

## N-Channel 650V (D-S) SiC Power MOSFET

PRODUCT SUMMARY		
$V_{DS}$ (V) at $T_J$ max.	650	
$R_{DS(on)}$ at 25 °C ( $\Omega$ )	$V_{GS} = 10$ V	0.040
$Q_g$ (nC)	98	

### FEATURES

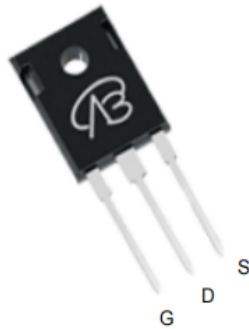
- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)



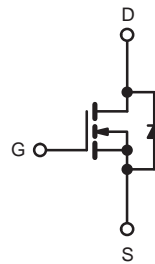
### APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- DC/DC converter

TO-247



Top View



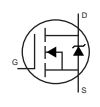
N-Channel MOSFET

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)				
PARAMETER	SYMBOL	LIMIT	UNIT	
Drain-Source Voltage	$V_{DS}$	650	V	
Gate-Source Voltage	$V_{GS}$	-10 / +22		
Continuous Drain Current ( $T_J = 150$ °C)	$V_{GS}$ at 18 V	$T_C = 25$ °C	50	A
		$T_C = 100$ °C	30	
Pulsed Drain Current <sup>a</sup>		$I_{DM}$	150	
Linear Derating Factor			2.1	W/°C
Single Pulse Avalanche Energy <sup>b</sup>		$E_{AS}$	650	mJ
Maximum Power Dissipation		$P_D$	320	W
Operating Junction and Storage Temperature Range		$T_J, T_{stg}$	-55 to +175	°C
Drain-Source Voltage Slope		$dV/dt$	50	V/ns
Reverse Diode $dV/dt$ <sup>d</sup>	$T_J = 125$ °C		15	
Soldering Recommendations (Peak Temperature) <sup>c</sup>			260	°C
			for 10 s	

### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 30$ mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 9$ A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

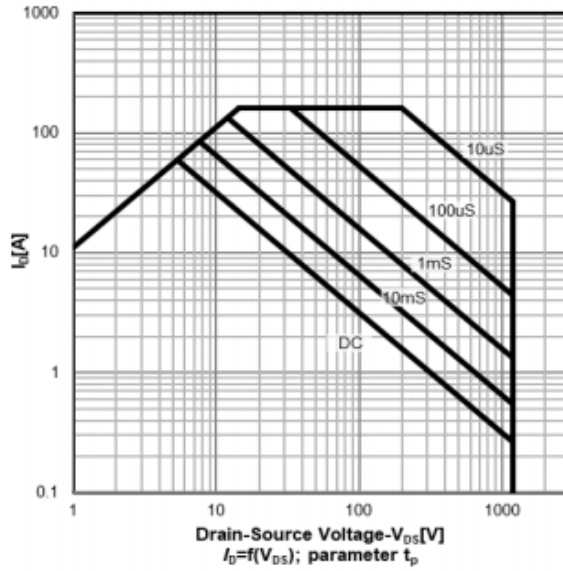
THERMAL RESISTANCE RATINGS				
PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum Junction-to-Ambient	$R_{thJA}$	-	40	°C/W
Maximum Junction-to-Case (Drain)	$R_{thJC}$	-	0.47	

SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted)						
PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650	-	-	V
$V_{DS}$ Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}, I_D = 1\text{ mA}$	-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 10\text{ mA}$	2.5	-	4.5	V
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = +22\text{ V}$	-	-	100	nA
		$V_{GS} = -10\text{ V}$	-	-	-100	μA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}$	-	10	-	μA
		$V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$	-	-	100	
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS} = 18\text{ V}, I_D = 30\text{ A}$	-	0.040	-	Ω
Forward Transconductance	$g_{fs}$	$V_{DS} = 0\text{ V}, I_D = 30\text{ A}$	-	16	-	S
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}, V_{DS} = 480\text{ V}, f = 1\text{ MHz}$	-	2000	-	pF
Output Capacitance	$C_{oss}$		-	123	-	
Reverse Transfer Capacitance	$C_{rss}$		-	10	-	
Effective Output Capacitance, Energy Related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 480\text{ V}, V_{GS} = 0\text{ V}$	-	156	-	
Effective Output Capacitance, Time Related <sup>b</sup>	$C_{o(tr)}$		-	268	-	
Total Gate Charge	$Q_g$	$V_{GS} = -5/18\text{ V}, I_D = 20\text{ A}, V_{DS} = 480\text{ V}$	-	98	-	nC
Gate-Source Charge	$Q_{gs}$		-	29	-	
Gate-Drain Charge	$Q_{gd}$		-	33	-	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 480\text{ V}, I_D = 20\text{ A}, V_{GS} = -5/18\text{ V}, R_g = 2\text{ }^\Omega$	-	18	25	ns
Rise Time	$t_r$		-	24	55	
Turn-Off Delay Time	$t_{d(off)}$		-	88	-	
Fall Time	$t_f$		-	12	-	
Gate Input Resistance	$R_g$	$f = 1\text{ MHz}, \text{ open drain}$	-	3.2	-	Ω
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Source-Drain Diode Current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 	-	-	50	A
Pulsed Diode Forward Current	$I_{SM}$		-	-	150	
Diode Forward Voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}, I_S = 30\text{ A}, V_{GS} = 0$	-	-	4.1	V
Reverse Recovery Time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 30\text{ A}, di/dt = 1000\text{ A}/\mu\text{s}, V_R = 480\text{ V}$	-	47	-	ns
Reverse Recovery Charge	$Q_{rr}$		-	220	-	μC
Reverse Recovery Current	$I_{RRM}$		-	60	-	A

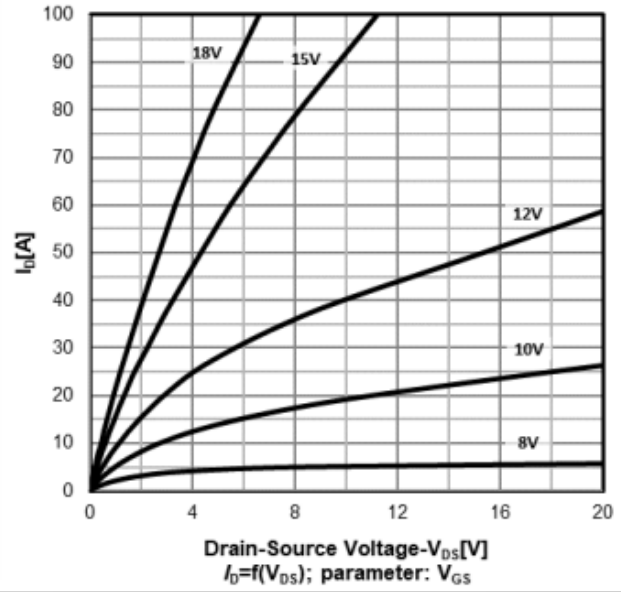
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .
- b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

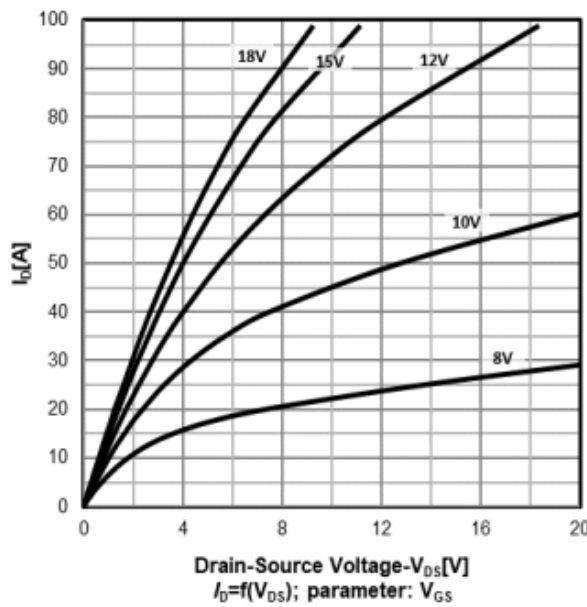
Safe operating area Tc=25 °C  
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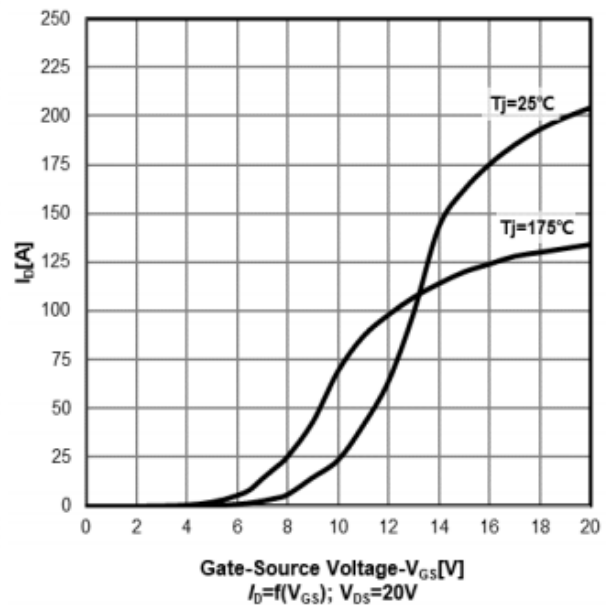
On-Region characteristics Tj=25 °C



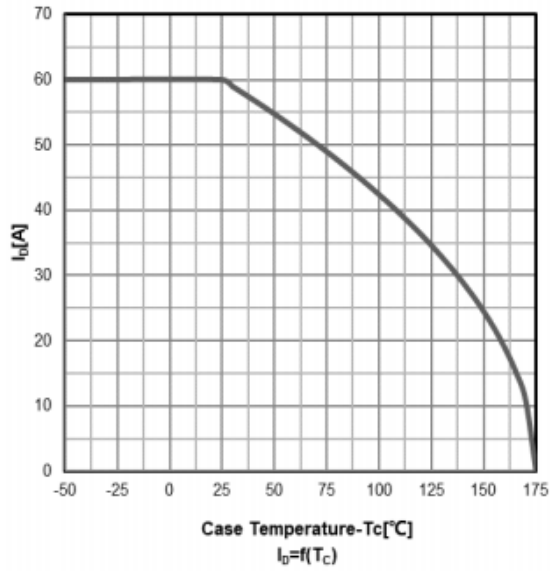
On-Region characteristics Tj=175 °C



Transfer characteristics



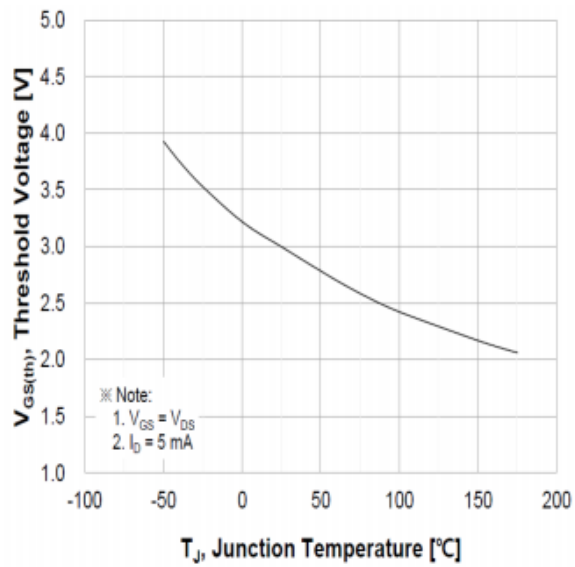
Drain current vs temperature



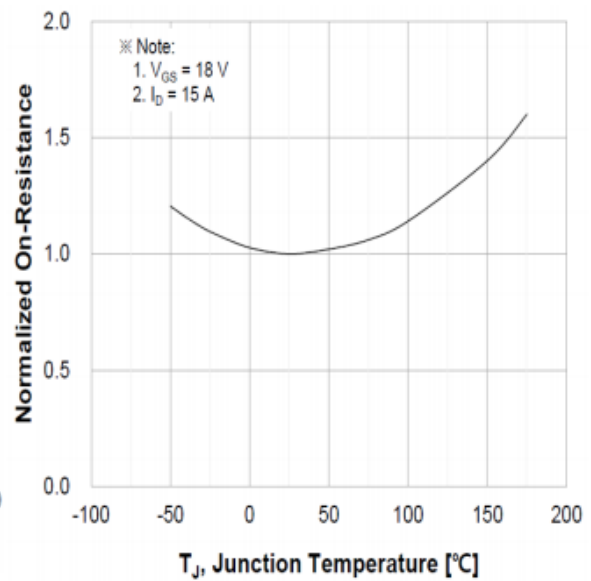
Power dissipation



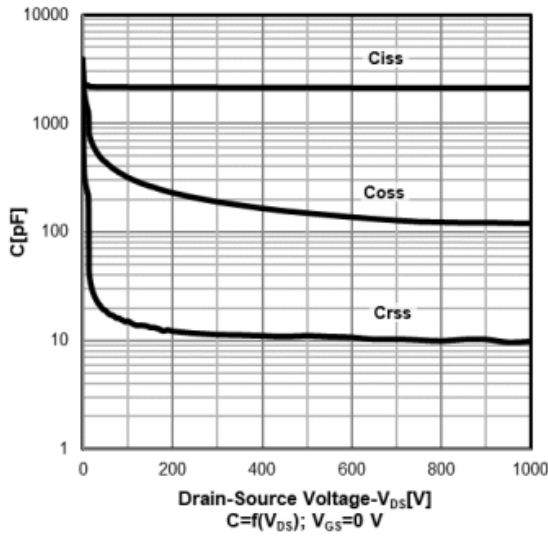
Threshold voltage vs temperature



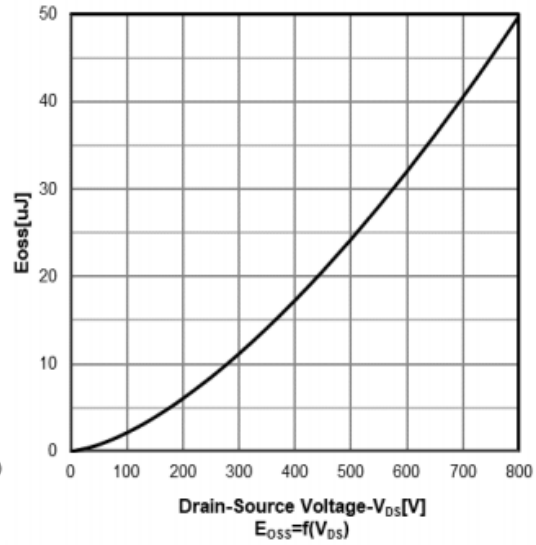
Normalized On-resistance vs temperature



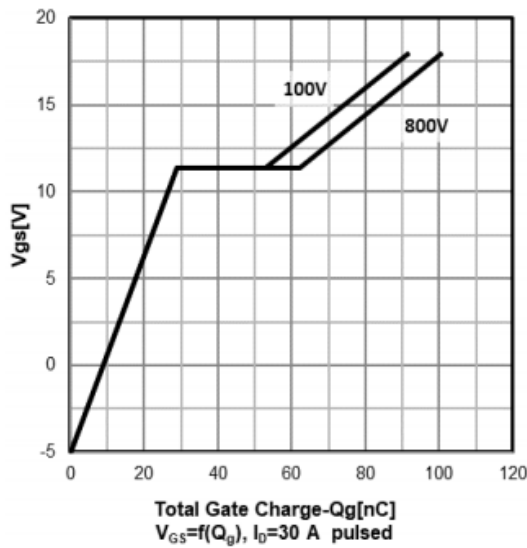
Typ. capacitances



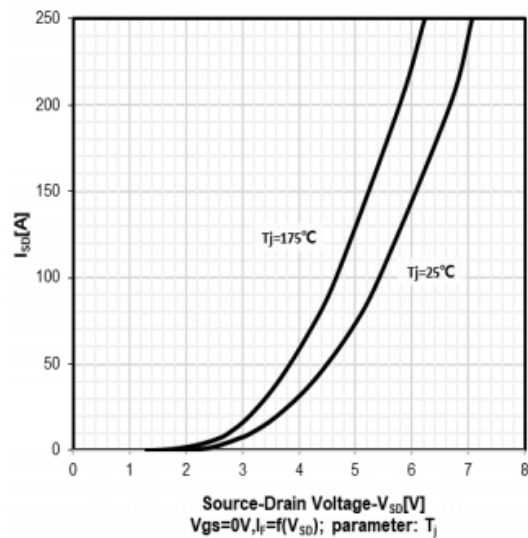
$C_{oss}$  stored energy



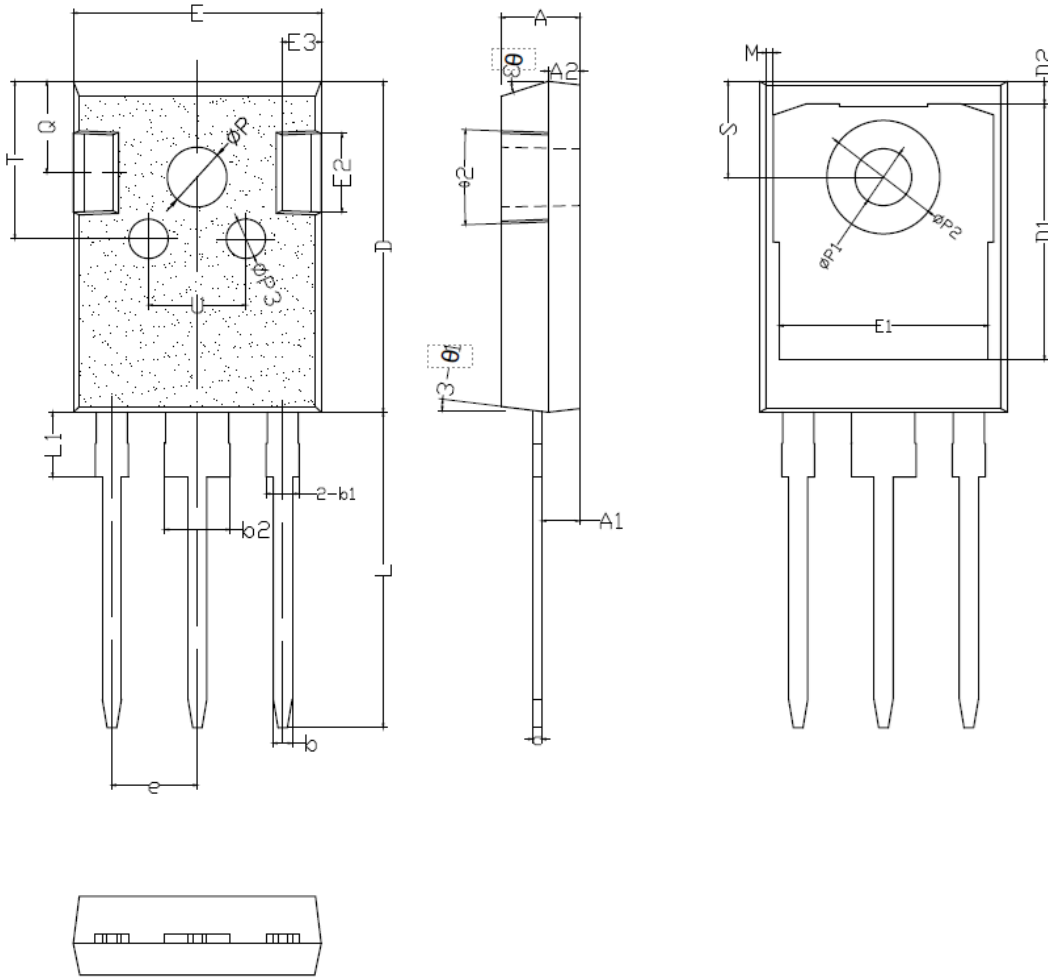
Typ. gate charge characteristics



Diode forward voltage characteristics  
 $T_j=25^\circ C/175^\circ C$



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SYMBOL	mm		
	MIN	NOM	MAX
*A	4.90	5.00	5.10
*A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
*b	1.15	1.20	1.25
*b1	1.95	2.10	2.25
*b2	2.95	3.10	3.25
*c	0.55	0.60	0.65
*D	20.90	21.00	21.10
D1	16.35	16.55	16.75
D2	1.05	1.20	1.35

*E	15.70	15.80	15.90
E1	13.10	13.25	13.40
E2	4.85	4.95	5.10
E3	2.40	2.50	2.60
*e	5.40	5.44	5.48
*L	19.80	19.98	20.15
*L1	-	-	4.30
*ΦP	3.40	3.50	3.60
*ΦP1	6.90	7.10	7.30
ΦP2	2.40	2.50	2.60
ΦP3	2.40	2.50	2.60
Q	5.60	5.80	6.00
*S	6.05	6.15	6.25
T	9.80	10.00	10.20
U	6.00	6.20	6.40
θ1	5°	7°	9°
θ2	1°	3°	5°
θ3	13°	15°	17°

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