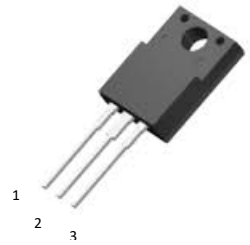
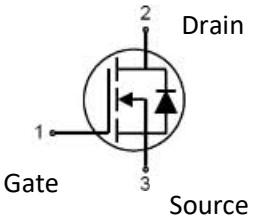
NW6506CJ1

650V Silicon Carbide Mosfet

Parameter	Value	Unit
V_{RRM}	650	V
$R_{DS(on)}$	53	mΩ
I_F (T_C = 25℃)	53	A

TO247-3





Features

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

Applications

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

Description

The NW6506CJ1 is a 650 V, SiC mosfet based on NovaWave's advanced SiC technology resulting in high performance and long-term reliability. It supports high-temperature operation while showing minimal losses , zero reverse recovery, and low leakage current.

Part Description

Part Number	Package	Marking
NW6506CJ1	TO247-3	NW6506CJ1

Pin Description

Pin1	Pin2	Pin3
Gate	Drain	Source

Absolute Maximum Ratings

T_J = 25 °C except as noted. Exceeding the maximum ratings may damage the device.

Parameter	Symbol	Value	Unit	Test conditions
Drain-Source Voltage	V_{DS}	650	V	
Continuous Drain Current	I_D	53 37	A	T_C = 25 °C V_{GS} =18V T_C = 100 °C
Peak Drain Current	I_{DM}	100	A	Pulse width t_p limited by T_{jmax}
Power Dissipation	P_{tot}	185 92	W	T_C = 25 °C T_C = 100 °C
Operating Junction Range	T_J	-40 to +175	°C	
Storage Temperature Range	T_{Stg}	-40 to +150	°C	
Soldering Temperature	T_{sold}	260	°C	1.6mm (0.063”) from case for 10s
Gate-Source Voltage, max. Transient Voltage	V_{GSmax}	-8 to +22	V	$t_p \leqslant 0.5\mu s$, D<0.001
Gate-Source Voltage	V_{GSmax}	-8 to +22	V	
Recommend Gate-Source Voltage	V_{GSop}	-4 to +18	V	
Non-Repetitive Avalanche Switching Energy	E_{AS}	512	mJ	V_{DD}=50V, L=1mH, I_D=32A
Repetitive Avalanche Energy	E_{AR}	332	mJ	V_{DD}=50V, L=650μH, I_D=32A
Short-Circuit Withstand Time	t_{SC}	3	μs	V_{DD}=400V, V_{GS}=18V, $V_{DS,peak}$ < 650V
Mounting Torque	M	0.6	Nm	M3 screw

Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance from Junction to Case	$R_{TH,\ J\text{-}C}$	0.81	°C/W

Electrical Characteristics

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	650			V	I_D=100μA, V_{GS}=0V
Zero Gate Voltage Drain Current	I_{DSS}		1	10	μA	V_{DS}=650V, V_{GS}=0V
Gate-Source Leakage Current	I_{GSS}			250	nA	V_{DS}=0V, V_{GS}=18V
Gate Threshold Voltage	$V_{GS(th)}$	2	2.7 1.9	4	V	V_{DS}=V_{GS},I_D=5mA ,T_j=25°C T_j=175°C
Drain-Source On-State Resistance	$R_{DS(on)}$		53 58	71	mΩ	V_{GS}=18V,I_D=20A,T_j=25°C T_j=175°C
Forward Transconductance	g_{fs}		10		S	V_{DS}=20V, I_D=10A
Input Capacitance	C_{iss}		1301		pF	V_{DS}=600V, f=1MHz, V_{GS}=0V
Output Capacitance	C_{oss}		138		pF	
Reverse Transfer Capacitance	C_{rss}		14		pF	
C_{oss} Stored Energy	E_{oss}		27		μJ	
Internal Gate Resistance	$R_{G(int)}$		2.1		Ω	f=1MHz
Total Gate Charge	Q_g		68		nC	V_{DS}=400V, I_D=20A, V_{GS}=-4V/18V
Gate to Source Charge	Q_{gs}		17		nC	
Gate to Drain Charge	Q_{gd}		22		nC	
Turn-On Delay Time	$t_{d(on)}$		12		ns	V_{DD}=400V, I_D=20A, V_{GS}=-4V/18V, $R_{G(ext)}$=2.5Ω, L=200μH, T_j=25°C
Rise Time	t_r		18		ns	
Turn-Off Delay Time	$t_{d(off)}$		18		ns	
Fall Time	t_f		7		ns	

Turn-On Energy	E_{on}		75		μJ	
Turn-Off Energy	E_{off}		47		μJ	
Turn-On Delay Time	$t_{d(on)}$		11		ns	V_{DD}=400V, I_D=20A, V_{GS}=-4V/18V, $R_{G(ext)}$=2.5Ω, L=200μH, T_j=175°C
Rise Time	t_r		17		ns	
Turn-Off Delay Time	$t_{d(off)}$		19		ns	
Fall Time	t_f		7		ns	
Turn-On Energy	E_{on}		107		μJ	
Turn-Off Energy	E_{off}		15		μJ	

Reverse Diode Characteristics

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Diode Forward Voltage	V_{SD}		4.6 4.0		V	V_{GS}=-4V,I_{SD}=10A,T_j=25°C T_j=175°C
			5.4 4.6		V	V_{GS}=-4V,I_{SD}=20A,T_j=25°C T_j=175°C
Continuous Diode Forward Current	I_S		33 18		A	V_{GS}=-4V,T_c=25°C, T_c=100°C
Reverse Recovery Time	t_{rr}		18		ns	V_{GS}=-4V,I_{SD}=20A, V_R=400V, di/dt=1076A/μs, T_j=25°C
Reverse Recovery Charge	Q_{rr}		88		nC	
Peak Reverse Recovery Current	I_{rrm}		8.3		A	
Reverse Recovery Time	t_{rr}		24		ns	V_{GS}=-4V,I_{SD}=20A, V_R=400V, di/dt=1076A/μs, T_j=175°C
Reverse Recovery Charge	Q_{rr}		144		nC	
Peak Reverse Recovery Current	I_{rrm}		10.5		A	

Electrical Performance Graphs

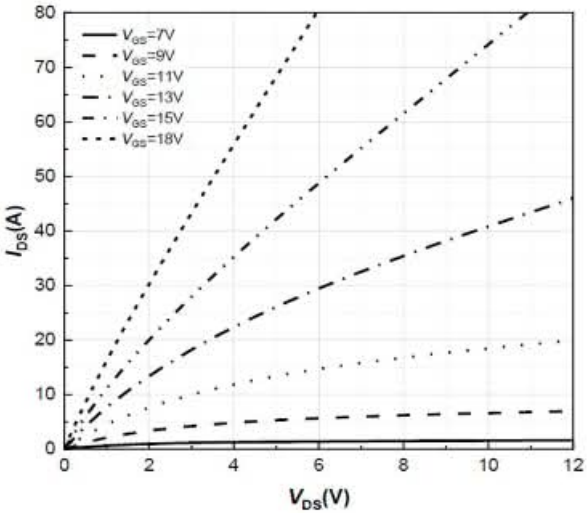


Figure 1: Output Characteristics
Tj=-40°C

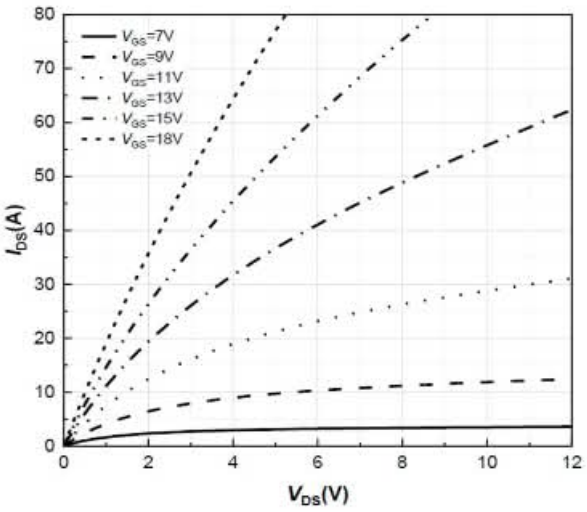


Figure 2: Output Characteristics
Tj=25°C

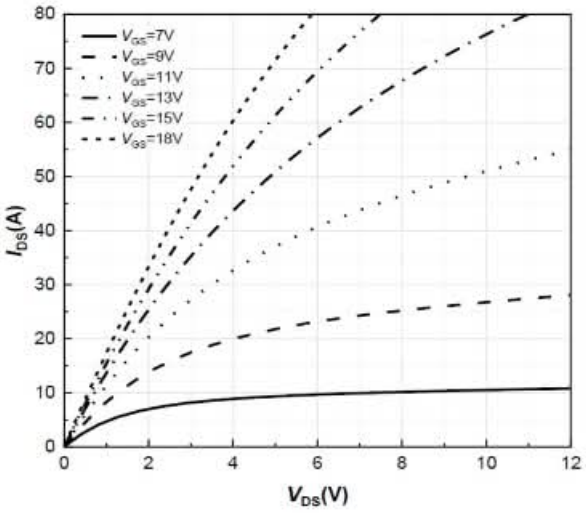


Figure 3: Output Characteristics
Tj=175°C

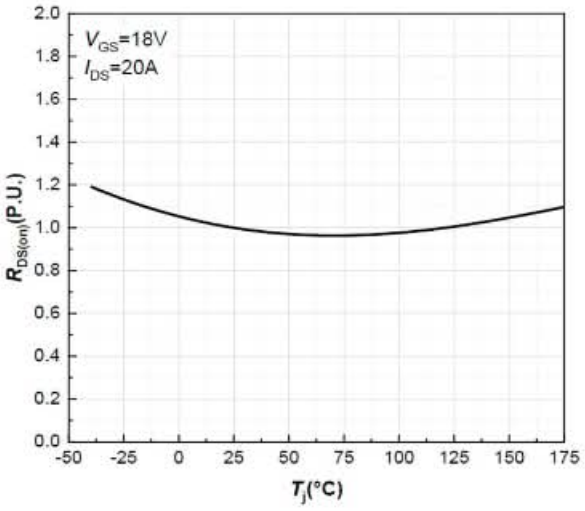


Figure 4: Normalized On-Resistance vs. Temperature

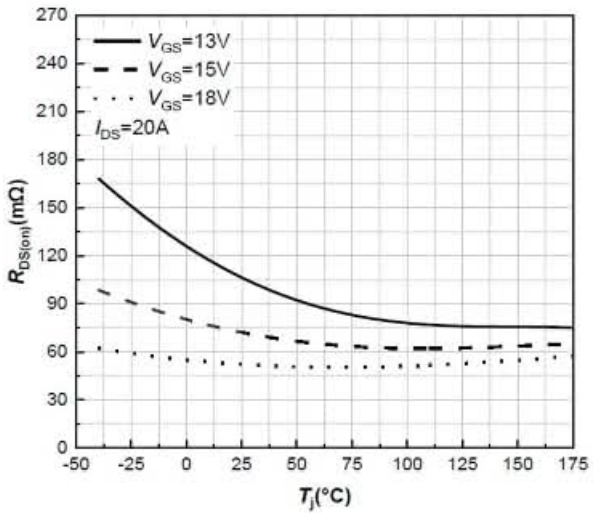


Figure 5: On-Resistance vs. Temperature
For Various Gate Voltage

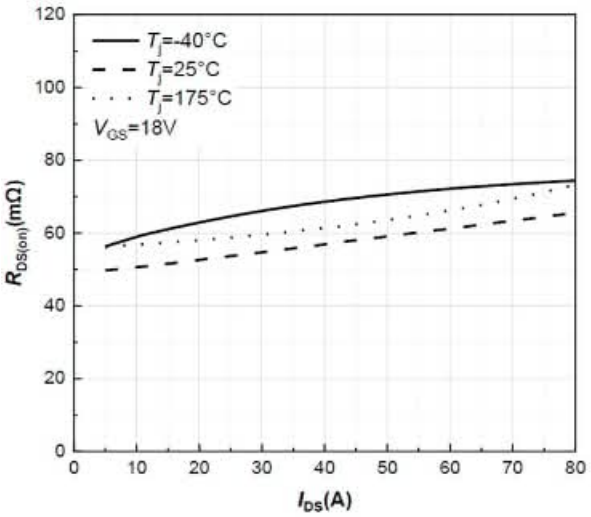


Figure 6: Transfer Characteristic for
Various Junction Temperatures

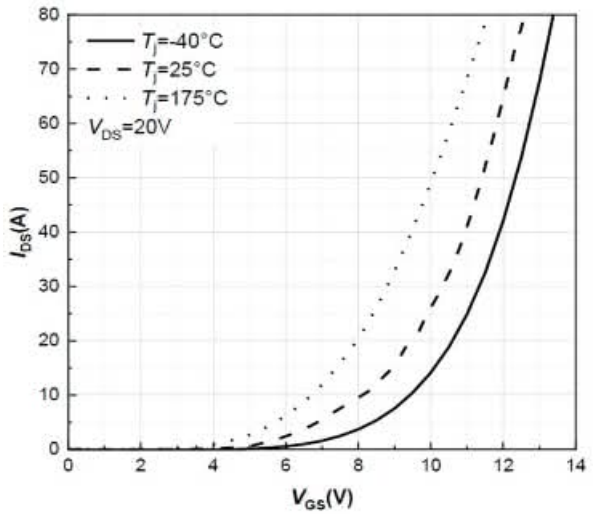


Figure 7: Transfer Characteristic for
Various Junction Temperatures

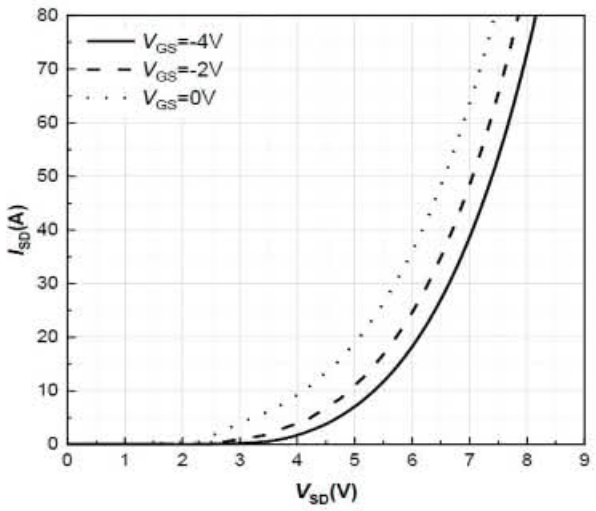


Figure 8: Body Diode Characteristic
T_j=-40°C

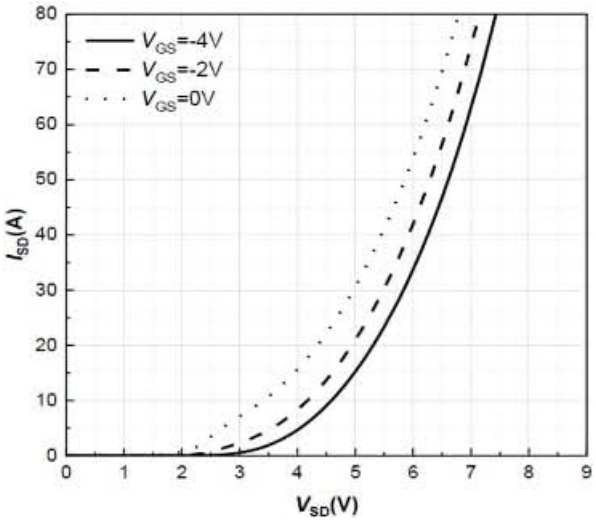


Figure 9: Body Diode Characteristic
T_j=25°C

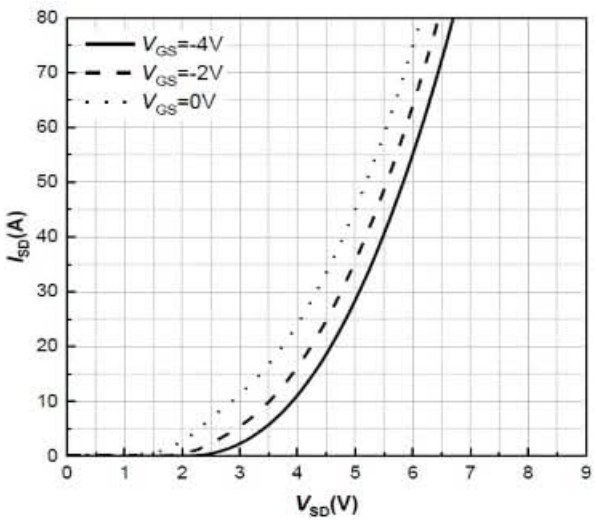


Figure 10: Body Diode Characteristic
T_j=175°C

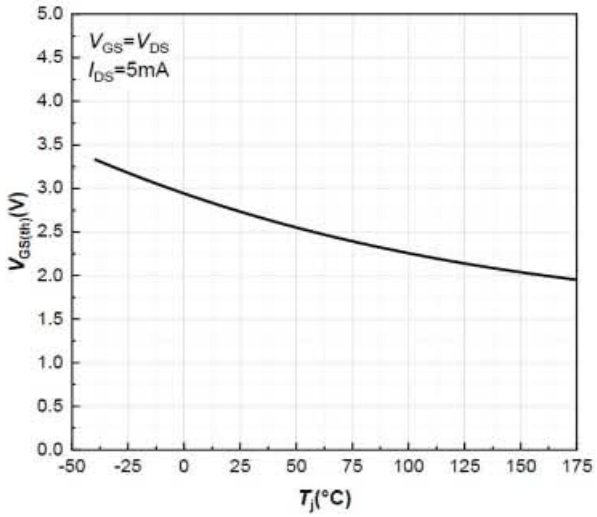


Figure 11. Threshold Voltage vs. Temperature

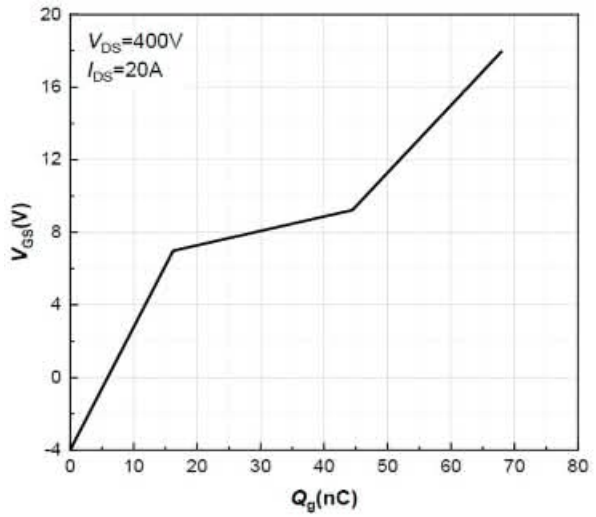


Figure 12. Gate Charge Characteristics

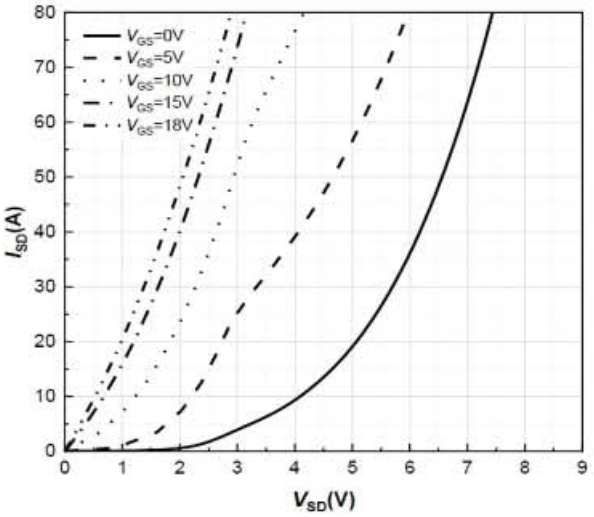


Figure 13. 3rd Quadrant Characteristic
T_j=-40°C

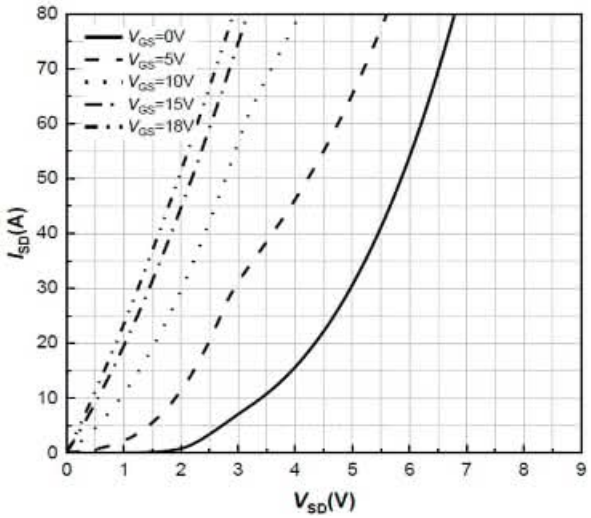


Figure 14. 3rd Quadrant Characteristic
T_j=25°C

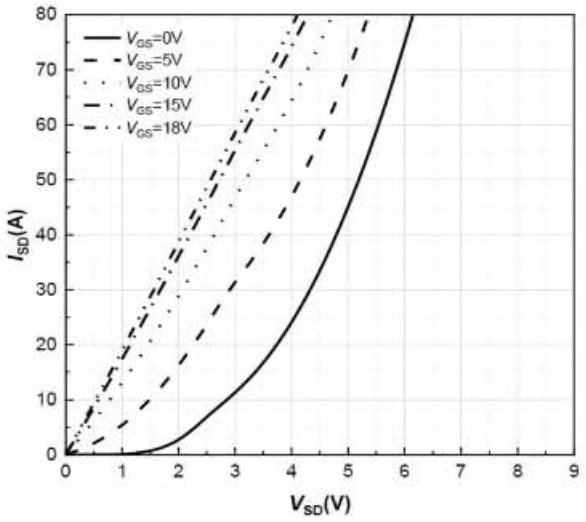


Figure 15. 3rd Quadrant Characteristic
T_j=175°C

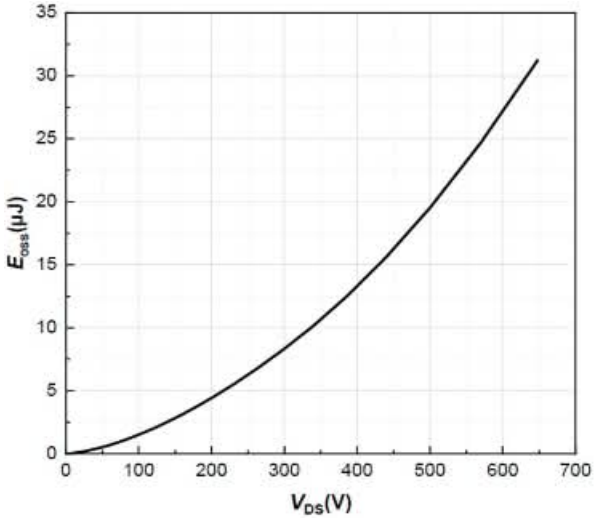


Figure 16. Output Capacitor Stored Energy

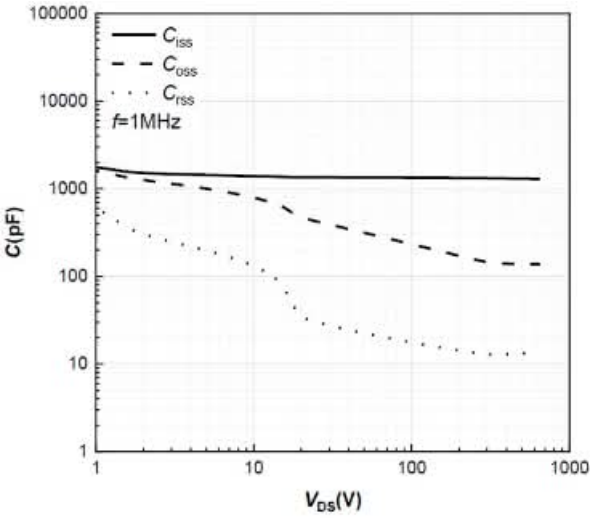


Figure 17: Capacitances vs. Drain-Source

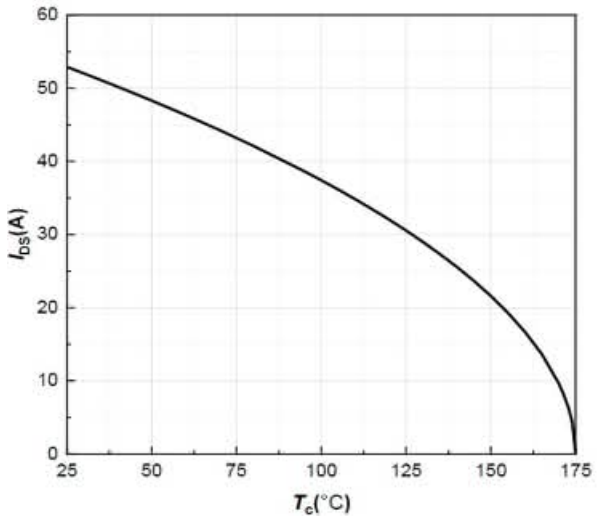


Figure 18: Continuous Drain Current Derating vs. Case Temperature

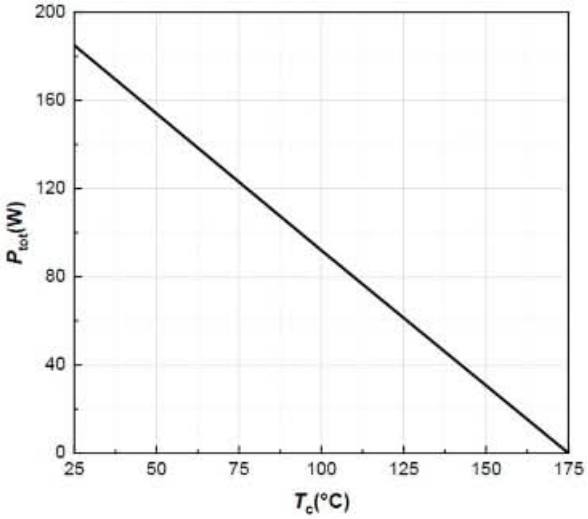


Figure 19: Maximum Power Dissipation Derating vs. Case Temperature

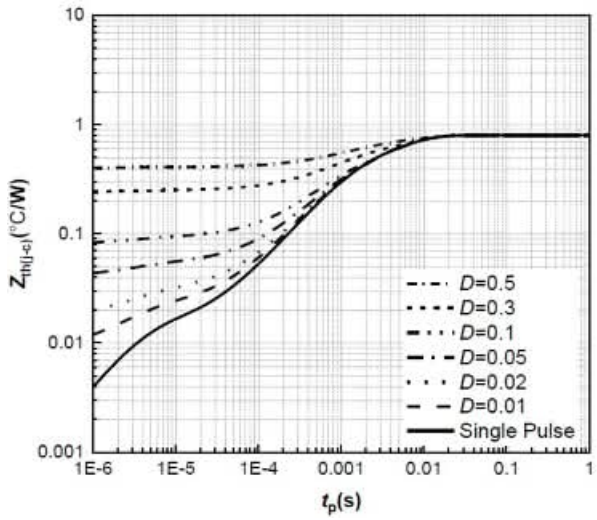


Figure 20: Transient Thermal Impedance

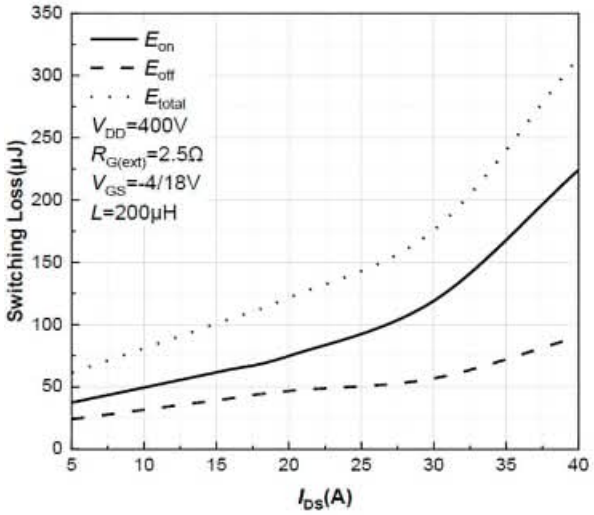


Figure 21: Clamped Inductive Switching Energy vs. Drain Current Tj=25°C

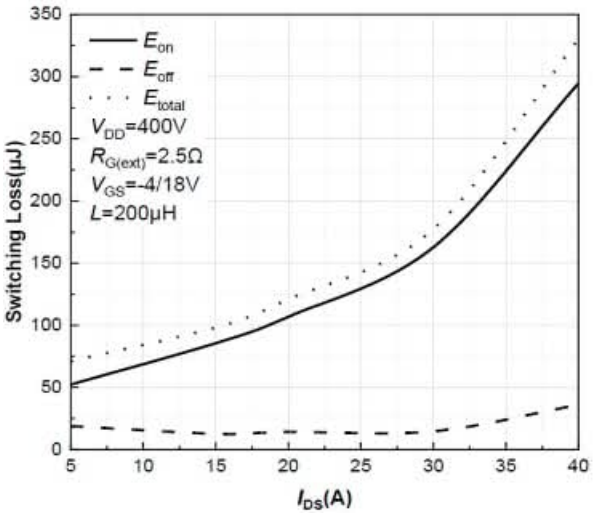


Figure 22: Clamped Inductive Switching Energy vs. Drain Current Tj=175°C

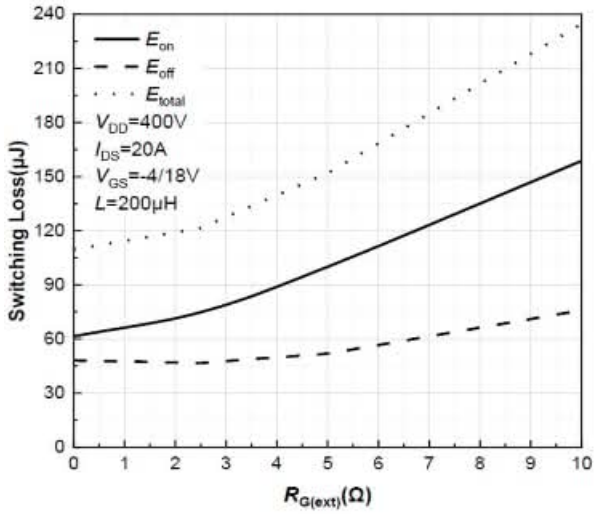


Figure23: Clamped Inductive Switching Energy vs. RG(ext) T_j=25°C

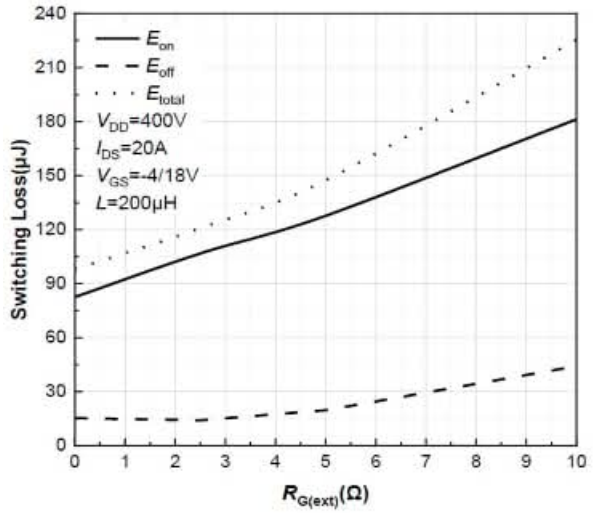


Figure 24: Clamped Inductive Switching Energy vs. RG(ext) T_j=175°C

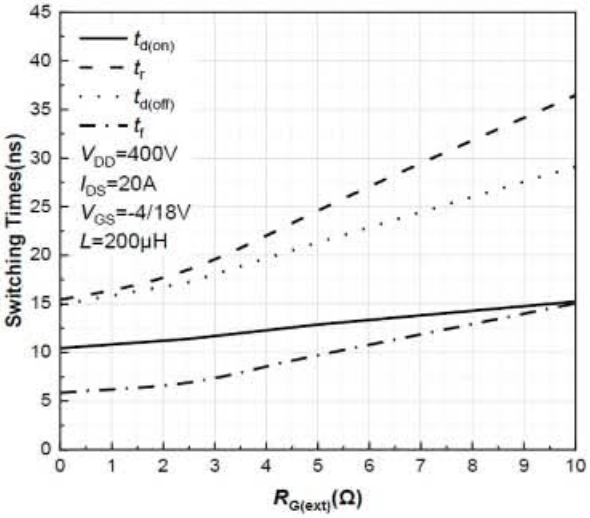


Figure25: Switching Times vs. RG(ext)
Tj=25°C

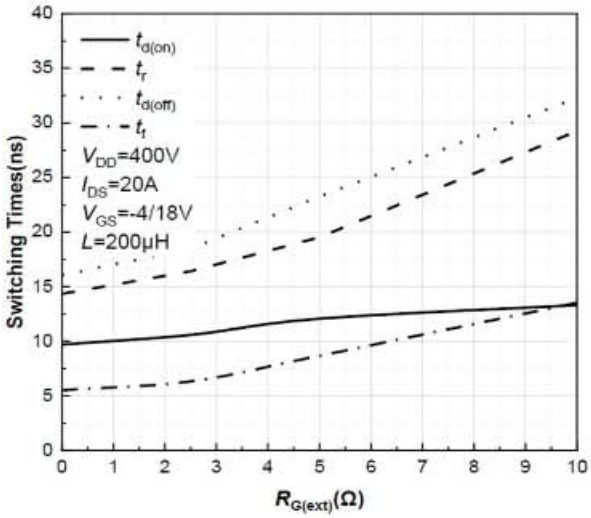


Figure 26: Switching Times vs. RG(ext)
Tj=175°C

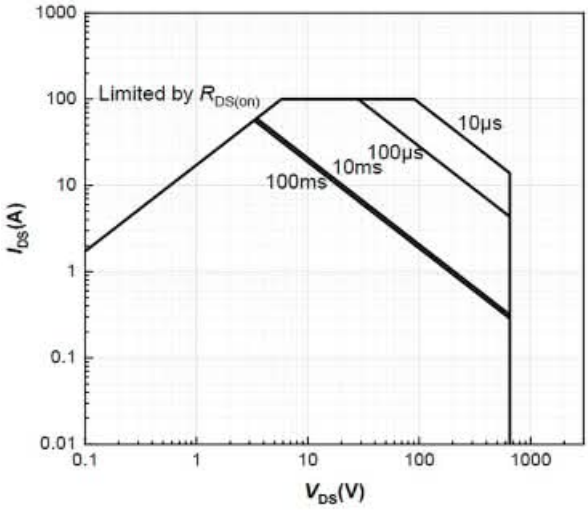
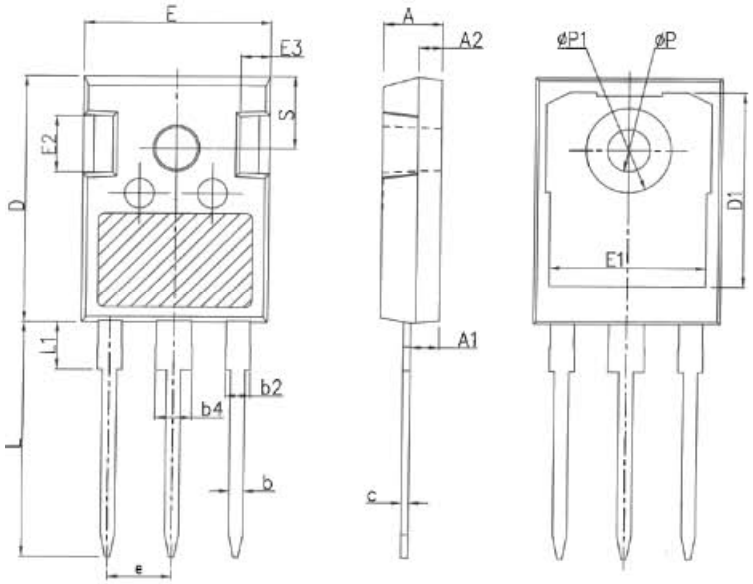


Figure 27: Safe Operating Area

Package Dimensions



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		

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