

## HCM2G0650170D

1700V N-Channel Silicon Carbide Power MOSFET

$V_{DS}$	=	1700 V
$R_{DS(on)}$	=	650 mΩ
$I_D$	=	9 A

### Features

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

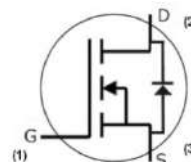
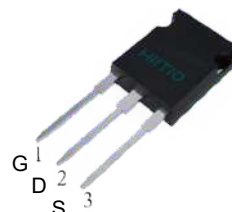
### Benefits

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

### Applications

- Switch Mode Power Supplies
- DC/DC converters
- Solar Inverters
- Battery Chargers
- Motor Drives

### Package



Part Number	Package	Marking
HCM2G0650170D	TO-247-3	HCM2G0650170D

### 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	9	A	$V_{GS} = 20\text{ V}$ , $T_C = 25\ ^\circ\text{C}$	Fig. 18
$I_{D(pluse)}$	Pulsed Drain Current	18	A	Pulse width $t_P$ limited by $T_{jmax}$	Fig. 21
$P_D$	Power Dissipation	85	W	$T_C = 25\ ^\circ\text{C}$	Fig. 19
$V_{GS,op}$	Recommend Gate Source Voltage (static)	-5/+20	V		
$V_{GSmax}$	Maximum Gate Source Voltage (dynamic)	-10/+25	V		
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to +175	$^\circ\text{C}$		
$T_L$	Soldering Temperature	260	$^\circ\text{C}$		

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

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
Static							
$BV_{DS}$	Drain-Source Breakdown Voltage	1700	--	--	V	$V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$	
$I_{DSS}$	Zero Gate Voltage Drain Current	--	0.9	100	$\mu\text{A}$	$V_{DS} = 1700\text{ V}, V_{GS} = 0\text{ V}$	
$I_{GSS}$	Gate-Source Leakage Current	--	2	250	nA	$V_{GS} = 20\text{ V}$	
$V_{GS(th)}$	Gate-Source Threshold Voltage	1.8	--	4	V	$I_D = 0.5\text{ mA}, V_{GS} = V_{DS}$	Fig. 11
$R_{DS(on)}$	Drain-Source On-Resistance	--	550	100	$\text{m}\Omega$	$V_{GS} = 20\text{ V}, I_D = 2\text{ A}$	Fig. 6
		--	650	--	$\text{m}\Omega$	$V_{GS} = 18\text{ V}, I_D = 2\text{ A}$	
		--	780	--	$\text{m}\Omega$	$V_{GS} = 15\text{ V}, I_D = 2\text{ A}$	
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	--	$\mu\text{J}$		Fig. 16
$Q_g$	Total Gate Charge	--	13.2	--	nC	$V_{DS} = 1200\text{ V}$ $I_D = 2\text{ A}$ $V_{GS} = -5/+20\text{ V}$ $L = 70\text{ mH}$	Fig. 12
$Q_{gs}$	Gate-Source Charge	--	5	--			
$Q_{gd}$	Gate-Drain Charge	--	4.5	--			
$E_{On}$	Turn-On Switching Energy		170		$\mu\text{J}$	$V_{DS} = 1000\text{ V}, V_{GS} = -5/+20\text{ V}$ $I_D = 2\text{ A}, R_{G(ext)} = 2.5\ \Omega,$ $L = 70\text{ mH}$	Fig. 22
$E_{Off}$	Turn-Off Switching Energy		68				
$t_{d(on)}$	Turn-on Delay Time	--	5	--	ns	$V_{DS} = 1000\text{ V}$ $V_{GS} = -5/+20\text{ V}$ $I_D = 2\text{ A}$ $R_{G(ext)} = 2.5\ \Omega$	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	--	$\Omega$	$f = 1.0\text{ MHz}, V_{AC} = 25\text{ mV}$	

**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	--	--	4	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	$I_S = 20\text{ A}, V_{DS} = 1200\text{ V}$ $V_{GS} = -5\text{ V}$ $di/dt = 1200\text{ A}/\mu\text{s}$	
$Q_{rr}$	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	/	1.74	/	$^\circ\text{C}/\text{W}$	Fig. 20

## Typical Performance

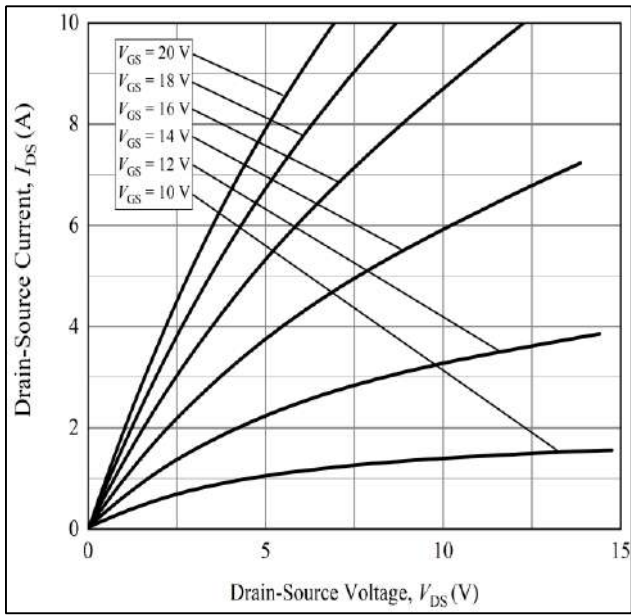
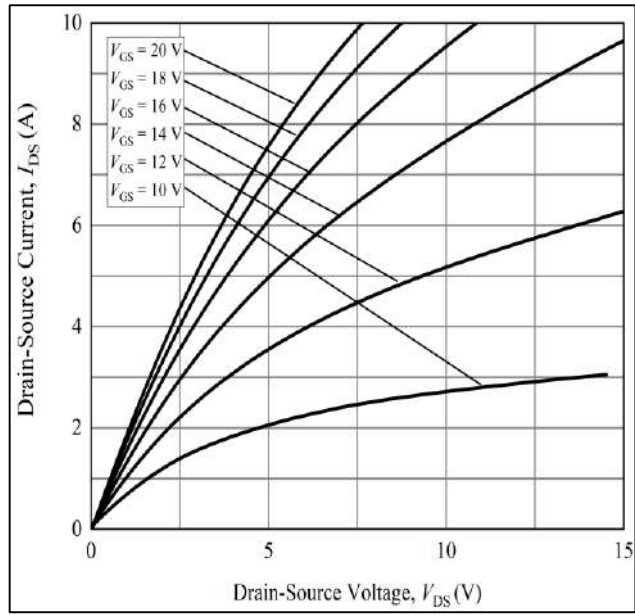
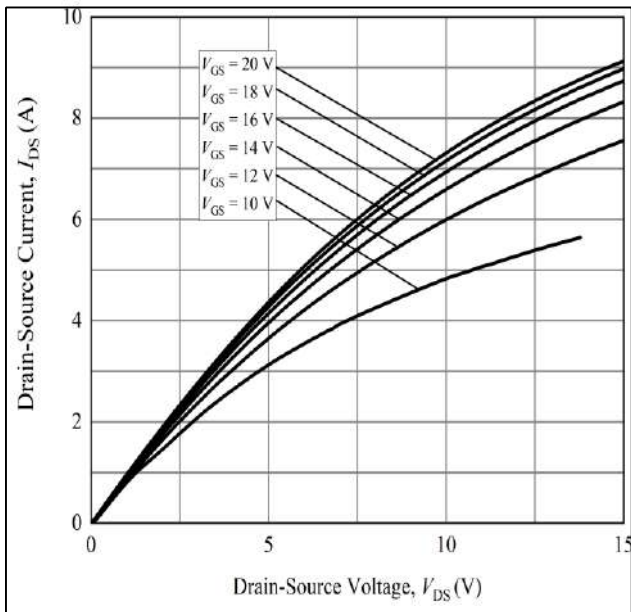
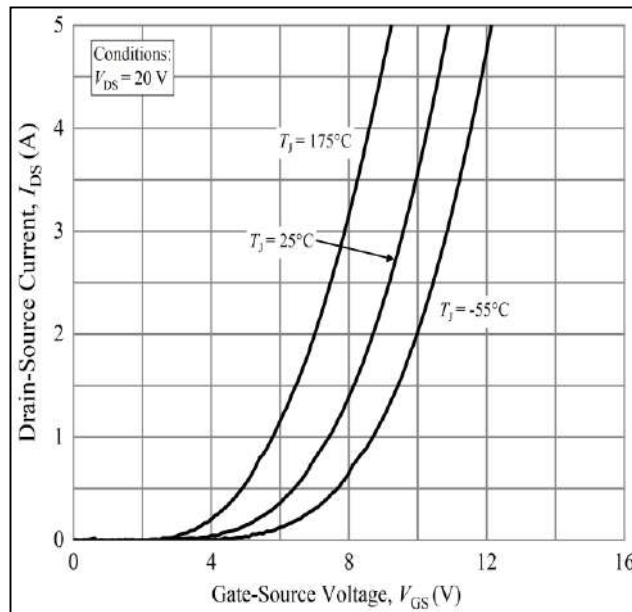

 Figure 1: Typical Output Characteristics at  $T_J = -55\text{ }^\circ\text{C}$ 

 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

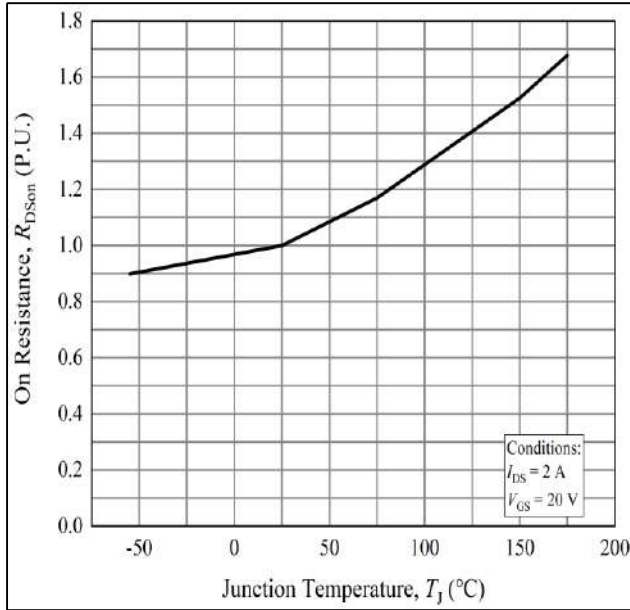


Figure 5: Normalized On-Resistance vs. Temperature

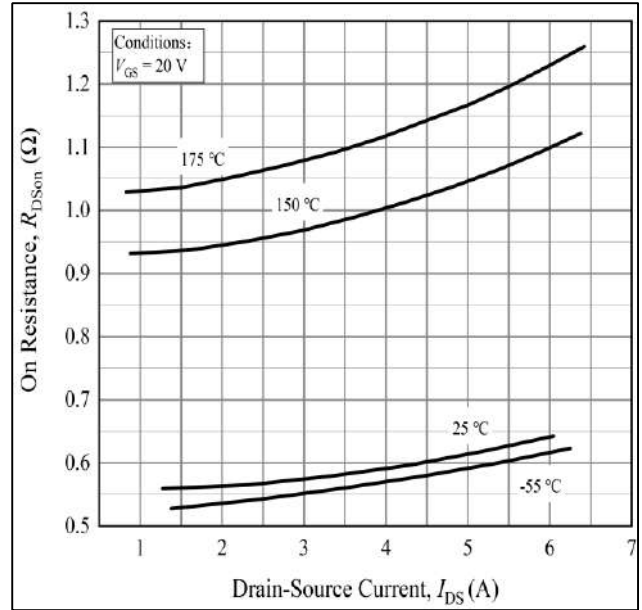


Figure 6: On-Resistance vs. Drain Current for Gate Various Temperatures

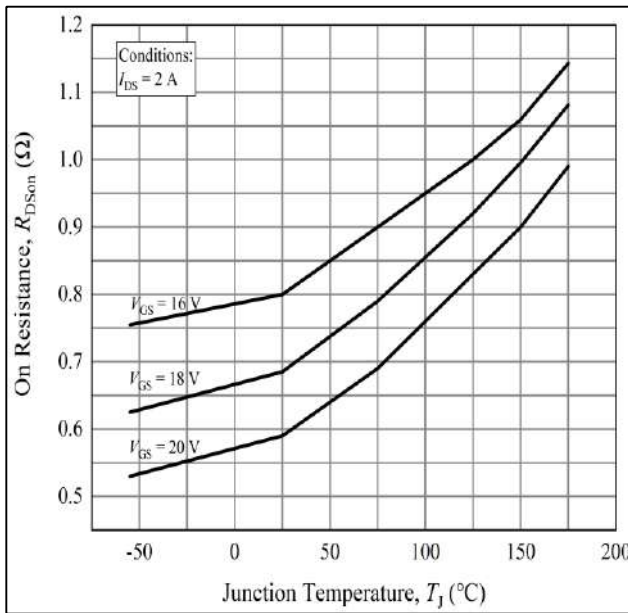


Figure 7: On-Resistance vs. Temperature for Various Voltage

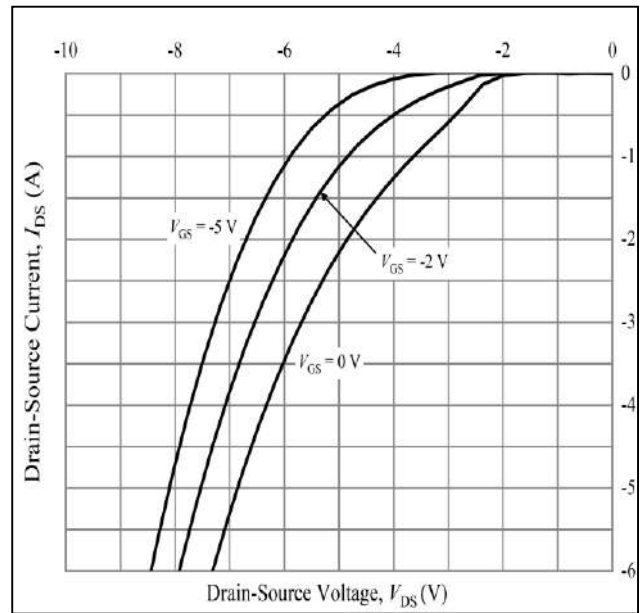


Figure 8: Typical Body Diode Characteristics at  $T_J = -55\text{ }^\circ\text{C}$

## Typical Performance

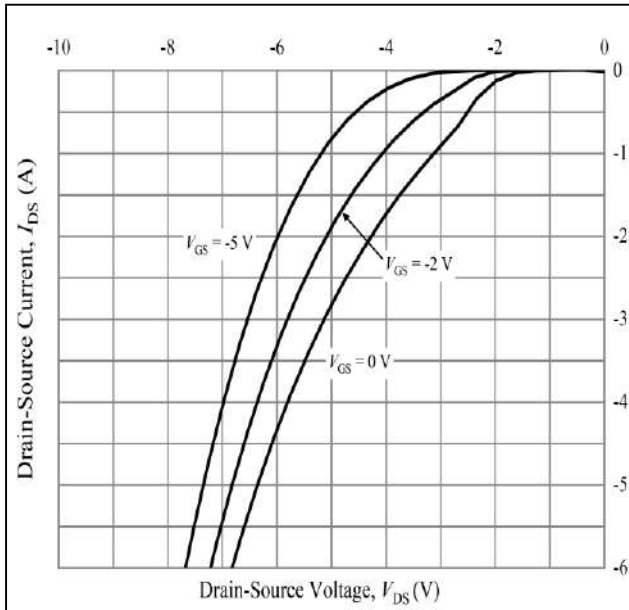


Figure 9: Typical Body Diode Characteristics at  $T_J = 25\text{ }^\circ\text{C}$

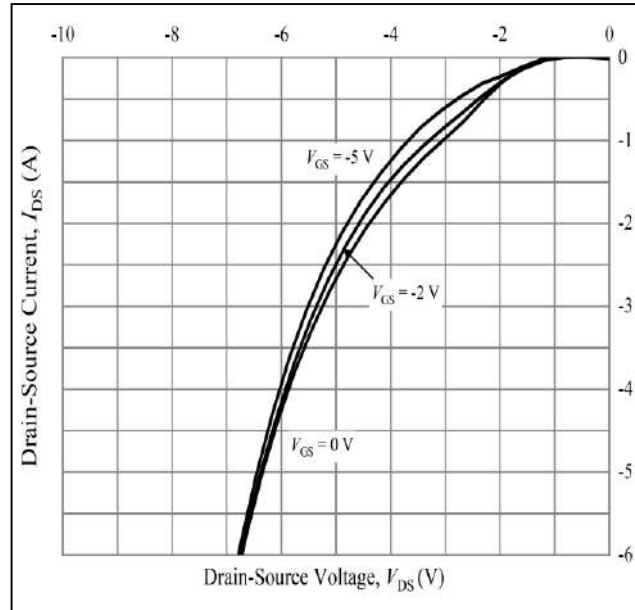


Figure 10: Typical Body Diode Characteristics at  $T_J = 175\text{ }^\circ\text{C}$

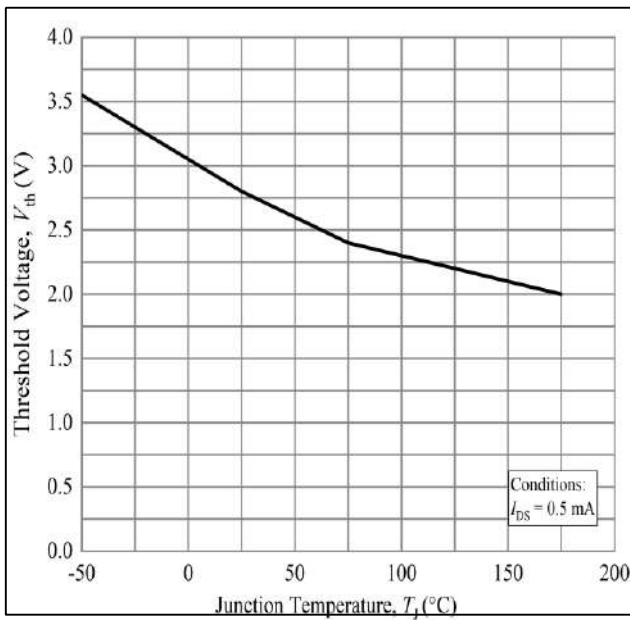


Figure 11: Typical Threshold Voltage vs. Temperature

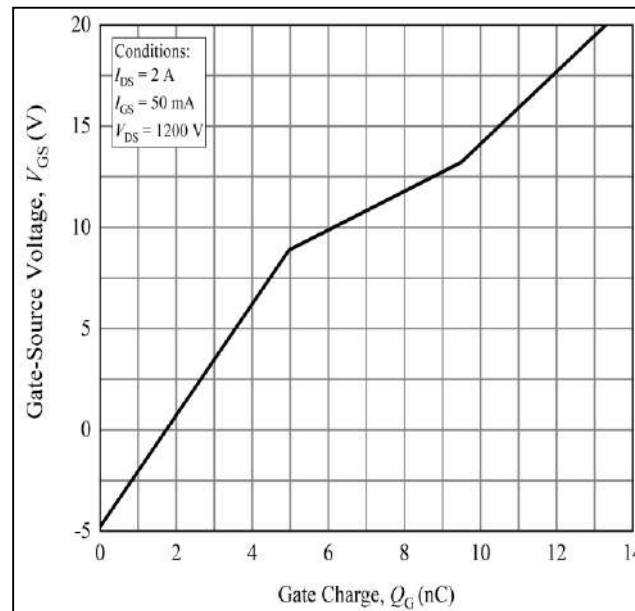


Figure 12: Typical Gate Charge Characteristics at  $T_J = 25\text{ }^\circ\text{C}$

## Typical Performance

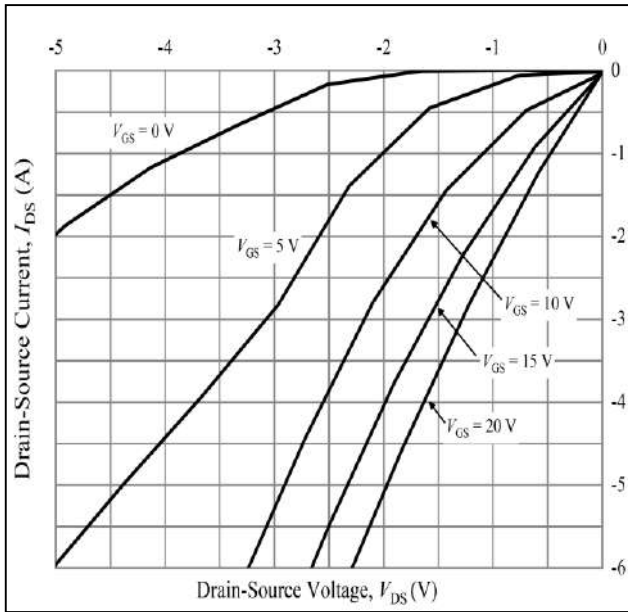


Figure 13: Typical 3rd Quadrant Characteristics  
 $T_J = -55\text{ }^\circ\text{C}$

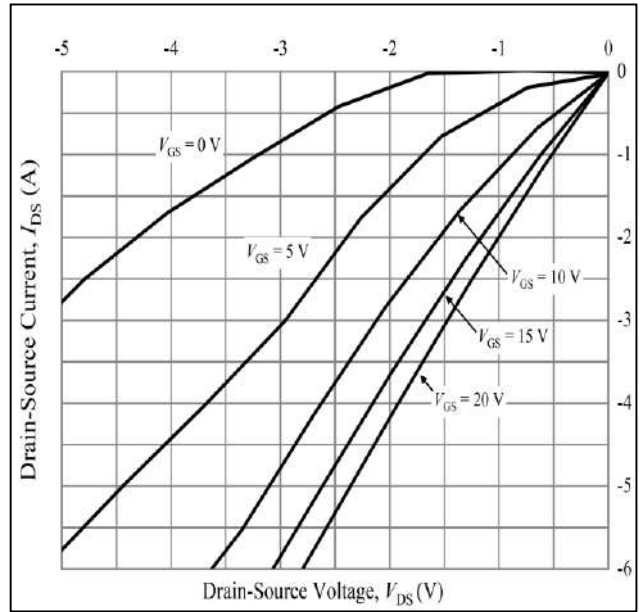


Figure 14: Typical 3rd Quadrant Characteristics at  
 $T_J = 25\text{ }^\circ\text{C}$

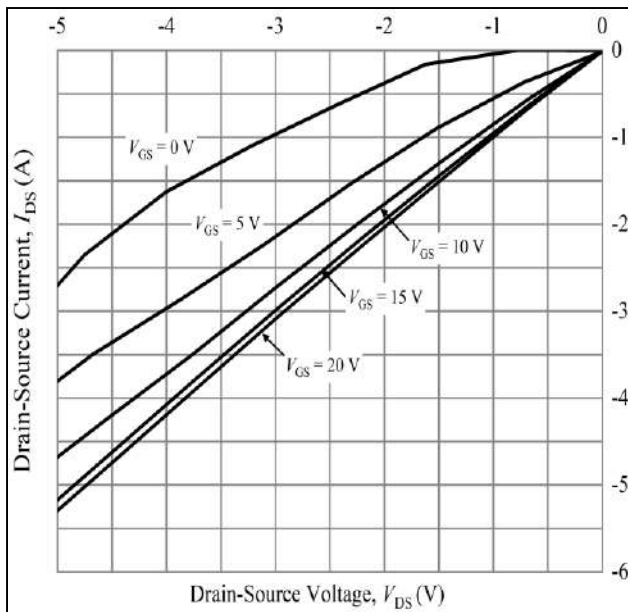


Figure 15: Typical 3rd Quadrant Characteristics  
 at  $T_J = 175\text{ }^\circ\text{C}$

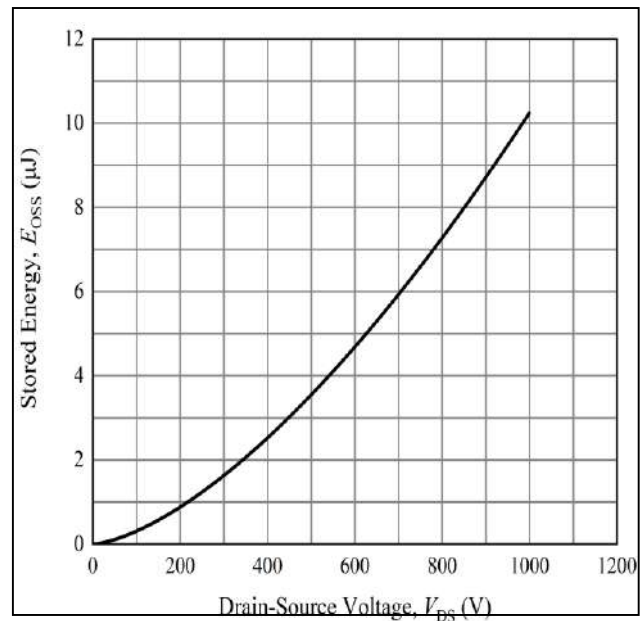


Figure 16: Typical Output Capacitor Stored Energy

Typical Performance

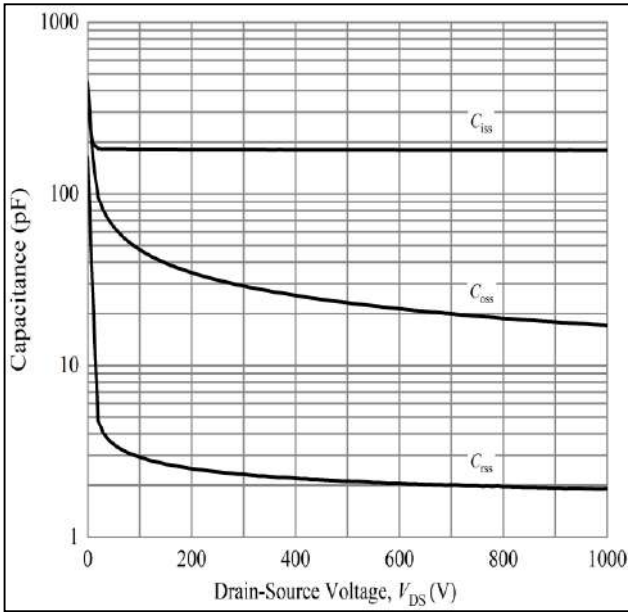


Figure 17: Typical Capacitances vs. Drain-Source Voltage

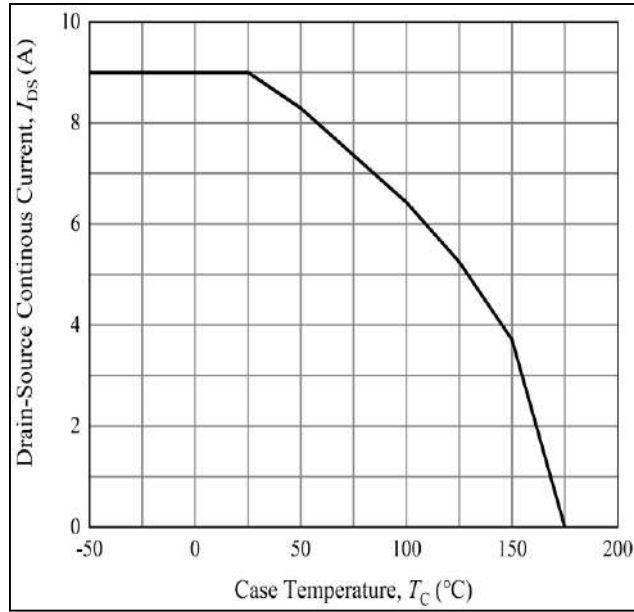


Figure 18: Continuous Drain Current Derating Curve

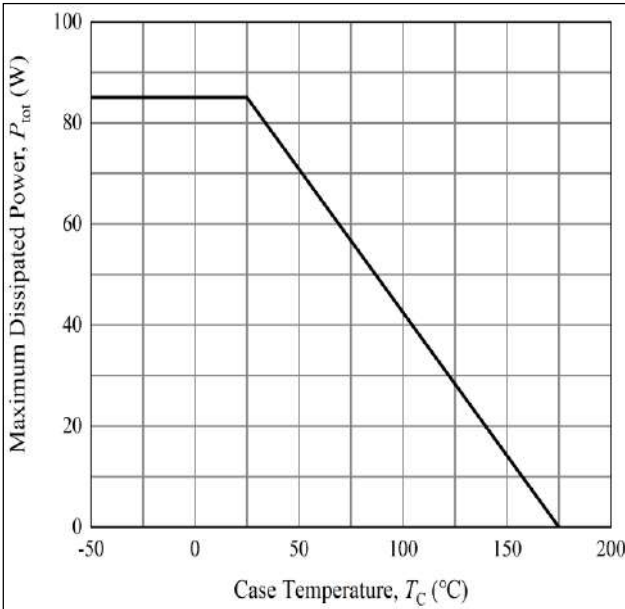


Figure 19: Power Dissipation Derating Curve

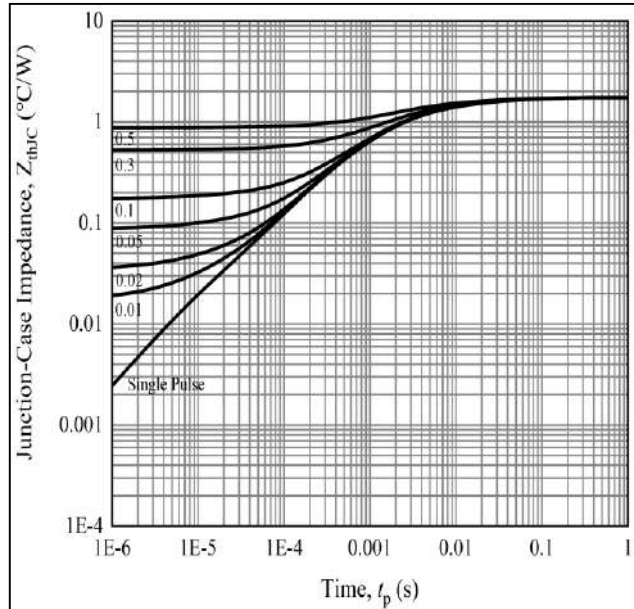


Figure 20: Typical Transient Thermal Impedance (Junction – Case) with Duty Cycle

Typical Performance

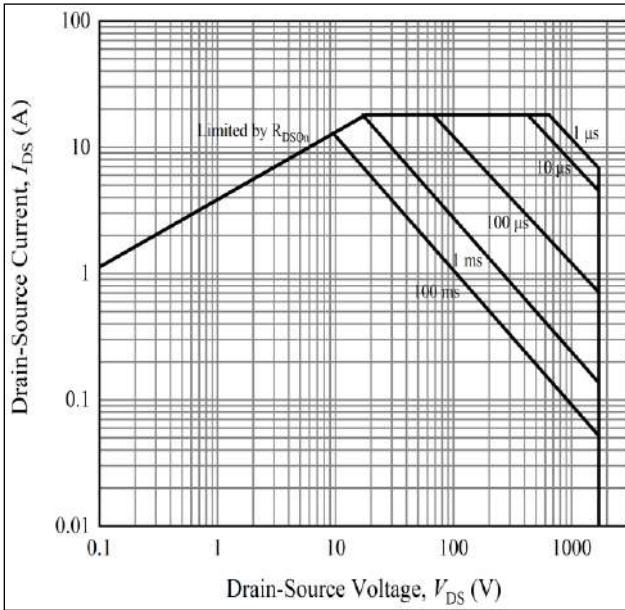


Figure 21: Safe Operate Area

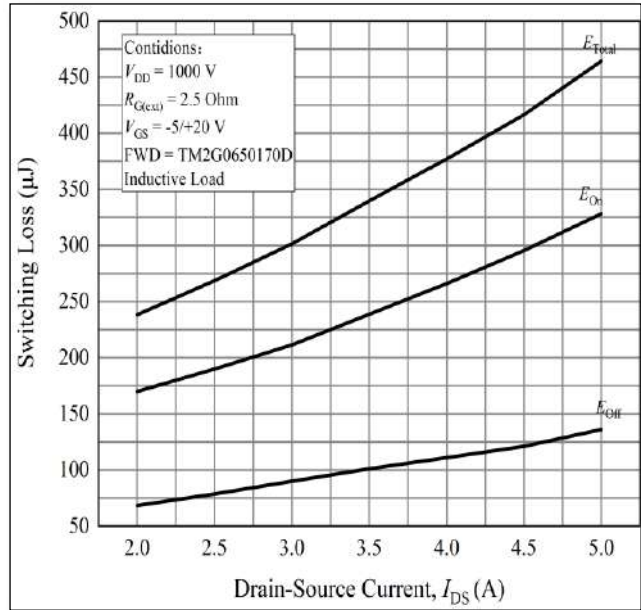


Figure 22: Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 1000$  V)

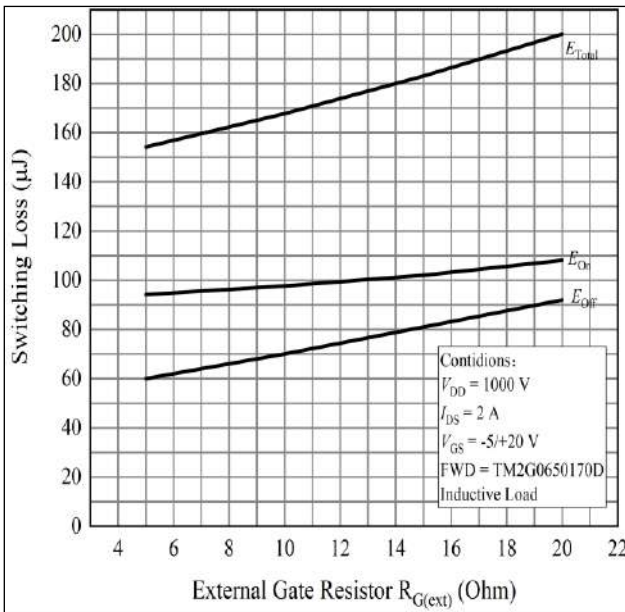


Figure 23: Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

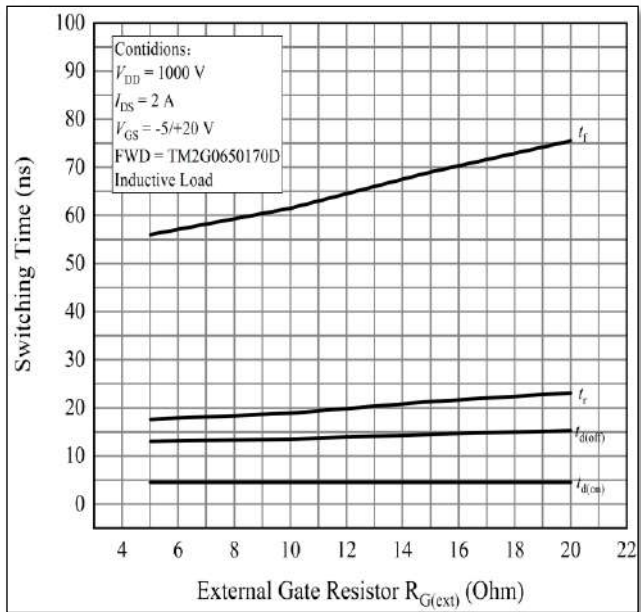


Figure 24: Switching Times vs.  $R_{G(ext)}$



## Package Dimensions

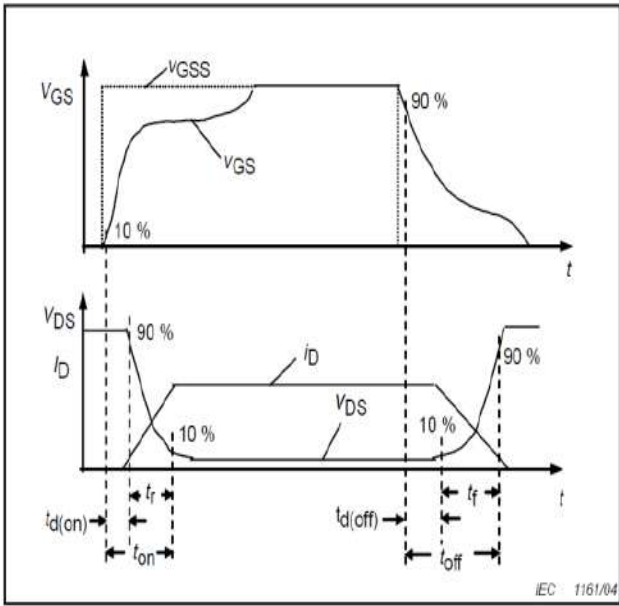


Figure 25: Resistive Switching Time Description

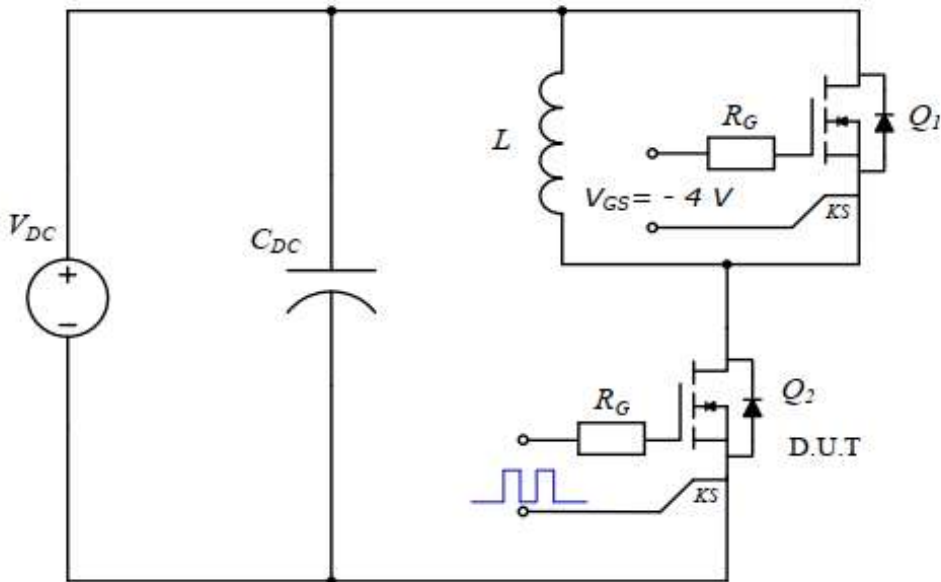
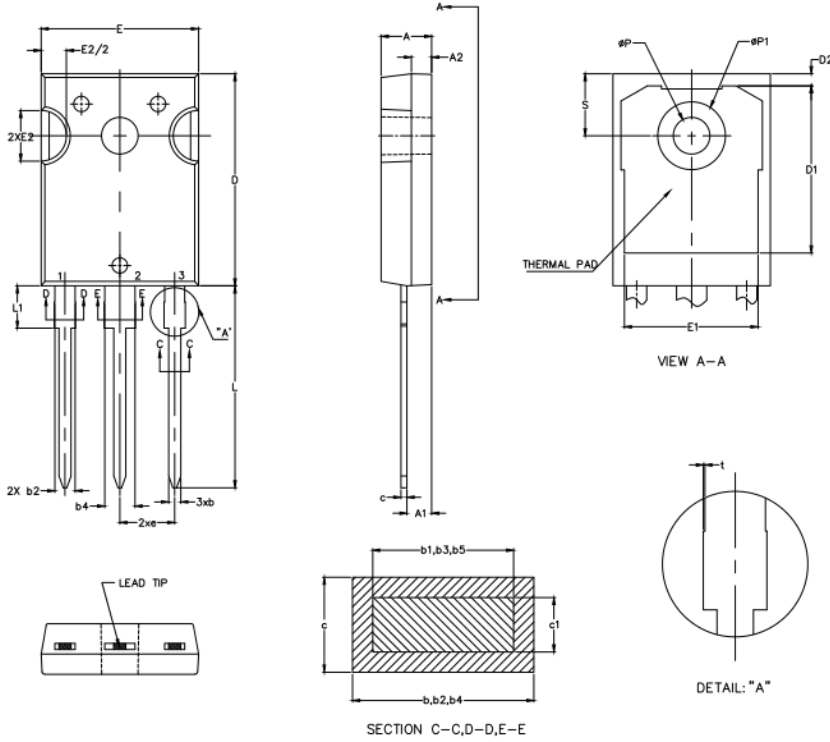


Figure 26: Clamped Inductive Switching Waveform Test Circuit

## Package Dimensions

Package: TO-247-3



DIMENSIONS	DIMENSIONS			
	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.15	1.22	0.045	0.048
b2	1.96	2.06	0.077	0.081
b3	1.95	2.02	0.077	0.080
b4	2.96	3.06	0.117	0.120
b5	2.95	3.02	0.116	0.119
c	0.59	0.66	0.023	0.026
c1	0.58	0.62	0.023	0.024
D	20.90	21.10	0.823	0.831
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.75	15.90	0.620	0.626
E1	13.26	—	0.552	—
E2	4.90	5.10	0.193	0.201
e	5.44BSC		0.214BSC	
L	19.80	20.10	0.780	0.791
L1	—	4.30	—	0.169
#P	3.50	3.70	0.138	0.146
#P1	—	7.40	—	0.291
S	6.05	6.25	0.238	0.246
t	0.00	0.15	0.000	0.006

## 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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