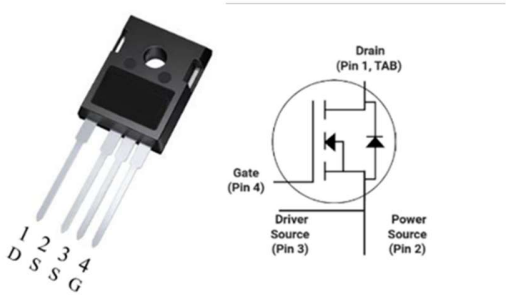
NW6504CJ1-4

650V N-Channel Silicon Carbide Power MOSFET

Parameter	Value	Unit
V_{DS}	650	V
$R_{DS(on)}$	39	mΩ
I_D	78	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 (Q_{rr})
- 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 NW6504CJ1-4 is a 650V N-Channel Silicon Carbide Power 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.

Pin Description

Part Number	Package	Marking
NW6504CJ1-4	TO247-4	NW6504CJ1-4

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Absolute Maximum Ratings, at T_J = 25℃, unless otherwise specified

Parameter	Symbol	Value	Unit	Test conditions
Drain-Source Breakdown Voltage	V_{DSmax}	650	V	V_{GS} = 0 V, I_D = 100 μA
Continuous Drain Current	I_D	78	A	V_{GS} = 20 V, T_C = 25 ℃
		55	A	V_{GS} = 20 V, T_C = 100 ℃
Pulsed Drain Current	$I_{D(pulse)}$	156	A	Pulse width t_p limited by T_{jmax}
Power Dissipation	P_D	362	W	T_C = 25 ℃
Recommend Gate Source Voltage	$V_{GS,op}$	-5/+20	V	
Maximum Gate Source Voltage	V_{GSmax}	-10/+25	V	AC （f > 1Hz)
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55 to +175	℃	
Soldering Temperature	T_L	260	℃	

Thermal Characteristics

Parameter	Symbol	Value	Unit
Thermal Resistance from Junction to Case	$R_{\theta JC}$	0.414	℃/W

Electrical Characteristics, at T_J = 25℃, unless otherwise specified

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

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Gate-Source Threshold Voltage	$V_{GS(th)}$	2	--	4	V	I_D = 5 mA, V_{GS} = V_{DS}
Drain-Source On-State Resistance	$R_{DS(on)}$	--	39	80	mΩ	V_{GS} = 20 V, I_D = 13.2 A
		--	52	--	mΩ	V_{GS} = 18 V, I_D = 13.2 A
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	$t_{d(on)}$	--	132.6	--	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	--	42.7	--		
Turn-off Delay Time	$t_{d(off)}$	--	21.3	--		
Turn-off Fall Time	t_f	--	14.5	--		
Internal Gate Resistance	$R_{G(int)}$	--	2.8	--	Ω	f = 1.0 MHz, V_{AC} = 25 mV

Body Diode Characteristics, at T_J = 25℃, unless otherwise specified

Parameters	Symbol	Min	Typ	Max	Unit	Condition
Continuous Diode Froward Current	I_S	--	--	78	A	

Diode pulse Curren	$I_{S(pulse)}$	--	156	--	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 dif/dt = 2100 A/µs
Reverse Recovery Charge	Q_{rr}	--	132	--	nC	
Peak Reverse Recovery Current	I_{rrm}	--	13	--	A	

Electrical Performance Graphs

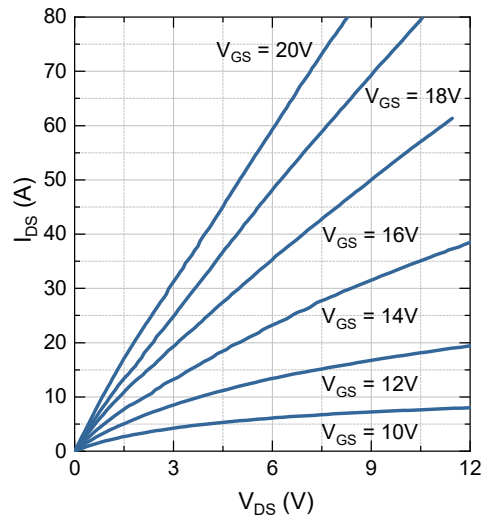


Figure 1: Typical Output Characteristics at T_J = -55 ℃

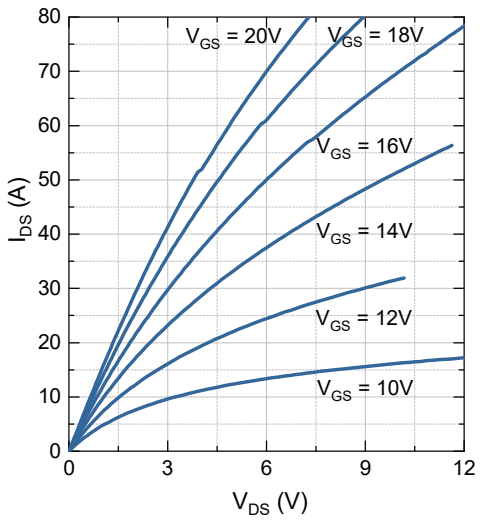


Figure 2: Typical Output Characteristics at T_J = 25 ℃

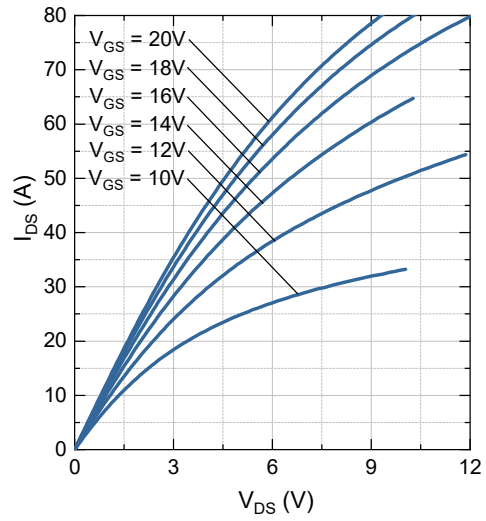


Figure 3: Typical Output Characteristics at T_J = 175 ℃

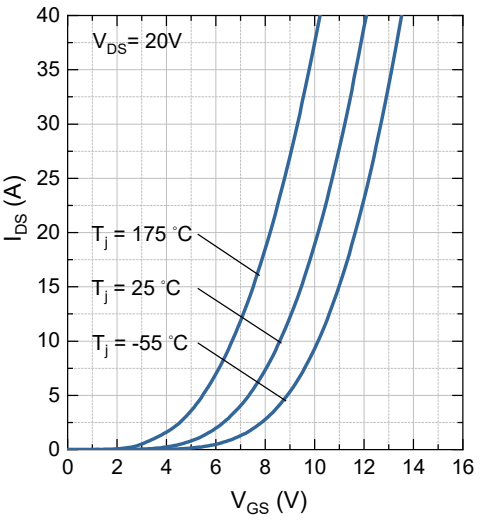


Figure 4: Typical Transfer Characteristics for Various Temperature

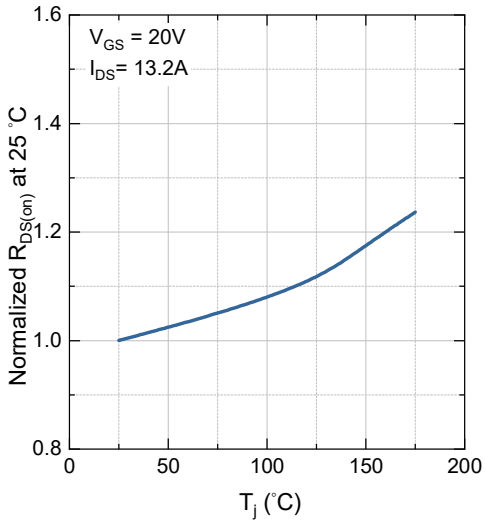


Figure 5: Normalized On-Resistance vs. Temperature

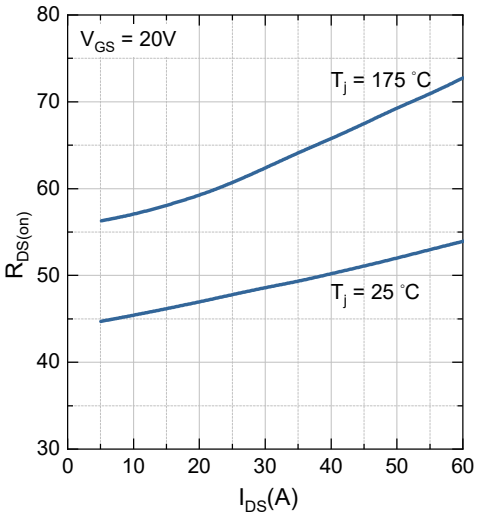


Figure 6: On-Resistance vs. Drain Current for Gate Various Temperatures

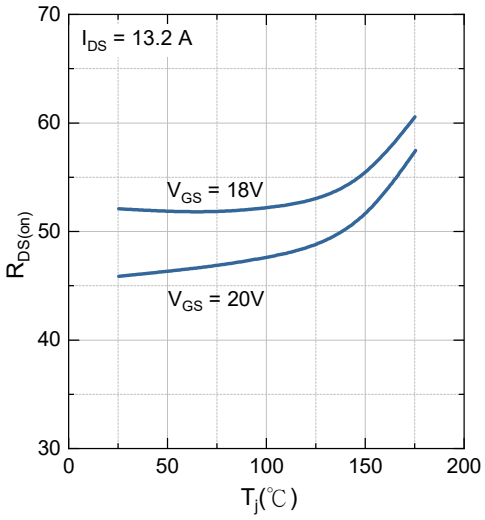


Figure 7: On-Resistance vs. Temperature for Gate Various Voltage

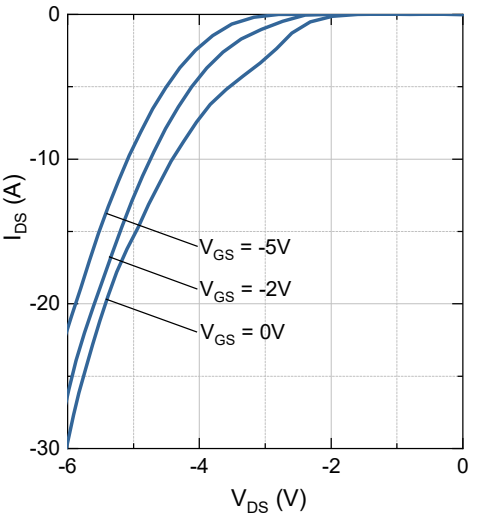


Figure 8: Typical Body Diode Characteristics at T_J = -55 ℃

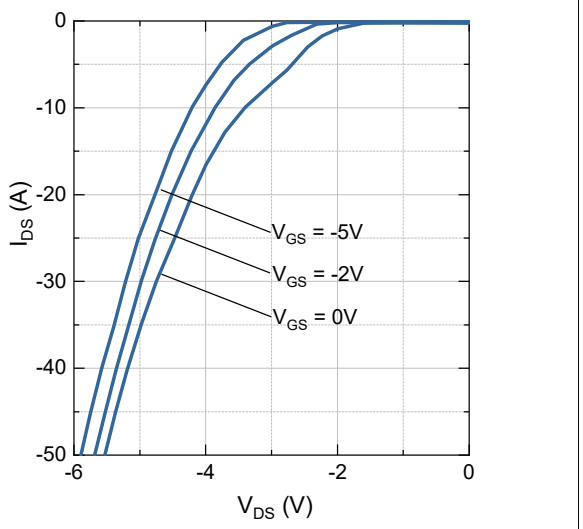


Figure 9: Typical Body Diode Characteristics at T_J = 25 ℃

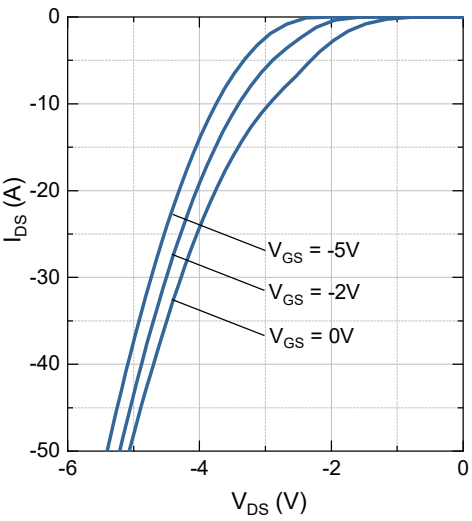


Figure 10: Typical Body Diode Characteristics at T_J = 175 ℃

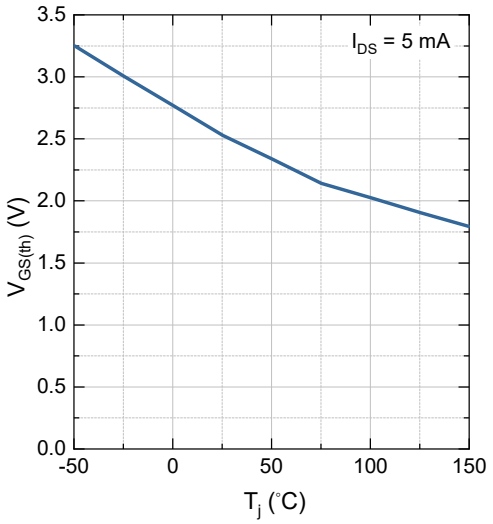


Figure 11: Typical Threshold Voltage vs. Temperature

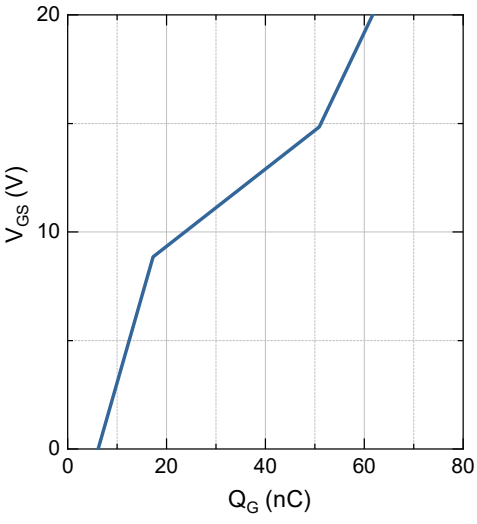


Figure 12: Typical Gate Charge Characteristics at T_J = 25 ℃

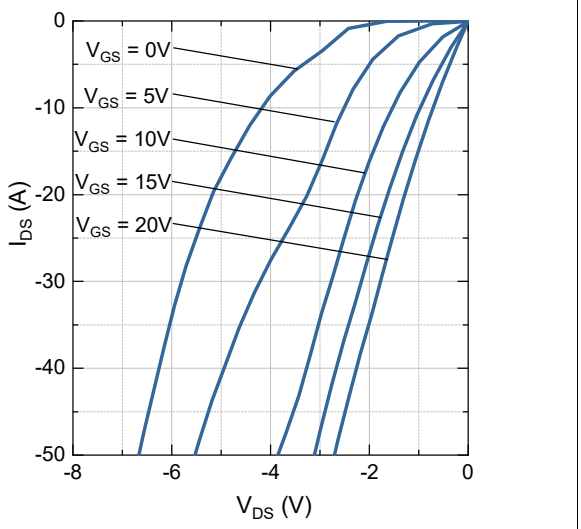


Figure 13: Typical 3rd Quadrant Characteristics T_J = -55 ℃

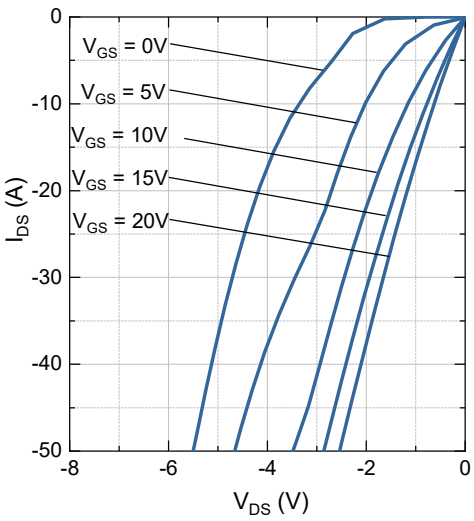


Figure 14: Typical 3rd Quadrant Characteristics T_J = 25 ℃

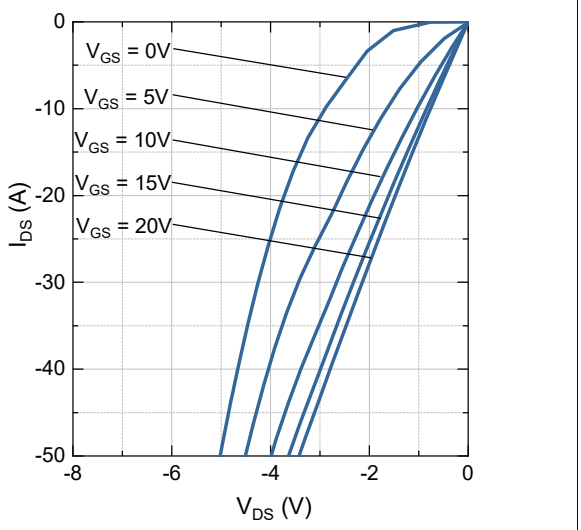


Figure 15: Typical 3rd Quadrant Characteristics T_J = 175 ℃

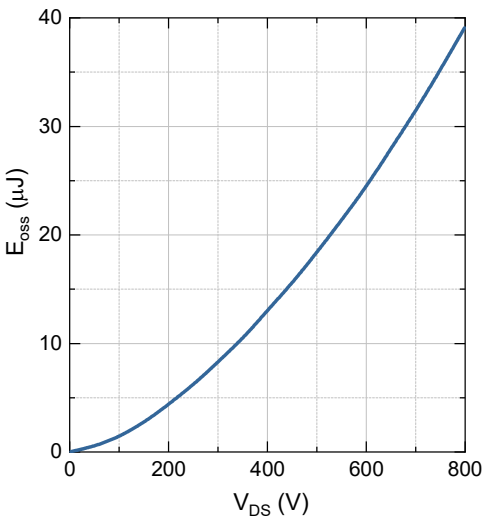


Figure 16: Typical Output Capacitor Stored Energy

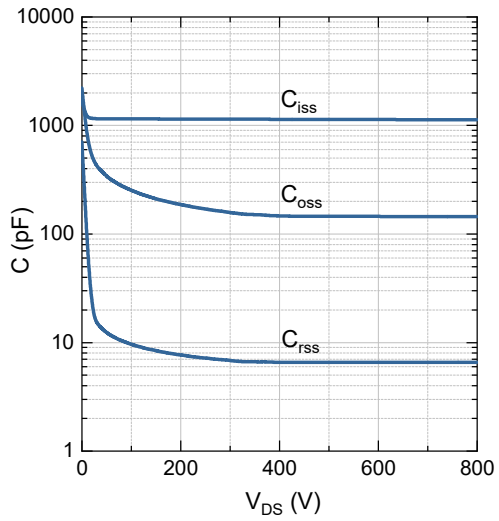


Figure 17: Typical Capacitances vs.Drain-Source Voltage

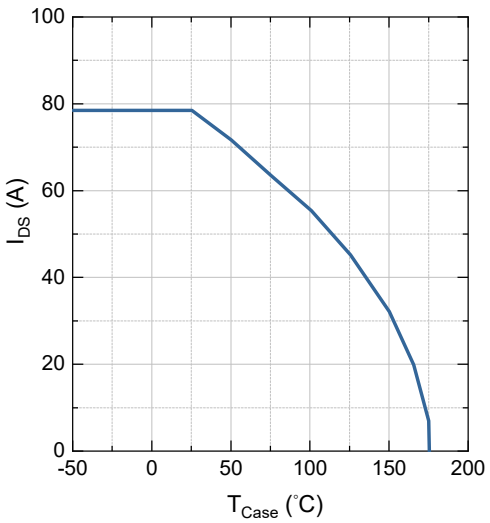


Figure 18: Continuous I_{DS} Current Derating Curve

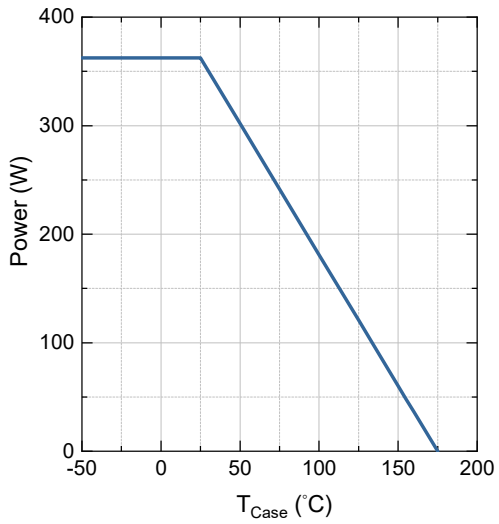


Figure 19: Power Dissipation Derating Curve

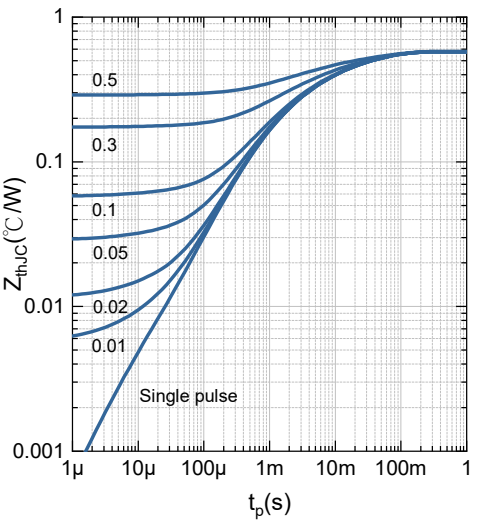


Figure 20: Typical Transient Thermal Impedance (Junction – Case) with Duty Cycle

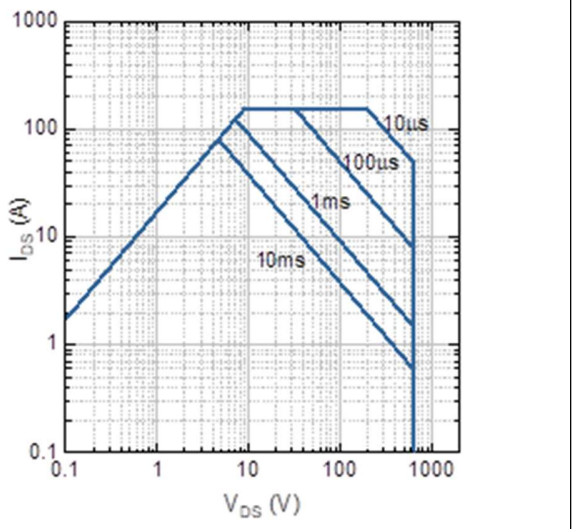


Figure 21: Safe Operating Area

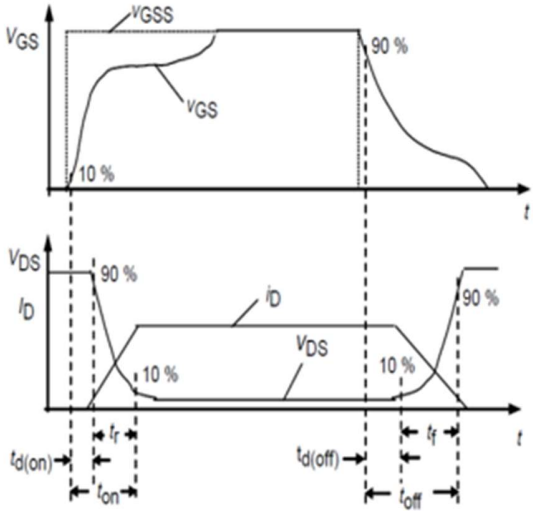


Figure 22: Resistive Switching Time Description

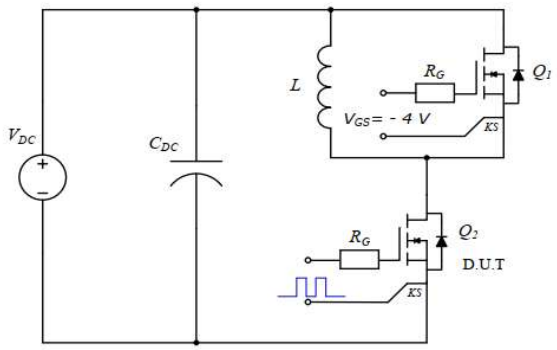
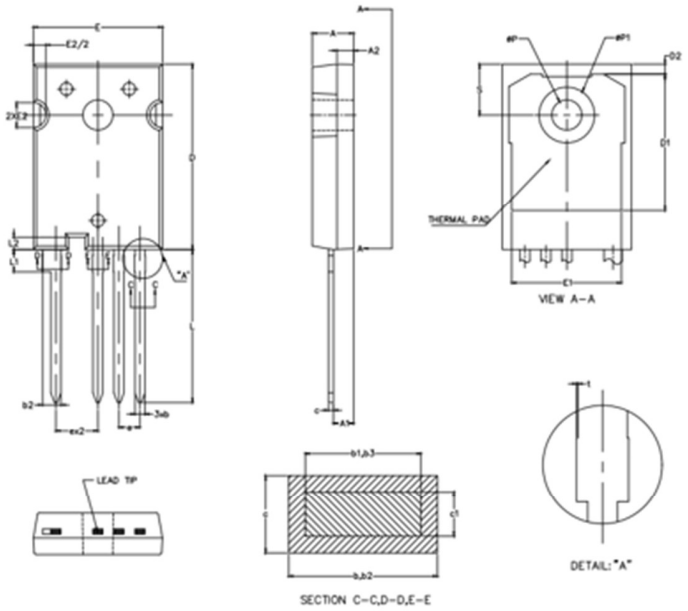


Figure 23: Clamped Inductive Switching Waveform Test Circuit

Package Dimensions

Package： TO247-4



SYMBOLS	DIMENSIONS			
	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A	4.90	5.10	0.193	0.201
A1	2.31	2.51	0.091	0.099
A2	1.90	2.10	0.075	0.083
b	1.16	1.26	0.046	0.050
b1	1.15	1.22	0.045	0.048
b2	2.16	2.26	0.085	0.089
b3	2.15	2.22	0.085	0.087
c	0.59	0.66	0.023	0.026
c1	0.58	0.62	0.023	0.024
D	22.40	22.60	0.882	0.890
D1	16.25	16.85	0.640	0.663
D2	1.05	1.35	0.041	0.053
E	15.75	15.90	0.620	0.626
E1	13.26	—	0.552	—
E2	2.90	3.10	0.114	0.122
e	2.54BSC		0.1BSC	
L	18.30	18.60	0.720	0.732
L1	—	2.80	—	0.110
L2	—	1.50	—	0.059
øP	3.50	3.70	0.138	0.146
øP1	—	7.40	—	0.291
S	6.05	6.25	0.238	0.246
t	0.00	0.15	0.000	0.006

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