650V N-Channel Silicon Carbide Power MOSFET

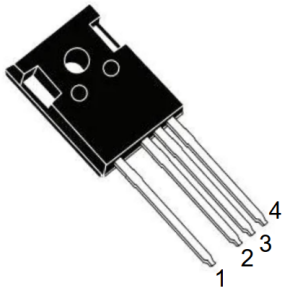
Features

- High-speed switching performance
- Best thermal conductivity and behavior
- Fast intrinsic diode with low reverse recovery (Q_{RR})
- Halogen-free，RoHS compliant (Note 1)

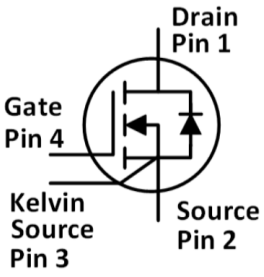
Applications

- EV charging infrastructure
- UPS (uninterruptable power supplies)
- Switched mode power supplies
- Solar PV inverters
- Energy storage and battery formation

Package



Top View



Part Number	Package
DTN50N65SC4	TO247-4

Absolute Maximum Ratings (T_C=25°C unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions
V_{DS}	Drain-Source voltage	650	V	V_{GS}=0V, I_D=100μA
V_{GSmax} (DC)	Maximum DC voltage	-4 to 15	V	Static (DC)
V_{GSmax} (Spike)	Maximum spike voltage	-8 to 19	V	<1% duty cycle, and pulse width<200ns
V_{GSon}	Recommended turn-on voltage	20±0.5	V	
V_{GSoff}	Recommended turn-off voltage	-3.5 to -2	V	
I_D	Drain current (continuous)	50	A	V_{GS}=20V, T_C=25°C
		35	A	V_{GS}=20V, T_C=100°C
I_{DM}	Drain current (pulsed)	100	A	Pulse width limited by SOA
P_{TOT}	Total power dissipation	214	W	T_C=25°C
T_{stg}	Storage temperature range	-55 to 175	°C	
T_J	Operating junction temperature	-55 to 175	°C	
T_L	Solder Temperature	260	°C	wave soldering only allowed at leads, 1.6mm from case for 10 s

Thermal Data

Symbol	Parameter	Value	Unit
$R_{\theta(J-C)}$	Thermal Resistance from Junction to Case	0.7	°C/W

Electrical Characteristics (T_C=25°C unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
I_{DSS}	Zero gate voltage drain current		5	50	μA	V_{DS}=650V, V_{GS}=0V
I_{GSS}	Gate leakage current			±100	nA	V_{DS}=0V, V_{GS}=-4~15V
V_{TH}	Gate threshold voltage	1.8	2.8	4	V	V_{GS}=V_{DS}, I_D=5mA
			2.1			V_{GS}=V_{DS}, I_D=5mA @ T_C=175°C
R_{ON}	Static drain-source on-resistance		45		mΩ	V_{GS}=15V, I_D=20A @T_J=25°C
			68		mΩ	V_{GS}=15V, I_D=20A @T_J=175°C
C_{iss}	Input capacitance		2600		pF	V_{DS}=600V, V_{GS}=0V, f=100 kHz , V_{AC}=25mV
C_{oss}	Output capacitance		145		pF	
C_{rss}	Reverse transfer capacitance		5		pF	
E_{oss}	C_{oss} stored energy		32		μJ	
Q_g	Total gate charge		81		nC	V_{DS}=400V, I_D=20A, V_{GS}=-4 to 15V
Q_{gs}	Gate-source charge		28.5		nC	
Q_{gd}	Gate-drain charge		18		nC	
R_g	Gate input resistance		1.4		Ω	f=1MHz
E_{ON}	Turn-on switching energy		44.7		μJ	V_{DS}=400V, I_D=20A, V_{GS}=-4 to 15V, $R_{G(ext)}$=2.5Ω, L=99μH
E_{OFF}	Turn-off switching energy		21.4		μJ	
$t_{d(on)}$	Turn-on delay time		16		ns	
t_r	Rise time		24			
$t_{d(off)}$	Turn-off delay time		21			
t_f	Fall time		56			

Reverse Diode Characteristics (T_C=25°C unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions
		Min.	Typ.	Max.		
V_{SD}	Diode forward voltage		4.8		V	I_{SD}=10A, V_{GS}=-4V
			4.2		V	I_{SD}=10A, V_{GS}=-4V, T_J=175°C
t_{rr}	Reverse recovery time		15		ns	V_{GS}=-4V I_{SD}=20A, V_R=400V, di/dt=5000A/us,
Q_{rr}	Reverse recovery charge		154		nC	
I_{RRM}	Peak reverse recovery current		17		A	

Typical Performance (curves)

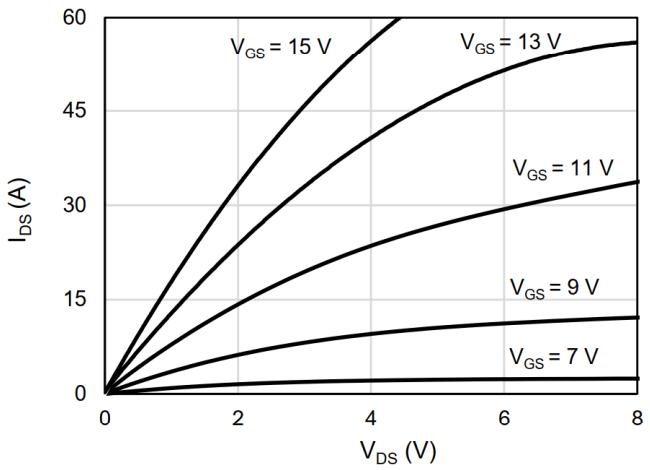


Figure 1: Output Characteristics T_J = -40℃

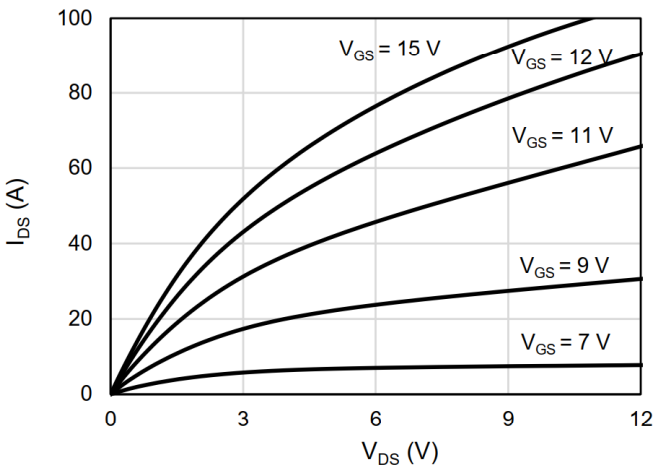


Figure 2: Output Characteristics T_J = 25℃

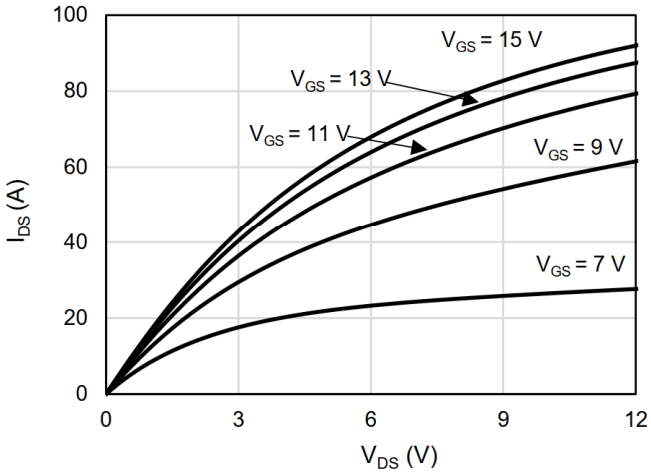


Figure 3: Output Characteristics T_J = 175℃

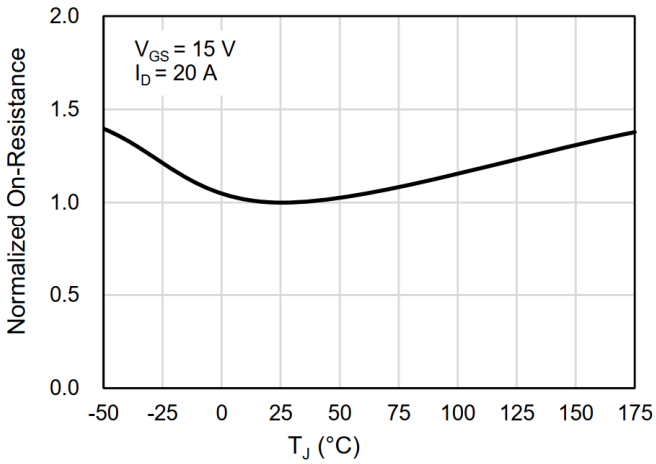


Figure 4: Normalized On-Resistance vs. Temperature

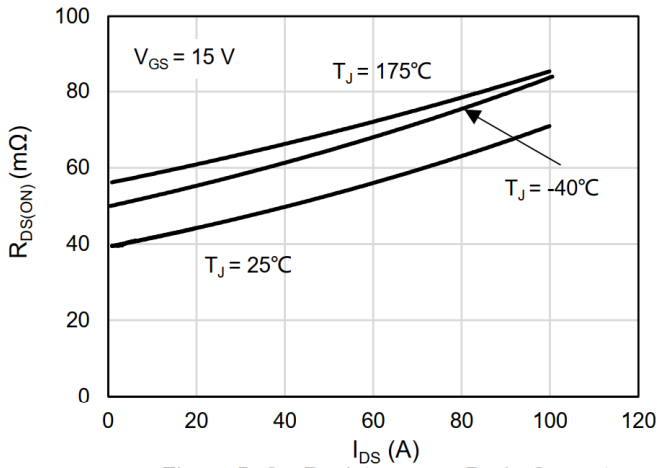


Figure 5: On-Resistance vs. Drain Current For Various Temperatures

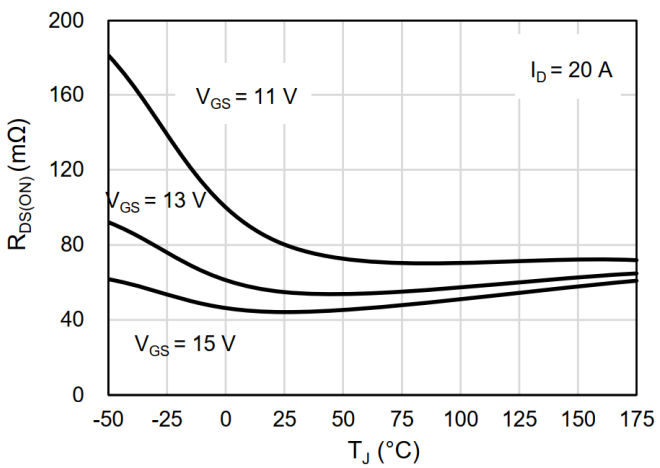


Figure 6: On-Resistance vs. Temperature For Various Gate Voltage

Typical Performance (curves)

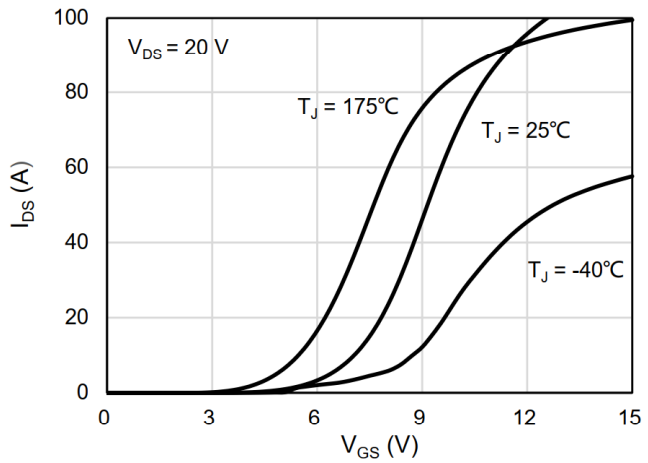


Figure 7: Transfer Characteristics For Various Junction Temparature

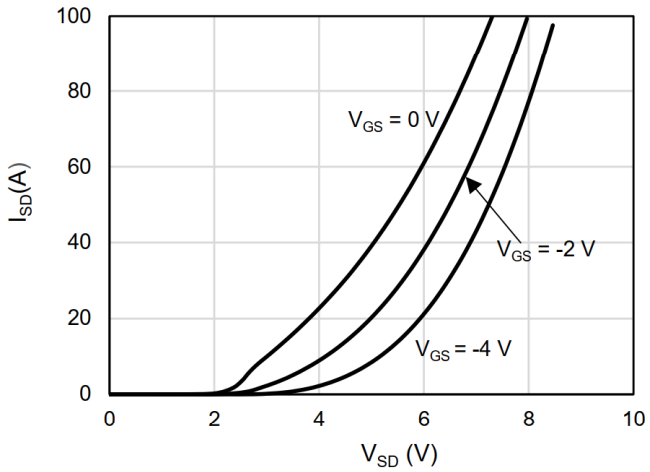


Figure 8: Body Diode Characteristics at -40℃

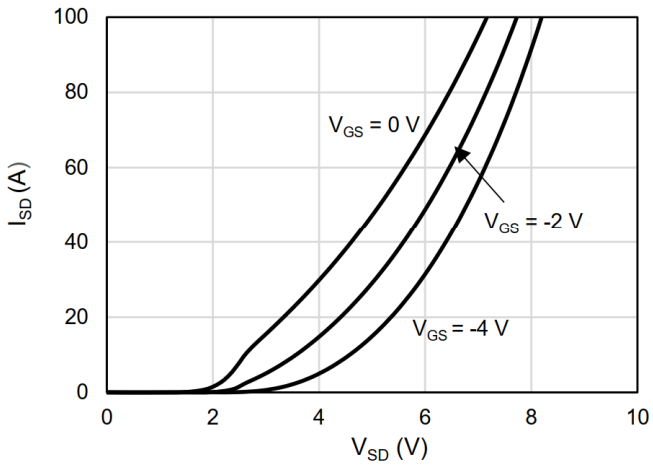


Figure 9: Body Diode Characteristics at 25℃

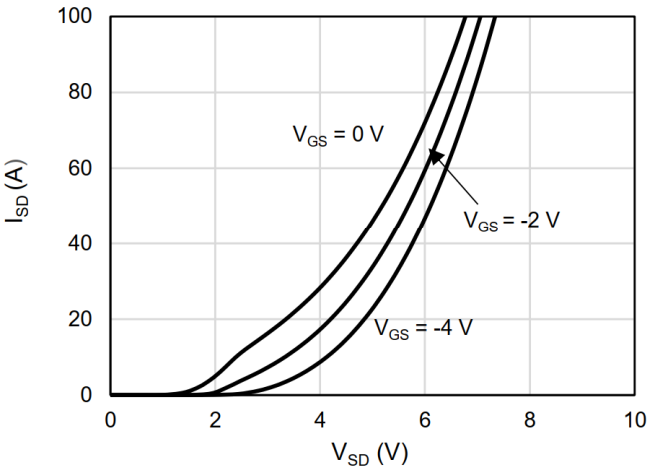


Figure 10: Body Diode Characteristics at 175℃

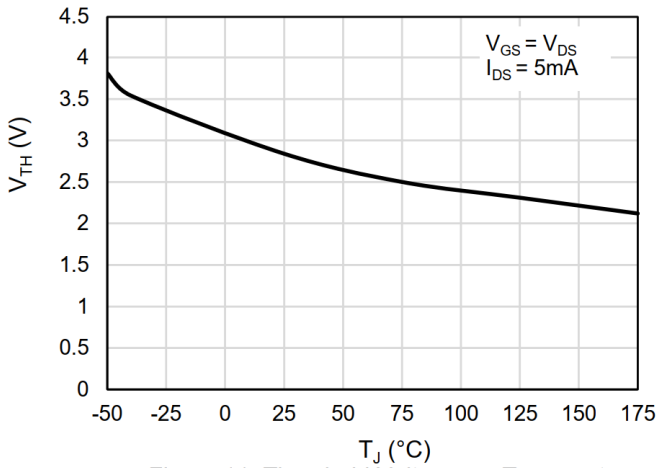


Figure 11: Threshold Voltage vs. Temperature

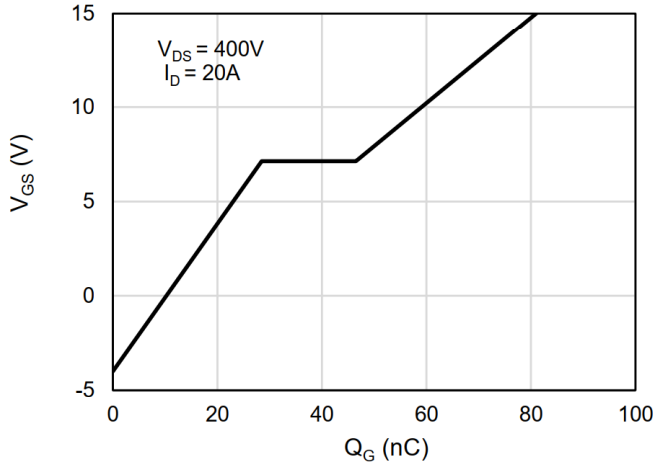


Figure 12: Gate-Charge Characteristics

Typical Performance (curves)

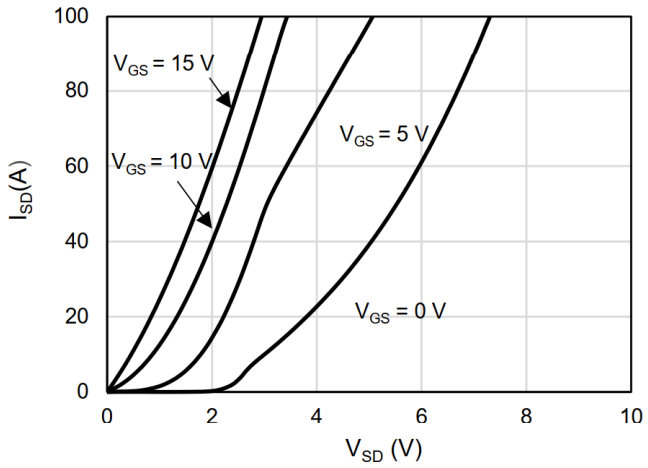


Figure 13: 3rd Quadrant Characteristics at -40℃

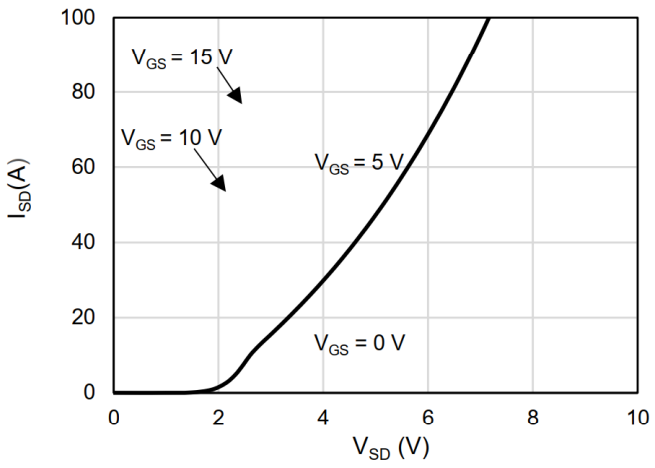


Figure 14: 3rd Quadrant Characteristics at 25℃

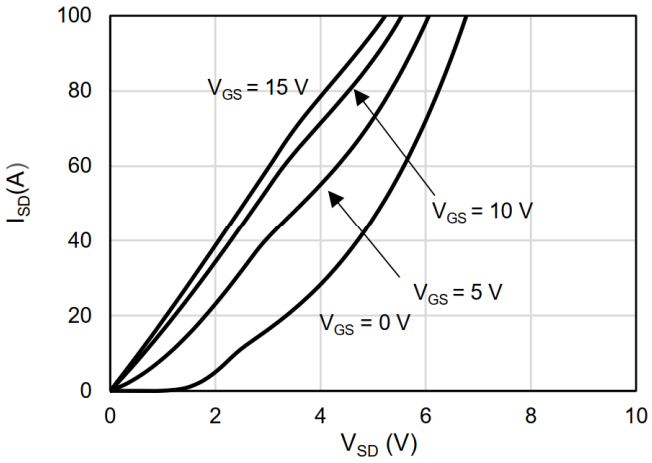


Figure 15: 3rd Quadrant Characteristics at 175℃

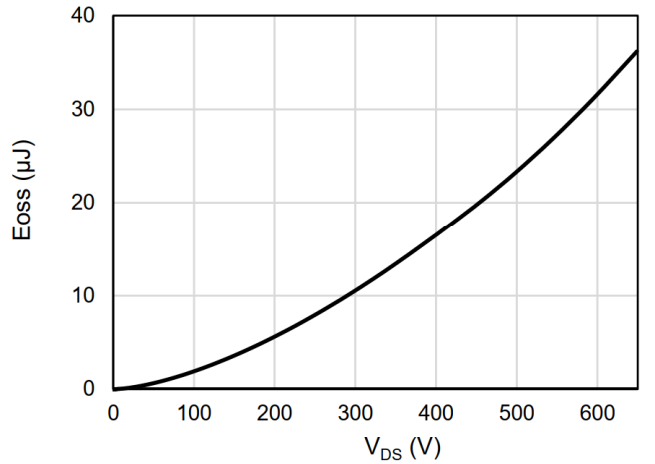


Figure 16: Output Capacitor Stord Energy

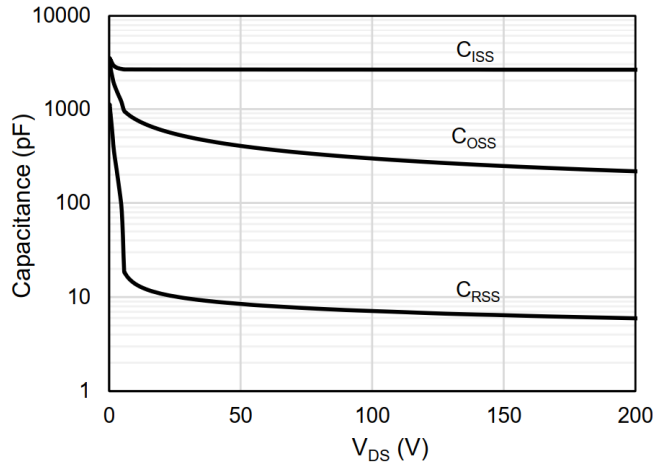


Figure 17: Capacitance Characteristics (0 - 200V)

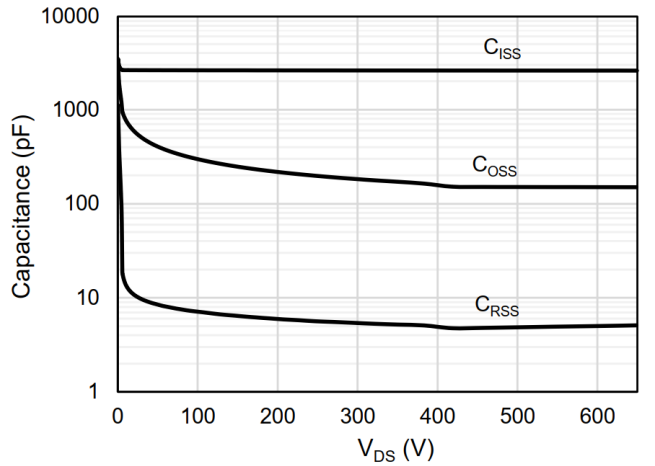


Figure 18: Capacitance Characteristics (0-650V)

Typical Performance (curves)

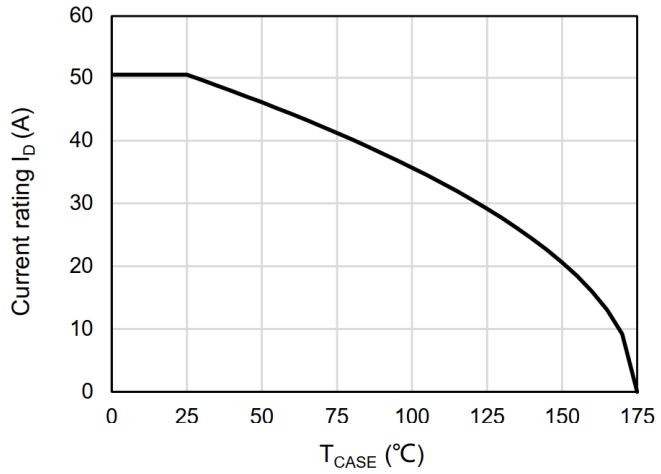


Figure 19: Current De-rating

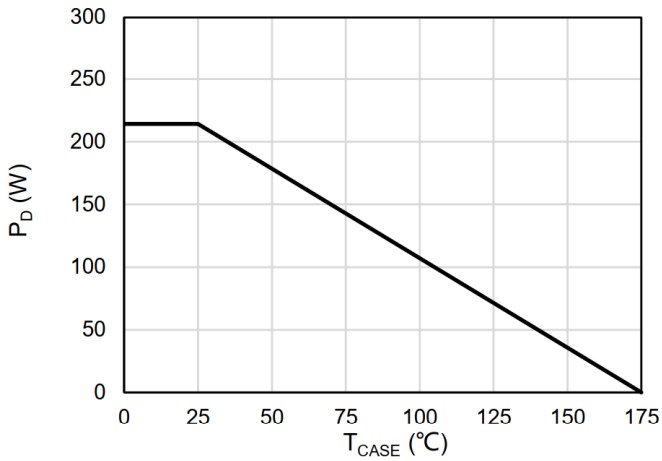


Figure 20: Maximum Power Disspation Derating vs CaseTemperature

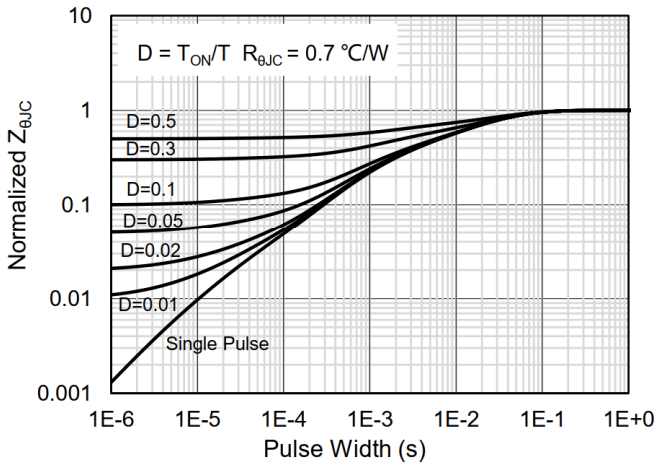


Figure 21: Normalized Maximum Transient Thermal Impedance

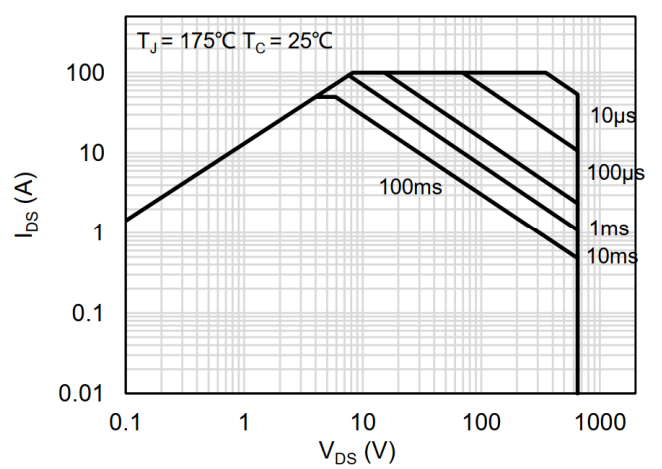


Figure 22: Maximum Forward Biased Safe Operating Area

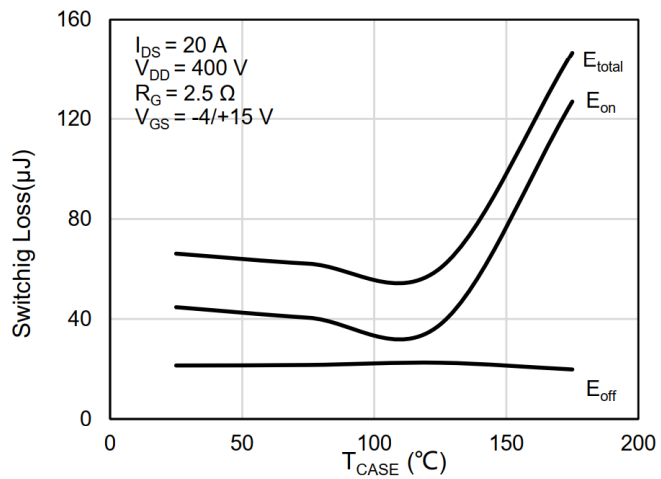


Figure 23: Clamped Inductive Switching Energy vs.Temperature

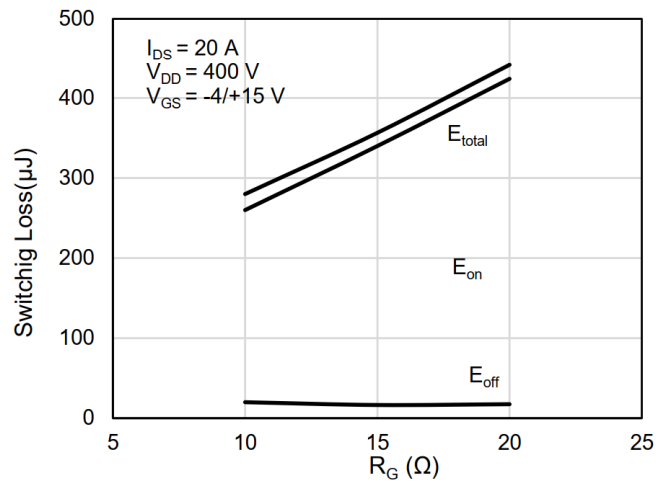


Figure 24: Clamped Inductive Switching Energy vs.$R_{G(ext)}$

Typical Performance (curves)

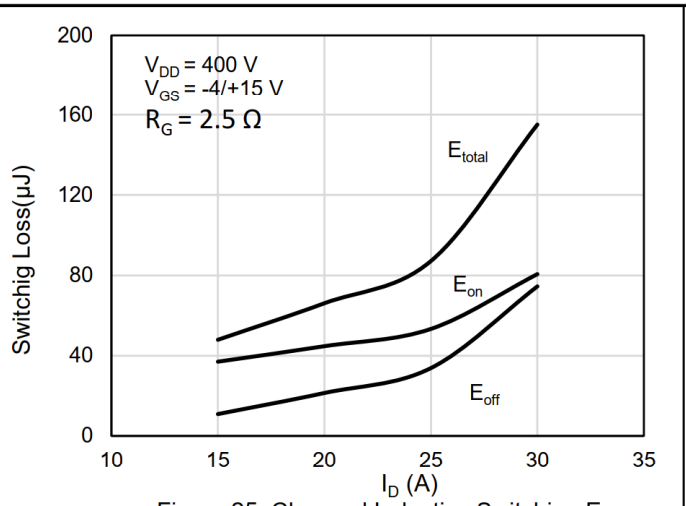


Figure 25: Clamped Inductive Switching Energy vs.Drain Current

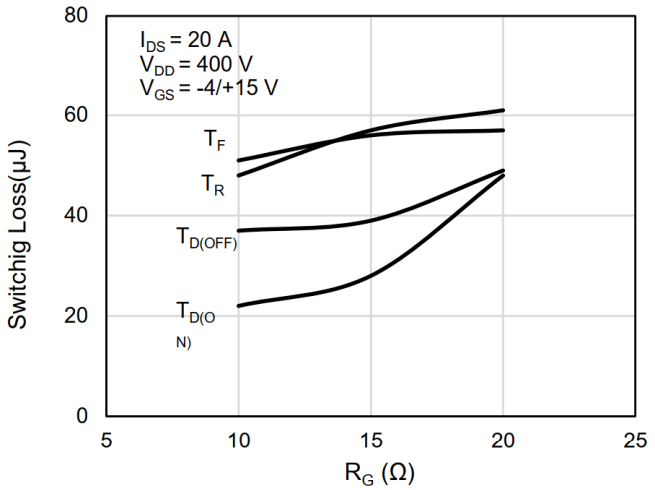
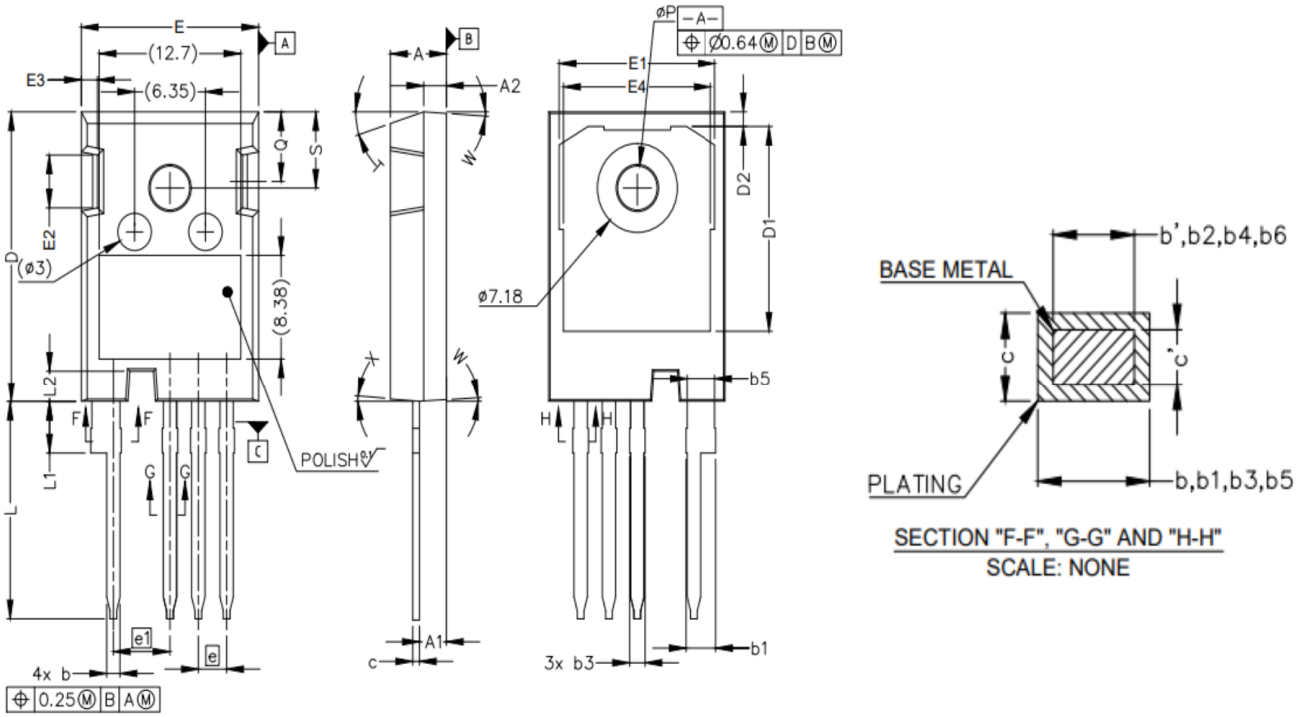


Figure 26: Switching Time vs.$R_{G(ext)}$

TO-247_4L PACKAGE OUTLINE



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	TYP	MAX	SYMBOL	MIN	TYP	MAX
A	4.50	5.02	5.50	E1	12.50	14.02	15.00
A1	2.00	2.40	2.80	E2	3.00	4.40	5.00
A2	1.80	2.00	2.30	E3	0.80	1.45	2.10
b'	0.90	1.20	1.40	E4	11.50	13.26	14.00
b	0.90	1.20	1.45	e	2.54BSC		
b1	2.15	2.67	3.10	e1	5.08BSC		
b2	2.15	2.67	3.05	N	4.00		
b3	0.90	1.30	1.80	L	16.00	17.57	19.00
b4	0.90	1.30	1.70	L1	3.47	4.19	4.87
b5	2.20	2.53	2.89	L2	2.05	2.50	2.95
b6	2.20	2.53	2.84	ΦP	3.21	3.61	3.95
c'	0.48	0.60	0.75	Q	5.09	5.79	6.40
c	0.48	0.60	0.78	S	5.74	6.21	6.60
D	22.50	23.45	24.50	T	17.5°REF		
D1	15.50	16.55	18.10	W	3.5°REF		
D2	0.85	1.19	1.35	X	4°REF		
E	15.00	15.94	17.00				

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