

Features

- ◆ High Speed Switching with Low Capacitances
- ◆ High Blocking Voltage with Low $R_{DS(on)}$
- ◆ Easy to Parallel
- ◆ Simple to Drive
- ◆ RoHS Compliant

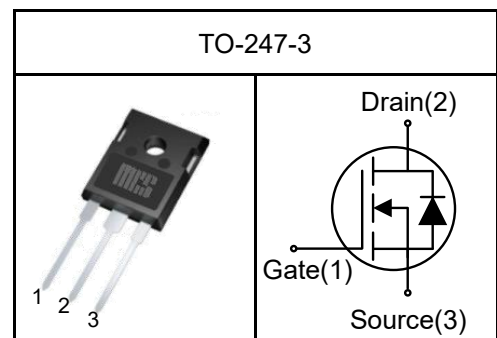
Benefits

- ◆ Increased Power Density
- ◆ Faster Operating Frequency
- ◆ Reduction of Heat Sink Requirements
- ◆ Higher Efficiency
- ◆ Reduced EMI

Applications

- ◆ Power Factor Correction Modules
- ◆ Switch Mode Power Supplies
- ◆ DC-AC Inverters
- ◆ High Voltage DC/DC Converters

Part NO.	MS1M060065D		
V_{DS}	=	650 V	
$I_D(T_c=25^\circ\text{C})$	=	53 A	
$R_{DS(on)}$	=	53 mΩ	

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

Symbol	Parameter	Test conditions	Value	Unit
V_{DS}	Drain-Source Voltage		650	V
I_D	Continuous Drain Current	$T_c=25^\circ\text{C}$ $T_c=100^\circ\text{C}$	53 37	A
I_{DM}	Peak Drain Current	Pulse width t_p limited by T_{jmax}	100	A
V_{GSmax}	Gate-Source Voltage		-8/+22	V
V_{GSop}	Recommend Gate-Source Voltage		-4/+18	V
P_{tot}	Power Dissipation	$T_c=25^\circ\text{C}$ $T_c=100^\circ\text{C}$	185 92	W
T_j	Operating Junction Temperature		-40~175	$^\circ\text{C}$
T_{stg}	Storage Temperature		-40~175	$^\circ\text{C}$

Electrical Characteristics

Static Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D=100\mu A$, $V_{GS}=0V$	650			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=650V$, $V_{GS}=0V$		1	100	μA
I_{GSS}	Gate-Source Leakage Current	$V_{DS}=0V$, $V_{GS}=18V$			250	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=5mA$ $T_j=25^\circ C$ $T_j=175^\circ C$	2	2.7 1.9	4	V
$R_{DS(on)}$	Drain-Source On-State Resistance	$V_{GS}=18V$, $I_D=20A$ $T_j=25^\circ C$ $T_j=175^\circ C$		53 58		m Ω

Thermal Characteristics

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
$R_{th(j-c)}$	Thermal Resistance from Junction to Case		0.81		$^\circ C/W$

Dynamic Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
C_{iss}	Input Capacitance	$V_{DS}=600V$, $f=1MHz$, $V_{GS}=0V$		1301		pF
C_{oss}	Output Capacitance			138		pF
C_{rss}	Reverse Transfer Capacitance			14		pF
$R_{G(int)}$	Internal Gate Resistance	$f=1MHz$		2.1		Ω
Q_g	Total Gate Charge	$V_{DS}=400V$, $I_D=20A$, $V_{GS}=-4/18V$		68		nC
Q_{gs}	Gate to Source Charge			17		nC
Q_{gd}	Gate to Drain Charge			22		nC

Switching Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-On Delay Time	$V_{DD}=400V$, $I_D=20A$, $V_{GS}=-4V/18V$, $R_{G(ext)}=2.5\Omega$, $L=200\mu H$		12		ns
t_r	Rise Time			18		ns
$t_{d(off)}$	Turn-Off Delay Time			18		ns
t_f	Fall Time			7		ns
E_{on}	Turn-On Energy			75		μJ
E_{off}	Turn-Off Energy			47		μJ

Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
V_{SD}	Diode Forward Voltage	$V_{GS}=-4V$, $I_{SD}=10A$ $T_j=25^\circ C$ $T_j=175^\circ C$ $V_{GS}=-4V$, $I_{SD}=20A$ $T_j=25^\circ C$ $T_j=175^\circ C$		4.6 4.0 5.4 4.6		V
I_S	Continuous Diode Forward Current	$V_{GS}=-4V$ $T_c=25^\circ C$ $T_c=100^\circ C$		33 18		A
t_{rr}	Reverse Recovery Time	$V_{GS}=-4V$, $I_{SD}=20A$, $V_R=400V$, $di/dt=1076A/\mu s$		18		ns
Q_{rr}	Reverse Recovery Charge			88		nC
I_{rrm}	Peak Reverse Recovery Current			8.3		A

Typical Performance

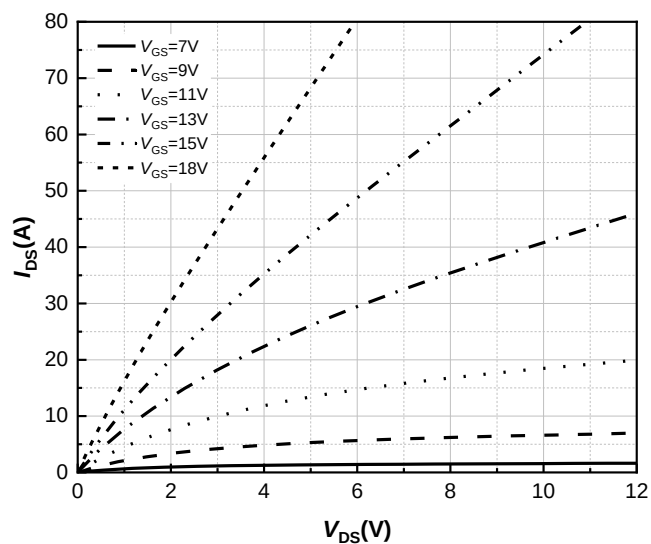


Figure 1. Output Characteristics
 $T_j = -40^\circ\text{C}$

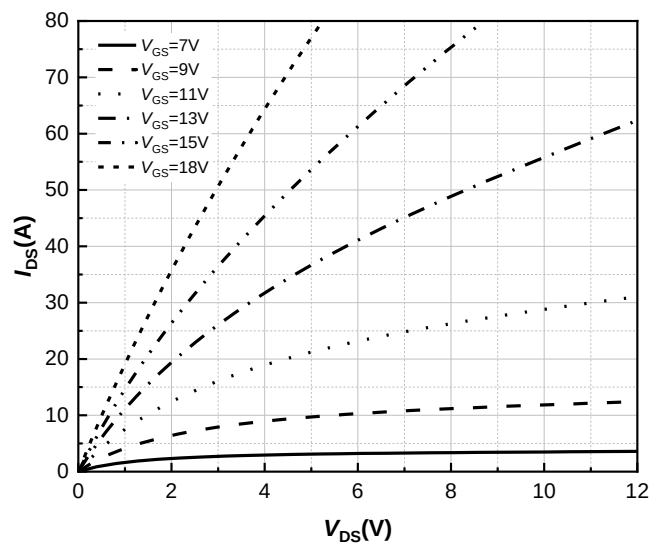


Figure 2. Output Characteristics
 $T_j = 25^\circ\text{C}$

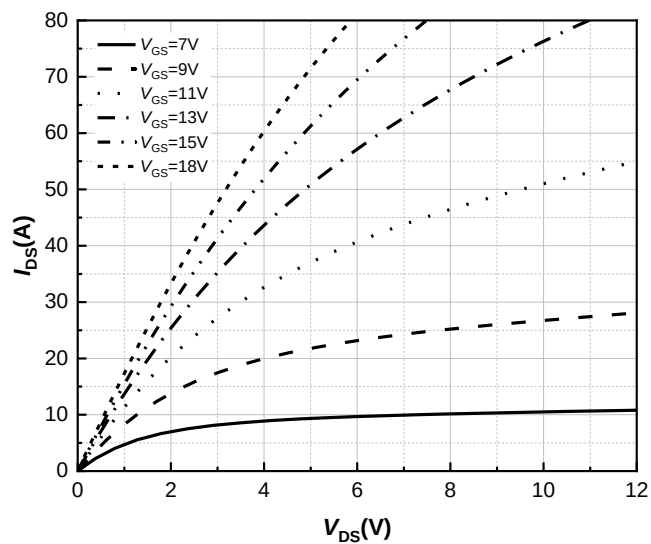


Figure 3. Output Characteristics
 $T_j = 175^\circ\text{C}$

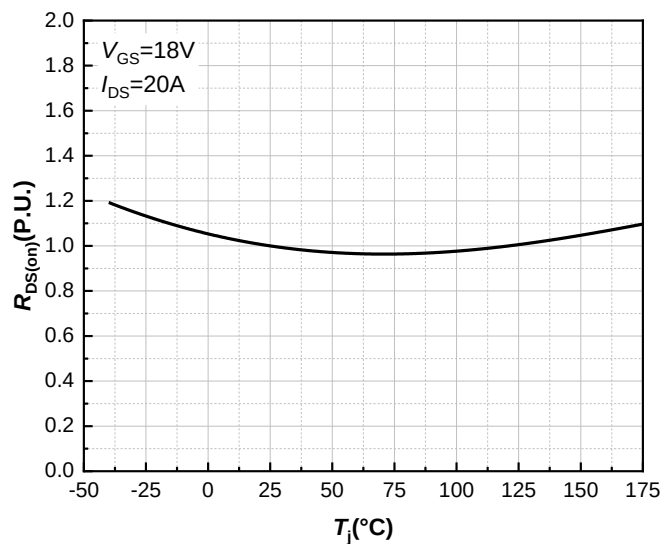


Figure 4. Normalized On-Resistance vs. Temperature

Typical Performance

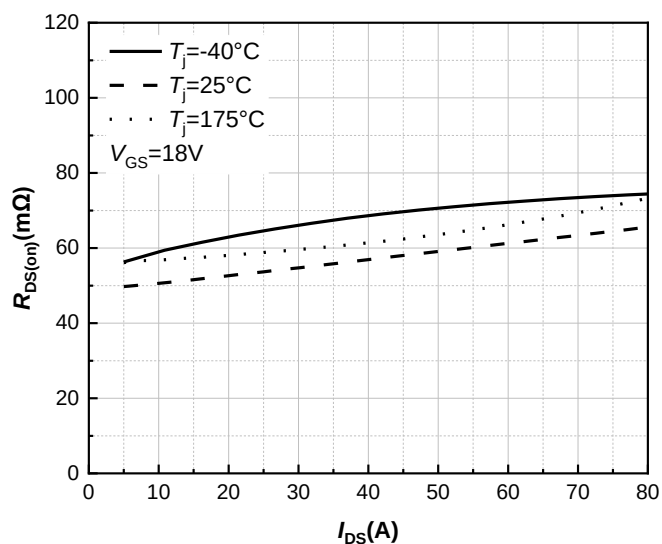


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

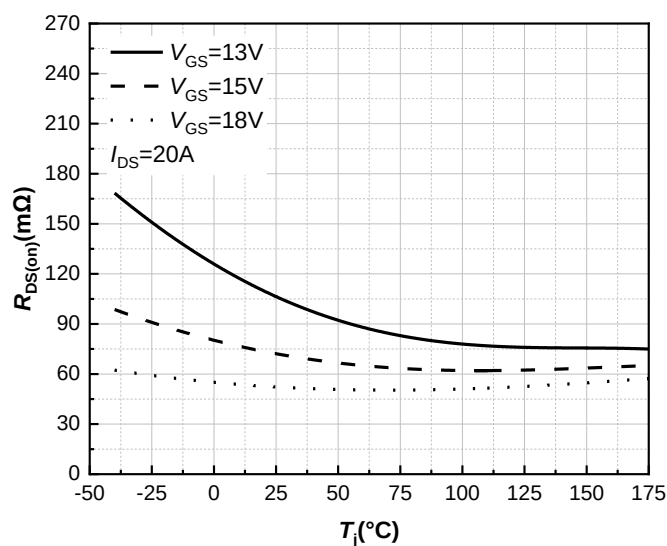


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

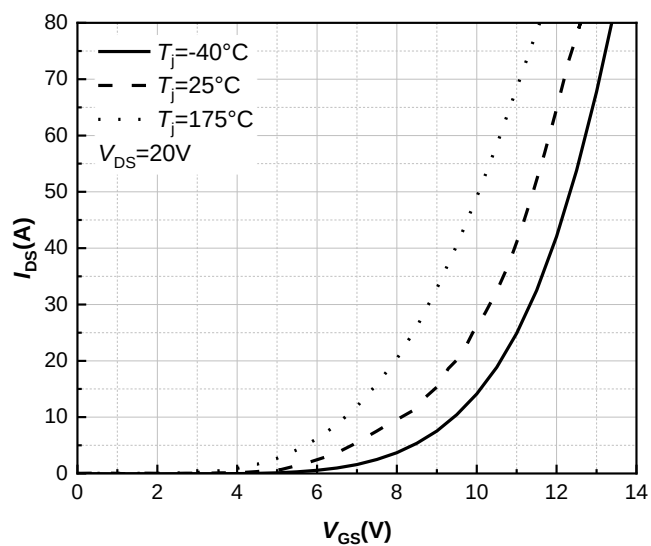


Figure 7. Transfer Characteristic for Various Junction Temperatures

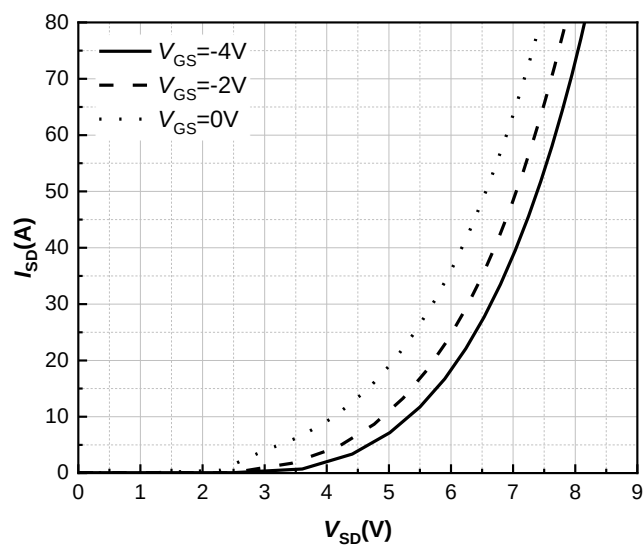


Figure 8. Body Diode Characteristic $T_j = -40^\circ\text{C}$

Typical Performance

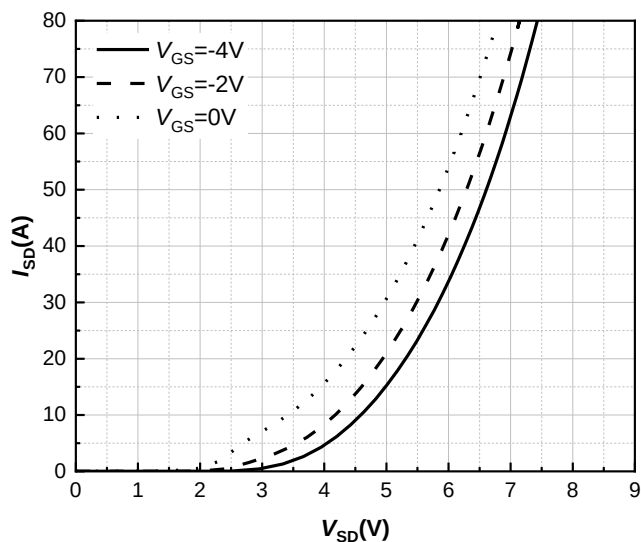


Figure 9. **Body Diode Characteristic**
 $T_j=25^{\circ}\text{C}$

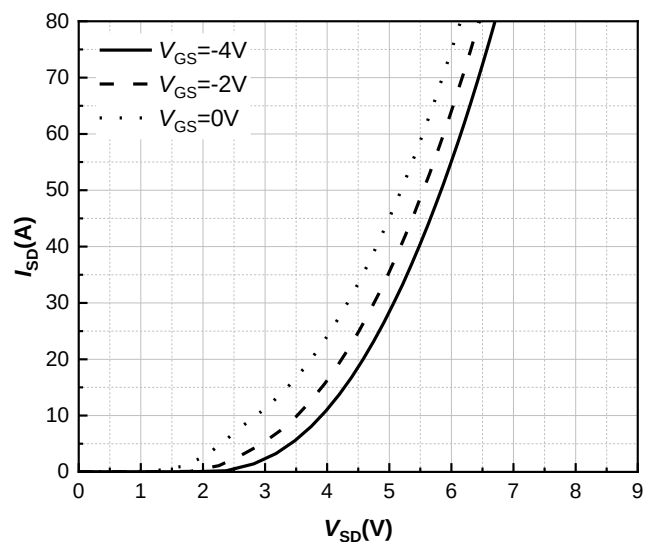


Figure 10. **Body Diode Characteristic**
 $T_j=175^{\circ}\text{C}$

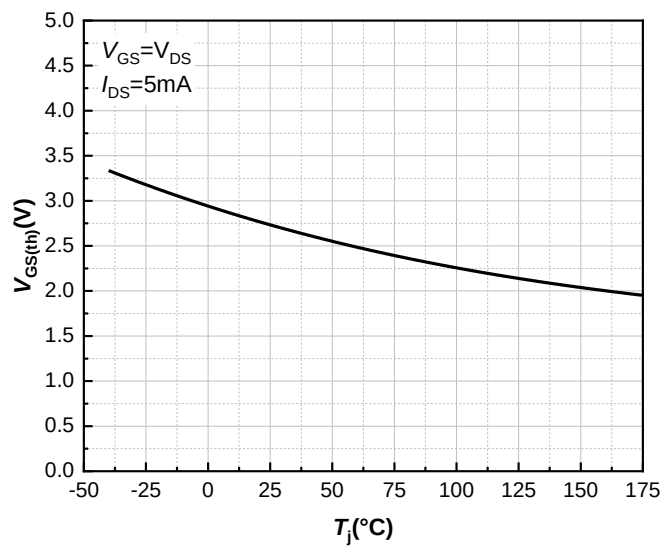


Figure 11. **Threshold Voltage vs. Temperature**

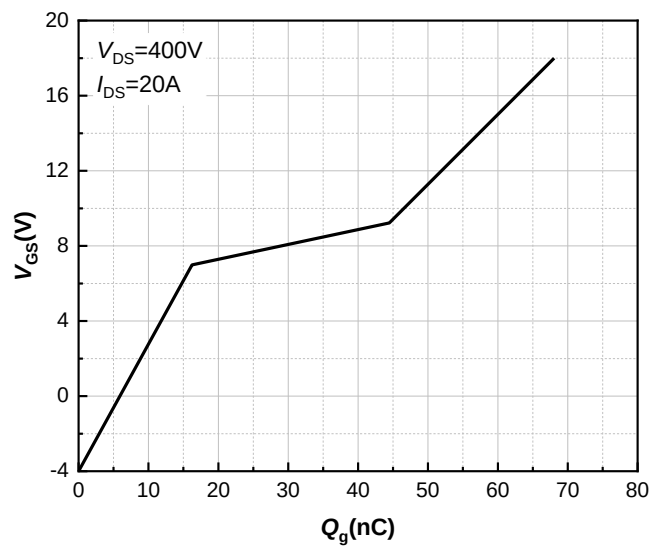


Figure 12. **Gate Charge Characteristics**

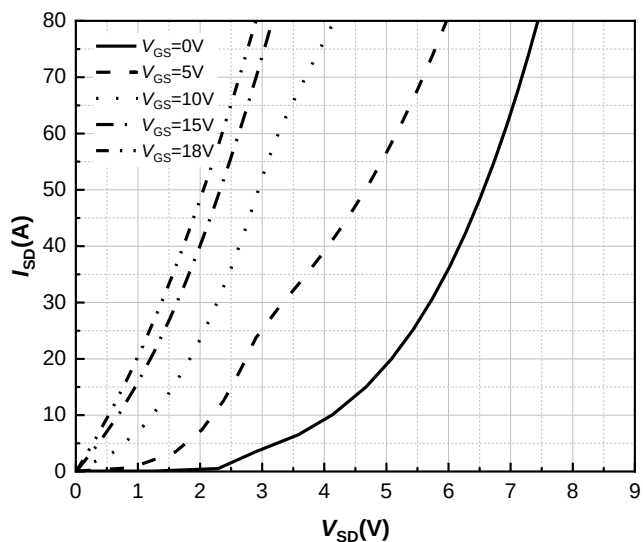
Typical Performance

Figure 13. 3rd Quadrant Characteristic
 $T_j = -40^\circ\text{C}$

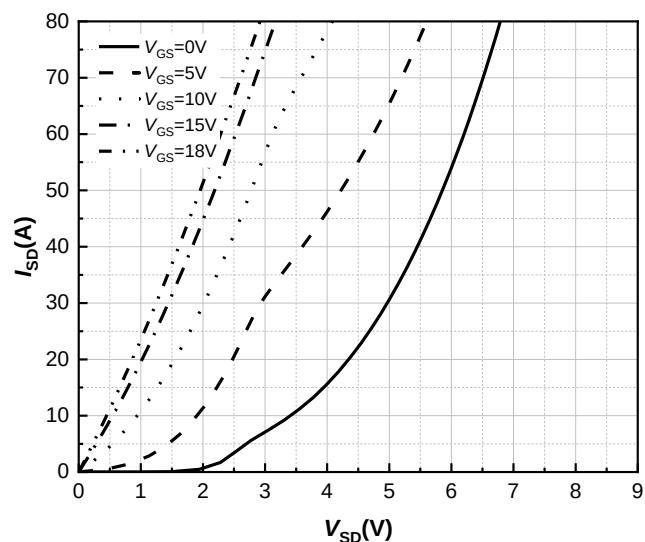


Figure 14. 3rd Quadrant Characteristic
 $T_j = 25^\circ\text{C}$

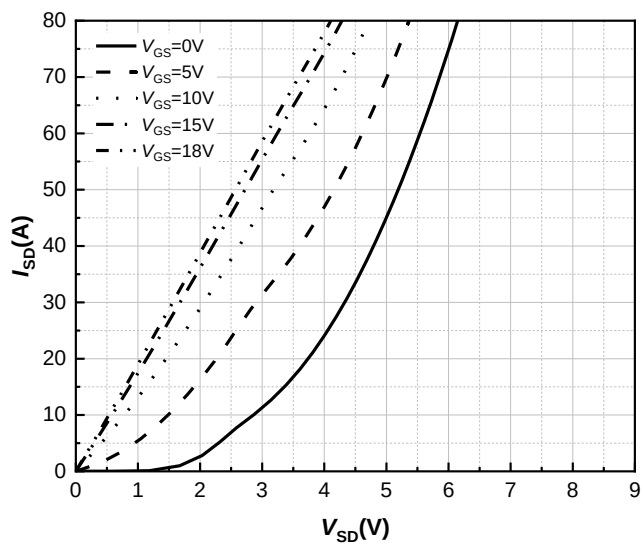


Figure 15. 3rd Quadrant Characteristic
 $T_j = 175^\circ\text{C}$

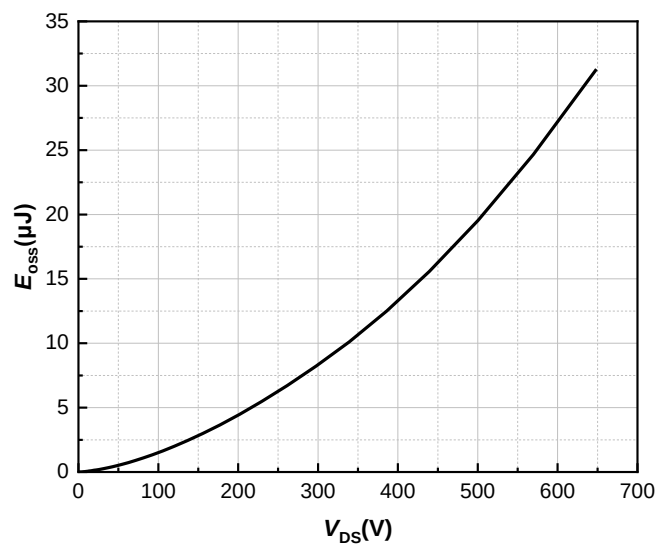


Figure 16. Output Capacitor Stored Energy

Typical Performance

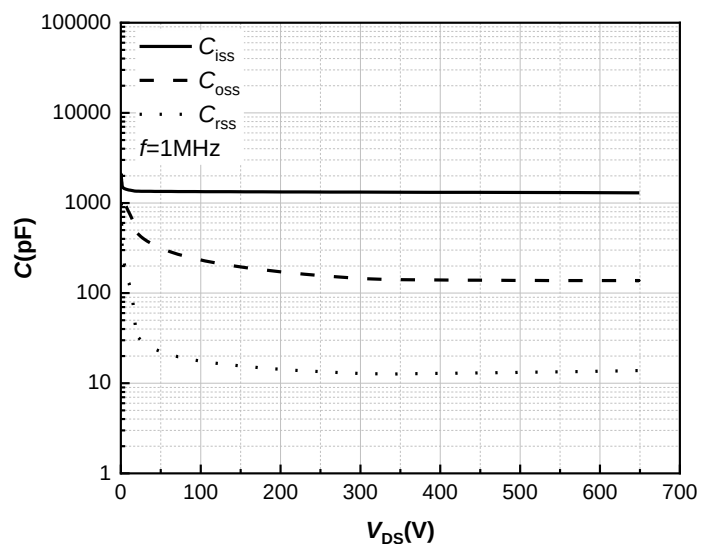


Figure 17. Capacitances vs. Drain-Source

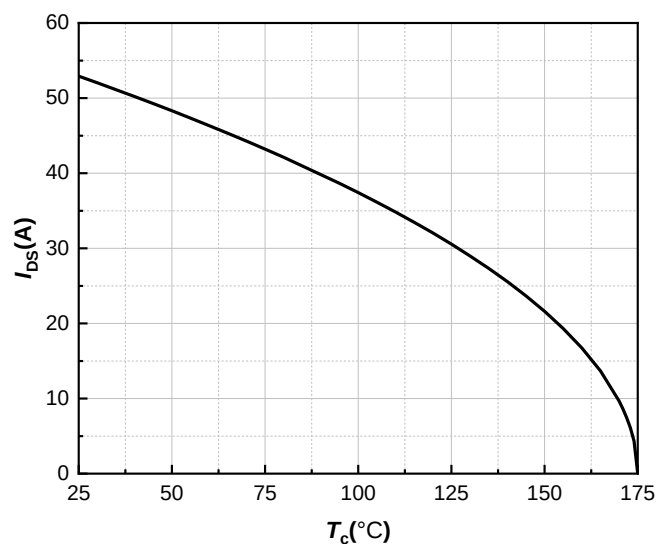


Figure 18. Continuous Drain Current Derating vs. Case Temperature

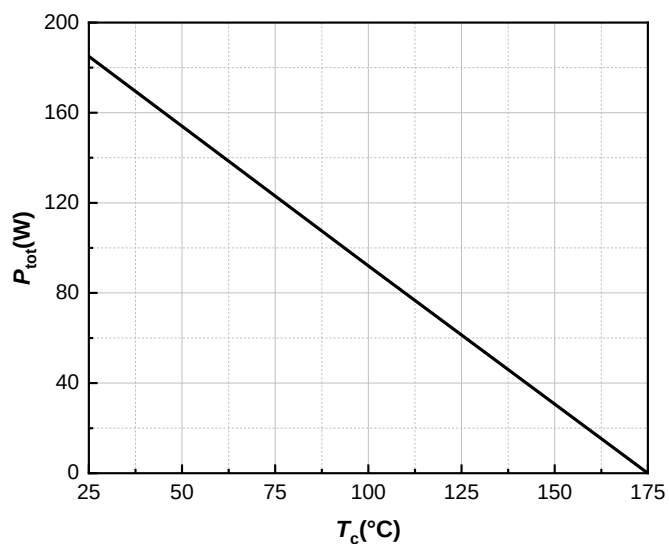


Figure 19. Maximum Power Dissipation Derating vs. Case Temperature

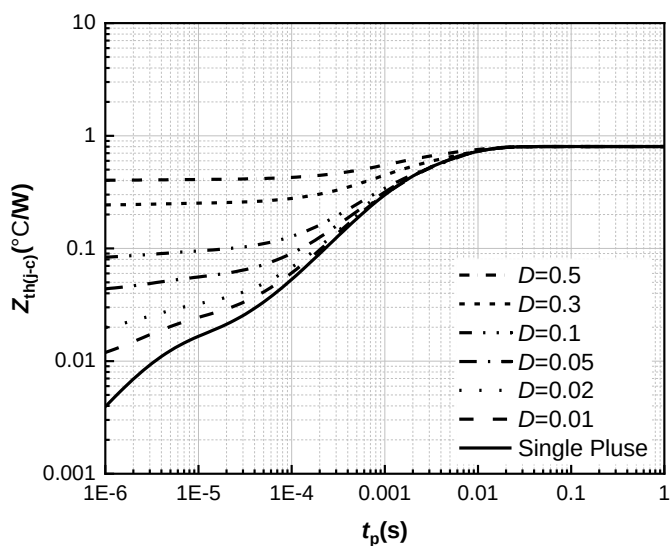


Figure 20. Transient Thermal Impedance

Typical Performance

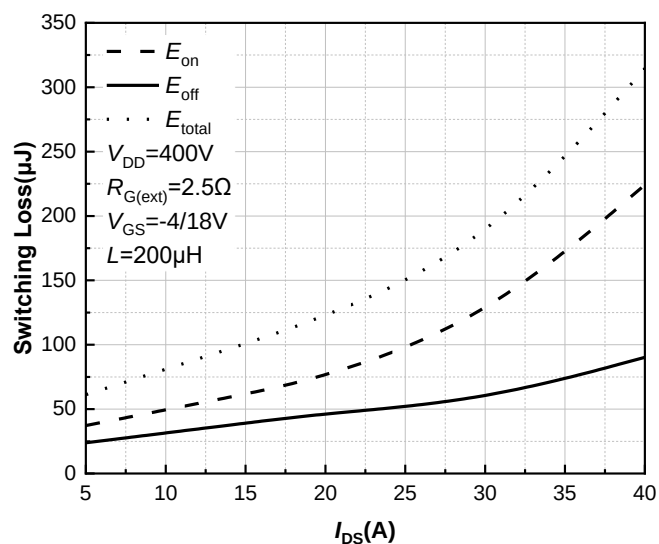


Figure 21. Clamped Inductive Switching Energy vs. Drain Current

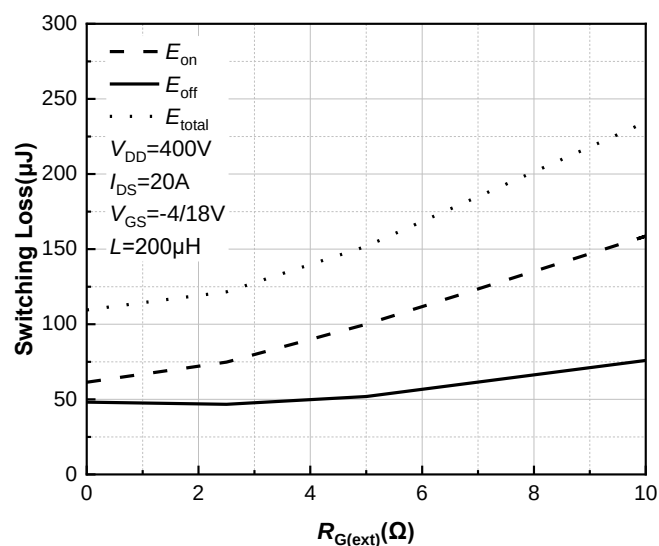


Figure 22. Clamped Inductive Switching Energy vs. $R_{\text{G(ext)}}$

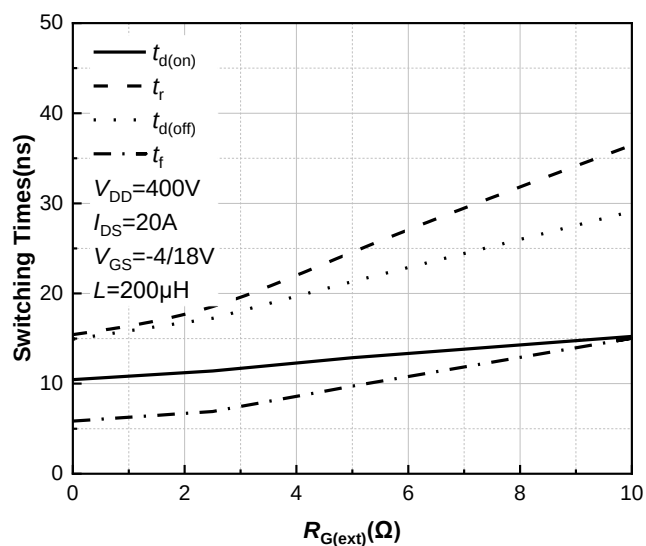


Figure 23. Switching Times vs. $R_{\text{G(ext)}}$

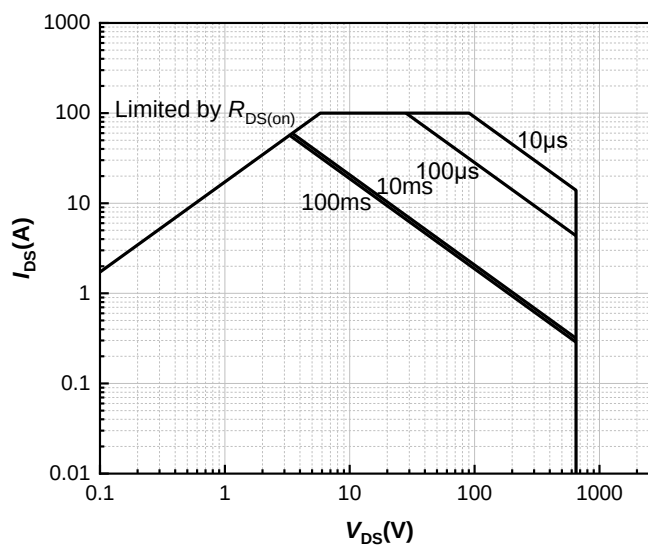
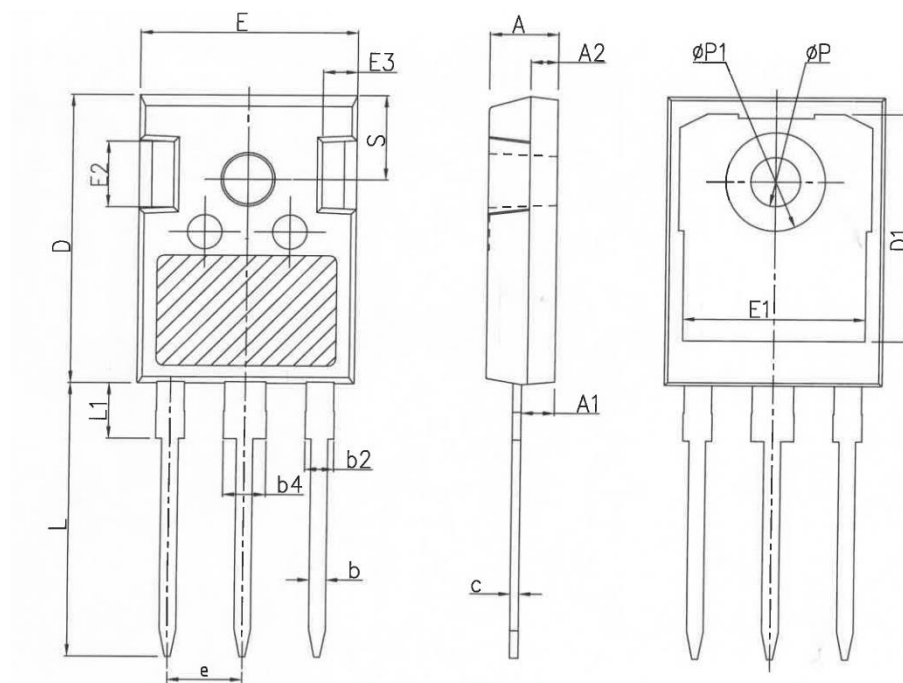


Figure 24. Safe Operating Area

Package Outlines

SYMBOL	Unit: 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	5.44 BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15 BSC		