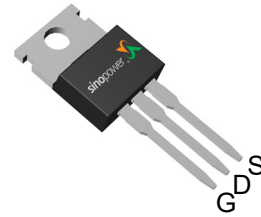


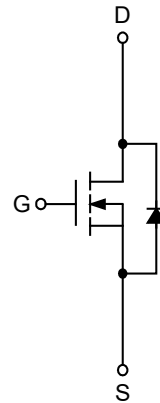
### Features

- 60V/170A\*  
 $R_{DS(ON)}=3.3m\Omega(max.)@V_{GS}=10V$
- 100% UIS +  $R_g$  Tested
- Reliable and Rugged
- Lead Free and Green Devices Available  
 (RoHS Compliant)

### Pin Description



TO-220

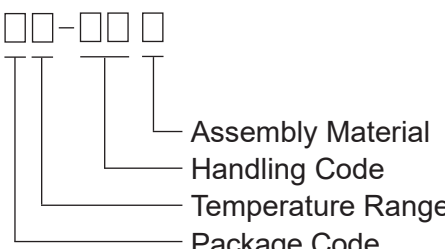



N-Channel MOSFET

### Applications

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

### Ordering and Marking Information

<p>SM6051NH □□-□□ □</p>  <p>Assembly Material          Handling Code          Temperature Range          Package Code</p>	<p>Package Code          F : TO-220          Operating Junction Temperature Range          D : -55 to 175 °C          Handling Code          TU : Tube          Assembly Material          G : Halogen and Lead Free Device</p>	
<p>SM6051NH F :</p>		<p>XXXXX - Lot Code</p>

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
<b>Common Ratings</b>			
$V_{DSS}$	Drain-Source Voltage	60	V
$V_{GSS}$	Gate-Source Voltage	$\pm 25$	
$T_J$	Maximum Junction Temperature	175	$^{\circ}\text{C}$
$T_{STG}$	Storage Temperature Range	-55 to 175	
$I_S$	Diode Continuous Forward Current	$T_C=25^{\circ}\text{C}$ 85	A
$I_D$	Continuous Drain Current	$T_C=25^{\circ}\text{C}$ 170 *	
	Continuous Drain Current	$T_C=100^{\circ}\text{C}$ 120 *	
$I_{DM}$	Pulsed Drain Current	$T_C=25^{\circ}\text{C}$ 400 <sup>a</sup>	
$P_D$	Maximum Power Dissipation	$T_C=25^{\circ}\text{C}$ 176.5	W
		$T_C=100^{\circ}\text{C}$ 88.2	
$R_{\theta JC}$	Thermal Resistance-Junction to Case	Steady State 0.85	$^{\circ}\text{C}/\text{W}$
$I_D$	Continuous Drain Current	$T_A=25^{\circ}\text{C}$ 20	A
		$T_A=70^{\circ}\text{C}$ 17	
$P_D$	Maximum Power Dissipation	$T_A=25^{\circ}\text{C}$ 2.4	W
		$T_A=70^{\circ}\text{C}$ 1.68	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	Steady State 62.5	$^{\circ}\text{C}/\text{W}$
$I_{AS}^b$	Avalanche Current, Single pulse	$L=0.5\text{mH}$ 42	A
$E_{AS}^b$	Avalanche Energy, Single pulse	$L=0.5\text{mH}$ 441	mJ

Note \* : Current limited by bonding wire. Bonding wire limitation current is 120A.

Note a : Pulse width limited by maximum junction temperature.

Note b : 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)

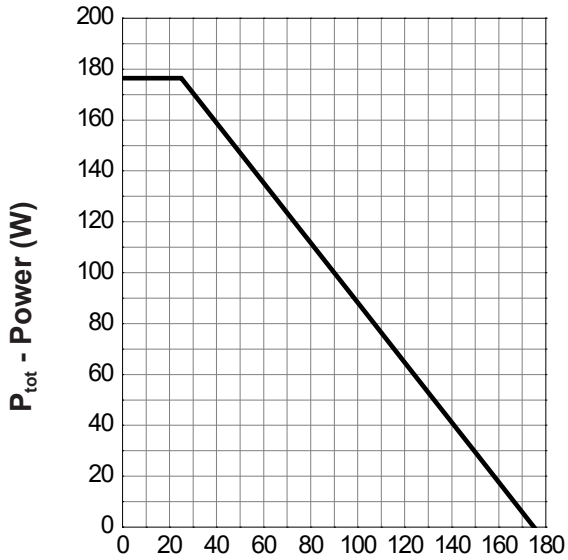
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_{DS}=250\mu A$	60	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=48V, V_{GS}=0V$	-	-	1	$\mu A$
		$T_J=85^\circ C$	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu A$	2	3	4	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 25V, V_{DS}=0V$	-	-	$\pm 100$	nA
$R_{DS(ON)}^c$	Drain-Source On-state Resistance	$V_{GS}=10V, I_{DS}=40A$	-	2.7	3.3	m $\Omega$
<b>Diode Characteristics</b>						
$V_{SD}^c$	Diode Forward Voltage	$I_{SD}=20A, V_{GS}=0V$	-	0.8	1.3	V
$t_{rr}$	Reverse Recovery Time	$I_{SD}=40A, di_{SD}/dt=100A/\mu s$	-	52	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	62	-	nC
<b>Dynamic Characteristics</b> <sup>d</sup>						
$R_G$	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1MHz$	-	1	-	$\Omega$
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=30V,$ Frequency=1.0MHz	-	4945	6430	pF
$C_{oss}$	Output Capacitance		-	1276	-	
$C_{rss}$	Reverse Transfer Capacitance		-	130	-	
$t_{d(ON)}$	Turn-on Delay Time		$V_{DD}=30V, R_L=30\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$	-	24	43
$t_r$	Turn-on Rise Time	-		15	27	
$t_{d(OFF)}$	Turn-off Delay Time	-		67	121	
$t_f$	Turn-off Fall Time	-		148	266	
<b>Gate Charge Characteristics</b> <sup>d</sup>						
$Q_g$	Total Gate Charge	$V_{DS}=30V, V_{GS}=10V,$ $I_{DS}=40A$	-	77	108	nC
$Q_{gs}$	Gate-Source Charge		-	23.5	-	
$Q_{gd}$	Gate-Drain Charge		-	18.5	-	

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

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

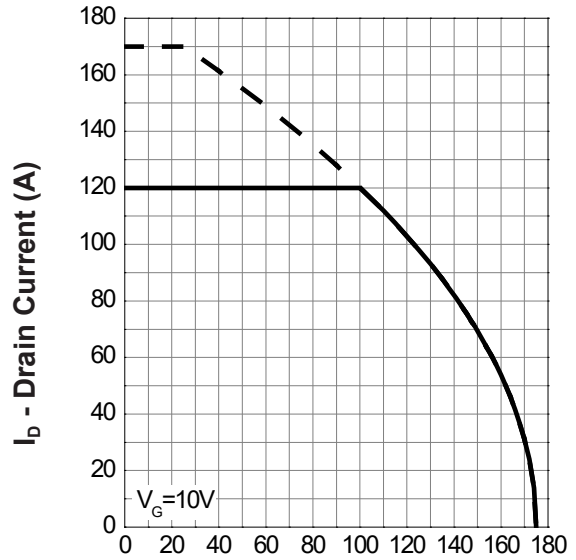
Typical Operating Characteristics

Power Dissipation



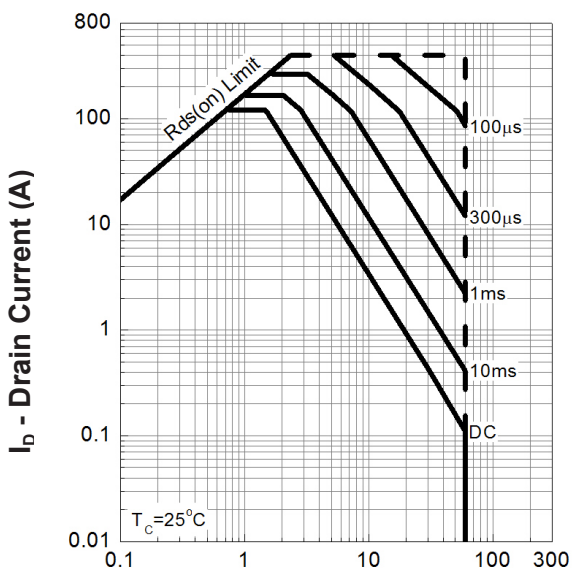
T<sub>c</sub> - Case Temperature (°C)

Drain Current



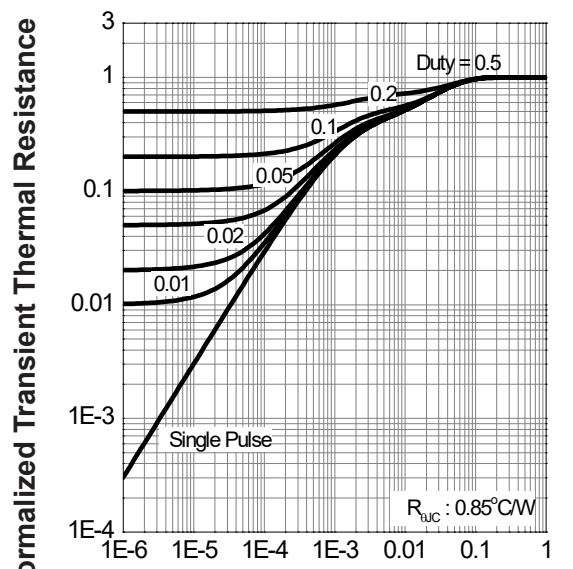
T<sub>c</sub> - Case Temperature (°C)

Safe Operation Area



V<sub>DS</sub> - Drain - Source Voltage (V)

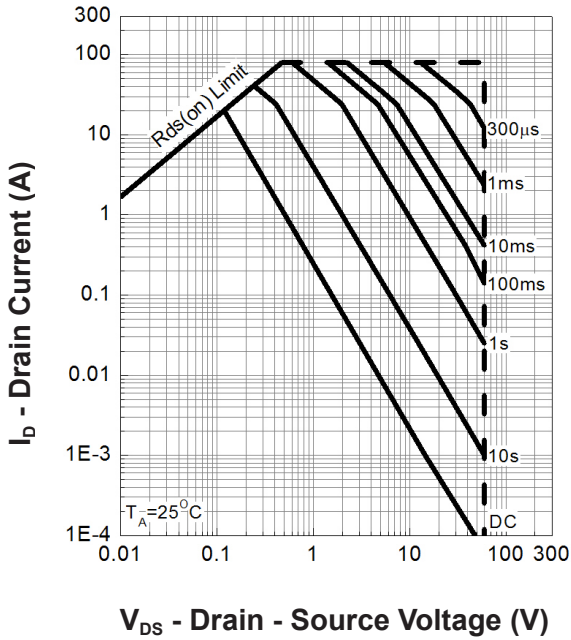
Thermal Transient Impedance



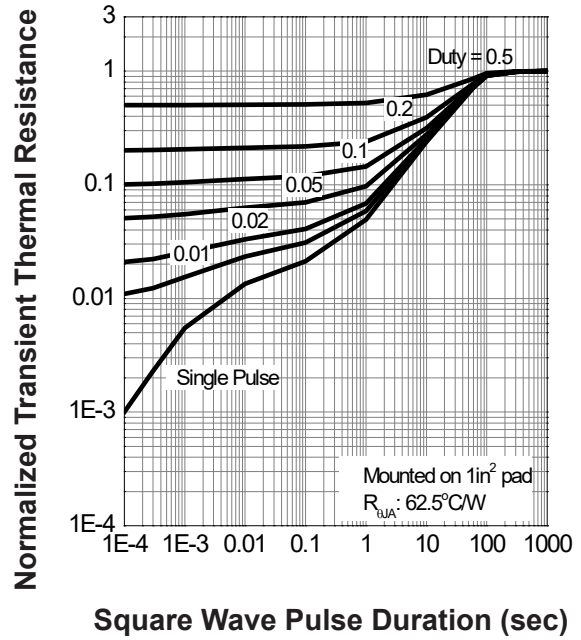
Square Wave Pulse Duration (sec)

Typical Operating Characteristics(Cont.)

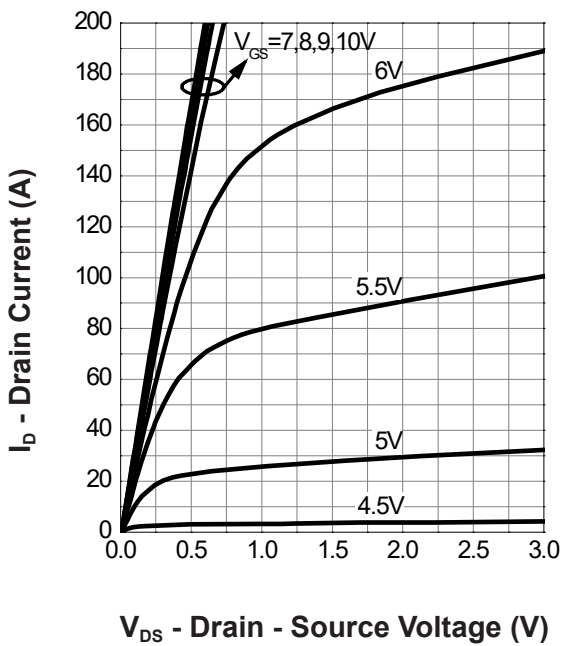
Safe Operation Area



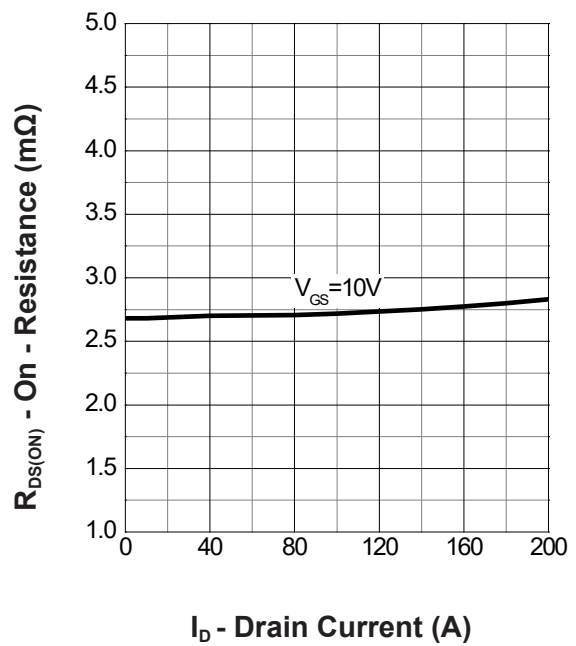
Thermal Transient Impedance



Output Characteristics

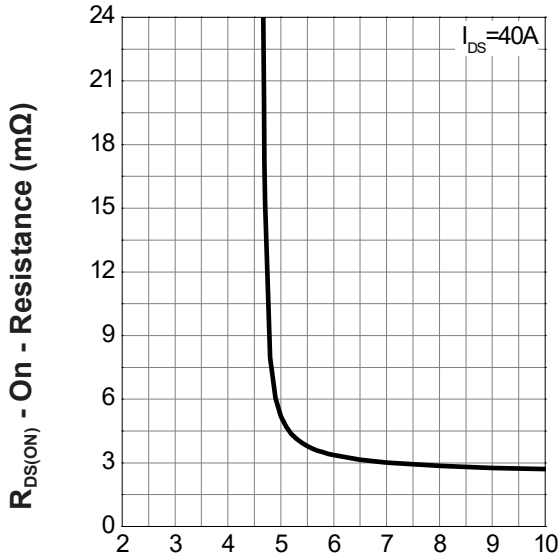


Drain-Source On Resistance



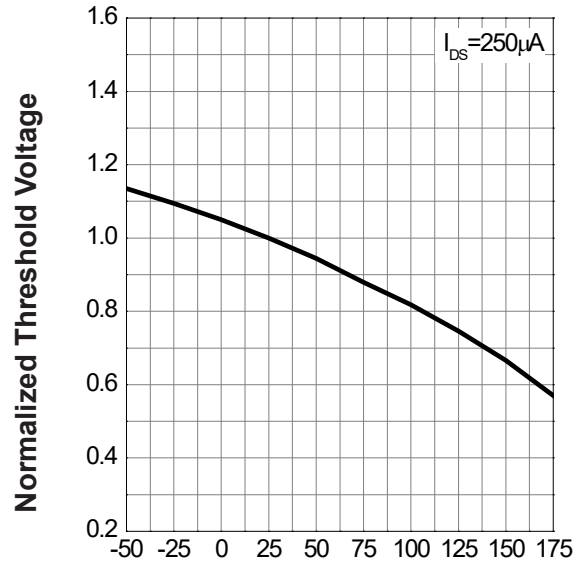
Typical Operating Characteristics(Cont.)

Gate-Source On Resistance



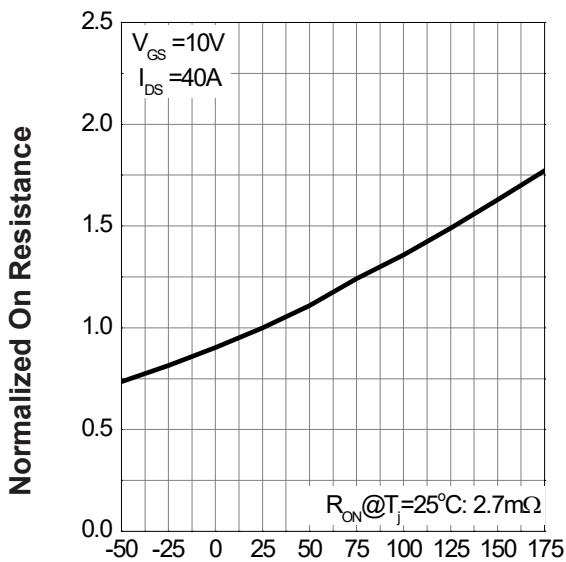
$V_{GS}$  - Gate - Source Voltage (V)

Gate Threshold Voltage



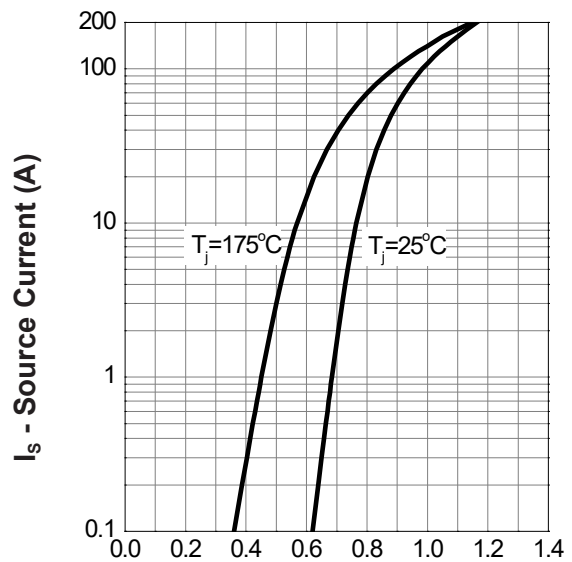
$T_J$  - Junction Temperature (°C)

Drain-Source On Resistance



$T_J$  - Junction Temperature (°C)

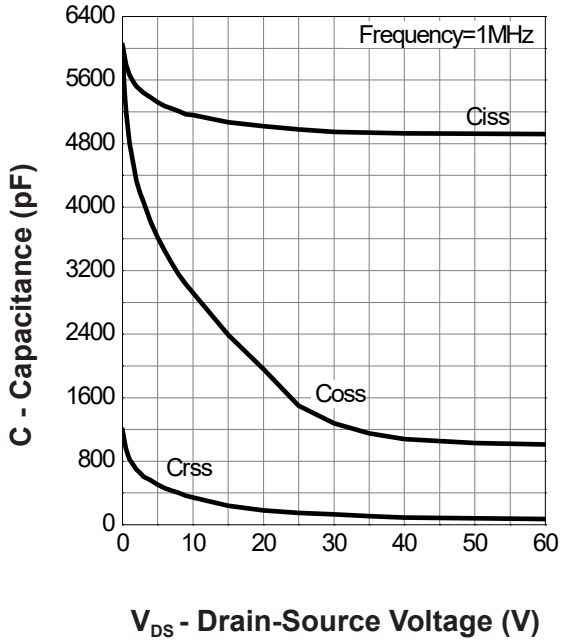
Source-Drain Diode Forward



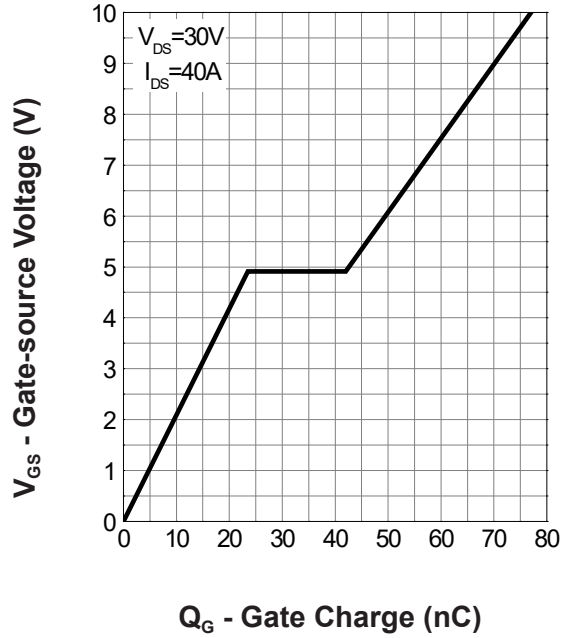
$V_{SD}$  - Source - Drain Voltage (V)

Typical Operating Characteristics(Cont.)

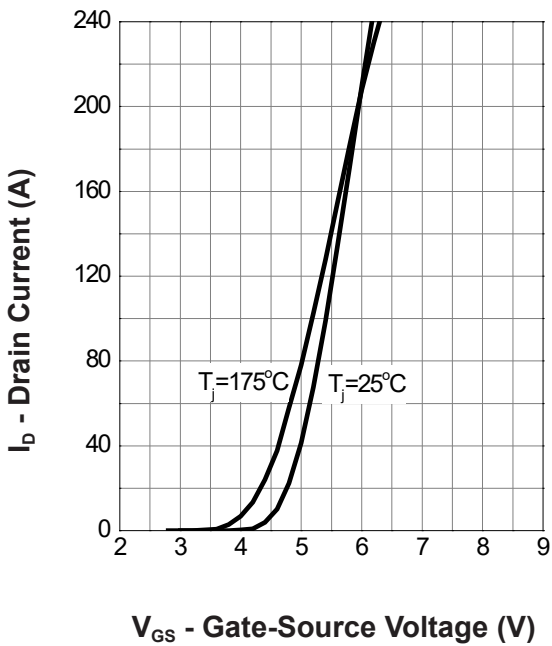
Capacitance



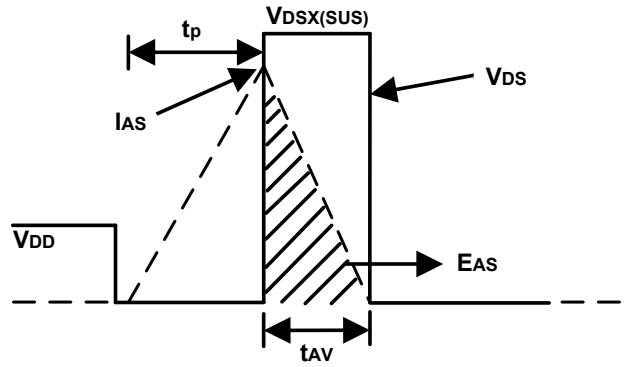
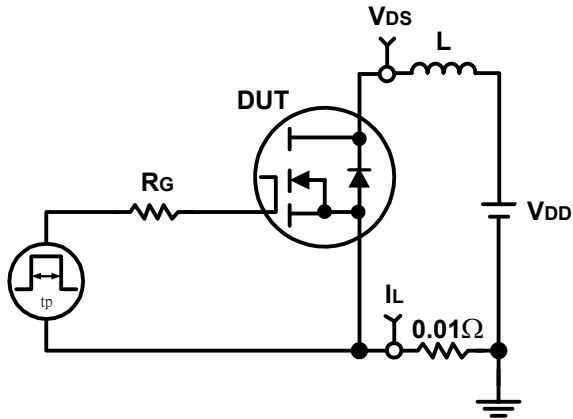
Gate Charge



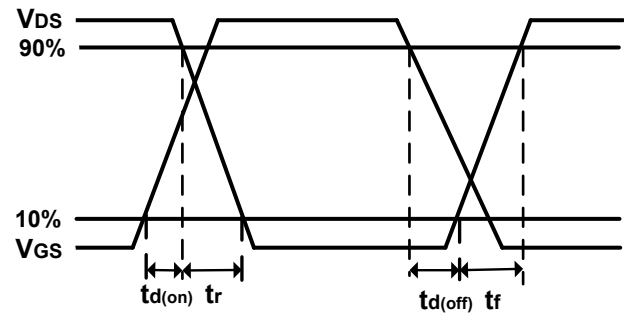
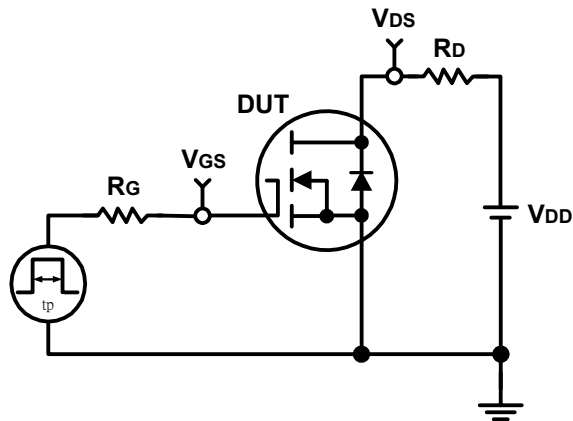
Transfer Characteristics



Avalanche Test Circuit and Waveforms



Switching Time Test Circuit and Waveforms





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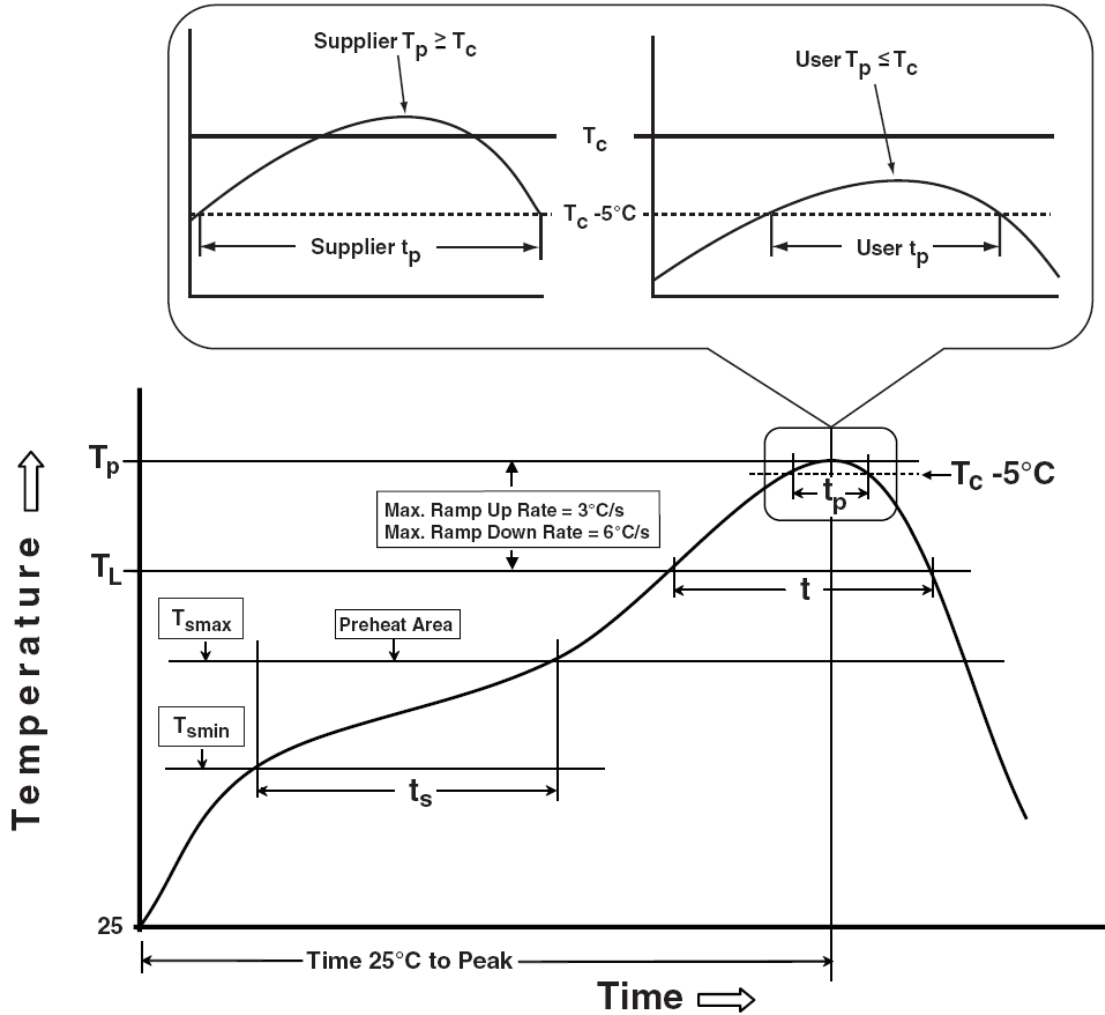
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Classification Profile



## Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
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 <sup>3</sup> <350	Volume mm <sup>3</sup> ≥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 <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >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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