NW6516CW1-3

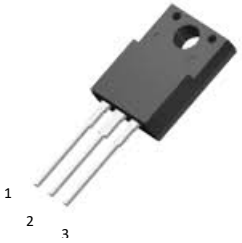
650V Silicon Carbide Mosfet

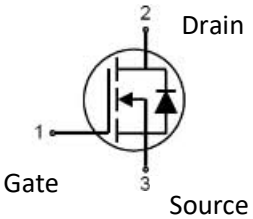
Parameter	Value	Unit
V_{DSS}	650	V
$R_{DS(on)}$(V_{GS}= 15V)	160	mΩ
$R_{DS(on)}$(V_{GS}= 18V)	119	mΩ
I_D (T_C = 25℃)	20	A

Features

- High-speed switching with low capacitances
- High blocking voltage with low on-resistance
- Low on-resistance with high junction temperature
- Fast intrinsic diode with low reverse recovery (Qrr)
- RoHS Compliant

TO220F-3





Applications

- PC Power
- LED Ligh
- EV Charging
- Server Power / Telecom Power
- Solar PV inverters / UPS

Description

The NW6516CW1-3 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.
Pin1-Gate
Pin2-Drain
Pin3-Source

Pin Description

Part Number	Package	Marking
NW6516CW1-3	TO220F-3	NW6516CW1-3

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	$V_{DSS\ max}$	650	V	Static
Continuous Drain Current, limited by $T_{vj(max)}$	I_D	23	A	V_{GS} = 18 V, T_C = 25 ℃
		16		V_{GS} = 18 V, T_C = 100 ℃
		20		V_{GS} = 15 V, T_C = 25 ℃
		14		V_{GS} = 15 V, T_C = 100 ℃
Pulse Drain Current, Pulse width tp limited by $T_{vj(max)}$	$I_{D(pulse)}$	34	A	V_{GS} = 15 V, T_C = 25 ℃
Avalanche energy, single pulse	E_{AS}	33	mJ	I_D = 11.5 A, V_{DS} = 50 V, L = 0.5 mH, V_{GS} = 15 V
Power Dissipation	P_D	69	W	T_C = 25 ℃
		35		T_C = 100 ℃
Maximum Gate Source Voltage,transient voltage	V_{GSmax}	-10 to +22	V	
Recommended turn-on Gate Source Voltage	$V_{GS(on)}$	15 to +18	V	
Recommended turn-off Gate Source Voltage	$V_{GS(off)}$	-4 to 0	V	
Storage Temperature Range	T_{stg}	-55 to +175	°C	
Soldering Temperature	T_L	260	°C	
Virtual junction temperature	T_{VJ}	-55 to +175	°C	

*Gate-source transient voltage, tp < 1 μs, t ⩽ 10 hours over lifetime,-10/+22V.

*T_{VJ} = Virtual Junction Temperature, equivalent to Junction Temperature for device rating and characterization.

Thermal Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	--	2.16	--	˚C/W

Electrical Characteristics（at T_{VJ} = 25℃, unless otherwise specified）

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Drain-Source Breakdown Voltage	BV_{DSS}	800	--	--	V	I_D=100μA, V_{GS}=0V
Zero Gate Voltage Drain Current	I_{DSS}	--	0.1	20	μA	V_{DS} = 650 V, V_{GS} = 0 V, T_{VJ} =25°C
		--	1	--		V_{DS} = 650 V, V_{GS} = 0 V, T_{VJ} =175°C
Gate-Source Leakage Current	I_{GSS}	--	--	250	nA	V_{GS}=22V
Gate Threshold Voltage	$V_{GS(th)}$	--	3.9	--	V	V_{DS}=V_{GS},I_D=10mA
		--	2.8	--		V_{DS}=V_{GS},I_D=10mA,T_{VJ}=175°C
Drain-Source On-State Resistance	$R_{DS(on)}$	--	160	--	mΩ	V_{GS}=15V,I_D=7A
		--	164	--		V_{GS}=15V,I_D=7A,T_{VJ}=175°C
		--	119	--		V_{GS}=18V,I_D=7A
		--	148	--		V_{GS}=18V,I_D=7A,T_{VJ}=175°C
Transconductance	g_{fs}	--	5	--	S	V_{DS}=20V, I_D=7A
Input Capacitance	C_{iss}	--	429	--	pF	V_{DS}=650V, f=100KHz, V_{GS}=0V
Output Capacitance	C_{oss}	--	32	--		
Reverse Transfer Capacitance	C_{rss}	--	3	--		

Internal Gate Resistance	$R_{G(int)}$	--	29	--	Ω	f=1MHz,V_{AC}=25mV,V_{DS}=0V
Total Gate Charge	Q_g	--	14.8	--	nC	V_{DS}=400V, I_D=7A, V_{GS}=0V/+15V
Gate to Source Charge	Q_{gs}	--	5.3	--		
Gate to Drain Charge	Q_{gd}	--	2.2	--		
Turn-On Delay Time	$t_{d(on)}$	--	29.2	--	ns	V_{DS}=400V, I_D=7A, V_{GS}=0V/+18V, $R_{G(ext)}$=2.2Ω, L=600µH, T_{VJ}=25°C FWD = Body Diode
Rise Time	t_r	--	11.7	--		
Turn-Off Delay Time	$t_{d(off)}$	--	46.1	--		
Fall Time	t_f	--	16.5	--		
Turn-On Switching Loss	E_{on}	--	67.8	--	µJ	
Turn-Off Switching Loss	E_{off}	--	15.0	--		
Total switching energy	E_{Total}	--	82.8	--		
Turn-On Delay Time	$t_{d(on)}$	--	27.6	--	ns	V_{DS}=400V, I_D=7A, V_{GS}=0V/+18V, $R_{G(ext)}$=2.2Ω, L=600µH, T_{VJ}=175°C FWD = Body Diode
Rise Time	t_r	--	10.8	--		
Turn-Off Delay Time	$t_{d(off)}$	--	43.1	--		
Fall Time	t_f	--	13.3	--		
Turn-On Switching Loss	E_{on}	--	67.5	--	µJ	
Turn-Off Switching Loss	E_{off}	--	10.5	--		
Total switching energy	E_{Total}	--	78.0	--		

Body Diode Characteristics(at T_{VJ}= 25°C, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Diode Forward Voltage	V_{SD}	--	3.3	--	V	V_{GS}=0V,I_S=3.5A,T_{VJ}=25°C
		--	2.8	--		V_{GS}=0V,I_S=3.5A,T_{VJ}=175°C
Continuous Diode Forward Current	I_S	--	--	23	A	V_{GS}=-4V
Diode pulse Current	$I_{S(pulse)}$	--	--	34	A	Pulse width t_p, limited by T_{VJmax}
Reverse Recovery Time	t_{rr}	--	26	--	ns	V_{GS}=0V,I_D=7A, V_{DS}=400V, di/dt=2A/ns, T_{VJ}=25°C
Reverse Recovery Charge	Q_{rr}	--	68	--	nC	
Peak Reverse Recovery Current	I_{rrm}	--	6.9	--	A	
Reverse Recovery Time	t_{rr}	--	27	--		V_{GS}=0V,I_D=7A, V_{DS}=400V, di/dt=2A/ns, T_{VJ}=175°C
Reverse Recovery Charge	Q_{rr}	--	82	--		
Peak Reverse Recovery Current	I_{rrm}	--	5.8	--		

Electrical Performance Graphs

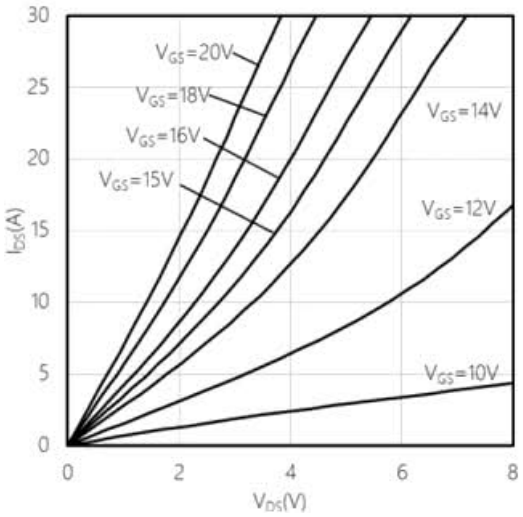


Figure 1: Typical Output Characteristics
T_{VJ}=-55°C

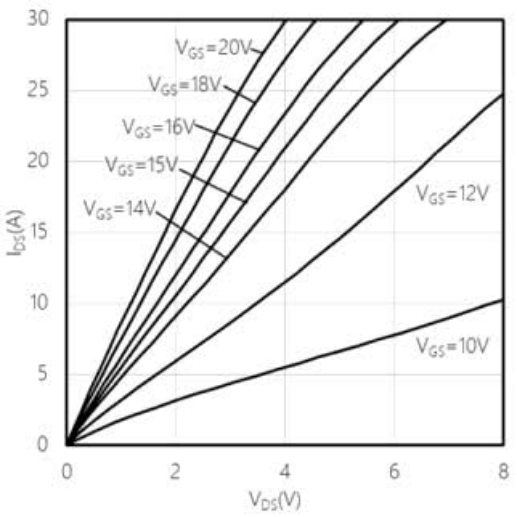


Figure 2: Typical Output Characteristics
T_{VJ}=25°C

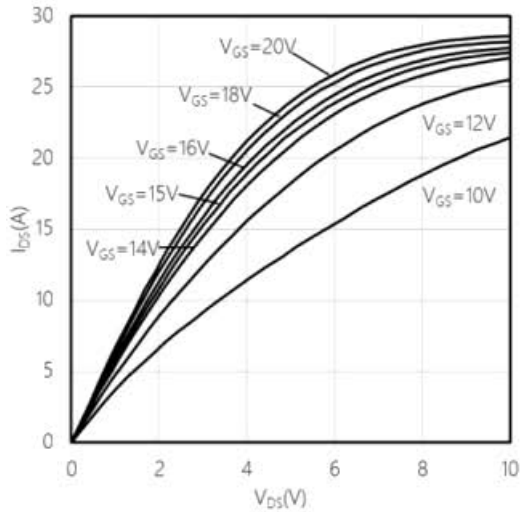


Figure 3: Typical Output Characteristics
T_{VJ}=175°C

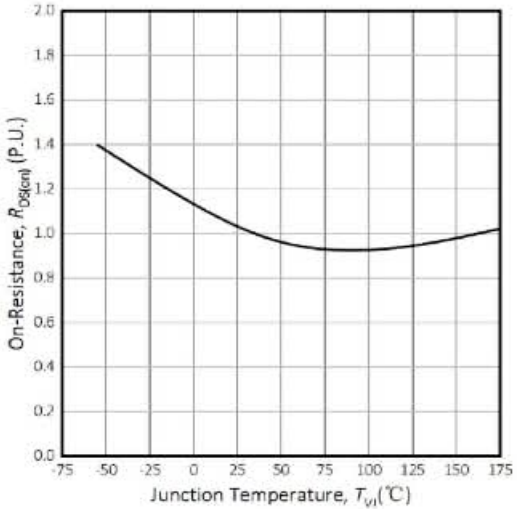


Figure 4: Normalized On-Resistance vs. Temperature
I_D = 7A, V_{GS} = 15 V

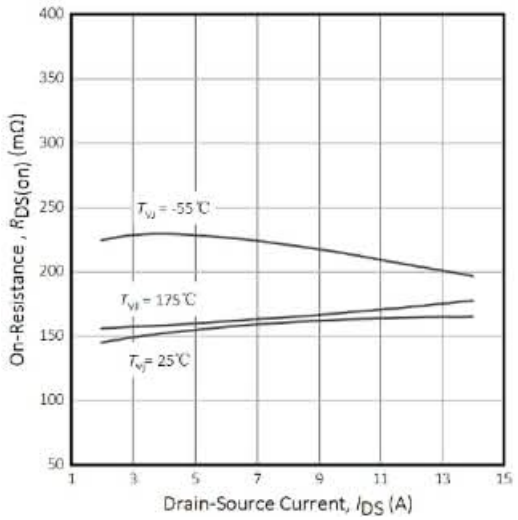


Figure 5: On-Resistance vs. Drain Current for Various Temperature V_{GS} = 15 V

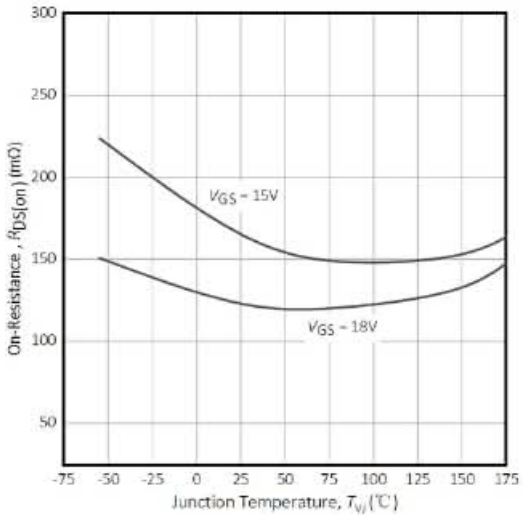


Figure 6: On-Resistance vs. Junction Temperature for VariousGate Voltage I_D = 7A

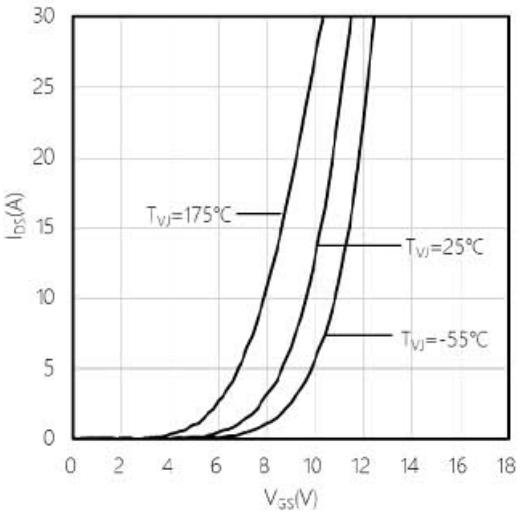


Figure 7: Transfer Characteristic for Various Temperature V_{DS}=20V

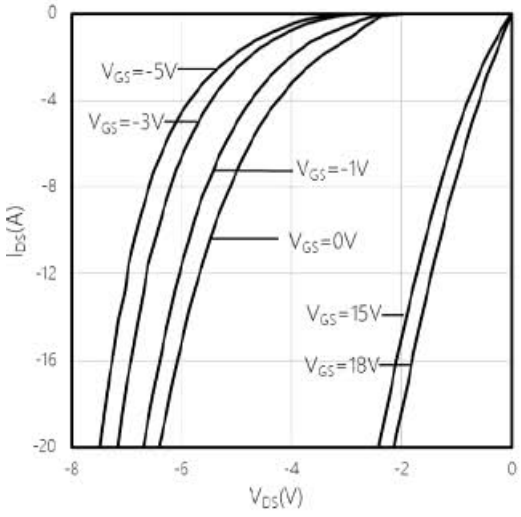


Figure 8: Typical 3rd Quadrant Characteristics T_{VJ}=-55°C

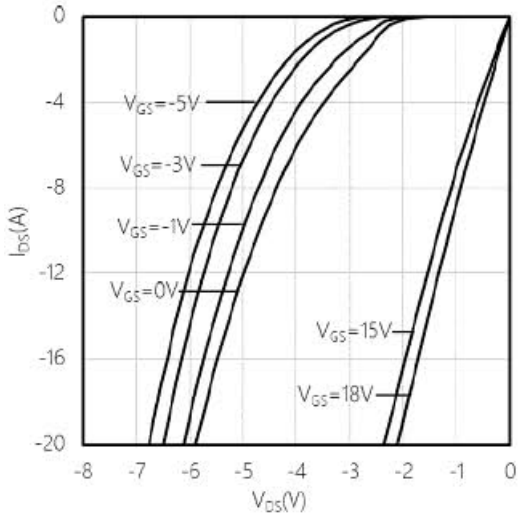


Figure 9. Typical 3rd Quadrant Characteristics
T_{VJ}=25°C

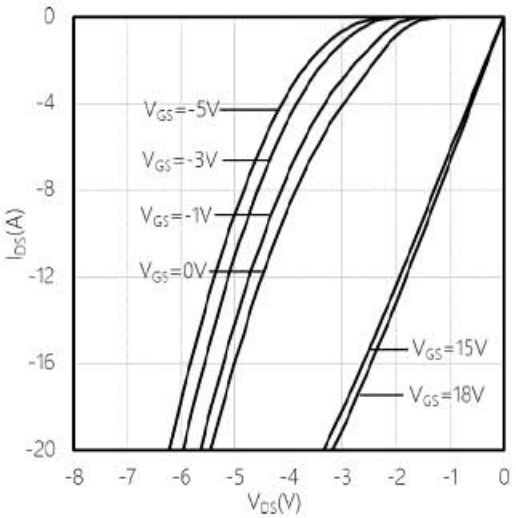


Figure 10. Typical 3rd Quadrant Characteristics
T_{VJ}=175°C

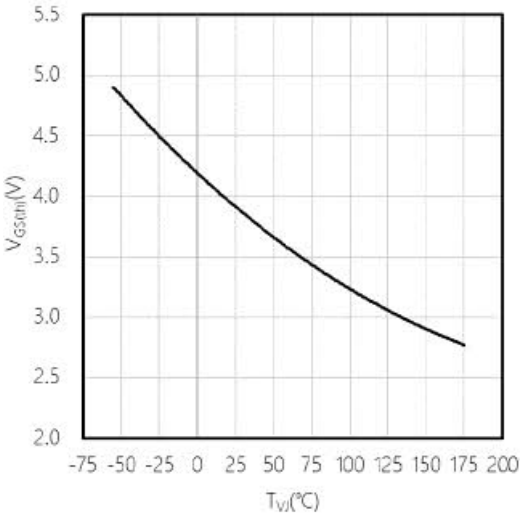


Figure 11. Threshold Voltage vs. Temperature
V_{GS} = V_{DS}, I_D = 10 mA

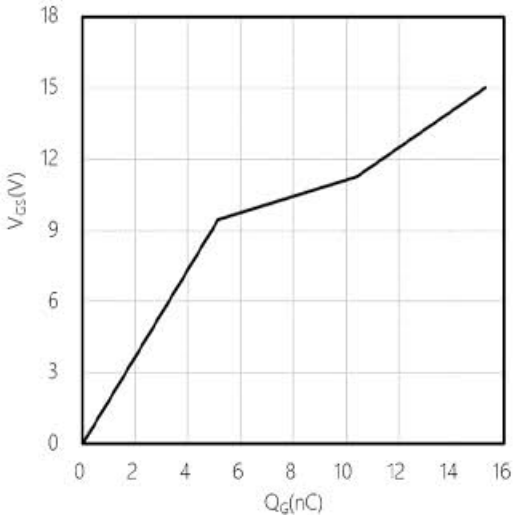


Figure 12. Gate Charge Characteristics
V_{DS} = 400V, T_{VJ} = 25°C

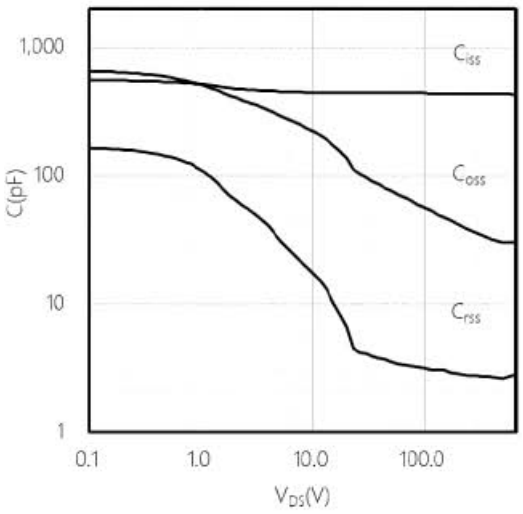


Figure 13: Typical Capacitances vs. Drain-Source Voltage (0 – 650V)
T_{VJ} = 25°C, V_{AC} = 25 mV, f = 100 KHz

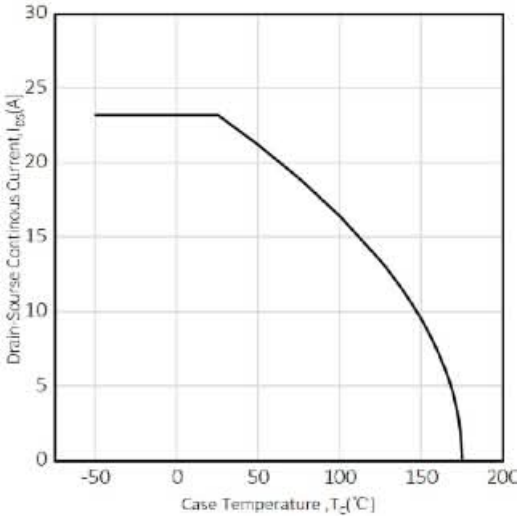


Figure 14: Continuous Drain Current Derating vs. Case Temperature $T_{VJ} \leq 175°C$

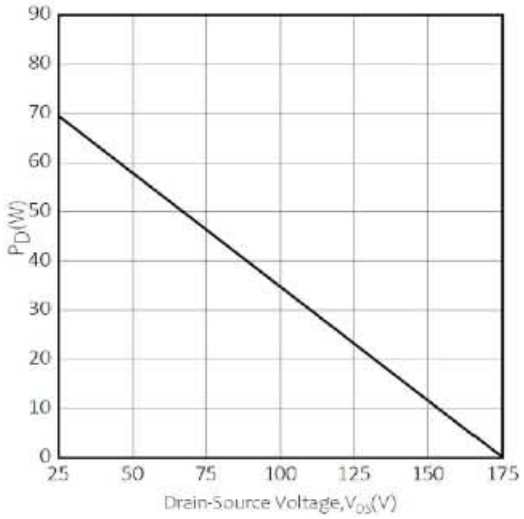


Figure 15: Maximum Power Dissipation Derating vs. Case Temperature $T_{VJ} \leq 175°C$

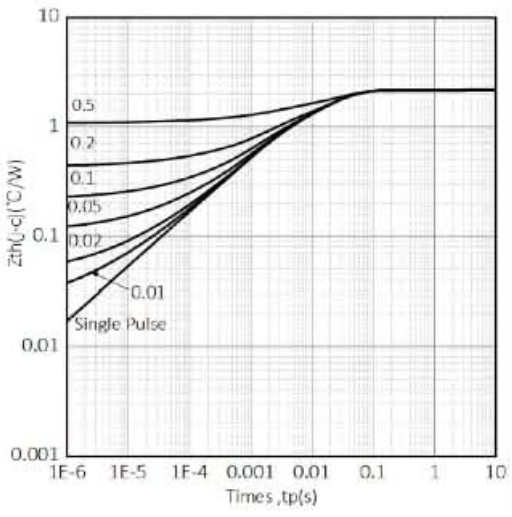


Figure 16: Transient Thermal Impedance (Junction-Case) with Different Duty Cycle

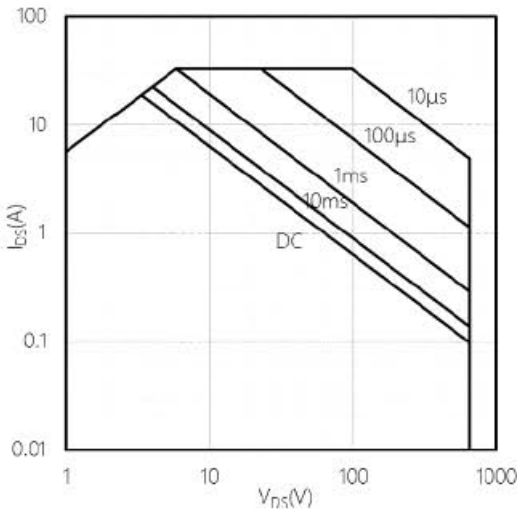


Figure 17: Safe Operating Area

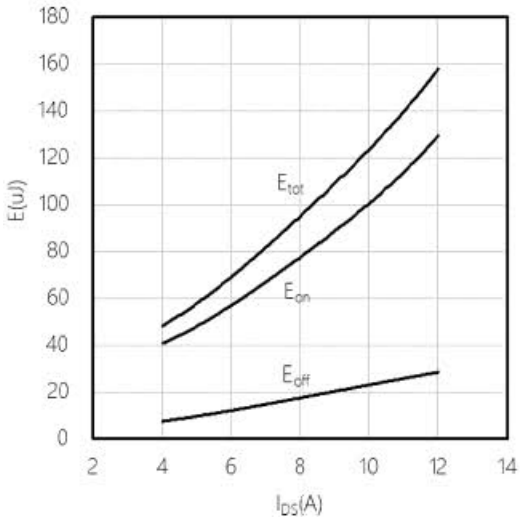


Figure 18: Clamped Inductive Switching Energy vs. Drain Current

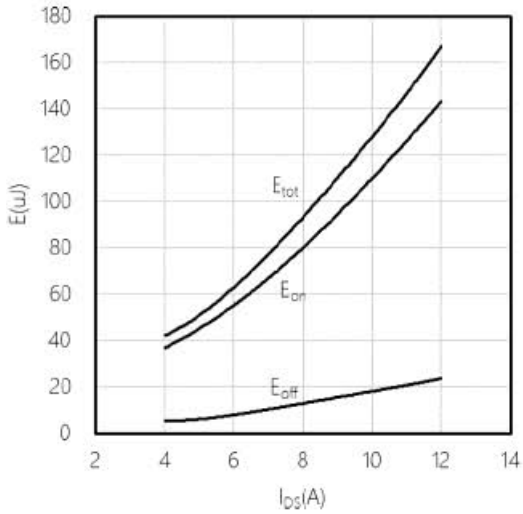


Figure 19: Clamped Inductive Switching Energy vs. Drain Current

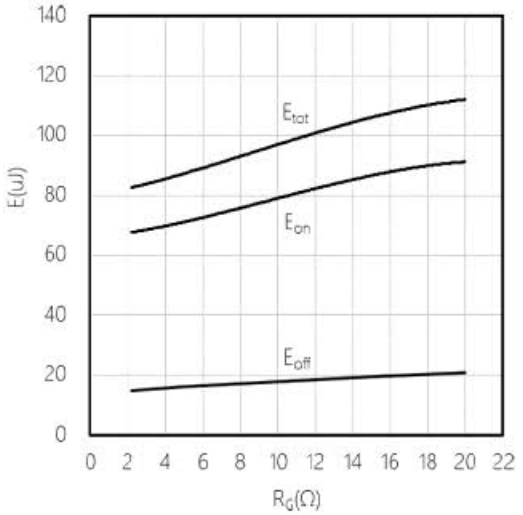


Figure 20: Clamped Inductive Switching Energy vs. $R_{G(ext)}$

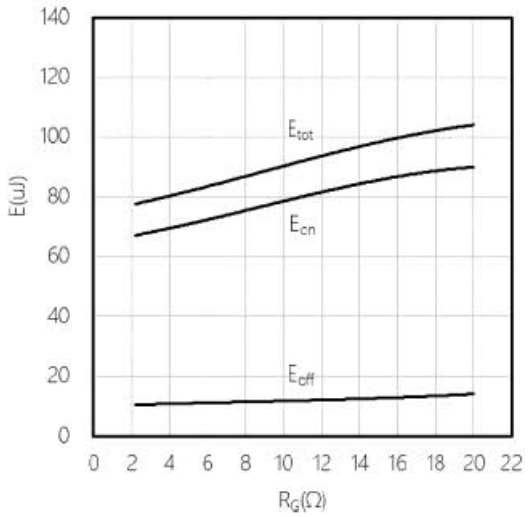


Figure 21: Clamped Inductive Switching Energy vs. $R_{G(ext)}$

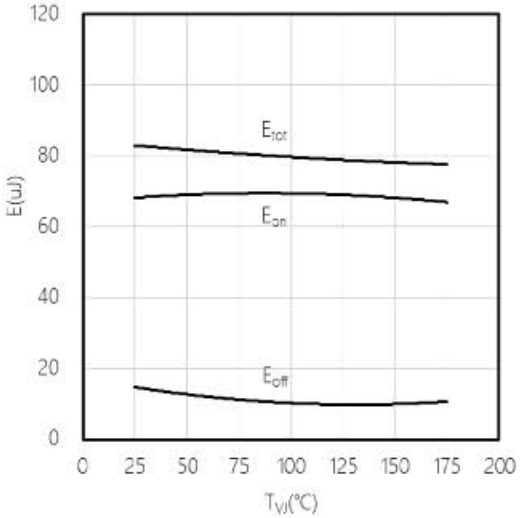


Figure 22: Clamped Inductive Switching Energy vs. Temperature

Testing conditions

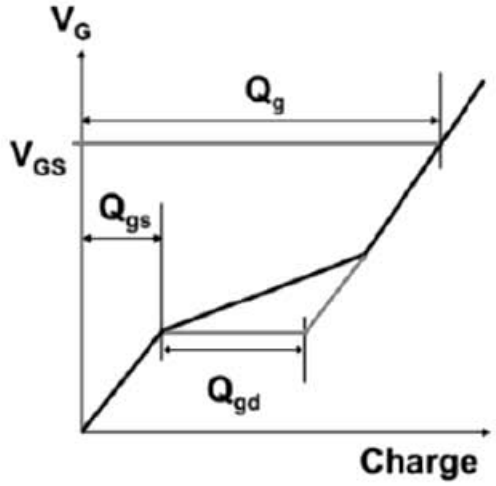


Figure A: Definition of Q_{gd}

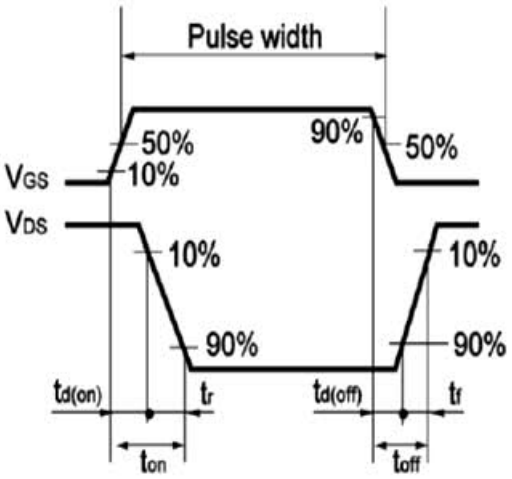


Figure B: Definition of switching times

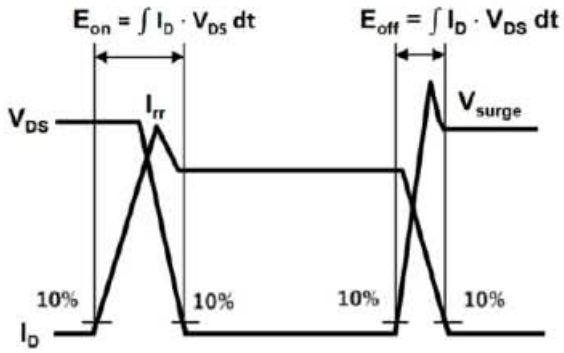


Figure C: Definition of switching losses

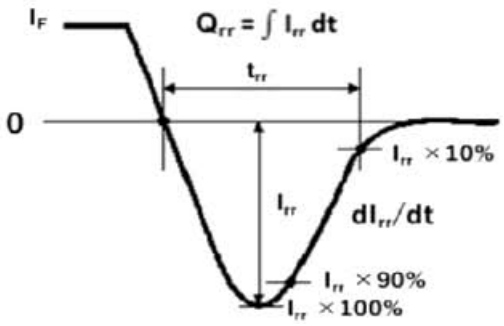
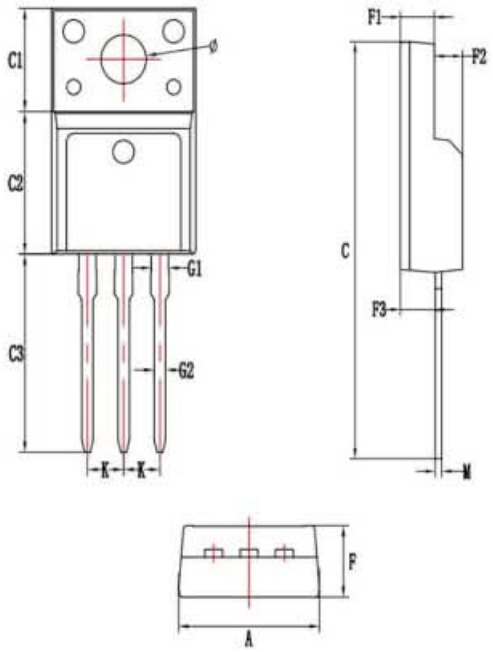


Figure D: Definition of reverse recovery

Package Dimensions



SYMBOL	Unit(mm)	
	Min	Max
A	10.00	10.20
C	28.20	29.00
C1	6.63	6.70
C2	9.17	9.27
C3	12.35	12.95
Ø	3.33	3.43
F	4.45	4.75
F1	2.40	2.60
F2	2.00	2.20
F3	2.30	2.70
G1	1.15	1.25
G2	0.75	0.85
K	2.54	
M	0.45	0.55

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