



# BCW120N21M1

## N-Channel Silicon Carbide Power MOSFET

bestirpower

1200 V, 100 A, 21 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

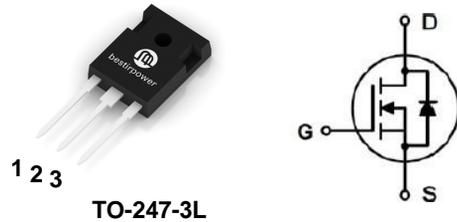
$BV_{DSS, T_C=25^\circ C}$	$I_D, T_C=25^\circ C$	$R_{DS(on), typ}$	$Q_{g, typ}$
1200 V	100 A	21 mΩ	209 nC

### Benefits

- System efficiency improvement
- Higher frequency applicability
- Increased power density
- Reduced cooling effort

### Applications

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



1 2 3

TO-247-3L



### Absolute Maximum Ratings ( $T_J = 25^\circ C$ 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 ( $V_{GS}=18V, T_C=25^\circ C$ )	100	A
		Continuous ( $V_{GS}=18V, T_C=100^\circ C$ )	71	
$I_{DM}$	Drain Current	Pulsed (Note1)	267	A
$P_D$	Power Dissipation	( $T_C=25^\circ C$ )	468	W
		Derate Above $25^\circ C$	3.1	W/°C
$T_J, T_{STG}$	Operating and Storage Temperature Range		-55 to 175	°C

※Note 1 : Limited by maximum junction temperature.

### Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.32	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	
$T_{sold}$	Soldering temperature, wave soldering only allowed at leads	260	°C

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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**Off Characteristics**

$BV_{DSS}$	Drain to Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	-	1.7	100	$\mu\text{A}$
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 175^\circ\text{C}$	-	2.4	-	
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS} = +22\text{ V}, V_{DS} = 0\text{ V}$	-	-	+100	nA
		$V_{GS} = -10\text{ V}, V_{DS} = 0\text{ V}$	-	-	-100	

**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	$V_{GS} = 18\text{ V}, I_D = 50\text{ A}$	-	18.8	-	$\text{m}\Omega$
		$V_{GS} = 18\text{ V}, I_D = 50\text{ A}, T_J = 175^\circ\text{C}$	-	31.6	-	
		$V_{GS} = 15\text{ V}, I_D = 50\text{ A}$	-	24	-	
		$V_{GS} = 15\text{ V}, I_D = 50\text{ A}, T_J = 150^\circ\text{C}$	-	28.4	-	
		$V_{GS} = 15\text{ V}, I_D = 50\text{ A}, T_J = 175^\circ\text{C}$	-	34	-	
		$V_{GS} = 18\text{ V}, I_D = 60\text{ A}$	-	19	-	
		$V_{GS} = 18\text{ V}, I_D = 62\text{ A}, T_J = 150^\circ\text{C}$	-	29	-	
		$V_{GS} = 18\text{ V}, I_D = 62\text{ A}, T_J = 175^\circ\text{C}$	-	32.2	-	
$g_{fs}$	Transconductance	$V_{DS} = 20\text{ V}, I_D = 50\text{ A}$	-	24.4	-	S

**Dynamic Characteristics**

$C_{iss}$	Input Capacitance	$V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, f = 250\text{ kHz}$	-	3683	-	$\text{pF}$
$C_{oss}$	Output Capacitance		-	225	-	
$C_{rss}$	Reverse Capacitance		-	26	-	
$E_{oss}$	Stored Energy in Output Capacitance	$V_{DS} = 0\text{ V to } 800\text{ V}, V_{GS} = 0\text{ V}$	-	47	-	$\mu\text{J}$
$C_{o(er)}$	Energy Related Output Capacitance		-	146	-	$\text{pF}$
$C_{o(tr)}$	Time Related Output Capacitance		-	446	-	
$Q_{g(tot)}$	Total Gate Charge	$V_{DS} = 800\text{ V}, I_D = 50\text{ A}, V_{GS} = -5\text{ V} / 18\text{ V}$	-	209	-	nC
$Q_{gs}$	Gate to Source Charge		-	52	-	
$Q_{gd}$	Gate to Drain "Miller" Charge		-	80	-	
$R_G$	Internal Gate Resistance		$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$ open drain	-	2.7	

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

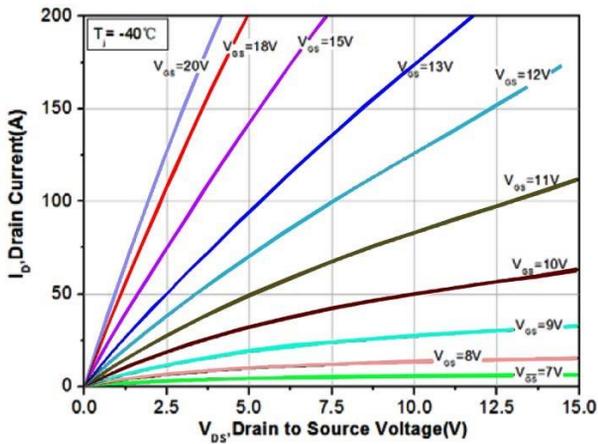
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 800\text{ V}$ , $I_D = 50\text{ A}$ , $V_{GS} = -5\text{ V} / 18\text{ V}$ , $R_G = 2.5\ \Omega$ , FWD: BCH120S020D1, Inductive load	-	46	-	ns
$t_r$	Turn-On Rise Time		-	19	-	
$t_{d(off)}$	Turn-Off Delay Time		-	55	-	
$t_f$	Turn-Off Fall Time		-	12	-	
$E_{on}$	Turn-on Switching Energy		-	1230	-	$\mu\text{J}$
$E_{off}$	Turn-off Switching Energy		-	302	-	
$E_{tot}$	Total Switching Energy	-	1532	-		

**Source-Drain Diode Characteristics**

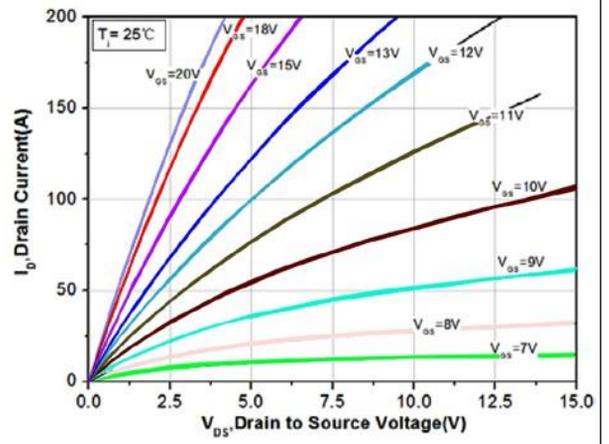
$I_S$	Maximum Continuous Diode Forward Current	-	-	100	A	
$I_{SM}$	Maximum Pulsed Diode Forward Current	-	-	250		
$V_{SD}$	Diode Forward Voltage	$V_{GS} = -5\text{ V}$ , $I_{SD} = 50\text{ A}$	-	4	-	V
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 800\text{ V}$ , $I_{SD} = 50\text{ A}$ , $di_F/dt = 1000\text{ A}/\mu\text{s}$	-	60	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	404	-	nC

**Typical Performance Characteristics**

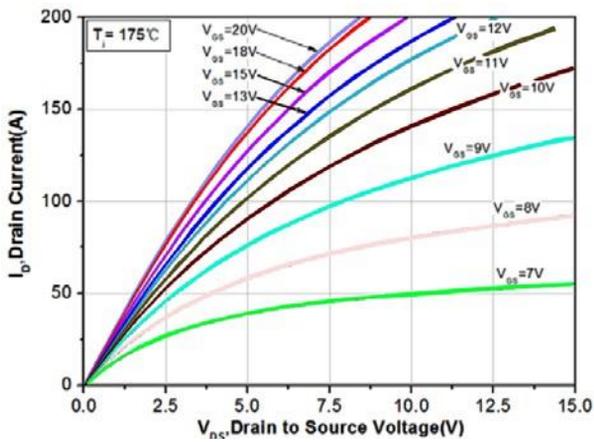
**Figure 1. On-Region Characteristics  $T_J = -40^\circ\text{C}$**



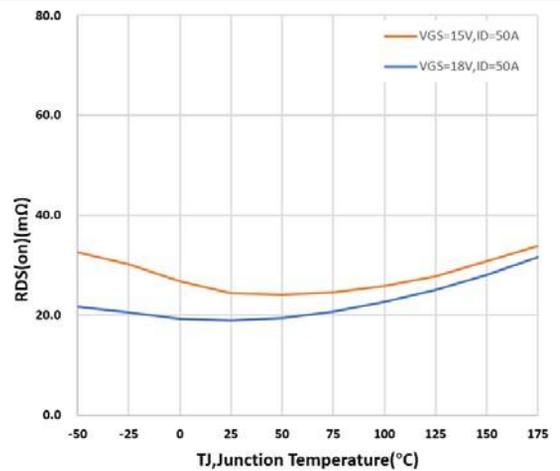
**Figure 2. On-Region Characteristics  $T_J = 25^\circ\text{C}$**



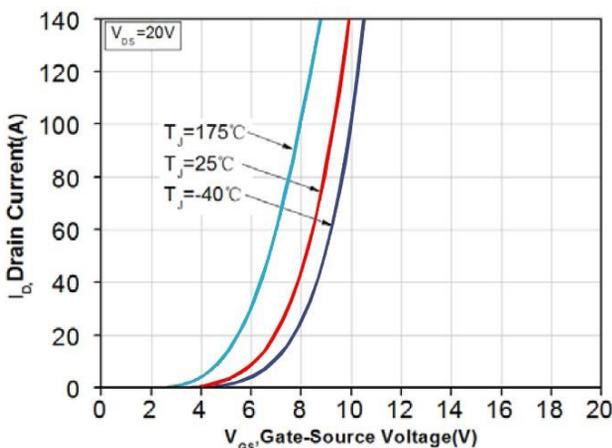
**Figure 3. On-Region Characteristics  $T_J = 175^\circ\text{C}$**



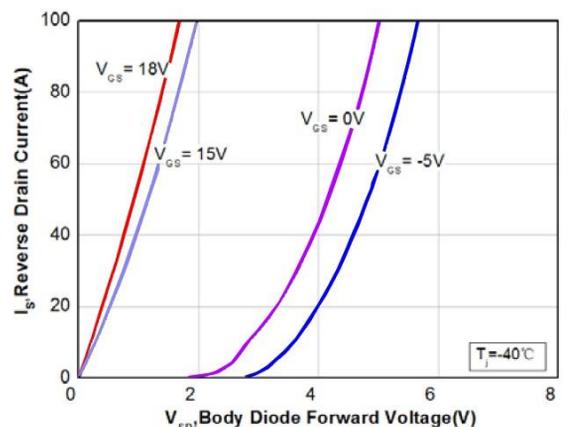
**Figure 4. Normalized On-Resistance Characteristics vs. Temperature**



**Figure 5. Transfer Characteristics**

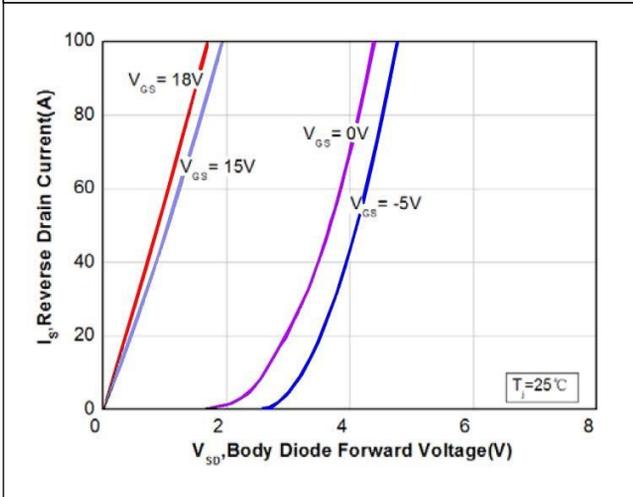


**Figure 6. Diode Forward Voltage Characteristics vs. Source-Drain Current  $T_J = -40^\circ\text{C}$**

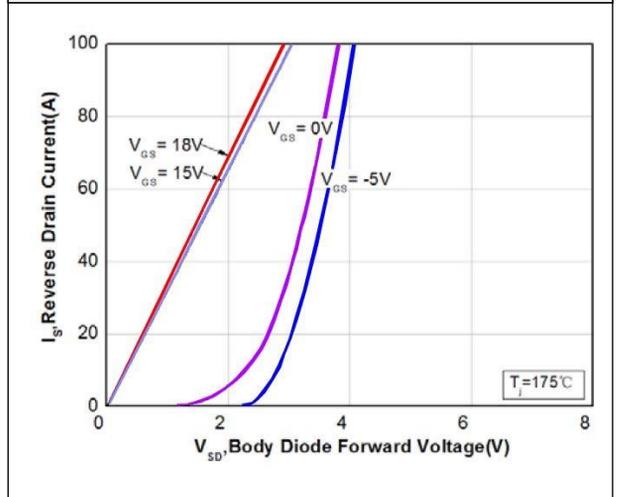


### Typical Performance Characteristics

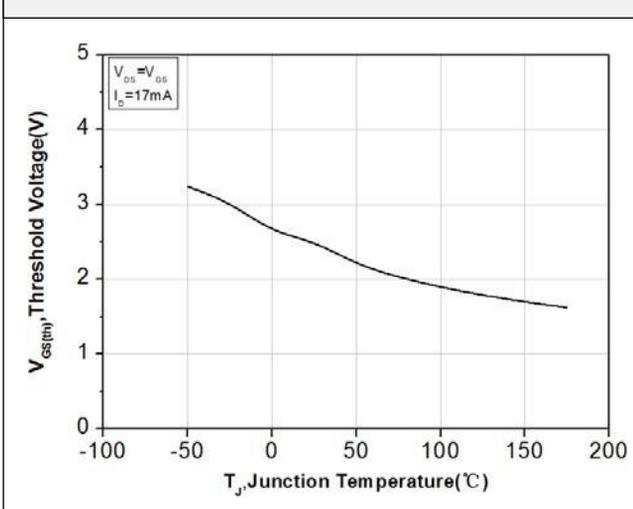
**Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current  $T_J = 25^\circ\text{C}$**



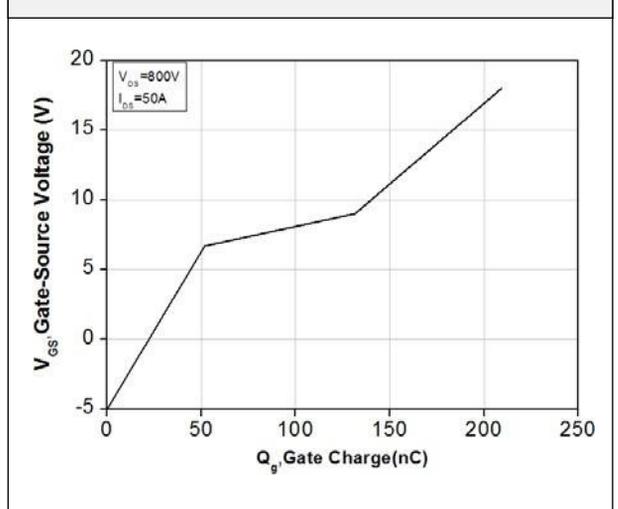
**Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current  $T_J = 175^\circ\text{C}$**



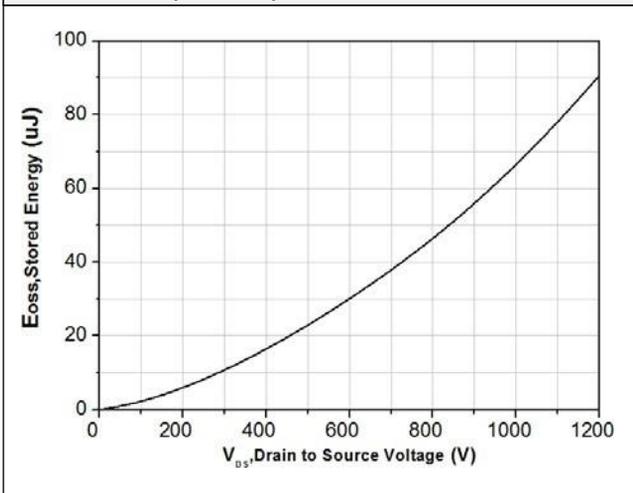
**Figure 9. Threshold Voltage vs. Temperature**



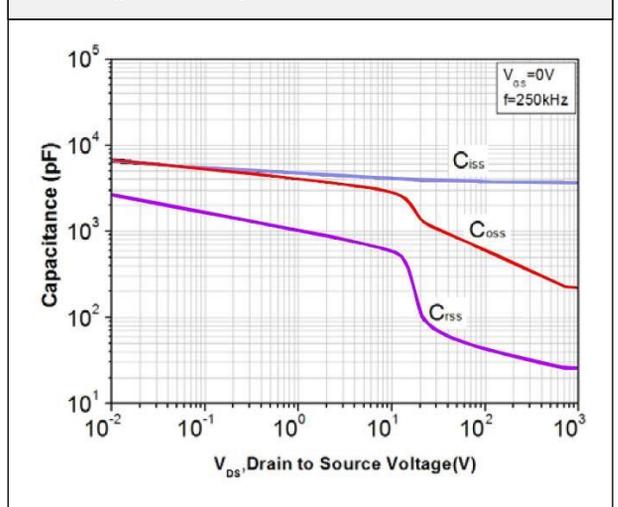
**Figure 10. Gate Charge Characteristics**



**Figure 11. Stored Energy in Output Capacitance (0~1200V)**

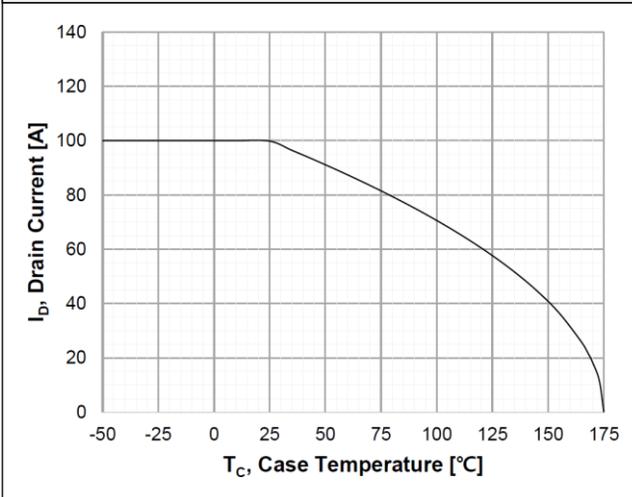


**Figure 12. Capacitance Characteristics**

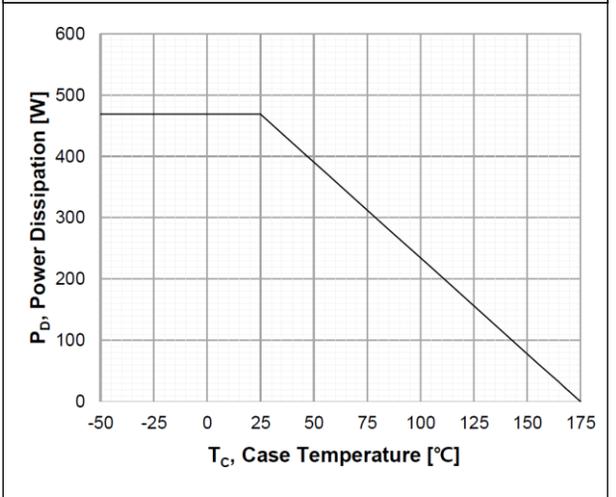


**Typical Performance Characteristics**

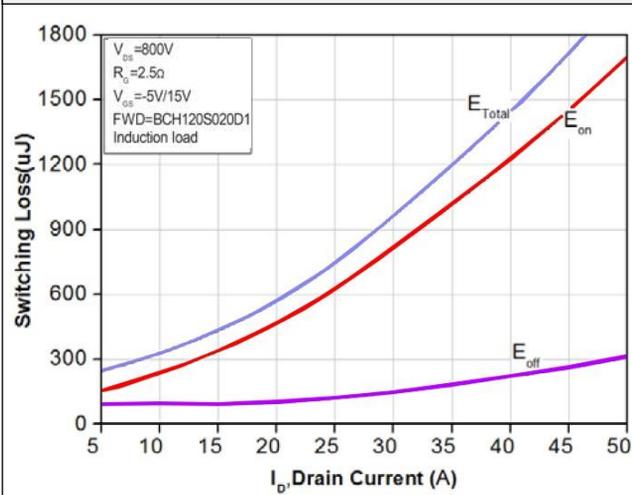
**Figure 13. Continuous Drain Current Derating vs. Case Temperature**



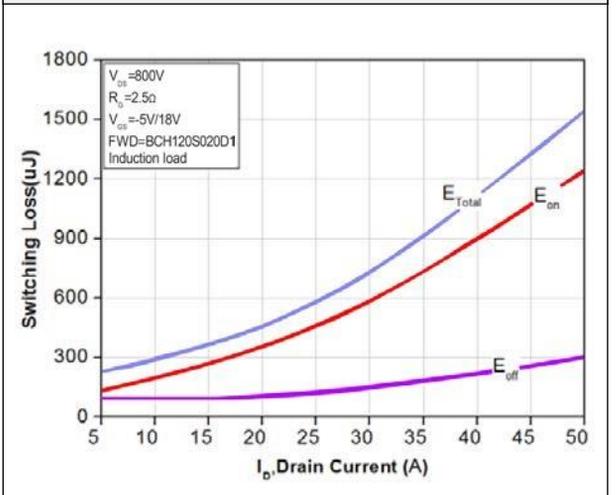
**Figure 14. Maximum Power Dissipation Derating vs. Case Temperature**



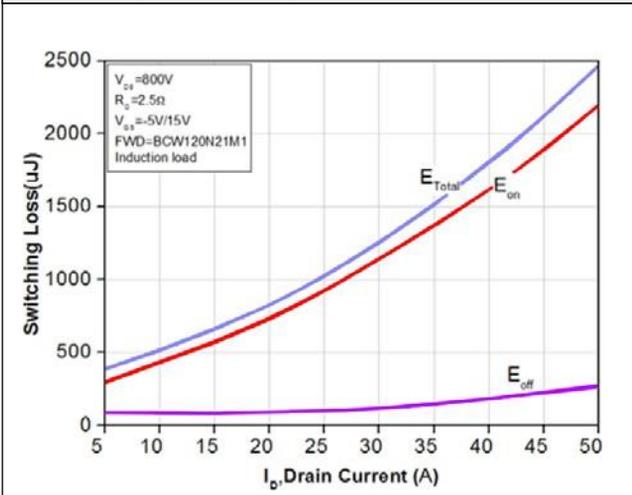
**Figure 15. Typ. Switching losses vs. Drain current (VGS=-5V/15V)**



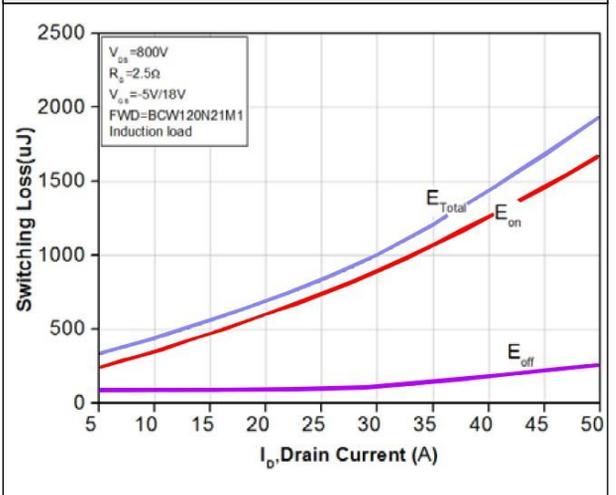
**Figure 16. Typ. Switching losses vs. Drain current (VGS=-5V/18V)**



**Figure 17. Typ. Switching losses vs. Drain current (VGS=-5V/15V)**

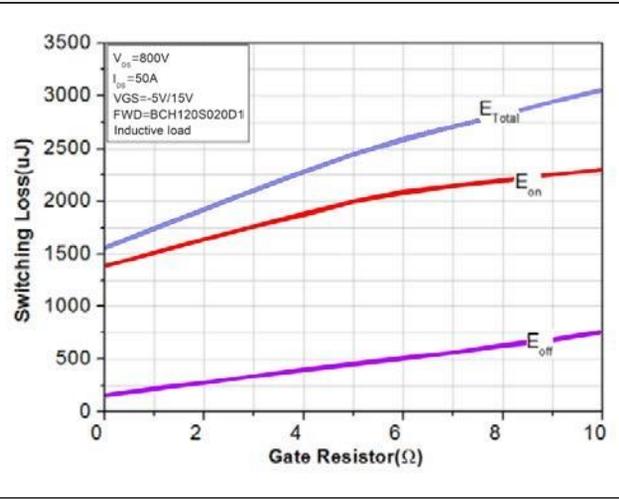


**Figure 18. Typ. Switching losses vs. Drain current (VGS=-5V/18V)**

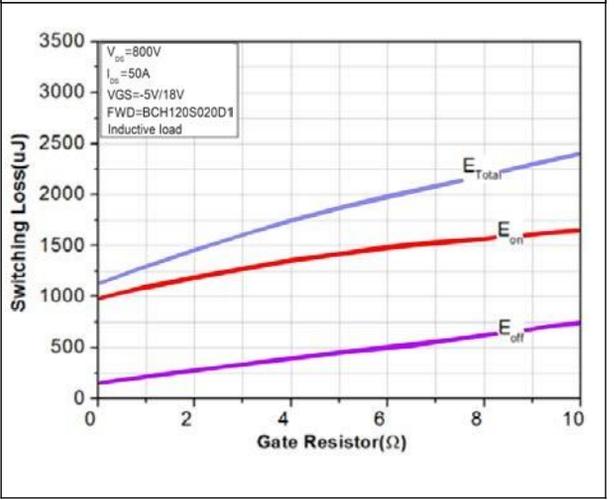


**Typical Performance Characteristics**

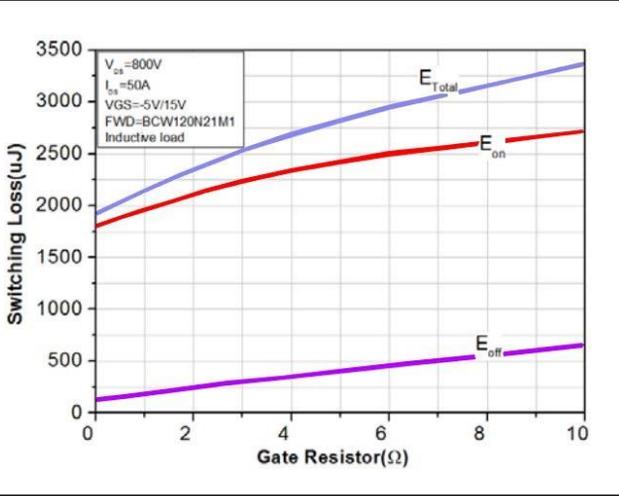
**Figure 19. Typ. Switching losses vs. Gate resistance (VGS=-5V/15V)**



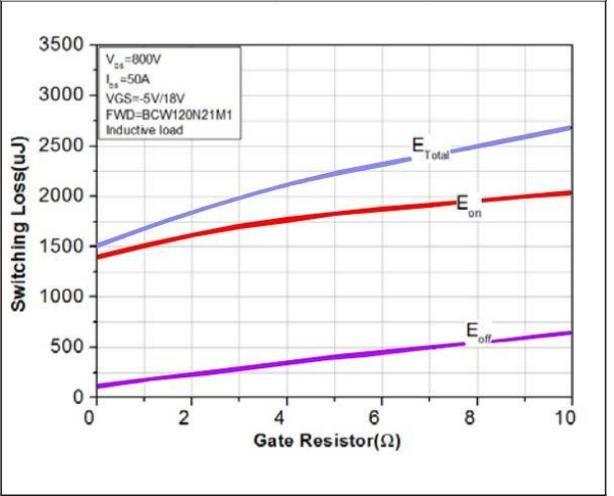
**Figure 20. Typ. Switching losses vs. Gate resistance (VGS=-5V/18V)**



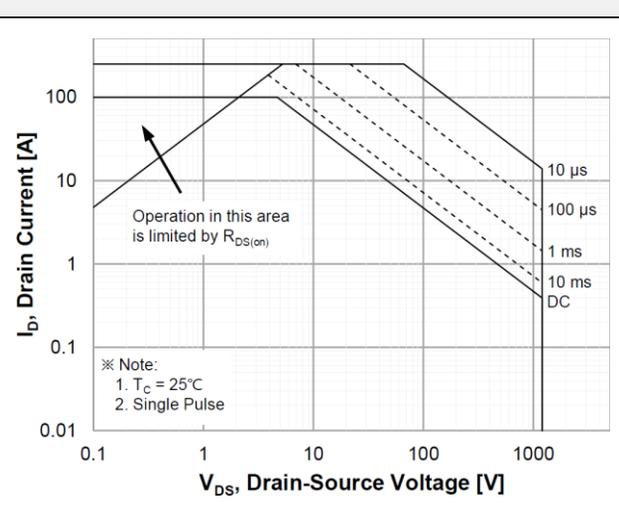
**Figure 21. Typ. Switching losses vs. Gate resistance (VGS=-5V/15V)**



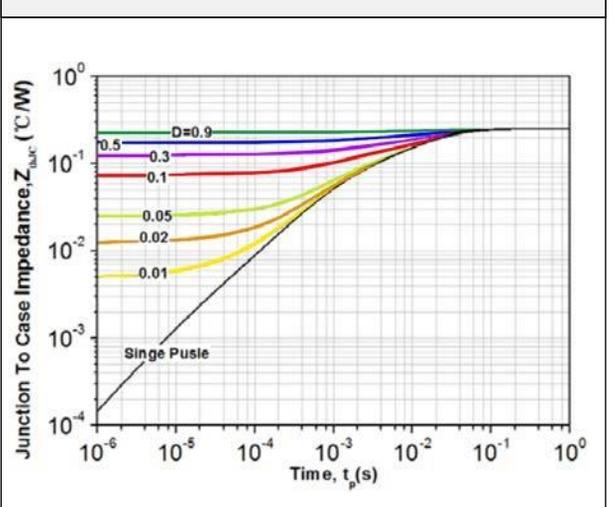
**Figure 22. Typ. Switching losses vs. Gate resistance (VGS=-5V/18V)**



**Figure 23. Maximum Safe Operating Area**

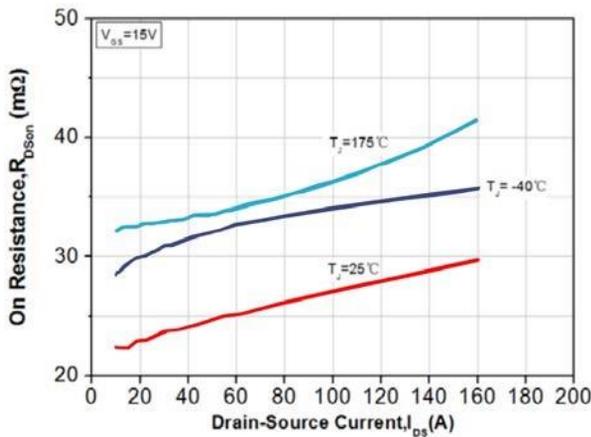


**Figure 24. Transient Thermal Response Curve**

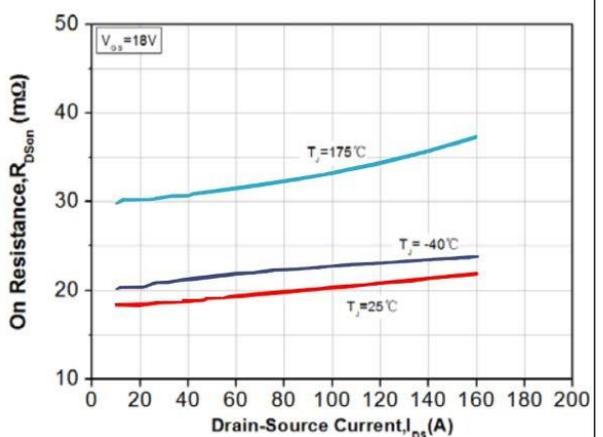


**Typical Performance Characteristics**

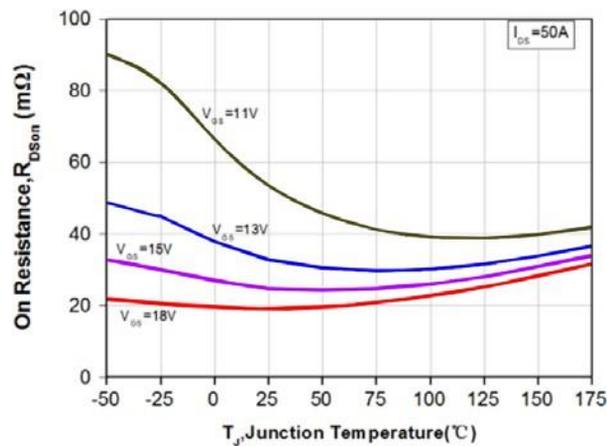
**Figure 25. On-Resistance vs. Drain Current For Various Temperature(VGS=15V)**



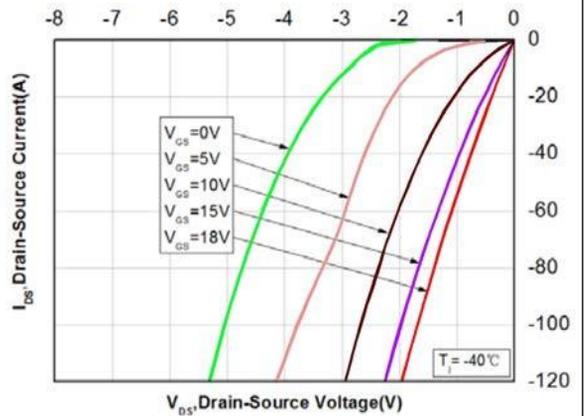
**Figure 26. On-Resistance vs. Drain Current For Various Temperature(VGS=18V)**



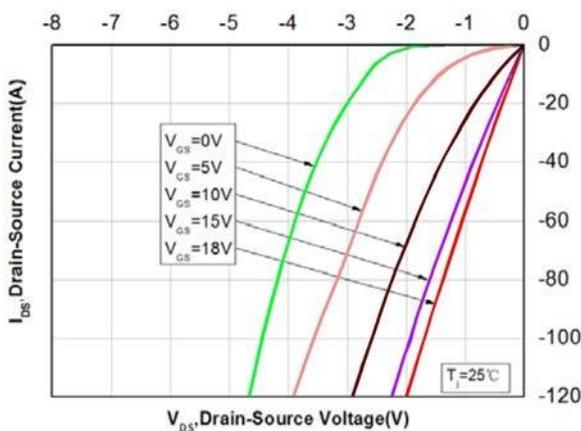
**Figure 27. On-Resistance vs. Temperature For Various Gate Voltage**



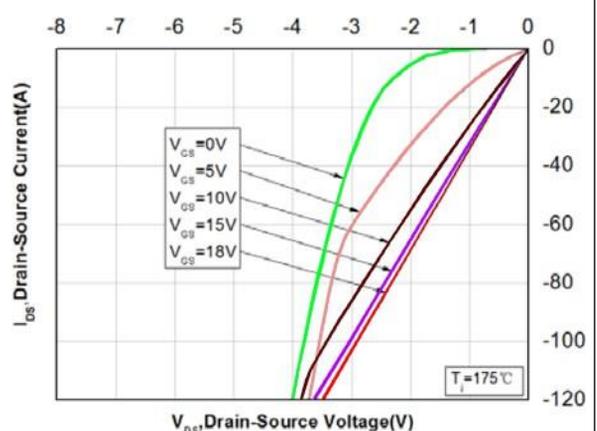
**Figure 28. 3rd Quadrant Characteristic at -40°C**



**Figure 29. 3rd Quadrant Characteristic at 25°C**

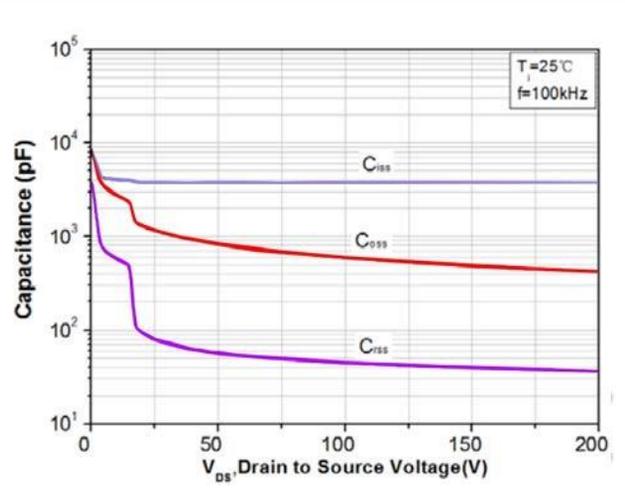


**Figure 30. 3rd Quadrant Characteristic at 175°C**

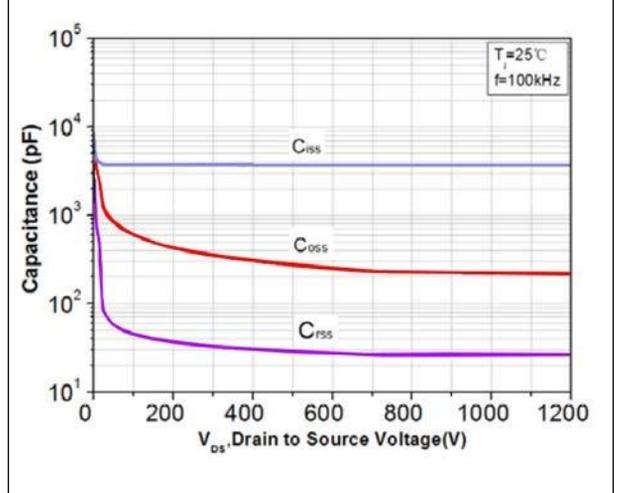


### Typical Performance Characteristics

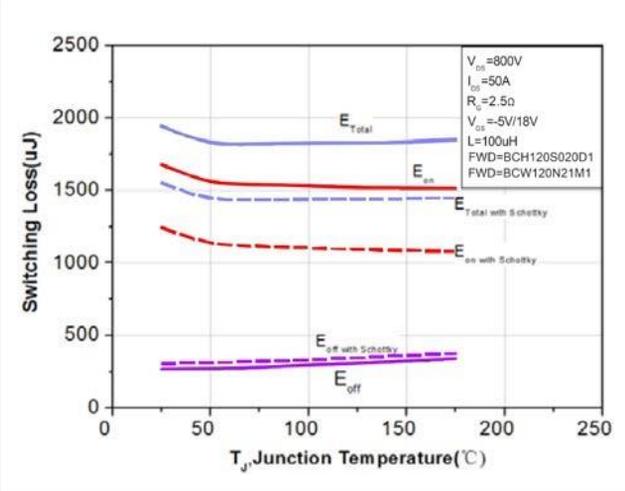
**Figure 31. Capacitance vs. Drain-Source Voltage (0~200V)**



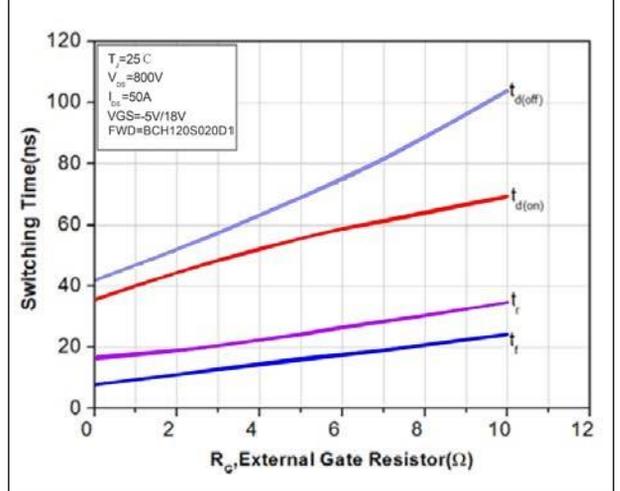
**Figure 32. Capacitance vs. Drain-Source Voltage (0~1200V)**



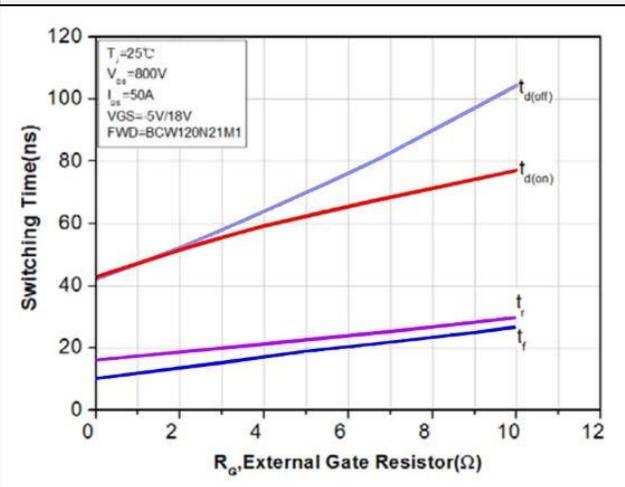
**Figure 33. Clamped Inductive Switching Energy vs. Temperature**



**Figure 34. Switching Times vs. R\_G(ext)**

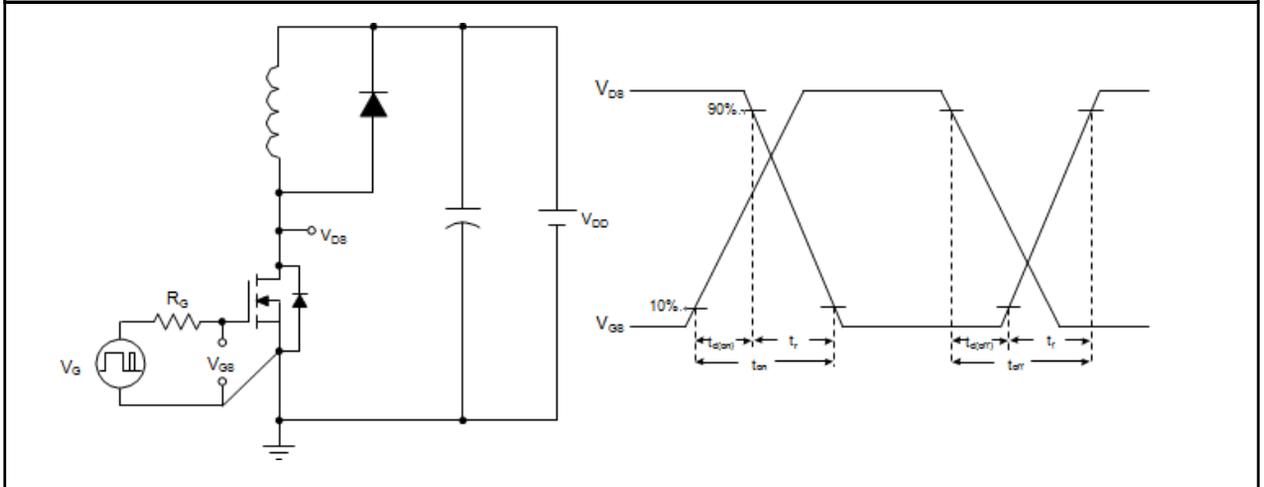


**Figure 35. Switching Times vs. R\_G(ext)**

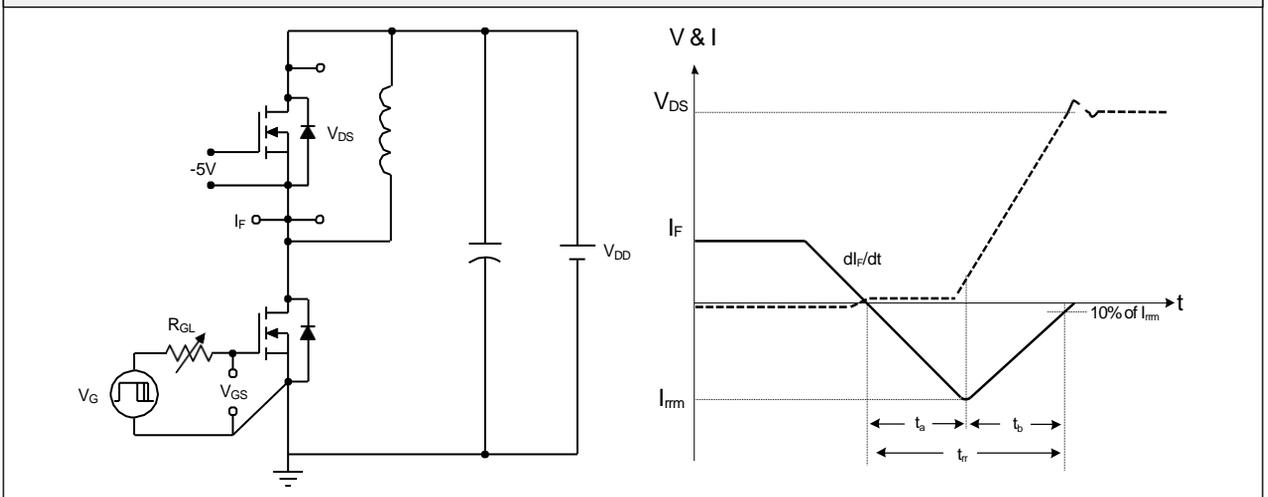


### Typical Performance Characteristics

**Figure 36. Inductive Load Switching Test Circuit and Waveforms**

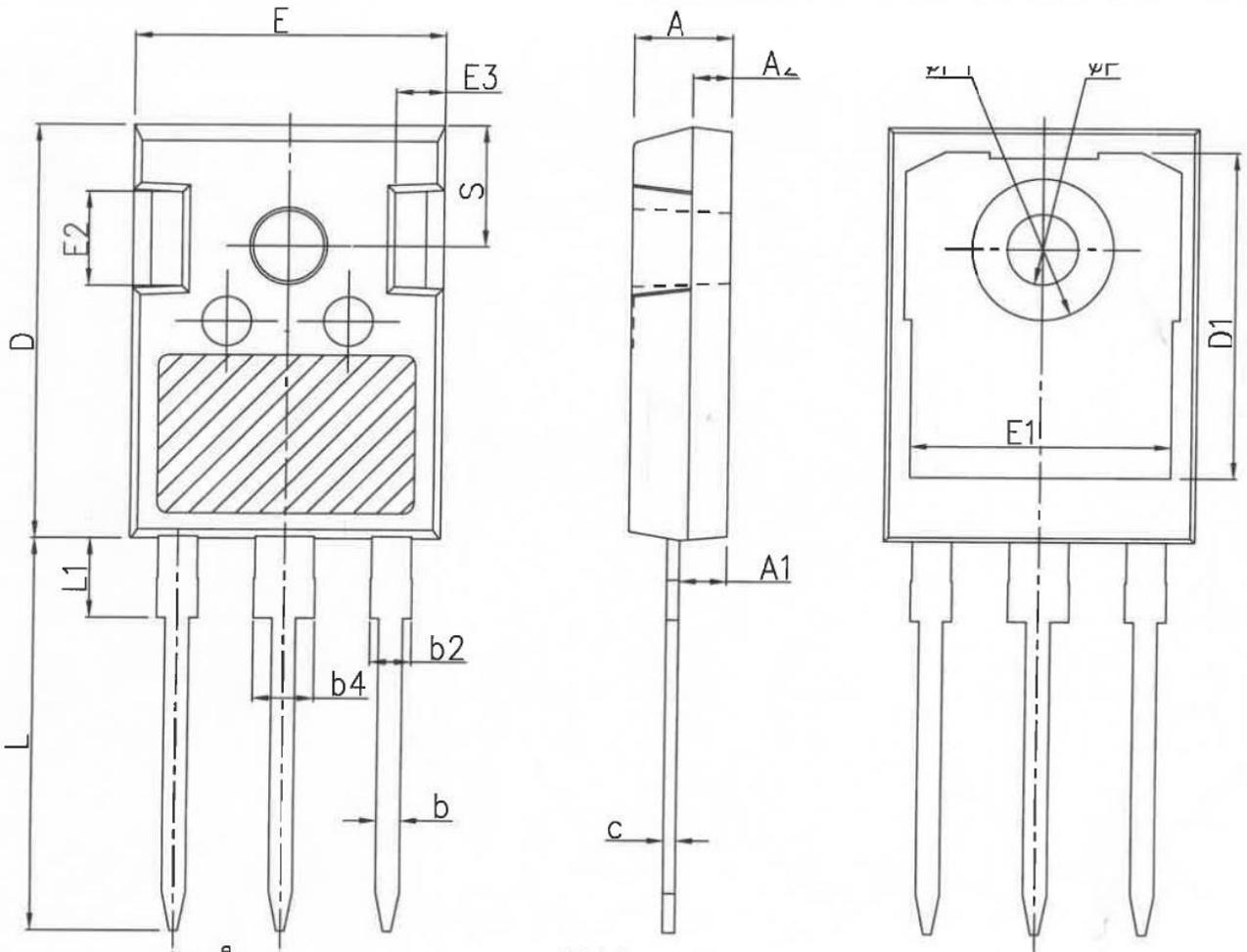


**Figure 37. Peak Diode Recovery  $dv/dt$  Test Circuit and Waveforms**



**Package Outlines**

**TO247-3**



**COMMON DIMENSIONS**

SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		

\*Dimensions in millimeters

## Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
BCW120N21M1	BCW120N21M1	TO247-3	Tube	30 units

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