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

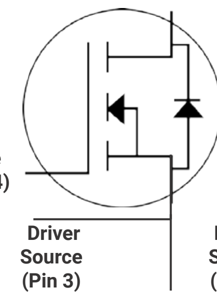
Benefits

- 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

Package



Ordering Part Number	Package	Marking
HC3M0060065K	TO247-4L	HC3M0060065K

Maximum Ratings

Symbol	Parameter	Value	Unit	Note
V_{DSS}	Drain - Source Voltage, T_C = 25 ˚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 V, T_C = 25˚C	37	A	Fig. 19
	Continuous Drain Current, V_{GS} = 15 V, T_C = 100˚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˚C, T_J = 175 ˚C	150	W	Fig. 20
T_J , T_{stg}	Operating Junction and Storage Temperature	-40 to +175	˚C	
T_L	Solder Temperature, 1.6mm (0.063”) from case for 10s	260	˚C	
M_d	Mounting Torque, (M3 or 6-32 screw)	1 8.8	Nm lbf-in	

Electrical Characteristics (T_C = 25˚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 V, I_D = 100 μA	
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_D = 5 mA	Fig. 11
			1.9		V	V_{DS} = V_{GS}, I_D = 5 mA, T_J = 175ºC	
I_{DSS}	Zero Gate Voltage Drain Current		1	50	μA	V_{DS} = 650 V, V_{GS} = 0 V	
I_{GSS}	Gate-Source Leakage Current		10	250	nA	V_{GS} = 15 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance	42	60	79	mΩ	V_{GS} = 15 V, I_D = 13.2 A	Fig. 4, 5,6
			80			V_{GS} = 15 V, I_D = 13.2 A, T_J = 175ºC	
g_{fs}	Transconductance		10		S	V_{DS}= 20 V, I_{DS}= 13.2 A	Fig. 7
			9			V_{DS}= 20 V, I_{DS}= 13.2 A, T_J = 175ºC	
C_{iss}	Input Capacitance		1020		pF	V_{GS} = 0 V, V_{DS} = 600 V f = 1 MHz V_{AC} = 25 mV	Fig. 17, 18
C_{oss}	Output Capacitance		80				
C_{rss}	Reverse Transfer Capacitance		9				
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		95		pF	V_{GS} = 0 V, V_{DS} = 0V to 400 V	Note 1
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		132				
E_{oss}	C_{oss} Stored Energy		15		μJ	V_{DS} = 600 V, 1 MHz	Fig. 16
E_{ON}	Turn-On Switching Energy (Body Diode)		70		μJ	V_{DS} = 400 V, V_{GS} = -4 V/15 V, I_D = 13.2 A, $R_{G(ext)}$ = 2.5Ω, L= 135 μH, T_J = 175ºC 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		μJ	V_{DS} = 400 V, V_{GS} = -4 V/15 V, I_D = 13.2 A, $R_{G(ext)}$ = 2.5Ω, L= 135 μH, T_J = 175ºC 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 V, V_{GS} = -4 V/15 V I_D = 13.2 A, $R_{G(ext)}$ = 2.5 Ω, L= 135 μH 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		Ω	f = 1 MHz, V_{AC} = 25 mV	
Q_{gs}	Gate to Source Charge		13		nC	V_{DS} = 400 V, V_{GS} = -4 V/15 V I_D = 13.2 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 Coss while Vds is rising from 0 to 400V
$C_{o(tr)}$, a lumped capacitance that gives same charging time as Coss while Vds is rising from 0 to 400V

Reverse Diode Characteristics (T_C = 25˚C unless otherwise specified)

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	5.1		V	V_{GS} = -4 V, I_{SD} = 6.6 A, T_J = 25 °C	Fig. 8, 9, 10
		4.8		V	V_{GS} = -4 V, I_{SD} = 6.6 A, T_J = 175 °C	
I_S	Continuous Diode Forward Current		23	A	V_{GS} = -4 V, T_C = 25˚C	
$I_{S, pulse}$	Diode pulse Current		99	A	V_{GS} = -4 V, pulse width t_P limited by T_{jmax}	
t_{rr}	Reverse Recover time	11		ns	V_{GS} = -4 V, I_{SD} = 13.2 A, V_R = 400 V dif/dt = 4500 A/µs, T_J = 175 °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 V, I_{SD} = 13.2 A, V_R = 400 V dif/dt = 2400 A/µs, T_J = 175 °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	°C/W		Fig. 21
$R_{\theta JA}$	Thermal Resistance From Junction to Ambient	40			

Typical Performance

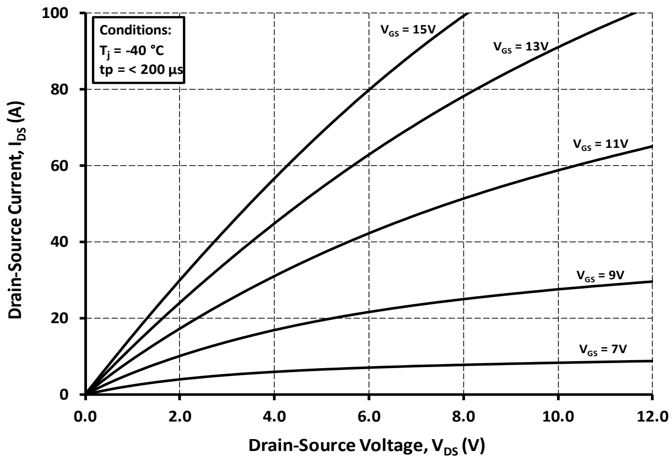


Figure 1. Output Characteristics T_J = -40 °C

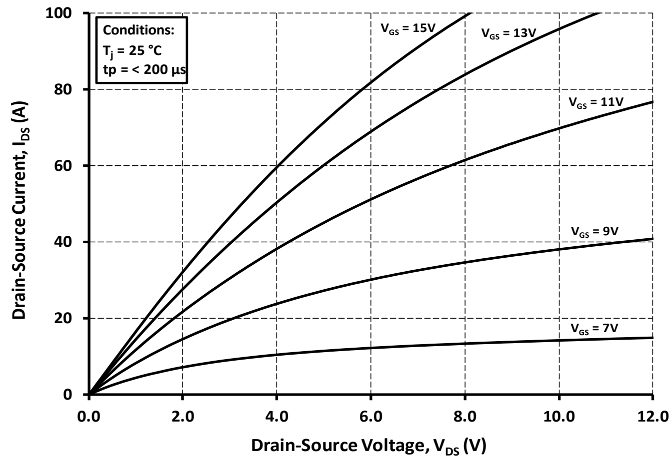


Figure 2. Output Characteristics T_J = 25 °C

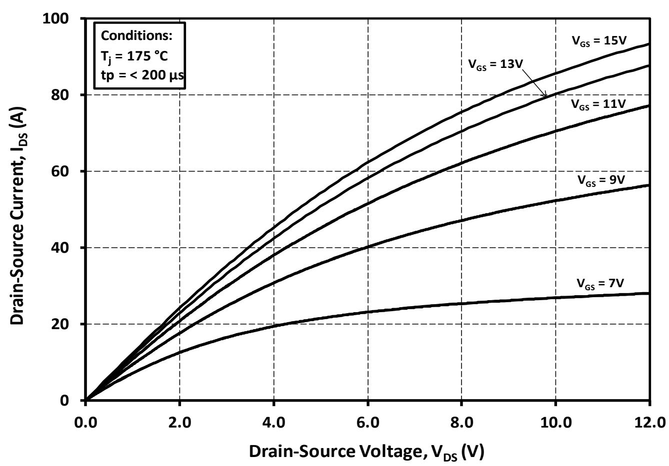


Figure 3. Output Characteristics T_J = 175 °C

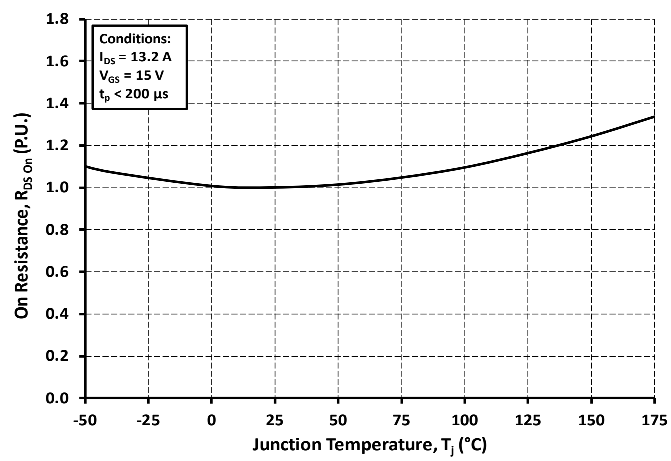


Figure 4. Normalized On-Resistance vs. Temperature

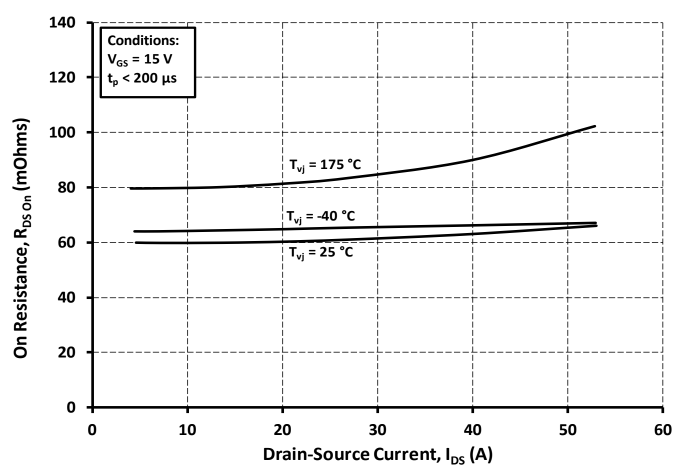


Figure 5. On-Resistance vs. Drain Current
For Various Temperatures

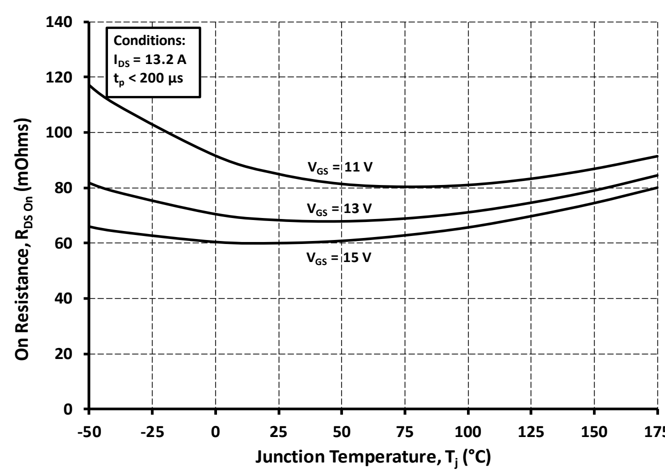


Figure 6. On-Resistance vs. Temperature
For Various Gate Voltage

Typical Performance

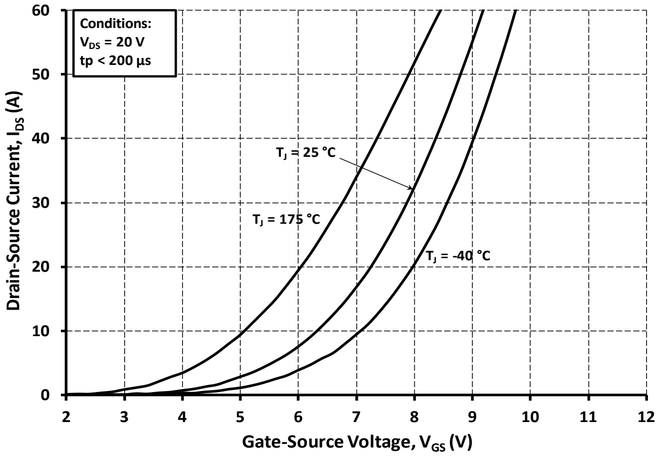


Figure 7. Transfer Characteristic for Various Junction Temperatures

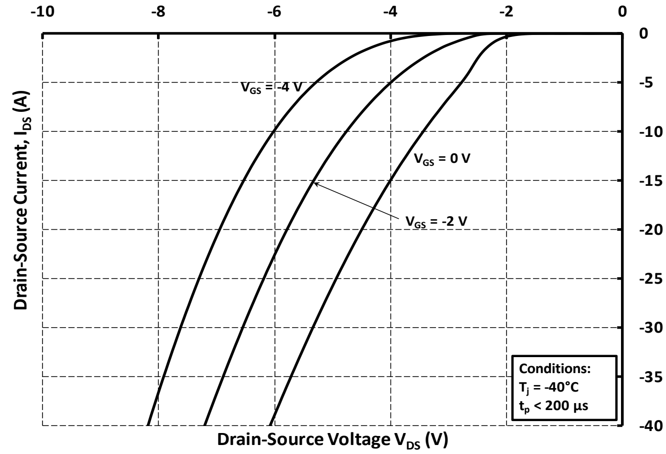


Figure 8. Body Diode Characteristic at -40 °C

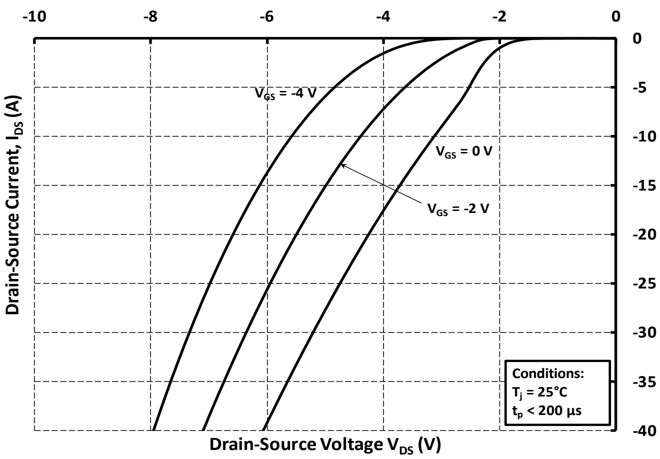


Figure 9. Body Diode Characteristic at 25 °C

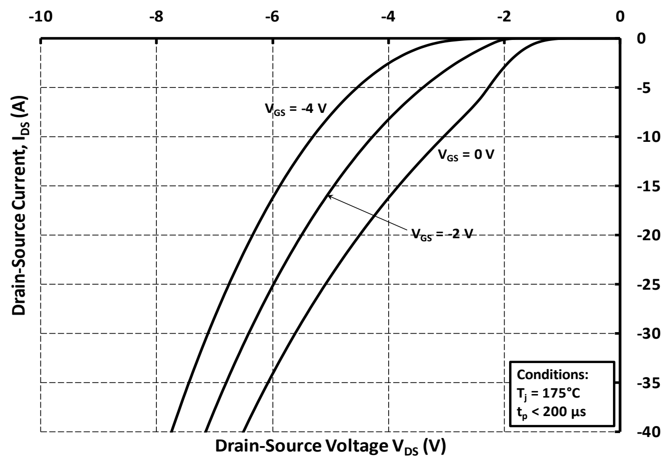


Figure 10. Body Diode Characteristic at 175 °C

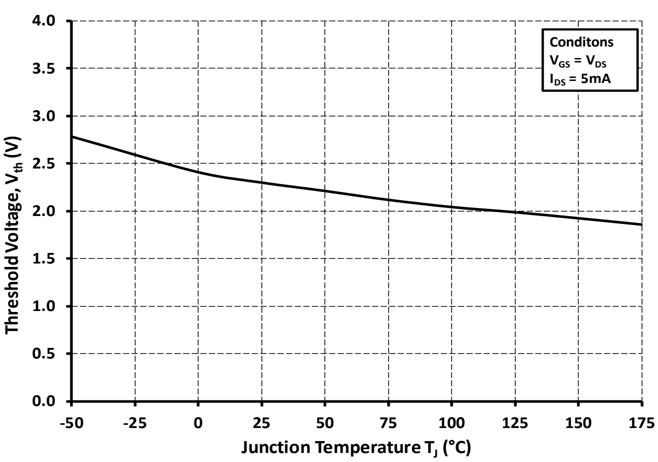


Figure 11. Threshold Voltage vs. Temperature

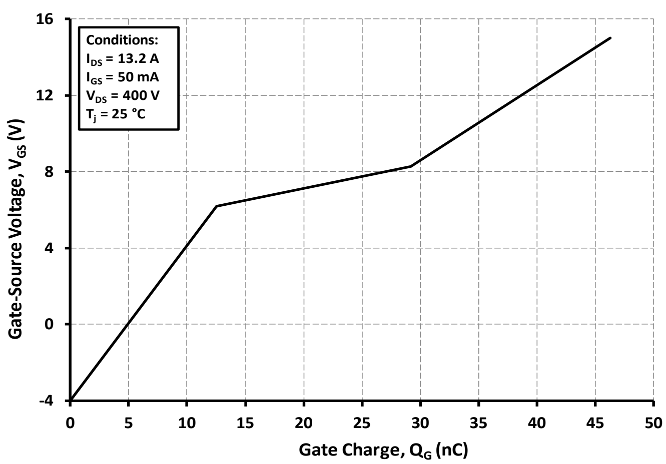


Figure 12. Gate Charge Characteristics

Typical Performance

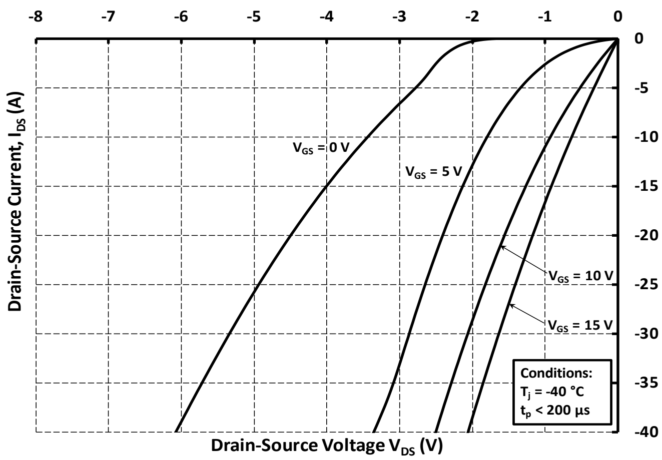


Figure 13. 3rd Quadrant Characteristic at -40 °C

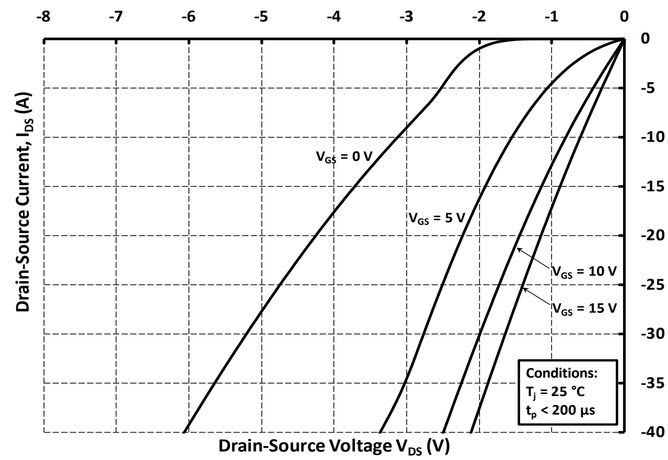


Figure 14. 3rd Quadrant Characteristic at 25 °C

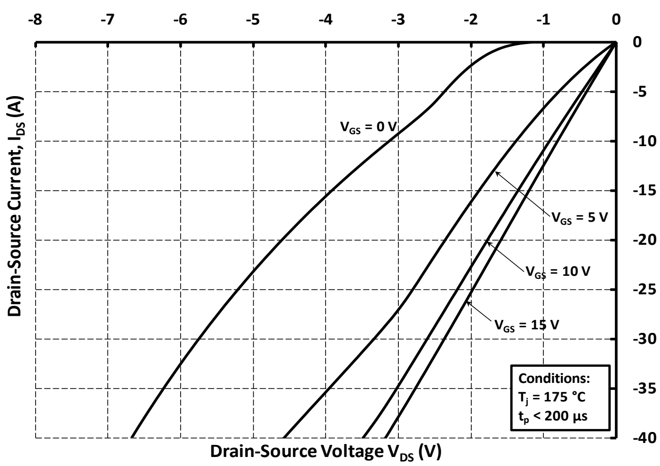


Figure 15. 3rd Quadrant Characteristic at 175 °C

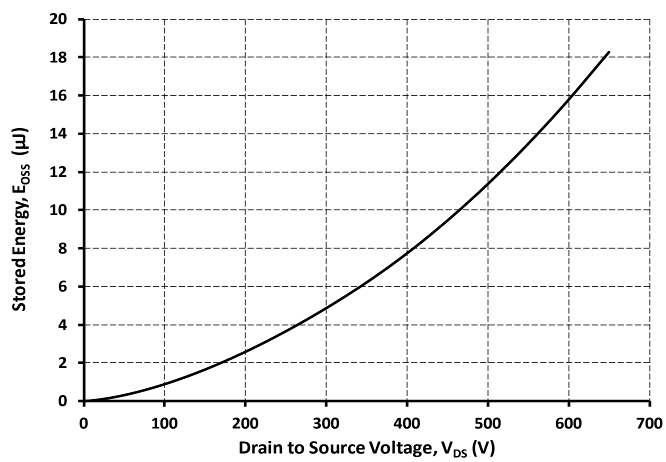


Figure 16. Output Capacitor Stored Energy

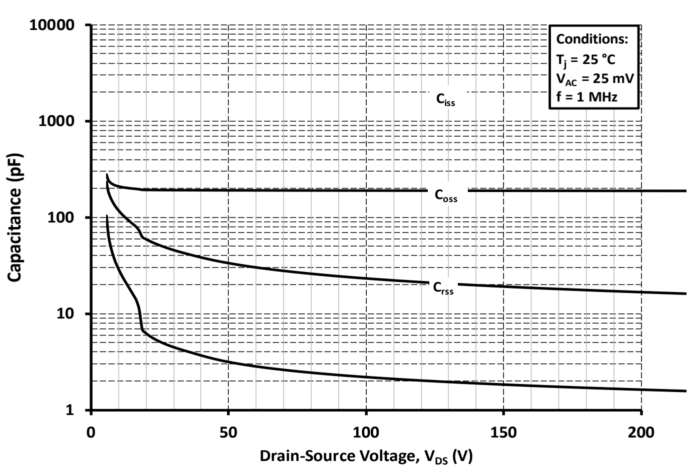


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

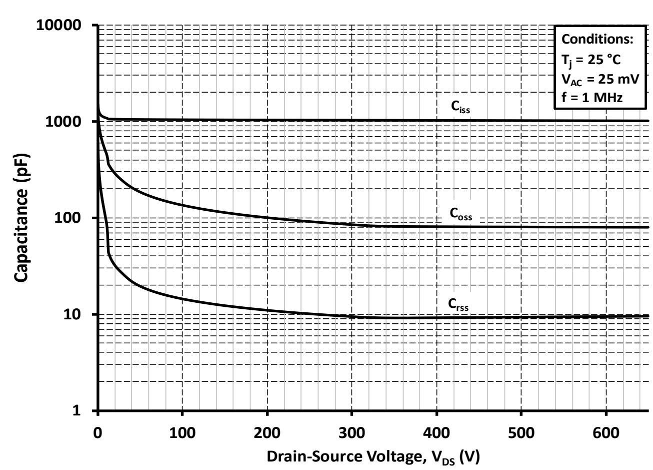


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 650V)

Typical Performance

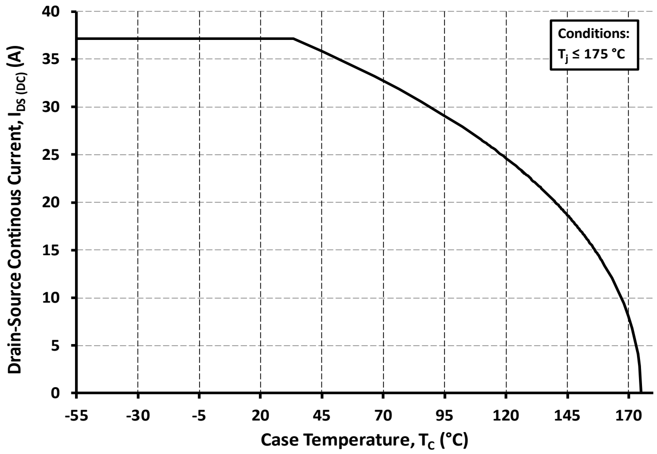


Figure 19. Continuous Drain Current Derating vs. Case Temperature

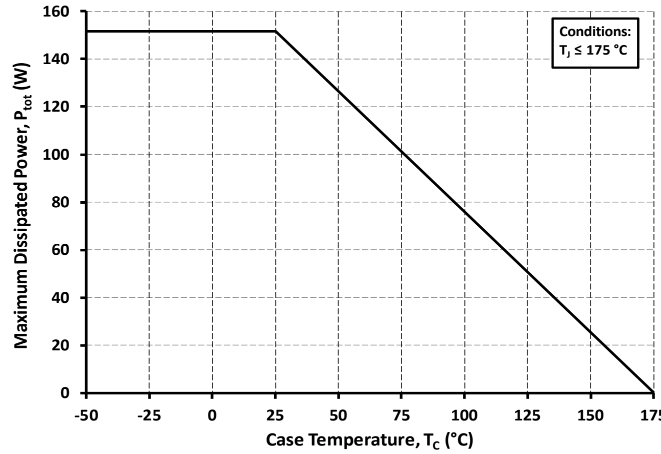


Figure 20. Maximum Power Dissipation Derating Vs Case Temperature

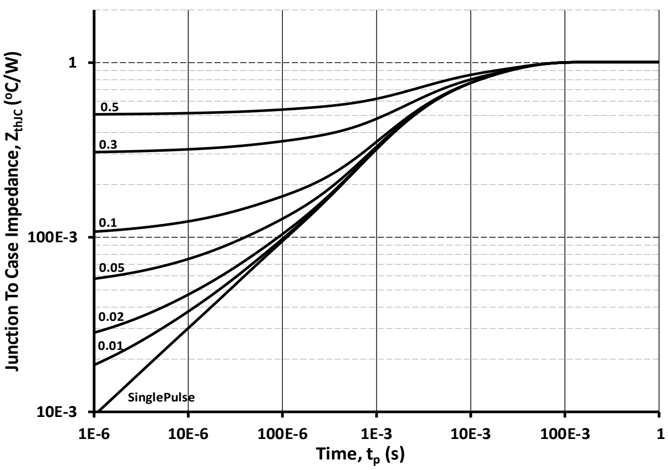


Figure 21. Transient Thermal Impedance (Junction - Case)

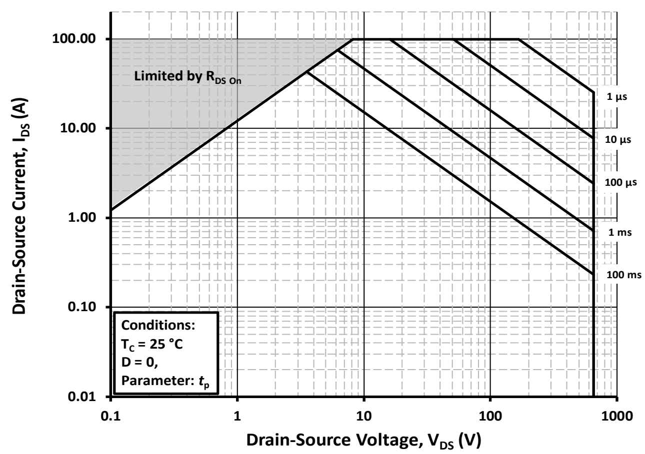


Figure 22. Safe Operating Area

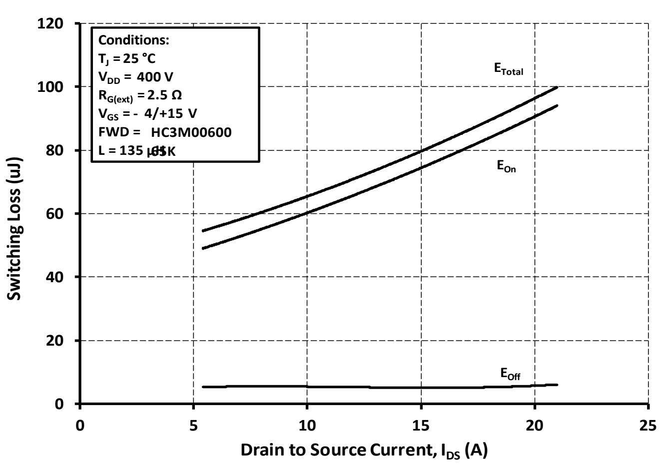


Figure 23. Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 400V)

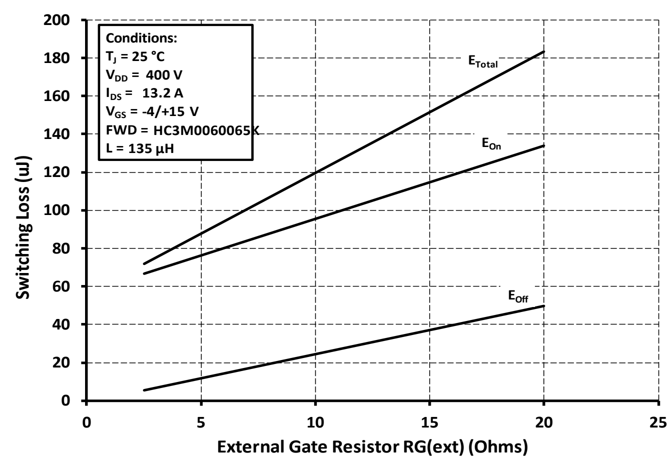


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

Typical Performance

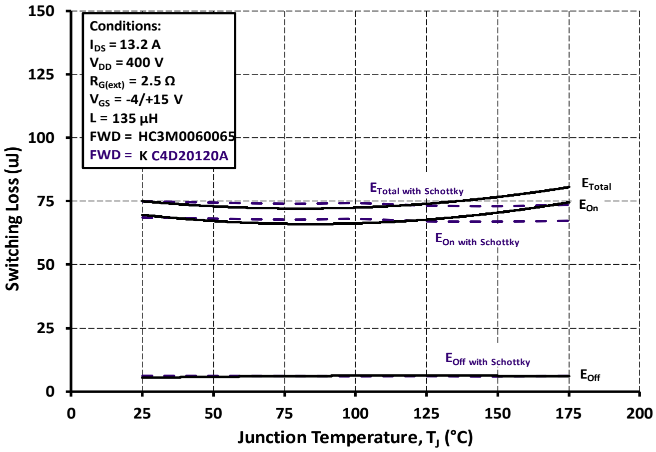


Figure 25. Clamped Inductive Switching Energy vs. Temperature

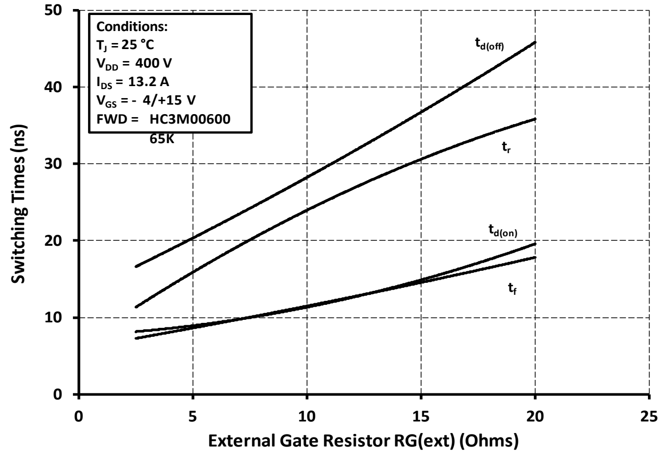


Figure 26. Switching Times vs. $R_{G(ext)}$

Test Circuit Schematic

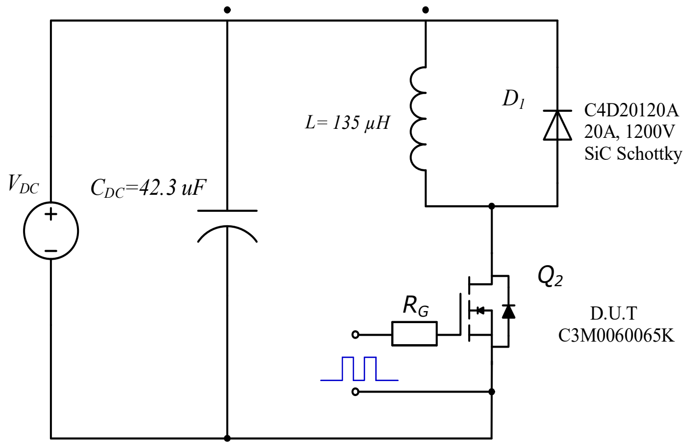


Figure 27. Clamped Inductive Switching Waveform Test Circuit

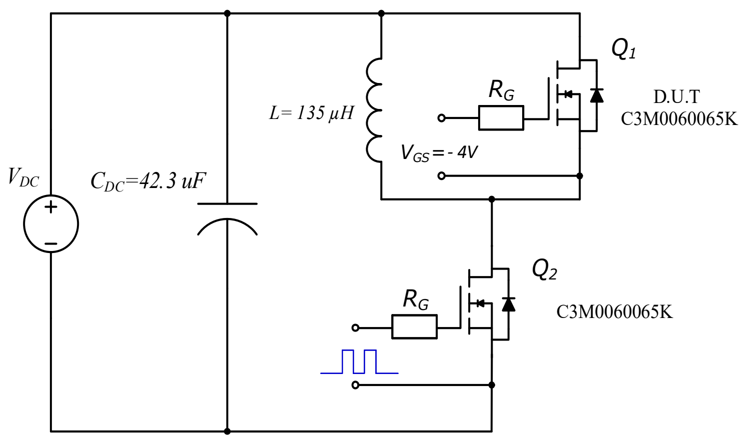


Figure 28. Body Diode Recovery Test Circuit

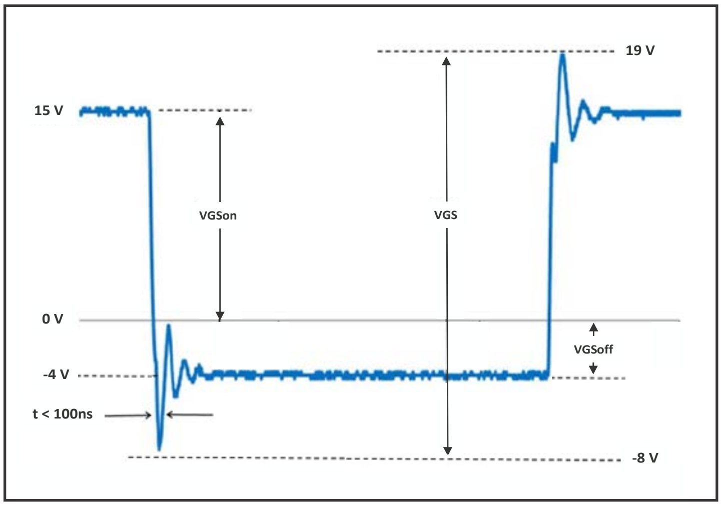
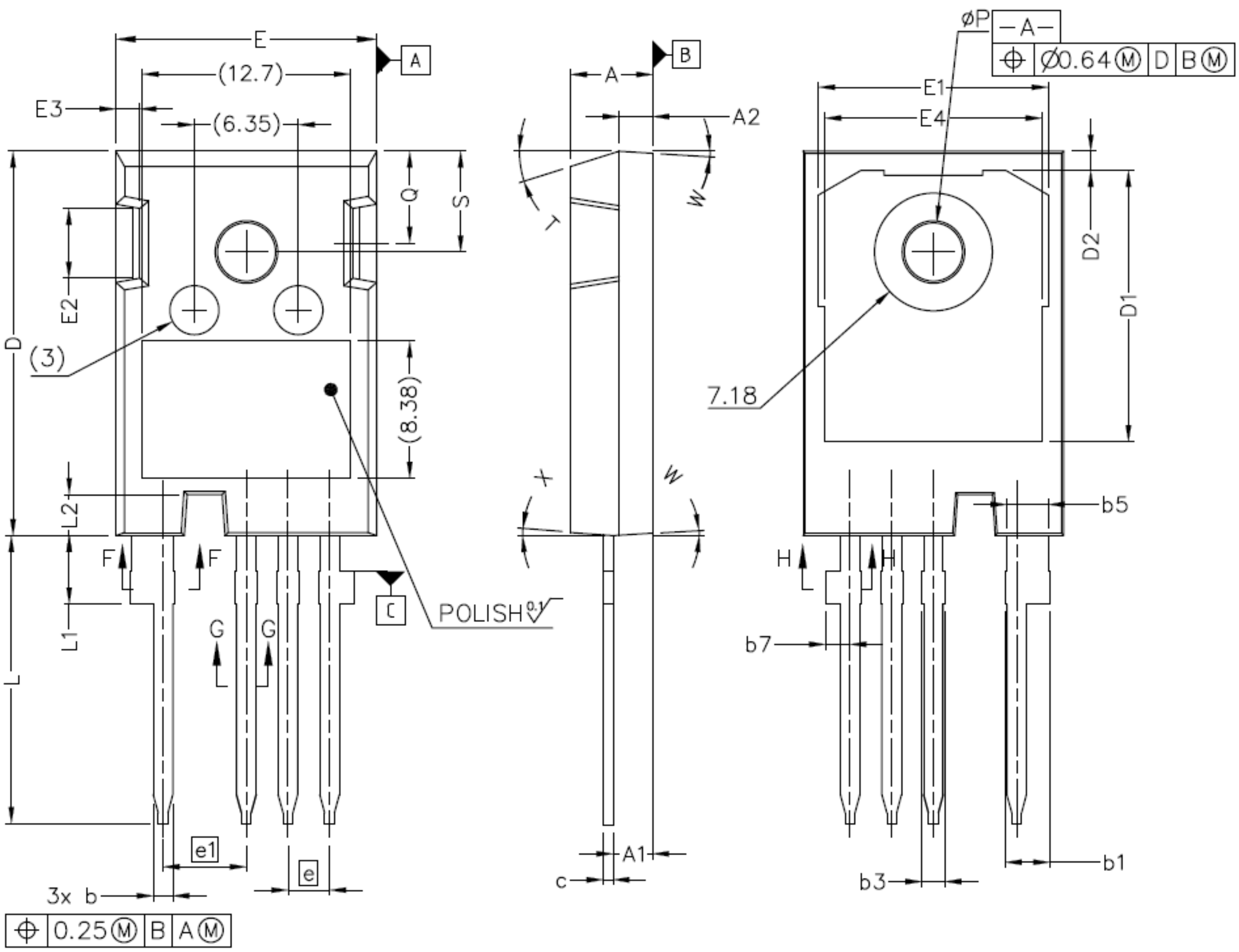
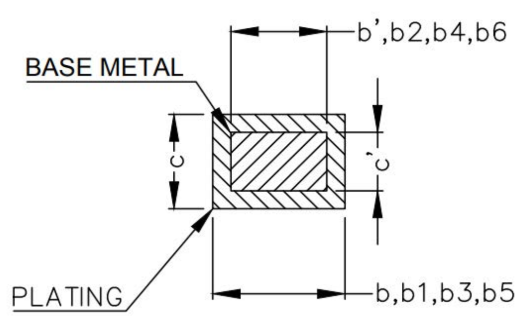


Figure 29. V_{GS} Waveform Example

Package Dimensions

Package TO247-4L





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

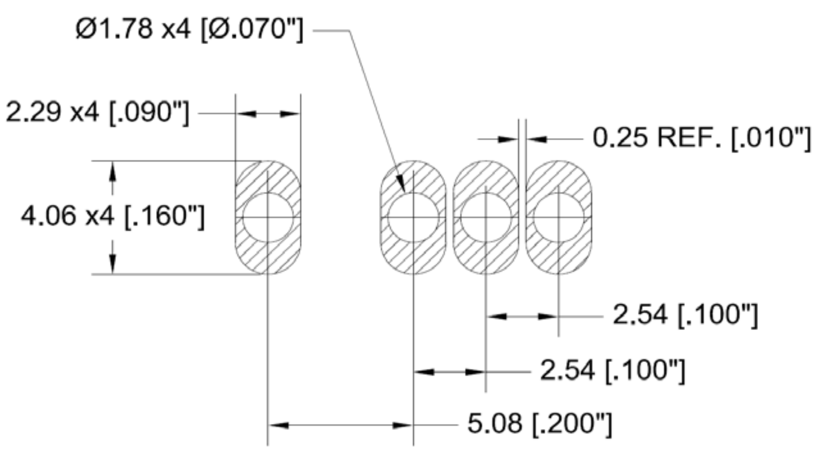
Package Dimensions

Package TO247-4L

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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