

Features

- ◆ High Speed Switching
- ◆ 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

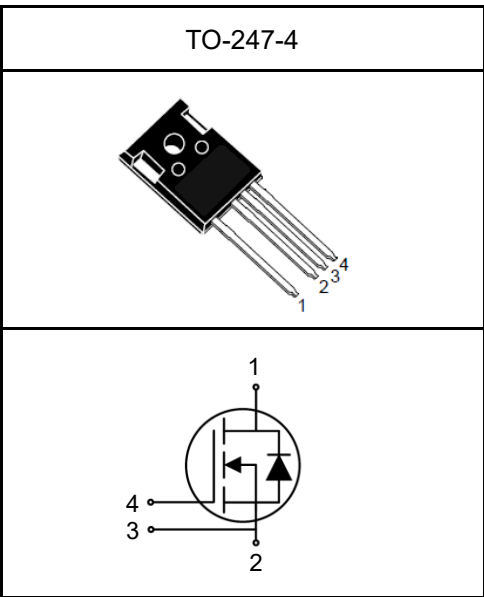
Applications

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

Description

- Pin 1 and Backside - Drain
- Pin 2 - Power Source
- Pin 3 - Driver Source
- Pin 4 - Gate

Part NO.	MS2M160065T4
V_{DS}	= 650 V
$I_D(T_c=25^{\circ}C)$	= 20 A
$R_{DS(on)}$	= 154 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	$V_{GS}=18\text{V}$ $T_c=25^{\circ}\text{C}$ $T_c=100^{\circ}\text{C}$	20 14	A
I_{DM}	Peak Drain Current	Pulse width t_p limited by T_{Jmax}	38	A
V_{GSmax}	Gate-Source Voltage, max. Transient Voltage	$t_p \leq 0.5\mu\text{s}$, $D < 0.001$	-8/+22	V
V_{GSmax}	Gate-Source Voltage		-8/+22	V
V_{GSop}	Recommend Gate-Source Voltage		-4/+18	V
P_{tot}	Power Dissipation	$T_c=25^{\circ}\text{C}$ $T_c=100^{\circ}\text{C}$	82 41	W
T_j	Operating Junction Temperature		-40~175	$^{\circ}\text{C}$
T_{stg}	Storage Temperature		-40~150	$^{\circ}\text{C}$
T_{sld}	Soldering Temperature	1.6mm (0.063") from case for 10s	260	$^{\circ}\text{C}$
M	Mounting Torque	M3 or 6-32 screw	1	Nm

Thermal Characteristics

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
$R_{th(j-c)}$	Thermal Resistance from Junction to Case		1.82		$^{\circ}\text{C/W}$

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	10	μA
I_{GSS}	Gate-Source Leakage Current	$V_{DS}=0V$, $V_{GS}=18V$			250	nA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$, $I_D=2.5mA$ $T_J=25^\circ C$ $T_J=175^\circ C$	2	2.9 2.1	4	V
$R_{DS(on)}$	Drain-Source On-State Resistance	$V_{GS}=15V$, $I_D=10A$ $T_J=25^\circ C$ $T_J=175^\circ C$		200 208	290	$m\Omega$
		$V_{GS}=18V$, $I_D=10A$ $T_J=25^\circ C$ $T_J=175^\circ C$		154 188	208	$m\Omega$
g_{fs}	Forward Transconductance	$V_{DS}=20V$, $I_D=10A$		7.2		S

Dynamic Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
C_{iss}	Input Capacitance	$V_{DS}=600V$, $f=1MHz$, $V_{GS}=0V$		308		pF
C_{oss}	Output Capacitance			32		pF
C_{rss}	Reverse Transfer Capacitance			4.2		pF
E_{oss}	C_{oss} Stored Energy			5.3		μJ
$R_{G(int)}$	Internal Gate Resistance	$f=1MHz$		3.9		Ω
Q_g	Total Gate Charge	$V_{DS}=400V$, $I_D=10A$, $V_{GS}=-4/18V$		15		nC
Q_{gs}	Gate to Source Charge			3		nC
Q_{gd}	Gate to Drain Charge			4.4		nC

Switching Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-On Delay Time	$V_{DD}=400V$, $I_D=10A$, $V_{GS}=-4V/18V$, $R_{G(ext)}=2.5\Omega$, $L=200\mu H$, $T_J=25^\circ C$		10		ns
t_r	Rise Time			13		ns
$t_{d(off)}$	Turn-Off Delay Time			15		ns
t_f	Fall Time			4		ns
E_{on}	Turn-On Energy			45		μJ
E_{off}	Turn-Off Energy			6		μJ
$t_{d(on)}$	Turn-On Delay Time	$V_{DD}=400V$, $I_D=10A$, $V_{GS}=-4V/18V$, $R_{G(ext)}=2.5\Omega$, $L=200\mu H$, $T_J=175^\circ C$		10		ns
t_r	Rise Time			12		ns
$t_{d(off)}$	Turn-Off Delay Time			16		ns
t_f	Fall Time			5		ns
E_{on}	Turn-On Energy			44		μJ
E_{off}	Turn-Off Energy			8		μJ

Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
V_{SD}	Diode Forward Voltage	$V_{GS}=-4V$, $I_{SD}=5A$ $T_J=25^\circ C$ $T_J=175^\circ C$		4.0 3.7		V
I_S	Continuous Diode Forward Current	$V_{GS}=-4V$ $T_c=25^\circ C$ $T_c=100^\circ C$		19 10		A

Reverse Diode Characteristics (Continued)

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
t_{rr}	Reverse Recovery Time	$V_{GS}=-4V$, $I_{SD}=5A$, $V_R=400V$, $di/dt=2000A/\mu s$, $T_J=25^{\circ}C$		7		ns
Q_{rr}	Reverse Recovery Charge			39		nC
I_{rrm}	Peak Reverse Recovery Current			9.3		A
t_{rr}	Reverse Recovery Time	$V_{GS}=-4V$, $I_{SD}=5A$, $V_R=400V$, $di/dt=2360A/\mu s$, $T_J=175^{\circ}C$		9		ns
Q_{rr}	Reverse Recovery Charge			70		nC
I_{rrm}	Peak Reverse Recovery Current			13.6		A

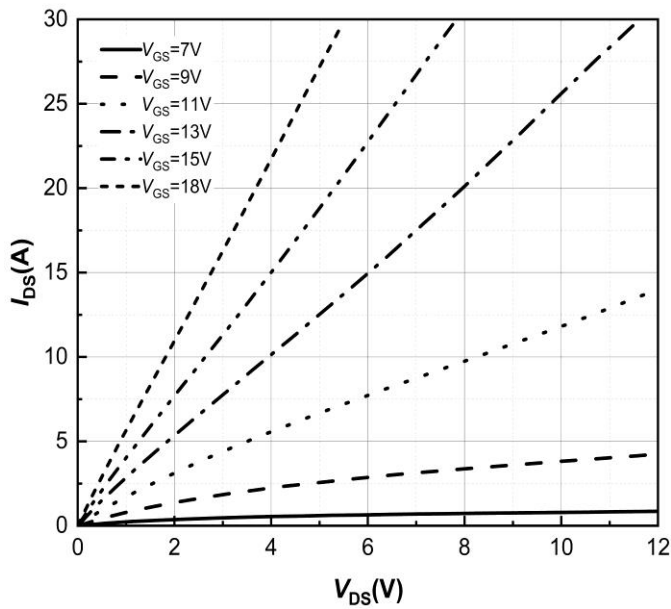
Typical Performance

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

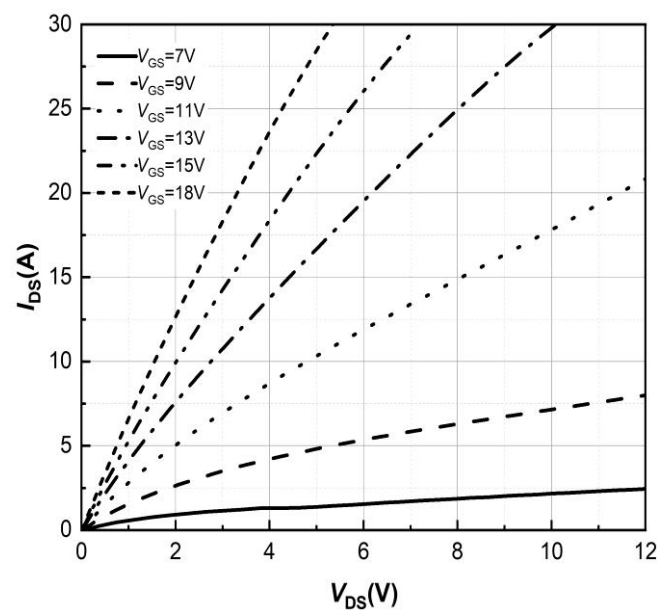


Figure 2. Output Characteristics
 $T_j = 25^\circ\text{C}$

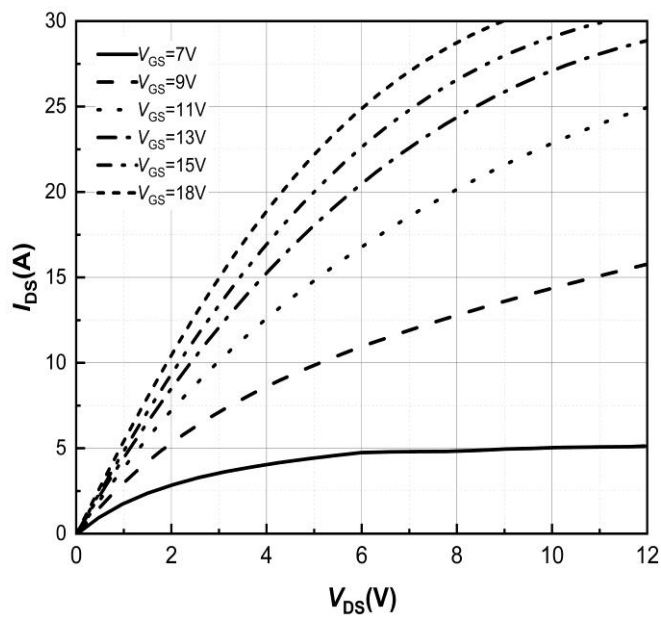


Figure 3. Output Characteristics
 $T_j = 175^\circ\text{C}$

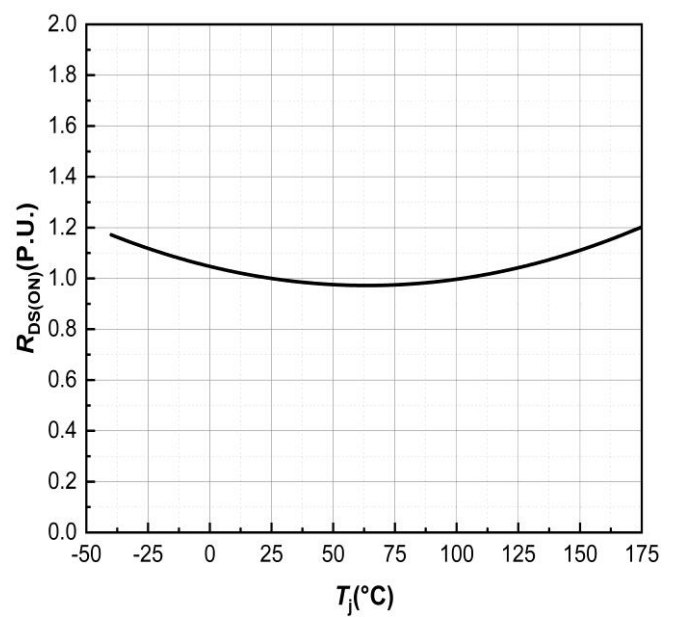


Figure 4. Normalized On-Resistance vs. Temperature

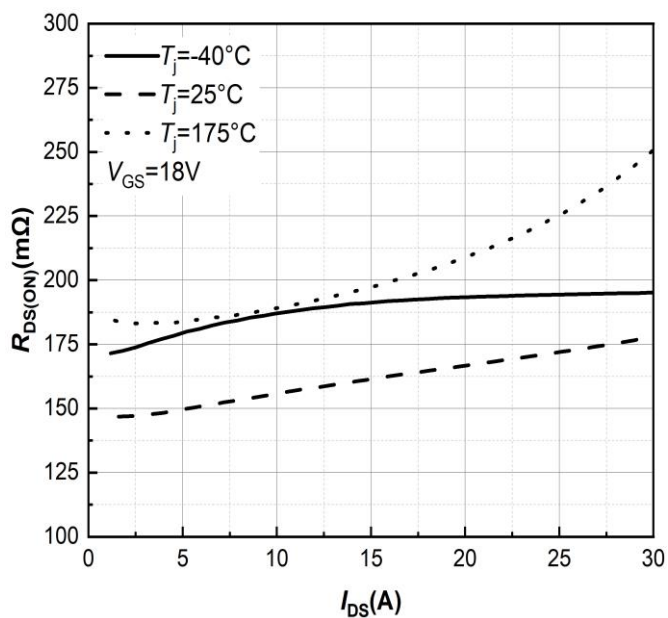
Typical Performance

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

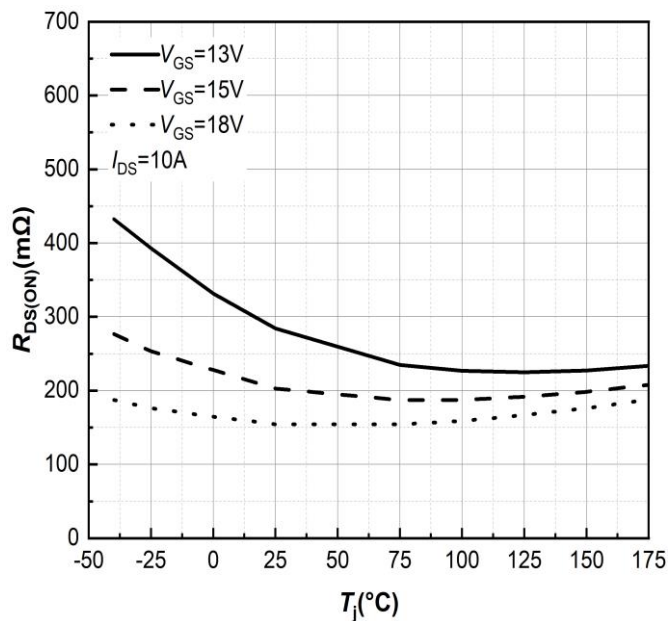


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

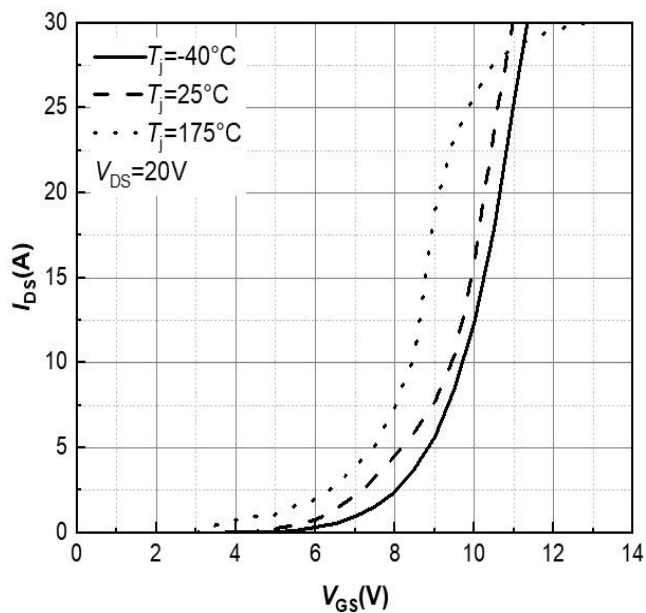


Figure 7. Transfer Characteristic for Various Junction Temperatures

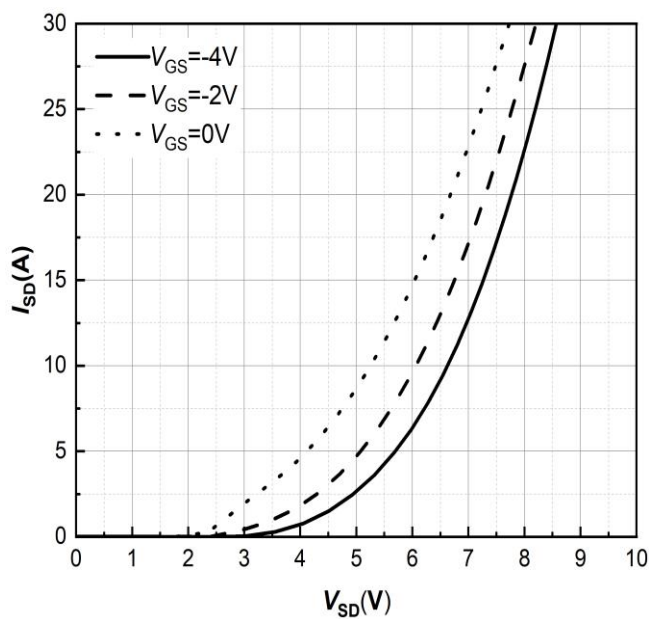


Figure 8. Body Diode Characteristic $T_j = -40^\circ\text{C}$

Typical Performance

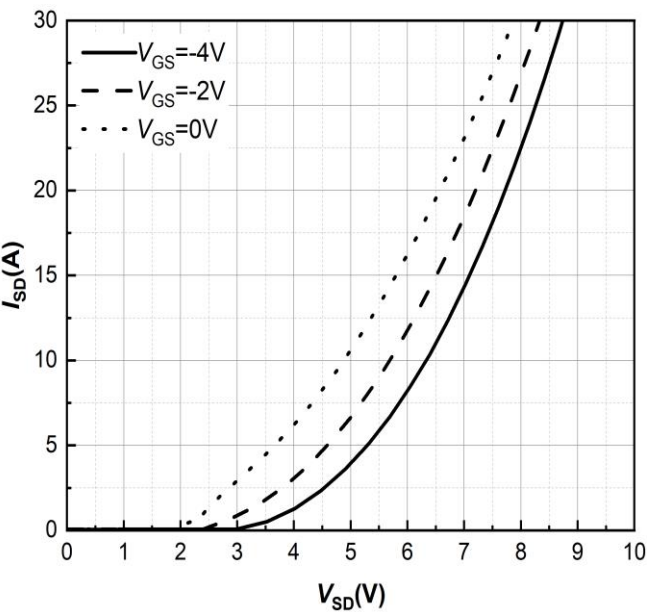


Figure 9. **Body Diode Characteristic**
 $T_j=25^{\circ}\text{C}$

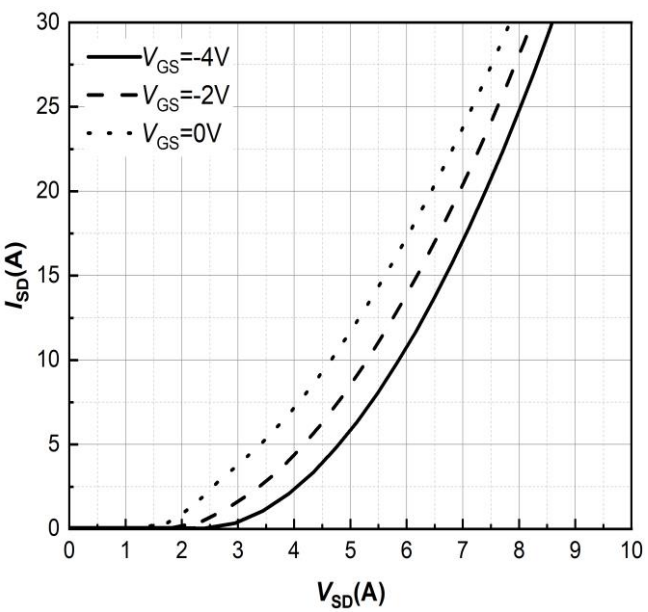


Figure 10. **Body Diode Characteristic**
 $T_j=175^{\circ}\text{C}$

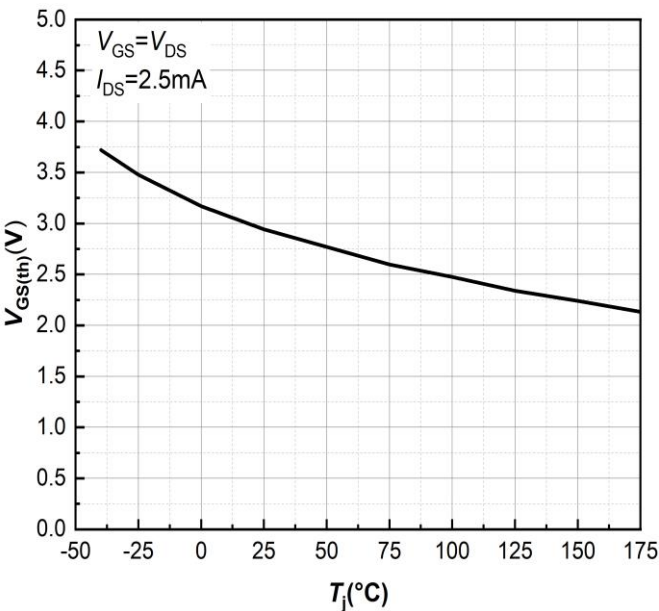


Figure 11. **Threshold Voltage vs. Temperature**

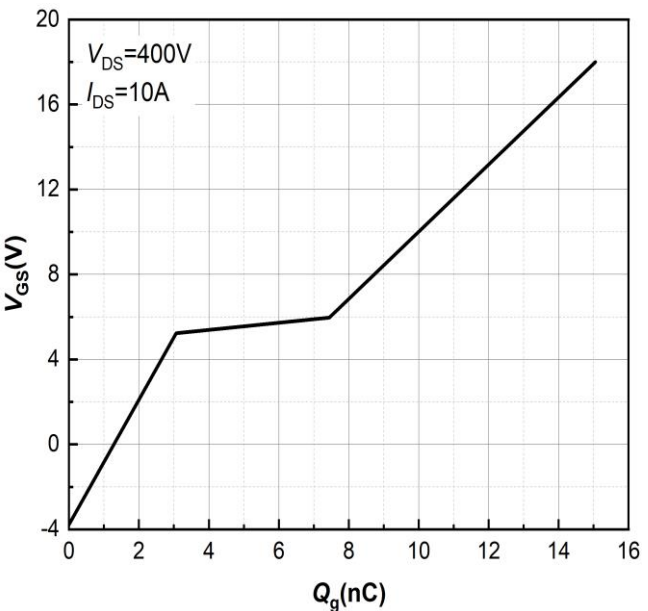


Figure 12. **Gate Charge Characteristics**

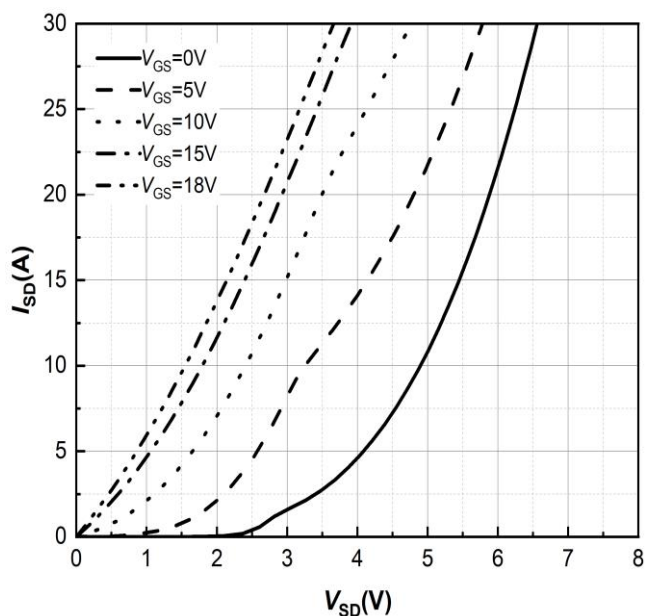
Typical Performance

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

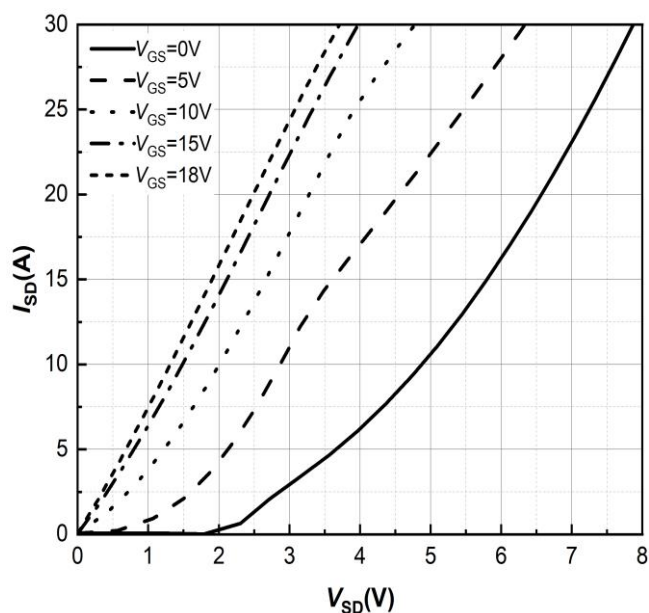


Figure 14. 3rd Quadrant Characteristic
 $T_j = 25^\circ\text{C}$

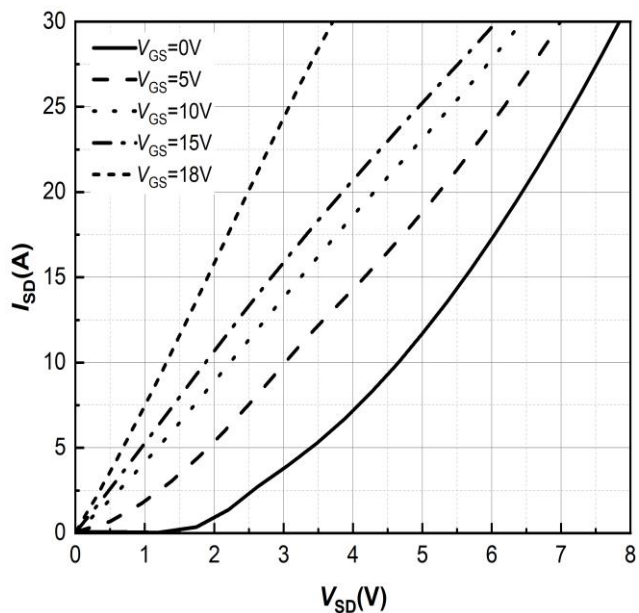


Figure 15. 3rd Quadrant Characteristic
 $T_j = 175^\circ\text{C}$

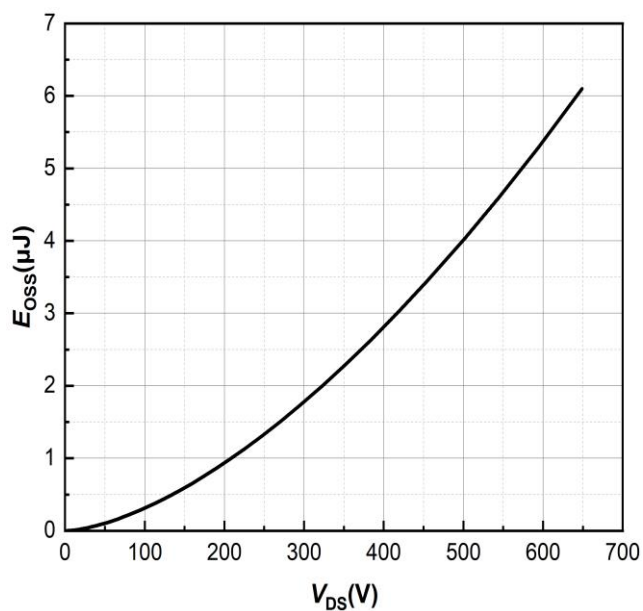


Figure 16. Output Capacitor Stored Energy

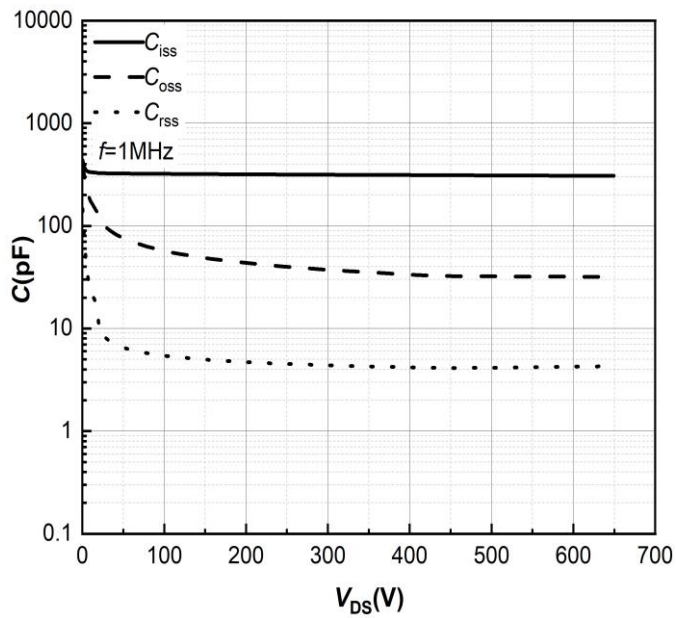
Typical Performance

Figure 17. Capacitances vs. Drain-Source

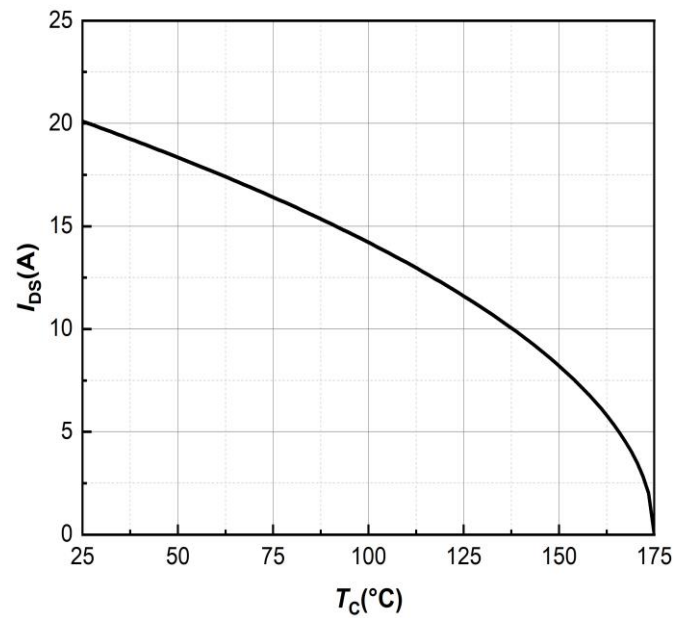


Figure 18. Continuous Drain Current Derating vs. Case Temperature

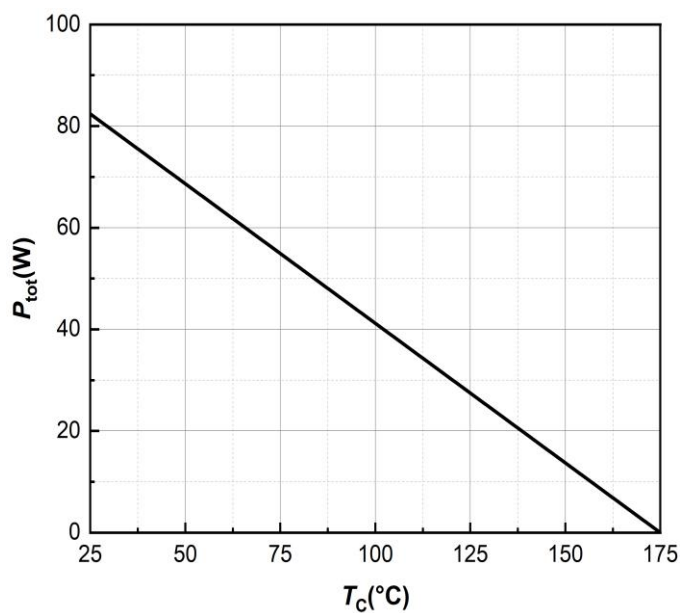


Figure 19. Maximum Power Dissipation Derating vs. Case Temperature

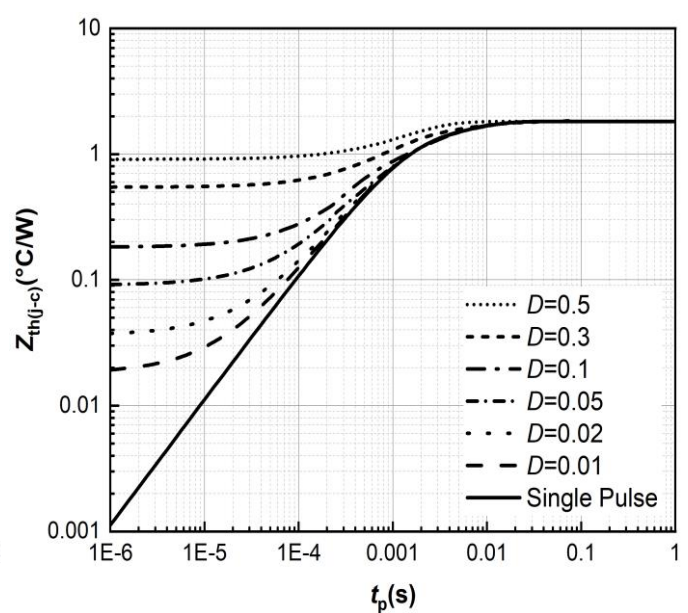


Figure 20. Transient Thermal Impedance

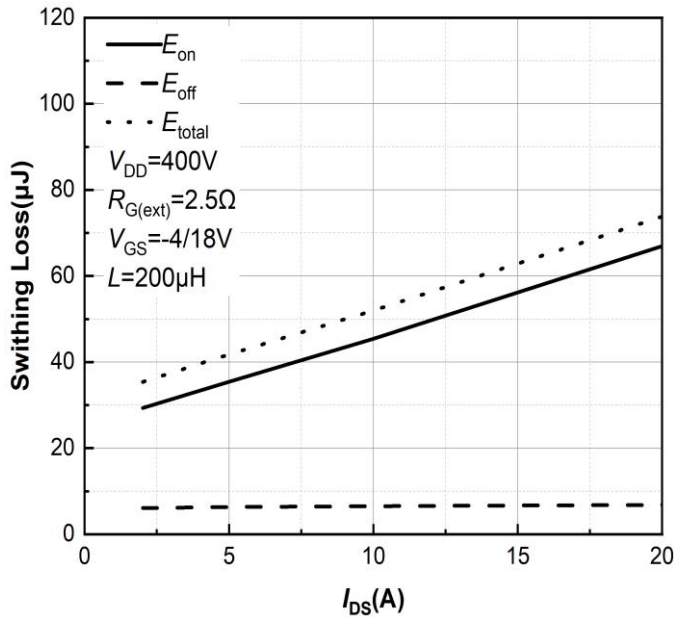
Typical Performance

Figure 21. Clamped Inductive Switching Energy vs. Drain Current
 $T_j = 25^\circ\text{C}$

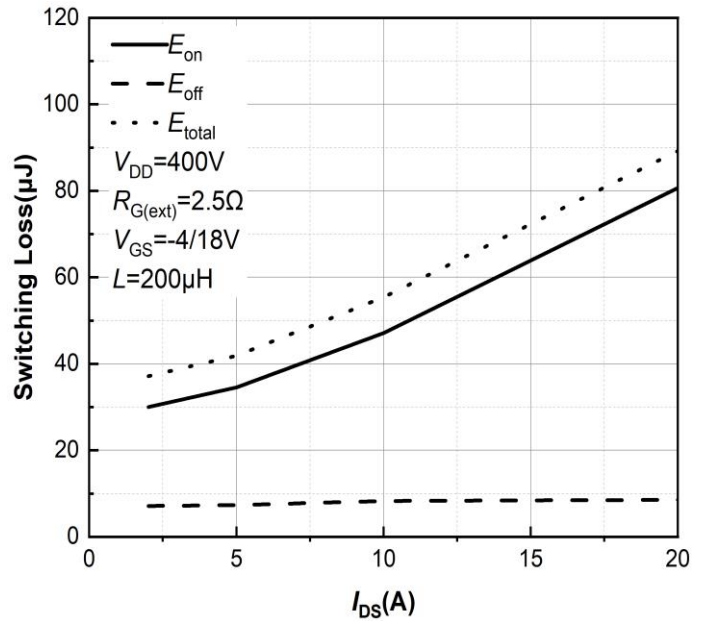


Figure 22. Clamped Inductive Switching Energy vs. Drain Current
 $T_j = 175^\circ\text{C}$

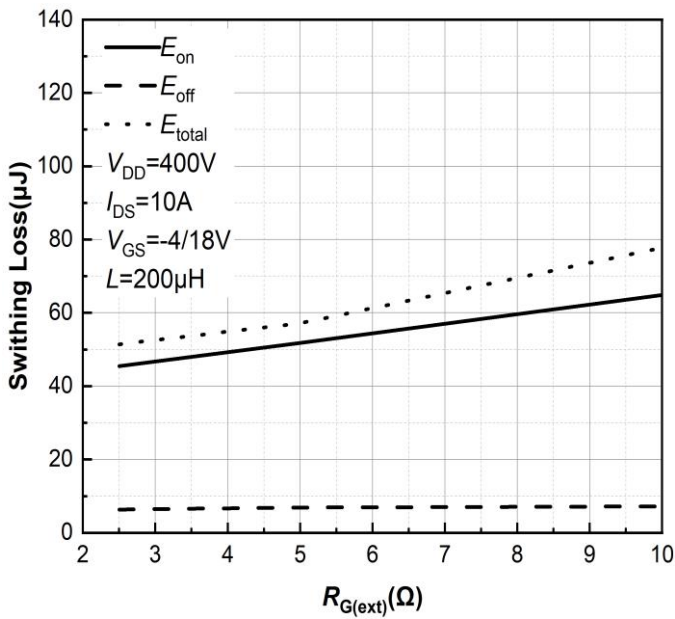


Figure 23. Clamped Inductive Switching Energy vs. $R_{G(ext)}$
 $T_j = 25^\circ\text{C}$

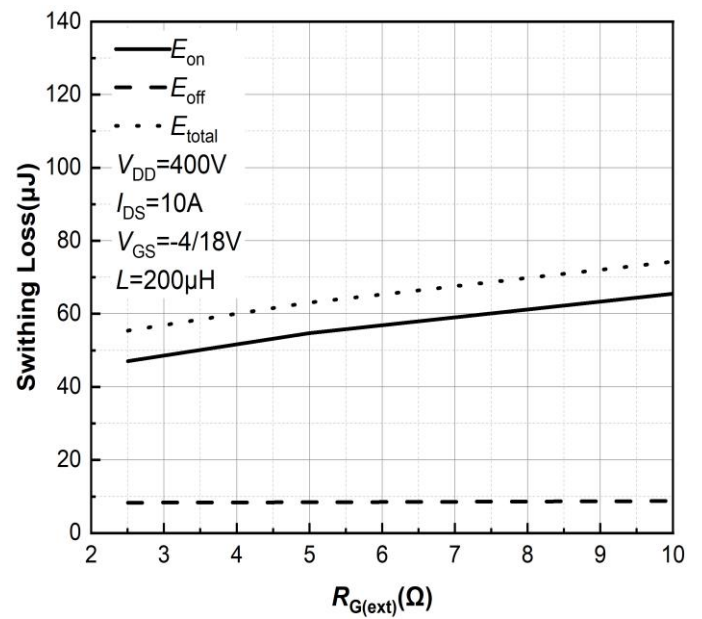


Figure 24. Clamped Inductive Switching Energy vs. $R_{G(ext)}$
 $T_j = 175^\circ\text{C}$

Typical Performance

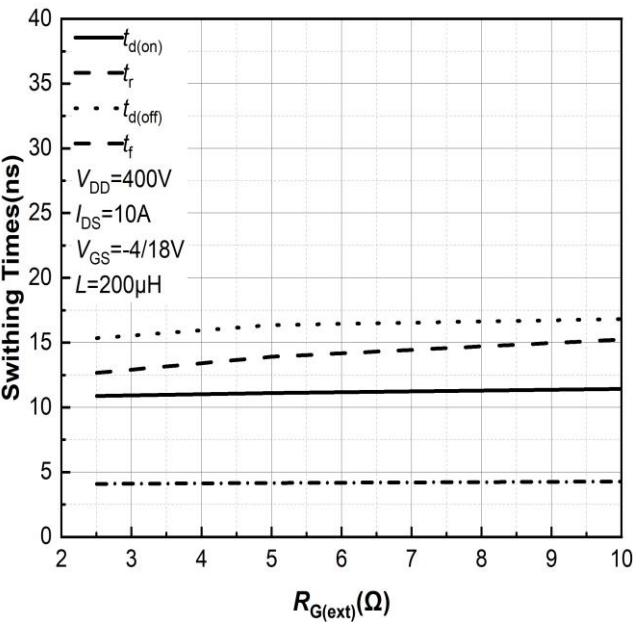


Figure 25. Switching Times vs. $R_{G(ext)}$
 $T_J=25^{\circ}C$

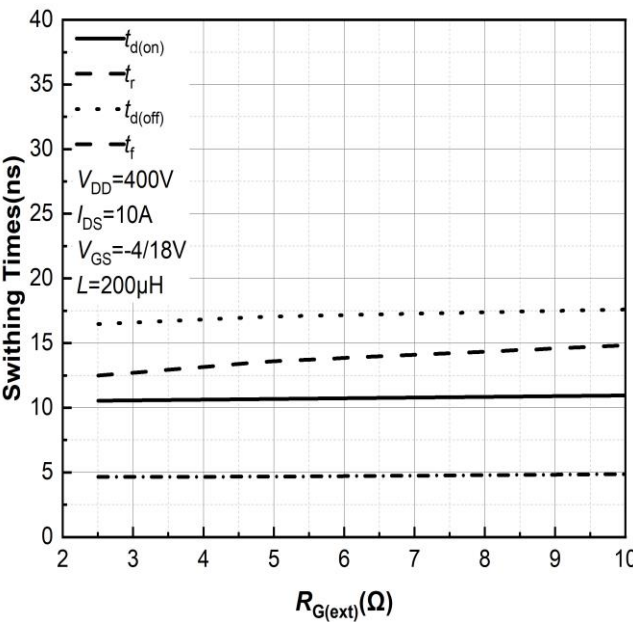


Figure 26. Switching Times vs. $R_{G(ext)}$
 $T_J=175^{\circ}C$

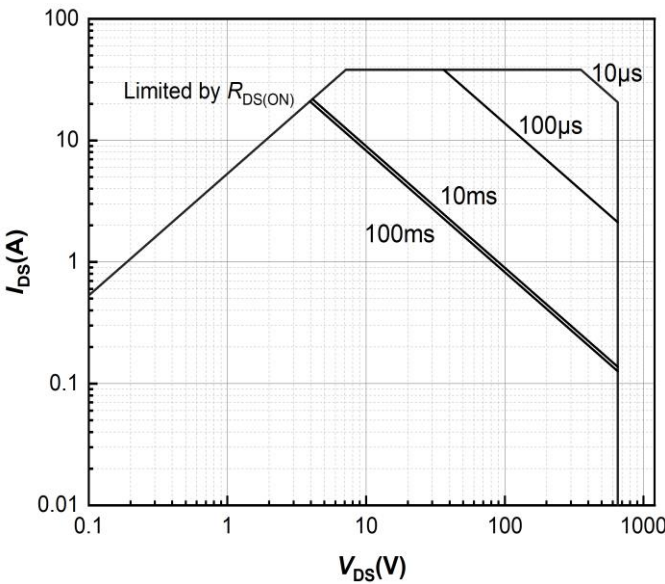
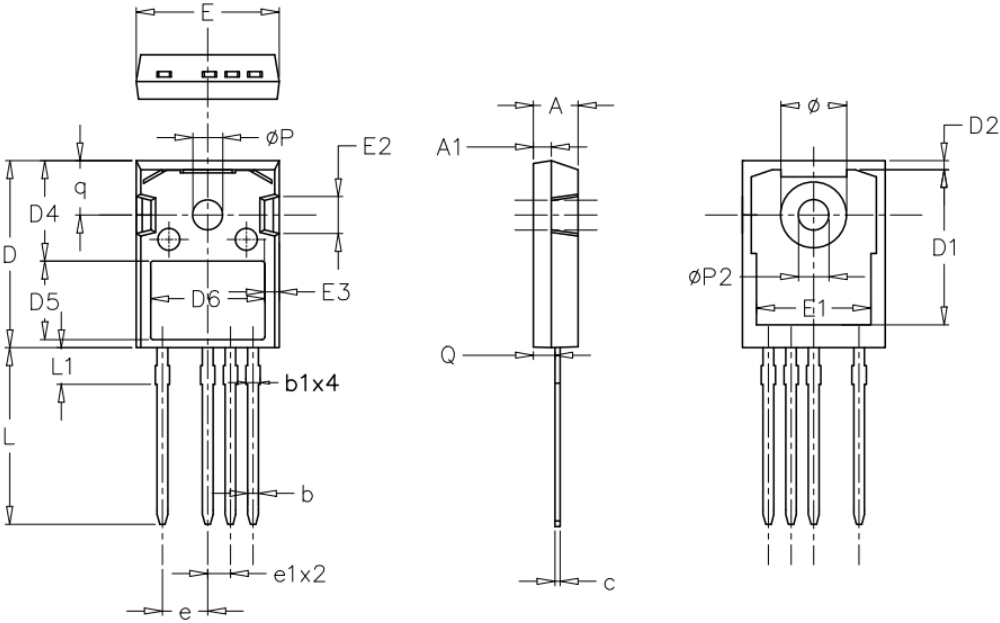


Figure 27. Safe Operating Area

Package Outlines



SYMBOL	Unit:mm			SYMBOL	Unit:mm		
	NOM	MIN	MAX		NOM	MIN	MAX
A	4.98	4.68	5.36	e	5.08	BSC	
A1	1.99	1.90	2.10	e1	2.54	BSC	
Q	2.41	2.30	2.60	q	6.24	5.99	6.58
c	0.6	0.48	0.72	ØP2	3.45	3.24	3.64
b	1.20	1.00	1.40	Ø	7.14	7.10	7.30
b1	1.75	1.65	1.80	D1	16.56	16.10	17.10
D	21.10	20.80	21.80	D2	0.98	0.80	1.36
E	15.98	15.38	16.20	E1	13.30	13.00	13.52
L	19.95	19.81	20.10	E2	5.64	5.10	6.10
L1	4.09	4.0	4.17	E3	2.33	1.90	2.70
ØP	3.66	3.45	3.85	D4	11.27	BSC	
D5	8.80	BSC		D6	12.80	BSC	