

### Description

The DFS600HF12I3C2 is a Half Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as Motor drives and Renewable energy.



### Features

- 1200V/3.6mΩ ( $V_{GS}=15V$ ), 3.2 mΩ ( $V_{GS}=18V$ )
- Low thermal resistance with Si<sub>3</sub>N<sub>4</sub> AMB
- 175°C maximum junction temperature
- Low inductive design
- Thermistor inside
- Pressfit terminal
- Copper base size: 79mm\*62mm

### Applications

- xEV Applications
- Motor Drive
- Vehicle Fast Chargers
- Renewable energy

### Circuit diagram

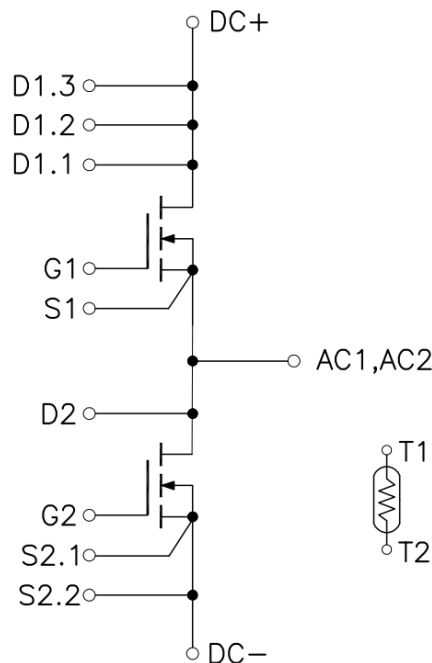


Figure 1. Out drawing & circuit diagram for DFS600HF12I3C2

Note: Please use **S2.1** for the low side drive signal and do not connect it to **S2.2** which is power terminal

### Pin Configuration and Marking Information

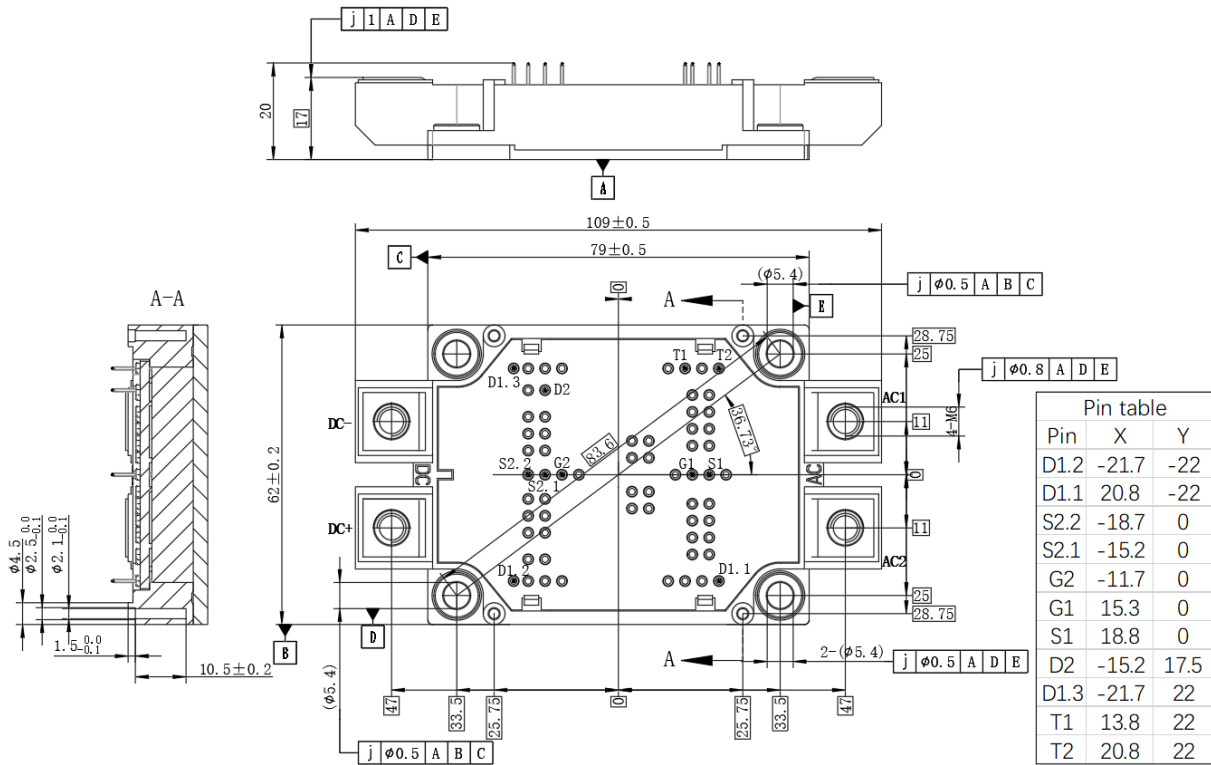


Figure 2. Pin configuration

### Module

Parameter	Conditions	Value	Unit
Isolation Voltage	RMS, f =50Hz, t =1min	3.4	KV
Material of module baseplate	-	Cu	-
Creepage distance	terminal to heatsink terminal to terminal	14.5 10	mm
Clearance	terminal to heatsink terminal to terminal	12.5 10	mm
CTI	-	>400	-
Module lead resistance, terminals – chip	T <sub>c</sub> =25°C	0.3	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	250	g

### Maximum Ratings (T<sub>j</sub> = 25°C unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V <sub>DSS</sub>	Drain-Source Voltage	G-S Short	1200	V
V <sub>GSS</sub>	Gate-Source Voltage	D-S Short, AC frequency ≥ 1Hz, Note1	-10 to 22	V
I <sub>DS</sub>	DC Continuous Drain Current	T <sub>f</sub> = 25°C, V <sub>GS</sub> = +15V	630	A
I <sub>DS</sub>	DC Continuous Drain Current	T <sub>f</sub> = 65°C, V <sub>GS</sub> = +15V	540	A
I <sub>SD</sub>	Source (Body diode) Current	T <sub>f</sub> = 25°C, with ON signal	630	A
I <sub>SD</sub>	Source (Body diode) Current	T <sub>f</sub> = 65°C, with ON signal	540	A
I <sub>DSM</sub>	Pulse Drain Current	T <sub>c</sub> = 65°C, Pulse width = 1ms, V <sub>GS</sub> = +15V, Note2	1200	A
P <sub>tot</sub>	Total Power Dissipation	T <sub>c</sub> = 25°C	2585	W
T <sub>jmax</sub>	Max Junction Temperature	-	175	°C
T <sub>stg</sub>	Storage Temperature	-	-40 to 125	°C

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

Note2: Pulse width limited by maximum junction temperature

### NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Resistance	T <sub>c</sub> = 25°C	-	5	-	kΩ
ΔR/R	Deviation of R100	T <sub>c</sub> = 100°C, R <sub>100</sub> = 493Ω	5	-	5	%
P <sub>25</sub>	Power dissipation	T <sub>c</sub> = 25°C	-	-	20	mW
B <sub>25/50</sub>	B-value	R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/50</sub> (1/T <sub>2</sub> - 1/(298,15 K))]	-	3375	-	K
B <sub>25/80</sub>	B-value	R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/80</sub> (1/T <sub>2</sub> - 1/(298,15 K))]	-	3411	-	K
B <sub>25/100</sub>	B-value	R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/100</sub> (1/T <sub>2</sub> - 1/(298,15 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> =600uA		1200	-	-	V	
I <sub>DSS</sub>	Zero gate voltage drain Current	V <sub>DS</sub> =1200V, V <sub>GS</sub> =0V		-	6	-	μA	
V <sub>GS(th)</sub>	Gate-source threshold Voltage	I <sub>D</sub> =210mA, V <sub>DS</sub> =V <sub>GS</sub>	T <sub>j</sub> =25°C	1.8	2.7	-	V	
I <sub>GSS</sub>	Gate-Source Leakage Current	V <sub>GS</sub> =20V, V <sub>DS</sub> =0V		-	-	600	nA	
R <sub>DS(on)</sub> (Chip)	Static drain-source On-state resistance	I <sub>D</sub> =600A V <sub>GS</sub> =+15V	T <sub>j</sub> =25°C	-	3.6	5.0	mΩ	
			T <sub>j</sub> =175°C	-	5.2	-	mΩ	
		I <sub>D</sub> =600A V <sub>GS</sub> =+18V	T <sub>j</sub> =25°C	-	3.2	-	mΩ	
			T <sub>j</sub> =175°C	-	4.4	-	mΩ	
V <sub>DS(on)</sub> (Chip)	Static drain-source On-state Voltage	I <sub>D</sub> =600A V <sub>GS</sub> =+15V	T <sub>j</sub> =25°C	-	2.16	3.0	V	
			T <sub>j</sub> =175°C	-	3.12	-	V	
		I <sub>D</sub> =600A V <sub>GS</sub> =+18V	T <sub>j</sub> =25°C	-	1.92	-	V	
			T <sub>j</sub> =175°C	-	2.64	-	V	
C <sub>iss</sub>	Input Capacitance	V <sub>D</sub> =800V, V <sub>GS</sub> =0V, f =100KHz		-	34.8	-	nF	
C <sub>oss</sub>	Output Capacitance			-	1.06	-	nF	
C <sub>rss</sub>	Reverse transfer Capacitance			-	0.086	-	nF	
Q <sub>g</sub>	Total gate charge	V <sub>DD</sub> =800V, I <sub>D</sub> =360A, V <sub>GS</sub> =+15/-5V		-	1080	-	nC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>DD</sub> =600V I <sub>D</sub> =600A V <sub>GS</sub> =+15/-4V R <sub>gon</sub> /R <sub>goff</sub> =5.1/3.3Ω Inductive load switching operation		T <sub>j</sub> =25°C	-	49	-	ns
				T <sub>j</sub> =150°C	-	46	-	
t <sub>r</sub>	Rise time			T <sub>j</sub> =25°C	-	30	-	ns
				T <sub>j</sub> =150°C	-	24	-	
t <sub>d(off)</sub>	Turn-off delay time			T <sub>j</sub> =25°C	-	112	-	ns
				T <sub>j</sub> =150°C	-	123	-	
t <sub>f</sub>	Fall time			T <sub>j</sub> =25°C	-	17	-	ns
				T <sub>j</sub> =150°C	-	441	-	
E <sub>on</sub>	Turn-on power dissipation			T <sub>j</sub> =25°C	-	28.8	-	mJ
				T <sub>j</sub> =150°C	-	26.8	-	
E <sub>off</sub>	Turn-off power dissipation	T <sub>j</sub> =25°C	-	12.4	-	mJ		
		T <sub>j</sub> =150°C	-	13.8	-			
R <sub>th(j-c)</sub>	FET Thermal Resistance	Junction to Case		-	0.058	-	K/W	
R <sub>th(c-f)</sub>	Contact thermal Resistance	With thermal conductive grease, Note3		-	0.015	-	K/W	

Note3: Assumes Thermal Conductivity of grease is 0.9W/m · K and thickness is 50um.

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

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max.		
V <sub>SD</sub>	Body Diode Forward Voltage	V <sub>GS</sub> = -5V I <sub>SD</sub> = 600A	T <sub>j</sub> = 25°C	-	5.2	-	V
			T <sub>j</sub> = 175°C	-	4.3	-	
T <sub>rr</sub>	Reverse recovery time	V <sub>DD</sub> = 600V I <sub>D</sub> = 600A	T <sub>j</sub> = 25°C	-	26	-	ns
			T <sub>j</sub> = 150°C	-	49	-	
Q <sub>rr</sub>	Reverse recovery charge	V <sub>GS</sub> = +15/-4V R <sub>gon</sub> /R <sub>goff</sub> = 5.1/3.3Ω	T <sub>j</sub> = 25°C	-	2.3	-	μC
			T <sub>j</sub> = 150°C	-	9.6	-	
E <sub>rr</sub>	Diode switching power dissipation	Inductive load switching operation	T <sub>j</sub> = 25°C	-	1.15	-	mJ
			T <sub>j</sub> = 150°C	-	4.12	-	

### Test Conditions

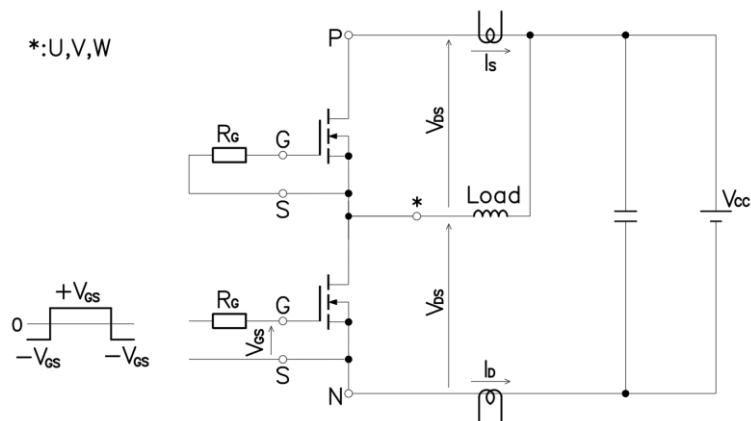


Figure 3. Switching time measure circuit

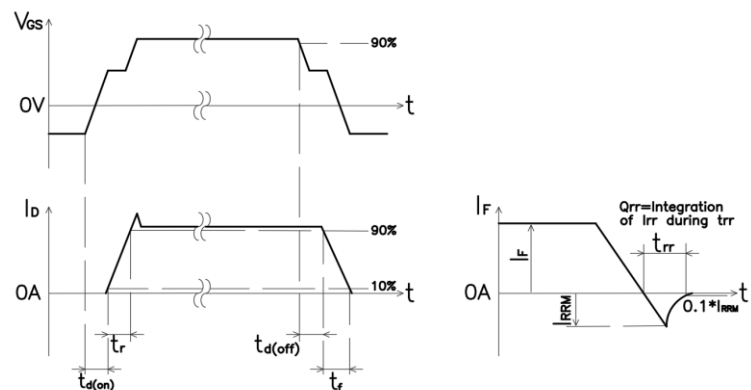


Figure 4. Switching time definition

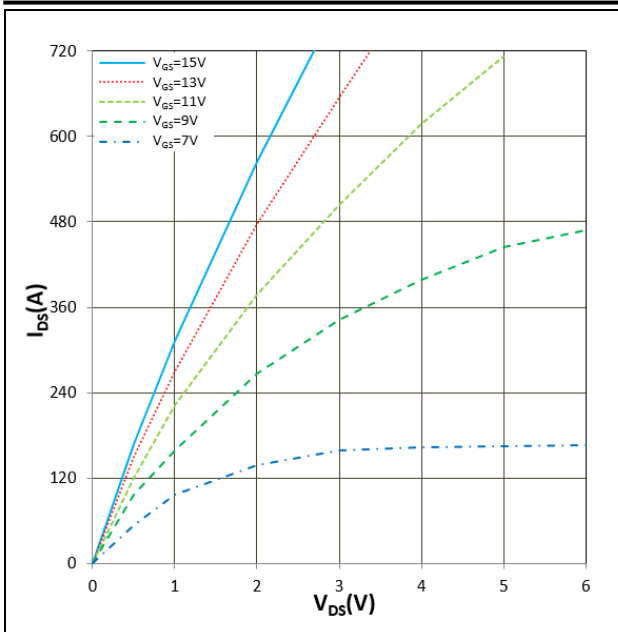


Figure 5. I<sub>DS</sub> vs V<sub>DS</sub>  
T<sub>j</sub> = 25°C

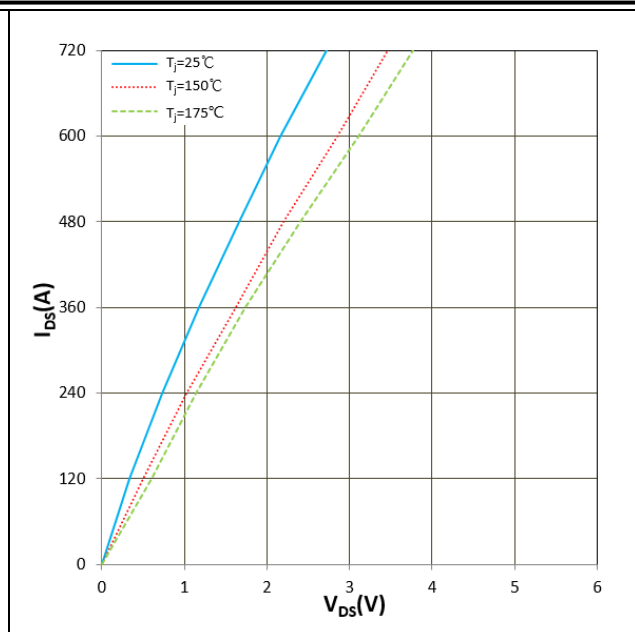


Figure 6. I<sub>DS</sub> vs V<sub>DS</sub>  
V<sub>GS</sub> = +15V

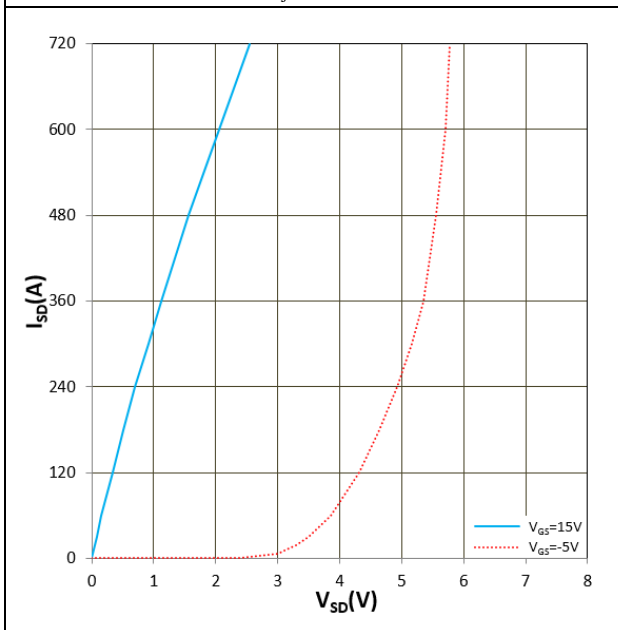


Figure 7. I<sub>SD</sub> vs V<sub>SD</sub> (V<sub>F</sub>)  
T<sub>j</sub> = 25°C

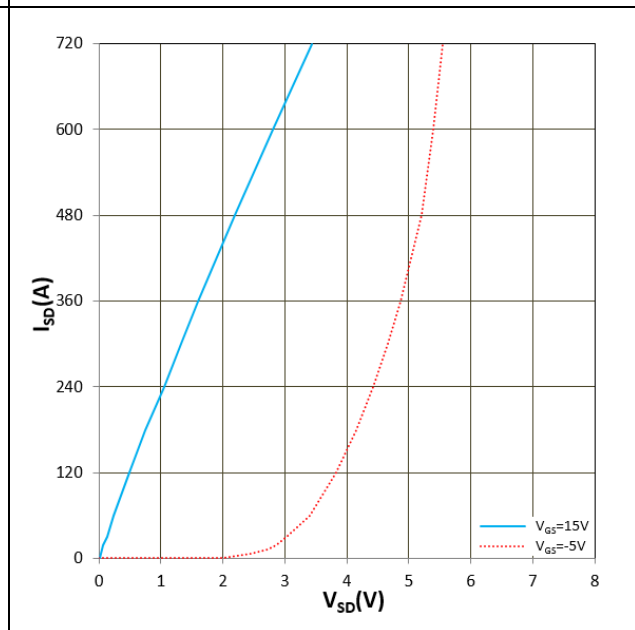


Figure 8. I<sub>SD</sub> vs V<sub>SD</sub> (V<sub>F</sub>)  
T<sub>j</sub> = 175°C

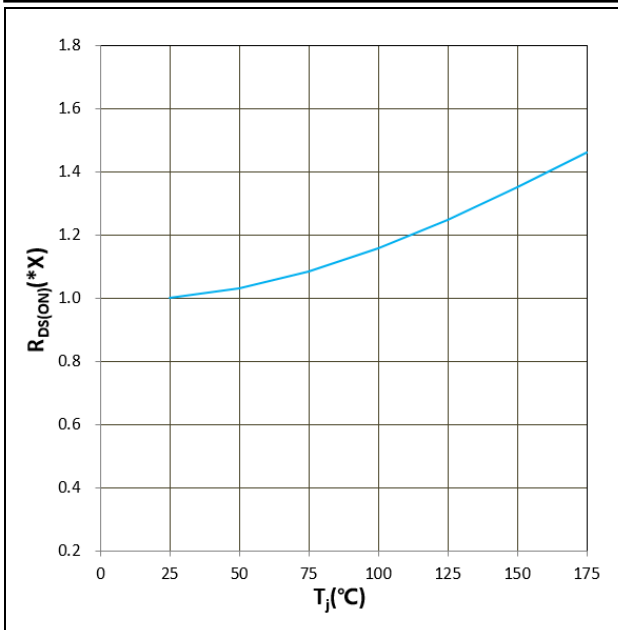


Figure 9.  $R_{DS(on)}$  vs  $T_j$   
 $V_{GS} = +15V, I_D = 600A, 1.0X = 3.6m\Omega$

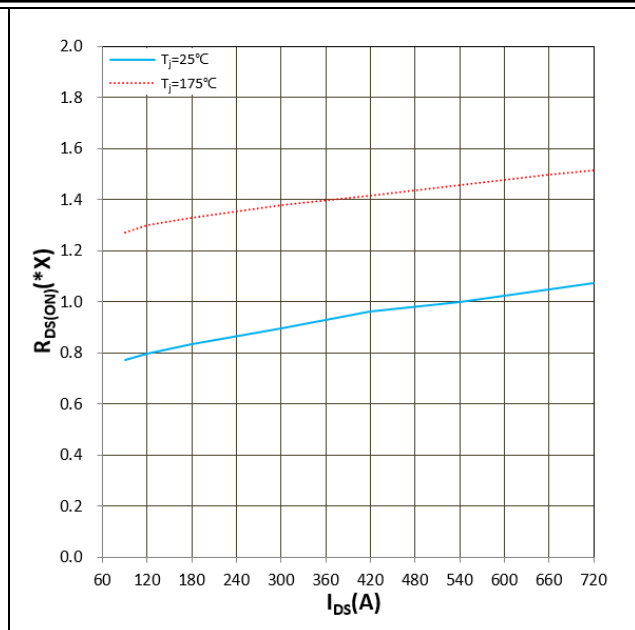


Figure 10.  $R_{DS(on)}$  vs  $I_{DS}$   
 $V_{GS} = +15V, I_D = 600A, 1.0X = 3.6m\Omega$

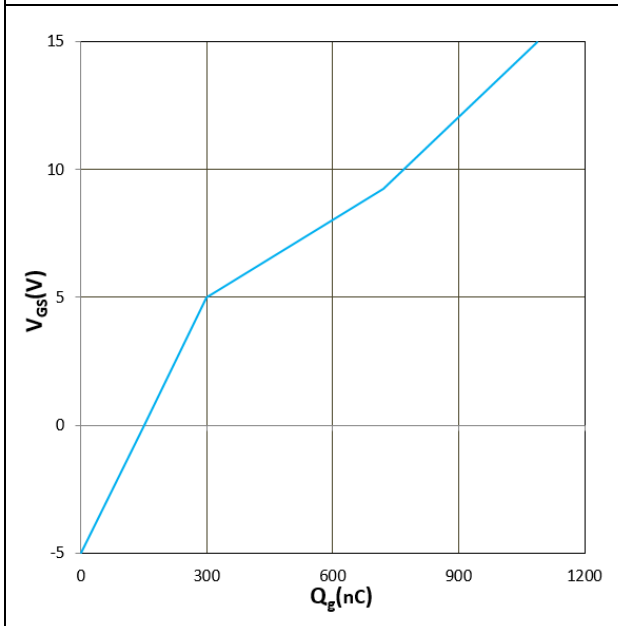


Figure 11.  $V_{GS}$  vs  $Q_g$   
 $V_{DS} = 800V, I_D = 360A, T_j = 25^\circ C$

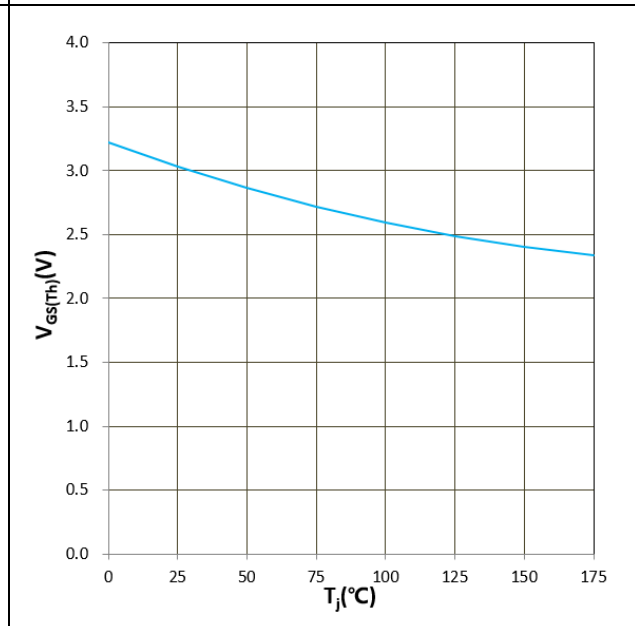


Figure 12.  $V_{GS(th)}$  vs  $T_j$   
 $V_{GS} = V_{DS}, I_D = 210mA$

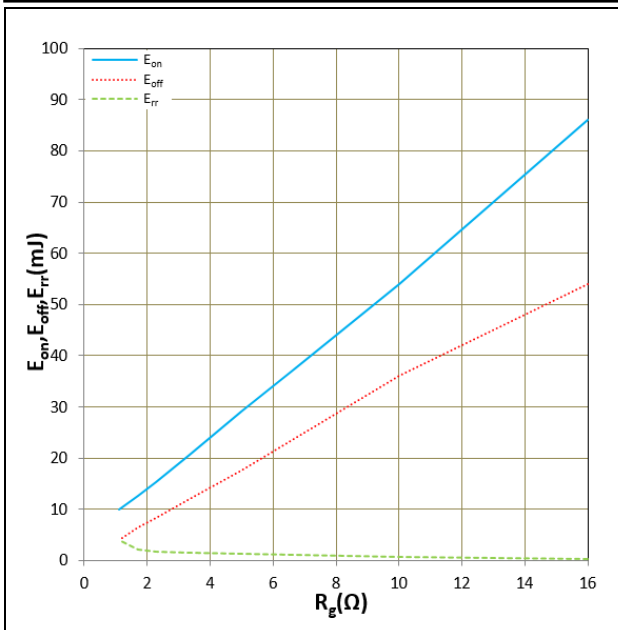


Figure 13.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$   
 $T_j=25^{\circ}\text{C}$ ,  $V_{CC}=600\text{V}$ ,  $V_{GS}=+15\text{V}/-4\text{V}$ ,  $I_D=600\text{A}$   
 Inductive Load

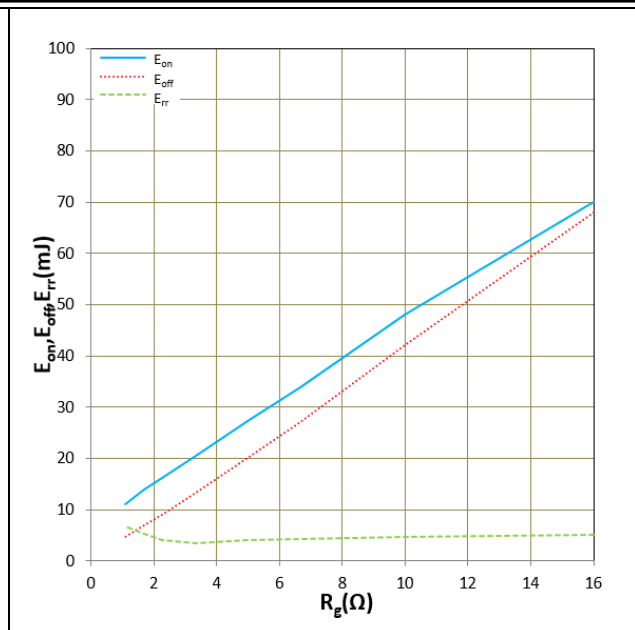


Figure 14.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$   
 $T_j=150^{\circ}\text{C}$ ,  $V_{CC}=600\text{V}$ ,  $V_{GS}=+15\text{V}/-4\text{V}$ ,  $I_D=600\text{A}$   
 Inductive Load

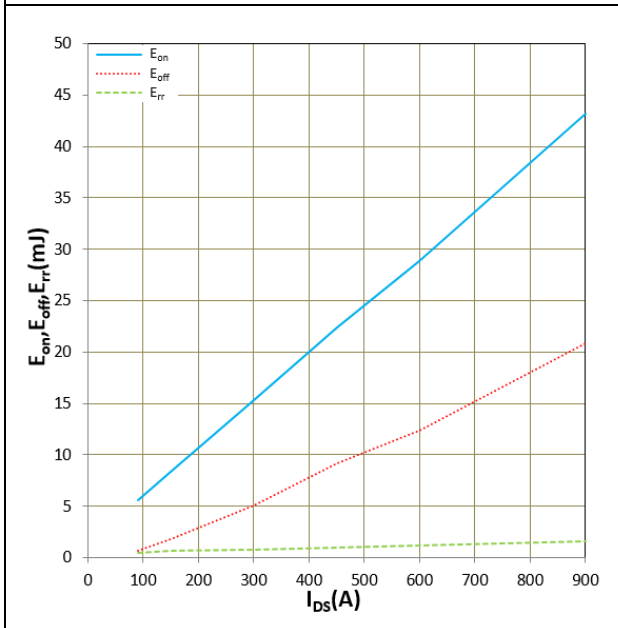


Figure 15.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_{DS}$   
 $T_j=25^{\circ}\text{C}$ ,  $V_{CC}=600\text{V}$ ,  $V_{GS}=+15\text{V}/-4\text{V}$   
 $R_{gon}/R_{goff}=5.1/3.3\Omega$ , Inductive Load

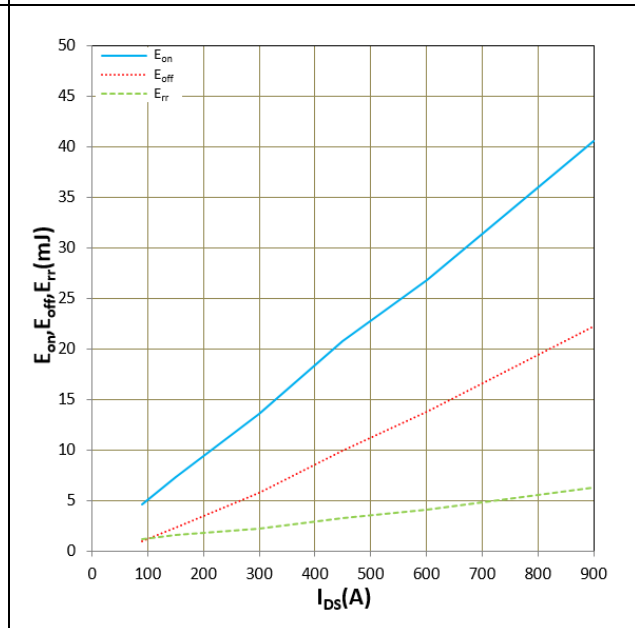


Figure 16.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_{DS}$   
 $T_j=150^{\circ}\text{C}$ ,  $V_{CC}=600\text{V}$ ,  $V_{GS}=+15\text{V}/-4\text{V}$   
 $R_{gon}/R_{goff}=5.1/3.3\Omega$ , Inductive Load



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