

IV2Q20045T4 – 2000V 45mΩ SiC MOSFET

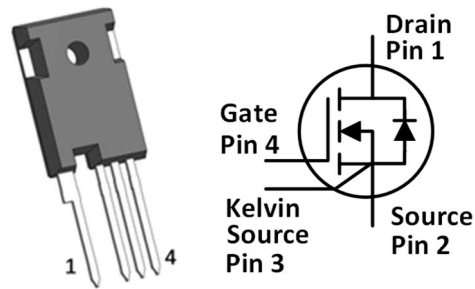
Features

- 2nd Generation SiC MOSFET Technology with +15~+18V gate drive
- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- 175°C operating junction temperature capability
- Very fast and robust intrinsic body diode
- Kelvin gate input easing driver circuit design

Applications

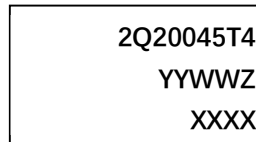
- Solar boosters
- UPS power supplies
- Motor drivers
- Switch mode power supplies

Outline:



TO247-4

Marking Diagram:



2Q20045T4 = Specific Device Code
 YY = Year
 WW = Work Week
 Z = Assembly Location
 XXXX = Lot Traceability

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

Symbol	Parameter	Value	Unit	Test Conditions	Note
V _{DS}	Drain-Source voltage	2000	V	V _{GS} =0V, I _D =100μA	
V _{GSmax} (Transient)	Maximum transient voltage	-10 to 23	V	Duty cycle<1%, and pulse width<200ns	
V _{GSon}	Recommended turn-on voltage	15 to 18	V		
V _{GSoff}	Recommended turn-off voltage	-5 to -2	V	Typical -3.5V	
I _D	Drain current (continuous)	62	A	V _{GS} =18V, T _C =25°C	Fig. 23
		46	A	V _{GS} =18V, T _C =100°C	
I _{DM}	Drain current (pulsed)	155	A	Pulse width limited by SOA and dynamic R _{θ(j-c)}	Fig. 25, 26
I _{SM}	Body diode current (pulsed)	155	A	Pulse width limited by SOA and dynamic R _{θ(j-c)}	Fig. 25,26
P _{TOT}	Total power dissipation	500	W	T _C =25°C	Fig. 24
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	Note
R _{θ(j-c)}	Thermal Resistance from Junction to Case	0.3	°C/W	Fig. 25

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		1	10	μA	$V_{DS}=2000\text{V}, V_{GS}=0\text{V}$	
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	2.8	4.5	V	$V_{GS}=V_{DS}, I_D=10\text{mA}$	Fig. 8, 9
			2.2			$V_{GS}=V_{DS}, I_D=10\text{mA}$ @ $T_J=175^\circ\text{C}$	
R_{ON}	Static drain-source on-resistance		43	56	$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=20\text{A}$ @ $T_J=25^\circ\text{C}$	Fig. 4, 5, 6, 7
			105		$\text{m}\Omega$	$V_{GS}=18\text{V}, I_D=20\text{A}$ @ $T_J=175^\circ\text{C}$	
			48		$\text{m}\Omega$	$V_{GS}=15\text{V}, I_D=20\text{A}$ @ $T_J=25^\circ\text{C}$	
			110		$\text{m}\Omega$	$V_{GS}=15\text{V}, I_D=20\text{A}$ @ $T_J=175^\circ\text{C}$	
C_{iss}	Input capacitance		3950		pF	$V_{DS}=1500\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}, V_{AC}=25\text{mV}$	Fig. 16
C_{oss}	Output capacitance		110		pF		
C_{rss}	Reverse transfer capacitance		13		pF		
E_{oss}	C_{oss} stored energy		145		μJ		Fig. 17
Q_g	Total gate charge		175		nC	$V_{DS}=1500\text{V}, I_D=20\text{A},$ $V_{GS}=-3\text{ to }18\text{V}$	Fig. 18
Q_{gs}	Gate-source charge		43		nC		
Q_{gd}	Gate-drain charge		63		nC		
R_g	Gate input resistance		1.5		Ω	$f=1\text{MHz}$	
E_{ON}	Turn-on switching energy		870		μJ	$V_{DS}=1200\text{V}, I_D=20\text{A},$ $V_{GS}=-3.5\text{ to }18\text{V},$ $R_{G(\text{ext})}=3.3\Omega,$ $L=400\mu\text{H}, T_J=25^\circ\text{C}$	Fig. 19, 20
E_{OFF}	Turn-off switching energy		150		μJ		
$t_{d(\text{on})}$	Turn-on delay time		25		ns		
t_r	Rise time		24				
$t_{d(\text{off})}$	Turn-off delay time		40				
t_f	Fall time		23				
E_{ON}	Turn-on switching energy		1470		μJ	$V_{DS}=1200\text{V}, I_D=20\text{A},$ $V_{GS}=-3.5\text{ to }18\text{V},$ $R_{G(\text{ext})}=3.3\Omega,$ $L=400\mu\text{H}, T_J=175^\circ\text{C}$	Fig. 22
E_{OFF}	Turn-off switching energy		130		μJ		

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		3.5		V	$I_{SD}=20\text{A}, V_{GS}=0\text{V}$	Fig. 10, 11, 12
			3.4		V	$I_{SD}=20\text{A}, V_{GS}=0\text{V}, T_J=175^\circ\text{C}$	
I_S	Diode forward current (continuous)			90	A	$V_{GS}=-2\text{V}, T_c=25^\circ\text{C}$	
				55	A	$V_{GS}=-2\text{V}, T_c=100^\circ\text{C}$	
t_{rr}	Reverse recovery time		46		ns	$V_{GS}=-3.5\text{V}/+18\text{V}, I_{SD}=20\text{A}, V_R=1200\text{V}$	
Q_{rr}	Reverse recovery charge		550		nC		
I_{RRM}	Peak reverse recovery current		23		A	$R_{G(\text{ext})}=5.1\Omega, di/dt=3000\text{A}/\mu\text{s}$	

Typical Performance (curves)

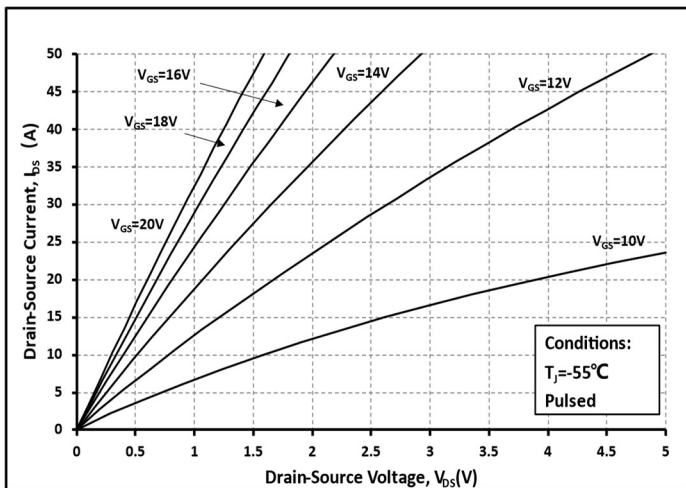


Fig. 1 Output Curve @ $T_J=-55^\circ\text{C}$

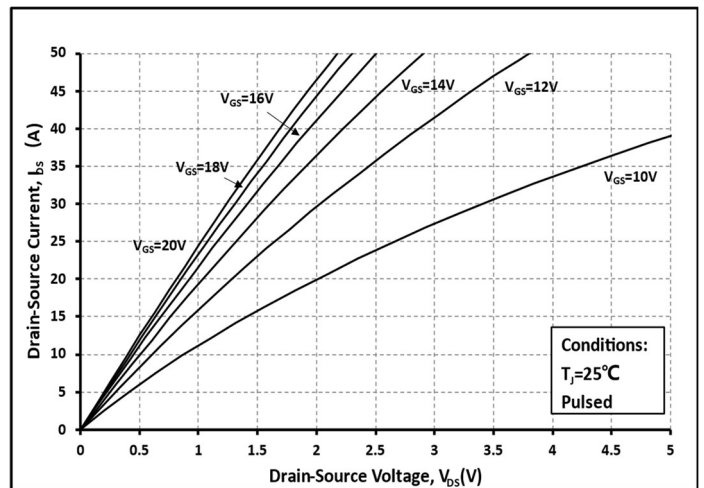


Fig. 2 Output Curve @ $T_J=25^\circ\text{C}$

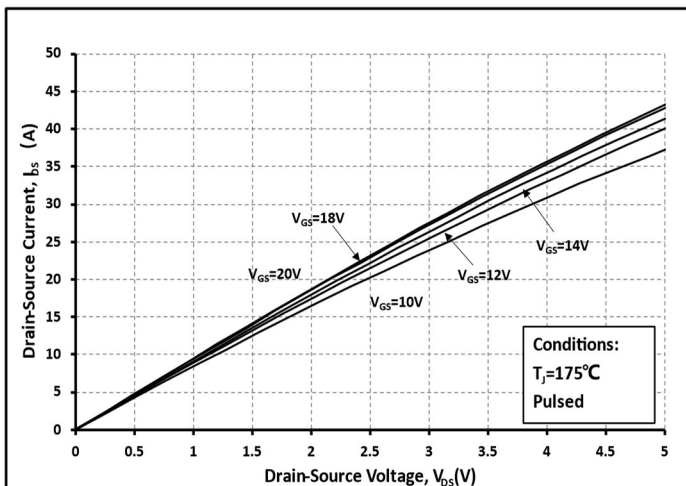


Fig. 3 Output Curve @ $T_J=175^\circ\text{C}$

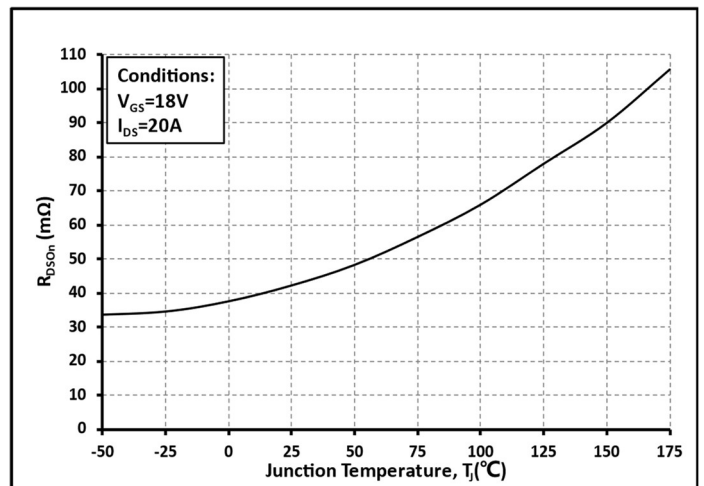


Fig. 4 R_{on} vs. Temperature

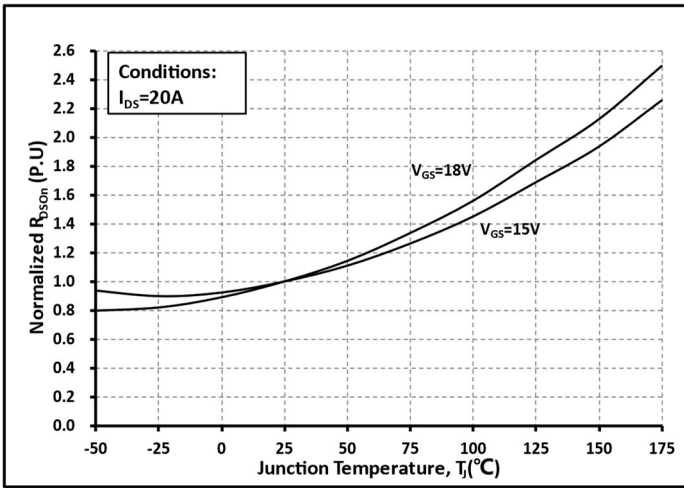


Fig. 5 Normalized Ron vs. Temperature

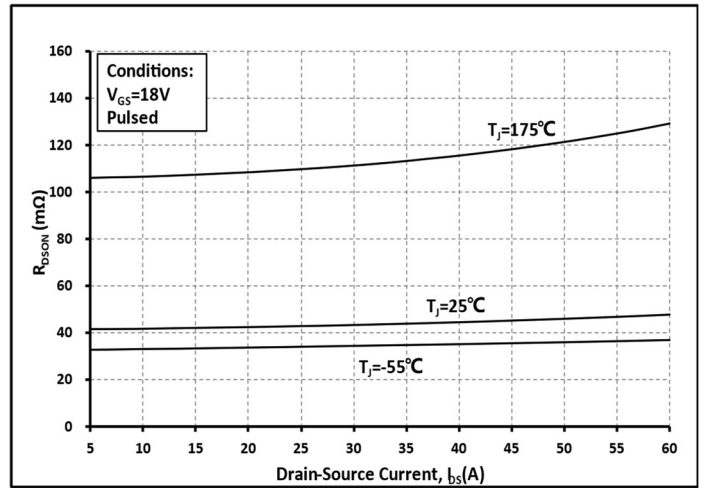


Fig. 6 Ron vs. Ids @ Various Temperature

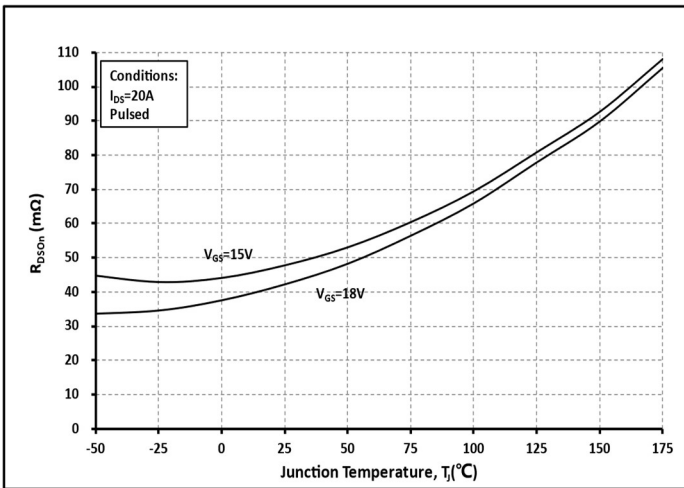


Fig. 7 Ron vs. Temperature @ Various Vgs

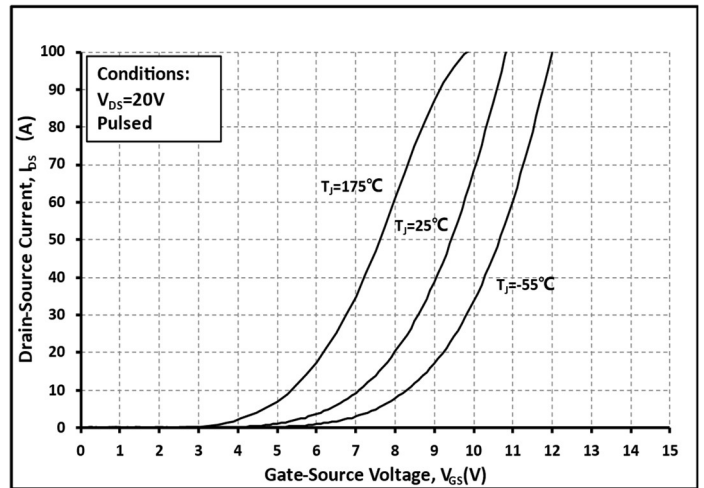


Fig. 8 Transfer Curves @ Various Temperature

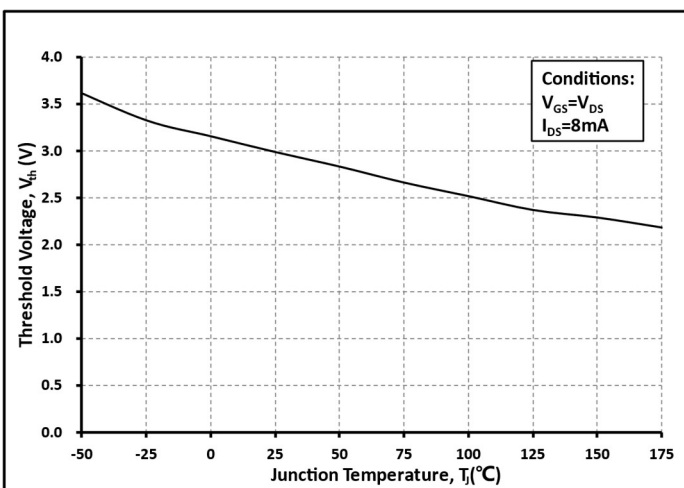


Fig. 9 Threshold Voltage vs. Temperature

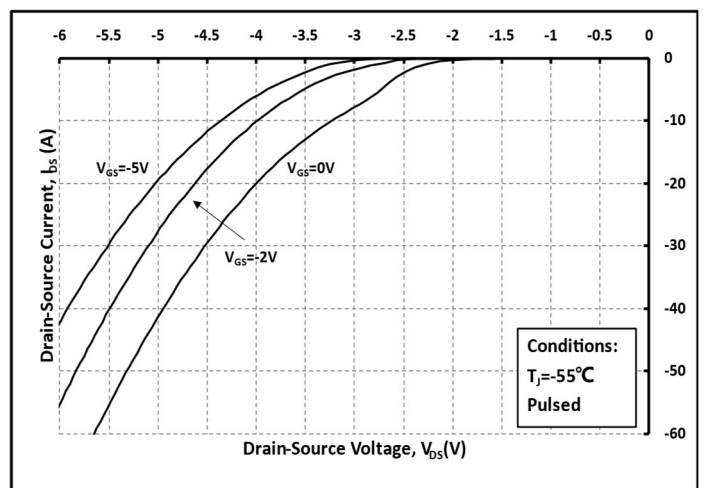


Fig. 10 Body Diode curves @ Tj=-55°C

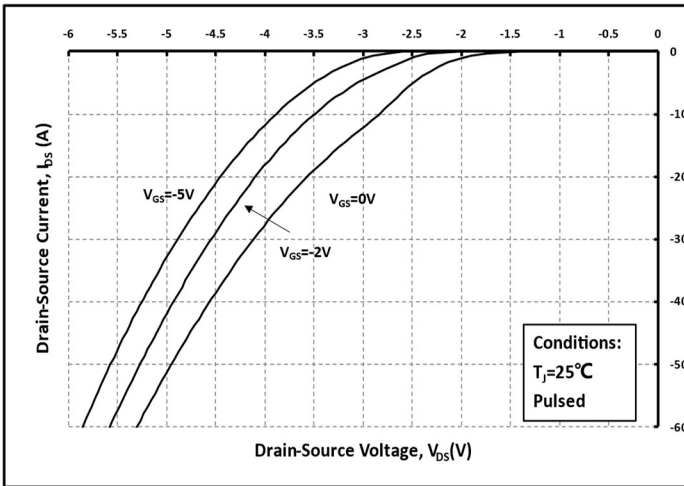


Fig. 11 Body Diode curves @ $T_j=25^\circ\text{C}$

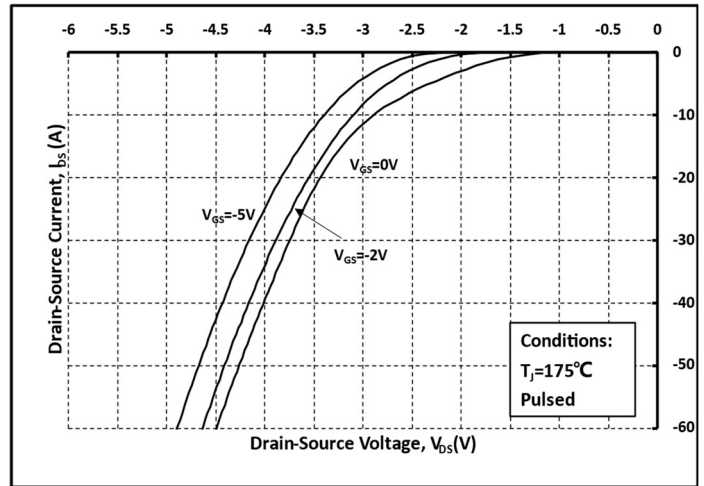


Fig. 12 Body Diode curves @ $T_j=175^\circ\text{C}$

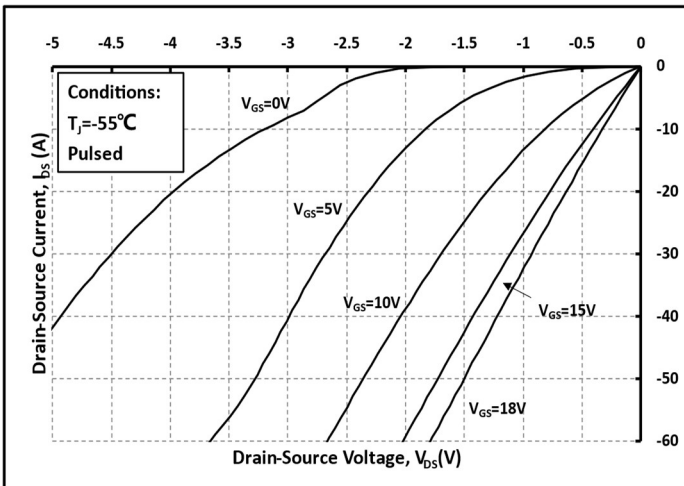


Fig. 13 3rd Quadrant curves @ $T_j=-55^\circ\text{C}$

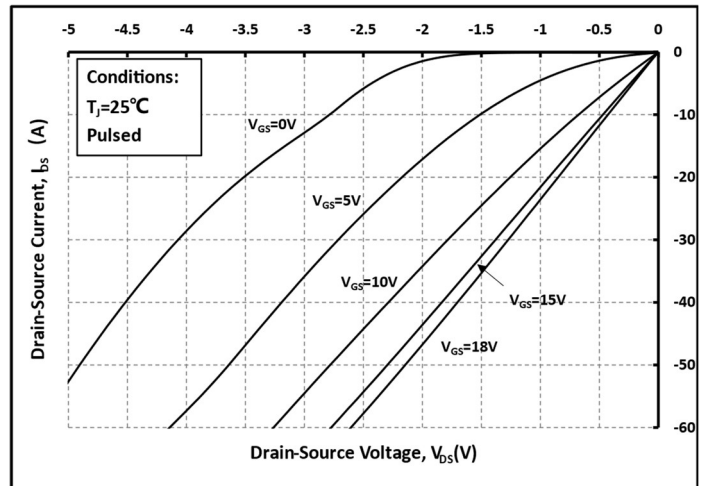


Fig. 14 3rd Quadrant curves @ $T_j=25^\circ\text{C}$

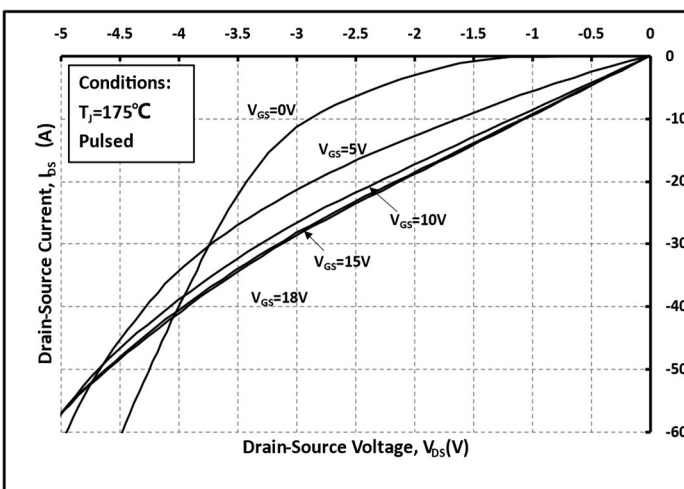


Fig. 15 3rd Quadrant curves @ $T_j=175^\circ\text{C}$

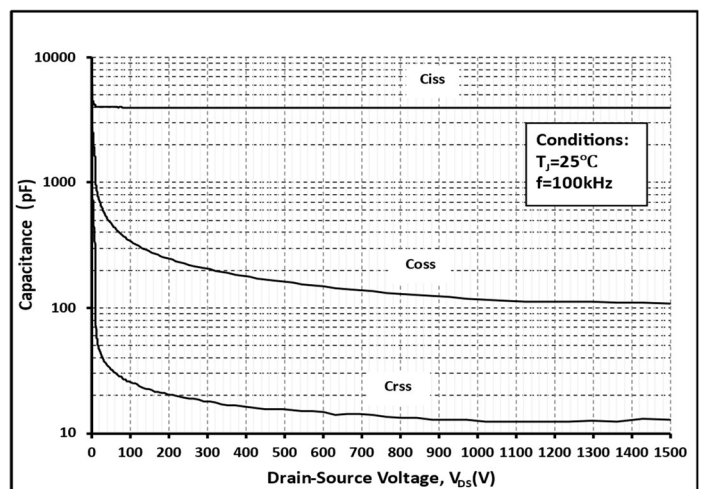


Fig. 16 Capacitance vs. V_{DS}

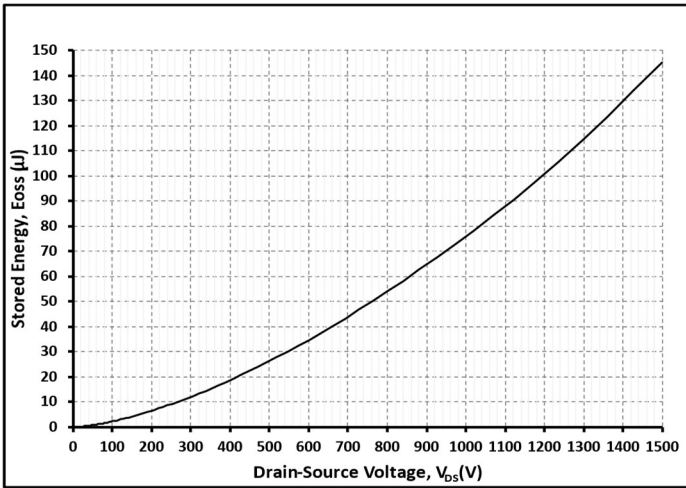


Fig. 17 Output Capacitor Stored Energy

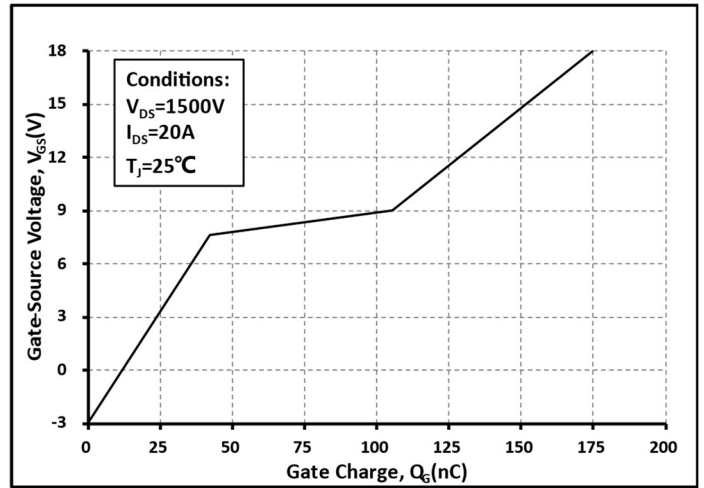


Fig. 18 Gate Charge Characteristics

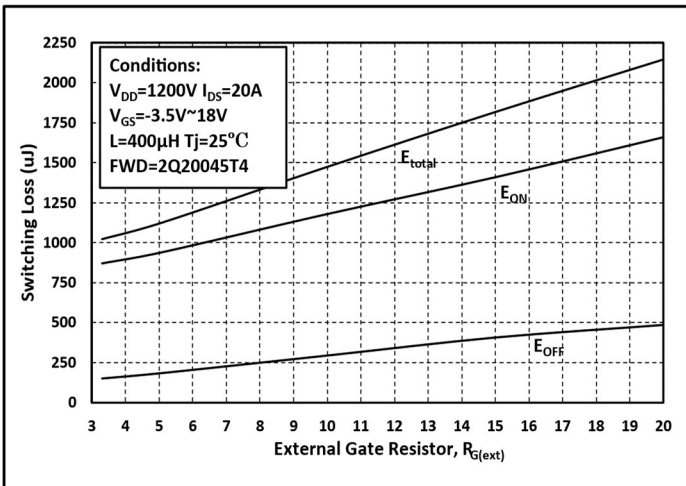


Fig. 19 Switching Energy vs. R_{G(ext)}

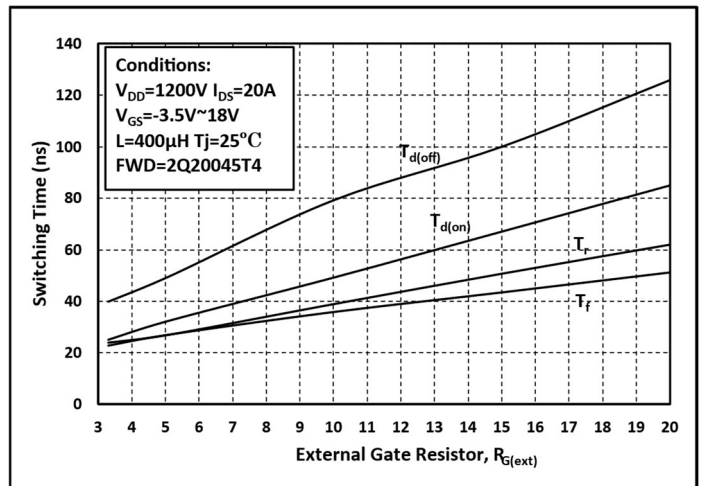


Fig. 20 Switching Times vs. R_{G(ext)}

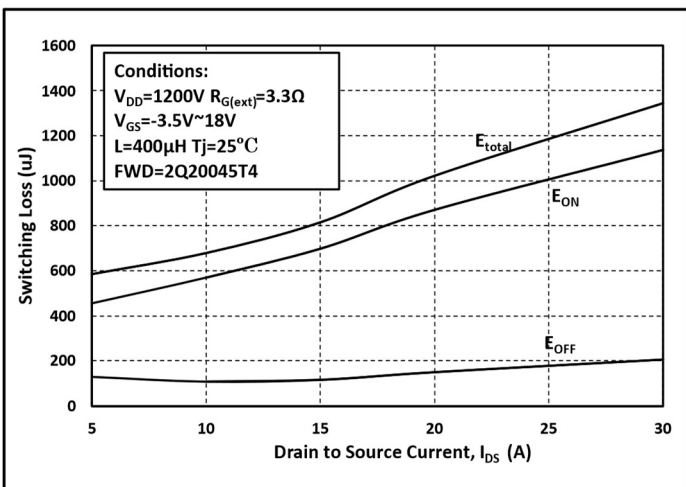


Fig. 21 Switching Energy vs. I_{DS}

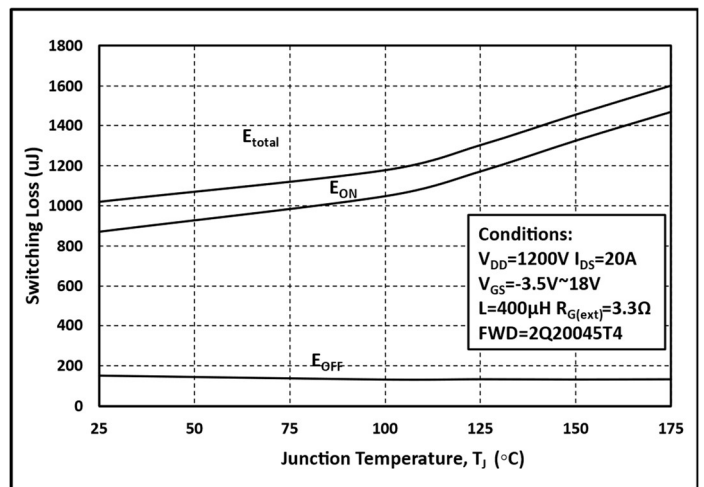


Fig. 22 Switching Energy vs. Temperature

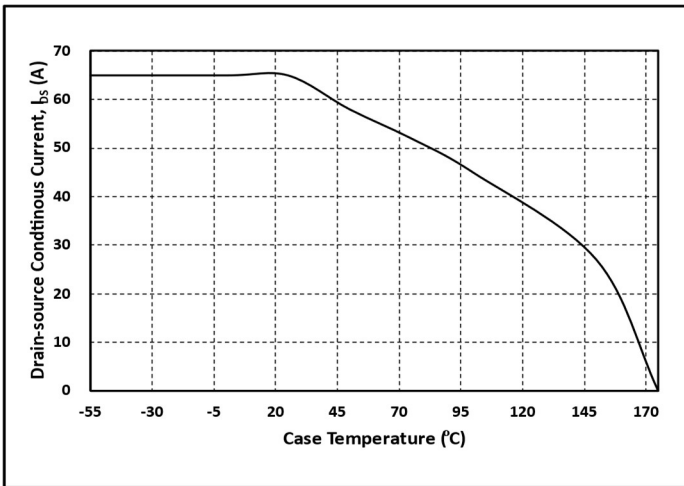


Fig. 23 Continuous Drain Current vs. Case Temperature

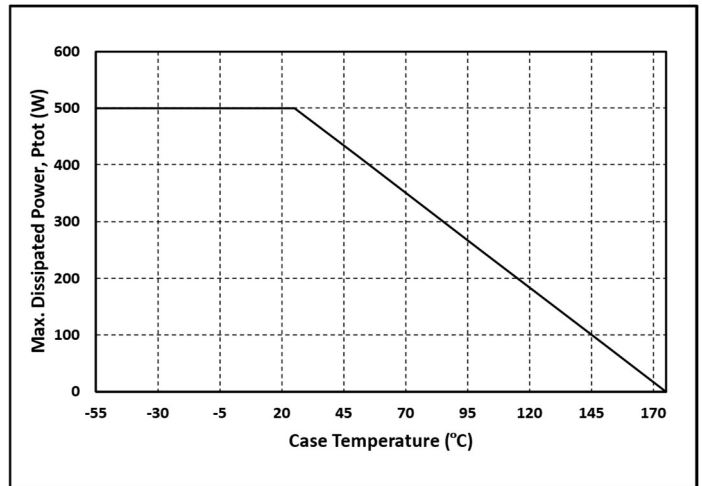


Fig. 24 Max. Power Dissipation Derating vs. Case Temperature

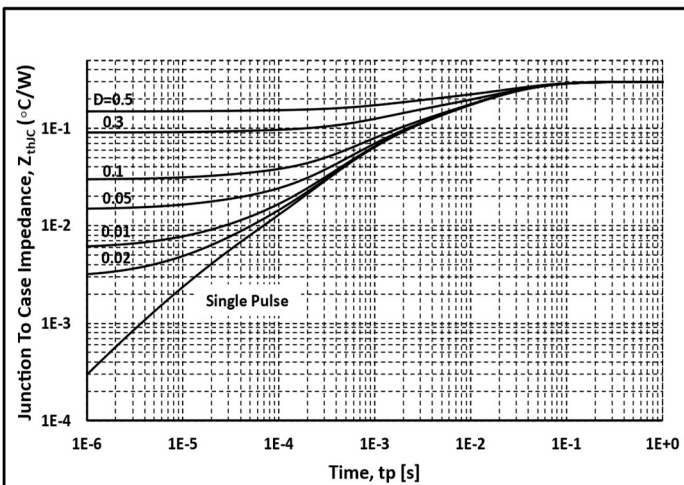


Fig. 25 Thermal impedance

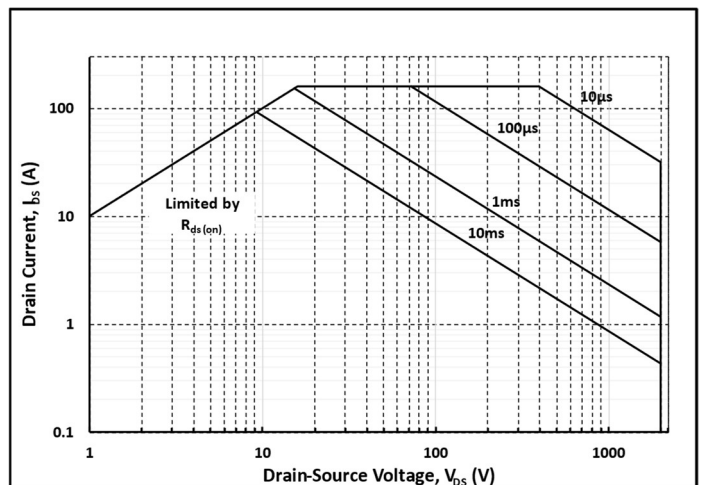
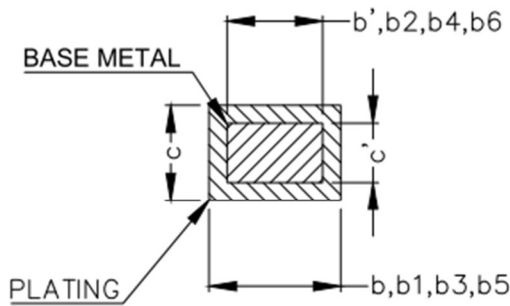
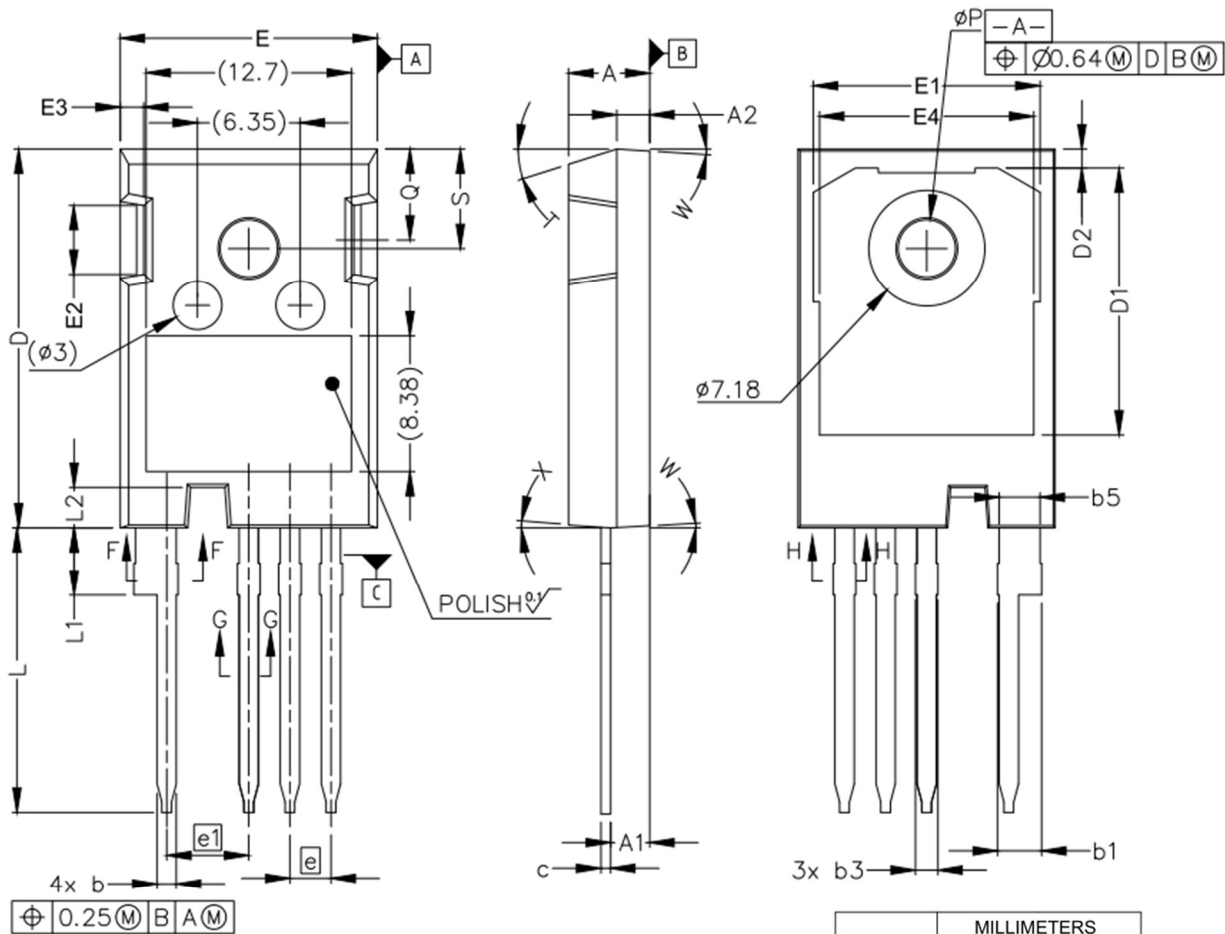


Fig. 26 Safe Operating Area

Package Dimensions



SECTION "F-F", "G-G" AND "H-H"
SCALE: NONE

Note:

1. ALL METAL SURFACES: TIN PLATED, EXCEPT AREA OF CUT
2. DIMENSIONING & TOLERANCEING CONFIRM TO ASME Y14.5M-1994.
3. ALL DIMENSIONS ARE IN MILLIMETERS. ANGLES ARE IN DEGREES.

SYMBOL	MILLIMETERS	
	MIN	MAX
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b'	1.07	1.28
b	1.07	1.33
b1	2.39	2.94
b2	2.39	2.84
b3	1.07	1.60
b4	1.07	1.50
b5	2.39	2.69
b6	2.39	2.64
c'	0.55	0.65
c	0.55	0.68
D	23.30	23.60
D1	16.25	17.65
D2	0.95	1.25
E	15.75	16.13
E1	13.10	14.15
E2	3.68	5.10
E3	1.00	1.90
E4	12.38	13.43
e	2.54 BSC	
e1	5.08 BSC	
N	4	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
øP	3.51	3.65
Q	5.49	6.00
S	6.04	6.30
T	17.5° REF.	
W	3.5° REF.	
X	4° REF.	

Notes

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