

Product Summary

V_{DS}	650 V
$I_D (T_c=25^\circ\text{C})$	64 A
$R_{DS(on).typ}$	40 mΩ@$V_{GS}=18\text{V}$

Features

- Low On-Resistance with High Blocking Voltage
- Low Capacitance
- Avalanche Ruggedness
- Halogen Free, Rohs Compliant

Benefits

- High Frequency Operation
- Enabling Higher Switching Frequency
- Increased Power Density
- Reduction of Heat Sink Requirements

Applications

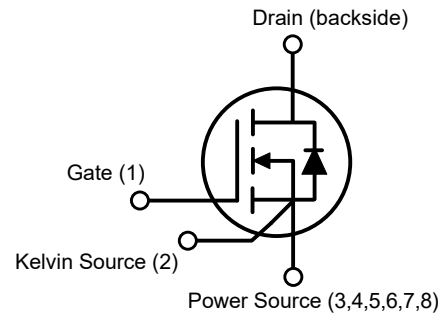
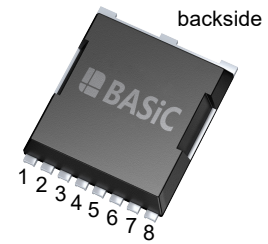
- Switch Mode Power Supplies (SMPS)
- Power Inverter & Solar Inverter
- Motor Drivers & EV Charging Station
- DC/DC Converter

Package Pin Definitions

- backside - Drain
- Pin1 - Gate
- Pin2 - Kelvin Source
- Pin3,4,5,6,7,8 - Power Source

Package Parameters

Part Number	Marking	Package
B3M040065L	B3M040065L	TOLL

Package: TOLL


Maximum Ratings

Symbol	Parameter	Test conditions	Value	Unit
V_{DSmax}	Drain-Source Voltage	$V_{GS}=0V, I_D=100\mu A$	650	V
$V_{GSmax}^{1)}$	Gate-Source Voltage		-10/22	V
V_{GSop}	Recommend Gate-Source Voltage		-4/18	V
I_D	Continuous Drain Current	$V_{GS}=18V, T_C=25^\circ C$	64	A
		$V_{GS}=18V, T_C=100^\circ C$	45	A
$I_{D,pulse}$	Pulsed Drain Current	Pulse with t_p limited by T_{jmax}	106	A
P_{tot}	Power Dissipation	$T_C=25^\circ C, T_j=175^\circ C$	230	W
T_j	Operating Junction Temperature		-55~175	$^\circ C$
T_{stg}	Storage Temperature		-55~175	$^\circ C$

1) Note: When using MOSFET Body Diode $V_{GSmax}=-4/22V$

Electrical Characteristics (Defined at $T_j=25^\circ C$ unless otherwise specified)
Static Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=100\mu A$	650			V
$V_{GS(th)}$	Gate Threshold Voltage	$V_{GS}=V_{DS}, I_D=7.5mA$ (tested after 1ms pulse at $V_{GS}=20V$)	2.3	2.7	3.5	V
		$V_{GS}=V_{DS}, I_D=7.5mA, T_j=175^\circ C$ (tested after 1ms pulse at $V_{GS}=20V$)		1.9		
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=18V, V_{DS}=0V$			100	nA
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=650V, V_{GS}=0V$		1	50	μA
		$V_{DS}=650V, V_{GS}=0V, T_j=175^\circ C$		10	200	
$R_{DS(on)}$	Drain-Source On-State Resistance	$V_{GS}=18V, I_D=20A$		40	55	m Ω
		$V_{GS}=18V, I_D=20A, T_j=175^\circ C$		55		
		$V_{GS}=15V, I_D=20A$		50		
g_{fs}	Transconductance	$V_{DS}=10V, I_D=20A$		10		S

Thermal Characteristics

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
$R_{th(jc)}$	Thermal Resistance from Junction to Case		0.65		K/W

AC Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
C_{iss}	Input Capacitance	$V_{GS}=0V, V_{DS}=400V$ $f=100kHz, V_{AC}=25mV$		1540		pF
C_{oss}	Output Capacitance			130		pF
C_{rss}	Reverse Transfer Capacitance			7		pF
E_{oss}	C_{oss} Stored Energy			12		μJ
$C_{O(ER)}$	Effective Output Capacitance, Energy Related	$V_{GS}=0V, 0V < V_{DS} < 400V$		150		pF
$C_{O(TR)}$	Effective Output Capacitance, Time Related	$V_{GS}=0V, 0V < V_{DS} < 400V$		204		pF
$R_{G(int)}$	Internal Gate Resistance	$f=1MHz, V_{AC}=25mV$		1.4		Ω

Gate Charge Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
Q_{GS}	Gate to Source Charge	$V_{DS}=400V$ $I_D=20A$ $V_{GS}=-4/+18V$		20		nC
Q_{GD}	Gate to Drain Charge			24		nC
Q_G	Total Gate Charge			60		nC

Switching Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-On Delay Time	$V_{DC}=400V$, $V_{GS}=-4/18V$ $I_D=20A$, $R_{G(ext)}=10\Omega$ $L_o=50nH$, $T_j=25^\circ C$ FWD ²⁾ : body diode at $V_{GS}=-4V$		10		ns
t_r	Rise Time			18		ns
$t_{d(off)}$	Turn-Off Delay Time			31		ns
t_f	Fall Time			8		ns
E_{on}	Turn-On Energy(FWD=Body Diode)			114		μJ
E_{off}	Turn-Off Energy(FWD=Body Diode)			25		μJ
E_{on}	Turn-On Energy(FWD=SiC Diode)	$V_{DC}=400V$, $V_{GS}=-4/18V$ $I_D=20A$, $R_{G(ext)}=10\Omega$ $L_o=50nH$, $T_j=25^\circ C$ FWD ²⁾ : B3D20065H		90		μJ
E_{off}	Turn-Off Energy(FWD=SiC Diode)			27		μJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DC}=400V$, $V_{GS}=-4/18V$ $I_D=20A$, $R_{G(ext)}=10\Omega$ $L_o=50nH$, $T_j=175^\circ C$ FWD ²⁾ : body diode at $V_{GS}=-4V$		7		ns
t_r	Rise Time			16		ns
$t_{d(off)}$	Turn-Off Delay Time			37		ns
t_f	Fall Time			7		ns
E_{on}	Turn-On Energy(FWD=Body Diode)			116		μJ
E_{off}	Turn-Off Energy(FWD=Body Diode)			25		μJ
E_{on}	Turn-On Energy(FWD=SiC Diode)	$V_{DC}=400V$, $V_{GS}=-4/18V$ $I_D=20A$, $R_{G(ext)}=10\Omega$ $L_o=50nH$, $T_j=175^\circ C$ FWD ²⁾ : B3D20065H		71		μJ
E_{off}	Turn-Off Energy(FWD=SiC Diode)			25		μJ

2) Note: FWD: Freewheeling diode

Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
V_{SD}	Diode Forward Voltage	$V_{GS}=-4V, I_{SD}=10A, T_j=25^{\circ}C$		4.0		V
		$V_{GS}=-4V, I_{SD}=10A, T_j=175^{\circ}C$		3.4		
I_{SD}	Continuous Diode Forward Current	$V_{GS}=-4V, T_c=25^{\circ}C$		40		A
$I_{SD,pulse}$	Pulse Diode Current	$V_{GS}=-4V$, pulse width t_p limited by T_{jmax}		82		A
t_{rr}	Reverse Recovery Time	$V_{GS}=-4V, V_{DC}=400V, I_{SD}=20A$ $-di_F/dt=2900A/\mu s$ $T_j=25^{\circ}C$		11		ns
Q_{rr}	Reverse Recovery Charge			100		nC
I_{rrm}	Peak Reverse Recovery Current			16		A
t_{rr}	Reverse Recovery Time	$V_{GS}=-4V, V_{DC}=400V, I_{SD}=20A$ $-di_F/dt=3700A/\mu s$ $T_j=175^{\circ}C$		12		ns
Q_{rr}	Reverse Recovery Charge			200		nC
I_{rrm}	Peak Reverse Recovery Current			27		A

Typical Performance

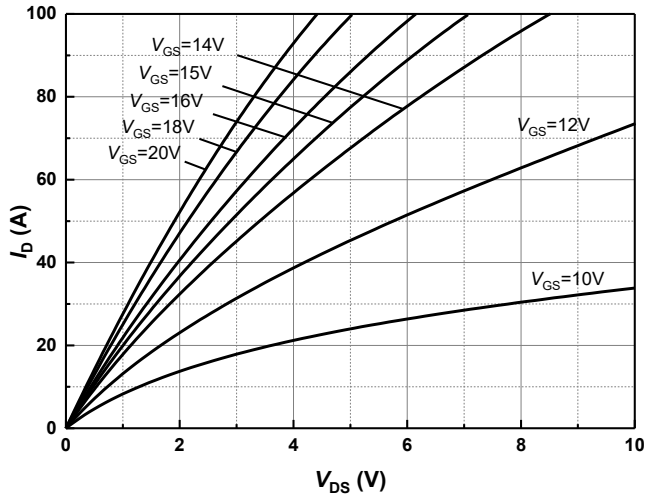


Figure 1 Typical Forward Output Characteristics at $T_j = 25^\circ\text{C}$

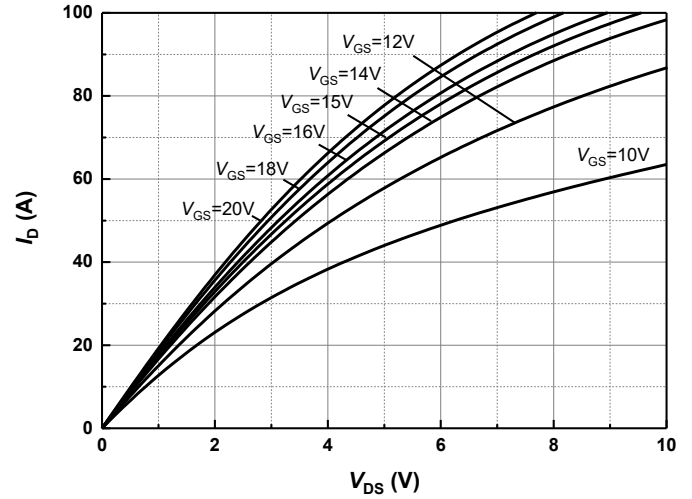


Figure 2 Typical Forward Output Characteristics at $T_j = 175^\circ\text{C}$

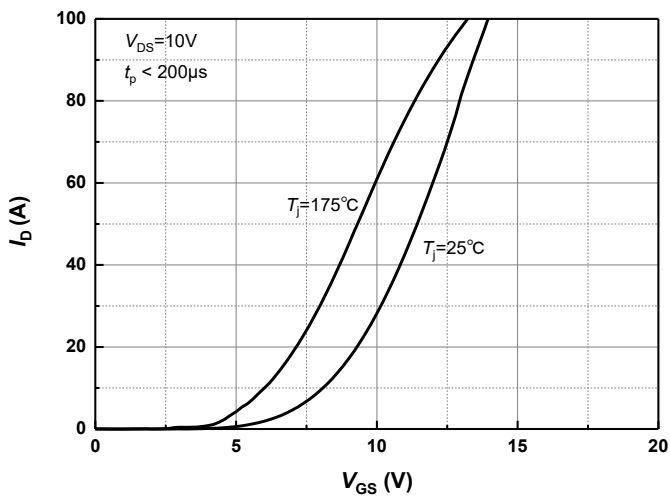


Figure 3 Transfer Characteristics for Various Temperature

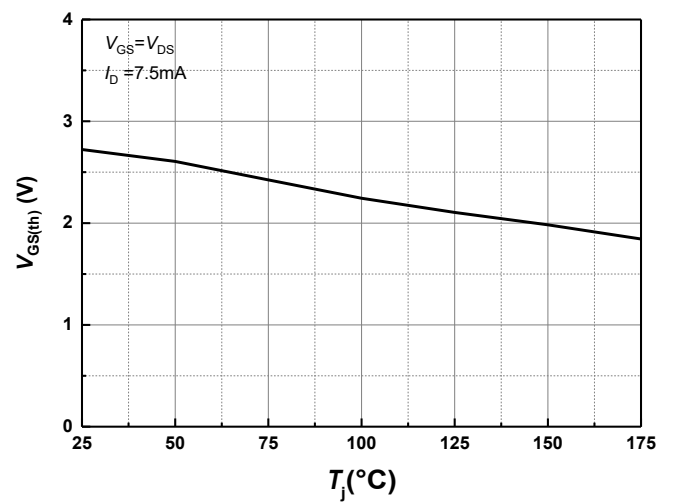


Figure 4 Threshold Voltage for Various Temperature

Typical Performance

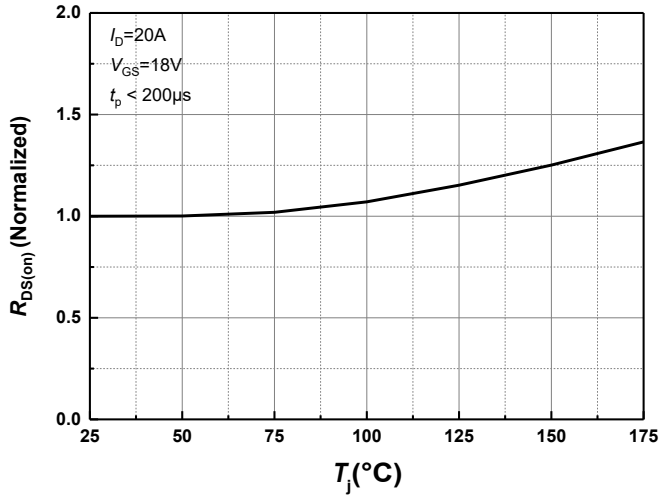


Figure 5 Normalized On-Resistance for Various Temperature

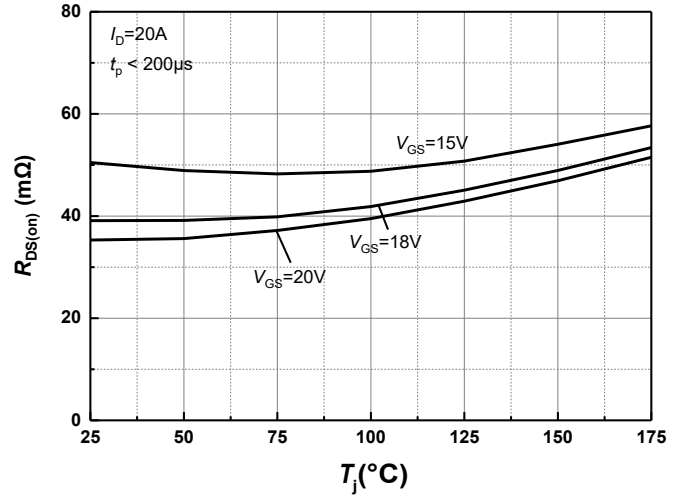


Figure 6 On-Resistance vs. Temperature for Various Gate-Source Voltage

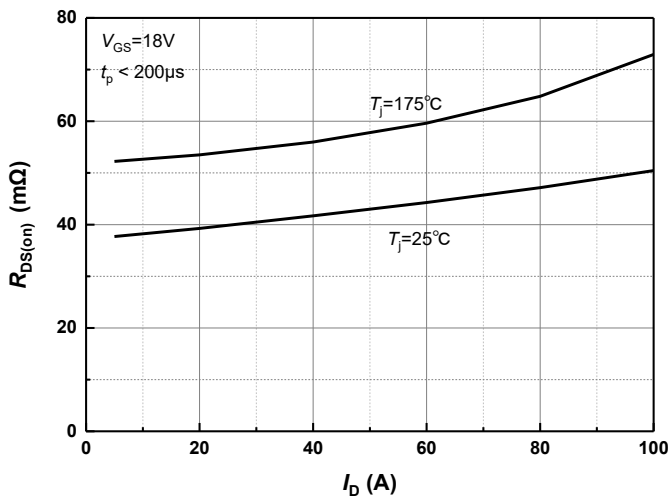


Figure 7 On-Resistance vs. Drain Current for Various Temperature

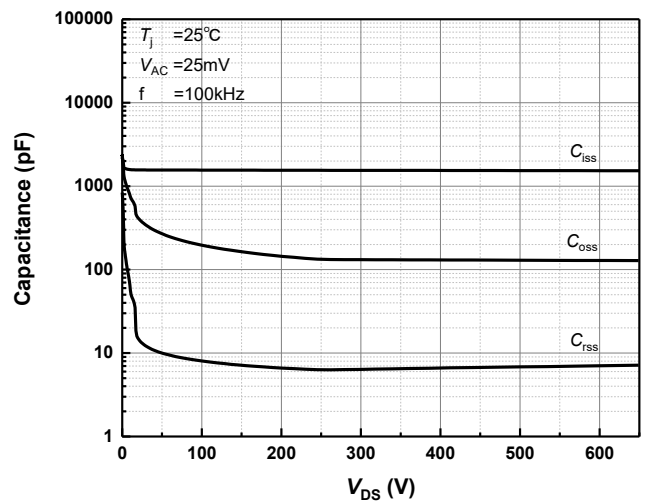


Figure 8 Capacitance vs. Drain-Source Voltage (0 - 650V)

Typical Performance

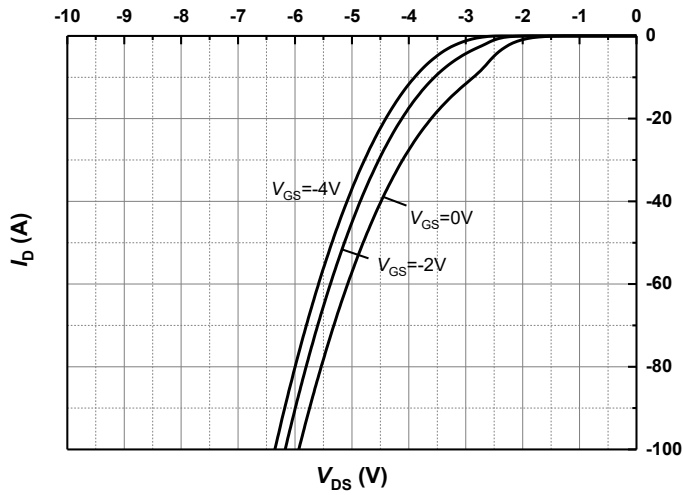


Figure 9 Body Diode Characteristics at $T_j=25^{\circ}\text{C}$

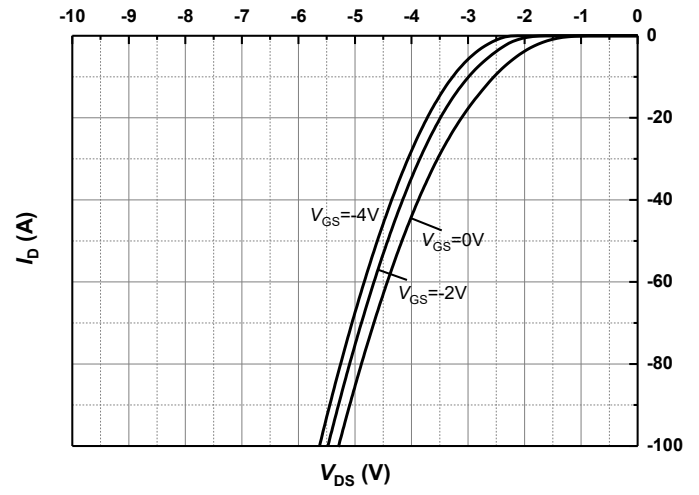


Figure 10 Body Diode Characteristics at $T_j=175^{\circ}\text{C}$

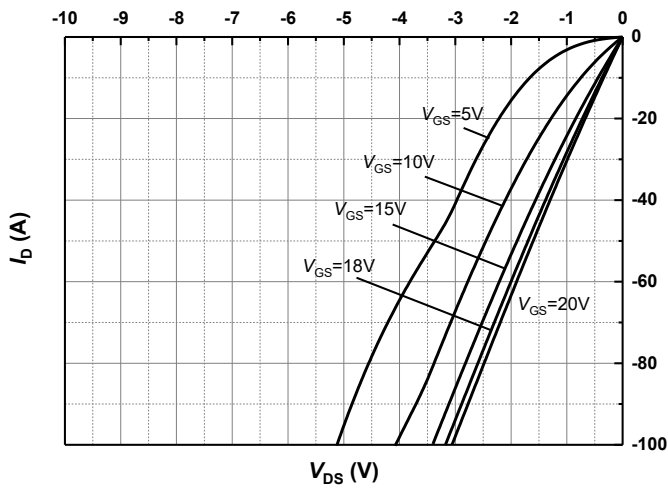


Figure 11 3rd Quadrant Characteristics at $T_j=25^{\circ}\text{C}$

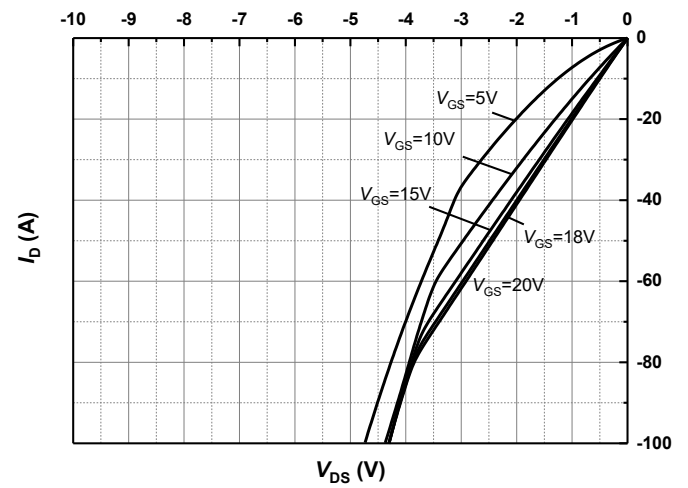


Figure 12 3rd Quadrant Characteristics at $T_j=175^{\circ}\text{C}$

Typical Performance

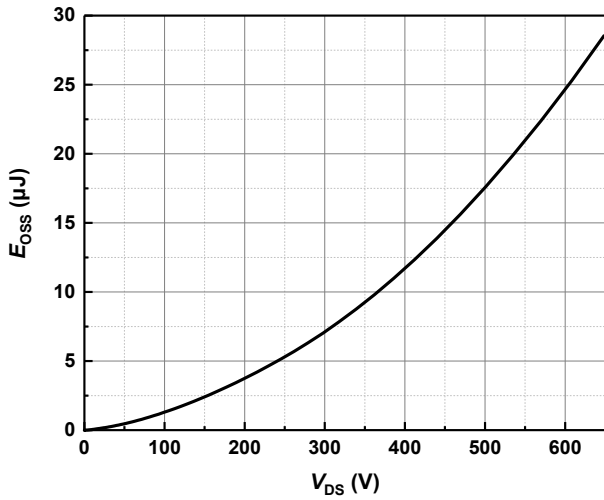


Figure 13 Output Capacitor stored Energy

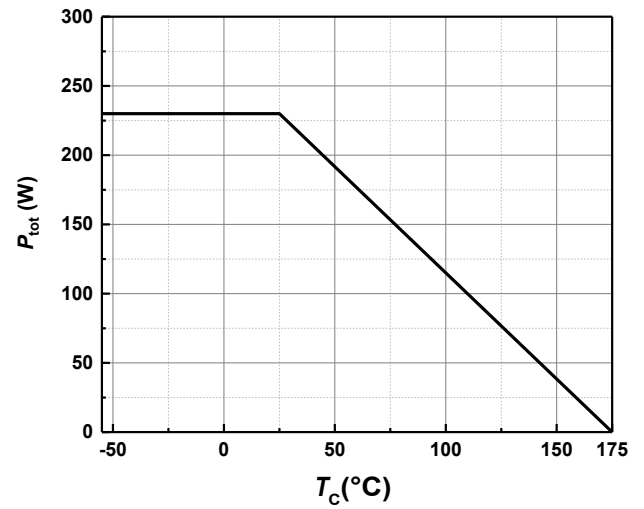


Figure 14 Maximum Power Dissipation Derating vs. Case Temperature

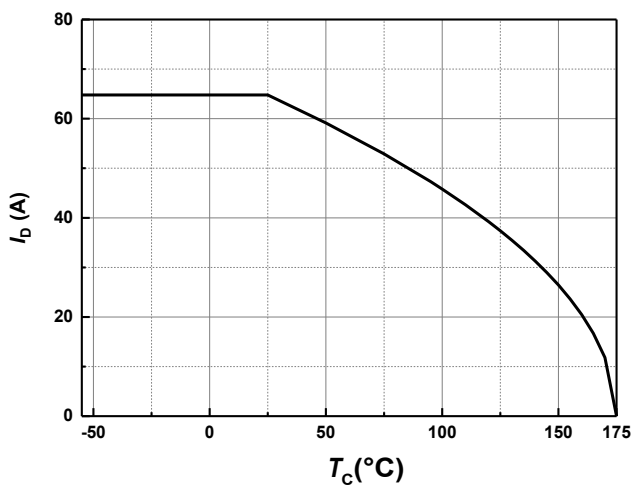


Figure 15 Continuous Drain Current Derating vs. Case Temperature

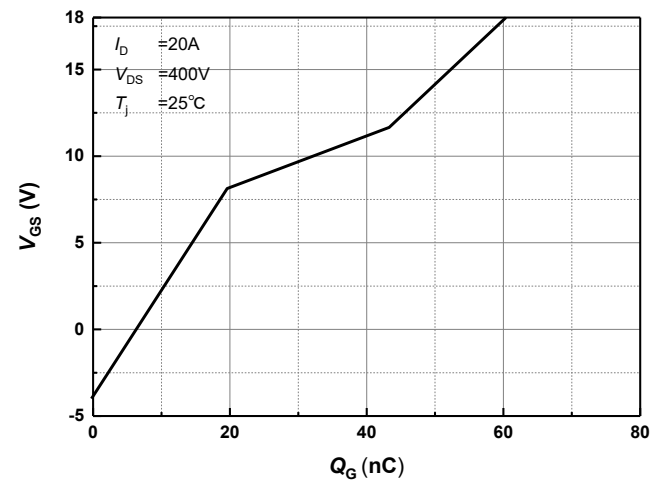


Figure 16 Gate Charge Characteristics

Typical Performance

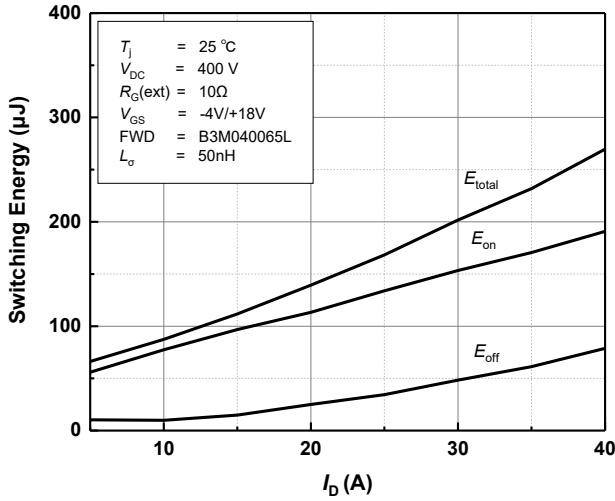


Figure 17 Clamped Inductive Switching Energy vs. Drain Current ($V_{\text{DC}} = 400\text{V}$) at $T_j = 25^\circ\text{C}$

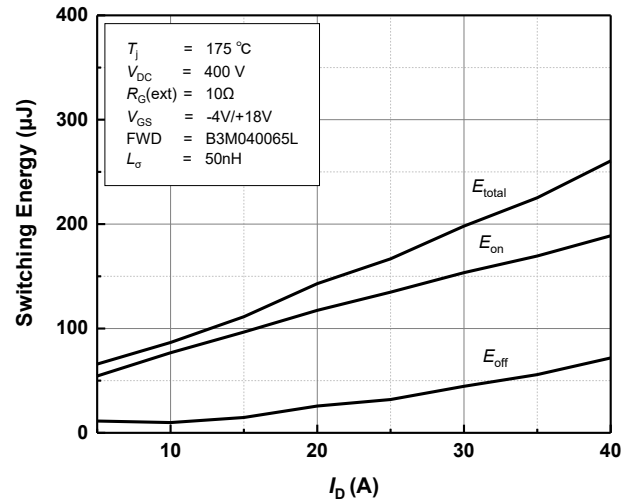


Figure 18 Clamped Inductive Switching Energy vs. Drain Current ($V_{\text{DC}} = 400\text{V}$) at $T_j = 175^\circ\text{C}$

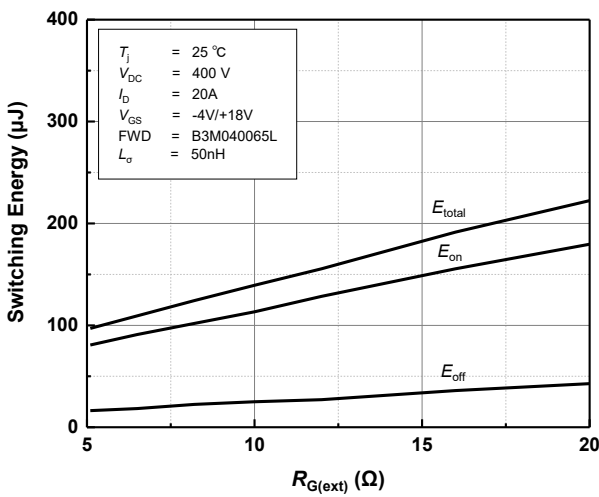


Figure 19 Clamped Inductive Switching Energy vs. External Gate Resistance at $T_j = 25^\circ\text{C}$

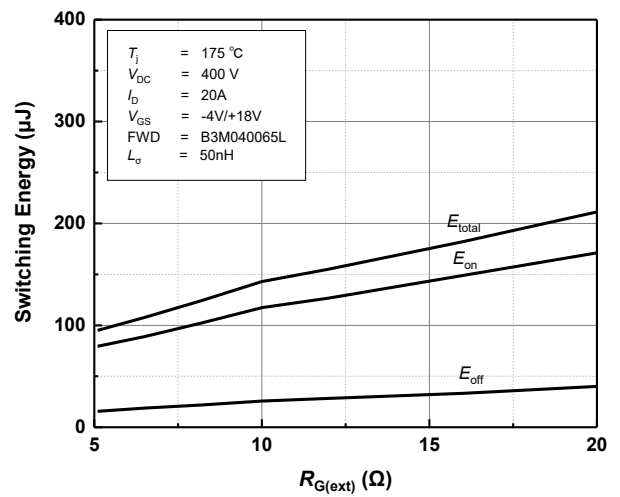


Figure 20 Clamped Inductive Switching Energy vs. External Gate Resistance at $T_j = 175^\circ\text{C}$

Typical Performance

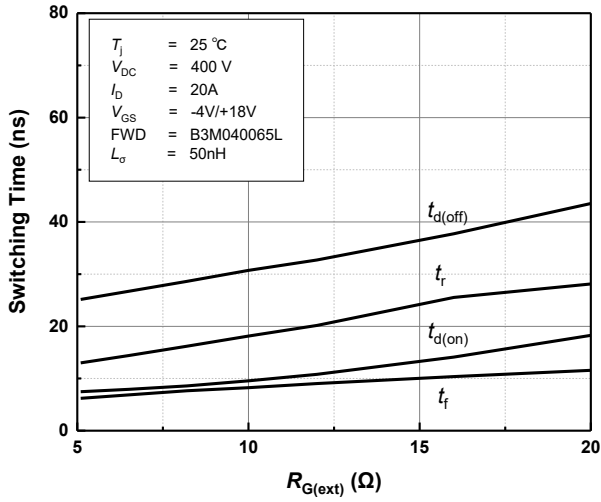


Figure 21 Clamped Inductive Switching Time vs. External Gate Resistance at $T_j=25^\circ\text{C}$

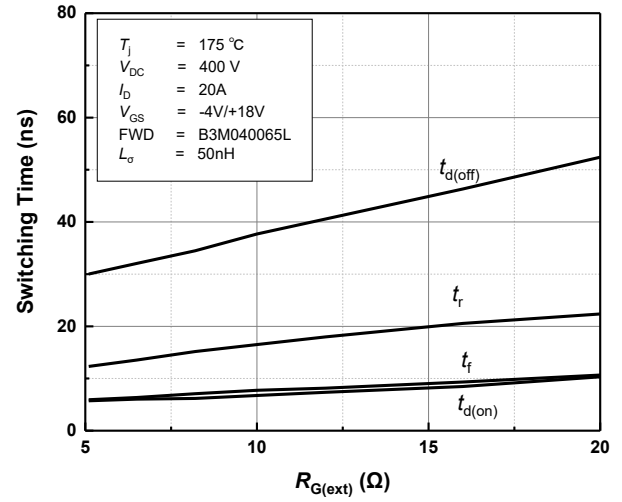


Figure 22 Clamped Inductive Switching Time vs. External Gate Resistance at $T_j=175^\circ\text{C}$

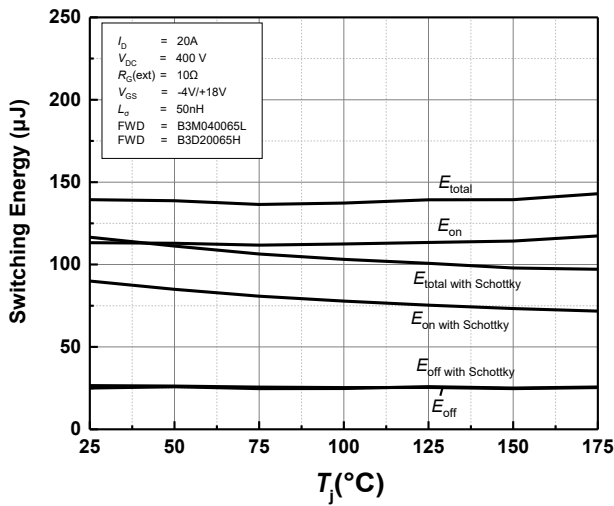


Figure 23 Clamped Inductive Switching Energy vs. Temperature

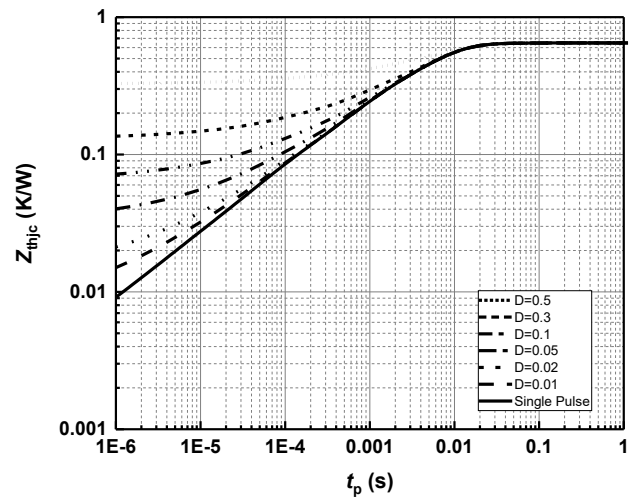


Figure 24 Transient Thermal Impedance (Junction - Case)

Typical Performance

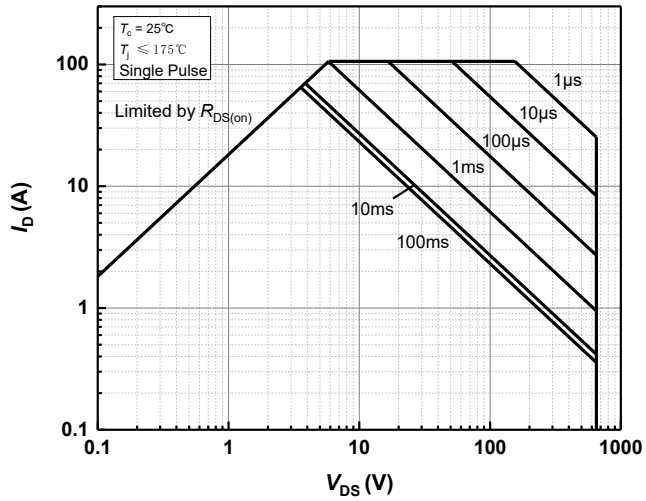
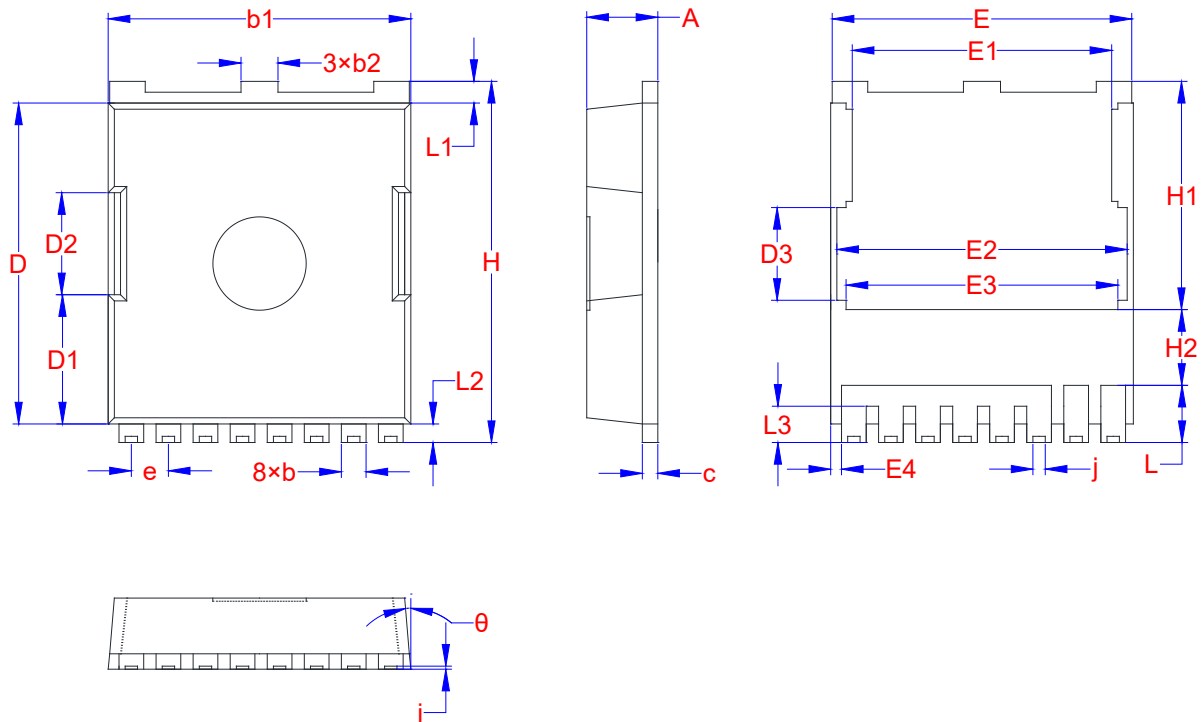


Figure 25 Forward Biased Safe Operating Area

Package Dimensions



SYMBOL	mm		
	MIN	NOM	MAX
A	2.20	2.30	2.40
b	0.70	0.80	0.90
b1	9.70	9.80	9.90
b2	1.20 REF.		
c	0.40	0.50	0.60
D	10.28	10.38	10.48
D1	4.08	4.18	4.28
D2	3.20	3.30	3.40
D3	3.16	3.26	3.36
E	9.80	9.90	10.00
E1	8.40	8.50	8.60
E2	9.30	9.40	9.50
E3	8.8 REF.		
E4	2.50	0.35	0.45
e	1.20 BSC		
H	11.58	11.68	11.78
H1	7.23	7.33	7.43
H2	2.45 REF.		
i	0.10		
j	0.45 REF.		
L	1.60	1.85	2.10
L1	0.60	0.70	0.80
L2	0.50	0.60	0.70
L3	1.00	1.15	1.30

Revision History

Document Version	Date of Release	Description of Changes
Rev. 0.0	2025-01-20	Draft datasheet created.

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