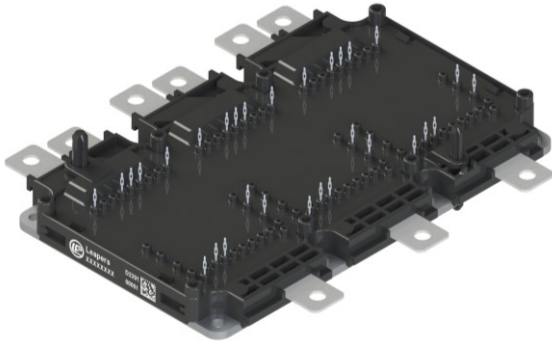


### Description

The DFS02FB12HDA1S 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
- $R_{DS(on)} = 2.5m\Omega$  ( $V_{GS} = 18V, T_j = 25^\circ C$ )
- 175°C maximum junction temperature
- Si<sub>3</sub>N<sub>4</sub> AMB substrate
- Direct Cooled Pin Fin Base Plate
- Thermistor inside
- Press FIT Contact Technology

### Applications

- xEV Applications
- Motor Drives

### Circuit diagram

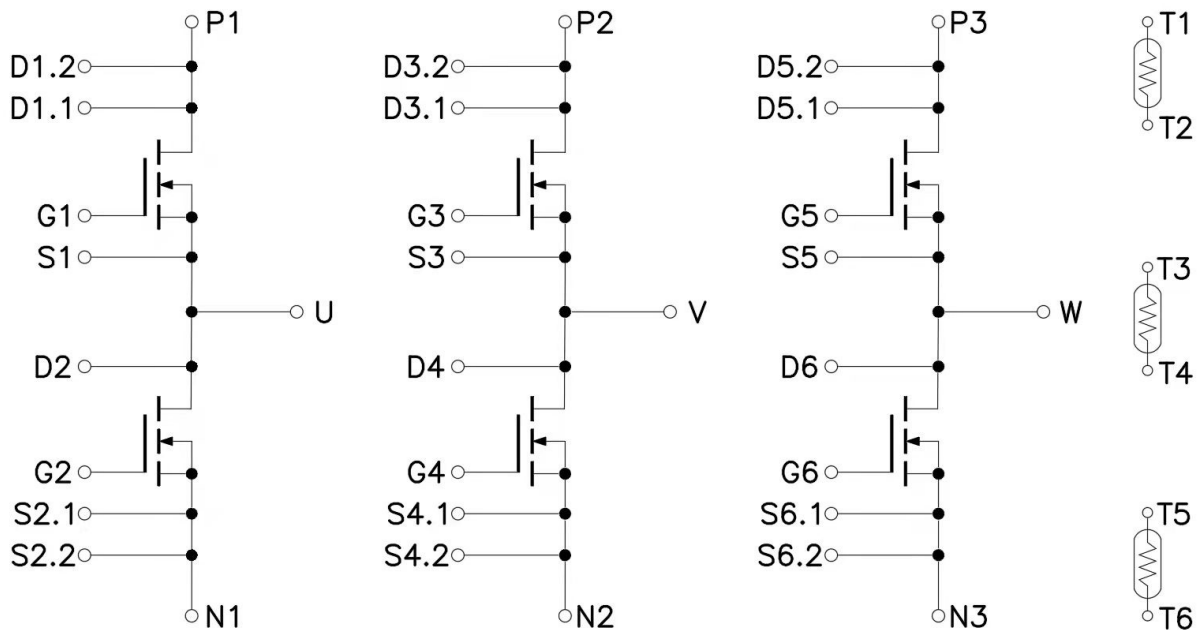


Figure 1. Out drawing & circuit diagram for DFS02FB12HDA1S



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

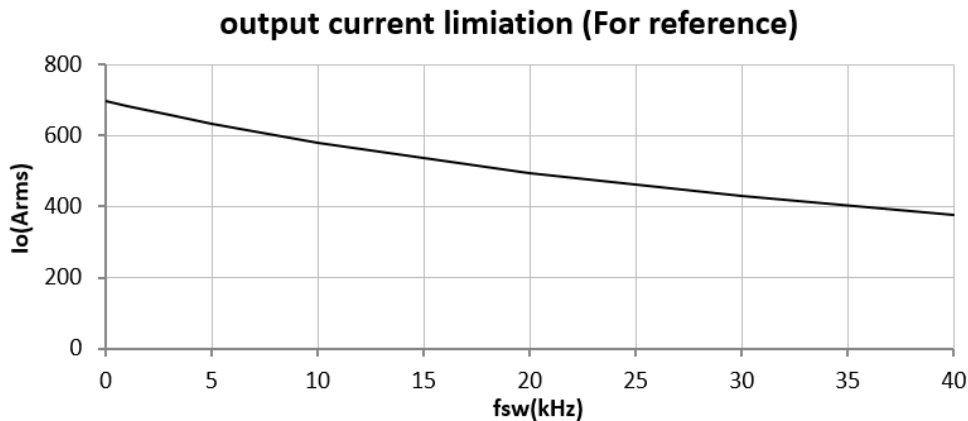
Symbol	Parameter	Conditions	Ratings	Unit
$V_{DSS}$	Drain-Source Voltage	G-S Short	1200	V
$V_{GSS}$	Gate-Source Voltage	D-S Short, AC frequency $\geq 1\text{Hz}$ , Note1	-10V/+23V	V
$I_{DS}$	DC Continuous Drain Current	$T_f=25^\circ\text{C}$ , $V_{GS}=18\text{V}$	590	A
$I_{DS}$	DC Continuous Drain Current	$T_f=65^\circ\text{C}$ , $V_{GS}=18\text{V}$	505	A
$I_{SD}$	Source (Body Diode) Current	$T_f=25^\circ\text{C}$ , with ON signal	590	A
$I_{SD}$	Source (Body Diode) Current	$T_f=65^\circ\text{C}$ , with ON signal	505	A
$I_{DP}$	Drain Pulse Current, Peak	Less than 1ms, Note2	1200	A
$P_D$	Maximum Power Dissipation	$T_f=25^\circ\text{C}$	1667	W
$T_j$	junction temperature	-	-40 to 175	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-	-40 to 125	$^\circ\text{C}$

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

Note2: Pulse width limited by maximum junction temperature

### Typical current output ability

Condition: SPWM control,  $V_{CC}=800\text{V}$ ,  $V_{GS}=+18/-4\text{V}$ ,  $R_{g(ON)}=R_{g(OFF)}=6.2\Omega$ ,  $T_f=65^\circ\text{C}$ ,  $T_{jmax}=175^\circ\text{C}$ , 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.

### 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	$T_f = 65^\circ\text{C}$	8	nH
Module lead resistance, terminals – chip	$T_f = 65^\circ\text{C}$	0.5	m $\Omega$
Mounting torque for module mounting	Screw M4 baseplate to heatsink	1.8 to 2.2	Nm
Weight	-	780	g

### NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Resistance	$T_c = 25^\circ\text{C}$	-	5	-	k $\Omega$
$\Delta R/R$	Deviation of R100	$T_c = 100^\circ\text{C}$ , R <sub>100</sub> =493 $\Omega$	-5	-	5	%
P <sub>25</sub>	Power dissipation	$T_c = 25^\circ\text{C}$	-	-	20	mW
B <sub>25/50</sub>	B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3375	-	K
B <sub>25/80</sub>	B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3411	-	K
B <sub>25/100</sub>	B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3433	-	K

### MOSFET Electrical characteristics (T<sub>j</sub> = 25°C unless otherwise specified, chip)

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max.		
V <sub>(BR)DSS</sub>	Drain-Source Breakdown Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 6mA	1200	-	-	V	
I <sub>DSS</sub>	Zero gate voltage drain current	V <sub>DS</sub> = 1200V, V <sub>GS</sub> = 0V	-	6	300	μA	
V <sub>GS(Th)</sub>	Gate-source threshold voltage	I <sub>D</sub> = 162mA V <sub>DS</sub> = V <sub>GS</sub>	T <sub>j</sub> = 25°C	2.0	2.8	3.7	V
			T <sub>j</sub> = 150°C	-	2.1	-	V
			T <sub>j</sub> = 175°C	-	2.0	-	V
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> = 18V, V <sub>DS</sub> = 0V	-	6	-1200	nA	
		V <sub>GS</sub> = -4V, V <sub>DS</sub> = 0V	-1200	-6	0	nA	
R <sub>DS(on)</sub> (Chip)	Static drain-source On-state resistance	I <sub>D</sub> = 600A V <sub>GS</sub> = 18V	T <sub>j</sub> = 25°C	-	2.5	-	mΩ
			T <sub>j</sub> = 150°C	-	4.1	-	mΩ
			T <sub>j</sub> = 175°C	-	4.7	-	mΩ
V <sub>DS(on)</sub> (Chip)	Static drain-source On-state voltage	I <sub>D</sub> = 600A V <sub>GS</sub> = 18V	T <sub>j</sub> = 25°C	-	1.50	-	V
			T <sub>j</sub> = 150°C	-	2.46	-	V
			T <sub>j</sub> = 175°C	-	2.82	-	V
C <sub>iss</sub>	Input capacitance	V <sub>DS</sub> = 1000V	-	25.8	-	nF	
C <sub>oss</sub>	Output capacitance	V <sub>GS</sub> = 0V	-	1.28	-	nF	
C <sub>rss</sub>	Reverse transfer capacitance	f = 100kHz	-	0.11	-	nF	
Q <sub>g</sub>	Total gate charge	V <sub>DS</sub> = 800V	-	1332	-	nC	
Q <sub>gs</sub>	Gate to source charge	I <sub>D</sub> = 480A	-	330	-	nC	
Q <sub>gd</sub>	Gate to drain charge	V <sub>GS</sub> = +18/-4V	-	528	-	nC	
R <sub>gint</sub>	Internal gate resistor	f = 1MHz	-	0.9	-	Ω	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>DD</sub> = 600V I <sub>D</sub> = 600A V <sub>GS</sub> = +18/-4V R <sub>G(ON)</sub> = 6.2Ω R <sub>G(OFF)</sub> = 6.2Ω Inductive load switching operation	T <sub>j</sub> = 25°C	-	131	-	ns
			T <sub>j</sub> = 150°C	-	110	-	
t <sub>r</sub>	Rise time		T <sub>j</sub> = 25°C	-	85	-	ns
			T <sub>j</sub> = 150°C	-	80	-	
t <sub>d(off)</sub>	Turn-off delay time		T <sub>j</sub> = 25°C	-	40	-	ns
			T <sub>j</sub> = 150°C	-	42	-	
t <sub>f</sub>	Fall time		T <sub>j</sub> = 25°C	-	58	-	ns
			T <sub>j</sub> = 150°C	-	64	-	
E <sub>on</sub>	Turn-on power dissipation		T <sub>j</sub> = 25°C	-	22.71	-	mJ
			T <sub>j</sub> = 150°C	-	31.22	-	
E <sub>off</sub>	Turn-off power dissipation		T <sub>j</sub> = 25°C	-	37.06	-	mJ
			T <sub>j</sub> = 150°C	-	38.31	-	
R <sub>th(j-f)</sub>	FET Thermal Resistance	Junction to cooling fluid ΔV/Δt = 10dm <sup>3</sup> /min, T <sub>r</sub> = 65°C	-	0.09	-	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	$V_{GS} = -4\text{V}$ $I_{SD} = 600\text{A}$	$T_j = 25^\circ\text{C}$	-	4.8	-	V
			$T_j = 175^\circ\text{C}$	-	4.2	-	
$T_{rr}$	Reverse recovery time	$V_{DD} = 600\text{V}$ $I_D = 600\text{A}$	$T_j = 25^\circ\text{C}$	-	32	-	ns
			$T_j = 150^\circ\text{C}$	-	47	-	
$Q_{rr}$	Reverse recovery charge	$V_{GS} = +18/-4\text{V}$ $R_{G(ON)} = R_{G(OFF)} = 6.2\Omega$	$T_j = 25^\circ\text{C}$	-	2.51	-	$\mu\text{C}$
			$T_j = 150^\circ\text{C}$	-	7.26	-	
$E_{rr}$	Diode switching power dissipation	Inductive load switching operation	$T_j = 25^\circ\text{C}$	-	0.57	-	mJ
			$T_j = 150^\circ\text{C}$	-	1.51	-	

### Test Conditions

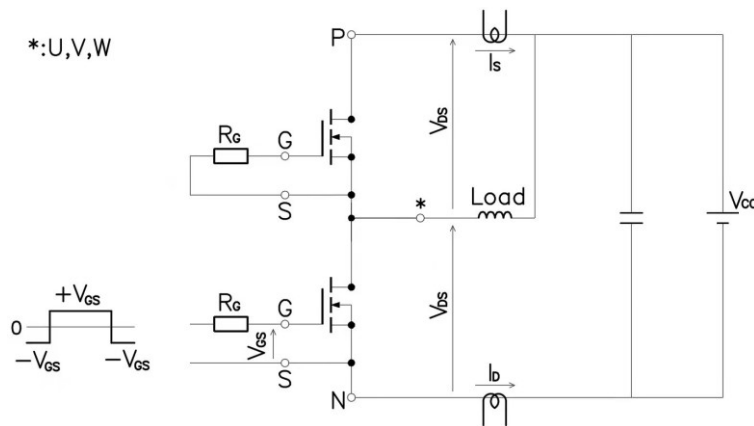


Figure 3. Switching time measure circuit

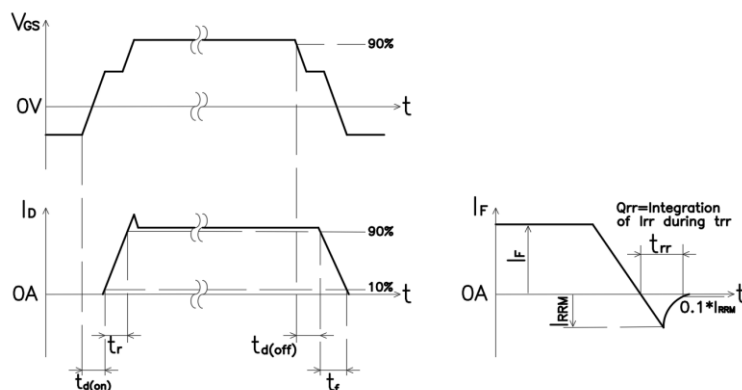


Figure 4. Switching time definition

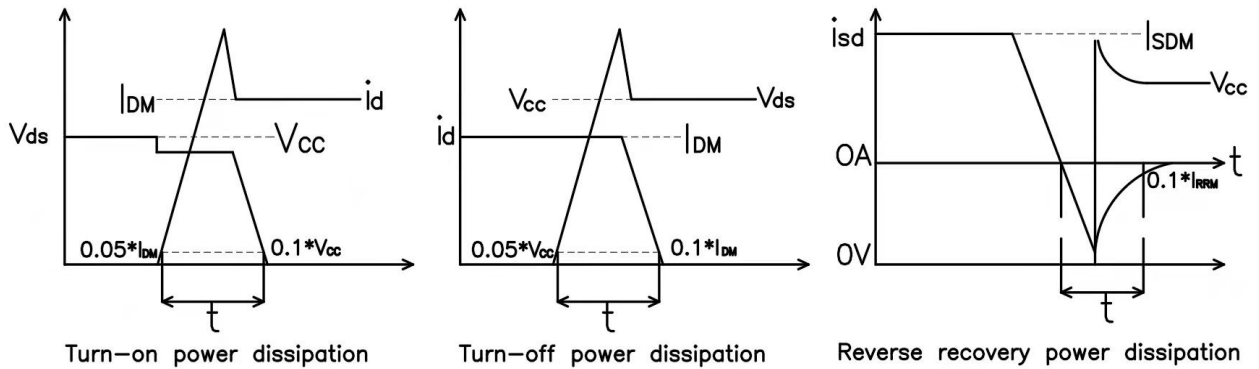


Figure 5. Switching power dissipation definition

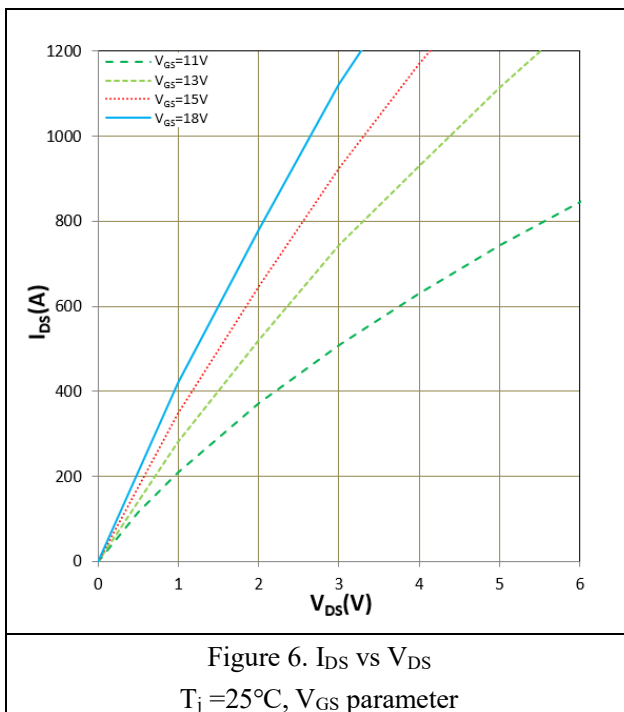


Figure 6.  $I_{DS}$  vs  $V_{DS}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{GS}$  parameter

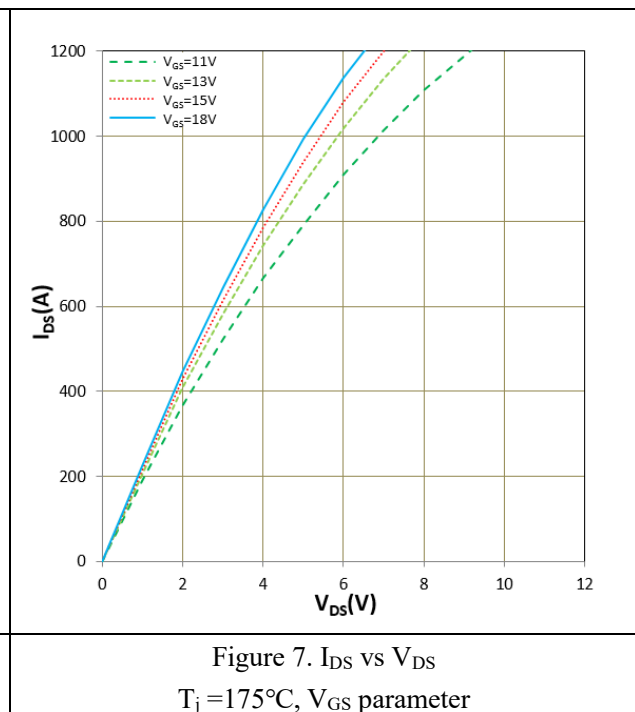


Figure 7.  $I_{DS}$  vs  $V_{DS}$   
 $T_j = 175^\circ\text{C}$ ,  $V_{GS}$  parameter

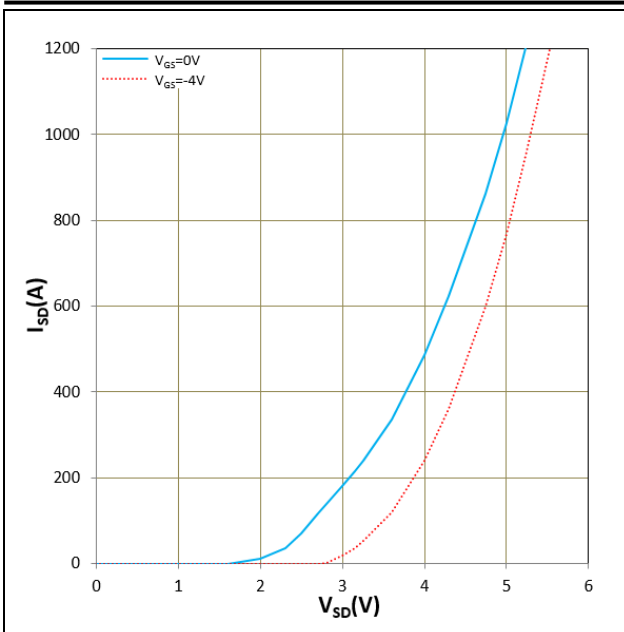


Figure 8.  $I_{SD}$  vs  $V_{SD}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{GS}$  parameter

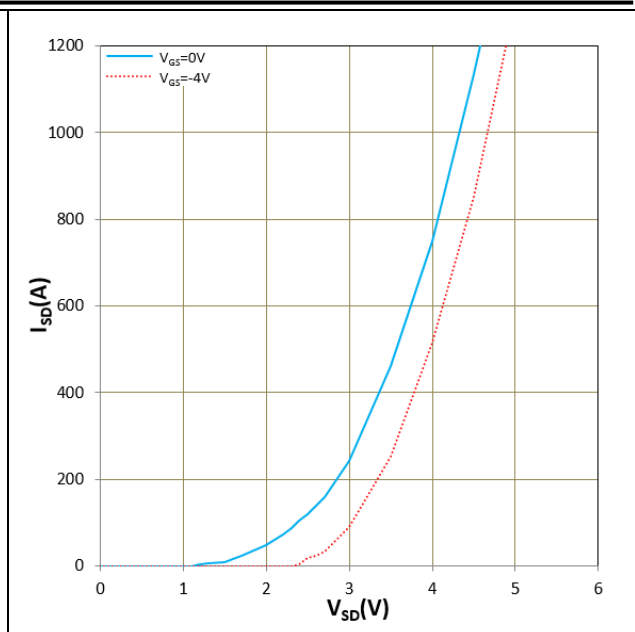


Figure 9.  $I_{SD}$  vs  $V_{SD}$   
 $T_j = 175^\circ\text{C}$ ,  $V_{GS}$  parameter

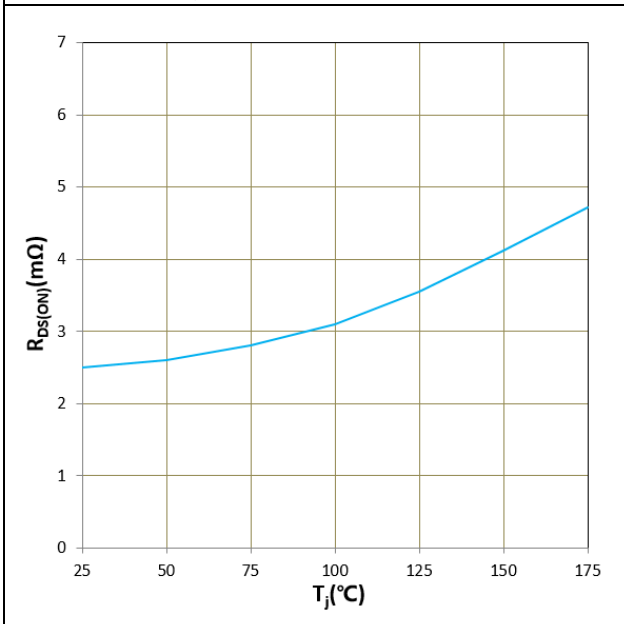


Figure 10.  $R_{DS(ON)}$  vs  $T_j$   
 $V_{GS} = +18\text{V}$ ,  $I_D = 600\text{A}$

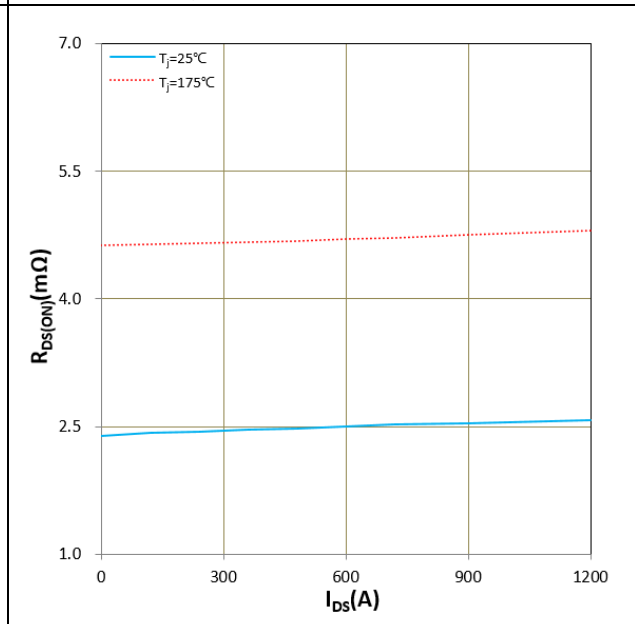


Figure 11.  $R_{DS(ON)}$  vs  $I_{DS}$   
 $V_{GS} = +18\text{V}$



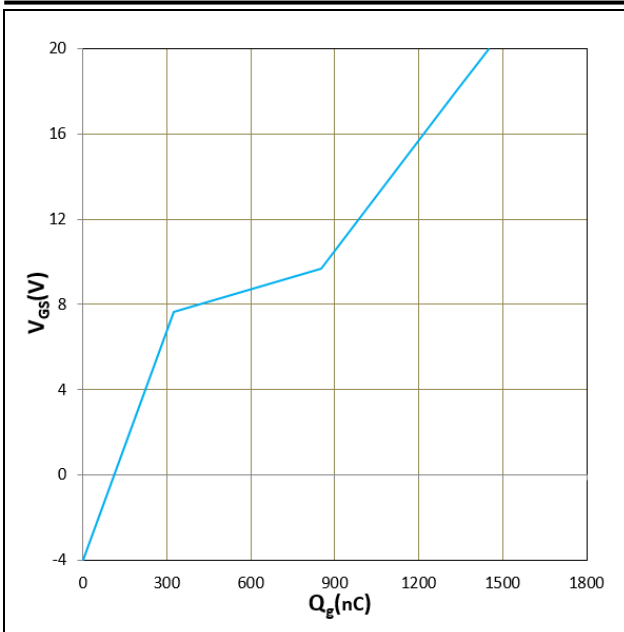


Figure 12.  $V_{GS}$  vs  $Q_g$   
 $T_j = 25^\circ\text{C}$ ,  $I_D = 480\text{A}$ ,  $V_{DS} = 800\text{V}$

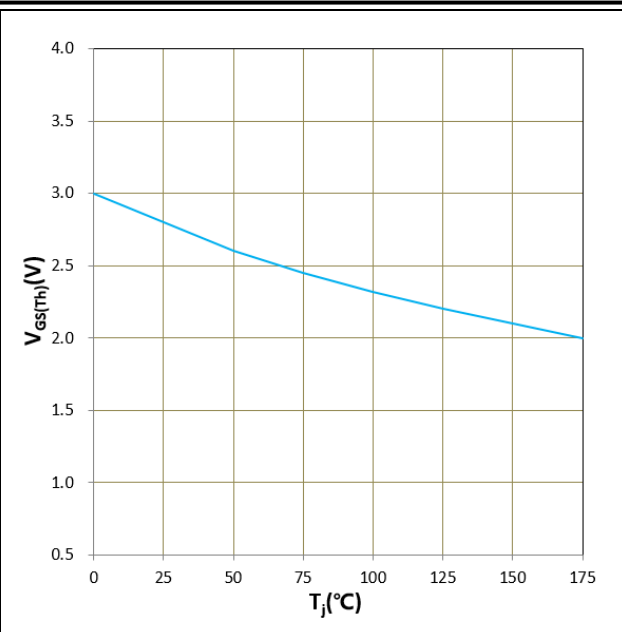


Figure 13.  $V_{GS(Th)}$  vs  $T_j$   
 $V_{GS} = V_{DS}$ ,  $I_D = 162\text{mA}$

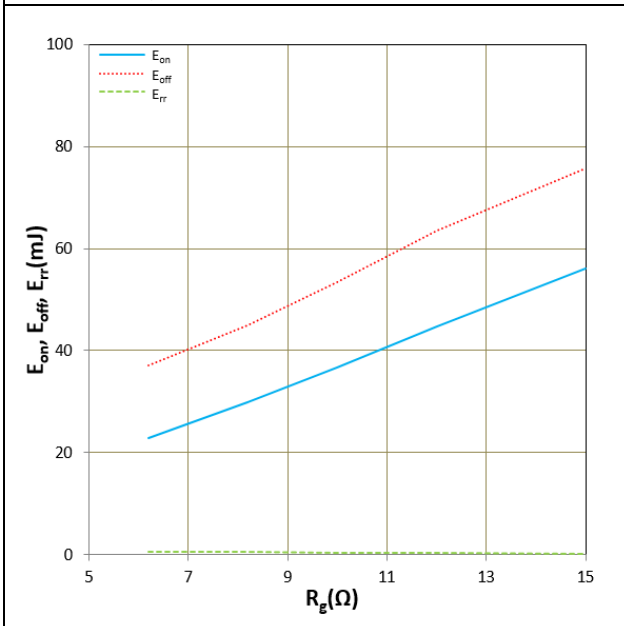


Figure 14.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$   
 $T_j = 25^\circ\text{C}$ ,  $V_{DD} = 600\text{V}$ ,  $I_D = 600\text{A}$ ,  $V_{GS} = +18\text{V}/-4\text{V}$   
 Inductive Load

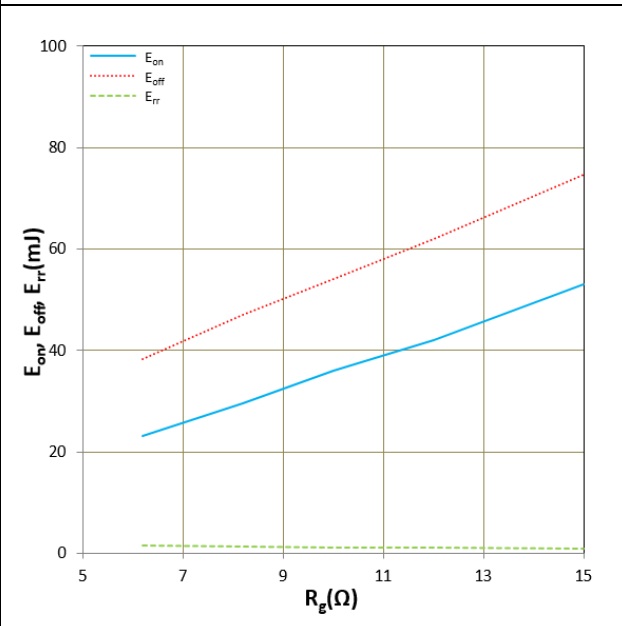


Figure 15.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$   
 $T_j = 150^\circ\text{C}$ ,  $V_{DD} = 600\text{V}$ ,  $I_D = 600\text{A}$ ,  $V_{GS} = +18\text{V}/-4\text{V}$   
 Inductive Load

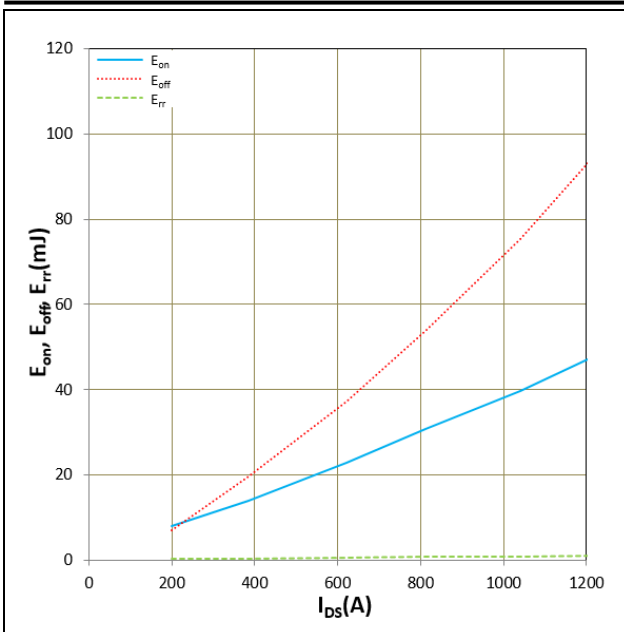


Figure 16.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_{DS}$

$T_j = 25^\circ\text{C}$ ,  $V_{DD} = 600\text{V}$ ,  $R_G = 6.2\Omega$ ,  $V_{GS} = +18\text{V}/-4\text{V}$   
Inductive Load

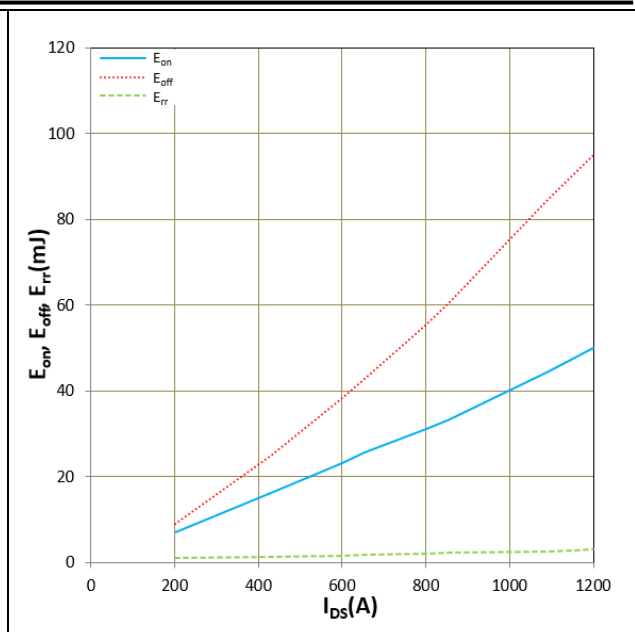


Figure 17.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_{DS}$

$T_j = 150^\circ\text{C}$ ,  $V_{DD} = 600\text{V}$ ,  $R_G = 6.2\Omega$ ,  $V_{GS} = +18\text{V}/-4\text{V}$   
Inductive Load

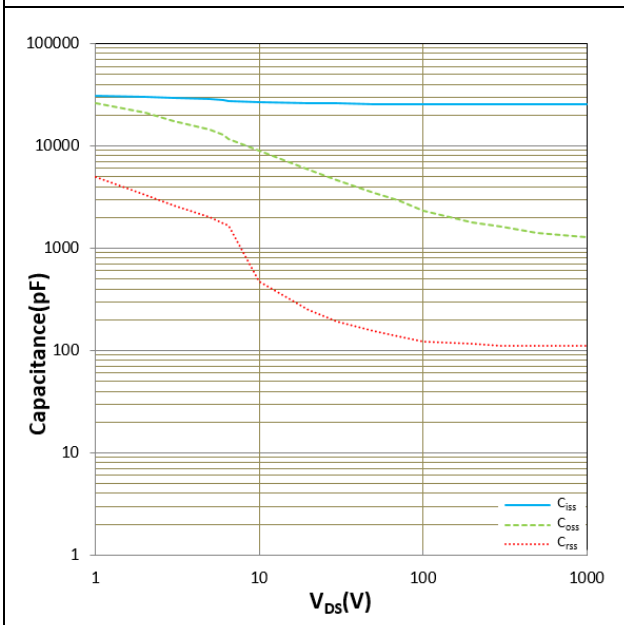


Figure 18.  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$  vs  $V_{DS}$

$T_j = 25^\circ\text{C}$ ,  $f = 100\text{kHz}$

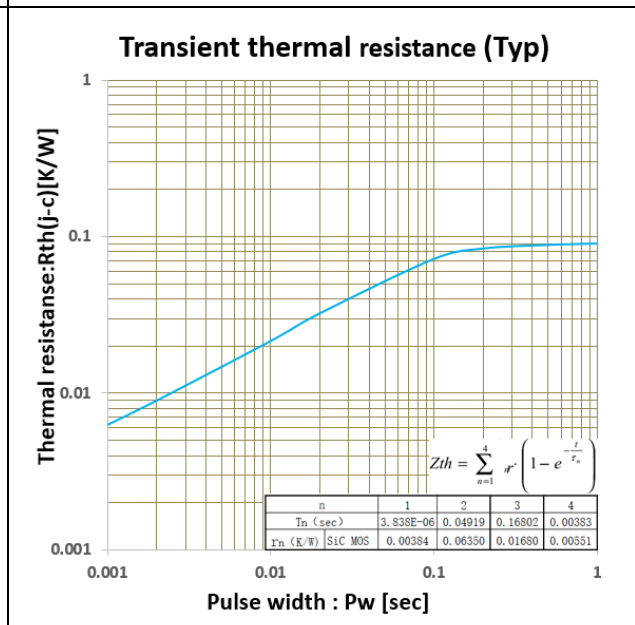


Figure 19. Transient thermal impedance

### IMPORTANT NOTICE:

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