

● General Description

This silicon carbide Power MOSFET device has been developed using ZMJ’s advanced 2<sup>nd</sup> generation SiC MOSFET technology. The device features a very low  $R_{DS(on)}$  over the entire temperature range combined with low capacitances and very high switching operations. It improves application performance in frequency, energy efficiency, system size and weight reduction.

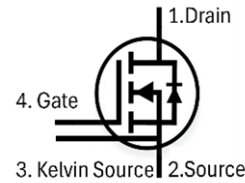
● Features

- High Blocking Voltage
- High Speed Switching With Low Capacitances
- Low  $R_{DS(on)}$  to Minimize Conductive Loss
- Low Gate Charge For Fast Switching
- Low Thermal Resistance
- 100% Avalanche Tested
- AEC-Q101 Qualified

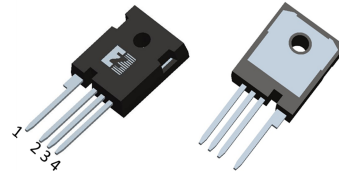
● Application

- Motor Drives
- On Board Charger
- DC-DC
- Auxiliary Drives

● Product Summary



$V_{DS} = 1200V$   
 $R_{DS(ON)} = 53m\Omega$   
 $I_D = 35A$



TO-247-4



● Ordering Information:

Part NO.	ZMCA060N120C4
Marking	ZMC060N120
Packing Information	BULK TUBE
Basic Ordering Unit (pcs)	600

● Absolute Maximum Ratings ( $T_C=25^\circ C$ )

Parameter	Symbol	Conditions	Value	Unit
Drain-Source Voltage	$V_{DS}$		1200	V
Gate-Source Voltage	$V_{GS}$	Transient Voltage	-10V/25V	V
	$V_{GS}$	Static Voltage	-10V/24V	V
Recommended Turn On Gate Voltage	$V_{GS(on)}$		15 to 18V	V
Recommended Turn Off Gate Voltage	$V_{GS(off)}$		-4V to 0V	V
Continuous Drain Current	$I_D$	$T_C=25^\circ C$	35	A
	$I_D$	$T_C=75^\circ C$	28	A
	$I_D$	$T_C=100^\circ C$	24	A

Pulsed Drain Current <sup>①</sup>	$I_{DM}$	Pulsed; $t_p \leq 10 \mu s$ ; $T_{mb} = 25^\circ C$ ;	140	A
Total Power Dissipation	$P_D$	$T_C = 25^\circ C$	197	W
Total Power Dissipation	$P_D$	$T_A = 25^\circ C$	3.8	W
Operating Junction Temperature	$T_J$		-55 to +175	$^\circ C$
Storage Temperature	$T_{STG}$		-55 to +175	$^\circ C$
Single Pulse Avalanche Energy	$E_{AS}$	$L=0.5mH, V_{GS}=18V, R_g=25\Omega$	361	mJ
ESD Level (HBM)			Class2	

### • Thermal Resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal Resistance, Junction - Case	$R_{thJC}$	-	-	0.76	$^\circ C/W$
Thermal Resistance, Junction-Ambient	$R_{thJA\oplus}$	-	-	40	$^\circ C/W$
Soldering Temperature(total time<10s)	$T_{sold}$	-	-	260	$^\circ C$

### • Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	1200	-	-	V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 5mA$	2	2.8	4	V
Drain-Source Leakage Current	$I_{DSS}$	$V_{GS} = 0V, V_{DS} = 1200V$	-	-	10	$\mu A$
Gate- Source Leakage Current	$I_{GSS}$	$V_{GS} = -10V, V_{DS} = 0V$	-	-	-100	nA
		$V_{GS} = 25V, V_{DS} = 0V$	-	-	100	nA
Static Drain-Source On Resistance	$R_{DS(on)}$	$T_J = 25^\circ C, V_{GS} = 18V, I_D = 20A$	-	53	65	m $\Omega$
		$T_J = 175^\circ C, V_{GS} = 18V, I_D = 20A$	-	110	-	m $\Omega$
		$T_J = 25^\circ C, V_{GS} = 15V, I_D = 20A$	-	63	-	m $\Omega$
Forward Transconductance	$g_{fs}$	$V_{DS} = 10V, I_{SD} = 20A$	-	8.5	-	S
Diode Forward Voltage	$V_{FSD}$	$V_{GS} = -4V, I_{SD} = 20A$	-	4.3	5	V

### • Dynamic Characteristics

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input Capacitance	$C_{iss}$	$f = 100KHz, V_{DS} = 800V$	-	1690	-	pF
Output Capacitance	$C_{oss}$		-	67	-	
Reverse Transfer Capacitance	$C_{rss}$		-	3	-	
Output Charge	$Q_{oss}$	$f = 100KHz, V_{GS} = 0V, V_{DS} = 0V \text{ to } 800V$	-	90	-	nC
Coss Stored Energy	$E_{oss}$		-	25	-	$\mu J$
Gate Resistance	$R_g$	$f = 1MHz$	-	1.7	-	$\Omega$
Total Gate Charge	$Q_g$	$V_{DD} = 800V, I_D = 20A, V_{GS} = -4V/18V$	-	69	-	nC
Gate - Source Charge	$Q_{gs}$		-	23	-	
Gate - Drain Charge	$Q_{gd}$		-	26	-	

Turn-ON Delay Time	$t_{D(on)}$	$V_{GS}=-4V/18V, V_{DS}=800V,$ $R_G=10\Omega, I_D=20A,$ $L=505\mu H$	-	13	-	ns
Turn-ON Rise Time	$t_r$		-	4.2	-	ns
Turn-Off Delay Time	$t_{D(off)}$		-	34	-	ns
Turn-Off Fall Time	$t_f$		-	15	-	ns
Turn-On Energy	$E_{on}$		-	580	-	$\mu J$
Turn-Off Energy	$E_{off}$		-	156	-	$\mu J$
Reverse Recovery Time	$t_{rr}$	$V_{DD}=800V, di_S/dt =$ $600A/\mu s, I_S=20A$	-	24	-	ns
Reverse Recovery Peak Current	$I_{rrm}$		-	5.5	-	A
Reverse Recovery Charge	$Q_{rr}$		-	74	-	nC

● Characteristics Diagrams

Fig.1 Gate-Charge Characteristics

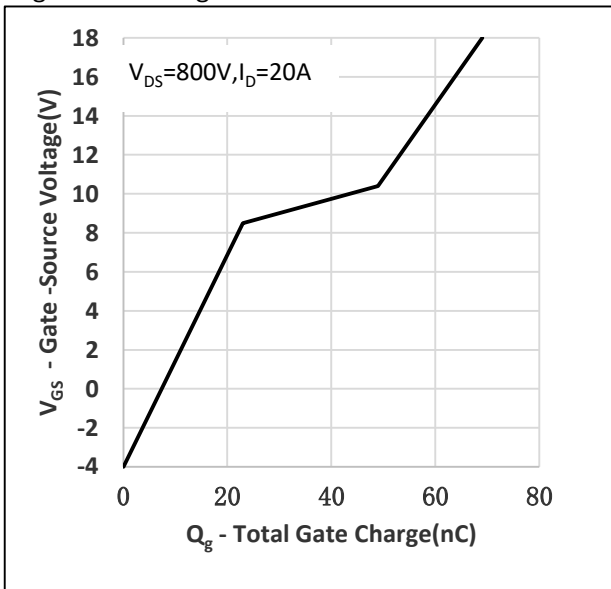


Fig.2 Capacitance Characteristics

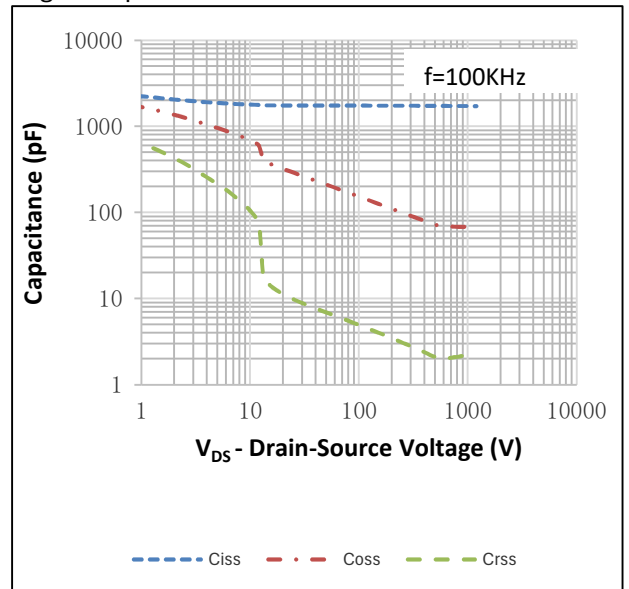


Fig.3 Power Dissipation

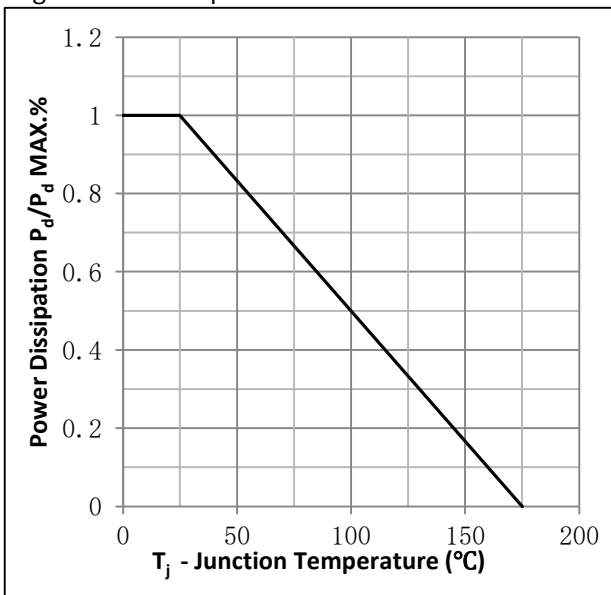


Fig.4 Typical Output Characteristics

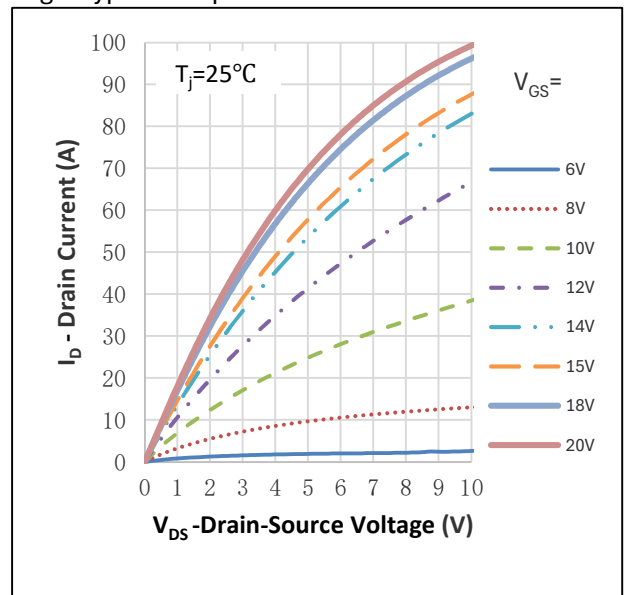


Fig.5 Threshold Voltage vs. Junction Temperature

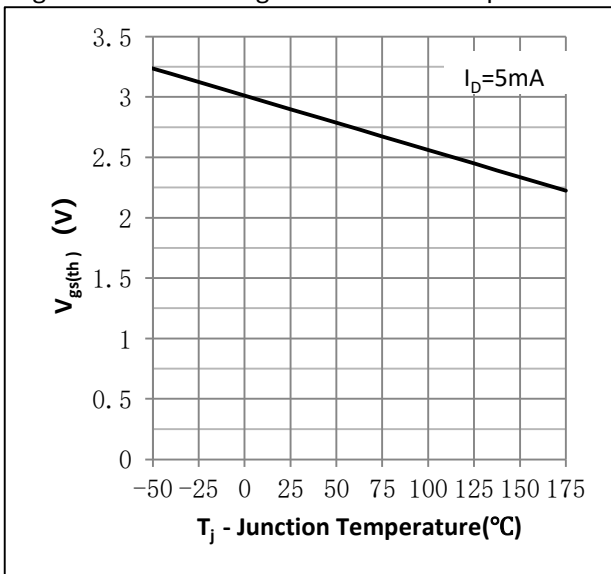


Fig.6 On-Resistance vs. Drain Current

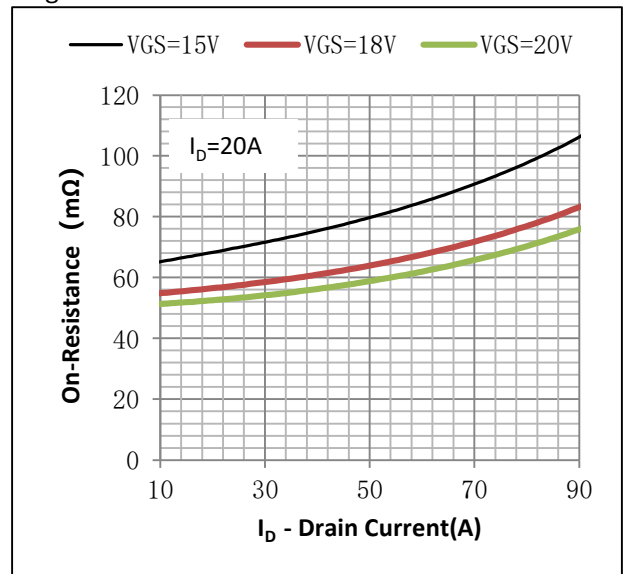


Fig.7 On-Resistance vs. Gate Source Voltage

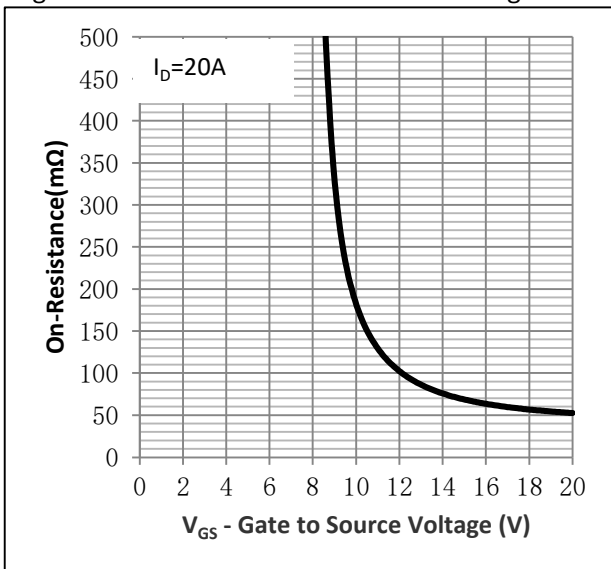


Fig.8 On-Resistance vs. Junction Temperature

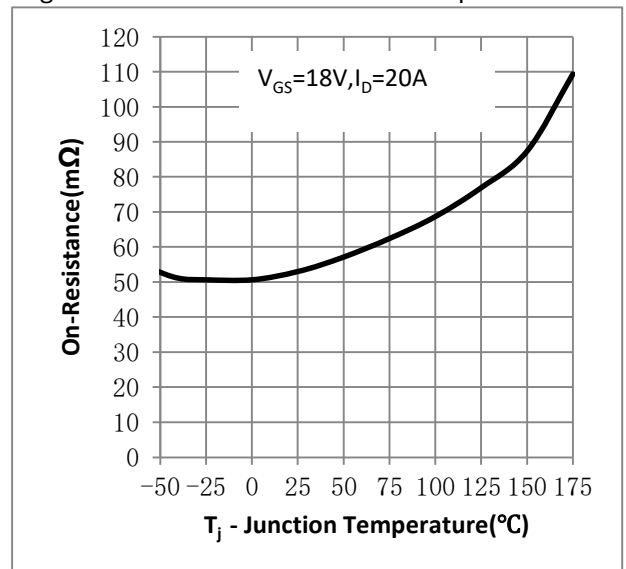


Figure 9. Diode Forward Voltage vs. Current

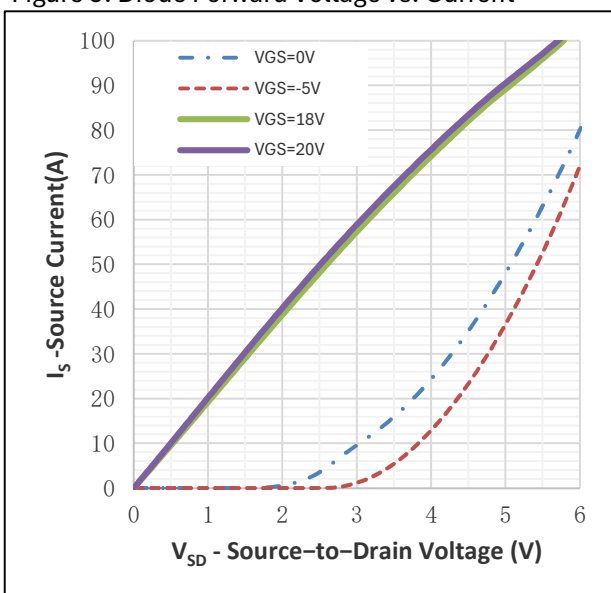


Figure 10. Transfer Characteristics

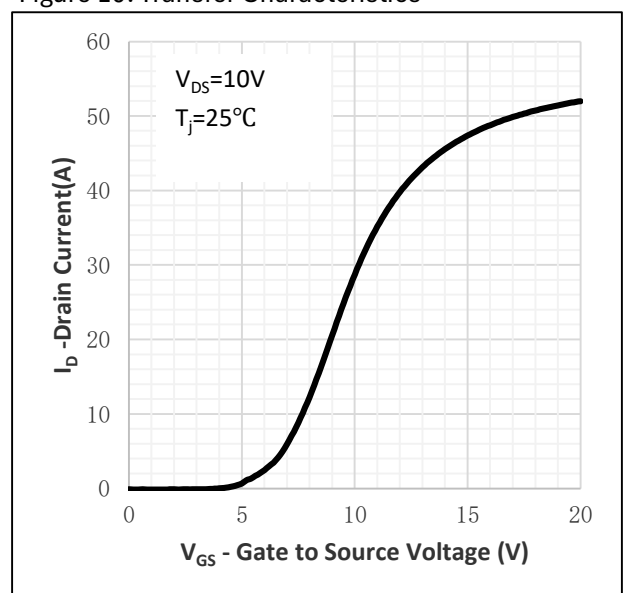


Fig.11 SOA Maximum Safe Operating Area

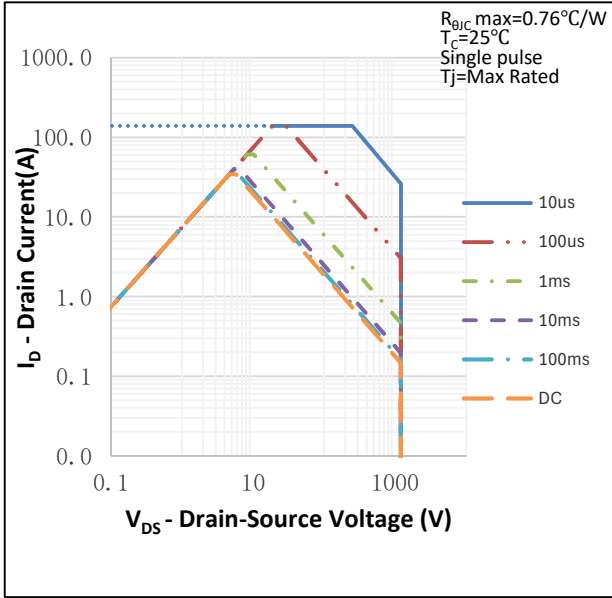


Fig.12  $I_D$  vs. Junction Temperature

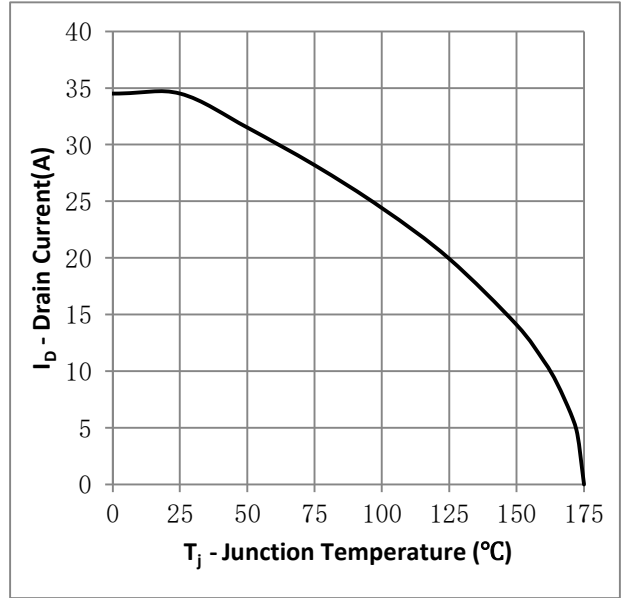


Fig.13 Output Capacitor Stored Energy

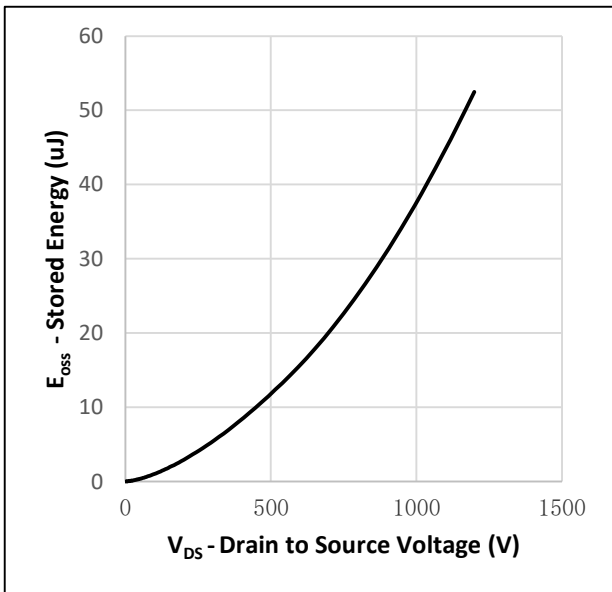
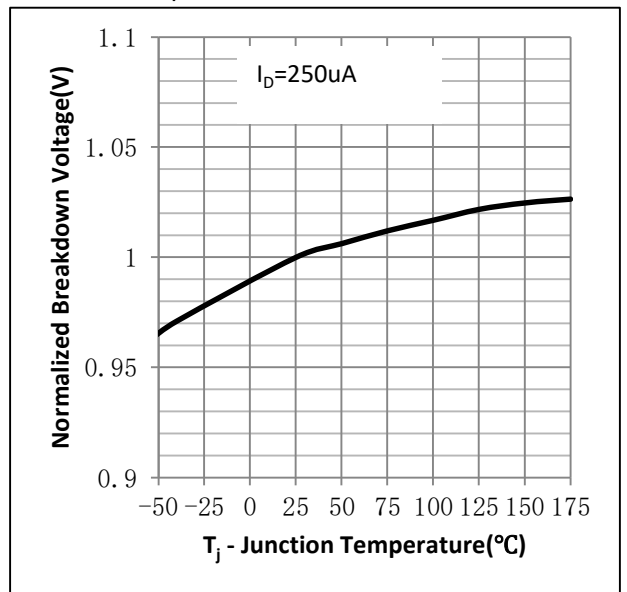
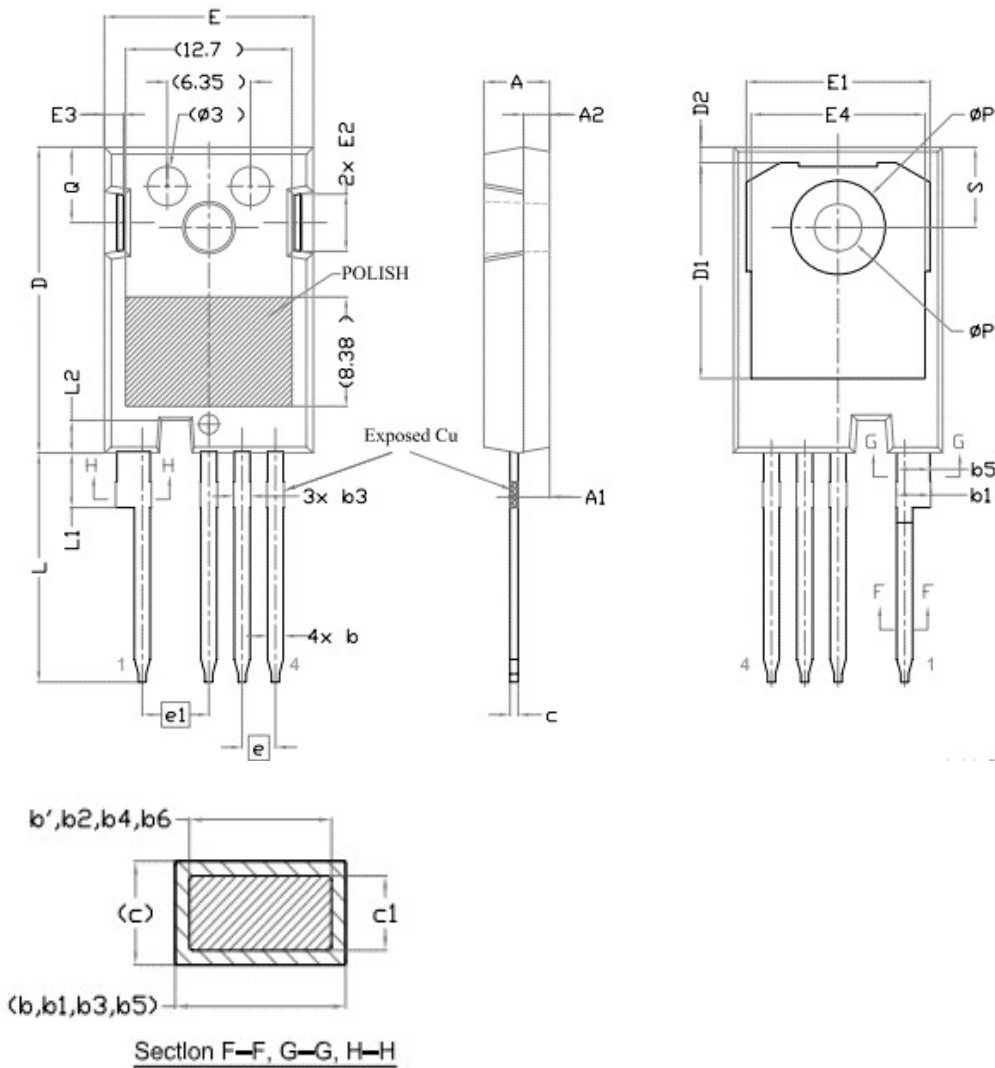


Fig.14 Normalized Breakdown Voltage vs. Junction Temperature



•TO-247-4 Package Outline



SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.00	2.16
b'	1.07	1.20	1.28
b	1.07	1.20	1.33
b1	2.39	2.67	2.94
b2	2.39	2.67	2.84
b3	1.07	1.30	1.60
b4	1.07	1.30	1.50
b5	2.39	2.53	2.69
b6	2.39	2.53	2.64
c	0.55	0.60	0.68
c1	0.55	0.60	0.65
D	23.30	23.45	23.60
D1	16.25	16.55	17.65
D2	0.95	1.19	1.25
E	15.75	15.94	16.13
E1	13.10	14.02	14.15
E2	3.68	4.40	5.10
E3	1.00	1.45	1.90
E4	12.38	13.26	13.43
e	2.54 BSC		
e1	5.08 BSC		
L	17.31	17.57	17.82
L1	3.97	4.19	4.37
L2	2.35	2.50	2.65
∅P	3.51	3.61	3.65
∅P1	7.19 REF.		
Q	5.49	5.79	6.00
S	6.04	6.17	6.30

**Note:**

- ① The value of  $R\theta JA$  is measured with the device in a still environment with  $T_A=25^\circ C$
- ② Practically the current will be limited by PCB, thermal design and operating temperature.  $V_{GS}=18V$ .

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**Revision History:**

Version	Date	Change
A	2024/6/7	New
B	2024/7/8	Correct Fig.8, update switching and reverse recovery result.
C	2024/11/22	Update VGS maximum rating and IGSS+ test condition.