

# TM2G0060065M

## 650V N-Channel Silicon Carbide Power MOSFET

$V_{DS}$	=	650 V
$R_{DS(on)}$	=	60 mΩ
$I_D$	=	56 A

### Features

- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- Low on-resistance with high junction temperature
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Easy to parallel
- RoHS compliant

### Benefits

- Higher System Efficiency
- Reduce cooling requirements
- Increased power density
- Minimize gate ringing
- Reduction of system complexity and cost

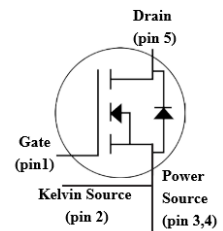
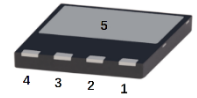
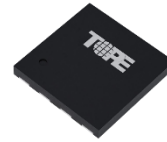
### Applications

- Switch Mode Power Supplies
- DC/DC converters
- Solar Inverters
- EV charging infrastructure
- Energy storage & battery
- Battery control unit

### Maximum Ratings ( $T_C = 25\text{ }^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
$V_{DSmax}$	Drain-Source Breakdown Voltage	650	V	$V_{GS} = 0\text{ V}$ , $I_D = 100\text{ }\mu\text{A}$	
$I_D$	Continuous Drain Current	56	A	$V_{GS} = 20\text{ V}$ , $T_C = 25\text{ }^\circ\text{C}$	Fig. 18
$I_{D(pulse)}$	Pulsed Drain Current	112	A	Pulse width $t_p$ limited by $T_{jmax}$	
$P_D$	Power Dissipation	259	W	$T_C = 25\text{ }^\circ\text{C}$	Fig. 19
$V_{GS,op}$	Recommend Gate Source Voltage	-5/+20	V		
$V_{GSmax}$	Maximum Gate Source Voltage	-10/+25	V	AC ( $f > 1\text{ Hz}$ )	
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to +175	$^\circ\text{C}$		
$T_L$	Soldering Temperature	260	$^\circ\text{C}$		

### Package



Part Number	Package	Marking
TM2G0060065M	DFN 8*8	TM2G0060065M

## Electrical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
Static							
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	650	--	--	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$I_{DSS}$	Zero Gate Voltage Drain Current	--	10	100	$\mu\text{A}$	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	
$I_{GSS}$	Gate-Source Leakage	--	5	250	nA	$V_{GS} = 20\text{ V}$	
$V_{GS(th)}$	Gate-Source Threshold Voltage	2	--	4	V	$I_D = 5\text{ mA}, V_{GS} = V_{DS}$	Fig. 11
$R_{DS(on)}$	Drain-Source On-State Resistance	--	60	80	m $\Omega$	$V_{GS} = 20\text{ V}, I_D = 13.2\text{ A}$	Fig. 6
			80		m $\Omega$	$V_{GS} = 18\text{ V}, I_D = 13.2\text{ A}$	
			89		m $\Omega$	$V_{GS} = 15\text{ V}, I_D = 13.2\text{ A}$	
Dynamic							
$C_{iss}$	Input Capacitance	--	1129	--	pF	$V_{GS} = 0\text{ V}, V_{DS} = 600\text{ V}$ $f = 1.0\text{ MHz}, V_{AC} = 25\text{ mV}$	Fig. 17
$C_{oss}$	Output Capacitance	--	114	--			
$C_{rss}$	Reverse Transfer Capacitance	--	6.5	--			
$E_{oss}$	$C_{oss}$ Stored Energy	--	25	--	$\mu\text{J}$		Fig. 16
$Q_g$	Total Gate Charge	--	62	--	nC	$V_{DS} = 400\text{ V}$ $I_D = 13.2\text{ A}$ $V_{GS} = -5/+20\text{ V}$	Fig. 12
$Q_{gs}$	Gate-Source Charge	--	18	--			
$Q_{gd}$	Gate-Drain Charge	--	33	--			
$t_{d(on)}$	Turn-on Delay Time	--	21.3	--	ns	$V_{DS} = 400\text{ V}$ $V_{GS} = -5/+20\text{ V}$ $I_D = 13.2\text{ A}$ $R_{G(ext)} = 2.5\ \Omega$	
$t_r$	Turn-on Rise Time	--	14.5	--			
$t_{d(off)}$	Turn-off Delay Time	--	132.6	--			
$t_f$	Turn-off Fall Time	--	42.7	--			
$R_{G(int)}$	Internal Gate Resistance	--	2.8	--	$\Omega$	$f = 1.0\text{ MHz}, V_{AC} = 25\text{ mV}$	

## Body Diode Characteristics, at $T_J = 25^\circ\text{C}$ , unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$I_S$	Continuous Diode Forward Current	--	--	56	A		
$I_{S(pulse)}$	Diode pulse Current	--	112	--	A		
$V_{SD}$	Diode Forward Voltage	--	3.0	--	V	$V_{GS} = 0\text{ V}, I_S = 6.6\text{ A}$	Fig. 8, 9, 10
$t_{rr}$	Reverse Recovery Time	--	23	--	ns	$I_S = 13.2\text{ A}, V_{DS} = 400\text{ V}$ $V_{GS} = -5\text{ V}$ $di/dt = 2100\text{ A}/\mu\text{s}$	
$Q_{rr}$	Reverse Recovery Charge	--	132	--	nC		
$I_{rrm}$	Peak Reverse Recovery Current	--	13	--	A		

## Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	--	0.59	--	$^\circ\text{C}/\text{W}$	Fig. 20

Typical Performance

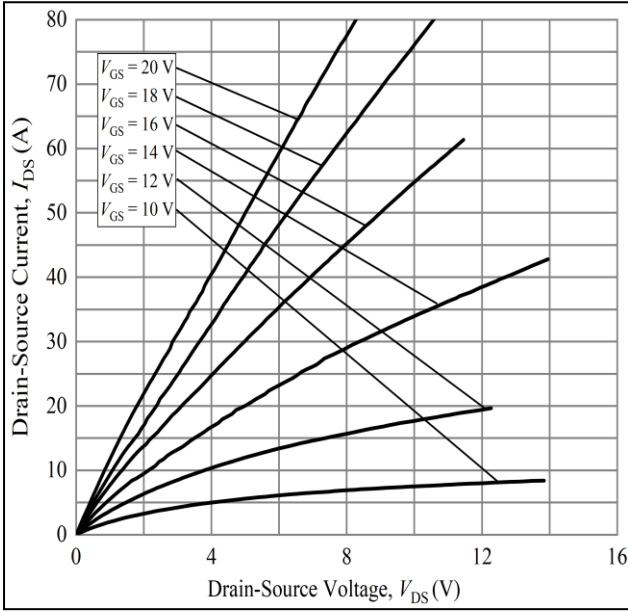


Figure 1: Typical Output Characteristics at  $T_j = -55\text{ }^\circ\text{C}$

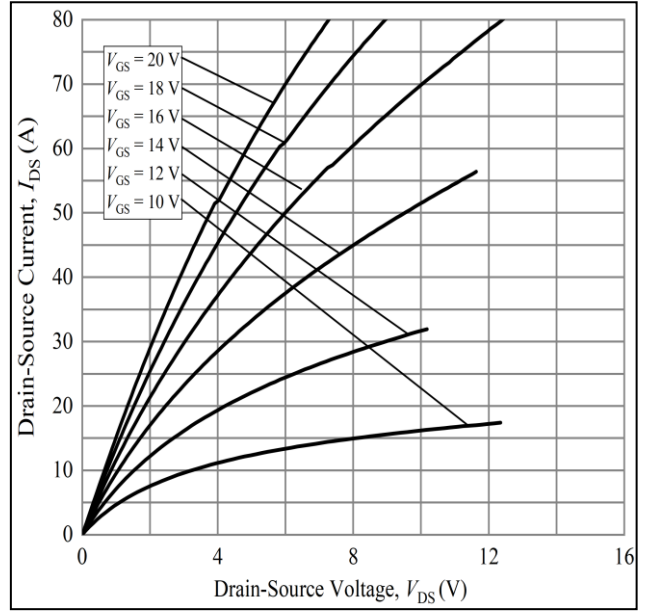


Figure 2: Typical Output Characteristics at  $T_j = 25\text{ }^\circ\text{C}$

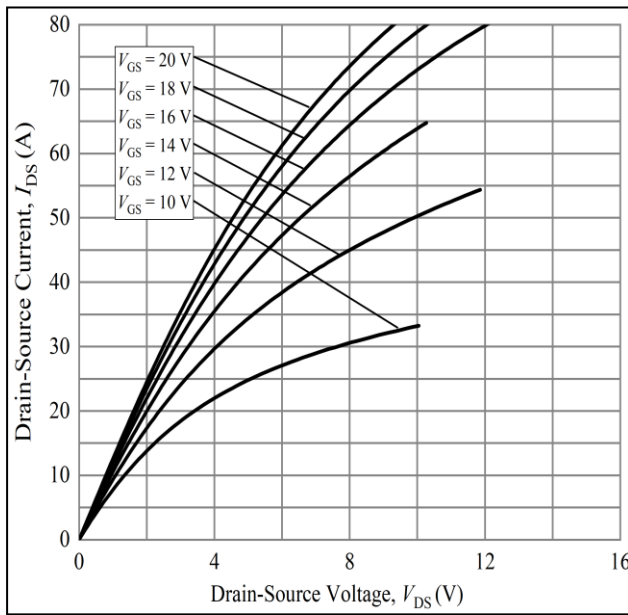


Figure 3: Typical Output Characteristics at  $T_j = 175\text{ }^\circ\text{C}$

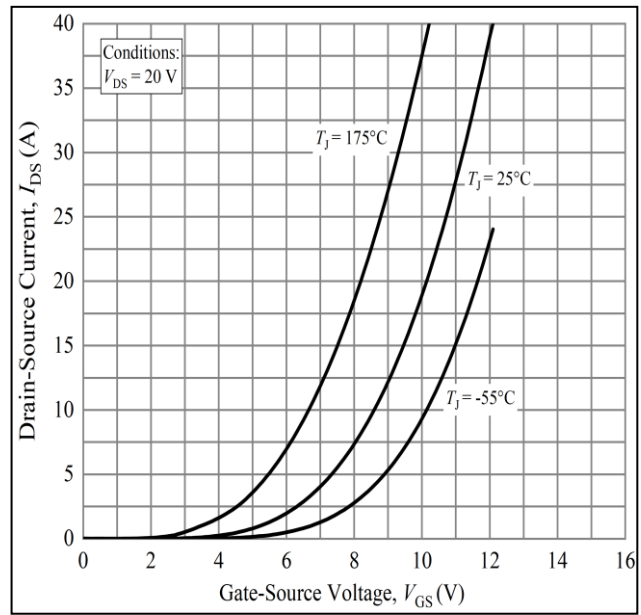


Figure 4: Typical Transfer Characteristics for Various Temperature

Typical Performance

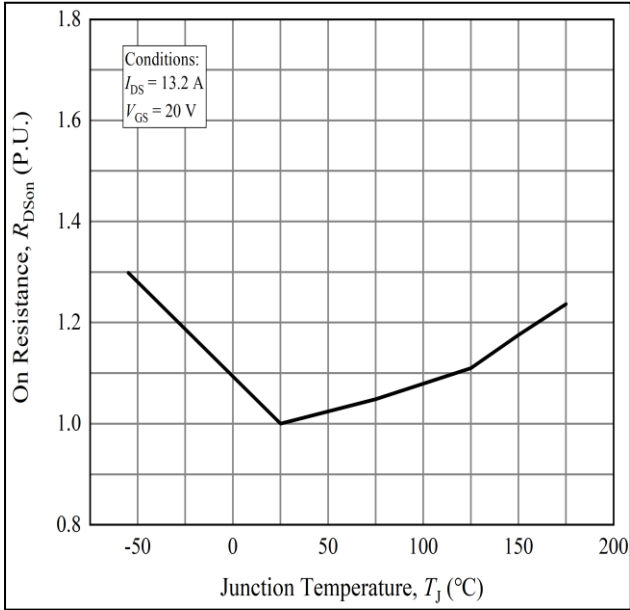


Figure 5: Normalized On-Resistance vs. Temperature

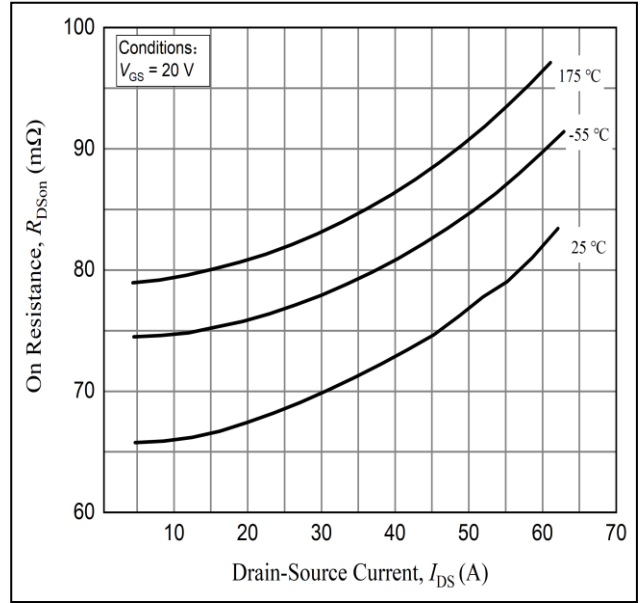


Figure 6: On-Resistance vs. Drain Current for Various Temperatures

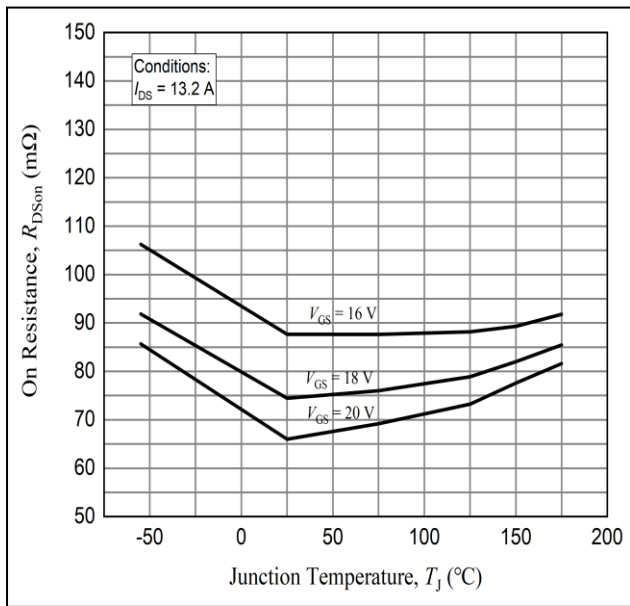


Figure 7: On-Resistance vs. Temperature for Various Gate Voltage

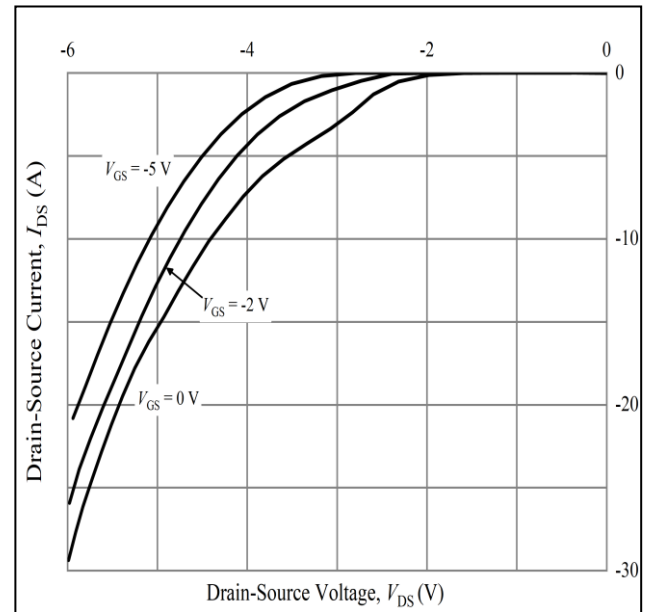


Figure 8: Typical Body Diode Characteristics at  $T_J = -55\text{ }^\circ\text{C}$

Typical Performance

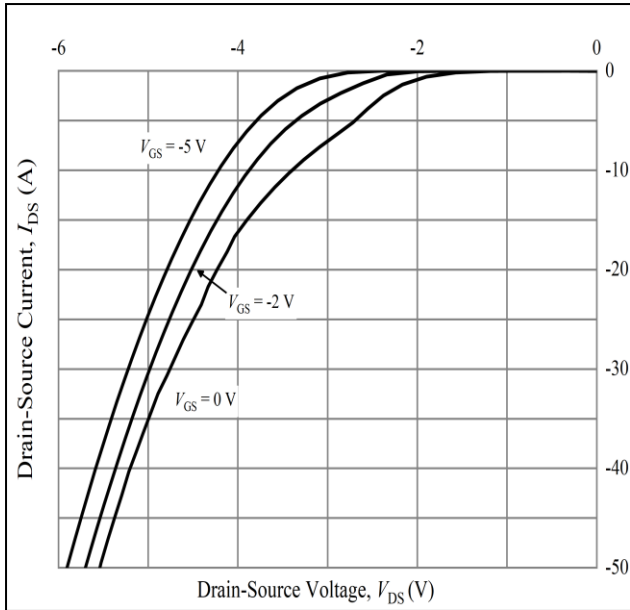


Figure 9: Typical Body Diode Characteristics at  $T_j = 25\text{ }^\circ\text{C}$

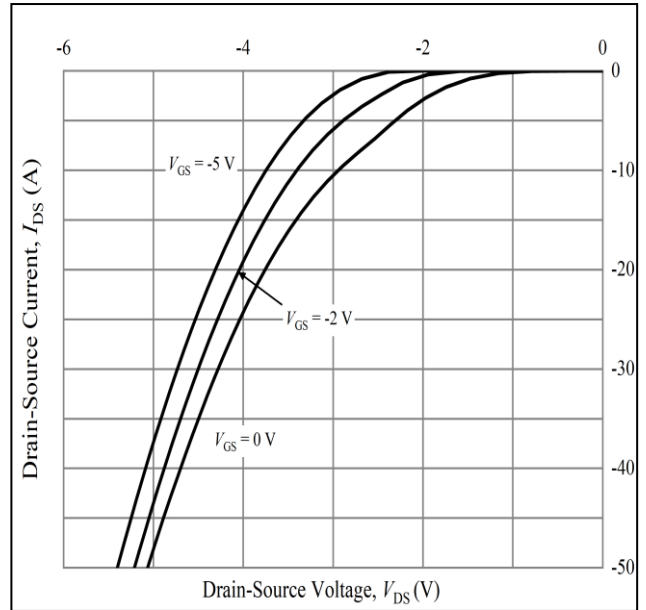


Figure 10: Typical Body Diode Characteristics at  $T_j = 175\text{ }^\circ\text{C}$

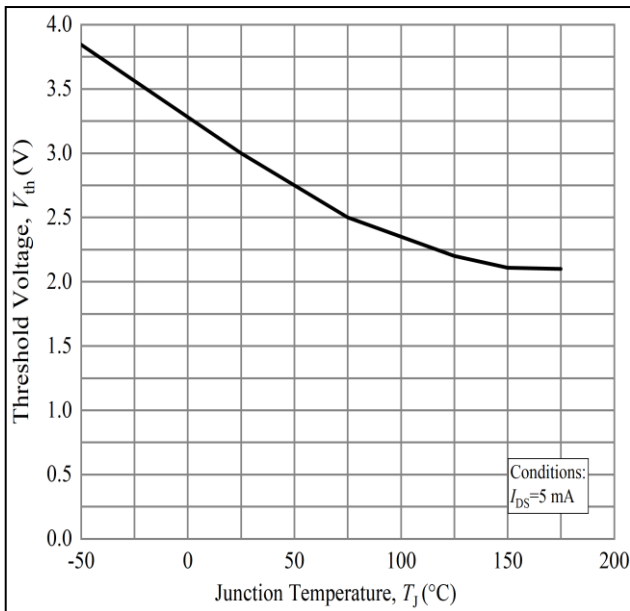


Figure 11: Typical Threshold Voltage vs. Temperature

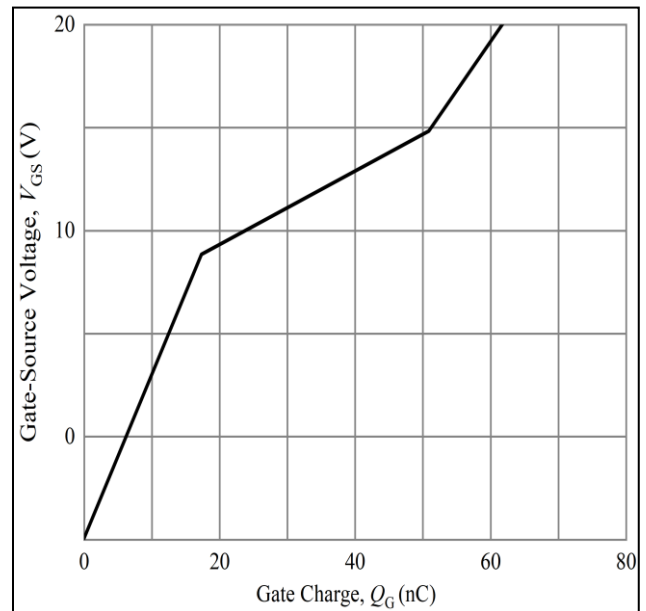


Figure 12: Typical Gate Charge Characteristics at  $T_j = 25\text{ }^\circ\text{C}$

Typical Performance

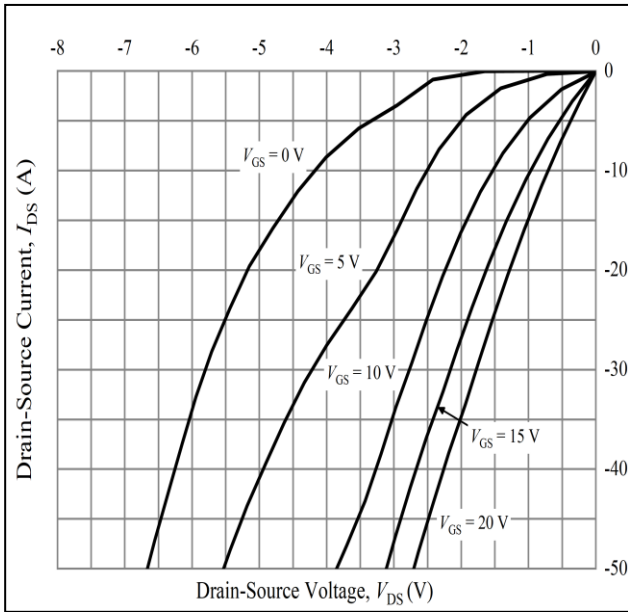


Figure 13: Typical 3rd Quadrant Characteristics  
 $T_j = -55\text{ }^\circ\text{C}$

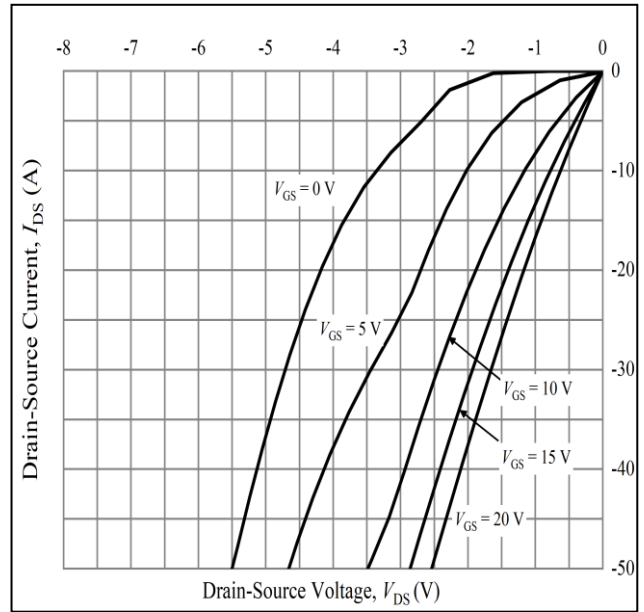


Figure 14: Typical 3rd Quadrant Characteristics at  
 $T_j = 25\text{ }^\circ\text{C}$

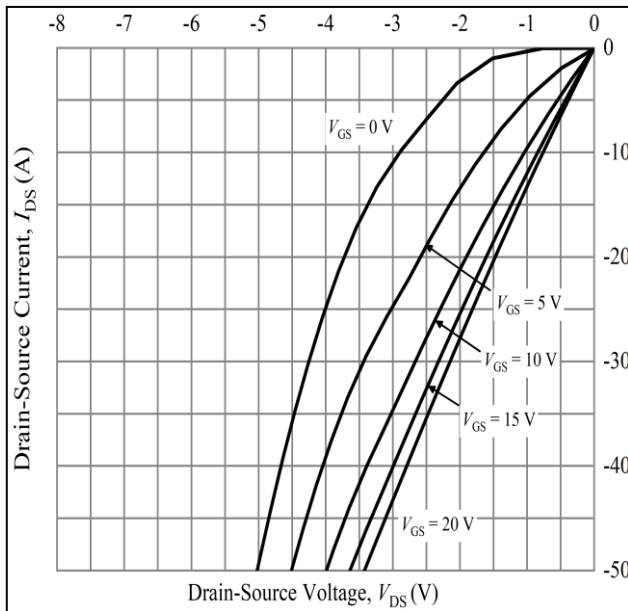


Figure 15: Typical 3rd Quadrant Characteristics  
at  $T_j = 175\text{ }^\circ\text{C}$

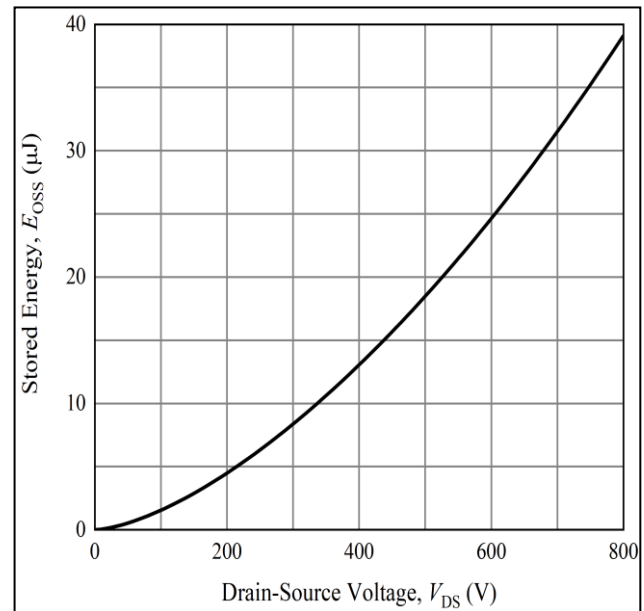


Figure 16: Typical Output Capacitor Stored Energy

Typical Performance

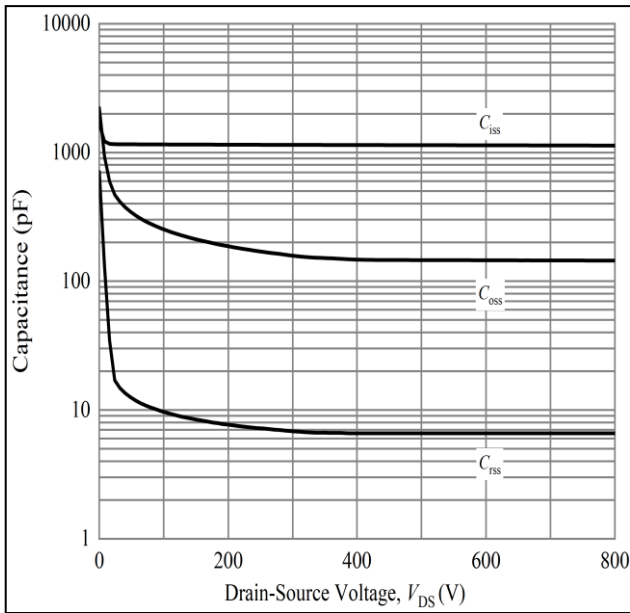


Figure 17: Typical Capacitances vs. Drain-Source Voltage

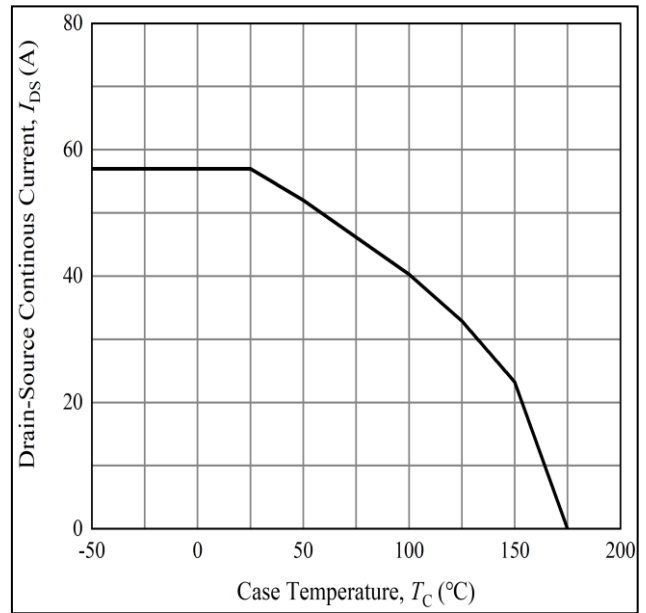


Figure 18: Continuous  $I_{DS}$  Current Derating Curve

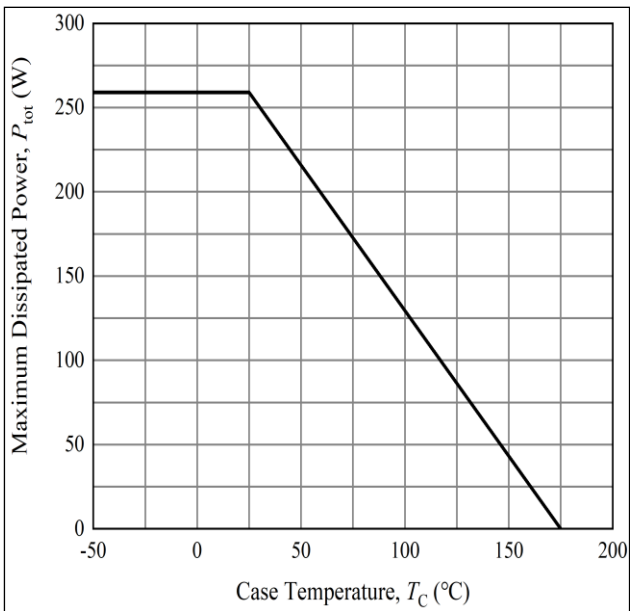


Figure 19: Power Dissipation Derating Curve

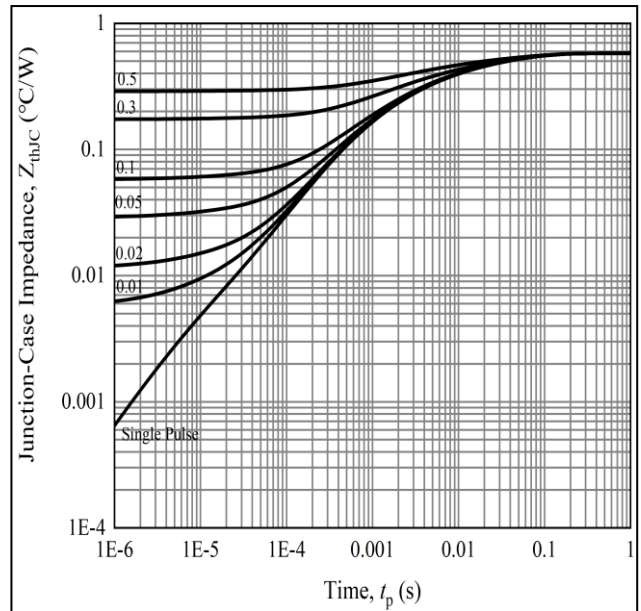


Figure 20: Typical Transient Thermal Impedance (Junction – Case) with Duty Cycle

Typical Performance

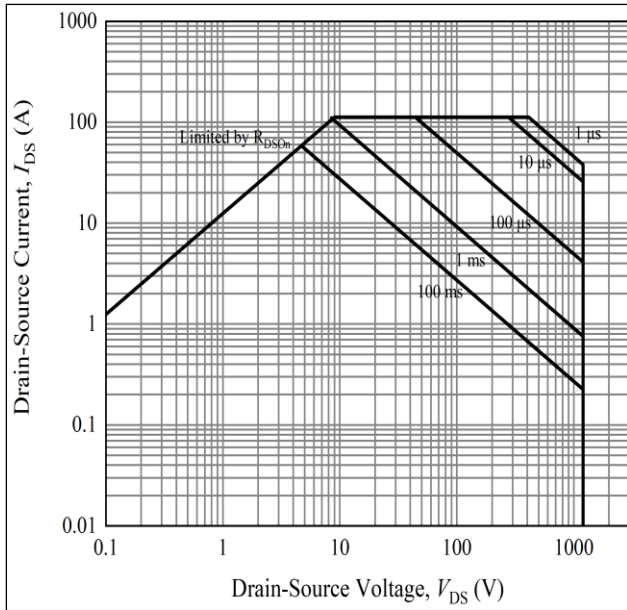


Figure 21: Safe Operate Area

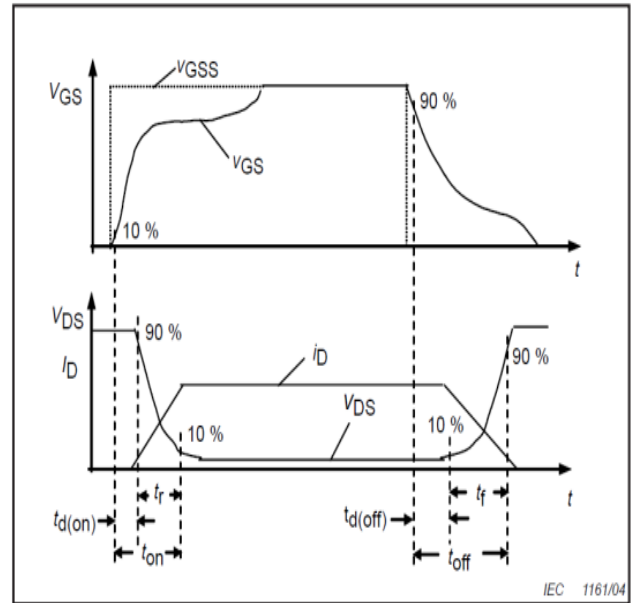


Figure 22: Resistive Switching Time Description



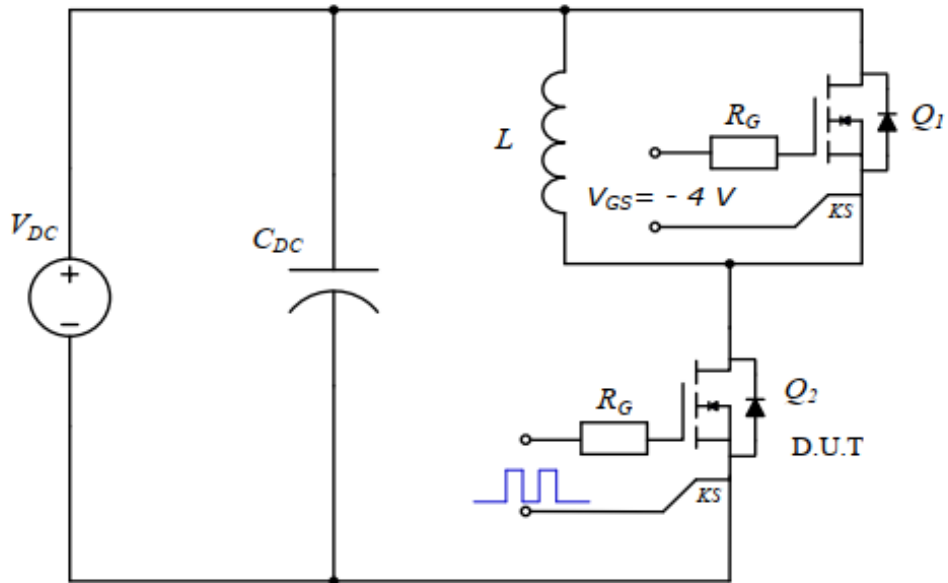


Figure 23: Clamped Inductive Switching Waveform Test Circuit



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## Revision History

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Document Version	Description of Changes
Rev.1.0	Released

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