Powerex, Inc., 173 Pavilion Lane, Youngwood, Pennsylvania 15697 (724) 925-7272
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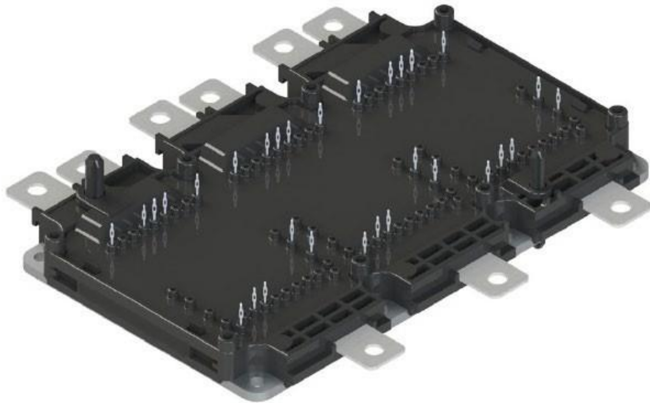
1200V/800A 3 Phase SiC MOSFET Module

PRXS02FB12HDB1



Description

The PRXS02FB12HDB1 is a 3 Phase SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips for xEV or motor drives application.

Features

- Blocking voltage 1200V
- $R_{DS(on)}$ =1.7mΩ (T_j =25°C)
- Arcbonding™ technology
- 175°C maximum junction temperature
- Si_3N_4 AMB substrate
- Direct Cooled Pin Fin Base Plate
- Thermistor inside
- Press FIT Contact Technology

Applications

- xEV Applications
- Motor Drives

Circuit Diagram

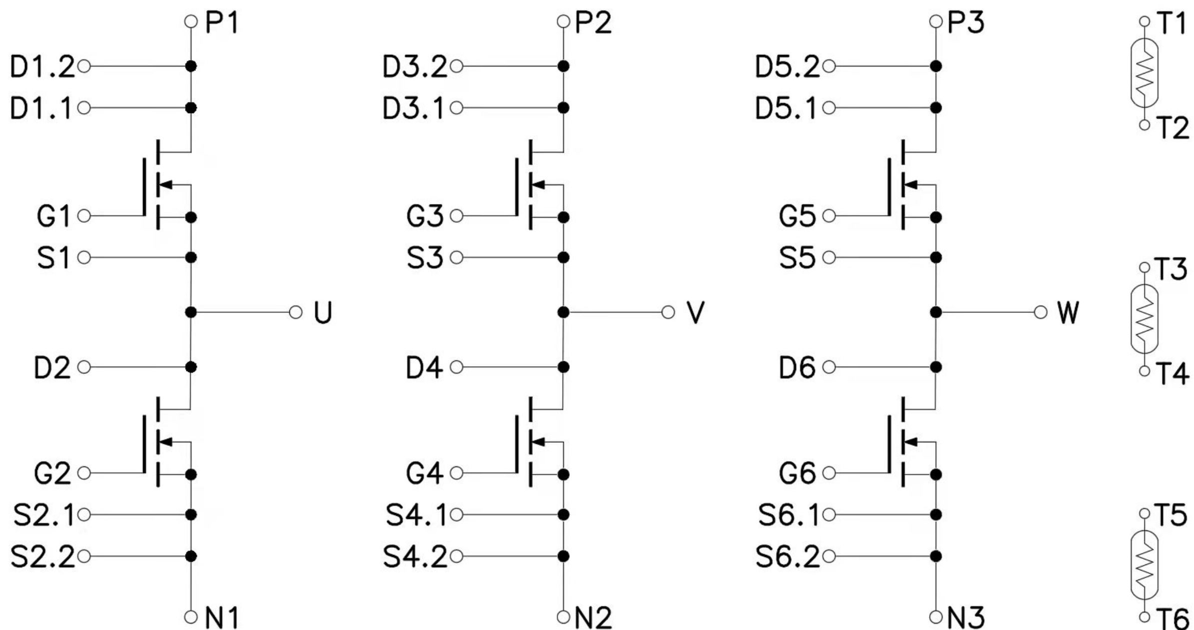


Figure 1. Out drawing & circuit diagram for PRXS02FB12HDB1

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Physical Dimensions

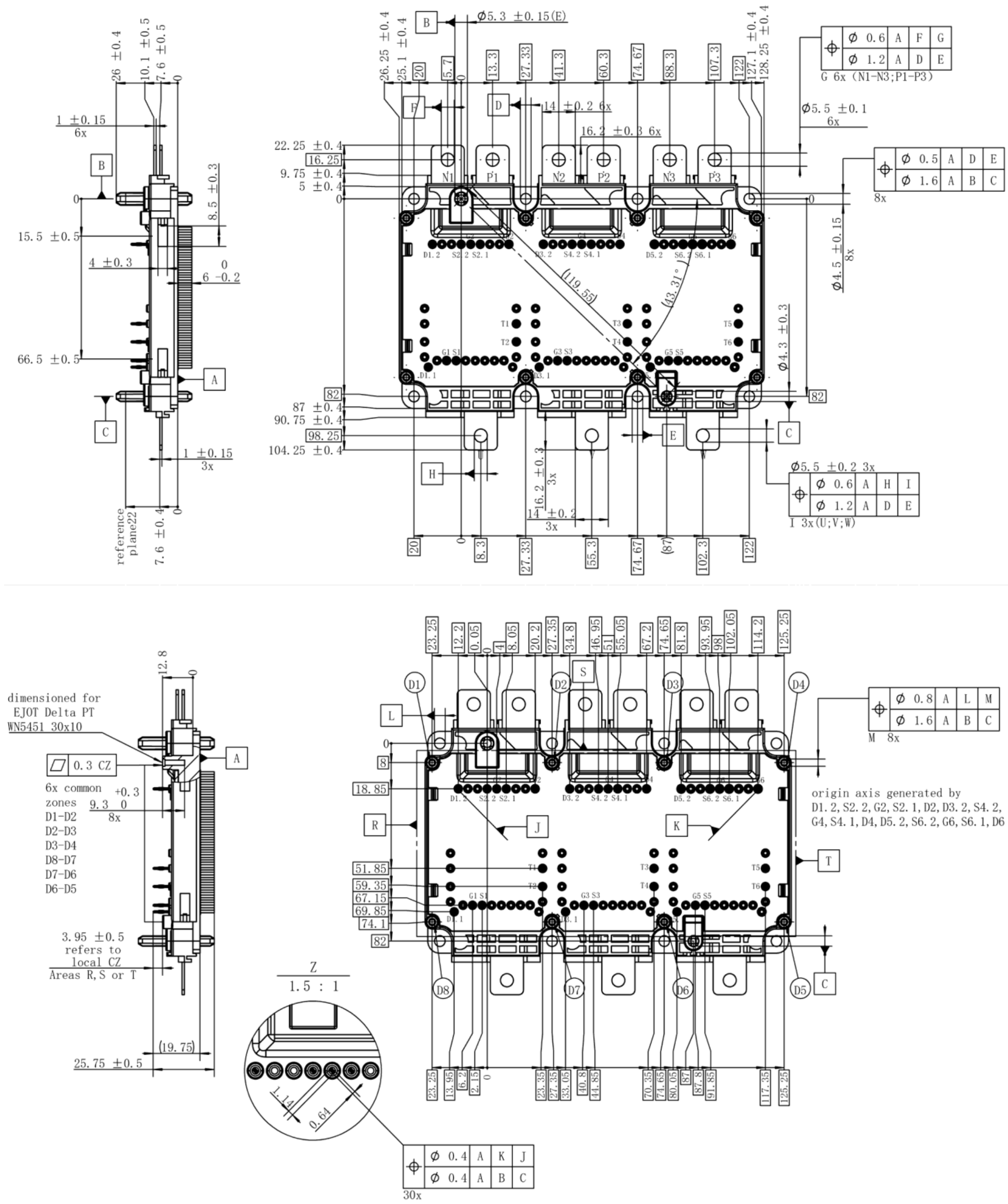

Figure 2. Physical Dimensions

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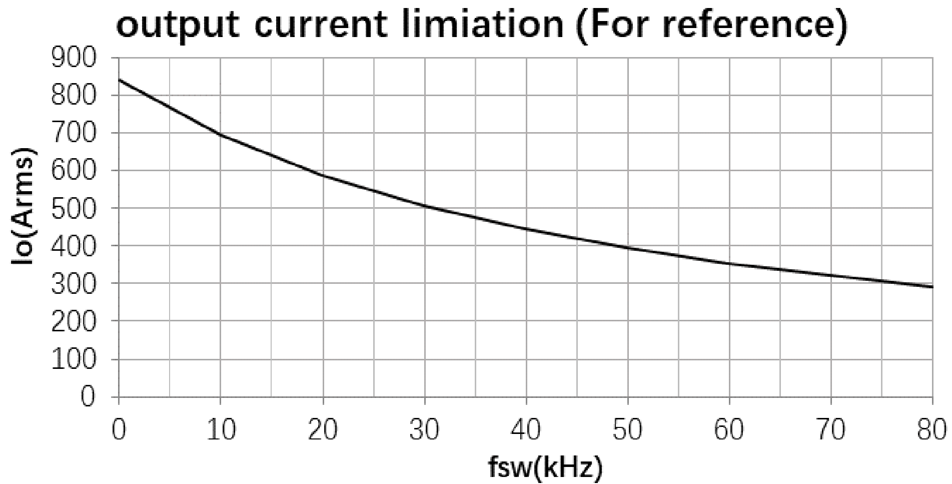
Maximum Ratings (T_j = 25°C unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V_{DSS}	Drain-Source Voltage	G-S Short	1200	V
V_{GSS}	Gate-Source Voltage	D-S Short, AC frequency ≥1Hz, Note1	-11V/+23V	V
I_{DS}	DC Continuous Drain Current	T_f =25°C	685	A
I_{DS}	DC Continuous Drain Current	T_f =65°C	590	A
I_{SD}	Source (Body Diode) Current	T_f =25°C, with ON signal	685	A
I_{SD}	Source (Body Diode) Current	T_f =65°C, with ON signal	590	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	1600	A
P_D	Maximum Power Dissipation	T_f =25°C	1923	W
T_j	junction temperature	-	-40 to 175	°C
T_{stg}	Storage temperature	-	-40 to 125	°C

Note1: Recommended Operating Value: -4V/+15V, -5V/+18V
Note2: Pulse width limited by maximum junction temperature

Typical Current Output Ability

Condition: SPWM control, V_{CC} = 800V, $R_{g(ON)}$ = $R_{g(OFF)}$ = 5Ω, T_f = 65°C, T_{jmax} = 175°C, PF = 0.8, Modulation rate = 1



Note3: This graph is calculated value for reference based on the limitation of T_{jmax} =175°C. The actual current out ability depends on inverter electrical, thermal and mechanic design. Please confirm it in actual application system.

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Module

Parameter	Conditions	Value	Unit
Isolation voltage	Main terminal to base plate, f =0Hz, t =1sec	4.2	kV
Material of module baseplate	-	Cu+Ni	-
Creepage distance	terminal to heatsink terminal to terminal	9	mm
Clearance	terminal to heatsink terminal to terminal	4.5	mm
Stray inductance module	T_f =65°C	8	nH
Module lead resistance, terminals – chip	T_f =65°C	0.2	mΩ
Mounting torque for module mounting	Screw M4 baseplate to heatsink	1.8 to 2.2	Nm
Weight	-	798	g

NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R_{25}	Resistance	T_c =25°C	-	5	-	kΩ
ΔR/R	Deviation of R100	T_c =100°C, R_{100} =493Ω	5	-	5	%
P_{25}	Power dissipation	T_c =25°C	-	-	20	mW
$B_{25/50}$	B-value	R2 =R25 exp [$B_{25/50}$(1/T2 - 1/(298,15 K))]	-	3375	-	K
$B_{25/80}$	B-value	R2 =R25 exp [$B_{25/80}$(1/T2 - 1/(298,15 K))]	-	3411	-	K
$B_{25/100}$	B-value	R2 =R25 exp [$B_{25/100}$(1/T2 - 1/(298,15 K))]	-	3433	-	K

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MOSFET Electrical characteristics (T_j =25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value Min.	Value Typ.	Value Max	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D =8mA		1200	-	-	V
I_{DSS}	Zero gate voltage drain current	V_{DS}=1200V, V_{GS} =0V		-	-	80	μA
$V_{GS(th)}$	Gate-source threshold voltage	I_D =80mA, V_{DS} =V_{GS}		2.1	-	5.8	V
I_{GSS}	Gate-Source Leakage Current	V_{GS} =20V, V_{DS} =0V, T_j =25°C		-	-	10	μA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D =800A V_{GS} =18V	T_j =25°C	1.1	1.7	2.3	mΩ
			T_j =175°C	2.6	4.0	5.4	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state voltage	I_D =800A V_{GS}=18V	T_j =25°C	-	1.34	1.84	V
			T_j =175°C	-	3.24	4.33	V
C_{iss}	Input capacitance	V_{DS}=850V V_{GS} =0V f =1MHz		-	32	-	nF
C_{oss}	Output capacitance			-	1.84	-	nF
C_{rss}	Reverse transfer capacitance			-	0.176	-	nF
Q_G	Total gate charge	V_{DD} =850V, I_D =800A, V_{GS} =-5/+18V		-	1520	-	nC
$t_{d(on)}$	Turn-on delay time	V_{DD} =600V I_D =800A V_{GS}=+15/-4V $R_{G(ON)}$ =5Ω $R_{G(OFF)}$ =5Ω Inductive load switching operation	T_j =25°C	-	160	-	ns
			T_j =150°C	-	140	-	
t_r	Rise time		T_j =25°C	-	125	-	ns
			T_j =150°C	-	110	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	340	-	ns
			T_j =150°C	-	385	-	
t_f	Fall time		T_j =25°C	-	85	-	ns
			T_j =150°C	-	100	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	42.9	-	mJ
			T_j =150°C	-	35.8	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	50.8	-	mJ
			T_j =150°C	-	51.2	-	
$R_{th(j-f)}$	FET Thermal Resistance	Junction to cooling fluid ΔV/Δt =10dm³/min, T_f =65°C		-	0.078	-	K/W

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Body Diode Electrical characteristics (T$_j$ =25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value Min.	Value Typ.	Value Max	Unit
V_{SD}	Body Diode Forward Voltage	V_{GS} =-4V	T_j =25°C	3.9	4.9	5.6	V
		I_{SD} =800A	T_j =175°C	3.1	4.2	5.2	
T_{rr}	Reverse recovery time	V_{DD} =600V	T_j =25°C	-	40	-	ns
		I_D =800A	T_j =150°C	-	57	-	
Q_{rr}	Reverse recovery charge	V_{GS} =+15/-4V	T_j =25°C	-	2.83	-	uC
		$R_{G(ON)}$ =$R_{G(OFF)}$ =5Ω	T_j =150°C	-	7.31	-	
E_{rr}	Diode switching power dissipation	Inductive load	T_j =25°C	-	0.57	-	mJ
		switching operation	T_j =150°C	-	1.81	-	

Test Conditions

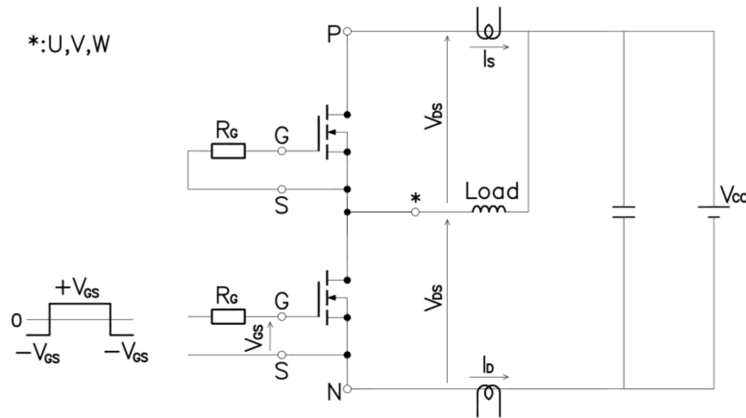

Figure 3. Switching time measure circuit

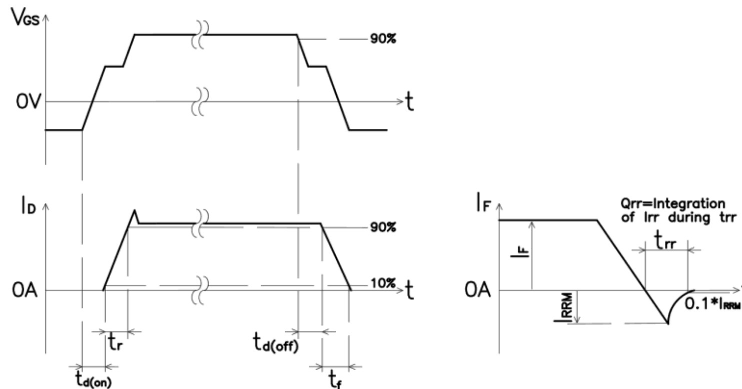

Figure 4. Switching time definition

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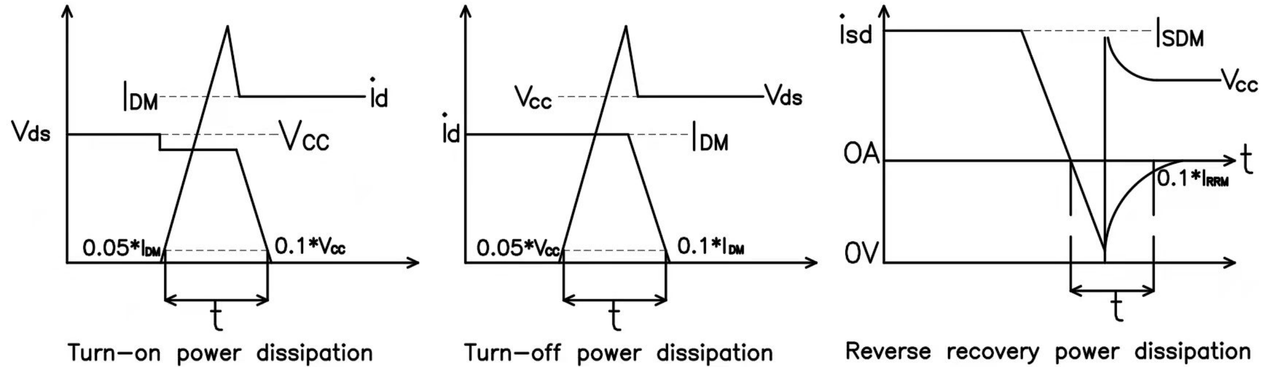

Figure 5. Switching power dissipation definition

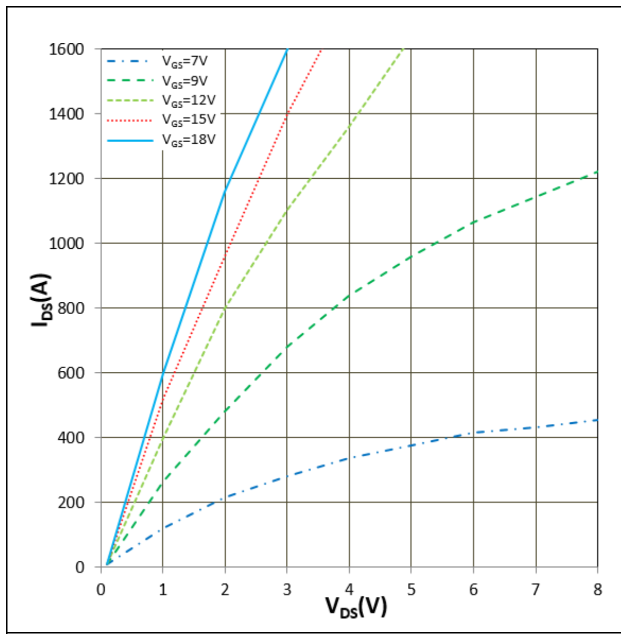

Figure 6. I_{DS} vs V_{DS}
T_j =25°C, V_{GS} parameter

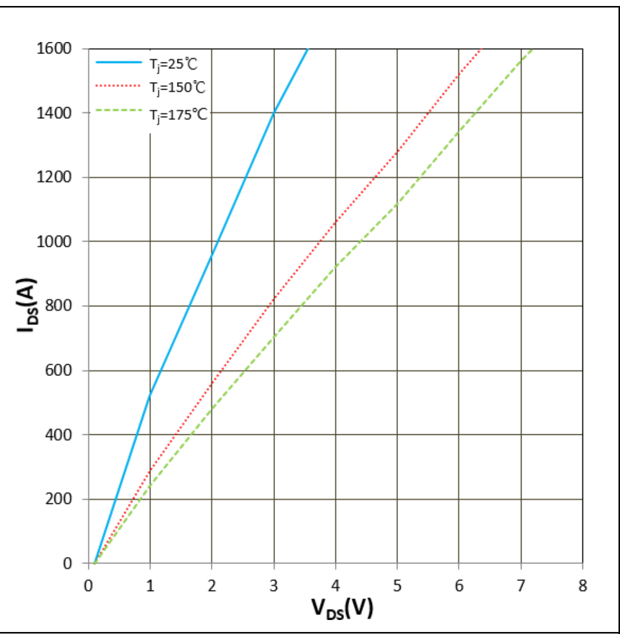

Figure 7. I_{DS} vs V_{DS}
V_{GS} =15V, T_j parameter

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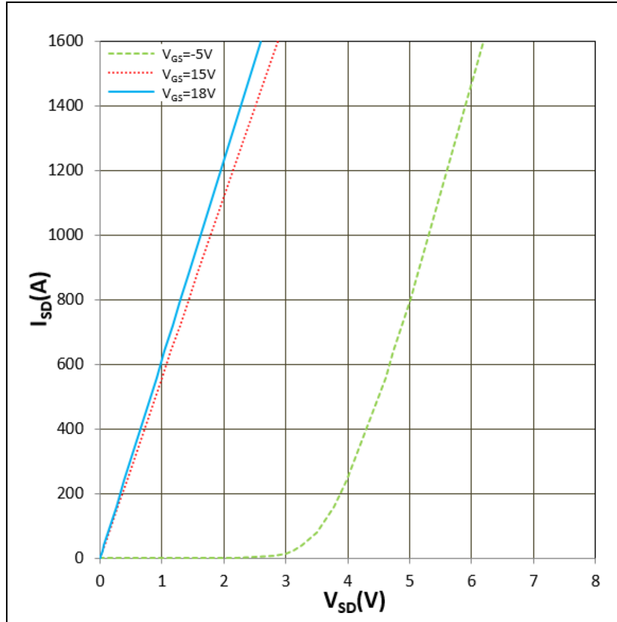

Figure 8. I_{SD} vs V_{SD}
T_j =25°C, V_{GS} parameter

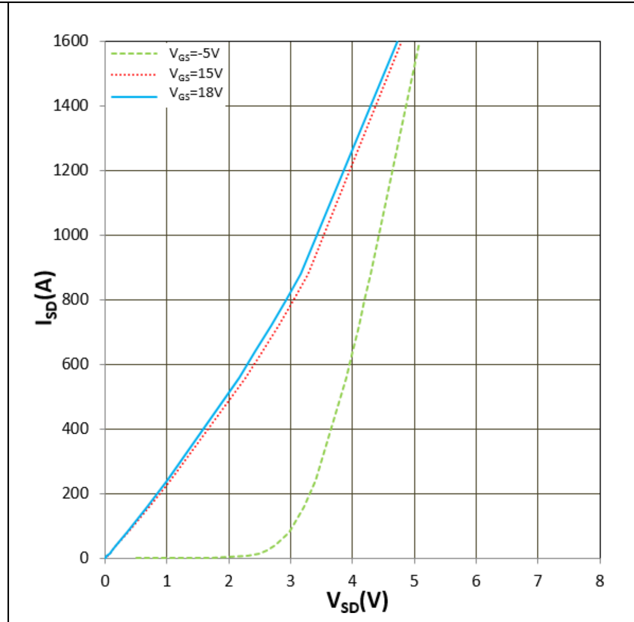

Figure 9. I_{SD} vs V_{SD}
T_j =175°C, V_{GS} parameter

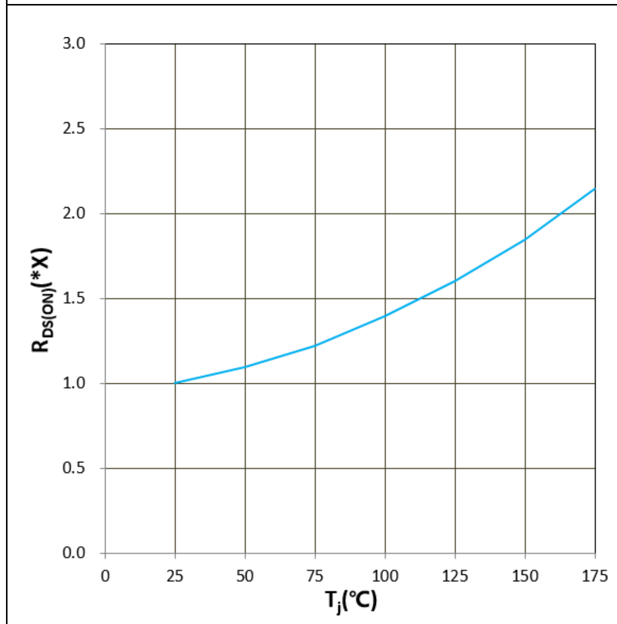

Figure 10. $R_{DS(ON)}$ vs T_j
V_{GS} =+15V, I_D =800A, 1.0x =2.0mΩ

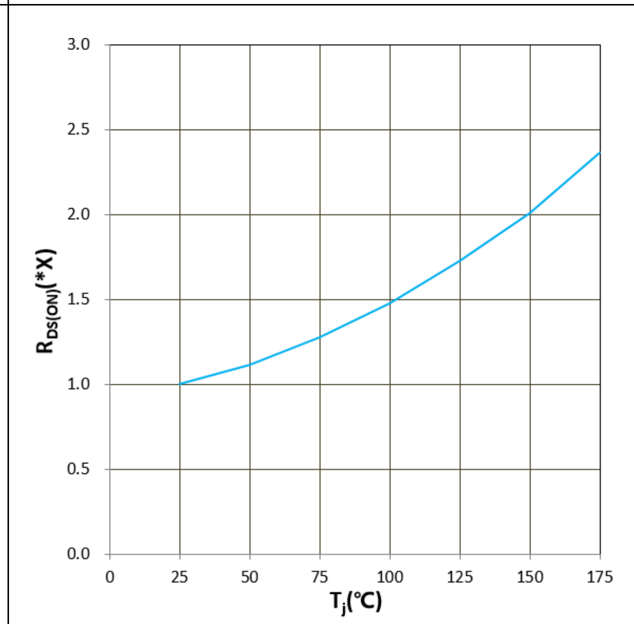

Figure 11. $R_{DS(ON)}$ vs T_j
V_{GS} =+18V, I_D =800A, 1.0x =1.7mΩ

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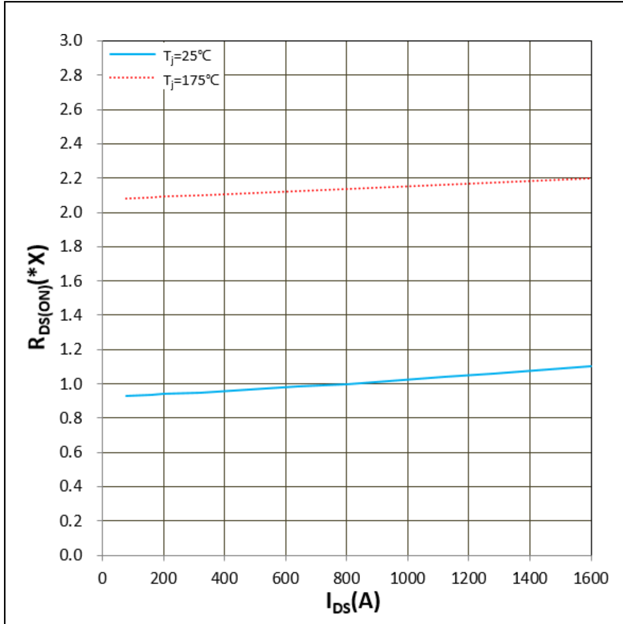

Figure 12. $R_{DS(ON)}$ vs I_{DS}
V_{GS} =+15V, 1.0x =2.0mΩ

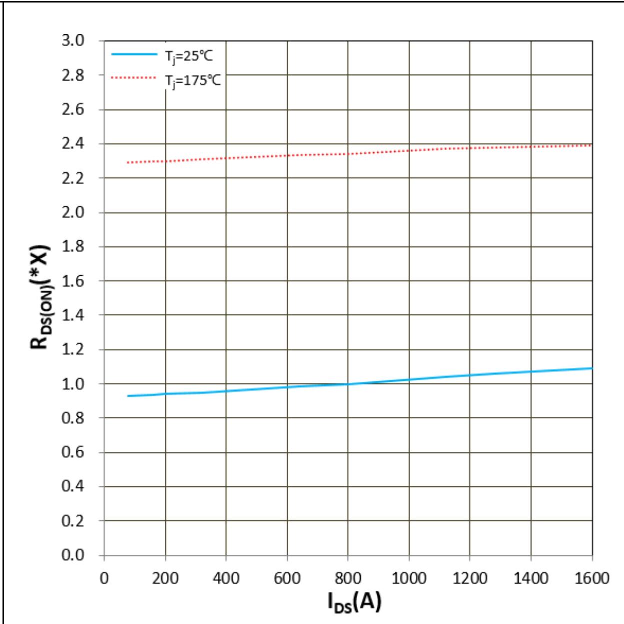

Figure 13. $R_{DS(ON)}$ vs I_{DS}
V_{GS} =+18V, 1.0x =1.7mΩ

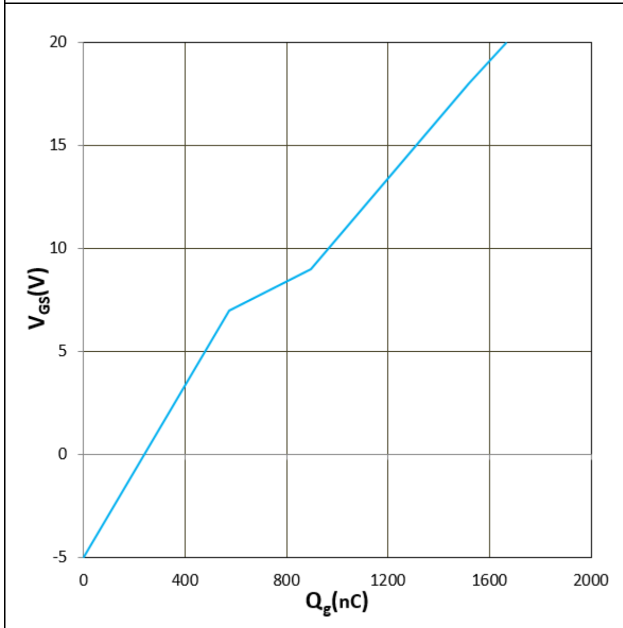

Figure 14. V_{GS} vs Q_g
T_j =25°C, I_{GS} =8mA

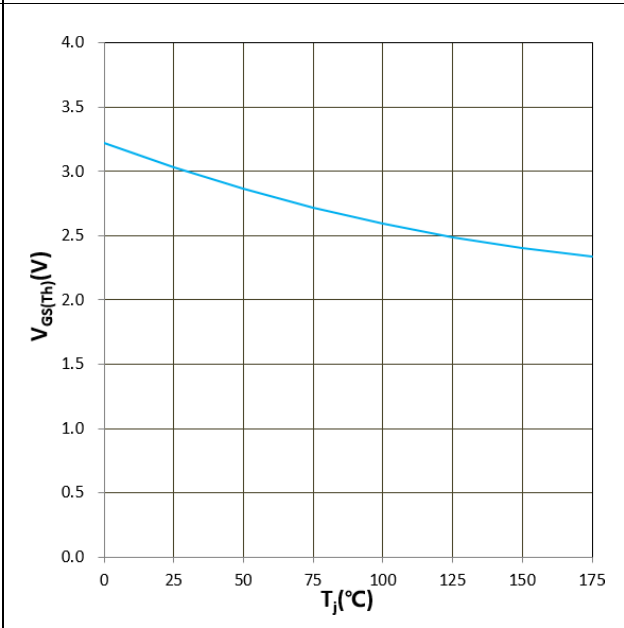

Figure 15. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS}, I_D =80mA

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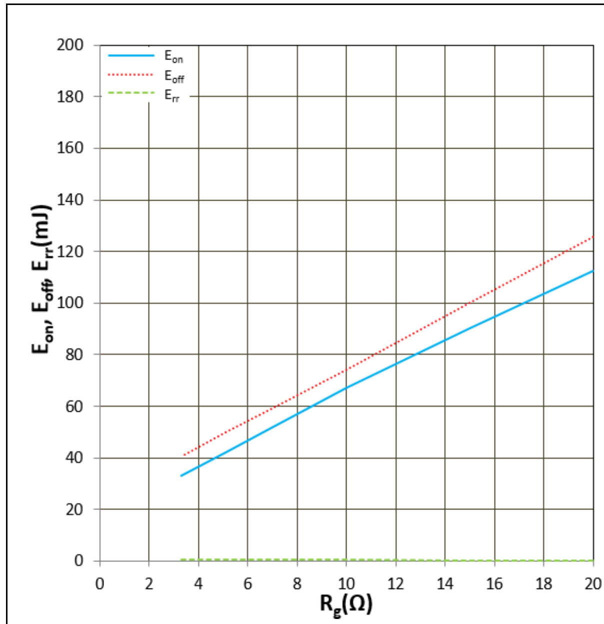

Figure 16. E_{on}, E_{off}, E_{rr} vs R_g
T_j =25°C, V_{CC} =600V, I_D =800A, V_{GS} =+15V/-4V
Inductive Load

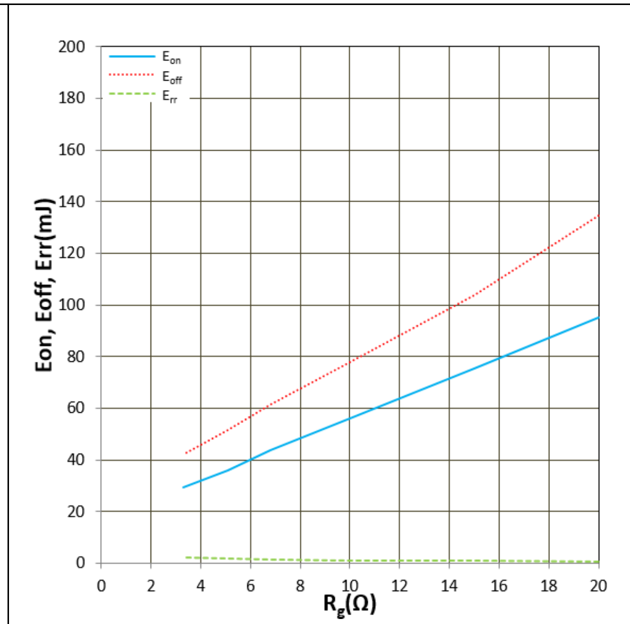

Figure 17. E_{on}, E_{off} , E_{rr} vs R_g
T_j =150°C, V_{CC} =600V, I_D =800A, V_{GS} =+15V/-4V
Inductive Load

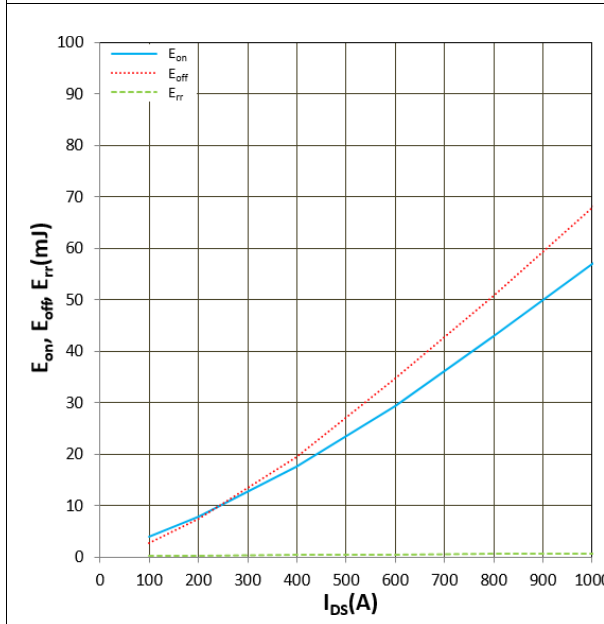

Figure 18. E_{on}, E_{off} , E_{rr} vs I_{DS}
T_j =25°C, V_{CC} =600V, R_G =5Ω, V_{GS} =+15V/-4V
Inductive Load

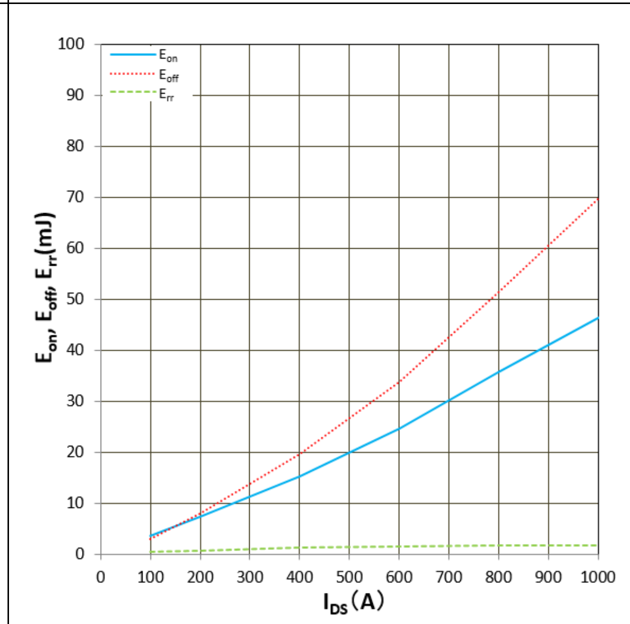

Figure 19. E_{on}, E_{off} , E_{rr} vs I_{DS}
T_j =150°C, V_{CC} =600V, R_G =5Ω, V_{GS} =+15V/-4V
Inductive Load

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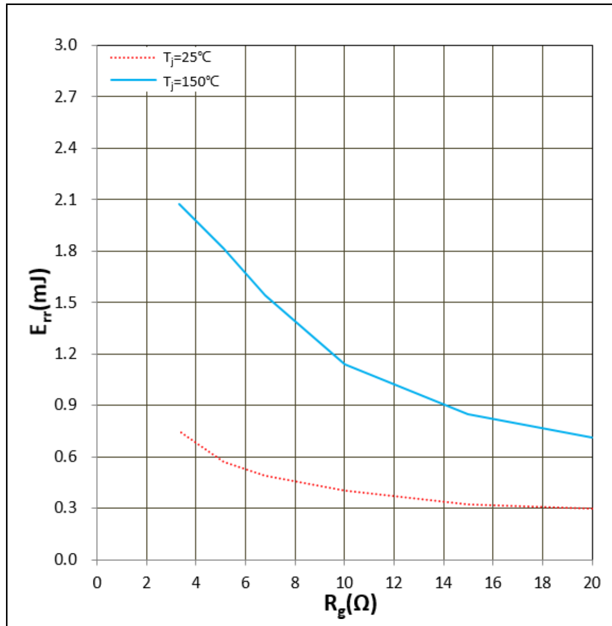
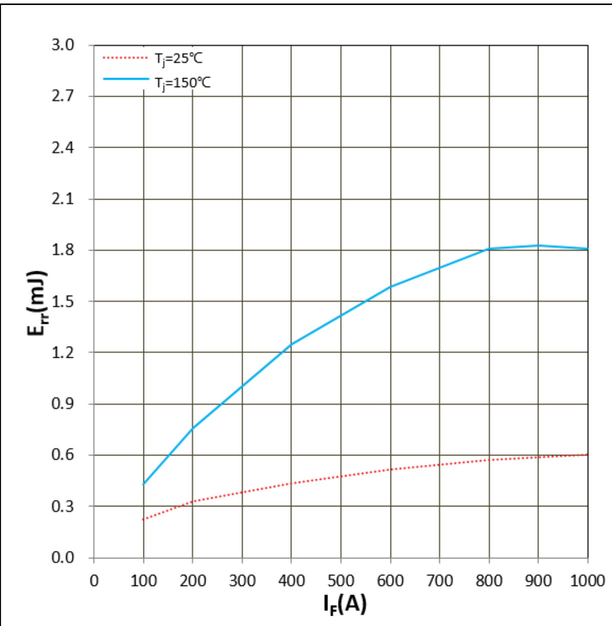
<tr><td>
</td><td>
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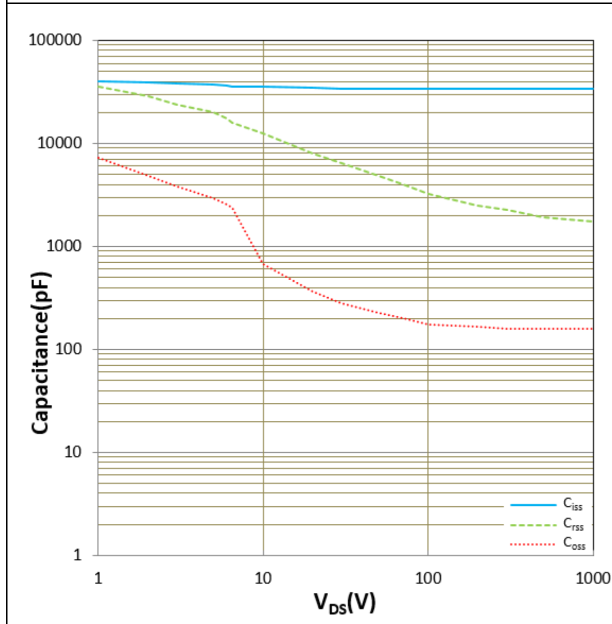
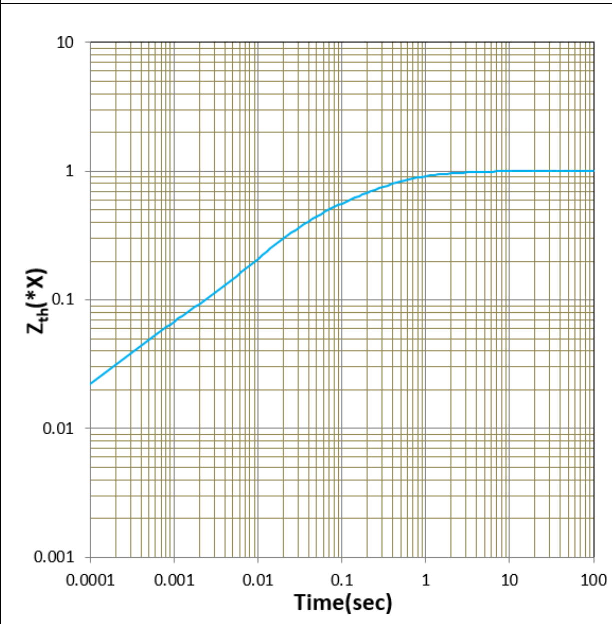
<tr><td>Figure 20. E_{rr} vs R_G
V_{DD} =600V, I_F =800A, V_{GS} =+15V/-4V
Inductive Load</td><td>Figure 21. E_{rr} vs I_F
V_{DD} =600V, R_G =5Ω, V_{GS} =+15V/-4V
Inductive Load</td></tr>
<tr><td>
</td><td>
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<tr><td>Figure 22. C_{iss},C_{oss},C_{rss} vs V_{DS}
T_j =25℃</td><td>Figure 23. Transient themal impedance
1.0x =0.078K/W</td></tr>
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