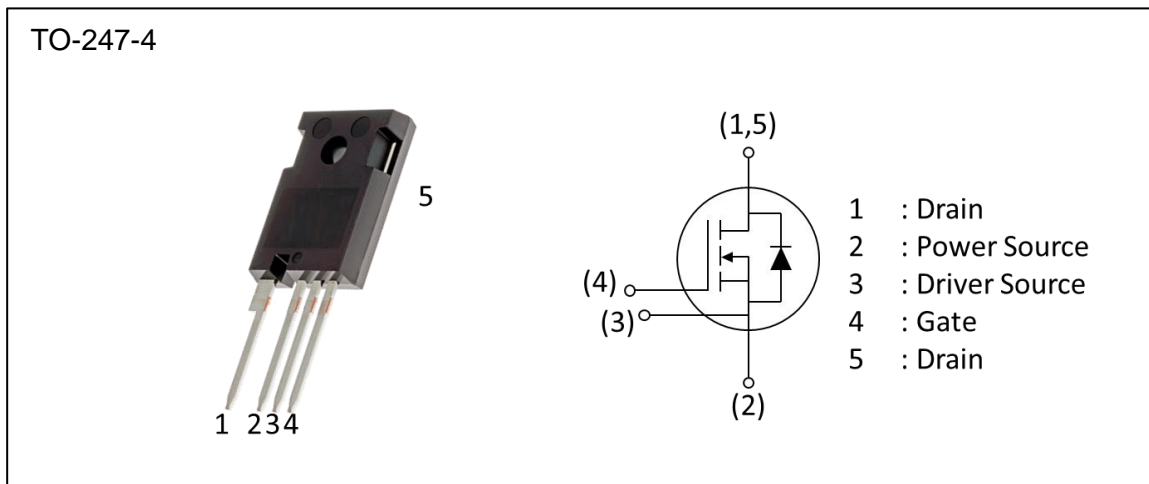


< SiC-MOSFET >

# BM040N120KJ

N series 1200V TO-247-4 Automotive Grade



## Features

- ✓ Low switching losses
- ✓ High tolerance for capacitive turn-on
- ✓ Fast reverse recovery of body diode
- ✓ Pb-free lead plating (RoHS compliant)

## Applications

- ✓ On Board Charger
- ✓ DC/DC Converter

## Key Performance

$V_{DSS}$	1200V
$I_D (T_C = 25^\circ\text{C})$	66A
$R_{DS(on)} (T_j = 25^\circ\text{C})$	40m $\Omega$

## Packaging Specifications

Part Number	BM040N120KJ
Package	TO-247-4
Marking	BM040N120KJ

**Maximum ratings ( $T_j = 25^\circ\text{C}$ , unless otherwise noted)**

Item	Symbol	Condition	Rating	Unit
Drain-source voltage	$V_{\text{DSS}}$	-	1200	V
Gate-source voltage	$V_{\text{GSS}}^{*1}$	-	-10/+22	V
Continuous drain current	$I_{\text{D}}^{*2}$	$T_{\text{C}} = 25^\circ\text{C}$	66	A
		$T_{\text{C}} = 100^\circ\text{C}$	48	A
Pulsed drain current	$I_{\text{D,pulse}}^{*3}$	Limited by $T_{\text{jmax}}$	160	A
Continuous body diode forward current	$I_{\text{S}}^{*2}$	$T_{\text{C}} = 25^\circ\text{C}$	59	A
Pulsed body diode forward current	$I_{\text{S,pulse}}^{*3}$	Limited by $T_{\text{jmax}}$	120	A
Power dissipation	$P_{\text{TOT}}^{*2}$	$T_{\text{C}} = 25^\circ\text{C}$	319	W
Operating junction temperature	$T_{\text{j}}$	-	-55 to 175	$^\circ\text{C}$
Storage temperature	$T_{\text{stg}}$	-	-55 to 150	$^\circ\text{C}$
Soldering temperature	$T_{\text{sold}}$	1.6mm from case for 10s	260	$^\circ\text{C}$
Mounting torque	M	-	0.8	N·m

**Thermal characteristics**

Item	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction-case	$R_{\text{th(j-c)}}^{*3}$	-	0.37	0.47	$^\circ\text{C/W}$

**Static characteristics (T<sub>j</sub> = 25 °C, unless otherwise noted.)**

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	V <sub>(BR)DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 10uA	1200	-	-	V
Drain-source on-state resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> = 15V, I <sub>D</sub> = 40A	-	40	60	mΩ
		T <sub>j</sub> = 25°C	-	42	-	
		T <sub>j</sub> = 100°C	-	53	-	
		T <sub>j</sub> = 175°C	-	-	-	
Body diode forward voltage	V <sub>SD</sub>	V <sub>GS</sub> = -5V, I <sub>SD</sub> = 40A, T <sub>j</sub> = 25°C	-	4.1	-	V
Gate-source threshold voltage	V <sub>GS(th)</sub> <sup>*4</sup>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 4.0mA	1.7	2.3	2.9	V
Drain-source leakage current	I <sub>DSS</sub>	V <sub>DS</sub> = 1200V, V <sub>GS</sub> = 0V	-	0.01	10	uA
Gate – Source leakage current	I <sub>GSS</sub>	V <sub>GS</sub> = 22V, V <sub>DS</sub> = 0V	-	-	100	nA
		V <sub>GS</sub> = -10V, V <sub>DS</sub> = 0V	-	-	100	
Transconductance	g <sub>fs</sub>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 40A	-	18	-	S
Internal gate resistance	R <sub>G,int</sub>	f = 500kHz	-	2	-	Ω
Input capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 800V, V <sub>GS</sub> = 0V, f = 500kHz	-	2600	-	pF
Output capacitance	C <sub>oss</sub>		-	135	-	
Reverse capacitance	C <sub>rss</sub>		-	6	-	
C <sub>oss</sub> Stored Energy	E <sub>oss</sub>		-	57	-	

**Dynamic characteristics ( $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise noted.)**

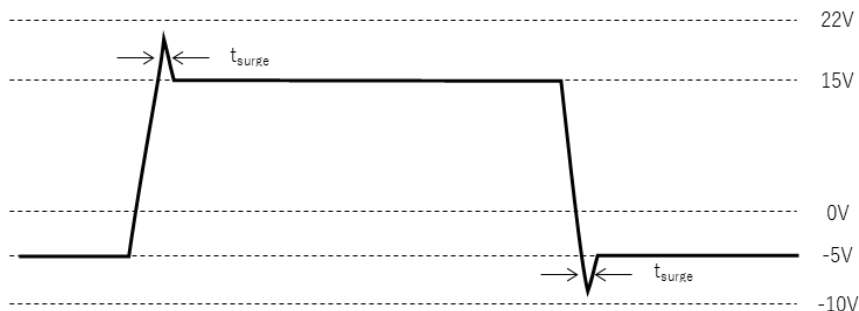
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Total gate charge	$Q_g$	$V_{DD} = 800\text{V}$ , $I_D = 40\text{A}$ , $V_{GS} = -5/15\text{V}$	-	94	-	nC
Gate to Drain charge	$Q_{gd}$		-	30	-	
Gate to Source charge	$Q_{gs}$		-	40	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 800\text{V}$ , $I_D = 40\text{A}$ , $V_{GS} = -5/15\text{V}$ , $R_{G,ext} = 2.2\Omega$ FWD: same type device as D.U.T. at $V_{GS} = -5\text{V}$ Inductive load	-	22	-	ns
Rise time	$t_r$		-	21	-	
Turn-off delay time	$t_{d(off)}$		-	29	-	
Fall time	$t_f$		-	9	-	
Turn-on switching loss	$E_{on}$		-	571	-	uJ
Turn-off switching loss	$E_{off}$		-	134	-	
Body diode reverse recovery charge	$Q_{rr}$		$V_{DD} = 800\text{V}$ , $I_S = 40\text{A}$ , $di/dt = 5200\text{A}/\mu\text{s}$ , $V_{GS} = -5\text{V}$	-	275	-
Body diode reverse recovery time	$t_{rr}$	-		13	-	ns
Body diode reverse recovery current	$I_{rr}$	-		35	-	A

\*1 Recommended turn-off gate voltage  $V_{GS\_off}$  is -5~0V.

Recommended turn-on gate voltage  $V_{GS\_on}$  is 15V.

Use with  $t_{surge} < 300\text{ns}$ . Do not use with  $V_{GS\_on} < 13\text{V}$ .

$V_{GS}$  Waveform Example



\*2 Limited by  $T_{jmax}$  and  $R_{th(j-c)max}$

\*3 Designed value (not tested).

\*4 Tested after applying  $V_{GS} = 20\text{V}$  for 200ms.

**Electrical Characteristic Curves**

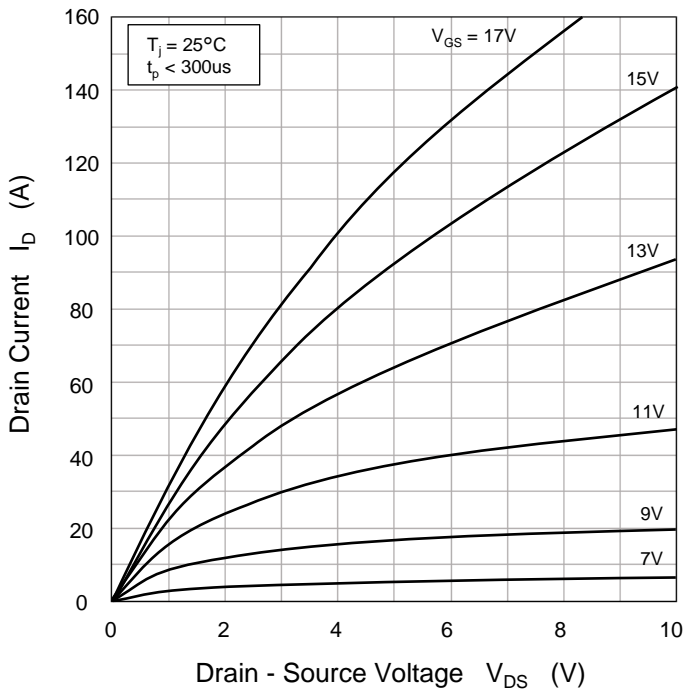


Figure 1 Typical Output Characteristics ( $T_j = 25^\circ\text{C}$ )

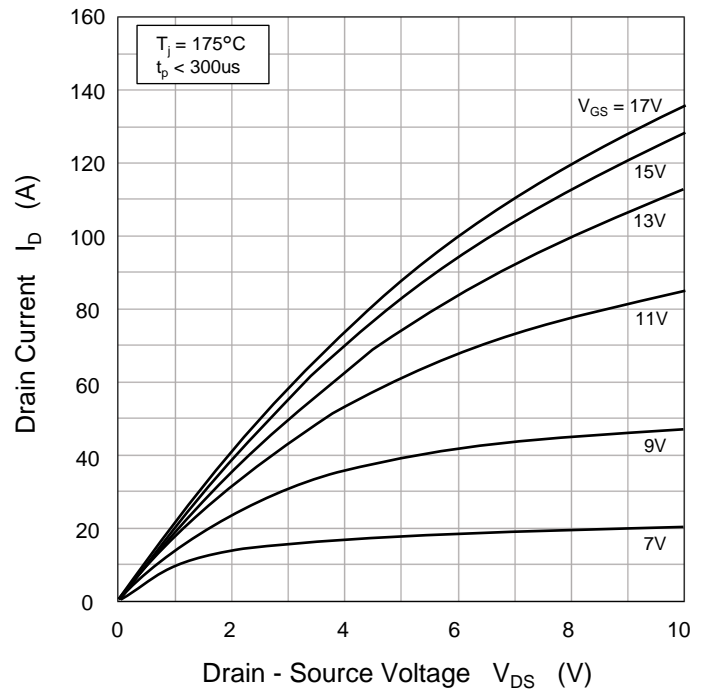


Figure 1 Typical Output Characteristics ( $T_j = 175^\circ\text{C}$ )

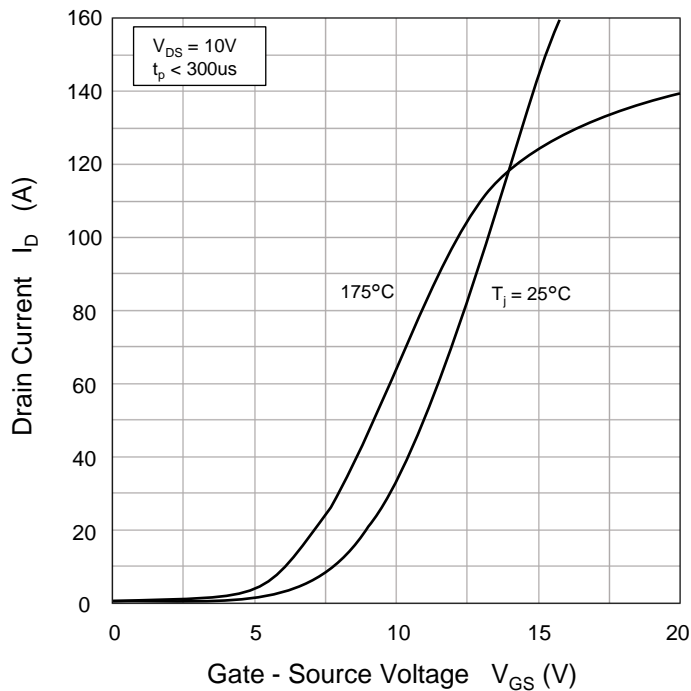


Figure 3 Typical Transfer Characteristics

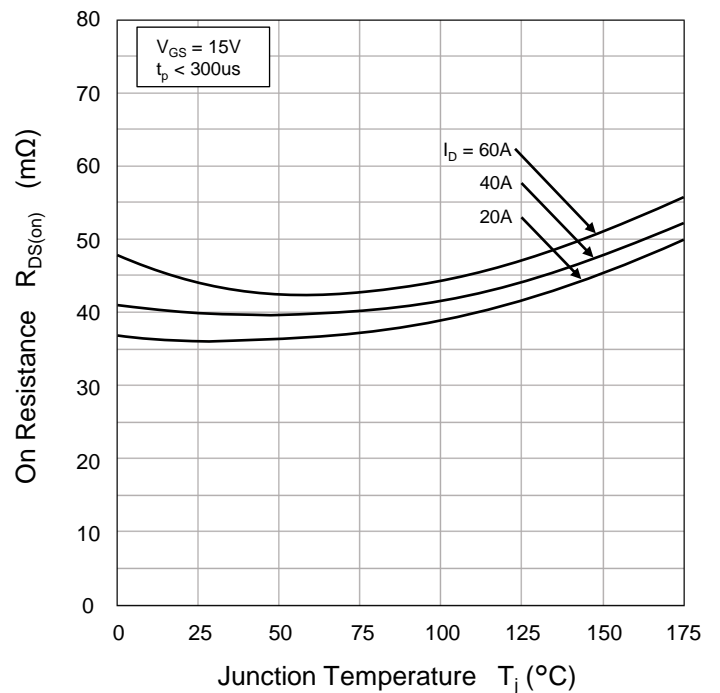


Figure 4 Typical On resistance vs. Junction Temperature

**Electrical Characteristic Curves**

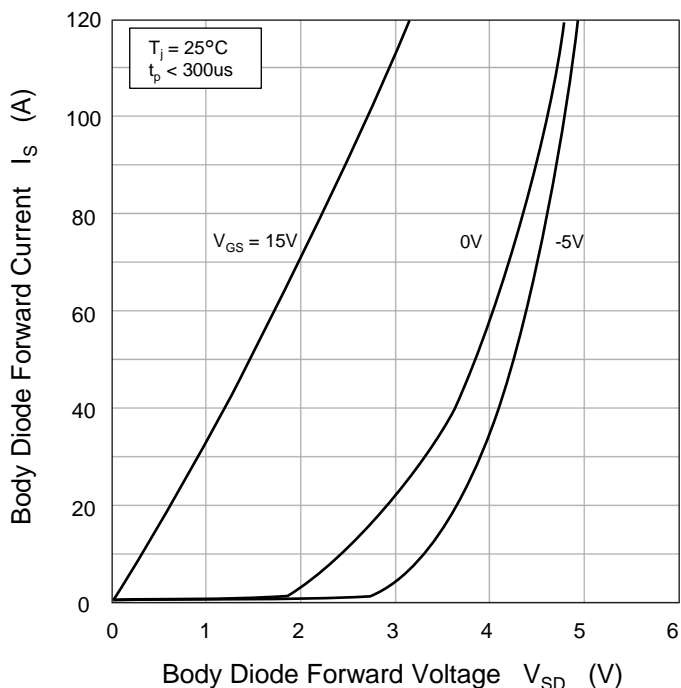


Figure 5 Typical Body Diode Forward current vs. Source-Drain Voltage ( $T_j = 25^\circ\text{C}$ )

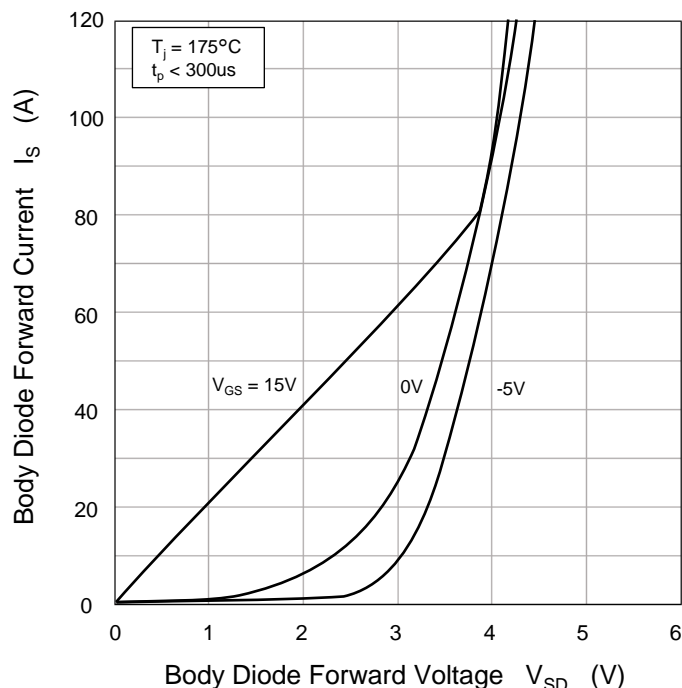


Figure 6 Typical Body Diode Forward current vs. Source-Drain Voltage ( $T_j = 175^\circ\text{C}$ )

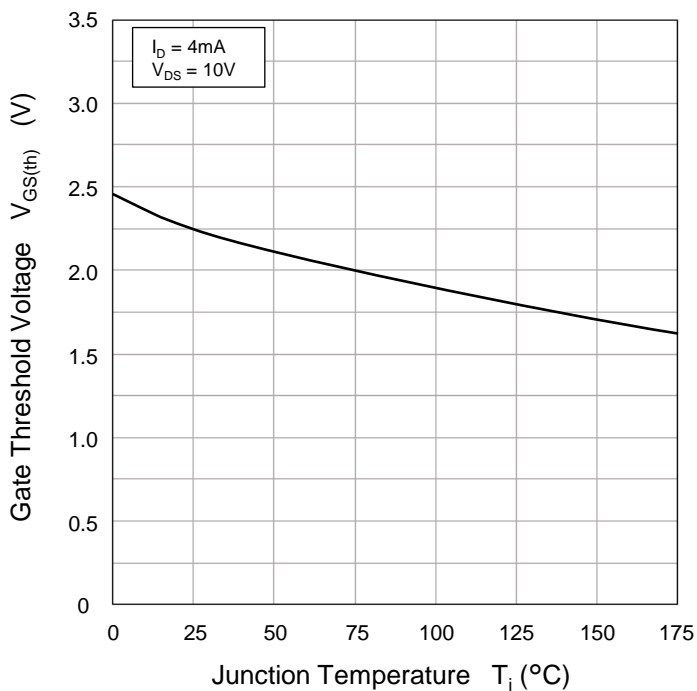


Figure 7 Typical Gate Threshold Voltage vs. Junction Temperature

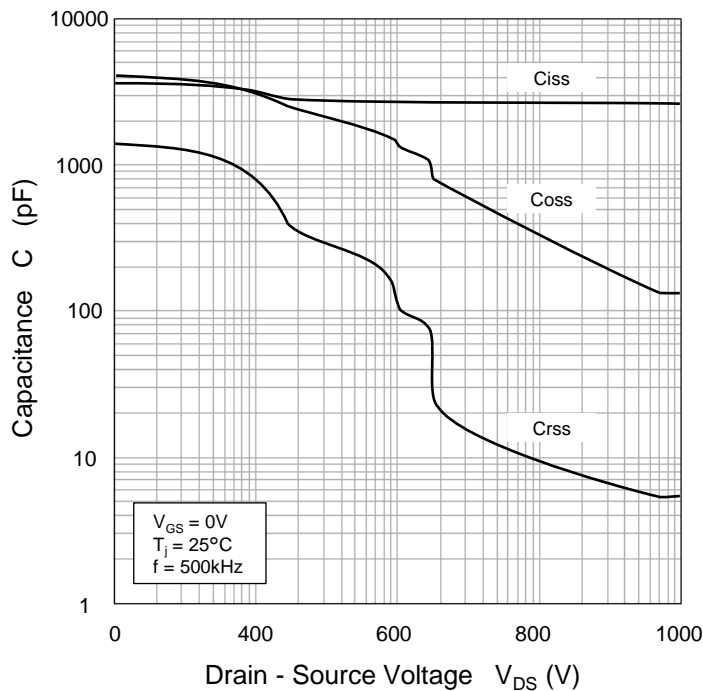


Figure 8 Typical Capacitance vs. Drain-Source Voltage

**Electrical Characteristic Curves**

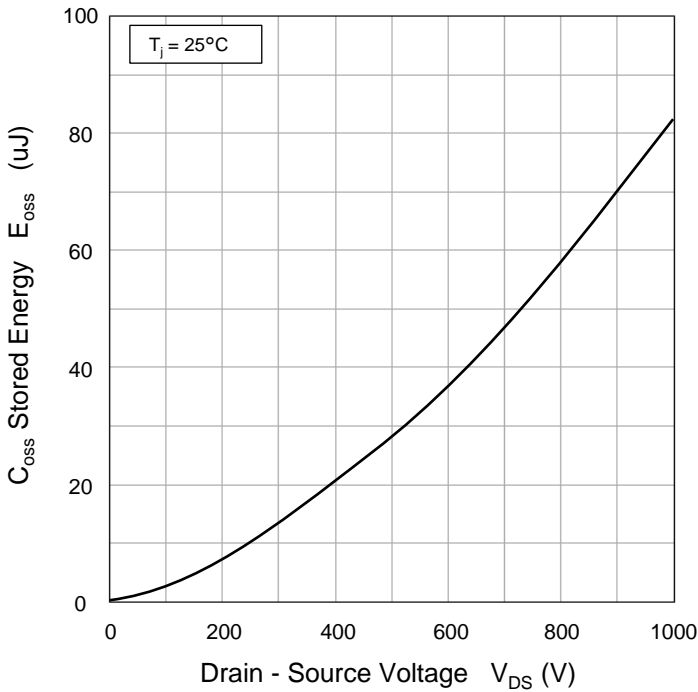


Figure 9 Typical  $C_{oss}$  Stored Energy

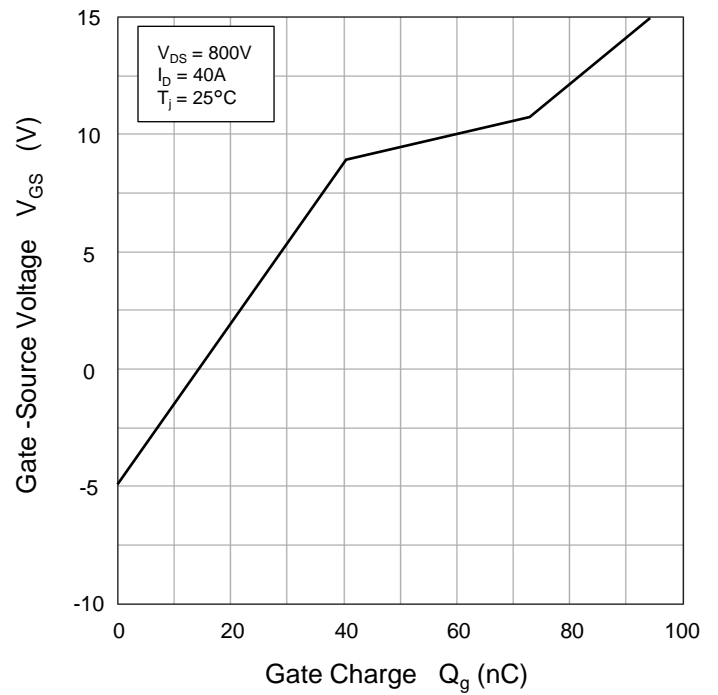


Figure 10 Typical Gate charge Characteristics

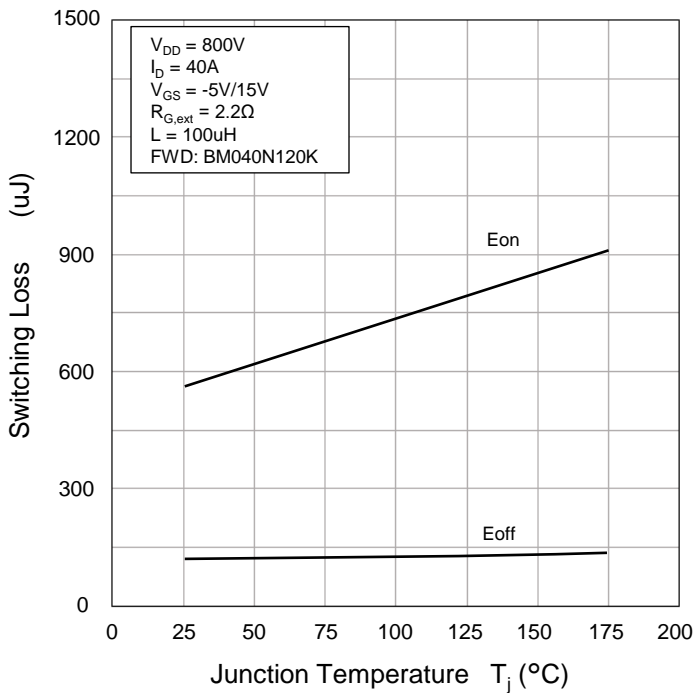


Figure 11 Typical Switching Loss vs. Junction Temperature

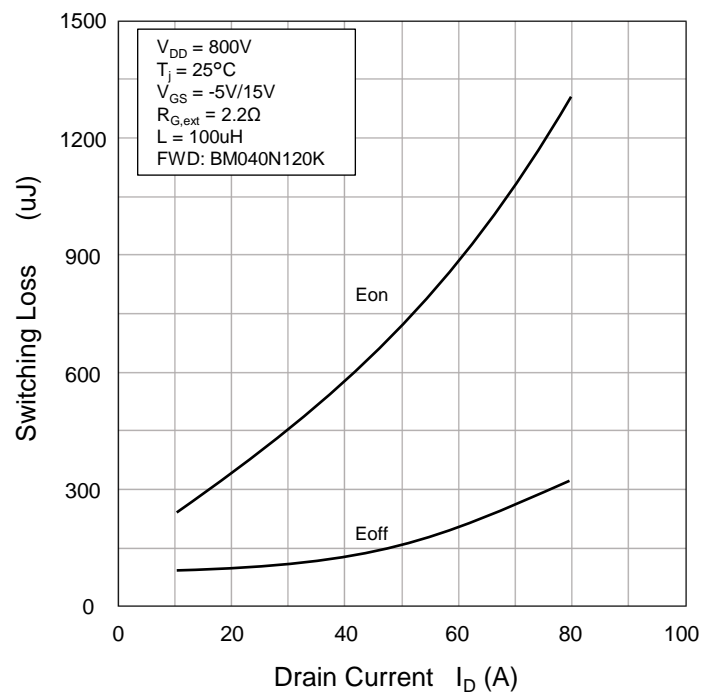


Figure 12 Typical Switching Loss vs. Drain Current ( $T_j = 25^\circ\text{C}$ )

**Electrical Characteristic Curves**

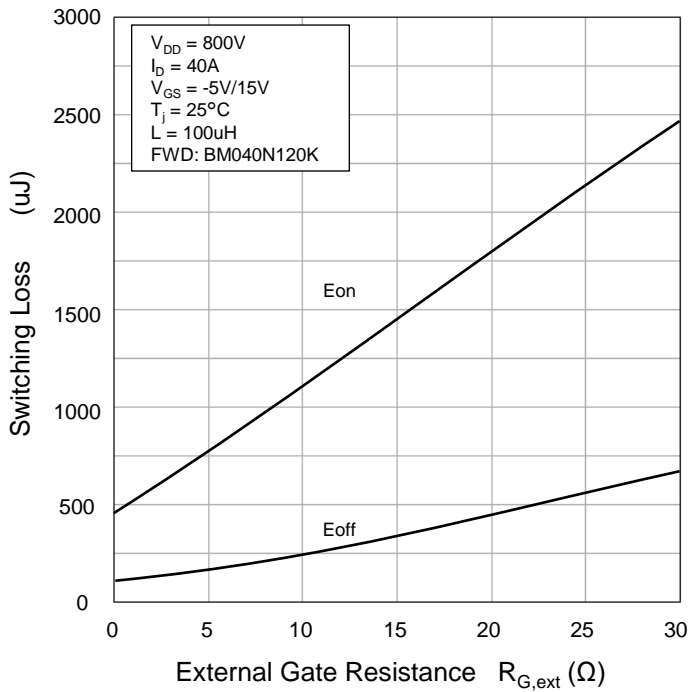


Figure 13 Typical Switching Loss vs.  $R_{G,ext}$   
( $T_j = 25^\circ\text{C}$ )

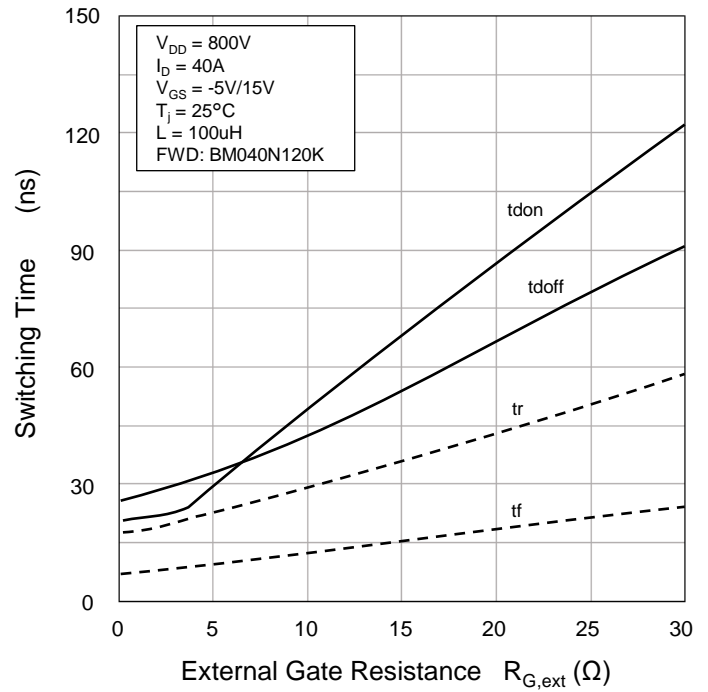


Figure 14 Typical Switching Times vs.  $R_{G,ext}$   
( $T_j = 25^\circ\text{C}$ )

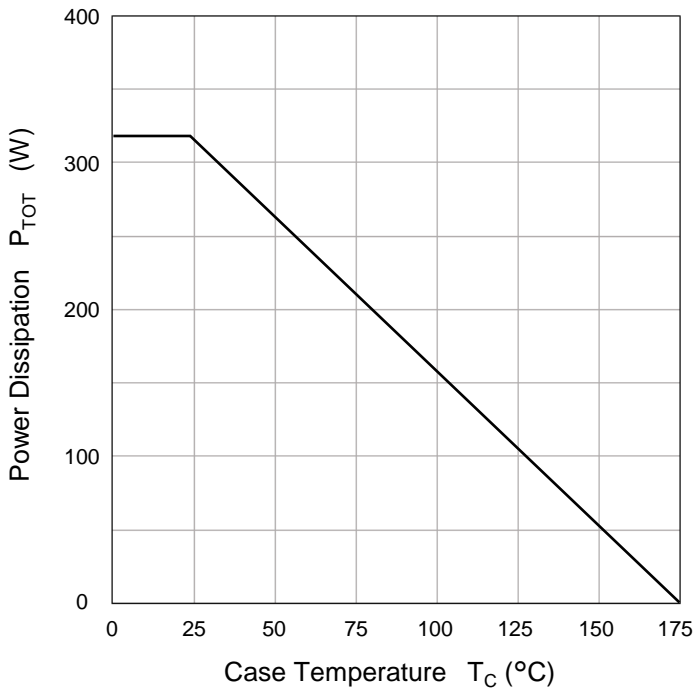


Figure 15 Maximum Power Dissipation Derating vs.  
Case Temperature

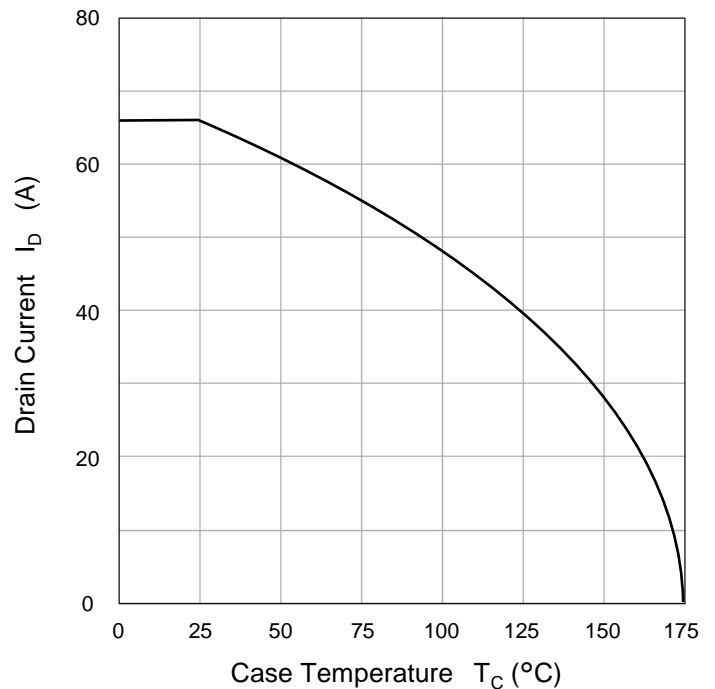


Figure 16 Maximum Continuous Drain Current vs.  
Case Temperature



## Electrical Characteristic Curves

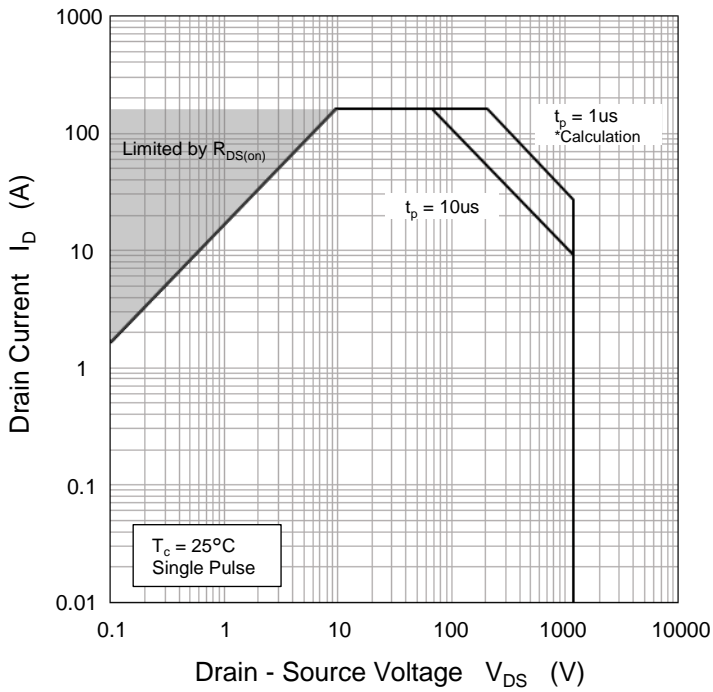


Figure 17 Maximum Safe Operating Area

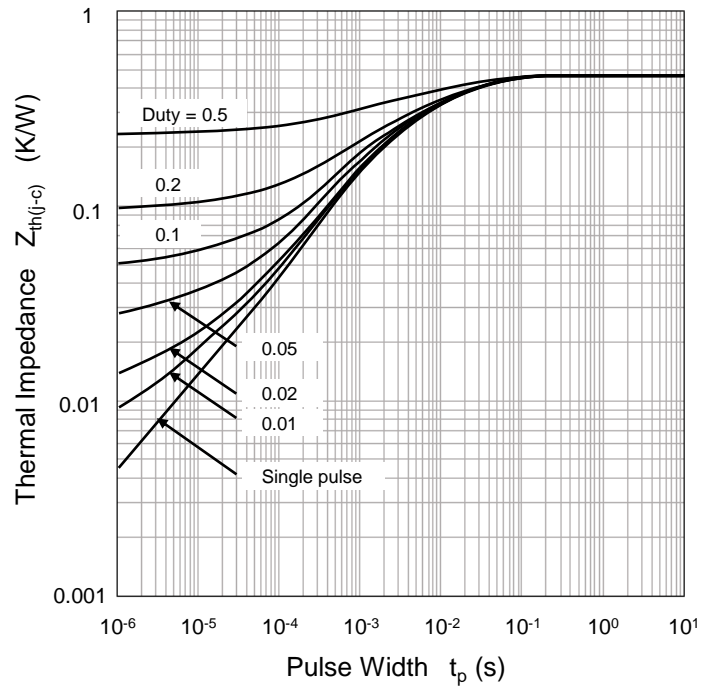
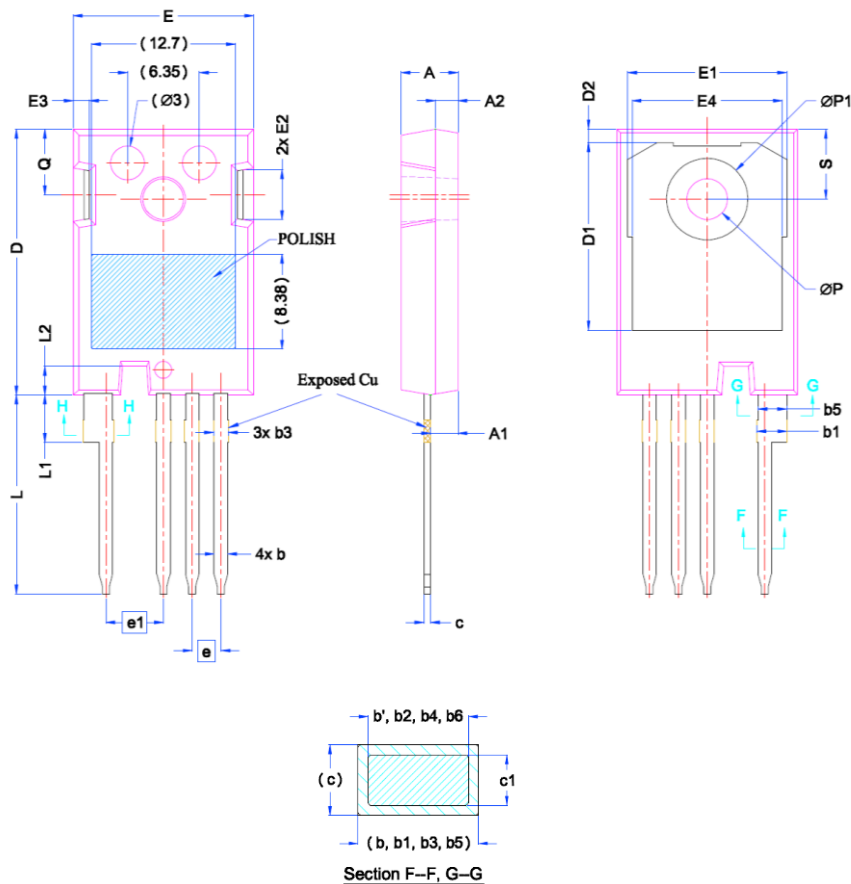


Figure 18 Maximum Transient Thermal Impedance vs. Pulse Width

**Package Dimensions**

TO-247-4 (unit : mm)



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
<b>A</b>	<b>4.83</b>	5.02	<b>5.21</b>
<b>A1</b>	<b>2.29</b>	2.41	<b>2.54</b>
<b>A2</b>	1.91	2.00	2.16
<b>b'</b>	1.07	1.20	1.28
<b>b</b>	<b>1.07</b>	1.20	<b>1.30</b>
<b>b1</b>	2.39	2.67	2.94
<b>b2</b>	2.39	2.67	2.84
<b>b3</b>	1.07	1.30	1.80
<b>b4</b>	1.07	1.30	1.50
<b>b5</b>	2.39	2.53	2.69
<b>b6</b>	2.39	2.53	2.64
<b>c</b>	0.55	0.60	0.68
<b>c1</b>	0.55	0.60	0.65
<b>D</b>	<b>23.30</b>	23.45	<b>23.60</b>
<b>D1</b>	16.25	16.55	17.65
<b>D2</b>	0.95	1.19	1.25
<b>E</b>	<b>16.75</b>	15.94	<b>16.13</b>
<b>E1</b>	13.10	14.02	14.15
<b>E2</b>	<b>3.98</b>	4.40	<b>5.10</b>
<b>E3</b>	1.00	1.45	1.90
<b>E4</b>	12.38	13.26	13.43
<b>e</b>	<b>2.54 BSC</b>		
<b>e1</b>	<b>5.08 BSC</b>		
<b>L</b>	<b>17.31</b>	17.57	<b>17.82</b>
<b>L1</b>	<b>3.97</b>	4.19	<b>4.37</b>
<b>L2</b>	2.35	2.50	2.65
<b>∅P</b>	3.51	3.61	3.65
<b>∅P1</b>	7.19 REF.		
<b>Q</b>	<b>5.49</b>	5.79	<b>6.00</b>
<b>S</b>	6.04	6.17	6.30

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