

IV1Q12050T4Z – 1200V 50mΩ Automotive SiC MOSFET

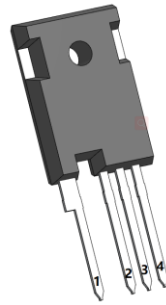
Features

- 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
- Kelvin gate input easing driver circuit design
- AEC-Q101 qualified

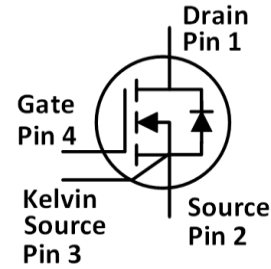
Applications

- On-board chargers
- Automotive compressor inverters
- Automotive DC/DC
- Solar inverters
- Switch mode power supplies

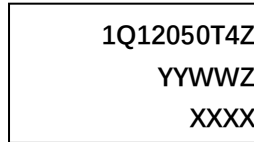
Outline:



TO247-4



Marking Diagram:



1Q12050T4Z= 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	1200	V	V _{GS} =0V, I _D =100μA	
V _{GSmax} (DC)	Maximum DC voltage	-5 to 22	V	Static (DC)	
V _{GSmax} (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 _D	Drain current (continuous)	58	A	V _{GS} =20V, T _c =25°C	Fig. 21
		43	A	V _{GS} =20V, T _c =100°C	
I _{DM}	Drain current (pulsed)	145	A	Pulse width limited by SOA	Fig. 24
P _{TOT}	Total power dissipation	344	W	T _c =25°C	Fig. 22
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	0.436	°C/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		5	100	μA	$V_{DS}=1200\text{V}, V_{GS}=0\text{V}$	
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	$V_{GS}=V_{DS}, I_D=6\text{mA}$	Fig. 8, 9
			2.2			$V_{GS}=V_{DS}, I_D=6\text{mA}$ @ $T_J=175^\circ\text{C}$	
R_{ON}	Static drain-source on-resistance		50	65	$\text{m}\Omega$	$V_{GS}=20\text{V}, I_D=20\text{A}$ @ $T_J=25^\circ\text{C}$	Fig. 4, 5, 6, 7
			80		$\text{m}\Omega$	$V_{GS}=20\text{V}, I_D=20\text{A}$ @ $T_J=175^\circ\text{C}$	
C_{iss}	Input capacitance		2750		pF	$V_{DS}=800\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}, V_{AC}=25\text{mV}$	Fig. 16
C_{oss}	Output capacitance		106		pF		
C_{rss}	Reverse transfer capacitance		5.2		pF		
E_{oss}	C_{oss} stored energy		43		μJ		Fig. 17
Q_g	Total gate charge		120		nC	$V_{DS}=800\text{V}, I_D=20\text{A},$ $V_{GS}=-5\text{ to }20\text{V}$	Fig. 18
Q_{gs}	Gate-source charge		25		nC		
Q_{gd}	Gate-drain charge		48		nC		
R_g	Gate input resistance		2.8		Ω	$f=1\text{MHz}$	
E_{ON}	Turn-on switching energy		455.4		μJ	$V_{DS}=800\text{V}, I_D=30\text{A},$ $V_{GS}=-2\text{ to }20\text{V},$ $R_{G(\text{ext})}=3.3\Omega,$ $L=450\mu\text{H}$	Fig. 19, 20
E_{OFF}	Turn-off switching energy		213.6		μJ		
$t_{d(\text{on})}$	Turn-on delay time		8.9		ns		
t_r	Rise time		28.9				
$t_{d(\text{off})}$	Turn-off delay time		25.6				
t_f	Fall time		17.2				

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		4.9		V	$I_{SD}=20\text{A}, V_{GS}=0\text{V}$	Fig. 10, 11, 12
			4.4		V	$I_{SD}=20\text{A}, V_{GS}=0\text{V},$ $T_J=175^\circ\text{C}$	
t_{rr}	Reverse recovery time		20		ns	$V_{GS}=-2\text{V}/+20\text{V},$ $I_{SD}=30\text{A}, V_R=800\text{V},$ $di/dt=1200\text{A}/\mu\text{s},$	
Q_{rr}	Reverse recovery charge		143.9		nC	$R_{G(\text{ext})}=20\Omega$ $L=450\mu\text{H}$	
I_{RRM}	Peak reverse recovery current		13		A		

Typical Performance (curves)

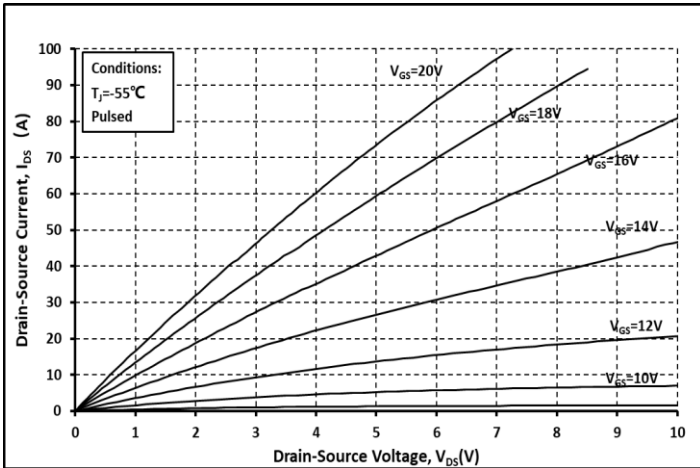


Fig. 1 Output Curve @ $T_j = -55^\circ\text{C}$

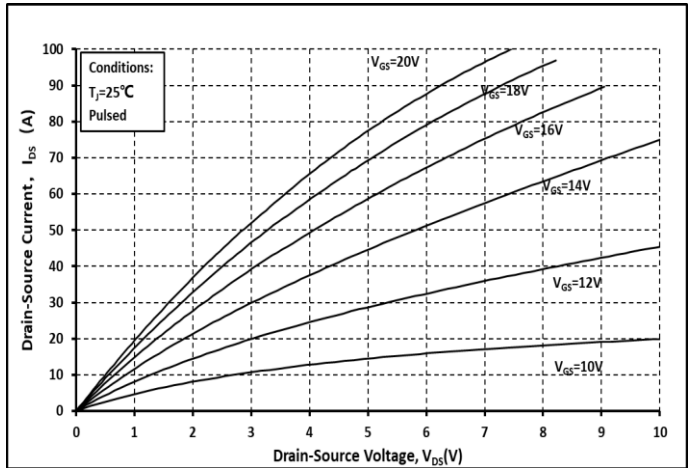


Fig. 2 Output Curve @ $T_j = 25^\circ\text{C}$

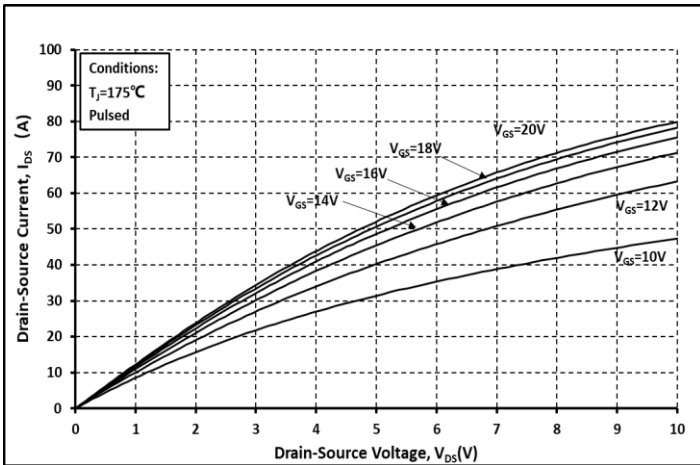


Fig. 3 Output Curve @ $T_j = 175^\circ\text{C}$

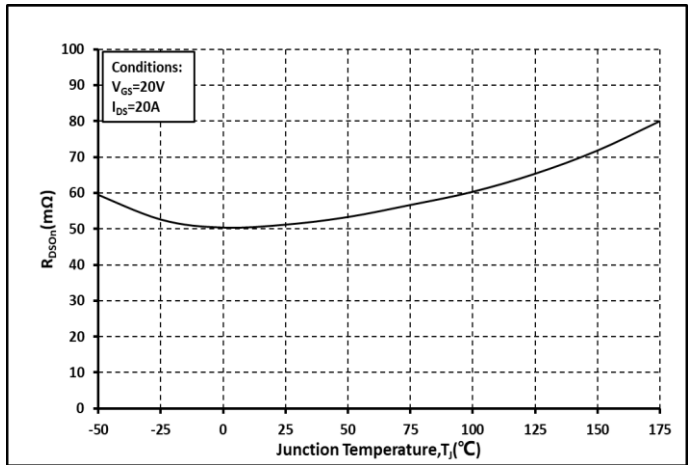


Fig. 4 R_{on} vs. Temperature

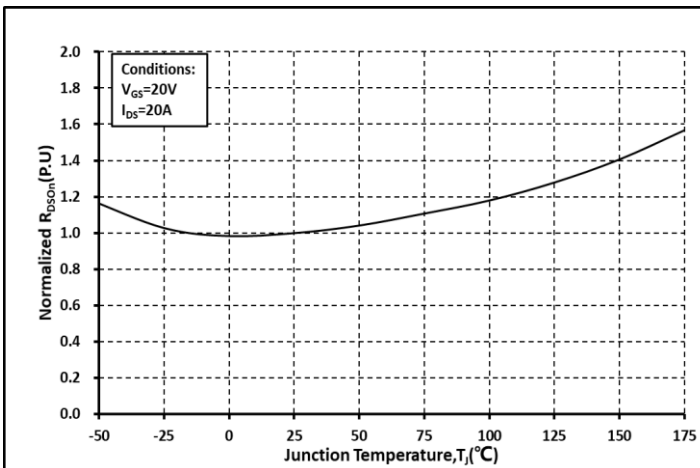


Fig. 5 Normalized R_{on} vs. Temperature

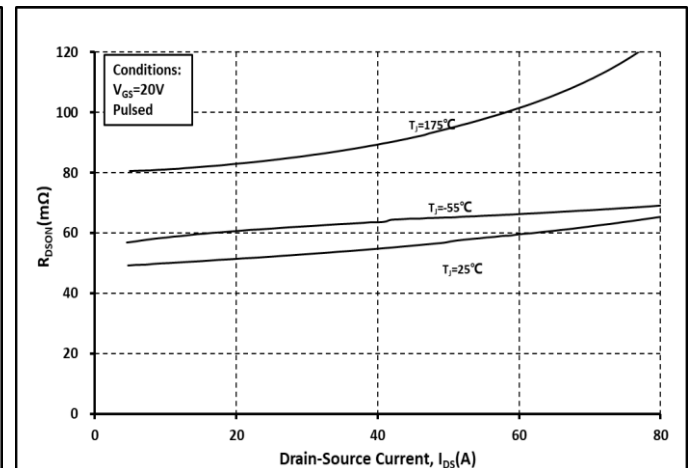


Fig. 6 R_{on} vs. I_{DS} @ Various Temperature

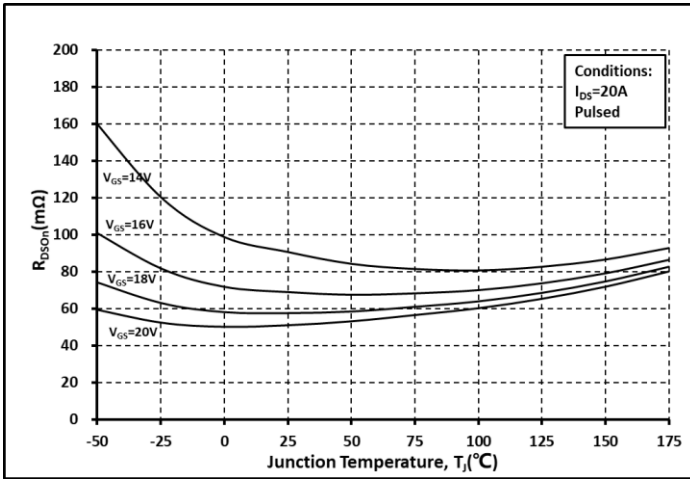


Fig. 7 Ron vs. Temperature @ Various V_{GS}

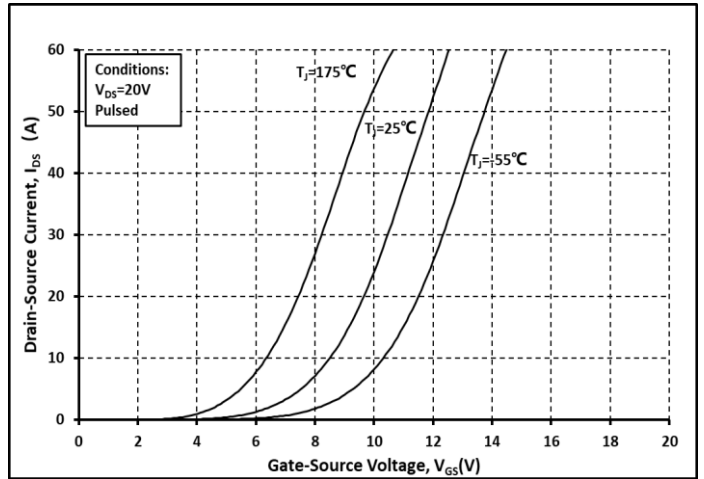


Fig. 8 Transfer Curves @ Various Temperature

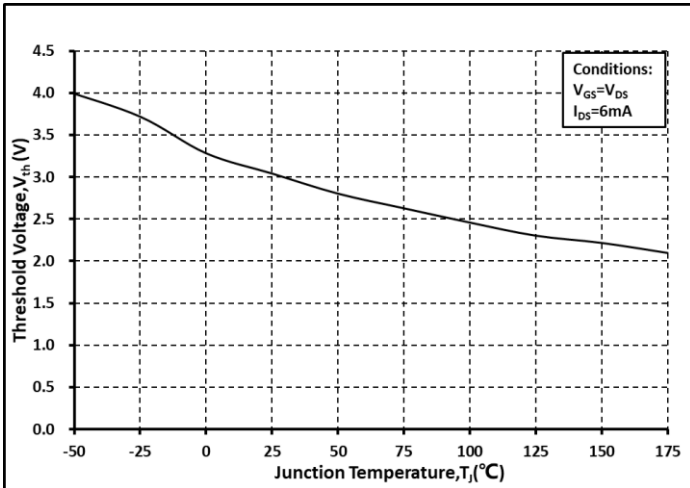


Fig. 9 Threshold Voltage vs. Temperature

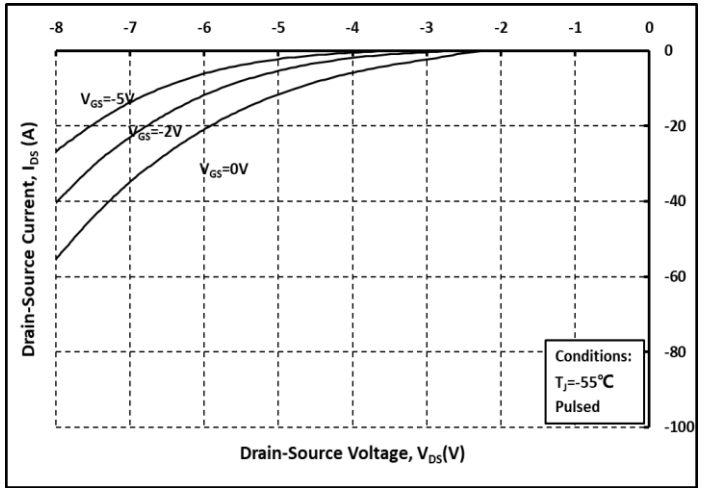


Fig. 10 Body Diode Curves @ $T_J=-55^\circ C$

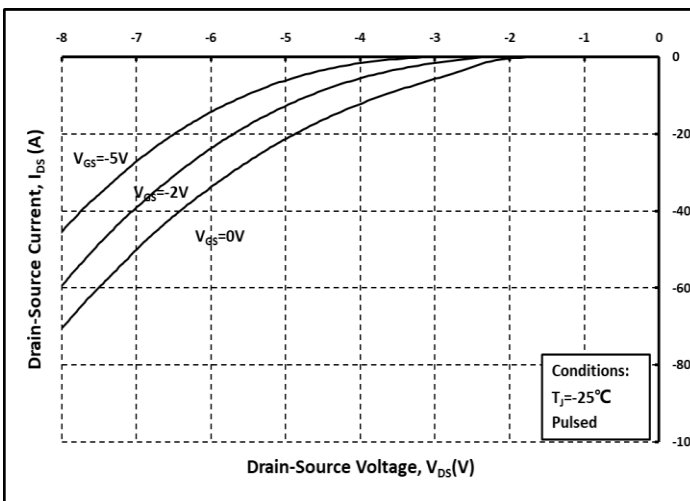


Fig. 11 Body Diode Curves @ $T_J=25^\circ C$

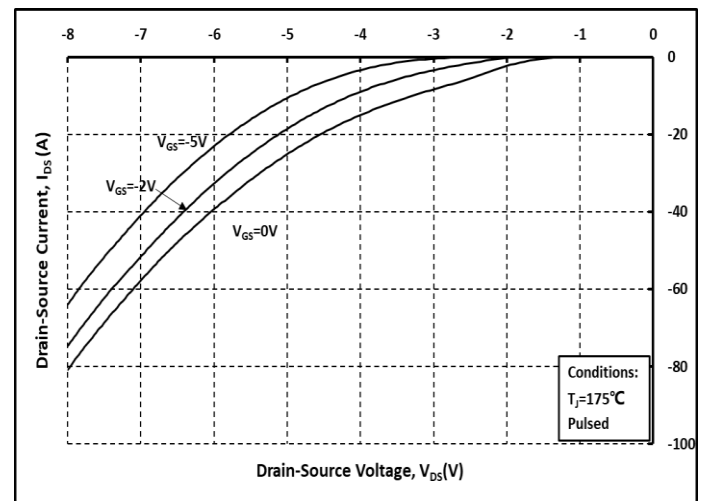


Fig. 12 Body Diode Curves @ $T_J=175^\circ C$

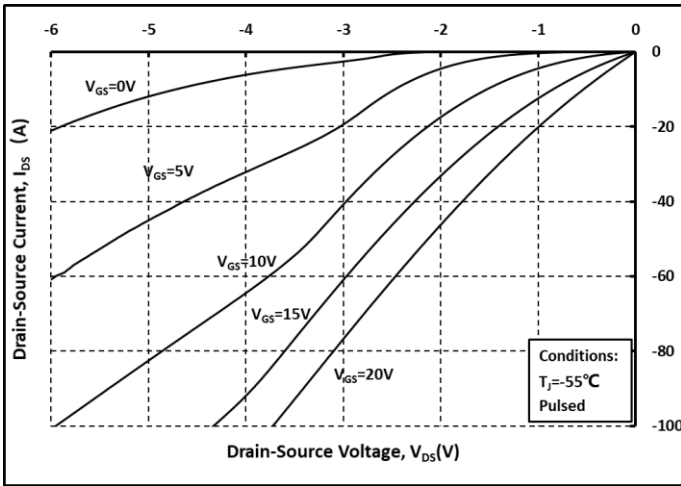


Fig. 13 3rd Quadrant Curves @ $T_j = -55^\circ\text{C}$

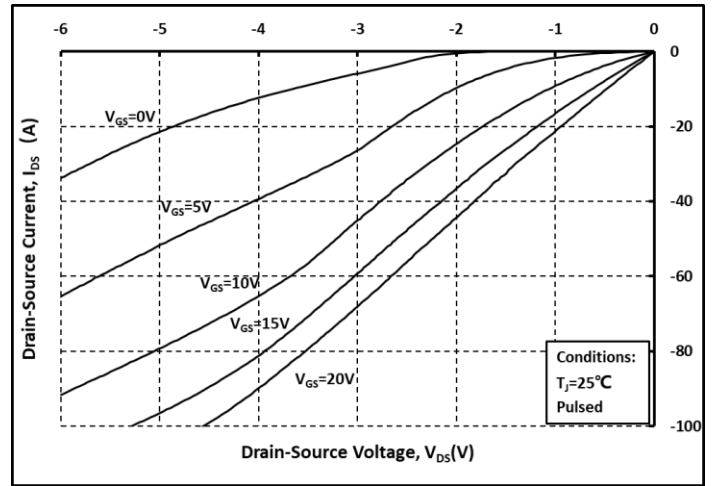


Fig. 14 3rd Quadrant Curves @ $T_j = 25^\circ\text{C}$

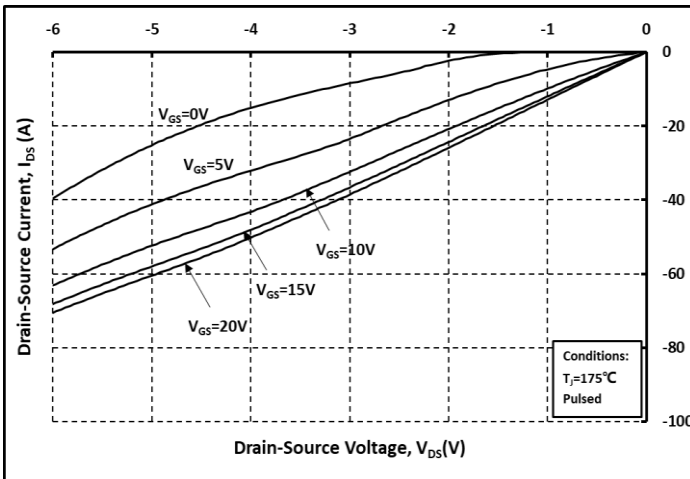


Fig. 15 3rd Quadrant Curves @ $T_j = 175^\circ\text{C}$

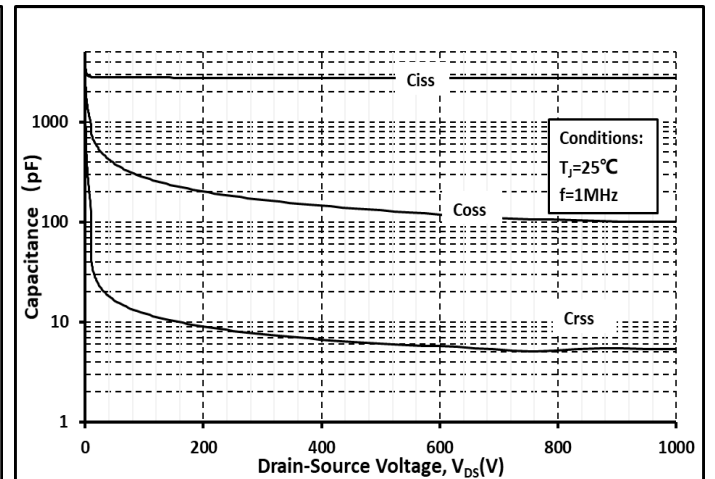


Fig. 16 Capacitance vs. V_{DS}

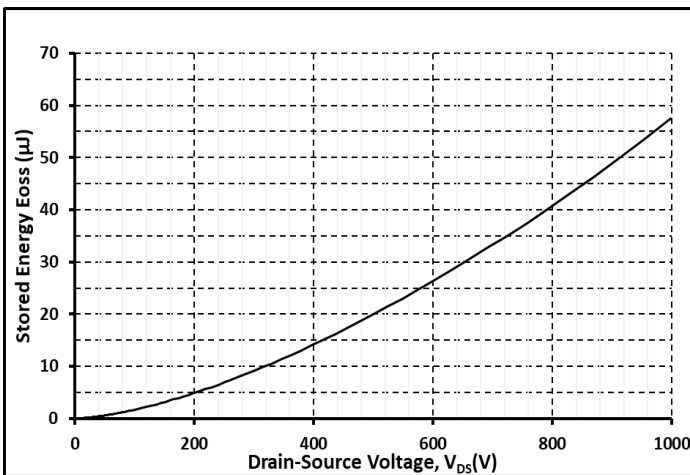


Fig. 17 Output Capacitor Stored Energy

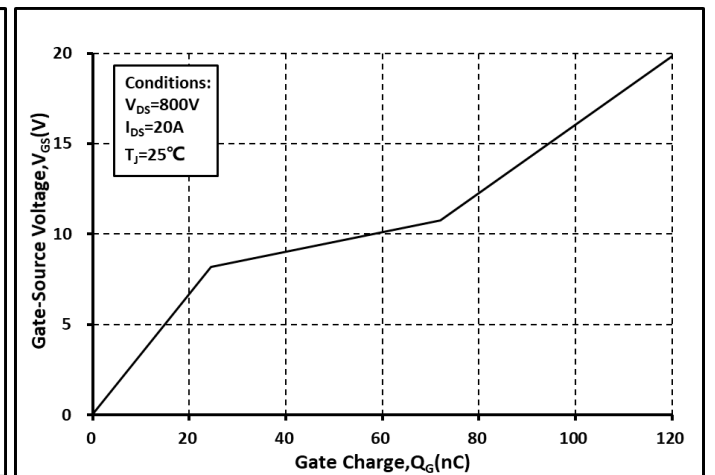


Fig. 18 Gate Charge Characteristics

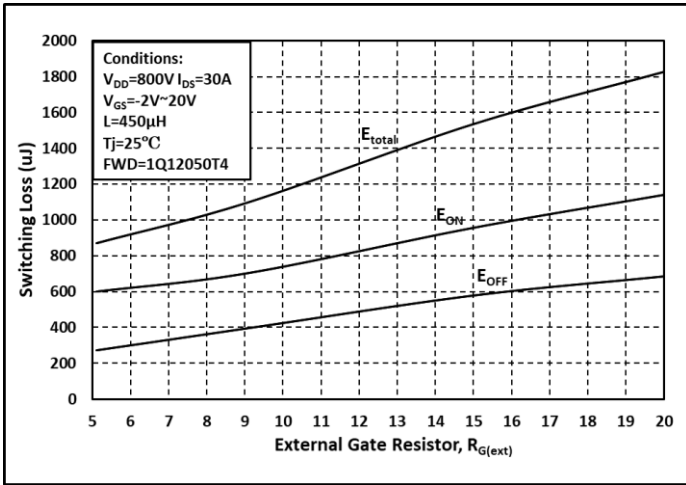


Fig. 19 Switching Energy vs. $R_{G(ext)}$

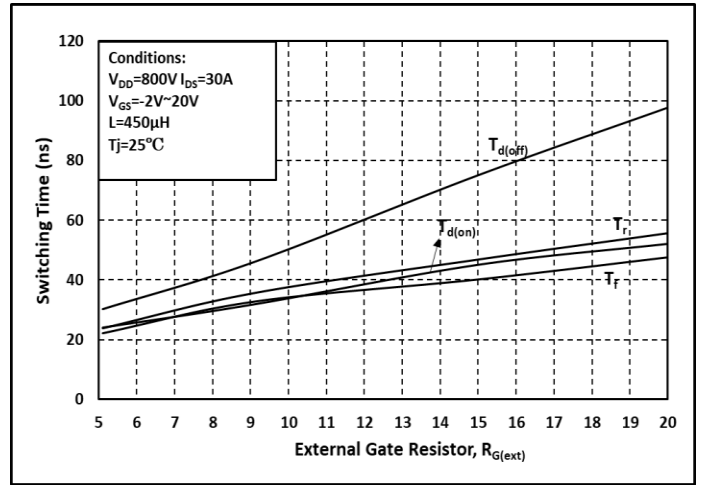


Fig. 20 Switching Times vs. $R_{G(ext)}$

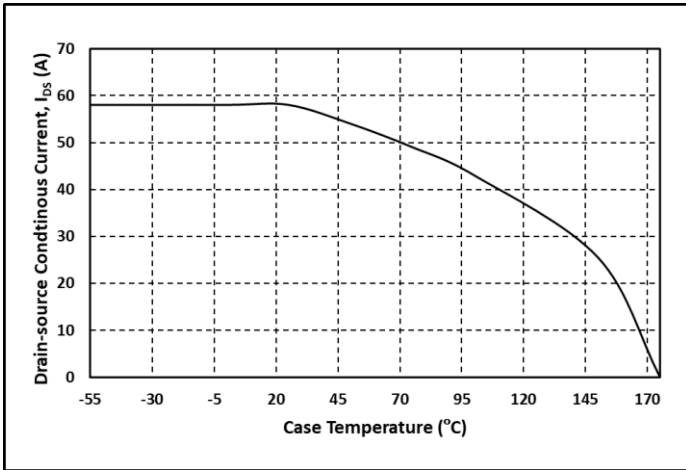


Fig. 21 Continuous Drain Current vs. Case Temperature

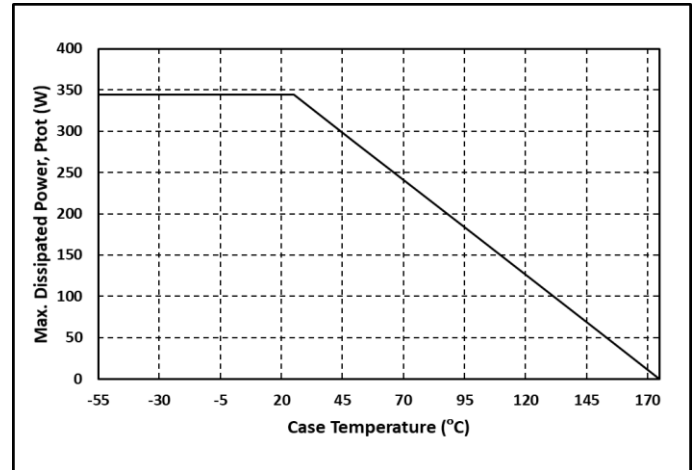


Fig. 22 Max. Power Dissipation Derating vs. Case Temperature

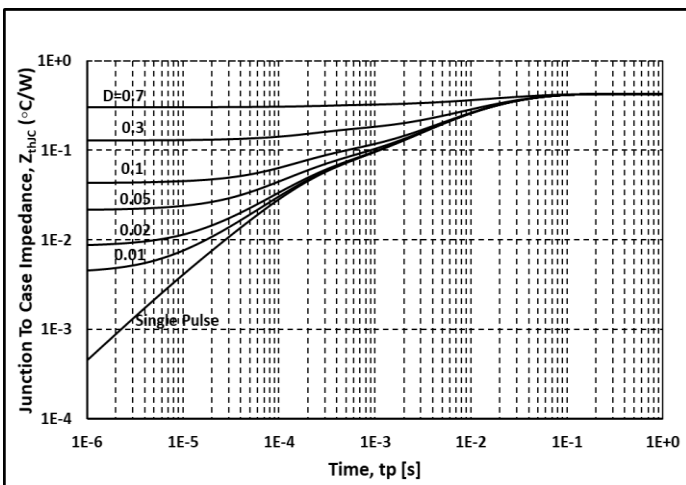


Fig. 23 Thermal Impedance

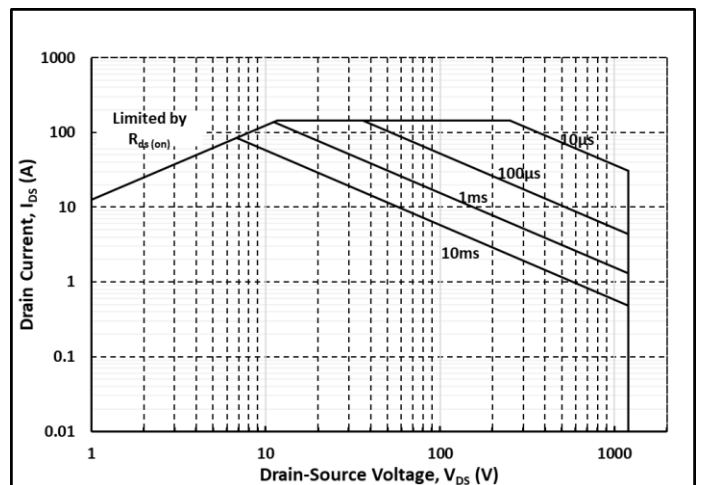
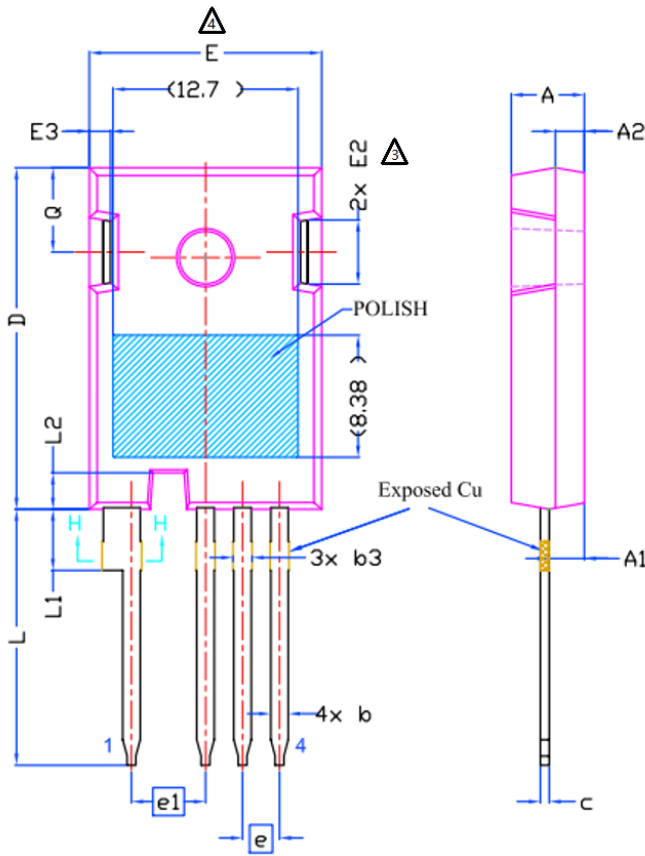
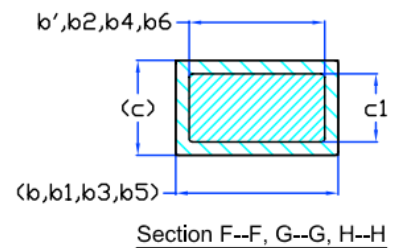
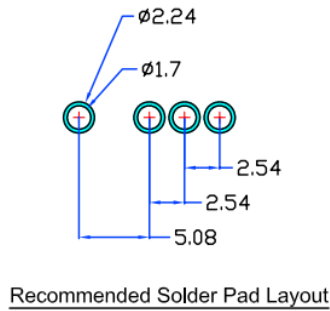
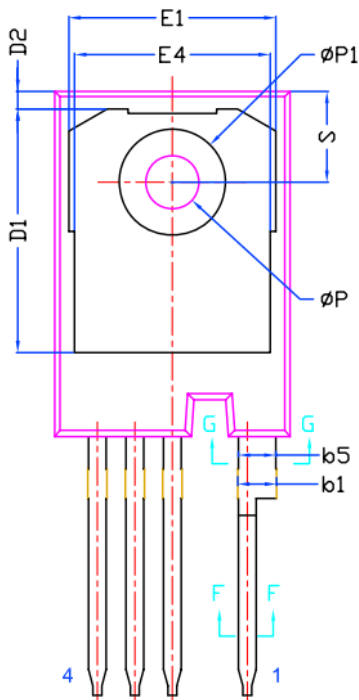


Fig. 24 Safe Operating Area

Package Dimensions



Dimensions In Millimeters		
SYMBOL	MIN.	MAX.
A	4.83	5.21
A1	2.29	2.54
A2	1.91	2.16
b	1.07	1.33
b'	1.07	1.28
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	0.68
c1	0.55	0.65
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	
L	17.31	17.82
L1	3.97	4.37
L2	2.35	2.65
N	4	
φ P	3.51	3.65
φ P1	7.18 REF.	
Q	5.49	6
S	6.04	6.3



Note:

1. Package Reference: JEDEC TO247, Variation AD
2. All Dimensions are in mm
3. Slot Required, Notch May Be Rounded
4. Dimension D&E Do Not Include Mold Flash
5. Subject to Change Without Notice

Notes

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