IceMOS Technology

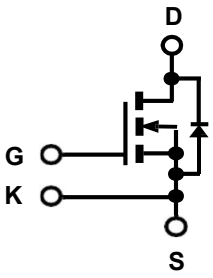
Preliminary
ICE40M230WP4

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Silicon Carbide Power MOSFET

Product Summary			
I_D	T_A=25°C	60A	Max
$V_{(BR)DSS}$	T_C=25°C	2300V	Min
$r_{DS(on)}$	V_{GS}=18V	40mΩ	Typ
Q_g	V_{DS}=1500V	305nC	Typ

Features

- 2300V 40mohm SiC MOSFET
- Low on-resistance
- Fast switching speed with low capacitances
- Fast intrinsic diode with low reverse recovery (Q_{rr})
- Optimized design for high performance power systems





TO247 Plus -4L
1: D, 2: S,
3: K, 4: G

RoHS COMPLIANT RoHS (EU) 2015/863

CE

HALOGEN FREE

Pb Lead Free

Maximum ratings [a] , at T_j=25°C, unless otherwise specified

Parameter	*Symbol*	*Conditions*	*Value*	*Unit*
Continuous drain current	I_D	T_c=25°C	60	A
		T_c=100°C	42	
Pulsed drain current	$I_{D,\ pulse}$		120	A
Maximum gate source voltage	$V_{GS(max)}$		-10/+22	V
Operational gate source voltage	$V_{GS\ op}$		-6/+18	V
Power dissipation	P_{tot}		454.5	W
Storage temperature	T_{stg}		-55 to +175	°C
Operating temperature	T_j			

a Pulse width limited by Tjmax

Parameter	Symbol	Conditions	Values			Unit
			Min	Typ	Max	
Thermal characteristics						
Thermal resistance, junction-case	R_{thJC}		-	-	0.33	°C/W
Thermal resistance, junction-ambient	R_{thJA}	leaded	-	-	40	°C/W
Soldering temperature, wave soldering only allowed at leads	T_{sold}	1.6mm (0.063in.) from case for 10 s	-	-	260	°C
Static characteristics						
Drain-source breakdown voltage	$V_{(BR)DSS}$	V_{GS}=0V, I_D=100μA	2300	-	-	V
Gate threshold voltage	$V_{GS(th)}$	V_{DS}=V_{GS}, I_D=11mA, T_j=25°C	1.8	3	4	V
		V_{DS}=V_{GS}, I_D=11mA, T_j=175°C	-	2.2	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS}=2300V, V_{GS}=0V	-	5	50	μA
Gate source leakage current	I_{GSS}	V_{GS}=-10/+22V, V_{DS}=0V	-	-	±100	nA
Drain-source on-state resistance	$R_{DS\ (on)}$	V_{GS}=18V, I_D=20A, T_j=25°C	-	40	52	mΩ
		V_{GS}=18V, I_D=20A, T_j=175°C	-	96	-	mΩ
Gate resistance	R_G	f=1 MHz, V_{AC}=25mV	-	1.6	-	Ω
Dynamic characteristics						
Input capacitance	C_{iss}	V_{DS}=1200V, V_{GS}=0V, f=100 kHz, V_{AC}=25mV	-	6710	-	pF
Output capacitance	C_{oss}		-	124	-	pF
Reverse transfer capacitance	C_{rss}		-	9	-	pF
C_{OSS} stored energy	E_{oss}		-	120	-	μJ
Forward transconductance	g_{FS}	V_{DS}=20V, I_D=20A	-	18	-	S
Turn-on delay time	$t_{d(on)}$	V_{DS}=1200V, V_{GS}=-4/+18V, I_D=20A, R_G=5Ω (External), L=100μH, T_j=25°C	-	34	-	ns
Rise time	t_r		-	12	-	ns
Turn-off delay time	$t_{d(off)}$		-	98	-	ns
Fall time	t_f		-	41	-	ns
Turn-on switching energy	E_{ON}	Diode: Body Diode at V_{GS} = -4V	-	934	-	μJ
Turn-off switching energy	E_{OFF}		-	400	-	μJ

Electrical characteristics [a], at T_j=25°C, unless otherwise specified

Parameter	Symbol	Conditions	Values			Unit
			Min	Typ	Max	
Dynamic characteristics						
Turn-on delay time	$t_{d(on)}$	V_{DS}=1200V, V_{GS}=-4/+18V, I_D=20A, R_G=5Ω (External), L=100µH, T_j=175°C	-	41	-	ns
Rise time	t_r		-	15	-	
Turn-off delay time	$t_{d(off)}$		-	130	-	
Fall time	t_f		-	41	-	
Turn-on switching energy	E_{ON}	Diode: Body Diode at V_{GS} = -4V	-	1165	-	µJ
Turn-off switching energy	E_{OFF}		-	440	-	
Gate Charge Characteristics						
Gate to source charge	Q_{gs}	V_{DS}=1200V, I_D=20A, V_{GS}=-4 to +18V	-	72	-	nC
Gate to drain charge	Q_{gd}		-	85	-	
Gate charge total	Q_g		-	305	-	
Reverse Diode						
Continuous forward current	I_S	V_{GS}=-4V	-	-	60	A
Diode forward voltage	V_{SD}	V_{GS}=-4V, I_{SD}=20A, T_j=25°C	-	4.5	-	V
		V_{GS}=-5V, I_{SD}=20A, T_j=175°C	-	4	-	
Reverse recovery time	t_{rr}	V_{GS}=-4V, V_{RR}=1200V, I_{SD}=20A, d_{iF}/d_t=2220 A/µs	-	22.5	-	ns
Reverse recovery charge	Q_{rr}		-	206	-	nC
Peak reverse recovery current	I_{rm}		-	22	-	A

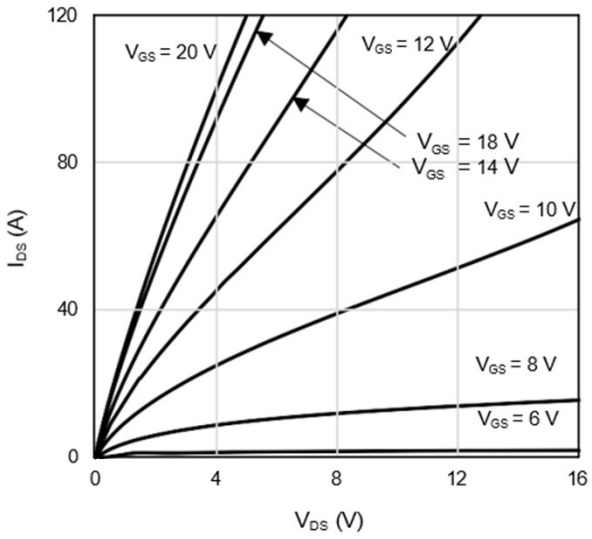


Figure 1: Output Characteristics T_J = -40°C

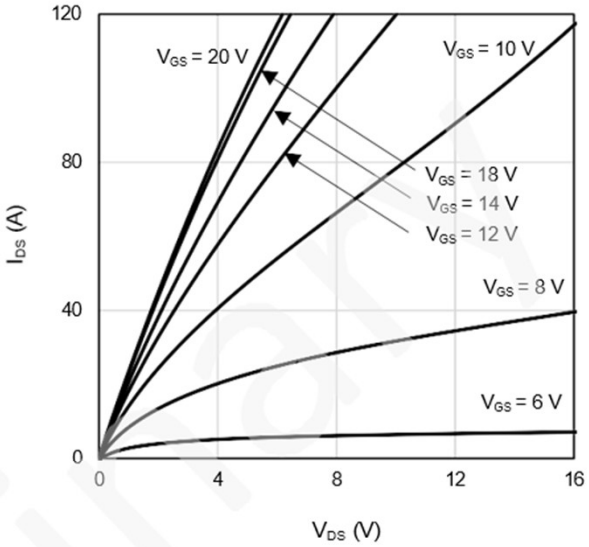


Figure 2: Output Characteristics T_J = 25°C

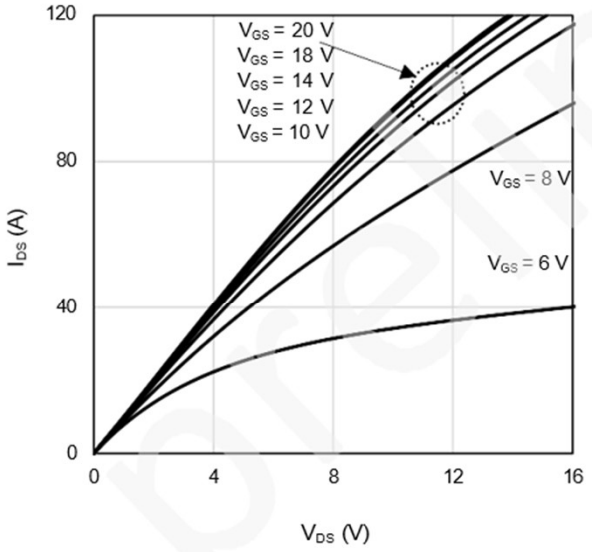


Figure 3: Output Characteristics TJ = 175°C

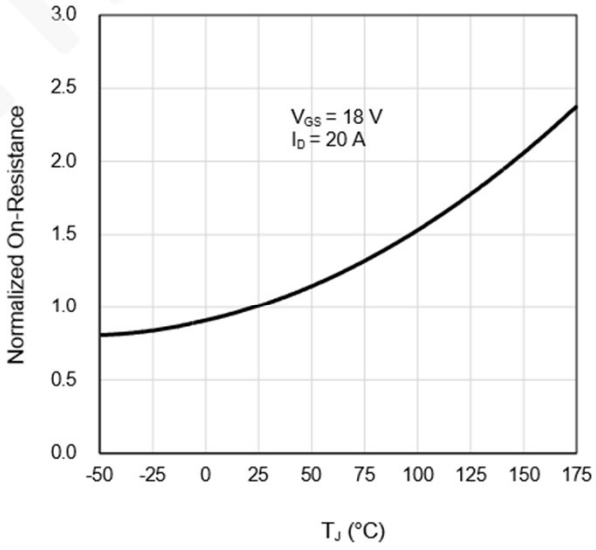


Figure 4: Normalized On-Resistance vs.

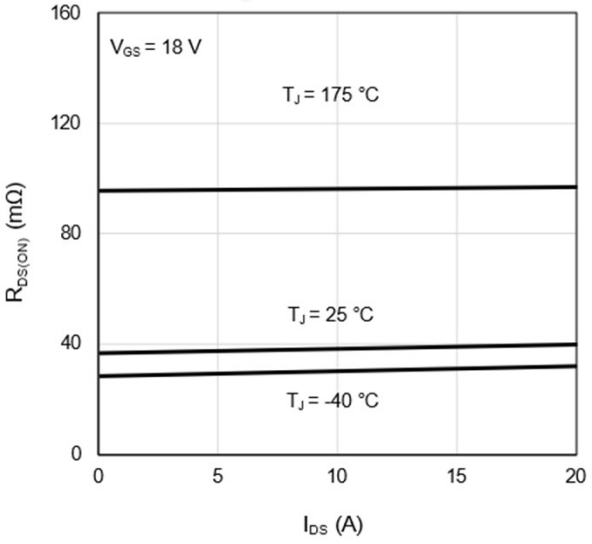


Figure 5: On-Resistance vs. Drain Current For Various Temperatures

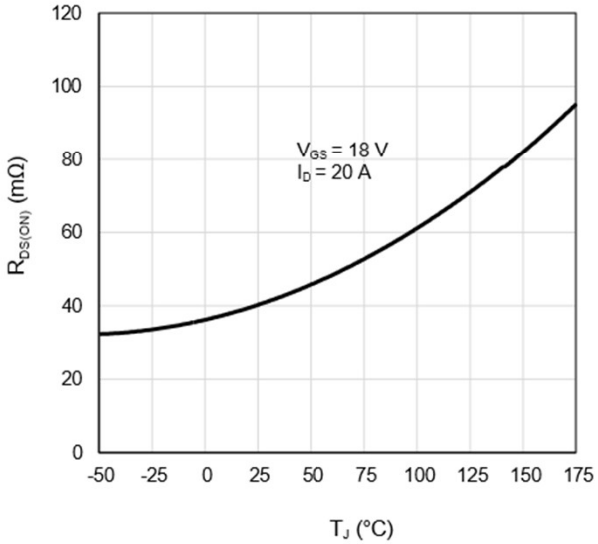


Figure 6: On-Resistance vs. Temperature

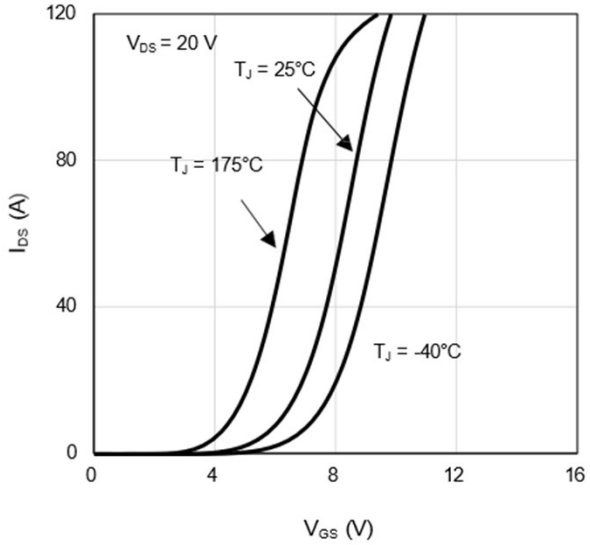


Figure 7: Transfer Characteristics For Various Junction Temparature

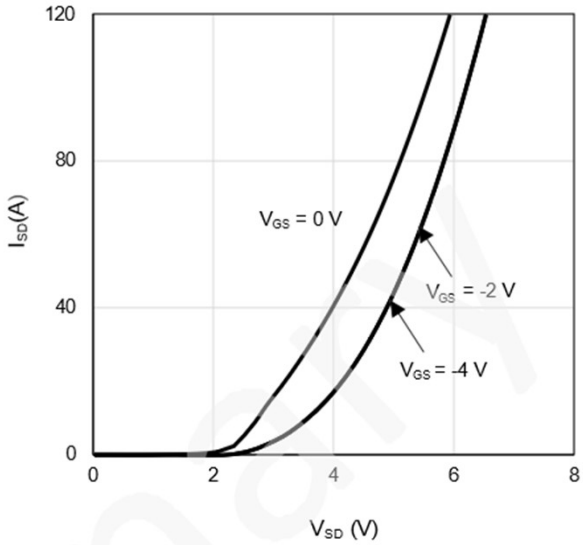


Figure 8: Body Diode Characteristics at -40°C

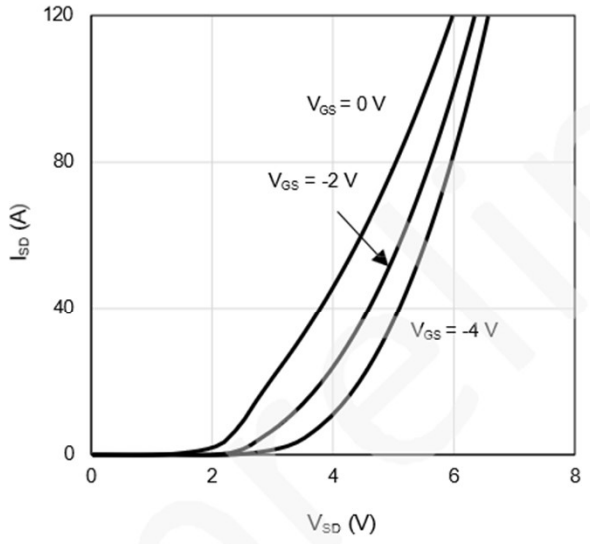


Figure 9: Body Diode Characteristics at 25°C

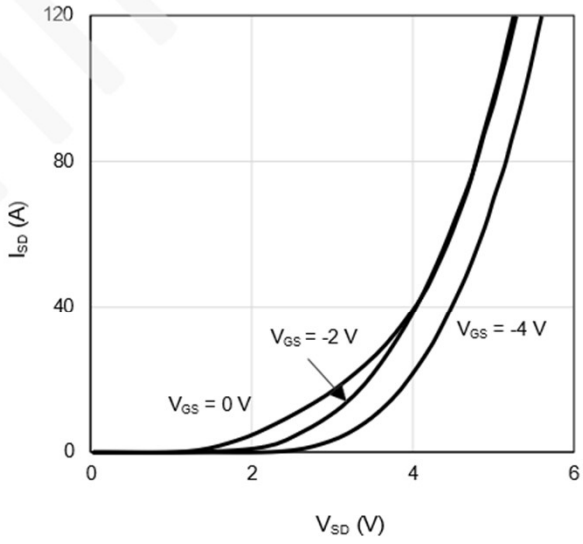


Figure 10: Body Diode Characteristics at 175°C

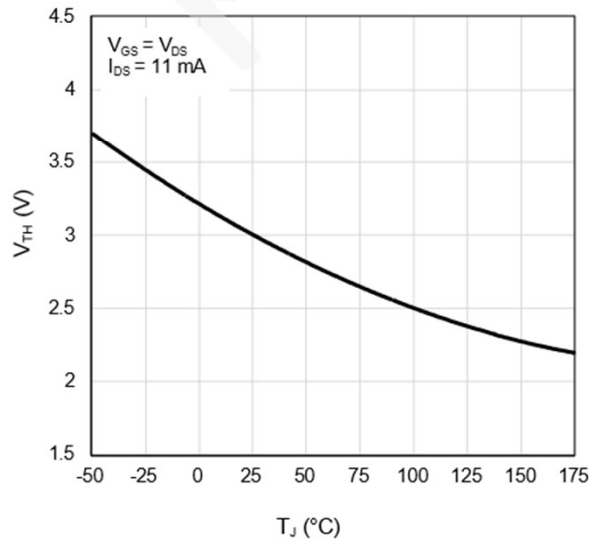


Figure 11: Threshold Voltage vs. Temperature

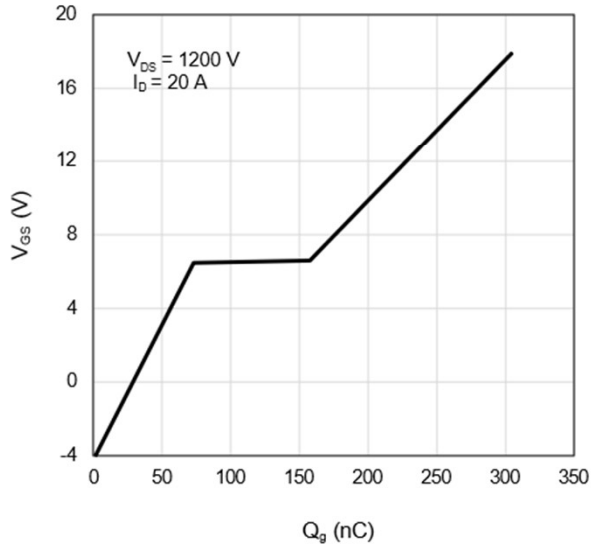


Figure 12: Gate-Charge Characteristics

Preliminary

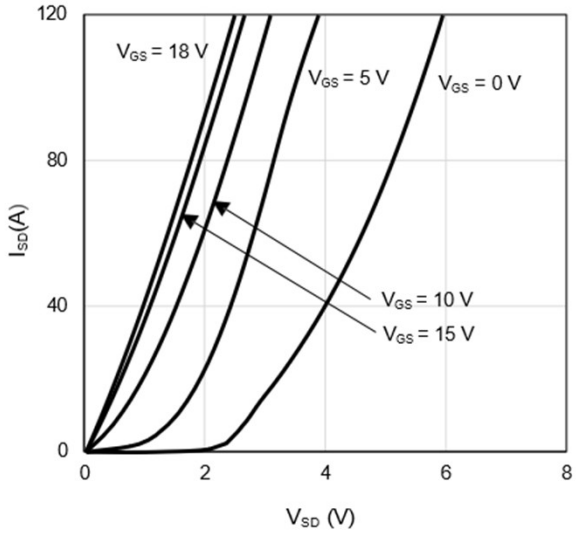


Figure 13: 3rd Quadrant Characteristics at -40°C

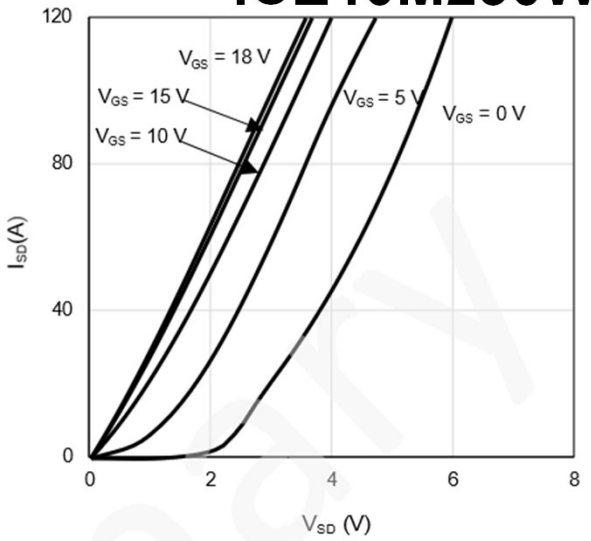


Figure 14: 3rd Quadrant Characteristics at 25°C

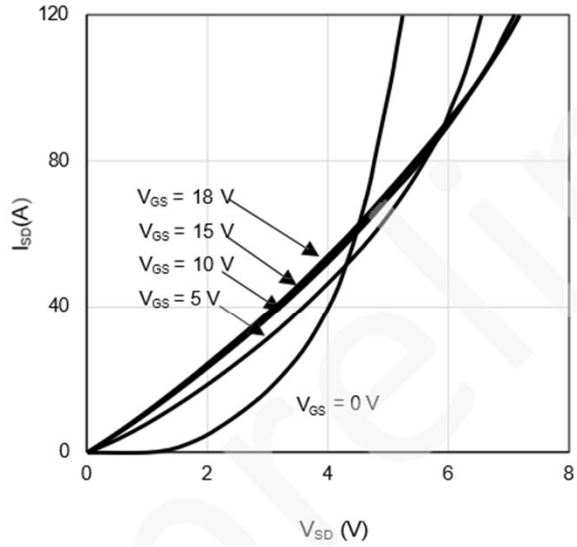


Figure 15: 3rd Quadrant Characteristics at 175°C

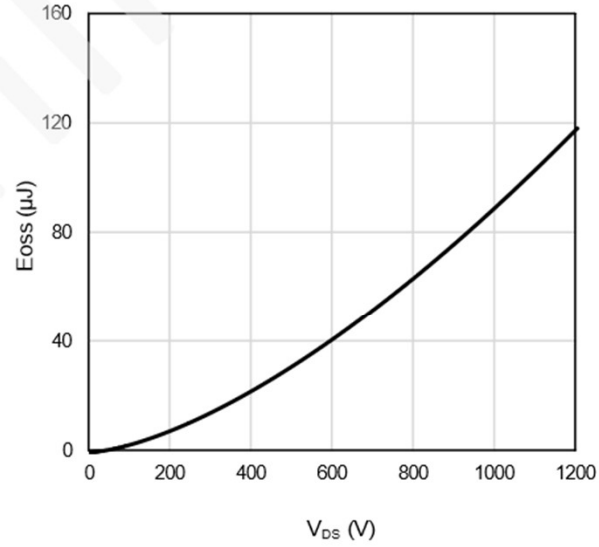


Figure 16: Output Capacitor Stord Energy

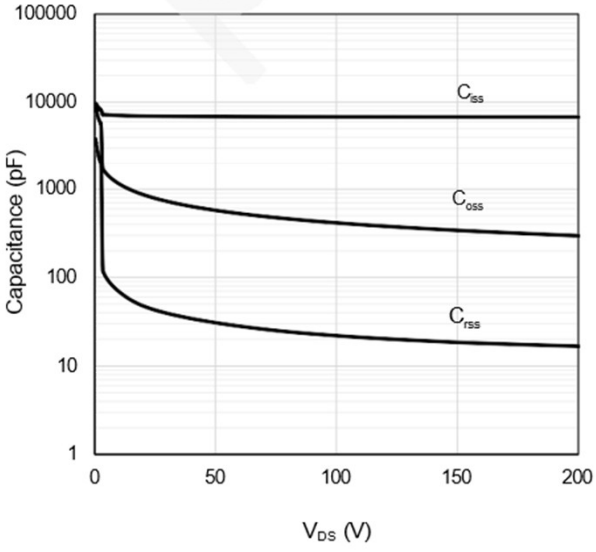


Figure 17: Capacitance Characteristics (0 - 200 V)

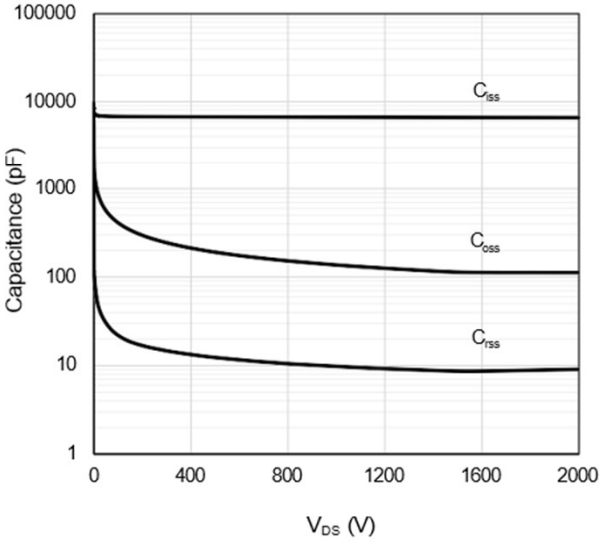


Figure 18: Capacitance Characteristics (0 - 2000 V)

Preliminary

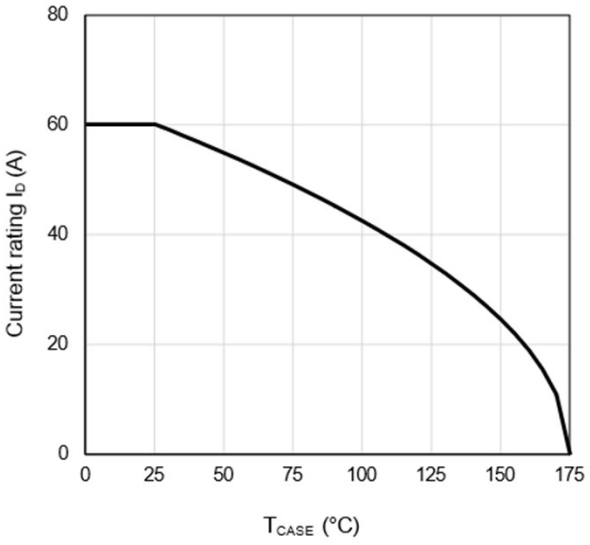


Figure 19: Current De-rating

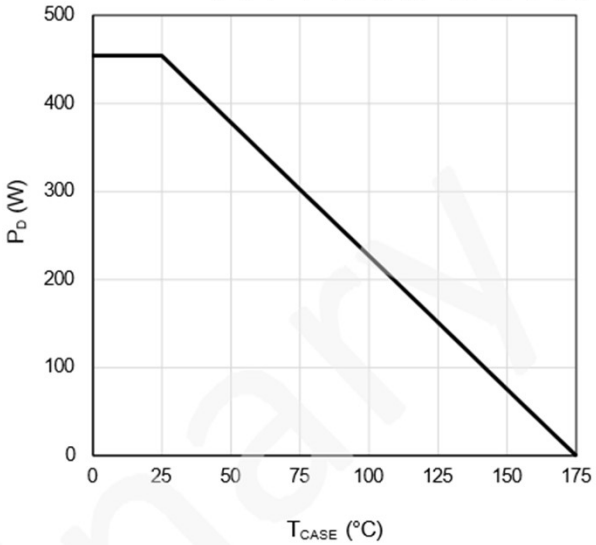


Figure 20: Maximum Power Disspation Derating vs. CaseTemperature

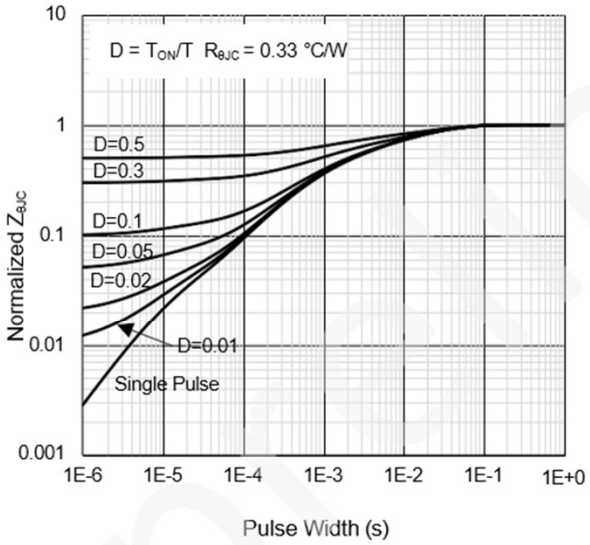


Figure 21: Normalized Maximum Transient Thermal Impedance

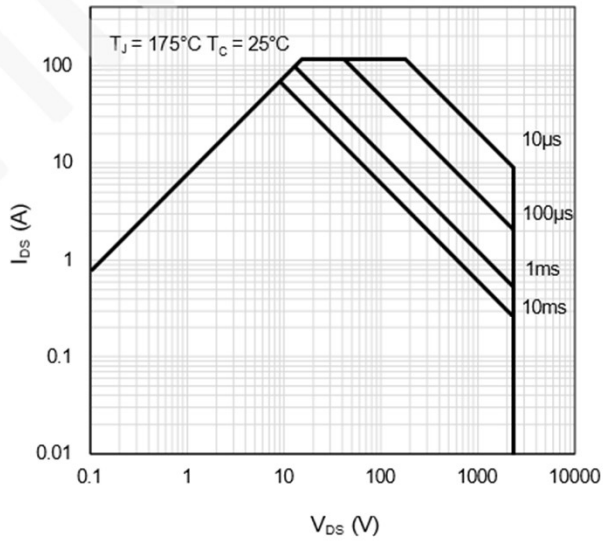


Figure 22: Maximum Forward Biased Safe Operating Area

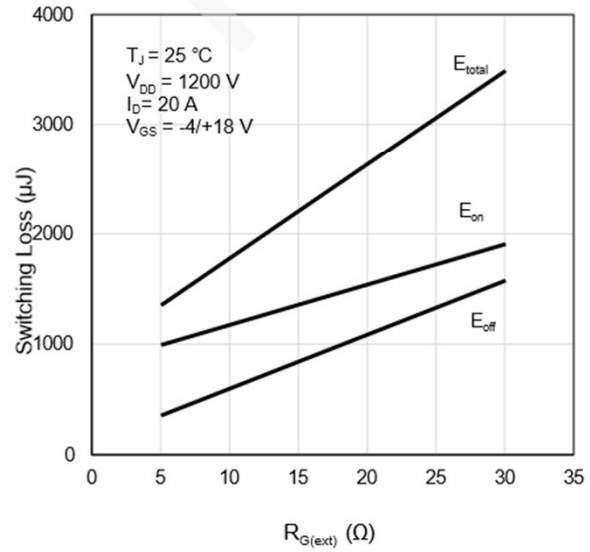


Figure 23: Clamped Inductive Switching Energy vs. $R_{G(ext)}$

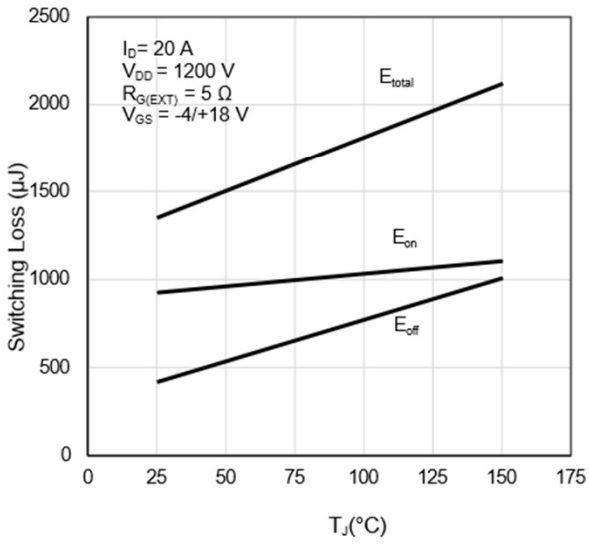


Figure 24: Clamped Inductive Switching Energy vs. T_J

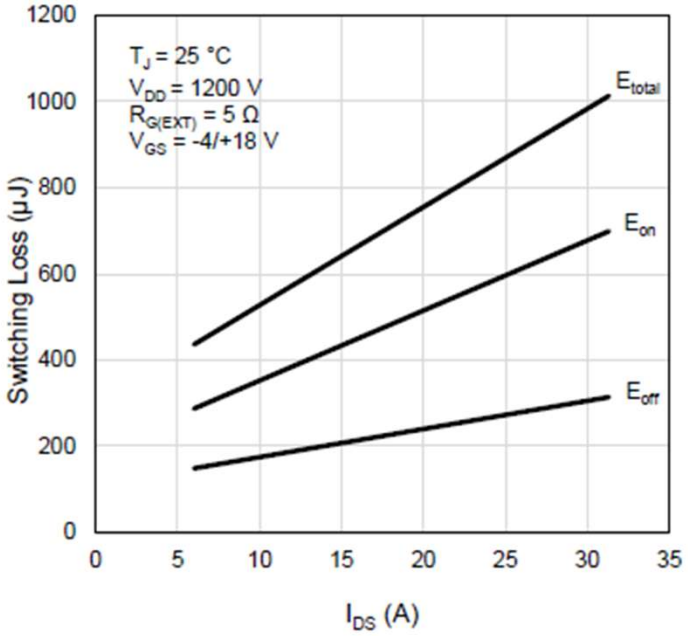


Figure 25: Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 800 V)

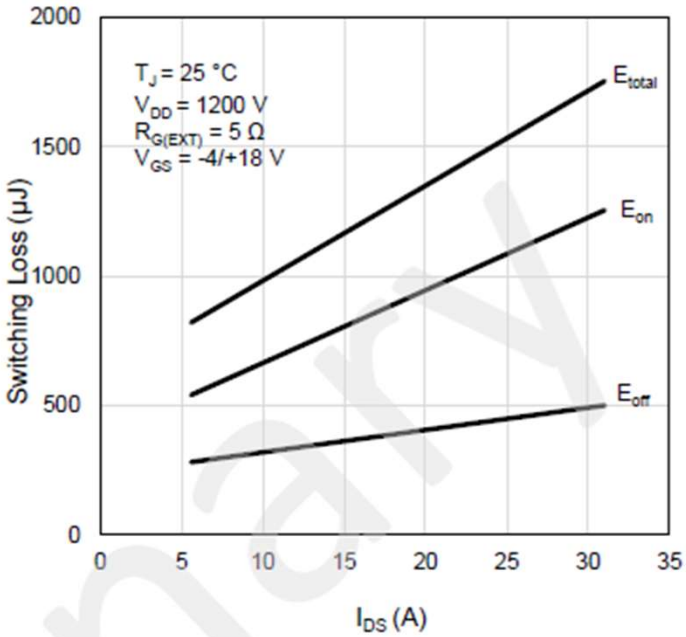


Figure 26: Clamped Inductive Switching Energy vs. Drain Current (V_{DD} = 1200 V)

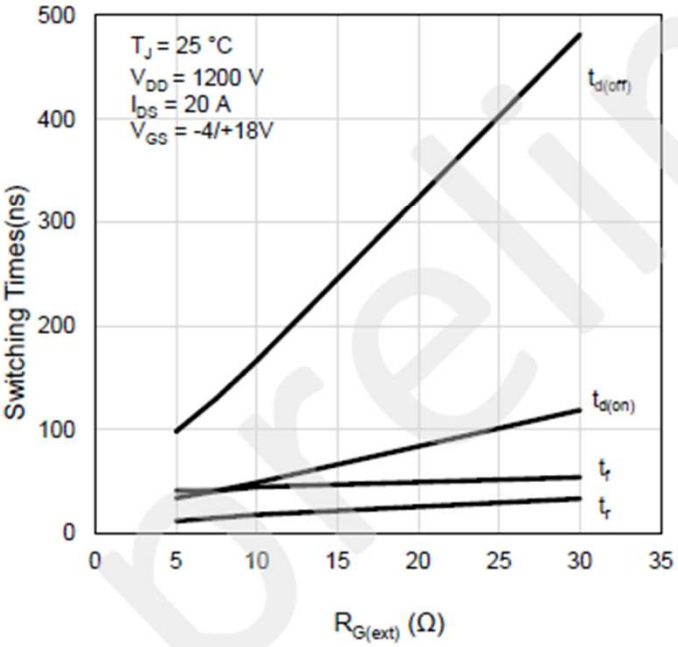
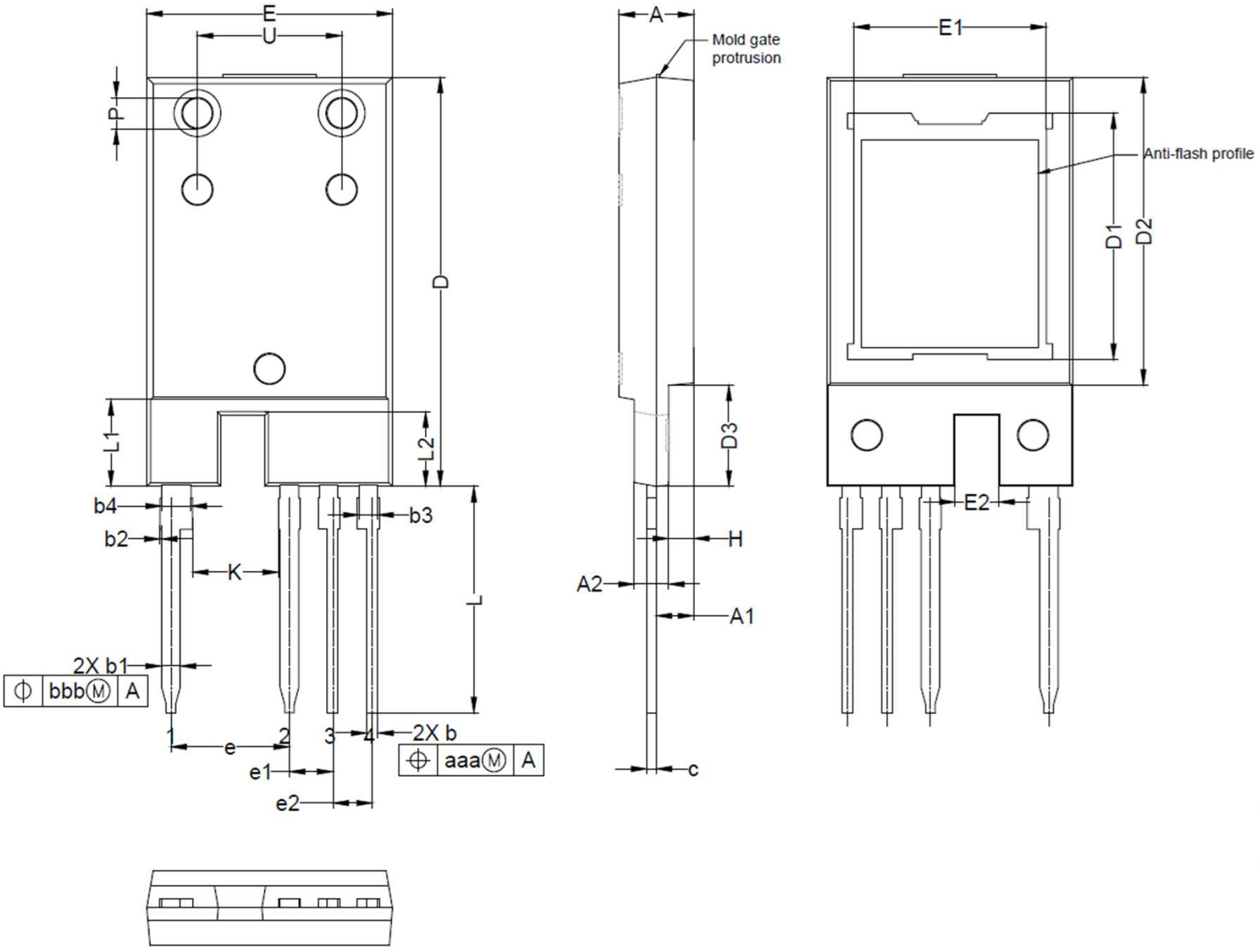


Figure 27: Switching Time vs. $R_{G(ext)}$

preliminary

Package Outline: TO-247 Plus -4L



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SYMBOL	MILLIMETERS		SYMBOL	MILLIMETERS	
	MIN	MAX		MIN	MAX
A	4.70	4.90	E1	12.00	12.80
A1	2.16	2.66	E2	2.60	3.00
A2	2.00	2.40	e	7.62 BSC.	
b	0.60	0.80	e1	2.79 BSC.	
b1	1.10	1.30	e2	2.54 BSC.	
b2	-	0.15	H	1.51	1.71
b3	1.10	1.30	K	5.50	-
b4	1.70	2.10	N	4	
c	0.50	0.70	L	14.48	14.68
D	26.23	26.43	L1	5.40	5.70
D1	15.50	16.30	L2	4.46	4.66
D2	19.40	20.20	P	1.75	2.25
D3	6.35	6.65	U	9.00	9.50
E	15.70	15.90	aaa	0.25	
			bbb	0.25	

Marking Information

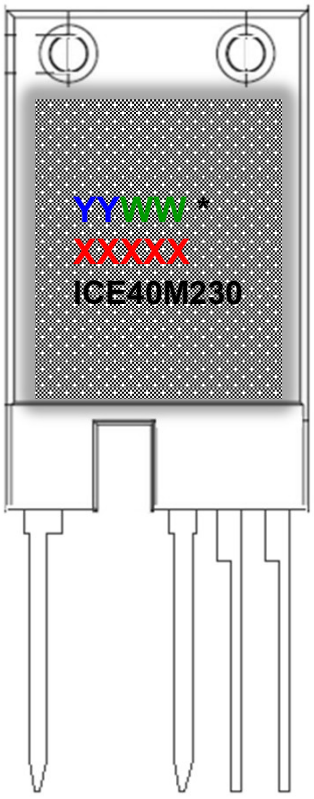
YY = Last two digits of the year

WW = Work week

* = Site ID

XXXXX = Lot ID

ICE40M230 = ICE is IceMOS logo and 40M230 is a designated device part number



Disclaimer

Information contained in this data sheet shall in no event be regarded as a guarantee of conditions or characteristics. All product, data sheet are subject to change without notice to improve reliability. ICEMOS technology will not be responsible for damages of any nature resulting from the use or reliance upon the information contained in this data sheet.