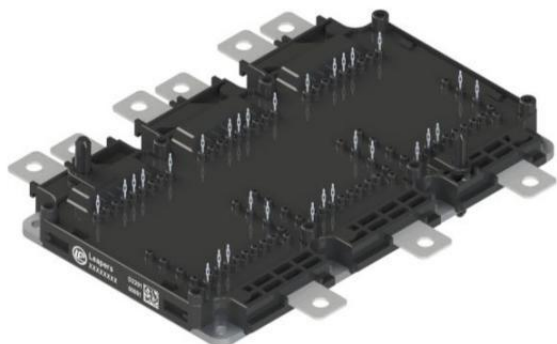


Description

The DFS03FB14HDA1S is a 3 Phase SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips for xEV or motor drives application.



Features

- Blocking voltage 1400V
- $R_{DS(on)} = 3.2m\Omega$ ($T_j = 25^\circ C$)
- $175^\circ C$ 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

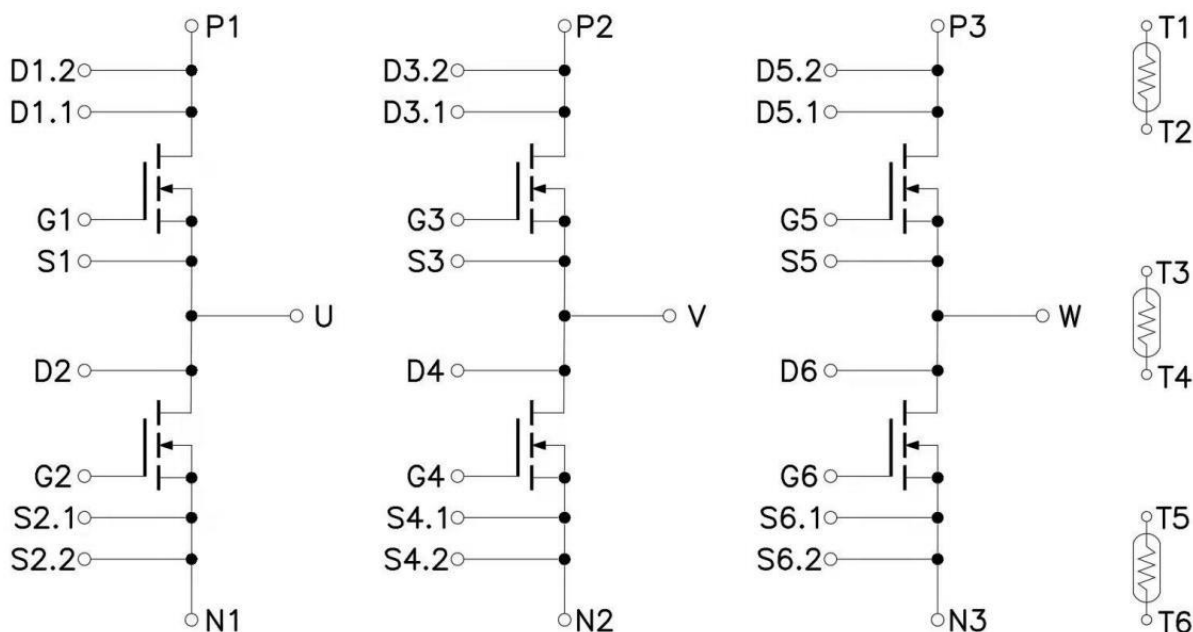


Figure 1. Out drawing & circuit diagram for DFS03FB14HDA1S

Physical Dimensions

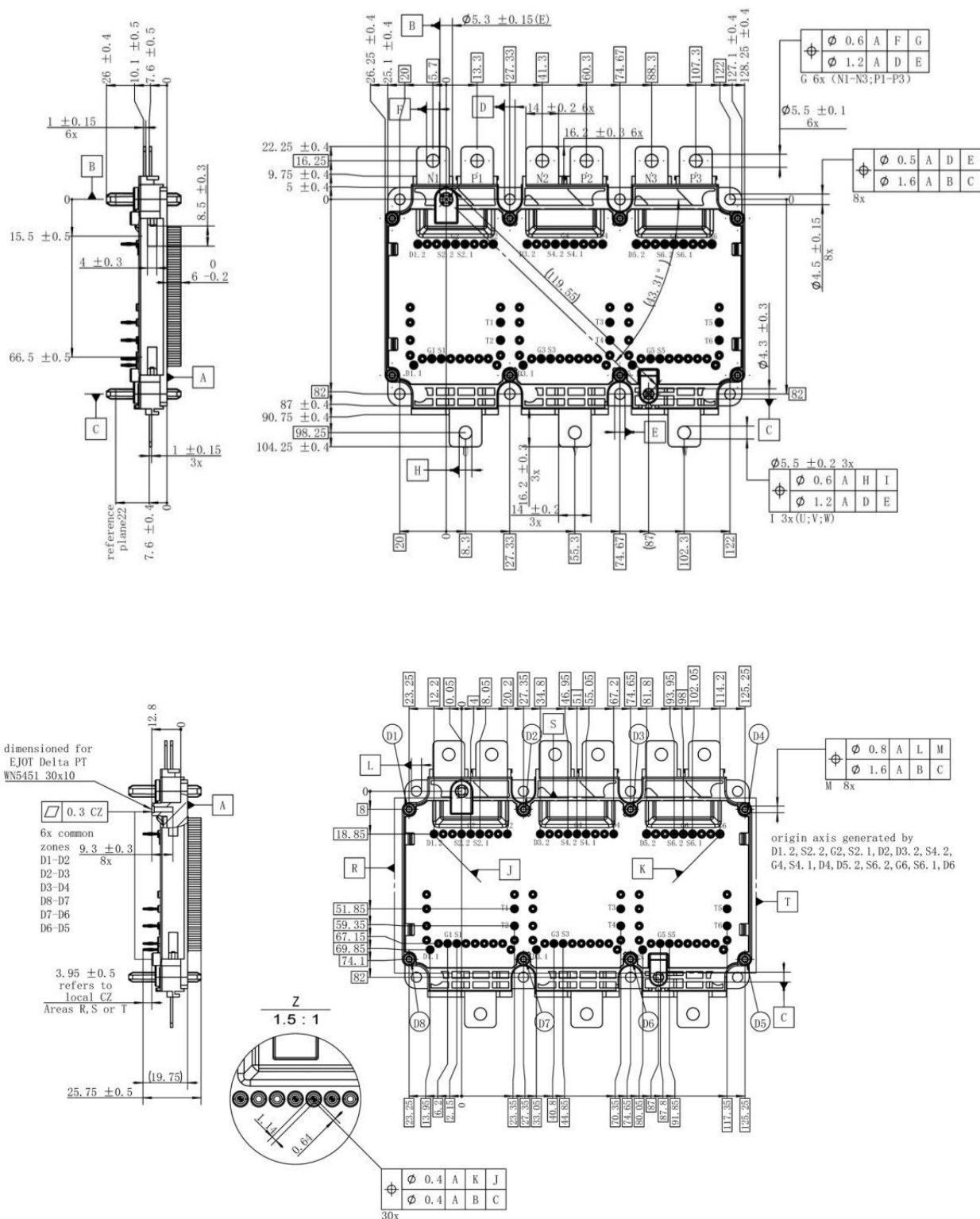


Figure2. Physical Dimensions

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

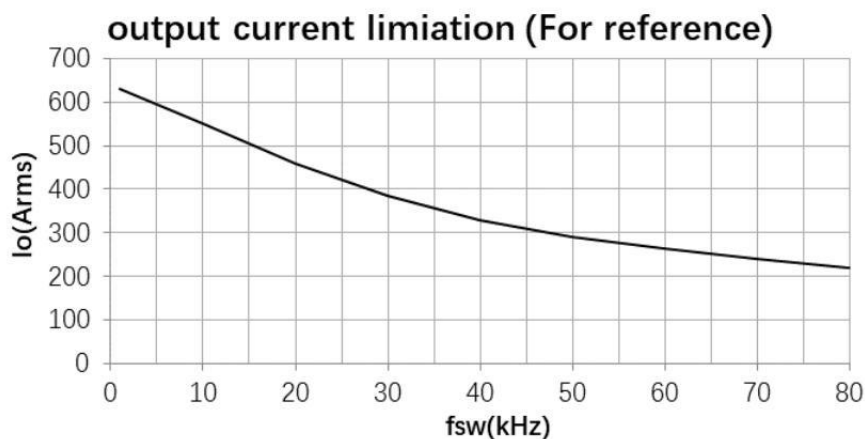
Symbol	Parameter	Condition	Ratings	Unit
V_{DS}	Drain-Source Voltage	G-S Short	1400	V
$V_{DS\text{ nom}}$	Continuous Operating DC Voltage	Not include surge voltage	1200	V
V_{GS}	Gate-Source Voltage	D-S Short, AC frequency $\geq 1\text{Hz}$, Note1	-10V/+25V	V
I_{DS}	DC Continuous Drain Current	$T_f = 25^\circ\text{C}$, $V_{GS} = 20\text{V}$	530	A
I_{DS}	DC Continuous Drain Current	$T_f = 65^\circ\text{C}$, $V_{GS} = 20\text{V}$	460	A
I_{SD}	Source (Body Diode) Current	$T_f = 25^\circ\text{C}$, with ON signal	530	A
I_{SD}	Source (Body Diode) Current	$T_f = 65^\circ\text{C}$, with ON signal	460	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	1200	A
P_D	Maximum Power Dissipation	$T_f = 25^\circ\text{C}$	1785	W
T_j	Operating Junction temperature	-	-40 to 175	$^\circ\text{C}$
T_{stg}	Storage temperature	-	-40 to 125	$^\circ\text{C}$

Note1: Recommended Operating Value, +20V/-5V, +18V/-4V, +15V/-4V

Note2: Pulse width limited by maximum junction temperature

Typical current output ability

Condition: SPWM control, $V_{DD} = 800\text{V}$, $R_{G(on)} = R_{G(off)} = 5.0\Omega$, $T_f = 65^\circ\text{C}$, $T_{jmax} = 175^\circ\text{C}$, PF = 0.8, Modulation rate = 1



Note1: This graph is calculated value for reference based on the limitation of $T_{jmax} = 175^{\circ}\text{C}$. 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	Condition	Value	Unit
Isolation voltage	Main terminal to base plate, f=0Hz, t=1sec	4.0	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 R ₁₀₀	T _c =100°C, R ₁₀₀ =493Ω	-5	-	5	%
P ₂₅	Power dissipation	T _c =25°C	-	-	20	mW
B _{25/50}	B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3375	-	K
B _{25/80}	B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3411	-	K
B _{25/100}	B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3433	-	K

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MOSFET Electrical characteristics ($T_j = 25^\circ\text{C}$ unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V _{(BR)DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _D =600μA		1400	-	-	V
I _{DSS}	Zero gate voltage drain current	V _{DS} =1400V, V _{GS} =0V		-	60	-	μA
V _{GS(th)}	Gate-source threshold Voltage	I _D =120mA V _{DS} =V _{GS}	T _j =25°C	1.9	2.5	4.0	V
			T _j =175°C	-	1.6	-	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =20V, V _{DS} =0V, T _j =25°C		-	-	1200	nA
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =600A V _{GS} =20V	T _j =25°C	-	3.2	-	mΩ
			T _j =175°C	-	6.2	-	
		I _D =600A V _{GS} =18V	T _j =25°C	-	3.5	-	
			T _j =175°C	-	6.5	-	
V _{DS(on)} (Chip)	Static drain-source On-state voltage	I _D =600A V _{GS} =20V	T _j =25°C	-	1.9	-	V
			T _j =175°C	-	3.7	-	
		I _D =600A V _{GS} =18V	T _j =25°C	-	2.1	-	
			T _j =175°C	-	3.9	-	
C _{iss}	Input capacitance	V _D =1000V, V _{GS} =0V f =100kHz		-	28.62	-	nF
C _{oss}	Output capacitance			-	1.30	-	nF
C _{rss}	Reverse transfer capacitance			-	0.10	-	nF
Q _G	Total gate charge	V _{DD} =800V, I _D =300A, V _{GS} =+20/-5V		-	1620	-	nC
Q _{GS}	Gate to source charge			-	372	-	nC
Q _{GD}	Gate to drain charge			-	468	-	nC
R _{Gint}	Internal Gate Resistance	T _j =25°C		-	1.5	-	Ω
t _{d(on)}	Turn-on delay time	V _{DD} =800V	T _j =25°C	-	71	-	ns
			T _j =150°C	-	63	-	
t _r	Rise time		T _j =25°C	-	59	-	ns
			T _j =150°C	-	48	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	48	-	ns

		$I_D = 600A$	$T_J = 150^{\circ}C$	-	63	-	
t_f	Fall time	$V_{GS} = +18/-4V$	$T_J = 25^{\circ}C$	-	30	-	ns
		$R_{G(on)} = 3.3\Omega$	$T_J = 150^{\circ}C$	-	41	-	
		$R_{G(off)} = 3.3\Omega$					
E_{on}	Turn-on power dissipation	Inductive load switching operation	$T_J = 25^{\circ}C$	-	16.2	-	mJ
			$T_J = 150^{\circ}C$	-	22.9	-	
E_{off}	Turn-off power dissipation		$T_J = 25^{\circ}C$	-	4.4	-	mJ
			$T_J = 150^{\circ}C$	-	7.1	-	
$R_{th(j-f)}$	FET Thermal Resistance	Junction to cooling fluid $\Delta V/\Delta t = 10dm^3/min, T_f = 65^{\circ}C$		-	0.084	-	K/W

Body Diode Electrical characteristics ($T_j=25^\circ\text{C}$ unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_{SD}	Body Diode Forward Voltage	$V_{GS} = -5\text{V}$ $I_{SD} = 600\text{A}$	$T_j = 25^\circ\text{C}$	-	5.8	-	V
			$T_j = 175^\circ\text{C}$	-	5.2	-	
T_{rr}	Reverse recovery time	$V_{RR} = 800\text{V}$, $I_D = 600\text{A}$ MOSFET side: $V_{GS} = +18/-4\text{V}$	$T_j = 25^\circ\text{C}$	-	44	-	ns
			$T_j = 150^\circ\text{C}$	-	51	-	
Q_{rr}	Reverse recovery charge	$R_{G(on)} = R_{G(off)} = 3.3\Omega$ Inductive load switching operation	$T_j = 25^\circ\text{C}$	-	3.4	-	μC
			$T_j = 150^\circ\text{C}$	-	7.3	-	
E_{rr}	Diode switching power dissipation	switching operation	$T_j = 25^\circ\text{C}$	-	0.9	-	mJ
			$T_j = 150^\circ\text{C}$	-	2.8	-	

Test Conditions

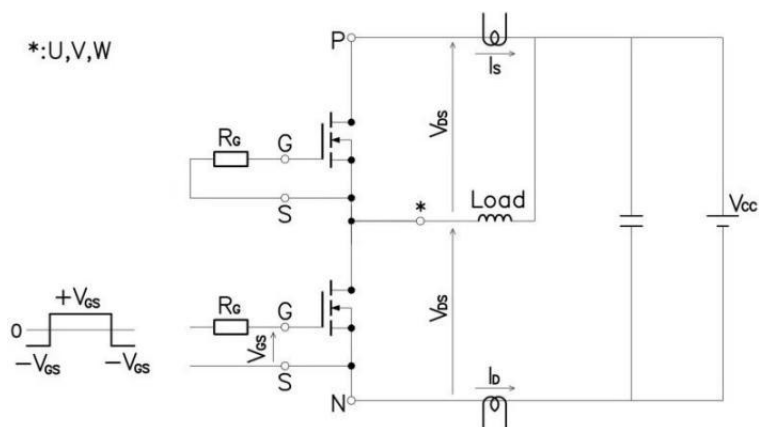


Figure 3. Switching time measure circuit

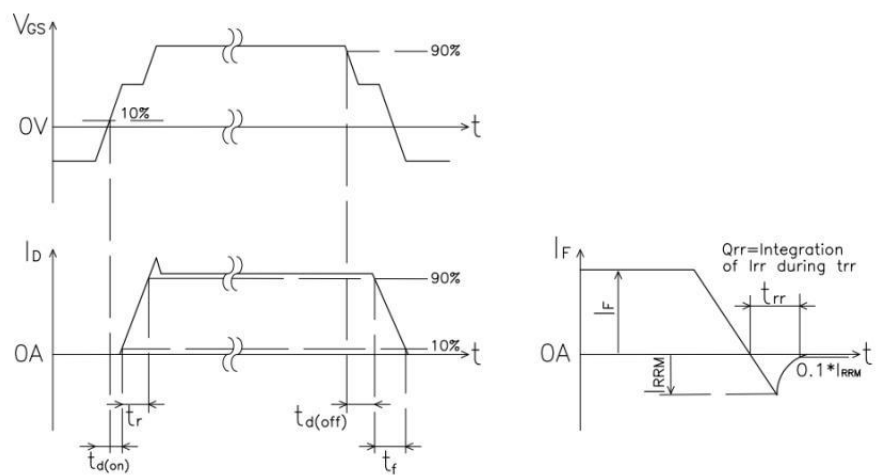


Figure 4. Switching time definition

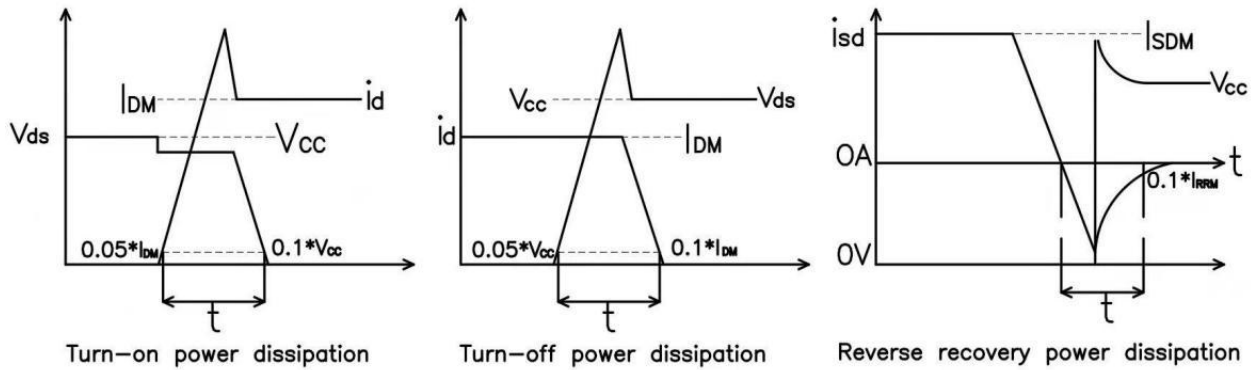


Figure 5. Switching power dissipation definition

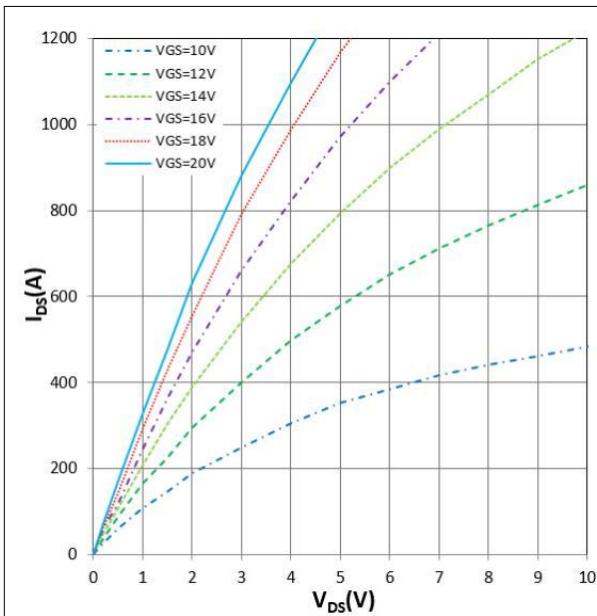


Figure 6. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

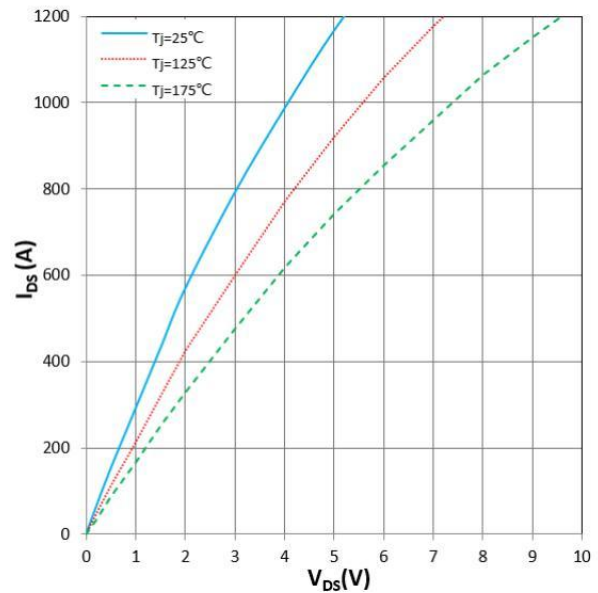


Figure 7. I_{DS} vs V_{DS}
 $V_{GS} = 18\text{V}$, T_j parameter

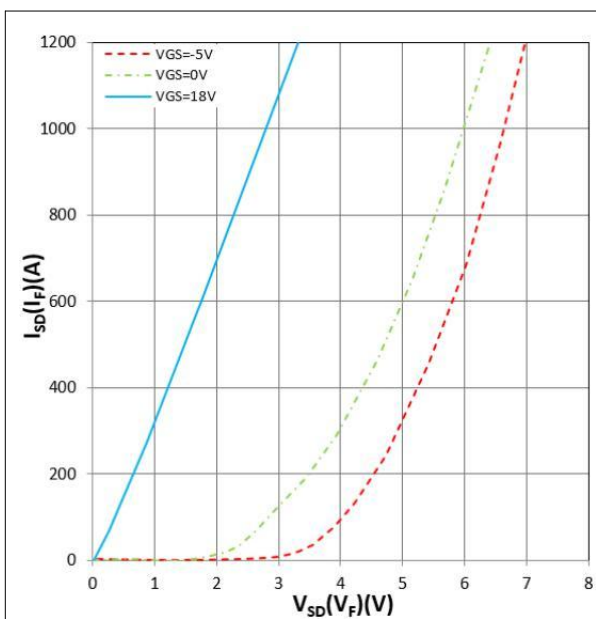


Figure 8. I_{SD} vs V_{SD}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

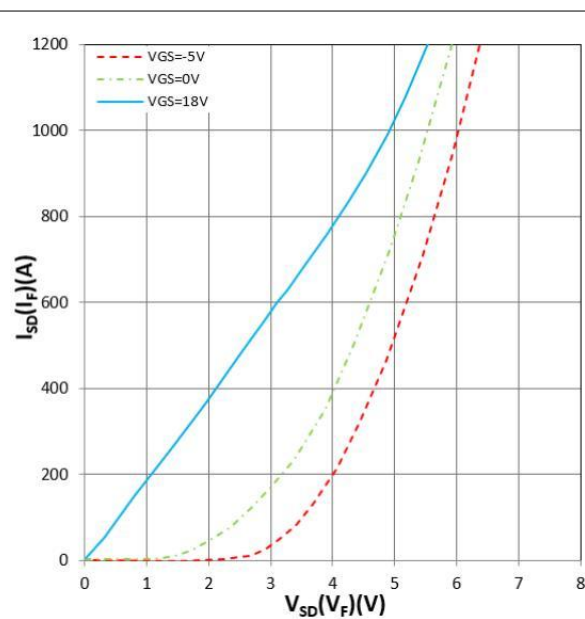


Figure 9. I_{SD} vs V_{SD}
 $T_j = 175^\circ\text{C}$, V_{GS} parameter

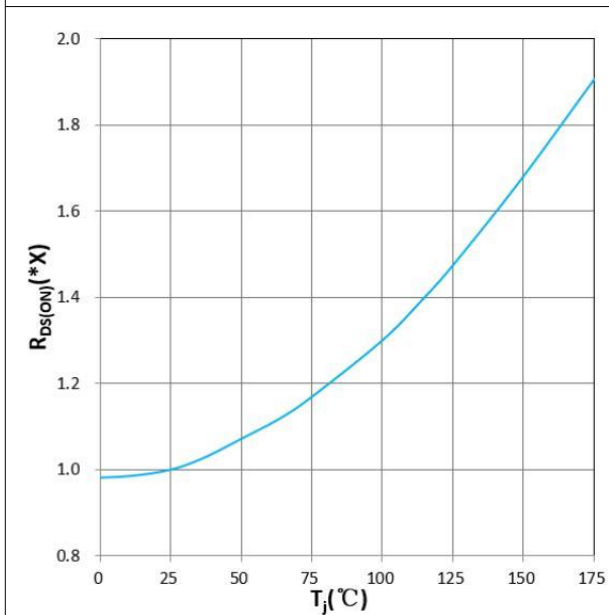


Figure 10. $R_{DS(ON)}$ vs T_j
 $V_{GS} = +20\text{V}$, $I_D = 600\text{A}$, $1.0X = 3.2\text{m}\Omega$

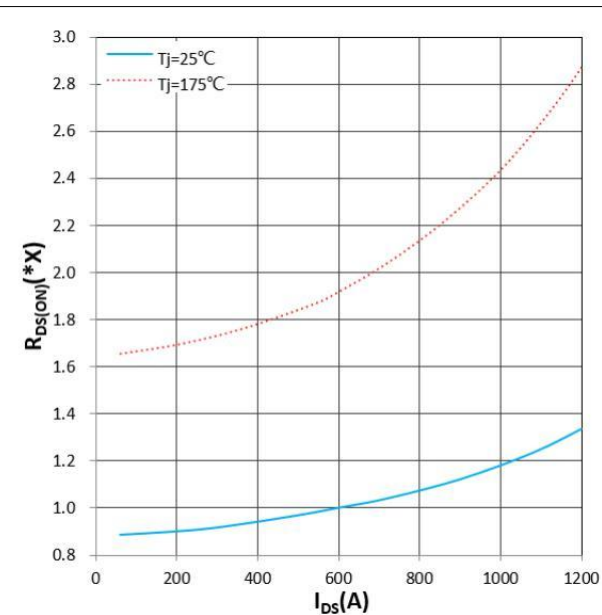


Figure 11. $R_{DS(ON)}$ vs I_{DS}
 $T_j = 25^\circ\text{C}/175^\circ\text{C}$, $V_{GS} = +20\text{V}$, $1.0X = 3.2\text{m}\Omega$

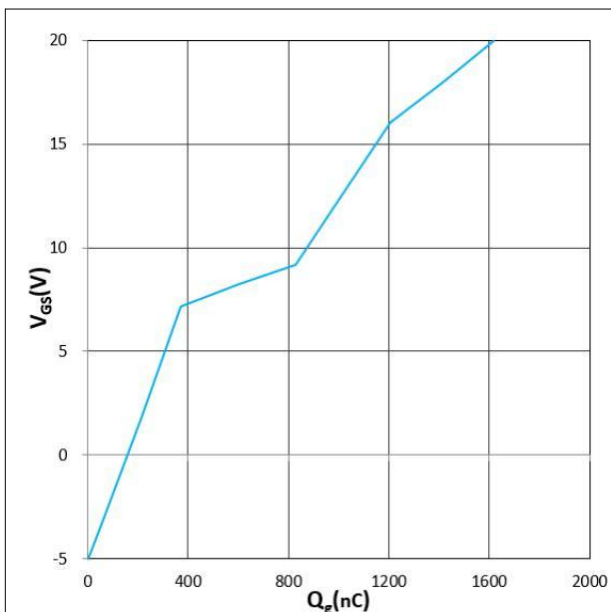


Figure 12. V_{GS} vs Q_g
 $T_j = 25^\circ\text{C}$, $V_{DS} = 800\text{V}$, $I_D = 300\text{A}$

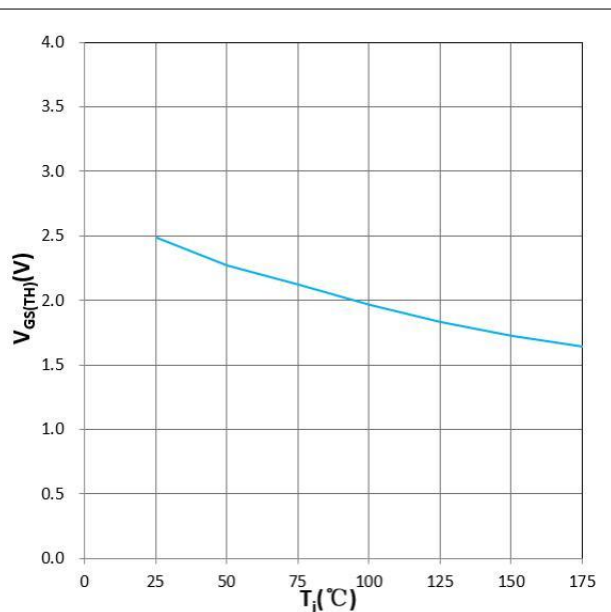


Figure 13. $V_{GS(TH)}$ vs T_j
 $V_{GS} = V_{DS}$, $I_D = 120\text{mA}$

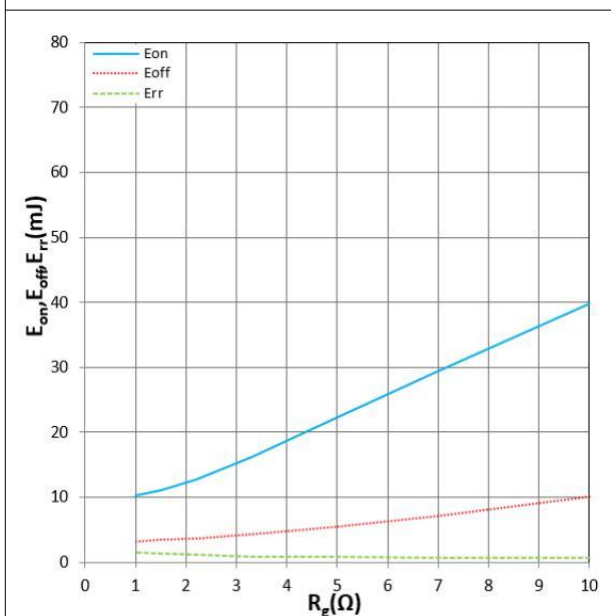


Figure 14. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 25^\circ\text{C}$, $V_{DD} = 800\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$, $I_D = 600\text{A}$
 Inductive Load

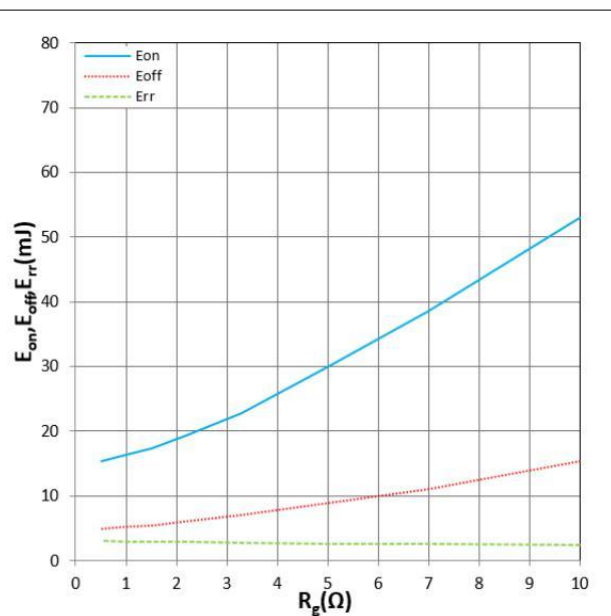


Figure 15. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $V_{DD} = 800\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$, $I_D = 600\text{A}$
 Inductive Load

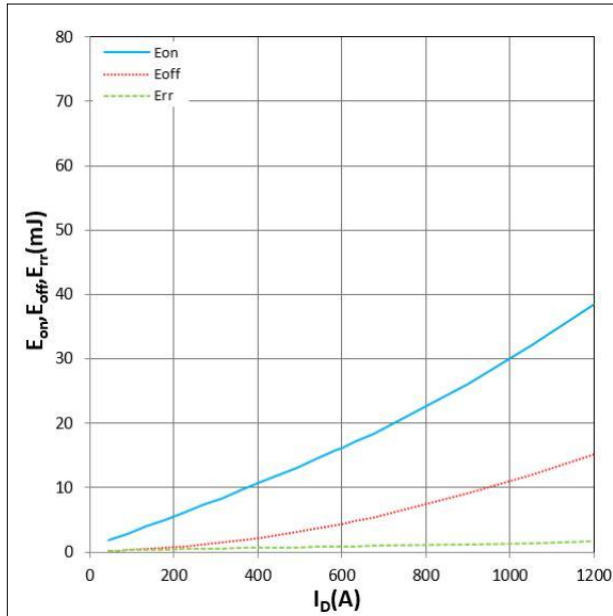


Figure 16. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=25^\circ\text{C}$, $V_{DD}=800\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $R_g=3.3\Omega$
 Inductive Load

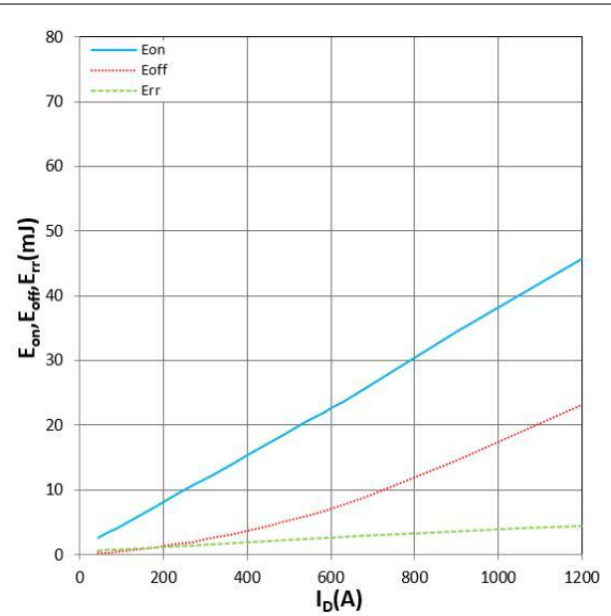


Figure 17. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=150^\circ\text{C}$, $V_{DD}=800\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $R_g=3.3\Omega$
 Inductive Load

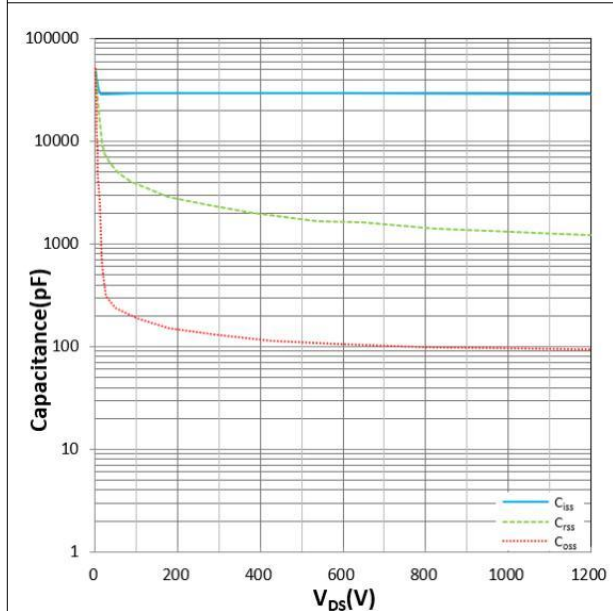


Figure 18. C_{iss} , C_{oss} , C_{rss} vs V_{DS}
 $V_{GS}=0\text{V}$, $f=100\text{kHz}$

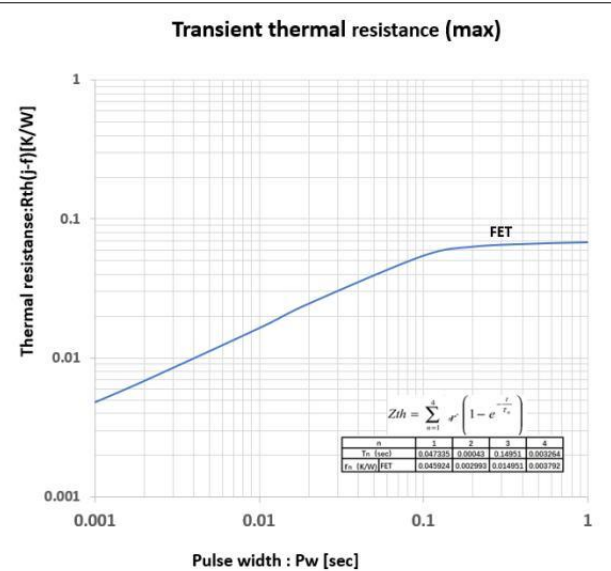


Figure 19. Transient thermal resistance

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