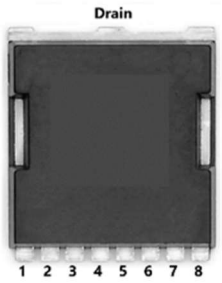
NW6506CL1

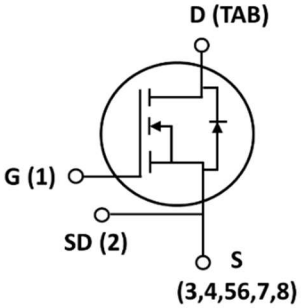
650V N-Channel Silicon Carbide Power MOSFET

Parameter	Value	Unit
V_{DS}	650	V
$R_{DS(on)}$	60	mΩ
I_D	67	A

Features

- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- Low on-resistance with high junction temperature
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery (Qrr)
- Easy to parallel
- RoHS compliant





Applications

- Switch Mode Power Supplies
- DC/DC Converters
- Solar Inverters
- EV charging infrastructure
- Energy storage & battery
- Battery control unit

Description

The NW6506CL1 is a 650V, 60mohm SiC MOSFET designed for improved system efficiency and large power density. It reduces cooling requirements and gate ringing while simplifying system complexity. This results in a significant cost reduction, making it an ideal solution for enhancing performance in a wide range of applications.

Part Description

Part No.	Package	Marking
NW6506CL1	TOLL	NW6506CL1

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 Breakdown Voltage	V_{DSmax}	650	V	V_{GS} = 0 V, I_D = 100 µA
Recommend Gate Source Voltage	$V_{GS,op}$	-5/+20	V	
Maximum Gate Source Voltage	V_{GSmax}	-10/+25	V	AC （f > 1Hz)
Continuous Drain Current	I_D	67 47	A	V_{GS} = 20 V, T_C = 25 °C V_{GS} = 20 V, T_C = 100 °C
Pulsed Drain Current	$I_{D(pulse)}$	112	A	Pulse width t_p limited by T_{jmax}
Power Dissipation	P_D	362	W	T_C = 25 °C
Operating Junction and Storage Temperature Range	T_J ,T_S	-55 to +175	°C	-
Soldering Temperature	T_L	260	°C	

Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance from Junction to Case	$R_{TH,J-C}$	0.414	°C/W

Electrical Characteristics

Static Characteristics

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	650	-	-	V	V_{GS}=0 V, I_D=100 µA
Zero Gate Voltage Drain Current	I_{Dss}	-	10	100	µA	V_{DS}=650 V, V_{GS}=0 V

Gate-Source Leakage	I_{Gss}	-	5	250	nA	V_{GS}=20 V
Gate-Source Threshold Voltage	$V_{GS(th)}$	2	-	4	V	I_D=5 mA, V_{GS}=V_{DS}
Drain-Source On-Resistance	$R_{DS(on)}$	-	60	80	mΩ	V_{GS}=20 V, I_D=13.2 A
		-	80	-		V_{GS}=18 V, I_D=13.2 A
		-	89	-		V_{GS}=15 V, I_D=13.2 A

Dynamic Characteristics

Input Capacitance	C_{iss}	-	1129	-	pF	V_{GS}=0 V, V_{DS}=600 V f=1.0 MHz, V_{AC}=25 mV
Output Capacitance	C_{oss}	-	114	-		
Reverse Transfer Capacitance	C_{rss}	-	6.5	-		
C_{OSS} Stored Energy	E_{OSS}	-	25	-	μJ	
Total Gate Charge	Q_g	-	62	-	nC	V_{DS}=400 V I_D=13.2 A V_{GS}=-5/+20 V
Gate-Source Charge	Q_{gs}	-	18	-		
Gate-Drain Charge	Q_{gd}	-	33	-		
Turn-on Delay Time	$t_{d(on)}$	-	21.3	-	ns	V_{DS}=400 V V_{GS}=-5/+20 V I_D=13.2 A $R_{G(ext)}$=2.5 Ω
Turn-on Rise Time	t_r	-	14.5	-		
Turn-off Delay Time	$t_{d(off)}$	-	132.6	-		
Turn-off Fall Time	t_f	-	42.7	-		
Internal Gate Resistance	$R_{G(int)}$	-	2.8	-	Ω	f=1.0 MHz, V_{AC}=25 mV

Body Diode Characteristics (at T_j of 25℃)

Continuous Diode Froward Current	I_S	-	-	56	A	

Diode pulse Curren	$I_{S(pulse)}$		112		A	
Diode Froward Voltage	V_{SD}	-	3.0	-	V	V_{GS}=0 V, I_S=6.6 A
Reverse Recovery Time	t_{rr}	-	23	-	ns	I_S=13.2 A, V_{DS}=400 V V_{GS}=-5 V di/dt=2100 A/μs
Reverse Recovery Charge	Q_{rr}	-	132	-	nC	
Peak Reverse Recovery Current	I_{rrm}	-	13	-	A	

Typical Performance

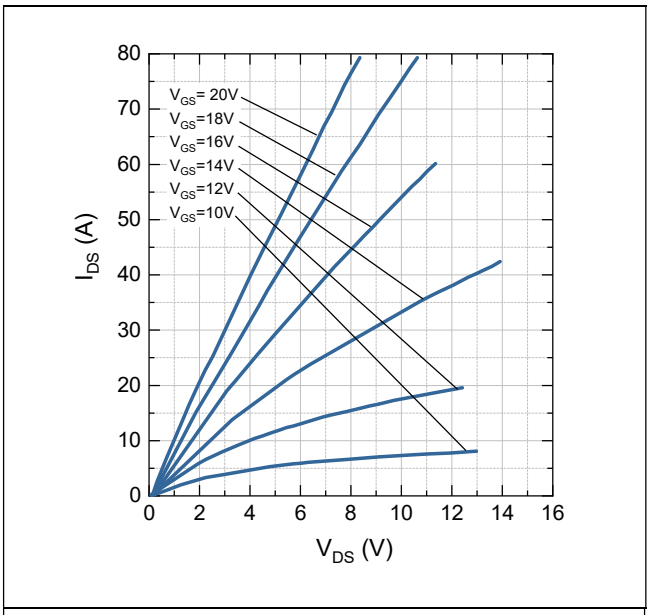


Figure 1: Typical Output Characteristics at T_J=-55 ℃

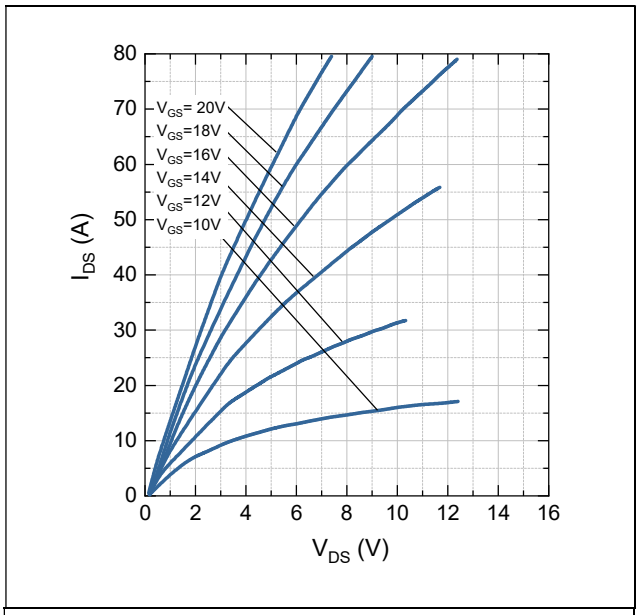


Figure 2: Typical Output Characteristics at T_J=25 ℃

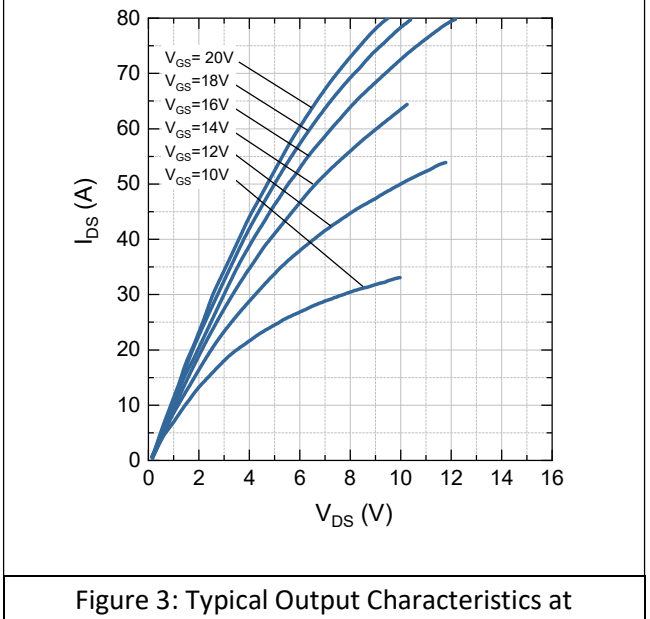


Figure 3: Typical Output Characteristics at T_J=175 ℃

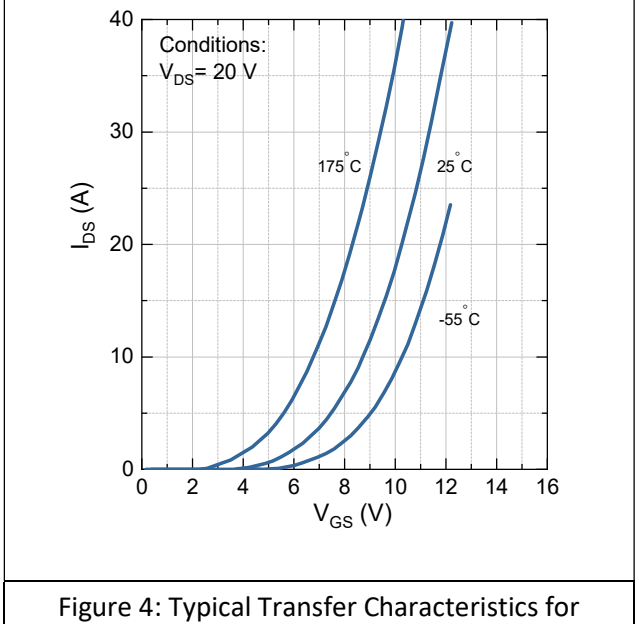


Figure 4: Typical Transfer Characteristics for Various Temperature

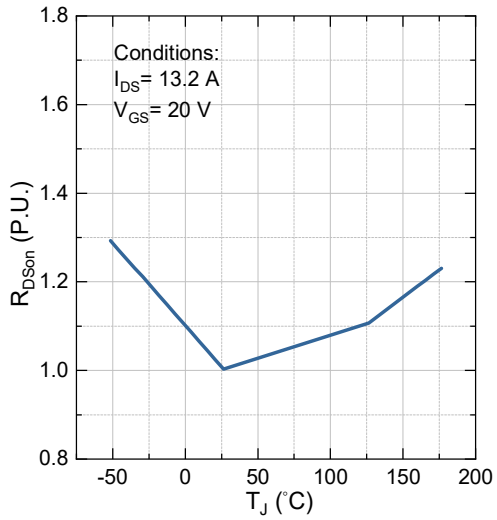


Figure 5: Normalized On-Resistance vs Temperature

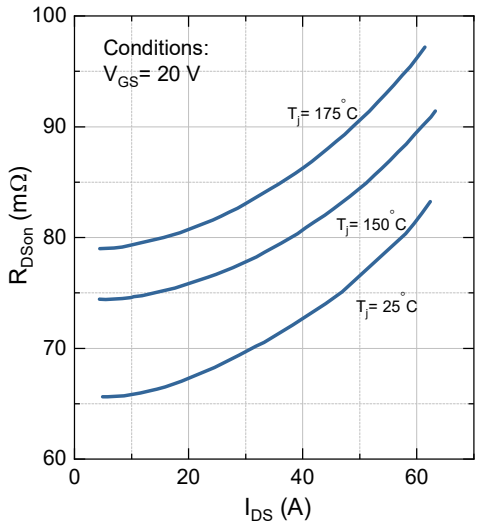


Figure 6: On-Resistance vs. Drain Current for Gate Various Temperatures

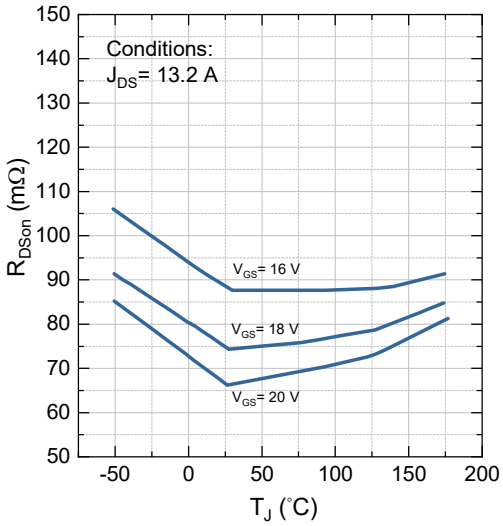


Figure 7: On-Resistance vs. Temperature for Various Voltage

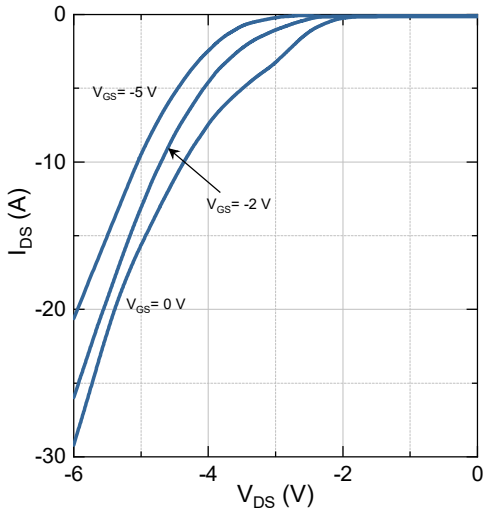


Figure 8: Typical Body Diode Characteristics at T_J=-55 ℃

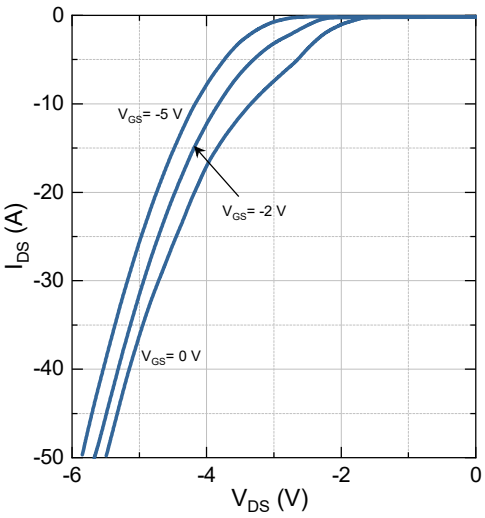


Figure 9: Typical Body Diode Characteristics at T_J=25 ℃

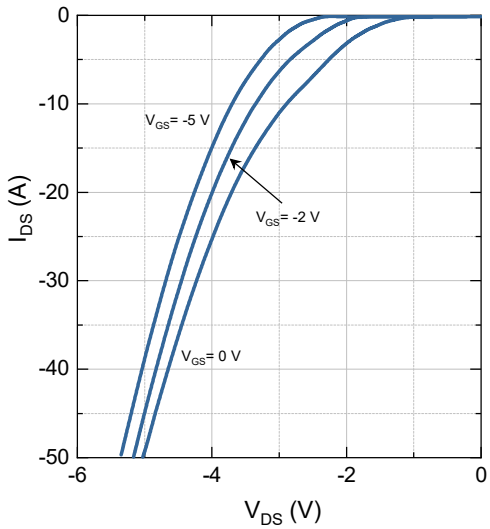


Figure 10: Typical Body Diode Characteristics at T_J=175 ℃

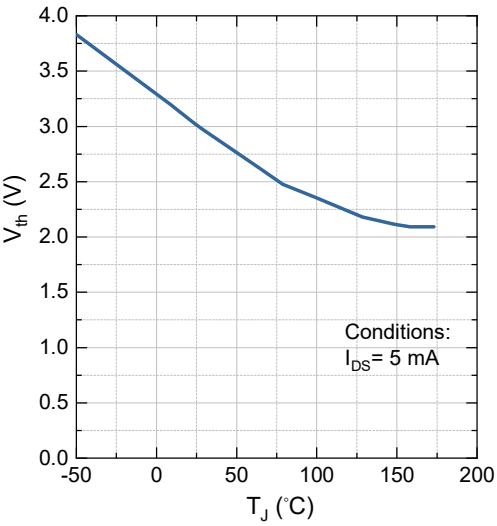


Figure 11: Typical Threshold Voltage vs. Temperature

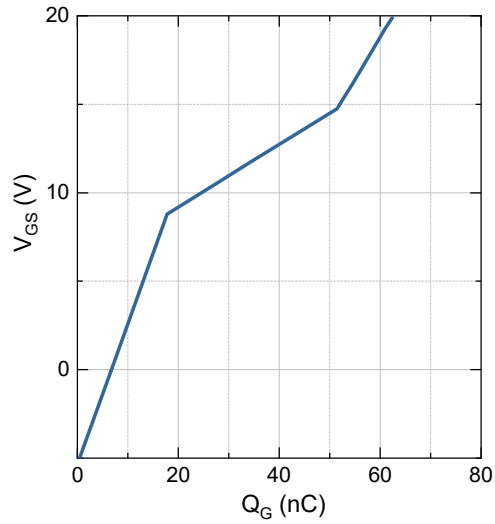


Figure 12: Typical Gate Charge Characteristics at T_J=25 ℃

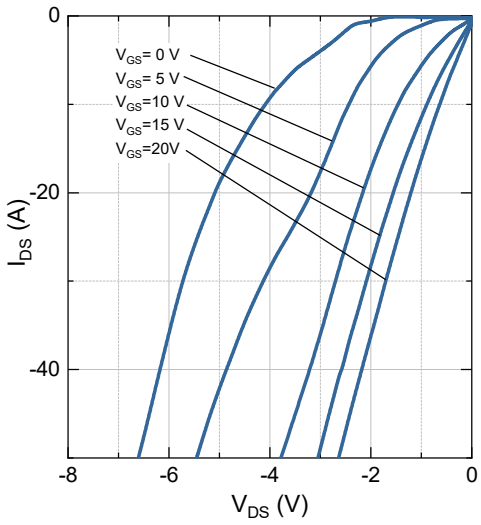


Figure 13: Typical 3rd Quadrant Characteristics T_J=-55 ℃

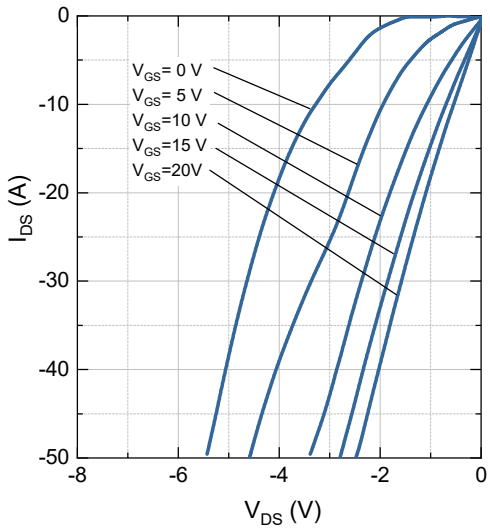


Figure 14: Typical 3rd Quadrant Characteristics at T_J=25 ℃

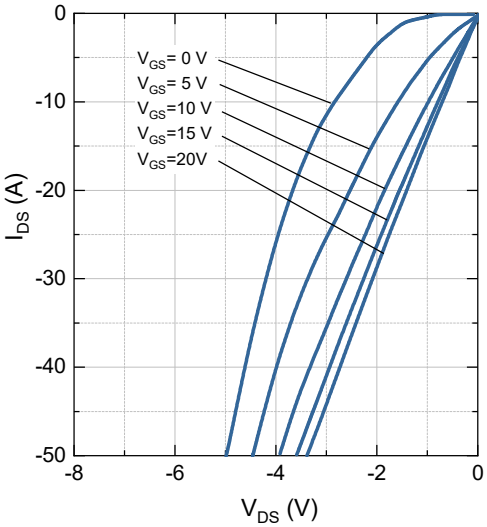


Figure 15: Typical 3rd Quadrant Characteristics at T_J=175 ℃

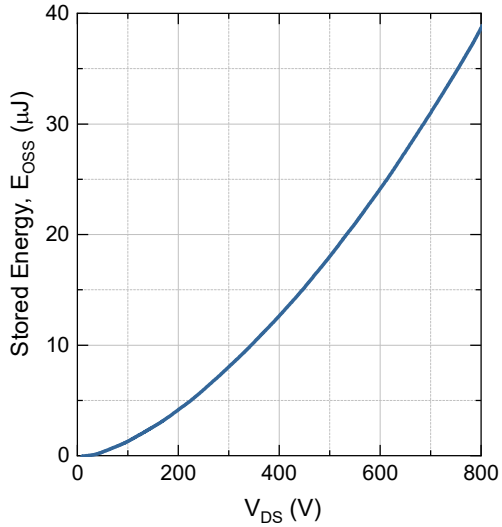


Figure 16: Typical Output Capacitor Stored Energy

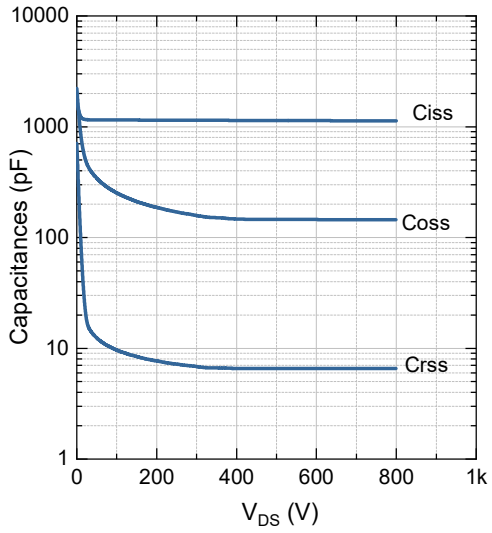


Figure 17: Typical Capacitances vs. Drain-Source Voltage

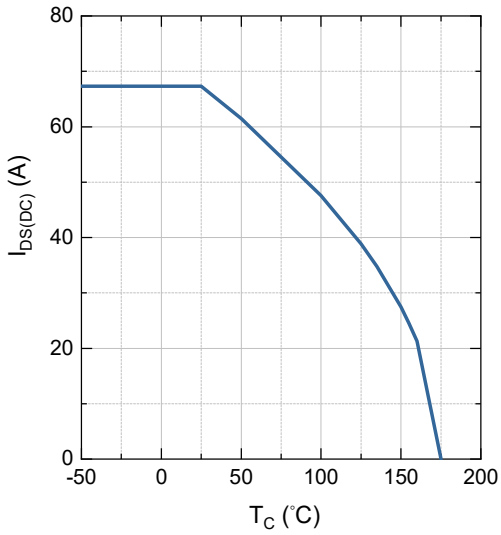


Figure 18: Continuous I_{DS} Current Derating Curve

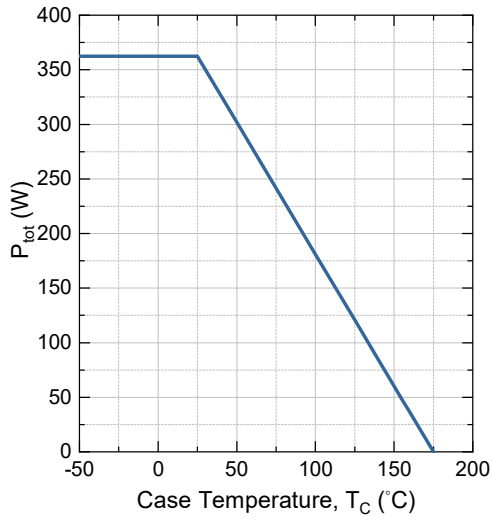


Figure 19: Power Dissipation Derating Curve

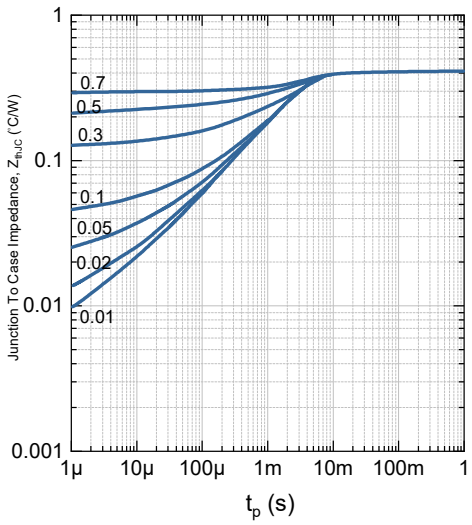


Figure 20: Typical Transient Thermal Impedance (Junction- Case) with Duty Cycle

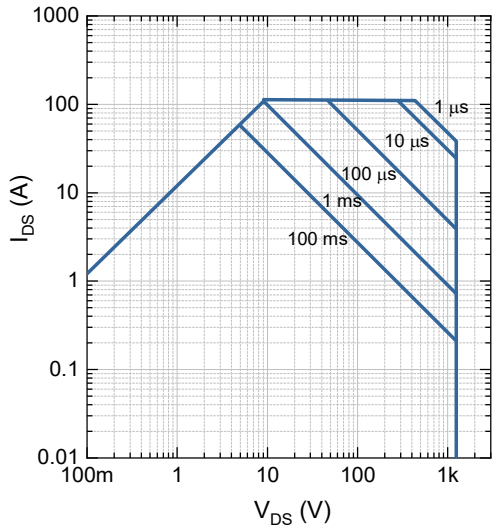


Figure 21: Safe Operate Area

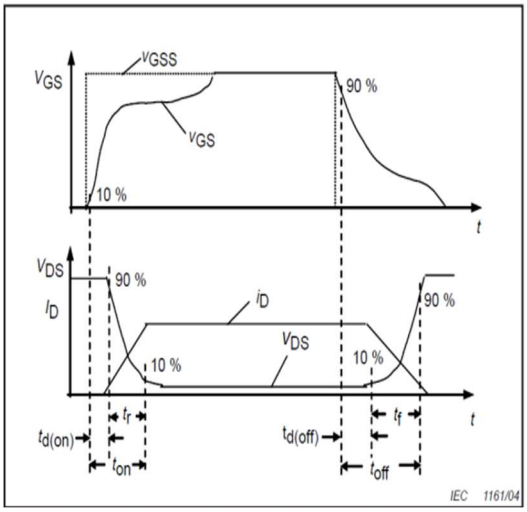


Figure 22: Resistive Switching Time Description

Test Circuit Schematic

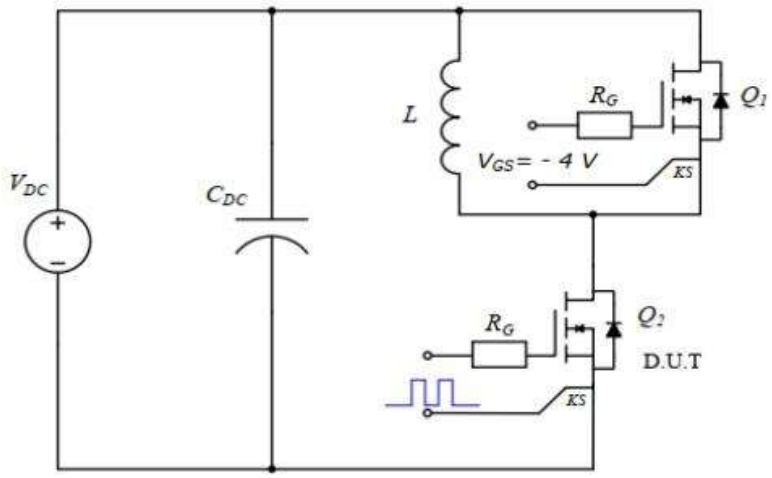
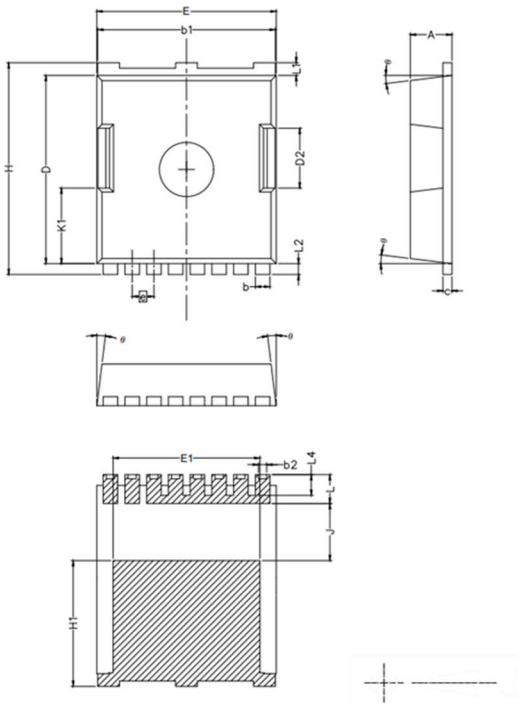


Figure 23: Clamped Inductive Switching Waveform Test Circuit

Package Dimensions

Package： TOLL



SYMBOL	MIN	MAX	NOTES
A	2.20	2.40	
b	0.70	0.90	1.0 DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
b1	9.70	9.90	2.0 ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.
b2	0.42	0.50	3.0 COPLANARITY APPLIES TO THE EXPOSED HEAT SLUG AS WELL AS THE TERMINAL.
c	0.40	0.60	
D	10.28	10.58	4.0 RADIUS ON TERMINAL IS OPTIONAL.
D2	3.10	3.50	
E	9.70	10.10	
E1	7.90	8.30	
e	1.20 BSC		
H	11.48	11.88	
H1	6.75	7.15	
N	8		
J	3.00	3.30	
K1	3.98	4.38	
L	1.40	1.80	
L1	0.60	0.80	
L2	0.50	0.70	
L4	1.00	1.30	
θ	4°	10°	

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