

HCM2G0650170J

1700V N-Channel Silicon Carbide Power MOSFET

$$\begin{aligned} V_{DS} &= 1700 \text{ V} \\ R_{DS(on)} &= 750 \text{ m}\Omega (V_{GS}=15\text{V}) \\ R_{DS(on)} &= 550 \text{ m}\Omega (V_{GS}=20\text{V}) \\ T_{J, \text{ max}} &= 175^\circ\text{C} \end{aligned}$$

Features

High blocking voltage
Low on-resistance with high junction temperature
Fast intrinsic diode with low reverse recovery (Q_{rr})
High-speed switching with low capacitances

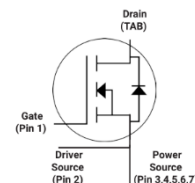
Benefits

Higher System Efficiency
Reduce cooling requirements
Increased power density
Enabling higher frequency
Minimize gate ringing

Applications

DC/DC converters
Solar Inverters
Battery Chargers
Motor Drives

Package



Part Number	Package	Marking
HCM2G0650170J	TO-263-7	HCM2G0650170J

Maximum Ratings, at $T_J = 25^\circ\text{C}$, unless otherwise specified

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain-Source Breakdown Voltage	1700	V	$V_{GS} = 0 \text{ V}, I_D = 100 \mu\text{A}$	
I_D	Continuous Drain Current	8	A	$V_{GS} = 15 \text{ V}, T_C = 25^\circ\text{C}$	
I_D	Continuous Drain Current	8.6	A	$V_{GS} = 20 \text{ V}, T_C = 25^\circ\text{C}$	Fig. 18
$I_{D(pulse)}$	Pulsed Drain Current	17	A	Pulse width t_P limited by T_{Jmax}	Fig. 21
P_D	Power Dissipation	78	W	$T_C = 25^\circ\text{C}$	Fig. 19
$V_{GS,op1}$	Gate- Source Voltage (Static)	-5/+20	V		
$V_{GS,op2}$	Gate- Source Voltage (Static)	-5/+15	V		
V_{GSmax}	Gate- Source Voltage (Dynamic)	-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	$^\circ\text{C}$		

Electrical Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
Static							
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	1700	--	--	V	$V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$	
I_{DSS}	Zero Gate Voltage Drain Current	--	0.9	100	μA	$V_{DS} = 1700\text{ V}, V_{GS} = 0\text{ V}$	
I_{GSS}	Gate -Source Leakage Current	--	2	250	nA	$V_{GS} = 20\text{ V}$	
$V_{GS(th)}$	Gate-Source Threshold Voltage	1.8	--	4.0	V	$I_D = 0.5\text{ mA}, V_{GS} = V_{DS}$	Fig. 11
$R_{DS(on)}$	Drain-Source On-Stage Resistance	--	750	1000	m Ω	$V_{GS} = 15\text{ V}, I_D = 2\text{ A}$	Fig. 6
		--	650	--	m Ω	$V_{GS} = 18\text{ V}, I_D = 2\text{ A}$	
		--	550	--	m Ω	$V_{GS} = 20\text{ V}, I_D = 2\text{ A}$	
Dynamic							
C_{iss}	Input Capacitance	--	183	--	pF	$V_{GS} = 0\text{ V}, V_{DS} = 1000\text{ V}$ $f = 1.0\text{ MHz}, V_{AC} = 25\text{ mV}$	Fig. 17
C_{oss}	Output Capacitance	--	17.1	--			
C_{rss}	Reverse Transfer Capacitance	--	2.1	--			
E_{oss}	C_{oss} Stored Energy	--	10.1	--	μJ		Fig. 16
Q_g	Total Gate Charge	--	13.2	--	nC	$V_{DS} = 1200\text{ V}$ $I_D = 2\text{ A}$ $V_{GS} = -5/+20\text{ V}$	Fig. 12
Q_{gs}	Gate-Source Charge	--	5.0	--			
Q_{gd}	Gate-Drain Charge	--	4.5	--			
E_{On}	Turn-On Switching Energy	--	170	--	μJ	$V_{DS} = 1000\text{V}, V_{GS} = -5/+20\text{ V}$ $I_D = 2\text{ A}, R_{G(ext)} = 2.5\Omega,$ $L = 70\text{ mH}$	Fig. 22
E_{Off}	Turn Off Switching Energy	--	68	--			
$t_{d(on)}$	Turn-on Delay Time	--	5	--	ns	$V_{DS} = 1000\text{ V}$ $V_{GS} = -5/+20\text{ V}$ $I_D = 2\text{ A}, L = 70\text{ mH}$ $R_{G(ext)} = 2.5\Omega$	Fig. 24
t_r	Turn-on Rise Time	--	17	--			
$t_{d(off)}$	Turn-off Delay Time	--	13	--			
t_f	Turn-off Fall Time	--	55.6	--			
$R_{G(int)}$	Internal Gate Resistance	--	25.2	--	Ω	$f = 1.0\text{ MHz}, V_{AC} = 25\text{ mV}$	

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
I_S	Continuous Diode Forward Current	--	--	8	A		
V_{SD}	Diode Forward Voltage	--	4.0	--	V	$V_{GS} = 0\text{ V}, I_S = 1\text{ A}$	Fig. 8, 9, 10
t_{rr}	Reverse Recovery Time	--	33	--	ns	$I_S = 2\text{ A}, V_{DS} = 1200\text{ V}$ $V_{GS} = -5\text{ V}$ $di/dt = 1200\text{ A}/\mu\text{s}$	
Q_{rr}	Reverse Recovery Charge	-	32	--	nC		
I_{rrm}	Peak Reverse Recovery Current	--	3	--	A		

Thermal Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	/	1.92	/	$^{\circ}\text{C}/\text{W}$	Fig. 20

Typical Performance

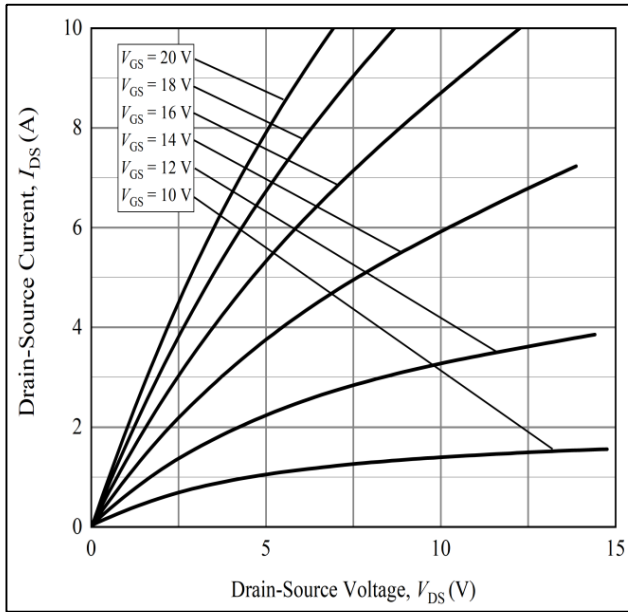


Figure 1: Typical Output Characteristics at $T_J = -55\text{ }^{\circ}\text{C}$

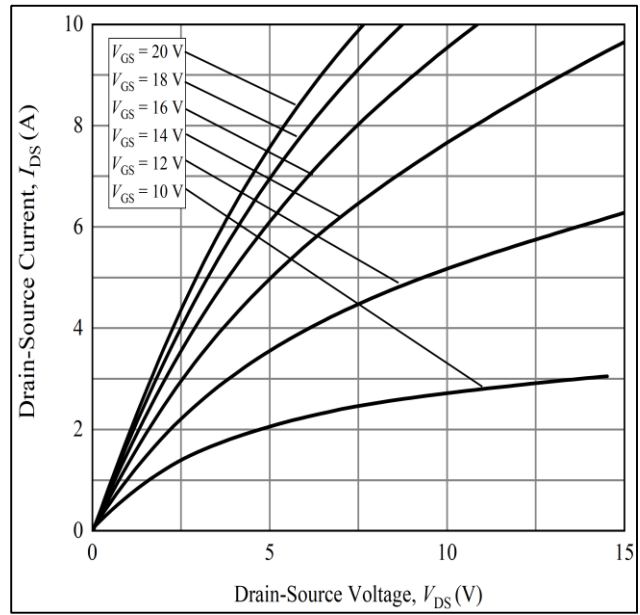


Figure 2: Typical Output Characteristics at $T_J = 25\text{ }^{\circ}\text{C}$

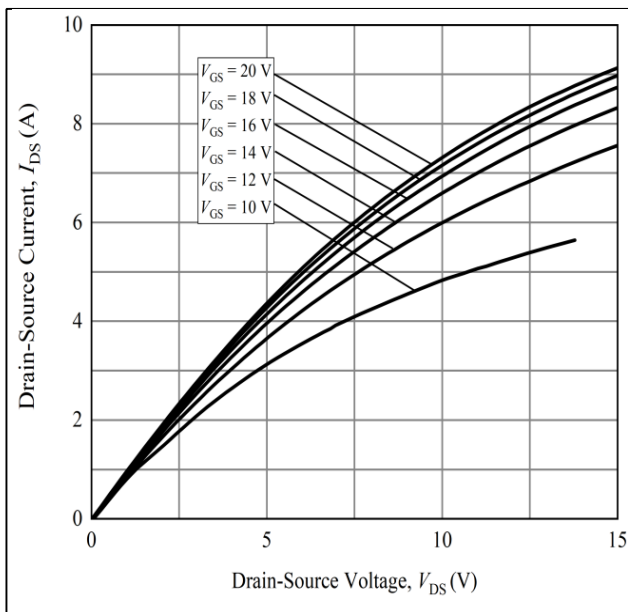


Figure 3: Typical Output Characteristics at $T_J = 175\text{ }^{\circ}\text{C}$

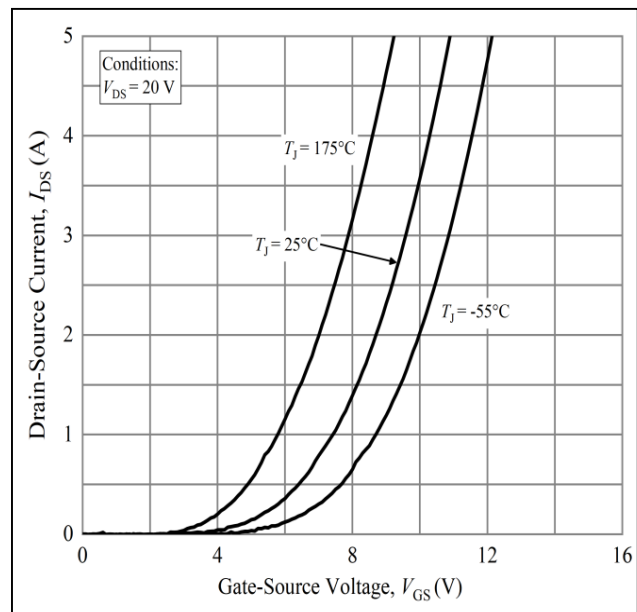


Figure 4: Typical Transfer Characteristics for Various Temperature

Typical Performance

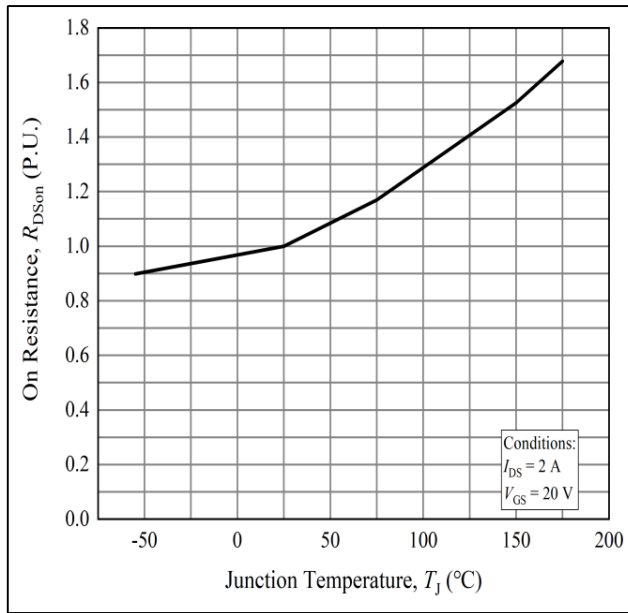


Figure 5: Normalized On-Resistance vs. Temperature

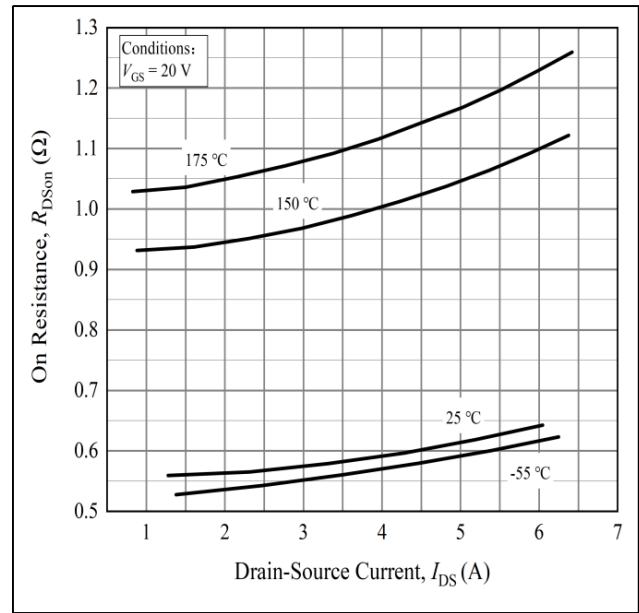


Figure 6: On-Resistance vs. Drain Current for Gate Various Temperatures

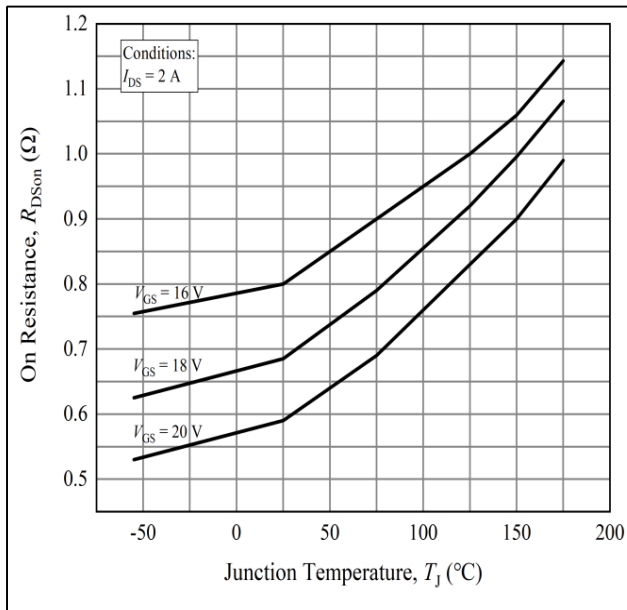


Figure 7: On-Resistance vs. Temperature for Various Voltage

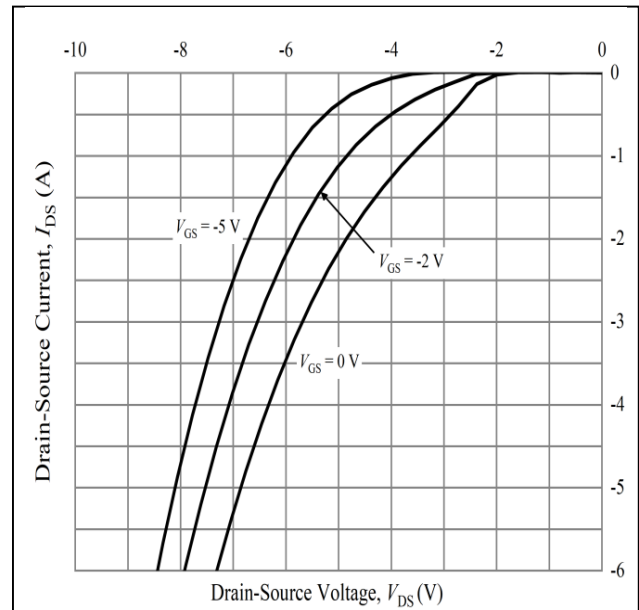


Figure 8: Typical Body Diode Characteristics at $T_J = -55\text{ }^{\circ}\text{C}$

Typical Performance

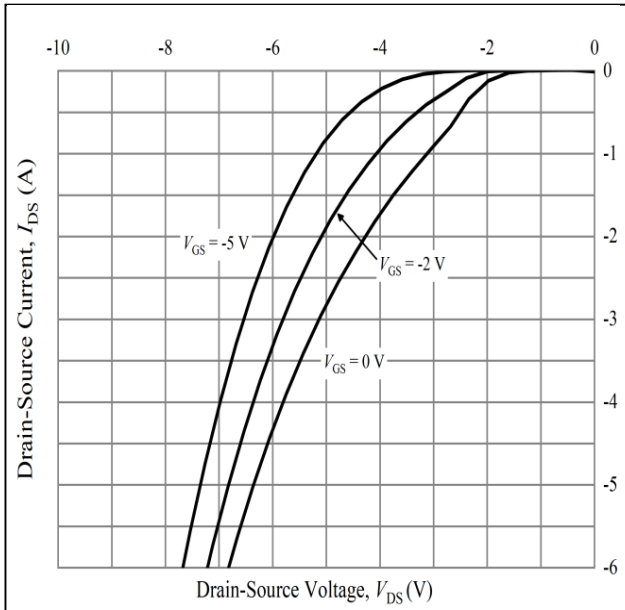


Figure 9: Typical Body Diode Characteristics at $T_J = 25\text{ }^{\circ}\text{C}$

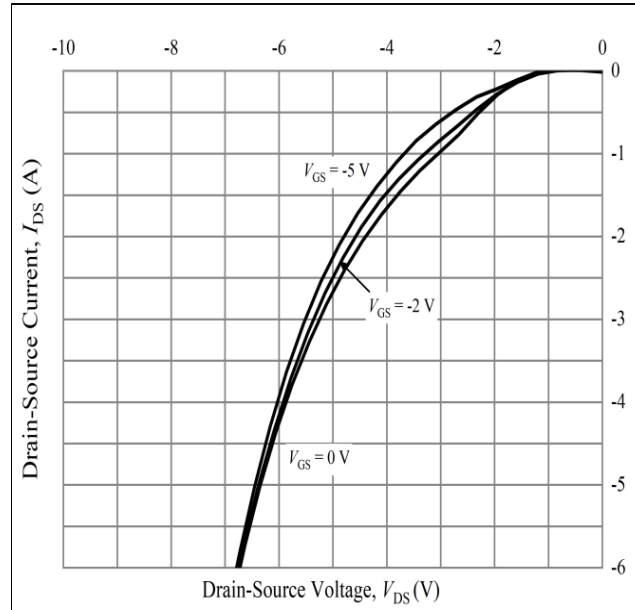


Figure 10: Typical Body Diode Characteristics at $T_J = 175\text{ }^{\circ}\text{C}$

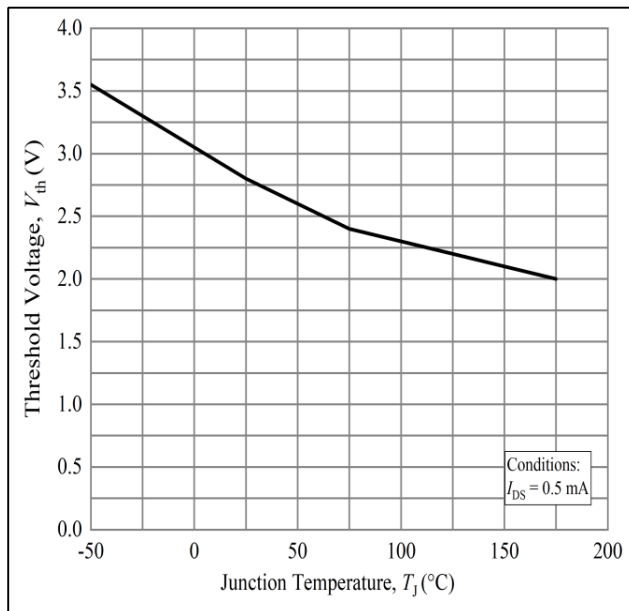


Figure 11: Typical Threshold Voltage vs. Temperature

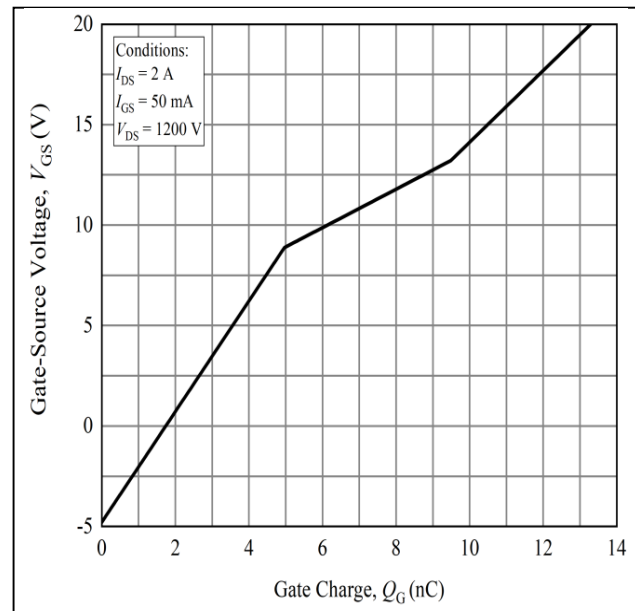


Figure 12: Typical Gate Charge Characteristics at $T_J = 25\text{ }^{\circ}\text{C}$

Typical Performance

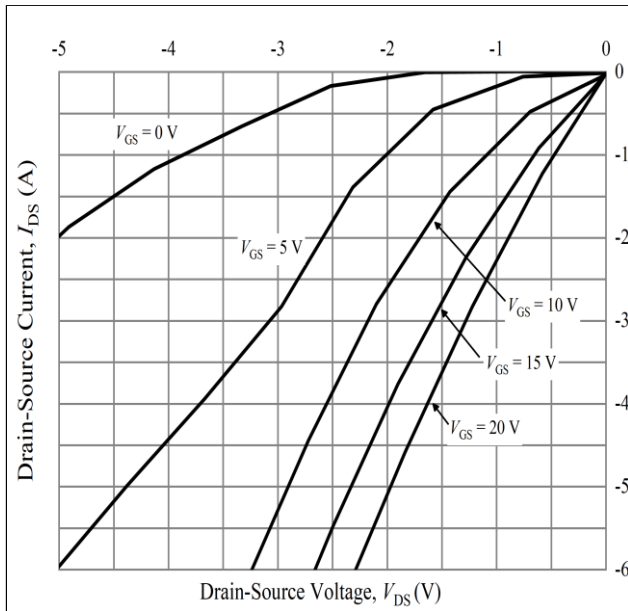


Figure 13: Typical 3rd Quadrant Characteristics
at $T_J = -55\text{ }^{\circ}\text{C}$

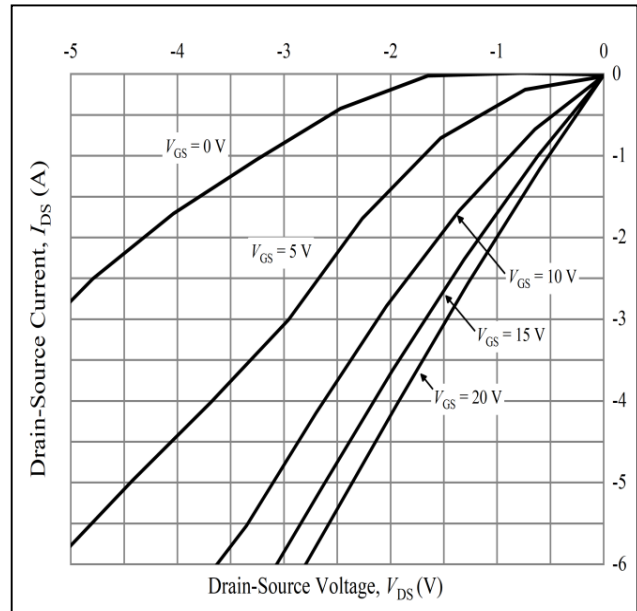


Figure 14: Typical 3rd Quadrant Characteristics at
 $T_J = 25\text{ }^{\circ}\text{C}$

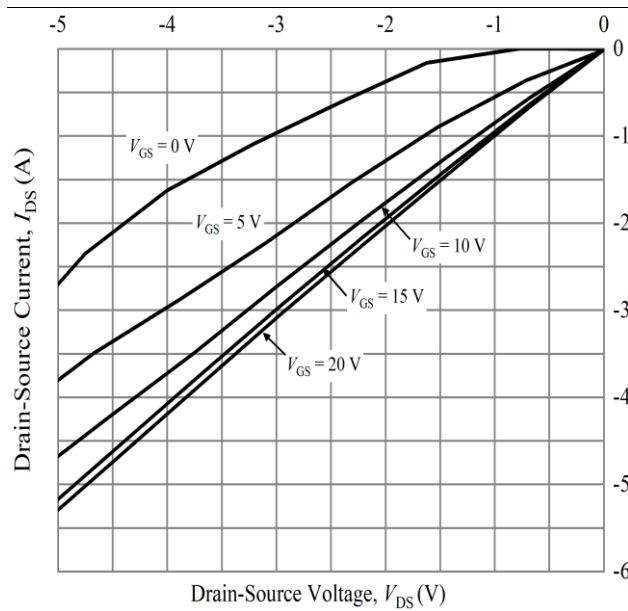


Figure 15: Typical 3rd Quadrant Characteristics
at $T_J = 175\text{ }^{\circ}\text{C}$

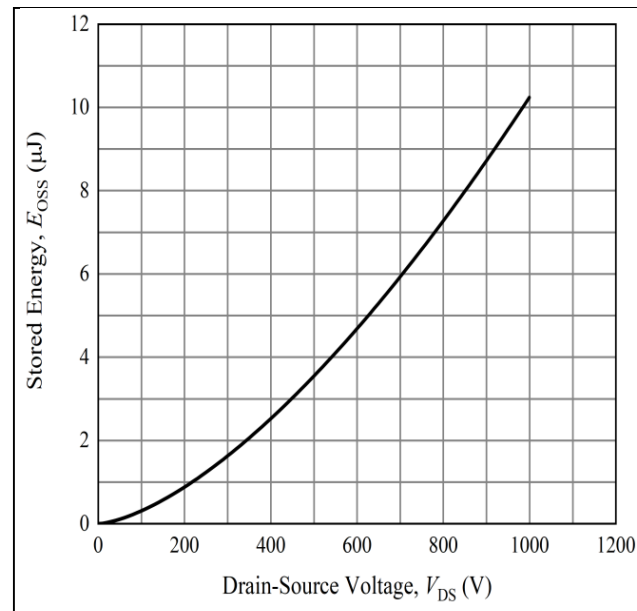


Figure 16: Typical Output Capacitor Stored Energy

Typical Performance

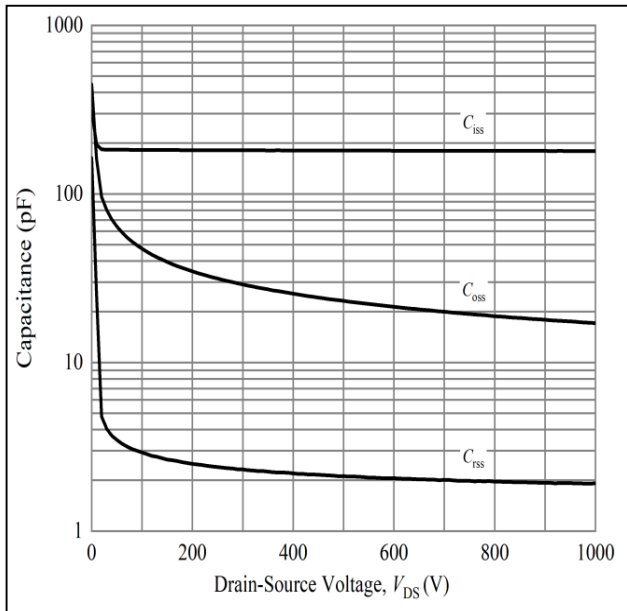


Figure 17: Typical Capacitances vs. Drain-Source Voltage

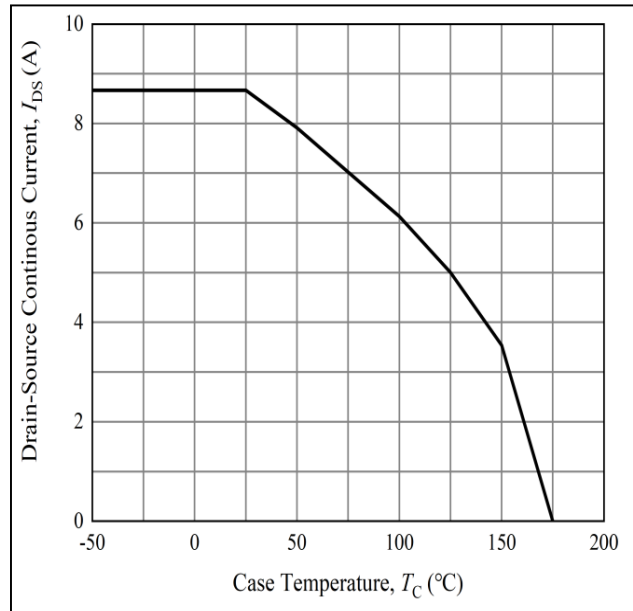


Figure 18: Continuous Drain Current Derating Curve

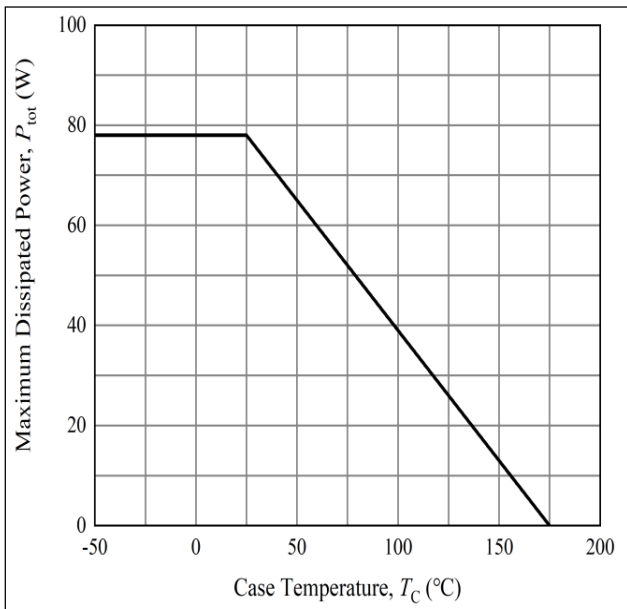


Figure 19: Power Dissipation Derating Curve

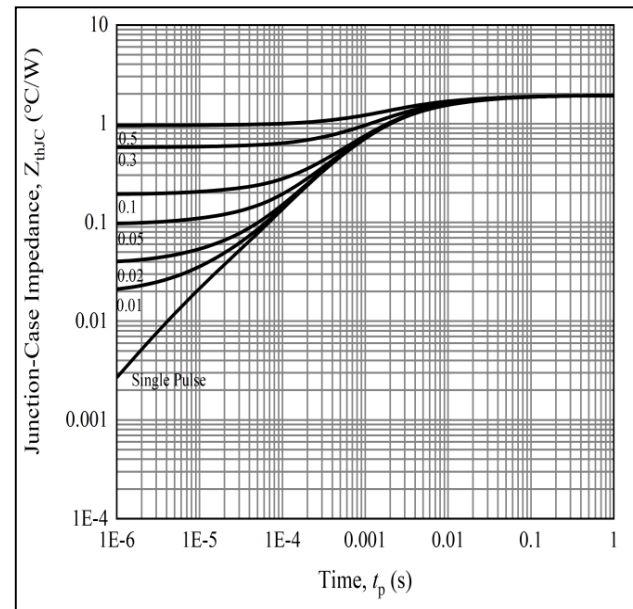


Figure 20: Typical Transient Thermal Impedance (Junction – Case) with Duty Cycle

Typical Performance

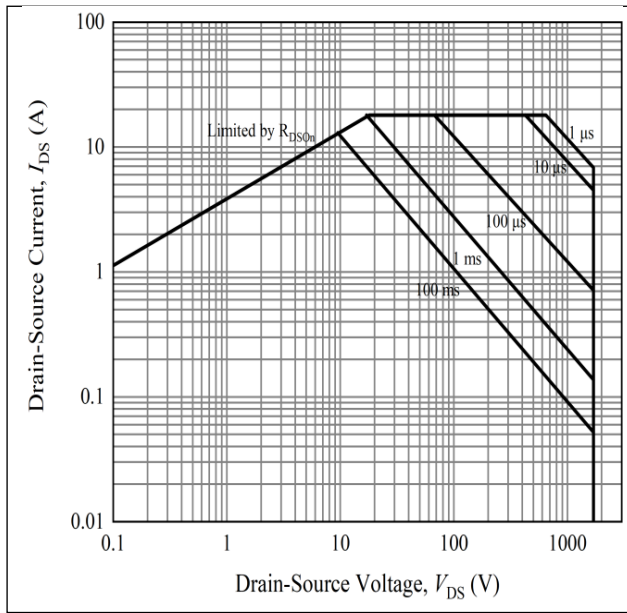


Figure 21: Safe Operate Area

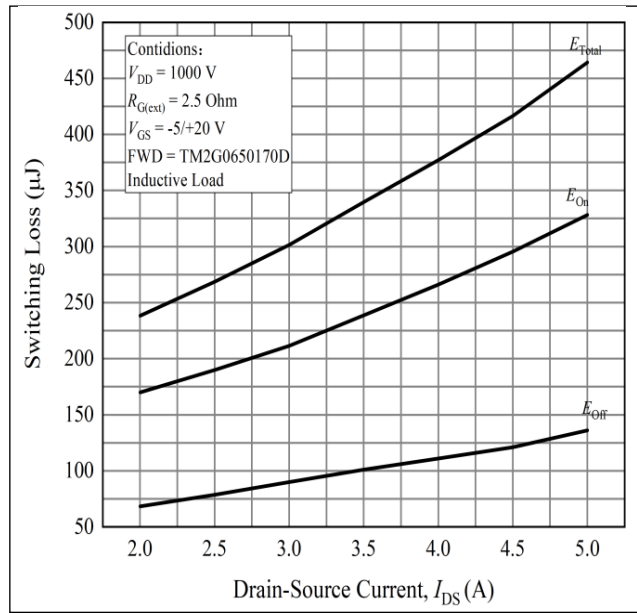


Figure 22: Clamped Inductive Switching Energy vs. Drain Current ($V_{DD} = 1000$ V)

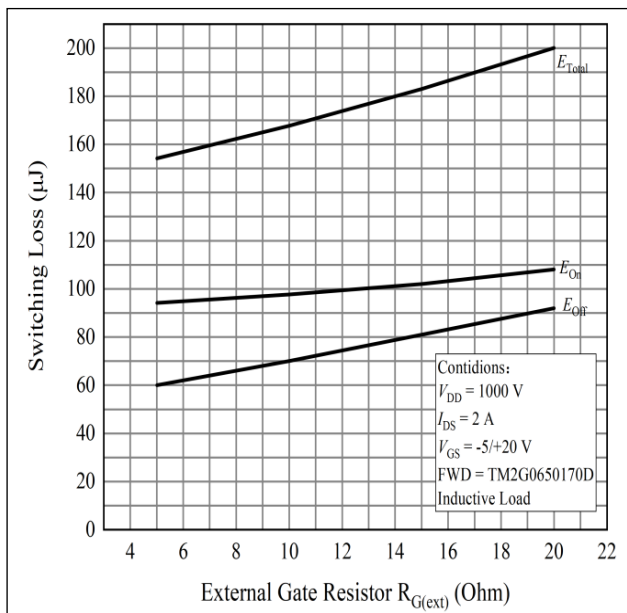


Figure 23: Clamped Inductive Switching Energy vs. $R_{G(ext)}$

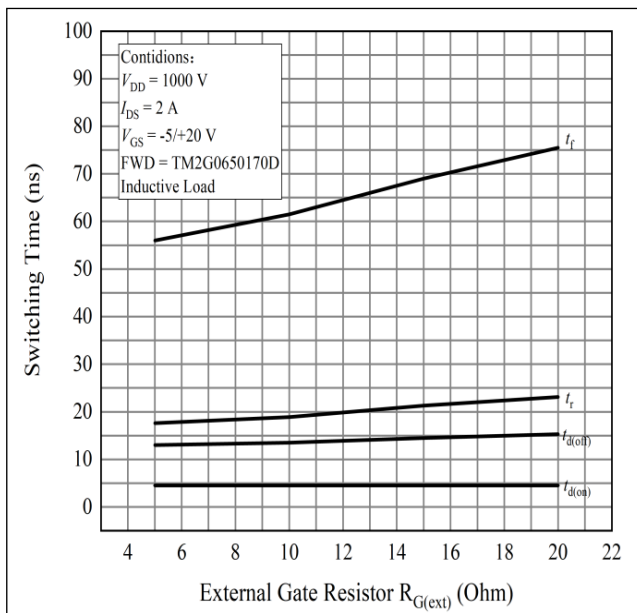


Figure 24: Switching Times vs. $R_{G(ext)}$

Package Dimensions

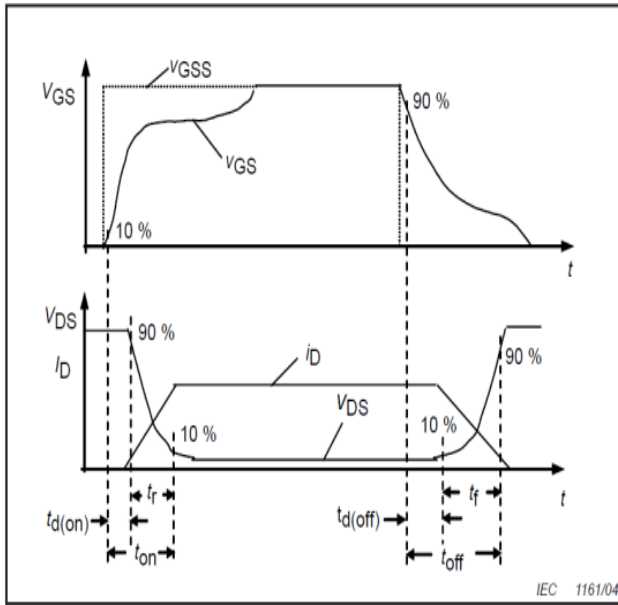


Figure 25: Resistive Switching Time Description

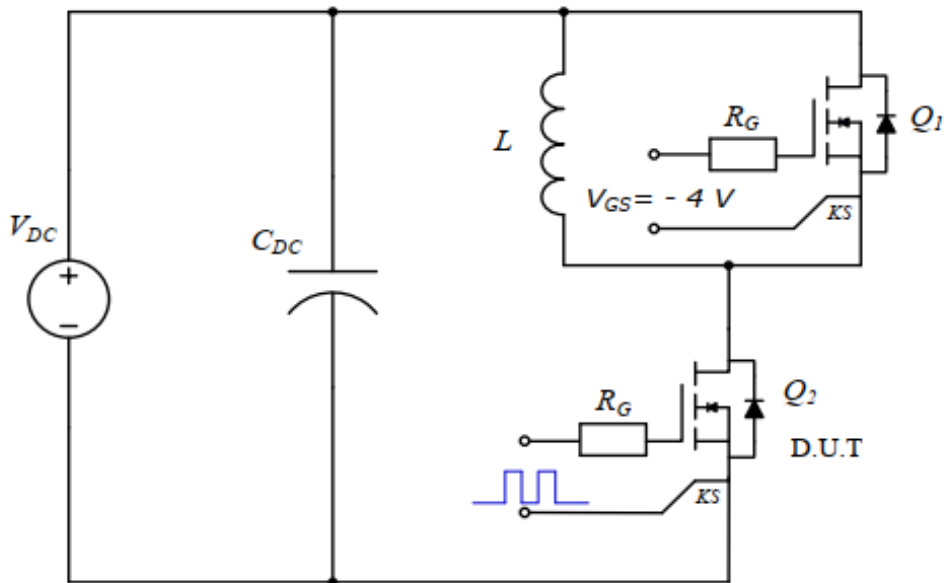
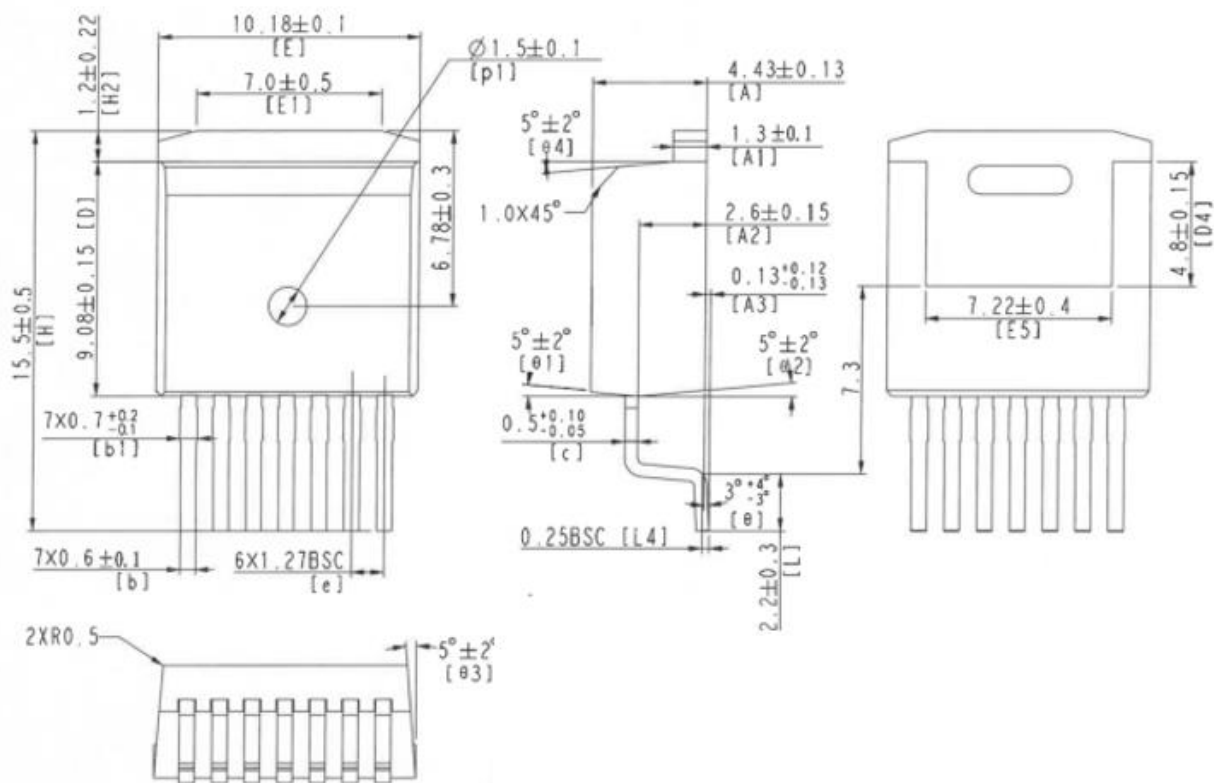


Figure 26: Clamped Inductive Switching Waveform Test Circuit

Package Dimensions

Package :TO-220F-3



Revision History

Document Version	Description of Changes
Rev.1.0	Released
Rev.2.0	Static parameters at different temperatures are added

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