

650V N-Channel Silicon Carbide Power MOSFET

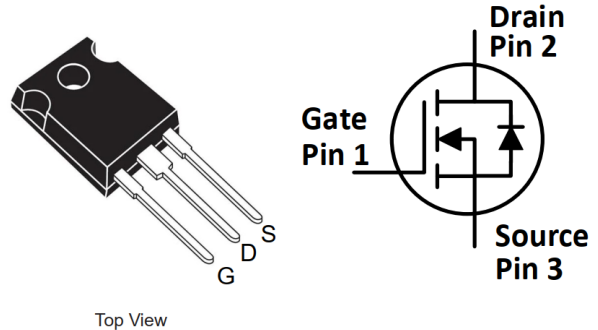
Features

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability
- Very fast and robust intrinsic body diode

Applications

- EV chargers
- Server & Telecom PSU
- Solar inverters
- UPS
- High voltage DC/DC converters
- Switch mode power supplies

Package



Part Number	Package
DTN70N65SC3	TO247-3

Absolute Maximum Ratings ($T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions	Note
V_{DS}	Drain-Source voltage	650	V	$V_{GS}=0\text{V}$, $I_b=100\mu\text{A}$	
$V_{GSmax}(\text{DC})$	Maximum DC voltage	-5 to 22	V	Static (DC)	
$V_{GSmax}(\text{Spike})$	Maximum spike voltage	-10 to 25	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_b	Drain current (continuous)	72	A	$V_{GS}=20\text{V}$, $T_c=25^\circ\text{C}$	Fig. 21
		58	A	$V_{GS}=20\text{V}$, $T_c=100^\circ\text{C}$	
I_{bM}	Drain current (pulsed)	180	A	Pulse width limited by SOA	Fig. 24
P_{TOT}	Total power dissipation	348	W	$T_c=25^\circ\text{C}$	Fig. 22
T_{stg}	Storage temperature range	-55 to 175	$^\circ\text{C}$		
T_j	Operating junction temperature	-55 to 175	$^\circ\text{C}$		
T_L	Solder Temperature	260	$^\circ\text{C}$	wave soldering only allowed at leads, 1.6mm from case for 10 s	

Thermal Data

Symbol	Parameter	Value	Unit	Note
$R_{\theta(j-c)}$	Thermal Resistance from Junction to Case	0.431	$^\circ\text{C}/\text{W}$	Fig. 23

Electrical Characteristics ($T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
I_{DSS}	Zero gate voltage drain current		3	100	μA	$V_{DS}=650\text{V}, V_{GS}=0\text{V}$	
I_{GSS}	Gate leakage current			± 100	nA	$V_{DS}=0\text{V}, V_{GS}=-5\sim 20\text{V}$	
V_{TH}	Gate threshold voltage	1.8	3.2	5	V	$V_{GS}=V_{DS}, I_D=6.1\text{mA}$	Fig. 8, 9
			2.2			$V_{GS}=V_{DS}, I_D=6.1\text{mA}$ @ $T_c=175^\circ\text{C}$	
R_{ON}	Static drain-source on-resistance		40	55	$\text{m}\Omega$	$V_{GS}=20\text{V}, I_D=20\text{A}$ @ $T_j=25^\circ\text{C}$	Fig. 4, 5, 6, 7
			53		$\text{m}\Omega$	$V_{GS}=20\text{V}, I_D=20\text{A}$ @ $T_j=175^\circ\text{C}$	
C_{iss}	Input capacitance		2692		pF	$V_{DS}=600\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}, V_{AC}=25\text{mV}$	Fig. 16
C_{oss}	Output capacitance		179		pF		
C_{rss}	Reverse transfer capacitance		10.8		pF		
E_{oss}	C_{oss} stored energy		35.6		μJ		Fig. 17
Q_g	Total gate charge		110.8		nC	$V_{DS}=400\text{V}, I_D=20\text{A},$ $V_{GS}=-5\text{ to }20\text{V}$	Fig. 18
Q_{gs}	Gate-source charge		26.8		nC		
Q_{gd}	Gate-drain charge		35.7		nC		
R_g	Gate input resistance		2		Ω	$f=1\text{MHz}$	
E_{ON}	Turn-on switching energy		289.1		μJ	$V_{DS}=400\text{V}, I_D=30\text{A},$ $V_{GS}=-2\text{ to }20\text{V},$ $R_{G(\text{ext})}=3.3\Omega,$ $L=450\mu\text{H}$	Fig. 19, 20
E_{OFF}	Turn-off switching energy		117.1		μJ		
$t_{d(\text{on})}$	Turn-on delay time		24.7		ns		
t_r	Rise time		20.3				
$t_{d(\text{off})}$	Turn-off delay time		12.4				
t_f	Fall time		29.6				

Reverse Diode Characteristics ($T_c=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value			Unit	Test Conditions	Note
		Min.	Typ.	Max.			
V_{SD}	Diode forward voltage		4.0		V	$I_{SD}=20\text{A}, V_{GS}=0\text{V}$	Fig. 10, 11, 12
			3.6		V	$I_{SD}=20\text{A}, V_{GS}=0\text{V},$ $T_J=175^\circ\text{C}$	
t_{rr}	Reverse recovery time		23		ns	$V_{GS}=-2\text{V}/+20\text{V},$ $I_{SD}=30\text{A}, V_R=400\text{V},$ $di/dt=1700\text{A}/\mu\text{s},$	
Q_{rr}	Reverse recovery charge		161		nC		
I_{RRM}	Peak reverse recovery current		10.4		A	$R_{G(\text{ext})}=3.3\Omega$ $L=450\mu\text{H}$	

Typical Performance (curves)

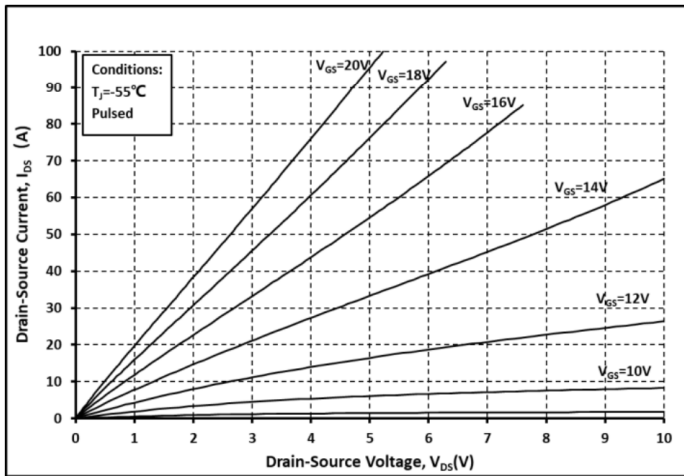


Fig. 1 Output Curve @ $T_j = -55^\circ\text{C}$

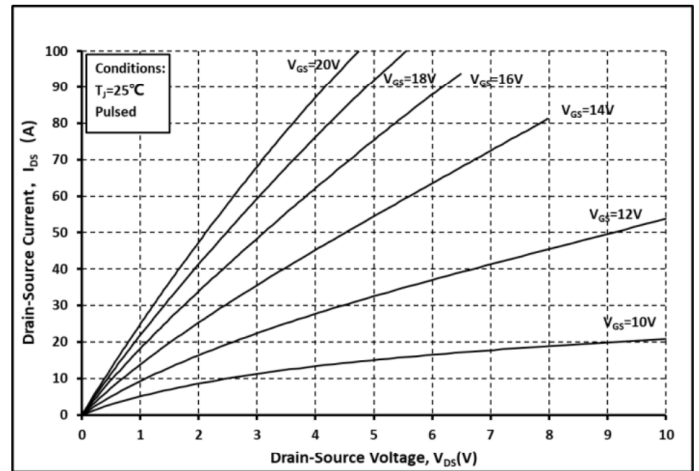


Fig. 2 Output Curve @ $T_j = 25^\circ\text{C}$

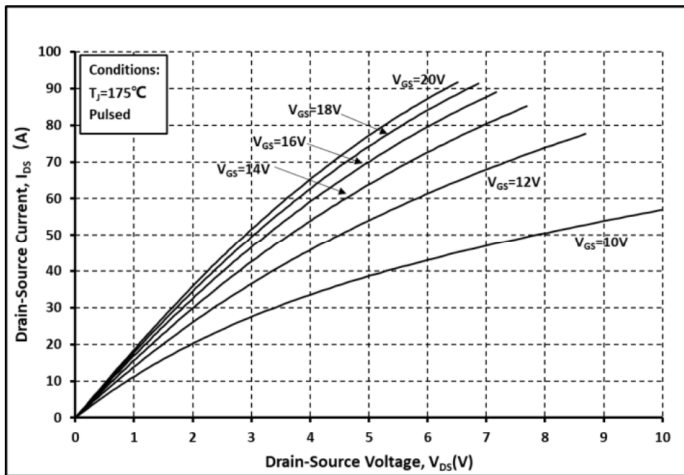


Fig. 3 Output Curve @ $T_j = 175^\circ\text{C}$

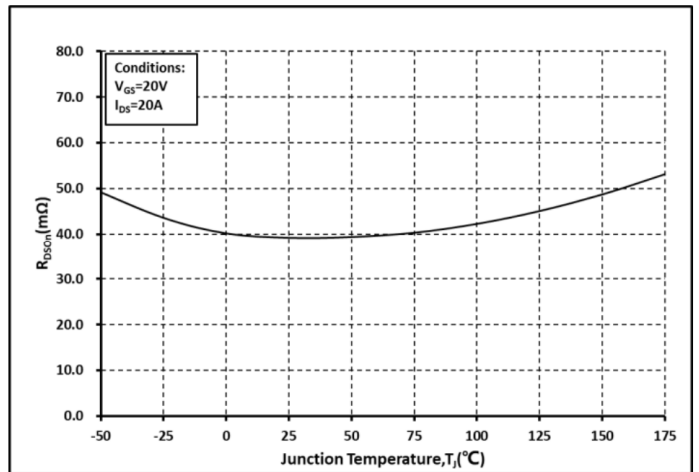


Fig. 4 $R_{DS(on)}$ vs. Temperature

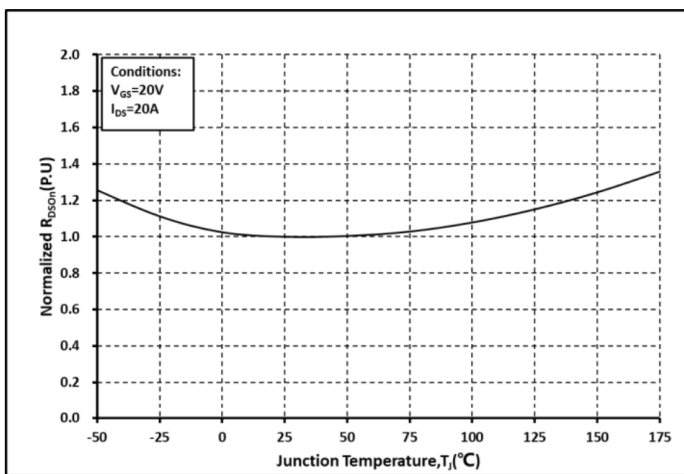


Fig. 5 Normalized $R_{DS(on)}$ vs. Temperature

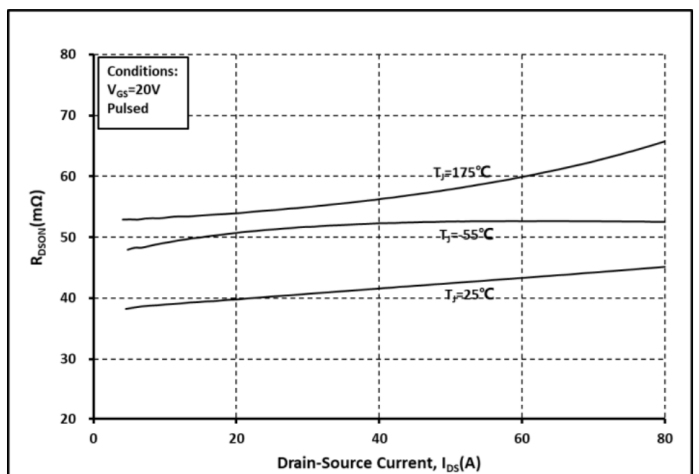


Fig. 6 $R_{DS(on)}$ vs. I_{DS} @ Various Temperature

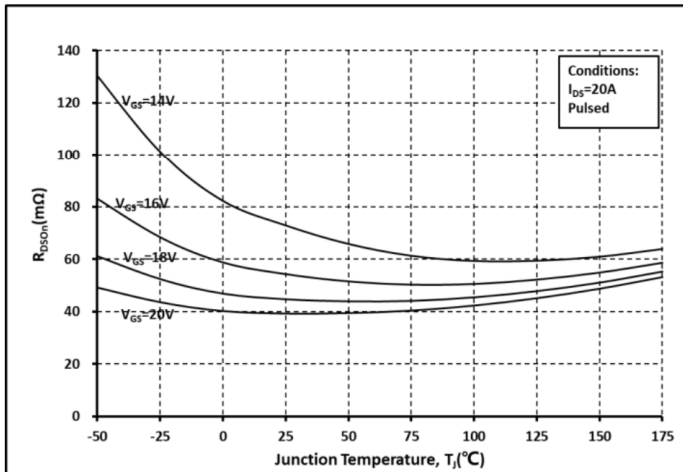


Fig. 7 Ron vs. Temperature @ Various V_{GS}

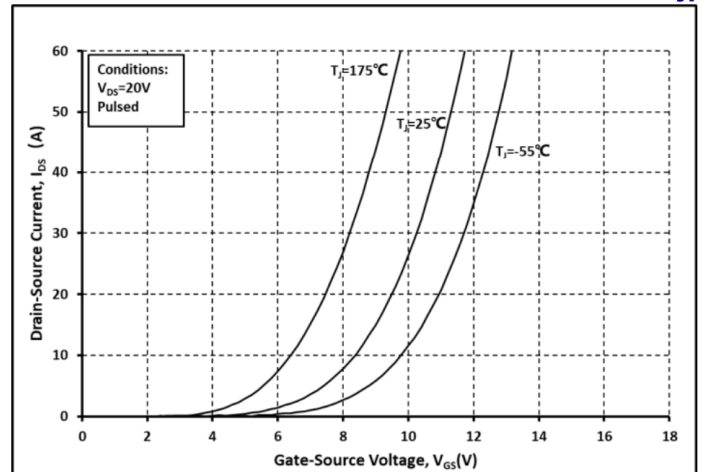


Fig. 8 Transfer Curves @ Various Temperature

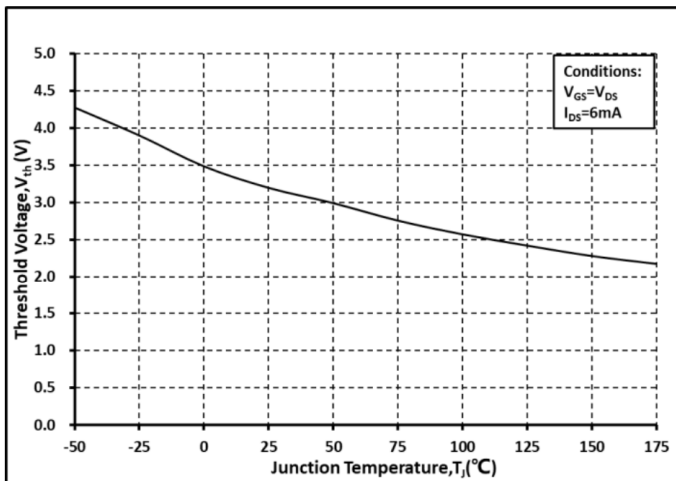


Fig. 9 Threshold Voltage vs. Temperature

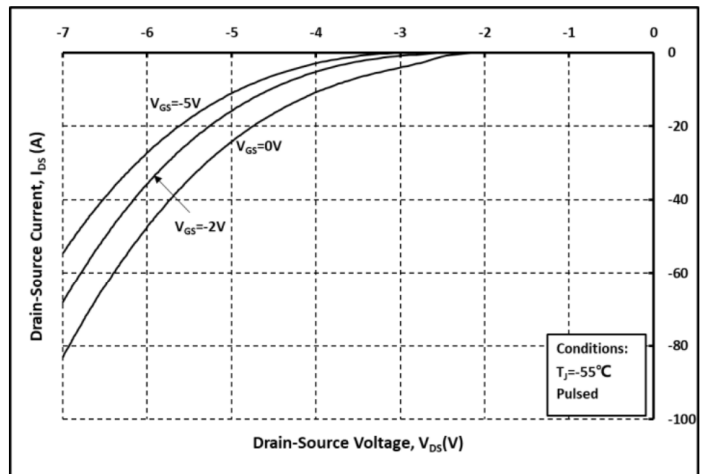


Fig. 10 Body Diode Curves @ $T_J = -55^\circ C$

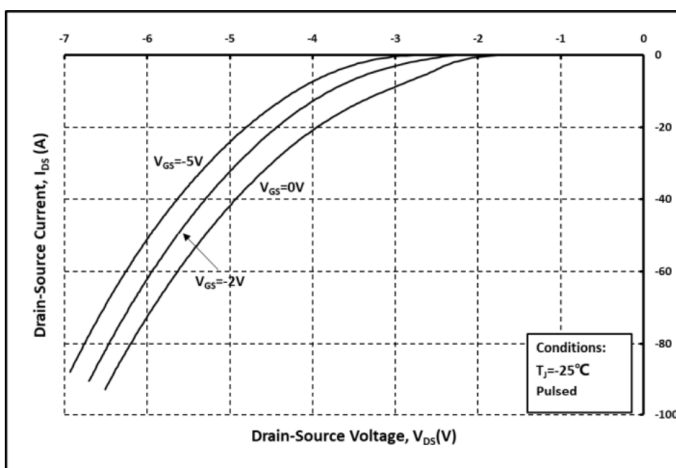


Fig. 11 Body Diode Curves @ $T_J = 25^\circ C$

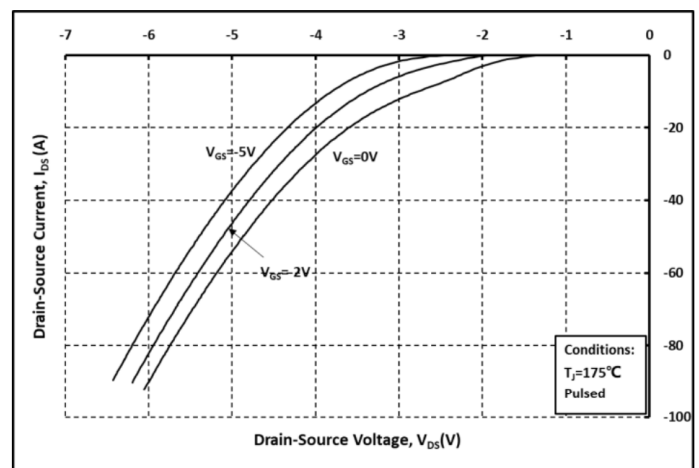


Fig. 12 Body Diode Curves @ $T_J = 175^\circ C$

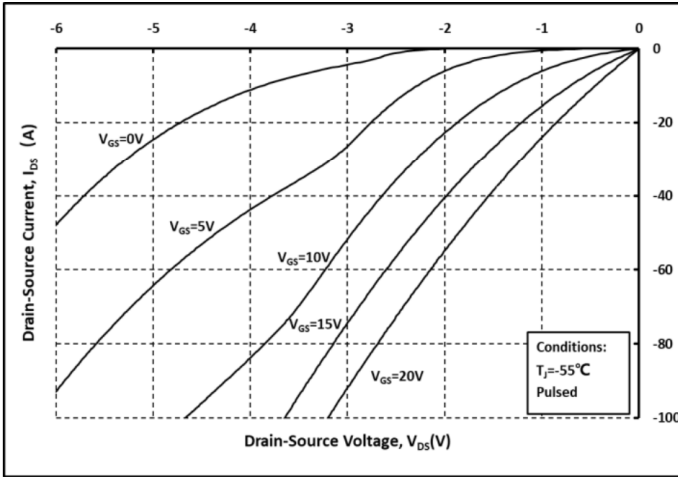


Fig. 13 3rd Quadrant Curves @ $T_j = -55^\circ\text{C}$

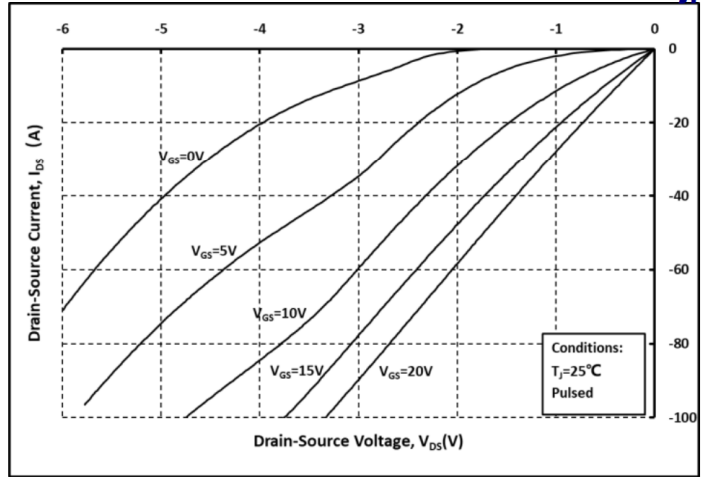


Fig. 14 3rd Quadrant Curves @ $T_j = 25^\circ\text{C}$

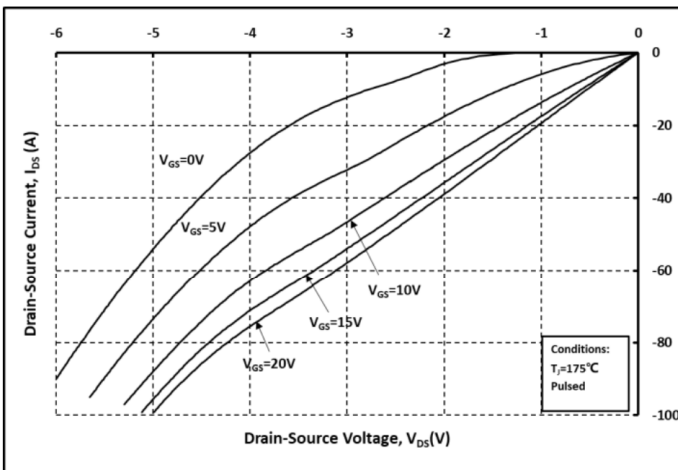


Fig. 15 3rd Quadrant Curves @ $T_j = 175^\circ\text{C}$

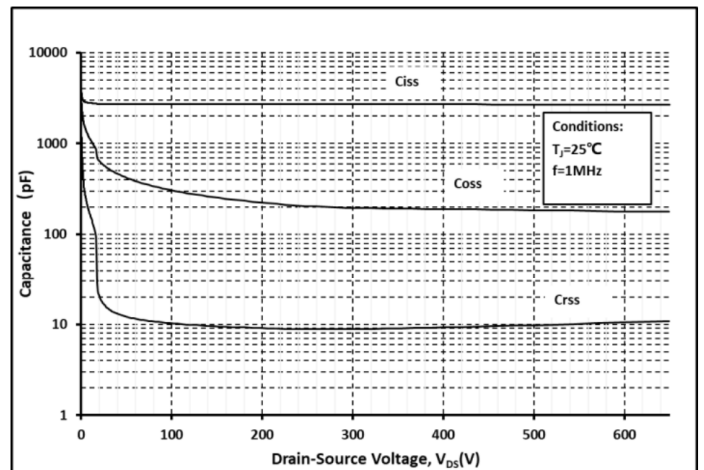


Fig. 16 Capacitance vs. V_{DS}

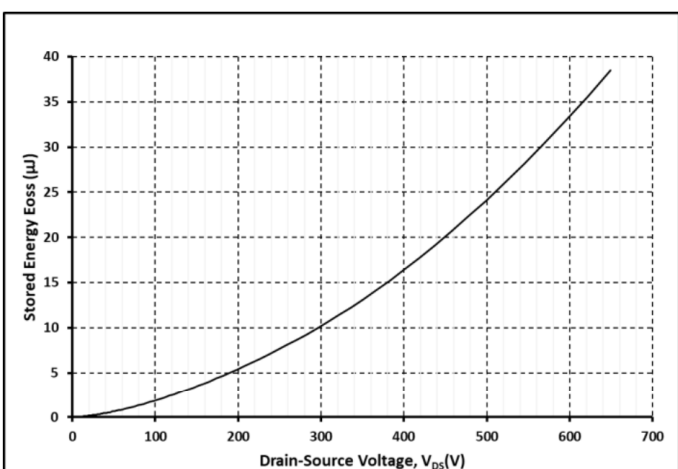


Fig. 17 Output Capacitor Stored Energy

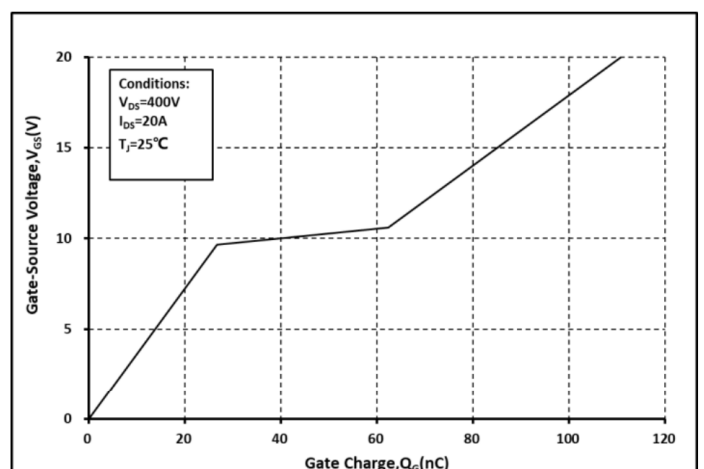


Fig. 18 Gate Charge Characteristics

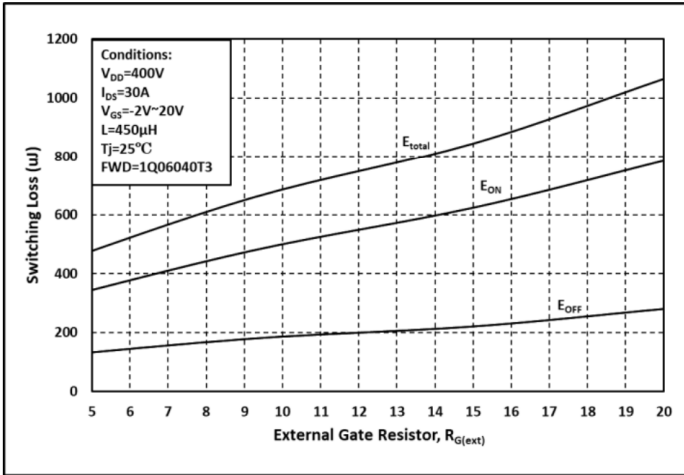


Fig. 19 Switching Energy vs. $R_{G(ext)}$

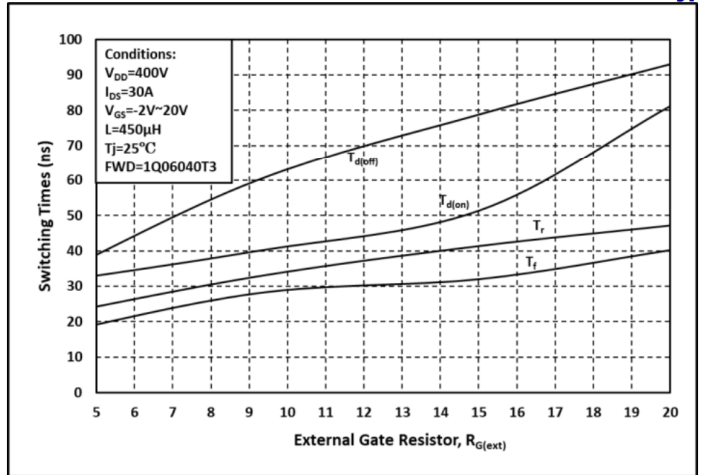


Fig. 20 Switching Times vs. $R_{G(ext)}$

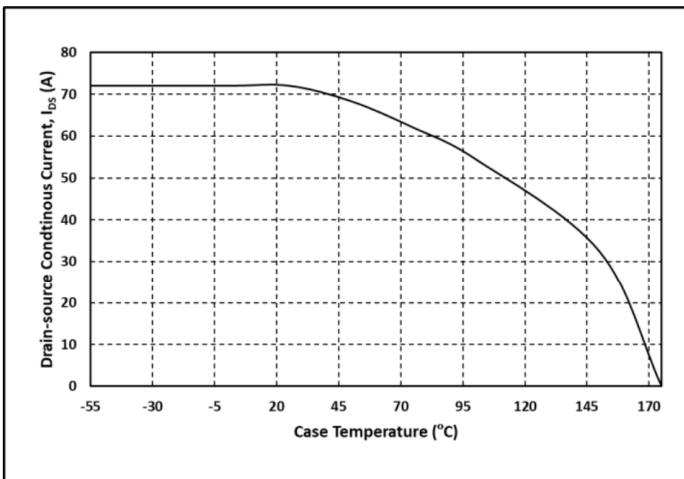


Fig. 21 Continuous Drain Current vs. Case Temperature

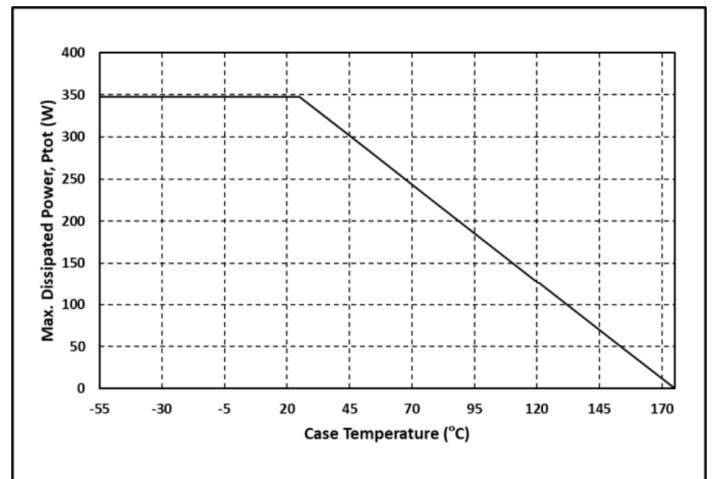


Fig. 22 Max. Power Dissipation Derating vs. Case Temperature

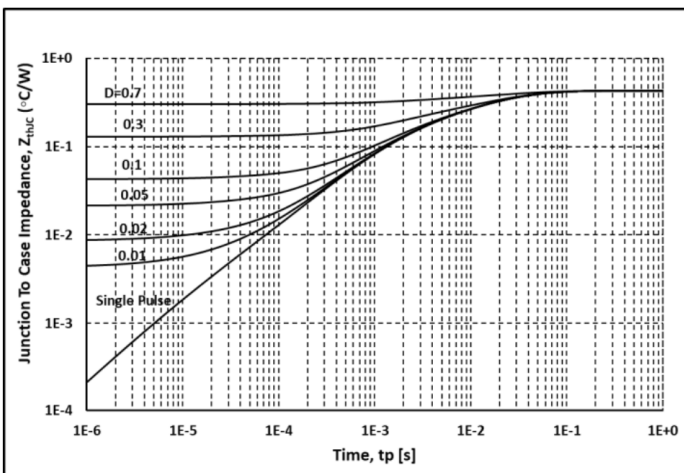


Fig. 23 Thermal Impedance

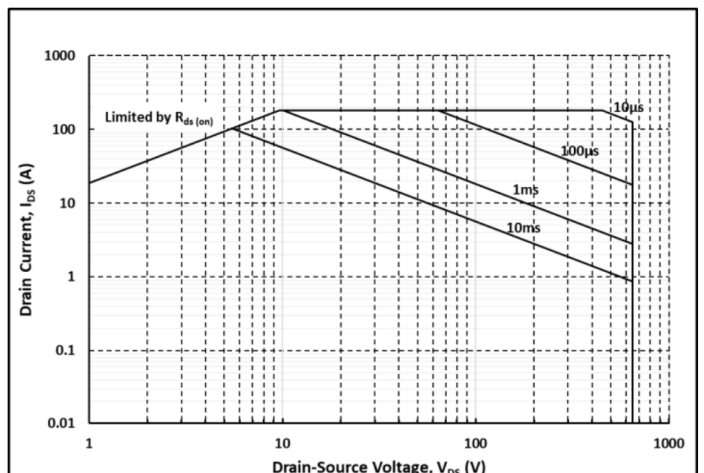
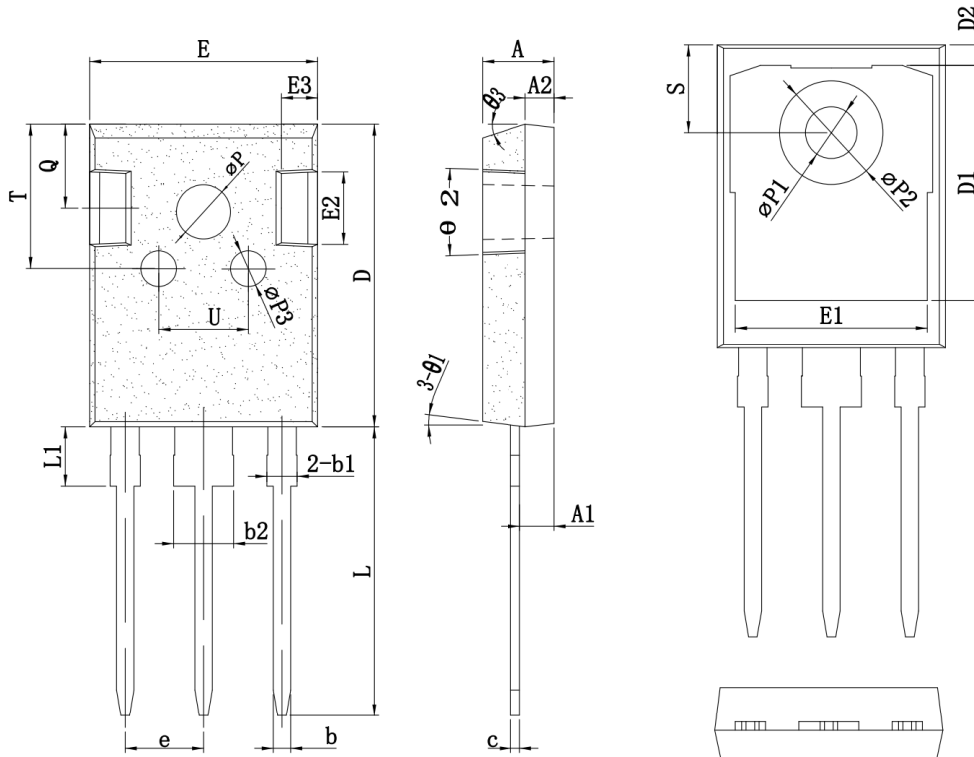


Fig. 24 Safe Operating Area

TO-247_3L PACKAGE OUTLINE



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	TYP	MAX	SYMBOL	MIN	TYP	MAX
A	4.60	5.00	5.40	e	2.10	5.44	5.70
A1	2.10	2.41	2.70	L	19.00	19.98	21.00
A2	1.70	2.00	2.30	L1	-	-	4.50
b	1.00	1.20	1.40	ΦP	3.30	3.70	4.00
b1	1.80	2.10	2.40	$\Phi P1$	3.25	3.55	3.85
b2	2.80	3.10	3.40	$\Phi P2$	6.80	7.18	7.60
C	0.45	0.60	0.75	$\Phi P3$	2.30	2.50	3.30
D	19.00	21.00	23.00	Q	5.50	5.80	6.30
D1	16.00	16.55	17.00	S	5.60	6.15	6.30
D2	0.95	1.20	1.45	T	9.50	10.00	10.50
E	15.70	15.80	16.50	U	6.00	-	8.00
E1	12.80	13.25	13.70	$\theta 1$	5°	7°	9°
E2	4.20	5.00	5.30	$\theta 2$	1°	3°	5°
E3	2.20	2.50	2.80	$\theta 3$	13°	15°	17°

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