

BCW120N40M1

N-Channel Silicon Carbide PowerMOSFET

1200 V,60 A, 40 mΩ



Features

- High switching speed with a low gate charge
- Fast intrinsic diode with low reverse recovery
- Robust Avalanche Capability
- 100% Avalanche Tested
- Pb-free, Halogen Free, and RoHS Compliant

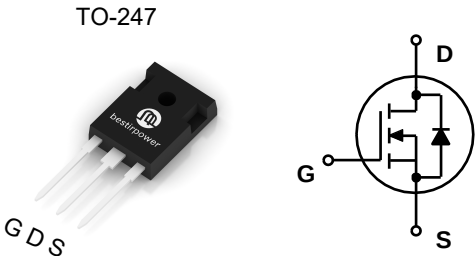
Benefits

- System efficiencyimprovement
- Higher frequency applicability
- Increased power density
- Reduced cooling effort

Applications

- Solar inverter
- EV charging station
- UPS
- Industrial power supply

BV _{DSS} , T _c =25°C	I _D , T _c =25°C	R _{DS(on)} ,typ, T _c =25°C	Q _g ,typ
1200 V	60 A	40 mΩ	109nC



Absolute Maximum Ratings (T_C = 25°C unless otherwise noted)



Symbol	Parameter		Value	Unit
V _{DSS}	Drain to Source Voltage		1200	V
V _{GS}	Gate to Source Voltage (DC)		-10 / +22	V
V _{GSop}	Recommended Operation Value		-5 / +18	V
I _D	Drain Current	Continuous (V _{GS} =18V, T _C = 25°C)	60	A
		Continuous (V _{GS} =18V, T _C = 100°C)	42	
I _{DM}	Drain Current	Pulsed (Note1)	160	A
E _{AS}	Avalanche Capability	VDD=100V, VGS=20V, L=2mH	1000	mJ
I _{AV}	Avalanche Capability	VDD=100V, VGS=20V, L=2mH	30	A
P _D	Power Dissipation	(T _C = 25°C)	375	W
		Derate Above 25°C	2.5	W/°C
T _J , T _{STG}	Operating and Storage Temperature Range		-55 to 175	°C

※Note 1 : Limited by maximum junctiontemperature.

Thermal Characteristics

Symbol	Parameter	Value	Unit
R _{θJC}	Thermal Resistance, Junction to Case, Max.	0.4	°C/W
R _{θJA}	Thermal Resistance, Junction to Ambient, Max.	34	
T _{sol} d	Soldering temperature, wave soldering only allowed at leads	260	°C

Electrical Characteristics (T_C = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
BV _{DSS}	Drain to Source Breakdown Voltage	V _{GS} = 0 V, I _D = 1 mA	1200	-	-	V
I _{DSS}	Zero Gate Voltage Drain Current	V _{DS} = 1200 V, V _{GS} = 0 V	-	1	100	μA
		V _{DS} = 1200 V, V _{GS} = 0 V, T _J = 175°C	-	5	-	
I _{GSS}	Gate-Source Leakage Current	V _{GS} = +22 V, V _{DS} = 0 V	-	-	+100	nA
		V _{GS} = -10 V, V _{DS} = 0 V	-	-	-100	

Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 10\text{ mA}$	2.0	3.0	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	$V_{GS} = 18\text{ V}, I_D = 30\text{ A}$	-	40	56	mΩ
		$V_{GS} = 18\text{ V}, I_D = 30\text{ A}, T_J = 175^\circ\text{C}$	-	51	-	
		$V_{GS} = 15\text{ V}, I_D = 30\text{ A}$	-	50	-	
		$V_{GS} = 15\text{ V}, I_D = 30\text{ A}, T_J = 150^\circ\text{C}$	-	53	-	
		$V_{GS} = 15\text{ V}, I_D = 30\text{ A}, T_J = 175^\circ\text{C}$	-	59	-	
		$V_{GS} = 18\text{ V}, I_D = 40\text{ A}$	-	40	-	
		$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 150^\circ\text{C}$	-	54	-	
		$V_{GS} = 18\text{ V}, I_D = 40\text{ A}, T_J = 175^\circ\text{C}$	-	58	-	
g_{fs}	Transconductance	$V_{DS} = 20\text{ V}, I_D = 30\text{ A}$	-	15	-	S

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$	-	1960	-	pF
C_{oss}	Output Capacitance		-	125	-	
C_{rss}	Reverse Capacitance		-	5	-	
E_{oss}	Stored Energy in Output Capacitance	$V_{DS} = 0\text{ V to } 800\text{ V}, V_{GS} = 0\text{ V}$	-	50	-	μJ
$C_{o(er)}$	Energy Related Output Capacitance		-	146	-	pF
$C_{o(tr)}$	Time Related Output Capacitance		-	258	-	
$Q_{g(tot)}$	Total Gate Charge	$V_{DS} = 800\text{ V}, I_D = 30\text{ A},$ $V_{GS} = -5\text{ V} / 18\text{ V}$	-	109	-	nC
Q_{gs}	Gate to Source Charge		-	28	-	
Q_{gd}	Gate to Drain "Miller" Charge		-	35	-	
R_G	Internal Gate Resistance	$f = 1\text{ MHz}, V_{AC} = 30\text{ mV open drain}$	-	3.5	-	Ω

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 800\text{ V}, I_D = 30\text{ A},$ $V_{GS} = -5\text{ V} / 18\text{ V},$ $R_G = 2.5\Omega,$ FWD: BCH120S020D1, Inductive load	-	18	-	ns
t_r	Turn-On Rise Time		-	13	-	
$t_{d(off)}$	Turn-Off Delay Time		-	35	-	
t_f	Turn-Off Fall Time		-	8	-	
E_{on}	Turn-on Switching Energy		-	232	-	μJ
E_{off}	Turn-off Switching Energy		-	73	-	
E_{tot}	Total Switching Energy		-	305	-	

Source-Drain Diode Characteristics

I _S	Maximum Continuous Diode Forward Current		-	-	60	A
I _{SM}	Maximum Pulsed Diode Forward Current		-	-	160	
V _{SD}	Diode Forward Voltage	V _{GS} = -5 V, I _{SD} = 30 A	-	4.2	-	V
t _{rr}	Reverse Recovery Time	V _{DD} = 800 V, I _{SD} = 30 A, dI _F /dt = 3000 A/μs	-	22	-	ns
Q _{rr}	Reverse Recovery Charge		-	348	-	nC
t _{rr}	Reverse Recovery Time	V _{GS} =-5V,V _{DD} = 800 V, I _{SD} = 40 A, dI _F /dt = 4200 A/μs	-	13	-	ns
Q _{rr}	Reverse Recovery Charge		-	182	-	nC
I _{rrm}	Peak Reverse Recovery Current		-	23	-	A

Typical Performance Characteristics

Figure 1. On-Region Characteristics $T_J = -40^{\circ}\text{C}$

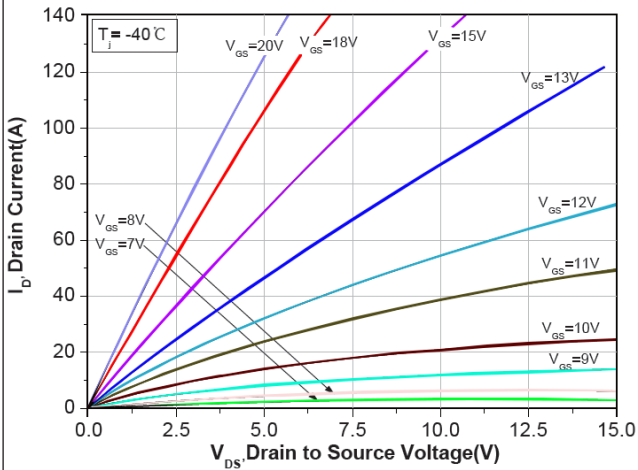


Figure 2. On-Region Characteristics $T_J = 25^{\circ}\text{C}$

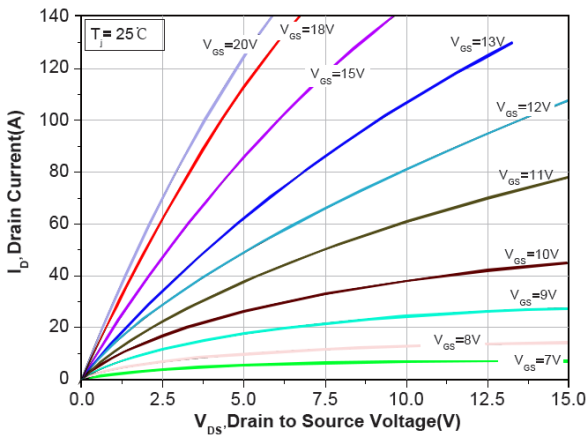


Figure 3. On-Region Characteristics $T_J = 175^{\circ}\text{C}$

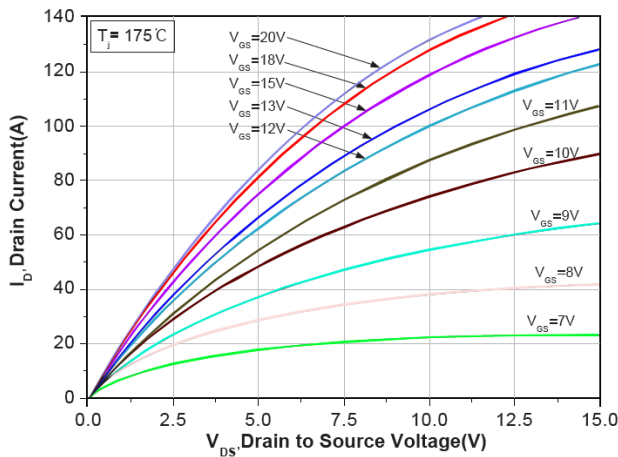


Figure 4. Normalized On-Resistance Characteristics vs. Temperature

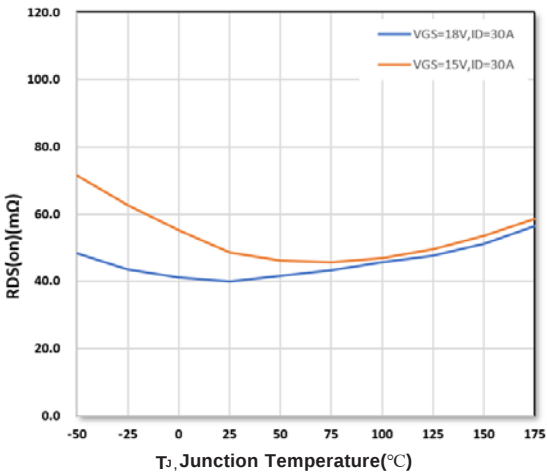


Figure 5. Transfer Characteristics

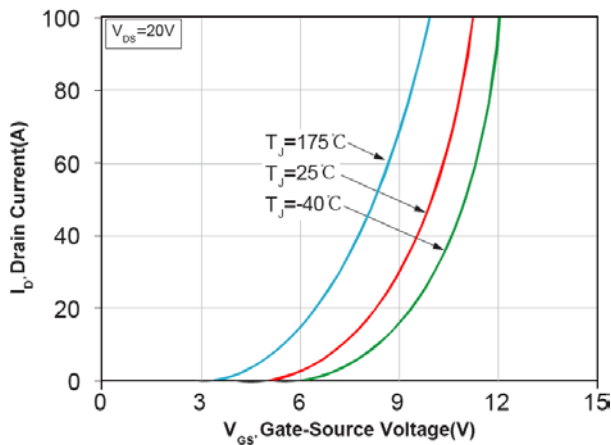
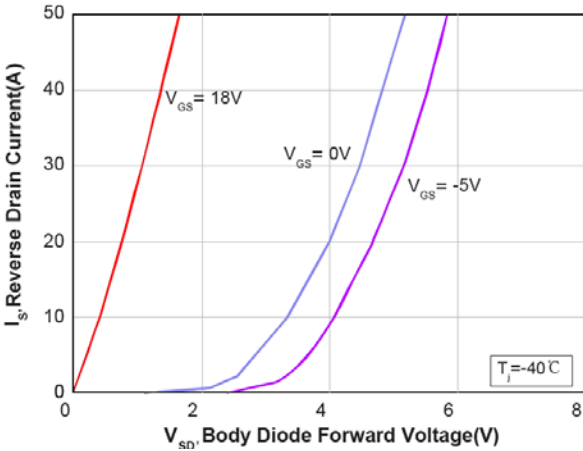


Figure 6. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = -40^{\circ}\text{C}$



Typical Performance Characteristics

Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 25^{\circ}\text{C}$

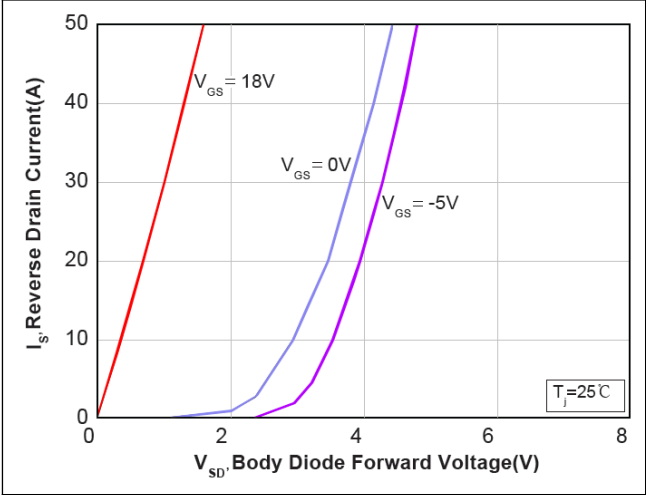


Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current $T_J = 175^{\circ}\text{C}$

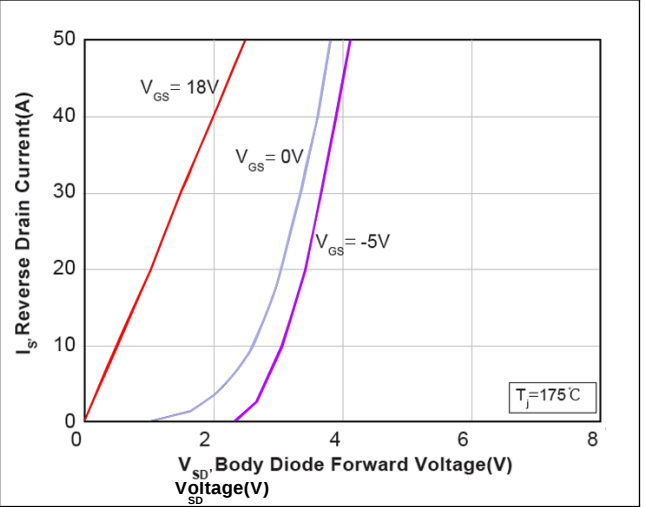


Figure 9. Threshold Voltage vs. Temperature

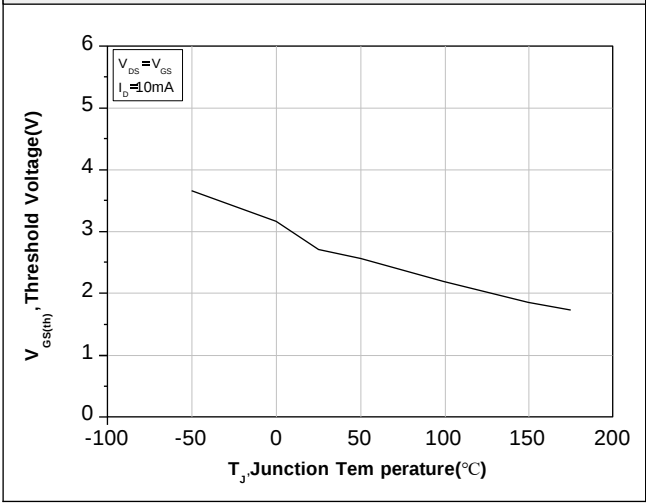


Figure 10. Gate Charge Characteristics

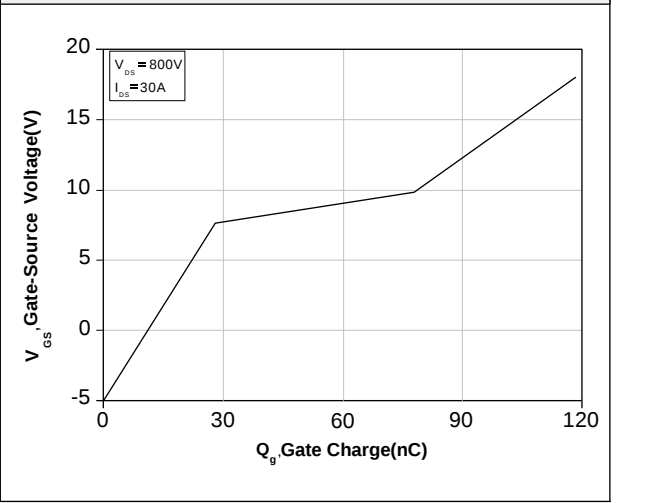


Figure 11. Stored Energy in Output Capacitance (0~800V)

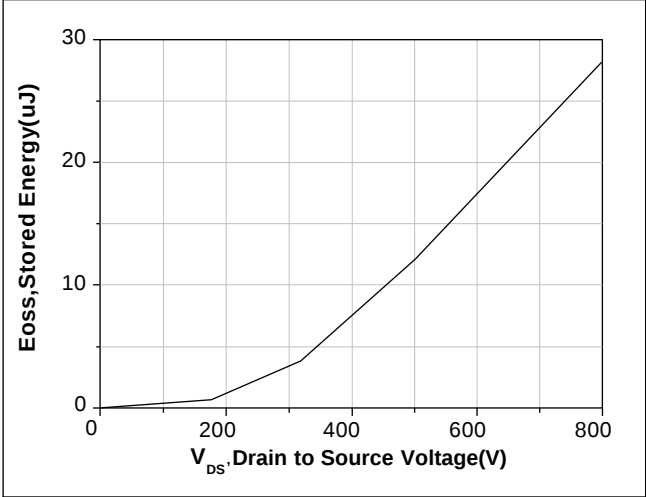
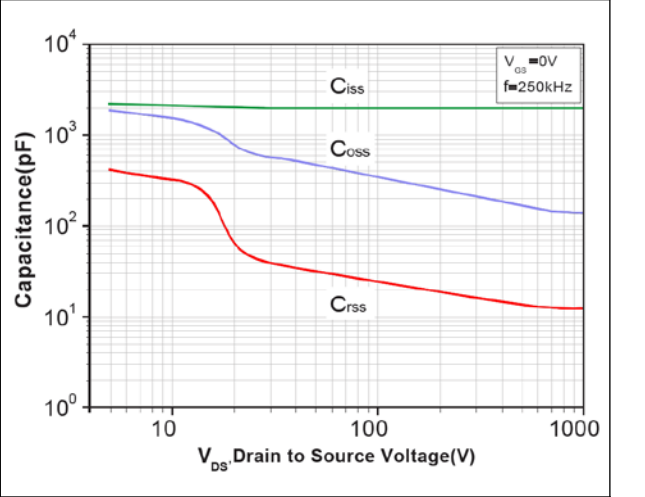


Figure 12. Capacitance Characteristics



Typical Performance Characteristics

Figure 13. Continuous Drain Current Derating vs. Case Temperature

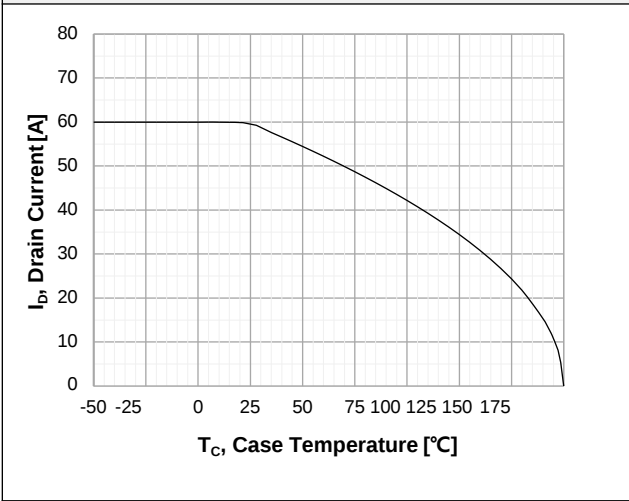


Figure 14. Maximum Power Dissipation Derating vs. Case Temperature

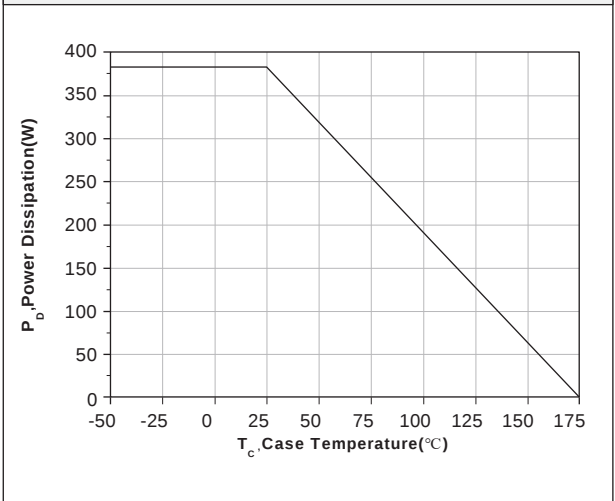


Figure 15. Typ. Switching losses vs. Drain current

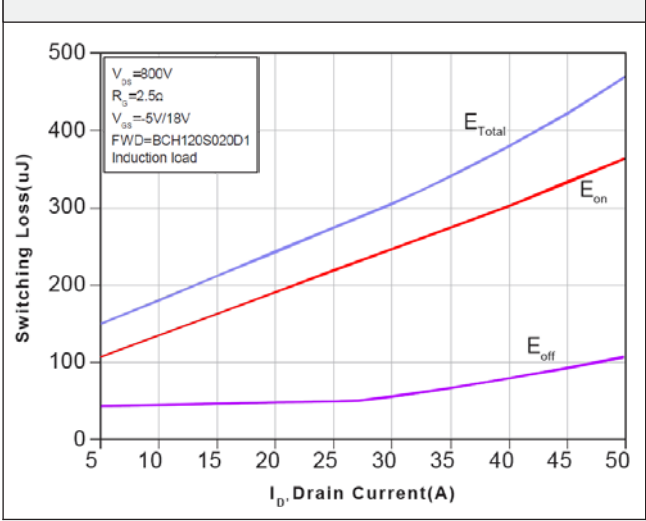


Figure 16. Typ. Switching losses vs. Gate resistance

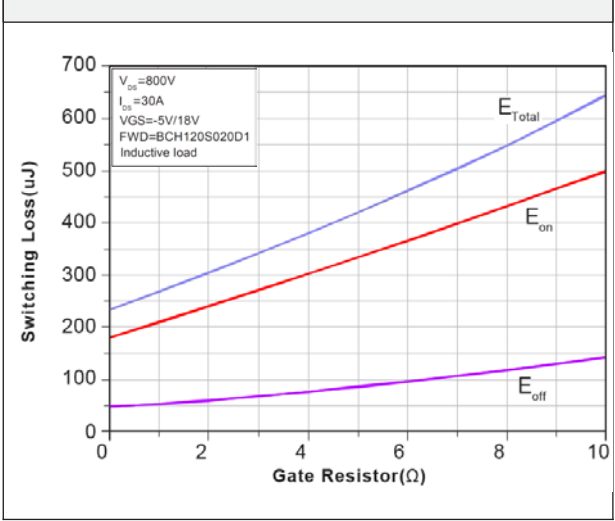


Figure 17. Typ. Switching losses vs. Drain current

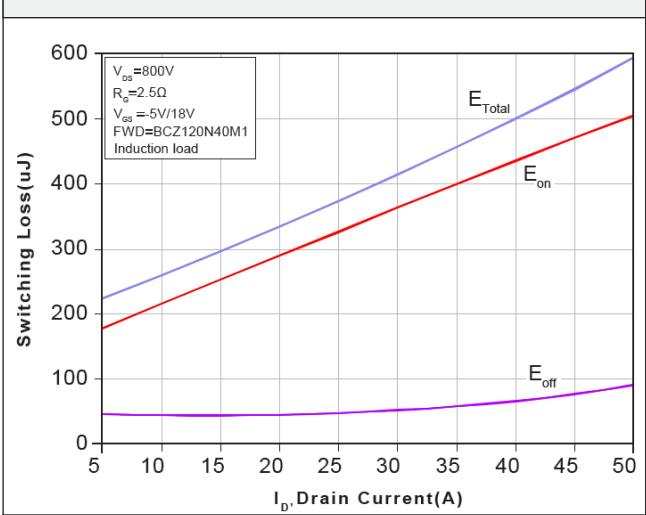
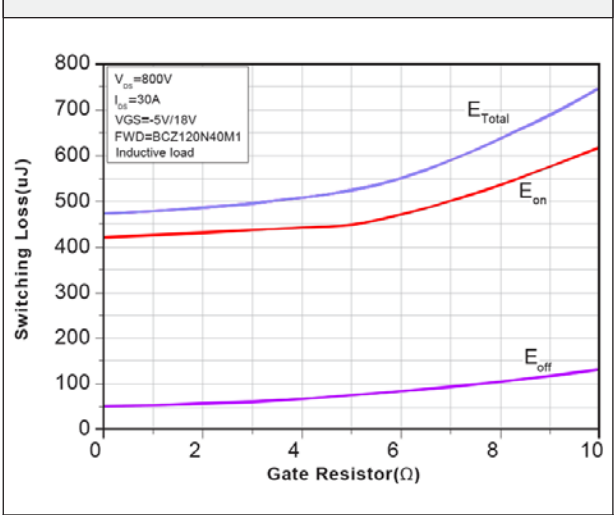


Figure 18. Typ. Switching losses vs. Gate resistance



Typical Performance Characteristics

Figure 19. Maximum Safe Operating Area

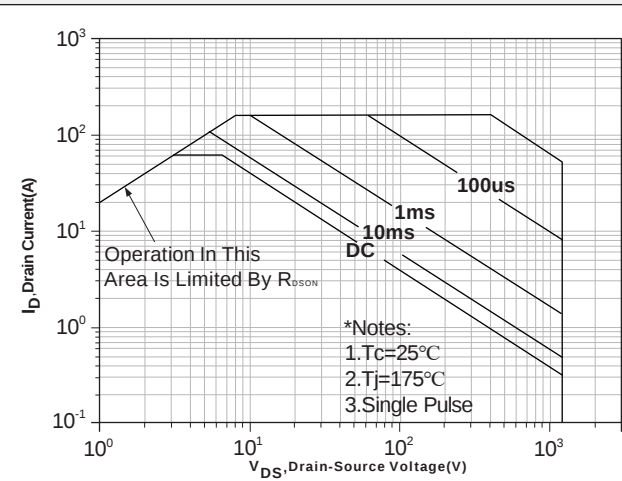


Figure 20. Transient Thermal Response Curve

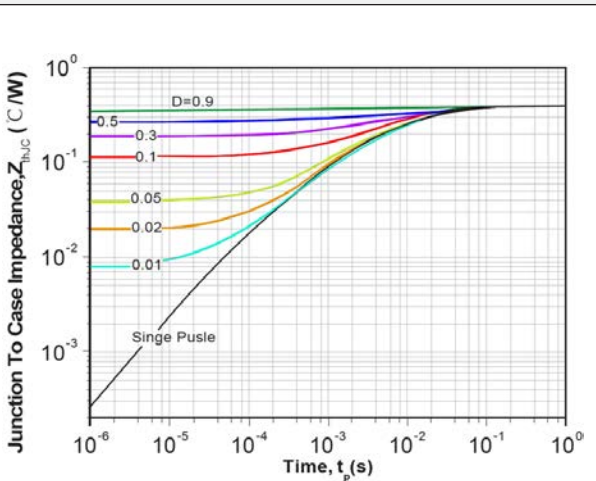


Figure 21. On-Resistance vs. Drain Current For Various Temperature

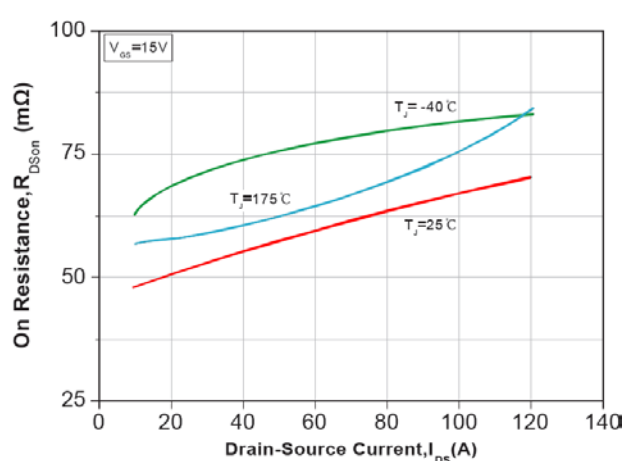


Figure 22. On-Resistance vs. Temperature For Various Gate Voltage

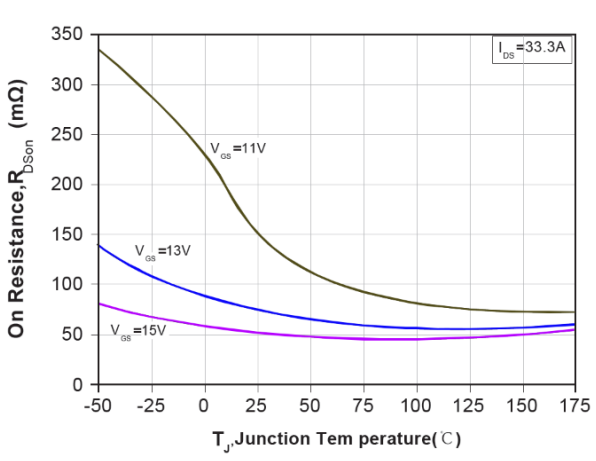


Figure 23. 3rd Quadrant Characteristic at -40°C

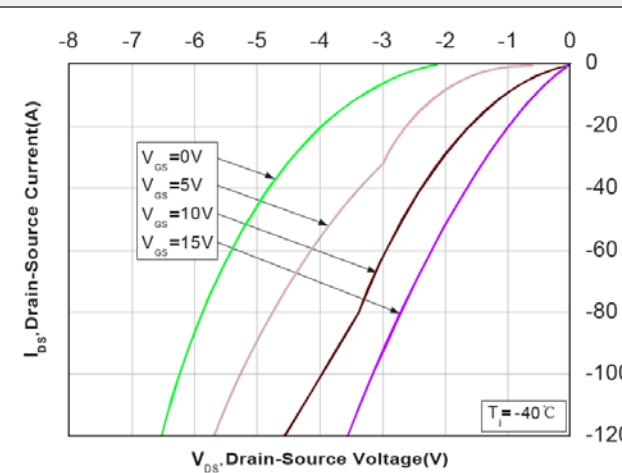
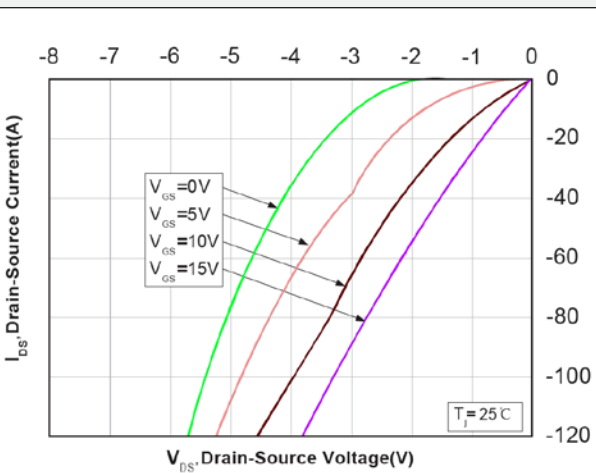


Figure 24. 3rd Quadrant Characteristic at 25°C



Typical Performance Characteristics

Figure 25. 3rd Quadrant Characteristic at 175°C

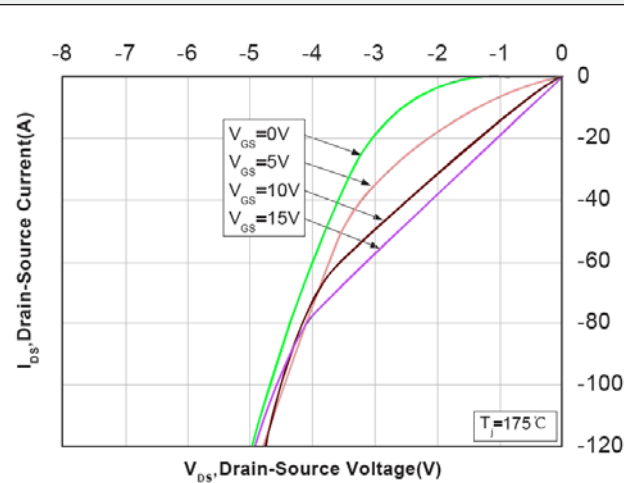


Figure 26. Capacitance vs. Drain-Source Voltage(0~200V)

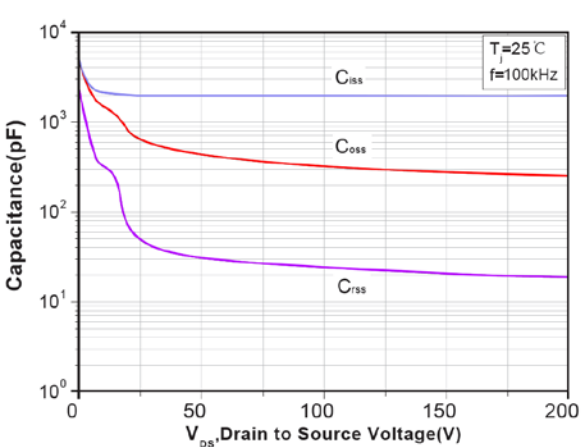


Figure 27. Capacitance vs. Drain-Source Voltage(0~1200V)

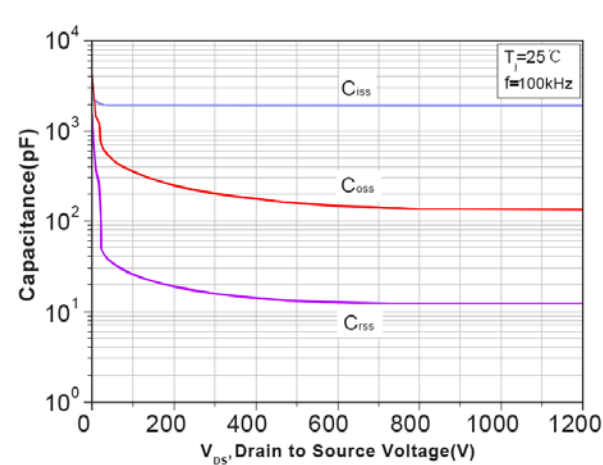


Figure 28. Clamped Inductive Switching Energy vs. Drain current(VDS=600V)

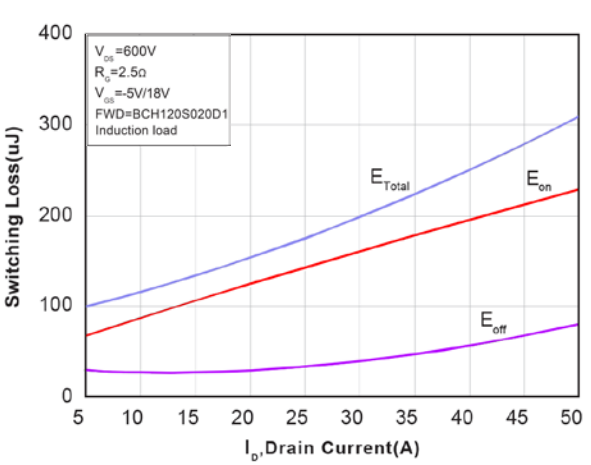


Figure 29. Clamped Inductive Switching Energy vs. Temperature

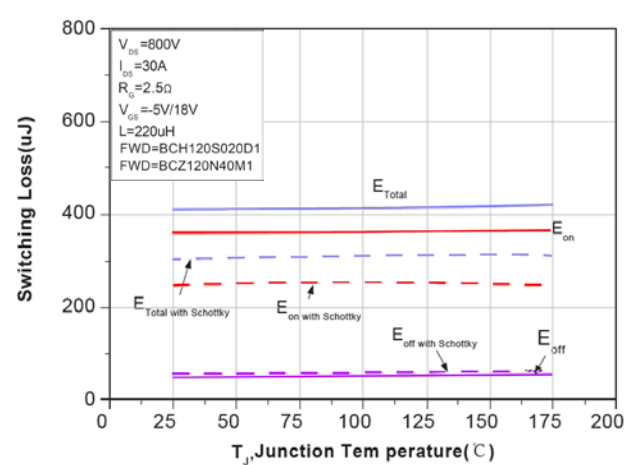
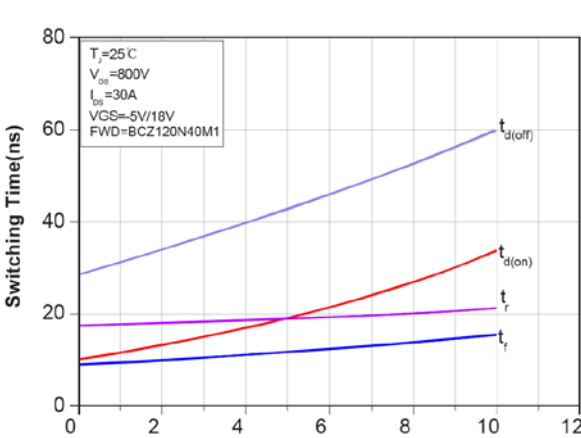


Figure 30. Switching Times vs. R_{G(ext)}



Typical Performance Characteristics

Figure 31. Switching Times vs. $R_{G(ext)}$

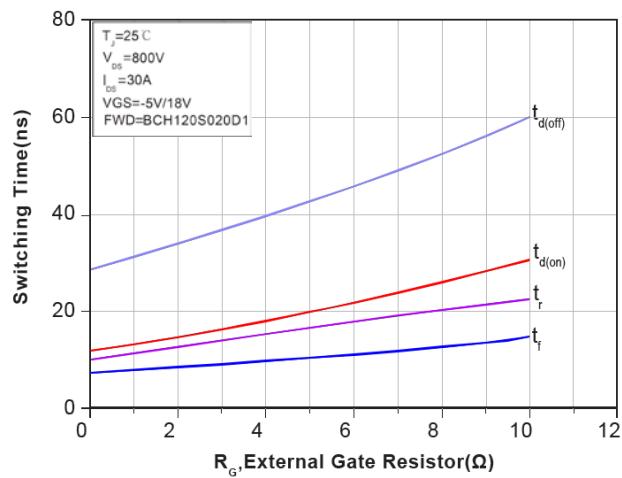


Figure 32. Stored Energy in Output Capacitance (0~1200V)

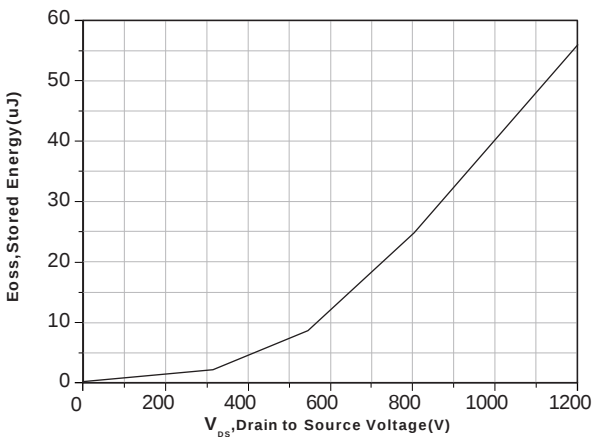


Figure 33. Inductive Load Switching Test Circuit and Waveforms

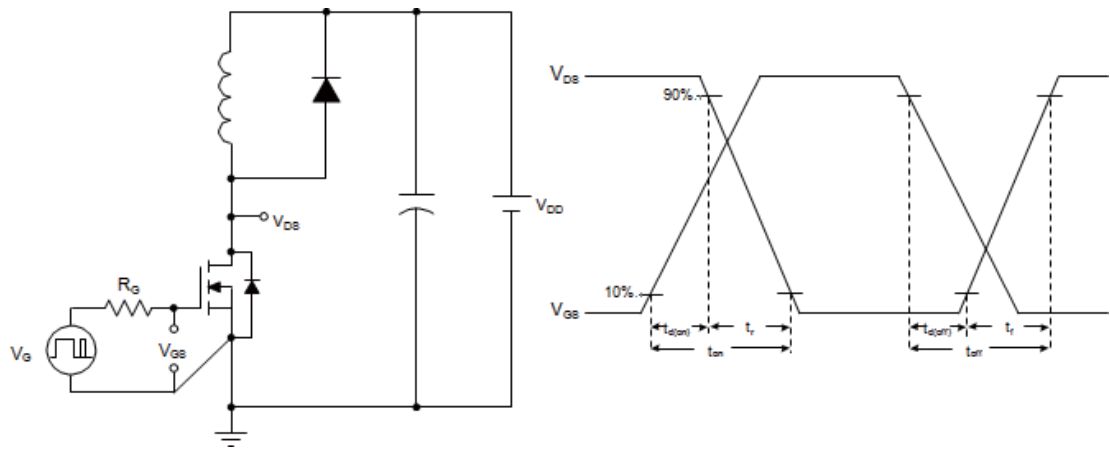
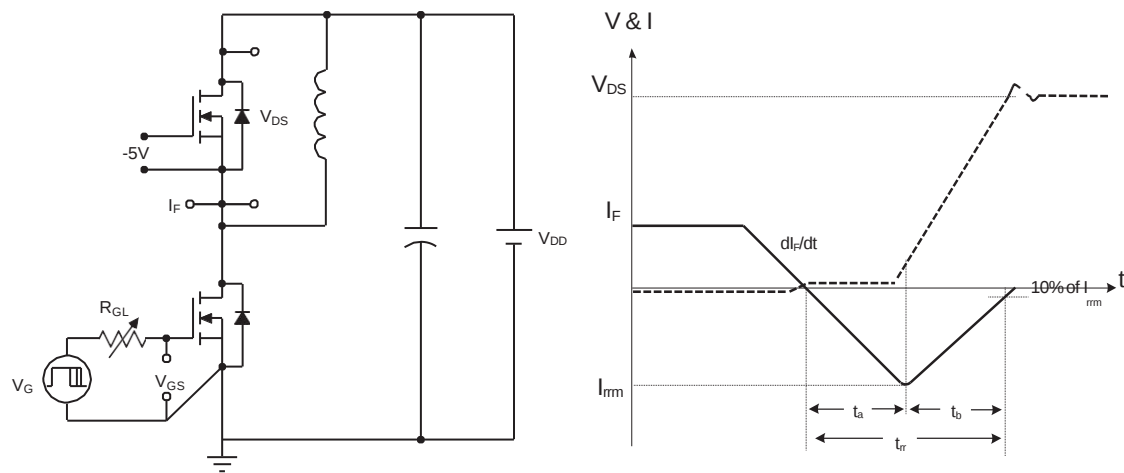
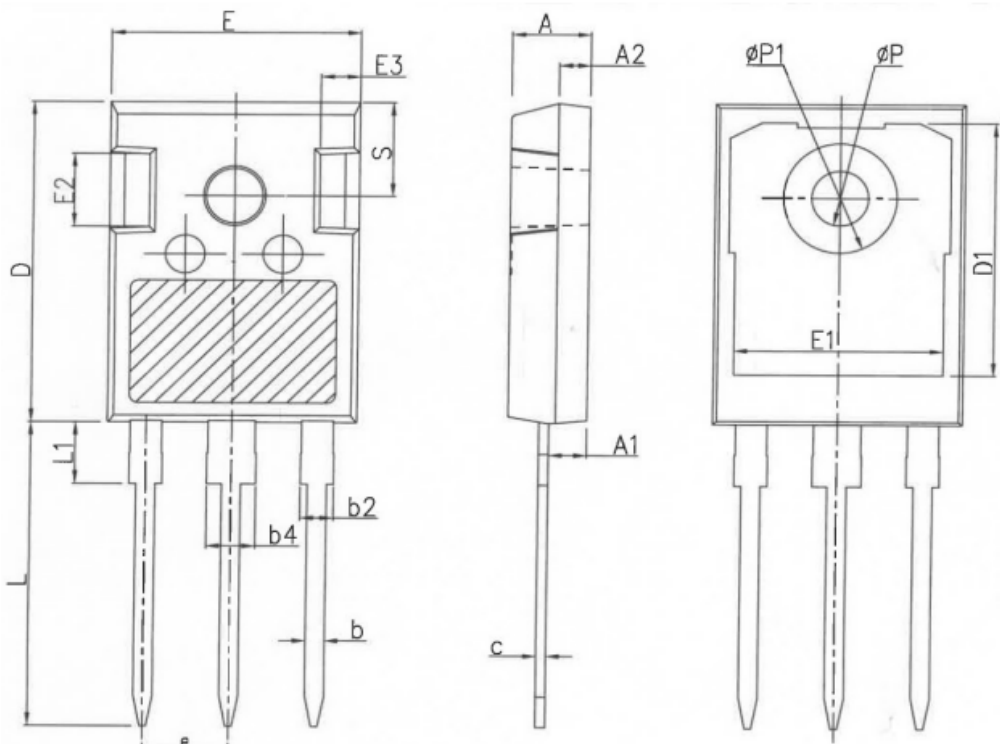


Figure 34. Peak Diode Recovery dv/dt Test Circuit and Waveforms



Package Outlines

TO247-3L



SYMBOL	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.29	2.42	2.54
A2	1.90	2.00	2.10
b	1.10	1.20	1.30
b1	1.91	2.06	2.20
b2	2.92	3.06	3.20
c	0.50	0.60	0.70
D	20.80	21.07	21.34
D1	17.43	17.63	17.83
E	15.75	15.94	16.13
E1	13.06	13.26	13.46
E2	4.32	4.58	4.83
e	5.45 BSC		
L	19.85	20.05	20.25
L1	4.05	4.27	4.49
ϕP	3.55	3.60	3.65
Q	5.59	5.89	6.19
S	6.15 BSC		

* Dimensions in millimeters

Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
BCW120N40M1	BCW120N40M1	TO247-3	Tube	30 units

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