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

PRODUCT SUMMARY		
V_{DS} (V)	650	
$R_{DS(on)}$ at 25 °C (Ω)	V_{GS} = 18 V	0.07
Q_g (nC)	90	

FEATURES

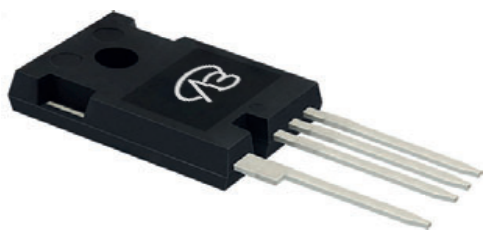
- Low figure-of-merit (FOM) R_{on} x Q_g
- Low input capacitance (C_{iss})
- Reduced switching and conduction losses
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)

RoHS

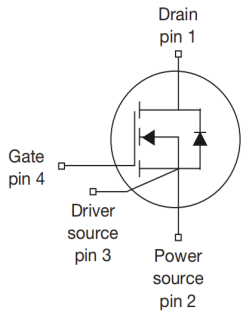
APPLICATIONS

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

TO-247



•Pin1 D - Drain
•Pin2 S - Source(Power)
•Pin3 S - Source(Driver)
•Pin4 G - Gate



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	I_D	30	A
		T_C = 100 °C		24	
Pulsed Drain Current [a]			I_{DM}	90	
Linear Derating Factor				2.1	W/°C
Single Pulse Avalanche Energy [b]			E_{AS}	225	mJ
Maximum Power Dissipation			P_D	187	W
Operating Junction and Storage Temperature Range			T_J, T_{stg}	-55 to +175	°C
Drain-Source Voltage Slope	T_J = 125 °C		dV/dt	50	V/ns
Reverse Diode dV/dt [d]				15	
Soldering Recommendations (Peak Temperature) [c]	for 10 s			260	°C

Notes

a. Repetitive rating; pulse width limited by maximum junction temperature.
b. V_{DD} = 100 V, starting T_J = 25 °C, L = 0.5mH, R_g = 25 Ω, I_{AS} = 30A.
c. 1.6 mm from case.
d. $I_{SD} \leq I_D$, dI/dt = 100 A/μs, 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}	-	0.8	

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)							
PARAMETER	**SYMBOL**	**TEST CONDITIONS**		**MIN.**	**TYP.**	**MAX.**	**UNIT**
Static							
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 1 mA		650	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	Reference to 25 °C, I_D = 1 mA		-	0.70	-	V/°C
Gate-Source Threshold Voltage (N)	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 10 mA		2	-	5	V
Gate-Source Leakage	I_{GSS}	V_{GS} = +22 V		-	-	100	nA
		V_{GS} = -10 V		-	-	100	µA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650V, V_{GS} = 0 V		-	10	-	µA
		V_{DS} = 650 V, V_{GS} = 0 V, T_J = 125 °C		-	-	100	
Drain-Source On-State Resistance	$R_{DS(on)}$	V_{GS} = 18 V	I_D = 20A	-	0.07	-	Ω
Forward Transconductance	g_{fs}	V_{DS} = 0 V, I_D = 30 A		-	12	-	S
Dynamic							
Input Capacitance	C_{iss}	V_{GS} = 0 V, V_{DS} = 600 V, f = 1 MHz		-	1600	-	pF
Output Capacitance	C_{oss}			-	175	-	
Reverse Transfer Capacitance	C_{rss}			-	9	-	
Effective Output Capacitance, Energy Related [a]	$C_{o(er)}$	V_{DS} = 0 V to 400 V, V_{GS} = 0 V		-	156	-	
Effective Output Capacitance, Time Related [b]	$C_{o(tr)}$			-	268	-	
Total Gate Charge	Q_g	V_{GS} = -5/18 V	I_D = 20 A, V_{DS} = 400 V	-	70	-	nC
Gate-Source Charge	Q_{gs}			-	20	-	
Gate-Drain Charge	Q_{gd}			-	23	-	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 400 V, I_D = 20A, V_{GS} = -5/18 V , R_g = 2 Ω		-	12	15	ns
Rise Time	t_r			-	10	13	
Turn-Off Delay Time	$t_{d(off)}$			-	20	-	
Fall Time	t_f			-	10	-	
Gate Input Resistance	R_g	f = 1 MHz, open drain		-	2.2	-	Ω
Drain-Source Body Diode Characteristics							
Continuous Source-Drain Diode Current	I_S	MOSFET symbol showing the integral reverse p - n junction diode		-	-	30	A
Pulsed Diode Forward Current	I_{SM}			-	-	90	
Diode Forward Voltage	V_{SD}	T_J = 25 °C, I_S = 20 A, V_{GS} = 0		-	-	4.1	V
Reverse Recovery Time	t_{rr}	T_J = 25 °C, I_F = I_S = 20 A, dI/dt = 1000 A/µs, V_R = 400 V		-	20	-	ns
Reverse Recovery Charge	Q_{rr}			-	60	-	µC
Reverse Recovery Current	I_{RRM}			-	10	-	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 60 % 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 60 % V_{DSS}.

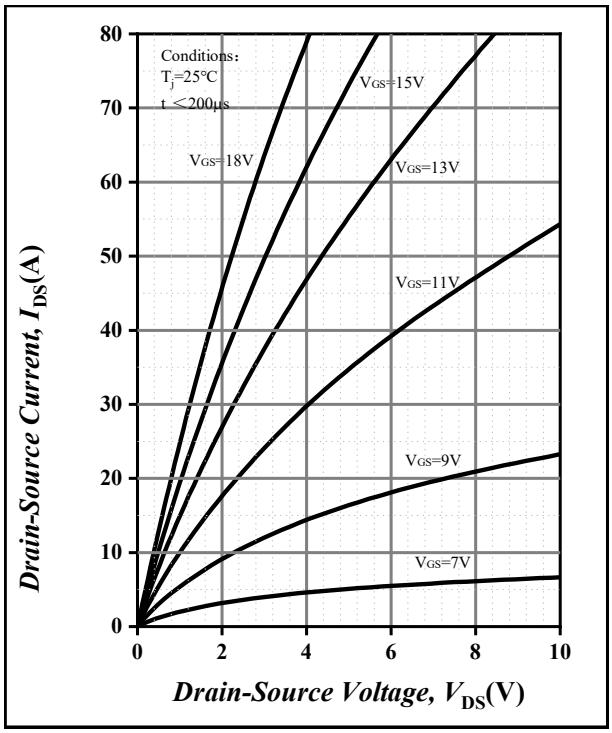


Fig.1 Output characteristics Tj=25℃

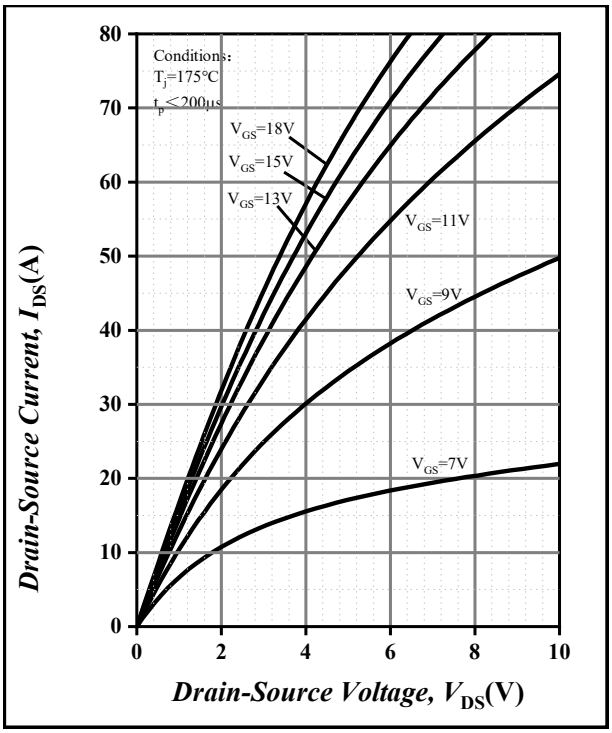


Fig.2 Output characteristics Tj=175℃

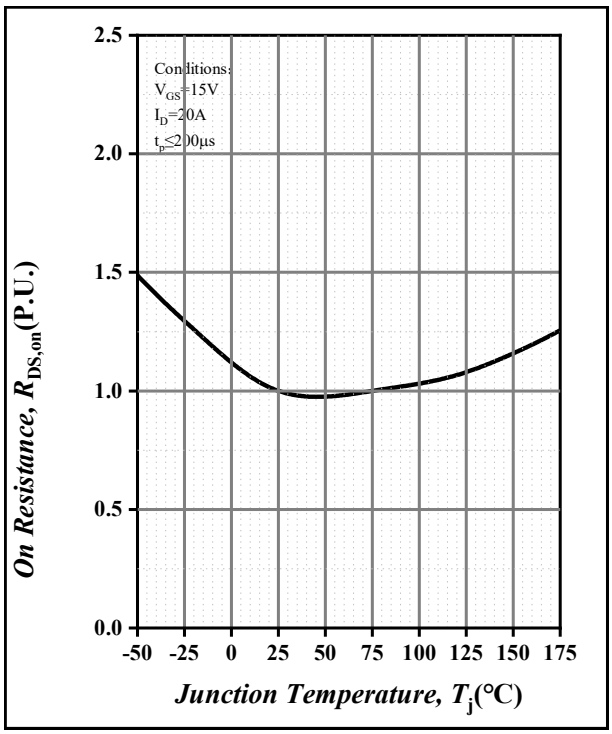


Fig.3 Normalized On-Resistance vs. Temperature

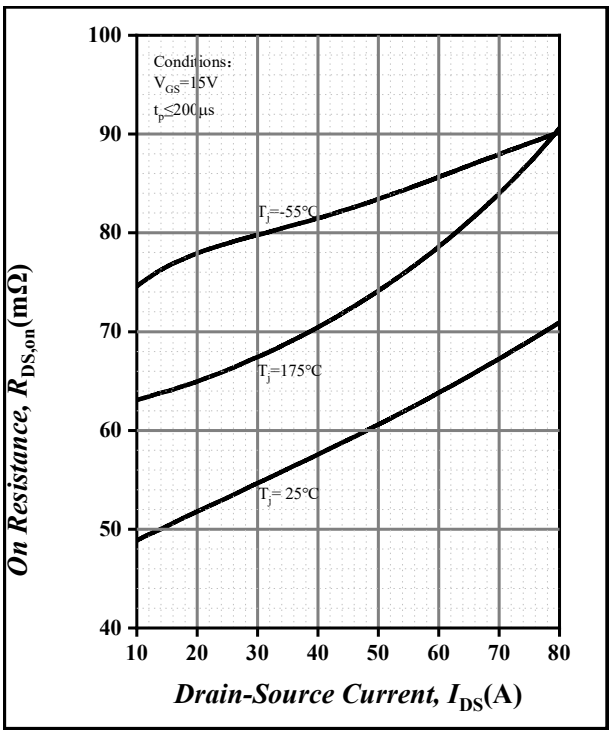


Fig.4 On-Resistance vs. Drain Current For Various Temperatures

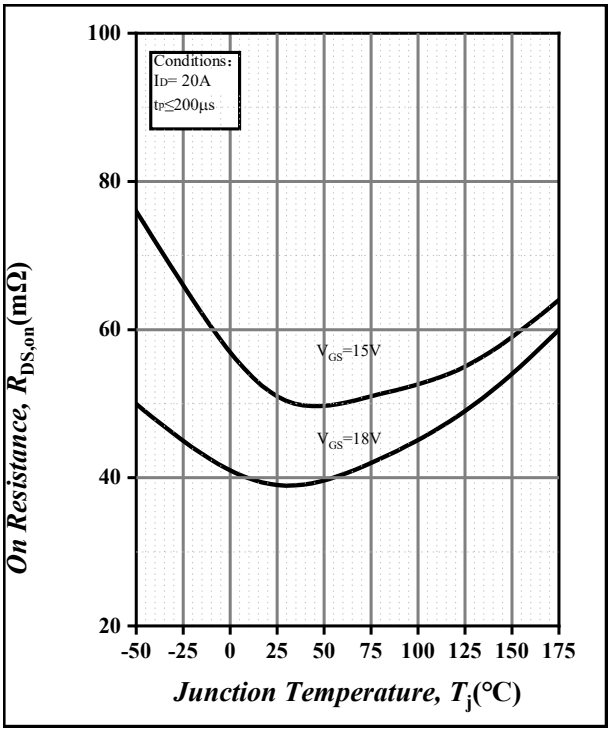


Fig.5 On-Resistance vs. Temperature For Various Gate Voltage

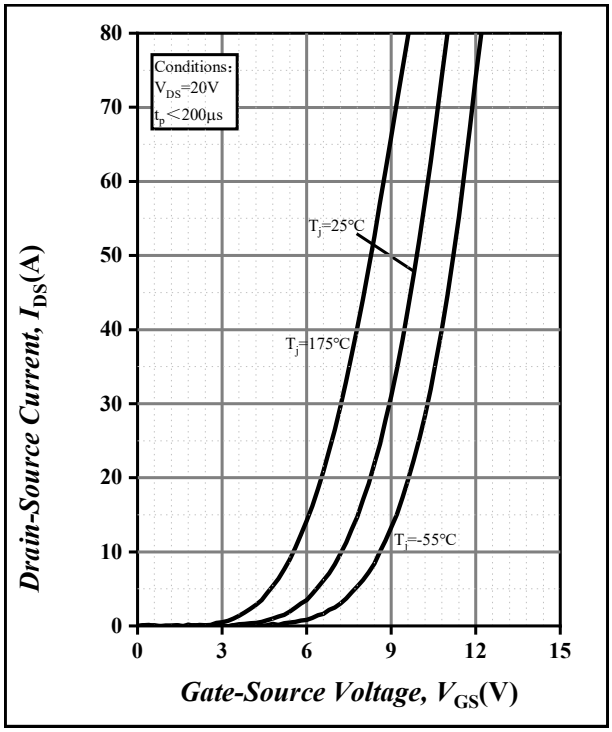


Fig.6 Transfer Characteristic For Various Junction Temperatures

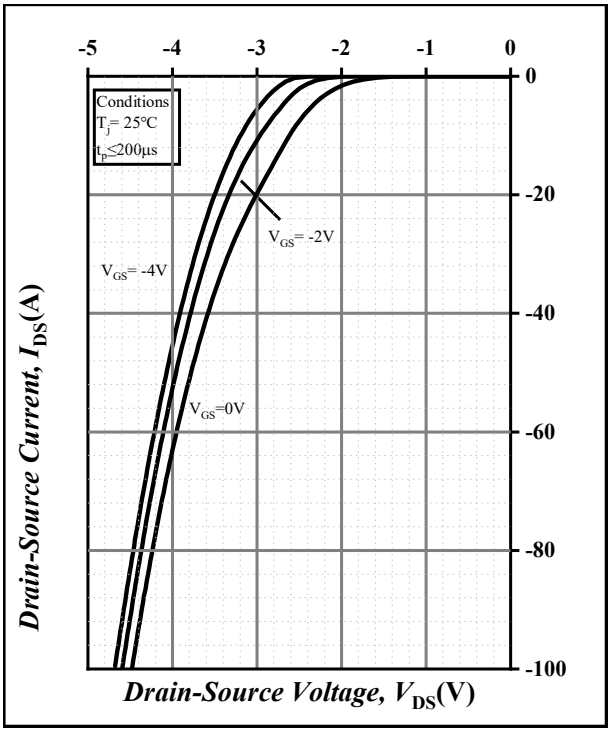


Fig.7 Body Diode Characteristic at 25℃

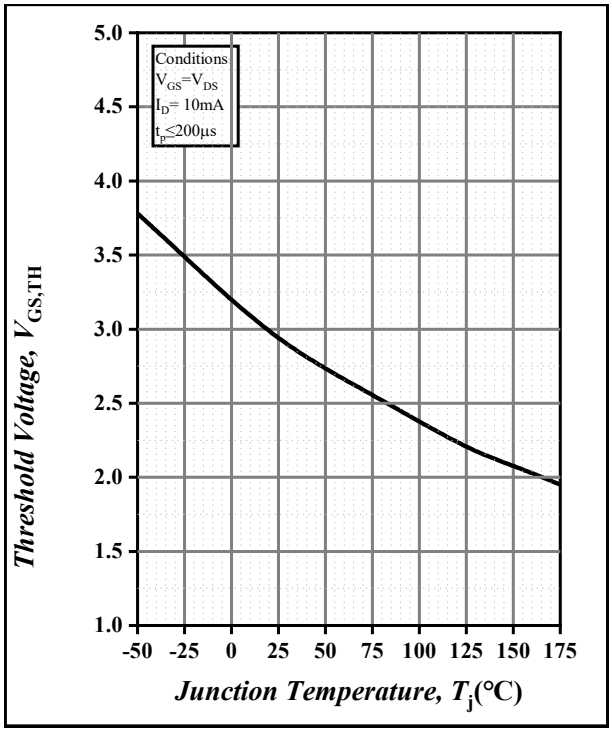


Fig.8 Threshold Voltage vs. Temperature

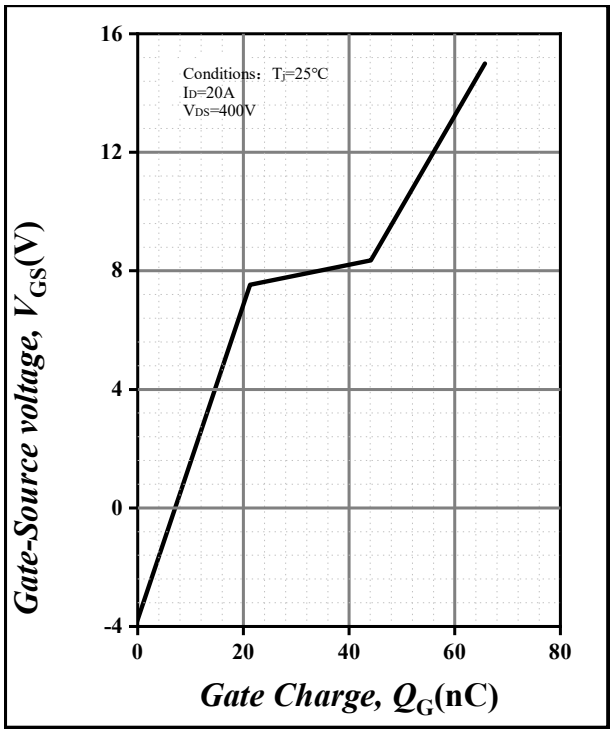


Fig.9 Gate Charge Characteristics

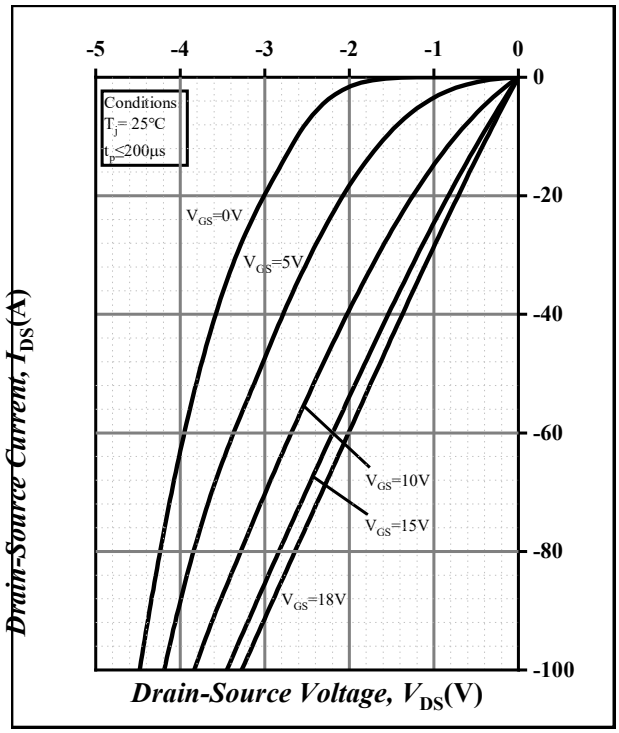


Fig.10 3rd Quadrant Characteristic at 25℃

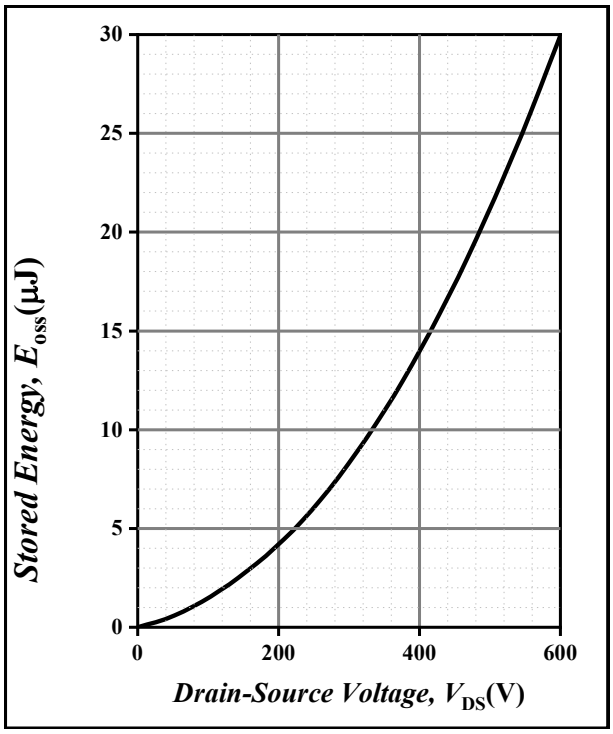


Figure 11. Output Capacitor Stored Energy

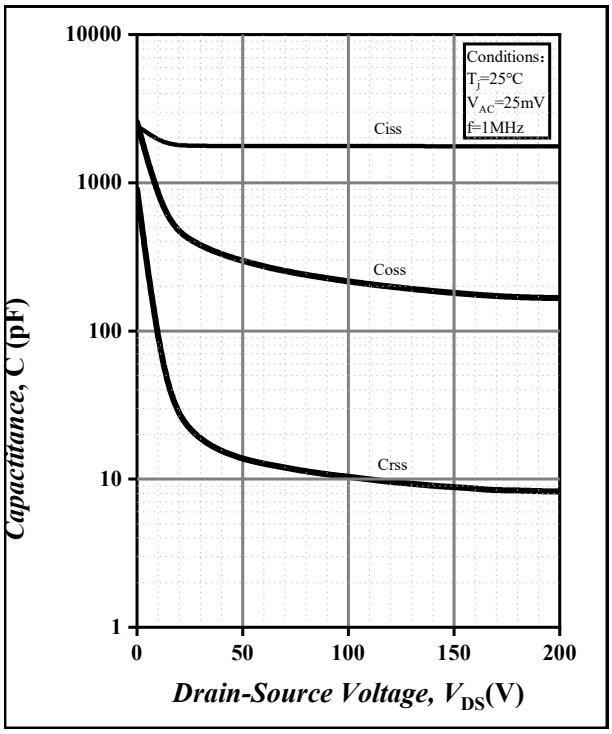


Fig.12 Capactitances vs. Drain-Source Voltage(0-200V)

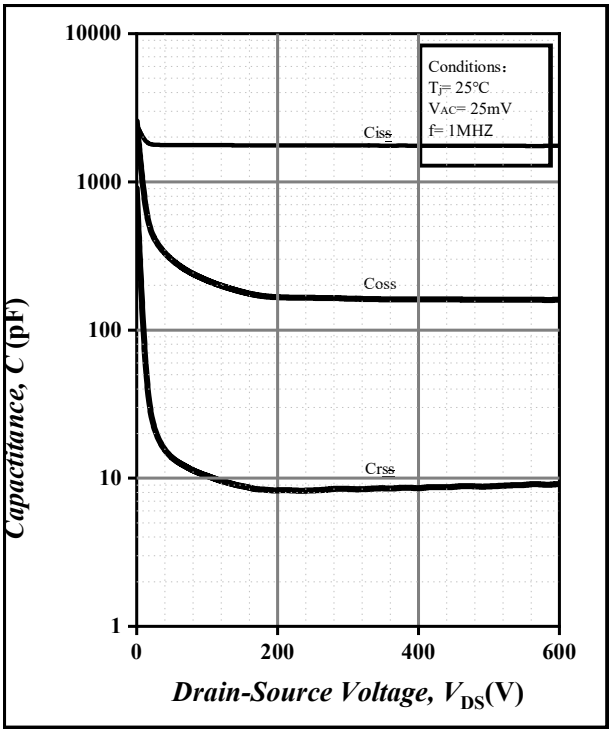


Fig.13 Capactitances vs. Drain-Source Voltage(0-600V)

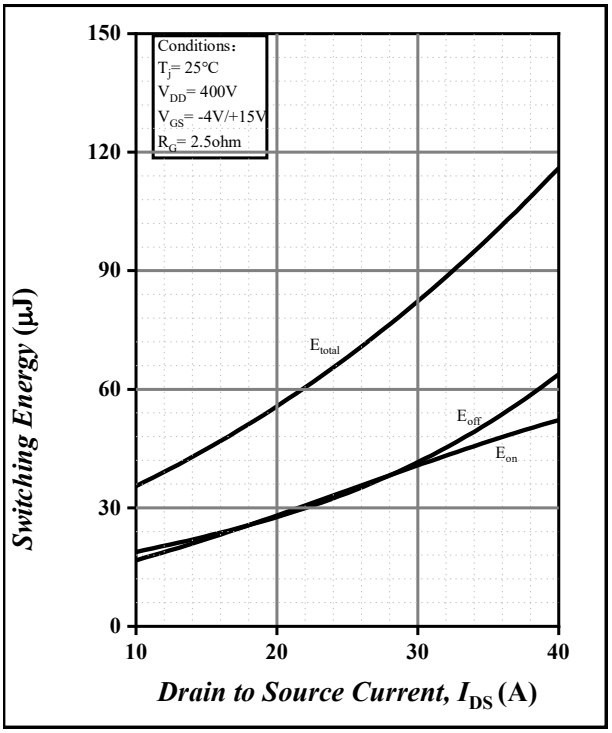


Figure 14. Clamped Inductive Switching Energy vs. Drain Current(V_{DD}=400V)

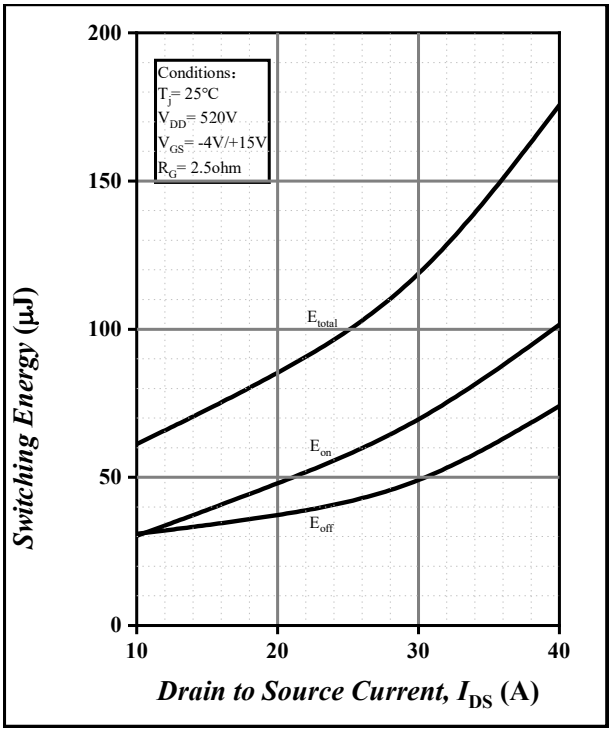


Figure 15. Clamped Inductive Switching Energy vs. Drain Current(V_{DD}=520V)

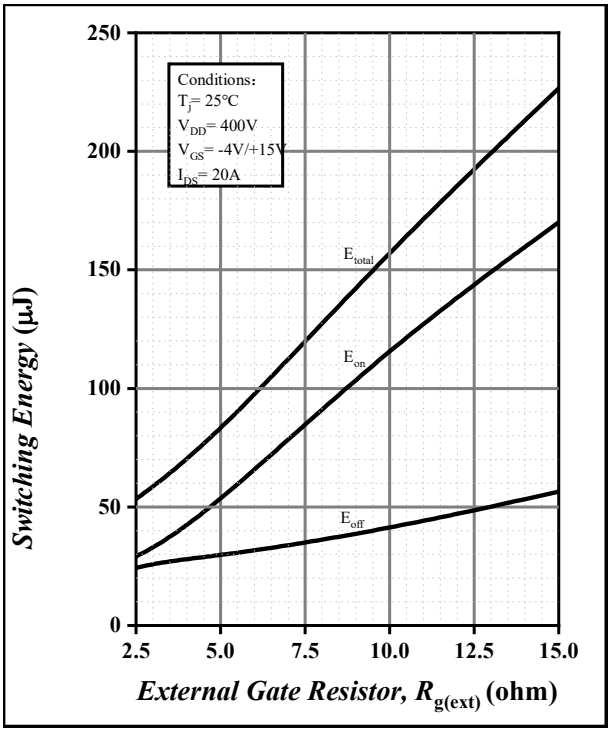


Figure 16. Clamped Inductive Switching Energy vs. $R_{g(ext)}$

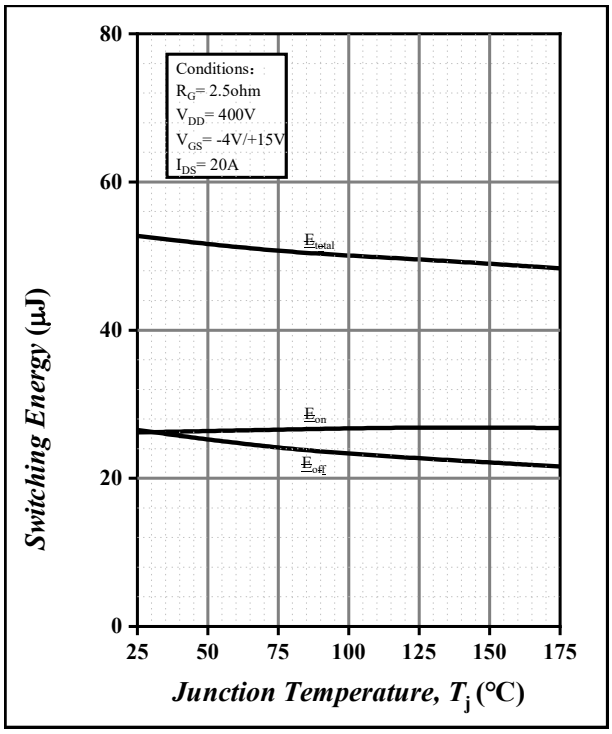


Figure 17. Clamped Inductive Switching Energy vs. Temperature

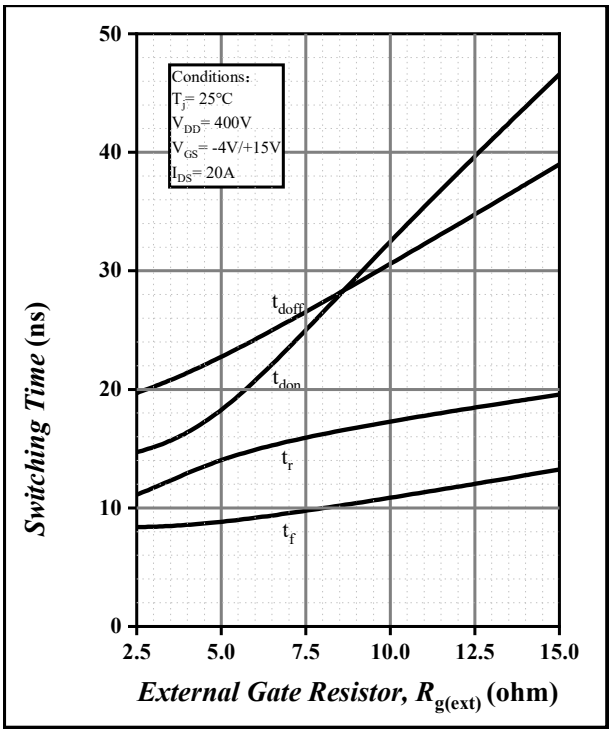


Figure 18. Switching Times vs. $R_{g(ext)}$

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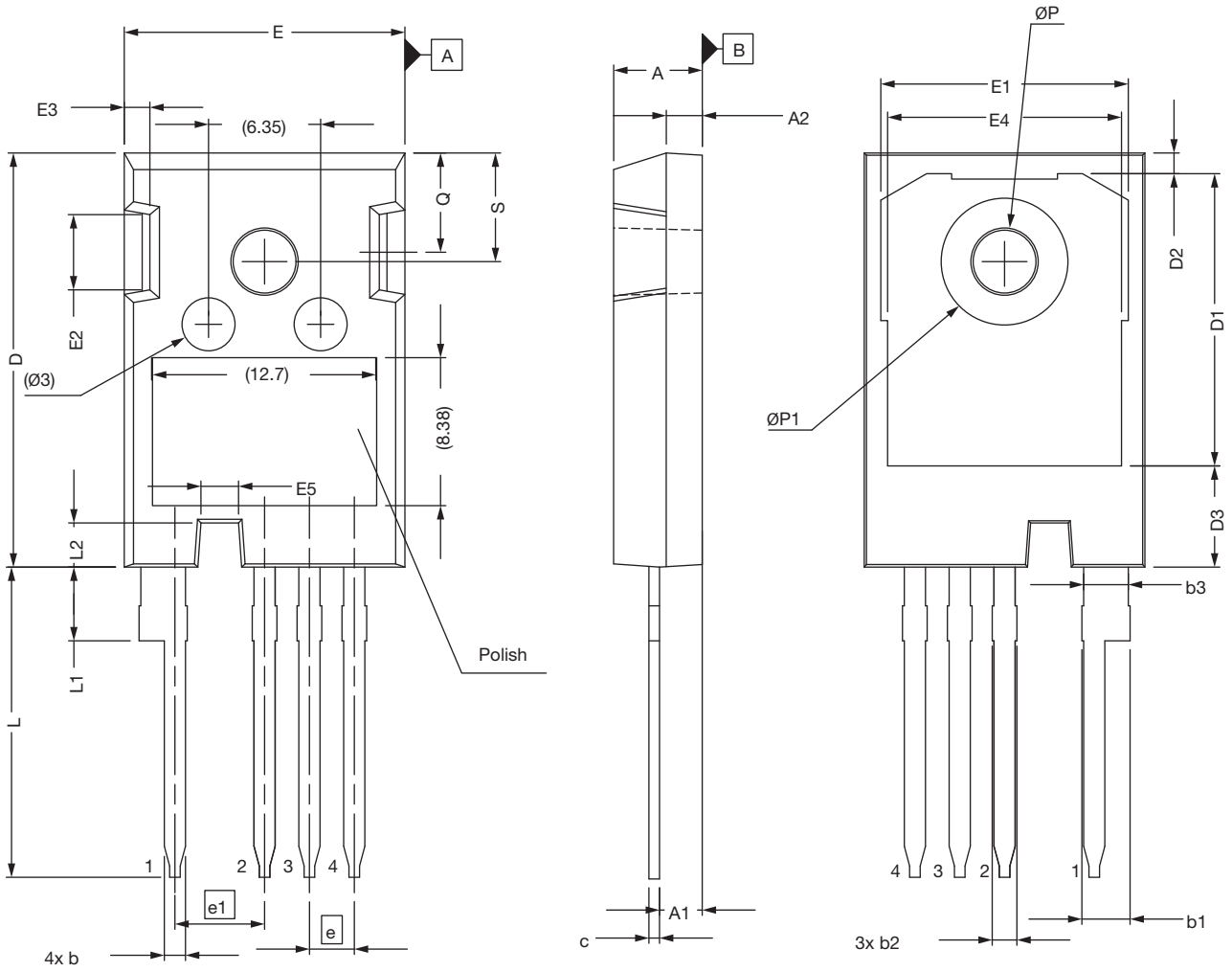
E
A
E3
(6.35)
Q
S
D
E2
(Ø3)
(12.7)
(8.38)
E5
L2
L1
L
Polish
1
2
3
4
e1
e
4x b
B
A
A2
A1
c
ØP
E1
E4
D2
D1
ØP1
D3
b3
4
3
2
1
b1
3x b2

DIM.	MILLIMETERS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b2	1.07	1.30	1.60
b3	2.39	2.53	2.69
c	0.55	0.60	0.68
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
D3	5.55	5.71	6.01
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
E5	1.95	2.15	2.35
e	2.54 BSC.		
e1	5.08 BSC.		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
ØP	3.51	3.61	3.65
ØP1	7.19 ref.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

Notes

- All dimensions are in mm
- Dimension D and E do not include mold flash.
- Creepage 1 is 8.40 mm (ref.) which is the distance alongside the surface between drain (pin 1) and trough the notch towards source (pin 2). Creepage 2 is 7.70 mm (ref.) which is the distance from end of the copper slug on the backside of the package to either pin 2, pin 3 or pin 4

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