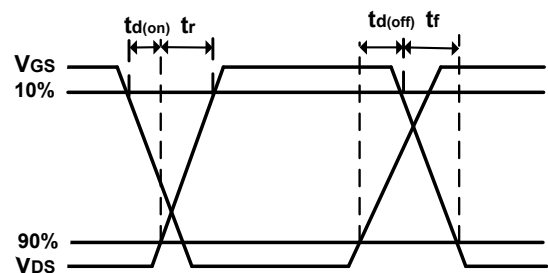
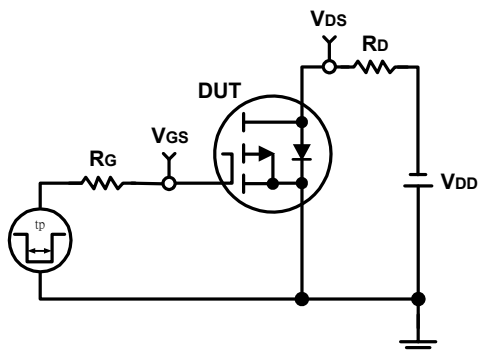


Switching Time Test Circuit and Waveforms

N Channel



P Channel



Disclaimer

Sinopower Semiconductor Inc. (hereinafter “Sinopower”) has been making great efforts to develop 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.

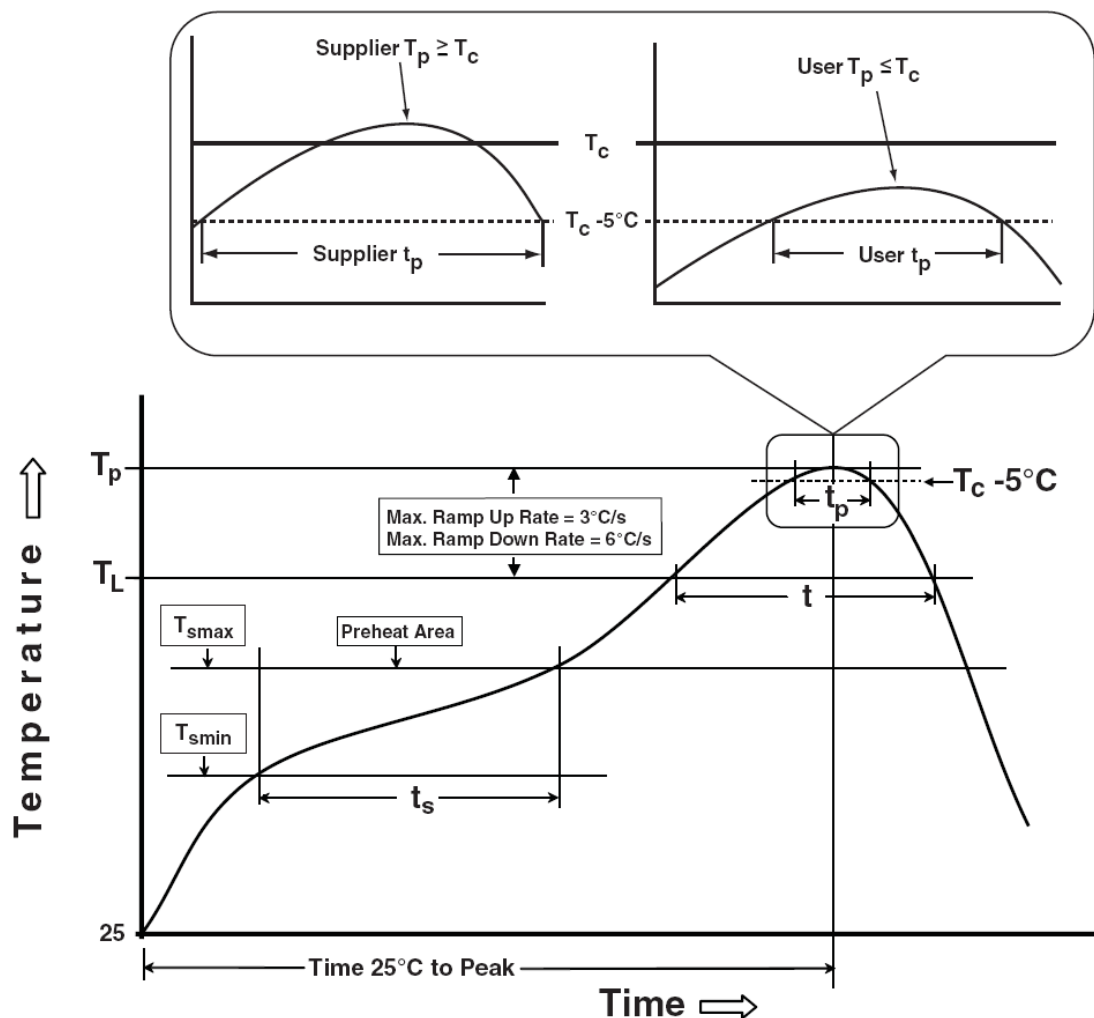
All information which is shown in the datasheet is based on Sinopower’s research and development result, therefore, Sinopower shall reserve the right to adjust the content and monitor the production.

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.

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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

Customer Service

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