MSTB065R045T2RH

N-Channel Silicon Carbide Power MOSFET
650V, 51A, 45mΩ, T2, TOLL

Product Highlight

Features

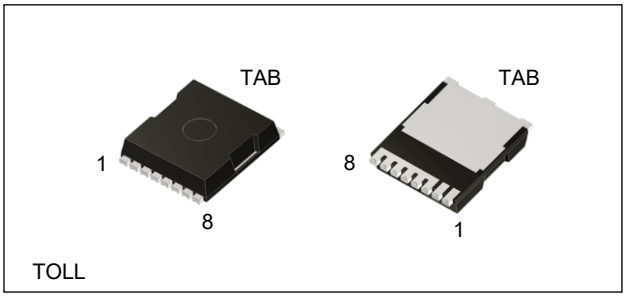
- High switching speed with a low gate charge
- Fast intrinsic diode with low reverse recovery
- Robust Avalanche Capability
- 100% Avalanche Tested
- Pb-free, Halogen Free, and RoHS Compliant

Benefits

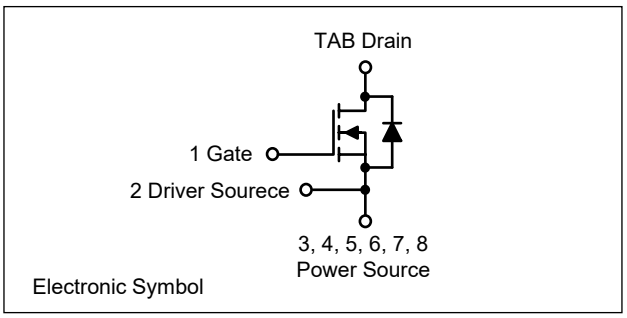
- System efficiency improvement
- Higher frequency applicability
- Increased power density
- Reduced cooling effort

Applications

- Server & Telecom power
- EV charging station
- Solar inverter / ESS / UPS
- Industrial power supply



TOLL



Electronic Symbol

RoHS Compliant
HALOGEN-FREE

Key Parameters

$BV_{DSS,\ Tc=25℃}$	$I_{D,\ Tc=25℃}$	$R_{DS(on),typ}$	$Q_{g,typ}$
650 V	51 A	45 mΩ	55 nC

Package Marking and Ordering Information

Part Number	Top Marking	Package	Packing Method	Quantity
MSTB065R045T2RH	065R045T2	TOLL	Tape & Reel	1000 units

Absolute Maximum Ratings (T_C = 25℃ unless otherwise noted)

Symbol	Parameter		Value	Unit
V_{DSS}	Drain to Source Voltage		650	V
V_{GS}	Gate to Source Voltage (DC)		-10 / +22	V
V_{GSop}	Recommended Operation Value		-5 / +18	V
I_D	Drain Current	Continuous (T_C = 25℃)	51*	A
		Continuous (T_C = 100℃)	36*	
I_{DM}	Drain Current	Pulsed (Note1)	137*	A
P_D	Power Dissipation	(T_C = 25℃)	214	W
		Derate Above 25℃	1.43	W/℃
T_J	Operating Temperature Range		-55 to 175	℃

*Limited by maximum junction temperature.
Note 1. Repetitive rating: pulse-width limited by maximum junction temperature.

1. Package

Temperature Ratings

Symbol	Parameter	Value	Unit
T_{STG}	Storage Temperature Range	-55 to 175	℃
T_L	Maximum Lead Temperature for Soldering, 1/8” from Case for 10 Seconds	260	℃

Thermal Characteristics

Symbol	Parameter	Value	Unit
$R_{\theta JC}$	Thermal Resistance, Junction to Case, Max.	0.7	℃/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient, Max.	40	

2. MOSFET

Electrical Characteristics (T_C = 25℃ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Off Characteristics						
BV_{DSS}	Drain to Source Breakdown Voltage	V_{GS} = 0 V, I_D = 1 mA	650			V
I_{DSS}	Zero Gate Voltage Drain Current	V_{DS} = 650 V, V_{GS} = 0 V		1	100	μA
		V_{DS} = 650 V, V_{GS} = 0 V, T_J = 175℃		10		
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	
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{GS} = V_{DS}, I_D = 7.0 mA (tested after V_{GS} = 22V, 1 ms pulse)	1.8	2.8	4.5	V
$R_{DS(on)}$	Static Drain to Source On Resistance	V_{GS} = 18 V, I_D = 20 A		45	63	mΩ
		V_{GS} = 18 V, I_D = 20 A, T_J = 175℃		61		
g_{fs}	Transconductance	V_{DS} = 20 V, I_D = 20 A		13.3		S
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{DS} = 400 V, V_{GS} = 0V, f = 250 kHz		1238		pF
C_{oss}	Output Capacitance			137		
C_{rss}	Reverse Capacitance			7.7		
E_{oss}	Stored Energy in Output Capacitance	V_{DS} = 0 V to 400 V, V_{GS} = 0 V		13.6		μJ
$C_{o(er)}$	Energy Related Output Capacitance			169		pF
$C_{o(tr)}$	Time Related Output Capacitance			242		
$Q_{g(tot)}$	Total Gate Charge	V_{DS} = 400 V, I_D = 20 A, V_{GS} = -5 V / 18 V, Inductive load		55		nC
Q_{gs}	Gate to Source Charge			16		
Q_{gd}	Gate to Drain “Miller” Charge			14		
R_G	Internal Gate Resistance	f = 1MHz		2.5		Ω
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	V_{DS} = 400 V, I_D = 20 A, V_{GS} = -5 V / 18 V, R_G = 5.6 Ω, Inductive load		13.9		ns
t_r	Turn-On Rise Time			10.8		
$t_{d(off)}$	Turn-Off Delay Time			27.9		
t_f	Turn-Off Fall Time			6.0		
E_{on}	Turn-on Switching Energy			33.6		μJ
E_{off}	Turn-off Switching Energy			22.8		
E_{tot}	Total Switching Energy			56.4		

3. Body Diode

Electrical Characteristics (T_C = 25℃ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Source-Drain Diode Characteristics						
I_S	Maximum Continuous Diode Forward Current				51*	A
I_{SM}	Maximum Pulsed Diode Forward Current				137*	
V_{SD}	Diode Forward Voltage	V_{GS} = -5 V, I_{SD} = 20 A		4.4		V
t_{rr}	Reverse Recovery Time	V_{DD} = 400 V, I_{SD} = 20 A, dI_F/dt = 1000 A/μs, Includes Q_{OSS}		17.9		ns
Q_{rr}	Reverse Recovery Charge			107		nC
I_{rrm}	Peak Reverse Recovery Current			10.1		A

*Limited by maximum junction temperature.

4. Typical Performance Characteristics

Figure 1. On-Region Characteristics T_J = -40℃

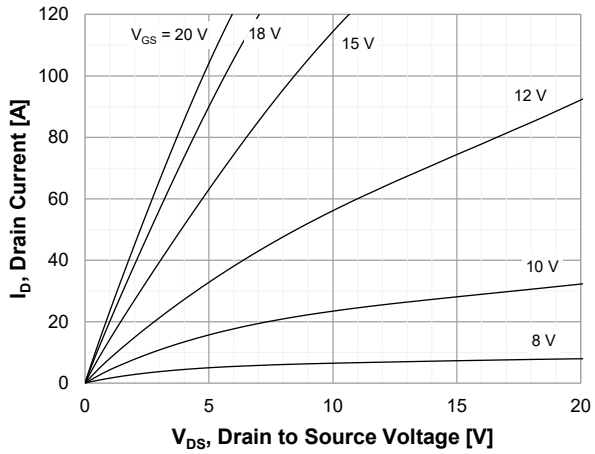


Figure 2. On-Region Characteristics T_J = 25℃

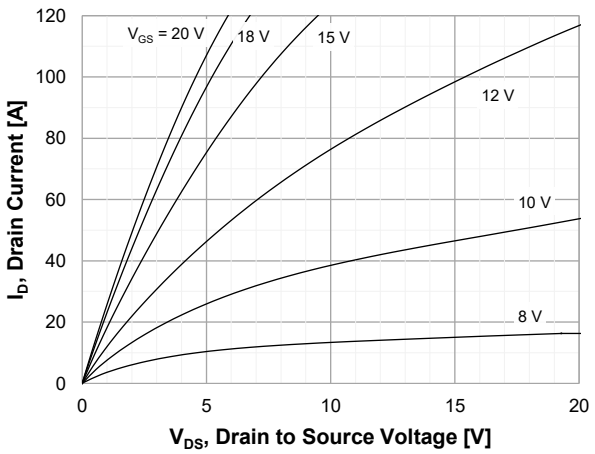


Figure 3. On-Region Characteristics T_J = 125℃

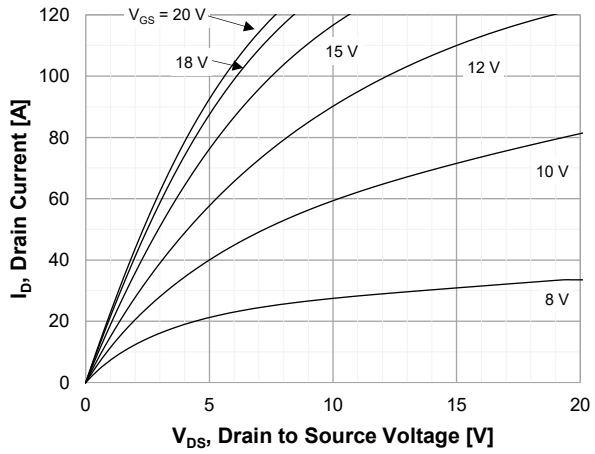


Figure 4. On-Region Characteristics T_J = 175℃

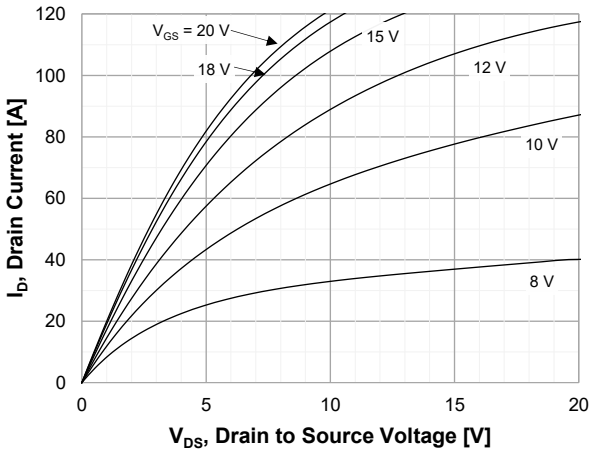


Figure 5. On-Resistance Characteristics vs. Temperature

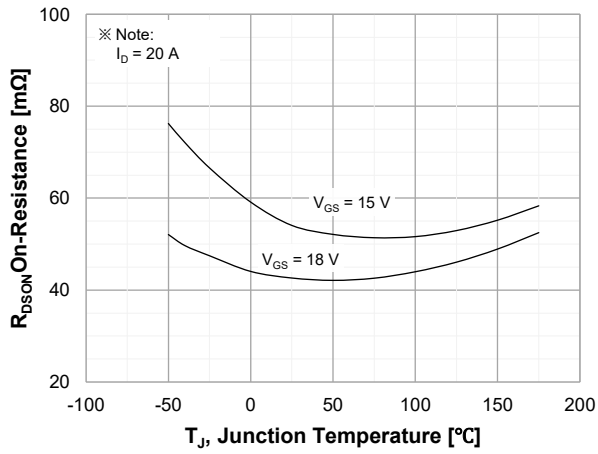
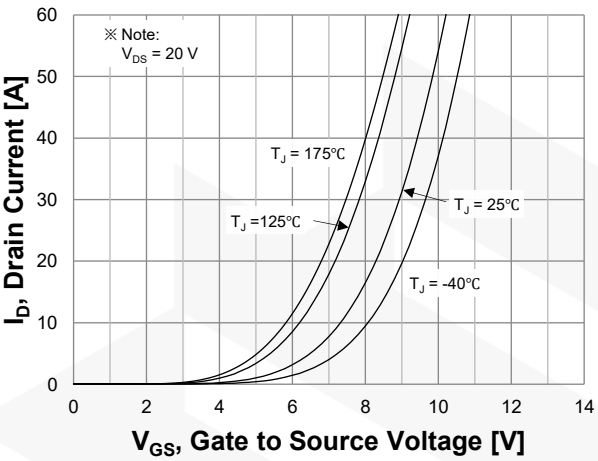


Figure 6. Transfer Characteristics



4. Typical Performance Characteristics

Figure 7. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = -40℃

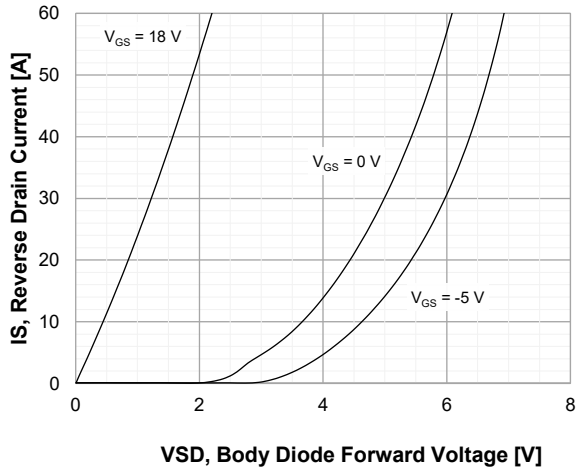


Figure 8. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = 25℃

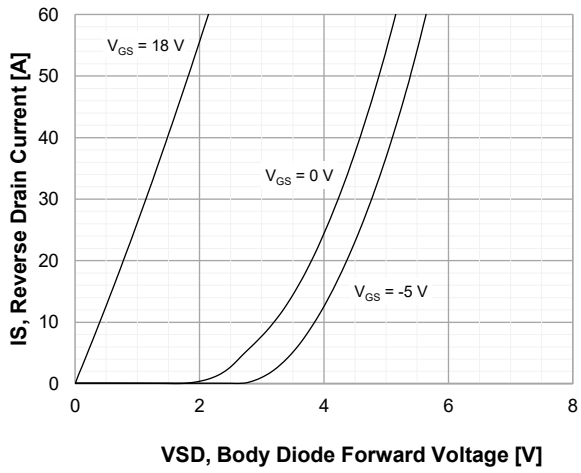


Figure 9. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = 125℃

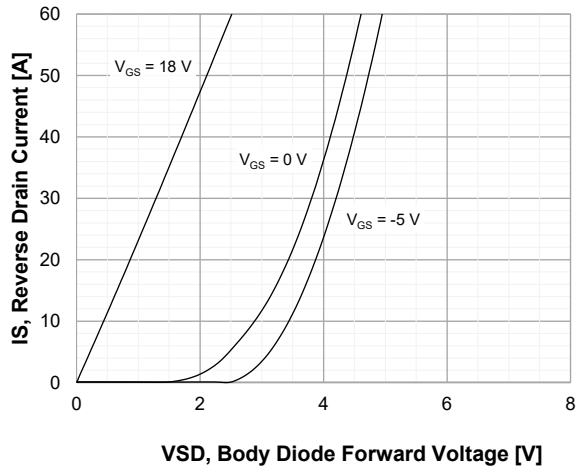


Figure 10. Diode Forward Voltage Characteristics vs. Source-Drain Current T_J = 175℃

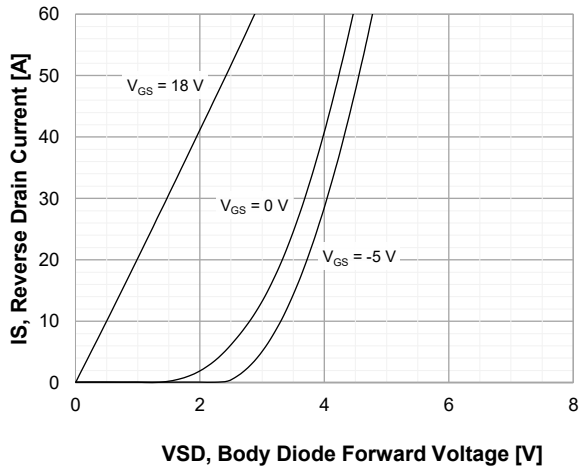


Figure 11. Threshold Voltage vs. Temperature

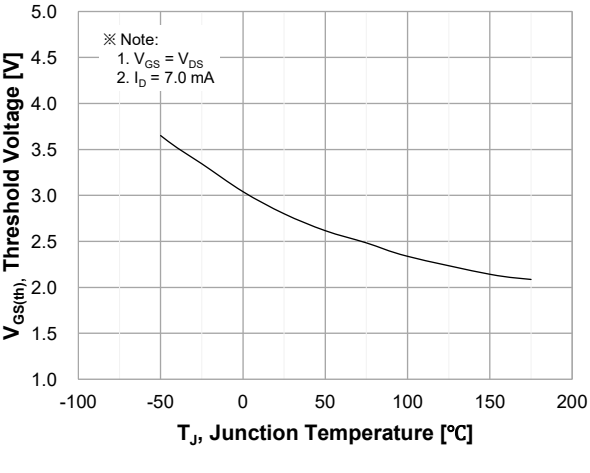
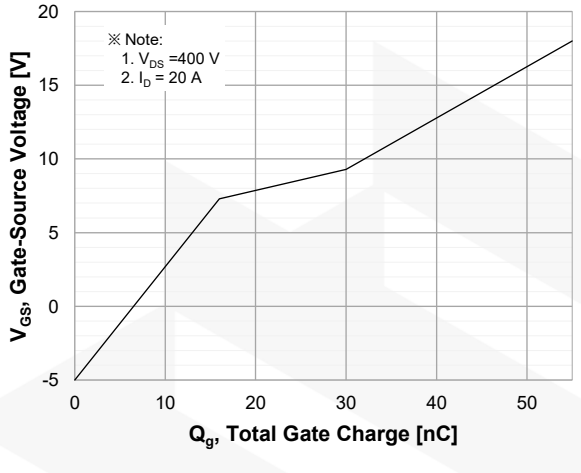


Figure 12. Gate Charge Characteristics



4. Typical Performance Characteristics

Figure 13. Stored Energy in Output Capacitance

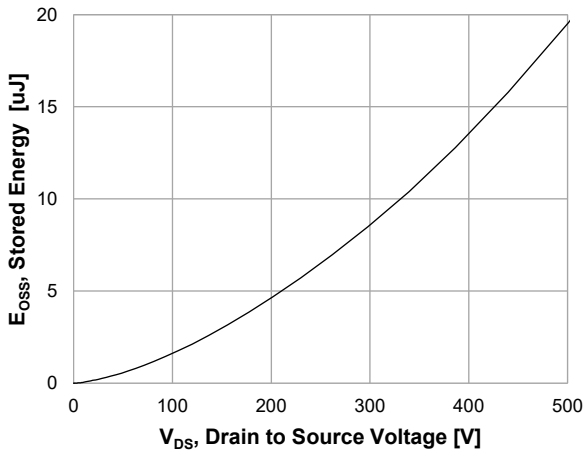


Figure 14. Capacitance Characteristics

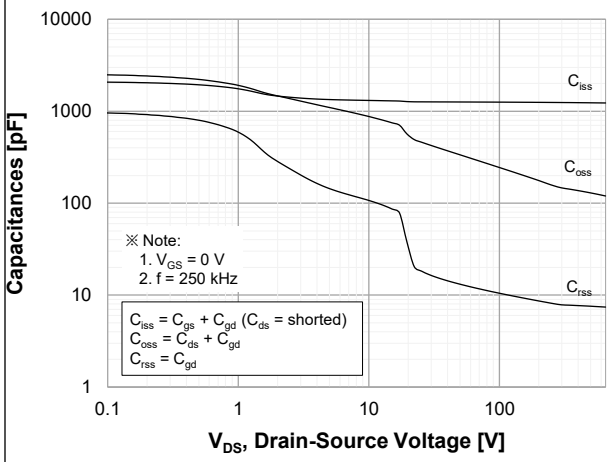


Figure 15. Continuous Drain Current Derating vs. Case Temperature

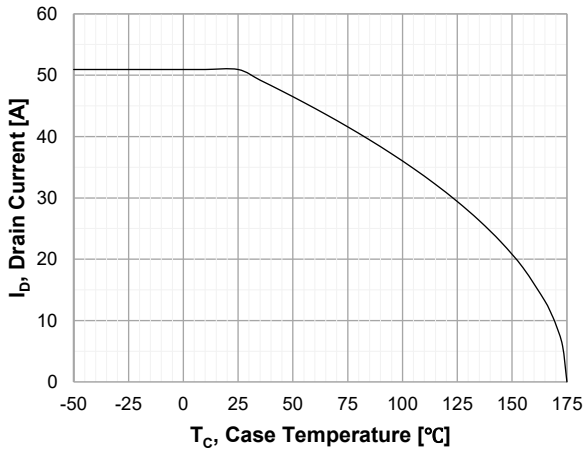


Figure 16. Maximum Power Dissipation Derating vs. Case Temperature

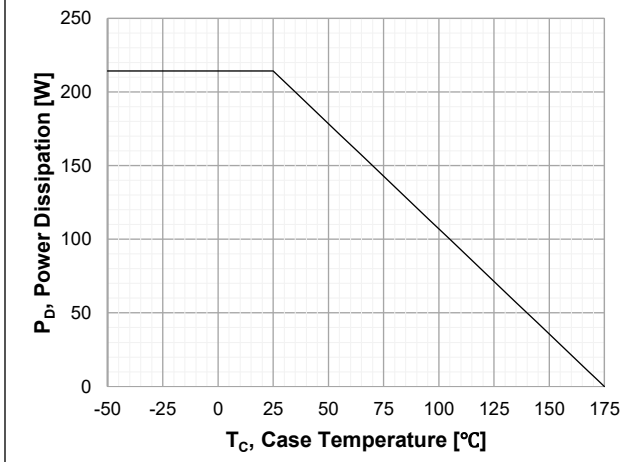


Figure 17. Typ. Switching Losses vs. Drain Current

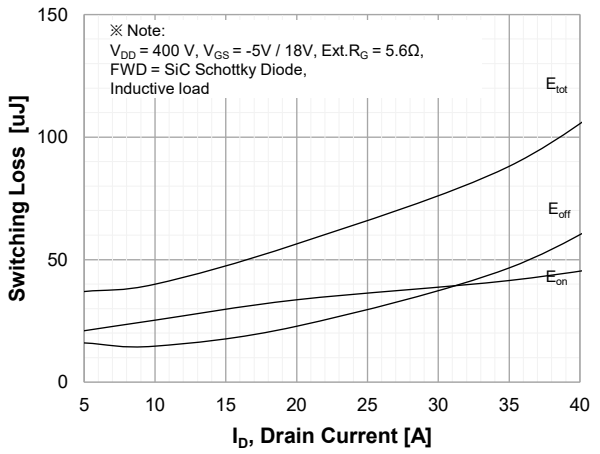
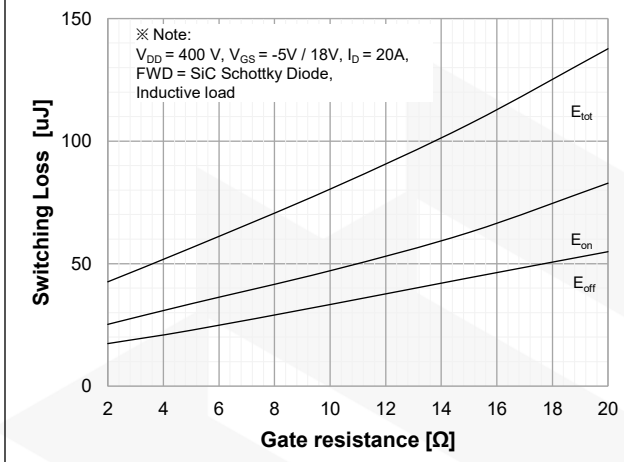


Figure 18. Typ. Switching Losses vs. Gate Resistance



4. Typical Performance Characteristics

Figure 19. Typ. Switching Losses vs. Drain Current

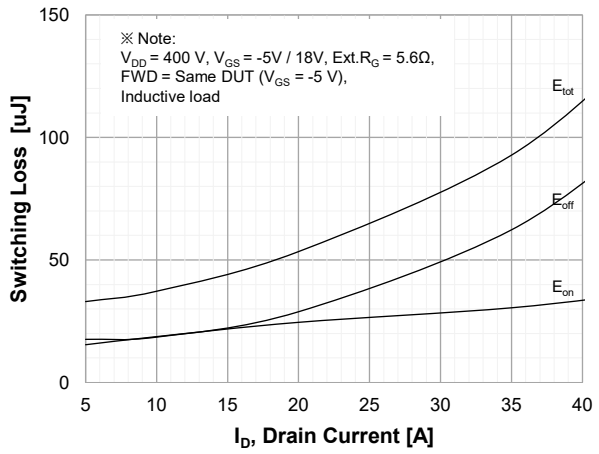


Figure 20. Typ. Switching Losses vs. Gate Resistance

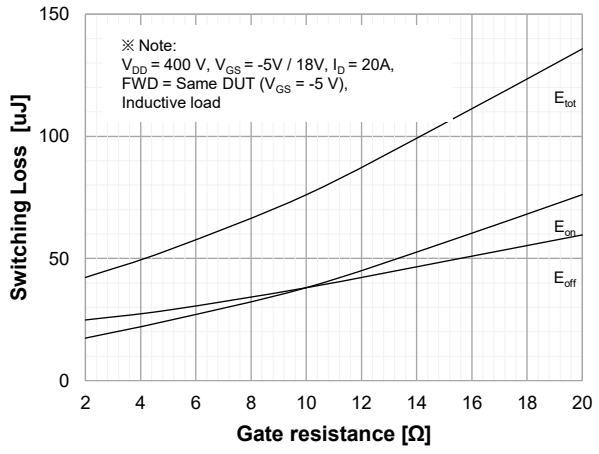


Figure 21. Maximum Safe Operating Area

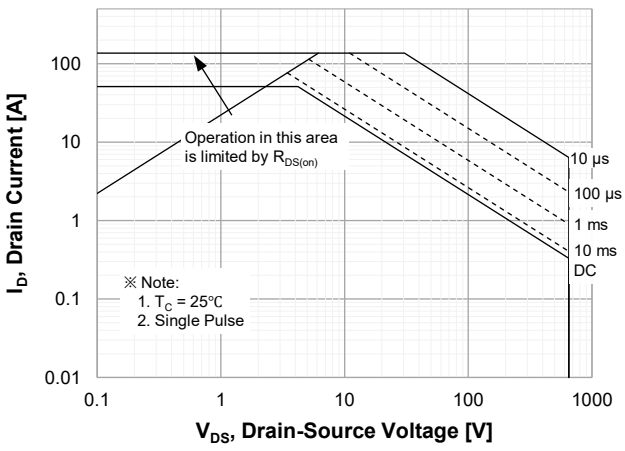
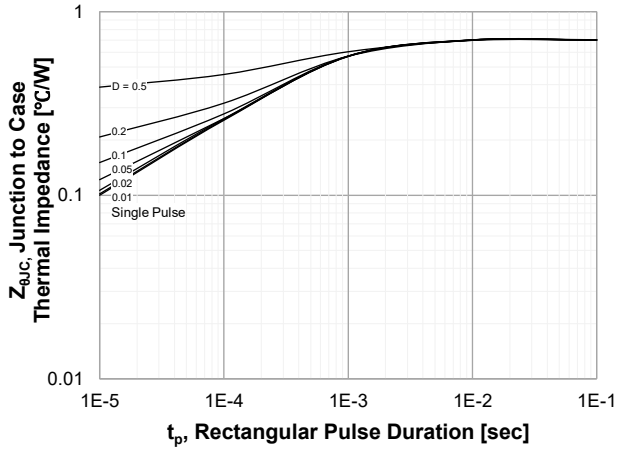


Figure 22. Transient Thermal Response Curve



5. Testing conditions

Figure 23. Inductive Load Switching Test Circuit and Waveforms

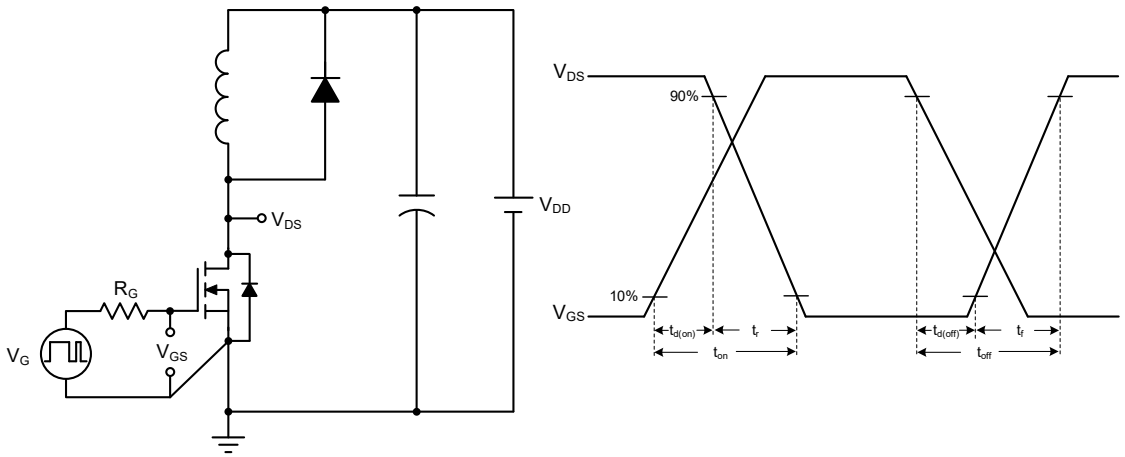
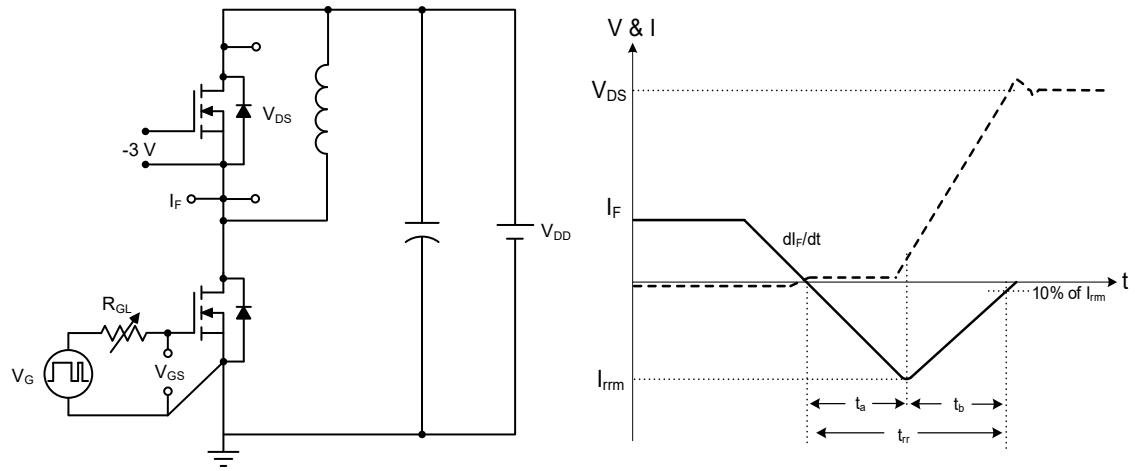
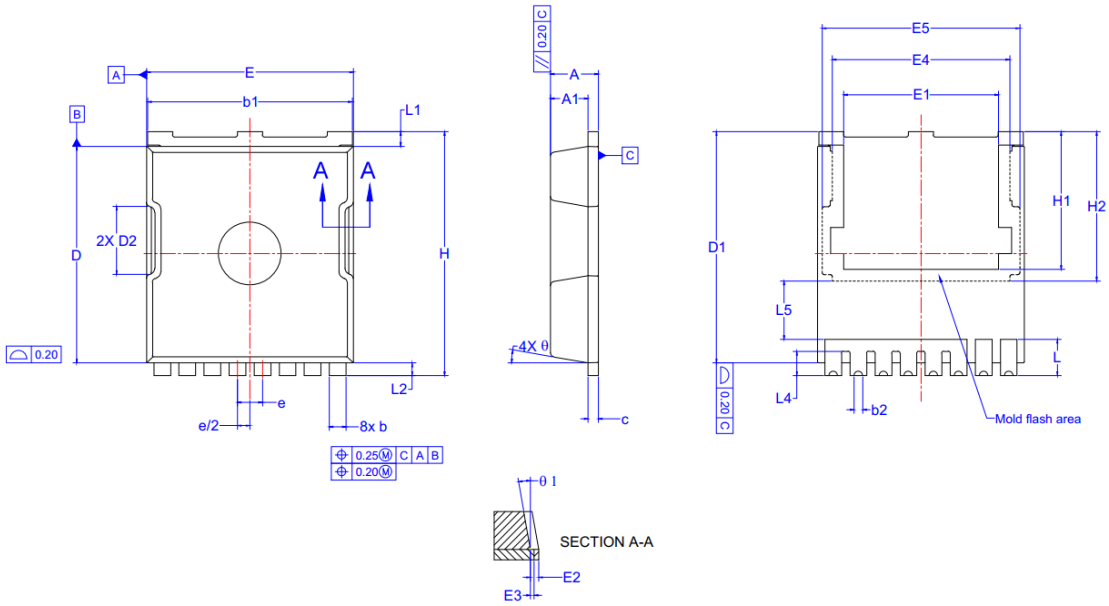


Figure 24. Peak Diode Recovery dv/dt Test Circuit and Waveforms



6. Package Outlines – TOLL

* Dimensions in millimeters



SYMBOL	MIN.	NOM.	MAX.
A	2.20	2.30	2.40
A1	1.70	1.80	1.90
b	0.70	0.80	0.90
b1	9.70	9.80	9.90
b2	0.36	0.41	0.51
c	0.40	0.50	0.60
D	10.28	10.38	10.48
D1	10.98	11.08	11.18
D2		3.30	
E	9.80	9.90	10.00
E1	7.32	7.42	7.52
E2	0.30	0.40	0.50
E3	0.15	0.18	0.21
E4		8.50	
E5		9.46	
e		1.20 BASIC	
H	11.58	11.68	11.78
H1	6.55	6.65	6.75
H2	7.05	7.15	7.25
L	1.63	1.73	1.83
L1	0.60	0.70	0.80
L2	0.50	0.60	0.70
L4	1.00	1.15	1.30
L5	2.70	2.80	2.90
N		8	
θ		10° REF.	
θ1		10° REF.	

* Dimensions in millimeters