



### Features

- 3rd generation SiC MOSFET technology
- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Halogen free, RoHS compliant

### Benefits

- Higher system efficiency
- Reduced cooling requirements
- Increased power density
- Increased system switching frequency
- Easy to parallel and simple to drive
- Enable new hard switching PFC topologies (Totem-Pole)

### Applications

- EV charging
- Server power supplies
- Solar PV inverters
- UPS
- DC/DC converters



Ordering Part Number	Package	Marking
HC3M0060065K	TO247-4L	HC3M0060065K

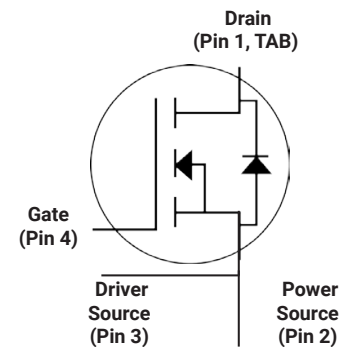
### Maximum Ratings

Symbol	Parameter	Value	Unit	Note
$V_{DSS}$	Drain - Source Voltage, $T_c = 25^\circ\text{C}$	650	V	
$V_{GS}$	Gate - Source voltage (Under transient events < 100 ns)	-8/+19	V	Fig. 29
$I_D$	Continuous Drain Current, $V_{GS} = 15\text{ V}$ , $T_c = 25^\circ\text{C}$	37	A	Fig. 19
	Continuous Drain Current, $V_{GS} = 15\text{ V}$ , $T_c = 100^\circ\text{C}$	27		
$I_{D(pulse)}$	Pulsed Drain Current, Pulse width $t_p$ limited by $T_{jmax}$	99	A	
$P_D$	Power Dissipation, $T_c=25^\circ\text{C}$ , $T_j = 175^\circ\text{C}$	150	W	Fig. 20
$T_J, T_{stg}$	Operating Junction and Storage Temperature	-40 to +175	$^\circ\text{C}$	
$T_L$	Solder Temperature, 1.6mm (0.063") from case for 10s	260	$^\circ\text{C}$	
$M_d$	Mounting Torque, (M3 or 6-32 screw)	1	Nm	
		8.8		



D S S G

Package





**Electrical Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions	Note
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	650			V	$V_{GS} = 0\text{ V}, I_b = 100\ \mu\text{A}$	
$V_{GSon}$	Gate-Source Recommended Turn-On Voltage		15		V	Static	Fig. 29
$V_{GSoff}$	Gate-Source Recommended Turn-Off Voltage		-4		V		
$V_{GS(th)}$	Gate Threshold Voltage	1.8	2.3	3.6	V	$V_{DS} = V_{GS}, I_b = 5\ \text{mA}$	Fig. 11
			1.9		V	$V_{DS} = V_{GS}, I_b = 5\ \text{mA}, T_J = 175^\circ\text{C}$	
$I_{DSS}$	Zero Gate Voltage Drain Current		1	50	$\mu\text{A}$	$V_{DS} = 650\ \text{V}, V_{GS} = 0\ \text{V}$	
$I_{GSS}$	Gate-Source Leakage Current		10	250	nA	$V_{GS} = 15\ \text{V}, V_{DS} = 0\ \text{V}$	
$R_{DS(on)}$	Drain-Source On-State Resistance	42	60	79	m $\Omega$	$V_{GS} = 15\ \text{V}, I_b = 13.2\ \text{A}$	Fig. 4, 5, 6
			80			$V_{GS} = 15\ \text{V}, I_b = 13.2\ \text{A}, T_J = 175^\circ\text{C}$	
$g_{fs}$	Transconductance		10		S	$V_{DS} = 20\ \text{V}, I_{DS} = 13.2\ \text{A}$	Fig. 7
			9			$V_{DS} = 20\ \text{V}, I_{DS} = 13.2\ \text{A}, T_J = 175^\circ\text{C}$	
$C_{iss}$	Input Capacitance		1020		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 600\ \text{V}$ $f = 1\ \text{MHz}$ $V_{AC} = 25\ \text{mV}$	Fig. 17, 18
$C_{oss}$	Output Capacitance		80				
$C_{riss}$	Reverse Transfer Capacitance		9				
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		95		pF	$V_{GS} = 0\ \text{V}, V_{DS} = 0\ \text{V to } 400\ \text{V}$	Note 1
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		132				
$E_{oss}$	$C_{oss}$ Stored Energy		15		$\mu\text{J}$	$V_{DS} = 600\ \text{V}, 1\ \text{MHz}$	Fig. 16
$E_{ON}$	Turn-On Switching Energy (Body Diode)		70		$\mu\text{J}$	$V_{DS} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_b = 13.2\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 135\ \mu\text{H}, T_J = 175^\circ\text{C}$ FWD = Internal Body Diode of MOSFET	Fig. 25
$E_{OFF}$	Turn Off Switching Energy (Body Diode)		5				
$E_{oN}$	Turn-On Switching Energy (External SiC Diode)		67		$\mu\text{J}$	$V_{DS} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}, I_b = 13.2\ \text{A},$ $R_{G(ext)} = 2.5\ \Omega, L = 135\ \mu\text{H}, T_J = 175^\circ\text{C}$ FWD = External SiC Diode	Fig. 25
$E_{oFF}$	Turn Off Switching Energy (External SiC Diode)		6				
$t_{d(on)}$	Turn-On Delay Time		8		ns	$V_{DD} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_b = 13.2\ \text{A}, R_{G(ext)} = 2.5\ \Omega, L = 135\ \mu\text{H}$ Timing relative to $V_{DS}$ Inductive load	Fig. 26
$t_r$	Rise Time		11				
$t_{d(off)}$	Turn-Off Delay Time		17				
$t_f$	Fall Time		5				
$R_{G(int)}$	Internal Gate Resistance		3		$\Omega$	$f = 1\ \text{MHz}, V_{AC} = 25\ \text{mV}$	
$Q_{gs}$	Gate to Source Charge		13		nC	$V_{DS} = 400\ \text{V}, V_{GS} = -4\ \text{V}/15\ \text{V}$ $I_b = 13.2\ \text{A}$ Per IEC60747-8-4 pg 21	Fig. 12
$Q_{gd}$	Gate to Drain Charge		17				
$Q_g$	Total Gate Charge		46				

Note (1):  $C_{o(er)}$ , a lumped capacitance that gives same stored energy as  $C_{oss}$  while  $V_{ds}$  is rising from 0 to 400V  
 $C_{o(tr)}$ , a lumped capacitance that gives same charging time as  $C_{oss}$  while  $V_{ds}$  is rising from 0 to 400V



**Reverse Diode Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$V_{SD}$	Diode Forward Voltage	5.1		V	$V_{GS} = -4\text{ V}, I_{SD} = 6.6\text{ A}, T_J = 25^\circ\text{C}$	Fig. 8, 9, 10
		4.8		V	$V_{GS} = -4\text{ V}, I_{SD} = 6.6\text{ A}, T_J = 175^\circ\text{C}$	
$I_S$	Continuous Diode Forward Current		23	A	$V_{GS} = -4\text{ V}, T_c = 25^\circ\text{C}$	
$I_{S,pulse}$	Diode pulse Current		99	A	$V_{GS} = -4\text{ V}$ , pulse width $t_p$ limited by $T_{jmax}$	
$t_{rr}$	Reverse Recover time	11		ns	$V_{GS} = -4\text{ V}, I_{SD} = 13.2\text{ A}, V_R = 400\text{ V}$ $dif/dt = 4500\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	
$Q_{rr}$	Reverse Recovery Charge	151		nC		
$I_{rrm}$	Peak Reverse Recovery Current	27		A		
$t_{rr}$	Reverse Recover time	16		ns	$V_{GS} = -4\text{ V}, I_{SD} = 13.2\text{ A}, V_R = 400\text{ V}$ $dif/dt = 2400\text{ A}/\mu\text{s}, T_J = 175^\circ\text{C}$	
$Q_{rr}$	Reverse Recovery Charge	110		nC		
$I_{rrm}$	Peak Reverse Recovery Current	12		A		

**Thermal Characteristics**

Symbol	Parameter	Typ.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.99	$^\circ\text{C}/\text{W}$		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			



### Typical Performance

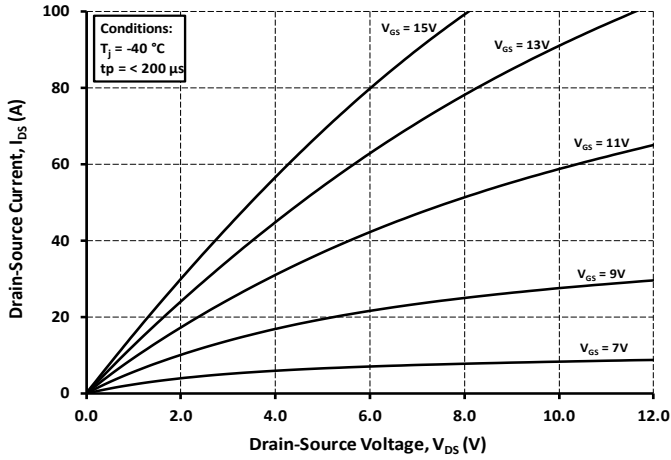


Figure 1. Output Characteristics  $T_J = -40\text{ }^\circ\text{C}$

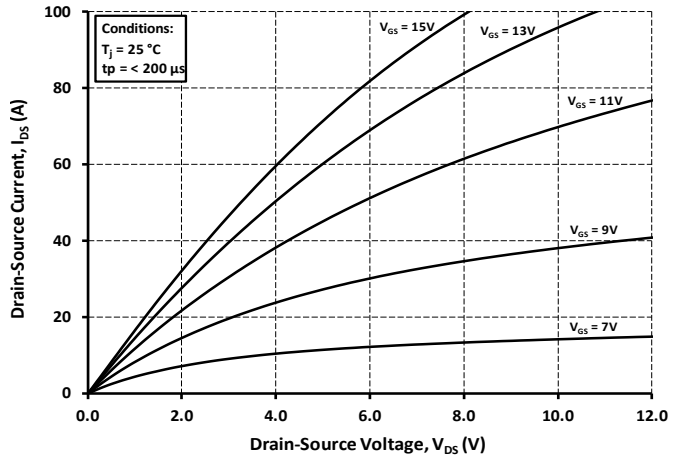


Figure 2. Output Characteristics  $T_J = 25\text{ }^\circ\text{C}$

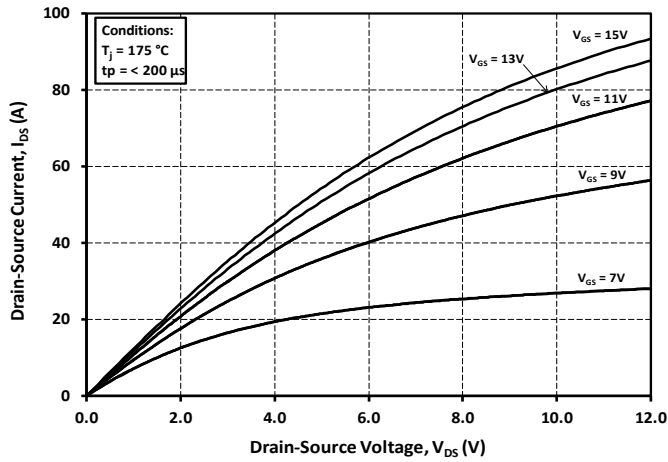


Figure 3. Output Characteristics  $T_J = 175\text{ }^\circ\text{C}$

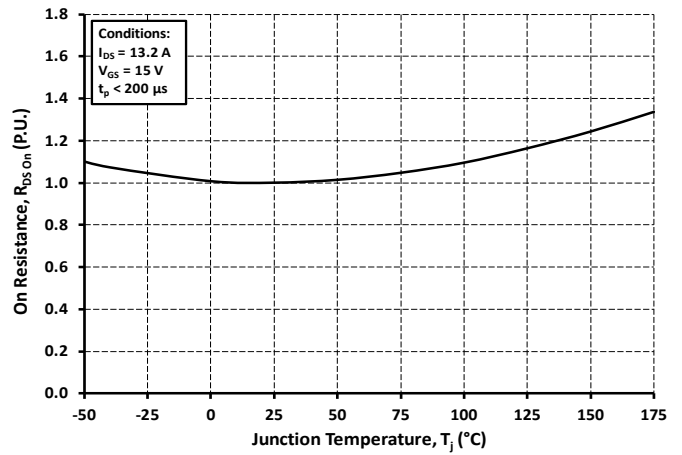


Figure 4. Normalized On-Resistance vs. Temperature

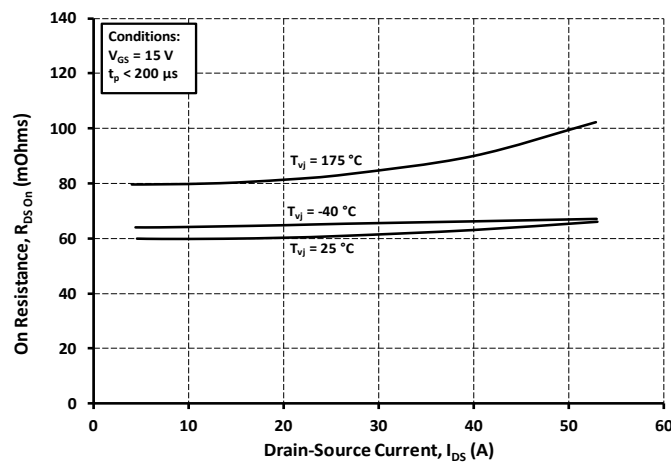


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

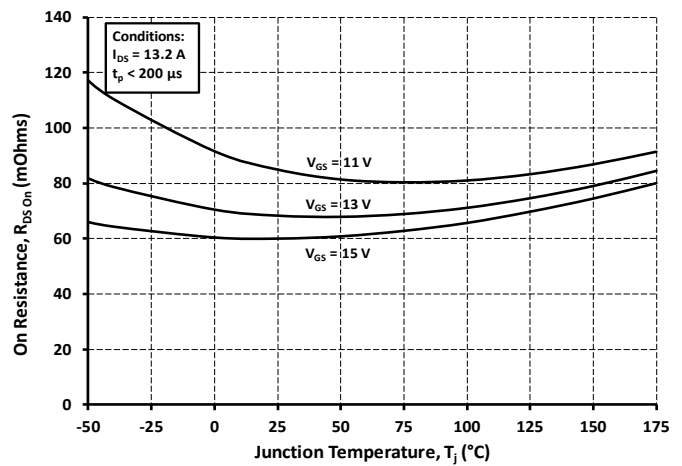


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage



### Typical Performance

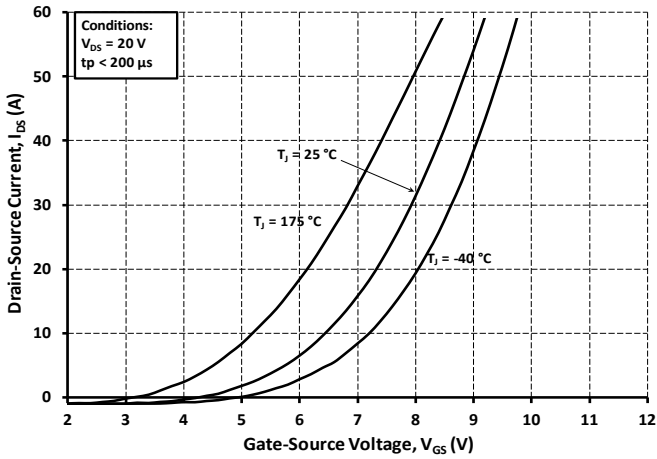


Figure 7. Transfer Characteristic for Various Junction Temperatures

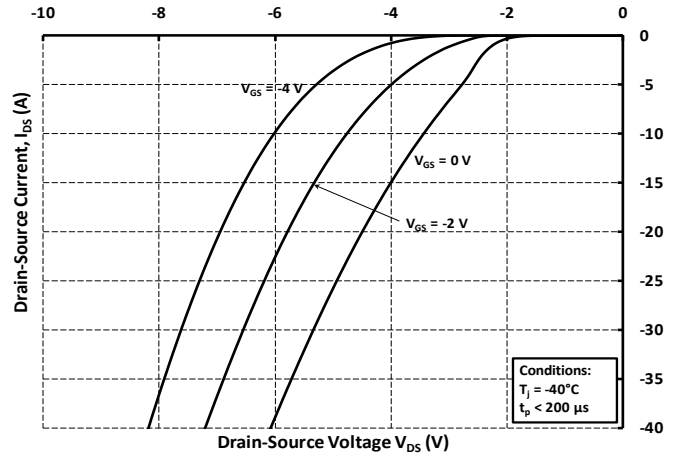


Figure 8. Body Diode Characteristic at -40 °C

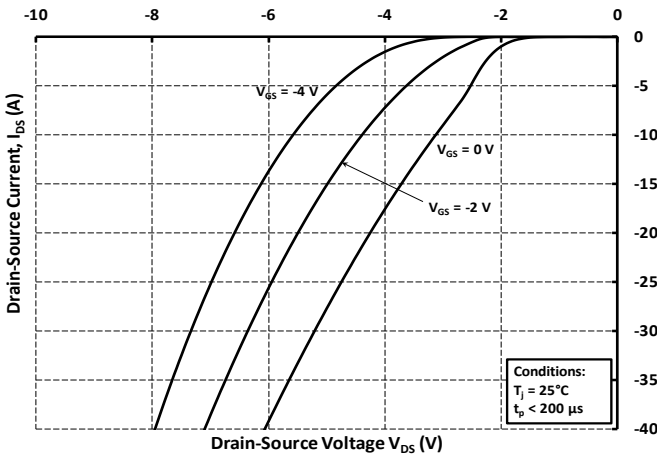


Figure 9. Body Diode Characteristic at 25 °C

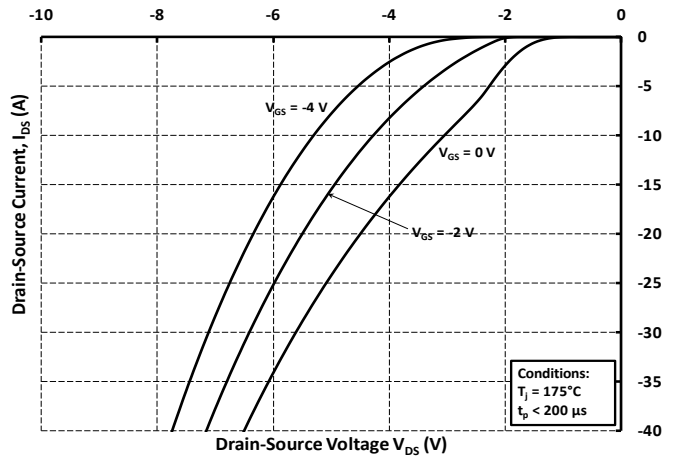


Figure 10. Body Diode Characteristic at 175 °C

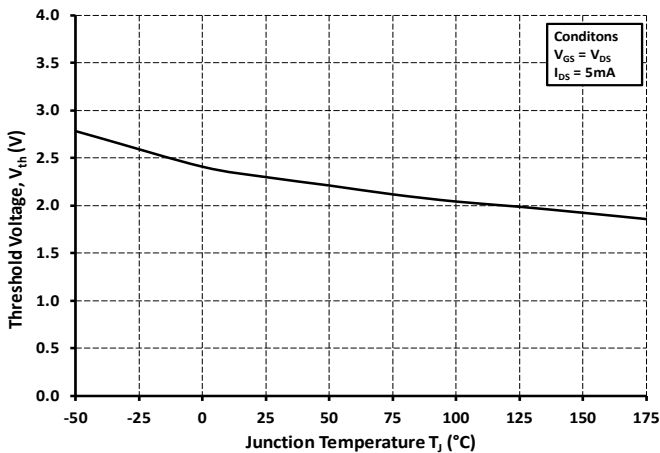


Figure 11. Threshold Voltage vs. Temperature

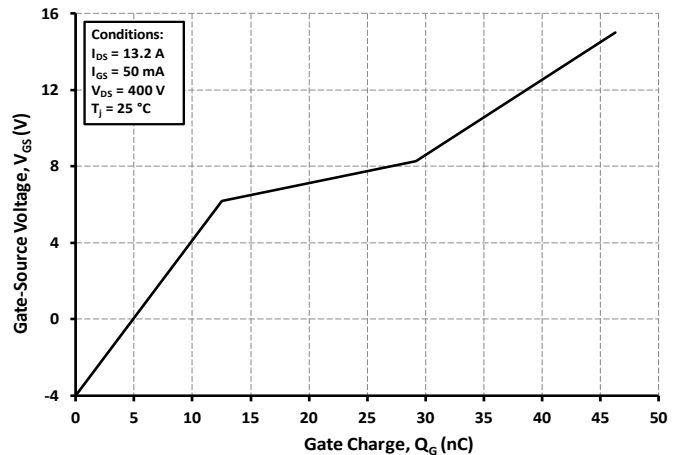


Figure 12. Gate Charge Characteristics



### Typical Performance

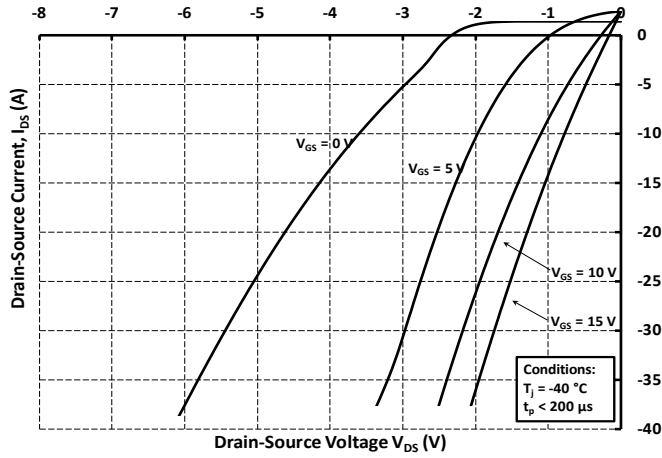


Figure 13. 3rd Quadrant Characteristic at -40 °C

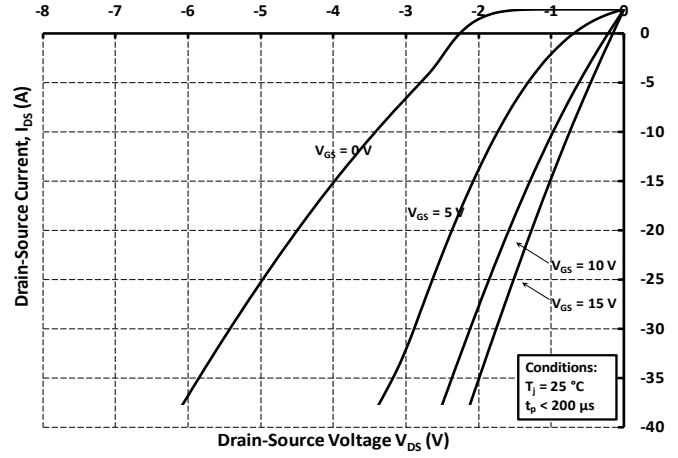


Figure 14. 3rd Quadrant Characteristic at 25 °C

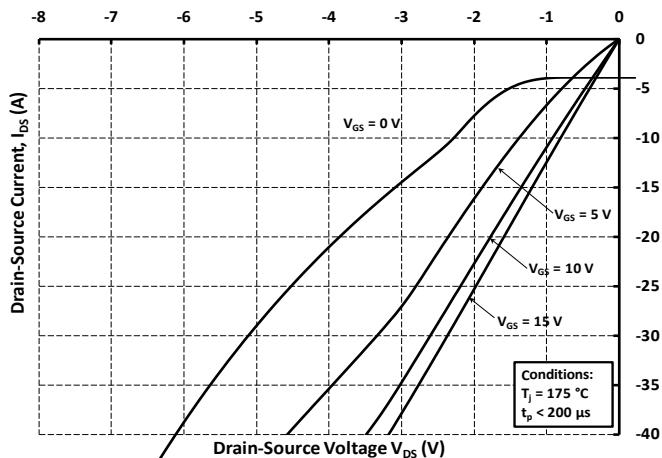


Figure 15. 3rd Quadrant Characteristic at 175 °C

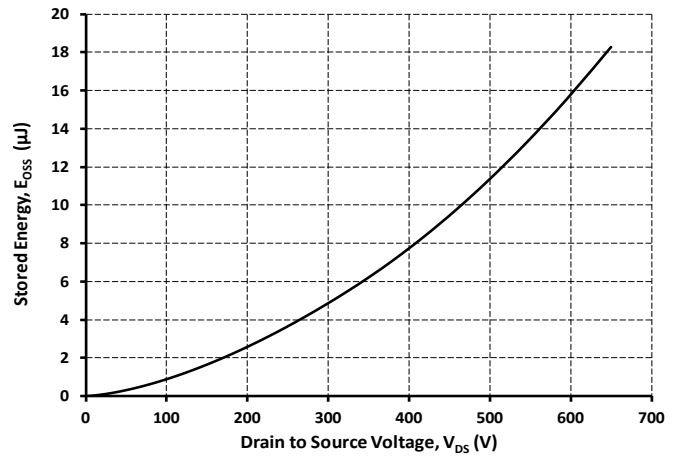


Figure 16. Output Capacitor Stored Energy

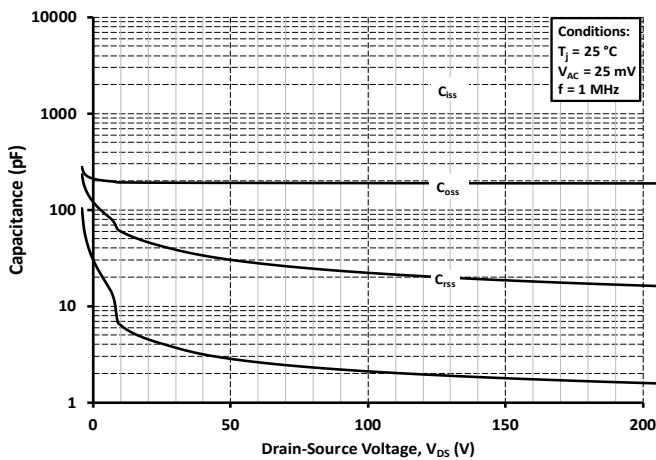


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

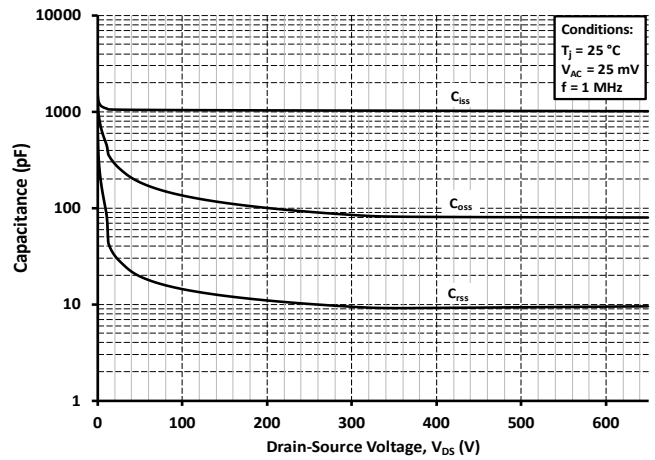


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 650V)



Typical Performance

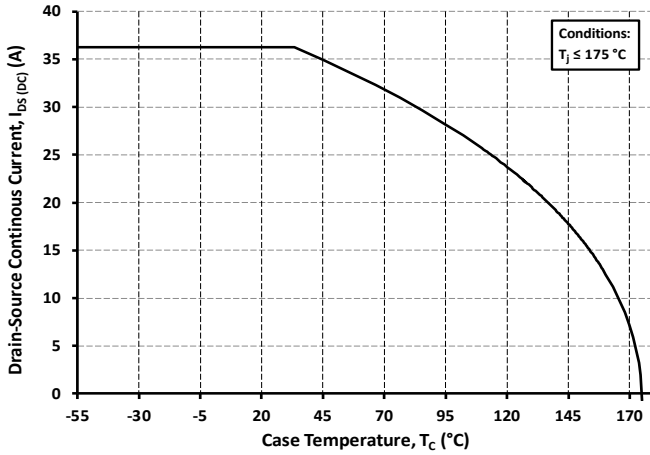


Figure 19. Continuous Drain Current Derating vs. Case Temperature

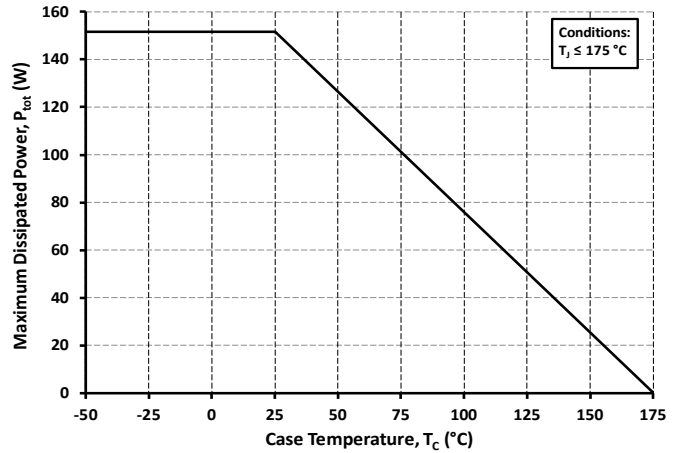


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

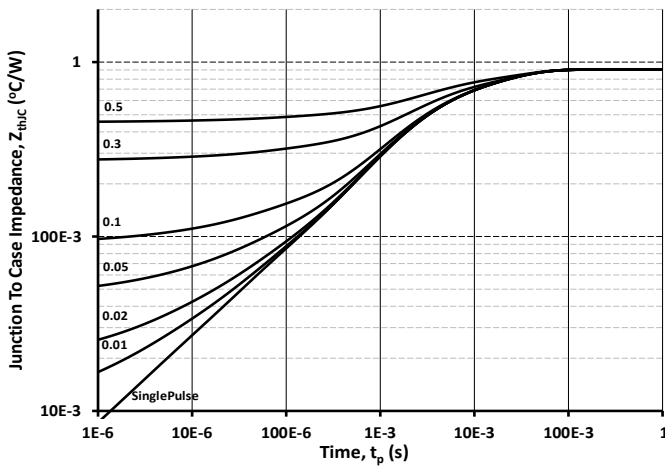


Figure 21. Transient Thermal Impedance (Junction - Case)

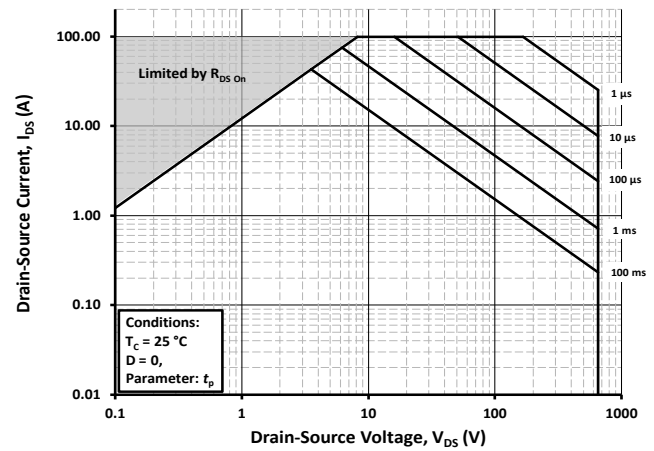


Figure 22. Safe Operating Area

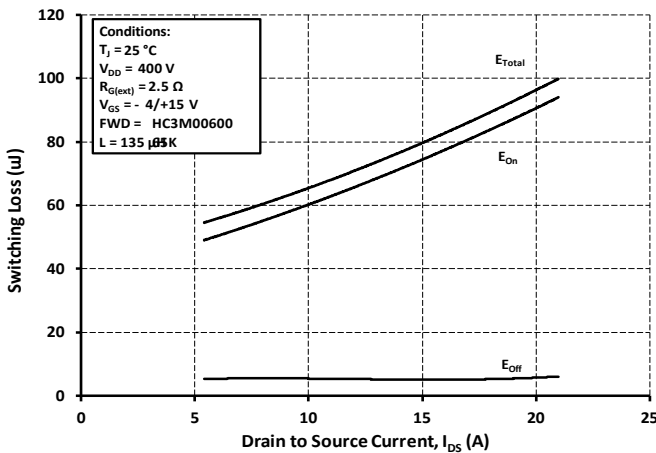


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 400V$ )

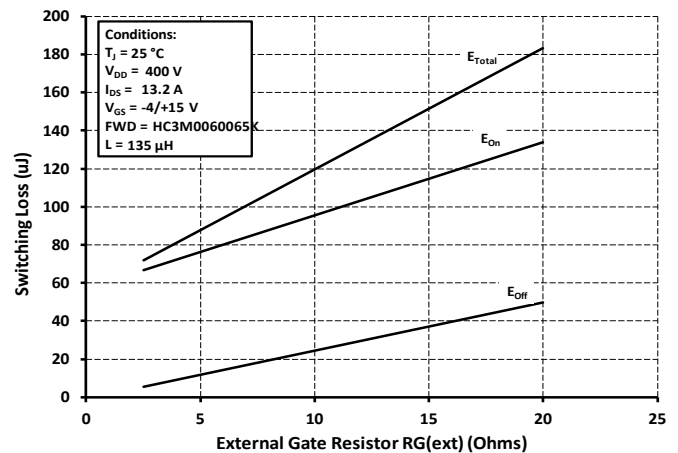


Figure 24. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$



### Typical Performance

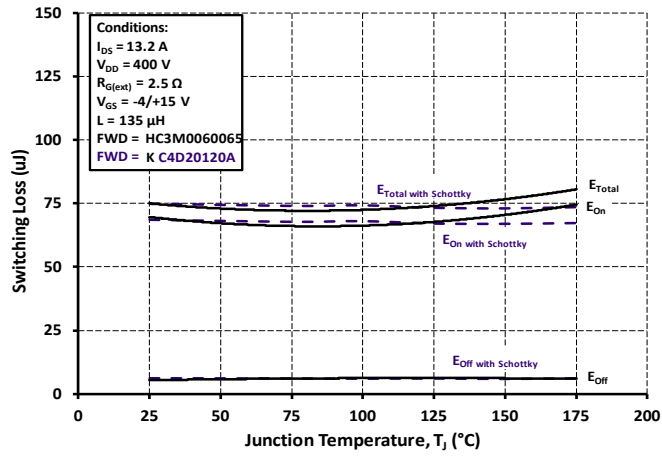


Figure 25. Clamped Inductive Switching Energy vs. Temperature

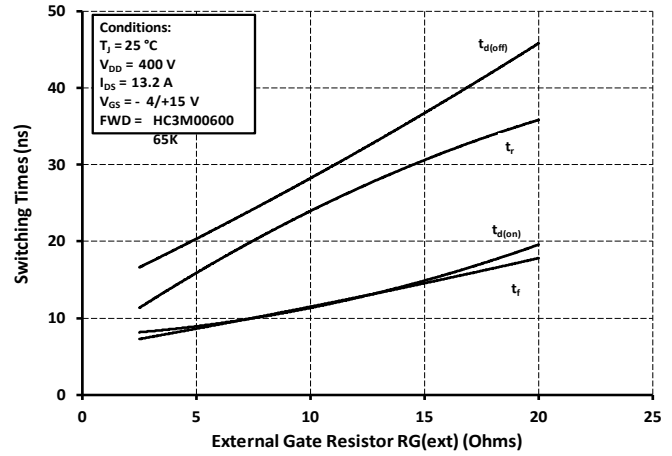


Figure 26. Switching Times vs.  $R_{G(ext)}$





### Test Circuit Schematic

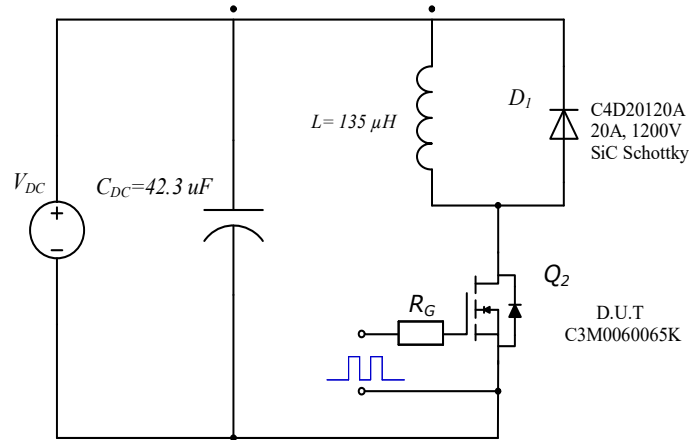


Figure 27. Clamped Inductive Switching Waveform Test Circuit

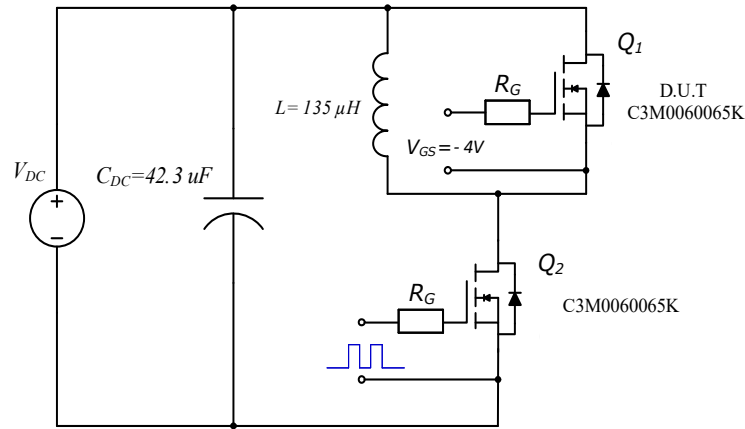


Figure 28. Body Diode Recovery Test Circuit

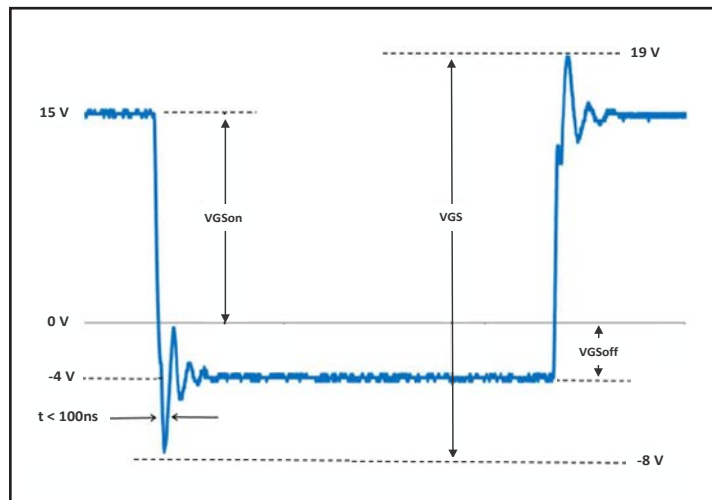
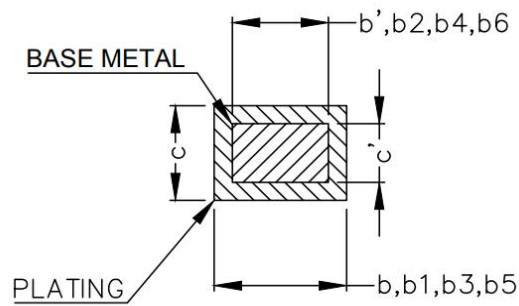
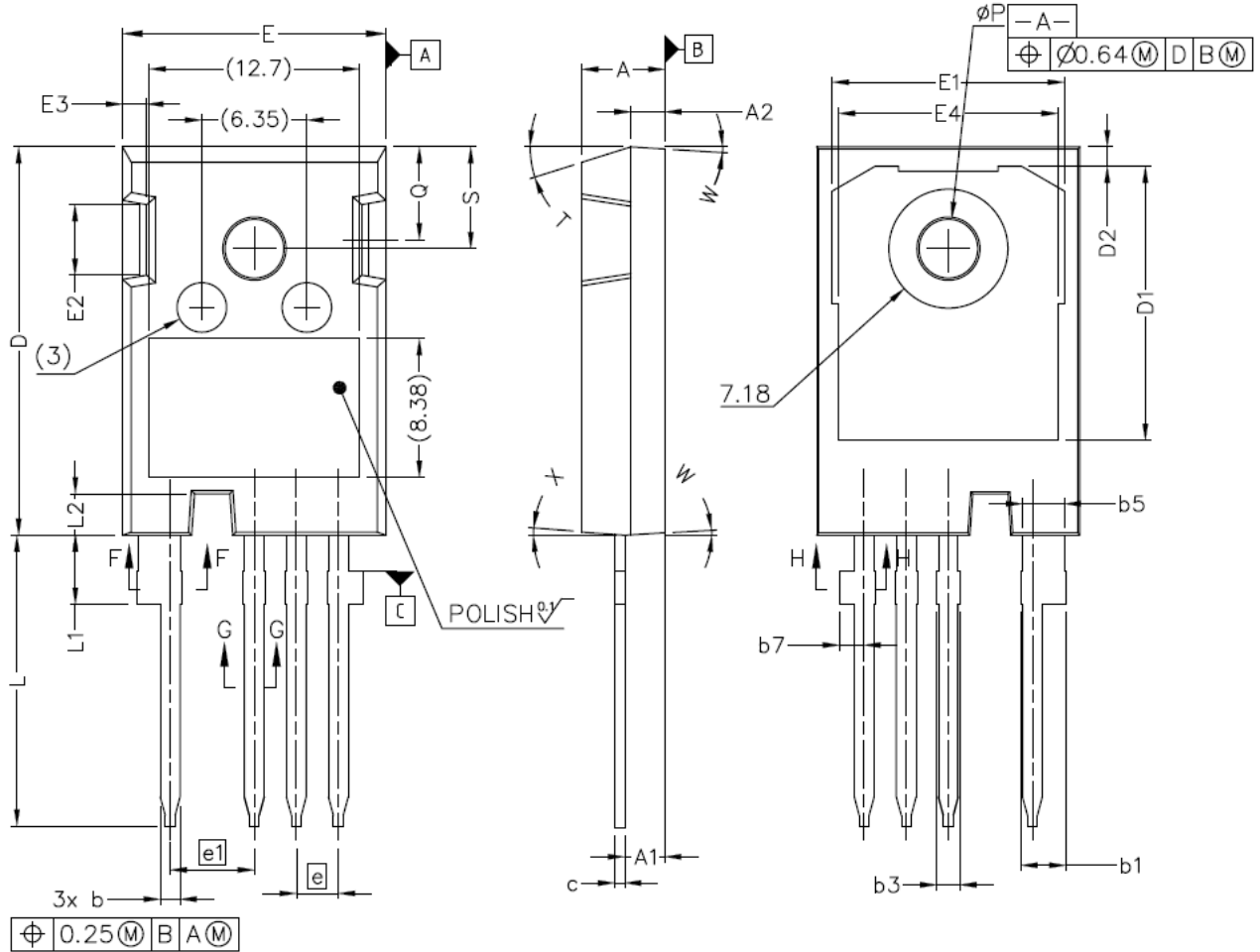


Figure 29.  $V_{GS}$  Waveform Example



### Package Dimensions

Package T0247-4L



SECTION "F-F", "G-G" AND "H-H"  
SCALE: NONE



**Package Dimensions**

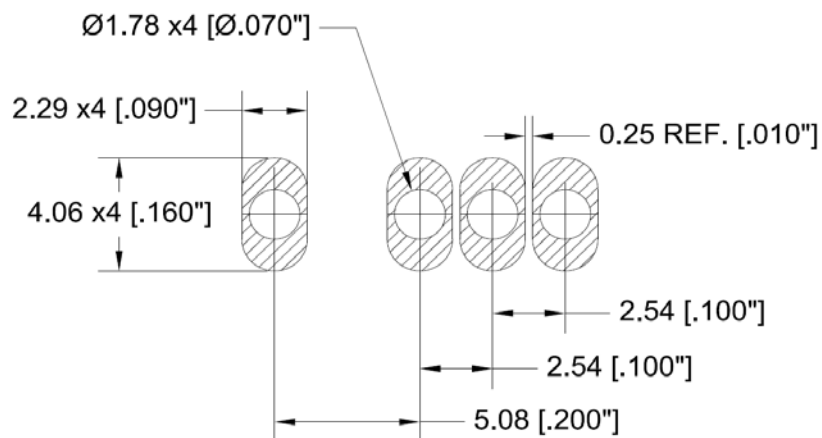
Package T0247-4L

NOTE ;

1. ALL METAL SURFACES: TIN PLATED, EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS.  
ANGLES ARE IN DEGREES.
4. 'N' IS THE NUMBER OF TERMINAL POSITIONS

SYM	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b`	1.07	1.28
b	1.07	1.33
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
b7	1.30	1.70
c`	0.55	0.65
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13

SYM	MILLIMETERS	
	MIN	MAX
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
N*	4	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
Ø P	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	





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