HC2M0045170P

SiC Power MOSFET N-Channel Enhancement Mode

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

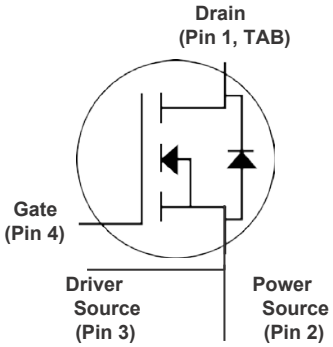
Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

Applications

- Renewable energy
- EV battery chargers
- High voltage DC/DC converters
- Switch Mode Power Supplies

TO-247-4L
Package



Ordering Part Number	Package	Marking
HC2M0045170P	TO-247-4L	HC2M0045170P

Maximum Ratings (T_C = 25 ˚C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DSmax}	Drain - Source Voltage	1700	V	V_{GS} = 0 V, I_D = 100 µA	
V_{GSmax}	Gate - Source Voltage	-10/+25	V	Absolute maximum values, AC (f >1 Hz)	Note: 1
V_{GSop}	Gate - Source Voltage	-5/+20	V	Recommended operational values	Note: 2
I_D	Continuous Drain Current	75	A	V_{GS} =20 V, T_C = 25˚C	Fig. 19
		48		V_{GS} =20 V, T_C = 100˚C	
$I_{D(pulse)}$	Pulsed Drain Current	160	A	Pulse width t_P limited by T_{jmax}	Fig. 22
P_D	Power Dissipation	338	W	T_C=25˚C, T_J = 150 ˚C	Fig. 20
T_J , T_{stg}	Operating Junction and Storage Temperature	-40 to +150	˚C		
T_L	Solder Temperature	260	˚C	1.6mm (0.063") from case for 10s	

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	1700			V	V_{GS} = 0 V, I_D = 100 μA	
$V_{GS(th)}$	Gate Threshold Voltage	2.0	3.0	4	V	V_{DS} = V_{GS}, I_D = 18mA	Fig. 11
			2.5		V	V_{DS} = V_{GS}, I_D = 18mA, T_J = 150 °C	
I_{DSS}	Zero Gate Voltage Drain Current		2	100	μA	V_{DS} = 1700 V, V_{GS} = 0 V	
I_{GSS}	Gate-Source Leakage Current			600	nA	V_{GS} = 20 V, V_{DS} = 0 V	
$R_{DS(on)}$	Drain-Source On-State Resistance		40	70	mΩ	V_{GS} = 20 V, I_D = 50 A	Fig. 4,5,6
			80			V_{GS} = 20 V, I_D = 50 A, T_J = 150 °C	
g_{fs}	Transconductance		24.7		S	V_{DS}= 20 V, I_{DS}= 50 A	Fig. 7
			23.4			V_{DS}= 20 V, I_{DS}= 50 A, T_J = 150 °C	
C_{iss}	Input Capacitance		3455		pF	V_{GS} = 0 V V_{DS} = 1200 V f = 1 MHz V_{AC} = 25 mV	Fig. 17,18
C_{oss}	Output Capacitance		171				
C_{rss}	Reverse Transfer Capacitance		6.7				
E_{oss}	C_{oss} Stored Energy		139		μJ		Fig 16
$C_{o(er)}$	Effective Output Capacitance (Energy Related)		188		pF	V_{GS} = 0 V, V_{DS} = 0... 1200V	Note: 3
$C_{o(tr)}$	Effective Output Capacitance (Time Related)		255		pF		
E_{ON}	Turn-On Switching Energy (SiC Diode FWD)		0.52		mJ	V_{DS} = 1200 V, V_{GS} = -5/20 V, I_D = 50A, $R_{G(ext)}$ = 2.5Ω, L= 99 μH, T_J = 150 °C, using SiC Diode as	Fig. 26, 29b Note 2
E_{OFF}	Turn Off Switching Energy (SiC Diode FWD)		0.43				
E_{ON}	Turn-On Switching Energy (Body Diode FWD)		2.0		mJ	FWD V_{DS}= 1200 V, V_{GS} = -5/20 V, I_D = 50A, $R_{G(ext)}$ = 2.5Ω, L= 99 μH, T_J = 150 °C, using MOSFET as	Fig. 26, 29a Note 2
E_{OFF}	Turn Off Switching Energy (Body Diode FWD)		0.31				
$t_{d(on)}$	Turn-On Delay Time		15		ns	FWD V_{DD} = 1200 V, V_{GS} = -5/20 V I_D = 50 A, $R_{G(ext)}$ = 2.5 Ω, Timing relative to V_{DS} Inductive load	Fig. 27, 29 Note 2
t_r	Rise Time		18				
$t_{d(off)}$	Turn-Off Delay Time		34				
t_f	Fall Time		12				
$R_{G(int)}$	Internal Gate Resistance		1.3		Ω	f = 1 MHz, V_{AC} = 25 mV	
Q_{gs}	Gate to Source Charge		46		nC	V_{DS} = 1200 V, V_{GS} = -5/20V I_D = 50 A Per IEC60747-8-4 pg 21	Fig. 12
Q_{gd}	Gate to Drain Charge		71				
Q_g	Total Gate Charge		204				

Reverse Diode Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
V_{SD}	Diode Forward Voltage	3.8		V	V_{GS} = - 5 V, I_{SD} = 25 A	Fig. 8, 9,10
		3.4		V	V_{GS}= - 5 V, I_{SD}= 25 A, T_J = 150 °C	Note 1
I_S	Continuous Diode Forward Current		76	A	V_{GS} = - 5 V, T_C= 25 °C	Note 1
$I_{S,\ pulse}$	Diode pulse Current		160	A	V_{GS} = - 5 V, pulse width t_P limited by T_{jmax}	Note 1
t_{rr}	Reverse Recovery Time	44		ns	V_{GS} = - 5 V, I_{SD} = 50 A , V_R = 1200 V dif/dt = 3000 A/µs, T_J = 150 °C	
Q_{rr}	Reverse Recovery Charge	1.9		uC		
I_{rrm}	Peak Reverse Recovery Current	64		A		
t_{rr}	Reverse Recovery Time	25		ns	V_{GS} = - 5 V, I_{SD} = 50 A , V_R = 1200 V dif/dt = 13450 A/µs, T_J = 150 °C	
Q_{rr}	Reverse Recovery Charge	2.4		uC		
I_{rrm}	Peak Reverse Recovery Current	166		A		

Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit	Test Conditions	Note
$R_{\theta JC}$	Thermal Resistance from Junction to Case	0.22	0.37	°C/W		Fig. 21
$R_{\theta JC}$	Thermal Resistance from Junction to Ambient		40			

Typical Performance

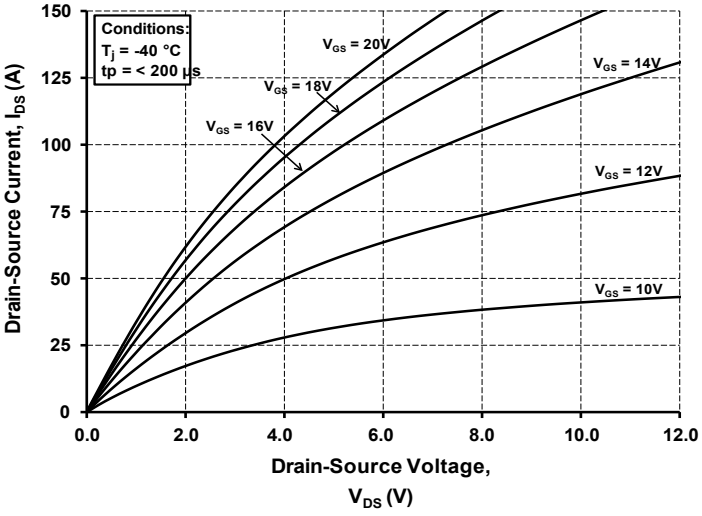


Figure 1. Output Characteristics T_J = -40 °C

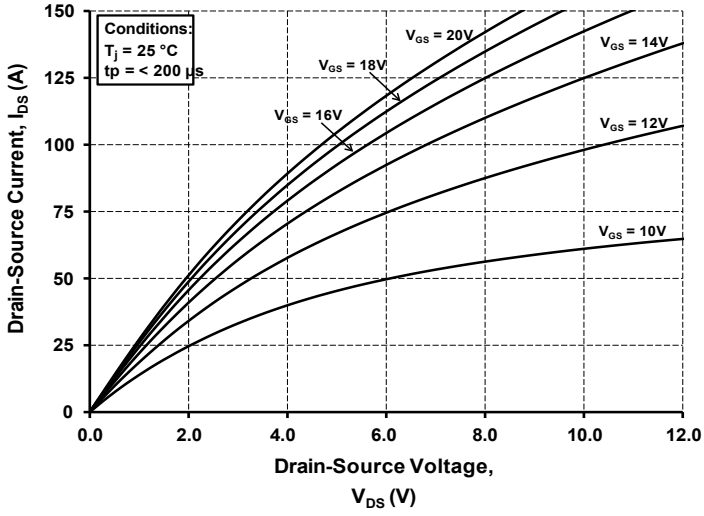


Figure 2. Output Characteristics T_J = 25 °C

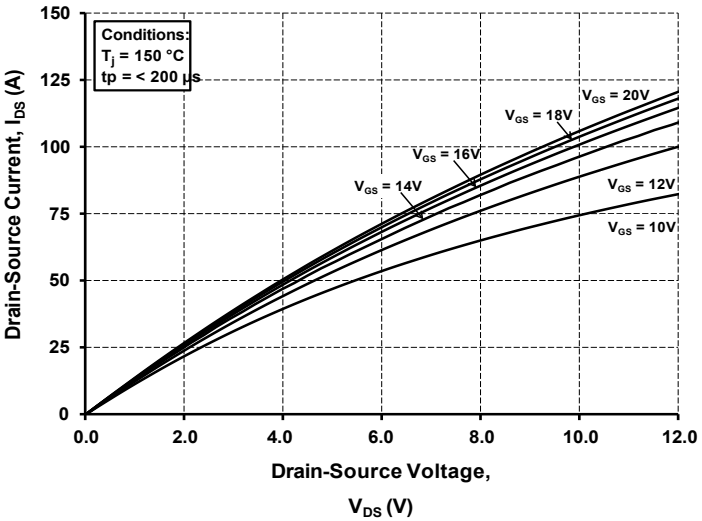


Figure 3. Output Characteristics T_J = 150 °C

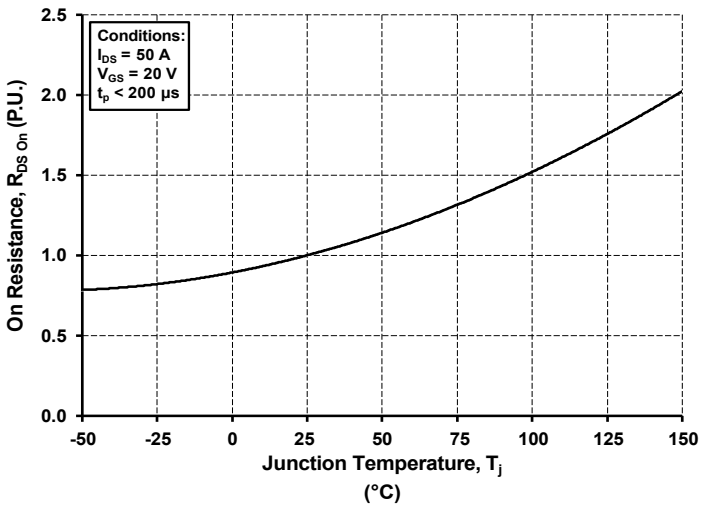
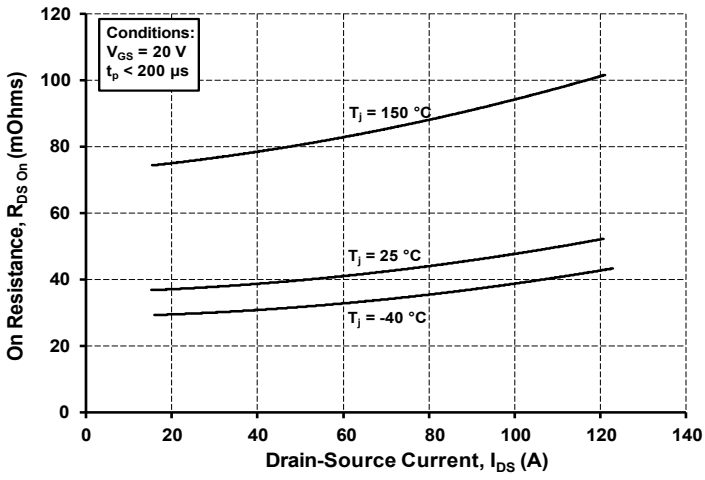
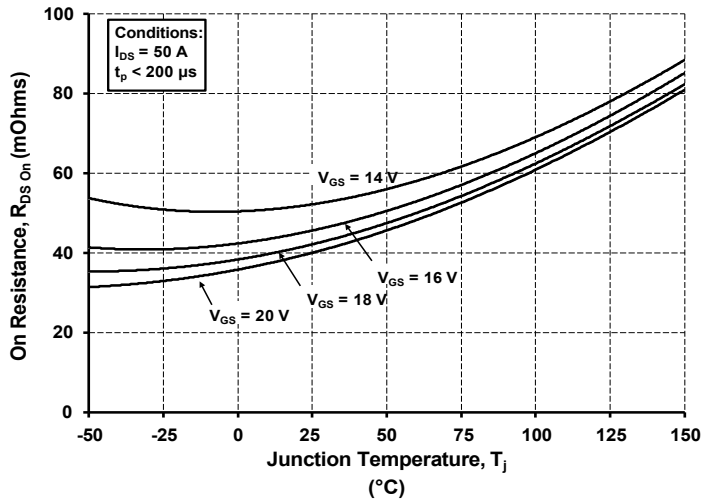


Figure 4. Normalized On-Resistance vs. Temperature





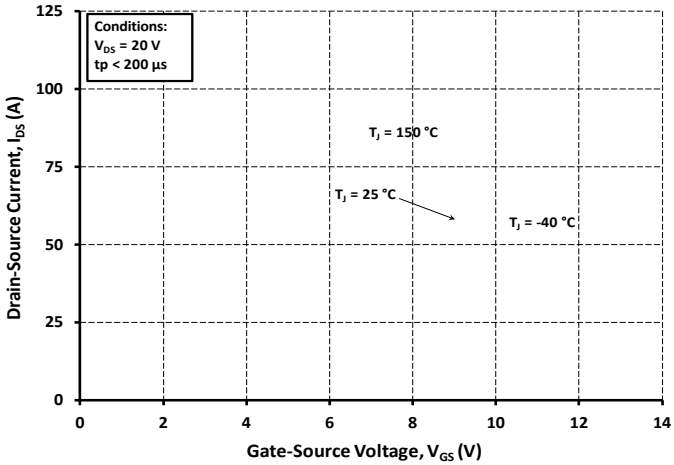


Figure 7. Transfer Characteristic For Various Junction Temperatures

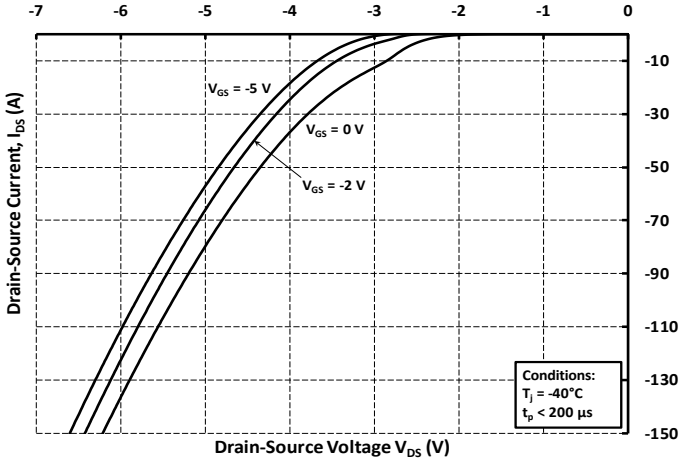


Figure 8. Body Diode Characteristic at -40 °C

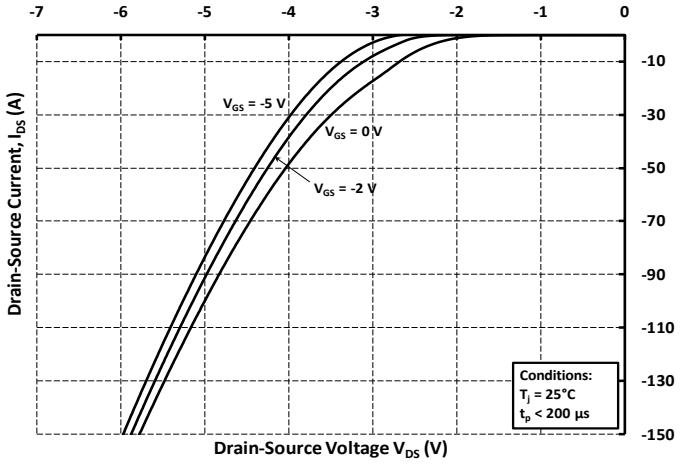


Figure 9. Body Diode Characteristic at 25 °C

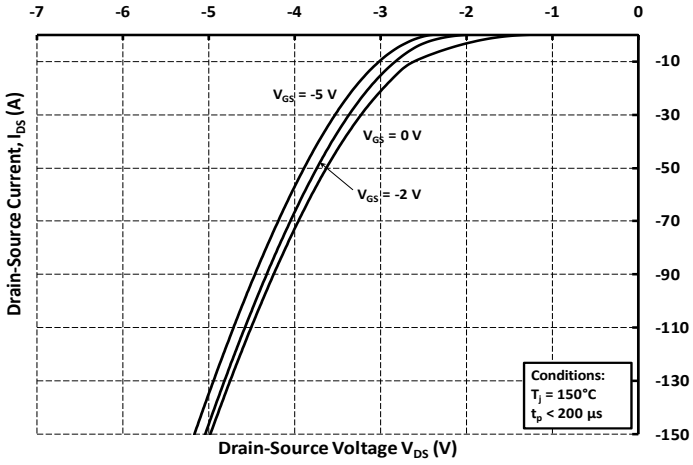
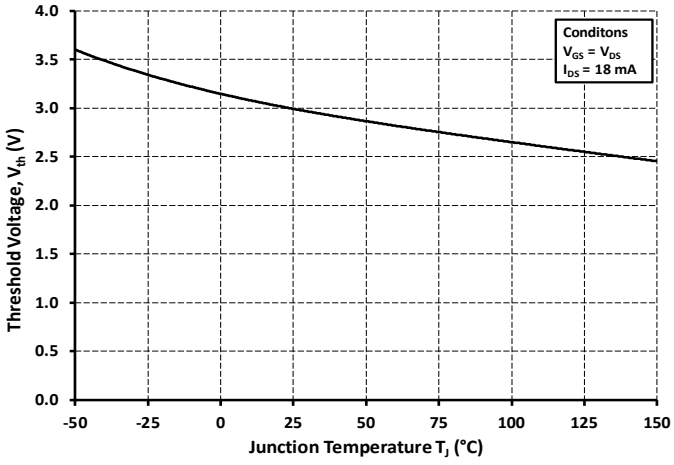
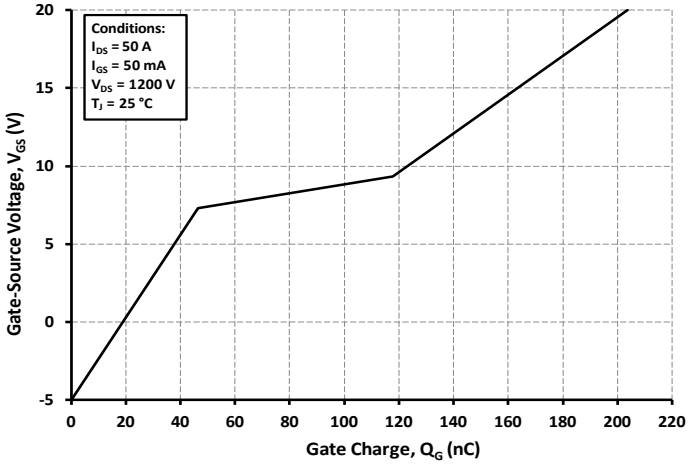


Figure 10. Body Diode Characteristic at 150 °C





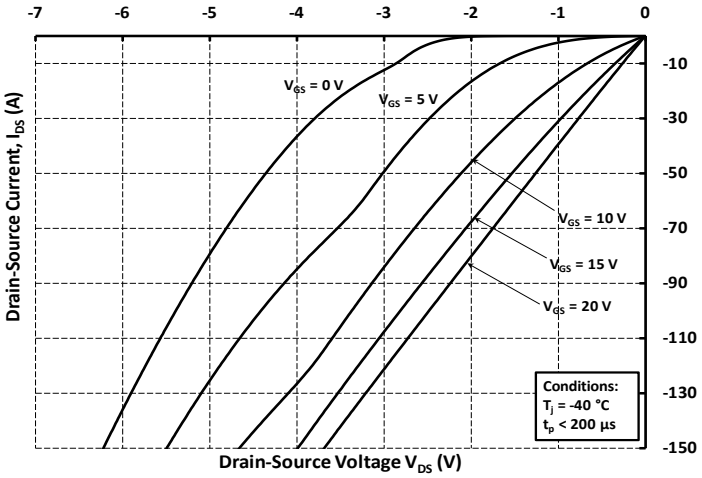


Figure 13. 3rd Quadrant Characteristic at -40 °C

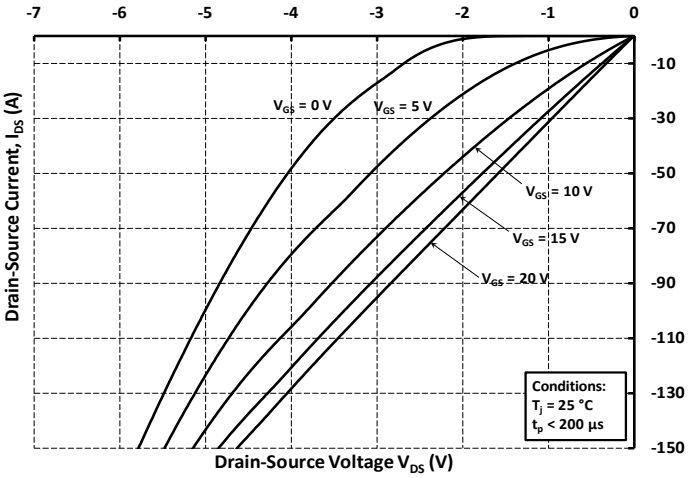


Figure 14. 3rd Quadrant Characteristic at 25 °C

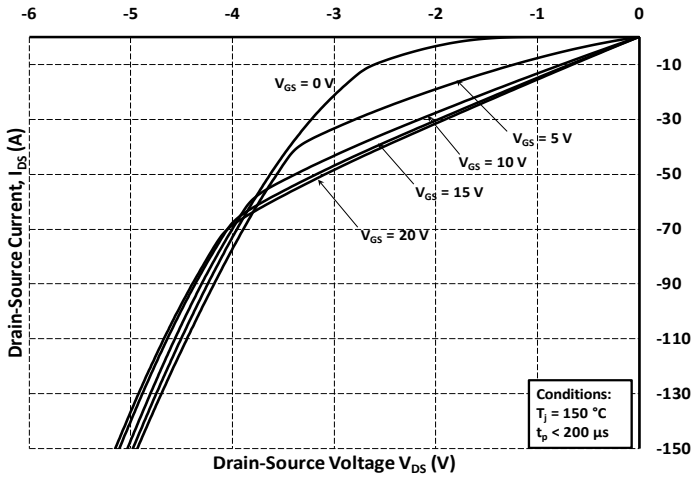


Figure 15. 3rd Quadrant Characteristic at 150 °C

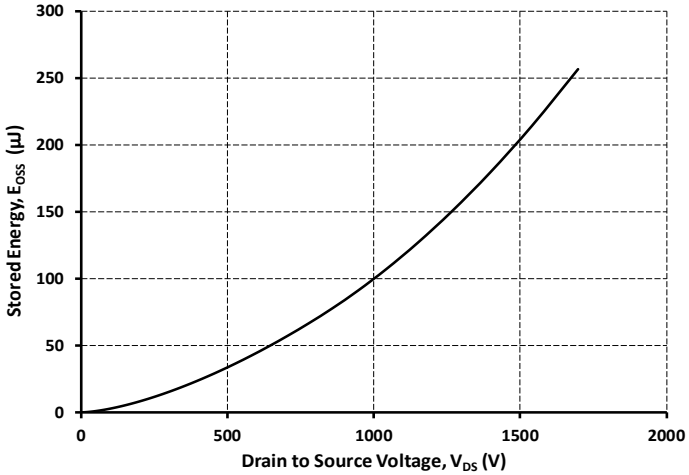
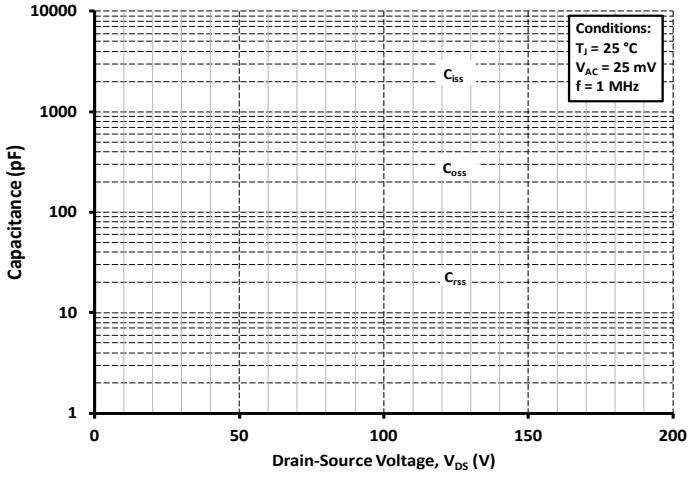
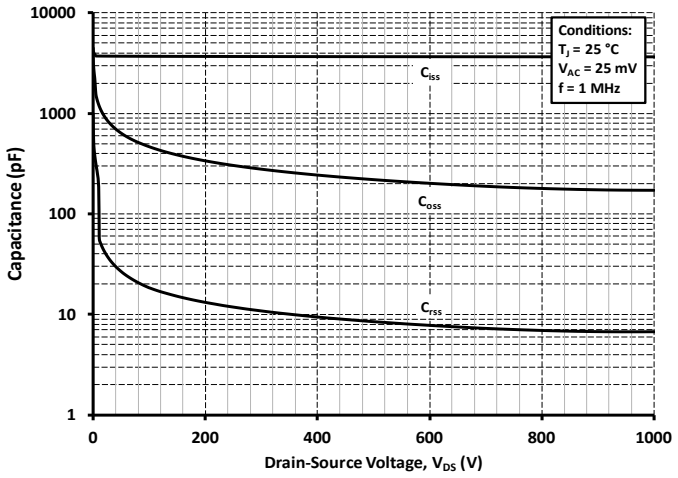


Figure 16. Output Capacitor Stored Energy





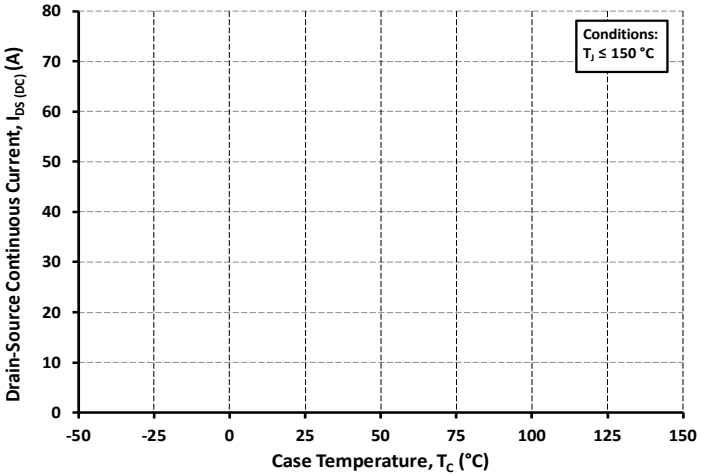


Figure 19. Continuous Drain Current Derating vs. Case Temperature

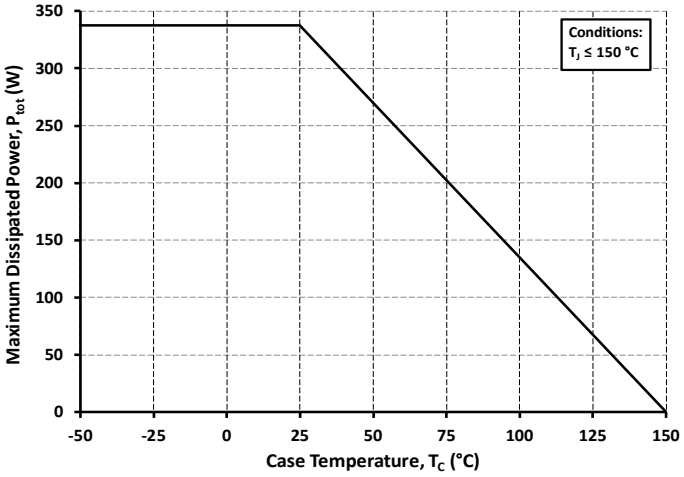


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

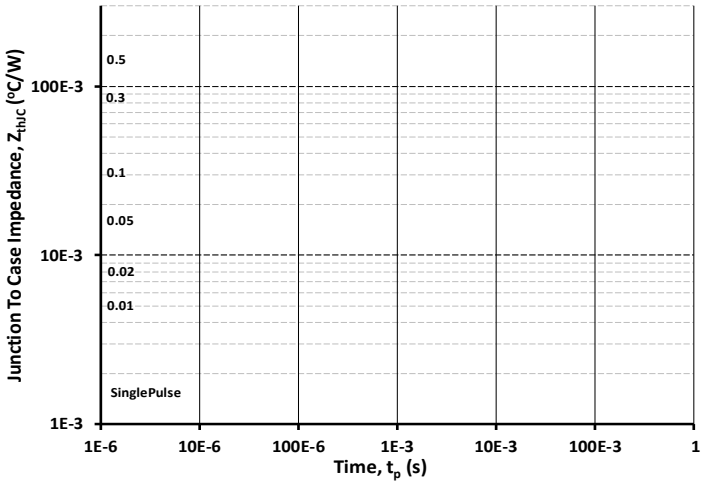


Figure 21. Transient Thermal Impedance (Junction - Case)

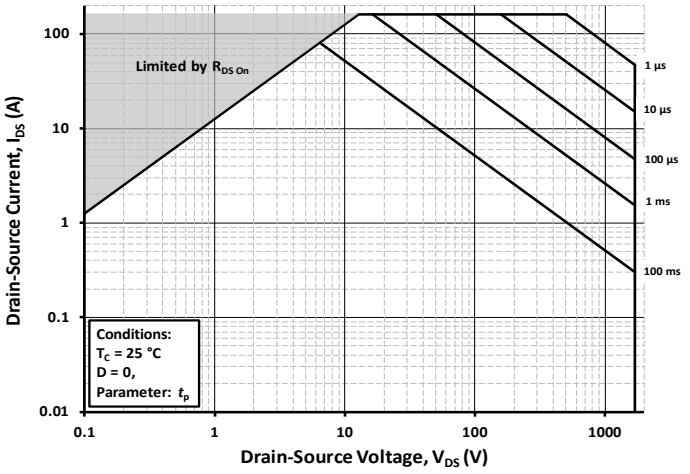
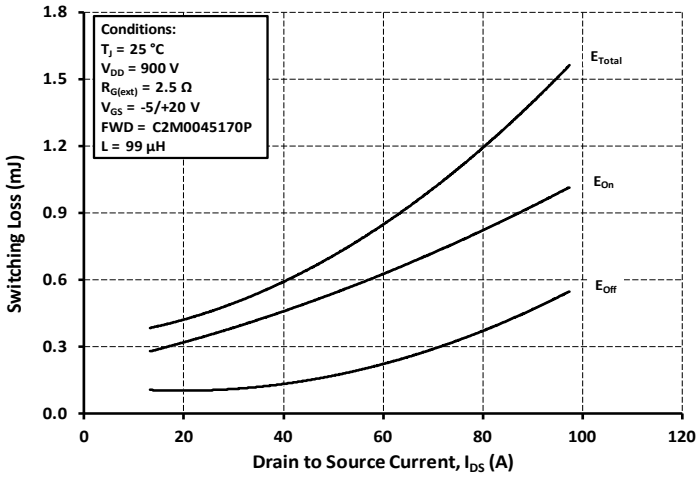
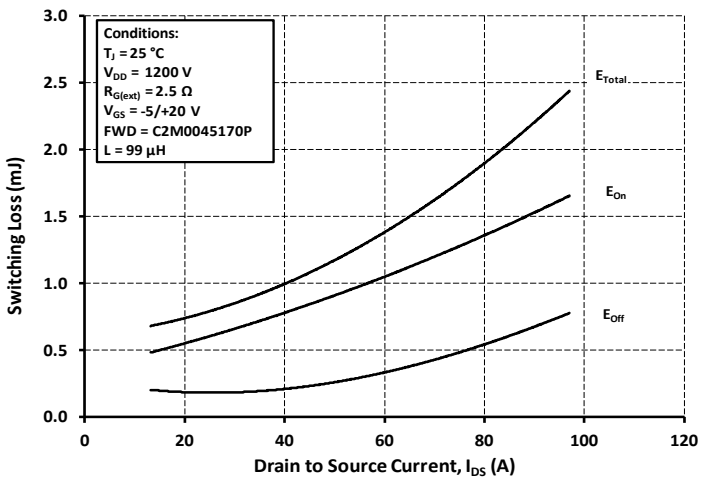


Figure 22. Safe Operating Area





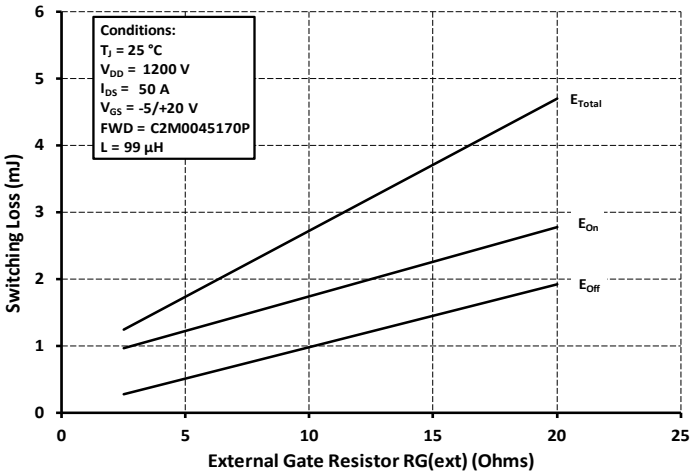


Figure 25. Clamped Inductive Switching Energy vs. $R_{G(ext)}$

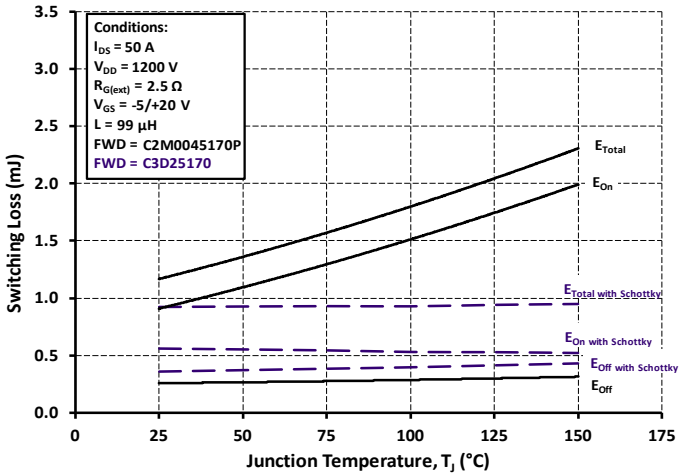


Figure 26. Clamped Inductive Switching Energy vs. Temperature

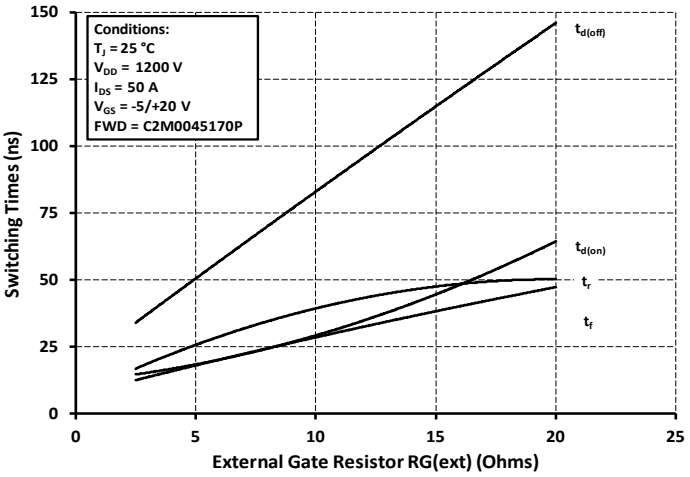


Figure 27. Switching Times vs. $R_{G(ext)}$

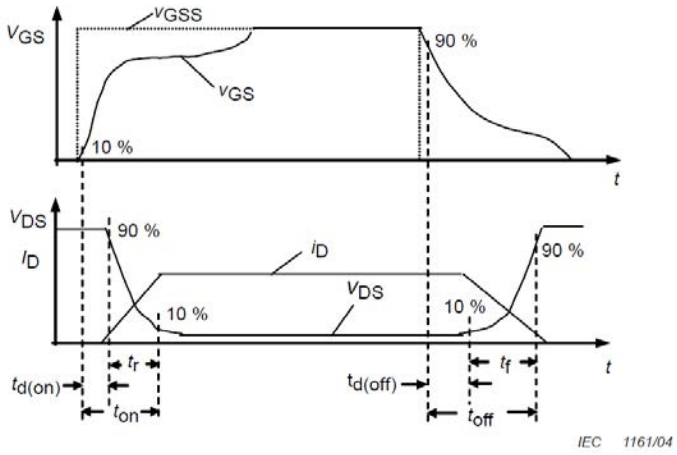
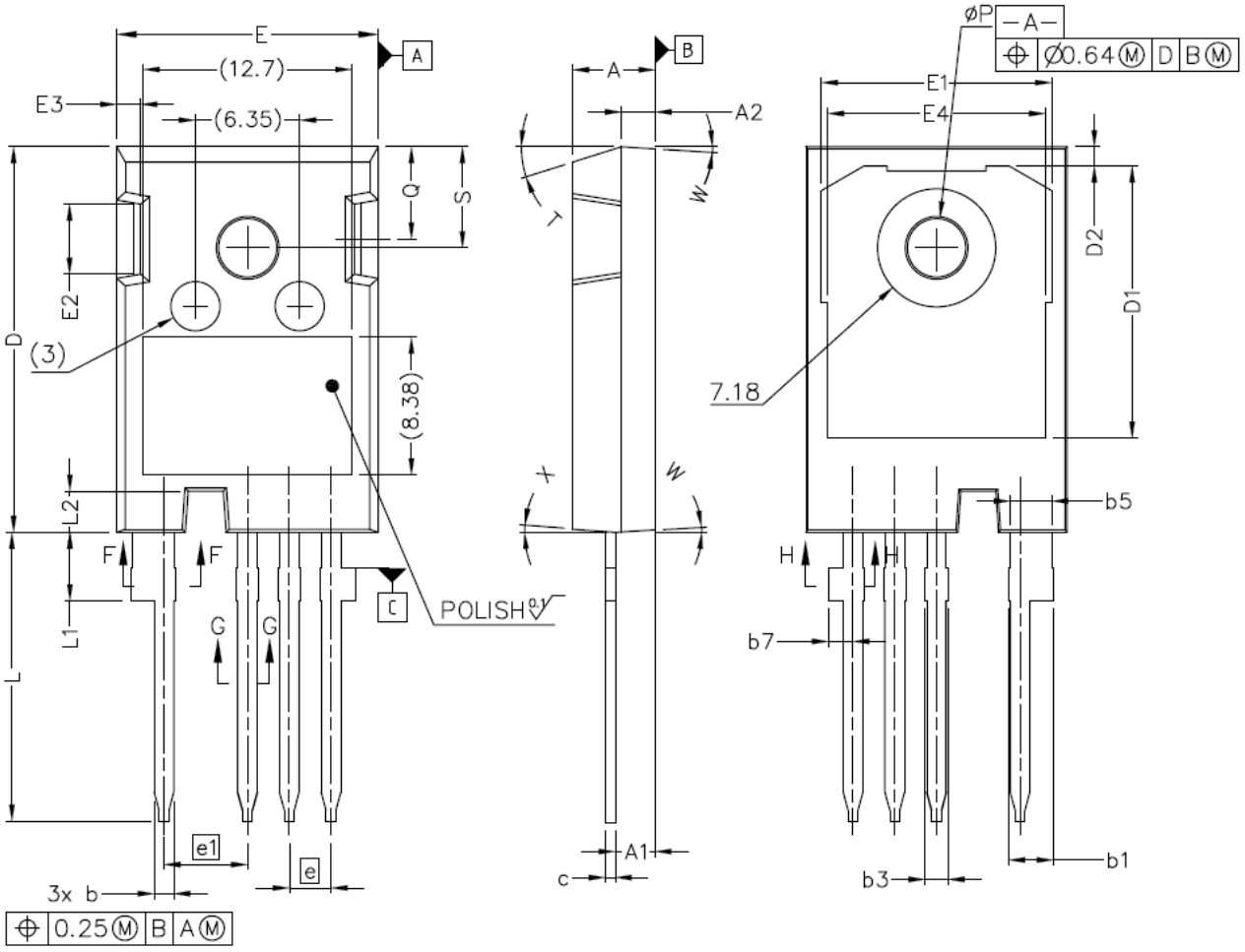
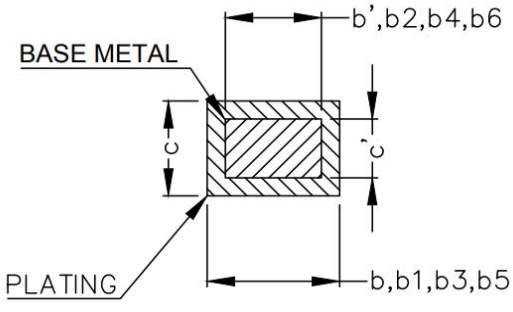


Figure 28. Switching Times Definition

Package Dimensions

Package TO-247-4L





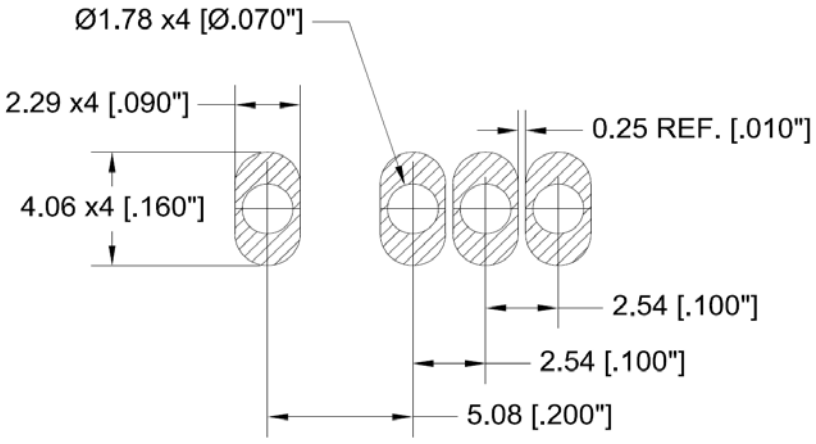
SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

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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give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.

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